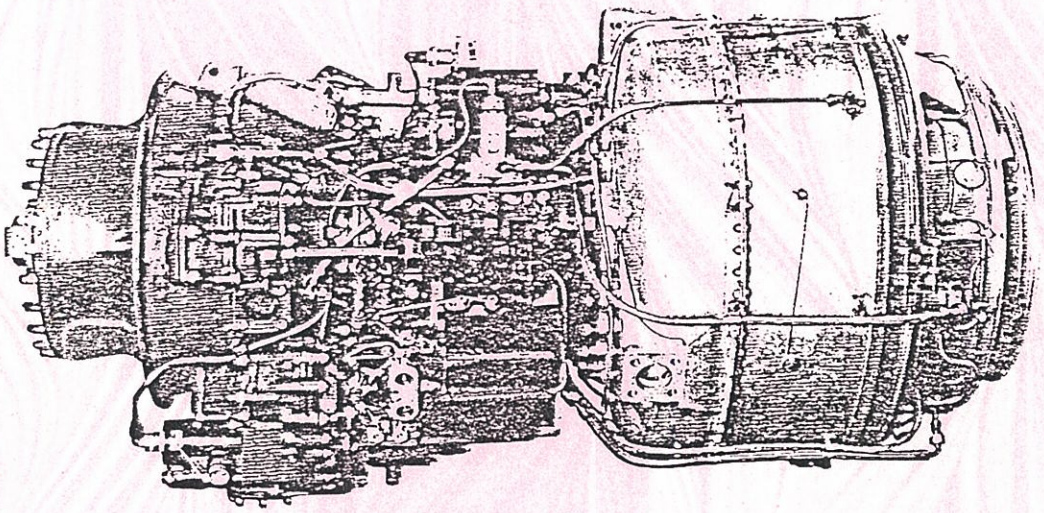
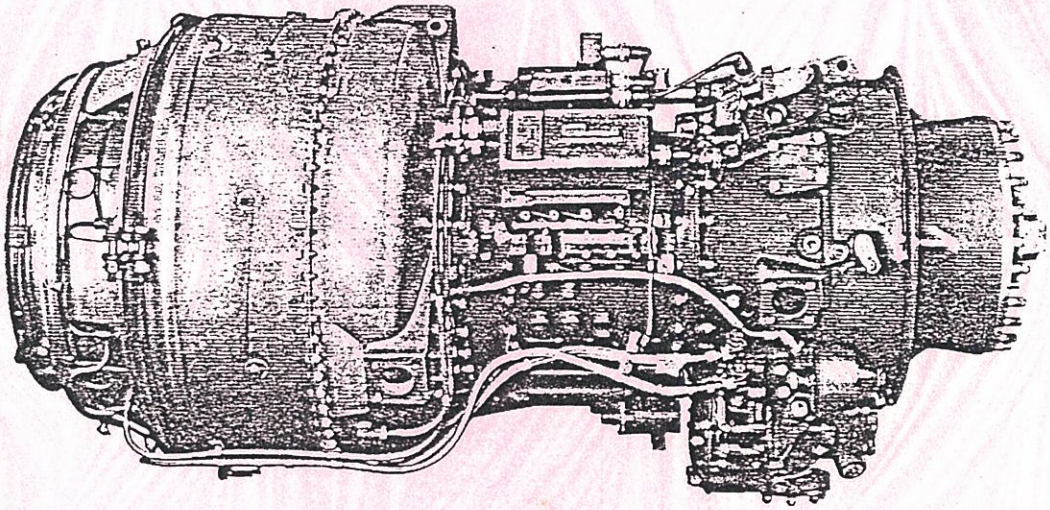
TECHNICAL MANUAL

ILLUSTRATED PARTS BREAKDOWN



Left Side View



Right Side View

MODEL

T53-L-1, -1A, -1B

AIRCRAFT ENGINES

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INTRODUCTION

GENERAL.

This manual contains information required for field maintenance of the basic model T53-L-1 shaft turbine engine designed and manufactured by Lycoming Division of Avco Corporation, Stratford, Connecticut.

Field maintenance instructions for model T53-L-1 shaft turbine engine also apply to models T53-L-1A and T53-L-1B shaft turbine engines, except when specifically noted. Instructions are limited to repair that can be made by maintenance personnel using authorized tools and equipment.

The engines are divided into five main sections in relationship to assembly and disassembly procedures. These are the air inlet, compressor, diffuser, combustion, and exhaust sections. (See illustration, Engine Orientation.) Field maintenance instructions are based on these engine subdivisions. For procurability of detail parts and field maintenance kits, refer to applicable Illustrated Parts Breakdown.

See illustration, Major Assemblies of Engine, for permissible field maintenance. See illustrations: Left Side View T53-L-1 Engine; and Right Side View, T53-L-1 Engine, for general characteristics.

ENGINE TIME.

Accomplishment of field maintenance has no effect on engine time.

ENGINE PERFORMANCE.

A thorough examination of engine performance shall be made to determine any trouble and to prevent unnecessary engine shipment to overhaul depots. Whenever engine performance decreases excessively or whenever exhaust gas temperature increases steadily during normal operation, clean the compressor blades and air passages. (Refer to paragraph 3-14.)

ENGINE PARTS.

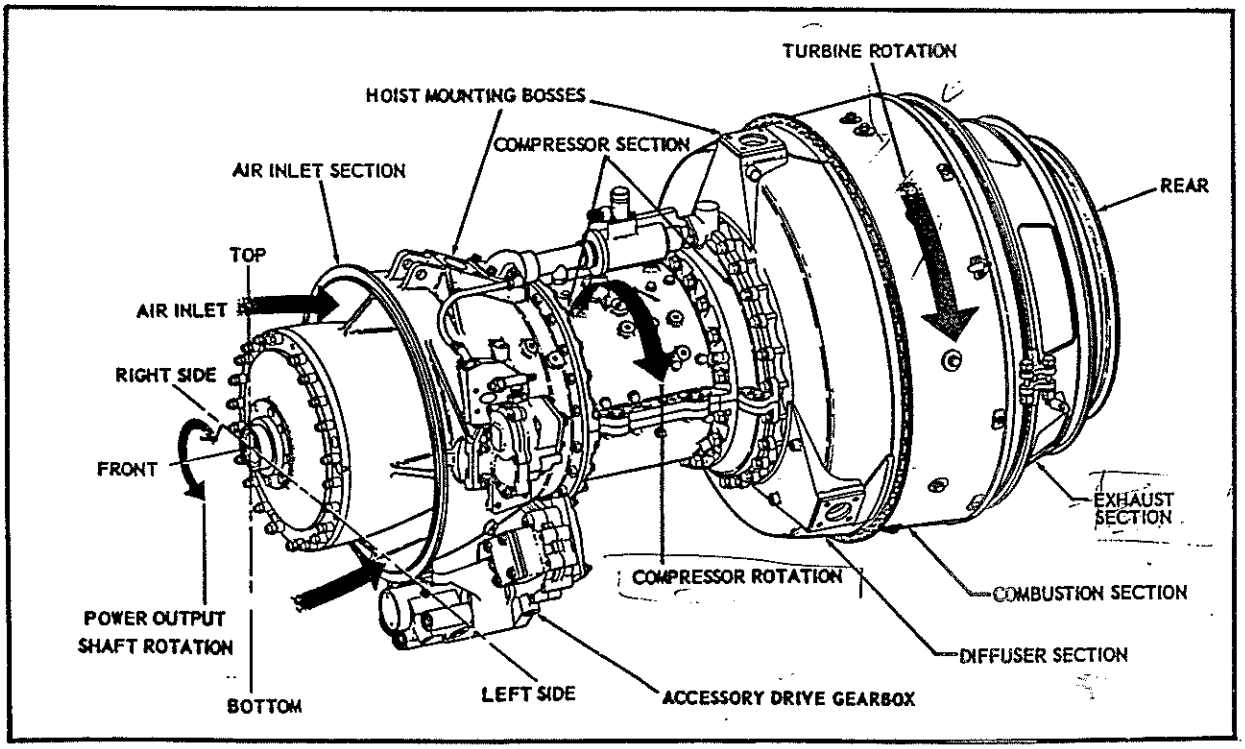
Small parts removed from engine, including engine nameplate, shall be bagged or wired together. An adequate description shall be attached to the removed parts. Parts to be exposed for a considerable length of time shall be covered and protected with corrosion-preventive compound, Military Specification MIL-C-6529.

GENERAL FIELD MAINTENANCE PROCEDURE.

When performing field maintenance, cleanliness of working area shall be maintained. To keep foreign materials out of engine, temporary covers shall be installed to seal openings on dismantled engine.

TABLE OF LIMITS.

For measurement of fits and tolerances, refer to Table of Limits, Section VII.



Engine Orientation

DIRECTIONAL REFERENCES.

The following directional references are used: (See illustration, Engine Orientation.)

Front	End of engine into which air is introduced. (Identified by power output shaft.)
Rear	End of engine from which exhaust is expelled. (Identified by large opening of exhaust cone.)
Right and Left Side	Determined by viewing engine from the rear.
Bottom	Determined by location of accessory drive gearbox.
Top	Directly opposite, or 180 degrees from accessory drive gearbox. (Identified by airflow regulator.)
Direction of Rotation	Determined by viewing engine from rear. The compressor rotor, first stage turbine, and second stage turbine rotate counter-clockwise. The power output shaft rotates clockwise.

EMERGENCY FUELS.

GENERAL. For continuous operation, use grade JP-4 fuel, Military Specification MIL-J-5624. If JP-4 is not available, the following emergency fuels may be used.

CAUTION

Use fuel on the emergency fuel list if standard fuel vaporizers are used in the engine. Use fuels on the alternate list if the bias-cut fuel vaporizers are used in the engine.

(1) Unleaded gasoline, Federal Specification VV-G-109.

(2) Aviation kerosene, Federal Specification VV-K-211.

(3) Fuel, grade JP-6, Military Specification MIL-F-25656.

(4) Fuel, grade JP-5, Military Specification MIL-J-5624.

(5) All grades aviation gasoline, Military Specification MIL-G-5572.

(6) Automotive gasoline, Federal Specification VV-G-76, VV-G-561A(2), and Military Specification MIL-G-3056.

CAUTION

Fuel that contains tricresylphosphate (TCP) additive shall not be used.

When JP-4 fuel is mixed with an emergency fuel, or when emergency fuels are mixed with each other, weighted time must be established for inspection purposes. The entire mixture shall be considered as fuel of the highest constant in the mixture.

NOTE

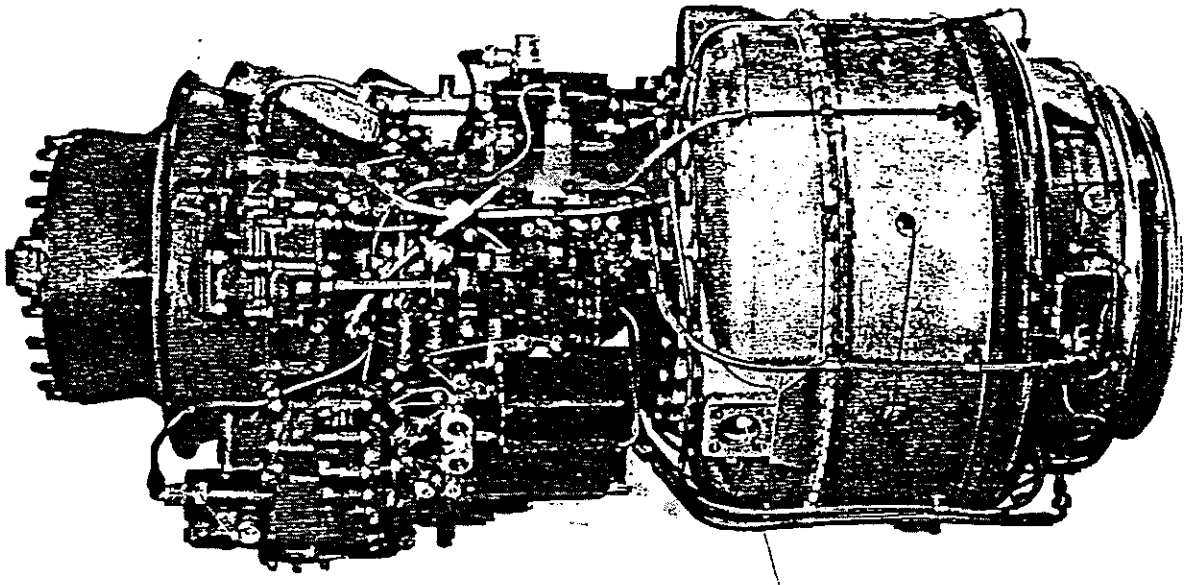
Weighted time equals actual operating time with emergency fuel multiplied by the constant assigned to the specific fuel.

EMERGENCY AND ALTERNATE FUEL CONSTANTS. The following fuel constants are used when weighted time is calculated.

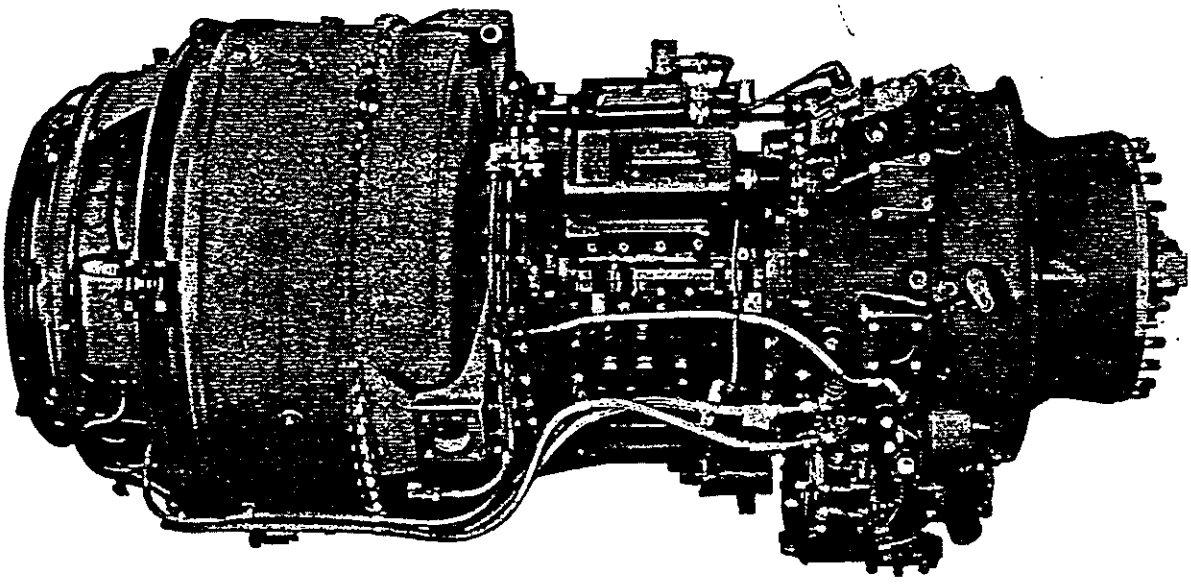
TYPE OF GASOLINE	GRADE	CONSTANT
Unleaded Gasoline, Federal Specification VV-G-109	All Grades	0
Aviation Gasoline, Military Specification MIL-G-5572	80/87	2
Aviation Gasoline, Military Specification MIL-G-5572	91/96	5
Aviation Gasoline, Military Specification MIL-G-5572	100/130	5
Aviation Gasoline, Military Specification MIL-G-5572	115/145	5
Automotive Gasoline, Federal Specification VV-G-76, VV-G-561A(2), and Military Specification MIL-G-3056	All Grades	5

When the weighted time limit of 50 hours is reached during any one of the engine operating ranges shown in column one below, inspection and cleaning of the combustion section shall not be delayed beyond the additional operating time shown in column 2.

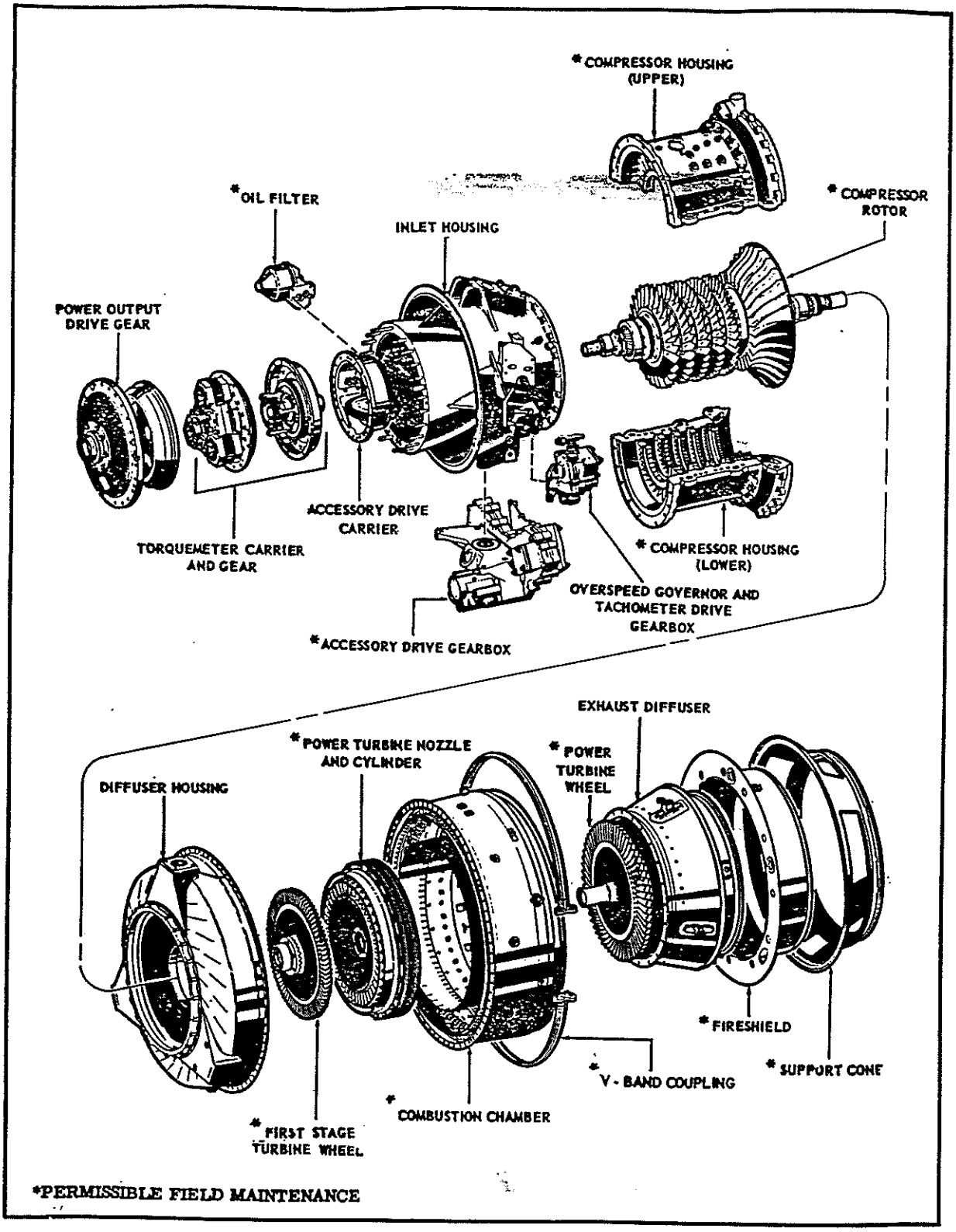
COLUMN 1	COLUMN 2
Engine operating time (hours) since new or overhaul	Inspect and clean at or before completion of this additional operating time (hours)
0 to 50	40
51 to 100	30
101 to 150	20
151 to 200	10
201 or more	0 Inspect at once



Left Side View, T53-L-1 Engine



Right Side View, T53-L-1 Engine



*PERMISSIBLE FIELD MAINTENANCE

Major Assemblies of Engine

SECTION I

SPECIAL TOOLS AND EQUIPMENT

1-1. GENERAL.

1-2. This section lists, in functional and numerical order the special tools and equipment applicable to the work prescribed in this manual. References to the tools in other sections of this manual are by group number indicated in the functional tool list.

CAUTION

Use plastic or rawhide hammer heads (never metal) when driving on any part of the engine. Never lift heavy parts by hand. Use a chain or powered hoist and special yokes. Pressure or tension shall be applied evenly to all bearing pushers or pullers. Jackscrews and attaching screws, bolts and nuts shall be tightened in small increments on opposite planes.

1-3. SPECIAL TOOLS AND EQUIPMENT LIST.

1-4. Special tools and equipment are listed alphabetically under functional groups. The functional tool nomenclature is determined by the work being performed and is listed alphabetically. Each functional group is assigned a group number. Individual tool numbers and figure numbers of special tool illustrations are listed also.

GROUP NO.	FUNCTIONAL TOOL NOMENCLATURE	TOOL NO.	FIGURE NO.
1	ACCESSORY DRIVE CARRIER, CHECKING BACKLASH OF		
	Driver, Bearing and Bushing	LTC-T79	5-8
	Fixture, Gear Holding	LTC-T80	5-7
	Gage, Backlash	LTC-T311	5-6
	Plate, Locating	LTC-T83	2-37
	Wrench, Double Socket and Stud, Face Spanner	LTC-T69	1-22
2	ACCESSORY DRIVE CARRIER, CHECKING GEAR PATTERN OF		
	Plate, Wrenching, Pinion Gear	LTC-T112	1-11
	Puller, Mechanical	LTC-T14	1-9
	Socket, Wrench, Face Spanner	LTC-T62	1-3
3	Deleted		
4	ACCESSORY DRIVE GEARBOX, ASSEMBLY OF		
	Device, Holding, Gear Drive	LTC-T115	1-8
	Tool, Installation and Removal, Oil Seal, Gas Producer Tachometer Drive	LTC-T99	1-2
	Tool, Installation and Removal, Oil Seal, Starter Generator Drive	LTC-T100	1-1
	Tool, Installation and Removal, Power Output, Gear Accessory Drive	LTC-T101	1-21
5	COMBUSTION CHAMBER, ASSEMBLY OF		
	Remover, Retaining Ring	LTC-T386	1-14
	Wrench, Fuel Harness	LTC-T219	1-7
	Wrench, Spanner, Combustion Vaporizing Tube	LTC-T57	2-51

GROUP NUMBER	FUNCTIONAL TOOL NOMENCLATURE	TOOL NO.	FIGURE NO.
6	COMBUSTION CHAMBER, DISASSEMBLY OF		
	Bar, Locating	LTC-T153	2-40
	Wrench, Spanner, Combustion Vaporizing Tube	LTC-T57	2-51
	Tool, Alinement, Power Shaft	LTC-T154	2-40
	Remover, Retaining Ring	LTC-T386	1-14
7	COMBUSTION CHAMBER, INSTALLATION OF		
	Sling, Combustion Chamber, Lifting	LTC-T53	5-13
8	COMBUSTION CHAMBER, REMOVAL OF		
	Sling, Horizontal Lifting Combustion Chamber	LTC-T87	1-24
9	COMPRESSOR ROTOR, INSTALLATION OF		
	Adapter, Hoisting, Compressor	LTC-T22	2-38
	Pin, Guide	LTC-T387	1-15
10	COMPRESSOR ROTOR, REMOVAL OF		
	Adapter, Hoisting, Compressor	LTC-T22	2-38
	Fixture, Compressor Rotor Assembly	LTC-T55	
	Pin, Guide	LTC-T387	1-15
11	COMPRESSOR ROTOR AND CENTRIFUGAL COMPRESSOR IMPELLER, CHECKING CLEARANCES OF		
	Punch, Drive Pin	LTC-T64	2-31
12	COMPRESSOR ROTOR BLADES, REMOVAL OF		
	Remover, Blade	LTC-T385	1-13
	Tool, Installation and Removal, Axial Compressor Blade	LTC-T90	3-21
13	COMPRESSOR SHAFT REAR BEARING NUT, TORQUING		
	Plate, Locating	LTC-T83	2-37
	Socket, Wrench, Face Spanner	LTC-T43	2-37
14	DIFFUSER HOUSING, INSTALLATION OF		
	Fixture, Inlet Housing, Mounting Pad Alinement	LTC-T116	5-4
15	DIFFUSER HOUSING, REMOVAL OF		
	Driver, Bearing and Bushing	LTC-T111	1-5
	Plate, Locating	LTC-T83	2-37
	Socket, Wrench, Face Spanner	LTC-T43	2-37
	Socket, Wrench, Face Spanner	LTC-T19	2-38
16	DIFFUSER HOUSING AND REAR BEARING SUPPORT, DISASSEMBLY OF		
	Driver, Bearing and Bushing	LTC-T15	1-6
17	ENGINE, PREOILING		
	Key, Screw, Socket Head	LTC-T70	1-16
18	ENGINE INSTALLATION IN STAND		
	Adapter, Engine (Army Use Only)	SWE-13852-100	2-5
	Adapter, Ring (Air Force Use Only)	LTC-T4	2-4
	Adapter, Transmission	SWE-13852-40	1-32
	Cover, Air Inlet	LTC-T59	1-4
	Sling, Engine	LTC-T384	1-31
	Stand, Engine Buildup	LTC-T307	2-4
	Workstand (Army Use Only)	SWE-13855	2-5

GROUP NUMBER	FUNCTIONAL TOOL NOMENCLATURE	TOOL NO.	FIGURE NO.
19	ENGINE PREPARATION FOR BLOCK TEST		
	Bellmouth, Inner, Air Inlet	LTC-T362	1-19
	Bellmouth, Outer, Air Inlet	LTC-T363	1-20
	Thermocouple, Immersion, Number Two Bearing	LTC-T430	1-17
	Thermocouple, Immersion, Numbers Three and Four Bearings	LTC-T431	1-17
	Thermocouple Assembly	LTC-T348	1-18
20	ENGINE REMOVAL FROM SHIPPING CONTAINER		
	Sling, Engine	LTC-T384	1-31
21	ENGINE VIBRATION TEST		
	Adapter, Inlet Housing, Vibration Pickup	LTC-T429	1-26
	Adapter, Diffuser Flange, Vibration Pickup	LTC-T427	1-27
	Adapter, Power Turbine, Vibration Pickup	LTC-T428	1-39
	Cable Assembly	CEC-49657-0300	
	Meter, Vibration	CEC-1-117	1-28
	Pickup, Vibration	CEC-4-118-0107	1-29
	Filter, Plug-in, Meter, Vibration	CEC-1-003-70	
22	EXHAUST GAS TEMPERATURE SYSTEM, CHECKING		
	Tester, Jet-Cal	BH112JA36	1-33
23	FIRST STAGE TURBINE ASSEMBLY, REMOVAL OF		
	Puller, Turbine Wheel	LTC-T120	1-25
24	FUEL CONTROL PUMP AND FUEL MANIFOLD PRESSURE, CHECKING		
	Gage, Fuel Pressure, Engine	440R	1-30
25	FUEL CONTROL UNIT, ASSEMBLY OF		
	Fixture, Alinement, Link Assembly, Fuel Control	STD63563	3-33
	Puller, Solenoid Sleeve and Check Valve Seat	STD63557	3-34
26	NUMBER ONE MAIN BEARING PINCH FIT, ESTABLISHING		
	Driver, Bearing and Bushing	LTC-T76	1-10
	Puller, Mechanical	LTC-T12	5-1
	Puller, Mechanical	LTC-T14	1-9
27	NUMBER ONE MAIN BEARING RETAINING NUT, TORQUING		
	Socket, Wrench, Face Spanner	LTC-T19	2-38
28	NUMBER TWO MAIN BEARING, REMOVAL OF		
	Driver, Bearing and Bushing	LTC-T77	1-34
29	Deleted		
30	POWER SHAFT, CHECKING END FLOAT OF		
	Tool, Staking, Tabwasher	LTC-T139	1-12
31	POWER TURBINE SUPPORT ASSEMBLY, DISASSEMBLY OF		
	Fixture, Power Turbine, Holding	LTC-T40	1-35
	Puller, Bearing Housing	LTC-T73	1-36
	Puller, Mechanical	LTC-T130	1-37
	Socket, Wrench, Face Spanner	LTC-T222	1-38
32	TORQUEMETER CARRIER AND GEAR, STAKING		
	Punch, Staking	LTC-T122	1-23

1-5. SPECIAL TOOLS AND EQUIPMENT NUMERICAL INDEX.

1-6. The special tools and equipment numerical index is listed alpha-numerically. The group number to which the special tool or equipment is assigned is listed also.

TOOL NUMBER	GROUP NUMBER
BH112JA36	22
CEC-1-003-70	21
CEC-1-117	21
CEC-4-118-0107	21
CEC-49657-0300	21
LTC-T100	4
LTC-T101	4
LTC-T111	15
LTC-T112	2
LTC-T115	4
LTC-T116	14
LTC-T12	26
LTC-T120	23
LTC-T122	32
LTC-T130	31
LTC-T139	30
LTC-T14	2, 26
LTC-T15	16
LTC-T153	6
LTC-T154	6
LTC-T19	15, 27
LTC-T219	5
LTC-T22	9, 10
LTC-T222	31
LTC-T307	18
LTC-T311	1
LTC-T348	19
LTC-T362	19
LTC-T363	19
LTC-T384	18, 20
LTC-T385	12
LTC-T386	5, 6
LTC-T387	9, 10
LTC-T4	18
LTC-T40	31
LTC-T427	21
LTC-T428	21
LTC-T429	21
LTC-T43	13, 15
LTC-T430	19
LTC-T431	19
LTC-T53	7
LTC-T55	10
LTC-T57	5, 6
LTC-T59	18
LTC-T62	2
LTC-T64	11
LTC-T69	1
LTC-T70	17
LTC-T73	31
LTC-T76	26
LTC-T77	28
LTC-T79	1
LTC-T80	1
LTC-T83	1, 13, 15
LTC-T87	8
LTC-T90	12
LTC-T99	4
STD63557	25
STD63563	25
SWE13852-100	18
SWE13852-40	18
SWE13855	18
440R	24

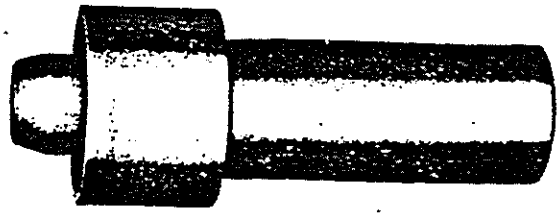


Figure 1-1. Oil Seal Installation and Removal Tool

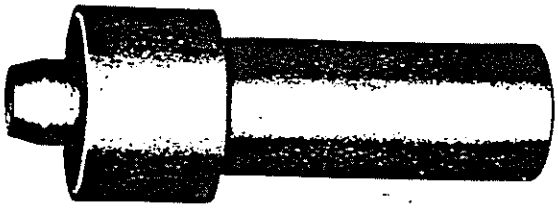


Figure 1-2. Oil Seal Installation and Removal Tool

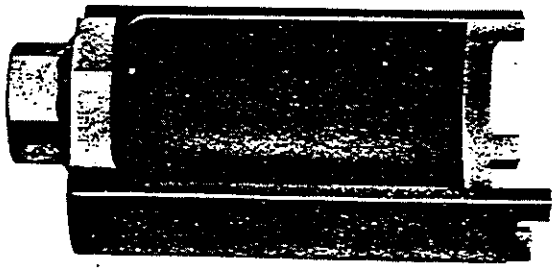


Figure 1-3. Face Spanner Socket Wrench

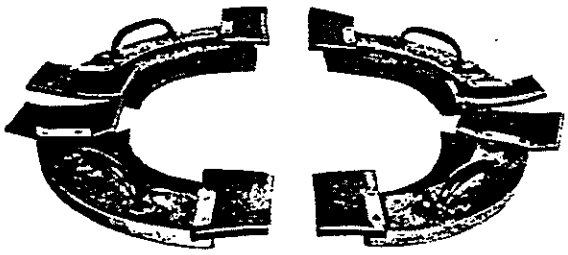


Figure 1-4. Air Inlet Cover

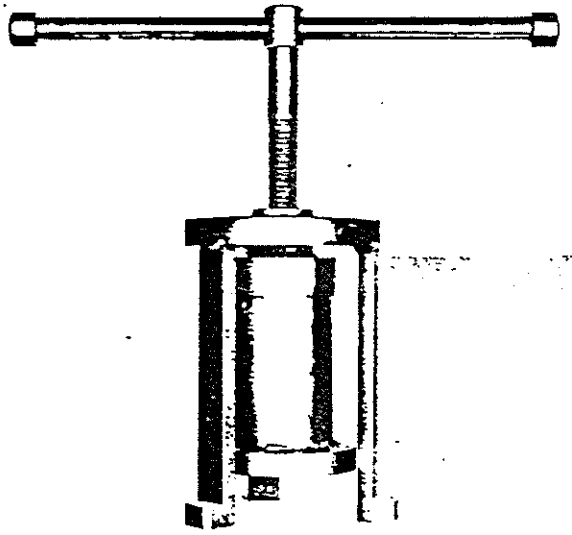


Figure 1-5. Bearing and Bushing Driver

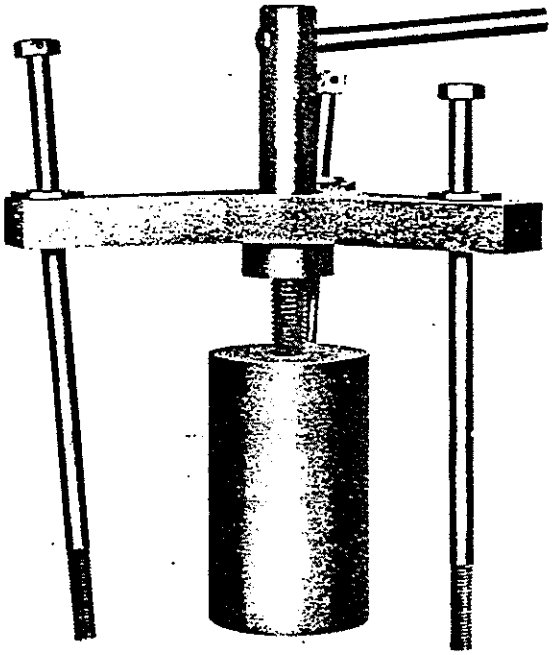


Figure 1-6. Bearing and Bushing Driver

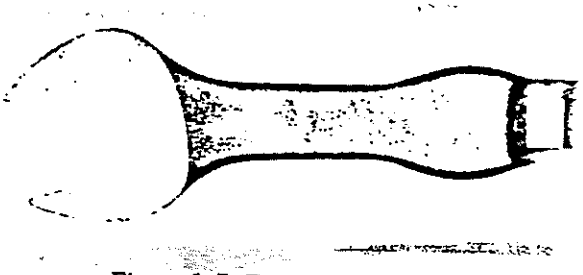


Figure 1-7. Fuel Harness Wrench

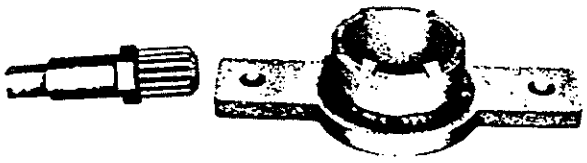


Figure 1-8. Gear Drive Holding Device

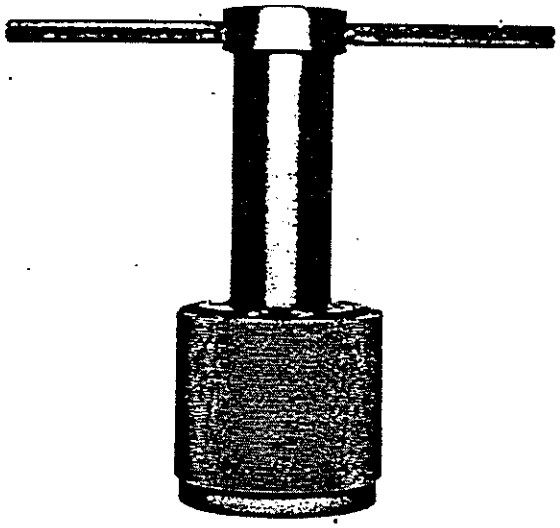


Figure 1-9. Mechanical Puller

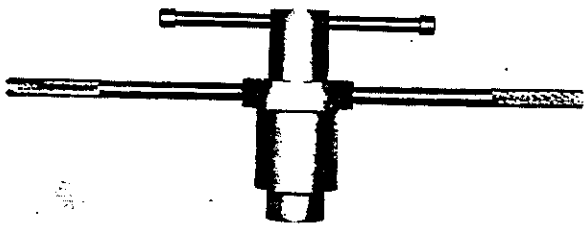


Figure 1-10. Bearing and Bushing Driver

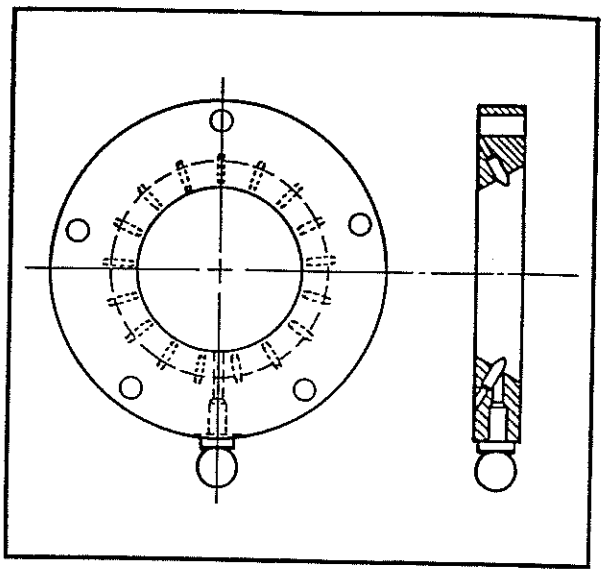


Figure 1-11. Wrenching Plate

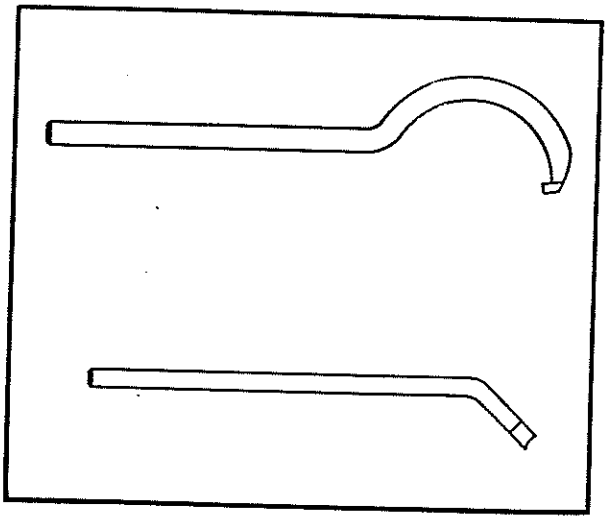


Figure 1-12. Tabwasher Staking Tool

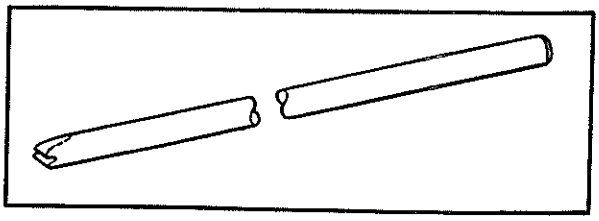


Figure 1-13. Blade Remover

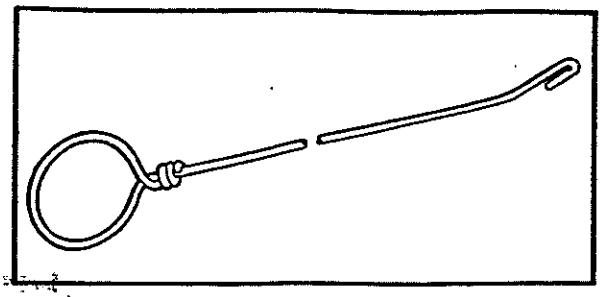


Figure 1-14. Retaining Ring Remover

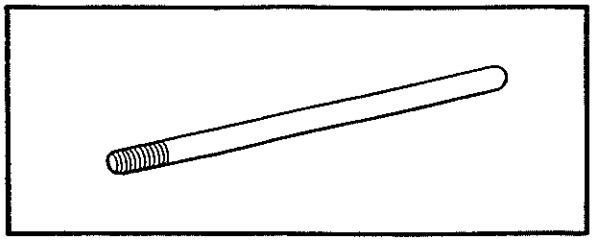


Figure 1-15. Guide Pin

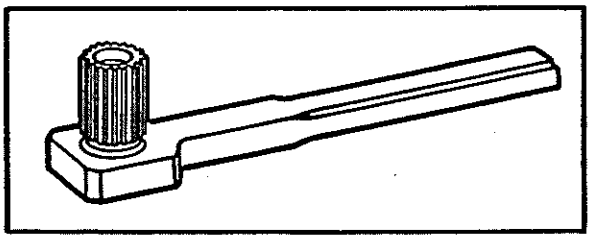


Figure 1-16. Socket Head Screw Key

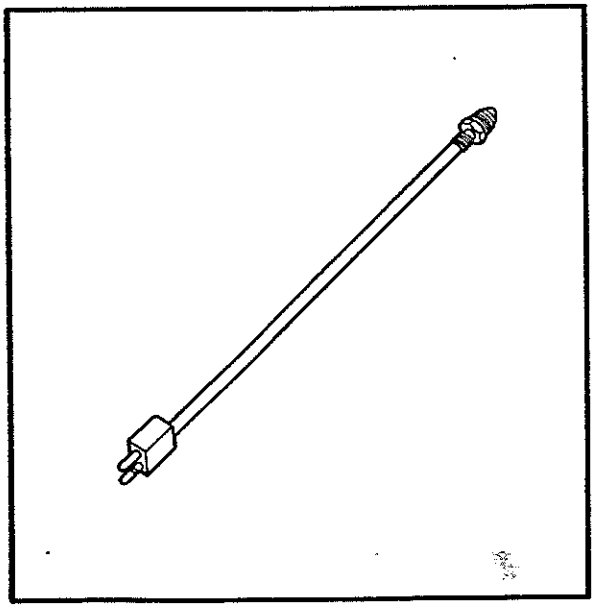


Figure 1-17. Immersion Thermocouple

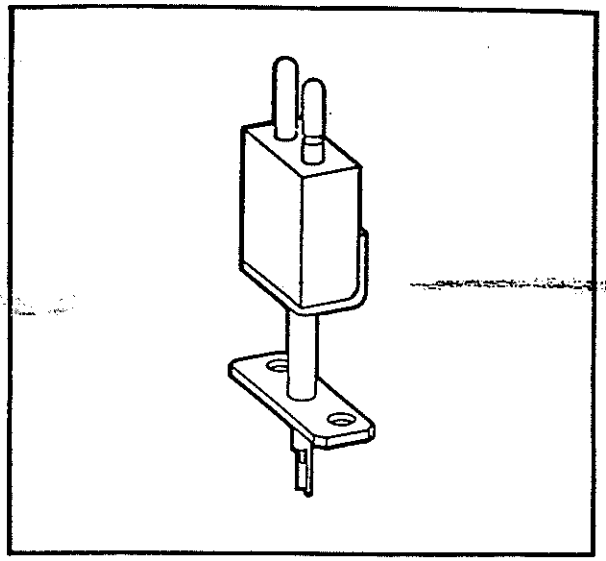


Figure 1-18. Thermocouple Assembly

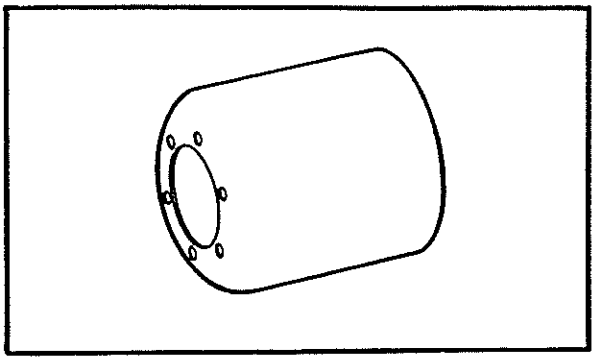


Figure 1-19. Air Inlet Inner Bellmouth

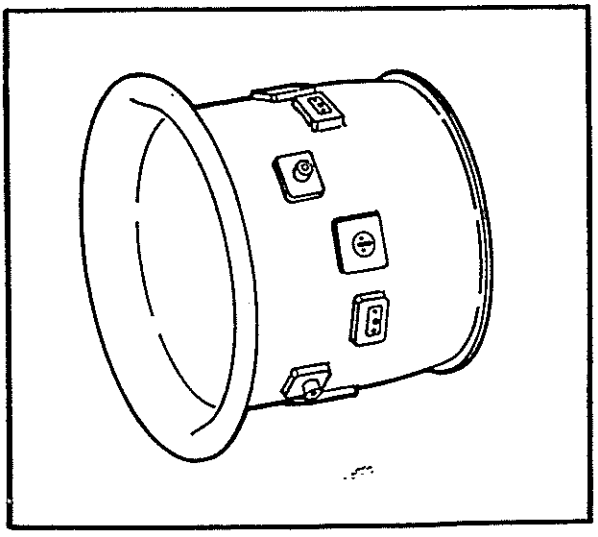


Figure 1-20. Air Inlet Outer Bellmouth

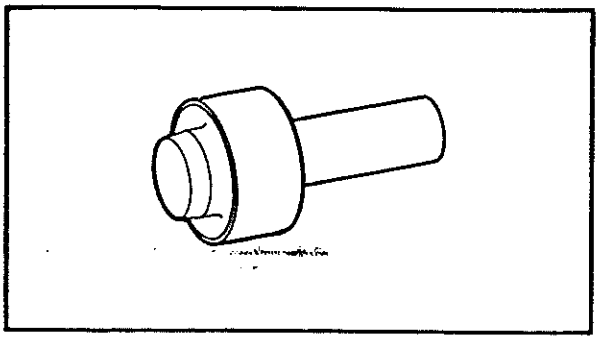


Figure 1-21. Installation and Removal Tool

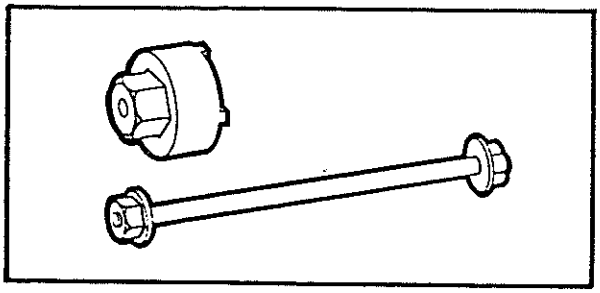


Figure 1-22. Double Socket and Stud Wrench

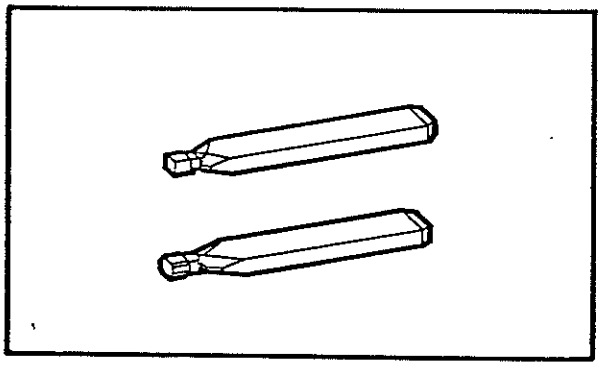


Figure 1-23. Staking Punch

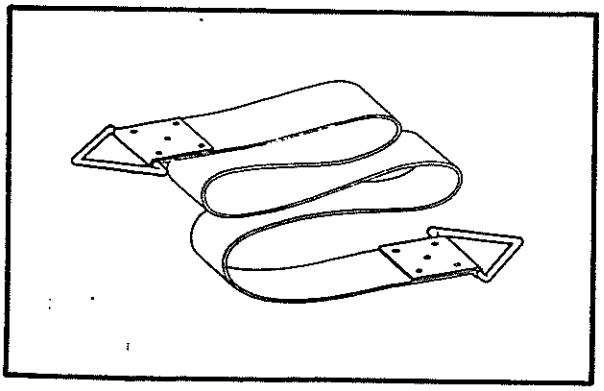


Figure 1-24. Horizontal Lifting Sling

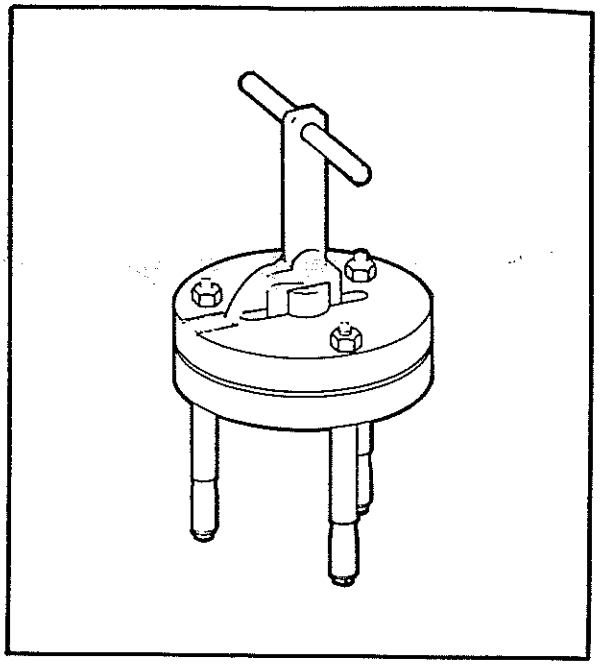


Figure 1-25. Turbine Wheel Puller

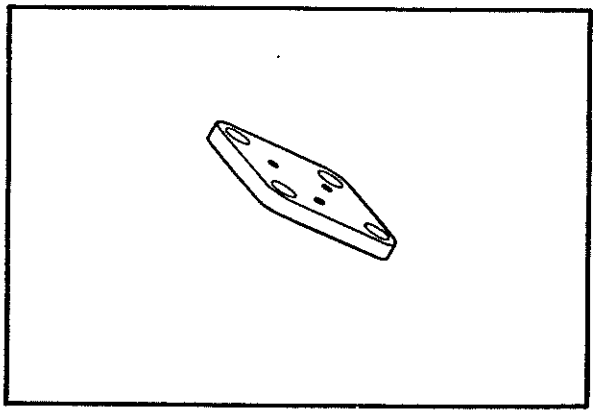


Figure 1-26. Vibration Pickup Adapter

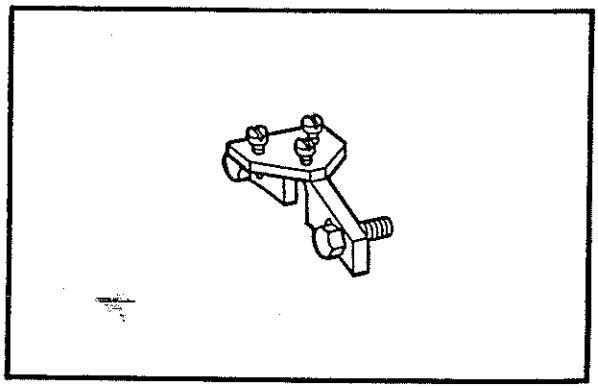


Figure 1-27. Vibration Pickup Adapter

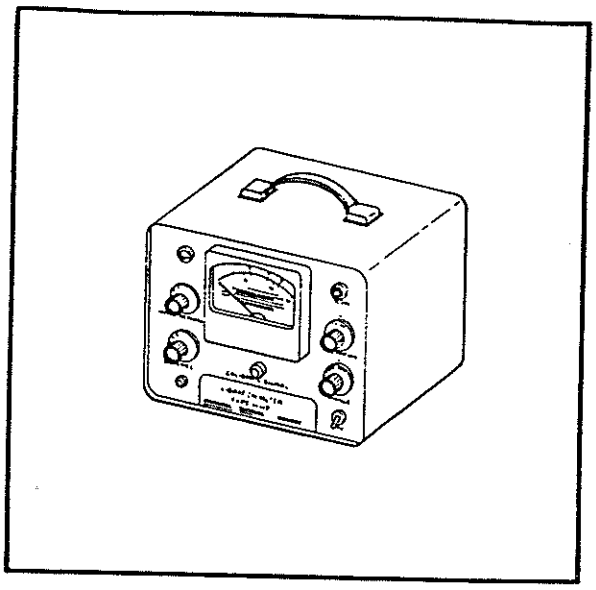


Figure 1-28. Vibration Meter

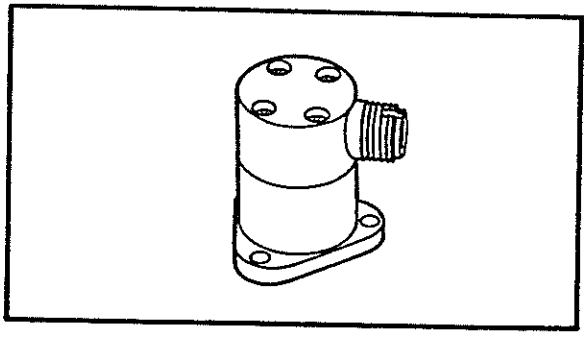


Figure 1-29. Vibration Pickup

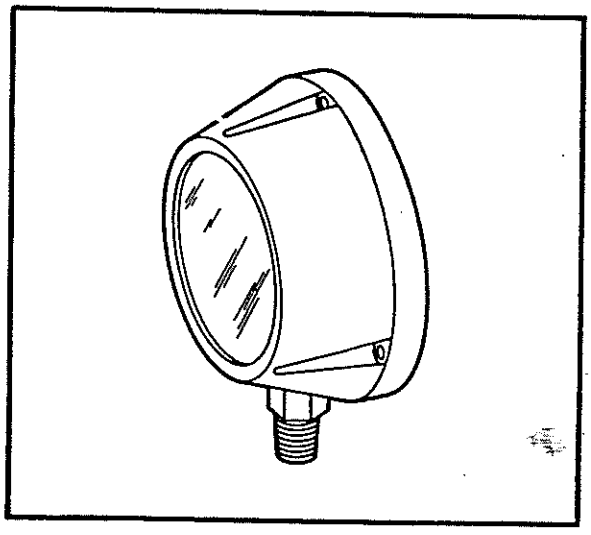


Figure 1-30. Fuel Pressure Gage

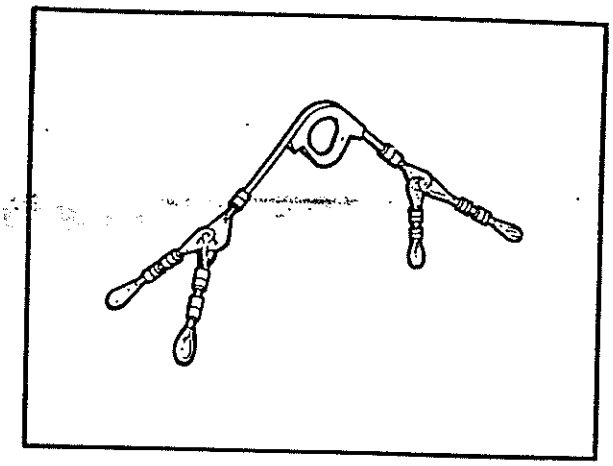


Figure 1-31. Engine Sling

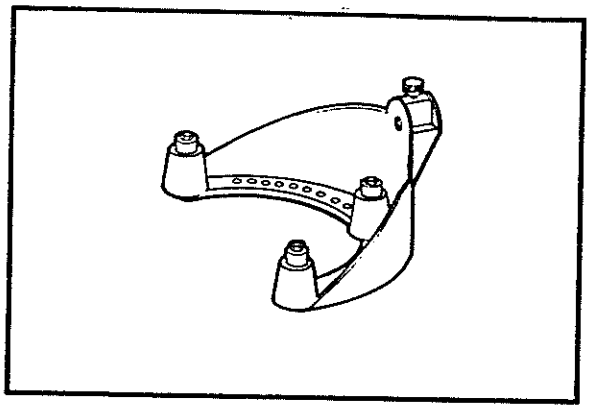


Figure 1-32. Transmission Adapter

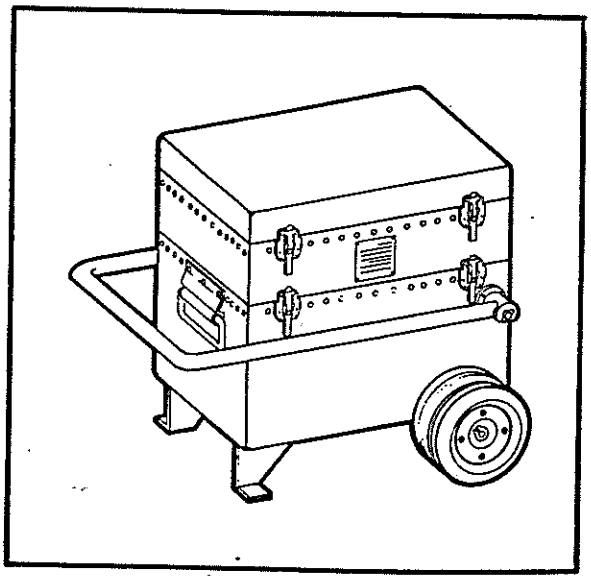


Figure 1-33. Jet-Cal Tester

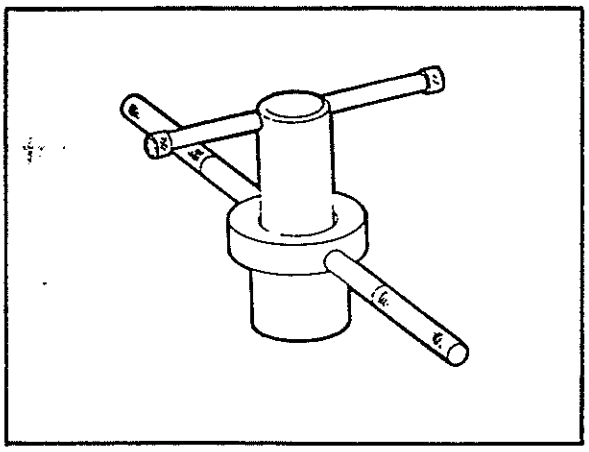


Figure 1-34. Bearing and Bushing Driver

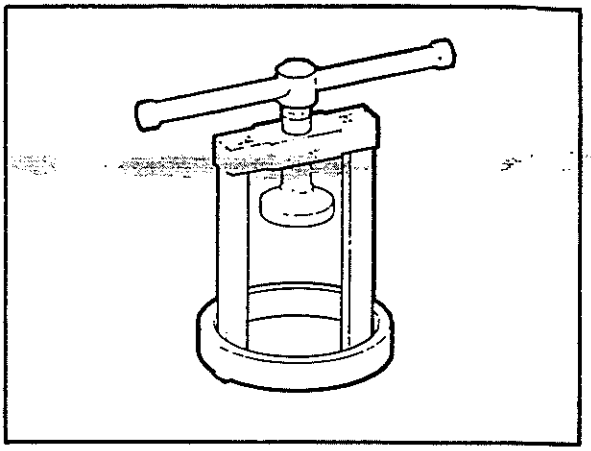


Figure 1-37. Mechanical Puller

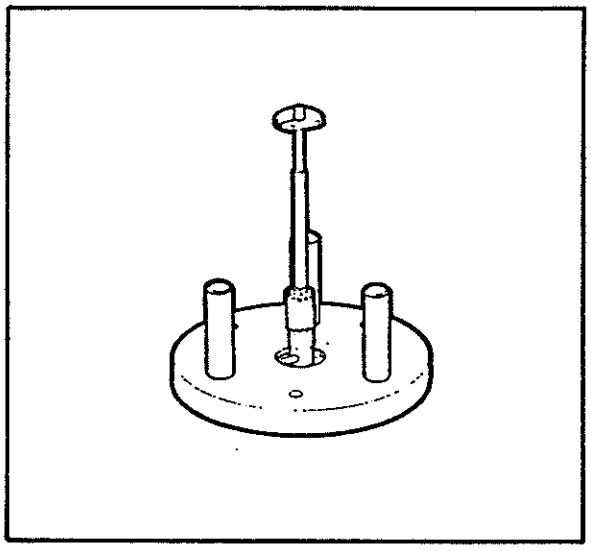


Figure 1-35. Power Turbine Holding Fixture

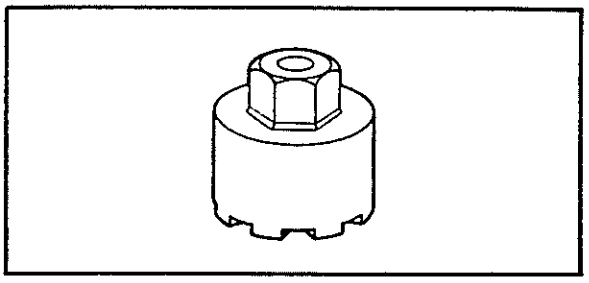


Figure 1-38. Spanner Face Socket Wrench

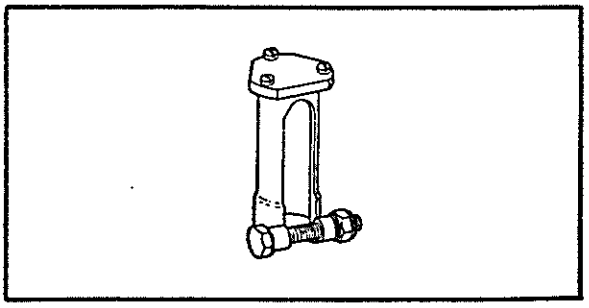


Figure 1-39. Vibration Pickup Adapter

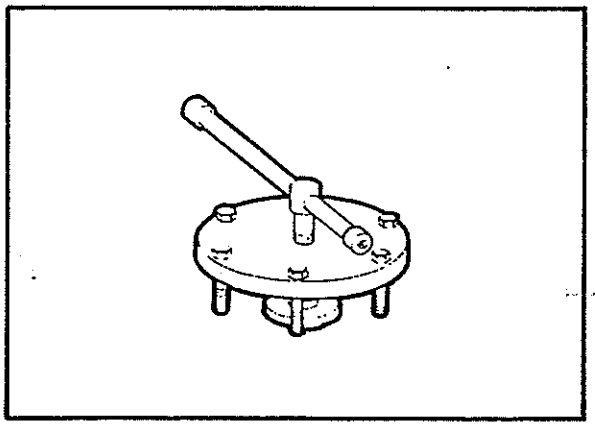


Figure 1-36. Bearing Housing Puller

Figure 1-40 deleted

SECTION II

DISMANTLING AND DISASSEMBLY

2-1. GENERAL.

2-2. Instructions in this section cover dismantling and disassembly of engine components before field repair.

2-3. References to model T53-L-1 shaft turbine engine also apply to models T53-L-1A and T53-L-1B except where noted.

2-4. Care must be exercised to prevent dirt and other foreign materials from entering the engine. Whenever practicable, temporary covers shall be used to seal all openings in the dismantled engine.

2-5. The engine shall be dismantled and disassembled only to the extent necessary to replace or repair an engine component that is not performing properly. Care must be exercised to avoid damaging engine components when dismantling and disassembling the engine.

2-6. During disassembly, examine all parts and assemblies for serviceability. Look for signs of work incorrectly performed in previous repair or overhaul. Report such indications according to current practice.

2-7. Discard removed lockwire, packing, cotter pins, gaskets, tabwashers, lockpins, and lockwashers.

2-8. TORQUE VALUES.

2-9. Standard torque values are given in Table of Standard Torque Values, Section VII. Special torque values are listed in Table of Limits (figure 7-7), Section VII.

2-10. MARKING ON HIGH TEMPERATURE MATERIALS.

2-11. Marking on materials subject to high temperatures shall be done only with one of the following: Colorbrite marking pencil (yellow, No. 2107); Marco ink (black, No. S1141); Marks-A-Lot ink pencil (red, green, or yellow); or Opco Marker (blue, green, or black).

2-12. SPECIAL TOOL AND EQUIPMENT REFERENCES.

2-13. Special tool and equipment references are listed by group number at the beginning of an operation. To locate tool numbers, refer to the group number in Functional Tool List, Section I.

2-14. REMOVAL OF ENGINE FROM SHIPPING CONTAINER.

2-15. SPECIAL TOOLS AND EQUIPMENT REFERENCES. (Refer to group number 20.)

2-16. PROCEDURE. (See figure 2-1.)

WARNING

Before opening shipping container, release air pressure from the container by removing the air valve at the front of the container.

a. Remove engine records from compartment.

b. Remove nuts and bolts that secure container halves.

c. Attach suitable sling to container upper half.

d. Using a suitable hoist attached to the sling, remove top half of container.

e. Remove nuts and washers that secure the four shipping trunnions to the shock mounts in the container lower half.

f. Insert a 7/16 inch diameter stud, 5 inches long, through the inlet housing mounting boss. Position engine sling cables (figure 1-31) on each end of stud. Secure cables with 1-1/2 inch diameter washers and nuts. Tighten nuts.

g. Insert 7/16 inch diameter stud, 6-1/2 inches long, through the diffuser housing mounting boss. Position

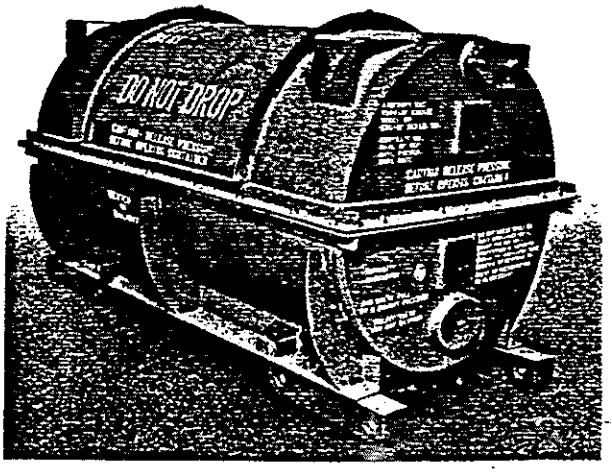


Figure 2-1. Engine Shipping Container

engine sling cables on each end of stud. Secure cables with 1-1/2 inch diameter washers and nuts. Tighten nuts.

h. Using a suitable hoist attached to engine sling, remove engine from container. (See figure 2-2.)

i. Remove shipping trunnions from engine mount pads.

j. If exhaust cone is included in shipment, remove the bolt that secures the cone. Lift out the exhaust cone.

2-17. INSTALLATION OF ENGINE IN ENGINE STAND.

2-18. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 18.)

2-19. PROCEDURE.

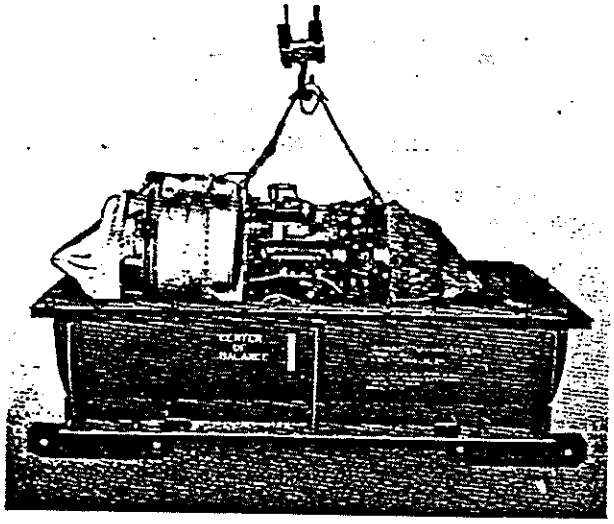


Figure 2-2. Removing Engine from Shipping Container

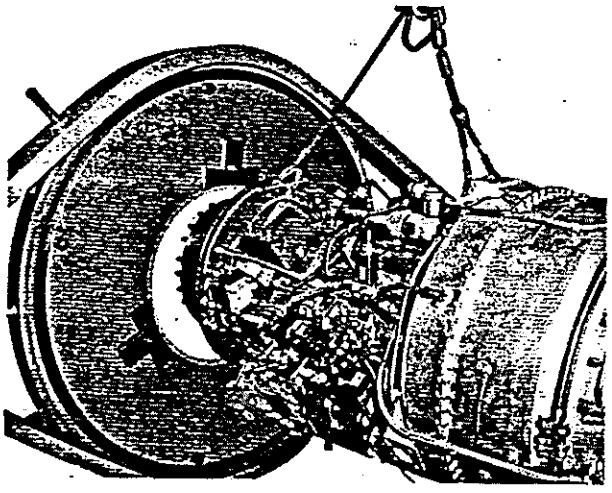


Figure 2-3. Installing Engine in Engine Stand

NOTE

Figures 2-3 and 2-4 illustrate the engine stand referred to in this manual. Figure 2-5 illustrates workstand.

CAUTION

Before installing engine in engine stand, check to see that the oil pump temperature sensing bulb connector does not interfere with the engine stand adapter ring. If interference is encountered, cut lockwire and disconnect connector. Cover exposed opening.

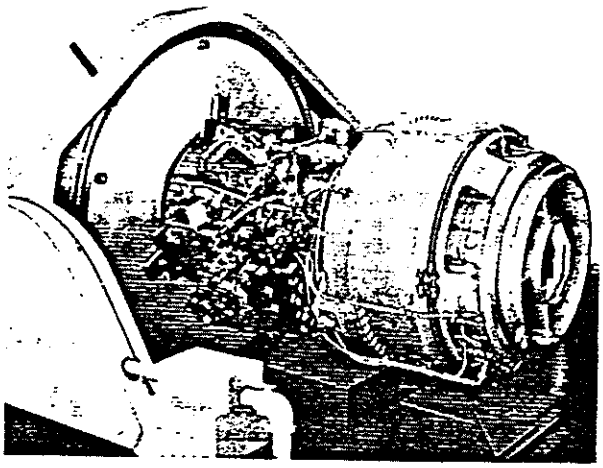


Figure 2-4. Engine Installed in Engine Stand

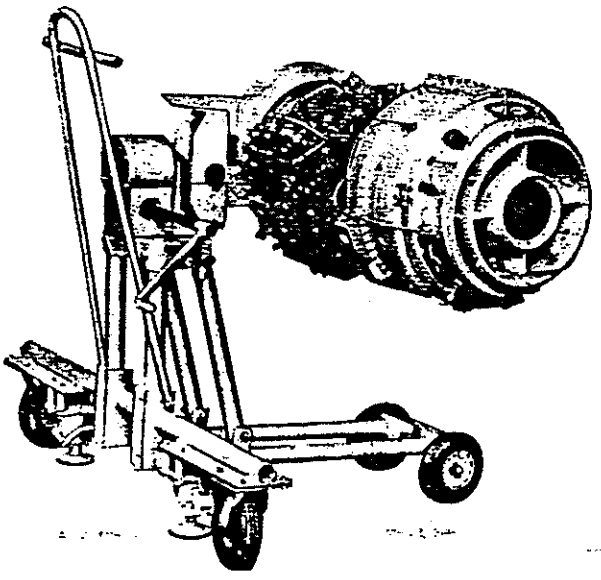


Figure 2-5. Engine Installed in Workstand

a. Remove air inlet cover (figure 1-4) from inlet housing.

b. Position engine stand mounting cradle so that engine is vertical. (See figure 2-3.)

c. Position one of the three adapter ring mounting lugs at 12 o'clock. (See figure 2-3.)

d. Using a suitable hoist attached to engine sling (figure 1-31), guide engine into engine stand adapter ring.

CAUTION

Use care to avoid damage to the inlet housing struts.

e. Position mounting lug at 12 o'clock over inlet housing flange and secure lightly.

f. Position the other two mounting lugs over inlet housing flange.

g. Tighten the three mounting lug nuts.

2-20. REMOVAL OF FUEL CONTROL.

2-21. PROCEDURE.

a. Remove screw and front half of clamp that secure the oil pressure hose and temperature sensing element line to clamp mounted on compressor housing flange. (See figure 2-6.)

b. Cut lockwire. Remove four bolts that secure the temperature sensing element housing to the inlet housing.

c. Remove and discard gasket.

