R-3896-5
VOLUME II

TECHNICAL MANUAL

MAINTENANCE AND OPERATION

F-1 ROCKET ENGINE
GROUND SUPPORT EQUIPMENT

(ROCKETDYNE)

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

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PUBLISHED UNDER AUTHORITY OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

28 OCTOBER 1968
CHANGE NO. 6 — 27 MARCH 1972

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 188 CONSISTING OF THE FOLLOWING:

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Upon receipt of the second and subsequent changes to this technical manual, personnel responsible for maintaining this publication in current status will ascertain that all previous changes have been received and incorporated. Action should be taken promptly if the publication is incomplete

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INTRODUCTION

This manual, consisting of Volumes I and II, is one of seven R-3896-series technical manuals prepared to provide official Rocketdyne field support documentation for the operation and maintenance of the F-1 Rocket Engine, Part Number 104001, Serial Numbers F-2025 through F-2098, and its related ground support equipment, designed and manufactured by Rocketdyne, a division of North American Rockwell Corporation, 6633 Canoga Avenue, Canoga Park, California 91304. The information in these manuals was prepared by Logistics Product Support Department of Rocketdyne.

The instructions in the manuals are used more effectively when each manual is current and complete (see figure 1) and the purpose and scope of each manual is known. The manuals that complete this series, and the nature of the data each provides, are found in the manuals' contents and support functions chart.

1. F-1 MANUALS--THEIR SUPPORT FUNCTIONS.

The manuals' contents and support functions chart lists all F-1 series technical manuals, describes the support function each manual serves, and lists the section titles of each manual. The chart also explains how the technical data in each manual relates to the support of the engine and its ground support equipment throughout a normal engine flow, as well as during unscheduled maintenance tasks. Information appearing in one manual is not duplicated in another manual. Thus, information on the description, operation, and maintenance of a particular piece of ground support equipment is found in R-3896-5, Volume I, F-1 Rocket Engine Ground Support Equipment Maintenance and Operation manual. However, the actual instructions for servicing the engine using that piece of ground support equipment is in R-3896-3, Volume I, F-1 Rocket Engine Maintenance and Repair manual.

Manual	Contents and Support Function		Section and Title
R-3896-1 F-1 Rocket Engine Data	This manual contains a physical description of the various F-1 engine systems and the individual engine system components; a description of the flow the engine follows from the time it is accepted by the Customer through Apollo/Saturn V launch; data pertaining to engine design characteristics including environmental conditions, attitude, mass properties data, turbopump inlet propellant conditions, and interface connections for mating the engine with the S-1C of the Saturn V vehicle; and nominal engine performance characteristics, methods for predicting engine variable characteristics, and other pertinent information that can be used as an aid for analyzing and/or determining specific engine performance. The manual serves to familiarize the reader with the design and operation of the F-1 engine and serves as a training aid document.	I II III	Description and Operation Interface Design Criteria Performance

Manual	Contents and Support Function	Section and Title	
R-3896-3, Volume I F-1 Rocket Engine Maintenance and Repair	This manual contains general maintenance practices that are peculiar to the engine covered in this volume and to the component repair procedures contained in Volume II of this manual; the use of engine, thrust chamber, and nozzle extension ground support equipment and the tasks necessary to prepare the equipment for maintenance using the applicable pieces of ground support equipment; detailed procedures for component removal, reinstallation, or replacement, and the post-maintenance test requirements that will verify the integrity of engine systems affected by the removal of individual engine components and lines. This volume and Volume II provide the necessary maintenance and repair data to perform unscheduled maintenance tasks on an uninstalled engine and the required post-maintenance tests to determine that the engine is in an operable condition.	I	General Maintenance and Repair
		II	Handling
		III	Component Removal and Installation
		IV	Post-Maintenance Test Requirements
R-3896-3, Volume II F-1 Rocket Engine Maintenance and Repair	This manual contains cleaning, inspecting, repairing, and testing procedures for the individual engine components. This manual provides the data to restore and/or maintain components of the engine in an operable condition for reinstallation on the engine or assignment as a spare.	I	Quick-Disconnect
		II	Gas Generator
		III	Gas Generator Ball Valve
		IV	Gas Generator Injector Purge and Pump Seal Purge Check Valve
		V	(Deleted)
		VI	Heat Exchanger
		VII	Heat Exchanger Check Valve
		VIII	Thrust Chamber (Installed)
		IX	Thrust Chamber (Uninstalled)
		X	Thrust OK Pressure Switch
		XI	Inert Prefill Check Valve
		XII	Oxidizer Dome Purge Check Valve
		XIII	Oxidizer Valve
		XIV	Fuel Valve
		XV	Turbopump
		XVA	Turbine
		XVI	Bearing Coolant Control Valve
		XVII	(Deleted)
		XVIII	Electrical Harness
		XIX	Hypergol Manifold
		XX	Ignition Monitor Valve
		XXI	Checkout Valve
		XXII	Engine Control Valve

Manual	Contents and Support Function	Section	Title
R-3896-3, Volume II (cont)		XXIII	Four-Way Solenoid Valve
		XXIV	Thrust Chamber Nozzle Extension
		XXV	Pressure Transducer
		XXVI	Temperature Transducer
		XXVII	Flight Instrumentation Junction Boxes
		XXVIII	Rigid Ducts, Flexible Lines, and Braided Flex Hoses
		XXIX	Redundant Shutdown Valve
		XXX	Volumetric Liquid Oxygen Transducer (Oxidizer Flowmeter)
		XXXI	Gimbal Boot, Insulation Boot, and Insulation Seal
R-3896-4 F-1 Rocket Engine Illustrated Parts Breakdown	This manual contains illustrative and columnar listings of all parts of the engine that can be disassembled, reassembled, repaired, replaced, or overhauled. This manual locates and identifies the interrelationship of parts, aids in the requisition of replacement parts, indicates part usage and interchangeability and recommended repair or replacement for the F-1 engine and its individual components and parts.	I	Introduction
		II	Group Assembly Parts List
		III	Numerical Index
R-3896-5, Volume I F-1 Rocket Engine Ground Support Equipment Maintenance and Operation	This manual contains safety requirements and general maintenance practices peculiar to the equipment covered in this volume and to equipment and T-tools covered in Volume II of this manual; inspection requirements, physical description, operation, intended usage, operating limitations, periodic maintenance, and parts listings with maintenance-level codes for the F-1 engine ground support equipment covered in this volume. This volume provides data to restore and/or maintain the F-1 rocket engine ground support equipment in an operable condition.	I	Safety Requirements, General Maintenance, and Handling and Shipping Equipment
		II	Hydraulic Pumping Unit G2025
		III	Hydraulic Pumping Unit G2026
		IV	Accumulator Unit G2027
		V	Engine Checkout Console G3142
		VI	Pneumatic Flow Monitors G3130 and G3131
		VII	Engine Vertical Installer G4049
		VIII	Engine Rotating Sling G4050
		IX	Flight Combustion Monitor 703227
		X	Components Test Console G3141 and Components Adapter Set G3143
		XI	Cryogenic Supply Unit G3146
		XII	Pneumatic Flow Testers G3104 and G3104MD1
		XIII	High-Voltage Igniter Tester G3153 and Inert Igniter 9026622

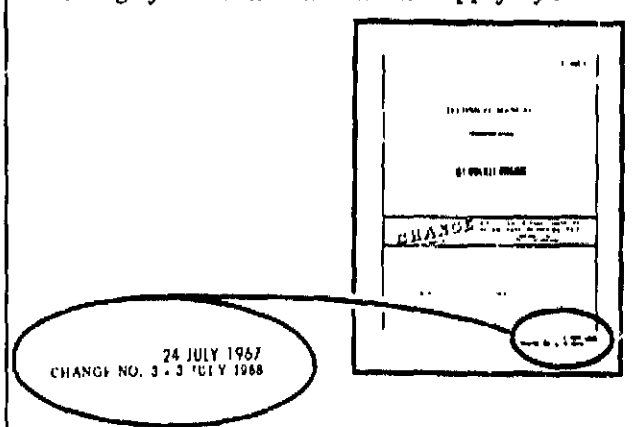
Manual	Contents and Support Function	Section and Title
R-3896-5, Volume I (cont)		XIV Impact Recorder Unit G4090 and 99-9014031 XV Components Welding Sets 9026560, 9026561, and 9026570
R-3896-5, Volume II F-1 Rocket Engine Ground Support Equipment Maintenance and Operation	This manual contains inspection requirements, physical description, operation, intended usage, operating limitations, periodic maintenance, and parts listing with maintenance-level codes for the F-1 engine ground support equipment end items that are considered tools (ie, test kits, sets, and tools) and T-tools. This volume provides data necessary to determine that those items of ground support equipment covered by this volume and the F-1 field T-tools are in an operable condition.	See detailed table of contents for this manual.
R-3896-6 F-1 Rocket Engine Thermal Insulation and Repair	This manual contains a description of the thermal insulation panels, special tools and equipment, installation and removal procedures, access provisions, repair data, and applicable packaging, storage, and handling information. This manual provides information pertinent to the maintenance and repair of F-1 engine thermal insulation.	I Description II Special Tools and Equipment III Installation and Removal (Engines F-2003 Through F-2016) IV Installation and Removal (Engines F-2017 and Subsequent) V Access Provisions VI Storage and Handling
R-3896-9 F-1 Rocket Engine Transportation	This manual contains procedures for preparing the F-1 rocket engine, nozzle extension, thermal insulation, and miscellaneous engine loose equipment for shipment, and procedures for shipping by truck, air, or water. Included are recommended truck-, air-, and water-transport check lists, which may be used to make sure that procedures and in-transit inspection have been performed.	I Preparation for Shipping II Shipping by Truck Transport III Shipping by Air Transport IV Shipping by Water Transport

Manual	Contents and Support Function	Section and Title	
R-3896-11 F-1 Rocket Engine Operating Instructions	This manual contains complete, authorized field operating requirements that affect F-1 flight engines F-2029 through F-2098 during normal operational flow from engine receipt at MAF through vehicle launch. Specific and general requirements and procedures for normal F-1 engine activities are provided and include acceptability criteria and limits, special constraints, safety precautions, and correct sequences required to satisfactorily accomplish the activities.	I II III	Operating Requirements General Requirements Operating Procedures

USE YOUR MANUAL ONLY IF CURRENT AND COMPLETE

Manuals that are not current and complete are not authoritative documents and are not to be used. The following outlines the method for determining whether your manual is current and complete.

A. DETERMINING CURRENCY. To be sure that yours is the latest issue of the manual, refer to Configuration Identification & Status Report , which is revised monthly and lists the technical manual numbers, titles, unincorporated supplements, and latest change or revision dates. Your manual must have a title page with the same or later date than the date shown in the Configuration Identification & Status Report. Your manual must also include the unincorporated supplements listed in the Configuration Identification & Status Report, or if your manual is later than shown in the report, the unincorporated supplements listed in the Manual Data Supplement Record in your manual. If your title page incorporates two dates as illustrated below, compare the change (lower) date. If your manual is not current, obtain a current copy through your technical manual supply system.