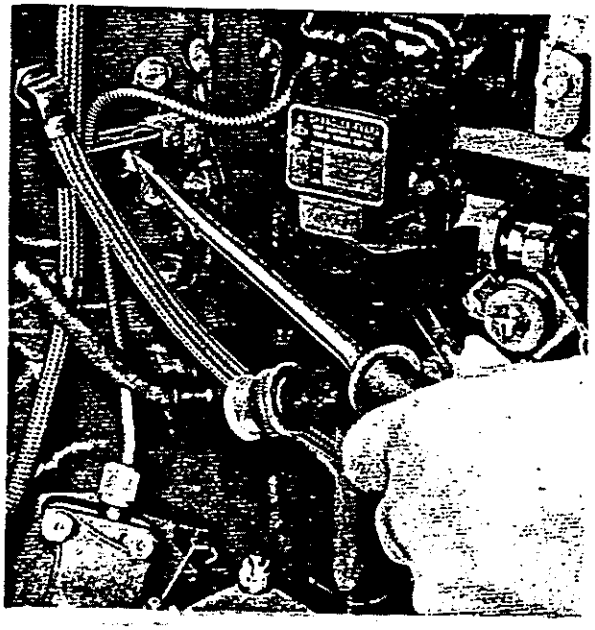


Figure 2-6. Loosening Temperature Sensing Element Line Clamp Screw

CAUTION

Do not bend or kink the line.

d. Cover exposed opening.

e. Disconnect starting fuel hose from fuel control.

f. Cover all exposed openings.

g. Disconnect main fuel hose from the fuel control discharge port tube.

h. Cover all exposed openings.

i. Cut lockwire. Disconnect electrical cable from fuel control.

j. Cover all exposed openings.

k. Remove four nuts and washers that secure the main fuel control to accessory drive gearbox. (See figure 2-7.)

l. Remove fuel control and second temperature sensing element housing. (See figure 2-8.)

m. Remove and discard packing.

CAUTION

Do not jar or strike fuel control drive shaft when handling fuel control.

n. Preserve the fuel control immediately, if it is not to be reinstalled on the engine within 24 hours. For fuel control preservation procedures, refer to paragraph 2-23.

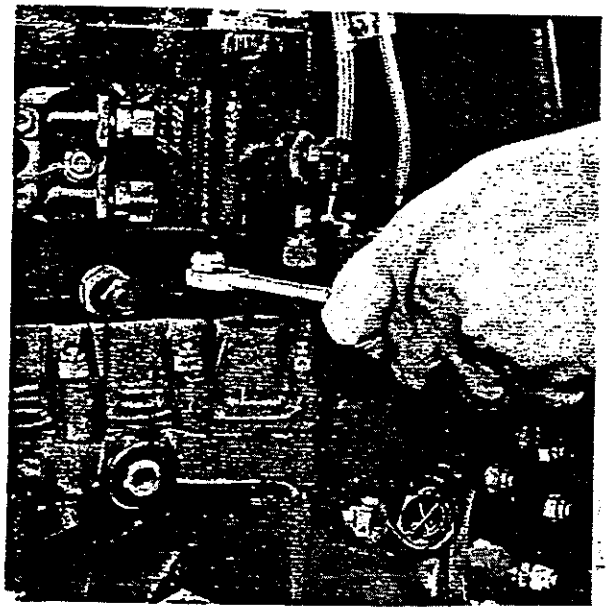


Figure 2-7. Removing Fuel Control Unit Nuts

CAUTION

If it is impossible to preserve the fuel control immediately, do not wait longer than 72 hours. Moisture present in JP-4 fuel, Military Specification MIL-J-5624, will corrode internal parts of the fuel control, causing serious damage.

o. Remove overspeed governor shaft tube and packings.

p. Discard packings.

q. Cover all exposed openings.

2-22. PRESERVATION OF FUEL CONTROL.

2-23. PROCEDURE.

a. Remove plugs or caps. Drain all fuel from pump pressure fittings, pump inlet pressure tap, fuel inlet port, fuel outlet port, igniter port, and vent port on top of cover assembly. Remove inlet filter, servo filter, and pump discharge filter.

b. Tilt and invert fuel control unit to ensure drainage of all fuel.

c. Recap all openings except vent port on top of cover assembly. Reinstall filters.

CAUTION

When replacing the servo and inlet filter assemblies, use care to prevent damaging the fine mesh screens.

d. Using lubricating oil, Military Specification MIL-O-6081, Grade 1010, fill fuel control through vent port, with 1 to 1-1/2 quarts of oil.

WARNING

Lubricating oil, Military Specification MIL-L-7808, or corrosion-preventive oil, Military Specification MIL-C-8188, shall not be used because of adverse effect on the seals and diaphragms. This is a safety of flight hazard.

e. Replace and tighten vent plug.

f. Tilt fuel control in various directions to allow air venting and to ensure adequate internal preservation.

g. Rotate both fuel control drives by hand, three to five times.

2-24. REMOVAL OF STARTING FUEL SOLENOID VALVE.

2-25. PROCEDURE.

a. Disconnect air hose at combustion chamber housing and at starting fuel solenoid valve.

b. Cover all exposed openings.

c. Remove nut and screw that secure loop clamp to bracket on flange.

d. Remove air hose.

e. Disconnect electrical cable at starting fuel solenoid valve.

f. Cover all exposed openings.

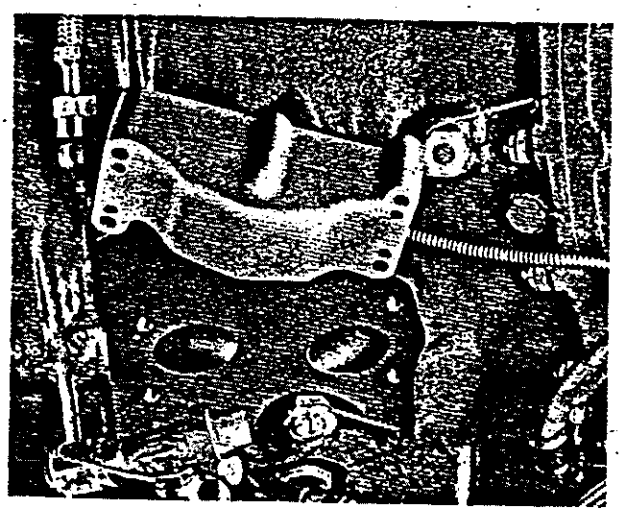


Figure 2-8. Removing Temperature Sensing Element Housing from Inlet Housing

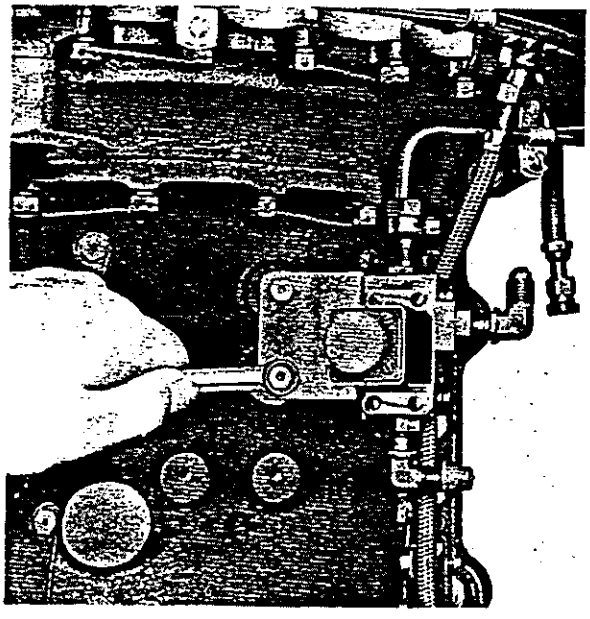


Figure 2-9. Removing Starting Fuel Solenoid Valve Bracket Bolts

g. Cut lockwire. Remove two nuts and three screws that support primer fuel hose between starting fuel solenoid valve and starting fuel manifold.

h. Disconnect coupling nut from starting fuel manifold.

i. Remove starting fuel hose.

j. Cover all exposed openings.

k. Cut lockwire. Remove four bolts that secure starting fuel solenoid valve and bracket to compressor housing. (See figure 2-9.)

l. Remove starting fuel solenoid valve and bracket.

2-26. REMOVAL OF ANTI-ICING SYSTEM (MODEL T53-L-1).

2-27. PROCEDURE. (See figure 2-10.)

a. Disconnect air hose (1) from anti-icing elbow (2) and temperature sensing element pad.

b. Remove air hose.

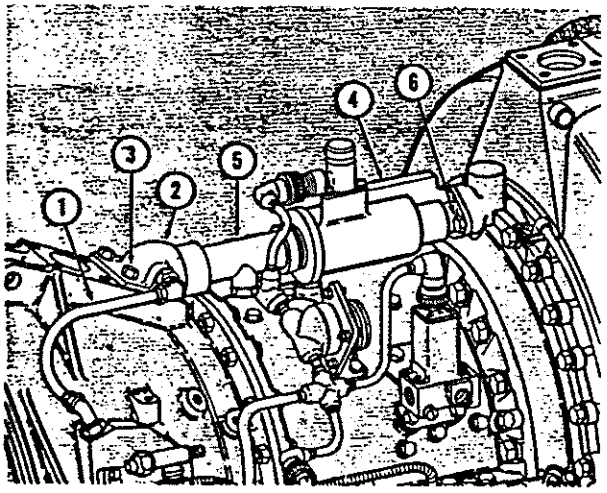
c. Cap all exposed openings.

d. Cut lockwire. Disconnect connector plug from airflow regulator (4).

e. Cover exposed opening.

f. Cut lockwire. Using a six-point socket wrench, remove four bolts (3) and washers that secure anti-icing elbow (2) to the inlet housing.

g. Remove two bolts (6) and washers at centrifugal compressor housing.



1. Hose
2. Elbow
3. Bolt
4. Regulator
5. Tube
6. Bolt

Figure 2-10. Airflow Regulator and Air Hose

h. Remove airflow regulator (4), anti-icing tube (5), and anti-icing elbow (2).

i. Remove and discard gasket.

j. Cover all exposed openings.

k. Disconnect two connector plugs from anti-icing interpreter. (See figure 2-11.)

l. Disconnect electrical cable assembly between interpreter and detector.

m. Cover all exposed connectors.

n. Cut lockwire. Remove four bolts that secure anti-icing interpreter brackets to compressor housing.

o. Remove anti-icing interpreter and brackets.

p. Cut lockwire. Disconnect electrical connector from detector.

q. Cover all exposed openings.

r. Cut lockwire. Remove two screws that secure strap to support plate.

s. Remove strap.

t. Cut lockwire. Disconnect jumper by removing two bolts that secure upper support plate to lower support plate.

u. Remove two flat washers, four shock washers, and two spacers.

v. Cut lockwire. Remove two bolts that secure detector to inlet housing.

w. Remove four flat washers and two shock washers.

x. Carefully remove detector.

y. Protect probe sensory holes with a suitable sleeve.

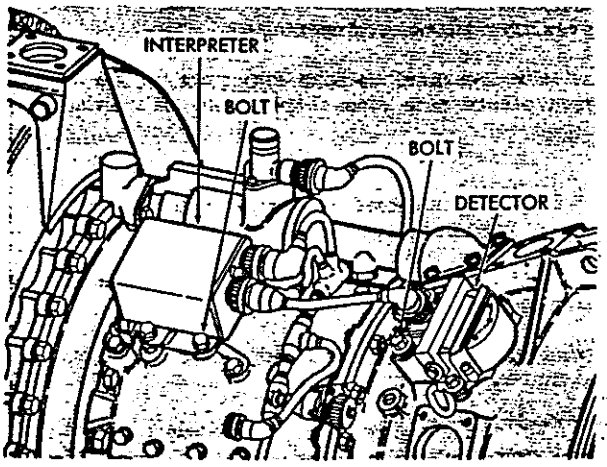


Figure 2-11. Anti-Icing Detector and Interpreter

z. Cover all exposed openings.

aa. Remove bushings from detector.

ab. Remove shock pad.

ac. Cut lockwire. Remove two bolts that secure lower support plate to inlet housing.

ad. Remove plate.

ae. Cover all exposed openings.

2-28. REMOVAL OF IGNITION UNIT (MODEL T53-L-1).

2-29. PROCEDURE.

a. Cut lockwire. Remove three connector plugs, one from electrical cable to ignition unit and two from ignition unit to igniter plugs leads.

WARNING

When removing an ignition unit, make certain that all electrical power is disconnected. Discharge all electrical power stored in the ignition unit by grounding igniter plug leads.

b. Cover all exposed openings.

c. Cut lockwire. Remove four bolts, two that secure bracket to centrifugal compressor housing and two that secure the bracket to the compressor housing.

d. Remove ignition unit and bracket.

2-30. REMOVAL OF ANTI-ICING SYSTEM AND IGNITION UNIT (MODELS T53-L-1A AND T53-L-1B).

2-31. PROCEDURE. (See figure 2-10.)

a. Disconnect air hose (1) from anti-icing elbow (2) and temperature sensing element pad.

b. Remove air hose.

c. Cover all exposed openings.

d. Cut lockwire. Remove four bolts (3) and washers that secure anti-icing elbow (2) to the inlet housing.

NOTE

Use a six-point socket wrench to prevent damage to bolt heads.

e. Cut lockwire. Remove connector plug from airflow regulator (4).

f. Remove two bolts (6) and washers at centrifugal compressor housing.

g. Remove airflow regulator, anti-icing tube (5), and anti-icing elbow.

h. Remove and discard gaskets.

i. Cover all exposed openings.

j. Cut lockwire. Disconnect two leads from ignition unit to igniter plugs.

k. Cover all exposed openings.

l. Cut lockwire. Disconnect electrical harness at ignition unit.

m. Cut lockwire. Disconnect three electrical harness connectors from interpreter.

n. Cover all exposed openings.

o. Cut lockwire. Remove four bolts (3, figure 2-12) that secure bracket (4), interpreter (1), and ignition unit (2) to compressor housing flange.

p. Remove interpreter and ignition unit.

q. Cut lockwire. Disconnect electrical connector from detector.

r. Cover exposed opening.

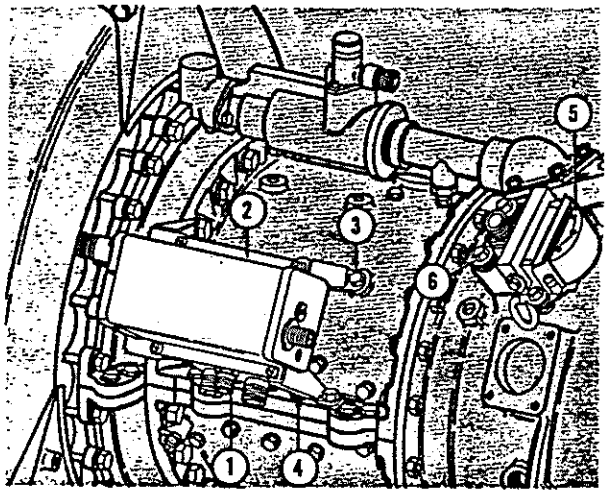
s. Cut lockwire. Remove two screws that secure strap to support plate.

t. Remove strap.

u. Cut lockwire. Disconnect jumper by removing two bolts that secure upper plate to lower plate.

v. Remove two flat washers, four shockwashers, and two spacers.

w. Cut lockwire. Remove two bolts (6) that secure detector (5) to inlet housing.



1. Interpreter
2. Ignition Unit
3. Bolt
4. Bracket
5. Detector
6. Bolt

Figure 2-12. Ignition Unit and Anti-Icing System (Models T53-L-1A and T53-L-1B)

x. Remove four flat washers and two shockwashers.

y. Remove detector.

z. Protect probe sensory holes with suitable materials.

aa. Remove bushings from detector.

ab. Remove shock pad.

ac. Cut lockwire. Remove two bolts that secure lower support plate to inlet housing.

ad. Remove plate from inlet housing.

ae. Cover exposed opening.

2-32. REMOVAL OF ELECTRICAL SYSTEM AND IGNITION LEADS.

2-33. PROCEDURE.

a. Cut lockwire. Remove all brackets and loop clamps that secure electrical harness to engine.

b. Remove electrical harness.

c. Cut lockwire. Remove four screws and two nuts that guide right ignition lead to igniter plug.

d. Cut lockwire. Disconnect coupling nut that secures lead and spark igniter on combustion chamber at the 4 o'clock position.

e. Remove lead and igniter plug.

f. Cover all exposed openings.

g. Break lockwire. Remove five screws and two bolts and nuts that guide left ignition lead to igniter plug.

h. Break lockwire. Disconnect coupling nut from igniter plug on combustion chamber at 8 o'clock.

i. Remove lead and igniter plug.

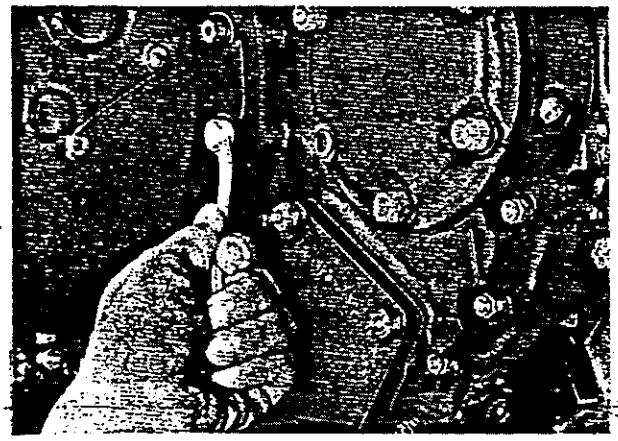


Figure 2-13. Removing Accessory Drive Gearbox Support Bolts

j. Cover all exposed openings.

CAUTION

When removing igniter lead to igniter plug coupling nuts, do not damage starting and main fuel manifold lines.

2-34. REMOVAL OF EXTERNAL OIL LINES.

2-35. PROCEDURE.

a. Disconnect scavenge oil hose assembly at numbers three and four main bearing scavenge oil outlet fitting.

b. Disconnect scavenge oil hose assembly at number two main bearing scavenge oil outlet fitting.

c. Disconnect pressure oil hose coupling nuts at oil filter and oil pressure manifold.

d. Remove two screws and nuts that support pressure oil hose between oil filter and pressure oil line.

e. Remove pressure oil hose.

f. Cover all exposed openings.

g. Cut lockwire. Remove four bolts that support oil manifold assembly on centrifugal compressor housing.

h. Disconnect pressure oil hose coupling nut at number two main bearing oil fitting on diffuser section.

i. Disconnect coupling nut at the pressure oil line.

j. Remove pressure oil hose.

k. Cover all exposed openings.

l. Cut lockwire. Remove four bolts that support oil manifold on the centrifugal compressor housing.

m. Disconnect pressure oil hose at pressure oil line.

n. Remove screw from loop clamp.

o. Remove oil pressure hose.

p. Cover all exposed openings.

q. Disconnect coupling nut at fitting for numbers three and four main bearings.

r. Remove two screws and one nut that secure pressure oil hose to combustion chamber.

2-36. REMOVAL OF ACCESSORY DRIVE GEARBOX.

2-37. PROCEDURE.

a. Support the drive gearbox before proceeding.

b. Cut lockwire. Remove three bolts and washers from flanges of axial compressor and inlet housings that secure accessory drive gearbox support to inlet housing. (See figure 2-13.)

c. Cut lockwire. Gradually loosen two long and two flange bolts that secure accessory drive gearbox to inlet housing. (See figures 2-14 and 2-15.)

CAUTION

As the bolts are being loosened and removed, hold the accessory drive gearbox so that it will not drop.

d. After the bolts have been removed, lower the accessory drive gearbox vertically until the drive shaft is freed from the inlet housing.

e. Remove and discard packings from drive shaft and gearbox strainer.

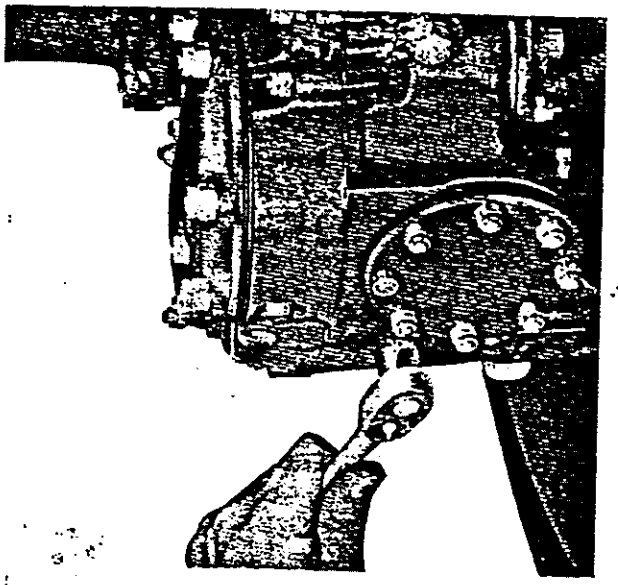


Figure 2-14. Removing Accessory Drive Gearbox Shouldered Bolt

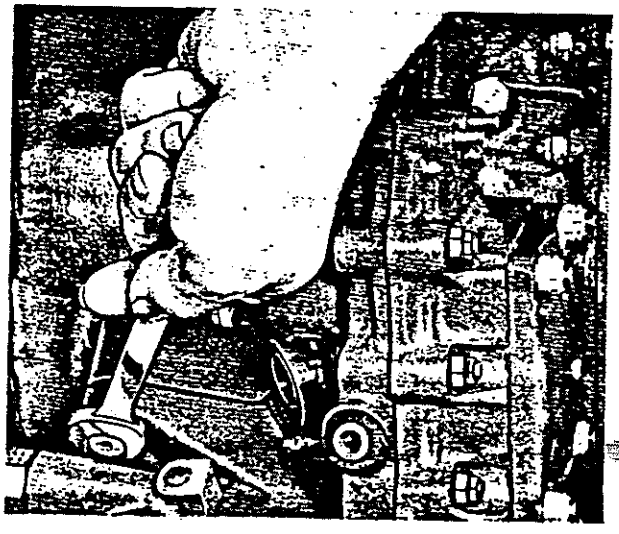


Figure 2-15. Removing Accessory Drive Gearbox Flange Bolts

f. Remove and discard seal.

g. Cover all exposed openings.

2-38. REMOVAL OF OVERSPEED GOVERNOR AND TACHOMETER DRIVE.

2-39. PROCEDURE.

a. Remove four nuts and washers that retain overspeed governor and tachometer drive to the inlet housing flange. (See figure 2-16.)

b. Remove overspeed governor and tachometer drive.

c. Remove and discard gaskets.

d. Remove governor drive shaft from inlet housing.

e. Cover all exposed openings.

2-40. REMOVAL OF OIL FILTER ASSEMBLY.

2-41. PROCEDURE.

a. Straighten tabwashers. Remove one long and one short bolt and seal nut. (See figure 2-17.)

b. Remove container.

c. Remove remaining bolts.

d. Guide oil filter away from the flange as the filter is being removed.

e. Remove and discard packings.

f. Cover all exposed openings.

2-42. REMOVAL OF COMBUSTION CHAMBER ASSEMBLY.

2-43. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 8.)

2-44. PROCEDURE.

a. Cut lockwire. Remove ten screws that retain rear bearing cover to exhaust diffuser. (See figure 2-18.)

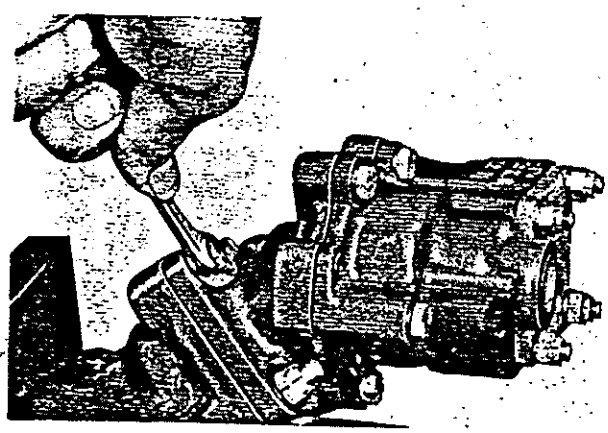


Figure 2-16. Removing Overspeed Governor and Tachometer Drive Gearbox Nuts

b. Using three puller screws, remove cover.

c. Bend lockwasher. Break torque on power shaft bolt. Remove power shaft bolt and adapter. (See figure 2-19.)

d. Discard lockwasher, seal, and packing.

e. (Models T53-L-1A and T53-L-1B.) Remove three nuts that secure combustion chamber cover boss.

f. Remove cover and boss gasket.

g. Remove swivel-joint assembly transfer tube and toruseal.

h. Attach sling (figure 1-24) and hoist to combustion chamber and prepare to separate chamber and diffuser housing.

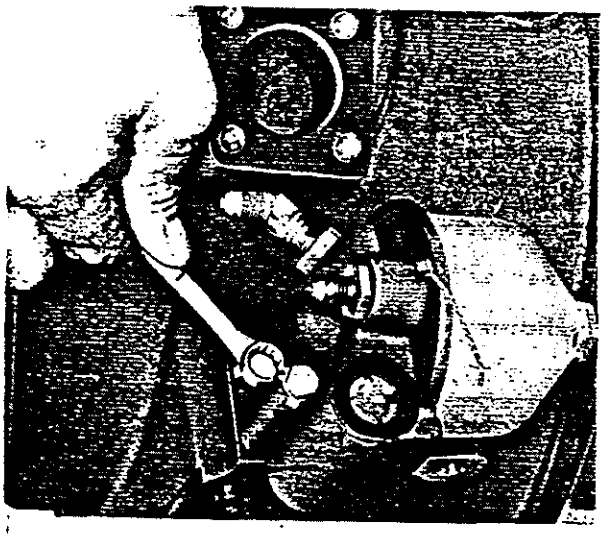


Figure 2-17. Removing Oil Filter Assembly Bolts

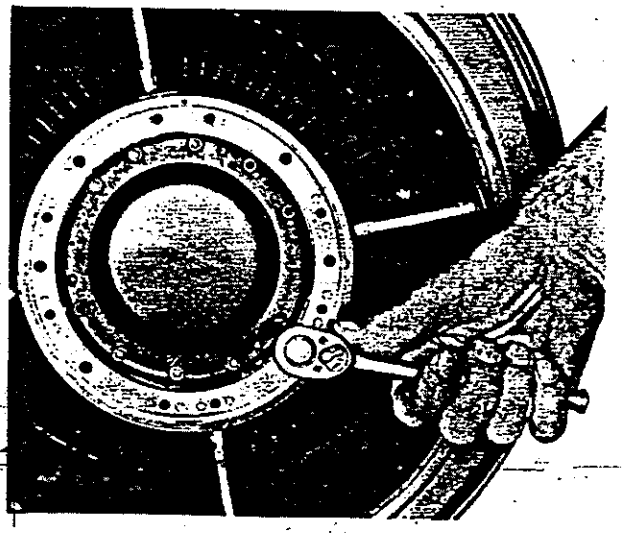


Figure 2-18. Removing Rear Bearing Cover Screws

i. Insert feeler stock through exhaust diffuser to lock second stage turbine to nozzle.

j. Remove 72 bolts and nuts that secure combustion chamber to diffuser housing.

CAUTION

Do not use starting and main fuel manifold or exhaust thermocouple as handles when removing combustion chamber from engine.

k. Using four puller screws, separate combustion chamber flange from diffuser housing flange.

l. Place combustion chamber on a bench, exhaust diffuser up.

CAUTION

When removing complete combustion chamber assembly, check for balance or mating marks between second stage turbine and power shaft splines. If none are visible, mark with approved marking pencil to ensure reassembly in the same positions. Never use a lead pencil when marking for location.

m. Remove feeler stock.

2-45. REMOVAL OF FIRST STAGE TURBINE, COOLING BAFFLE, AND FIRST STAGE TURBINE NOZZLE ASSEMBLY.

2-46. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 23.)

2-47. PROCEDURE.

a. Before removing first stage turbine nozzle, perform an eight-point blade tip clearance. (See figure 2-20.) Check tip clearance between first stage turbine and turbine nozzle. (Refer to Reference 35, Table of Special Torque Limits, Section VII.)

b. Insert a feeler gage between first stage turbine blade tip and nozzle.

c. Rotate the turbine wheel at each of the eight checkpoints. (See figure 2-21.)

d. Record readings for reference when engine is reassembled.

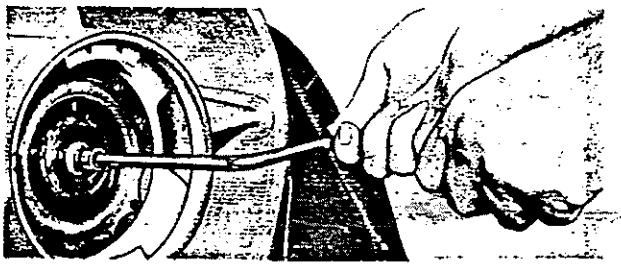


Figure 2-19. Removing Power Shaft Bolt

e. Bend three tabwashers with a punch and plastic mallet.

NOTE

The bolts are tablocked in pairs.

f. Using two six-point wrenches, one to prevent first stage turbine from rotating, the other to loosen retaining bolts, remove five bolts. (See figure 2-22.)

g. Support first stage turbine wheel and first turbine wheel plate and, with a six-point wrench, loosen the sixth bolt by applying a quick shock to the bolt head.

CAUTION

Use six-point socket wrenches to prevent turbine wheel plate bolt damage.

h. Remove and discard tabwashers.

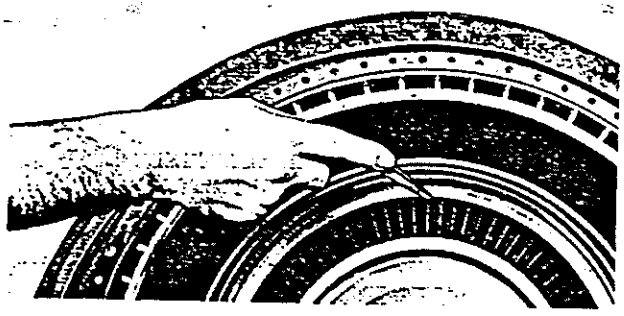


Figure 2-20. Checking First Stage Turbine Blade Tip Clearances

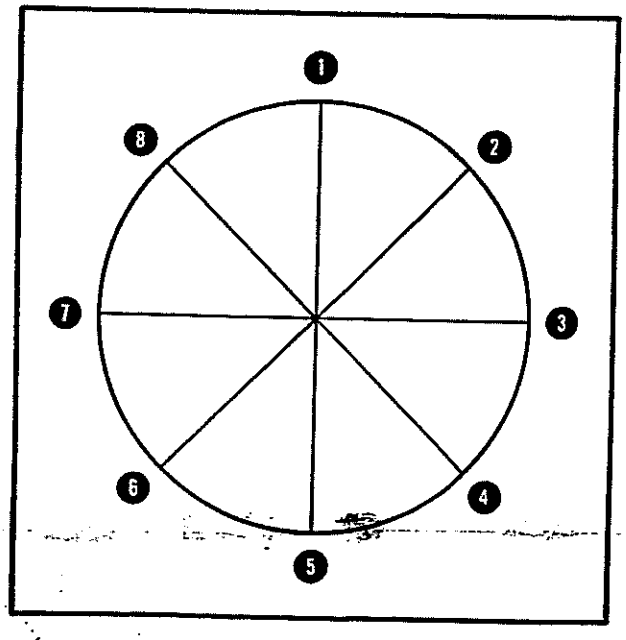


Figure 2-21. Eight-Point Clearance Check Diagram

CAUTION

Before removing the first stage turbine wheel, check for balance or mating marks between wheel and compressor rotor rear shaft. If none are visible, mark both the first stage turbine wheel and compressor rotor rear shaft with approved marking pencil to ensure reassembly in the same position. Never use a lead pencil when marking for location.

i. Remove first stage turbine wheel.

j. Remove turbine cooling bellows from compressor rotor rear shaft nut.

k. Bend six tabwashers with a punch and plastic mallet.

l. Remove 12 nuts and 6 tabwashers. (See figure 2-23.)

m. Remove turbine cooling baffle.

n. Remove and discard tabwashers. Install locating plate onto diffuser housing.

o. Remove three screws that secure first stage turbine nozzle. (See figure 2-24.)

p. Remove first stage turbine nozzle.

q. Remove curl.

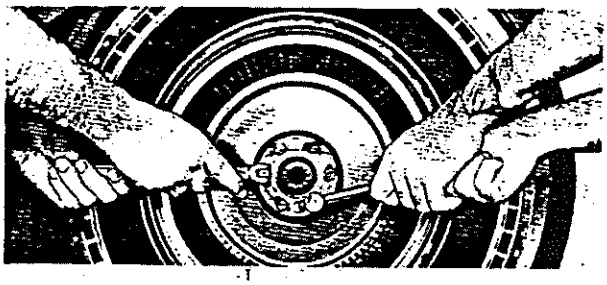


Figure 2-22. Removing First Stage Turbine Wheel Plate Bolts

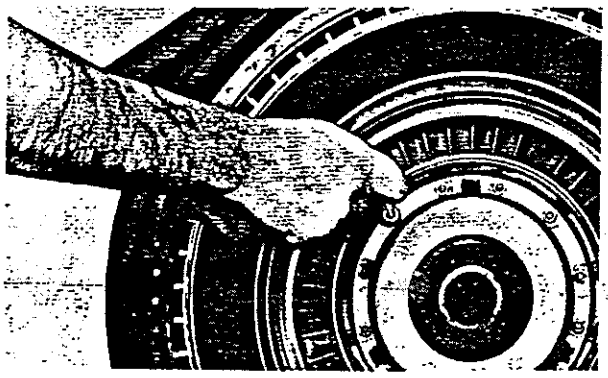


Figure 2-23. Removing Turbine Cooling Baffle Nuts

CAUTION

Record the effective flow area of the nozzle for later reference, if this assembly requires replacement. The effective flow area of each first stage nozzle is indicated on the inner flange of the nozzle.

r. Cut lockwire. Remove oil inlet cap and gasket from support assembly at approximately the 3 o'clock position.

s. Remove and discard gasket.

t. Remove oil inlet strainer. (See figure 2-25.)

u. Remove and discard packings.

2-48. REMOVAL OF POWER OUTPUT DRIVE GEAR ASSEMBLY.

2-49. PROCEDURE.

CAUTION

Remove the overspeed governor and tachometer drive (paragraph 2-38) before attempting to remove the power output drive gear assembly.

a. Remove 22 nuts, washers, and spacers that secure ring gear support housing on the inlet housing.

b. Bend tabwashers. Remove three bolts and tabwashers from recessed holes in support housing. (See figure 2-26.)

CAUTION

When bending tabwashers, do not damage support housing assembly.

c. Install three puller screws in puller screw holes in support housing. (See figure 2-27.)

NOTE

Apply equal tension to screws when separating power output gear from inlet housing flange.

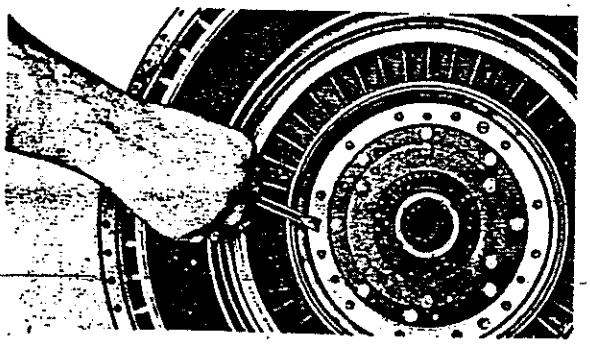


Figure 2-24. Removing First Stage Turbine Nozzle Assembly Screws

d. Withdraw power output gear.

e. Remove and discard seal inside pilot diameter of support housing.

2-50. REMOVAL OF TORQUEMETER CARRIER AND GEAR ASSEMBLY.

2-51. PROCEDURE.

CAUTION

Cover lower strut opening in inlet housing to prevent engine damage by foreign objects.

a. Bend 15 tabwashers.

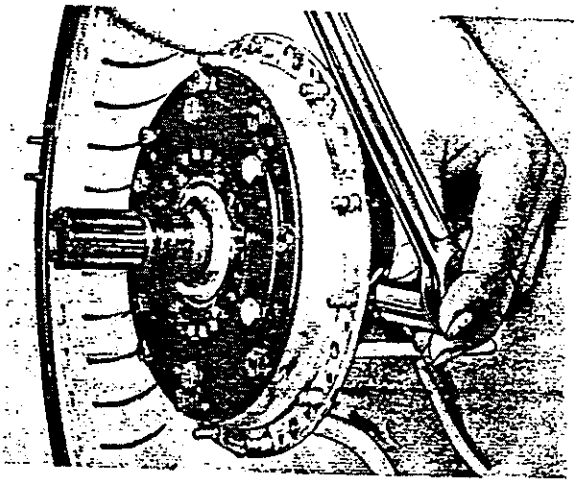


Figure 2-25. Removing Number Two Main Bearing Oil Inlet Strainer

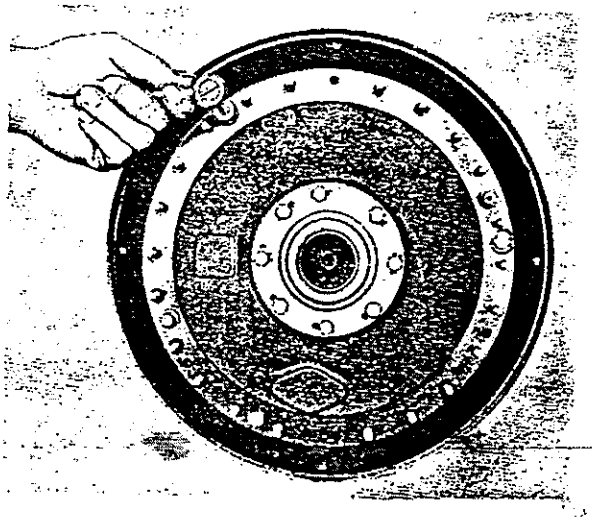


Figure 2-26. Removing Power Output Drive Gear Assembly Bolts

b. Remove 15 bolts and tabwashers. (See figure 2-28.)

c. Carefully remove torquemeter carrier and gear from inlet housing.

CAUTION

Do not remove planetary sun gear assembly and accessory drive carrier assembly.

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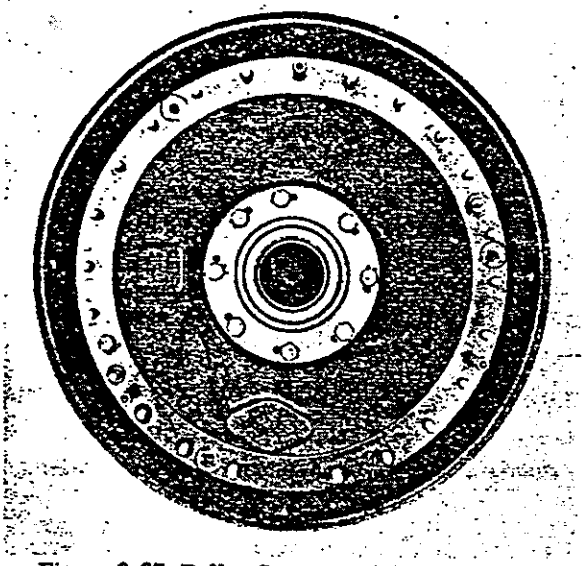

Figure 2-27. Puller Screws Installed in Power Output Drive Gear Assembly

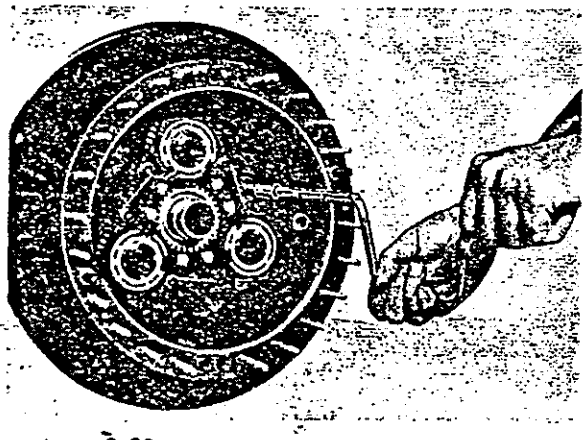

Figure 2-28. Removing Torquemeter Carrier and Gear Assembly Bolts

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2-59. Deleted.

2-60. Deleted.

2-61. REMOVAL OF DIFFUSER HOUSING.

2-62. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 15.)

2-63. PROCEDURE. (See figure 2-35.)

a. Straighten lockring. Install locating plate on diffuser and bearing support housing and in turbine wheel adapter.

b. Using a suitable wrench, break torque on the rear bearing compressor shaft nut. (See figure 2-36.)

NOTE

Do not remove nut.

c. With a holding wrench applied on the compressor rear shaft and using a suitable wrench, break torque on the compressor front shaft spanner nut. (See figure 2-37.)

d. Remove wrenches.

NOTE

Do not remove nut.

Figure 2-29 deleted

Figure 2-30 deleted

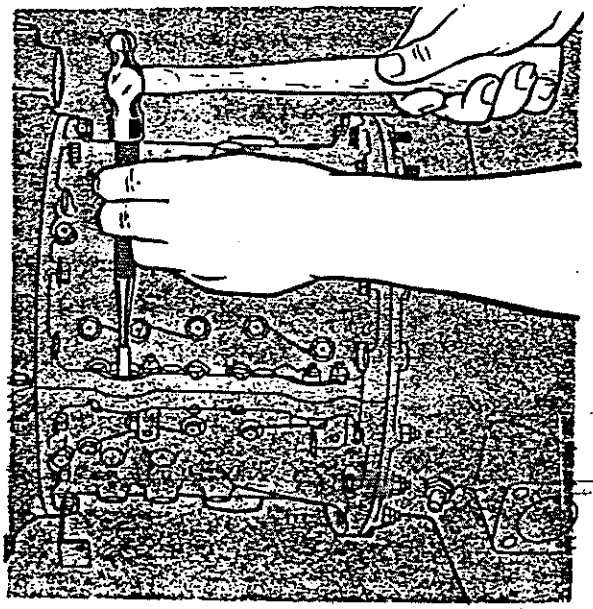

Figure 2-31. Removing Threaded Tapered Pins

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f. Remove accessory drive carrier assembly. (See figure 2-30.)

g. Remove locating plate from diffuser housing.

2-58. COMPRESSOR ROTOR AND CENTRIFUGAL COMPRESSOR IMPELLER CLEARANCES.

2-59. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 11.)

2-60. PROCEDURE.

NOTE

Recording clearances during disassembly is recommended but not mandatory. The record of these clearances will serve as a checklist at final assembly. If clearance check is not made, disregard procedures in paragraphs 2-59 and 2-60.

a. Remove nuts and washers from locating taper pins of axial compressor housing flange.

b. Thread drive pin punch onto taper pin. Remove taper pin by striking punch with hammer. (See figure 2-31.)

CAUTION

Using suitable brass stock, backup compressor housing flange before striking punch.

c. Cut lockwire. Remove bolts that secure axial compressor housing upper half to inlet housing and centrifugal compressor housing.

d. Cut lockwire. Remove bolts that secure axial compressor housing upper half to lower half.

e. Remove upper half of axial compressor housing.

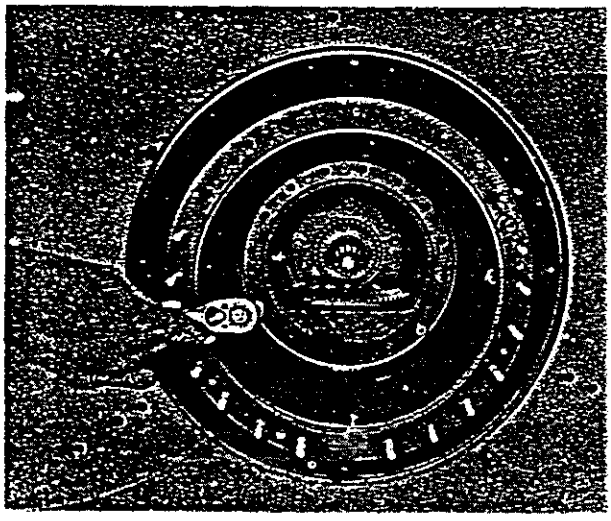


Figure 2-30. Removing Accessory Drive Carrier Assembly

f. Remove bolts that secure fifth stage vane assembly to lower half of axial compressor housing.

g. Tap vane with plastic hammer until it is flush at parting line.

h. Remove nut and tapered pins that secure centrifugal compressor housing halves.

i. Remove remaining bolts that secure the upper half of the centrifugal compressor housing to diffuser housing.

j. Remove upper half of the centrifugal compressor housing.

CAUTION

Move upper half of centrifugal compressor housing forward toward inlet housing, then lift and remove. Do not allow upper half of centrifugal compressor housing to strike compressor rotor or centrifugal compressor impeller blades.

k. Using a plastic hammer, relocate fifth stage vane assembly.

l. Secure vane assembly to lower half of the axial compressor housing with two bolts.

m. Tighten bolts.

n. Check clearance between compressor rotor and axial compressor housing.

o. Check clearance between centrifugal compressor impeller blades and centrifugal compressor housing.

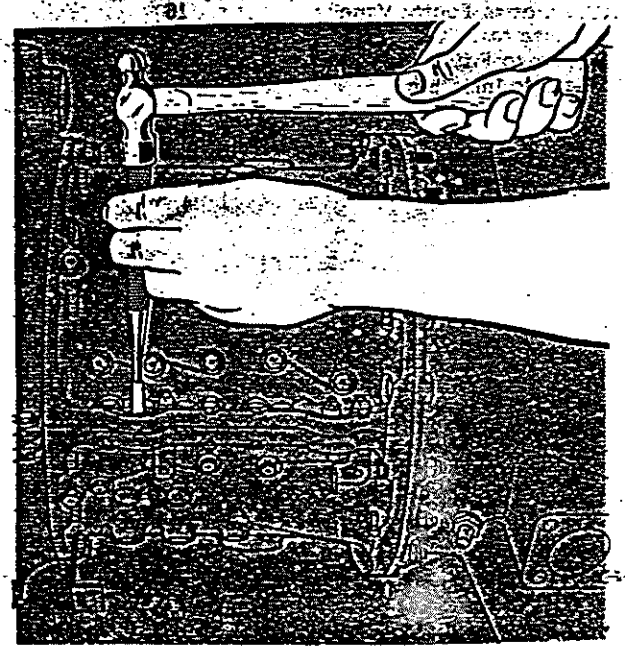


Figure 2-31. Removing Threaded Tapered Pins

p. Place engine in a vertical position.

q. Using a feeler gage, check radial tip clearances between compressor rotor blades and axial housing at two points, 180 degrees apart. (See figure 2-32.)

r. Record clearances for use during final assembly. Table of Limits references for compressor rotor blades are as follows.

STAGE	T/L REFERENCE
First	2
Second through Fifth	5, 10, 15, 20

s. Using feeler gage, check radial tip clearances between five compressor vanes and spacers at ten points. (See figure 2-33.)

t. Record clearances for use at final assembly. Table of Limits references for clearances between vanes and spacers are as follows.

STAGE	T/L REFERENCE
Second through Fifth	7, 8, 12, 13, 17, 18, 22

u. Using feeler gage, check axial clearances between first through fifth stage rotor blades and vanes at two points, 180 degrees apart. (See figure 2-34.)

v. Record clearances for use at final assembly. Table of Limits references for axial clearances between first through fifth stage rotors and vanes are as follows.

ROTOR AND VANE	T/L REFERENCE
First Rotor to First Vane	3
First Vane to Second Rotor	4
Second Rotor to Second Vane	6
Second Vane to Third Rotor	9
Third Rotor to Third Vane	11
Third Vane to Fourth Rotor	14
Fourth Rotor to Fourth Vane	16
Fourth Vane to Fifth Rotor	19
Fifth Rotor to Fifth Vane	21
Fifth Vane to Impeller	23

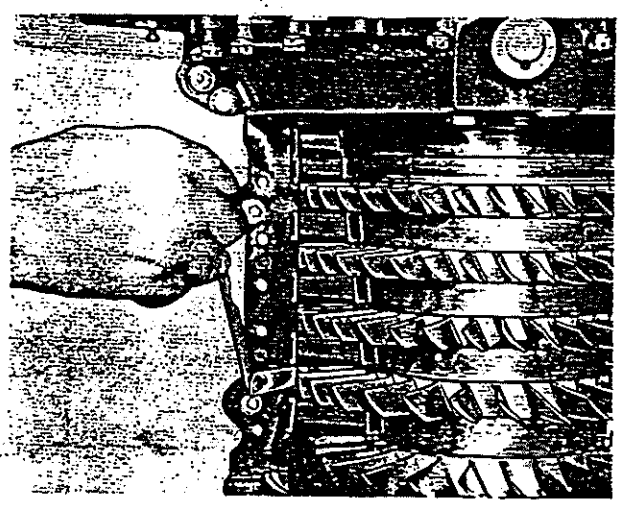


Figure 2-32. Checking Compressor Rotor Blade Tip Clearance

w. Using a feeler gage, check the radial tip clearances between the centrifugal compressor impeller blades and the centrifugal compressor housing at two points, 180 degrees apart.

x. Record these clearances for use at final assembly.

y. Assemble upper halves of axial and centrifugal compressor housings. Secure with two bolts.

z. Reinstall housing on engine and secure to lower housing with four bolts. Table of Limits references for centrifugal compressor impeller to centrifugal compressor housing clearances during final assembly are as follows.

CENTRIFUGAL COMPRESSOR IMPELLER TO CENTRIFUGAL COMPRESSOR HOUSING	T/L REFERENCE
Radial	24
Radial - Axial	25
Axial	26

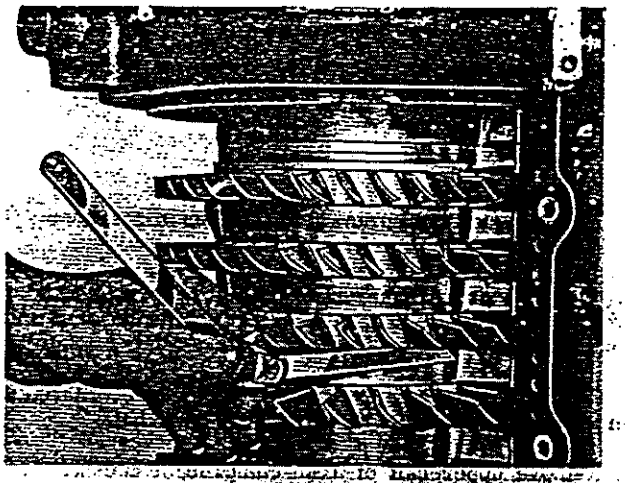


Figure 2-33. Checking Clearance Between Compressor Vane and Spacer

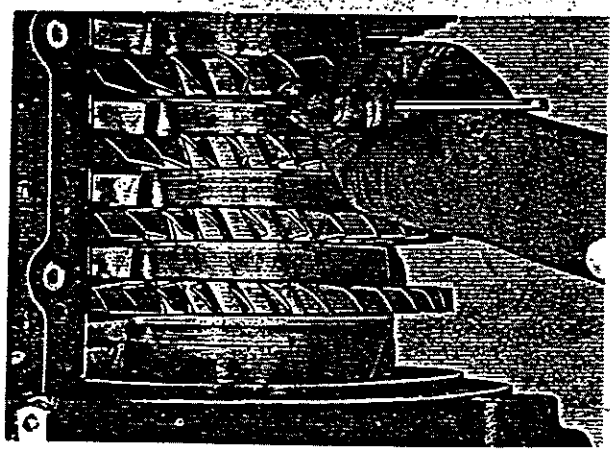


Figure 2-34. Checking Clearance Between Rotor Blades and Vane

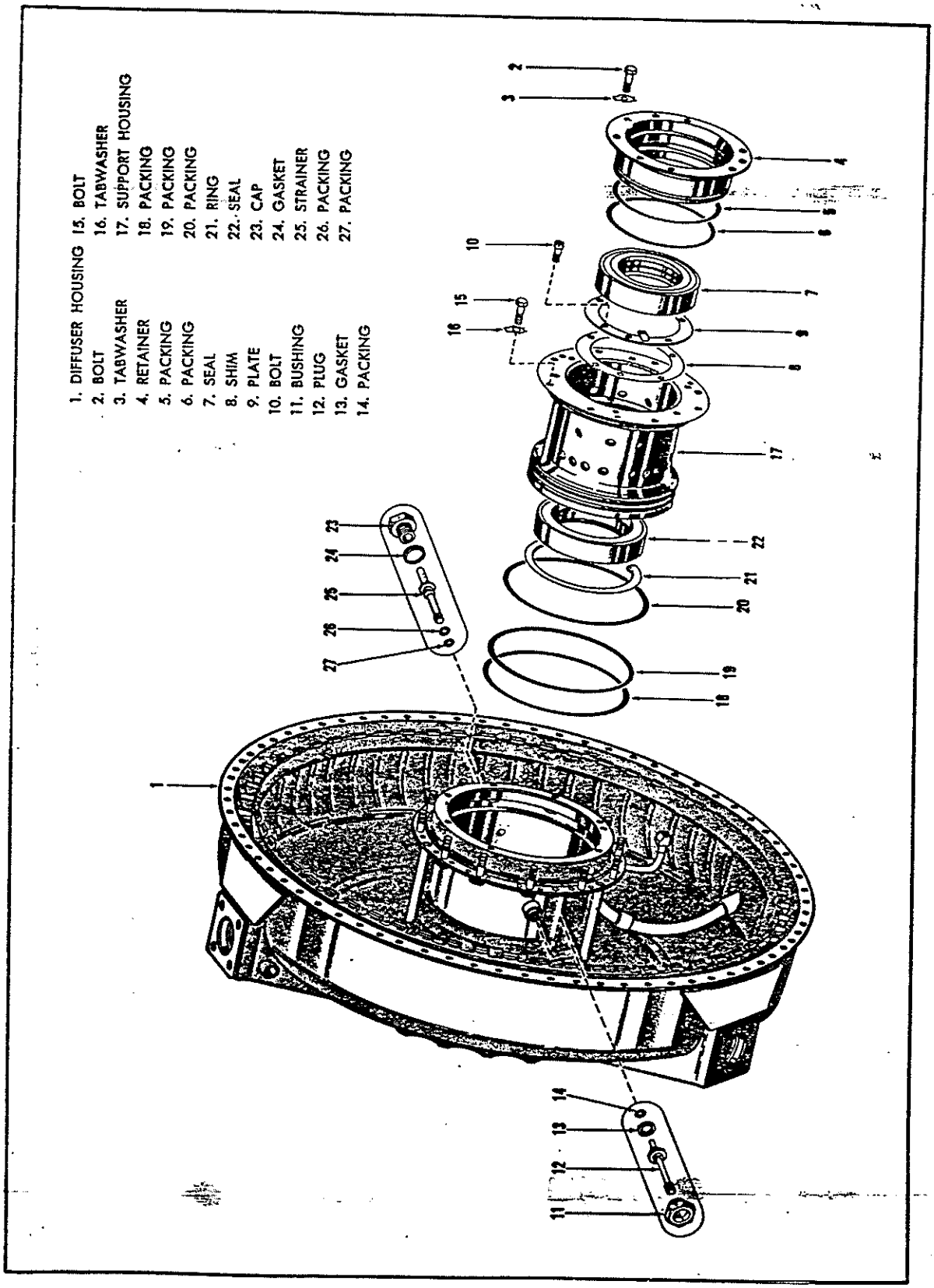


Figure 2-35. Diffuser Housing and Rear Bearing Support Housing Assembly

e. Remove rear bearing compressor shaft nut.

f. Remove rear bearing compressor shaft nut lockring.

g. Install driver on turbine wheel adapter.

h. Remove adapter front pilot cone and control gap seal sleeve.

CAUTION

The lockring can be withdrawn by lifting it evenly on all sides. Do not damage power shaft threads.

i. Using three puller screws, remove seal retainer (4, figure 2-35), seal (7), and two packing rings (5 and 6).

j. Cut lockwire. Remove six bolts (10) from plate (9).

k. Remove plate and shim (8).

l. Remove bolts that secure diffuser housing to centrifugal compressor housing.

m. Remove diffuser housing.

2-64. REMOVAL OF AXIAL AND CENTRIFUGAL COMPRESSOR HOUSINGS.

2-65. PROCEDURE.

a. Cut and remove lockwire from bolts where necessary.

b. Remove nuts and washers from four locating taper pins on the axial compressor housing flange.

c. Thread drive pin punch onto tapered pin. Remove tapered pin by striking punch with hammer. (See figure 2-31.)

CAUTION

Use suitable brass stock to support axial compressor housing flange before striking punch with hammer.

d. Remove ten bolts and washers that secure axial compressor housing upper half to inlet housing.

e. Remove 12 bolts and washers that secure axi compressor housing upper half to lower half.

f. Remove nine bolts and washers that secure axia compressor housing upper half to centrifugal compressor housing.

g. Remove upper half of axial compressor housing.

CAUTION

The centrifugal compressor housing has a pilot flange that fits into the axial compressor housing. To prevent damaging this flange during disassembly, remove the axial compressor housing before removing the centrifugal compressor housing.

h. Remove six bolts and washers that secure the fifth stage compressor vanes to the lower half of the axial compressor housing.

NOTE

The two fifth stage compressor vanes (front and rear) will project slightly above the mating surface at one side of the lower half of the axial compressor housing. To prevent damaging these vanes during the removal of the centrifugal compressor housing, relocate vanes as explained in step i.

i. With a plastic mallet, gently tap the projecting ends of the fifth stage compressor vanes until they are flush with the mating surface of the axial compressor housing.

j. Remove nuts and washers from two locating tapered pins on the centrifugal compressor housing.

k. Thread drive pin punch onto tapered pin. Remove tapered pin by striking punch with hammer.

CAUTION

Use suitable brass stock to support centrifugal compressor housing flange before striking punch with hammer.

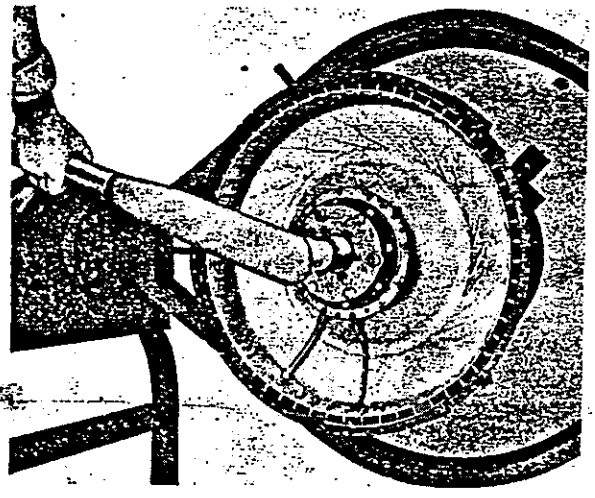


Figure 2-36. Breaking Torque on Rear Bearing Compressor Shaft Nut

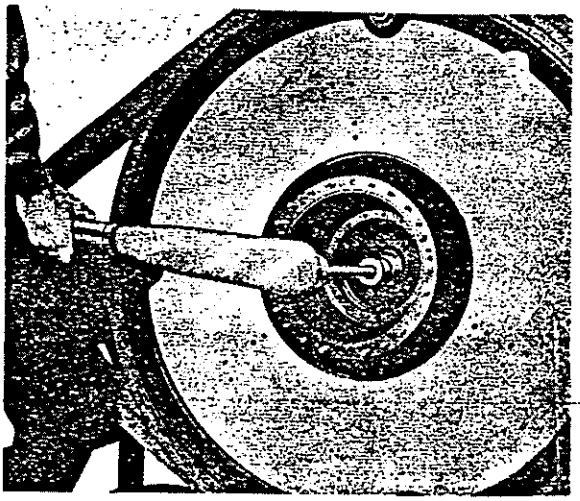


Figure 2-37. Breaking Torque on Compressor Front Shaft Spanner Nut

l. Remove two bolts and washers that secure the upper and lower halves of the centrifugal compressor housings.

m. Remove upper half of centrifugal compressor housing.

CAUTION

Move upper half of centrifugal compressor housing forward, toward inlet housing, then lift and remove. Do not allow the upper half of the centrifugal compressor housing to strike the centrifugal compressor impeller blades or the axial compressor blades. Such contact may damage the blades or the inner surface of the housing.

n. With plastic mallet, gently tap the fifth stage compressor vanes (lower half) until they are located in their original position, projecting slightly above one side of the axial compressor housing.

o. Secure fifth stage compressor vanes to the lower half of the axial compressor housing with six washers and bolts. Torque the center bolts to 45 pound-inches and the outer bolts (near horizontal mating surface) to 15 pound-inches.

2-66. REMOVAL OF COMPRESSOR ROTOR.

2-67. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 10.)

2-68. PROCEDURE.

a. Install hoisting adapter on compressor rotor rear shaft.

b. Place hook in hoisting adapter.

c. Remove five bolts and tabwashers from inlet housing.

d. Remove bearing retainer, shim, and two bearing pin retaining plates.

NOTE

Record shim thickness for use during reassembly.

e. Using a hoist, carefully remove compressor rotor from inlet housing by gently rocking rotor while slowly raising the hoist. (See figure 2-38.)

f. Using a fiber drift and mallet, remove bearing liner from inlet housing.

g. Place compressor rotor assembly in a vertical position in holding fixture, with the centrifugal compressor assembly downward.

h. Remove spanner nuts.

CAUTION

Cover compressor rotor with barrier material, Military Specification MIL-P-130. Do not dent or nick numbers one and two main bearings or the pinion gear.

2-69. DISASSEMBLY OF MAJOR COMPONENTS.

2-70. Although complete disassembly instructions are given, disassemble engine major components only as far as necessary to clean, inspect, and repair.

NOTE

Follow all safety precautions and general practices in paragraphs 2-1 through 2-13 when major components are disassembled.

2-71. DISASSEMBLY OF ACCESSORY DRIVE GEARBOX ASSEMBLY.

2-72. Refer to Section III for disassembly, inspection, repair, and assembly of accessory drive gearbox.

2-73. DISASSEMBLY OF OIL FILTER ASSEMBLY.

2-74. Refer to Section III for disassembly, inspection, repair, and assembly of oil filter.

2-75. DISASSEMBLY OF AXIAL COMPRESSOR HOUSING ASSEMBLY.

2-76. PROCEDURE. (See figure 2-39.)

a. Remove six bolts (6) and washers (7) that secure first stage compressor vanes (5) to axial compressor housing halves.

b. Remove vanes.

c. Remove six bolts (11, 12, and 13) and washers (14, 15, and 16) that attach the second (8), third (9),

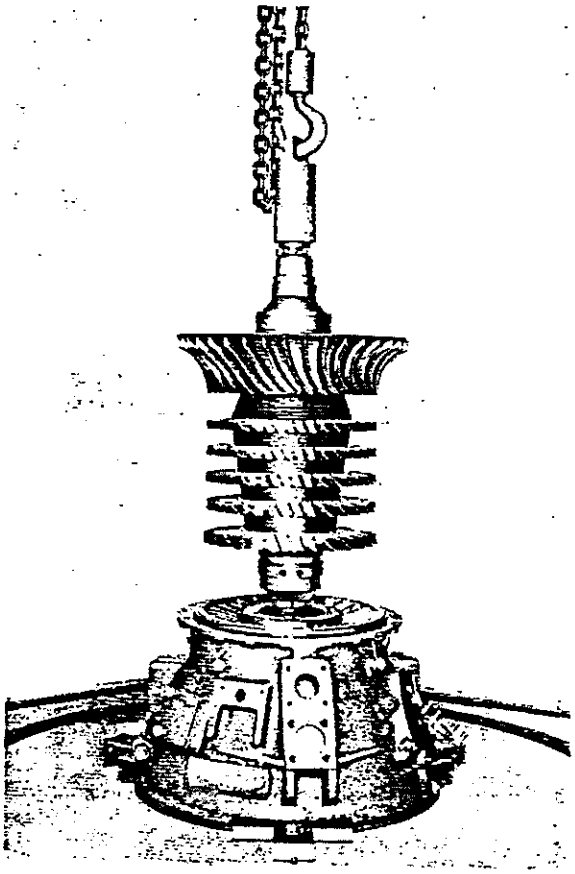
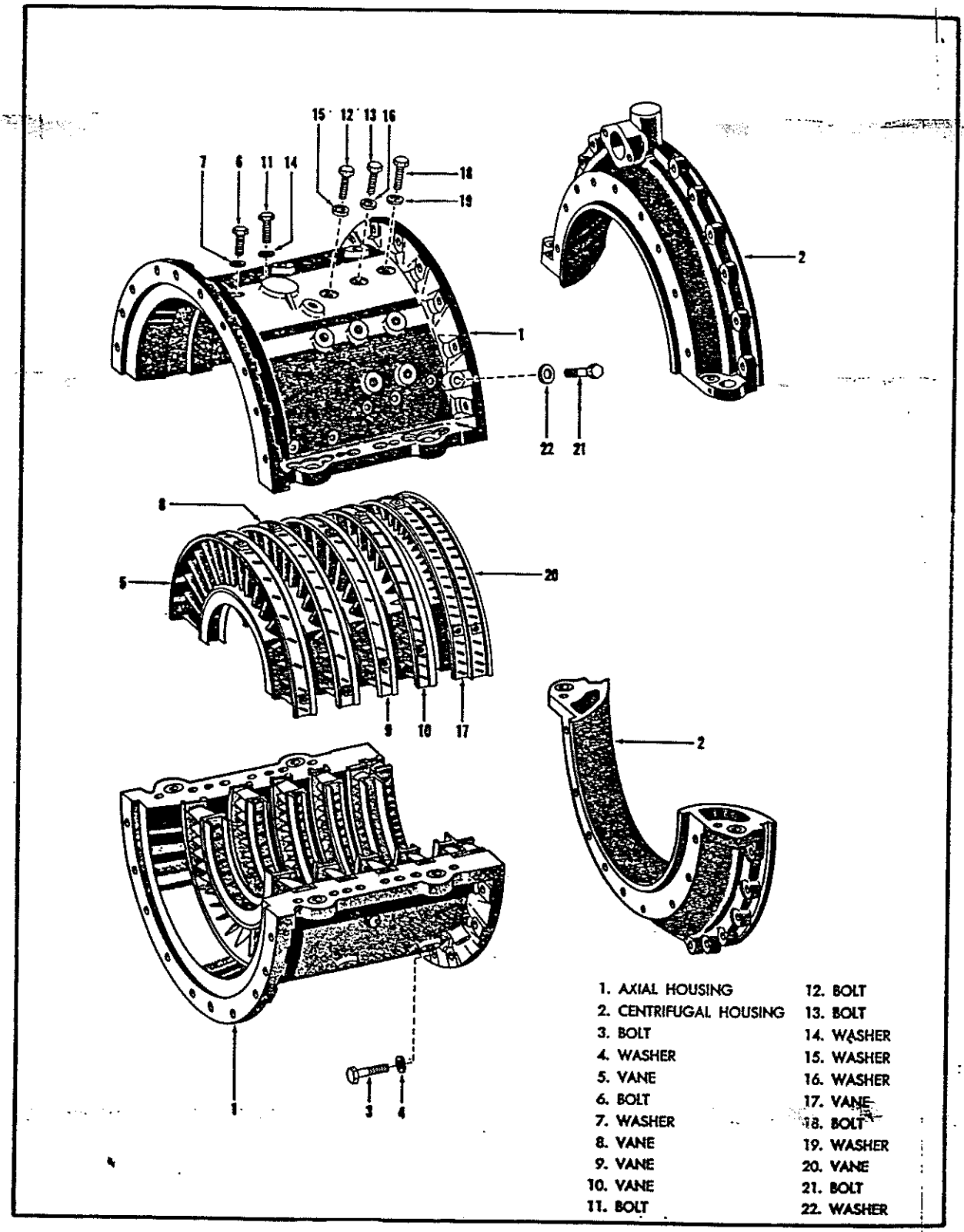


Figure 2-38. Removing Compressor Rotor from Inlet Housing



1. AXIAL HOUSING	12. BOLT
2. CENTRIFUGAL HOUSING	13. BOLT
3. BOLT	14. WASHER
4. WASHER	15. WASHER
5. VANE	16. WASHER
6. BOLT	17. VANE
7. WASHER	18. BOLT
8. VANE	19. WASHER
9. VANE	20. VANE
10. VANE	21. BOLT
11. BOLT	22. WASHER

Figure 2-39. Axial and Centrifugal Compressor Housing Assemblies

and fourth (10) stage compressor vanes to axial compressor housing halves.

d. Remove vanes.

e. Remove six bolts (18) and washers (19) that secure front fifth stage compressor vane (17) to axial compressor housing.

f. Remove vane.

g. Remove four bolts (21) and washers (22) that secure rear fifth stage compressor vane (20) to axial compressor housing.

h. Remove vane.

2-77. DISASSEMBLY OF DIFFUSER HOUSING AND REAR BEARING SUPPORT HOUSING ASSEMBLY.

2-78. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 16.)

2-79. PROCEDURE.

CAUTION

To prevent damage to the thermocouple, remove thermocouple before removing bearing support.

a. Cut lockwire. Remove thermocouple bushing (11), plug (12), gasket (13), and packing (14) from diffuser housing (1).

b. Remove eight bolts (15) and tabwashers (16).

c. With driver (figure 1-6), remove rear bearing support housing (17, figure 2-35) from diffuser housing.

2-80. DISASSEMBLY OF COMPLETE COMBUSTION CHAMBER.

2-81. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 6.)

2-82. PROCEDURE.

CAUTION

Before disassembling the power turbine and combustion chamber, record the depth of the power shaft plug in relation to the combustion chamber housing pilot flange. (See figure 2-40.) Record this depth reading. It will be used to re-establish the power shaft plug depth if the complete power turbine is replaced.

a. Place combustion chamber and exhaust diffuser on a bench, with combustion chamber up.

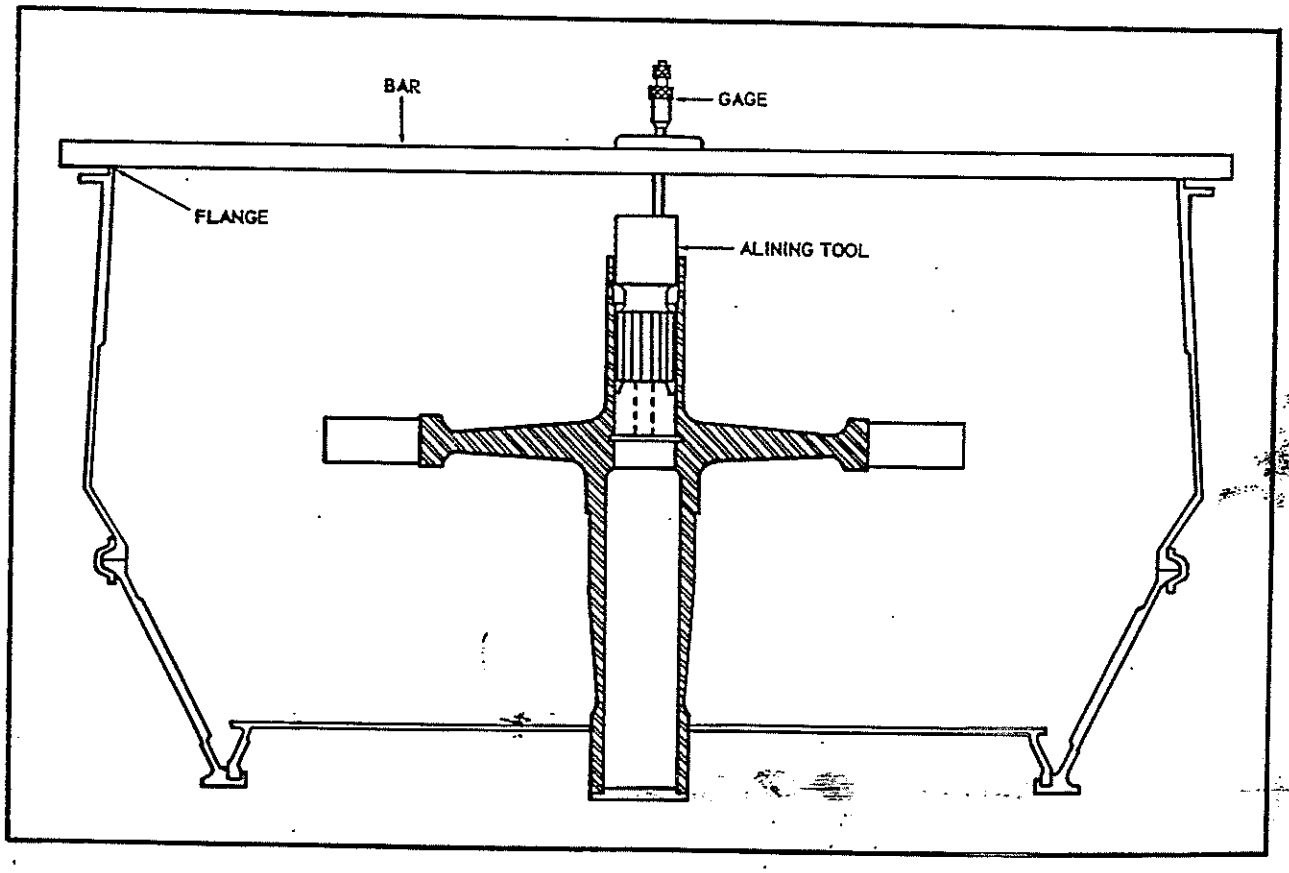


Figure 2-40. Power Shaft Plug Depth Measurement

CAUTION

Before installing the power shaft alining tool in the power turbine journal, be sure that the upper and lower faces of the alining tool, the face of the power shaft plug, and the locating bar are clean.

b. Place power shaft alining tool in the power turbine journal flush against the face of the power shaft plug. (See figure 2-40.)

c. Place parallel bar across pilot flange.

d. With depth gage, take a reading between top of bar and upper face of splined adapter tool.

e. Subtract thickness of parallel bar from this reading. This dimension, plus the length of the splined adapter tool, is the depth measurement of the power shaft plug.

f. Record this measurement.

g. Turn over combustion chamber and exhaust diffuser.

h. Remove six nuts that retain thermocouple harness flanges to exhaust diffuser. (See figure 2-41.)

i. Remove thermocouple harness.