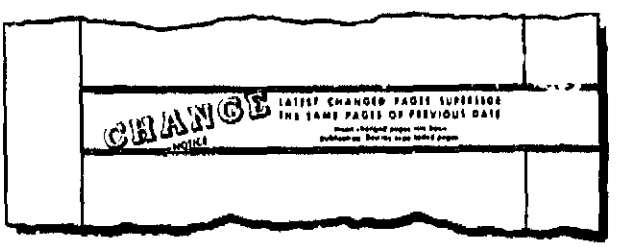


B. DETERMINING COMPLETENESS. To be sure that your manual is complete, make a page-by-page comparison of its pages to those listed in the List of Effective Pages. The List of Effective Pages, which shows the change status since the basic issue or last revision, is found on the alphabetically lettered page(s) immediately following the title page. All pages, except supplements, are listed with their issue dates. Manual pages that are dated must have the same date as that appearing in the List of Effective Pages for that page. Unchanged pages are listed as "original" and are not dated.

HOW TO KEEP YOUR MANUAL UP-TO-DATE

As design changes are made to the rocket engine and ground support equipment and better methods of maintenance are discovered, your manual is periodically changed, revised, or supplemented. The following steps will help you keep your manual up-to-date:

A. CHANGES. Updating by adding to or partially replacing existing pages is defined as a change. Changes can be identified by the change notice on the new title page.



To collate a change, refer to the Filing Instructions sheet issued with the manual and proceed as follows:

1. Remove the pages listed in the "Remove" column of the Filing Instructions sheet from the manual and destroy them. Do not concern yourself with the data on the opposite side of the deleted page since, if this date is not deleted, it is replaced in the change package.

2. Insert all pages listed in the "Insert" column of the Filing Instructions sheet in sequence. Pages with a suffix letter are inserted in alphabetical order following the page with the same basic number; for example, pages 3-14A, 3-14B, etc, follow page 3-14.

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Figure 1. How to Maintain Your Manual (Sheet 1 of 2)

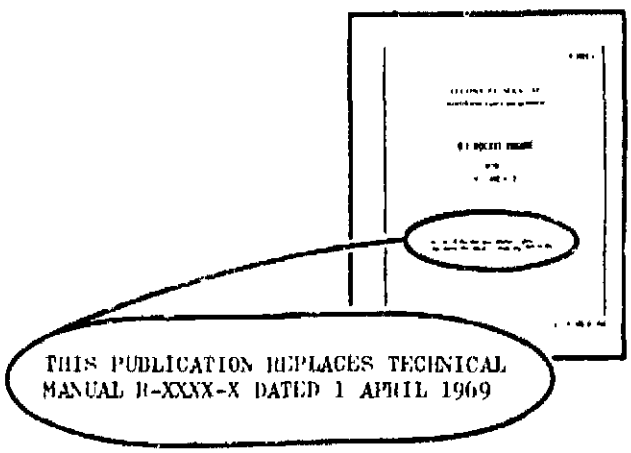
3. If you are unsure of the status of any page or pages, refer to the List of Effective Pages and make sure your manual contains pages (with the corresponding change dates) listed in the List of Effective Pages.

4. Remove manual supplements that have been incorporated.

NOTE

Incorporated supplements can be determined by reviewing the newly issued Manual Data Supplement Record.

B. REVISIONS. Updating by replacing all the existing pages of a manual is defined as a revision. Revisions can be identified by the replacement notice on the new title page.



To collate a revision, proceed as follows:

1. Remove and destroy all existing pages of your manual except Manual Data Supplements that have not been incorporated.

NOTE

Unincorporated supplements can be identified by reviewing the Manual Data Supplement Record supplied in the revision.

2. Insert the new pages in your cover.

C. SUPPLEMENTS. Updating that authorizes the addition to, or alteration of, the existing data in your manual is defined as a Manual Data Supplement. Information on how to insert supplements is found in the supplements.

HOW TO KEEP ABREAST OF THE LATEST CHANGES TO TECHNICAL DATA

Changes and/or additions to technical data are identified by a vertical bar (change bar) in the margin of the page adjacent to the changed data. A direct comparison between the new (identified by the change bar) and the old data will help you in identifying specific changes made.

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Figure 1. How to Maintain Your Manual (Sheet 2 of 2)

2. CONFIGURATION IDENTIFICATION.

EQUIPMENT CONFIGURATION. The MD identification symbol and the equipment model designation indicate the configuration of the equipment and distinguish it from models incorporating different changes and from basic models. A basic, unchanged configuration of the equipment has no MD identification symbol. MD identification symbols are added as changes affecting configuration are incorporated into the equipment. The MD identification symbol is stamped on the MD plate, which is mounted near the engine nameplate.

MD IDENTIFICATION SYMBOLS. The MD identification symbol is a composite number representing all the changes affecting configuration (MD changes) that are incorporated or not incorporated into the equipment. The symbol represents a consecutively numbered series of MD changes. Any MD change, or series of MD changes, not incorporated is represented by an "X." Multi-digit numbers are underlined. Two figures together represent the limits of a series of incorporated MD changes. Figure 2 illustrates how MD changes incorporated in the equipment are represented by the MD identification symbol.

MANUAL REFERENCE. A reference that appears in the manual may refer to a series of MD changes or to an individual MD change; for example, "MD9" refers to MD1 through MD9, but "MD9 change," refers to the individual MD change 9. This latter type of reference, which is illustrated in figure 2, identifies separate sets of information required by differences in configuration. When an MD reference appears in this manual, examine that MD identification symbol on the equipment to determine which set of information is applicable.

3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

Refer to R-3896-5, Volume I, for a list of approved ECP's (Engineering Change Proposals) and associated MD numbers applicable to equipment covered in this manual. Ground Support Equipment configuration information is in R-5857, Saturn F-1 Configuration Identification & Status Report.