CAUTION

When removing the thermocouple harness from the exhaust diffuser, be extremely careful to avoid damage to the thermocouple harness ends. Flex or bend the thermocouple harness only as necessary to remove the unit.

j. Cut lockwire from the fuel fitting nuts on the main and starting fuel manifolds. (See figure 2-42.)

k. Disconnect the 11 fuel fitting nuts that retain the main fuel manifold to the fuel vaporizer tubes in the combustion chamber. (See figure 2-42.)

l. Disconnect five coupling nuts that retain starting fuel manifold to igniter nozzles in combustion chamber.

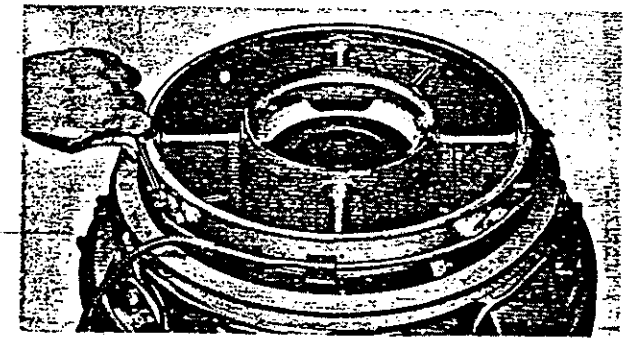


Figure 2-41. Removing Exhaust Thermocouple Nuts

m. Disconnect locknut that retains tee to bracket on exhaust diffuser support.

n. Carefully remove both starting and main fuel manifolds from combustion chamber.

CAUTION

Cover all exposed openings.

o. Cut lockwire. Remove oil scavenge connector, from exhaust diffuser housing.

p. Remove and discard gasket.

q. Cut lockwire. Remove four bolts that secure drain valve body to combustion chamber housing.

r. Remove drain valve body.

s. Remove and discard gasket.

t. Cut lockwire. With two wrenches, one holding oil strainer housing adapter, and the other on the oil strainer housing, remove the oil strainer housing.

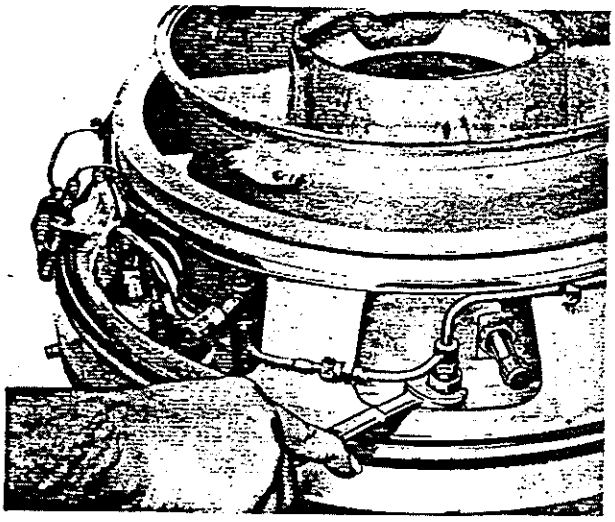


Figure 2-42. Removing Main Fuel Manifold Fitting Nuts

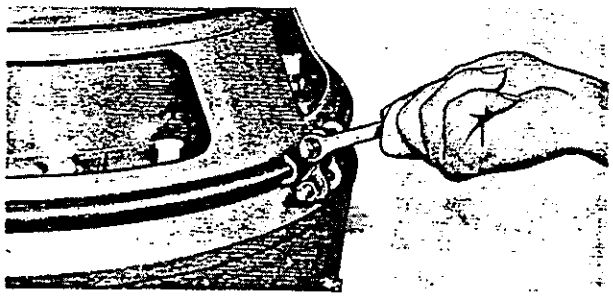


Figure 2-43. Removing V-Band Coupling Bolts and Nuts

u. Remove and discard gasket.

v. Carefully remove oil nozzle.

w. Remove strainer and packing from nozzle.

x. Discard packing.

y. Remove oil strainer housing adapter and packing.

z. Discard packing.

aa. Remove V-band coupling retaining nuts, washers, and bolts. (See figure 2-43.)

ab. Remove V-band coupling and support cone.

ac. Cut lockwire. Remove thermocouple tube plug.

ad. Remove and discard packing.

ae. Cut lockwire. Remove 11 adapter nuts that retain vaporizer tubes and fireshield to combustion chamber. (See figure 2-44.)

af. Remove five igniter nozzles from combustion chamber. (See figure 2-45.)

ag. Remove and discard gasket.

ah. Remove four screws. Withdraw two igniter mounts from combustion chamber.

ai. Remove fireshield. (See figure 2-46.)

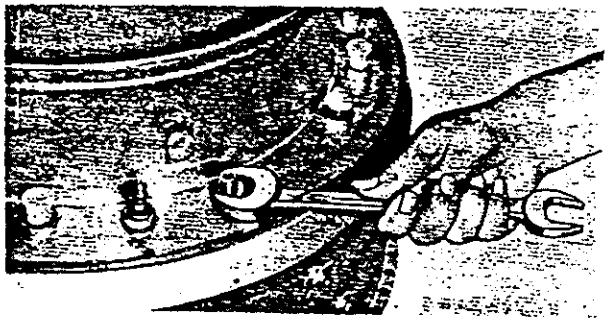


Figure 2-44. Removing Fuel Vaporizer Adapter Nut

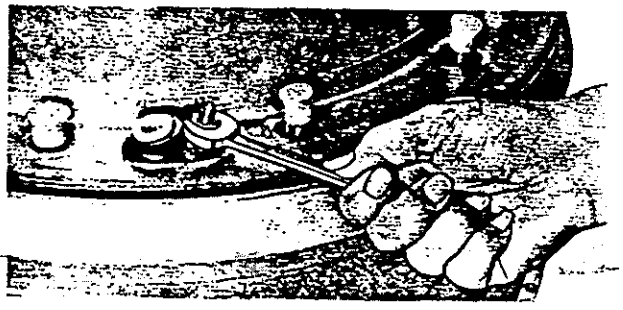


Figure 2-45. Removing Starting Fuel Igniter Nozzle

NOTE

Each igniter mount contains an igniter plug and an igniter nozzle.

aj. Cut lockwire. Remove three power turbine tubes.

NOTE

Perform an eight-point blade tip clearance check between second stage power turbine and second stage nozzle and cylinder. At each of the eight points, rotate the second stage power turbine with feeler gage between blade tip and cylinder. (Refer to Reference 38, Table of Limits, Section VII.) Record clearances for reference when engine is reassembled.

CAUTION

Complete step aj. before further disassembly of combustion chamber and diffuser support.

ak. Cut lockwire. Remove 22 bolts that secure exhaust diffuser and power turbine to combustion chamber. (See figure 2-47.)

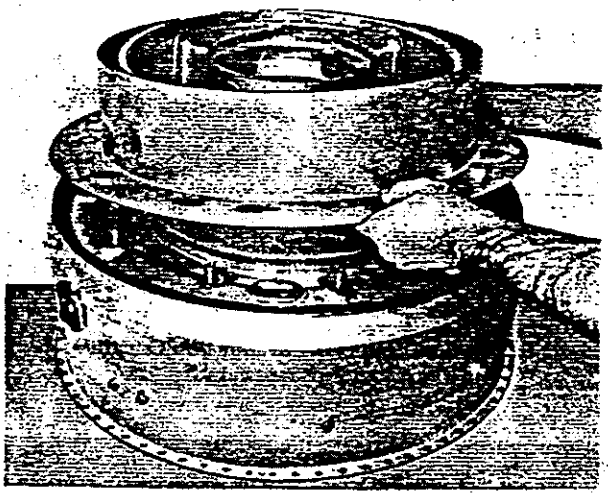


Figure 2-46. Removing Power Turbine Fireshield

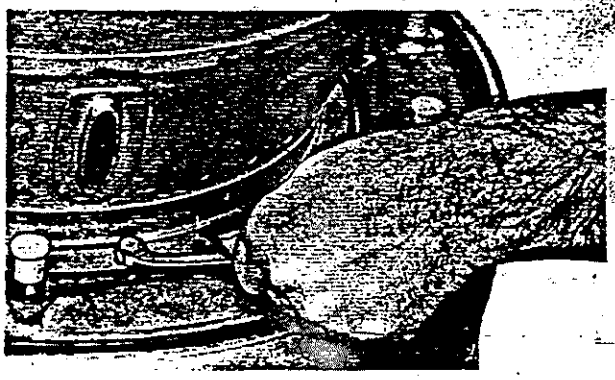


Figure 2-47. Removing Exhaust Diffuser Bolts

al. Withdraw exhaust diffuser and power turbine from combustion chamber. (See figure 2-48.)

NOTE

Do not remove exhaust diffuser from power turbine at this time.

am. Remove six screws that retain power turbine nozzle to combustion chamber liner.

an. Remove cylinder and nozzle.

CAUTION

To prevent cylinder and nozzle from dropping out of combustion chamber, support the assembly as last two screws are removed.

ao. Bend 11 tabwashers.

ap. Remove 22 bolts that secure sealing flange and power turbine nozzle to power turbine cylinder. (See figure 2-49.)

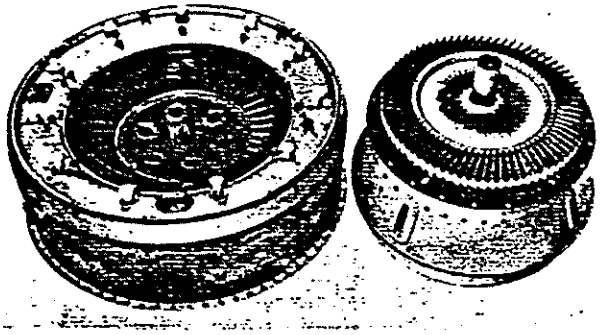


Figure 2-48. Exhaust Diffuser and Combustion Chamber Separated

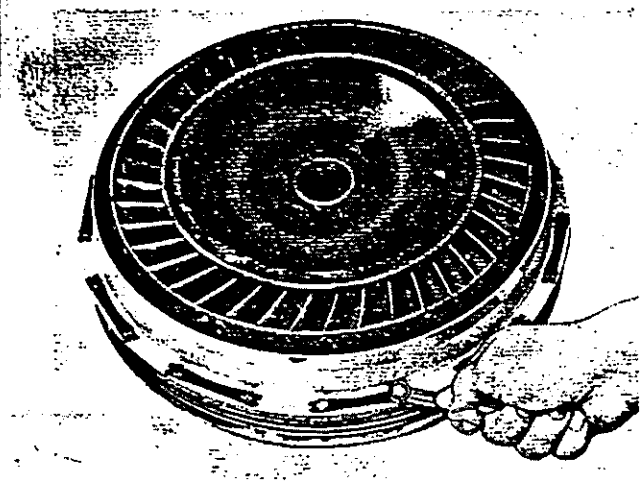


Figure 2-49. Removing Second Stage Power Turbine Sealing Flange Bolts

aq. Remove sealing flange and power turbine nozzle from power turbine cylinder.

ar. Remove vaporizer tube locking nuts. (See figure 2-50.)

as. Using removing tool, remove vaporizer tubes.

at. Tag and indicate location for reassembly.

au. Cut lockwire. Remove 12 bolts and washers that secure scoop and shroud to combustion chamber. (See figure 2-51.)

NOTE

When removing scoop and shroud, withdraw smaller segment before withdrawing larger segments.

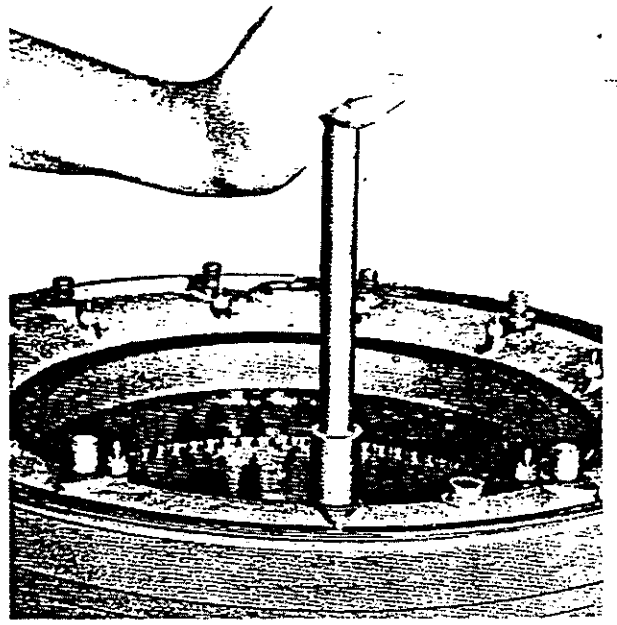


Figure 2-50. Removing Fuel Vaporizer Tube Locking Nut

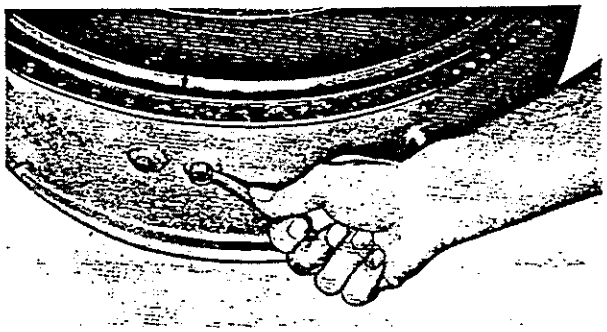


Figure 2-51. Removing Combustion Chamber Scoop and Shroud Bolts

av. Invert combustion chamber.

aw. Remove 11 nuts and washers that retain combustion chamber liner to combustion chamber. (See figure 2-52.)

ax. Remove liner.

ay. Remove two screws. (See figure 2-53.)

az. Remove exhaust diffuser from power turbine.

2-83. DISASSEMBLY OF POWER TURBINE SUPPORT ASSEMBLY.

2-84. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 31.)

2-85. PROCEDURE.

a. Install power turbine and support in fixture (figure 1-35). Straighten lock cup (1, figure 2-54).

b. With holding tool (figure 1-35) and socket wrench (figure 1-38), torque and remove spanner nut (2, figure 2-54) and lock cup.

c. Remove rear pump rotor (3) and rear pump housing (4).

d. With puller (figure 1-36), remove bearing housing (5, figure 2-54) from second stage turbine (6).

e. Remove packing (7), bearing (8), shim (9), and spacer (10) from bearing housing.

f. Invert bearing housing. Cut lockwire and remove eight bolts (12) that secure air cooling deflector (11) to bearing housing. Remove deflector.

g. Remove seal (13) and seal housing (14). Remove packing (15).

h. Remove forward pump rotor (16) and forward pump housing (17).

i. Using puller (figure 1-37), remove bearing (18).

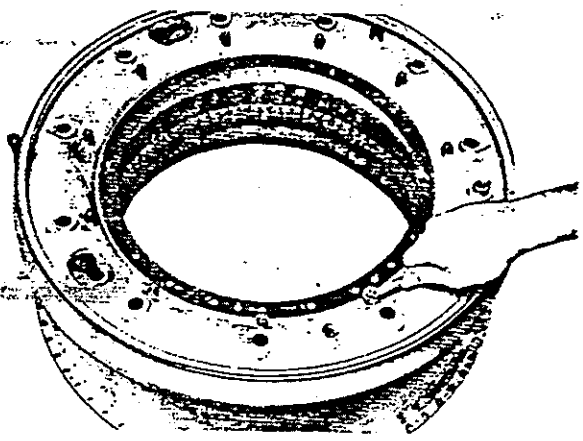


Figure 2-52. Removing Combustion Chamber Liner Nuts

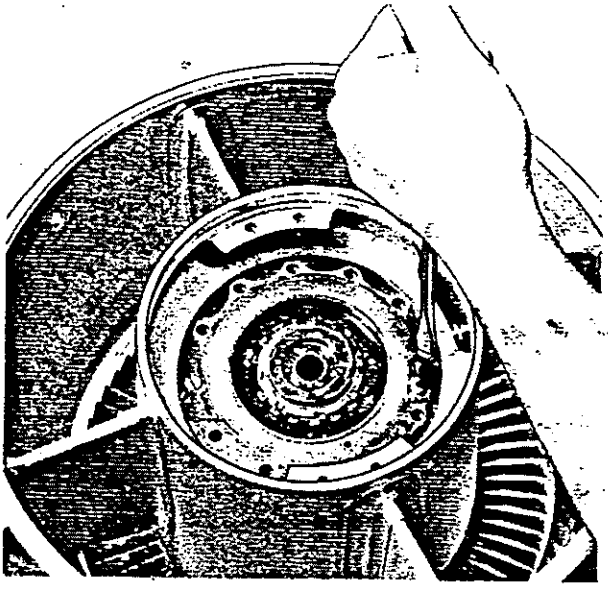


Figure 2-53. Removing Power Turbine Support Screws

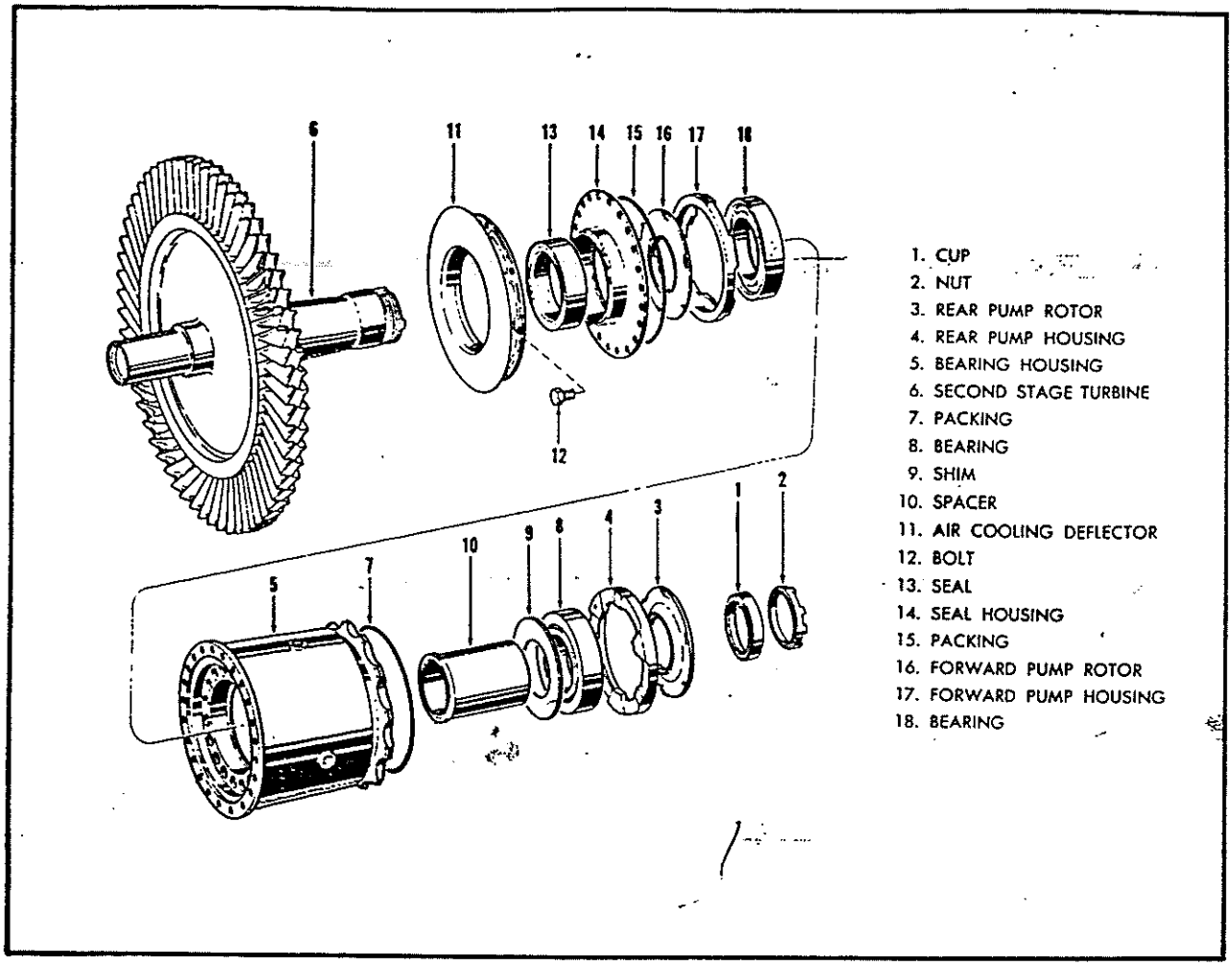


Figure 2-54. Power Turbine Support Assembly

SECTION III

CLEANING, INSPECTION AND REPAIR

3-1. GENERAL.

3-2. To ensure maximum engine life and performance, a complete inspection of all engine components should be performed. The slightest damage must be remedied; an engine cannot operate efficiently if burrs, nicks, or surface roughness creates interference.

3-3. Clean parts after disassembly of any major section of the engine. Degrease all parts with trichloroethylene, Military Specification MIL-T-7003, in a vapor degreaser tank. Remove carbon in an agitated bath of carbon remover, Military Specification MIL-C-25107. The hot-type carbon remover is recommended. Rinse parts by spraying with dry-cleaning solvent, Federal Specification P-S-661. Allow parts to dry thoroughly. Clean further, if necessary, with blasting grit, Military Specification MIL-G-5634, applied with air pressure. Slush parts in a cold application of corrosion preventive, Military Specification MIL-C-14201.

WARNING

Observe extreme caution when handling cleaning materials. Wear tight goggles, respirators, rubber gloves, and other protective devices. Cleaning areas shall be free from fire hazards, and should be equipped with automatic health hazard devices, such as combustible or poisonous gas indicators and oxygen deficiency indicators. The ingredients in carbon remover are poisonous and caustic. Proper precautions should be taken to prevent contact with skin and clothing, and to avoid inhalation of the vapors. If eye or skin contact should occur, wash the affected area immediately with water. Call a physician as soon as possible.

3-4. MARKING ON MATERIALS SUBJECT TO HIGH TEMPERATURE.

3-5. Marking on materials subject to high temperature shall be done only with one of the following: Colorbrite marking pencil (yellow, No. 2107); Marco ink (black, No. S1141); Marks-A-Lot ink pencil (red, green, or yellow); or Opco Marker (blue, green, or black).

3-6. SPECIAL TOOL AND EQUIPMENT REFERENCES.

3-7. Special tool and equipment references are listed by group number at the beginning of an operation. To locate a tool number, refer to the group number in the Functional Tool List in Section I.

CAUTION

Do not use cadmium-plated tools for any of the disassembly or reassembly procedures described in this manual. Cadmium plating has a tendency to chip. If the chips enter the engine they will contaminate the lubrication system and cause magnesium parts to deteriorate.

3-8. TORQUE VALUES.

3-9. Standard torque values are given in Table of Standard Torque Values, Section VII. The special torque values are listed in List of Special Torque Values, Section VII.

3-10. TABLE OF LIMITS.

3-11. Fits and tolerance measurements are given in Table of Limits (figure 7-7) in Section VII.

3-12. DEFINITION OF TERMS FOR INSPECTION.

3-13. Terms used for the most common surface conditions found during inspection of engine parts are as follows.

Abrasion	Wearing away of small amounts of metal between parts by friction.
Blister	The raised portion of a surface; caused by separation of layers of material.
Buckling	Large scale deformation of a part; usually caused by pressure or impact of a foreign object, unusual structural stresses, excessive localized heating, or any combination of these.
Burn	Discoloration by excessive heat.
Burr	A sharp rough projection or edge.
Corrosion	A chemical action resulting in surface discoloration, a layer of oxide, or the removal of surface metal in advanced stages.
Crack	Fissure or break in material.
Dent	A smooth, round-bottomed depression.

Distortion	Change from the original shape.
Flaking	Loose particles of metal on a surface or evidence of removal of surface covering.
Fretting	Metal worn in rippled pattern; caused by intermittent friction.
Galling	Chafing; caused by friction.
Gouging	Removal of surface metal, typified by rough and deep depressions.
Grooving	Smooth, rounded dent; caused by concentrated wear.
Inclusion	Foreign matter enclosed in metal.
Metalization	Coating by melted metal sprayed through the engine.
Nick	A sharp-bottomed depression with rough outer edges.
Peening	Metal flattening or displacement by repeated blows. A surface may be peened by continuous impact of foreign objects or loose parts.
Pitting	Small indentation on surface of part.
Scoring	Deep scratches created in a part along the path of travel.
Scratch	Narrow, shallow marks or lines; resulting from the movement of a particle or sharp object across a surface.
Scuffing	A dulling or moderate wear of a surface; resulting from a slight amount of rubbing.
Seizure	A welding or binding of two nearby surfaces that prevents further movement.
Stress	Metal failure; caused by compression, tension, shear, torsion, or shock.
Tear	Metal torn by excessive vibration or other stresses.
Unbalance	A condition of a rotating body, created by an unequal distribution of weight about an axis. Usually results in vibration.
Wear	A condition resulting from a relatively slow removal of material. Frequently invisible to the unaided eye.

3-14. CLEANING COMPRESSOR BLADES AND AIR PASSAGES.

3-15. GENERAL. Compressor blades and air passages shall be cleaned whenever engine performance decreases excessively, or when exhaust gas temperature increases steadily during normal operation. Cleaning is performed while the engine is installed in the aircraft, by introducing walnut shell grit, Military Specification MIL-D-563, into the inlet housing air intake.

NOTE

Use walnut shells ground to size 54 grit. Normally, 2 to 2-1/2 pounds of the grit will be required for cleaning an engine.

3-16. PROCEDURE.

a. Remove the necessary airframe air intake components.

b. Cover all exposed openings.

c. Cover holes in anti-icing plug located in the inlet housing.

CAUTION

When covering anti-icing plug, do not use an adhesive-base tape directly on the anti-icing plug. Apply paper over the plug, then cover with the tape.

d. Disconnect air hose assembly from pressure tap assembly, attached to the combustion chamber housing at 11 o'clock.

e. Energize airflow regulator.

f. Shut off engine air supply to the airframe.

g. Start engine and operate at ground idle.

h. Feed approximately 1/2 pound of walnut shells, by hand, at moderately slow intervals into any one of the inlet housing quadrants.

i. Allow engine to clear itself of the shells. This will take approximately 1 minute.

j. Repeat steps h. and i., for the remaining three inlet housing quadrants.

k. Shut down engine. Inspect inlet guide vanes.

NOTE

If inlet guide vanes are not completely clean, perform step l.

l. Using a swab cloth and perchlorethylene, Military Specification MIL-P-12050, or equivalent, clean inlet guide vanes.

m. Remove protective caps.

n. Clean threaded areas of lines and reconnect lines.

3-17. CLEANING AFTER DISASSEMBLY.

3-18. GENERAL. The purpose in cleaning engine parts is to remove residual deposits and to aid visual inspection. To ensure safe and efficient operation of engines after maintenance, a thorough inspection is necessary. Cleaning of engine parts is important to field maintenance as a preinspection procedure.

WARNING

Atomized solvents should always be applied in exhaust ventilated booths. Rubber gloves and protective hand cream are required.

3-19. All inspection procedures should be carried out in a lighted, dust- and dirt-free room. Benches should be covered with clean, dry paper to keep previously cleaned parts dirt- and dust-free. All parts shall be suitably tagged to indicate repair or replacement. Though a majority of parts require only visual inspection, some require the use of micrometers or special gages. Deep-seated damage may be inspected by magnetic-particle or fluorescent-penetrant method.

3-20. For cleaning purposes, the gas turbine engine is divided into two sections, cold and hot. The cold section consists of the centrifugal compressor, axial compressor section, air inlet section, and other parts in this area. The hot section consists of the air diffuser section, first and second stage turbines, combustion chamber components, exhaust section, and other parts in this area.

3-21. Components that operate at low temperatures in the cold section do not carbonize. Cleaning is relatively easy. Because of the high operating temperatures in the hot section, cleaning is more complex. To inspect parts, it is necessary to remove a sufficient amount of heat scale and all carbon deposits. Heat scale is a natural protective coating to heat-resistant metals, that does not interfere with the flow of gases through an engine. Heat scale will interfere with welding of cracks and should be removed before making any repair.

3-22. CLEANING MATERIALS. Clean nonferrous parts with dry-cleaning solvent, Federal Specification P-S-661, or an approved alternate. Remove carbon discolorations with carbon removal compound, Military Specification MIL-C-25107. After cleaning steel parts, treat with a cold application of corrosion-preventive, Military Specification MIL-C-14201.

WARNING

The ingredients in carbon removal compound, Military Specification MIL-C-25107, are poisonous and caustic. Proper precautions should be taken to prevent contact with skin and clothing, and to avoid inhalation of the vapors. If eye or skin contact should occur, wash the affected area immediately with water. Call a physician as soon as possible.

3-23. ALUMINUM, MAGNESIUM, AND STEEL PARTS. Use care when separating parts. Different metals require specific cleaners and procedures. Caustic cleaners will damage aluminum parts permanently and remove coatings from magnesium parts, but not damage steel parts.

CAUTION

Take particular care in selecting cleaning solutions to ensure that anodizing or dichromate material is not removed from the surface. Do not use caustics.

3-24. CLEANING FUEL VAPORIZERS AFTER USING EMERGENCY FUEL.

3-25. PROCEDURE.

WARNING

To prevent lead-oxide poisoning, wear gloves and a face mask.

a. Place fuel vaporizers in carbon-loosener solvent, Federal Specification P-C-111.

NOTE

The time that fuel vaporizers remain in the solution is governed by the thickness of the lead-oxide deposits.

CAUTION

Remove fuel dividers from fuel vaporizers before immersing vaporizers in the cleaning solution. Place protective covers on fuel dividers.

b. Remove fuel vaporizers from solvent after carbon loosens.

c. Using a stiff-bristle fiber brush, brush away lead-oxide deposits.

d. Using a stiff-bristle fiber brush, brush off internal deposits.

e. Rinse parts thoroughly in clean water.

f. Dry fuel vaporizers with compressed air.

3-26. ALTERNATE METHOD OF CLEANING FUEL VAPORIZERS AFTER USING EMERGENCY FUEL.

3-27. PROCEDURE.

WARNING

To prevent lead-oxide poisoning, wear gloves and a face mask.

a. Using a stiff-bristle fiber brush, loosen light lead-oxide deposits on fuel vaporizers.

b. Using a clean wiping cloth, wipe light lead-oxide deposits from fuel vaporizers.

c. Using a stiff-bristle fiber brush with a solution of water and detergent, Military Specification MIL-D-12182, remove heavy lead-oxide deposits from fuel vaporizer.

WARNING

To prevent lead-oxide dust deposits from circulating through the surrounding air, keep the fuel vaporizers wet at all times.

d. Using a stiff-bristle fiber brush, clean lead-oxide deposits from fuel vaporizer exit legs.

CAUTION

Do not damage fuel vaporizer ceramic coating.

NOTE

Follow the same cleaning procedures established in paragraphs 3-24 through 3-27 when cleaning fuel vaporizers after the engine has been operated with alternate fuels.

3-28. CARBON SEALS.

3-29. Inspect all carbon seals to ensure that they are free of grease, foreign matter, chips, or nicks. Carbon seals shall be installed in engine as they are received. If installation is not possible, the carbon seals shall be stored and maintained in a clean, dust-free container, in a dry area until assembly.

CAUTION

Never coat a carbon seal element with lubricating oil before installing the carbon seal into the engine. Never coat subassemblies containing carbon seal elements with a preservative before storage.

3-30. FLUORESCENT-PENETRANT INSPECTION.

3-31. GENERAL. Fluorescent-penetrant inspection, Military Specification MIL-I-6866, is a method of testing for cracks, flaws, and other defects with surface openings. It can be applied to a wide variety of materials, such as aluminum, magnesium, brass, copper, tungsten, ceramics, plastics, or glass. Defects revealed are surface defects only, such as porosity, cold shuts, seams, forging laps, lack of bond between joined metals, and poor welds.

3-32. Before fluorescent-penetrant application, clean all surfaces of foreign materials, such as grease, heavy oil, rust, and scale, that may prevent oil from penetrating surface flaws and cause false indications. Do not polish surfaces, because surface flaws would be covered and cause poor indications. Remove heavy oil and grease by vapor degreasing. Remove inert dirt and scale by vapor blasting.

3-33. The following parts shall be fluorescent-penetrant inspected if they are removed for maintenance or repair:

a. Anti-Icing Elbow

b. Axial Compressor Housing

c. Centrifugal Compressor Housing

d. Combustion Chamber Coupling Bolt

e. Combustion Chamber Drain Valve Body

f. Combustion Chamber Liner

g. Combustion Chamber Static Tap Plug

h. Combustion Chamber Vaporizer Tube

i. Double Throttle Tee

j. Rear Adapter Pilot Cone

k. Turbine Cooling Bellows

l. V-Band Coupling

m. Second Stage Turbine Rear Bearing Cover.

3-34. Proceed as follows.

a. Thoroughly clean the part to be inspected.

b. Apply a water-emulsifying, low-viscosity oil that displays highly fluorescent properties when exposed to ultraviolet light. Soak the part long enough to allow oil to penetrate surface openings.

c. Wash part in warm water. Spray to remove excess oil, leaving only oil that has penetrated surface flaws.

d. Dry the part in hot-air dryer or equivalent.

e. Apply Spot Check No. 3, Type SKD-4, or Dry Zyglo, Type ZP-4, developers, Military Specification MIL-I-25135, to the part surface.

f. Inspect part in booth or dark area equipped with properly filtered ultraviolet light.

3-35. FLUORESCENT OIL APPLICATION. Fluorescent oil may be applied either by immersing the part in oil or by pouring the oil over the part. A minimum of 30 minutes is required for correct oil penetration.

NOTE

If the oil is poured over the part, place a suitable container under the part.

3-36. DEVELOPING POWDER APPLICATION. After excess oil has been removed, air-dry part thoroughly and cover with developing powder. The developer reveals surface flaws under ultraviolet light. Extent and nature of surface flaws may be determined by amount of oil around defects.

WARNING

Penetrating oil that remains on the skin for several days may result in skin inflammation. Brackets and rubber gloves may be used to protect the skin from the oil. Penetrating oil on skin may be detected under ultraviolet light. Although the fluorescent-penetrant inspection method causes eyes to tire, the light is harmless to eyes and skin. Green tinted glasses can ease this fatigue. Developing powder is harmless when inhaled, but heavy concentrations can be annoying.

3-37. NONFLUORESCENT-PENETRANT INSPECTION (DYE CONTRAST-PENETRANT).

3-38. GENERAL. Dye contrast penetrant inspection is a nonfluorescent-penetrant method of testing for cracks, flaws, and other defects with surface openings. It can be applied to a wide variety of materials, such as aluminum, magnesium, brass, copper, tungsten, ceramics, plastics, or glass. Defects revealed are surface defects only, such as porosity, cold shuts, seams, forging laps, lack of bond between joined metals, and poor welds.

3-39. Before dye contrast-penetrant application, use Spot Check number one cleaner, type SKC-2, Military Specification MIL-I-25135, to clean all surfaces of foreign materials, such as grease, heavy oil, rust, and scale, that might clog the surface openings or retain penetrant, thereby producing false indications. Do not polish surfaces, because surface flaws would be covered resulting in poor indications. Remove heavy oil and grease by vapor-degreasing. Remove inert dirt and scale by vapor-blasting.

3-40. Proceed as follows.

a. After thoroughly cleaning the part to be inspected, allow sufficient time for the surface to dry.

b. Apply Spot Check number two penetrant, SKL-3, Military Specification MIL-I-25135, to the part surface by immersion, spraying, or brushing, so as to completely cover all surfaces to be inspected.

c. Allow sufficient time (approximately five minutes) for penetrant to enter any flaws.

d. Wipe all penetrant covered surfaces with a rag until the surfaces are clean. If necessary, use cleaner, Military Specification MIL-I-25135, to remove excessive penetrant.

e. Apply Spot Check number three developer, type SKD-4, Military Specification MIL-I-25135, to the part by brushing or spraying. Use the minimum amount necessary to wet surfaces thinly and evenly.

f. Allow sufficient time for developer to dry to a thin translucent layer. Allow an additional few minutes for smaller indications to appear.

g. Inspect part under ordinary white light.

3-41. MAGNETIC-PARTICLE INSPECTION.

3-42. GENERAL. Magnetic-particle inspection, Military Specification MIL-I-6868, detects surface or subsurface flaws, or flaws too small to be seen with a magnifying glass. This method, applicable only to magnetic steels, has no effect on nonferrous materials, austenitic steels, or nonmagnetic weld material. Any part inspected by this method before rework, must be fully reinspected in the same manner after repair.

3-43. Magnetic-particle inspection consists of part magnetization and application of a suitable inspection medium. (See figures 3-1 and 3-2.)

a. A magnetic field is formed as an electric current is passed through a conductor. The magnetic field lines of force form concentric rings at a right angle to the conductor current flow direction. Circular magnetization and longitudinal magnetization are two methods used. Choice of method is dependent on part shape and field direction required.

b. If the major axis of a flaw is perpendicular or almost perpendicular to the magnetic field, opposite magnetic poles are placed at the sides of the flaw and a leakage field flows through the air between the opposite magnetic poles. When an inspection medium is applied, the magnetic particles suspended in the medium bridge the gap between the two magnetic poles. Defects 90 degrees to the magnetic field will give the strongest indication. Indication intensity decreases as the angle approaches zero. Subsurface flaws or inclusions form the same leakage field pattern; however, the indication is not as intense.

3-44. Magnetic-particle inspection shall be achieved using the wet-continuous method and a horizontal-type inspection unit with an eight-inch solenoid.

a. Each part shall be stripped, degreased, cleaned, and decarbonized before magnetic-particle inspection.

b. When using the circular method, use a central conductor when possible. Where applicable, the conductor OD shall approximate the part bore ID.

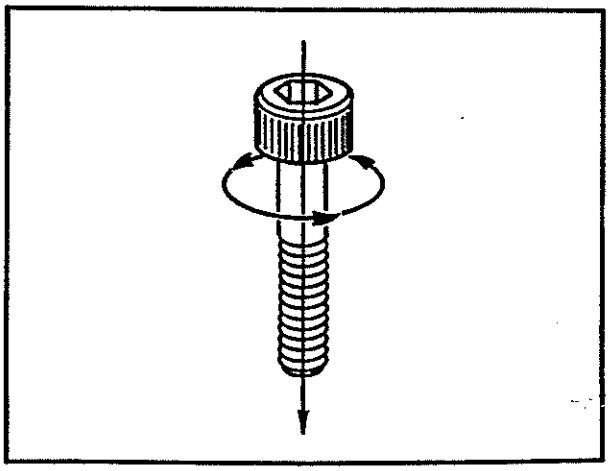


Figure 3-1. Magnetizing a Cylindrical Part

c. Before magnetization, remove plugs from internal gears.

d. Where applicable, inspection sequence shall be: low current application, first inspection, high current application, second inspection.

CAUTION

Clean electrodes in the area of positive part contact are required in direct magnetization. This is to prevent burning the part at points of contact. Do not release electrodes until ammeter needle has returned to zero.

e. Multiple part inspection is permitted when using a central conductor for circular magnetization. Parts must not come in contact with each other during magnetization or until inspection is completed.

f. If possible, use a central conductor as a holding device during longitudinal magnetization.

g. Unless otherwise specified, use three current applications ranging from 0.4 to 0.5 second duration for circular or longitudinal magnetization. The liquid medium shall be applied during the first two current applications.

h. Insert parts subject to longitudinal magnetization in the magnetizing coil so that the major part axis, centers of long shafts, and the axis of rotation of rotating parts are parallel with the coil axis.

i. Unless otherwise specified, inspect bolts by longitudinal magnetization. Bolts and studs may be magnetized in multiples, if the units are inserted in the coil with the major axes parallel to the coil axis.

j. Inspect nuts by circular magnetization, unless otherwise specified. Nuts may be magnetized in multiples, if they do not contact each other during magnetization or until the completion of inspection. No stacking is permitted.

NOTE

When magnetizing parts in multiples, limit the number of parts in one load to prevent one part from shielding another. Shielded parts may distort the magnetic field and give false indications. Do not stack parts.

3-45. RESIDUAL METHOD. There are two methods of magnetization, residual and continuous. The dry residual method consists of dusting ferromagnetic particles on a magnetized part. The wet residual method immerses the part in a bath compound of a petroleum distilled with magnetic iron-oxide particles in suspension.

3-46. CONTINUOUS METHOD. The dry continuous method consists of dusting a part with ferromagnetic particles while the part is being magnetized. In the wet continuous method magnetic iron-oxide particles suspended in a petroleum distillate are poured over the part while it is being magnetized.

NOTE

The residual or continuous wet method is preferred on finished parts.

3-47. CIRCULAR MAGNETIZATION. Circular magnetization is typified by concentric flux lines that occur at a right angle to current flow.

a. When magnetizing a shaft, stud, or similarly shaped part, current is passed through the part to create concentric lines of flux perpendicular to the current flow.

b. Hollow parts, such as ring gears and sleeves, are magnetized by induction. A rod, through which current is passed, is placed through the part and magnetizes it.

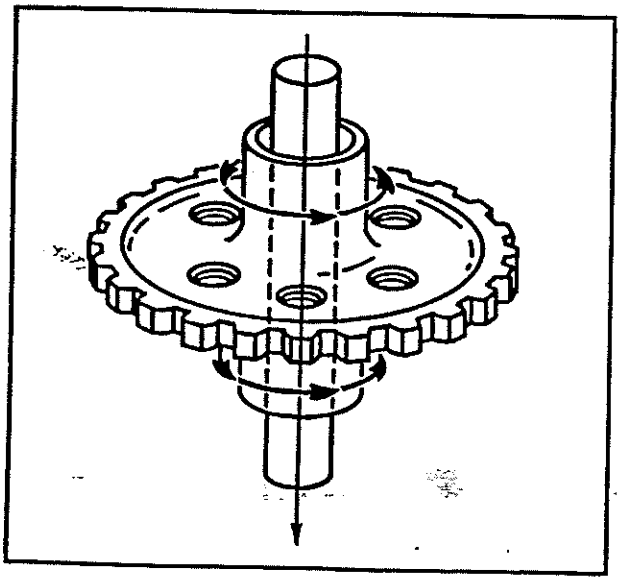


Figure 3-2. Magnetizing a Hollow Cylindrical Part

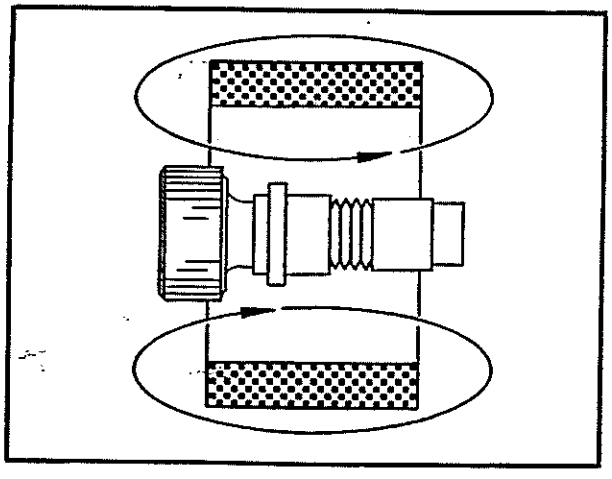


Figure 3-3. Longitudinal Inspection of a Part

NOMENCLATURE	METHOD WR	METHOD WC	CENTRAL CONDUCTOR AMPS	END TO END AMPS	LONGITUDINAL AMP TURNS
Adapter, Power Shaft Bolt	X		500		
Adapter, 1st Stage Turbine Wheel	X				3000
Bellows, Turbine Cooling	X		750		
Bolts, Compressor Vane Attaching	X				3000
Coupling, Oil Pump Splined	X		500		2000
Mount, Igniter	X		1000		
Nut, Accessory Gear Box Spanner	X		500		
Plate, Turbine Wheel	X		1000		
Plug, Power Shaft	X		500		
Ring, Rotor Sealing	X		500		
Shaft, Accessory Drive	X			1000	
Shaft, Oil Pump Coupling	X			500	
Spacer, Starter Generator Drive	X		500		
Strainer, Rear Bearing Housing Oil Inlet	X			500	

Figure 3-4. Table of Parts That Require Magnetic-Particle Inspection

c. Circular magnetization will show flaws that have longest surface dimensions approximately parallel to direction of current flow, along the major axis of the part.

3-48. LONGITUDINAL MAGNETIZATION. (See figure 3-3.) Longitudinal magnetization is effected by placing a part in a solenoid and passing a current through the solenoid. This method is also called bipolar magnetization; the magnetic field produced is parallel to the solenoid centerline. Longitudinal magnetization is used to indicate transverse flaws, or those flaws with the longest surface dimensions perpendicular to the major axis of the part.

3-49. Magnetically inspect parts listed in figure 3-4 if they are removed for maintenance.

3-50. DEMAGNETIZATION. Demagnetize parts after magnetization and inspection. This may be done by passing each part slowly through a demagnetizing coil, with the axis of part rotation parallel to the axis of the coil winding. Previously plugged oil passages should be unplugged and the parts rinsed thoroughly in kerosene, Federal Specification VV-K-211. Remove all magnetic material from the part. Dry part with air blast or wipe with cloth.

3-51. WELD REPAIR.

3-52. GENERAL. After each part has been inspected, replacement may be required to restore the engine to a serviceable condition. Extreme care must be used to ensure correct part replacement. Follow repair instructions carefully. All repair welds shall be made by foot control. To ensure matching after repair, fit precision parts and mating parts during repair. All areas to be rewelded shall be free of dirt, chips, oil, scale, and other foreign material. Clean repaired parts and slush in a rust-preventive medium. Cover all openings with caps, plugs, or masking tape. Requirements for repair welding of arc welded assemblies are listed in figure 3-5.

3-53. GENERAL. Each imperfection shall be routed to expose clean, sound base metal, subject to the following conditions.

a. Butt, corner, and edge joints may be completely routed to the opposite side, backed up with gas or copper to prevent oxidation, and rewelded. The repaired weld must blend with the parent metal.

b. Fillet weld imperfection routing should be minimized to prevent breaking through the parent metal to the opposite side. If necessary, the weld may be routed through the parent metal. The imperfection should be gas- or copper-backed and rewelded.

NOMENCLATURE	PROCESS	FILLER WIRE*	INSPECTION		
			MP	FP	X-Ray
Accessory Drive Gear Box Support Assembly	Inert Arc	Class 5		X	X
Anti-icing Tube Assembly	Inert Arc	Class 5		X	X
Combustion Chamber Housing Assembly	Inert Arc	AMS 5784	X	X	X
Combustion Chamber Liner Assembly	Inert Arc	Class 3		X	X
Diffuser Housing Assembly					
Stainless Steel Components	Inert Arc	AMS 5784	X	X	X
Low Alloy Steel Components	Inert Arc	17-22-AS	X	X	X
Front Ignition Unit Bracket	Inert Arc	Linde 32 CMS	X		
Fuel Vaporizer Tube Assembly	Inert Arc	Class 3		X	
Oil Manifold Assembly	Inert Arc	Class 5		X	
Power Turbine Nozzle					
Within Inner Shroud	Inert Arc	Class 5		X	X
Outer Shroud to Vane	Inert Arc	Class 3		X	X
Inner Shroud to Vane	Inert Arc	Class 3		X	X
Inner Shroud to Support	Inert Arc	Class 5		X	X
Rear Ignition Unit Bracket	Inert Arc	Linde 32 CMS	X		
Scoop and Shroud Assembly					
Within Outer Shroud	Inert Arc	Class 5			X
Within Inner Shroud	Inert Arc	Class 3		X	
Within Nut and Plate Assembly	Inert Arc	Class 5		X	X
Within Scoop Assembly	Inert Arc	Class 5		X	
Scoop Assembly to Inner Shroud	Inert Arc	Class 5			X
Inner Shroud to Louver	Inert Arc	Class 5		X	
Outer Shroud to Strips	Inert Arc	Class 5		X	X
Starting Fuel Manifold Tee	Inert Arc	Class 5		X	
Stud Retaining Washer	Inert Arc	Class 5		X	
Turbine Cooling Baffle	Inert Arc	AMS 5784	X		X
Turbine Nozzle Assembly					
Within Inner Seal	Inert Arc	Class 5		X	
Within Outer Seal	Inert Arc	Class 5		X	
Within Liner	Inert Arc	Class 3		X	X
Within Nozzle Assembly	Inert Arc	Class 13		X	X
Nozzle Assembly to Support	Inert Arc	Class 5		X	X
Support to Flange	Inert Arc	Class 5		X	X

* Military Specification MIL-R-5031 Class Number, Aeronautical Material Specification Number or Commercial Designation

MP indicates Magnetic-Particle Inspection; FP indicates Fluorescent-Penetrant Inspection.

Note: All repair-weld procedures outlined in this chart shall be carried out at room temperature.

Figure 3-5. Weld Repair Requirements

NOTE

Any burnthrough must blend smoothly with the surrounding parent metal to minimize stress raisers.

3-54. FILLER WIRE. Unless otherwise specified, AMS 5784 filler wire shall be used. After routing, weld repairs up to 0.25 inch long in the weld or parent metal shall be welded cold by means of the arc process.

NOTE

Avoid concave welds. Weld ends should be built up to avoid craters.

3-55. PERMISSIBLE WELD REPAIR LENGTH. The total length of weld repair on the exhaust diffuser, power turbine sealing flange, combustion chamber housing, turbine cooling baffle, and turbine wheel plate shall meet the following conditions.

a. In original welds 20.0 inches or less, weld repair length shall not exceed 20 percent of the original weld length.

b. In original welds 20.0 inches or more, weld repair length shall not exceed 4.0 inches.

c. A single weld repair shall be separated from other weld repairs by an equal length of unrepaired weld. But single weld repairs under 1.0 inch long shall be separated from other weld repairs by an acceptable unrepaired weld twice the length of the completed weld repair.

3-56. REPAIR. Proceed as follows.

a. Inspect part by correct inspection method: magnetic-particle, refer to paragraphs 3-41 through 3-50; fluorescent-penetrant, refer to paragraphs 3-30 through 3-36.

b. Remove defects by blending if possible; otherwise grind out defective area.

c. To ensure removal of defect, repeat penetrant inspection.

d. Preheat part if necessary, and weld ground-out area, using filler wire as instructed in paragraph 3-54.

e. Stress relieve part at 1175 to 1225°F(635 to 663°C) in atmospheric furnace. Hold at heat for two hours, then cool to room temperature.

f. Blend repair weld to wall thickness of parent metal.

g. To ensure complete weld repair, repeat penetrant inspection.

3-57. BRAZING.

3-58. When it is necessary to disassemble a brazed assembly for rework, the following procedure is recommended.

a. Strip surface as required. Do not damage part components.

b. Vapor degrease the assembly.

c. Immerse assembly in braze stripper solution. Keep assembly submerged until brazed parts can be easily separated.

d. Rinse in room temperature water.

e. Rinse in hot water, between 150 and 180°F(65 to 82°C), containing corrosion preventive, Military Specification MIL-C-6529.

f. Air dry.

3-59. BRAZE REPAIR. Proceed as follows.

a. Vapor degrease.

b. Apply flux on areas to be repaired.

c. Torch braze with filler wire. (See figure 3-6.)

d. Clean and descale.

e. Inspect for cracks.

3-60. REFINISHING PAINTED SURFACES. The following steps are recommended.

a. If the paint is removed from the parts for inspection or rework, bonderize as described in the following paragraph. Repaint as required.

b. Refinishing of anodized aluminum parts is not required, if all the paint has been removed and the anodizing is neither damaged nor destroyed. Spot reanodizing of aluminum surfaces is permissible.

3-61. TOUCH BONDERIZING. The following procedure is recommended when touchup bonderizing is required before repainting.

a. Prepare a solution of 115 cubic centimeters of Bonderite No. 160 or equivalent, and one gallon of water. Mix thoroughly.

b. Prepare a solution of two grams of chromic acid, Federal Specification O-C-303, and one gallon of water. Mix thoroughly.

c. Clean area to be bonderized with dry-cleaning solvent, Federal Specification P-S-661.

d. Apply bonderite solution with nylon brush at 160°F(71°C).

e. Allow bonderite solution to remain five to ten minutes.

f. Using tap water or a fine spray, rinse off the solution.

g. Rinse area with chromic acid solution at 160°F (71°C) for one minute.

PART NAME	FILLER WIRE *
Anti-Icing Tube Assembly	Class 5
Bearing Oil Supply Nozzle Assembly	Class 5
Compressor Vane Assemblies	Classes 5 and 7
Diffuser Housing Assembly	Class 7
Diffuser Housing Oil-Inlet Tube Assembly	Class 5 and AMS 4772
Power Shaft Bolt Assembly	Class 5
Power Turbine Oil Nozzle Assembly	Class 5
Power Turbine Rear Bearing Cover Assembly	Class 7
Rear Bearing Support Housing Assembly	Class 7
Starting Fuel Manifold Assemblies	Class 5
* Federal Specification QQ-S-561 Class Number or Aeronautical Material Specification Number	

Figure 3-6. Braze Repair Requirements

3-62. OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

3-63. REMOVAL. Proceed as follows.

a. Disconnect the nut that secures the double throttle tee to the overspeed governor and tachometer drive.

b. Unscrew the double throttle tee from the nut. Remove and discard the ring.

c. Remove the four nuts and washers that retain the cover and the gasket to the overspeed governor and tachometer drive.

d. Remove the cover and gasket. Discard the gasket. Remove the seal.

3-64. INSPECTION. Proceed as follows.

a. Visually inspect the cover and seal for scratches and scoring.

b. Visually inspect the nuts for stripped and crossed threads.

c. Inspect the governor drive shaft and the governor drive end shaft for improper wear pattern, sharp edges, pitting, scoring, and nicks.

d. Using fluorescent-penetrant inspection outlined in paragraphs 3-30 through 3-36, inspect the double throttle tee.

3-65. REPAIR AND REPLACEMENT. Proceed as follows.

a. Remove nicks and dents with a fine stone or with Crocus cloth, Federal Specification P-C-458.

b. Remove sharp edges from governor drive shaft with a fine stone.

c. Replace damaged parts.

d. Dry the parts thoroughly with an air hose. Using trichloroethylene, Military Specification MIL-T-7003, degrease the governor drive shaft, the governor drive end shaft, and the cover.

3-66. ASSEMBLY. Proceed as follows.

a. Install the seal. Secure the cover and the gasket to the overspeed governor and tachometer drive with four nuts and washers.

b. Install the ring, nut, and the double throttle tee to the overspeed governor and tachometer drive.

3-67. FLOW CHECK. Proceed as follows.

a. Flow-check double throttle tee with lubricating oil, Military Specification MIL-L-7808, at 70 psi and 80°F(27°C). (See figure 3-7.)

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

b. Flow at exit A shall be 140 to 160 cubic centimeters per minute.

c. Flow at exit B shall be 65 to 75 cubic centimeters per minute.

d. With exit A capped, flow at exit B shall be 120 to 135 cubic centimeters per minute.

e. Reject double throttle tee that does not meet these requirements.

3-68. POWER OUTPUT DRIVE GEAR ASSEMBLY.

3-69. REMOVAL. Proceed as follows.

a. Bend tabwashers. Remove the eight bolts that secure the seal retainer to the housing. (See figure 3-8.)

b. Remove the seal retainer, shim, and two packing rings.

c. Remove the seal. Remove ring gear support face plate and packing.

3-70. INSPECTION. Proceed as follows.

a. Visually inspect the bolts for stripped or crossed threads.

b. Visually inspect the seal retainer, the seal, and the face plate for scoring, improper wear pattern, nicks, and dents.

3-71. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using dry-cleaning solvent, Federal Specification P-S-661, clean the bolts with a soft wire brush.

b. Replace seal retainer that has nicks, dents, scored areas, or improper wear patterns.

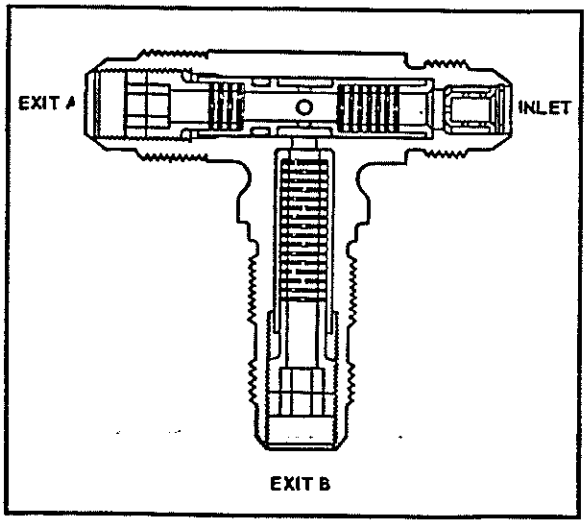


Figure 3-7. Flow-Checking Double Throttle Tee

c. Replace ring gear support face plate and seal that have scored areas or improper wear patterns.

CAUTION

If it is necessary to replace either the seal or ring gear support face plate, both parts shall be replaced. Replacement of only one part may result in wear patterns and scoring on non-sealing surfaces. These could cause oil leakage.

d. Using an airhose, thoroughly dry the parts.

3-72. ASSEMBLY. Proceed as follows.

a. Install the packing on the ring gear support face plate. Position the ring gear support face plate over end of the ring gear.

b. Install large and small rings in seal retainer. Insert seal into seal retainer.

CAUTION

When replacing a seal in the seal retainer, do not damage the seal faces.

c. Position the seal retainer and the shim on the ring gear support housing. Secure with eight tabwashers and bolts.

3-73. TORQUEMETER CARRIER AND GEAR ASSEMBLY.

3-74. SPECIAL TOOLS AND EQUIPMENT. (Refer to group number 32.)

3-75. INSPECTION. Proceed as follows.

a. Inspect 15 bolts for stripped or crossed threads.

b. Visually inspect the torquemeter carrier and gear for scoring, nicks, dents, pitting, and improper wear pattern.

3-76. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean the bolts.

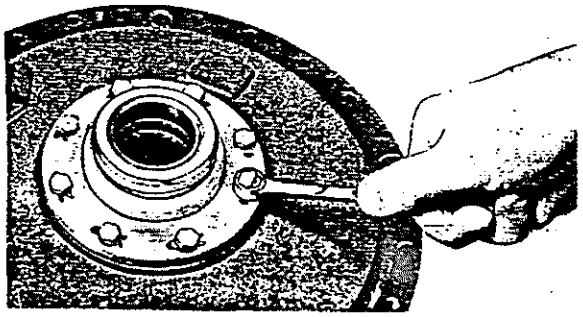


Figure 3-8. Removing Retaining Oil Seal Bolts

b. Air dry bolts.

c. Replace damaged bolts.

d. Check the three planet gear bearing retaining clamps for looseness.

e. If retaining clamp is loose, in excess of 0.004, break stake and remove nut. Use a file and/or emery stone to remove stake burrs from clamp.

CAUTION

When any retaining clamp looseness is noted, check bearing inner race for evidence of rotation. Metal adhesion from clamp or nut, scoring, flaking, or build-up on any of the six bearing inner races shall be cause for rejection of complete torquemeter assembly.

f. Replace and tighten nut to proper torque. Using staking punch (figure 1-23), restake retaining clamp at two points 90 degrees from original staked areas.

NOTE

Retaining clamps may be staked twice. This permits a total of four stake points prior to discard of a clamp provided that restaking the second time can be accomplished at points 90 degrees to the original stakes. If this is not possible within torque limitations, replace retaining clamp and nut.

g. Check the axial movement of the three planet gears with a dial indicator. (Refer to 1A, Table of Limits, figure 7-7.)

3-77. PLANETARY SUN GEAR ASSEMBLY.

3-78. INSPECTION. Proceed as follows.

a. Inspect 16 bolts for stripped or crossed threads.

b. Visually inspect sun gear for scoring, nicks, and dents.

3-79. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean the bolts.

b. Air dry bolts.

c. Replace damaged bolts.

3-80. ACCESSORY DRIVE CARRIER ASSEMBLY.

3-81. INSPECTION. Proceed as follows.

a. Visually inspect the accessory drive carrier for scoring, nicks, and dents.

b. Inspect the accessory drive driven gear for improper wear pattern, sharp edges, scoring, pitting, and scratches.

3-82. OIL PUMP ASSEMBLY.

3-83. REMOVAL. Proceed as follows. (See figure 3-9.)

a. Remove protective cover from accessory drive gearbox. Cut lockwire and remove four bolts (3,4, and 5) that secure oil pump to gearbox.

b. Remove oil pump (2), oil pump coupling shaft (6), and snapring (7). Discard packings (8, 9, and 10).

c. Remove checknut from pump. Remove adjusting screw. Withdraw compression spring.

NOTE

On engine data sheet, record the number of turns required to remove the adjusting screw from the adjusting screw body.

d. Remove packing behind spring. Remove conical valve and adjusting screw body. Remove and discard packing behind adjusting screw.

3-84. INSPECTION. Proceed as follows.

a. Inspect conical valve for corrosion or wear and for evidence of leakage.

b. Inspect adjusting screw body for corrosion or wear and for evidence of leakage.

c. Visually inspect the compression spring.

3-85. REPAIR AND REPLACEMENT. Proceed as follows.

a. Replace conical valve, if damaged.

b. Replace adjusting screw body, if cracked.

3-86. ASSEMBLY. Proceed as follows.

a. Lubricate parts lightly with lubricating oil, Military Specification MIL-L-7808.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

b. Support the adjusting screw body vertically.

c. Position conical valve, packing, and compression spring in adjusting screw body. Secure with adjusting screw.

d. Tighten adjusting screw with approximately the same number of turns that were required to remove it from adjusting screw body.

NOTE

Refer to engine data sheet for the required number of turns to reinstall adjusting screw body.

e. Lubricate packing.

f. Position packing and relief valve in oil pump with a gentle twisting motion. Secure with checknut.

CAUTION

To prevent shearing or tearing of the packing, install the relief valve with extreme care.

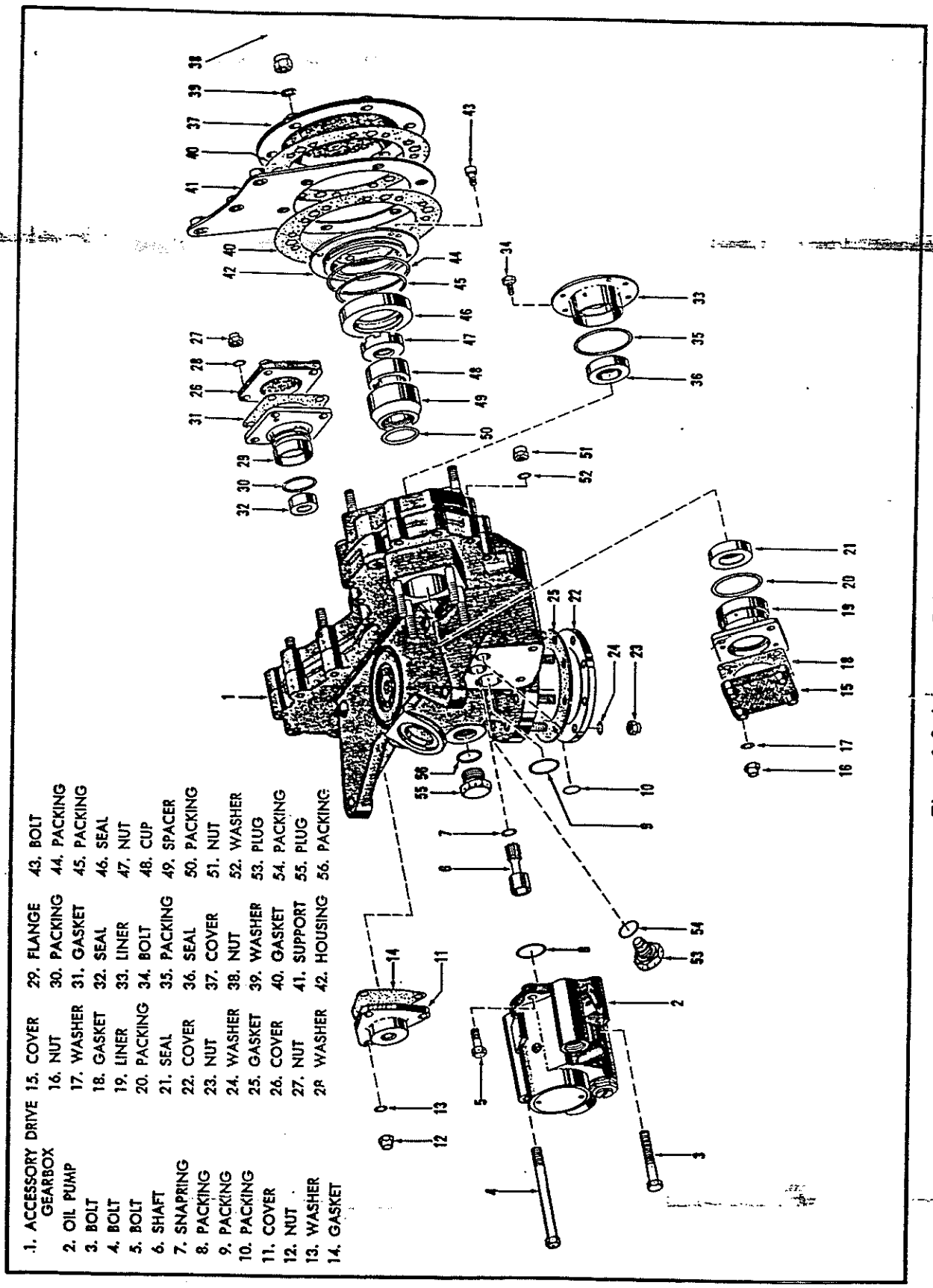


Figure 3-9. Accessory Drive Gearbox

3-87. ACCESSORY DRIVE GEARBOX ASSEMBLY.

3-88. SPECIAL TOOLS AND EQUIPMENT. (Refer to group number 4.)

3-89. REMOVAL. Proceed as follows. (See figure 3-9.)

a. Remove protective cover.

b. Cut lockwire. Remove three bolts (3, 4, and 5) that secure oil pump (2) to accessory drive gearbox (1).

c. Remove oil pump, oil pump coupling shaft (6), and snapring (7).

d. Remove and discard packings (8, 9, and 10).

e. Remove compressor rotor locking device from accessory drive gearbox.

f. Remove three nuts (12) and washers (13) that secure cover (11) and gasket (14) to accessory drive gearbox.

g. Remove cover and gasket.

h. Remove four nuts (16) and washers (17).

i. Remove cover (15), gasket (18), hydraulic pump drive liner (19), and packing (20).

j. Using removing tool (figure 1-1) and arbor press, remove seal (21, figure 3-9) from liner.

k. Remove seven nuts (23) and washers (24) that secure cover (22) and gasket (25) to accessory drive gearbox.

l. Remove four nuts (27) and washers (28) that secure cover (26) to accessory drive gearbox.

m. Remove and discard gasket (31).

n. With two puller screws, remove tachometer drive flange (29) from accessory drive gearbox.

o. Install tachometer drive flange on arbor press.

p. With removing tool (figure 1-2), press seal (32, figure 3-9) from flange.

q. Remove and discard packing (30).

r. Cut lockwire. Remove four bolts (34) that secure fuel control liner (33) to accessory drive gearbox.

s. Using two puller bolts, remove liner and packing (35).

t. Discard packing.

u. Remove puller bolts.

v. Place liner and seal (36) on arbor press.

w. With removing tool (figure 1-1), press seal from liner.

x. Remove nuts (38, figure 3-9) and washers (39) that secure cover (37), gaskets (40), and gearbox support (41) to accessory drive gearbox.

y. Cut lockwire. Remove six bolts (43) that secure oil seal housing (42) to accessory drive gearbox.

z. With two puller bolts, separate oil seal housing from accessory drive gearbox.

aa. Remove puller bolts.

ab. Remove and discard packing (44).

ac. Place oil seal housing on an arbor press.

ad. Using removing tool, press seal (46, figure 3-9) from oil seal housing.

ae. Remove and discard packing (45).

af. Place gear drive holding device (figure 1-8) over studs on starter generator mounting pad and on spanner nut.

ag. Tighten gear drive holding device with two nuts.

ah. Insert splined shaft tool into driven gear outer gear.

ai. Using a suitable wrench, break torque on spanner nuts.

aj. Remove wrench, splined shaft tool, two nuts, and gear drive holding device.

ak. Straighten lock cup (48, figure 3-9). Remove spanner nut, lock cup, seal spacer (49), and packing (50).

al. Cut lockwire. Remove magnetic plug (53) and packing (54).

am. Cut lockwire. Remove plug (55) and packing (56).

CAUTION

To prevent foreign matter from entering the accessory drive gearbox while inspecting and cleaning parts, place protective covers on all exposed openings.

3-90. INSPECTION. Proceed as follows.

a. Inspect all bolts, nuts, plugs, and magnetic plug for crossed or stripped threads.

b. Inspect covers, liners, and support for dents, nicks, scoring, and other damage.

c. Visually inspect oil pump coupling shaft for sharp edges, wear, nicks, and dents.

d. Inspect seals for scratches and wear. If seals are damaged, replace with new seals.

e. Using magnetic-particle inspection method, Military Specification MIL-I-6868, inspect support (41, figure 3-9). (Refer to paragraphs 3-41 through 3-50.)

f. For weld repair of accessory drive gearbox support, refer to paragraphs 3-51 through 3-56.

3-91. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean threads of nuts, bolts, and plugs. Clean magnetic plug.

b. Replace nuts (51, figure 3-9) and washers (52) if necessary.

c. Remove sharp edges from oil pump coupling shaft. Remove nicks and burrs.

d. Air dry parts.

e. Replace damaged parts.

3-92. ASSEMBLY. Proceed as follows. (See figure 3-9.)

a. Remove protective covers when necessary.

b. Install packing (56) and plug (55).

c. Install other packing (54) and magnetic plug (53).

d. Lockwire plugs.

e. Install packing (50), seal spacer (49), lock cup (48), and spanner nut (47) on the driven gearshaft.

f. Place packing (45) into oil seal housing (42).

g. Place oil seal housing on an arbor press. (See figure 3-10.)

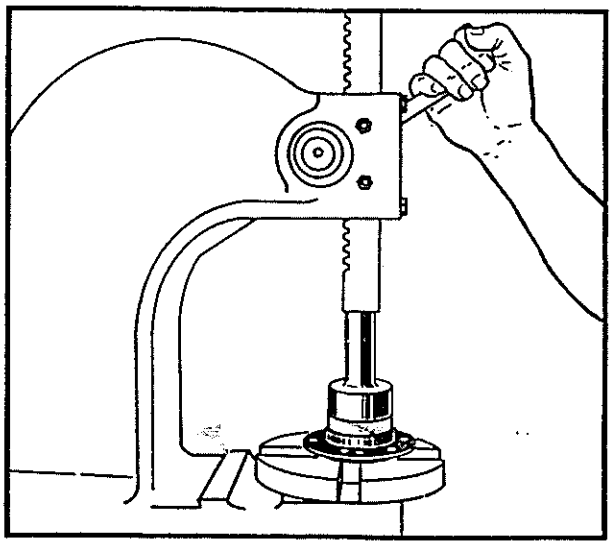


Figure 3-10. Installing Starter Generator Drive Oil Seal

h. With installing tool, press seal (46, figure 3-9) into oil seal housing.

i. Place packing (44) over oil seal housing.

j. Install oil seal housing into starter generator mounting pad.

k. Secure with six bolts (43).

l. Place gear drive holding device over studs on starter generator mounting pad and on spanner nut. (See figure 1-8.)

m. Secure with two nuts.

n. Insert splined shaft tool into driven gear outer gear.

o. Place torque wrench over splined shaft tool.

p. Tighten spanner nut.

q. Remove torque wrench, splined shaft tool, two nuts, and gear drive holding device.

r. Bend lock cup to spanner nut slots.

s. Lockwire bolts.

t. Install gaskets (40, figure 3-9), gearbox support (41), and cover (37) on studs.

CAUTION

To prevent seizure of threads or excessive torque, coat threads of studs with anti-seize thread compound, Military Specification MIL-T-5544.

u. Secure cover with washers (39) and nuts (38).

v. Tighten nut.

w. Place liner (33) on an arbor press.

x. Using installing tool, press seal (36) into liner. Install packing (35).

y. Install fuel control liner into accessory drive gearbox.

z. Secure liner to accessory drive gearbox with four bolts (34).

aa. Lockwire bolts in pairs.

ab. Install packing (30) into groove on tachometer drive flange (29).

ac. Place flange on an arbor press. (See figure 3-10.)

ad. Using installing tool, press seal (32, figure 3-9), into flange.

ae. Position tachometer drive flange over mounting studs.

af. Secure gasket (31) and cover (26) to accessory drive gearbox with four nuts (27) and washers (28).

ag. Tighten nuts.

ah. Install gasket (25) and cover (22).

ai. Secure cover to accessory drive gearbox with seven nuts (23) and washers (24).

aj. Place packing (20) into groove on hydraulic pump drive liner (19).

ak. Using installing tool (figure 1-1) and arbor press, press seal (21, figure 3-9) into liner.

al. Install cover (15), gasket (18), and hydraulic pump drive liner into accessory drive gearbox.

am. Secure cover with four washers (17) and nuts (16).

an. Install gasket (14) and cover (11) on accessory drive gearbox.

ao. Secure cover to accessory drive gearbox with three nuts (12) and washers (13).

ap. Install packings (8, 9, and 10) in accessory drive gearbox.

aq. Install oil pump coupling shaft (6) and snapring (7) in accessory drive gearbox.

ar. Mesh nI pump coupling shaft with oil pump (2).

as. Install oil pump.

at. Secure oil pump to accessory drive gearbox (1) with four bolts (3, 4, and 5).

au. Install temperature sensing bulb in oil pump.

av. Install drain and magnetic plugs at lowest point of accessory drive gearbox.

aw. Install fitting for accessory drive drain.

ax. Install pressure fitting in accessory drive gearbox.

ay. Install tee fitting for number two main bearing scavenge drain.

az. Install fitting for numbers three and four main bearing scavenge drain.

3-93. INLET GUIDE VANE.

3-94. INSPECTION. Proceed as follows. (See figure 3-11.)

a. Inspect each vane for nicks, burrs, pits, and dents.

b. Inspect the shroud, ring, and all brazed joints for cracks.

3-95. REPAIR AND REPLACEMENT. Proceed as follows.

a. Repairs shall be made with a small die-sinker file or carborundum stones. Crocus cloth, Federal Specification P-C-458, shall be used for final polishing. Power tools shall not be used. All repairs shall be blended and finished smoothly. The finish strokes of all repair work shall be parallel to the longitudinal axis of the vane. No scratches are permitted. Use AM3850 brazing rod for braze repair. Remove all excess brazing and flash after repair work.

b. Dents with smooth contours are acceptable without rework if they do not exceed the maximum permissible limits.

c. Nicks, burrs, pits, and dents shall be repair blended if the damage after repair does not exceed 0.010 inch deep and 0.200 inch on longest side.

d. Cracks that do not exceed 0.250 inch are acceptable in the shrouds, ring, and braze joints.

e. Repair cracks that exceed 0.250 inch in shrouds, ring, and braze joints. Slight dimensional changes are acceptable if they do not affect the mating part.

CAUTION

Remove all flashing from air passages.

f. Dents shall not exceed one third of the surface area on a side of a vane.

g. One dent is permitted on vane leading edge.

h. If the space between two dents is less than the longer dimension of either dent, they shall be considered one dent.

i. Straighten bent vanes.

CAUTION

Inspect the vane for cracks after straightening.

j. If eight or more vanes require repair, replace the inlet guide vane.

3-96. INLET HOUSING.

3-97. INSPECTION. Proceed as follows.

a. Clean all parts.

b. Inspect parts for nicks and burrs.

c. Inspect parts for irreparable distortion.

d. Inspect threaded parts for crossed or worn threads.

e. Using magnetic-particle inspection, inspect parts for cracks and foreign inclusions. (Refer to paragraphs 3-41 through 3-50.)

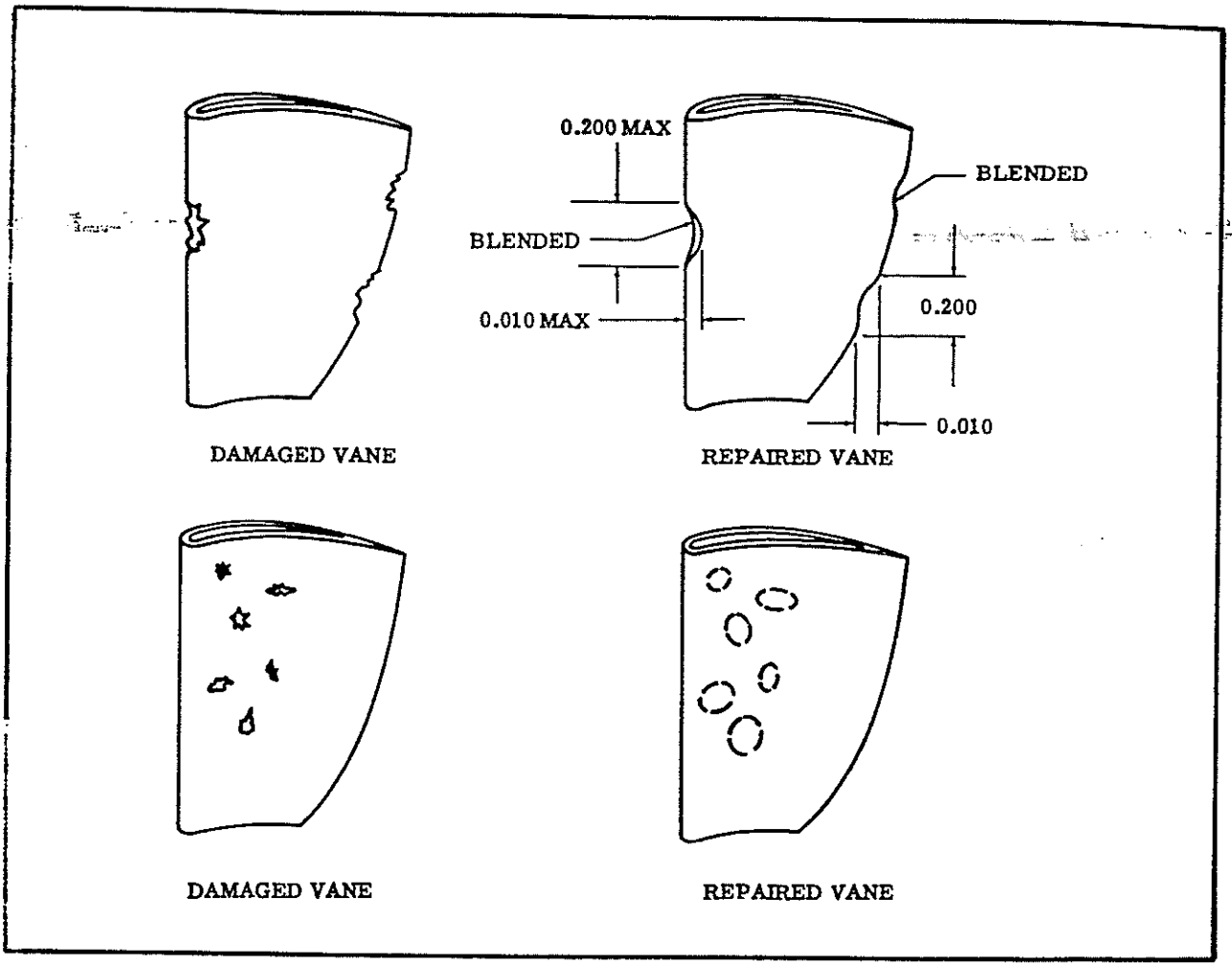


Figure 3-11. Inlet Guide Vane Repair Limits

3-98. REPAIR AND REPLACEMENT. Proceed as follows.

a. Remove nicks and burrs.

b. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean threads.

c. Replace parts that have cracks, crossed threads, or irreparable distortion.

3-99. DIFFUSER, CURL, AND NOZZLE.

3-100. INSPECTION. Proceed as follows. (See figure 3-12.)

a. Inspect nuts (5 and 10) and screws (11) for stripped threads.

b. Inspect turbine cooling baffle (4), turbine nozzle (3), combustion chamber curl (2), and diffuser housing (1) for cracks, nicks, dents, scoring, and other damage.

c. Check wall cooling slots of turbine nozzle for cracks.

d. Remove and discard gasket (9).

e. Inspect oil strainer (8) for stripped threads.

f. Inspect the holes for damage and foreign matter.

g. Remove and discard tabwashers (6 and 7).

3-101. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean nuts and screws.

b. Air dry parts.

c. Weld repair cracks as necessary. (Refer to paragraphs 3-51 through 3-56.)

3-102. DIFFUSER HOUSING AND REAR BEARING SUPPORT HOUSING.

3-103. INSPECTION. Proceed as follows.

a. Inspect bolts, thermocouple plug, oil inlet strainer, oil inlet cap, and thermocouple bushing for crossed or stripped threads.

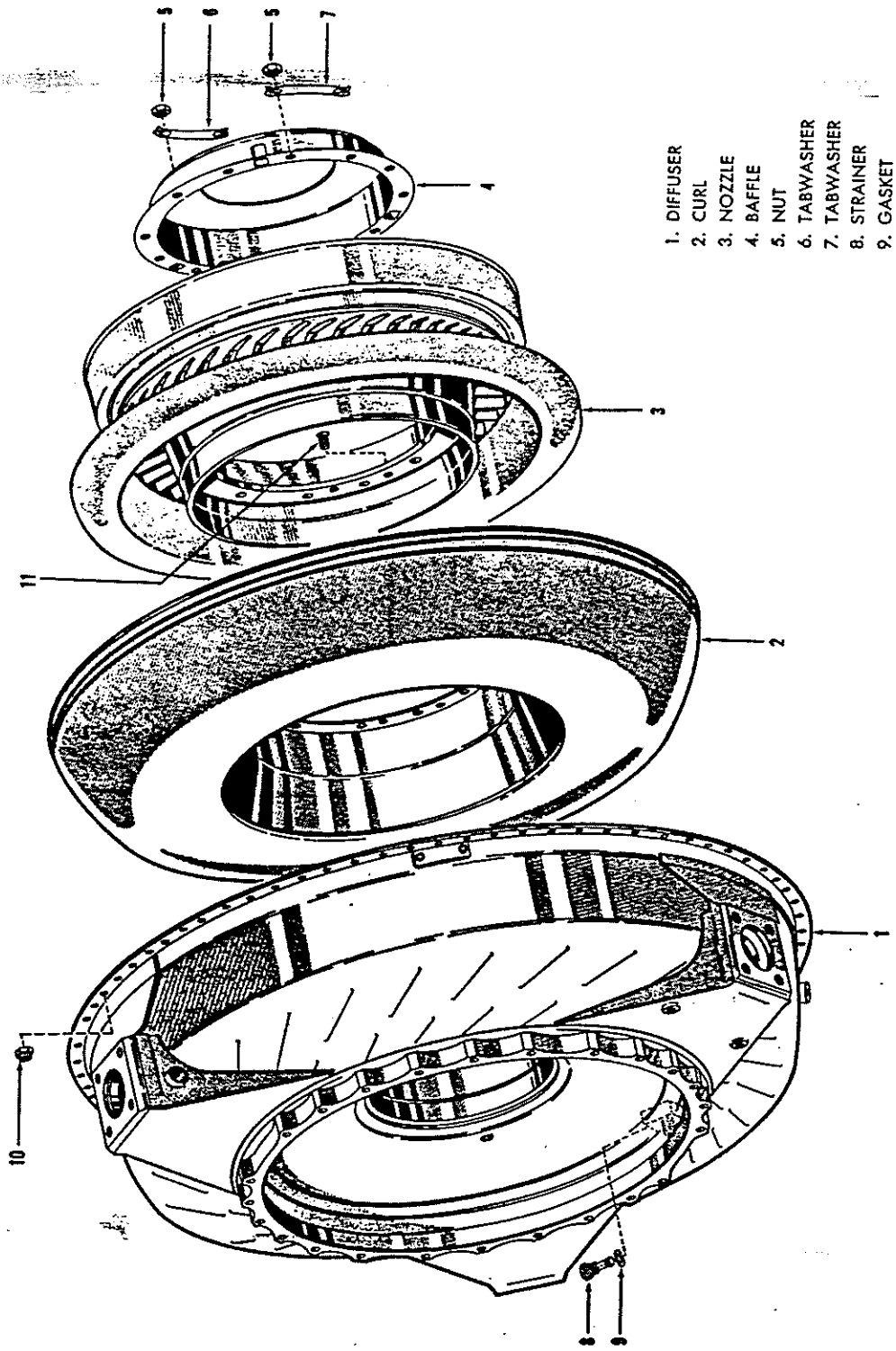


Figure 3-12. Diffuser, Curl, and Nozzle

b. Inspect seal retainer, seals, retaining plate, and support housing for scoring, wear, nicks, dents, and improper wear pattern.

3-104. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean bolts.

b. Replace a damaged oil strainer.

c. Remove foreign matter from support housing.

d. Air dry bolts.

e. Remove all grease, chips, and foreign matter from control gap seals.

3-105. COMBUSTION CHAMBER HOUSING.

3-106. INSPECTION. Proceed as follows.

a. Visually inspect threaded parts for crossed threads.

b. Inspect V-band coupling for wear and dents.

c. Inspect combustion chamber drain valve connector for scoring and cross threading.

d. Using fluorescent-penetrant inspection method, Military Specification MIL-I-6866, inspect the combustion chamber housing for cracks. (Refer to paragraphs 3-30 through 3-36.)

e. Using fluorescent-penetrant inspection method, Military Specification MIL-I-6866, inspect the V-band coupling, coupling bolts, static tap plug, and combustion chamber drain valve body. (Refer to paragraphs 3-30 through 3-36.)

f. Inspect fuel vaporizers for lead deposits.

WARNING

Lead deposits are a result of the engine being operated with leaded fuel. The outer layers of these deposits, which may be in powder form, are poisonous. Every precaution should be taken to prevent the powder from entering any cuts or body opening, particularly the mouth and nostrils.

g. Using fluorescent-penetrant inspection method, inspect the swivel joint assembly for cracks. (Refer to paragraphs 3-30 through 3-36.)

NOTE

Step g. applies to models T53-L-1A and T53-L-1B engine only.

3-107. CLEANING. Lead deposits may be removed from the combustion chamber by either of the following methods:

a. Degrease contaminated part with trichloroethylene, Military Specification MIL-T-7003. Soak in hot alkali solution for three hours. Remove part from tank. Brush away deposits with a bristle or stainless steel brush. Rinse thoroughly in hot water and air dry.

b. For heavier lead deposits, degrease part and soak in hot alkali solution as instructed in step a. Impress a line voltage of 6 to 10 volts across tank. Set cathode time for ten seconds and anode time for five seconds. Allow ten minutes in tank before removing part. Rinse in alternate baths of hot and cold water. Air dry.

NOTE

Cleaning instructions in steps a. and b. apply only to the combustion chamber. Clean lead deposits from the vaporizer tubes by the method in paragraphs 3-24 through 3-27.

3-108. REPAIR AND REPLACEMENT. Proceed as follows.

a. Replace combustion chamber housing, if cracked.

b. Replace combustion chamber drain valve, if damaged.

c. Replace swivel joint assembly, if cracked.

CAUTION

If the engine has been operated while the swivel joint assembly was removed, inspect the combustor before further operation. Do not run the engine until the swivel joint assembly has been reinstalled. Serious damage may result.

3-109. FIRESHIELD, SUPPORT CONE, AND POWER TURBINE OIL TUBES.

3-110. INSPECTION. Proceed as follows.

a. Using magnetic-particle inspection method, inspect support cone, fireshield, and igniter mounts for cracks. (Refer to paragraphs 3-41 through 3-50.)

b. Visually inspect threaded parts for crossed threads.

c. Visually inspect parts for distortion.

3-111. REPAIR AND REPLACEMENT.

a. Remove all nicks and burrs.

b. Using the weld procedure in paragraphs 3-51 through 3-56, repair cracks on the fireshield and support cone.

c. Replace power turbine oil tube and igniter mounts, if cracked.

3-112. POWER TURBINE SUPPORT.

3-113. INSPECTION. Proceed as follows.

a. Visually inspect parts for nicks, burrs, and excessive wear.

b. Using fluorescent-penetrant inspection method, inspect cooling air deflector, bearing, and power shaft bolt for cracks. (Refer to paragraphs 3-30 through 3-36.)

c. Using magnetic-particle inspection method, inspect forward and rear pump rotors and housing, power shaft plug, power shaft bolt adapter, and gearing housing cover for cracks and foreign inclusions. (Refer to paragraphs 3-41 through 3-50.)

d. Inspect bearing housing and spacers as follows.

(1) Inspect bearing housing for burrs, nicks, dents, and scratches.

(2) Inspect housing contact surfaces for mulilations or distortion.

(3) Replace bearings that show excessive wear.

3-114. REPAIR AND REPLACEMENT.

a. Remove all damaging nicks and burrs.

b. Remove high metal from bearing housing and spacers.

c. Remove aluminum seal pickup from bearing housings with sodium hydroxide, Federal Specification O-S-598.

d. Replace parts that have cracks, crossed threads, irreparable distortion, or excessive wear.

e. Replace bearings, if damaged.

f. Replace seals and packings.

3-115. ASSEMBLY. Proceed as follows.

NOTE

Aline match marks with bearing housing when installing bearings, pump rotors, spacer, and power turbine into power turbine bearing housing.

a. Install number three bearing (18, figure 2-54) in bearing housing (5). Install forward pump housing (17) in bearing housing.

CAUTION

Ensure correct location of guide pin in forward pump housing. Do not install guide pin in oil passage.

b. Install forward pump rotor (16) in bearing housing. Lubricate and install packing (15). Install seal (13) and seal housing (14) in bearing housing.

c. Install air-cooling deflector (11) on bearing housing. Secure air-cooling deflector to bearing housing with eight bolts (12). Lockwire bolts in pairs.

d. Place second stage turbine (6), with shorter journal down, in holding fixture. Using arbor press and proper sleeve, press inner race of number three main bearing (18) onto power turbine journal.

e. Install bearing housing on power turbine. Install bearing spacer (10) and shim (9) in bearing housing.

f. Using proper sleeve and arbor press, install bearing (8). Install rear pump housing (4).

CAUTION

Be certain guide pin is positioned properly in bearing housing and does not block oil passage.

g. Install rear pump rotor (3). Install lock cup (1) and bearing retainer spanner nut (2). With tool and torque wrench, tighten nut. Bend lock cup into spanner nut slots.

h. Install packing (7). Install exhaust diffuser on power turbine bearing housing. With two screws, secure exhaust diffuser to bearing housing.

3-116. EXHAUST DIFFUSER.

3-117. INSPECTION. Proceed as follows.

a. Visually inspect the exhaust diffuser in critical and non-critical areas for foreign object damage, cracks, or burns. (See figures 13 and 14.)

b. Using a yellow Colorbrite marking pencil, number 2107 or equivalent, mark all cracks within the maximum permissible limits, and tag the exhaust diffuser for stop drilling. If field inspection limits are exceeded, tag the exhaust diffuser for overhaul inspection and weld repair. If overhaul repair is not possible, replace the exhaust diffuser.

NOTE

The nonfluorescent-penetrant (dye contrast-penetrant) inspection method, Military Specification MIL-I-6866, may be used when inspecting questionable crack areas. (Refer to paragraphs 3-37 through 3-40.)

3-118. ALLOWABLE LIMITS (NON-CRITICAL AREAS).

a. In non-critical areas an unlimited number of cracks not exceeding 1/2 inch in length after stop drilling are acceptable, provided no two adjacent cracks are convergent. (See figures 13 and 14.)

CAUTION

Do not stop drill cracks in leading edge of strut fairing. Cracks in strut fairing shall be tagged for weld repair at overhaul.

b. Burns not exceeding one inch in diameter are acceptable, providing no holes appear in the burned area.

c. Buckling caused by heat is acceptable, providing no interference with mating parts is evident.

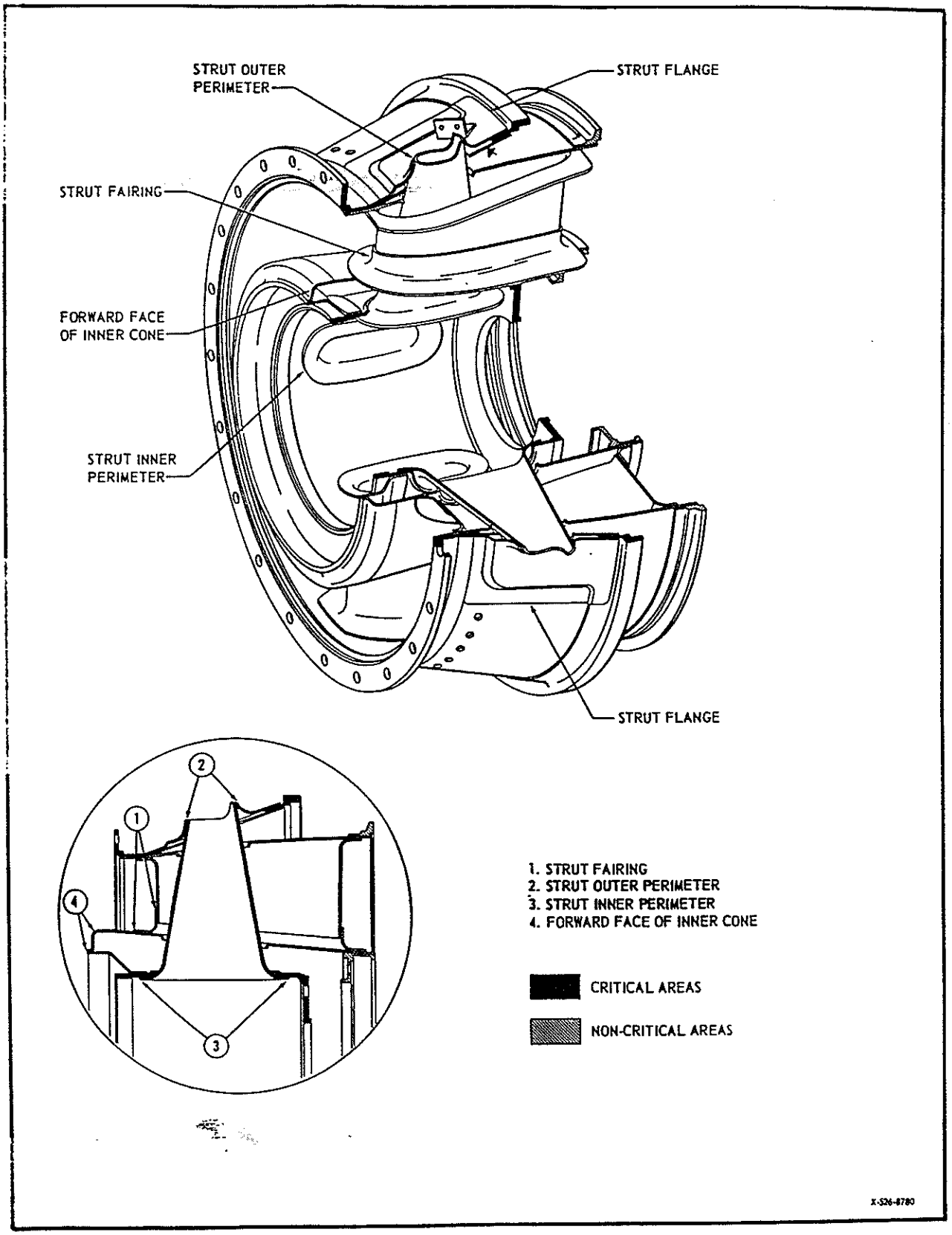


Figure 3-13. Exhaust Diffuser, Critical and Non-Critical Areas

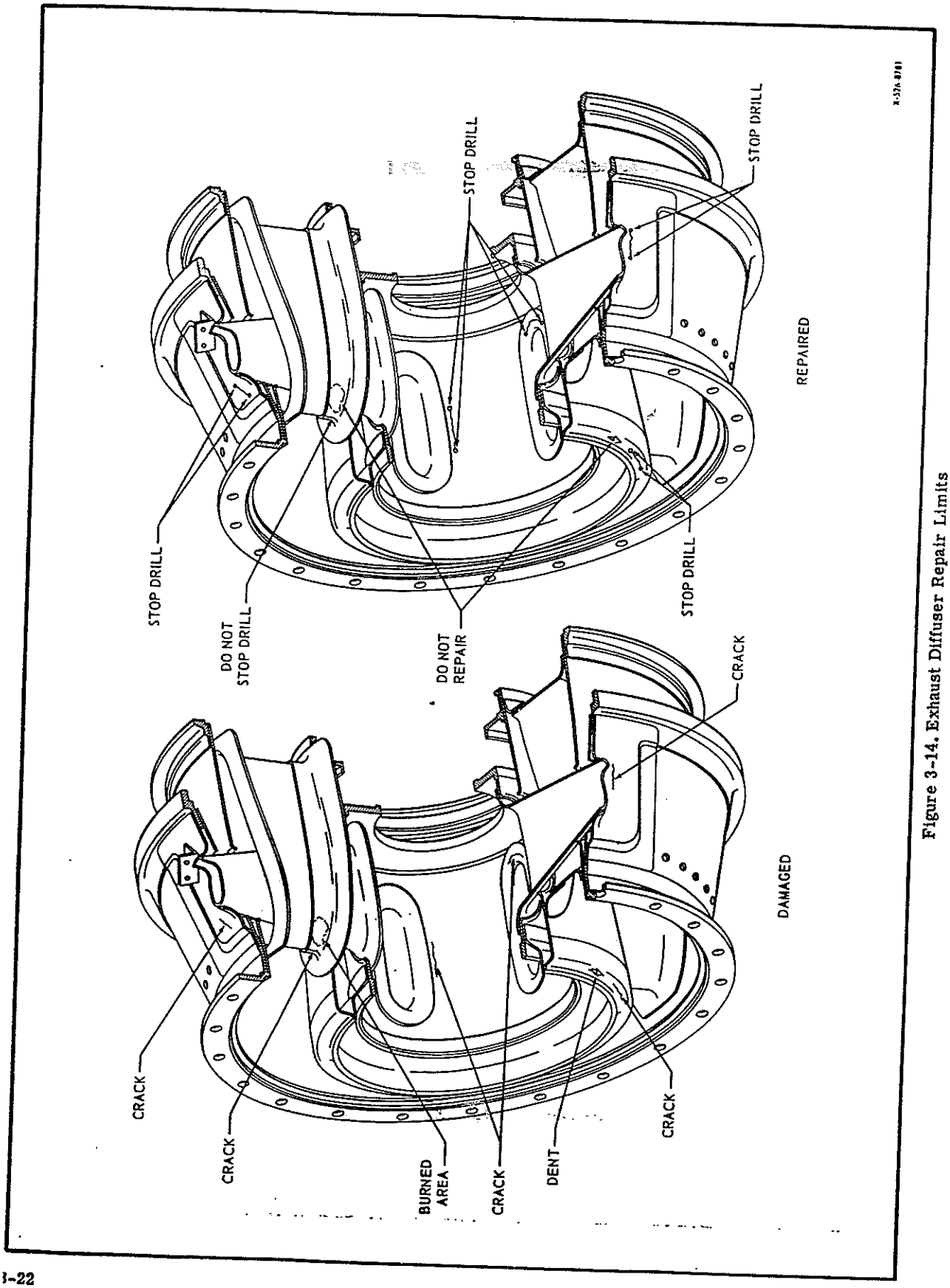


Figure 3-14. Exhaust Diffuser Repair Limits

d. Dents not exceeding 1/4 inch in diameter and 0.031 inch in depth are acceptable.

3-119. ALLOWABLE LIMITS (CRITICAL AREAS).

a. In critical areas an unlimited number of cracks not exceeding 1/2 inch in length after stop drilling are acceptable, provided no two adjacent cracks are convergent.

CAUTION

Do not stop drill cracks in welded areas. Cracks in welded areas shall be tagged for repair welding at overhaul.

b. Cracks in strut flange shall be stop drilled. Two cracks, not exceeding one inch maximum in length, per strut flange, are acceptable. Not more than two strut flanges per diffuser assembly may be cracked.

3-120. REPAIR AND REPLACEMENT. Stop drill all cracks within specified limits as follows.

a. Using a fine abrasive, remove paint from cracked area.

b. Determine the ends of the crack.

c. Using a 1/16 inch diameter drill bit, stop drill end of crack.

CAUTION

Where more than one thickness of metal is present, be careful not to drill through second thickness.

3-121. COMBUSTION CHAMBER LINER AND SCOOP AND SHROUD.

3-121A. GENERAL. Cracks in combustor assembly surfaces are of a stress relieving type and, as such, are not usually serious since the rate of growth decreases as the crack lengthens. Thermal stresses relieve original stress conditions. It is normal to observe repetitive occurrences of a given type of deterioration from one combustor to another.

3-121B. To ensure consistency and to eliminate confusion in reports or inspection standards, use established nomenclature for the various components of the combustor assemblies as shown in figures 3-14A and 3-14M.

3-121C. Crack and burn limits are defined for acceptance of used combustor parts and are subject to replacement if limits are exceeded.

3-122. INSPECTION. Proceed as follows.

3-122A. Conduct a general visual inspection of the combustor liner and scoop and shroud for cracks, burns, deposits, warpage, and other defects. This inspection can be accomplished after the combustion chamber assembly has been separated from the diffuser housing and the fuel vaporizers have been removed, if necessary. (See figure 3-14B.) Determine the condition of the combustor assembly. It may be re-used if no defects are found. If it is defective, disassemble further using the following allowable limits as a guide.

NOTE

In visual inspections use mirrors, lights, and a 10-power magnifying glass as required.

3-122B. COMBUSTION CHAMBER LINER.

3-122C. ALLOWABLE LIMITS (LINER END).

a. Individual non-convergent cracks up to five inches in length are acceptable. A total of four 5-inch cracks or a total of 20 inches shall not be exceeded. (See figures 3-14C and 3-14D.)

b. An individual crack must not be open more than 1/32 of an inch.

c. Cracks separated by less than one inch of parent metal shall be considered as one crack.

d. Two adjacent maximum length cracks shall be separated by a minimum of three inches of parent metal.

e. A maximum of three cracks between any three holes in the outer rim of the liner shall be acceptable.

f. A maximum of five cracked radial rows of holes shall be acceptable.

g. The failing of three adjacent welds or rivets at the joint between the liner end and the rear inner liner section shall be maximum acceptable.

h. Moderate ring warpage shall be acceptable.

i. Burned areas shall not exceed a total of one-fourth square inch.

3-122D. ALLOWABLE LIMITS (FORWARD AND REAR LINERS).

a. Cracks up to 1-1/4 inch maximum are acceptable. (See figure 3-14E.)

b. A total of three maximum limit cracks or a total crack length of six inches shall be the maximum acceptable.

c. Adjacent cracks shall be separated by a minimum distance of three-quarters inch of parent metal at the terminal end of the crack.

d. Only one missing tab on the forward inner liner section shall be acceptable. (See figure 3-14F.)

e. Burned areas shall not exceed one-half square inch. (See figures 3-14G and 3-14H.)

f. Moderate warpage around liner is acceptable. (See figures 3-14J and 3-14K.)

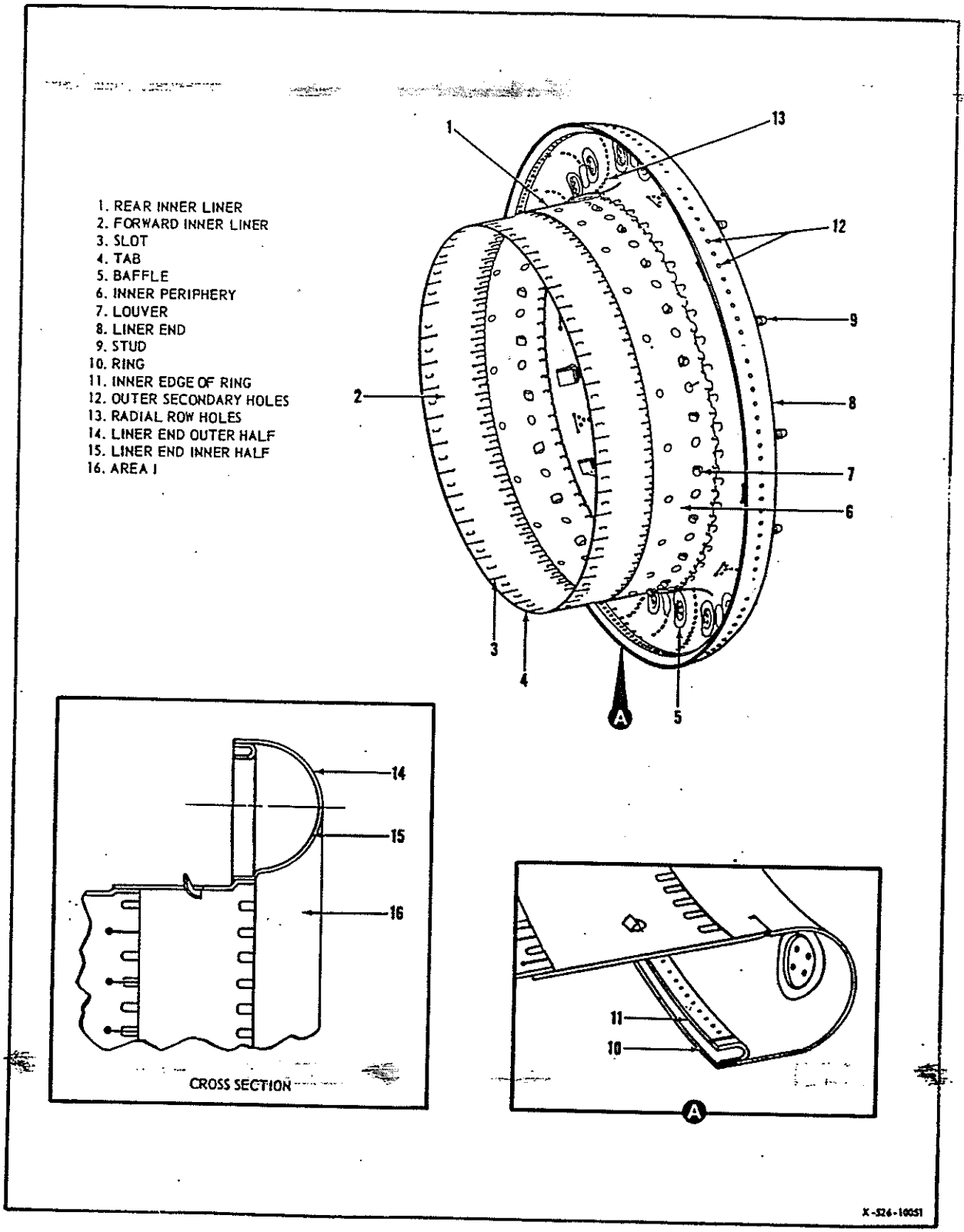


Figure 3-14A. Combustion Chamber Liner

3-122E. REPAIR AND REPLACEMENT (COMBUSTION CHAMBER LINER).

a. Stop drill all cracks in Area I (figure 3-14A) within specified limits as follows.

(1) Determine ends of crack.

(2) Using a 1/16 inch diameter drill bit, stop drill 1/16 inch beyond end of crack.

(3) Deburr both sides of holes.

b. Replace the liner if cracks exceed maximum allowable limits.

c. Replace the liner if the number of weld or rivets that have failed exceeds the acceptable limits. (Refer to step g., paragraph 122C.)

d. Replace the liner if more than one tab is missing.

e. Replace the liner if burned area exceeds maximum allowable limits.

f. Replace liner if more than two burned areas, approximately one-half square inch, on the rear or forward inner liner sections of the combustion liner, are closer than those shown in figure 3-14L.

g. Replace liner assembly if more than four cracks develop as a result of warping.

h. Replace liner if there is a possibility of metal breaking away during any future operation of engine.

i. Moderate warpage along the inner periphery can be straightened using an undistorted section as a reference plane. (See figure 3-14A.)

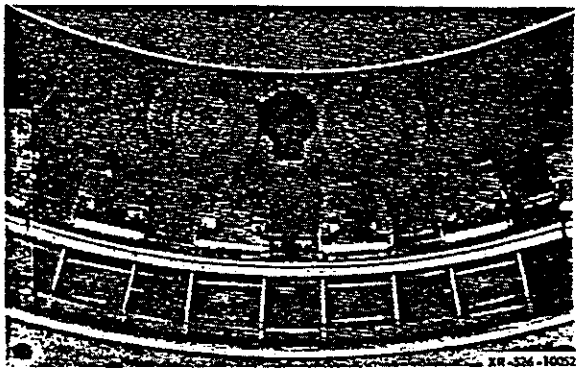


Figure 3-14B. Combustion Chamber Assembly with Fuel Vaporizer Removed

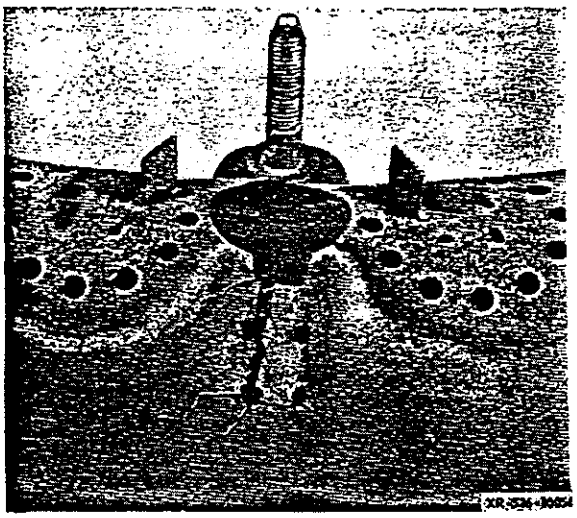


Figure 3-14D. Combustion Chamber Liner Cracks

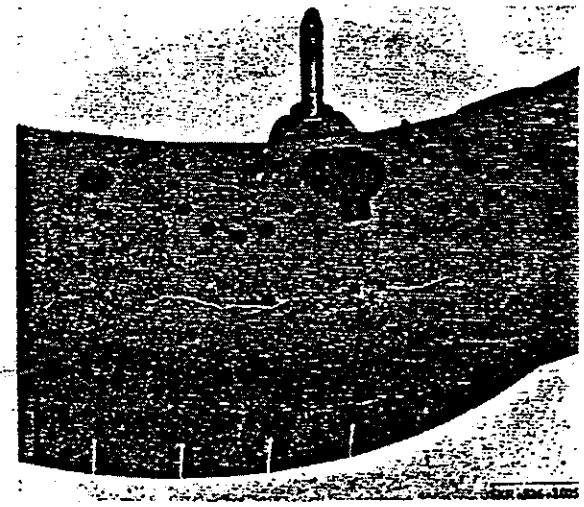


Figure 3-14C. Combustion Chamber Liner with Nonconvergent Cracks

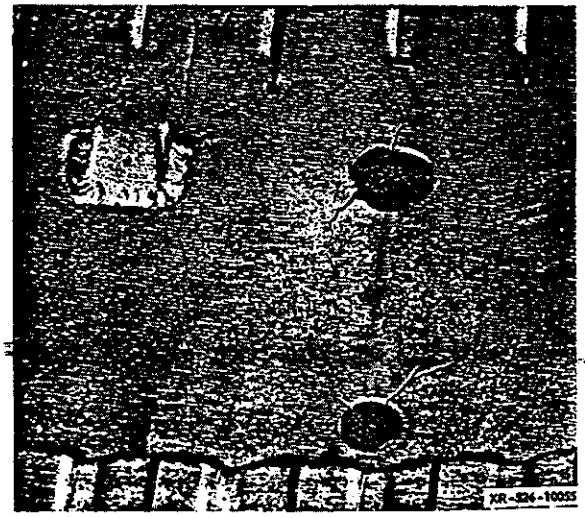


Figure 3-14E. Rear Inner Liner Cracks

j. Moderate warpage along the inner edge of the ring can be straightened using an undistorted section as a reference plane.

3-122F. SCOOP AND SHROUD ASSEMBLY.

3-122G. ALLOWABLE LIMITS. (See figure 3-14M.)

a. Individual non-convergent cracks up to 1-1/2 inches long or a total of six inches shall be acceptable.

b. A burned area on one or both corners for up to 25 percent of all the scoop assemblies (22 corners total) shall be acceptable provided that one-eighth inch of the weld remains on each scoop. (See figure 3-14N.)

c. Burned areas at both corners of all scoop assemblies (44 scoop assemblies total) shall be acceptable provided that one-quarter inch of the weld remains at each. (See figure 3-14P.)

d. Burned areas on louvers shall not exceed one-eighth inch length.

e. Complete loss of any two louvers shall be maximum allowable.

f. A burned area, three-quarters inch in length, shall be maximum for any cover strip.

g. A maximum loss of any two cover strips shall be acceptable.

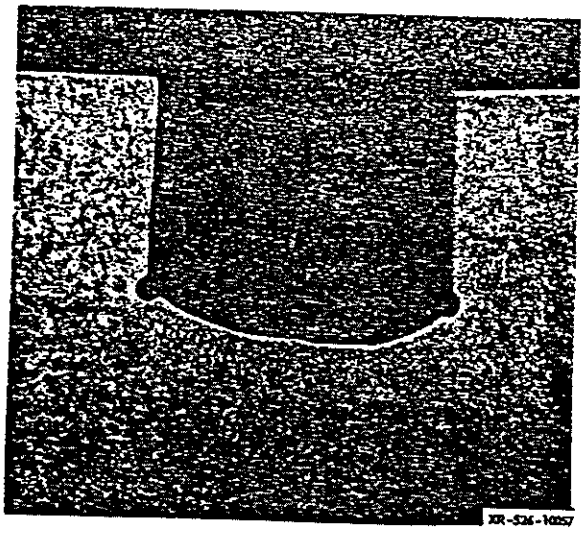


Figure 3-14F. Forward Inner Liner with One Missing Tab

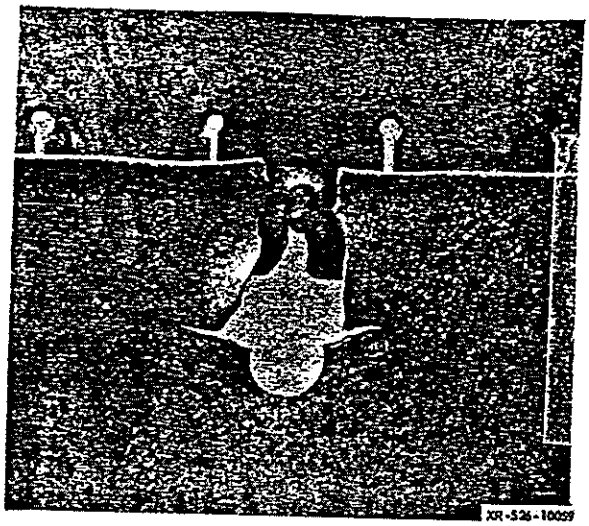


Figure 3-14H. Unacceptable Burned Inner Liner

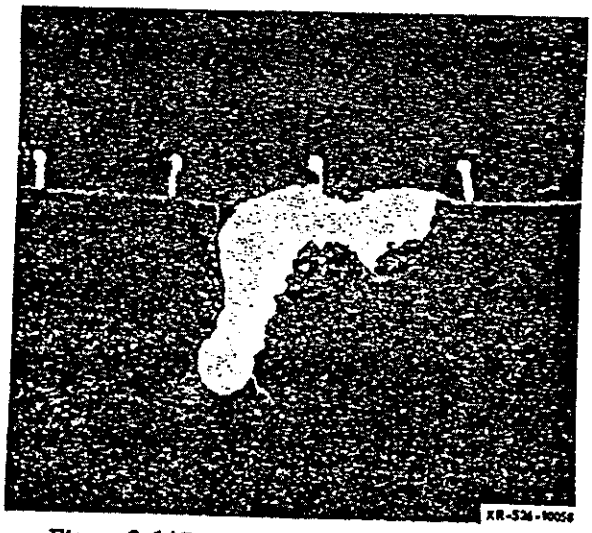


Figure 3-14G. Unacceptable Burned Areas on Inner Liners

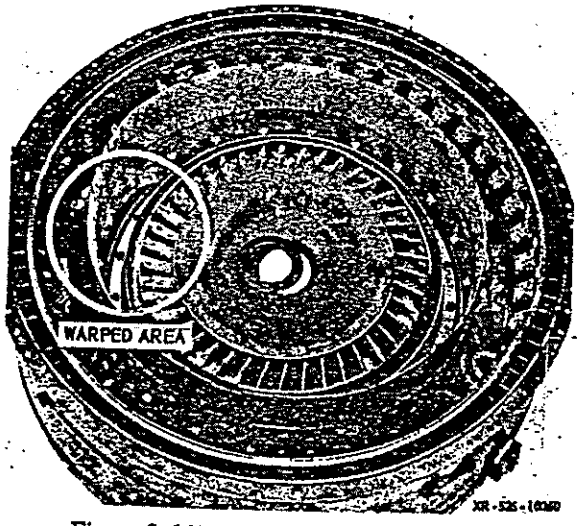


Figure 3-14J. Moderate Liner Warpage

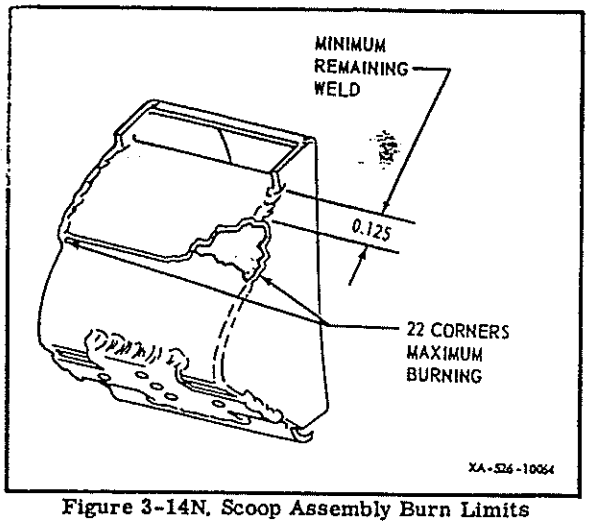


Figure 3-14N. Scoop Assembly Burn Limits

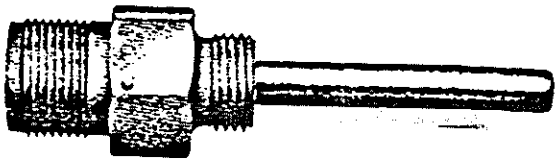


Figure 3-15. Temperature Sensing Bulb

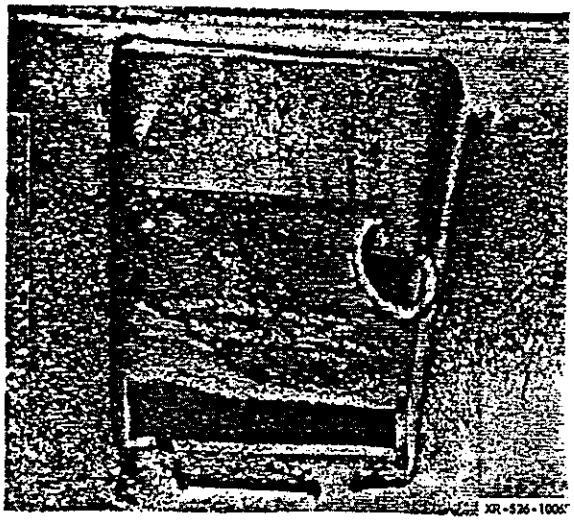


Figure 3-14P. Burned Area on Scoop Assembly

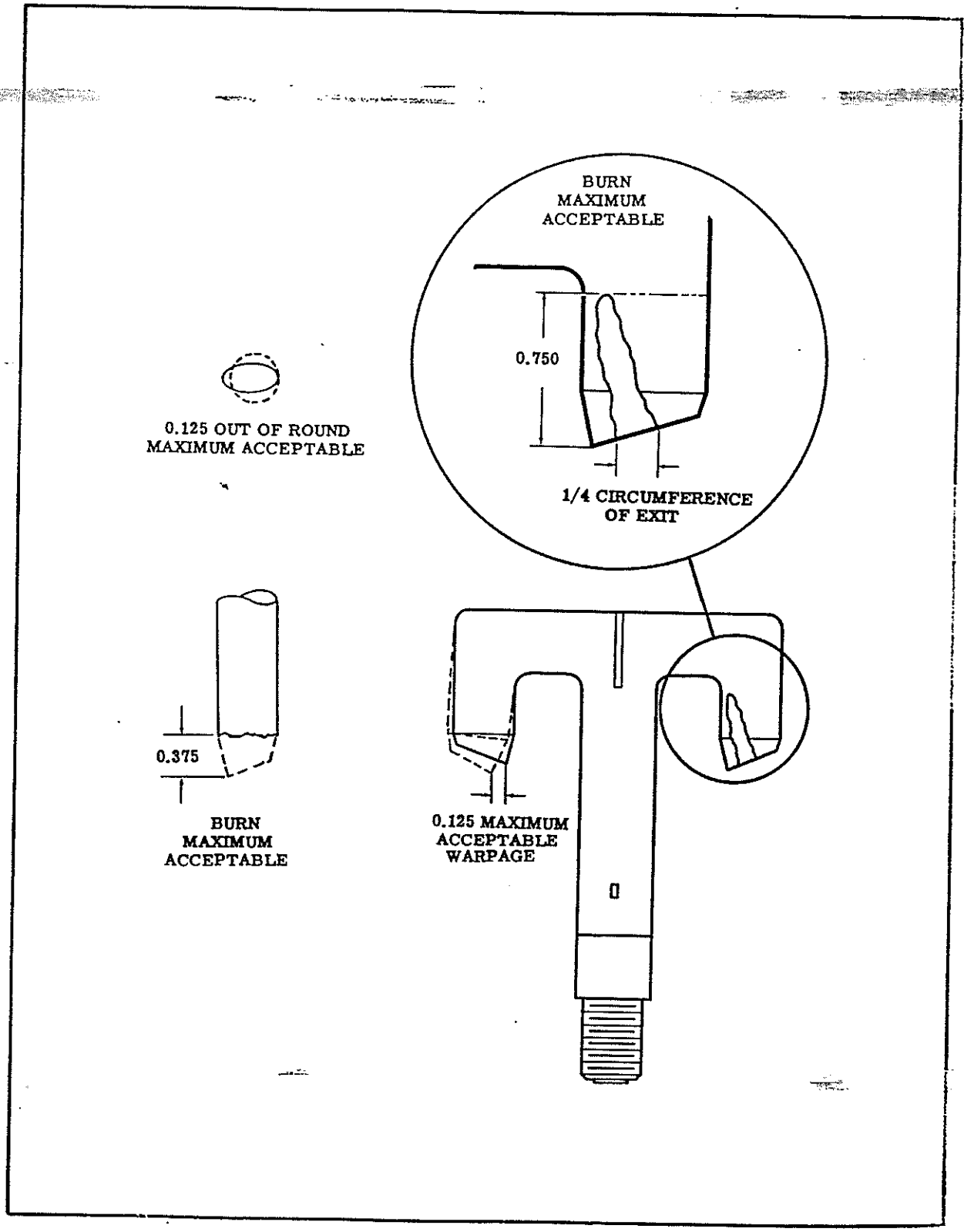


Figure 3-16. Fuel Vaporizer Tube Burn Limits

3-130. EXTERNAL OIL LINES.

3-131. GENERAL. When oil lines are disconnected or removed, they shall be visually inspected for cracks, tears, frays, and foreign matter. They shall be capped or plugged immediately. Flexible lines shall be properly removed and installed. When tightening fittings, lines shall not be gripped with pliers. The hoses shall be slackened gradually to prevent crushing the inner core. Oil tubes, hoses, and manifolds shall be flushed with dry-cleaning solvent, Federal Specification P-S-661.

3-132. INSPECTION. Proceed as follows.

a. Inspect nuts and screws for stripped threads.

b. Inspect clamps and brackets for nicks and dents.

c. Inspect oil manifold, oil line, and oil pressure hoses for wear, cracks, dents, and nicks.

d. Inspect brazed joints.

e. Inspect for scores and scratches.

f. Inspect mating parts.

g. Inspect oil scavenge tees and plugs for crossed threads and wear.

h. For inspection of the oil filter, refer to paragraph 3-179.

3-133. FUEL VAPORIZER, STARTING NOZZLES, AND FUEL MANIFOLD.

3-134. GENERAL. When fuel lines are removed or taken apart, they shall be visually inspected for cracks, tears, frays, and foreign matter. They shall be capped or plugged immediately. Flexible lines shall be properly removed and installed. When tightening fittings, lines shall not be gripped with pliers. The lines shall be slackened gradually to prevent crushing the inner core. Injectors and other fittings, shall be protected with caps when not installed. Tubes, lines, and manifolds shall be flushed with referee jet fuel, Military Specification MIL-J-5161.

3-135. INSPECTION. Proceed as follows.

a. Inspect fuel vaporizer tube for burning. Burns to 0.750 inch on end of tube are permissible. (See figure 3-16.) Complete leg burnoff beyond 0.375 inch is not permissible. Replace tube if complete burnoff exceeds 0.375 inch.

b. Inspect fuel manifold for leaks and clogging, and the tubes for clogged airflow.

c. Flow-check fuel vaporizer tube with a 400 psi fuel pressure. Each exit tube shall deliver 47 to 53 percent of total fluid through tube. If the flow check is unsatisfactory, replace fuel vaporizer tube.

d. Using fluorescent-penetrant inspection method, Military Specification MIL-I-6866, inspect fuel vaporizer tubes for cracks. Replace cracked fuel vaporizer tubes.

CAUTION

When inspecting fuel vaporizer tubes, do not immerse the entire tube assembly in the fluorescent-penetrant solution. Developing powder used in this solution can clog the 0.030-inch diameter hole in the vaporizer's fuel divider. If immersion of the tube is necessary, remove the fuel divider. Install a new teflon sleeve on the fuel divider before reinserting it in the fuel vaporizer tube.

e. Inspect for fuel leakage at fuel vaporizer tube and manifold fitting attaching point.

NOTE

The following procedure shall be performed only on those fittings which have developed fuel leakage.

(1). Using fuel harness wrench (figure 1-7), torque the fuel fitting nuts to between 350 and 400 pound-inches. If fuel fittings still have leakage, perform steps 2. through 14.

(2). Remove manifold assembly.

(3). Visually check surface of fuel vaporizer tube for an indication of positive contact. (See figure 3-17.)

NOTE

Complete contact can be distinguished as a shiny unbroken ring, as opposed to a non-contact machined-finished or vapor-blasted gray matte surface.

(4). If a clean visual contact of 360 degrees is not indicated, the seating surface of the fuel vaporizer tube shall be reworked.

(5). Insert a standard 8/32 allen screw into the fuel vaporizer divider, and remove the divider.

(6). Remove the fuel vaporizer sleeve from divider and discard.

(7). Screw barrel of fuel vaporizer tube receding tool, part number LTC-T537, onto threaded portion of fuel vaporizer tube. Revolve knurled knob, periodically reversing directions. Check seating surface condition frequently, since very little lapping is required.

NOTE

For a finer surface finish, apply a light coating of oil to the emery cloth attached to receding tool.

(8). If fuel vaporizer tube receding tool is not available, the surface shall be reworked by using a small, flat, fine grit handstone, lightly coated with oil. Hold stone firmly against the surface to be reworked, moving the stone with a flat circular motion.

(9). Visually check surface to ascertain rework. Rework will appear as a smooth surface throughout 360 degrees of reworked area.

(10). Clean reworked area using dry-cleaning solvent, Federal Specification P-S-661, and blow clean with shop air.

(11). Insert new teflon sleeve on fuel divider, and insert fuel divider into fuel vaporizer tube.

CAUTION

When inserting fuel divider, ensure that the slot in the fuel divider straddles the internal partition of fuel vaporizer tube.

(12). Install manifold and torque to between 350 and 400 pound-inches.

(13). Remove manifold and check reworked surface for 360 degrees positive contact indication.

(14). If positive contact has been effected, reinstall manifold and torque to between 350 and 400 pound-inches.

NOTE

If positive contact has not been realized, repeat steps 7. through 14. Replace fuel vaporizer if the rework does not correct the fitting leakage condition.

(15). Check for fuel leaks at first engine run after rework. If leakage persists, replace fuel vaporizer tube. If positive contact on fuel vaporizer tube has been effected, but leakage persists, replace the manifold.

3-136. REPAIR AND REPLACEMENT. Proceed as follows.

a. With a stiff-bristle fiber brush, remove carbon from outside of fuel vaporizer.

b. Clean inside of tubes by directing compressed air through exhaust end inlet of flow divider.

NOTE

Do not clean spark igniters.

c. Replace spark igniters if igniters are not heard firing when engine is started.

d. Disassemble clogged starting nozzles.

e. Clean filter.

f. With a thin, sharp instrument, clean metering passages.

CAUTION

Do not mar metal surfaces when cleaning passages. Do not misplace or lose small parts of nozzle.

g. With a soft wire brush, clear plugged fuel metering injectors.

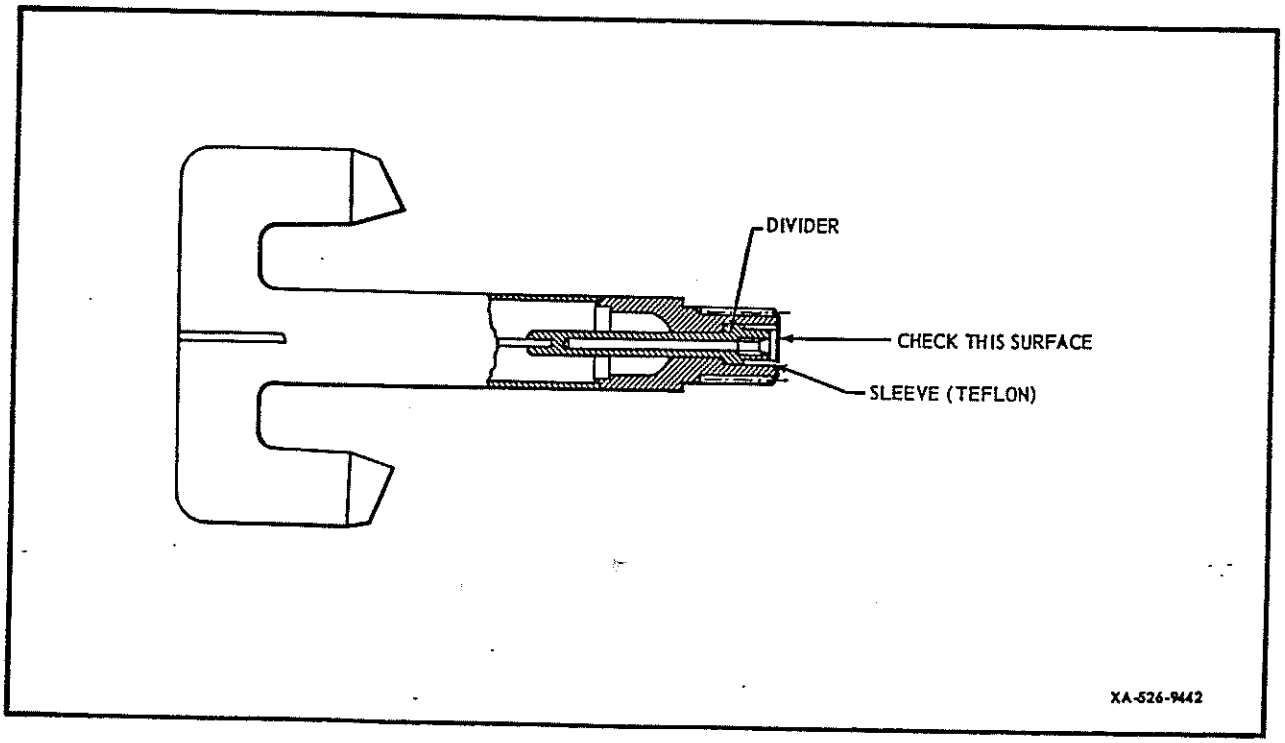


Figure 3-17. Reworking Fuel Vaporizer Tube Assembly

CAUTION

To avoid enlarging holes when cleaning injectors, use a 0.010 inch maximum diameter wire.

h. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean nuts and screws.

i. Remove nicks and dents with a fine stone.

j. Air dry parts.

k. Replace damaged parts.

3-137. STARTING FUEL AND AIR PURGE LINES AND SOLENOID VALVE.

3-138. INSPECTION. Proceed as follows.

a. Inspect screws for stripped threads.

b. Inspect brackets and clamps for dents, cracks, scratches, and nicks.

c. Inspect manifold and hoses for wear, cracks, dents, and nicks. Inspect mating surfaces.

d. Inspect igniter nozzles for stripped threads.

e. Inspect solenoid valve for scores, nicks, dents, and crossed threads.

3-139. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean threads.

b. Flush tubes, hoses, and manifolds with referee jet fuel, Military Specification MIL-J-5161.

c. Air dry parts.

d. Replace damaged parts.

3-140. PRESSURE TESTING. Proceed as follows.

NOTE

Interior of starting fuel hose shall be free of dirt, chips, and foreign matter.

a. Insert plug in one end of flexible hose.

NOTE

Do not tighten plug.

b. Apply other end of hose to a hydraulic pressure source. Tighten hose.

c. Bleed air by loosening plug.

d. Tighten plug.

e. Apply hydraulic pressure. Check for leaks.

f. Reduce hydraulic pressure to zero.

g. Disconnect hydraulic pressure.

h. Remove plug and drain fluid from line.

i. Reinsert and tighten plug.

j. Assemble other end of hose to air pressure.

k. Submerge hose in water.

l. Apply air pressure.

m. Check for leaks by bending hose in different ways.

n. Reject any hose that leaks.

o. The ferrule shall bottom on the tube as specified.

p. Check internal clearance by placing a 0.125 inch diameter gaging ball in one end of the hose.

q. Tilt hose.

NOTE

Ball must pass freely through hose.

3-141. ANTI-ICING SYSTEM.

3-142. GENERAL. When the anti-icing air hose is removed or taken apart, it shall be visually inspected for cracks, tears, frays, and foreign matter. It shall be capped or plugged immediately. The hose shall be properly removed and installed. When tightening fittings, the line shall not be gripped with pliers. The hose shall be slackened gradually to prevent crushing the inner core.

3-143. INSPECTION. Proceed as follows.

a. Inspect nut, bolts, and plug for stripped threads.

b. Inspect brackets and clamps for dents, cracks, nicks, and distortion.

c. Inspect hose for excessive wear, tears, cracks, and breaks.

d. Inspect connectors for scoring or cross-threading.

e. Inspect braided cover of hose for broken strands.

f. Inspect brazed areas for visible cracks.

g. Inspect detector for damaged threads and scoring.

h. Inspect probe sensing holes for clogging.

i. Inspect probe root for cracks.

j. Inspect probe end for loss of plug.

k. Inspect interpreter for dents, scoring, and cross-threading.

l. Inspect rubber shock mounts for damage, wear, and fatigue.

m. Inspect jumper for wear and distortion.

n. Inspect elbow and tube for scoring, dents, and improper fit.

o. Using fluorescent-penetrant inspection, inspect the anti-icing elbow for cracks. (Refer to paragraphs 3-30 through 3-36.)

3-144. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using trichloroethylene, Military Specification MIL-T-7003, vapor degrease anti-icing hose.

WARNING

Atomized solvents should always be applied in exhaust ventilated booths. Rubber gloves and protective hand cream are required.

b. Wash hose assembly in dry-cleaning solvent, Federal Specification P-S-661. Flex during washing to loosen particles lodged in the corrugated interior.

c. Brush out hose interior with a suitable cylindrical brush.

d. Flush with dry-cleaning solvent, Federal Specification P-S-661.

e. Clean fitting threads with fine wire brush dipped in dry-cleaning solvent, Federal Specification P-S-661.

f. Cracked brazed joints may be repaired as outlined in paragraph 3-59.

g. With a fine stone, remove nicks and dents from detector and interpreter.

h. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean screws and bolts.

i. Remove nicks and dents from brackets, plates, elbow, and tube.

j. Air dry parts thoroughly.

k. Replace damaged parts.

3-145. PRESSURE TESTING. Proceed as follows.

a. Interior of hose shall be free from dirt, chips, and other foreign matter.

b. Insert plug in one end of flexible assembly. Do not tighten plug.

c. Connect end to hydraulic pressure and tighten.

d. Pressurize line. Bleed air by loosening plug.

e. Tighten plug.

f. Apply hydraulic pressure. Check for leaks.

g. Reduce hydraulic pressure to zero.

h. Disconnect hydraulic pressure.

i. Remove plug.

j. Drain fluid from line.

k. Reinsert and tighten plug.

l. Connect other end of hose to air pressure.

m. Submerge hose in water.

n. Apply pressure.

o. Check for leaks by bending hose in different ways.

p. Reject leaking hose.

q. Reduce air pressure to zero and disconnect pressure source and remove plug.

r. Insert ball in hose.

s. Tilt hose.

NOTE

Ball must pass freely through line.

3-146. COMPRESSOR HOUSING.

3-147. INSPECTION. Proceed as follows.

a. Inspect compressor and centrifugal housings for burrs, nicks, dents, and foreign matter.

b. Inspect anti-icing outlet cover for dents and nicks.

c. Inspect bolts, nuts, and inserts for stripped threads.

d. Inspect bolt holes of vanes for damaged threads and foreign matter.

3-148. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean bolts, nuts, and inserts.

b. With a fine handstone, remove nicks, dents, burrs, and pits.

c. With dry-cleaning solvent, Federal Specification P-S-661, remove foreign matter from housings and vanes.

d. Air dry parts.

e. Replace damaged parts.

f. For braze repairing of compressor vanes, refer to paragraph 3-59. (See figure 3-6.)

3-148A. AXIAL COMPRESSOR ROTOR AND CENTRIFUGAL COMPRESSOR IMPELLER CLEARANCES.

3-148B. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 11.)

NOTE

Recording compressor rotor and centrifugal compressor impeller clearances at this time is recommended but not mandatory. The record of these clearances will serve as a checklist at final assembly.

3-148C. PROCEDURE.

a. Using a 12 inch feeler gage, take radial blade tip clearances of the five axial compressor stages. Take two clearance readings, 180 degrees apart, for each rotor stage. Clearance readings should be measured between the axial compressor rotor blade tips and the axial compressor housing. Rotate the compressor one full turn while taking clearance readings at each of the ten checkpoints. (See figure 3-17A.)

NOTE

When taking blade tip clearances, insert feeler gage 0.250 to 0.500 inch below the axial compressor housing flange line.

b. Table of limits references for compressor rotor blades are as follows. (See figure 7-7.)

STAGE	T/L REFERENCES
First	2
Second	5
Third	10
Fourth	15
Fifth	20

c. Using a 12 inch feeler gage, check radial seal clearance of five compressor rotor vanes. Take clearance readings from compressor rotor vane to compressor rotor spacers as follows. (See figure 3-17B.)

(1) Take two clearance readings, 180 degrees apart, from front of first stage compressor rotor vane to first stage compressor rotor spacer. Rotate the rotor one full turn while taking clearance readings at each of these two checkpoints.

(2) Take two clearance readings, 180 degrees apart, from rear of first stage compressor rotor vane to first stage compressor rotor spacer. Rotate the compressor one full turn while taking clearance readings at each of these two checkpoints.

(3) Take two clearance readings at front and two clearance readings at the rear of each compressor rotor vane to each compressor rotor spacer for the second through fifth rotor stages. Rotate the compressor one full turn while taking clearance readings at each of the 16 checkpoints.

d. Table of limit references for clearances between compressor rotor vanes and compressor rotor spacers are as follows. (See figure 7-7.)

STAGE	T/L REFERENCES
First	27A, 27B
Second	7, 8
Third	12, 13
Fourth	17, 18
Fifth	22, 27C

e. Using a 12 inch feeler gage, take axial clearance of compressor rotor blades to compressor rotor vanes for first through fifth stages. Take two clearance readings, 180 degrees apart for each rotor stage. (See figure 3-17C.) Rotate the compressor one full

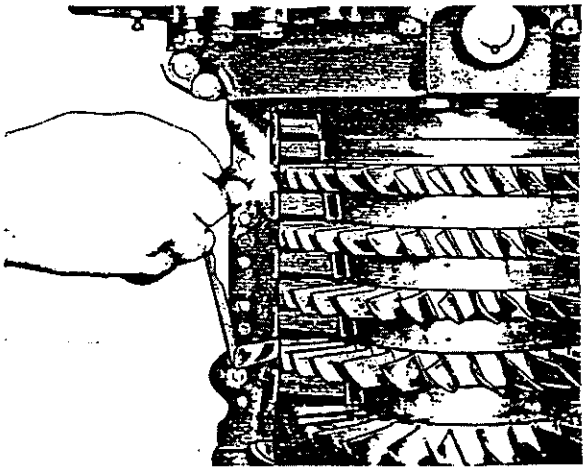


Figure 3-17A. Checking Compressor Rotor Blade Tip Clearance

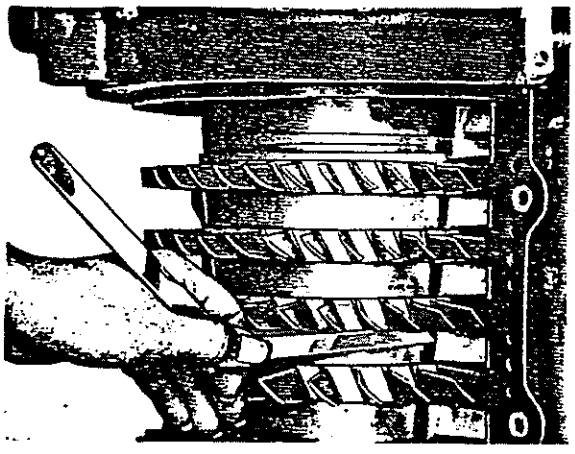


Figure 3-17B. Checking Clearance Between Compressor Vane and Spacer

turn while taking clearance readings at each of the checkpoints. The location and sequence for these clearances are given in step g.

f. Using a 12 inch feeler gage, take two axial clearance readings from centrifugal compressor impeller blades to fifth stage compressor rotor vane. Rotate the compressor one full turn while taking clearance readings at each of these two checkpoints. The location for this clearance is given in step g.

g. Table of limits references for axial clearances between first through fifth stage rotors and vanes are as follows. (See figure 7-7.)

ROTOR AND VANE	T/L REFERENCES
First Rotor To First Vane	3
First Vane To Second Rotor	4
Second Rotor To Second Vane	6
Second Vane To Third Rotor	9
Third Rotor To Third Vane	11
Third Vane To Fourth Rotor	14
Fourth Rotor To Fourth Vane	16
Fourth Vane To Fifth Rotor	19
Fifth Rotor To Fifth Vane	21
Fifth Vane To Impeller	23

h. Using a 12 inch feeler gage, take radial tip clearance from centrifugal compressor impeller blades to centrifugal compressor housing. Take clearance reading at front, center, and rear of impeller blades on right side of engine and clearance readings at front, center, and rear of impeller blades on left side of engine. Rotate the compressor one full turn while taking clearance readings at each of the six checkpoints.

i. Table of limits references for centrifugal compressor impeller to centrifugal compressor housing are as follows. (See figure 7-7.)

CENTRIFUGAL COMPRESSOR IMPELLER TO CENTRIFUGAL COMPRESSOR HOUSING	T/L REFERENCES
Radial	24
Radial - Axial	25
Axial	26

j. Using 12 inch feeler gage, check radial tip clearance between centrifugal compressor impeller and diffuser housing. (Refer to 27, table of limits, figure 7-7.)

k. If compressor rotor and centrifugal compressor impeller clearances are within specified limits and no further repair is required to the engine, the axial and centrifugal compressor housings may be reinstalled by following the procedure in paragraph 5-15.

NOTE

No further disassembly is allowed. If necessary, forward to next higher level of maintenance.