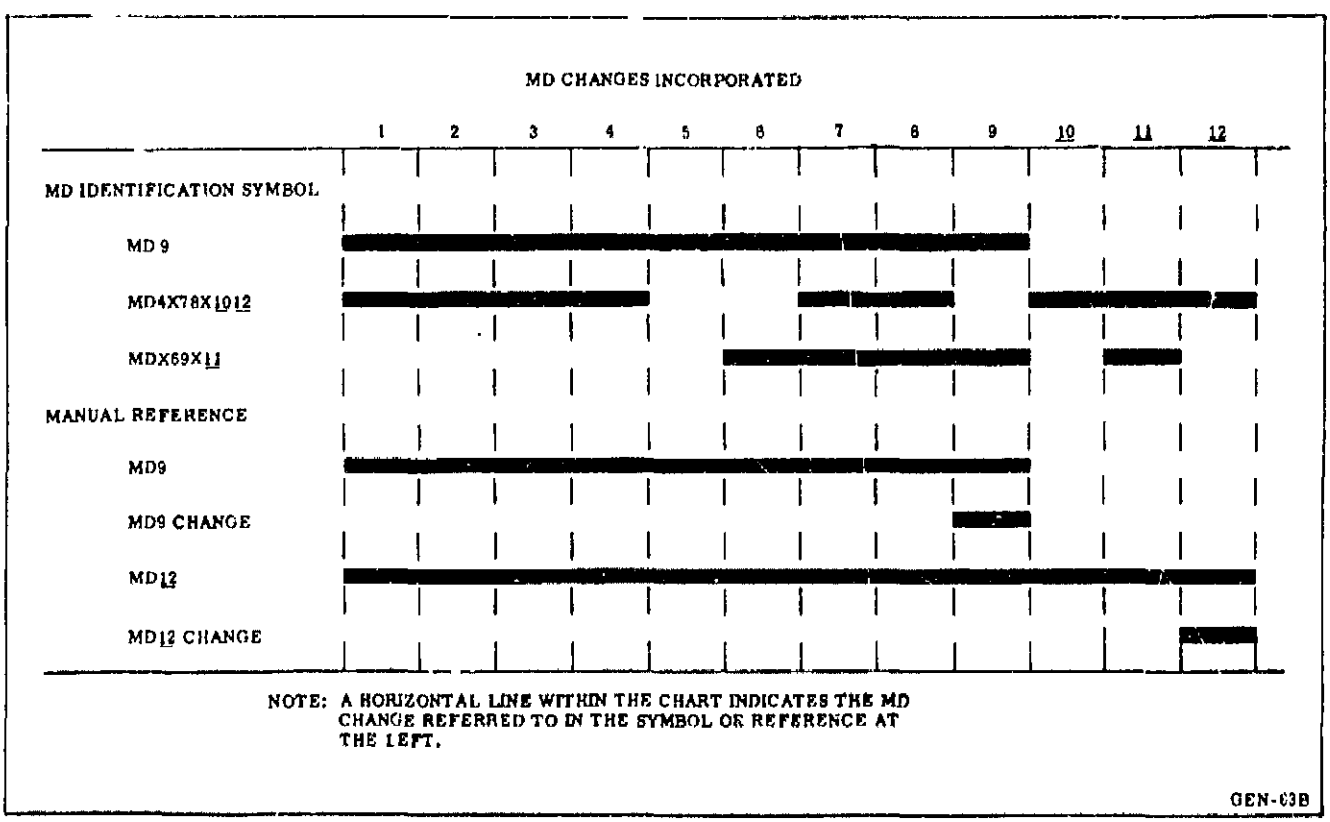


Figure 2. MD System

SOURCE AND RECOVERABILITY CODE LIST.

The Source and Recoverability Code List indicates the maintenance level at which an item may be repaired, or the level at which it may be replaced as a complete unit.

The Source and Recoverability Code consists of two parts, a letter and a number. The letter denotes the level at which the item may be removed and replaced and the type of action that may be taken. The number denotes the level at which the item may be repaired. Definitions of the codes are as follows:

Source Code

A . . . . Assembled from component parts

F . . . . Removed and replaced at field level (using sites)

D . . . . Removed and replaced at depot level (Rocketdyne)

X . . . . Will not be procured

M . . . . May be manufactured at level designated by accompanying digit

Recoverability Code

1 . . . . Field level (using sites)

2 . . . . Depot (Rocketdyne)

3 . . . . Nonrepairable

The following examples illustrate the use of the Source and Recoverability Code:

Valve (F-1)	Replaced at field sites; repaired at field sites
Seal (F-3)	Replaced at field sites; no repair at any location
Piston (D-2)	Replaced at depot; repaired at depot

SECTION I

TEST KITS, SETS, AND TOOLS

WARNING

THE FOLLOWING GROUND SUPPORT EQUIPMENT MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

G2030, Oxidizer Dome Flushing Kit
G2037, Fuel Drainage Kit
G2038, Temperature Transducer Installer and Remover Kit
G2039, Scavenge Pump
G3135, Hypergol System Tool Kit
G3136, Thrust Chamber Throat Plug
G3144, Turbine Exhaust Exit Pressure Check Fixture
G4079, Nozzle Extension Alinement Tool
G4086, Trunnion Nut Torque Wrench Extension
99-2012908, Fuel Drain Vent Adapter Kit

1-1. SCOPE. This section contains inspection, description, operation, and maintenance of test kits, sets, and tools. Refer to R-3896-5, Volume I, for safety precautions and general repair procedures. The parts list consists of a tabulated listing of all parts required for support of the equipment at the field sites. The parts are listed in disassembly order, except where disassembly order does not apply, and are keyed to an associated illustration by index number. The relation of a part to its next higher assembly is indicated by indention.