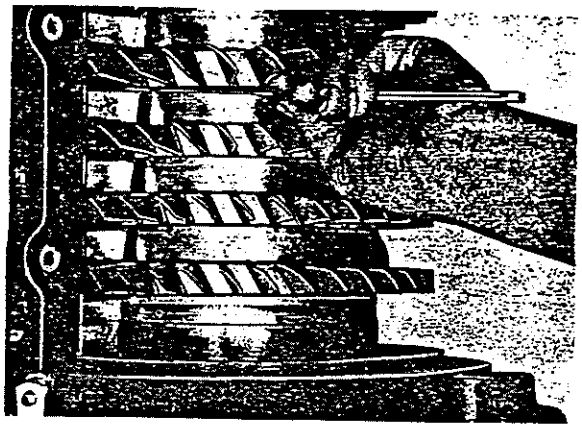


Figure 3-17C. Checking Clearance Between Rotor Blades and Vane

3-149. COMPRESSOR VANE.

NOTE

These instructions apply to the first through fifth stage compressor vanes.

3-150. INSPECTION. Proceed as follows.

a. Inspect leading and trailing edge of each vane for nicks, burrs, pits, and dents.

b. Inspect each vane for bends and distortion.

c. Using the fluorescent-penetrant inspection method, inspect the inner and outer shrouds for cracks. (Refer to paragraphs 3-30 through 3-36.)

3-151. REPAIR AND REPLACEMENT. (See figure 3-18.) Proceed as follows.

a. Repairs shall be made with a small die-sinker file or carborundum stones. Crocus cloth, Federal Specification P-C-458, shall be used for final polishing. Power tools shall not be used. All repairs shall be blended and finished smoothly. The finish strokes of all repair work shall be parallel to the length of the vane. No scratches are permitted.

b. Cracks in the inner shroud shall be repaired if the cracks do not extend into the parent material of the vane.

c. Bent vanes shall be straightened. If the straightening generates a crack in the vane, the assembly half shall be replaced. If five or more vanes are bent or distorted, the assembly half shall be replaced.

NOTE

When an assembly half is replaced, it is not necessary to replace the other half.

d. Dents with smooth contours are acceptable without rework if they do not exceed the maximum permissible limits.

e. Nicks, burrs, pits, and dents on vanes shall be repair-blended, if the damage after repair does not exceed 0.200 inch. If five or more vanes require repair-blending, the assembly half shall be replaced.

f. If nicks or dents are opposite each other on the same vane, the assembly half shall be replaced.

g. Nicks or dents on vanes in inaccessible areas of repair are acceptable without rework if they do not exceed the maximum permissible limits.

h. If the space between two dents is less than the length of the longest dent, they shall be considered one dent.

i. Dents shall not exceed one third of the surface area on a side of a vane.

3-152. COMPRESSOR ROTOR.

3-153. INSPECTION. Proceed as follows.

a. Inspect bolts for stripped threads.

b. Inspect turbine wheel plate for nicks, dents, and scoring.

c. Inspect turbine wheel adapter for nicks, dents, and wear.

d. Inspect teeth for wear and distortion.

e. Inspect bellows, nut, lockring, and cone for nicks, dents, and improper wear pattern.

f. Inspect control gap seals for chips and nicks.

3-154. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean bolts.

b. With a fine handstone, remove nicks and dents.

c. Air dry parts.

d. Replace damaged parts.

e. Remove all grease, foreign matter, chips, and nicks.

3-155. COMPRESSOR ROTOR BLADES.

3-156. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 12.)

3-157. INSPECTION OF CRITICAL AREAS. Critical areas of the compressor rotor blades depend upon the compressor rotor stage to which the blade belongs. (See figure 3-19.)

3-158. INSPECTION OF OTHER AREAS. (See figure 3-18.)

a. The following requirements apply to areas not covered in paragraph 3-153.

b. Pits and dents shall be smooth, shallow, and free of foreign material.

c. Original blade chordal dimensions are 0.900 inch for first stage rotor blade, 0.800 inch for second stage rotor blade, and 0.680 inch for third, fourth, and fifth stage rotor blades.

CAUTION

Returning a bent blade to its original shape and dimension will weaken the metal structure. Bent blades shall be replaced.

3-159. REPAIR. The following definitions cover all reparable and nonreparable areas of compressor rotor blades. Dents are smooth round-bottomed depressions.

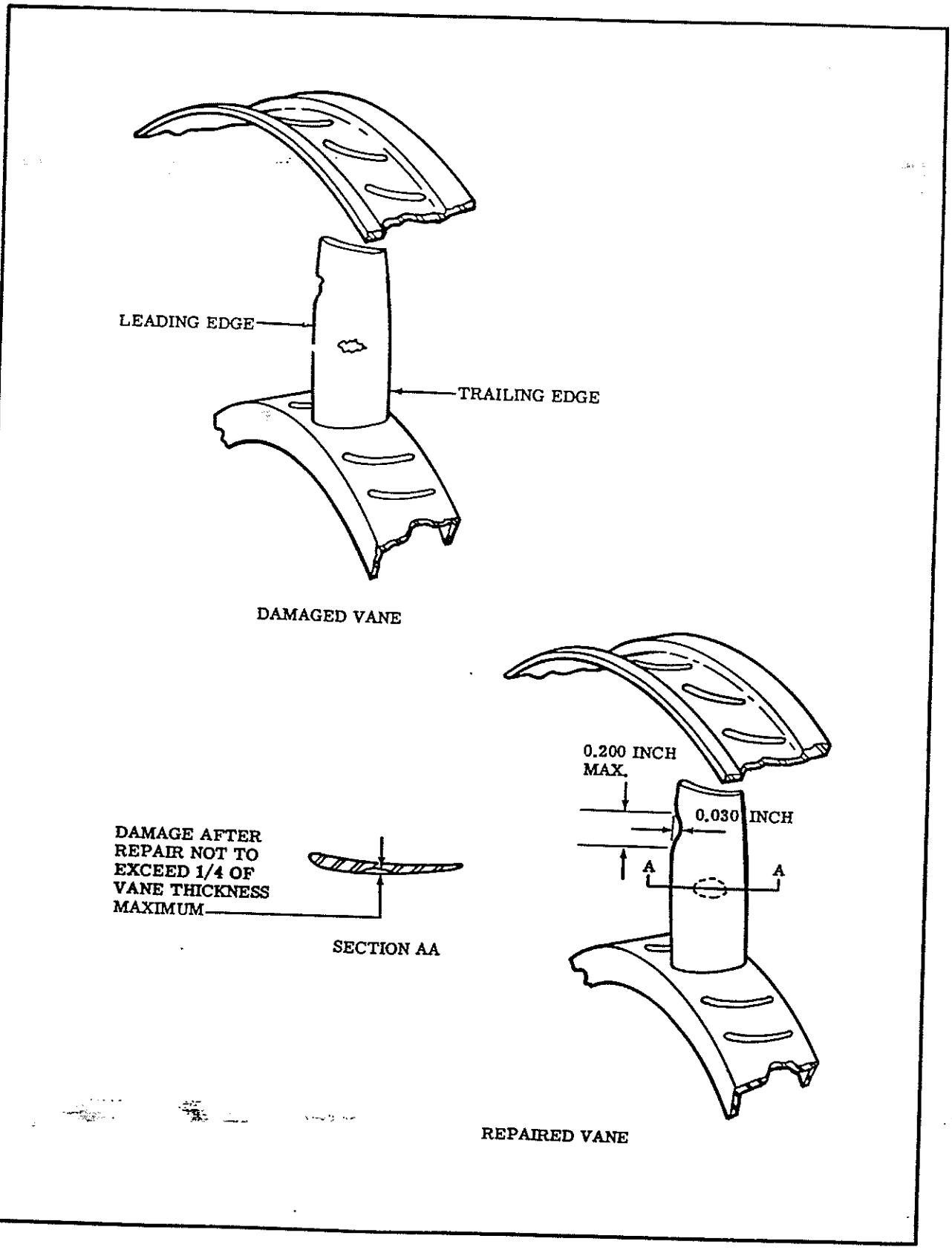
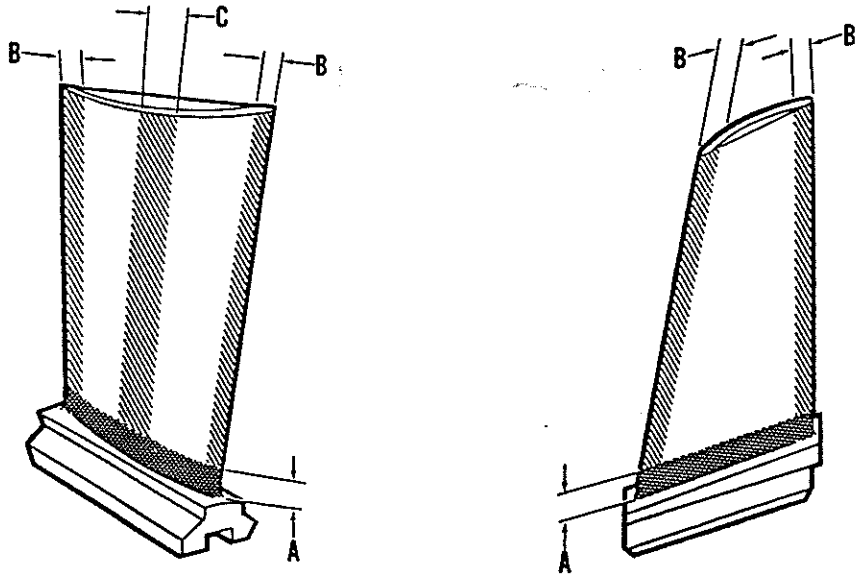


Figure 3-18. Compressor Vane Repair Limits



BLADE AREAS	A	B	C	CHORDAL DIMENSION
1ST STAGE	0.250	0.125	0.250	0.900
2ND STAGE	0.190	0.090	0.190	0.800
3RD, 4TH, 5TH STAGE	0.125	0.060	0.125	0.680

CRITICAL

NO REPAIR ALLOWED. SMOOTH DENTS, NOT EXCEEDING 0.030 INCH ON LONGEST SIDE AND 0.010 INCH DEEP, ARE ACCEPTABLE WITHOUT REWORK. ANY DAMAGE IN EXCESS OF THESE LIMITS IS CAUSE FOR BLADE REPLACEMENT. ANY NICK IN THIS AREA IS CAUSE FOR REPLACEMENT.

SEMI-CRITICAL

DENTS OR NICKS, NOT EXCEEDING 0.190 INCH ON LONGEST SIDE AND 0.010 INCH DEEP AFTER REPAIR ARE ACCEPTABLE. DENTS THAT ARE SMOOTH AND SHALLOW, NOT EXCEEDING 0.030 INCH ON LONGEST SIDE AND 0.010 INCH DEEP, ARE NOT CONSIDERED DAMAGE AND ARE ACCEPTABLE WITHOUT REWORK.

NON-CRITICAL

DENTS OR NICKS, NOT EXCEEDING 0.310 INCH ON LONGEST SIDE AND 0.015 INCH DEEP AFTER REPAIR, ARE ACCEPTABLE. DENTS THAT ARE SMOOTH AND SHALLOW, NOT EXCEEDING 0.030 INCH ON LONGEST SIDE AND 0.010 INCH DEEP, ARE NOT CONSIDERED DAMAGE AND ARE ACCEPTABLE WITHOUT REWORK.

Figure 3-19. Compressor Rotor Blade Repair Limits

Nicks are sharp-bottomed depressions with rough outer edges. All limits given refer to dimensions after repairs have been made.

a. Critical Areas - Damage that exceeds limits shown in figure 3-19 is cause for blade replacement. No rework is allowed.

b. Semi-critical Areas - Reparable damage shall be reworked within limits. Minor dents and nicks shall not be reworked if they are within acceptable limits. (See figure 3-19.)

c. Non-critical Areas - Reparable damage shall be reworked within limits. Minor damage shall not be reworked if it is within the acceptable limits. (See figure 3-19.)

d. Repair shall be made with small die-sinker type files, India or carborundum stones, and crocus cloth, Federal Specification P-C-458, for final polishing. Power tools shall not be used. All repairs shall be blended and finished smoothly. Lines, scratches, or sharp edges that might cause a stress concentration are not permitted. The finish strokes of all repair work shall be parallel to the length of the blade. If a blade is repaired on the leading and trailing edge, the leading or trailing edge shall be blended to a smooth radius as part of the repair. (For damage before and after repair to compressor rotor blades, see figure 3-20.)

CAUTION

Ensure that foreign matter does not enter engine.

3-160. REMOVAL OF COMPRESSOR ROTOR BLADES. The first stage compressor rotor blades are removed rearward. The second through fifth stage compressor rotor blades are removed in a forward direction.

NOTE

The compressor rotor blades may be removed and replaced either with the compressor rotor installed in the engine or with the compressor rotor removed from the engine.

3-160A. PROCEDURE.

a. With a punch and mallet, bend locking plate away from root of the compressor rotor blade to be replaced.

b. Place blade removing tool (figure 1-13) against the root of the blade to be removed.

NOTE

For the first stage compressor, insert blade removing tool or suitable brass drift through inlet housing and inlet guide vane until it rests at the blade root.

c. Gently tap blade out of disc with blade removing tool. (See figure 3-21.)

d. Remove locking plate and pin.

NOTE

After removing a blade, follow the same procedure to remove the blade 180 degrees, or as nearly 180 degrees as possible, from the damaged blade.

3-160B. REPLACEMENT OF COMPRESSOR ROTOR BLADES.

3-160C. General. Blades will be replaced in the opposite direction from which they were removed. Replacement blades will be furnished in pairs. Both blades will be approximately equal in weight. Each rotor stage will require a different pair of blades. Select a matched pair of replacement blades from the blade series as follows:

Replacement Blade Numbers

First	1-100-236-12
Second	1-100-241-12
Third	1-100-243-14
Fourth	1-100-245-11
Fifth	1-100-247-01

NOTE

The maximum number of blades to be replaced in field maintenance is ten blades per stage (five pairs) and a total of 50 blades per compressor rotor.

3-160D. PROCEDURE.

a. Install new pin. Install new locking plate in the disc over the pin.

b. With blade installing tool, gently tap new blade into slot with a light drive fit. Tap blade until it contacts pin in middle of disc.

NOTE

For the second stage compressor rotor blades, insert blade installing tool or suitable brass drift through inlet housing guide vane and first stage compressor rotor disc. Gently tap blade into slot.

NOTE

Replace locking plate with an oversized or undersized locking plate as required, until a light drive fit is obtained.

c. Bend locking plate against blade root.

d. After blade installation, check blade protrusion on both sides of disc. Blades must be flush with disc on either side.

NOTE

Blades are pre-tipground and will not require tip grinding.

3-161. CENTRIFUGAL COMPRESSOR IMPELLER.

3-162. DEFINITIONS OF TERMS. The following terms are used in describing reparable and nonreparable areas of centrifugal compressor impeller blades.

Dents	Smooth, round-bottomed depressions.
Nicks	Sharp-bottomed depressions with rough outer edges. (For repair dimensions, refer to paragraph 3-164.)

3-163. REPAIR. (See figure 3-22.)

a. Critical Areas - Damage exceeding limits in paragraph 3-164 is cause for replacement of centrifugal compressor impeller assembly. No rework is allowed.

b. Semi-critical Areas - Reparable damage shall be reworked within limits. Minor dents and nicks shall not be reworked if they are within the acceptable limits. (Refer to paragraph 3-164.)

c. Non-critical Areas - Reparable damage shall be reworked within limits. Minor dents and nicks shall not be reworked if they are within the acceptable limits. (Refer to paragraph 3-164.)

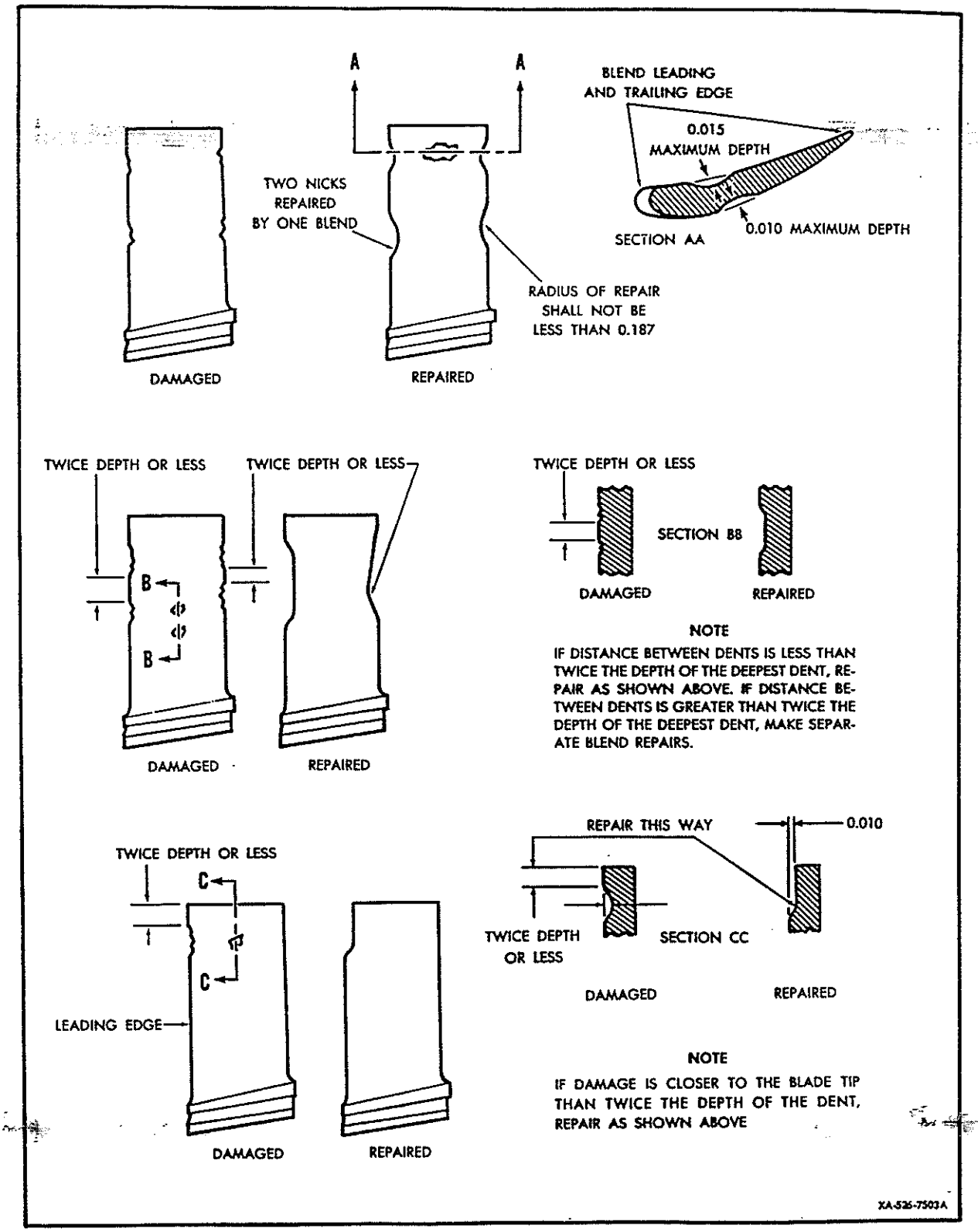


Figure 3-20. Typical Blade Damage Before and After Repair

d. Repair shall be made with small die-sinker type files and India or carborundum stone. Crocus cloth, Federal Specification P-C-458, shall be used for final polishing. Power tools shall not be used. All repairs shall be blended and finished smoothly. Lines, scratches, or sharp edges that might cause a stress concentration are not permitted. The finish strokes of all repair work shall be parallel to the length of the blade. If a blade is repaired on the leading and trailing edge, the leading or trailing edge shall be blended to a smooth radius as part of the repair.

CAUTION

Ensure that foreign matter does not enter engine.

3-164. PROCEDURE.

a. Repair along tip of blade in semi-critical area. (Refer to blade area A, figure 3-22.) Maximum permissible finished repair depth is 0.030 inch. Minimum permissible repair length is three times the depth.

NOTE

The total number of repairs to the tip and edge of tip shall not exceed five per blade (steps a. and b.). The maximum number of reparable blades is ten per assembly.

b. Repair on edge of tip. (Refer to blade area B, figure 3-22.) Maximum permissible finished repair depth is 0.030 inch. Minimum permissible repair length is three times the depth. A minimum airfoil thickness of 0.030 inch must remain. If airfoil thickness is less than 0.030 inch, blend along tip as in step a. (Refer to blade area A, figure 3-22.)

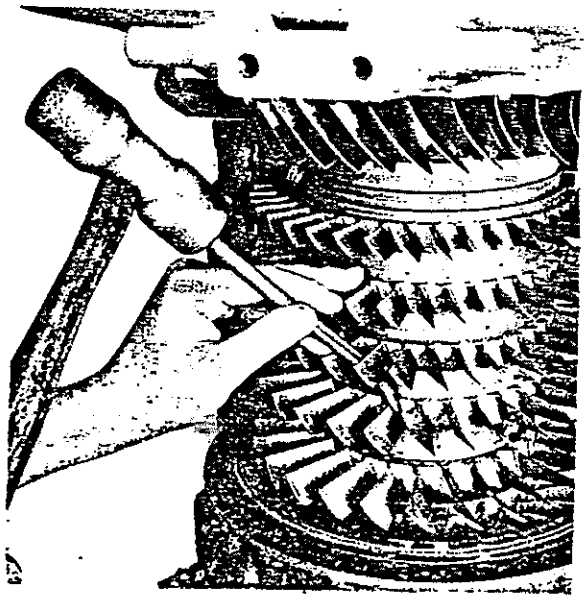


Figure 3-21. Removing Second Stage Compressor Rotor Blade

NOTE

The total number of repairs to the tip and edge of tip shall not exceed five per blade (steps a. and b.) The maximum number of reparable blades is ten per assembly.

c. Repair to leading or trailing edge of blade. (Refer to blade area C, figure 3-22.) Maximum permissible finished repair depth is 0.030 inch. Minimum permissible repair length is two times the depth. When repair is 0.060 inch from the tip, the repair shall be continued to the tip and the corner finished as in step e. (Refer to blade area E, figure 3-22.)

d. Repair to face of airfoil. (Refer to blade area D, figure 3-22.) When damage is 0.060 inch from the tip edge, blend out to tip provided a 0.030 inch airfoil thickness remains. Should it be impossible to maintain a minimum of 0.030 inch thickness at the tip, blend the blade as in step a.

e. Repair to corner of the airfoil. (Refer to blade area E, figure 3-22.) Maximum permissible finished repair depth is 0.030 inch. Minimum permissible repair length to the corner of an airfoil shall extend along the tip a distance of two times the depth and along the adjacent edge two times the depth. The corner shall be finished with a smooth radius.

3-165. FIRST STAGE TURBINE.

NOTE

Turbine wheel inspection may be made easier by vapor blasting both sides of the wheel before inspection.

3-166. INSPECTION. With a 10-power magnifying glass, inspect blade roots for cracks. (See figure 3-23.) No cracks are permissible at blade roots or turbine wheel area of the blade slots. Replace the turbine if cracks are found.

3-167. REPAIR AND REPLACEMENT. (See figures 3-24 and 3-25.)

a. Repair shall be made with a small die-sinker type file, India or carborundum stone, and crocus cloth, Federal Specification P-C-458, for final polishing. Power tools shall not be used. All repairs shall be blended and finished smoothly. Lines, scratches, or sharp edges that might cause a stress concentration are not permitted. The finish strokes of all repair work shall be parallel to the length of the blade. If the leading or trailing edge of a blade is repaired, the edge must be blended to a smooth radius as part of the repair.

b. Dents or nicks no more than 0.010 inch deep and 0.030 inch long are acceptable without rework, whether they occur in critical or semi-critical areas.

c. Repairs are not permitted in blade critical areas. Damage in critical areas beyond the limits in step b. shall be cause for turbine wheel replacement.

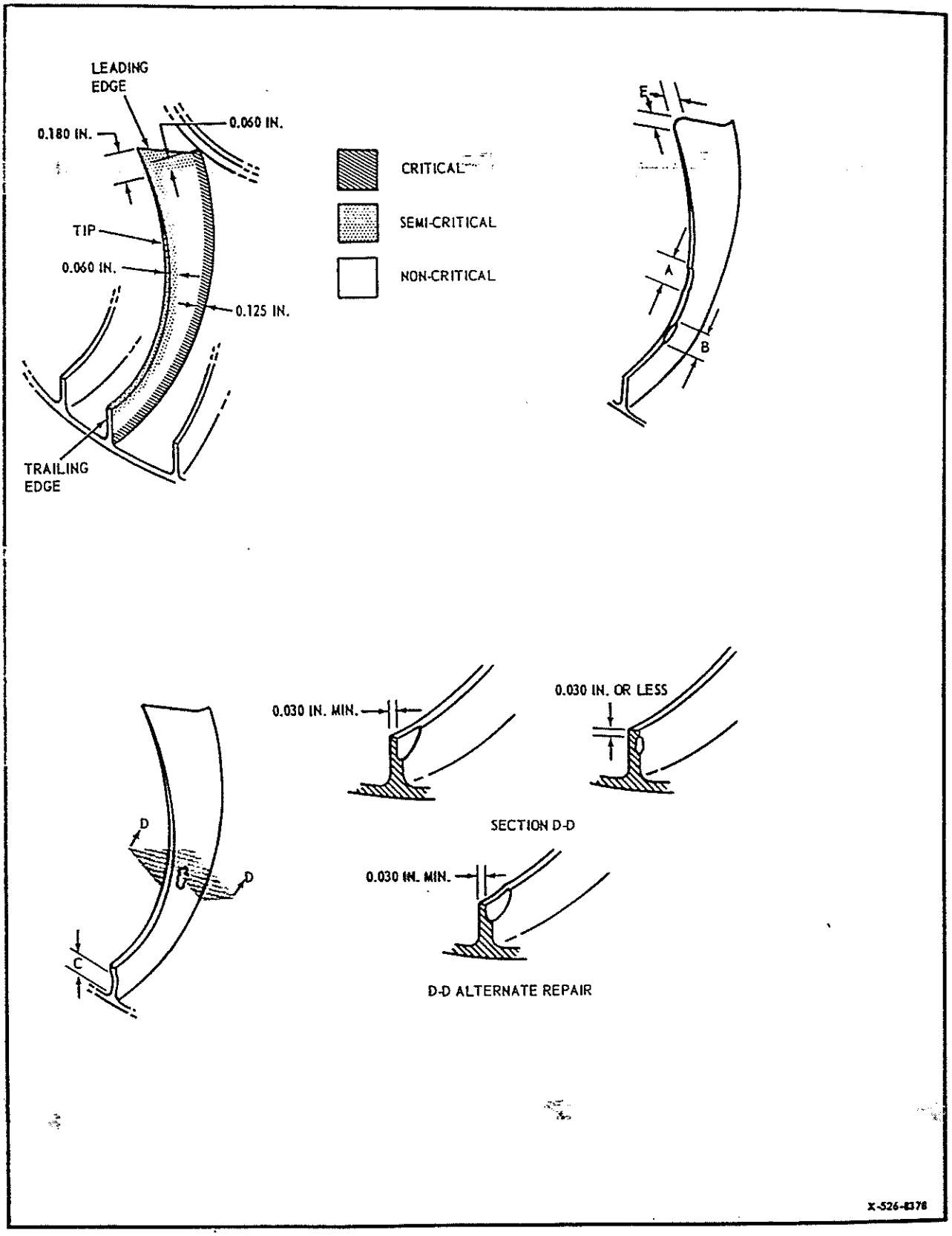


Figure 3-22. Centrifugal Compressor Impeller Blade Repair

d. Repairs may be made within the limits shown in figures 3-24 and 3-25 on leading and trailing edge semi-critical areas.

e. Damage may be repaired if the depth of the damage after repair does not extend beyond zero to

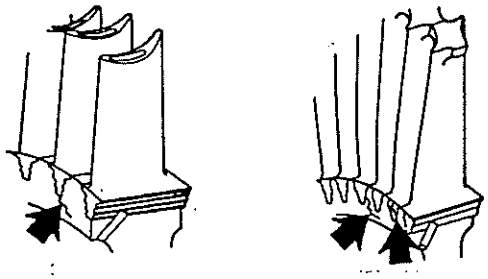


Figure 3-23. Checking First and Second Stage Turbine Wheel and Blade Roots for Cracks

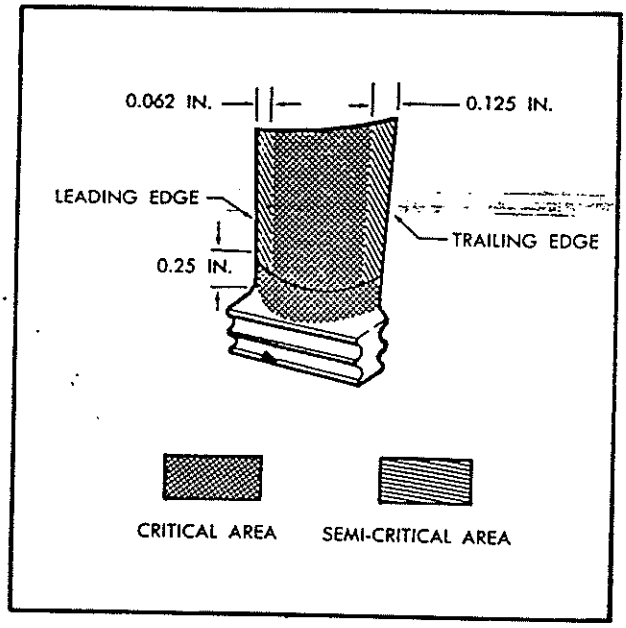


Figure 3-24. First Stage Turbine Blade Repair Limits

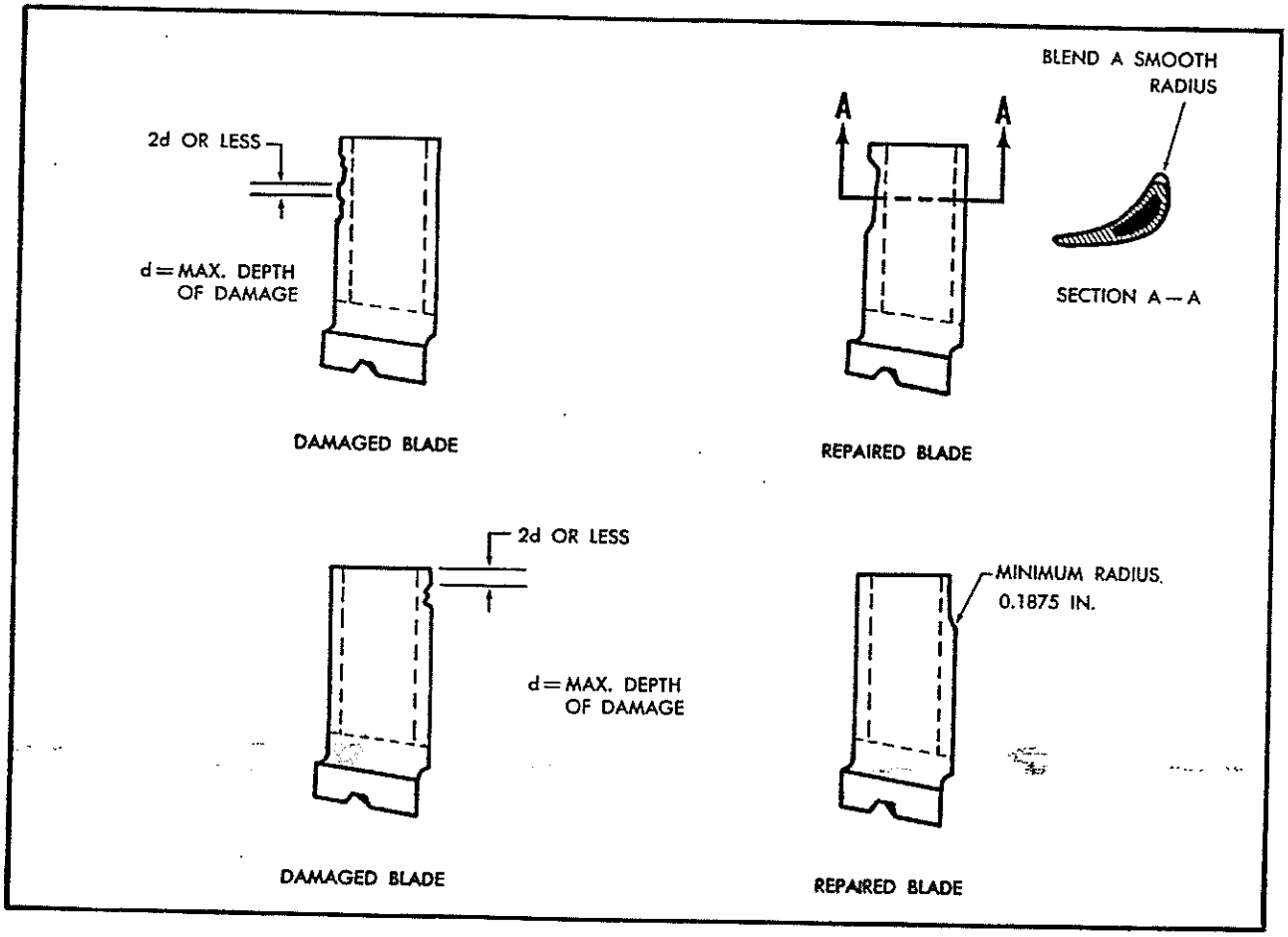


Figure 3-25. Typical Repair of First and Second Stage Turbine Blades

0.125 inch on the trailing edge and zero to 0.062 inch on the leading edge. (See figure 3-24.)

f. If the distance between damaged areas on leading and trailing edges is less than twice the depth of the damage (figure 3-25), the repair may be extended to include both damaged areas as shown in figure 3-25.

g. If damage occurs at a distance of 2d or less from the blade tip, the repair may be extended to the tip of the blade as shown in figure 3-25.

h. Repairs to leading or trailing edges shall include blending the blade edge to a smooth radius. Minimum permissible radius is 0.1875 inch.

3-168. SECOND STAGE TURBINE.

3-169. INSPECTION. with a 10-power magnifying glass, inspect the blade roots for cracks. No cracks are permissible at blade roots or turbine wheel area of the blade slots. Replace turbine support if cracks are found. Check turbine blades for damage.

3-170. REPAIR. (See figures 3-25 and 3-26.)

a. Repairs shall be made with a small die-sinker type file, India or carborundum stone, and crocus cloth, Federal Specification P-C-458, for final polishing. Power tools are not permitted. All repairs shall be blended and finished smoothly. Lines, scratches, or sharp edges that might cause a stress concentration are not permitted. The finish strokes of all repair work shall be parallel to the length of the blade. When the leading or trailing edge of the blade is repaired, the edge must be blended to a smooth radius as part of the repair.

b. No repairs shall be made in either the critical areas or shrouds. Damage in the critical areas or shrouds shall be cause for replacement of the power turbine and bearing housing.

c. Damage may be repaired in semi-critical areas within limits shown in figure 3-25.

d. Depth of damage after repair shall not extend beyond zero to 0.062 inch on the leading edge and zero to 0.062 inch on the trailing edge.

e. If the distance between damaged areas on leading and trailing edges is less than twice the depth of the damage, the repair may be extended to include both damaged areas as shown in figure 3-25.

f. Repairs may be made on the convex side of the blade, in semicritical areas if dent or nick length after repair does not exceed 0.190 inch and the depth after repair does not exceed 0.010 inch.

g. Repairs to leading or trailing edges shall include blending the blade edge to a smooth radius. Minimum permissible radius is 0.1875 inch.

3-171. FIRST STAGE TURBINE NOZZLE.

3-172. INSPECTION. Proceed as follows.

a. Inspect leading and trailing edges of each vane for nicks, dents, pits, burrs, and cracks.

b. Check vanes for burned or melted areas.

c. Check inner and outer shrouds for cracks or burned areas.

d. Check all vanes for bending or distortion.

e. Check welded areas for cracks.

3-173. ALLOWABLE LIMITS. Proceed as follows.

a. Maximum allowable limits after repair shall not exceed dimensions shown in figure 3-27.

b. Burned vanes are acceptable if the area of burning does not exceed limits shown in figure 3-28.

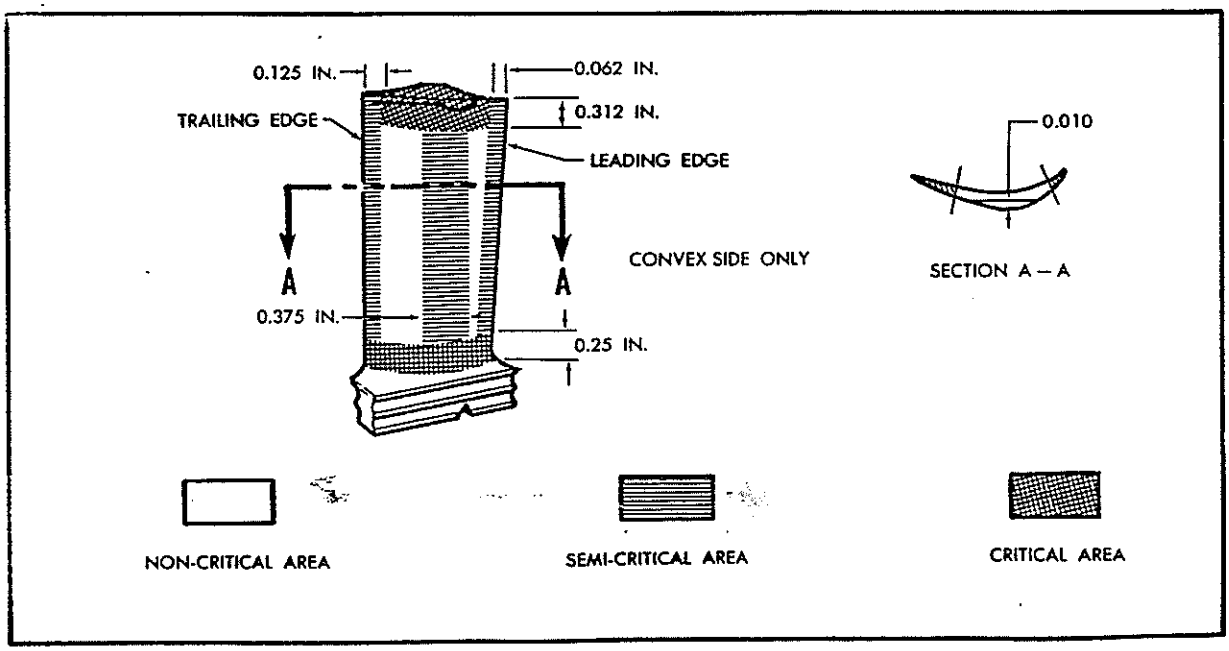


Figure 3-26. Second Stage Turbine Blade Repair

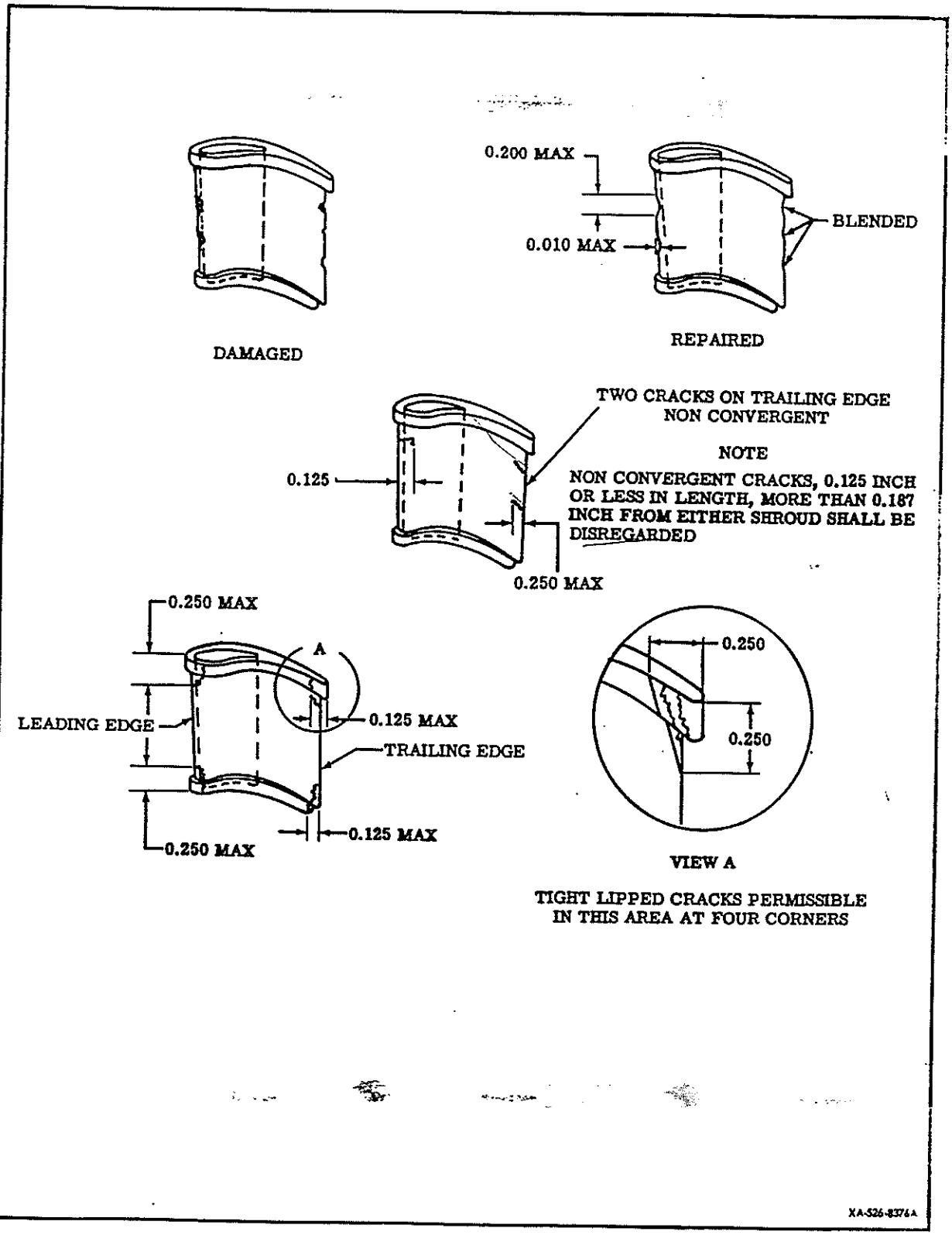


Figure 3-27. First Stage Turbine Nozzle Vane Repair Limits

NOTE

It is normal for a crack to appear in the burned area, such cracks are acceptable within the limits of figure 3-27.

c. Cracks in outer shroud shall be repair-welded.

d. Cracks in inner shroud parent metal are cause for nozzle replacement.

e. Cracks in welded area where support attaches to inner shroud will be repair-welded provided a 0.060-inch bead is maintained and no excessive thinning of the shroud is present prior to welding.

f. Burned areas on shrouds are cause for nozzle replacement.

g. Cracks in welded areas may be re-welded.

h. If more than two adjacent vanes, or six total, are distorted or bent, the first stage turbine nozzle assembly shall be replaced. Bowing at the center of the trailing edge is permissible up to 0.100 inch.

i. The total surface area of dents per vane shall not exceed one-third the surface area of one side of vane.

j. Two dents spaced apart less than the longer dimension of the two shall be considered one dent.

k. If more than one-quarter the total number of vanes require blending, the nozzle shall be inspected by fluorescent-penetrant method for more serious damage.

l. Dents with smooth contours are acceptable without rework provided they do not exceed the maximum permissible limit.

NOTE

A holding fixture is necessary for all weld repairs.

3-174. REPAIR. Proceed as follows.

a. Nicks, dents, pits, and burrs may be repair-blended providing the dimensions after repair do not exceed the limits specified in figure 3-27.

b. Using AMS 5796 welding rod, reweld cracks in welded areas.

c. Using AMS 5680 welding rod, repair cracks in shroud.

NOTE

Dimensional changes due to weld repair may affect the clearance with rotating parts or the gas passage areas.

3-175. SECOND STAGE TURBINE NOZZLE.

3-176. INSPECTION. Proceed as follows.

a. Inspect leading and trailing edge of each vane for nicks, dents, cracks, pits, and burrs.

b. Check vanes for burned areas.

c. Check inner and outer shrouds for cracks or burned areas.

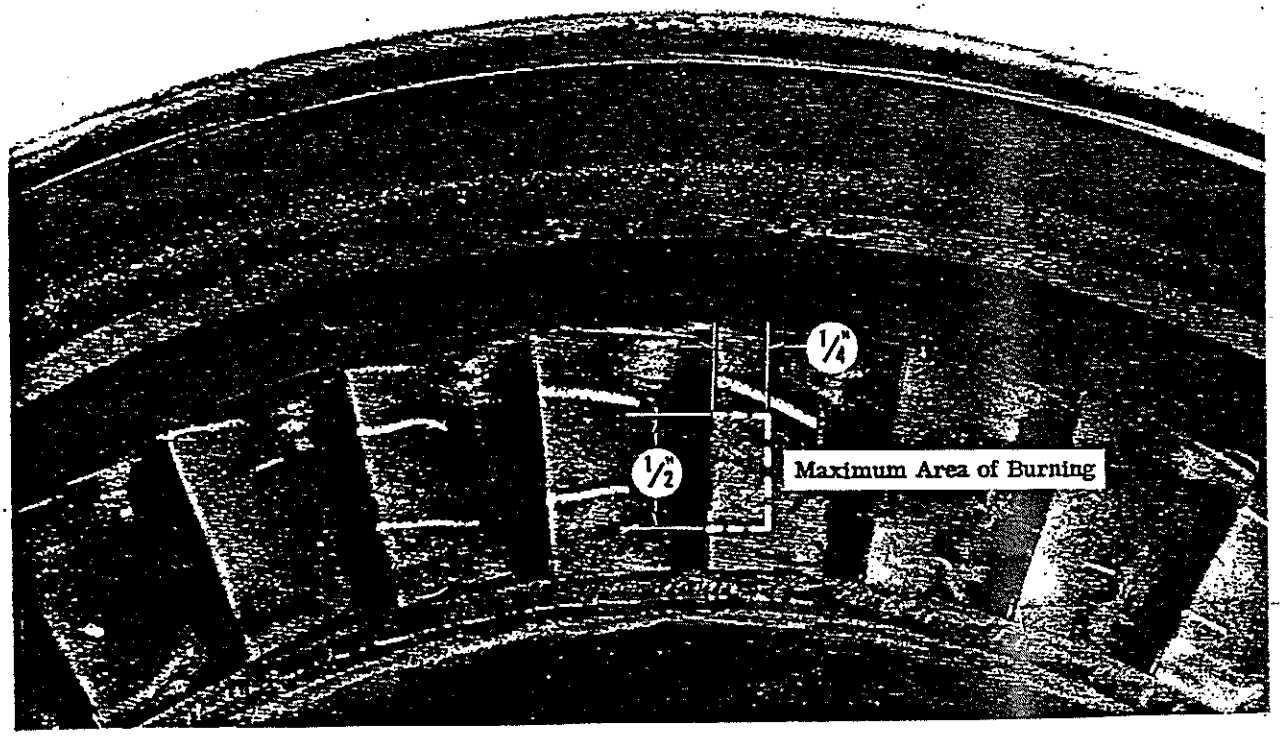


Figure 3-28. First Stage Turbine Nozzle Burn Limits

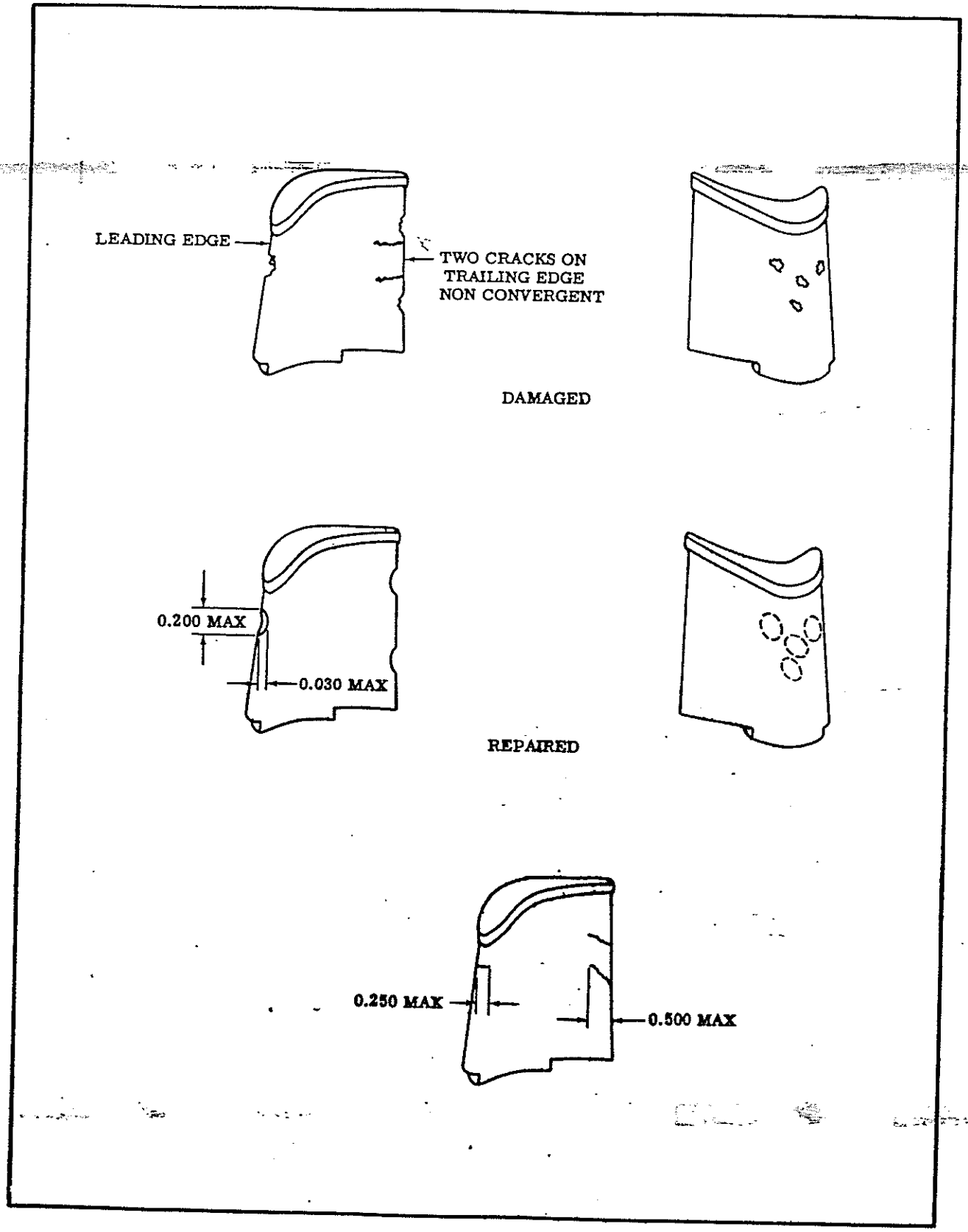


Figure 3-29. Second Stage Turbine Nozzle Vane Repair Limits

d. Check all vanes for bending or distortion.

e. Check welded areas for cracks.

3-177. ALLOWABLE LIMITS. Proceed as follows.

a. Maximum allowable limits after repair shall not exceed dimensions shown in figure 3-29.

b. Burned vanes are acceptable if the area of burning does not exceed the limits shown in figure 3-30.

c. Cracks in welded areas shall be rewelded.

d. Cracks within the limits shown in figure 3-29, are acceptable without rework. If more than two adjacent vanes, or six total, are distorted or bent, the second stage turbine nozzle assembly shall be replaced. Bowing at the center of the trailing edge is permissible up to 0.125 inch.

e. The total surface area of dents per vane shall not exceed one-third the surface area of one side of vane.

f. Two dents spaced apart less than the longer dimension of the two shall be considered one dent.

g. If more than one-quarter the total number of vanes require maximum blending, the nozzle shall be replaced.

NOTE

On the T53-L-1A and T53-L-1B engines only, every third vane is welded on the outer shroud. A holding fixture is necessary for all weld repairs.

3-178. REPAIR. Proceed as follows.

a. Dents with smooth contours are acceptable without rework, provided they do not exceed the maximum permissible limit.

b. Nicks, dents, pits, and burrs may be repair-blended providing the dimensions after repair do not exceed the limits specified in figure 3-29.

c. Cracks in shrouds and welded areas shall be rewelded, using AMS 5680 welding rod.

NOTE

Use AMS 5694 welding rod at junctions of shroud and vane.

d. If cracks are found on welded vane weld two adjacent vanes.

e. Weld-repair on vane airfoil surface is not permitted.

3-179. OIL FILTER.

3-180. REMOVAL. Proceed as follows. (See figure 3-31.)

a. Cut lockwire.

b. Remove seal nut (2), packing (3), container (4), and packing (5) from oil filter body (1).

c. Remove and discard packings.

d. Cut lockwire. Remove jam nut (7), retainer cup (8), filters (9), and spacers (10) from tube (6). Withdraw tube from stud (11).

e. Remove stud from body (1).

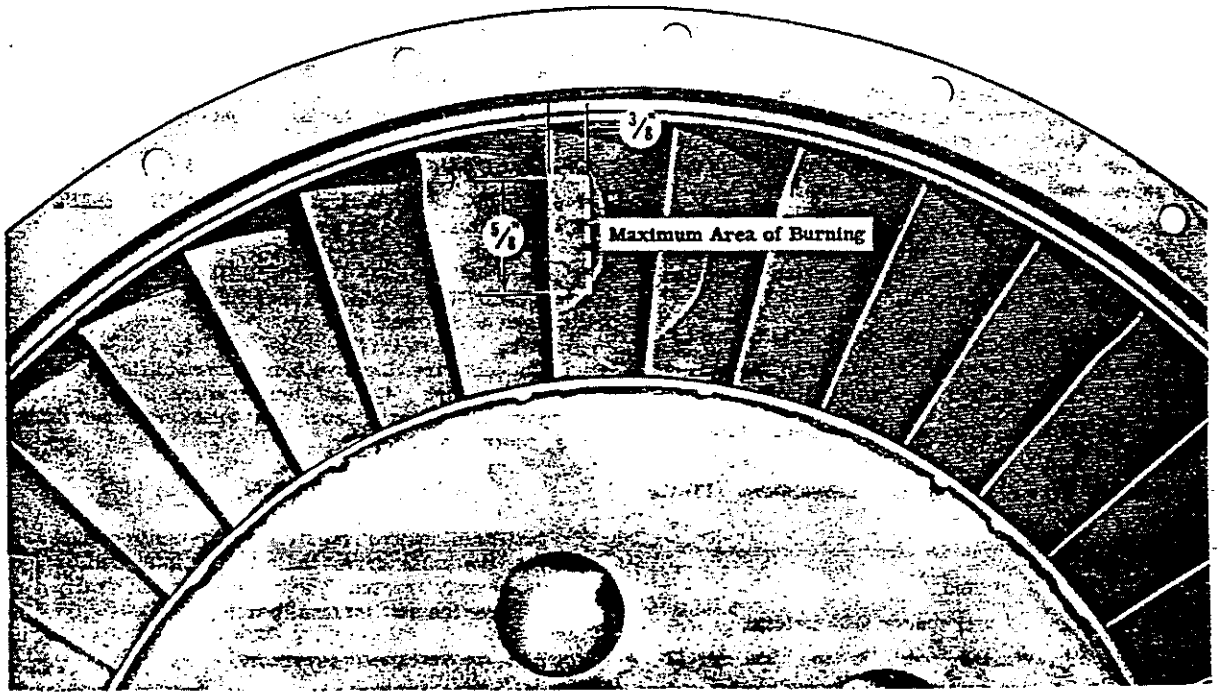


Figure 3-30. Second Stage Turbine Nozzle Burn Limits

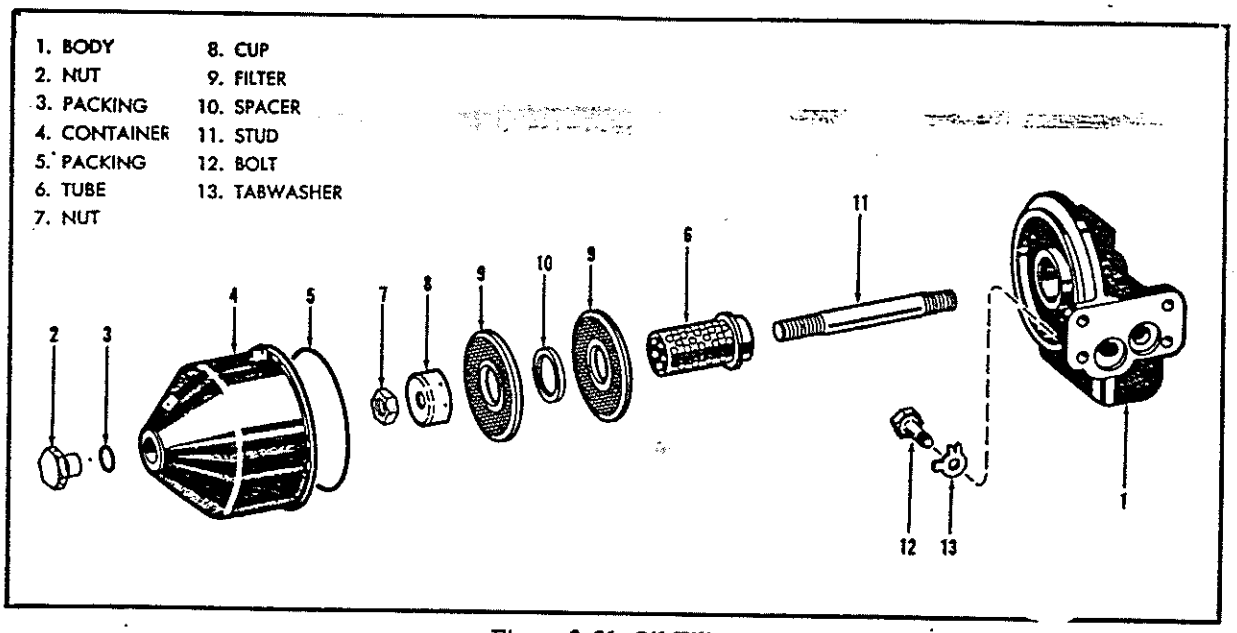


Figure 3-31. Oil Filter

f. Remove two bolts (12) and tabwashers (13) from body.

3-181. REPAIR AND REPLACEMENT. Proceed as follows. (See figure 3-31.)

a. Place filters on a suitable shaft and flush clean with dry-cleaning solvent, Federal Specification P-S-661.

CAUTION

During cleaning of filter discs, make certain that they are placed on a shaft with a diameter equal to that of the disc center. The filter can become contaminated if the center is not covered or placed on a suitable shaft.

b. Inspect oil filters for accumulation of metal chips, lint, or other foreign material. If filters are damaged, replace complete cartridge, which consists of retainer cup (8), filters (9), spacer (10), and tube (6).

c. Inspect the container (4) for dents and cracks.

d. Replace dented or cracked container. Replace the stud (11) if stud threads are damaged.

3-182. ASSEMBLY. Proceed as follows. (See figure 3-31.)

a. Install two bolts (12) and tabwashers (13) in body (1).

b. Install stud (11) in body.

c. Install tube (6) on stud.

d. Install filters (9) and spacer (10) on tube.

e. Secure with retainer cup (8) and jam nut (7).

f. Tighten jam nut until filters do not rotate on tube.

CAUTION

Do not overtighten.

g. Lockwire nut.

h. Install packing (5) on oil filter container (4).

i. Assemble and aline container on stud and body (1).

j. Install seal nut (2) and packing (3) to container.

k. Tighten seal nut.

l. Lockwire seal nut to tab on container.

3-183. FUEL CONTROL UNIT.

3-184. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 25.)

3-185. REMOVAL OF OVERSPEED GOVERNOR (P/N 8700-B4 for T53-L-1 and T53-L-1A). Proceed as follows.

a. Cut lockwire. Remove four screws (3, figure 3-32), three washers (4), and temperature sensing tube support clamp that secure overspeed governor (2) to fuel control housing (1).

CAUTION

In all fuel control repair, be extremely careful that the main drive shaft is not disturbed or carelessly treated. The drive shaft can easily damage the soft internal bearings.

b. Remove overspeed governor.

c. Remove and discard seal (5) and packing (6).

1. HOUSING
2. GOVERNOR
3. SCREW
4. WASHER
5. SEAL
6. PACKING
7. COVER
8. BOLT
9. NUT
10. SHAFT
11. SCREW
12. LEVER
13. TUBE
14. SCREW
15. UNION
16. PACKING
17. LEVER
18. PIN
19. NUT
20. BOLT
21. WASHER
22. LINK ASSEMBLY
23. SCREW
24. COVER
25. PLATE
26. WASHER
27. SPRING
28. WASHER
29. RING
30. DIAPHRAGM
31. SCREW
32. COVER
33. WASHER
34. FILTER PULLER ASSEMBLY
35. PACKING
36. PACKING
37. SOLENOID
38. SCREW
39. WASHER
40. LUG
41. SLEEVE
42. PACKING
43. STRAINER
44. SCREW
45. PACKING
46. PACKING
47. SHIELD
48. SCREW
49. WASHER
50. FITTING
51. SCREW
52. PACKING
53. SCREEN

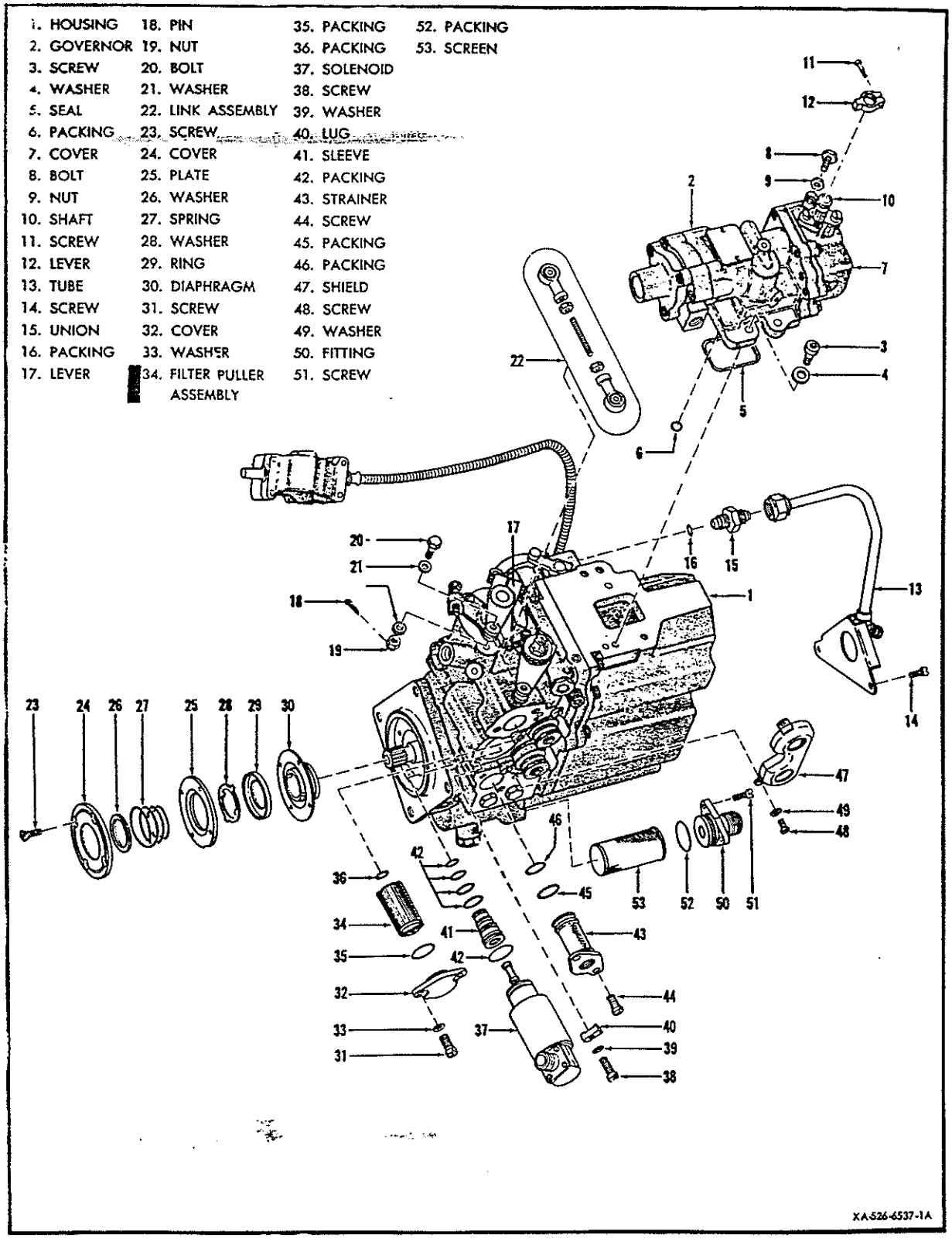


Figure 3-32. Fuel Control

3-186. INSPECTION. Inspect attaching governor screws for stripped threads.

3-187. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean attaching governor screw threads.

b. Remove nicks and burrs, using a fine stone.

c. If further repair is required, replace overspeed governor.

NOTE

Check decal on replacement overspeed governor (P/N 87000-B4). On T53-L-1 and T53-L-1A engines, call out for minimum stop lever setting should be zero degrees, the maximum setting should be called out at 60 degrees plus or minus two degrees, and should require only minor adjustments to conform to airframe requirements.

3-188. INSTALLATION. Proceed as follows.

a. With petrolatum, Federal Specification VV-P-236, coat new packing (6, figure 3-32) and new seal (5).

b. Place packing and seal in overspeed governor (2).

c. Secure overspeed governor to fuel control housing (1) with three washers (4), temperature sensing tube support clamp, and four screws (3).

d. Tighten screws evenly to between 30 and 40 pound-inches torque. Lockwire.

3-189. REMOVAL OF FUEL DISCHARGE PORT TUBE. Proceed as follows.

CAUTION

In all fuel control repair, be extremely careful that the main drive shaft is not disturbed or carelessly treated. The drive shaft can easily damage the soft internal bearings.

a. Remove screw (14, figure 3-32) from bracket of fuel discharge port tube (13).

b. Disconnect nut from flared tube union (15).

c. Remove flared tube union.

d. Discard packing (16).

3-190. INSPECTION. Proceed as follows.

a. Inspect screw for stripped and nicked threads. Inspect slotted head for mutilation.

b. Inspect flare tube union for cross threads, scoring, and nicks.

c. Inspect discharge port tube for dents, nicks, and damage.

d. With standard pressure test equipment, pressure test discharge port tube with soap and water at 1000 psi.

3-191. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean flared tube union.

b. With dry-cleaning solvent, Federal Specification P-S-661, clean discharge port tube.

c. Air dry parts.

d. Replace damaged screw.

e. Remove nicks and burrs from discharge port tube and flared tube union.

3-192. ASSEMBLY. Proceed as follows.

a. With petrolatum, Federal Specification VV-P-236, coat packing (16, figure 3-32).

b. Install packing to flared tube union (15).

c. Connect union to fuel control housing and to discharge port tube (13).

CAUTION

Inside of discharge port tube must be free of dirt, chips, and other foreign matter.

d. Connect discharge port tube to fuel control housing with screw (14).

e. Tighten screw.

3-193. REMOVAL OF LINK. Proceed as follows.

CAUTION

In all fuel control unit repair, be extremely careful that the main drive shaft is not disturbed or carelessly treated. The drive shaft can easily damage the soft internal bearings.

a. Remove cotter pins (18, figure 32) from nuts (19).

b. Remove bolts (20) and washers (21) that secure link assembly (22) to levers (17).

c. Remove link.

CAUTION

Do not remove levers from stop throttle and pivot bearing housing.

3-194. INSPECTION. Inspect bolts and nuts for crossed or stripped threads.

3-195. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean bolts and nuts. Air dry parts.

b. Replace damaged nuts and bolts.

c. Replace damaged link.

3-196. ASSEMBLY. Proceed as follows.

a. Remove two fixture cover screws and retaining washers from fixture. (See figure 3-33.)

b. Install link assembly (22, figure 3-32).

c. Secure link with the two fixture cover screws and retaining washers of the fixture.

d. Adjust checknuts on rod ends.

NOTE

The required dimension of the link on the fixture shall be 2.50 inches.

e. Lockwire nuts.

f. Remove link from fixture.

g. Install link to levers (17).

h. Install bolts (20), washers (21), and nuts (19) on levers.

i. Insert cotter pins (18) in nuts.

j. Tighten bolts.

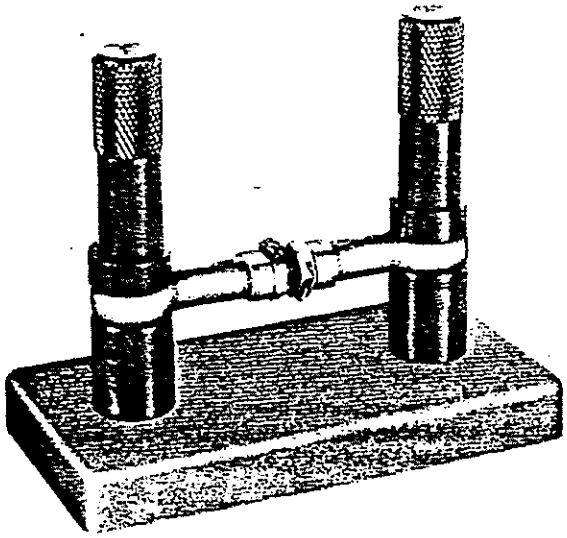


Figure 3-33. Link Assembly in Adjustment Fixture

k. Spread the cotter pins.

CAUTION

Be sure that the fuel control link moves freely.

3-197. REMOVAL OF DIAPHRAGM. Proceed as follows.

CAUTION

In all fuel control repair, be extremely careful that the main drive shaft is not disturbed or carelessly treated. The drive shaft can easily damage the soft internal bearings.

a. Remove four screws (23, figure 3-32) that secure cover (24) and seal plate (25) to fuel control housing (1).

b. Remove cover, washer (26), seal spring (27), and seal plate.

c. Remove washer (28) and diaphragm ring (29).

d. Remove diaphragm (30) from main drive shaft.

CAUTION

When removing diaphragm, be sure that the main drive shaft does not fall out of the fuel control housing.

e. Gently remove diaphragm from assembly.

CAUTION

During removal or installation of the diaphragm, be careful not to scratch or damage the carbon seal face.

f. Place diaphragm in a pan of jet fuel, Military Specification MIL-J-5624.

3-198. INSPECTION. Proceed as follows.

a. Inspect screws for stripped threads.

b. Inspect cover, seal plate, seal spring, washers, and diaphragm for scratches, dents, nicks, and other damage.

c. Inspect rubber diaphragm for tears and wrinkles.

3-199. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean screws.

b. Remove foreign matter from holes in cover and seal plate.

c. Remove nicks and burrs.

d. Air dry parts.

e. Replace the rubber diaphragm if it fits loosely against the main drive shaft. Replace rubber diaphragm if there is oil seepage after the diaphragm has been assembled.

3-200. ASSEMBLY. Proceed as follows.

a. Install the diaphragm (30, figure 3-32) on the main drive shaft.

CAUTION

Be sure the rubber diaphragm fits snugly.

b. Install new diaphragm ring (29) and new washer (28) on main drive shaft.

c. Install seal plate (25), seal spring (27), and washer (26) to cover (24).

d. Secure cover to fuel control housing with four screws (23).

e. Stake screws at three equally spaced places.

3-201. REMOVAL OF FILTER PULLER ASSEMBLY. Proceed as follows. (See figure 3-32.)

CAUTION

In all fuel control repair, be extremely careful that the main drive shaft is not disturbed or treated carelessly.

a. Cut lockwire. Remove two screws (31) that secure filter cover (32) to fuel control housing.

b. Remove two washers (33).

c. Remove packing (35).

d. Discard packing.

e. Withdraw filter puller assembly from fuel control housing.

NOTE

Filter puller assembly is equipped with a wire handle for ease of removal and assembly.

f. Remove and discard packing (36).

3-202. INSPECTION. Proceed as follows.

a. Inspect screws for stripped and nicked threads. Inspect slotted heads of screws for mutilation.

b. Inspect filter cover for scoring, dents, nicks, and other damage.

3-203. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean screw threads.

b. Clean filter cover.

c. Remove nicks and burrs from filter cover.

d. Air dry parts.

e. Replace damaged screws.

3-204. ASSEMBLY. Proceed as follows.

a. Coat packing (36, figure 3-32) with petrolatum, Federal Specification VV-P-236.

b. Install packing.

c. Install new filter puller assembly (34).

d. Coat packing (35) with petrolatum, Federal Specification VV-P-236. Install packing on filter puller assembly.

e. Secure filter cover (32) to fuel control housing with two washers (33) and screws (31).

f. Tighten screws.

g. Lockwire.