1-2. INSPECTION.

1-3. Figure 1-1 lists items to be inspected, conditions to be sought and corrected, and frequency of inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions and to make sure that hardware configuration is in accordance with appropriate records. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. (See figure 1-1 for inspection and periodic intervals.)

Inspection	Periodic (Months) 3	6	12	24
Visual inspections for all units				
1. Obvious signs of damage to all structural members				
2. Illegible stencils, decals, or nameplates				
3. Contamination that could result in adverse effects to equipment or engine				
4. Completeness of units and records				
5. Damage to threaded fasteners, inserts, and fittings				
3. Damage to sealing surfaces and gasket seals				
Oxidizer dome flushing kit G2030				
1. Cuts or abrasions in holes and damaged coupling nuts		X		
2. Damage to gages, disconnects, manifold, and fittings		X		
3. Pressure gage calibration check		X		
4. Proof-test expiration (paragraph 1-11)			X	

Figure 1-1. Inspection Requirements (Sheet 1 of 3)

Inspection	Periodic (Months) 3	6	12	24
Thermal insulation installation set G2035				
1. Binding of alinement clamp and flange bending tools			X	
2. Broken jaws of flange unbending tools			X	
3. Damage or deterioration of liner in container				X
Fuel drainage kit G2037				
1. Damage to ends of extension wrench	Before use.			
2. Damage to threads of setscrews	Before use.			
3. Damage to threads of adapter	Before use.			
4. Damage or deterioration of liner in container	Before use.			
Temperature transducer installer and remover kit G2038				
1. Damage to threads of shaft			X	
2. Damage to threads of guide			X	
3. Damage to threads of shoe			X	
4. Damage to threads of pilot			X	
5. Damage to surface of pilot			X	
Scavenge pump G2039				
1. Cuts or abrasions in hose, and damaged coupling nuts		X		
2. Deterioration of Tygon tubing			X	
3. Proper lubrication (paragraph 1-54L)			X	

Inspection	Periodic (Months) 3	6	12	24
Test plate, plug, and tool set G3132				
1. Improper rating on test plate burst diaphragms and incorrect installation			X	
2. Damage to sealing surfaces and gaskets of test plates		X		
3. Proper lubrication (paragraph 1-66)		X		
Hypergol system tool kit G3135				
1. Damage to sealing surface			X	
2. Binding lever and push rod			X	
Thrust chamber throat plug G3136				
1. Damage to threads of shaft			X	
2. Damage to throat seal inflatable tube and seating surface			X	
3. Improper rating on burst diaphragm and incorrect installation			X	
4. Proof-test expiration (paragraph 1-88)			X	
Turbine exhaust exit pressure test fixture G3144				
1. Damage to inflatable seal		X		
2. Damage to threads clamp assembly		X		

Figure 1-1. Inspection Requirements (Sheet 2 of 3)

Inspection	Periodic (Months) 3	6	12	24
Nozzle extension alinement tool G4079				
1. Deterioration of girth and support straps			X	
2. Damage to threaded parts			X	
3. Proper lubrication (paragraph 1-119)		X		
Turbopump support G4083				
1. Proper lubrication (paragraph 1-132)			X	
2. Binding of connector thumbwheel and keeper			X	
3. Damage to wrench flats of adjustment nut			X	
4. Galled threads in clevis			X	
5. Proof-test expiration (paragraph 1-129)			X	
Thermal insulation alinement fixture G4084				
1. Alinement of locators			X	
Trunnion nut torque wrench extension G4086				
1. Damage to threads of bushing			X	

Inspection	Periodic (Months) 3	6	12	24
Band clamp tool kit G4087				
1. Damage to jaws			X	
Air-powered stapler 9023569				
1. Alinement of head to die			X	
Thermal insulator grommet tool set 9023570				
1. Damage to swages and backing tools			X	
2. Damaged or cracked spring			X	
Four-way hydraulic manifold check valve cap 88-557487				
1. Damage to boss threads			X	
2. Damage to sealing surface			X	
Insulation moisture detector 99-9026366				
1. Timer adjustment			X	
Fuel drain vent adapter kit 99-9012908				
1. Deterioration of Tygon tubing			X	
2. Damage to threads			X	

Figure 1-1. Inspection Requirements (Sheet 3 of 3)

1-4. OXIDIZER DOME FLUSHING KIT G2030.

1-5. DESCRIPTION.

1-6. The oxidizer dome flushing kit consists of a manifold, two quick-disconnects, two pressure gages, five hoses, a handle, and a mounting bracket. On units incorporating MD3 change, a sixth hose is added to provide a gaseous nitrogen purge to the fuel side of the gas generator injector. The internal passages of the manifold are arranged to interconnect two inlet ports with five outlet ports. The quick-disconnects are a body assembly provided by the user, and a nose assembly with caps which mate with the body assembly. The pressure gages are low-pressure gages and indicate up to 300 psig. Each of the outlet ports, No. 1 through No. 5, contains a spool and necessary unions. The No. 5 outlet port also has an orifice. Four of the five hoses are identical, except varying in length, including the necessary unions for connection to the engine oxidizer dome. The fifth hose has an adapter instead of a union, for connection to the engine gas generator ball valve. On units incorporating MD4 change, a new bracket is added for use when thermal insulation is installed.

1-7. OPERATION.