3-205. REMOVAL OF SOLENOID AND VALVE SLEEVE. Proceed as follows.

CAUTION

In all fuel control unit repair, be extremely careful that the main drive shaft is not disturbed or treated carelessly. The drive shaft can easily damage the soft internal bearings.

a. Cut lockwire. Remove screw (38, figure 3-32), washer (39), and lug (40) from solenoid (37).

b. Remove solenoid.

c. (See figure 3-34.) With removing tool, remove valve sleeve (41, figure 3-32).

d. Remove packings (42).

e. Remove tool.

3-206. INSPECTION. Proceed as follows.

a. Inspect screw for stripped threads and damaged head.

b. Inspect lug and solenoid for scoring, nicks, and dents.

c. Inspect valve sleeve for damage.

d. Energize the solenoid to check operation. If the solenoid does not indicate a reading, replace the complete solenoid and valve sleeve.

3-207. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean screw.

b. Clean solenoid with dry-cleaning solvent, Federal Specification P-S-661.

c. Remove nicks and dents from solenoid with a fine stone.

d. Air dry parts.

e. Replace damaged screw, lug, solenoid, and valve sleeve.

3-208. ASSEMBLY. Proceed as follows.

a. Coat packings (42, figure 3-32) with petrolatum, Federal Specification VV-P-236.

b. Install on valve sleeve (41).

c. With installing tool, carefully install valve sleeve into fuel control housing.

CAUTION

To seal rings snugly, insert valve sleeve with a slight twist.

d. Remove installing tool.

e. Install solenoid (37).

f. Install lug (40), washer (39), and screw (38).

g. Tighten screw.

h. Lockwire.

3-209. REMOVAL OF FUEL STRAINER. Proceed as follows.

CAUTION

In all fuel control repair, be extremely careful that the main drive shaft is not disturbed or treated carelessly. The drive shaft can easily damage the soft internal bearings.

a. Cut lockwire. Remove two screws (44, figure 3-27) that secure fuel strainer (43) to fuel control housing.

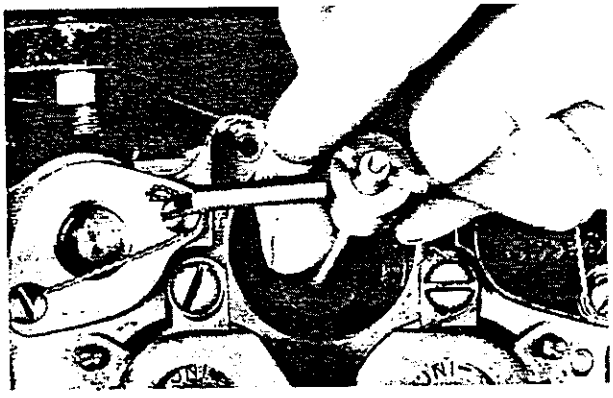


Figure 3-34. Removing Valve Sleeve

b. With a standard removing tool, remove fuel strainer.

c. Remove packings (45 and 46).

d. Discard packings.

3-210. INSPECTION. Proceed as follows.

a. Inspect screws for stripped threads and damaged heads.

b. Inspect fuel strainer for scoring, dents, nicks, and stripped threads.

3-211. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean screws.

b. Clean fuel strainer.

c. Remove nicks and burrs from fuel strainer.

d. Air dry parts.

e. Replace damaged screws.

3-212. ASSEMBLY. Proceed as follows.

a. Coat packings (45 and 46, figure 3-32) with white petrolatum, Federal Specification VV-P-236.

b. Install packings.

c. Install fuel strainer (43).

d. Secure strainer to fuel control housing with two screws (44).

e. Tighten screws.

f. Lockwire.

3-213. REMOVAL OF SHIELD ADJUSTMENT. Proceed as follows.

CAUTION

In all fuel control unit repair, be extremely careful that the main drive shaft is not disturbed or treated carelessly. The drive shaft can easily damage the soft internal bearings.

a. Remove two screws (48, figure 3-32) and washers (49) that secure shield (47) to fuel control housing.

b. Remove shield.

3-214. INSPECTION. Proceed as follows.

a. Inspect screws for stripped threads.

b. Inspect shield for dents, cracks, and scoring.

3-215. REPAIR AND REPLACEMENT. Proceed as follows.

a. Using a soft wire brush and dry-cleaning solvent, Federal Specification P-S-661, clean screw threads.

b. Remove foreign matter from shield.

c. Remove nicks and burrs from shield.

d. Air dry parts.

e. Replace damaged screws.

3-216. ASSEMBLY. Proceed as follows.

a. Secure shield (47, figure 3-32) to fuel control housing with two washers (49) and screws (48).

b. Tighten screws.

c. Lockwire.

3-217. REMOVAL OF FUEL INLET SCREEN. Proceed as follows.

CAUTION

In all fuel control repair, be extremely careful that the main drive shaft is not disturbed or treated carelessly. The drive shaft can easily damage the soft internal bearings.

a. Cut lockwire. Remove three screws (51, figure 3-32) that secure fitting (50) to fuel control housing.

b. Remove fitting and packing (52).

c. Discard packing.

d. Remove screen assembly (53).

3-218. INSPECTION. Proceed as follows.

a. Inspect fitting for dents, scoring, and stripped threads.

b. Inspect screws for stripped threads and damaged slots in screw heads.

c. Inspect screen assembly for nicks, cracks, dents, tears, and broken or bent mesh.

3-219. REPAIR AND REPLACEMENT. Proceed as follows.

a. Remove nicks and burrs.

NOTE

Broken or torn mesh is cause for screen assembly replacement. Bent mesh can be straightened by bending out the kinks by hand.

b. Clean threads of screws, fitting, and holes in fitting with soft wire brush.

c. Clean parts with dry-cleaning solvent, Federal Specification P-S-661.

d. Dry parts with compressed air.

e. Replace damaged screws and fitting.

3-220. ASSEMBLY. Proceed as follows.

a. Install screen assembly (53, figure 3-32) in fuel control housing.

NOTE

To assure screen is not binding, measure at two points, 180 degrees apart. To prevent crushing the screen when installing the cover, the measured depth should be approximately 5/16 inch.

b. Coat packing (52) with white petrolatum, Federal Specification VV-P-236.

c. Install packing.

d. Secure fitting (50) to fuel control housing with three screws (51).

e. Tighten screws.

f. Lockwire.

SECTION IV

ASSEMBLY OF SUBASSEMBLIES

4-1. GENERAL.

4-2. This section contains instructions for assembly of component parts into major assemblies. All references to the T53-L-1 gas turbine engine apply to the T53-L-1A and T53-L-1B engines also, except where specifically noted.

4-3. GENERAL PRECAUTIONS.

4-4. Observe the following precautions:

a. Use care to ensure complete cleanliness of all oil passages, oil-spray jets, and filters during assembly.

b. Carefully inspect all parts installed in the engine.

c. Always use new packing rings, cotter pins, lockwire, gaskets, tabwashers, and lockwashers.

d. Standard torque values are given in the Table of Standard Torque Values (figure 7-3). Special values are referenced to the Table of Limits (figure 7-7), Section VII.

4-5. LUBRICANTS.

4-6. Where assembly instructions recommend the use of lubricants, only the following apply:

a. Lubriplate (Fiske Brothers Refining Company) for low temperature applications and Ease-Off 990, Federal Stock Number 8030-664-6146, for high temperature applications.

b. Lubricating oil, Military Specification MIL-L-7808, on all packing rings.

c. Grease, Military Specification MIL-G-21164, or grease, Military Specification MIL-G-3545, for lubrication of splined shafts.

4-7. MARKING ON HIGH TEMPERATURE MATERIALS.

4-8. Marking on materials subject to high temperatures shall be done only with one of the following: Colorbrite marking pencil (yellow, No. 2107); Marco ink (black, No. S1141); Marks-A-Lot ink pencil (red, green, or yellow); or Opco Marker (blue, green, or black).

4-9. SPECIAL TOOL AND EQUIPMENT REFERENCES.

4-10. Special tools and equipment are referenced by group number at the beginning of an operation. To locate tool numbers, refer to the group number in Functional Tool List in Section I.

CAUTION

Do not use cadmium-plated tools for any of the disassembly or reassembly procedures described in this manual. Cadmium plating has a tendency to chip. If these chips enter the engine, they will contaminate the lubrication system and cause magnesium parts to deteriorate.

4-11. LOCKWIRING.

4-12. Lockwiring is a method of tying two or more installed parts together to prevent loosening. Unless assembly instructions recommend special safetying methods, the following general practice shall be used.

a. Corrosion-resistant steel lockwire, Military Standard MS20995C32, eight twists to the inch, is recommended for use throughout engine assembly unless otherwise noted.

b. Be certain that parts are torqued and wire passages are parallel. If parts cannot be positioned properly within specified torque limits, replace parts until the required positions are obtained.

4-13. Be certain the holes of the parts to be lockwired are parallel (step 1, figure 4-1). Always install lockwire to tighten and keep parts in place. Pull and twist lockwire tightly to prevent excessive vibration or rubbing. During lockwiring procedure, do not loosen or tighten parts to manipulate wire. Lockwiring applications are shown in figure 4-2. When lockwiring is completed, allow at least three complete turns of wire to remain before cutting the excess wire.

4-14. When parts have been properly torqued, positioned, and inspected, use the following procedure:

a. Insert wire through hole in first bolt (step 2, figure 4-1).

b. Bend wire to the right around the head of the bolt and under the other end of the lockwire. Tighten wire around head of bolt (step 3).

c. Keeping wire tight around head of first bolt, twist wire strands around each other until twisted length is just short of hole in second bolt (step 4).

d. Insert one end of the wire through the hole in the second bolt and pull with pliers (step 5) until tight.

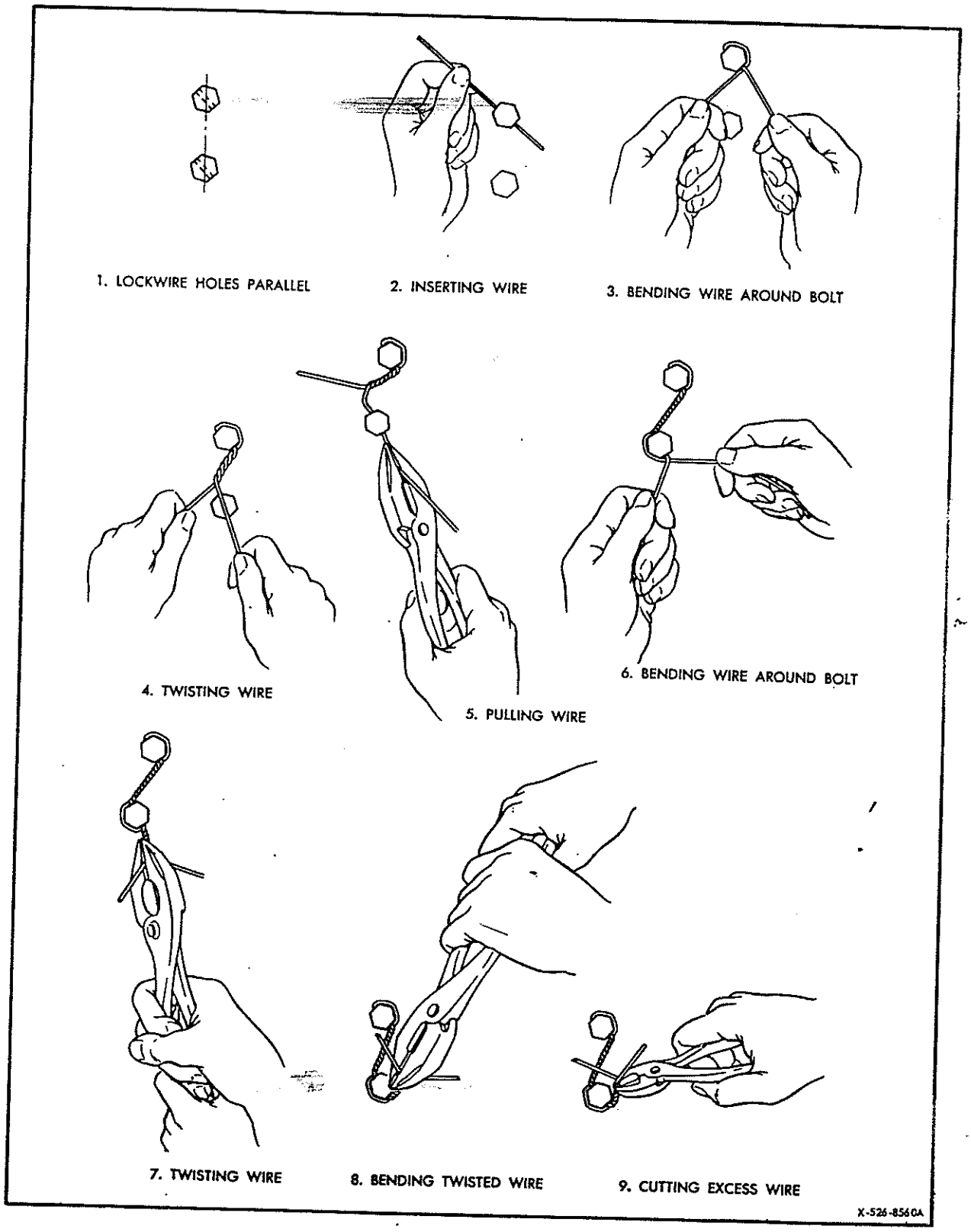


Figure 4-1. Lockwiring Procedure

e. Bring other end of the wire around head of bolt and under lockwire protruding from bolt (step 6).

f. Keeping wire tight, twist ends together (step 7). During final twist, bend twisted wire down and around head of bolt (step 8).

g. Cut off excess wire. Bend sharp ends in toward engine (step 9).

4-15. ASSEMBLY OF AXIAL COMPRESSOR HOUSING.

4-16. PROCEDURE. (See figure 2-39.)

a. Place upper and lower compressor housings (1) on a bench. Arrange the compressor vanes (5, 8, 9, 10, 17, and 20) in pairs beside their respective housings.

NOTE

The fifth stage compressor vane assembly contains a front and rear compressor vane.

b. Install five pairs of compressor vanes in upper and lower compressor housings. Secure first stage compressor vane to housings with six bolts (6) and washers (7).

c. Secure second, third, and fourth stage compressor vanes to housings with bolts (11, 12, and 13) and washers (14, 15, and 16), respectively.

d. Secure fifth stage front compressor vane to housings with six bolts (18) and washers (19).

e. Tighten center row of bolts to 45 pound-inches and outer row of bolts to 15 pound-inches. Lockwire.

f. Secure fifth stage rear compressor vane to housings with four bolts (21) and washers (22). Tighten bolts and lockwire.

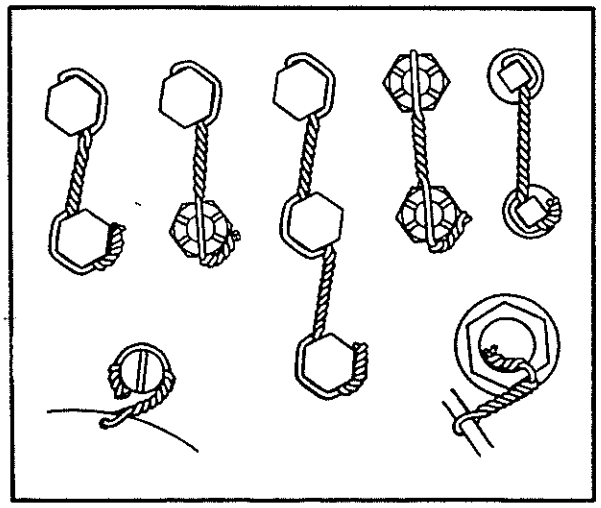


Figure 4-2. Lockwiring Applications

NOTE

Check matching marks on compressor housing and inlet housing.

g. Secure upper and lower halves of the centrifugal compressor housing (2) to their respective compressor housing halves with eighteen bolts (3) and washers (4).

h. Tighten and lockwire bolts.

NOTE

Lockwire three center bolts as a group. Lockwire four bolts in pairs at each side of the compressor housing.

4-17. ASSEMBLY OF DIFFUSER HOUSING AND REAR BEARING SUPPORT.

4-18. PROCEDURE. (See figure 2-35.)

a. Aline match marks and install outer race of number two main bearing in bearing support housing (17).

b. Using lubricating oil, Military Specification MIL-L-7808, lightly coat the running face of control gap seal (22). Press control gap seal into bearing support housing (17), ensuring that carbon side of seal faces outward.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

c. Install retaining ring (21). Install large packing ring (20) and two small packing rings (19 and 18).

NOTE

Before installing shim (8) and retaining plate (9), establish proper thickness of shim to maintain a 0.003 to 0.006 inch pinch fit for number two main bearing. Determine dimension from bearing seat to retaining plate mounting surface. Measure bearing width. Subtract dimension from first dimension and add 0.003 to 0.006 inch. This total shall be thickness of shim to maintain proper pinch fit.

d. Install shim (8) of proper thickness. Install bearing retaining plate (9), and secure plate and shim with six bolts (10). Lockwire bolts in pairs.

e. Lubricate support housing with Lubriplate (Fiske Brothers Refining Company). Aline the match marks and install the support housing into the diffuser housing (1). Secure support housing, using eight bolts (15) and tabwashers (16).

f. Install two packings (27 and 26) on oil inlet strainer (25). Install strainer in diffuser housing. Install gasket (24) and cap (23). Tighten and lockwire cap.

1. LINER
2. CHAMBER
3. WASHER
4. WASHER
5. NUT
6. SCOOP AND SHROUD
7. BOLT
8. WASHER
9. TUBE
10. NUT
11. NOZZLE
12. CYLINDER
13. FLANGE
14. TABWASHER
15. BOLT
16. SCREW
17. SUPPORT
18. BOLT
19. TUBE
20. FIRESHIELD
21. NUT
22. MOUNT
23. SCREW
24. GASKET
25. IGNITER NOZZLE
26. PACKING
27. PLUG
28. ADAPTER
29. PACKING
30. OIL NOZZLE
31. STRAINER
32. PACKING
33. HOUSING
34. CONNECTOR
35. CONE
36. COUPLING
37. BOLT
38. WASHER
39. NUT
40. TORUSEAL
41. SWIVEL JOINT ASSEMBLY
42. GASKET
43. COVER
44. NUT
45. BODY
46. GASKET
47. BOLT

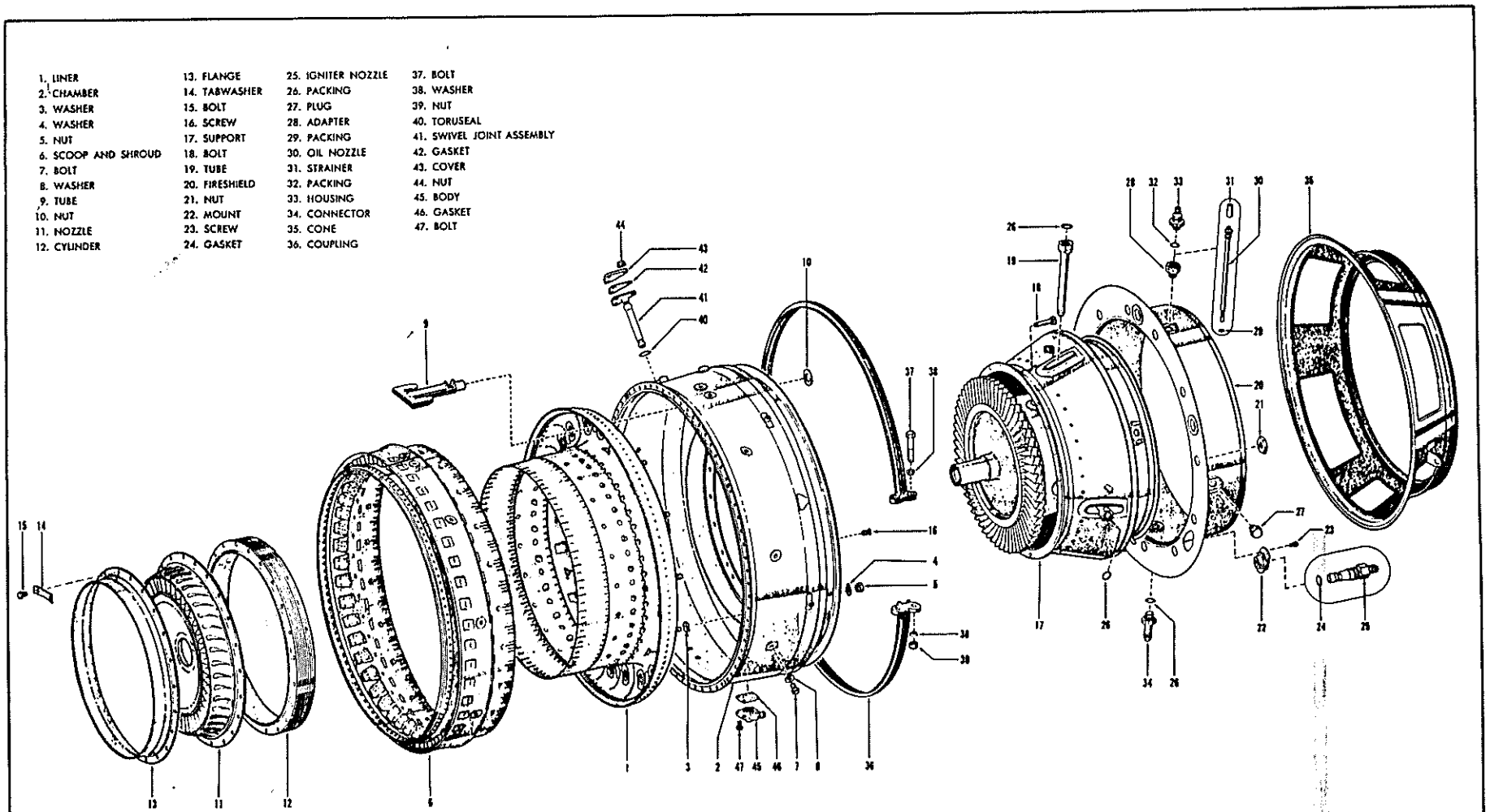


Figure 4-3. Combustion Chamber, Power Turbine Nozzle and Exhaust Diffuser Assemblies

g. Install gasket (13) and packing ring (14) on thermocouple plug (12). Install plug in diffuser housing. Check proper seating of packing ring. Tighten and lockwire bushing (11) to thermocouple pad.

4-19. ASSEMBLY OF COMPLETE COMBUSTION CHAMBER.

4-20. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 5.)

4-21. PROCEDURE. (See figure 4-3.)

a. With a suitable measuring device, check the clearance between baffle flanges and combustion chamber liner.

NOTE

Maintain a 0.05 inch clearance between the entire circumference of the baffle flange and liner.

b. With a feeler gage, check openings of cooling slots in liner (1).

NOTE

Front openings should be 0.025 to 0.035 inch; rear openings 0.055 to 0.065 inch.

c. Position combustion chamber (2) over combustion chamber liner (1). Aline openings and secure liner to combustion chamber with 11 washers (3), retaining washers (4), and nuts (5). Tighten nuts.

d. Turn combustion chamber assembly over and install three sections of scoop and shroud (6). Install larger segments first and secure with bolts (7) and washers (8). Install small segment and secure with remaining bolts and washers. Ensure that 0.030 to 0.040 inch gap separates each scoop and shroud section with equal space between joints.

NOTE

If difficulty is encountered in maintaining clearance between liner (1) and scoop and shroud (6), remove 11 washers (3) and proceed with assembly.

e. Install 11 fuel vaporizer tubes (9) in combustion chamber assembly. Secure tubes to chamber with 11 vaporizer tube locking nuts (10). Hand tighten nuts. Install plastic caps to protect tube openings from dirt or damage.

CAUTION

Be certain that bead on vaporizing tube is not bent or broken when installing and alining tube in combustion chamber.

f. Install power turbine nozzle (11) on power turbine cylinder (12). Position sealing flange (13) on power turbine nozzle. Coat bolts with Ease-Off 990, Federal Stock Number 8030-664-6146. Secure assembly with 11 tabwashers (14) and 22 bolts (15). Tighten bolts.

g. (See figure 4-4.) Install complete power turbine nozzle assembly into combustion chamber. Secure nozzle assembly with six screws (16, figure 4-3).

h. Install power turbine support assembly into power turbine exhaust diffuser. Aline bolt holes carefully. Secure power turbine support assembly and power turbine exhaust diffuser with two screws. Tighten screws. (Refer to Reference 305, Table of Limits, Section VII.)

i. Install power turbine support (17) into combustion chamber assembly. Coat two bolts (18) with Ease-Off 990, Federal Stock Number 8030-664-6146. Insert bolts in power turbine assembly and hand tighten.

NOTE

When installing power turbine exhaust diffuser assembly, place oil hole in power turbine exhaust diffuser assembly approximately ten degrees to left of pin in combustion chamber.

CAUTION

Before tightening 22 bolts (18, figure 4-3), be certain that overall clearance between power turbine cylinder and power turbine wheel blade tip is established. (Refer to Reference 38, Limits, Section VII.) Make this clearance check in at least eight places, 45 degrees apart. When tip clearance has been established, tighten bolts. Check again to ensure tightening operation did not alter tip clearance. Lockwire bolts in pairs.

j. Place assembled combustion chamber and exhaust diffuser assembly on a clean surface with power turbine shaft up.

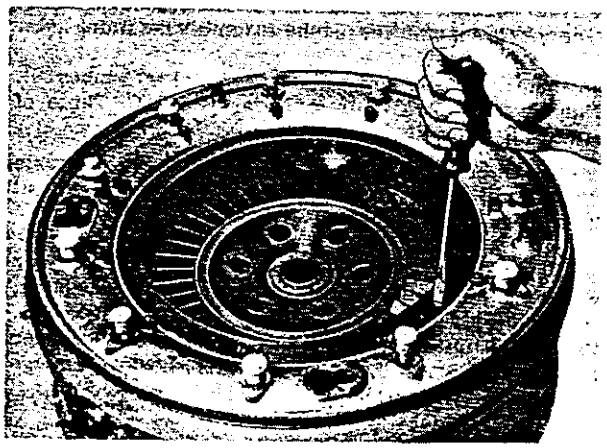


Figure 4-4. Installing Power Turbine Nozzle to Combustion Chamber Screws

NOTE

If a new power turbine support assembly is being installed in the engine, refer to paragraph 2-82, steps a. through e., for power shaft plug depth. Power shaft plug depth of the new power turbine support assembly shall conform to plug depth of the assembly being replaced. To be certain, check replaced plug depth against log book entry.

k. If power shaft plug depth does not conform, use retaining ring remover (figure 1-14) and remove plug retaining ring and plug. Refer to paragraph 5-44, steps o. through s., for replacement or reworking of plug.

CAUTION

When seating power shaft plug assembly and retaining ring in step k., use hand pressure only. Do not use a hammer to strike drift as this will cause plug to bounce and seat improperly, producing an incorrect plug depth measurement.

l. Install two packing rings on power shaft plug. Insert plug assembly and retaining ring into second stage power turbine journal. Using a plastic drift and hand pressure, drive assembly into journal until plug seats firmly on power shaft and retaining ring snaps into holding groove in journal.

m. Install three power turbine tubes (19, figure 4-3) into the top, bottom, and left-hand struts of the exhaust diffuser. Tighten tubes. (Refer to Reference 309, Table of Limits, Section VII.) Lockwire the tubes to adjacent tabs on exhaust diffuser.

n. Aline guide pin and hole and install fireshield (20) on combustion chamber assembly. Install 11 tube assembly adapter nuts (21). Tighten nuts. (Refer to Reference 313, Table of Limits, Section VII.) Lockwire nuts in pairs at four locations. Lockwire three remaining nuts as a group.

o. Install two igniter mounts (22). Secure mounts to the fireshield with four screws (23). Lockwire.

p. Position gaskets (24) on igniter nozzles. Install five igniter nozzles (25) into combustion chamber. Lockwire nozzle assemblies to tube assembly retaining nuts.

q. Install packing (26) and adapter (28) into tube (19). Tighten adapter. (Refer to Reference 310, Table of Limits, Section VII.)

r. Install oil strainer (31) and packing (29) on nozzle (30). Install nozzle in tube. Install packing (32) and oil strainer housing (33) in adapter.

s. Using two wrenches, one securing the oil strainer adapter and the other holding the oil strainer housing, tighten oil strainer housing. (Refer to Reference 311, Table of Limits, Section VII.) Lockwire oil strainer housing to oil strainer housing adapter. Lockwire adapter to tab on fireshield.

t. Install packing on oil tube connector (34) and install oil tube connector in bottom power turbine tube. Tighten oil tube connector. (Refer to Reference 312, Table of Limits, Section VII.) Lockwire oil tube connector to adjacent tab on fireshield.

u. Install exhaust diffuser support cone (35) on exhaust diffuser. Position V-band coupling (36) over support cone flange and combustion chamber outer rear flange. Secure with four bolts (37), eight washers (38), and four nuts (39).

CAUTION

To ensure seating and clamping of the support cone to the combustion chamber, tap the V-band coupling starting from the middle and moving toward the bolts. Hand-tighten nuts and repeat tapping until support cone is firmly seated.

v. Tighten bolts. (Refer to Reference 306, Table of Limits, Section VII.) Lockwire nuts and bolts.

CAUTION

Check torque of V-band coupling bolts a second time to ensure exhaust diffuser assembly is tightly secured. Insufficient tightening of V-band bolts will result in excessive vibration during engine test run. This vibration may be falsely interpreted as second stage turbine runout.

w. Install thermocouple harness. Secure with six nuts.

x. Install main and starting fuel manifolds. With fuel harness wrench (figure 1-7) and torque wrench, tighten main fitting nuts. (Refer to Reference 308, Table of Limits, Section VII.) Lockwire adapters to the coupling nuts.

y. Position toruseal (40) on swivel joint assembly (41) and insert swivel in combustion chamber (2).

NOTE

Steps y. and z. apply to models T53-L-1A and T53-L-1B engines only.

CAUTION

If the engine has been operated with the swivel joint assembly removed, inspect the combustor before further operation. Do not run the engine until the swivel joint assembly has been reinstalled. Serious damage may result.

z. Position gasket (42) and cover (43) on swivel joint assembly and secure cover with nuts (44).

SECTION V

FINAL ASSEMBLY

5-1. GENERAL.

5-2. This section contains instructions for final assembly of the engine. Instructions for assembling all basic external components and systems are included. All adjustments and inspections to prepare the engine for testing after repair are included also.

5-3. All references to the T53-L-1 gas turbine engine apply to the T53-L-1A and T53-L-1B engines, except where noted.

5-4. All precautions and instructions in paragraphs 4-3 through 4-14, Section IV, also apply to final assembly.

5-5. LUBRICANTS.

5-6. Where assembly instructions recommend the use of lubricants, only the following apply:

a. Lubriplate (Fiske Brothers Refining Company) for low temperature applications and Ease-Off 990, Federal Stock Number 8030-664-6146, for high temperature applications.

b. Lubricating oil, Military Specification MIL-L-7808, on all packing rings.

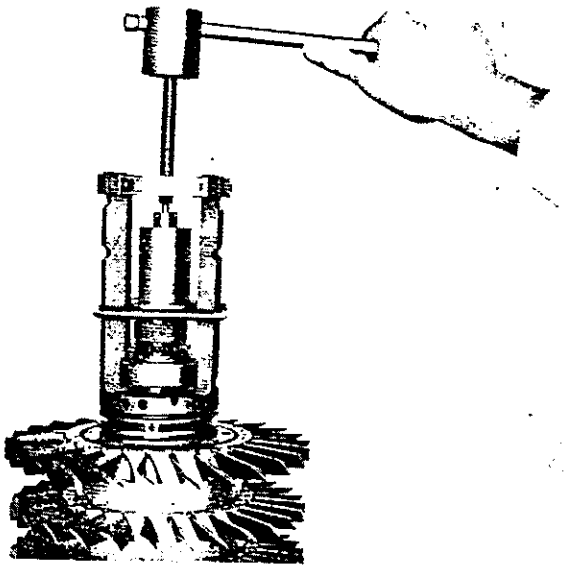


Figure 5-1. Removing Number One Main Bearing from Compressor Rotor Shaft

c. Grease, Military Specification MIL-G-21164, or grease, Military Specification MIL-G-3545, for splined shaft lubrication.

5-7. SPECIAL TOOL AND EQUIPMENT REFERENCES.

5-8. Special tools and equipment are referenced by group number at the beginning of an operation. To locate a tool number, refer to the group number in Functional Tool List, Section I.

CAUTION

Do not use cadmium-plated tools for any of the disassembly or reassembly procedures in this manual. Cadmium plating has a tendency to chip. If these chips enter the engine they will contaminate the lubrication system and cause magnesium parts to deteriorate.

5-9. NUMBER ONE MAIN BEARING PINCH FIT.

5-10. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 26.)

5-11. PROCEDURE.

NOTE

Before installing the compressor rotor in the inlet housing, establish number one main bearing pinch fit.

a. With mechanical puller (figure 1-9), remove pinion gear.

b. Remove accessory drive gear shim.

c. Remove number one main bearing with mechanical puller. (See figure 5-1.)

d. Remove oil seal housing, control gap seal, packing, and seal retainer shim.

e. Discard packing.

f. Temporarily install bearing liner on inlet housing with two bolts.

g. With a micrometer, measure the length of the inlet housing bore and the width of the bearing liner flange.

h. Record these measurements (See A and B, figure 5-2.)

i. Remove liner.

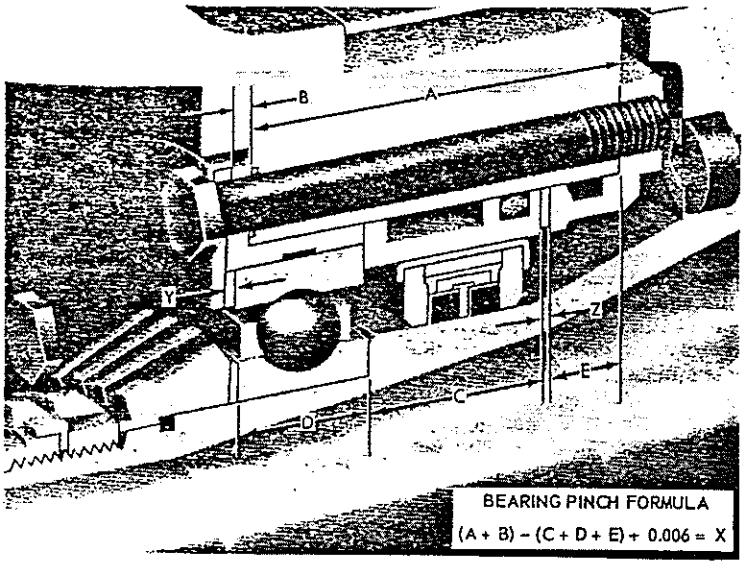


Figure 5-2. Cutaway View of Number One Main Bearing Pinch Fit

j. With a depth gage, measure the depth of the oil seal housing retainer.

k. With a micrometer, measure the width of the number one main bearing and the length of the seal housing. (See C, D, and E, figure 5-2.)

l. Add the readings.

m. Subtract this reading from step h.

n. Add the 0.006-inch bearing pinch to this reading. This total is the shim requirement.

o. Record the reading.

p. Subtract the forward shim thickness from the total reading. This is the shim thickness for the seal retainer shim.

NOTE

Bearing shim thickness was recorded at disassembly. (Refer to paragraph 2-68, step d. and NOTE.)

q. Install oil seal housing seal retainer shim. Install new packing.

r. Apply a light coat of lubricating oil, Military Specification MIL-L-7808, to running face of control gap seal.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This poisonous additive is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

s. Install seal and oil seal housing.

t. Lubricate ID of bearing and OD of compressor rotor front shaft journal with Lubriplate (Fiske Brothers Refining Co.).

u. With bearing driver (figure 1-10), install number one main bearing on the compressor shaft.

v. Install accessory drive gear shim.

w. Install pinion gear.

x. Install spanner nut.

5-12. INSTALLATION OF COMPRESSOR ROTOR.

5-13. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 9.)

5-14. PROCEDURE.

a. Mount lifting eye on compressor rear shaft.

b. Connect hoisting adapter to lifting eye and prepare to lower compressor rotor into inlet housing.

c. With chalk, mark the two holes that are closest together on the oil seal housing retainer. Repeat this marking on the two mating holes in bearing liner, bearing retainer, and inlet housing bore.

CAUTION

Never use lead pencil when marking parts. Lead will create a hot spot in high temperature areas.

d. Install a guide pin, threaded on one end, into one of the marked holes in oil seal housing retainer.

e. Lower compressor rotor into inlet housing.

f. Install five packings in counterbore of inlet housing.

g. Install bearing liner.

h. Tap gently with plastic drift until liner is tight.

i. Install two packings on front bearing retainer.

j. Install shim with proper thickness as described in paragraph 5-11, steps g. through p.

k. Install front bearing retainer and two bearing pin retaining plates.

l. Aline markings on bearing liner and bearing retainer with markings on inlet housing bore.

m. Install five tabwashers and five paraffin-coated retaining bolts.

n. Tighten bolts.

NOTE

Do not remove guide pin until ready to install last bolt.

5-15. INSTALLATION OF AXIAL AND CENTRIFUGAL COMPRESSOR HOUSINGS.

5-16. PROCEDURE.

NOTE

Taking clearance readings prior to installing axial and centrifugal compressor housings is mandatory. This procedure is outlined in paragraphs 3-148A through 3-148C.

a. Install the upper half of the centrifugal compressor housing.

NOTE

Do not attach the diffuser housing bolts at this time.

b. Insert the two tapered pins into the centrifugal compressor housing flange. Secure with washers and nuts. Torque nuts to between 30 and 35 pound-inches. The centrifugal compressor housing is now located.

c. Secure upper half at the centrifugal compressor housing to diffuser housing with bolts. Torque bolts to between 70 and 80 pound-inches.

d. Install the upper half of the axial compressor housing, and insert four tapered pins. Secure with washers and nuts. Torque nuts to between 30 and 35 pound-inches. This will locate the axial compressor housing.

e. Secure upper half of axial compressor housing to the inlet housing and the centrifugal compressor housing. Torque the bolts to between 70 and 80 pound-inches.

f. Lockwire all bolts where necessary.

CAUTION

Do not rotate the compressor rotor under any circumstances. Rotation of the compressor rotor may damage the magnesium centrifugal compressor impeller blades.

5-17. INSTALLATION OF DIFFUSER HOUSING.

5-18. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 14.)

5-19. PROCEDURE.

a. Lubricate inner face of outer race of number two bearing with lubricating oil, Military Specification MIL-L-7808.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

b. Install the diffuser housing onto the centrifugal compressor housing. (See figure 5-3.)

c. Secure the diffuser housing to the rear half of centrifugal compressor housing with 12 bolts.

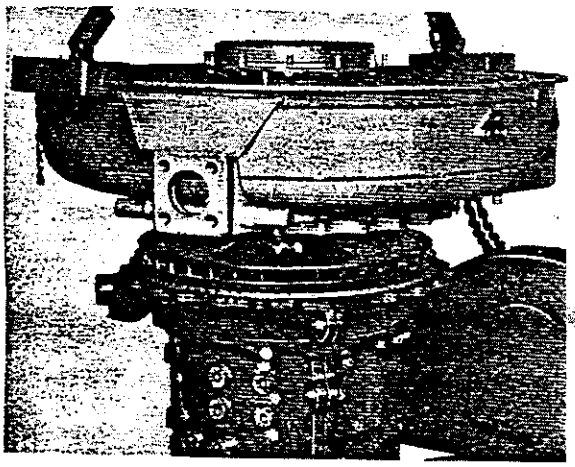


Figure 5-3. Lowering Diffuser Section onto Centrifugal Housing

d. Secure the diffuser housing to front half of centrifugal compressor housing with two bolts.

e. Tighten bolts.

f. Using alinement fixture (figure 5-4), aline diffuser housing mounting pads with inlet housing mounting pads.

NOTE

If mounting pads do not aline, loosen bolts on diffuser and compressor housings and twist diffuser housing until alinement fixture locator handles can be easily inserted.

CAUTION

To prevent small objects falling into the engine, be careful when working above the diffuser after the diffuser housing is installed on the centrifugal compressor housing. Should anything fall into air passages, disassemble the diffuser housing and remove all foreign objects.

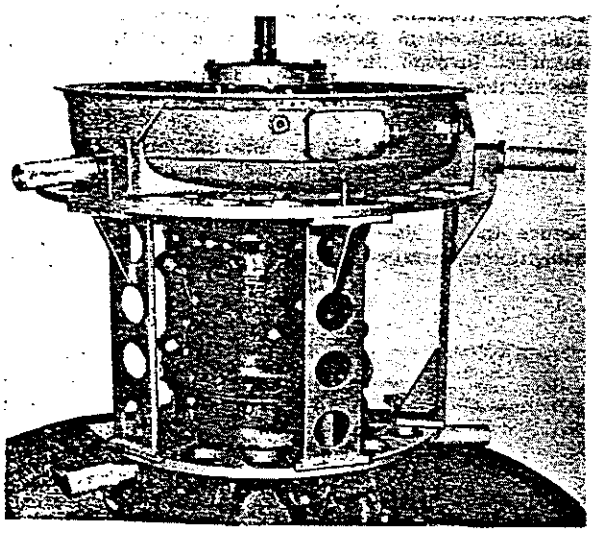


Figure 5-4. Engine Installed in Alinement Fixture

g. Lightly coat running face of control gap seal with lubricating oil, Military Specification MIL-L-7808.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

h. Press control gap seal into seal retainer.

i. Install two packings on seal retainer.

j. Install seal retainer in bearing support housing, and secure with six bolts and tabwashers.

5-20. INSTALLATION OF NUMBER ONE MAIN BEARING SPANNER NUT.

5-21. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 27.)

5-22. PROCEDURE.

a. Install the turbine wheel adapter in the diffuser housing.

b. Install the locating plate on the diffuser housing.

c. To prevent the compressor rotor from turning when torquing the number one main bearing spanner nut, install the inner row of bolts in the turbine wheel adapter.

d. Turn engine to horizontal.

e. Tighten nut.

f. Return engine to vertical.

g. Remove wrench and turbine wheel adapter.

5-23. Deleted.

5-24. Deleted.

5-25. Deleted.

All data deleted from page 5-5.

5-26. INSTALLATION OF REAR BEARING COMPRESSOR SHAFT NUT.

5-27. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 13.)

5-28. PROCEDURE.

a. Position engine vertical.

b. Install control gap seal sleeve, front adapter pilot cone, turbine wheel adapter, rear adapter pilot cone, compressor shaft lockring, and compressor shaft rear bearing nut in rear bearing support housing.

c. Install locating plate on diffuser housing. Insert bolts in turbine wheel adapter.

d. With a wrench, tighten compressor shaft rear bearing nut.

e. Remove wrench.

f. Mount dial indicator unit on diffuser flange. (See figure 5-5.)

g. Tilt engine 45 degrees.

h. Position dial indicator pointer to zero at the low point on turbine wheel adapter. Runout reading and location are indicated on adapter. The dial indicator must reflect this reading at this point.

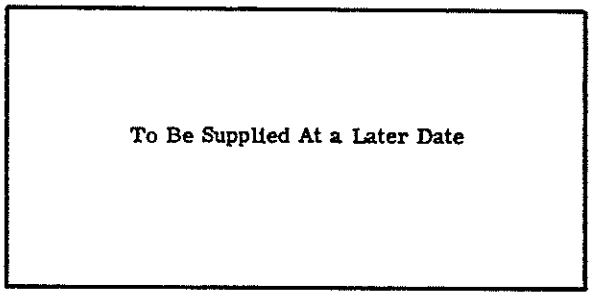


Figure 5-5. Checking Runout on Turbine Wheel Adapter

i. If the readings are not identical, remove compressor nut and reseat pilot cone.

j. Install and tighten compressor nut.

k. Recheck runout on adapter.

l. Remove only the bolts from locating plate of wrench that are inserted in the turbine wheel adapter. This will allow the compressor rotor to rotate freely during installation of accessory drive carrier.

5-29. Deleted.

5-30. Deleted.

5-31. CHECKING ACCESSORY DRIVE CARRIER BACKLASH.

5-32. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 1.)

5-33. PROCEDURE.

a. Install locating plate bolts into turbine wheel adapter to prevent the compressor rotor from turning.

b. Check accessory carrier drive driven gear backlash to the accessory drive pinion gear at four points, 90 degrees apart.

c. Install backlash gage tool through the accessory drive shaft opening in the inlet housing. (See figure 5-6.)

d. Using a dial indicator, check backlash by moving the flag back and forth, contacting the scribe mark on the backlash flag.

e. Record the reading.

f. Remove bolts from the locating plate.

g. Rotate compressor rotor 90 degrees.

h. Install bolts in turbine wheel adapter to secure compressor rotor.

i. Zero dial indicator.

j. Check backlash.

k. Record the reading. A 0.006 to 0.012 inch backlash is required.

NOTE

If backlash is maintained, proceed to paragraph 5-34. If backlash is not maintained, perform steps l. through af.

l. Remove dial indicator and backlash flag.

m. Using three puller screws, separate accessory drive carrier from inlet housing.

n. Remove accessory drive carrier.

o. Remove and discard packing.

p. Place accessory drive carrier on holding fixture.

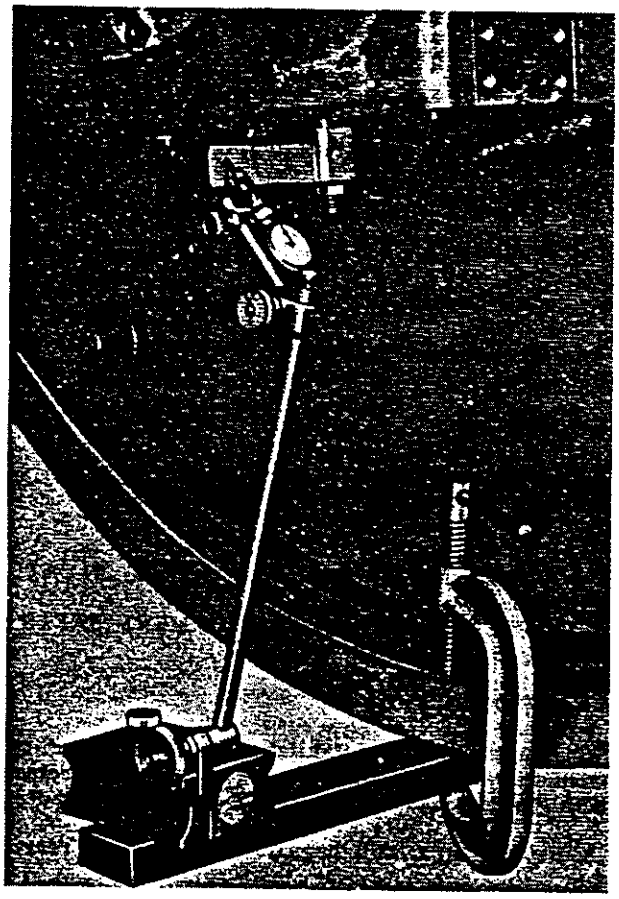


Figure 5-6. Backlash Gage Installed on Inlet Housing

q. Straighten spanner washer.

r. Break torque of spanner nut. (See figure 5-7.)

s. Remove spanner nut and washer.

t. Cut lockwire. Remove three bolts that secure retainer to accessory drive carrier.

u. Using driver and three puller screws, remove bearing retainer, bearing liner, and shim. (See figure 5-8.)

v. Replace shim to establish required backlash tolerance.

w. Install shim on bearing liner.

x. Install bearing liner in accessory driver carrier. Maintain 0.001 to 0.003 inch pinch fit between bearing and bearing retainer.

y. Secure bearing retainer to bearing liner and accessory drive carrier with three bolts.

z. Lockwire bolts.

aa. Install spanner washer and nut on driven gear journal.

ab. Tighten spanner nut.

ac. Bend spanner washer tabs.

ad. Install packing.

ae. Install accessory drive carrier into inlet housing.

af. Check backlash again. Backlash shall be 0.006 to 0.012 inch.

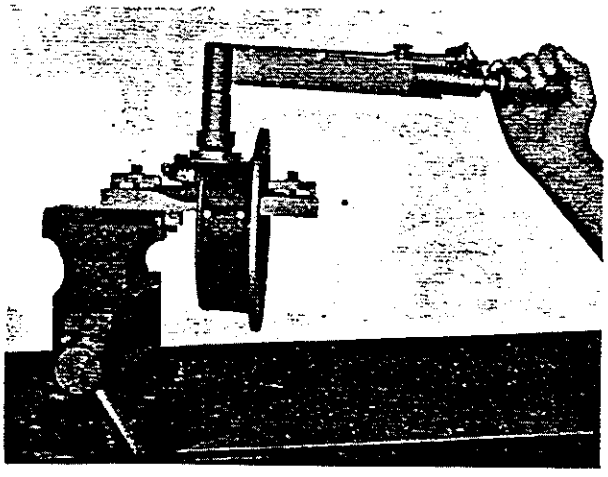


Figure 5-7. Breaking Bearing Retainer Spanner Nut Torque

5-34. CHECKING ACCESSORY DRIVE CARRIER GEAR PATTERN.

5-35. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 2.)

5-36. PROCEDURE.

a. Remove bolts from turbine wheel adapter locating plate.

b. Paint the accessory drive pinion gear with iron-blue, Federal Specification TT-I-677, and the accessory drive driven gear with gear marking compound, No. Y-5227-C (C.K. Williams Company).

c. While holding slight pressure on the accessory drive driven gear, turn compressor.

d. Check gear pattern.

NOTE

If proper gear pattern is obtained, proceed to paragraph 5-37. If proper gear pattern is not obtained, perform steps e. through y.

e. Measure the distance from the accessory drive seat face on the inlet housing to the forward face of number one main bearing. Record the reading.

f. Measure the distance from the carrier seat face to the accessory drive driven gear centerline. Record the reading.

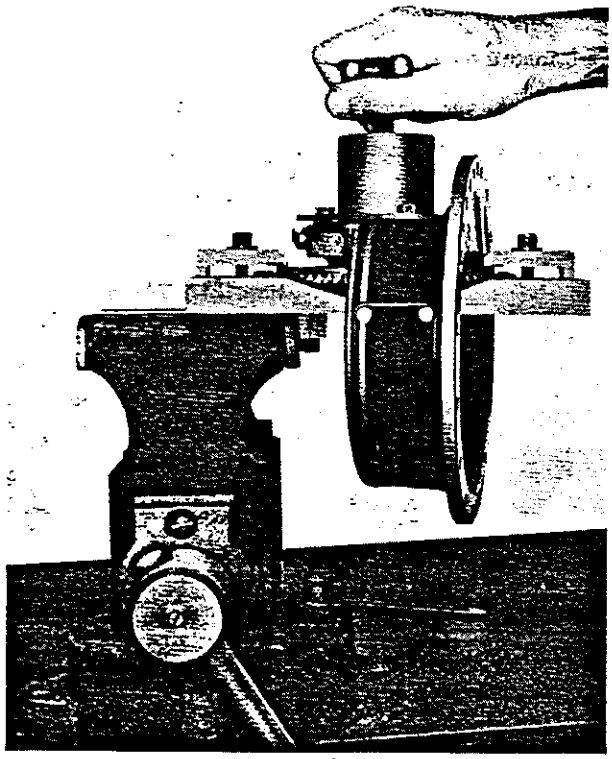


Figure 5-8. Removing Bearing Retainer

g. Subtract measurement obtained in step f. from the measurement obtained in step e. Record the reading.

h. Measure the distance from the pinion gear rear face to the apex of the pitch lines of the pinion gear. Record the reading.

i. Subtract measurement obtained in step h. from measurement obtained in step g. Record the reading. This is the required dimension of the thickness of the shim behind the pinion gear.

j. Remove accessory drive carrier from inlet housing.

k. Install wrenching plate (figure 1-11) on pinion gear.

l. Secure plate to bearing liner with five bolts.

m. Using socket (figure 1-3) and torque wrench, break spanner nut torque.

n. Remove wrenching plate.

o. Using puller (figure 1-9), remove pinion gear.

p. Remove accessory drive gear shim.

q. Replace shim.

r. With an arbor press, install pinion gear.

s. Remove arbor press.

t. Install wrenching plate.

u. Install spanner nut.

v. With wrench and torque wrench, tighten nut. (Refer to Reference 314, Table of Limits in Section VII.)

w. Remove plate.

x. Install accessory drive carrier.

y. Check gear pattern.

5-37. CHECKING POWER SHAFT END FLOAT.

5-38. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 30.)

5-39. PROCEDURE.

a. With engine horizontal, take a depth gage reading from end of power shaft to end of compressor rotor with the power shaft pulled forward. (See figure 5-9.)

b. Repeat step a. with the power shaft pushed to rear.

c. Subtract the reading of step b. from the reading of step a. The result is the full float of the power shaft.

d. Install tabwasher and packing ring.

e. Apply a light coat of lubricating oil, Military Specification MIL-L-7808, to the control gap seal face.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

f. Install seal and seal housing on compressor rotor.

g. Tighten seal housing.

h. Using staking tool (figure 1-12), bend tabwashers in two places, 180 degrees apart; first stake forward toward seal housing and second stake rearward toward spanner nut.

i. Using a depth gage, measure the distance from power shaft tip to the seal housing.

j. Add one half the difference between the readings in steps a. and b. to the reading in step i. This is the power shaft mean float dimension.

5-40. INSTALLATION OF THE COMBUSTION CHAMBER CURL, FIRST STAGE TURBINE NOZZLE, AND FIRST STAGE TURBINE.

5-41. PROCEDURE. (See figure 2-35.)

a. Position two packings (26 and 27) on number two main bearing oil inlet strainer (25).

b. Install number two main bearing oil strainer in diffuser housing.

c. Check proper seating of packings.

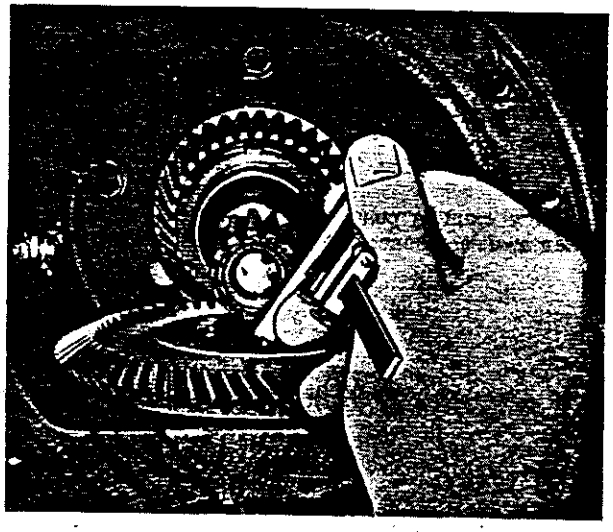


Figure 5-9. Depth Gage Reading from End of Power Shaft to End of Compressor Rotor

d. Install gasket (24) on oil inlet cap (23).

e. Install oil inlet cap over the number two main bearing oil strainer.

f. Tighten oil inlet cap.

g. Lockwire.

h. With engine vertical, place combustion chamber curl over bolts in diffuser housing.

CAUTION

If it is necessary to replace the first stage turbine nozzle, select the new nozzle to ensure an effective flow area. This flow area, marked on inner flange of removed nozzle, shall be within plus or minus 0.100 square inch of flow area of new nozzle.

i. Install first stage turbine nozzle.

j. Using three nuts, compress nozzle to diffuser.

k. Remove nuts and install three screws.

l. Install turbine cooling baffle on diffuser.

m. Secure cooling baffle to diffuser with 6 tabwashers and 12 nuts. (See figure 5-10.)

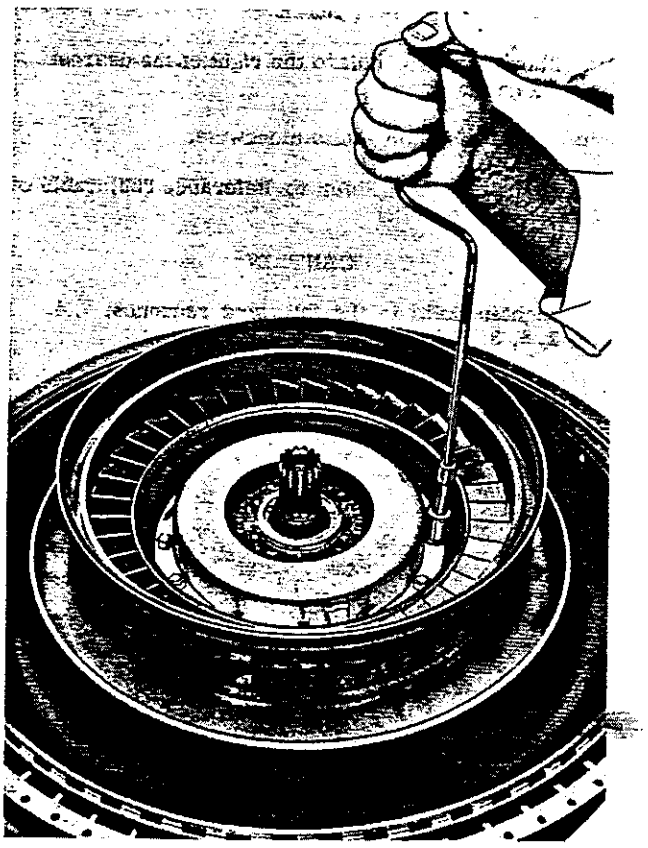


Figure 5-10. Securing Turbine Cooling Baffle to Turbine Nozzle

n. Tighten nuts.

o. Bend tabwashers.

p. Position turbine cooling bellows on compressor shaft nut.

q. Mark turbine cooling bellows rear surface with chalk.

r. Aline match marks and install first stage turbine on turbine adapter.

s. Remove first stage turbine. Check contact between mating surfaces of turbine cooling bellows and first stage turbine.

NOTE

If an even contact is not obtained, disassemble and check for nicks or obstructions on turbine cooling bellows, turbine adapter coupling teeth, and first stage turbine. Ensure that all surfaces are free of foreign matter that might affect mating parts.

t. Aline match marks and install first stage turbine on turbine adapter.

u. Using a six-point socket wrench, secure first stage turbine and turbine wheel plate with three tabwashers and six bolts. (See figure 5-11.)

NOTE

Place the first bolt to the right of the nearest match mark.

v. Install remaining bolts clockwise.

w. Tighten bolts. (Refer to Reference 303, Table of Limits, Section VII.)

CAUTION

Tighten bolts in the following sequence: 1, 4, 2, 5, 3, 6, and 1.

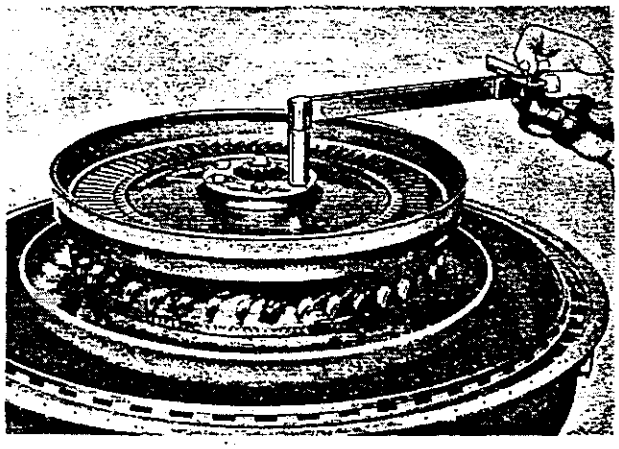


Figure 5-11. Tightening First Stage Turbine Wheel Plate Bolts

x. Check first stage turbine blade to first stage turbine nozzle tip clearance. (Refer to Reference 35, Table of Limits, Section VII.)

CAUTION

If a first stage turbine wheel is removed and reinstalled or replaced, the engine must be given a vibration check before flight operations are resumed.

y. If clearance is not obtained, remove first stage turbine and cooling baffle.

z. Reposition first stage nozzle. Reinstall baffle. Check clearance.

aa. Locate a dial indicator at a point just inside of blade root and check first stage turbine wheel face runout; it shall not exceed 0.006 inch FIR. (See figure 5-12.)

ab. Check for nicks or obstructions on turbine cooling bellows, turbine adapter coupling teeth, and first stage turbine.

ac. Ensure that surfaces are free of foreign matter that might affect mating parts.

ad. Reinstall first stage turbine and repeat runout check. If the runout is not within 0.006 inch FIR, repeat steps ab. through ac. until runout is correct.

5-42. INSTALLATION OF THE COMPLETE COMBUSTION CHAMBER ASSEMBLY.

5-43. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 7.)

5-44. PROCEDURE.

a. Using a phenolic rod, apply pressure to the aft end of the power shaft. The power shaft should move forward against the spring tension and return to its original position when the pressure is slowly released. If the movement is smooth, it indicates a properly positioned power shaft retainer button.

b. Using sling and hoist, lower combustion chamber onto diffuser housing. (See figure 5-13.)

c. Aline existing punch marks 180 degrees apart on power shaft and second stage turbine.

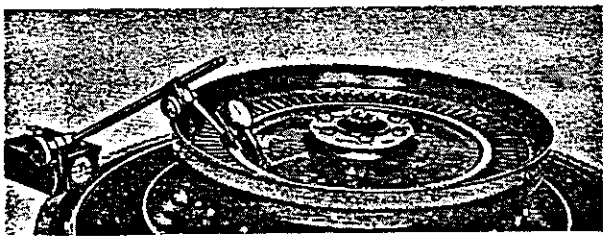


Figure 5-12. Checking First Stage Turbine Runout

d. Secure diffuser housing to combustion chamber with 72 nuts and bolts.

e. Engage the power shaft bolt approximately two threads. Recheck the spring tension by applying pressure against the power shaft bolt; if the movement is smooth no further checking is necessary. If the power shaft button is cocked, binding will take place and little or no spring tension will be felt. The power shaft must be worked forward and aft until free movement is obtained.

NOTE

If free movement cannot be obtained by working the power shaft forward and aft, remove the planetary sun gear assembly. (Refer to paragraph 2-52.) Reposition the power shaft retainer button and reinstall planetary sun gear assembly. (Refer to paragraph 5-46.)

f. Remove sling.

g. (Steps d. through h. apply to T53-L-1A and T53-L-1B engines only.) (See figure 4-3.) Place new toruseal (40) in counterbore of combustion chamber impingement starter boss.

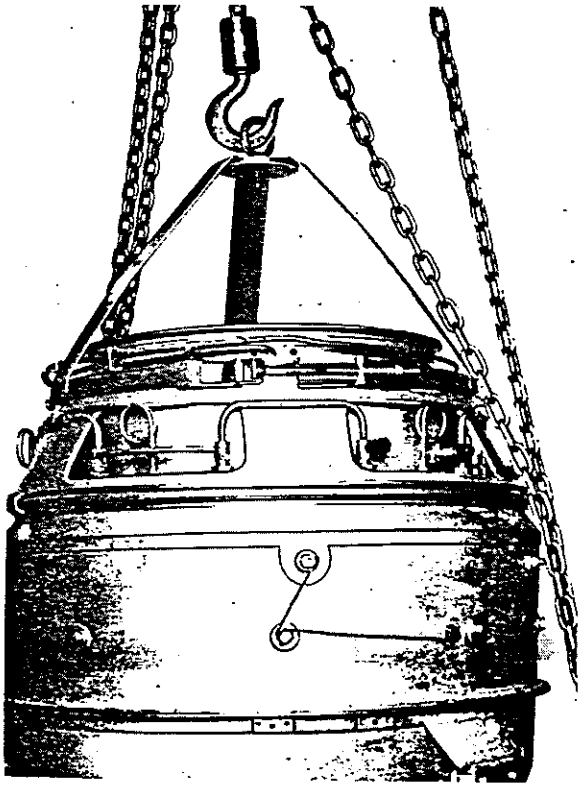


Figure 5-13. Lowering Combustion Chamber onto Diffuser Housing

h. Insert swivel joint assembly (41) in nozzle located in first stage turbine nozzle.

i. Place gasket (42) and cover (43) over three studs on boss.

j. Secure cover with three nuts (44).

k. Tighten nuts.

l. Apply Ease-Off 990, Federal Stock Number 8030-664-6146, to power shaft bolt threads.

m. Install power shaft bolt, adapter, packing, seals, and lockwasher that secure power shaft to second stage power turbine. (See figure 5-14.)

n. Tighten power shaft retainer bolt. (Refer to Reference 307, Table of Limits, Section VII.)

o. After the power shaft bolt is installed, find the distance from tip of the power shaft to the tip of the seal housing. This reading shall be plus or minus 0.020 inch of the mean dimension. (Refer to paragraph 5-39, step j.) This reading is the actual float dimension.

p. If the combustion chamber housing, exhaust diffuser, power turbine, or the number three or number four bearing package is replaced and the actual float dimension is not within 0.020 inch of the mean float dimension, a relocation of the power shaft may be necessary. Remove the power shaft bolt, retaining ring, and power shaft plug.

NOTE

The relocation of the power shaft shall be performed by changing or reworking the power shaft plug.

q. If the existing plug is short, replace it. If a replaced plug is long, it must be reworked to a smaller B dimension to be within 0.020 inch of the mean float dimension. (See figure 5-15.)

CAUTION

The only surface of the plug that may be reworked is the 45-degree chamfer on the aft end of the plug.

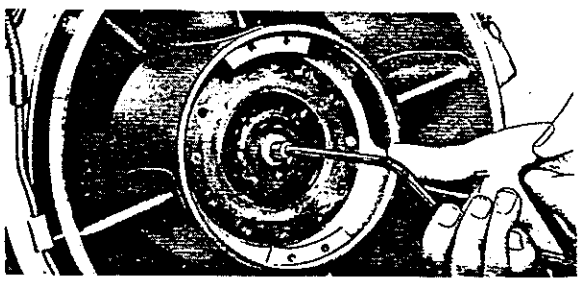
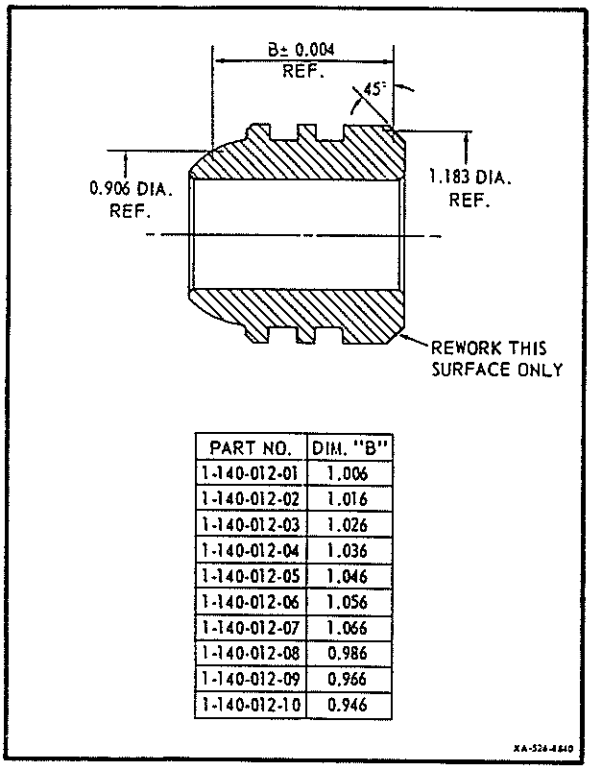


Figure 5-14. Installing Power Shaft Bolt

r. With an electric etcher, identify the reworked plug with the mark RWK, immediately after the part number.

s. Record the part number of the plug in the Historical Record Form DD 829, identifying the plug as having been reworked. The power shaft plug thus can be identified at overhaul.



PART NO.	DIM. "B"
1-140-012-01	1.006
1-140-012-02	1.016
1-140-012-03	1.026
1-140-012-04	1.036
1-140-012-05	1.046
1-140-012-06	1.056
1-140-012-07	1.066
1-140-012-08	0.986
1-140-012-09	0.966
1-140-012-10	0.946

Figure 5-15. Reworking Power Shaft Plug

t. Coat two new packings with petrolatum, Federal Specification VV-P-236.

u. Install packings on plug.

v. Secure plug in second stage turbine shaft with retaining ring.

w. Reinstall power shaft bolt.

x. Tighten power shaft bolt.

y. Install power turbine cover and packing.

z. Secure cover with ten screws.

aa. Tighten screws.

ab. Lockwire screws.

ac. Find the distance from the power shaft tip to control gap seal housing tip. This reading shall be within 0.020 inch of mean dimension. (Refer to paragraph 5-39, step j.)

NOTE

After field inspection, if the combustion chamber, exhaust diffuser, power turbine, or power turbine rear bearing and housing is replaced, the maximum allowable distance the power shaft may be displaced from its original location within the compressor, as recorded in the Historical Record Form DD 829, is plus or minus 0.010 inch. Record disassembly sheet information in the Historical Record Form DD 829.

5-45. Deleted.

5-46. Deleted.

Figure 5-16 deleted

Figure 5-17 deleted

5-47. INSTALLATION OF THE TORQUEMETER CARRIER AND GEAR ASSEMBLY.

5-48. PROCEDURE.

a. Install two seal rings on carrier support.

b. Install torquemeter into inlet housing.

c. Mesh planet gears with sun gear.

d. Secure torquemeter to the torquemeter cylinder with 15 tabwashers and bolts.

e. Tighten bolts. (See figure 5-18.)

CAUTION

To prevent foreign objects entering engine, cover inlet housing lower strut before installing torquemeter.

f. Check free movement of all gears.

g. Check end float of torquemeter carrier manually.

5-49. INSTALLATION OF THE POWER OUTPUT DRIVE GEAR ASSEMBLY.

5-50. PROCEDURE.

NOTE

Before removing cover from inlet housing strut, make certain that no foreign objects can fall into the accessory drive gearbox through the hollow strut.

a. Remove cover from strut in the inlet housing.

b. Install packing rings in oil inlet and scavenge passages in inlet housing.

c. Install ring on ring gear support housing.

d. Position drive power output gear in inlet housing.

e. Mesh three planet gears with ring gear.

f. Secure power output drive gear to inlet housing with three tabwashers and bolts. (See figure 5-19.)

g. Tighten bolts.

h. Bend tabwashers.

i. Install and secure 22 washers, spacers, and nuts on cover retaining studs.

j. Tighten nuts.

5-51. INSTALLATION OF THE OIL FILTER ASSEMBLY.

5-52. PROCEDURE.

a. Install two packings into oil filter mounting flange.

b. Secure oil filter body to inlet housing pad with two tabwashers, one long bolt, and one short bolt.

c. Tighten four bolts.

NOTE

Two short bolts were installed in the oil filter body earlier. (Refer to paragraph 3-182, step a.)

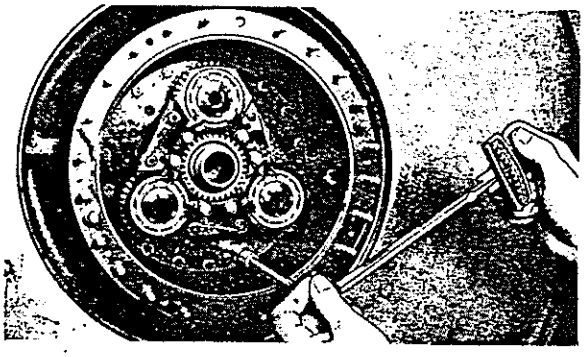


Figure 5-18. Securing Torquemeter Carrier and Gear to Planetary Sun Gear

5-53. INSTALLATION OF THE OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

5-54. PROCEDURE.

a. Insert and mesh overspeed governor drive shaft in the overspeed drive gear located in inlet housing. (See figure 5-20.)

b. Install gasket.

c. Install overspeed governor drive gearbox and secure gearbox to inlet housing with four washers and nuts.

d. Tighten nuts. (See figure 5-21.)

NOTE

To prevent cracking of casing mounting lugs, apply an even torque, between 70 and 75 pound-inches, on all four mounting nuts.

5-55. INSTALLATION OF THE ACCESSORY DRIVE GEARBOX ASSEMBLY.

5-56. PROCEDURE.

a. Install drive shaft into inlet housing, meshing shaft splines with accessory drive driven gear. (See figure 5-22.)

b. Remove three bolts and washers that secure axial compressor housing to inlet housing.

c. Coat two packings and seal with petrolatum, Federal Specification VV-P-236.

d. Install packings and seal on accessory drive gearbox flange.

e. Position and install accessory drive gearbox to inlet housing.

f. Mesh drive shaft to coupling in accessory drive gearbox.

CAUTION

Ensure that a support is on accessory drive gearbox before installing accessory drive gearbox onto inlet housing.

g. Tighten two long and two short bolts that secure accessory drive gearbox to inlet housing.

h. Tighten bolts.

i. Lockwire.

j. With three washers and bolts, secure accessory drive gearbox support to flanges of inlet and axial compressor housings.

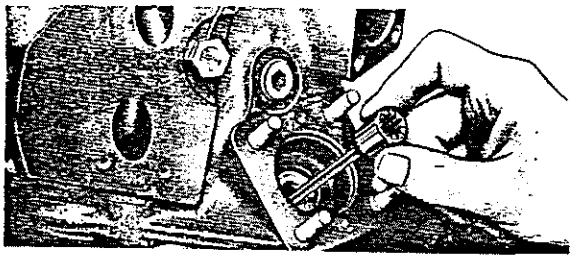


Figure 5-20. Installing Overspeed Governor Drive Shaft into Inlet Housing

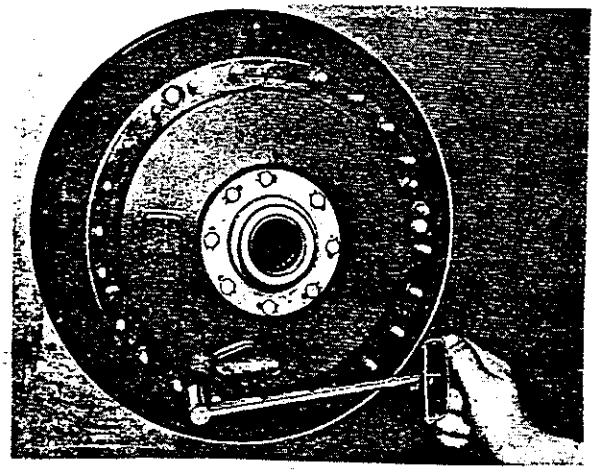


Figure 5-19. Securing Power Output Drive Gear to Inlet Housing

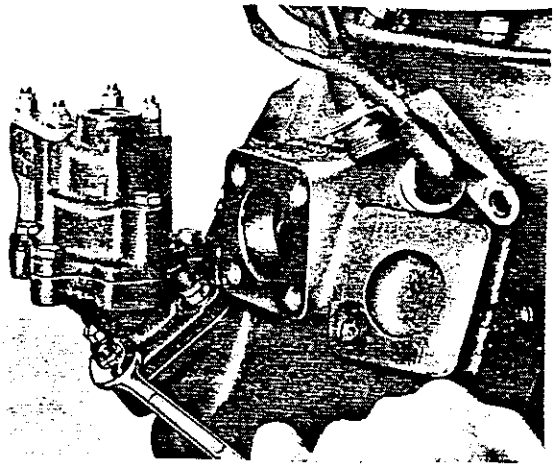


Figure 5-21. Tightening Overspeed Governor and Tachometer Drive Gearbox Nuts

k. Tighten bolts.

l. Lockwire. (See figure 5-23.)

NOTE

Do not lockwire oil drain plug. This plug must be removed later when the engine is preoiled.

5-57. INSTALLATION OF THE FUEL CONTROL.

5-58. PROCEDURE.

CAUTION

Before installing the fuel control unit ensure that the T53-L-1 and T53-L-1A engines incorporate overspeed governor assembly, part number 87000-B4.

Before installing the fuel regulator, ensure that the T53-L-1B engine incorporates overspeed governor assembly, part number 80400 series.

a. Position engine vertical.

b. Install overspeed governor shaft into overspeed governor and tachometer drive gearbox.

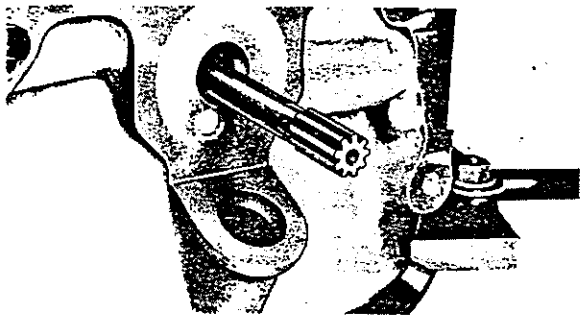


Figure 5-22. Accessory Drive Shaft Installed in Inlet Housing

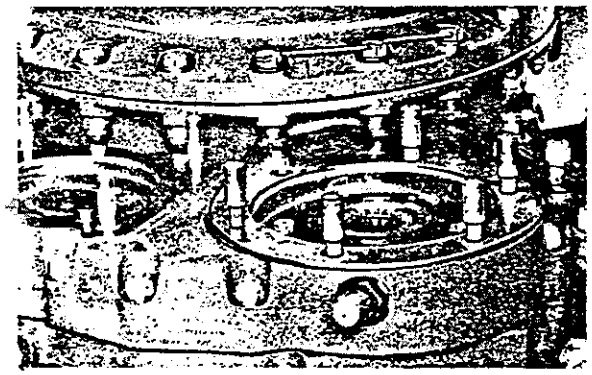


Figure 5-23. Accessory Drive Gearbox Support Bolts Lockwired

c. Mate spline of overspeed governor shaft with overspeed governor shaftgear.

d. Place two packings on overspeed shaft tube. Install tube on overspeed governor shaft.

e. Install gasket on fuel control pad of accessory drive gearbox.

f. Install fuel control on accessory drive gearbox.

g. To assist meshing splines of fuel control with the spline in the accessory drive gearbox, remove starter-generator cover and rotate driven gear outer gear.

h. To assist meshing spline of overspeed governor shaft with spline in fuel control, rotate the power turbine.

i. Install starter-generator.

j. Secure starter-generator with five washers and nuts.

k. With four nuts and washers, secure fuel control to accessory drive gearbox.

l. Tighten nuts. (See figure 5-24.)

CAUTION

To prevent cracking attaching fuel control flange, tighten nuts equally when torquing.

m. Pull governor shaft tube toward the rear. One end of the tube shall be seated inside the fuel control, the other end inside the overspeed governor and tachometer drive gearbox.

n. Place ring in governor shaft tube groove.

o. Secure tube to fuel control.

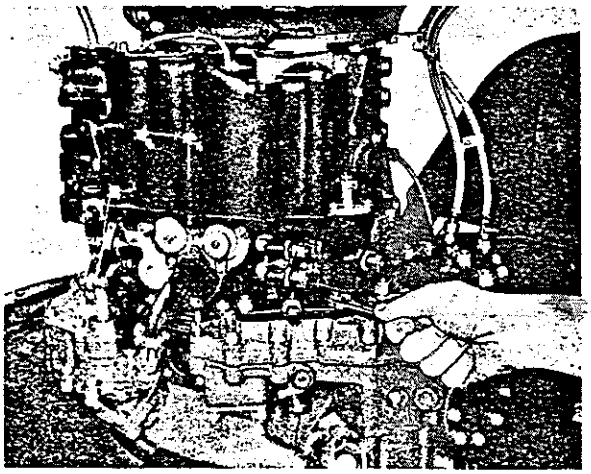


Figure 5-24. Tightening Fuel Control Retaining Nuts

p. Position engine horizontal.

q. Install temperature sensing element mounting pad gasket on inlet housing.

r. Install temperature sensing element.

s. Secure sensing element with four bolts.

t. Tighten bolts.

u. Lockwire bolts.

CAUTION

Do not bend or kink temperature sensing element capillary tube.

5-59. INSTALLATION OF THE ANTI-ICING INTERPRETER AND DETECTOR (MODEL T53-L-1).

5-60. PROCEDURE. (See figure 2-12.)

a. Secure detector support plate to inlet housing with two bolts.

b. Lockwire bolts.

c. Install two mounting spacers and shockwashers on detector support plate.

d. Place intermediate support plate over shockwashers.

e. Place two shockwashers and two flat washers on intermediate support plate.

f. Secure support plate to detector support plate with two bolts.

g. Position shock pad over probe on bottom of detector.

h. Insert two mounting bushings into detector.

i. Install detector on the intermediate support plate.

j. Secure detector with four washers, two shockwashers, and bolts.

k. Position detector strap over detector.

l. Secure straps to intermediate support plate with two screws.

m. Remove bolt from right side of intermediate support plate.

n. Place jumper connector on support plate.

o. Reinstall bolt.

p. Lockwire all bolts and screws.

q. Install two ice interpreter brackets on axial compressor.

r. Secure brackets with four bolts.

s. Lockwire bolts.

t. With anti-icing interpreter connectors pointing forward, place interpreter on ice interpreter brackets.

u. Secure interpreter with four bolts and nuts.

5-61. INSTALLATION OF THE ANTI-ICING DETECTOR, ANTI-ICING INTERPRETER, AND IGNITION UNIT (MODELS T53-L-1A AND T53-L-1B).

5-62. PROCEDURE. (See figure 2-12.)

a. Secure detector support plate to inlet housing with two bolts.

b. Lockwire bolts.

c. Install two mounting spacers and shockwashers on detector support plate.

d. Place intermediate support plate over shockwashers.

e. Place two shockwashers and two flat washers on intermediate support plate.

f. Secure support plate to detector support plate with two bolts.

g. Position shock pad over probe on bottom of detector.

h. Insert two mounting bushings into detector.

i. Install detector on the intermediate support plate.

j. Secure detector with four washers, two shockwashers, and bolts.

k. Position detector strap over detector.

l. Secure straps to intermediate support plate with two screws.

m. Remove bolt from right side of intermediate support plate. Place jumper connector on support plate.

n. Reinstall bolt.

o. Lockwire all bolts and screws.

p. Place anti-icing interpreter on interpreter bracket.

q. Secure interpreter with four bolts and nuts.

r. Place two ice interpreter brackets on axial compressor.

s. Secure brackets with four bolts.

t. Lockwire bolts.

u. Place ignition unit and anti-icing interpreter on the two ice interpreter brackets.

v. Secure ignition unit and interpreter with four screws and nuts.

5-63. INSTALLATION OF THE IGNITION UNIT (MODEL T53-L-1).

5-64. PROCEDURE.

a. Remove two bolts, at approximately 9 and 11 o'clock positions, from centrifugal compressor upper housing half.

b. Install rear ignition unit bracket on centrifugal compressor upper housing half.

c. Secure bracket with two bolts.

d. Tighten bolts.

e. Lockwire bolts.

f. Remove bolt and spacer from axial compressor upper flange.

g. Position front ignition unit bracket on axial compressor flange.

h. Secure bracket with bolt, spacer, and bolt.

i. Lockwire bolts.

j. Install ignition unit on ignition unit brackets.

k. Secure ignition unit with four nuts and screws.

l. Lockwire screws.

5-65. INSTALLATION OF THE AIRFLOW REGULATOR.

5-66. PROCEDURE. (See figure 2-10.)

a. Insert packing into airflow regulator.

b. Insert packing and plug into anti-icing tube.

c. Place packing on anti-icing tube sleeve end.

d. Install anti-icing tube into the airflow regulator. Push tube as far to the rear as possible.

NOTE

Do not damage packing when installing anti-icing tube.

e. Place gasket and airflow regulator onto mounting pad on the centrifugal compressor.

f. Secure regulator with two washers and bolts (6).

g. Place gasket and anti-icing elbow onto mounting pad on the inlet housing.

h. Secure elbow with four washers and bolts.

i. Slide anti-icing tube forward into anti-icing elbow.

j. Connect anti-icing air hose (1) to union on anti-icing elbow.

k. Connect electrical plug to airflow regulator connector.

l. Lockwire plug.

5-67. INSTALLATION OF THE LUBRICATION SYSTEM.

5-68. PROCEDURE. (See figure 5-25.)

a. Install oil pressure line brackets (4 and 7) on centrifugal compressor flange.

b. Secure brackets with four bolts.

c. Connect pressure oil hose (2) to elbow on the oil filter (3) and pressure oil line connector.

d. Place two clamps around pressure oil hose.

e. Secure clamps to brackets (4) on axial compressor flange with two screws and nuts.

f. Connect pressure oil hose (5) to pressure oil line connector and number two main bearing strainer (6).

g. Place clamp around pressure oil hose (5).

h. Secure clamp to bracket (7) on diffuser housing with screw.

i. Lockwire screw.

j. Connect scavenge oil hose (8) to adapter on diffuser housing and tee (9) on accessory drive gearbox.

k. Connect scavenge oil hose (10) to oil tube connector on the fireshield and tee (11) on accessory drive gearbox.

l. Place clamps (12) around scavenge oil hoses (8 and 10).

m. Secure clamps to bracket on axial compressor flange with screw and nut.

n. Place clamps (13) around scavenge oil hoses (8 and 10).

o. Secure clamps to bracket on axial compressor.

p. Place clamps (14) around scavenge oil hose (10).

q. Secure clamps to bracket with screw and nut.

r. Secure clamp to combustion chamber with screw.

s. Lockwire screw.

t. Connect pressure oil hose (15) to pressure oil line connector and double throttle tee (16) on overspeed governor and tachometer drive.

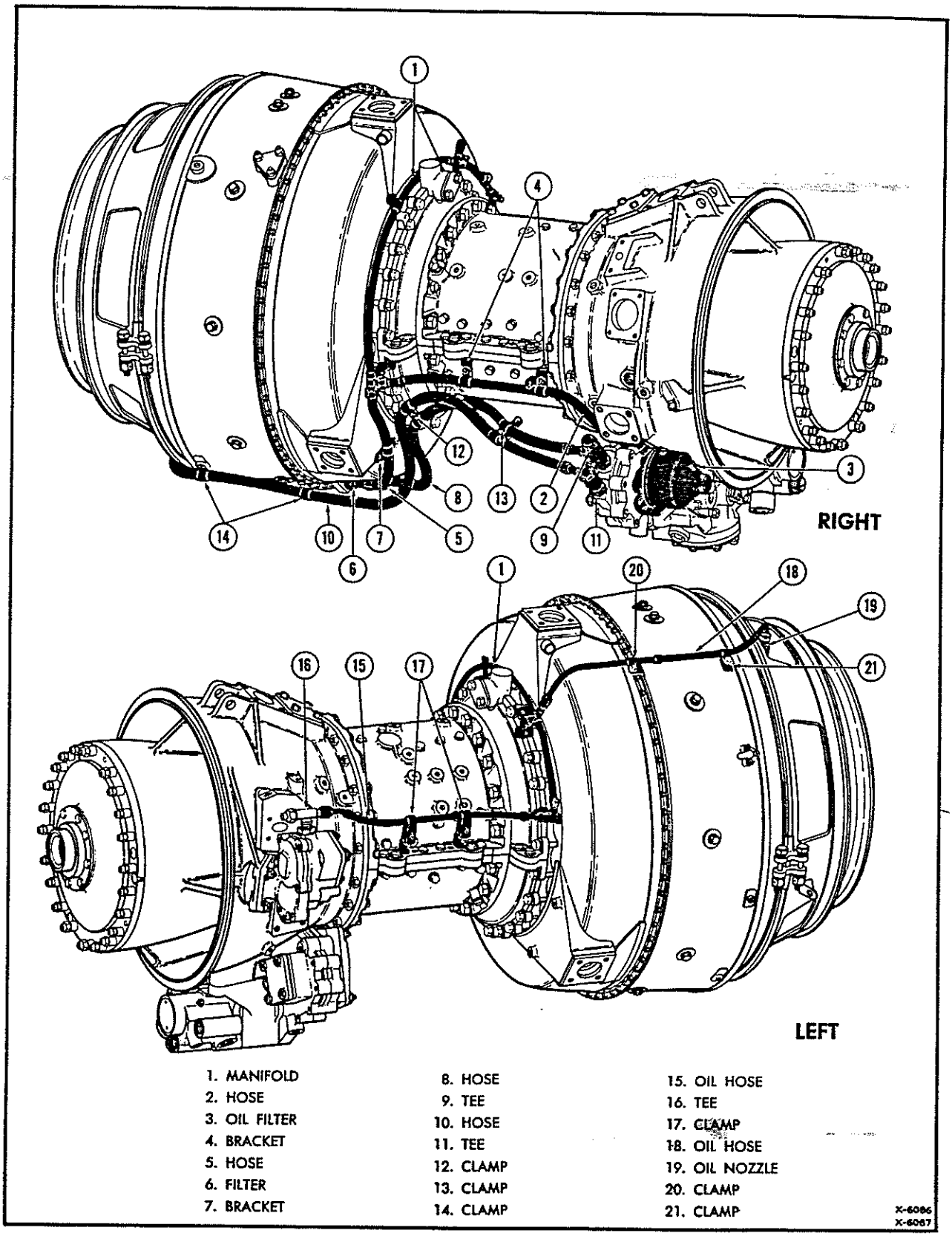


Figure 5-25. Left and Right Side Views of External Oil Lines

u. Place two clamps (17) around pressure oil hose (15).

v. Secure clamp to bracket on axial compressor flange with two bolts and nuts.

w. Connect pressure oil hose (18) to pressure oil line connector and oil strainer connector on the fireshield.

x. Place clamp (20) around pressure oil hose (18).

y. Secure clamp to bracket on combustion chamber flange with screw and nut.

z. Place clamp (21) around pressure oil hose (18).

aa. Secure clamp to combustion chamber with screw.

ab. Lockwire screw.

5-69. INSTALLATION OF THE ELECTRICAL SYSTEM (MODEL T53-L-1).

5-70. PROCEDURE. (See figure 5-26.)

a. Place solenoid valve bracket (1) on axial compressor housing.

b. Secure bracket with four bolts.

c. Lockwire bolts.

d. Install solenoid valve (2) on solenoid valve bracket (1).

e. Secure solenoid valve with two screws, washers, and nuts.

f. Place receptacle bracket (4) on axial compressor housing.

g. Secure bracket with two bolts.

h. Lockwire bolts.

i. Place electrical cable assembly (3) on the receptacle bracket (4) on axial compressor housing.

j. Secure cable with four screws and nuts.

k. Position electrical cable leads around axial compressor housing.

l. Place harness plug-in bracket (7) on inlet housing flange.

m. Secure bracket with two nuts.

n. Place electrical cable assembly (3) on harness plug-in bracket (7).

o. Secure cable with four screws and nuts. Install protective cap (8).

p. Place bracket (9) on lower axial compressor flange.

q. Place clamp (10) around electrical cable assembly (3).

r. Secure clamp to bracket (9) with screw and nut.

s. Place clamp (11) around electrical cable assembly.

t. Secure clamp to bracket with screw and nut.

u. Place electrical harness bracket (5) on inlet housing flange.

v. Secure electrical cable assembly (3) to bracket with two spacers and bolts.

w. Connect electrical cable plugs to the connectors for airflow regulator (12), solenoid valve (2), fuel control (13), oil pump (14), anti-icing interpreter (15), and ignition unit (16). Lockwire.

x. Connect electrical cable assembly (17) to anti-icing interpreter (15) and detector (18).

y. Install two igniter plugs (20) on igniter mounts.

z. Lockwire plugs.

CAUTION

Check for interference between combustion chamber liner and igniter plugs by moving plugs slightly from side to side. If either plug rubs against combustion chamber liner, loosen igniter mount screws. Move mount slightly until rubbing stops. Tighten screws. Check again for rubbing. When plugs are clear of interference, tighten screws. Lockwire.

aa. Connect spark igniter plug lead (19) to the ignition unit (16) and igniter plug (20).

ab. Place three clamps (21) around spark igniter lead (19).

ac. Secure clamps to pressure oil line brackets with three screws.

ad. Place flat bracket on diffuser housing.

ae. Secure bracket with bolt.

af. Lockwire bolt.

ag. Place two clamps (22) around spark igniter plug.

ah. Secure clamps with two bolts.

ai. Lockwire bolt.

aj. Place two clamps (23) around spark igniter plug.

ak. Secure one clamp with screw and nut to bracket on combustion chamber.

al. Secure the other clamp to the combustion chamber.

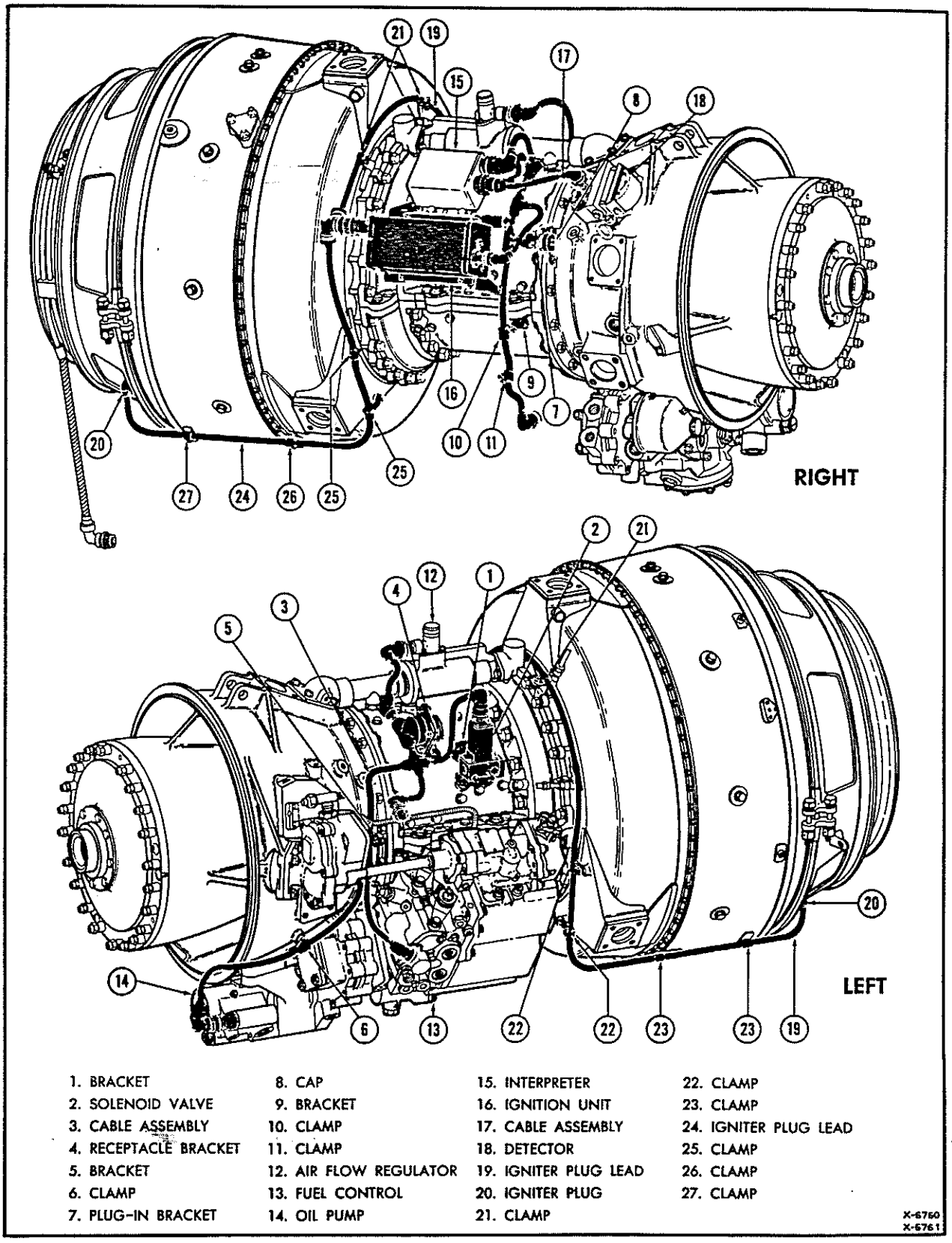


Figure 5-26. Left and Right Side Views of Electrical System (Model T53-L-1)

am. Lockwire screws.

an. Connect spark igniter plug lead (24) to the ignition unit (16) and igniter plug (20).

ao. Place two clamps (25) around spark igniter lead.

ap. Secure one clamp to diffuser housing with screw.

aq. Lockwire screw.

ar. Place bracket on diffuser mount.

as. Secure clamp on the pressure oil hose to bracket with screw.

at. Lockwire.

au. Secure clamp (25) to the bracket with screw and nut.

av. Place clamp (26) around spark igniter lead.

aw. Secure clamp with screw to bracket on combustion chamber flange.

ax. Place clamp (27) around spark igniter lead.

ay. Secure clamp with screw to combustion chamber.

az. Lockwire screw.

5-71. INSTALLATION OF THE ELECTRICAL SYSTEM (MODELS T53-L-1A AND T53-L-1B).

5-72. PROCEDURE. (See figure 5-27.)

a. Place solenoid valve bracket (1) on the axial compressor housing.

b. Secure bracket with four bolts.

c. Place solenoid valve (2) on solenoid valve bracket.

d. Secure solenoid valve with two screws, washers, and nuts.

e. Place receptacle bracket (4) on axial compressor housing.

f. Secure bracket with two bolts.

g. Lockwire bolts.

h. Place electrical cable assembly (3) on receptacle bracket (4).

i. Secure cable with four screws and nuts.

j. Position electrical cable assembly (3) around axial compressor housing.

k. Place electrical cable bracket (5) on inlet housing flange.

l. Secure bracket with two bolts.

m. Place clamp around electrical cable assembly (3).

n. Secure clamp with screw to the electrical cable bracket (5).

o. Place harness plug-in bracket (7) on inlet housing flange.

p. Secure bracket with two nuts.

q. Place electrical cable assembly (3) on harness plug-in bracket (7).

r. Secure cable to the bracket with four screws and nuts.

s. Install protective cap.

t. Place brackets (8, 9, and 10) on axial compressor flange.

u. Secure brackets to flange with bolts.

v. Place two clamps around electrical cable assembly (3).

w. Secure clamps to brackets (8 and 9) with screws and nuts.

x. Place clamp around electrical cable assembly (3).

y. Secure clamp with two washers and screws.

z. Connect electrical cable plugs to the airflow regulator (11), solenoid valve (2), fuel control (12), oil pump (13), anti-icing interpreter (14), ignition unit (15), and anti-icing detector (16).

aa. Install igniter plugs (18) on igniter mounts. Lockwire.

CAUTION

Check for interference between combustion chamber liner and igniter plugs by moving plugs slightly from side to side. If either plug rubs against combustion chamber liner, loosen the igniter mount screws. Move mount slightly until rubbing stops. Tighten screws. Check again for rubbing. When plugs are clear of interference, tighten screws. Lockwire.

ab. Connect spark igniter plug lead (17) to ignition unit (15).

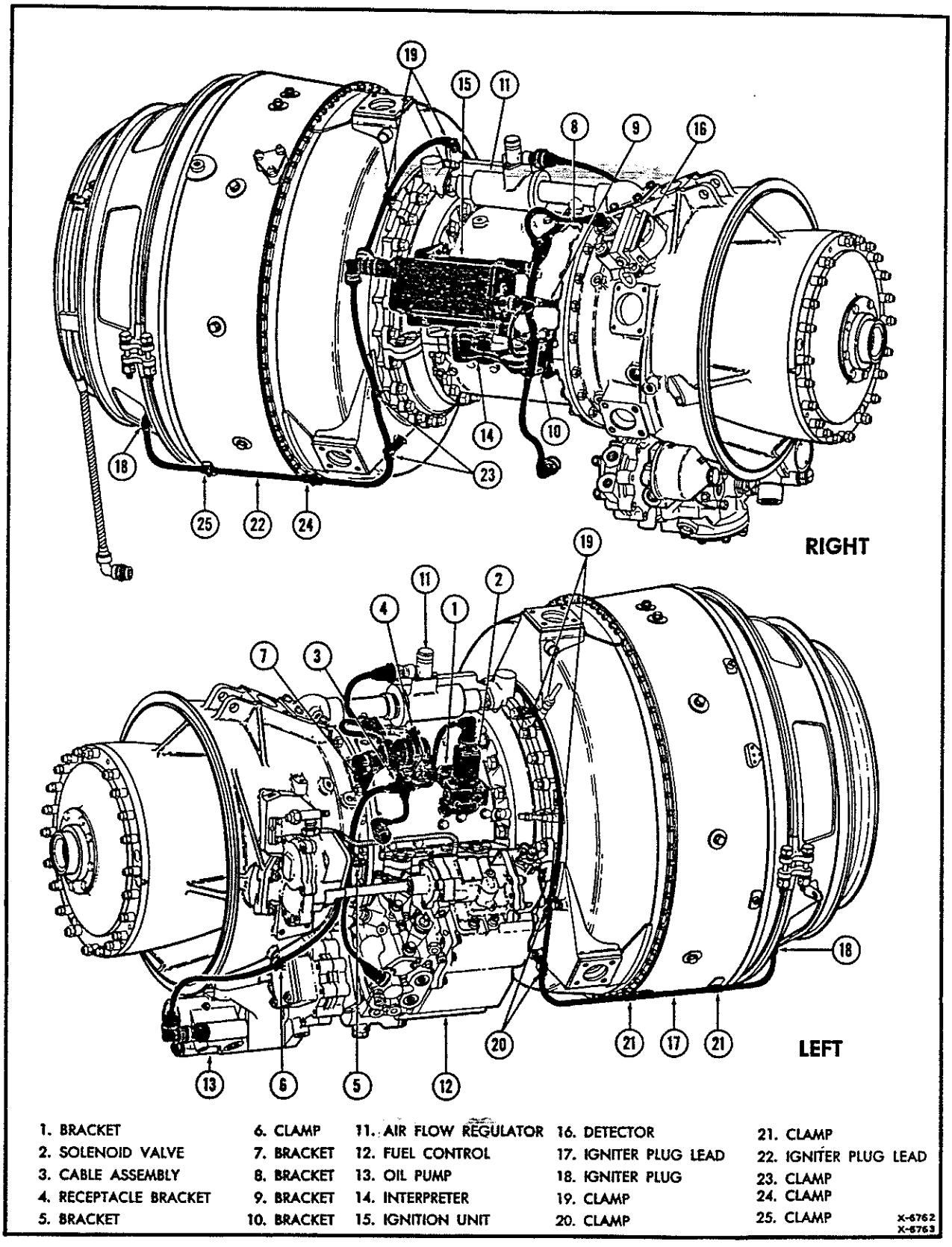
ac. Place three clamps (19) around spark igniter plug.

ad. Secure clamps with three screws to pressure oil hose brackets.

ae. Place flat bracket on diffuser mount.

af. Secure bracket with screw.

ag. Lockwire screw.



1. BRACKET	6. CLAMP	11. AIR FLOW REGULATOR	16. DETECTOR	21. CLAMP
2. SOLENOID VALVE	7. BRACKET	12. FUEL CONTROL	17. IGNITER PLUG LEAD	22. IGNITER PLUG LEAD
3. CABLE ASSEMBLY	8. BRACKET	13. OIL PUMP	18. IGNITER PLUG	23. CLAMP
4. RECEPTACLE BRACKET	9. BRACKET	14. INTERPRETER	19. CLAMP	24. CLAMP
5. BRACKET	10. BRACKET	15. IGNITION UNIT	20. CLAMP	25. CLAMP

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X-6763

Figure 5-27. Left and Right Side Views of Electrical System (Models T53-L-1A and T53-L-1B)

ah. Place two clamps (20) around the spark igniter lead (17).

ai. Secure one clamp with screw.

aj. Lockwire.

ak. Secure the other clamp screw to the flat bracket with screw and nuts.

al. Place two clamps (21) around spark igniter plug lead (17).

am. Secure one clamp with screw and nut.

an. Secure the other clamp with screw to combustion chamber.

ao. Lockwire screw.

ap. Connect spark igniter plug lead to ignition unit (15) and igniter plug (18).

aq. Place flat bracket on diffuser mount.

ar. Secure bracket with screw.

as. Lockwire screw.

at. Place two clamps (23) around spark igniter plug lead (22).

au. Secure one clamp with a screw.

av. Lockwire.

aw. Secure the other clamp with screw and nut.

ax. Place clamp (24) around spark igniter lead.

ay. Secure clamp to the bracket with screw and nut.

az. Place clamp (25) around spark igniter lead.

ba. Secure clamp with screw to combustion chambers.

bb. Lockwire screw.

5-73. INSTALLATION OF THE FUEL SYSTEM.

5-74. PROCEDURE. (See figure 5-28.)

NOTE

Main and starting fuel manifolds (1 and 2) are bracketed together.

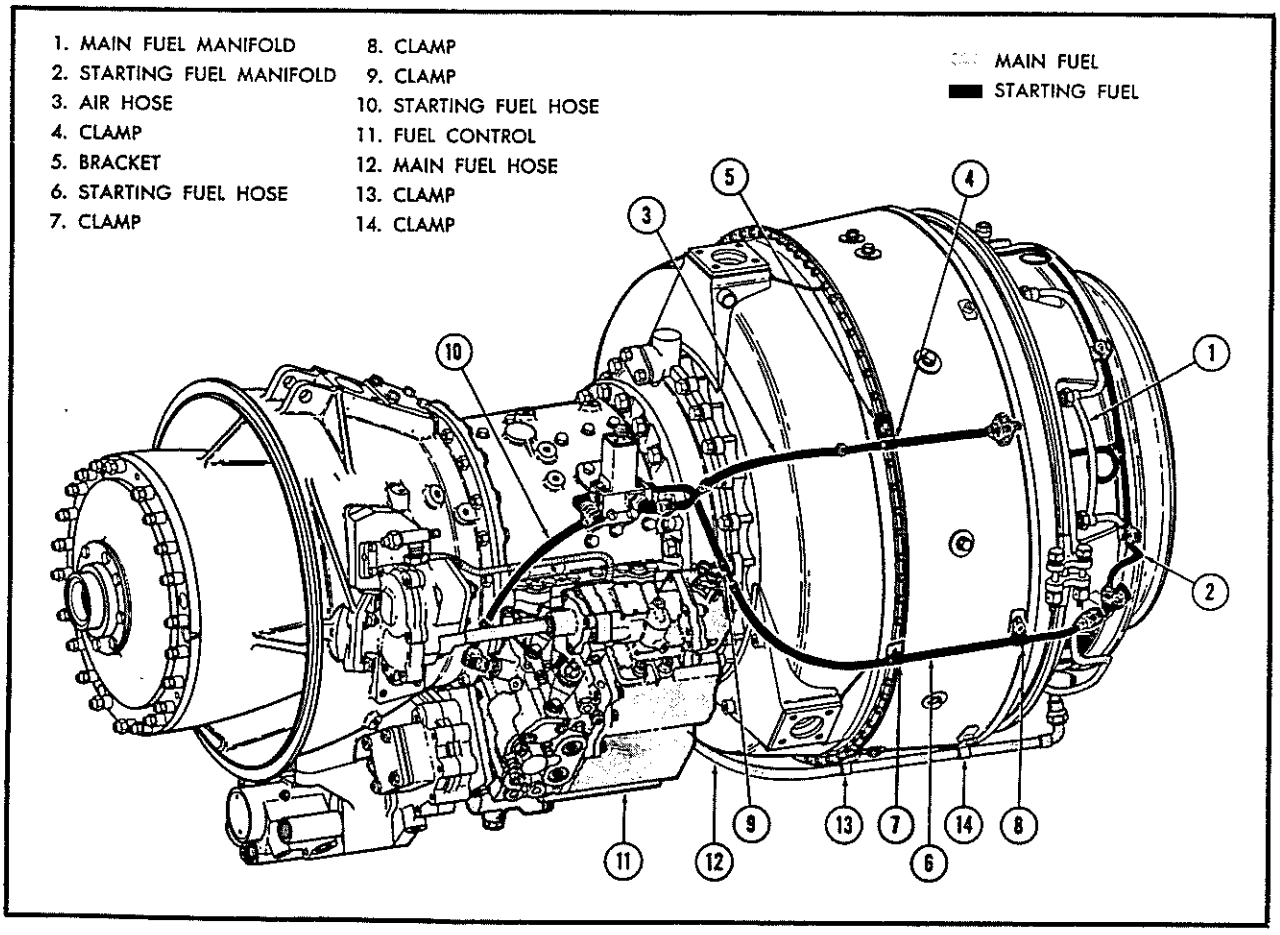

Figure 5-28. Left Side View of Starting and Main Fuel Manifolds and Hoses

a. Connect airhose (3) to elbow on solenoid valve and pressure-tap connector on the combustion chamber.

b. Place bracket (5) on combustion chamber flange.

c. Secure bracket with screw and nut.

d. Connect starting fuel hose (6) to union on solenoid valve and manifold tee.

e. Place clamp (7) around starting fuel hose (6).

f. Secure clamp with screw and nut to bracket.

g. Place clamp (8) around starting fuel hose (6).

h. Secure clamp with screw to combustion chamber.

i. Lockwire screw.

j. Place clamp (9) around starting fuel hose (6).

k. Secure clamp with screw and nut to bracket on centrifugal impeller flange.

l. Connect starting fuel hose (10) to solenoid valve and fuel control (11).

CAUTION

Do not use force when connecting fuel hose to the solenoid valve. If the hose kinks, loosen hose connectors on each end. Loosen impingement starter. Reconnect fuel hose. Retighten impingement starter and hose connectors.

m. Connect main fuel hose (12) to fuel control (11) and main fuel manifold (1).

n. Place clamp (13) around main fuel hose (12).

o. Secure clamp with screw and nut to bracket mounted on combustion chamber flange.

p. Place clamp (14) around main fuel hose (12).

q. Secure clamp with screw to the combustion chamber.

r. Lockwire screw.

SECTION VI

TESTING AFTER REPAIR

6-1. GENERAL.

6-2. This section contains instructions for testing an engine after repair. The test shall be performed with maintenance equipment available.

6-3. In this section, the symbol nI means compressor rotor (gas producer); the symbol nII means power turbine.

6-4. MARKING ON MATERIALS SUBJECT TO HIGH TEMPERATURE.

6-5. Marking on materials subject to high temperature shall be done only with one of the following: Colorbrite marking pencil (yellow, No. 2107); Marco ink (black, No. S1141); Marks-A-Lot ink pencil (red, green, or yellow); or Opco Marker (blue, green, or black).

6-6. SPECIAL TOOL AND EQUIPMENT REFERENCES.

6-7. Special tools and equipment are referenced by group number at the beginning of an operation. To locate tool numbers, refer to the group number in Functional Tool List, Section I.

6-8. STANDARD TOOLS.

6-9. Do not use cadmium plated tools. Cadmium plating has a tendency to chip. If these chips enter the engine they will contaminate the lubrication system and cause magnesium parts to deteriorate.

6-10. TORQUE VALUES.

6-11. Standard torque values are given in Table of Standard Torque Values, in Section VII. Special torque values are given in Table of Limits (figure 7-7), Section VII.

6-12. TABLE OF LIMITS.

6-13. Fit and tolerance measurements are given in Table of Limits, Section VII.

6-14. ENGINE TEST REQUIREMENTS.

6-15. After maintenance, a functional test of the engine in an aircraft or a block test of the engine shall be performed. The test to be performed shall be determined by degree of maintenance.

CAUTION

If an engine has been removed because of internal failure that may have caused the oil to become contaminated with metal particles, the airframe oil system shall be thoroughly flushed and the airframe oil cooler replaced before installation of another engine and/or functional test of an engine in the aircraft.

6-16. REQUIREMENTS FOR FUNCTIONAL TEST OF ENGINE. Tie aircraft down and functionally test the engine if limited maintenance has been performed on any of the following items.

a. Accessories
b. Accessory Drive Gearbox
c. Overspeed Governor and Tachometer Drive
d. External Systems
e. Igniter Nozzle
f. Power Output Gear
g. Torquemeter and Carrier
h. Planetary Sun Gear
i. Combustion Chamber
j. Compressor Rotor Blades
k. First Stage Turbine (not including blade replacement)
l. Second Stage Turbine and Support
m. Combustion Chamber
n. First and Second Stage Turbine Nozzles

NOTE

The first and second stage turbine nozzles may be replaced without engine block test if the replacement nozzle exit area limits can be maintained.

6-17. ENGINE BLOCK TEST REQUIREMENTS. Perform an engine block test when nozzle exit area limits cannot be maintained after a change of compressor rotor assembly or replacement of first or second stage turbine nozzle assembly.

6-18. REQUIRED READINGS FOR TESTING ENGINE.

6-19. Provisions shall be made to take the following readings:

a. Time of day
b. Observed nI and nII rpm
c. Wet- and dry-bulb temperatures
d. True barometric pressure
e. Fuel inlet pressure
f. Observed fuel flow in pph
g. Oil filter outlet pressure in psig
h. Observed average exhaust gas temperature in degrees Fahrenheit

i. Fuel nozzle manifold pressure in psig
j. Compressor inlet pressure in inches of mercury absolute
k. Compressor inlet temperature in Fahrenheit
l. Vibration displacement in mils
m. Vibration velocity in inches per second
n. Torquemeter pressure
o. Accessory drive gearbox pressure

NOTE

A differential pressure gage may be installed on the engine to obtain readings n. and o.

p. Oil pump discharge temperature.

6-20. ATMOSPHERIC CONDITIONS.

6-21. The performance of shaft turbine engines is greatly affected by surrounding atmospheric conditions, such as air pressure, temperature, and vapor pressure. Because it is not practical to provide test values for all atmospheric conditions, such values shall be compared in performance charts with the minimum allowable performance corrected to standard atmospheric conditions.

6-22. EXHAUST GAS TEMPERATURE.

6-23. SPECIAL TOOLS AND EQUIPMENT. (Refer to group number 22.)

6-24. Exhaust gas temperature is an average of the readings obtained from three thermocouples located in the thermocouple harness. If temperature reading is abnormally high or low, check out the thermocouple harness with a jet-cal tester. (See figure 1-33.)

6-25. FUEL.

6-26. Use engine fuel, Military Specification MIL-J-5161 or MIL-J-5624, during engine test.

6-27. Fuel inlet pressure shall be 15 to 25 psi. Fuel temperature shall be as delivered.

6-28. LUBRICATION.

6-29. Use lubricating oil, Military Specification MIL-L-7808, at all operating temperature ranges.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

6-30. ENGINE PREPARATION FOR BLOCK TEST.

6-31. SPECIAL TOOL AND EQUIPMENT REFERENCES. (Refer to group number 19.)

6-32. Install the following fittings and equipment on the engine to facilitate pressure, temperature, and other readings:

a. One AN815-4 union in boss on anti-icing tube for measuring anti-icing pressure.

b. One AN832-4D union in fuel control inlet pressure fitting.

c. Two AN815-4 unions in fitting for fuel control pump pressures.

d. One AN790-C4 elbow at oil pump discharge pressure fitting.

e. One AN815-4 union at oil filter outlet pressure fitting.

f. One AN815-4 union at torquemeter.

g. One filter fitting on main fuel manifold.

h. One AN815-4 union on accessory drive gearbox.

i. One thermocouple in tee fitting at number two main bearing oil scavenge line. (See figure 1-17.)

j. One thermocouple in tee fitting at numbers three and four main bearings oil scavenge line. (See figure 1-17.)

k. One union at oil pump inlet.

l. One union at scavenge pump discharge.

m. One AN815-4 union on overspeed governor seal drain line.

n. One AN815-4 union in fuel control seal drain.

o. One AN815-4 union in starter seal drain.

p. One AN815-4 union in fuel control inlet boss.

q. One AN919-12 union in gearbox vent fitting.

r. Two tachometer generators on pads provided.

s. Fuel control power levers on compressor rotor governor shaft and power turbine governor shaft.

t. One inner and one outer bellmouth. (See figures 1-19 and 1-20.)

6-33. DETERMINING nI SPEED FOR A STANDARD DAY.

6-34. PROCEDURE. (See figure 6-1.)

a. Measure and record ambient temperature in degrees Fahrenheit.

b. Measure percentage of actual nI speed.

c. Divide the percentage of actual nI speed by the deviation in regulated nI speed corresponding to the measured ambient temperature. The result is the standard day nI speed.

6-35. FUEL CONTROL ADJUSTMENTS.

6-36. PROCEDURE.

a. With a suitable wrench, loosen lockscrew. (See figure 6-2.)

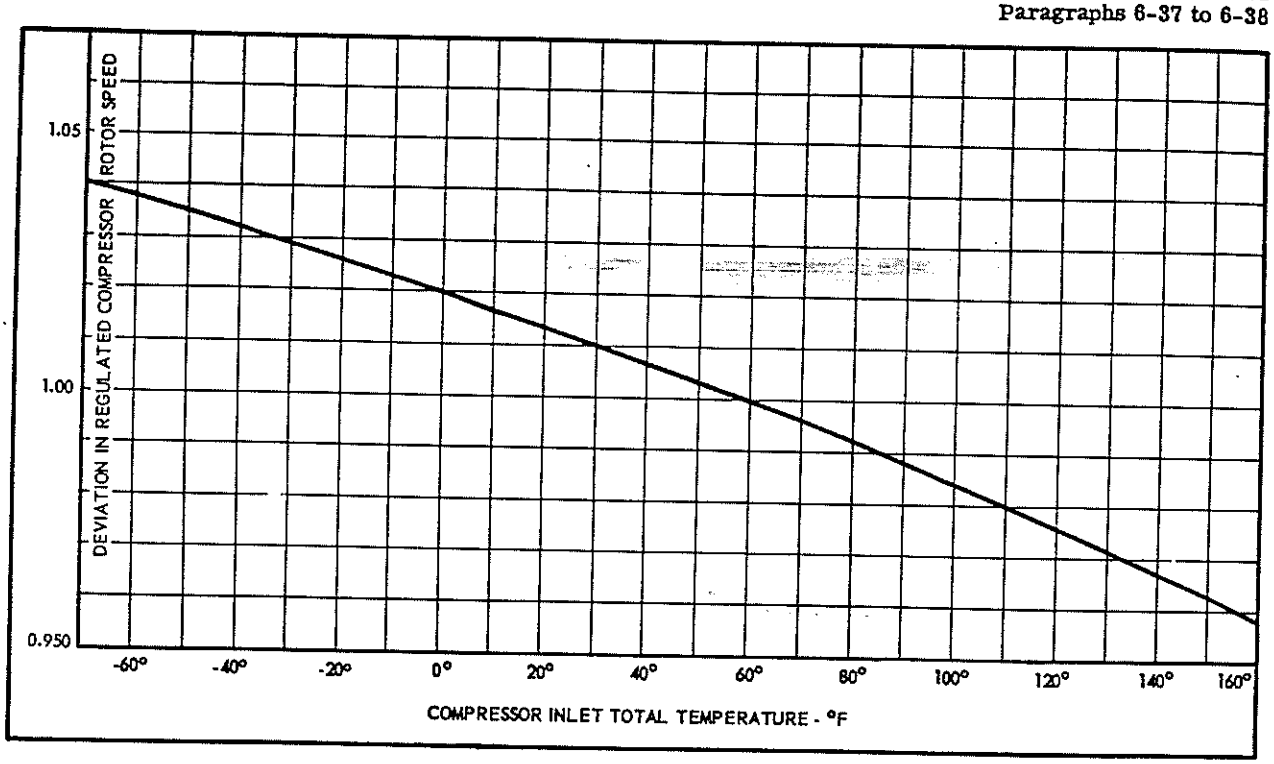

Figure 6-1. Bias Curve Chart

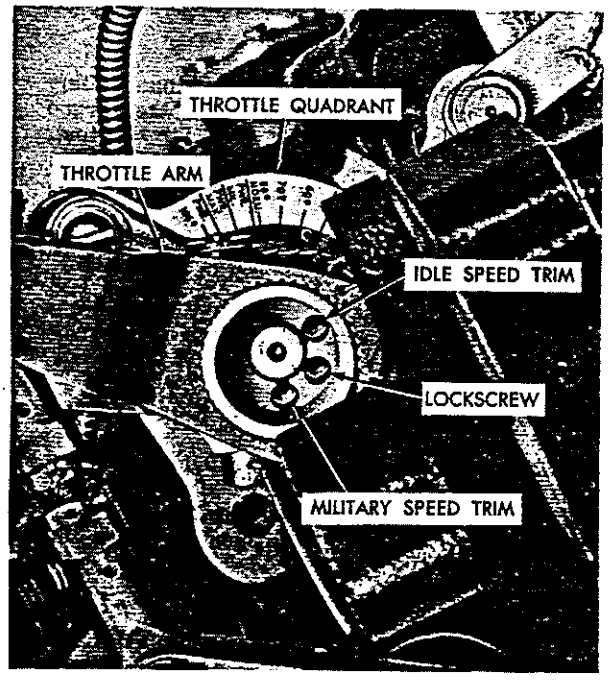

Figure 6-2. Idle and Military Speed Trim Adjustments

NOTE

To decrease fuel rate, turn screw clockwise. To increase fuel rate turn screw counter-clockwise.

b. At ground idle, when idle speed trim is adjusted, read change in rpm.

c. Estimate the military speed trim adjustment as follows. One turn of military speed trim is equivalent to ten percent change in fuel rate at MRP. Adjust military speed trim while engine is operating at ground idle.

NOTE

Remove the backlash between increase and decrease settings before counting turns in either direction.

d. Tighten lockscrew securely after adjustment.

6-37. PRESSURE REGULATING VALVE ADJUSTMENT.

6-38. PROCEDURE.

a. Cut lockwire from automatic pressure regulating valve adjustor. (See figure 6-3.)

b. Increase setting to decrease acceleration time and decrease setting to increase acceleration time.

NOTE

One turn equals approximately one second change in acceleration time.

6-39. DETERMINING STANDARD DAY DO-NOT-EXCEED nI SPEED FOR THE T53-L-1B ENGINE.

6-40. GENERAL. An engine power check is required when an engine component that affects engine performance has been replaced and test cell information is not available. The following conditions shall be met before attempting to determine the standard day-do-not-exceed nI (gas producer) speed for the T53-L-1B engine.

a. Tachometer nI red line reading must never exceed 97 percent actual do-not-exceed-speed.

b. Exhaust gas temperature red line reading must never exceed 593°C(1100°F).

c. Torquemeter gage reading must be accurate to plus or minus 0.500 psi.

d. Customer airbleed switch must be in off position.

e. Under no circumstances is the aircraft to be trimmed under inlet icing conditions.

f. When a fuel control has been replaced on an engine, perform an acceleration check by accelerating from flight idle to maximum available torque five times, before attempting to stabilize the engine for trimming.

g. Depreservation procedures shall be observed.

h. Use extreme care to ensure proper fuel control trim settings. Proper trim adjustments ensure the following:

(1) Availability of desired torque.

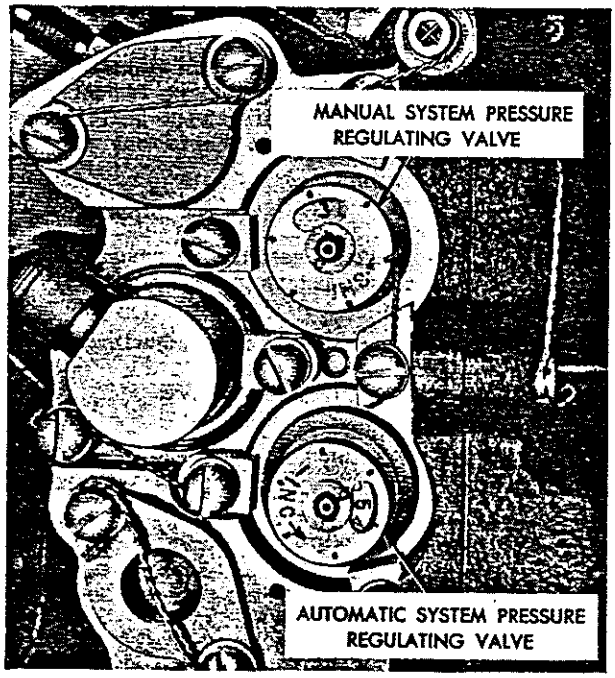

Figure 6-3. Manual and Automatic Pressure Regulator Adjustments

(2) Protection against extreme overtemperature.

(3) Protection against overspeed problems.

(4) Fewer ground delays due to maintenance.

(5) Longer periods between trim adjustments.

(6) Maximum engine life.

6-41. To determine a base point on figure 6-4, proceed as follows:

a. Determine pressure altitude and outside air temperature.

b. Locate the pressure altitude point on the y-axis of figure 6-4.

c. Locate the outside air temperature point on the x-axis of figure 6-4.

d. To locate the base point on figure 6-4, draw a horizontal line through the altitude point on the y-axis, or pressure altitude axis, parallel to the x-axis. Draw a vertical line through the outside air temperature axis, parallel to the y-axis. The intersection of these two lines is the base point that will be used in this test.

EXAMPLE:

Given: Pressure altitude ..... 5000 feet
Outside air temperature ..... 68°F(20°C)

e. Using the data given above and following the procedure in steps b. through d., determine the location of the base point in figure 6-4. This base point is given in figure 6-4 as point A.

NOTE

The torque pressure line located immediately above base point A represents the torque pressure line that will be used for this test.

EXAMPLE:

The 31 psi torque pressure line is immediately above point A.

6-42. To stabilize the pressure altitude and outside air temperature readings on the 31 psi torque pressure line, proceed as follows.

a. Set the aircraft altimeter at 29.92.

b. Climb the aircraft to an altitude above point A (5000 feet altitude) at an air speed of 30 to 60 knots, until both pressure altitude and outside air temperature stabilize on the 31 psi torque pressure line of figure 6-4.

6-43. To determine test altitude point B in figure 6-4, draw a line from point A parallel to either of standard lapse rate lines in figure 6-4, until the 31 psi torque pressure line is intersected. The point of intersection is test altitude point B.

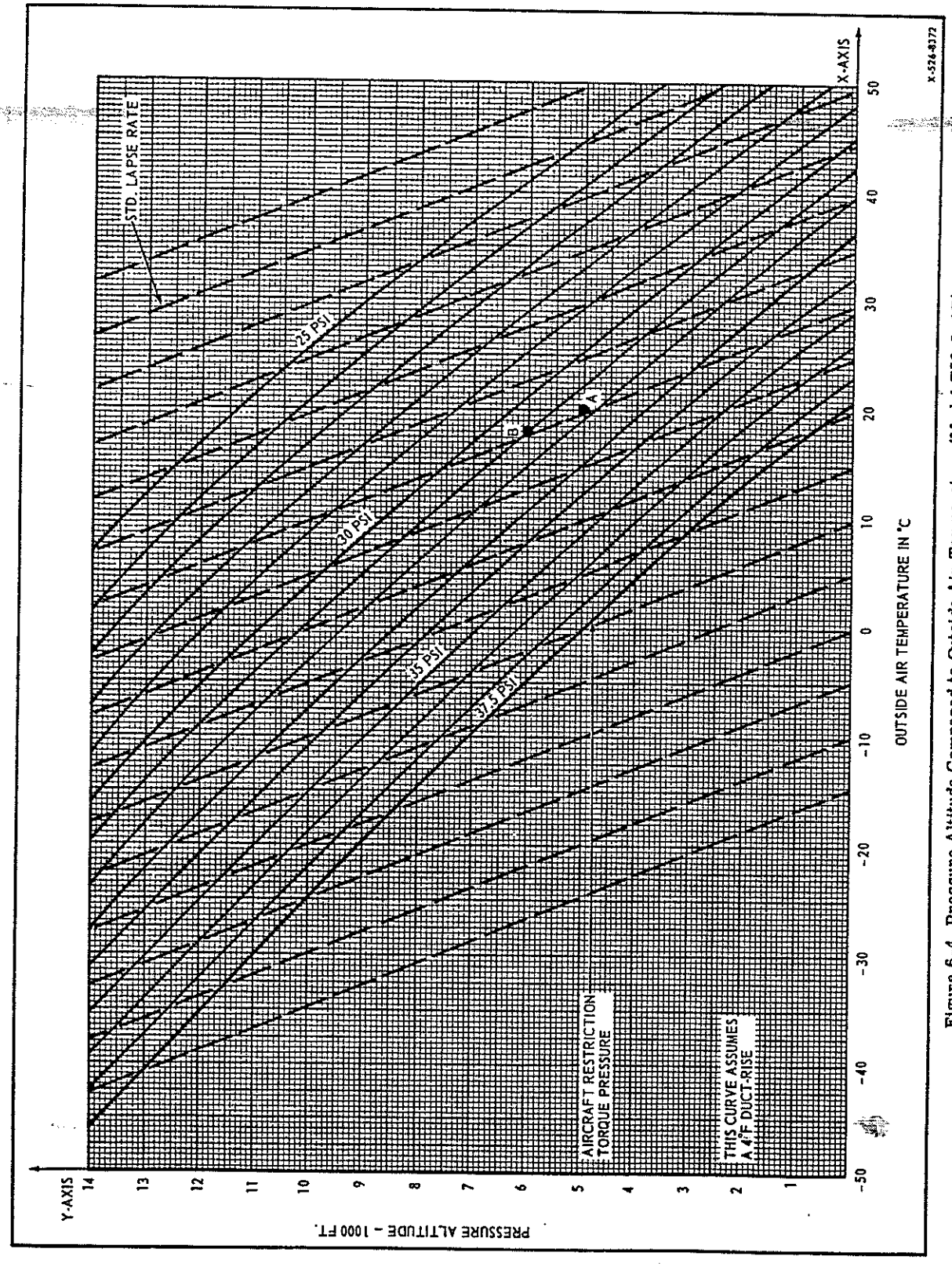

Figure 6-4. Pressure Altitude Compared to Outside Air Temperature (Model T53-L-1B)

6-44. To determine test altitude point B in figure 6-4 by a second method, use a standard lapse rate of 2°C per 1000 feet.

EXAMPLE:

A standard lapse rate of 2°C per 1000 feet above point A in figure 6-4, would predict a 6000 foot base pressure altitude and 64.4°F (18°C) outside air temperature at the test altitude. This test altitude is given in figure 6-4 as point B.

NOTE

The actual test altitude is the combination of pressure altitude and outside air temperature that falls on the torque pressure line of figure 6-4. The test altitude used in this example occurs when a torquemeter pressure of 31 psi is achieved. The use of standard lapse rate, 2°C per 1000 feet, is for preflight planning purposes only.

6-45. When the proper test altitude (point B) for actual atmospheric conditions has been determined, increase speed at the test altitude or rate of climb through the test altitude, until the test torque level indicates 105 percent nII speed. Hold the test torque at 31 plus or minus 0.500 psi. At 31 plus or minus 0.500 psi and 6000 feet base pressure altitude, record the following readings.

a. Test altitude in psi

b. Outside air temperature in °C

c. Test torque

d. nI speed required to develop test torque

e. Exhaust gas temperature.

NOTE

If the military speed trim adjustment is set low, it may not be possible to reach the required test torque at the specified test altitude. A readjustment of the military speed trim is required.

6-46. To readjust the military speed trim setting proceed as follows.

a. Record test altitude, outside air temperature, and the maximum available torque at 105 percent nII speed.

b. Land the aircraft and loosen the lockscrew shown in figure 6-2. Turn the nI military speed trim screw one-quarter turn counterclockwise for each one psi that the maximum torque is below the test torque level, and one-quarter turn clockwise for each one psi that the maximum torque is above the test torque level. After making the military speed trim adjustment, tighten the lockscrew.

EXAMPLE:

If maximum available torque at 6000 feet and 64.4°F(18°C) is 28 psi, turn the military speed trim screw three-quarters of a turn counterclockwise. This will increase the torque to 31 psi which is equal to the test torque.

c. Repeat procedures in paragraphs 6-39 through 6-46 until the test torque can be achieved at the outside air test temperature and test altitude. Record the data (paragraph 6-45, readings a. through e.).

NOTE

If outside air temperature has changed at test altitude since the last flight, the torque pressure will also change. To obtain the new test torque pressure required, refer to figure 6-4.

d. The nI speed recorded in paragraph 6-45, step d. is the actual do-not-exceed nI speed for the outside air temperature. The actual do-not-exceed nI speed shall be adjusted using the temperature bias curve shown in figure 6-5.

6-47. To adjust the actual do-not-exceed nI speed, proceed as follows.

a. Algebraically subtract the temperature bias correction, obtained from figure 6-5, from the actual do-not-exceed nI speed recorded in paragraph 6-45, step d. The difference that is obtained is the Standard Day DO-NOT-EXCEED nI SPEED.

EXAMPLE:

Using test temperature of 64.4°F(18°C), determine from figure 6-5 the maximum allowable corrected nI. At 64.4°F(18°C) the temperature correction is -0.35 percent.

Therefore: Test temperature equals 64.4°F(18°C), nI test speed equals 96.5 percent, temperature bias correction equals -0.35 percent.

Algebraically subtract the temperature bias correction from the test nI speed.

96.5 percent - (-0.35 percent) equals 96.85 percent.

Therefore 96.85 percent is Standard Day DO-NOT-EXCEED nI SPEED.

b. Enter the final recorded data (paragraph 6-45) and the Standard Day DO-NOT-EXCEED nI SPEED (96.85 percent) in the engine logs, AFTO Form 781, Aircraft Flight Report, and Maintenance Record.

c. The recorded Standard Day DO-NOT-EXCEED nI SPEED shall be used for all future nI check-outs for that T53-L-1B engine.

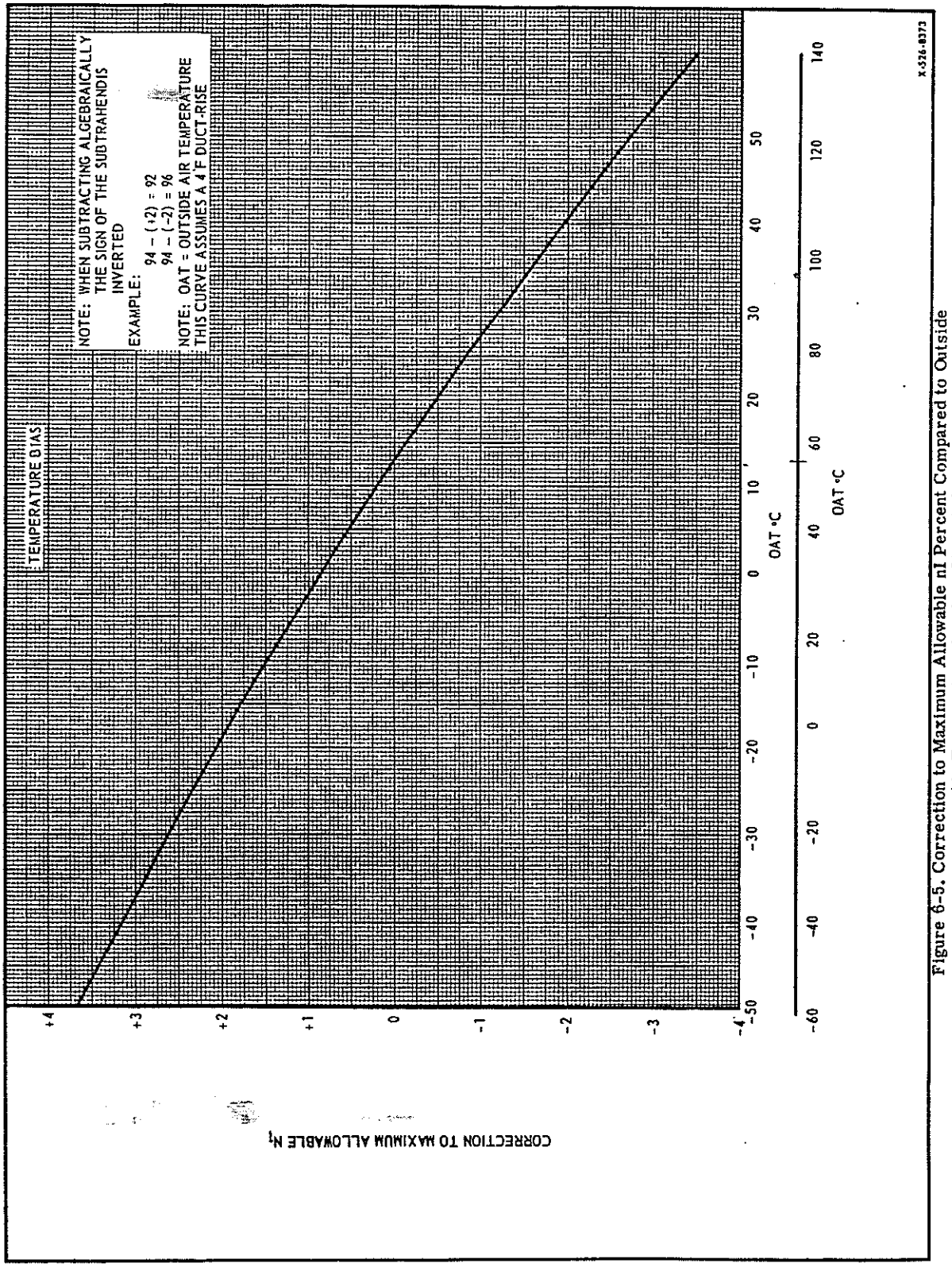

Figure 6-5. Correction to Maximum Allowable n1 Percent Compared to Outside Air Temperature (Model T53-L-1B)

6-48. ENGINE VIBRATION TEST.

6-49. GENERAL. An engine vibration test is required after the first stage turbine wheel, the second stage turbine wheel, the combustion section, or the exhaust section is removed and reinstalled, or when excessive engine vibration is suspected. The vibration test measures axial and radial vibrations in mils. Vibration pickups, attached to adapters on the engine, transmit impulses to the vibration meter, which indicates the peak-to-peak displacement of the vibration cycles and the average velocity. These readings are compared with the maximum permissible engine motion limits to determine the acceptability of an engine for use.

6-50. VIBRATION METER TRIM ADJUSTMENT.

6-51. SPECIAL TOOLS. (Refer to group number 21.)

6-52. PROCEDURE.

a. Inspect vibration meter (figure 6-6) to be sure it includes an internal 70 cycle high-pass filter, P/N CEC 1-003-70. If filter is not included with meter, it must be installed, as follows.

(1) Remove meter housing.

(2) Plug filter into INPUT NETWORK socket number 1.

(3) Lock filter with screw.

(4) Reinstall meter housing.

(5) Using India Ink, print "70 CPS" below number 1 on face of INPUT NETWORK dial.

b. Connect vibration meter power lead to a suitable source of electrical power (105 to 125 v, 50/60/400 cycles, 30 watts).

c. With meter power switch on, allow approximately one half hour warm-up time for meter temperature to stabilize.

NOTE

Any suitable source of power may be used for preliminary meter warm-up. However, trim of meter must be adjusted with same source of power to be used during vibration test.

d. Set OPERATION dial to C. (Needle will move to right of scale.)

e. Set CHANNEL dial to 1.

f. Push in CALIBRATE SIGNAL control knob. Turn knob until meter indicates 9.9 on 0 to 15 scale.

NOTE

If reading of 9.9 cannot be obtained, meter must be recalibrated internally by qualified personnel.

g. Carefully release knob without turning. Meter should indicate 15.0 on 0 to 15 scale.

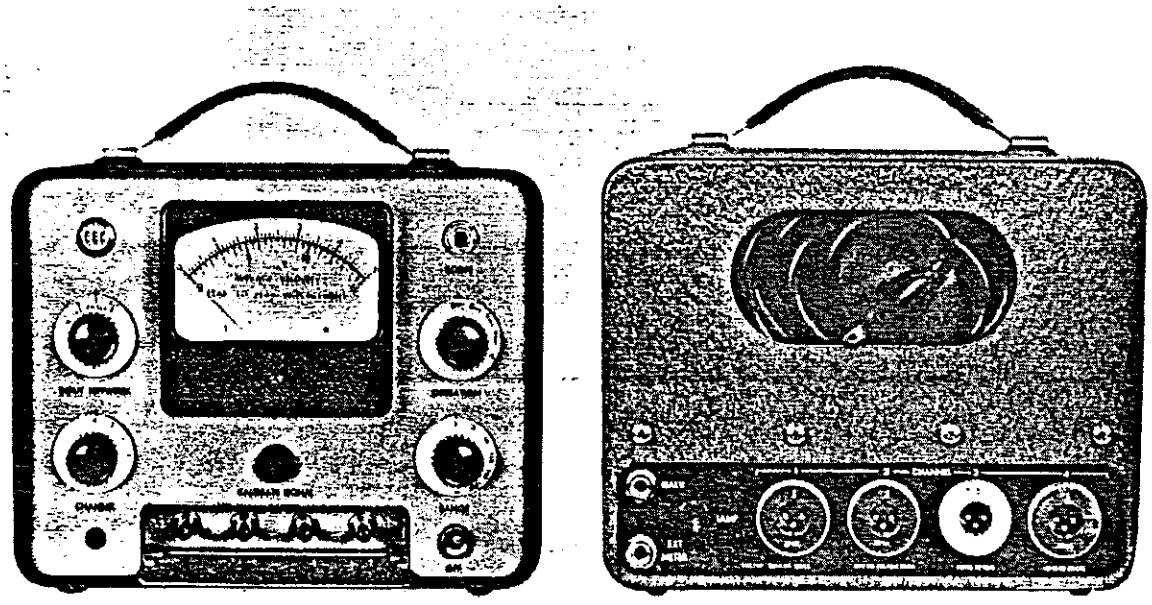

Figure 6-6. Vibration Meter

NOTE

If reading of 15.0 is not obtained, perform step h. If reading of 15.0 is obtained proceed to step i.

h. Adjust the SENSITIVITY control as follows.

(1) Open cover below CALIBRATE SIGNAL control.

(2) Turn SENSITIVITY control screw for channel being trimmed, until meter indicates 15.0.

(3) If reading of 15.0 cannot be obtained, meter must be recalibrated internally by qualified personnel.

i. Repeat steps f. and g. until 9.9 reading and 15.0 reading are assured.

j. Repeat steps f. through h. for channels 2, 3, and 4.

6-53. VIBRATION PICKUP CHECK.

6-54. SPECIAL TOOLS. (Refer to group number 21.)

6-55. PROCEDURE.

NOTE

Handle vibration pickup with care. If a vibration pickup is dropped or struck with force, its accuracy will be destroyed.

a. Adjust trim of vibration meter. (Refer to paragraph 6-50.)

b. Connect each of the four vibration pickup leads, P/N CEC 4-118-0107, to each of the four cable assemblies, P/N CEC 49657-0300, at disconnect plug. (Refer to paragraph 6-62 if only three pick-ups are available.)

c. Connect cable assemblies to vibration meter at proper receptacles. (See figure 6-6.)

d. Turn power switch on. Set OPERATION dial to Dx0.1.

e. Set CHANNEL dial to 1.

f. While observing vibration meter needle, shake pickup by hand. Meter needle should show slight movement.

NOTE

If needle does not jog or show slight movement, check condition of pickup, connectors, cable, and vibration meter receptacle. Replace defective items.

g. Repeat step f. for channels 2, 3, and 4.

6-56. INSTALLATION OF VIBRATION TEST EQUIPMENT.

6-57. SPECIAL TOOLS. (Refer to group number 21.)

6-58. PROCEDURE.

NOTE

Check the airframe engine mounts for looseness, wear, or insufficient torque before attempting a vibration check. Secure Marman clamps, inlet ducts and screens, exhaust pipe with clamps, lines, and hoses before testing.

a. Remove engine bolts as necessary, and install four adapters on engine. (See figures 6-7 and 6-8.)

Adapter Part No. (Figure 6-9 or Figure 6-10)	Adapter Attaching Location (Figure 6-8)	Vibration Pickup Attaching Location (Figure 6-8)	Pickup Cables to Vibration Meter Attaching Location (rear of meter) (Figure 6-6)
LTC-T429	Inlet Housing, Forward Engine Mount Pad	Attach pickups to adapter pads	No. 1 Channel
LTC-T427	Diffuser Flange, Vertical, 12 o'clock position		No. 2 Channel
LTC-T428	Power Turbine Nos. 3 and 4 Oil Strainer Housing		No. 3 Channel
LTC-T433	Diffuser Flange Axial, 11:30 o'clock position		No. 4 Channel — If a fourth pickup is not available, refer to paragraph 6-62.