1-8. The oxidizer dome flushing kit is used whenever decontamination of the oxidizer dome and gas generator oxidizer injector is required. It is a portable unit that attaches to the engine to provide close connect points for flushing and purging the thrust chamber oxidizer dome and the gas generator oxidizer injector. A facility source of trichloroethylene at 90 psig and gaseous nitrogen at 175 psig is supplied to the inlets. Inlet pressure is indicated on the manifold pressure gages. The spools create an aspirator effect which causes the gaseous nitrogen to atomize the trichloroethylene at the outlets, thereby dispersing it through the five hoses to the engine.

1-9. MAINTENANCE.

1-10. Maintenance of the oxidizer dome flushing kit consists of performing proof, leak, and function tests, disassembling, cleaning, assembling, and servicing.

1-11. PROOF TESTING. Proof-test the oxidizer dome flushing kit at 12-month intervals or any time the manifold or hoses are modified, repaired, or replaced. The hoses supplied are restricted for use with the oxidizer dome flushing kit only.

WARNING

Proof tests are extremely hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Remove caps from manifold TRICH and GN_2 inlet quick-disconnects.

b. Cap or plug outlet ends of all hoses, and firmly secure hoses.

c. Connect a source of gaseous nitrogen (MIL-P-27401) to GN_2 inlet.

d. Pressurize manifold to 300-310 psig and hold for 2-3 minutes; then decrease pressure to zero.

e. Inspect manifold and hoses for deformation or damage. Deformation or damage is not allowable.

f. Disconnect gaseous nitrogen source from GN_2 inlet.

g. Inspect manifold TRICH and GN_2 inlet quick-disconnects for freedom of operation; they must operate smoothly without binding.

h. Install pressure caps on TRICH and GN_2 inlet quick-disconnects.

1-12. LEAK TESTING. The leak test is performed any time the unit has been disassembled for repair or cleaning.

a. Connect a source of gaseous nitrogen (MIL-P-27401) to GN_2 inlet.

b. Cap or plug remaining inlet and outlet hose assemblies.

c. Slowly increase gaseous nitrogen pressure to 180 psig, as indicated on flushing kit pressure gages.

d. Check all joints, fittings, and connections for leakage with leak-test compound (MIL-L-25567). No leakage is allowable.

e. Reduce gaseous nitrogen pressure to zero; remove source from GN_2 inlet.

f. Cap GN_2 inlet.

1-13. FUNCTION TESTING. The function test is performed any time the unit has been disassembled for repair or cleaning. See figure 1-2 for index and part numbers.

a. Connect a source of gaseous nitrogen (MIL-P-27401), capable of maintaining a pressure of 180 ±20 psig at a flowrate of 300-800 scfm, to TRICH inlet.

b. Connect a flowmeter, with a range of 20-200 scfm, to outlet of hoses (3, 9, 10, 11, 12). On units incorporating MD3 change, install pressure caps on hoses (43).

c. Increase source pressure to 180 ±20 psig, at a flowrate of approximately 300 scfm, and record flowrate at each hose. Flowrate must be 20 ±3 percent of total flowrate. If flowrate is not in tolerance, spool (8) may be changed to obtain specified flowrate, and leak-test in paragraph 1-12 repeated.

NOTE

If a flowmeter for each hose is not available, one flowmeter may be used by moving it from hose to hose, if the hoses are secured and uncapped and flowrate is constant while the individual flowrates are taken.

d. Decrease source pressure to zero, disconnect source from TRICH inlet, and connect to GN_2 inlet. On units incorporating MD3 change, remove pressure caps installed in step b.

e. Increase source pressure to 180 ±20 psig at a flowrate of approximately 800 scfm and record flowrate at each hose. Flowrate at each hose, connect to No. 1 through No. 4 outlet ports, must be 23 ±3 percent of total flowrate. Flowrate at hose connected to No. 5 outlet port must be 8 ±2 percent of total flowrate. On units incorporating MD3 change, measure and record flowrate at hoses (43) (combined flow must be 8-18 scfm) and subtract this value from total input flowrate to determine the total flowrate to be used for calculating the percentages listed above.

f. Reduce source pressure to zero; disconnect source from GN_2 inlet.

g. Remove test equipment and cap inlet and outlet connections.

1-14. DISASSEMBLING. Disassemble the oxidizer dome flushing kit, as required, to accomplish necessary repair or replacement. See figure 1-2 for index and part numbers.

1-15. CLEANING. Clean, inspect, handle, and package parts of the oxidizer dome flushing kit as outlined in R-3896-5, Volume I. Hand-clean pressure gages externally and flush with trichloroethylene (MIL-T-27602).

WARNING

Trichloroethylene is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

1-16. ASSEMBLING. See figure 1-2 for index and part numbers. The lubricant used for straight threads, tube sleeves, and O-rings is lubricant grease RB0140-012 (Rocketdyne). For tapered threads, use thread sealant tape RB0140-002 (Rocketdyne). Refer to R-3896-5, Volume I, for lubricant application. Gasket (6) and ring (7) must be replaced when parts (4 through 8) are disassembled.

a. Install spool (8), ring (7), gasket (6), nut (5), and union (4) into ports No. 1 through No. 4. Torque nut (5) to 450-650 inch-pounds.

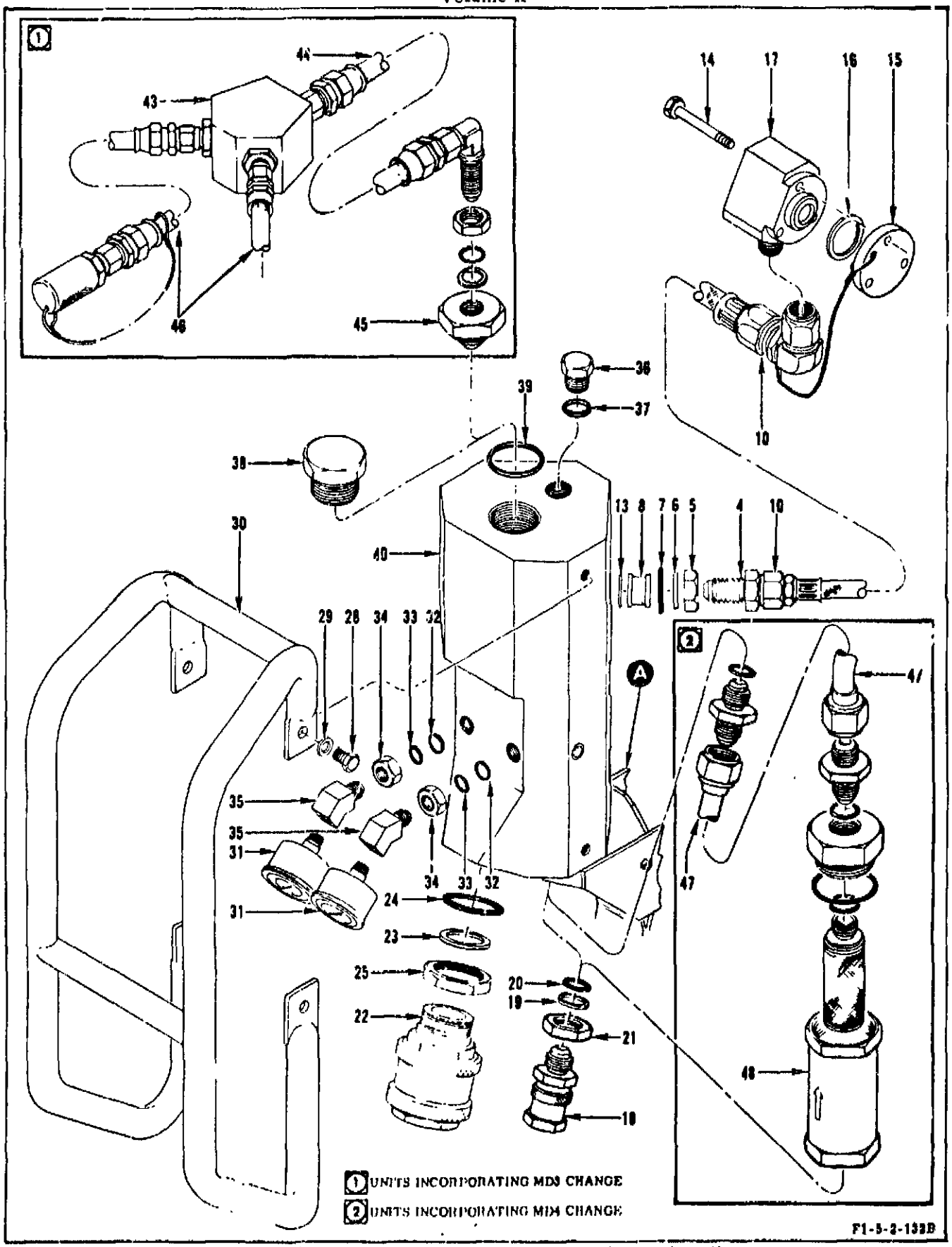


Figure 1-2. Oxidizer Dome Flushing Kit (Sheet 1 of 4)