Figure 6-7. Installation of Vibration Equipment

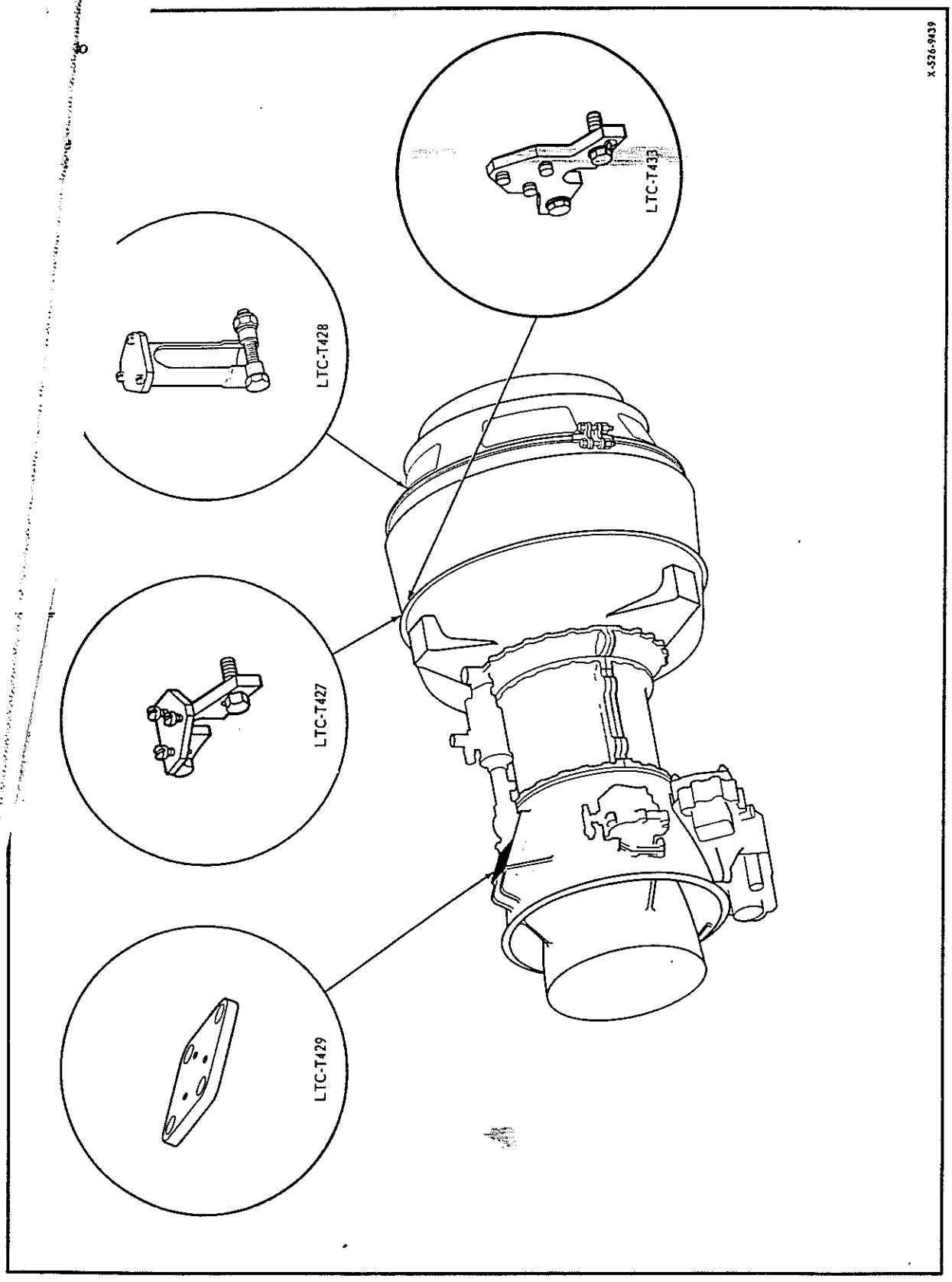

Figure 6-8. Location of Engine Vibration Adapters

NOTE

The inlet housing adapter must be attached with engine mounting bolts. The power turbine adapter is attached to the oil strainer housing line. Tighten all adapter attaching bolts to between 250 and 325 pound-inches torque.

b. Secure each vibration pickup to each adapter with three 4-40 screws. (Refer to paragraph 6-62 if only three pickups are available.)

NOTE

Attach vibration pickups securely to avoid possibility of vibration frequencies originating at the point of attachment.

c. Secure all wiring to engine with tape, cord, or other means.

CAUTION

Avoid kinks and sharp bends in cables. Avoid conditions which would cause cables to deteriorate from heat or abrasion.

d. Connect vibration meter power lead to suitable electrical power source (105 to 125 V, 50/60/400 cycles, 30 watts).

NOTE

Use any source of suitable electrical power for vibration meter preliminary warm-up. Meter trim must be adjusted with same source of power used for testing.

6-59. ENGINE VIBRATION TEST.

6-60. PROCEDURE.

a. Adjust trim of vibration meter. (Refer to paragraphs 6-50 through 6-52.)

b. Check operation of vibration pickups. (Refer to paragraphs 6-53 through 6-55.)

c. Install vibration test equipment. (Refer to paragraphs 6-56 through 6-58.)

d. Perform prestart check. (Refer to paragraphs 6-71 through 6-73.)

e. Start engine. (Refer to paragraphs 6-74 and 6-75.)

f. With meter power on, make sure meter has warmed up sufficiently for temperature to stabilize.

g. Adjust vibration meter dials as follows.

(1) Set INPUT NETWORK dial at 1.

(2) Set OPERATION dial at Dx1.0.

(3) Set RANGE dial at 5.

h. Prepare proper ENGINE VIBRATION ANALYSIS DATA SHEET (figure 6-9 or 6-10) for engine to be tested by completing form at top of data sheet.

NOTE

Figure 6-9 shows vibration data sheet for models T53-L-1 and L-1A. Figure 6-10 shows vibration data sheet for model T53-L-1B.

i. Perform engine vibration test at nI and nII speeds in columns 1 and 2 of data sheet.

j. Take reading of peak-to-peak displacement in mils by switching CHANNEL dial to applicable pickup.

NOTE

Take readings of peak-to-peak displacement from 0 to 5 scale, only after vibration meter needle has stabilized.

k. Record readings in appropriate columns (3, 4, 5, and 6) of data sheet.

l. Compare readings, as recorded, with maximum permissible engine motion given in parentheses. If recorded readings exceed maximum permissible engine motion, obtain reading of average velocity at that nI and nII speed, as follows.

(1) Set OPERATION dial to Vx1.0.

(2) Record reading in column 7 or 8 of the data sheet, noting pickup number.

CAUTION

To prevent possible damage to the engine when peak-to-peak displacement exceeds the allowable limit by more than 1.5 mils, record the velocity reading and shut down the engine.

NOTE

After shutting down engine, check vibration meter trim adjustments to ensure proper readings. If trim adjustment is correct, refer to paragraph 6-61, steps a. and b.

(a) If the peak-to-peak displacement exceeds the allowable limit by less than 1.5 mils, record the velocity reading, then proceed to the next higher speed called for on the vibration data sheet.

(b) If the peak-to-peak displacement on the next higher speed still exceeds the allowable limit (numbers in parentheses on vibration data sheet), record the velocity reading and shut down the engine.

(c) If the peak-to-peak displacement at the next higher speed is within the allowable limit, continue the vibration testing.

(3) At the conclusion of the vibration test, recheck the trim of the vibration meter. (Refer to paragraph 6-52, steps d. through j.)

1A Engine Vibration Analysis Data Sheet

Engine Serial No. _____

_____ Date _____ A/C Time _____ Engine Time _____

_____

117 (with 70CPS Filter) Serial Number _____

.0107 Cable CEC 49657-0300

		3	4	5	6	7	8
	rcent	#1 Pickup Inlet Housing	#2 Pickup Diffuser Flange Vertical	#3 Pickup Power Turbine Oil Line	#4 Pickup Diffuser Flange Axial	Average Velocity When Required	
		S/N _____	S/N _____	S/N _____	S/N _____	Pickup No.	Pickup No.
00	75	(3.0)	(3.0)	(4.1)	(3.0)		
,000	80	(3.0)	(3.0)	(4.1)	(3.0)		
6,000	85	(3.0)	(3.0)	(4.1)	(3.0)		
6,000	90	(3.0)	(3.0)	(4.1)	(3.0)		
6,000	93	(3.0)	(3.0)	(4.1)	(3.0)		
6,000	Max	(3.0)	(3.0)	(4.1)	(3.0)		
6,200	75	(3.0)	(3.0)	(3.9)	(3.0)		
6,200	80	(3.0)	(3.0)	(3.9)	(3.0)		
6,200	85	(3.0)	(3.0)	(3.9)	(3.0)		
6,200	90	(3.0)	(3.0)	(3.9)	(3.0)		
6,200	93	(3.0)	(3.0)	(3.9)	(3.0)		
6,200	Max	(3.0)	(3.0)	(3.9)	(3.0)		
6,400	75	(3.0)	(3.0)	(3.8)	(3.0)		
6,400	80	(3.0)	(3.0)	(3.8)	(3.0)		
6,400	85	(3.0)	(3.0)	(3.8)	(3.0)		
6,400	90	(3.0)	(3.0)	(3.8)	(3.0)		
6,400	93	(3.0)	(3.0)	(3.8)	(3.0)		
6,400	Max	(3.0)	(3.0)	(3.8)	(3.0)		

NOTE: Figures in parenthesis are maximum permissable engine motion. If figures are exceeded, record velocity in column 7 or 8.

X-526-9440

Figure 6-9. Vibration Data Sheet (Models T53-L-1 and T53-L-1A)

Checked By _____

T53-L-1B Engine Vibration Analysis Data Sheet

Aircraft Serial No. _____ Engine Serial No. _____

Location _____ Date _____ A/C Time _____ Engine Time _____

Reason for Check _____

Vibration Meter Type – CEC 1-117 (with 70CPS Filter) Serial Number _____

Vibration Pickup CEC 4-118-0107 Cable CEC 49657-0300

1	2	3	4	5	6	7	8
n_{II} %	n_I %	#1 Pickup Inlet Housing	#2 Pickup Diffuser Flange Vertical	#3 Pickup Power Turbine Oil Line	#4 Pickup Diffuser Flange Axial	Average Velocity When Required	
		S/N _____	S/N _____	S/N _____	S/N _____	Pickup No.	Pickup No.
		Displacement (MILS)	Displacement (MILS)	Displacement (MILS)	Displacement (MILS)		
96	75	(3.0)	(3.0)	(4.1)	(3.0)		
96	80	(3.0)	(3.0)	(4.1)	(3.0)		
96	85	(3.0)	(3.0)	(4.1)	(3.0)		
96	90	(3.0)	(3.0)	(4.1)	(3.0)		
96	93	(3.0)	(3.0)	(4.1)	(3.0)		
96	Max	(3.0)	(3.0)	(4.1)	(3.0)		
100	75	(3.0)	(3.0)	(3.9)	(3.0)		
100	80	(3.0)	(3.0)	(3.9)	(3.0)		
100	85	(3.0)	(3.0)	(3.9)	(3.0)		
100	90	(3.0)	(3.0)	(3.9)	(3.0)		
100	93	(3.0)	(3.0)	(3.9)	(3.0)		
100	Max	(3.0)	(3.0)	(3.9)	(3.0)		
104	75	(3.0)	(3.0)	(3.8)	(3.0)		
104	80	(3.0)	(3.0)	(3.8)	(3.0)		
104	85	(3.0)	(3.0)	(3.8)	(3.0)		
104	90	(3.0)	(3.0)	(3.8)	(3.0)		
104	93	(3.0)	(3.0)	(3.8)	(3.0)		
104	Max	(3.0)	(3.0)	(3.8)	(3.0)		

Figure in parenthesis ( ) is the maximum permissable engine motion. If this figure is exceeded, record velocity in column 7 or 8. X-526-9441

Figure 6-10. Vibration Data Sheet (Model T53-L-1B)

.gine vibration test,
of peak-to-peak dis-
d the maximum per-
n figures in parentheses
nd 6. If these figures are
velocity readings must be
ngineering evaluation.

missible engine motion is exceeded
1, 2, or 4, engine disposition must
field engineering.

. permissible engine motion is exceeded
ber 3, the second stage power turbine
ated. (Refer to paragraph 6-63.)

NE VIBRATION TESTING WITH THREE

only three vibration pickups are available,
act engine vibration test for channels 1, 2, and 3
ording to the procedures outlined in paragraphs
48 through 6-61.

b. Record these vibration test readings in columns 3, 4, and 5 of the vibration data sheet.

c. To obtain readings for column 6 of the vibration data sheet proceed as follows.

(1) Remove pickup from the diffuser flange adapter and install it on diffuser flange axial adapter. (See figures 6-7 and 6-8.) Do not disconnect cable from vibration meter channel number 2.

(2) Using procedures outlined in paragraphs 6-48 through 6-61, repeat only one of the three nII speed settings (such as 100 percent nII) with the accompanying six nI speeds.

NOTE

Since the pickup mounted on the diffuser flange axial adapter measures nI vibration only, it is not necessary to vary nII speed to obtain the readings.

(3) Record the reading from channel number 2 in column 6 of the data sheet.

6-63. SECOND STAGE POWER TURBINE RELOCATION. Remove combustion chamber as described in paragraph 2-44, steps a. through k. Do not remove combustion chamber completely, move it rearward only enough to allow rotation of the second stage power turbine without disturbing the position of the power shaft.

NOTE

Before disengaging the power shaft and power turbine completely, mark the power spline and power turbine journal axially with a Colorbrite marking pencil (yellow, No. 2107) to provide indication for power turbine relocation.

CAUTION

Do not use lead pencil when marking power shaft and power turbine.

6-64. Proceed as follows.

a. Rotate the power turbine 180 degrees for the first relocation.

b. Using lifting sling and hoist, position combustion chamber over diffuser housing.

c. Secure combustion chamber to diffuser housing with 72 bolts and nuts. Remove sling.

d. Install power shaft bolt adapter, two packing seals, and lockwashers that aline and secure the power turbine to the power shaft.

e. Tighten power shaft bolt to between 195 and 200 pound-inches torque. Release torque to zero pound-inches. Retighten power shaft bolt to between 115 and 125 pound-inches torque.

6-65. Run engine again to determine vibration evaluation. (Refer to instructions in paragraphs 6-48 through 6-61.) Vibration meter readings will either be within specified limits or will greatly exceed the original readings. If meter readings are still in excess of specified limits, rotate the second stage power turbine an additional 90 degrees.

NOTE

If the engine does not operate within specified vibration limits after the second relocation of second stage power turbine, rotate the second stage power turbine an additional 180 degrees. After relocating second stage power turbine a third time, engine should check out within limits. However, if engine still does not check out within specified vibration limits, tear engine down and investigate for misalinement or unbalance of power turbine system components.

6-66. ENGINE TEST SCHEDULE.

6-67. GENERAL. The following test schedule is recommended for T53-L-1, T53-L-1A, and T53-L-1B shaft turbine engines. Figure 6-11 represents a maximum run-in period for an engine following field maintenance. Only the requirements necessary to prove the engine is performing satisfactorily are included. Test requirements will depend upon the extent of maintenance.

6-68. PERFORMANCE EVALUATIONS. Performance evaluations are comparisons of repaired engine performance with new engine guarantees. The compensated shaft horsepower for any given ambient temperature, to meet new engine requirements, must equal or exceed values given in figure 6-12. The fuel rate, to meet new engine guarantees, shall not exceed values given in figure 6-13. Correction factors are shown in figure 6-14.

SEQUENCE	TIME IN MINUTES	ENGINE OPERATION	ENGINE RPM	REMARKS
1		Start and check idle		
2	3	Idle	40% nI	
3	1	Engine and control check	60% nI	
4	1	Engine and control check	80% nI	
5	1	Engine and control check	90% nI	
6	1	Engine and control check	MAX nI	
7	1	Decelerate and idle	60% nI	
8	1	Accelerate	MAX nI	
9	1	Idle	40% nI	
10	5	Military rated power	MAX nI	
*11		Wave-off check for engine surge		(Transition - 1 SEC)
12	1	Decelerate and stabilize	60% nI	
13 to 14	5	Emergency control check	60% MAX nI	
15	1	Decelerate and idle	40% nI	
16		Engine shut-down		

CAUTION

Emergency control checks as outlined in steps 13 through 14 shall not be made until nI speed has been reduced below 70% RPM. Never attempt jam acceleration in the emergency fuel control position. If increased shaft horsepower is to be drawn with emergency fuel control in operation, it must be accelerated gradually to avoid dumping unmetered fuel into the engine.

*Wave-off check: Refer to paragraph 6-78.

Figure 6-11. Block Test Schedule

6-69. ENGINE TEST REQUIREMENTS. The following limits shall be noted during test.

a. Maximum fuel element pump pressure at military rated power shall be 650 psig.

b. Maximum pressure difference between pump elements shall be 50 psig.

c. Fuel inlet pressure shall be 15 to 50 psig.

d. Maximum fuel manifold pressure shall be 350 psig at 640 pph.

e. Inlet oil pressure shall be 0 to 5 psig.

f. Inlet oil temperature shall be 180 to 190°F(82 to 88°C).

g. Oil pump discharge pressure shall be adjusted to provide 70 to 90 psig at filter outlet pressure at NRP and above.

h. Minimum oil filter outlet pressure at sea level and ground idle shall be 10 psig.

i. Maximum oil outlet temperature shall be 300°F (149°C).

j. Maximum oil consumption at NRP and MRP is 0.14 gph.

k. Maximum scavenge oil temperature for numbers two, three, and four main bearings shall be 400°F (205°C).

l. Maximum turbine outlet temperature at MRP shall be 1100°F(594°C) and 1060°F(571°C) at NRP or below.

m. Maximum nI speed shall be 24,440 rpm.

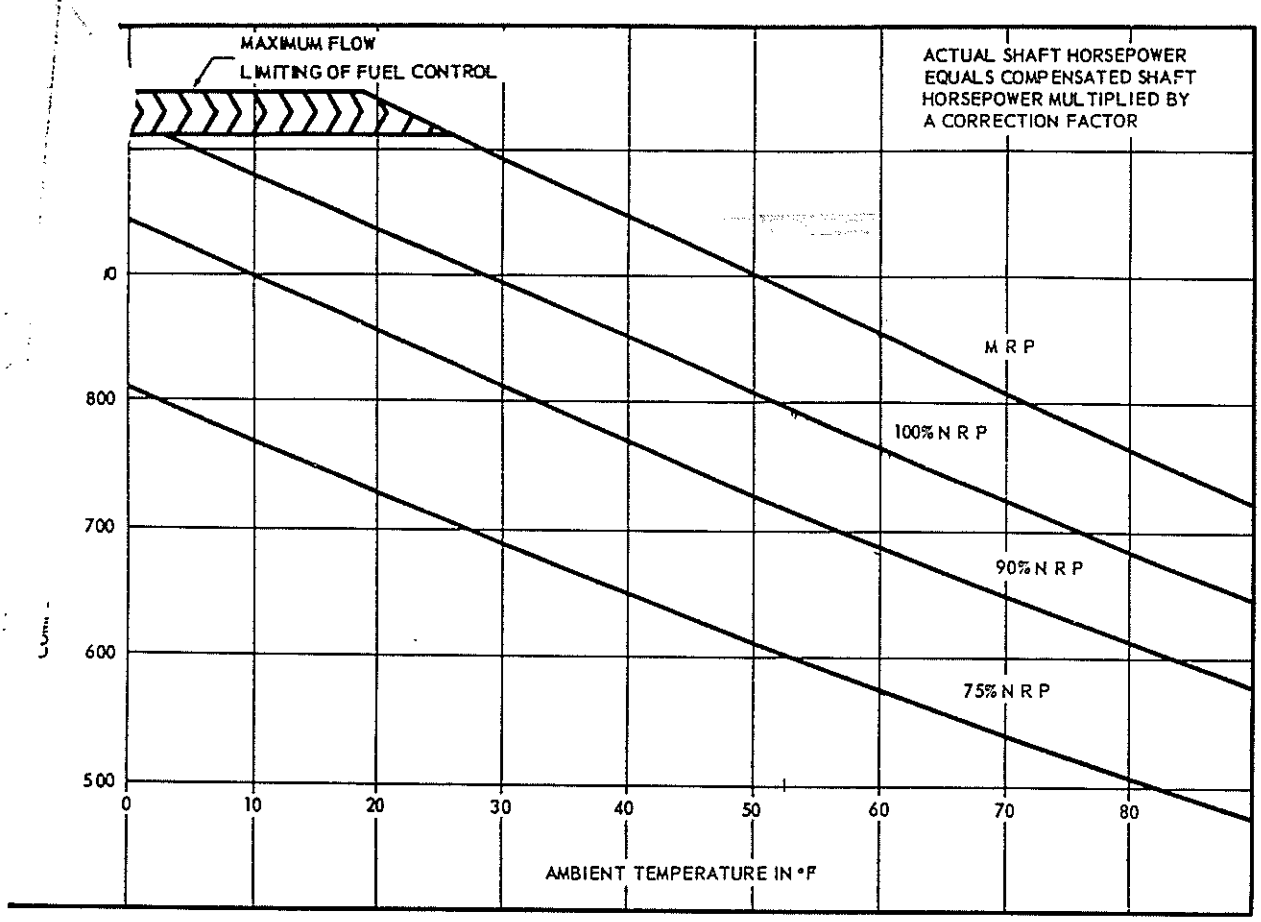

Figure 6-12. Compensated Shaft Horsepower as Compared to Ambient Temperature

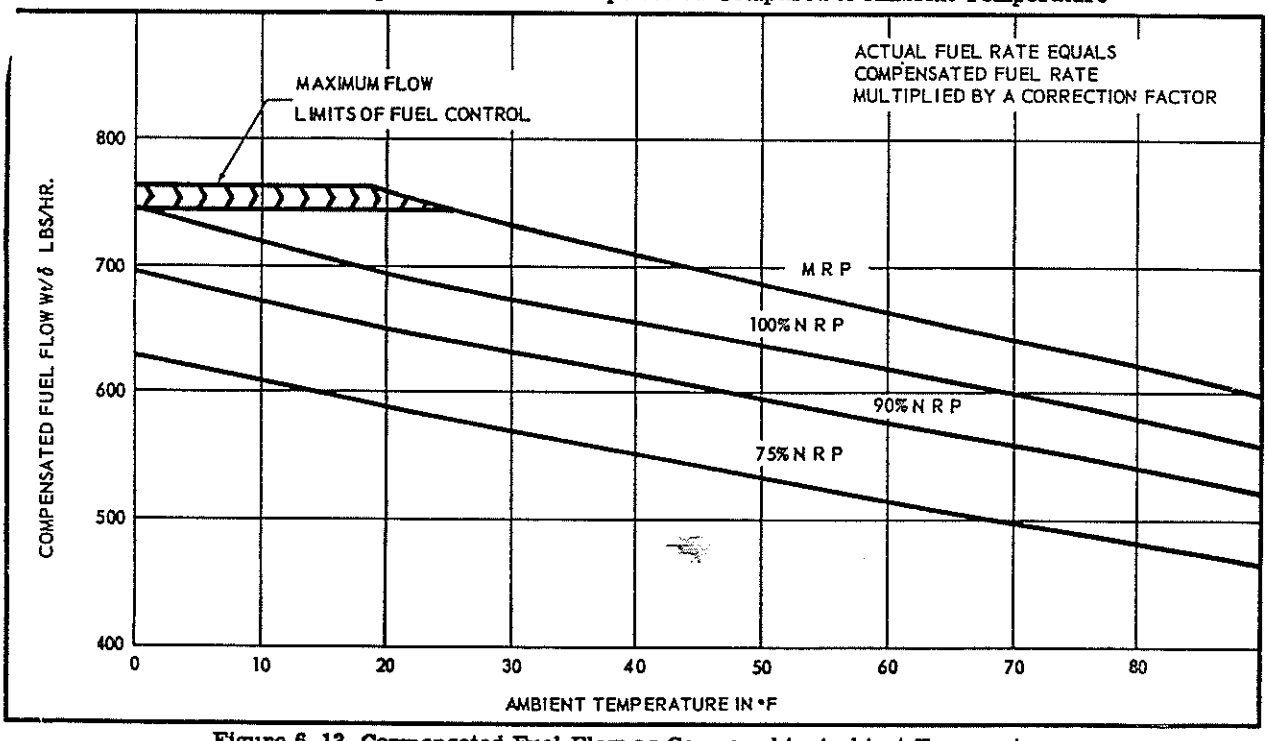

Figure 6-13. Compensated Fuel Flow as Compared to Ambient Temperature

NOTE

During transient operation, the nI speed may be exceeded by three percent for not more than three seconds.

CAUTION

The maximum egt during starting and transients shall be 1400°F(760°C). During acceleration, the egt shall not exceed 1200°F(648°C) for more than five seconds.

6-70. POWER TURBINE AND OUTPUT SHAFT SPEED LIMITS (MODELS T53-L-1A AND T53-L-1B).

a. Maximum steady-state power turbine speed for the T53-L-1A engine is 21,500 rpm. Maximum steady-state output shaft speed for the T53-L-1A engine is 6680 rpm.

NOTE

At an nI speed of 85 percent or less, a steady-state nII output shaft speed of 6900 rpm is permissible for the T53-L-1A engine only.

b. Maximum steady-state power turbine speed for the T53-L-1B engine is 21,000 rpm. Maximum steady-state output shaft speed for the T53-L-1B engine is 6520 rpm.

c. Maximum allowable power turbine overspeed for the T53-L-1A and T53-L-1B engines is 23,000 rpm. Maximum allowable output shaft overspeed for the T53-L-1A and T53-L-1B engines is 7140 rpm.

CAUTION

The maximum allowable time that the power turbine and output shaft overspeed conditions can exist is three seconds.

6-71. VISUAL INSPECTION PRIOR TO STARTING.

6-72. PROCEDURE.

a. Inspect the inlet and exhaust areas for obstruction or foreign objects.

b. Drain accessory drive gearbox. Reinstall AN plug and lockwire.

c. Remove engine oil filter, clean and reinstall.

d. Disconnect and prime engine oil inlet line. Reconnect line.

6-73. MOTORING ENGINE. Motor engine with starter generator. Open and close engine throttle during motoring cycle. As the engine rotates, check the following.

CAUTION

Limit starter energized time according to manufacturer's instructions.

a. Listen for rubs, noises, or vibrations.

TABLE OF COMPENSATING FACTORS
FOR CALCULATING ACTUAL HORSEPOWER AND FUEL FLOW
FROM COMPENSATED VALUES

Actual HP = Compensated HP x δ Compensated HP = Actual HP / δ		Actual Fuel Flow = Compensated Fuel Flow x δ Compensated Fuel Flow = Actual Fuel Flow / δ	
Barometer	δ	Barometer	δ
28.48	0.9525	29.90	0.9993
28.60	0.9559	29.92	1.000
28.70	0.9592	30.00	1.003
28.80	0.9626	30.10	1.006
28.90	0.9659	30.20	1.009
29.00	0.9693	30.30	1.013
29.10	0.9726	30.40	1.016
29.20	0.9759	30.50	1.019
29.30	0.9793	30.60	1.023
29.40	0.9826	30.70	1.026
29.50	0.9860	30.80	1.029
29.60	0.9893	30.90	1.033
29.70	0.9926	31.00	1.036
29.80	0.9960		

Figure 6-14. Correction Factors

b. Check entire engine for leaks.

c. Ensure that engine oil pressure is rising.

CAUTION

If oil pressure gage does not indicate rise in engine oil pressure, stop engine rotation and prime oil inlet line.

6-74. ENGINE STARTING AND FUNCTIONAL TEST PROCEDURE.

6-75. PROCEDURE.

a. Calibrate throttle position indicator against throttle position on fuel control unit at ground idle, flight idle, 60 degrees, 80 degrees, normal rated power, and military rated power.

b. Set loading device at minimum power requirement.

c. Position power lever in ground idle position.

d. Check fuel system selector switch to ensure it is in automatic position.

e. Energize starter, ignition, and starting fuel system.

CAUTION

If ignition does not occur immediately, shut down engine and check ignition system. Before attempting to restart the engine, remove any raw fuel that may have collected in the tail pipe. If the engine does not start, a three minute cooling period is recommended before attempting a second start.

f. With engine started, de-energize the starter and igniters at 28 percent nI or 700°F(400°C) egt.

CAUTION

Engine speed should come up to ground idle. If it does not, perform fuel control changeover check (step g.). Trim fuel control to ground idle speed (40 to 44 percent nI).

g. To ensure that solenoid valve is wired and functioning properly, check fuel control changeover system as follows.

(1) Check fuel system selector switch to ensure it is in automatic position.

(2) Accelerate engine by slowly moving power lever from ground idle to flight idle position. Engine speed should reach flight idle rpm (60 to 64 percent), which is in the normal automatic regime.

NOTE

If no ground idle position is provided, an nI speed of 42 percent will be used while operating the engine in the normal automatic position.

(3) Check solenoid valve operation by switching the fuel selector switch from automatic to manual position. The nI speed should drop-off approximately 20 percent.

(4) With power lever in flight idle position, return fuel selector switch to automatic position. The nI speed should increase approximately 20 percent to flight idle rpm.

CAUTION

If rapid power movements are used while the fuel selector switch is in the manual position; engine surge, engine overspeed, or high exhaust temperatures may result. Movement of the power lever shall be slow and smooth at approximately two percent per second.

h. Record acceleration time and maximum egt from start to ground idle.

i. Shaft horsepower shall not exceed 35 shp at ground idle.

j. Oil filter outlet pressure shall be 10 psig minimum.

k. Bearing scavenge oil temperatures shall be gradually increasing to stabilized temperatures.

l. Check engine for external leaks.

m. Check temperature and pressure indications.

n. Check vibration readings with engine stabilized for two to five seconds.

o. Check to ensure anti-icing system is operative by manually operating anti-icing switch. Look for a slight variation in the nI indicator.

NOTE

If no variation in indicator reading is observed, anti-icing system is off or not operating properly. An anti-icing system that is operating improperly must be replaced.

p. Set switch to automatic position if anti-icing system is functioning satisfactorily.

q. Check to ensure inlet oil temperature is not exceeding 190°F(88°C).

r. With engine nI set in the flight idle position and nII overspeed governor at minimum stop selection, slowly advance nI throttle to maximum stop.

s. Reset nII overspeed governor over entire range to check reset capability.

t. Set nII speed selector at 100 percent and slowly increase nI setting to 70, 80, and 90 percent nI and maximum stop.

NOTE

Maximum nI speed will occur at maximum load above which the selected nII speed cannot be maintained.

u. For all settings, check indications outlined in steps i. through r.

NOTE

At maximum stop, oil flow shall be 2300 pph; bearing scavenge oil temperature shall be 400°F(205°C); oil inlet temperature shall be 180 to 190°F(82 to 88°C); egt shall be 1100°F (595°C); and oil outlet temperature shall be 300°F(149°C).

v. In aircraft with droop compensator throttle installation, the overspeed governor should hold the selected speed. In aircraft not equipped with the droop compensator throttle, the overspeed governor should show an approximate six percent speed loss from zero to full power with a proportionate loss for all intermediate readings.

w. Check overspeed governor linkage if governor performance does not conform to applicable standards. Repeat test.

NOTE

If trouble persists, replace the overspeed governor.

x. For rated engines, check the maximum SHP against MRP line. (See figure 6-12.)

y. If SHP exceeds required SHP by more than 25 SHP, or does not meet required SHP, adjust maximum fuel trim. (Refer to paragraph 6-36.)

z. For derated engines, usually only a flight check is possible. However, with high ambient temperature conditions, when maximum power available is less than load limits, the instructions for rated engines will apply. Under these conditions repeat steps x. and y.

6-76. ACCELERATION CHECK.

6-77. PROCEDURE.

a. Record nI speed and maximum allowable torque at maximum throttle stop.

b. Without reducing load, pull back throttle to ground idle.

c. Cool engine for three minutes.

d. Jam power lever to maximum allowable stop and simultaneously start watch.

NOTE

Movement of power lever to maximum setting shall be accomplished within one second.

e. At maximum power, stop watch. Record elapsed time and egt.

NOTE

Acceleration time shall be 10 seconds or less.

f. When engine has stabilized at maximum power, decelerate to flight idle and cool engine for three minutes.

g. Jam power lever to maximum allowable stop and simultaneously start watch.

NOTE

Movement of power lever to maximum setting shall be accomplished within one second.

h. At maximum power, stop watch. Record elapsed time and egt.

NOTE

Acceleration time shall be five seconds or less.

i. When engine has stabilized at maximum power, decelerate to flight idle and cool engine for three minutes.

j. If engine surge is encountered during acceleration check, immediately pull back power lever to ground idle position.

k. Cut and remove lockwire from the automatic pressure regulating valve located on fuel control. (See figure 6-3.)

l. Decrease automatic pressure regulating valve fuel flow by turning the hand adjustment cap marked INC., two full turns clockwise.

m. If acceleration time limits are exceeded while performing steps d. through i. increase the automatic pressure regulating valve fuel flow by turning the hand adjustment cap in a counterclockwise direction, until required acceleration time is achieved.

NOTE

Turning the hand adjustment cap one full turn clockwise or counterclockwise, changes acceleration time by approximately one second.

n. Lockwire automatic pressure regulating valve.

o. Record all fuel control adjustments on data sheets.

6-78. WAVEOFF CHECK.

6-79. PROCEDURE. Before a waveoff check can be performed, ensure that the engine has been operating for two minutes at MRP.

a. Quickly pull back throttle to flight idle.

b. As nI speed passes 75 percent, jam throttle to MRP stop.

NOTE

If a surge is encountered, immediately pull throttle back and wait for normal engine operation.

c. Cut and remove lockwire from automatic pressure regulating valve located on fuel control.

d. Decrease fuel control pressure regulating valve one turn clockwise and repeat waveoff check.

NOTE

If surge still is encountered, decrease fuel control adjustment one-quarter turn further and repeat waveoff check.

e. When surge is eliminated, pull back throttle to flight idle. Recheck accelerations.

f. Lockwire automatic pressure regulating valve.

CAUTION

If surge cannot be eliminated, replace fuel control unit.

6-80. EMERGENCY SYSTEM CHECK.

6-81. PROCEDURE.

a. With throttle at flight idle, switch fuel control selector switch to manual position.

NOTE

A drop in the nI speed is normal, and engine power can be reset to flight idle by increasing throttle position slowly.

b. Slowly advance throttle to maximum stop.

NOTE

Because the automatic acceleration limiter is not used during manual operation, exercise care when adjusting the throttle to prevent surge. The throttle motion should not exceed the acceleration rates of the automatic system.

c. Slowly pull back throttle to flight idle position and switch to automatic operation.

NOTE

Engine will automatically reset itself to flight idle speed.

6-82. SHUT-DOWN.

6-83. PROCEDURE.

a. Pull back throttle to ground idle and operate engine for two minutes.

b. Shut down engine by pulling back throttle to cut-off position.

c. During engine coastdown, check for noise, rubs, and vibrations.

d. Check oil filter, fuel, and oil screens.

6-84. ENGINE PRESERVATION AFTER TEST.

6-85. PROCEDURE.

CAUTION

If engine is to be inactive less than 14 days perform steps o. through z., below, to preserve the engine. If the engine is to be inactive for more than 14 days, preserve the engine and fuel control by performing the following steps a. through z.

a. Disconnect the main and starting fuel hose assemblies at the manifold, and allow the fuel to drain into suitable container.

b. Remove the vent plug on top of the fuel control.

c. Disconnect fuel inlet line at the fuel control, and allow fuel from the line to drain into suitable container.

d. Attach a hose from a suitable container of preserving oil, Military Specification MIL-O-6081, grade 1010, to the fuel control inlet fitting.

e. Place power lever in military rated power position.

f. Disconnect electrical connnector from input side of ignition unit.

g. Energize starting fuel solenoid valve until preserving oil flows from starting manifold.

h. Motor engine by energizing starter until preserving oil flows from fuel outlet lines.

i. Reconnect the main, starting, and inlet fuel lines.

j. Replace and tighten fuel control vent plug.

k. Remove and disassemble engine oil filter assembly. (Refer to paragraphs 2-40 and 2-73.)

l. Clean oil filter elements.

m. Immerse oil filter elements in corrosion preventive oil, Military Specification MIL-C-8188.

n. Reassemble oil filter. (Refer to paragraph 3-182.)

o. Remove outer and inner bellmouths from inlet housing.

NOTE

Before proceeding with compressor preservation, cool engine sufficiently to prevent auto-ignition.

p. Motor engine with starter.

q. Hold spray gun containing corrosion preventive oil, Military Specification MIL-C-8188, 18 inches from air inlet openings of the engine.

r. When engine has reached approximately six percent nI speed, spray preserving oil into air inlet openings.

CAUTION

Do not operate starter for more than two runs of 40 seconds for each 60 minute period. Allow three minutes cooling time between operations.

s. Continue spraying oil into inlet openings during maximum time limit for starter operation.

t. Discontinue spraying when engine coasts down to six percent nI speed.

u. Repeat steps q. through t.

NOTE

Do not motor engine when preserving turbine wheels.

v. Using a spray gun containing preserving oil, Military Specification MIL-C-8188, spray turbines sufficiently to cover wheels.

w. Connect all lines.

x. Drain accessory drive gearbox of excessive preserving oil.

y. Tag engine as preserved to Military Specification MIL-E-5607B.

z. Record completion of engine preservation on data sheet.

6-86. FOLLOWING PRESERVATION RUN.

6-87. PROCEDURE.

a. Remove all fittings installed for pressure and temperature measurement and seal drainage.

b. Plug all tapped openings.

c. Install temporary plugs in oil pump inlet, scavenge oil discharge, and fuel control inlet.

d. Cap all male fittings.

SECTION VII

TABLE OF LIMITS

7-1. GENERAL.

7-2. The table of limits, standard torque tables, special torque limits, their reference charts, and instructions for the use of torque wrenches are contained in this section. The Table of Limits (figure 7-7) is used to determine the proper relation between two mating parts. Not intended for dimensional inspection use during engine disassembly or reassembly, the table may be used as a supplement to visual inspection during parts replacement or to verify serviceability of used parts. Dimensional inspection is required only if difficulty is encountered at engine reassembly.

7-3. GENERAL INSTRUCTIONS ON USE OF TORQUE WRENCHES.

7-4. GENERAL. Torque wrenches shall be used for tightening parts to a specific torque value. The manufacturer's instructions on the care of torque wrenches shall be observed.

7-5. TORQUE WRENCH CALIBRATION. Torque wrenches must be calibrated frequently by using weights and a measured lever arm. Inaccurate readings may occur because of abuse or constant use. Do not check one wrench against another.

7-6. RECOMMENDED TORQUE WRENCH SIZES. Figure 7-1 lists the recommended torque wrench sizes.

7-7. TORQUE WRENCH EXTENSIONS AND ADAPTERS. Extensions or adapters may be used with any torque wrench. Because extensions or adapters change the length of the torque arm for which the scale is calibrated, torque applied at the end of the extension or adapter is not correctly indicated on the scale and must be calculated. When using extensions or adapters, apply the manual torque at the calculated arm length, which is the center of the handle. When substituting values in formulas, use inch units to get an answer in pound-inches and foot units to get an answer in pound-feet. The center line of the wrench and the wrench extension or adapter shall aline as shown in figure 7-2. To determine the indicated torque, using extensions or adapters, use the following formula:

$$I = \frac{RL}{L + L_1}$$

I is the indicated torque on the wrench.

R is the required torque at the bolt.

L is the length of the torque wrench in inches (wrench head to midpoint of handle).

L_1 is the length of the extension or adapter in inches.

7-8. PROCEDURE FOR APPLYING TORQUE. Clean parts to be tightened in dry-cleaning solvent, Federal Specification P-S-661. Unless instructed otherwise, lubricate parts to be tightened with lubricating oil, Military Specification MIL-L-7808. Torque should be applied slowly and evenly until the specified torque value is reached and then held at this value until the nut, bolt, or screw has stopped turning.

WARNING

Lubricating oil, Military Specification MIL-L-7808, contains triorthocresylphosphate. This additive is poisonous and is readily absorbed through the skin. Make certain that this oil does not remain on the skin.

7-9. When applying torques, proceed in steps of gradually increasing tension. Tighten the bolts, screws, or nuts in a staggered sequence until the

REQUIRED TORQUE	TORQUE WRENCH
0 to 25 Pound-Inches	30 Pound-Inches
25 to 140 Pound-Inches	150 Pound-Inches
140 to 550 Pound-Inches	600 Pound-Inches
30 to 40 Pound-Feet	150 Pound-Feet
140 to 240 Pound-Feet	250 Pound-Feet
240 to 1000 Pound-Feet	1000 Pound-Feet

Figure 7-1. Recommended Torque Wrench Sizes

part is firmly seated, then apply a gradual increase in torque on each part until the specified torque value is reached.

7-10. When lockwiring holes are to be alined, the following torque procedure is recommended.

a. First tighten the nut or bolt to the minimum torque value.

b. If lockwiring holes do not aline, continue to tighten the part until holes do aline, but do not exceed the maximum torque value specified for the operation.

c. If the holes still do not aline, select another nut or bolt and retighten to the recommended torque value.

d. For locking parts other than pins, a selection of parts may be necessary to obtain proper locking position in the specific torque range.

7-11. STANDARD TORQUE VALUES.

7-12. Standard torque values for general applications are listed in figure 7-3.

7-13. TABLE OF LIMITS.

7-14. The table of limits (figure 7-7) lists minimum and maximum clearances between two parts. Minimum and maximum dimensions are the specified design dimensions for new parts. If maximum replace limits are not listed, replacement shall be governed by the minimum and maximum limits given for the part. These limits, together with visual inspection, shall be a guide in determining the use, repair, or rejection of part and shall be followed throughout inspection.

7-15. SPECIAL TORQUE LIMITS. Special torque limits, under or over standard torque values, are listed under special torque limits at the end of the table of limits (figure 7-7).

7-16. DEFINITIONS. T or L following a value in the limit columns indicates a tight or loose fit. FIR refers to full indicator reading. TIR refers to total indicator reading. ID refers to inside diameter, OD to outside diameter. Radial clearance between parts is measured at a right angle to a common axis. Axial clearance between parts is measured laterally on a common axis. Axial-radial clearance between parts is given where the location requires a combination of clearances. Backlash is the clearance between parts to determine looseness or wear of parts.

7-17. TABLE OF LIMITS REFERENCE, ILLUSTRATIONS. The various fits, clearances, ring gaps, backlashes, and special torque values are shown in figures 7-4 through 7-7.

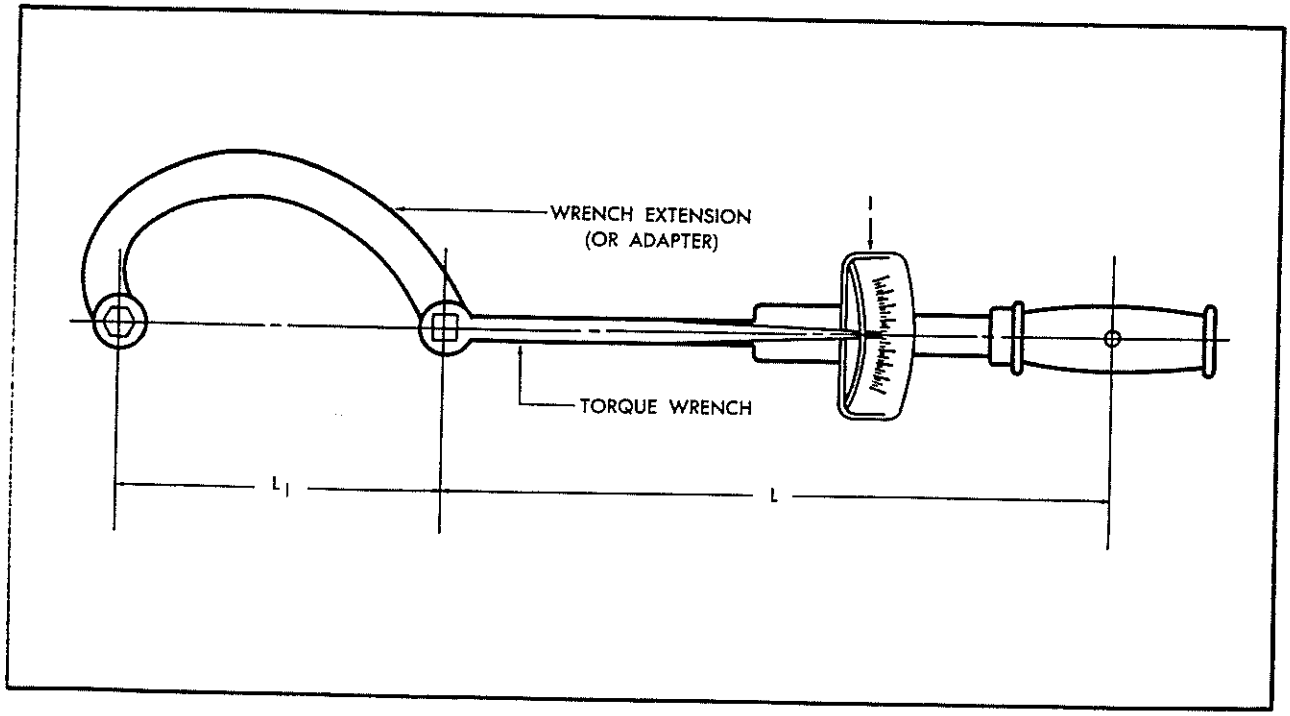

Figure 7-2. Torque Wrench Extension Calibration

STANDARD SCREWS, BOLTS, AND NUTS		
THREAD SIZE	TYPE	TORQUE
8-32	Screws, bolts, nuts, and self-locking nuts	10 to 15 lb-in.
8-36	Screws	10 to 15 lb-in.
10-24	Screws (flat, round, and fillister head)	15 to 20 lb-in.
10-24	Bolts, nuts, self-locking nuts	20 to 30 lb-in.
10-32	Screws (flat, round, and fillister head)	20 to 25 lb-in.
10-32	Bolts, nuts, and self-locking nuts	30 to 40 lb-in.
1/4-20	Bolts, nuts	60 to 75 lb-in.
1/4-28	Screws (flat, round, and fillister head)	35 to 50 lb-in.
1/4-28	Screws (socket head)	80 to 100 lb-in.
1/4-28	Bolts, nuts, and self-locking nuts	80 to 100 lb-in.
5/16-18	Screws	70 to 90 lb-in.
5/16-24	Bolts and nuts	140 to 180 lb-in.
5/16-24	Self-locking nuts	160 to 190 lb-in.
3/8-16	Bolts and nuts	225 to 265 lb-in.
3/8-24	Bolts and nuts	240 to 300 lb-in.
3/8-24	Self-locking nuts	265 to 325 lb-in.
7/16-14	Bolts and nuts	360 to 480 lb-in.
7/16-20	Bolts and nuts	380 to 500 lb-in.
1/2-20	Bolts and nuts	45 to 55 lb-ft
9/16-12	Bolts and nuts	55 to 65 lb-ft
9/16-18	Bolts and nuts	65 to 80 lb-ft
5/8-18	Bolts	80 to 100 lb-ft
All sizes	Pal nuts	60° or 1 flat

TORQUE VALUES FOR PIPING ASSEMBLIES
NOTE When tightening or loosening hose coupling nuts, make sure that the hose nipple does not turn on the mating fitting seat. Bottoming torque on bushing-type parts that seat metal-to-metal over a seal will be the same as for fittings with like thread size.

FLEXIBLE HOSE ALUMINUM COUPLING NUTS ON ALUMINUM FITTINGS		
THREAD SIZE	WRENCH SIZE	TORQUE
7/16-20	9/16	40 to 65 lb-in.
1/2-20	5/8	60 to 80 lb-in.
9/16-18	11/16	80 to 120 lb-in.
3/4-16	7/8	15 to 200 lb-in.
7/8-14	1	200 to 350 lb-in.
1 1/16-12	1-1/4	300 to 500 lb-in.
1 5/16-12	1-1/2	60 to 80 lb-ft
1 5/8-12	2	80 to 100 lb-ft

Figure 7-3. Table of Standard Torque Values (Sheet 1 of 3)

FLEXIBLE HOSE STEEL COUPLING NUTS ON STEEL FITTINGS, AND SOLID STEEL TUBE, STEEL, OR ALUMINUM COUPLING NUTS ON STEEL FITTINGS

THREAD SIZE	WRENCH SIZE	TORQUE
5/16-24	3/8	35 to 40 lb-in.
3/8-24	7/16	65 to 100 lb-in.
7/16-20	9/16	125 to 175 lb-in.
1/2-20	5/8	150 to 200 lb-in.
9/16-18	11/16	200 to 250 lb-in.
3/4-16	7/8	325 to 400 lb-in.
7/8-14	1	475 to 575 lb-in.
1 1/16-12	1 1/4	55 to 65 lb-ft
1 5/16-12	1 1/2	60 to 80 lb-ft

FLEXIBLE HOSE ALUMINUM COUPLING NUTS ON STEEL FITTINGS, AND SOLID STEEL TUBE, STEEL, OR ALUMINUM COUPLING NUTS ON ALUMINUM FITTINGS

THREAD SIZE	WRENCH SIZE	TORQUE
3/8-24	7/16	40 to 60 lb-in.
7/16-20	9/16	65 to 100 lb-in.
1/2-20	5/8	90 to 135 lb-in.
9/16-18	11/16	125 to 175 lb-in.
3/4-16	7/8	250 to 325 lb-in.
7/8-14	1	350 to 500 lb-in.
1 1/16-12	1 1/4	450 to 600 lb-in.
1 5/16-12	1 1/2	40 to 60 lb-ft
1 5/8-12	2	80 to 100 lb-ft

U.F. LOCKNUTS (NOTCHED HYDRAULIC)

THREAD SIZE	WRENCH SIZE	TORQUE
7/16-20	11/16	75 to 100 lb-in.
9/16-18	7/8	150 to 200 lb-in.
1 1/16-12	1 3/8	550 to 650 lb-in.

ALUMINUM OR STEEL U.F. LOCKNUTS (PLAIN) AND ALUMINUM OR STEEL UNIONS

THREAD SIZE	WRENCH SIZE	TORQUE
5/16-24	9/16	18 to 25 lb-in.
3/8-24	5/8	50 to 75 lb-in.
7/16-20	11/16	55 to 80 lb-in.
9/16-18	13/16	100 to 150 lb-in.
3/4-16	1	200 to 300 lb-in.
7/8-14	1 1/8	300 to 450 lb-in.
1 1/16-12	1 3/8	420 to 600 lb-in.
1 5/16-12	1 5/8	50 to 70 lb-ft
1 5/8-12	1 7/8	65 to 85 lb-ft
1 5/8-12	1 15/16	65 to 85 lb-ft
1 7/8	2 3/16	70 to 90 lb-ft
1 7/8	2 1/8	60 to 75 lb-ft

Figure 7-3. Table of Standard Torque Values (Sheet 2 of 3)

PLUG AND BLEEDER

THREAD SIZE	WRENCH SIZE	TORQUE
5/16-24	9/16	10 to 16 lb-in.
3/8-24	5/8	30 to 40 lb-in.
7/16-20	11/16	40 to 65 lb-in.
1/2-20	3/4	60 to 80 lb-in.
9/16-18	13/16	80 to 120 lb-in.
3/4-16	1	150 to 200 lb-in.
7/8-14	1 1/8	200 to 350 lb-in.
1 1/16-12	1 3/8	300 to 500 lb-in.

PIPE PLUGS

Pipe Plugs	Tight Enough to Seat

Plugs using copper or aluminum asbestos gaskets, tighten as required, loosen and retighten.

HOSE CLAMPS

All hose clamps	Initial Installation	15 to 20 lb-in.
	Retightening	10 to 15 lb-in.

ELECTRICAL COUPLING NUTS

THREAD SIZE	WRENCH SIZE	MATING PARTS NON-STEEL TORQUE	MATING PARTS OF STEEL TORQUE
1/2-28	5/8	20 to 40 lb-in.	50 to 70 lb-in.
5/8-24	3/4	30 to 50 lb-in.	70 to 90 lb-in.
3/4-20	7/8	50 to 70 lb-in.	90 to 120 lb-in.
7/8-20	1	70 to 90 lb-in.	120 to 140 lb-in.
1-20	1 1/8	100 to 125 lb-in.	140 to 160 lb-in.
1-20	Spanner	100 to 125 lb-in.	140 to 160 lb-in.
1 1/8-18	Spanner	100 to 125 lb-in.	195 to 220 lb-in.
1 1/4-18	Spanner	100 to 125 lb-in.	245 to 270 lb-in.
1 3/8-18	Spanner		285 to 310 lb-in.
1 1/2-18	Spanner		305 to 330 lb-in.
1 5/8-18	Spanner		305 to 330 lb-in.
1 3/4-18	Spanner		355 to 380 lb-in.

1/2-28 thru 1 1/2-18 Knurled - Fingertight, plus approximately 20° and lockwire.

Figure 7-3. Table of Standard Torque Values (Sheet 3 of 3)

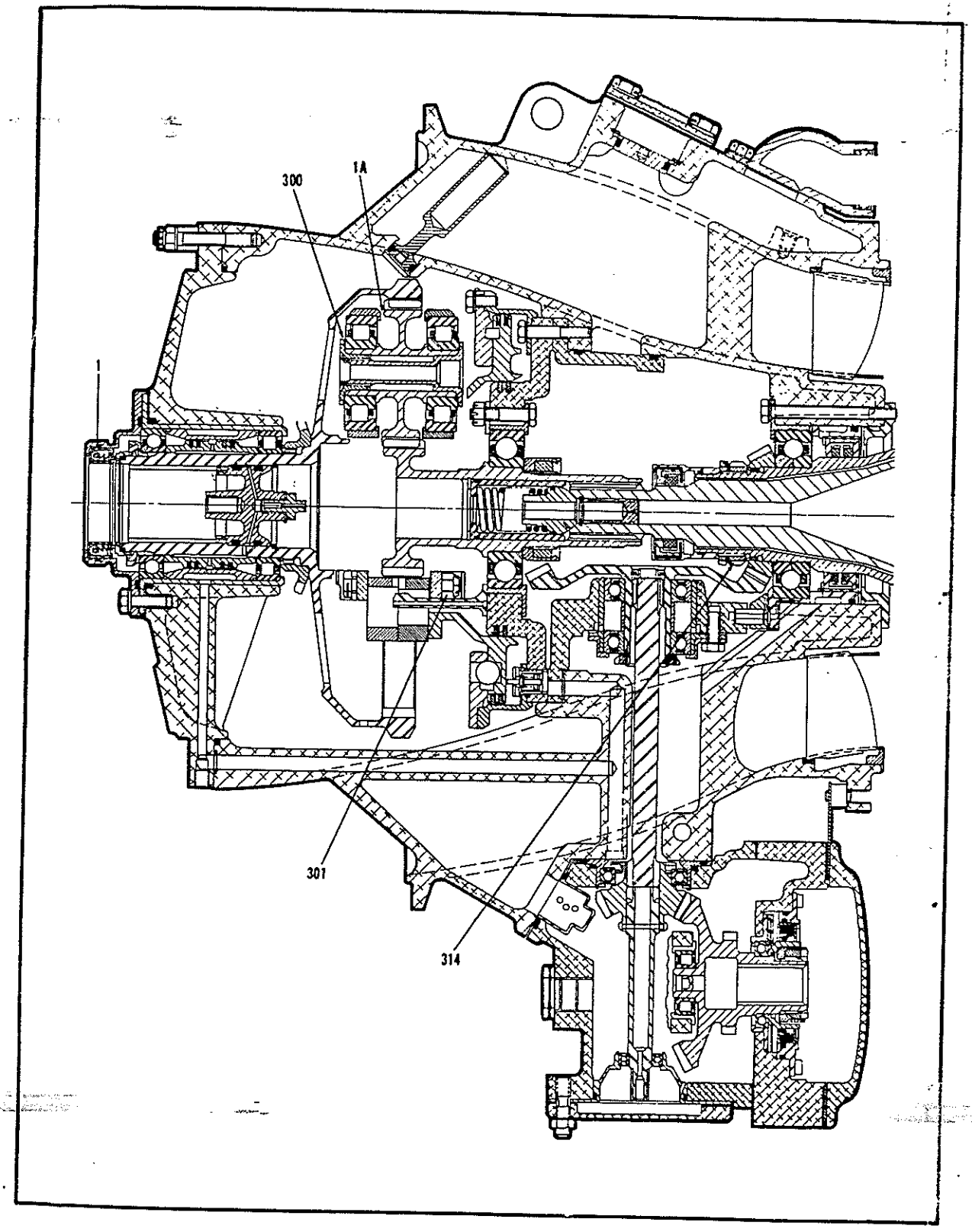

Figure 7-4. Inlet Housing and Reduction Gearing

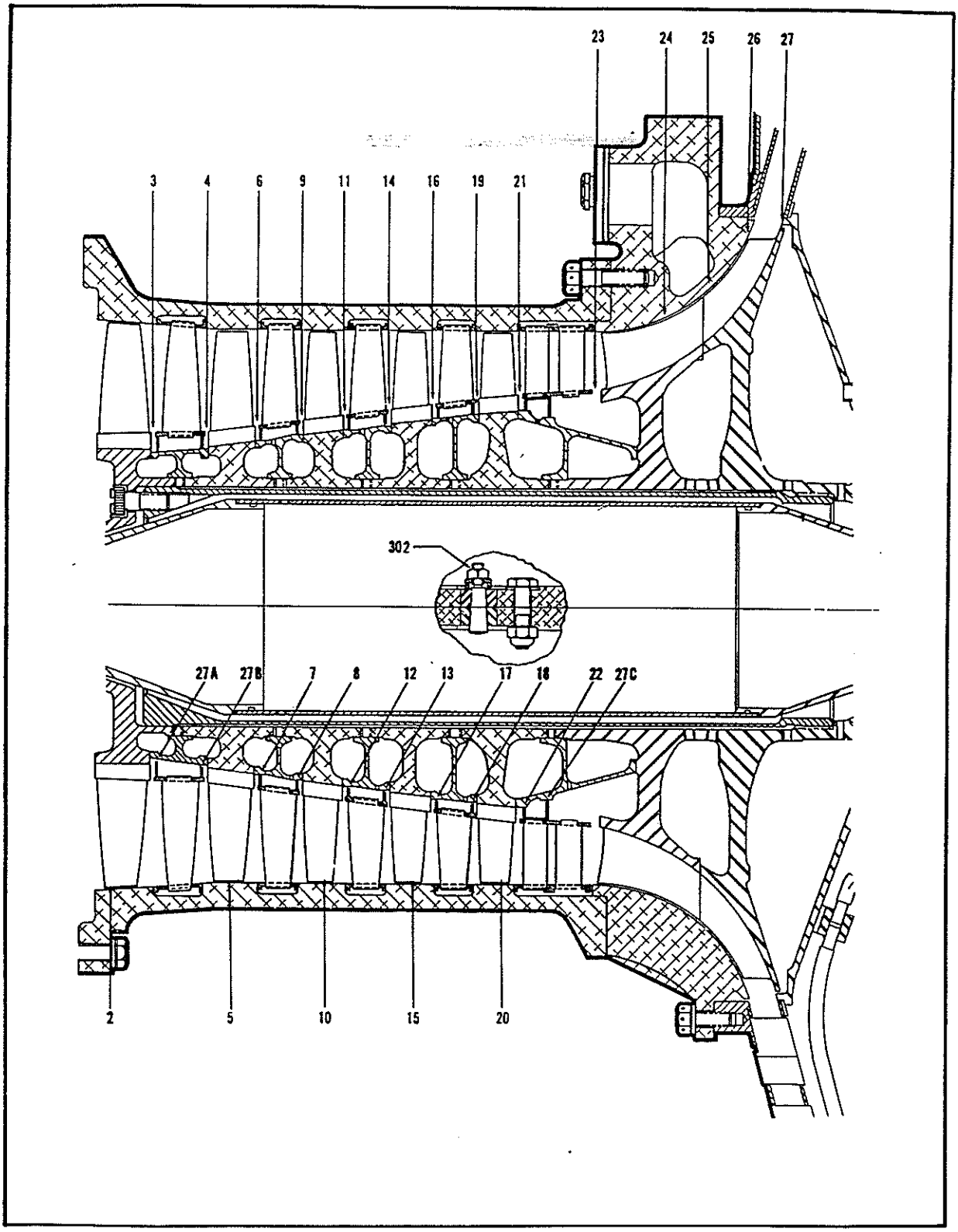

Figure 7-5. Compressor Rotor and Compressor Housing

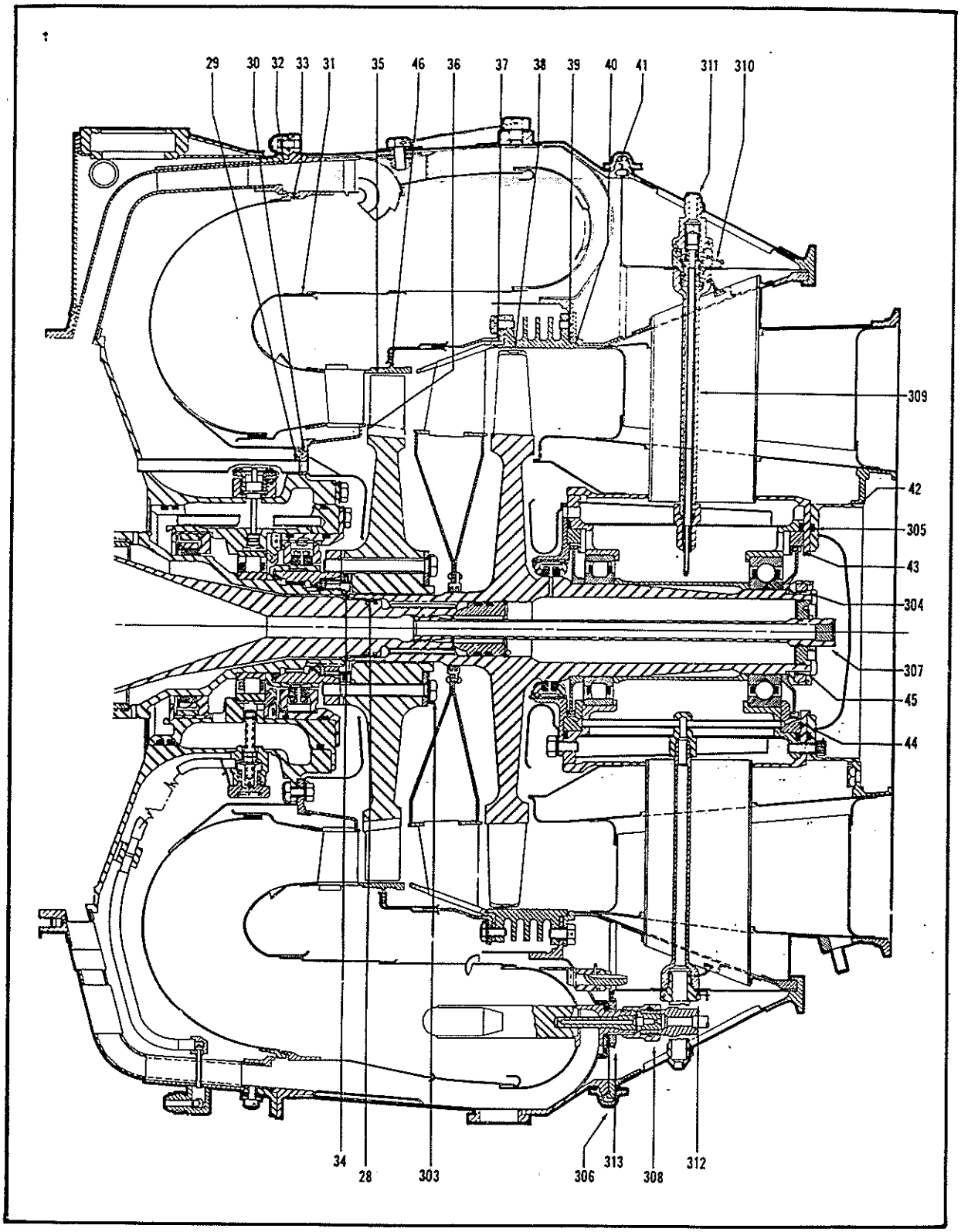

Figure 7-6. Diffuser, Combustion Chamber and Support Assembly

Ref No.	Figure No.	Description	Direction Measured	Minimum Fit	Maximum Fit	Maximum Replace
1	7-4	Seal Retainer ID to Seal OD	Diameter	0.0000	0.0040T	0.0010L
1A	7-4	Planet Gear Movement	Axial	0.0150	0.0300	0.0310
2	7-5	First Stage Rotor Blade to Compressor Housing Tip Clearance	Radial	0.0210	0.0330	0.0350
3	7-5	Clearance between First Stage Rotor and First Stage Vane	Axial	0.0230 0.0300	0.0800** 0.0870***	Relocate*
4	7-5	Clearance between First Stage Vane and Second Stage Rotor	Axial	0.0430 0.0350	0.0950** 0.0880***	Relocate*
5	7-5	Second Stage Rotor Blade to Compressor Housing Tip Clearance	Radial	0.0240	0.0300	0.0320
6	7-5	Clearance between Second Stage Rotor and Second Stage Vane	Axial	0.0230 0.0300	0.0750** 0.0820***	Relocate*
7	7-5	Clearance between Second Stage Spacer and Second Stage Vane - Front	Radial	0.0260	0.0320	0.0340
8	7-5	Clearance between Second Stage Spacer and Second Stage Vane - Rear	Radial	0.0260	0.0320	0.0340
9	7-5	Clearance between Second Stage Vane and Third Stage Rotor	Axial	0.0440 0.0370	0.0930** 0.0860***	Relocate*
10	7-5	Third Stage Rotor Blade to Compressor Housing Tip Clearance	Radial	0.0240	0.0300	0.0330
11	7-5	Clearance between Third Stage Rotor and Third Stage Vane	Axial	0.0250 0.0320	0.0740** 0.0810***	Relocate*
12	7-5	Clearance between Third Stage Spacer and Third Stage Vane - Front	Radial	0.0260	0.0320	0.0340
13	7-5	Clearance between Third Stage Spacer and Third Stage Vane - Rear	Radial	0.0260	0.0320	0.0340
14	7-5	Clearance between Third Stage Vane and Fourth Stage Rotor	Axial	0.0470 0.0400	0.0920** 0.0850***	Relocate*
15	7-5	Fourth Stage Rotor Blade to Compressor Housing - Tip Clearance	Radial	0.0240	0.0300	0.0320
16	7-5	Clearance between Fourth Stage Rotor and Fourth Stage Vane	Axial	0.0270 0.0340	0.0720** 0.0790***	Relocate*
17	7-5	Clearance between Fourth Stage Spacer and Fourth Stage Vane - Front	Radial	0.0260	0.0320	0.0340
18	7-5	Clearance between Fourth Stage Spacer and Fourth Stage Vane - Rear	Radial	0.0260	0.0320	0.0340
19	7-5	Clearance between Fourth Stage Vane and Fifth Stage Rotor	Axial	0.0480 0.0410	0.0890** 0.0820***	Relocate*
20	7-5	Fifth Stage Rotor Blade to Compressor Housing - Tip Clearance	Radial	0.0240	0.0300	0.0320

Figure 7-7. Table of Limits (Sheet 1 of 4)

Ref No.	Figure No.	Description	Direction Measured	Minimum Fit	Maximum Fit	Maximum Replace
21	7-5	Clearance between Fifth Stage Rotor and Fifth Stage Vane	Axial	0.0360 0.0430	0.0880** 0.0950***	Relocate*
22	7-5	Clearance between Fifth Stage Spacer and Fifth Stage Vane - Front	Radial	0.0260	0.0320	0.0340
23	7-5	Clearance between Fifth Stage Vane and Centrifugal Compressor Impeller	Axial	0.0410	0.1680	Relocate*
24	7-5	Clearance between Centrifugal Compressor Impeller and Centrifugal Compressor Housing	Radial	0.0170	0.0230	Relocate*
25	7-5	Clearance between Centrifugal Compressor Impeller Midpoint and Centrifugal Compressor Housing	Radial-Axial	0.0170	0.0430	Relocate*
26	7-5	Clearance between Centrifugal Compressor Impeller and Centrifugal Compressor Housing	Axial	0.0370	0.0430	Relocate*
27	7-5	Centrifugal Compressor Impeller to Diffuser Housing - Tip Clearance	Radial	0.0360	0.0440	0.0460
27A	7-5	Clearance between First Stage Spacer and First Stage Vane - Front	Radial	0.0260	0.0320	0.0340
27B	7-5	Clearance between First Stage Spacer and First Stage Vane - Rear	Radial	0.0260	0.0320	0.0340
27C	7-5	Clearance between Fifth Stage Spacer and Fifth Stage Vane - Rear	Radial	0.0260	0.0320	0.0340
28	7-6	First Stage Turbine Discs ID to Second Stage Power Turbine Disc OD	Diameter	0.1030L	0.1120L	0.1140L
29	7-6	Diffuser Housing OD to Combustion Chamber Curl ID	Diameter	0.0010L	0.0050L	0.0060L
30	7-6	Diffuser Housing OD to Turbine Nozzle ID	Diameter	0.0010L	0.0030L	0.0040L
31	7-6	Turbine Nozzle OD to Combustion Chamber Liner ID	Diameter	0.0680L	0.1280L	Snug Fit
32	7-6	Combustion Chamber Housing OD to Diffuser Housing ID	Diameter	0.0000	0.0040L	0.0050L
33	7-6	Scoop and Shroud Assembly OD to Combustion Chamber Curl ID	Diameter	0.0050L	0.0250L	0.0270L
34	7-6	Power Turbine Cooling Bellows ID to Compressor Shaft Nut OD Cooling Bellows Width	Diameter Axial	0.1430L 0.3210	0.1550L 0.3260	Rework Must be 0.3210 Minimum
35	7-6	First Stage Turbine Blade to First Stage Turbine Nozzle - Tip Clearance	Radial	0.020	None	

Figure 7-7. Table of Limits (Sheet 2 of 4)

Ref No.	Figure No.	Description	Direction Measured	Minimum Fit	Maximum Fit	Maximum Replace
36	7-6	First Stage Turbine Disc to First Stage Turbine Nozzle	Axial	0.0640	0.0910	Must be 0.0600 Minimum
37	7-6	Second Stage Turbine Nozzle ID to Power Turbine Cylinder OD	Diameter	0.0005L	0.0035L	0.0070L
38	7-6	Second Stage Power Turbine Blade to Second Stage Power Turbine Nozzle and Cylinder - Tip Clearance	Radial	0.0300	None	
39	7-6	Power Turbine Cylinder OD to Combustion Chamber Housing ID	Diameter	0.0005L	0.0035L	0.0050L
40	7-6	Exhaust Diffuser ID to Power Turbine Cylinder OD	Diameter	0.0005L	0.0035L	0.0055L
41	7-6	Support Cone ID to Combustion Chamber Housing OD	Diameter	0.0010L	0.0030L	0.0040L
		Marman Clamp End Gap	Circumference	Must be 0.0600 minimum on both sides		
42	7-6	Rear Bearing Cover OD to Exhaust Diffuser ID	Diameter	0.0020L	0.0055L	0.0060L
43	7-6	Rear Bearing Cover ID to Exhaust Diffuser OD	Diameter	0.0010L	0.0040L	0.0045
44	7-6	Exhaust Diffuser ID to Numbers 3 and 4 Bearing Housing OD	Diameter	0.0010L	0.0030L	Rework
45	7-6	Power Shaft Bolt Adapter to Second Stage Power Turbine	Diameter	0.0010L	0.0040L	0.0045L
46	7-6	First Stage Nozzle Seal to First Stage Nozzle Flange	Diameter	Snug Fit required		Rework

* Shim or adjust to obtain required mounting distance.

** Lycoming engines incorporating fifth stage spacer, part number 1-100-205-03, shall conform to these clearances.

*** Lycoming engines incorporating fifth stage spacer, part number 1-100-205-04, shall conform to these clearances.

Figure 7-7. Table of Limits (Sheet 3 of 4)

The following references represent special torque limits expressed in pound-inches.

Ref No.	Figure No.	Description	Minimum	Maximum
300	7-4	Planet Gear Front Bearing Retaining Nut	250	275
301	7-4	Torquemeter Carrier Retaining Bolt	175	225
302	7-5	Compressor Housing Tapered Pin Nuts	30	35
303	7-6	First Stage Turbine Wheel Plate, Retaining Bolt	130	150
304	7-6	Second Stage Power Turbine Bearing Retaining Nut	2700	3000
305	7-6	Exhaust Diffuser to Second Stage Power Turbine Support Screws	20	30
306	7-6	V-band Coupling Retaining Bolts	145	155
				Tighten nuts to 200 pound-inches torque. Seat clamp by tapping the V-band. Release torque to 0 pound-inches. Tighten with 145 to 155 pound-inches torque.
307	7-6	Power Shaft Retainer Bolt		Apply anti-seize compound Ease-off 990, Federal Stock Number 8030-664-6146, to the threads. Tighten bolt to between 195 and 200 pound-inches torque. Release torque to zero pound-inches. Re-tighten bolt to between 115 and 125 pound-inches torque.
308	7-6	Main Fuel Fitting Nut	350	400
309	7-6	Power Turbine Tube	50	50
310	7-6	Oil Strainer Housing Adapter	50	50
311	7-6	Oil Strainer Housing	100	100
312	7-6	Oil Tube Connector	100	100
313	7-6	Fuel Vaporizer Adapter Nut	180	180
314	7-4	Spanner Nut (Front Rotor Shaft)	3840	3840

Figure 7-7. Table of Limits (Sheet 4 of 4)