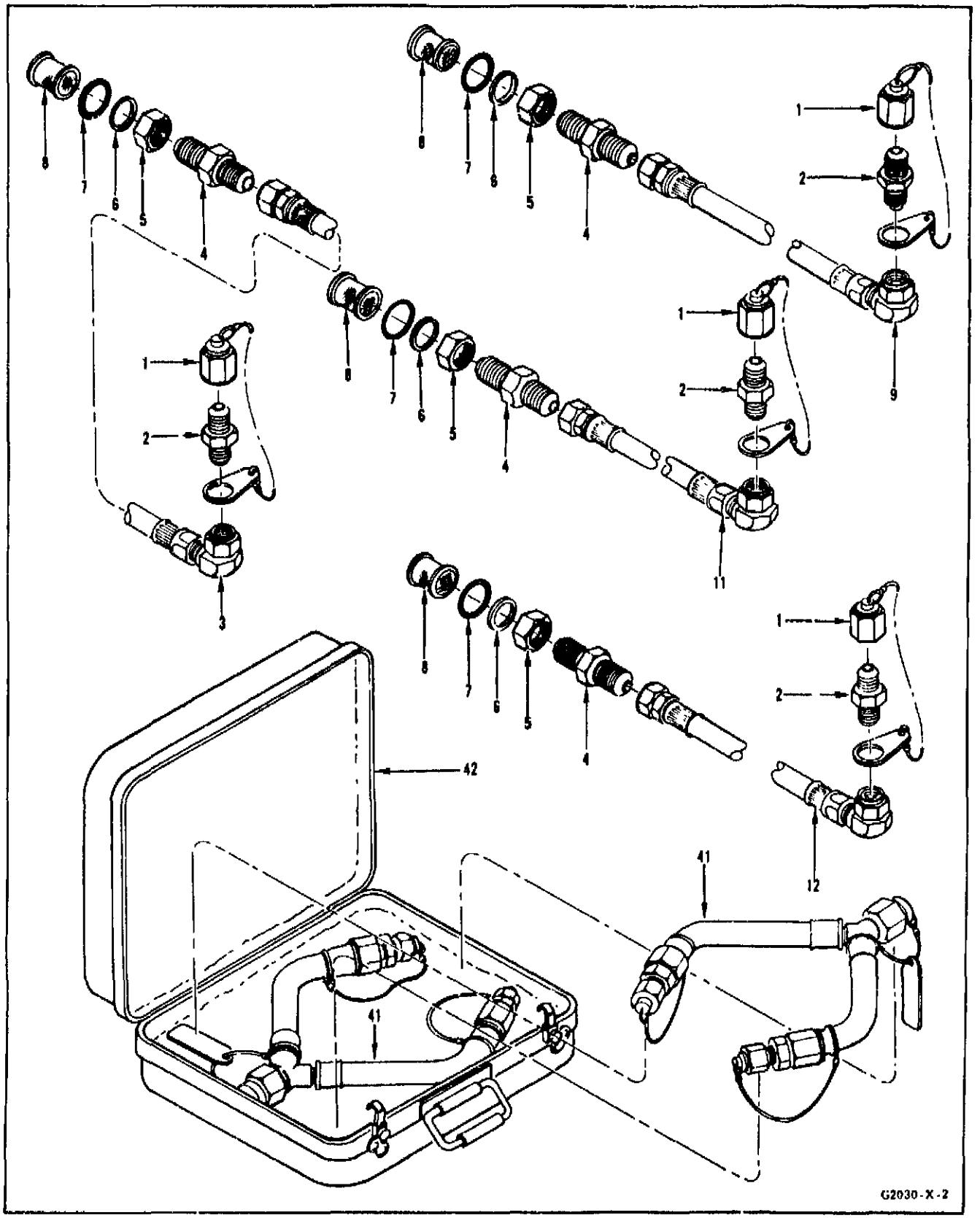
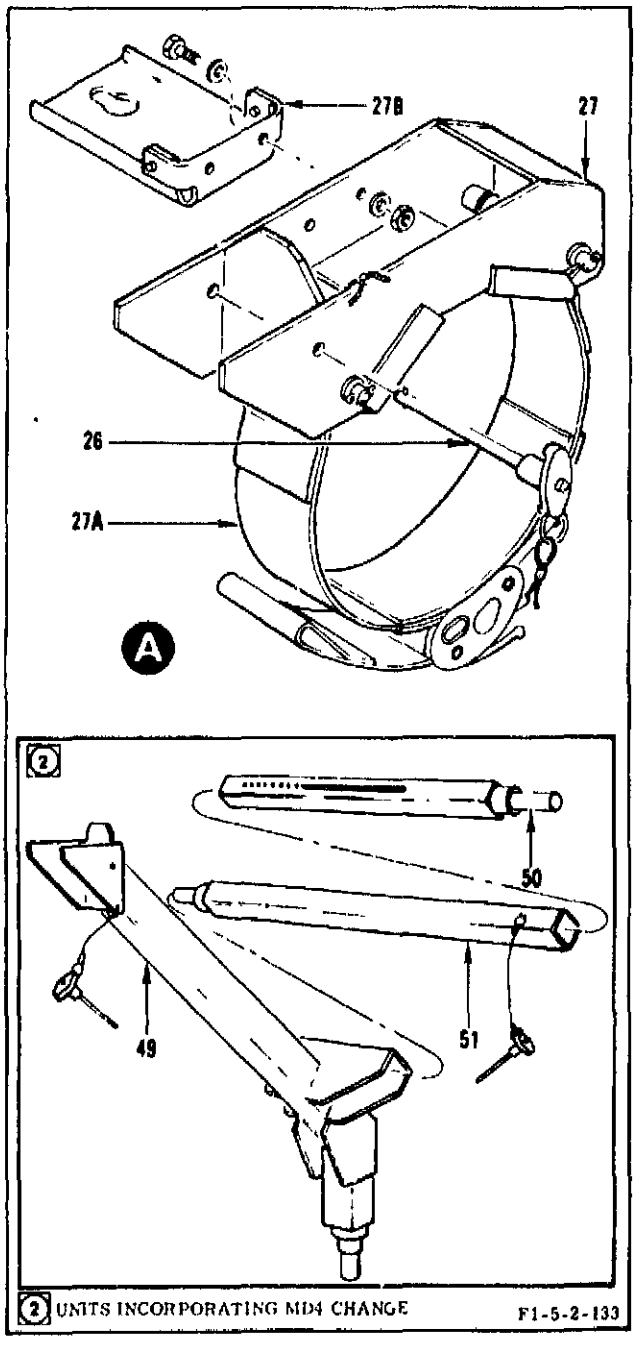


Figure 1-2. Oxidizer Dome Flushing Kit (Sheet 2 of 4)



Index No.	Part No.	Description
1	RD265-1001-0012	Cap (F-3)
2	AN815-12C	Union (F-3)
3	R3806-12-0600	Hose (F-3)
4	AN832-12-C	Union (F-3)
5	AN6289C12	Nut (F-3)
6	RD262-3001-0012	Gasket (F-3)

Index No.	Part No.	Description
7	MS28777-12	Ring (F-3)
8	405091	Spool (F-3)
9	R3806-12-1080	Hose (F-3)
10	R3806-12-0800	Hose (F-3)
11	R3806-12-1000	Hose (F-3)
12	R3806-12-0500	Hose (F-3)
13	9022050	Orifice (F-3)
14	NAS1004-28H	Bolt (F-3)
15	9020502	Cover (F-3)
16	9022110	Gasket (F-3)
17	9022108	Adapter (F-1)
18	500CA-A-E4	Cap (F-3)
	502A-857-E4	Nose (F-3)
19	RD262-3001-0008	Gasket (F-3)
20	MS28777-8	Ring (F-3)
21	AN6289C8	Nut (F-3)
22	24C-A-E4	Cap (F-3)
	242A-2457	Nose (F-3)
23	RD262-3001-0024	Gasket (F-3)
24	MS28777-24	Ring (F-3)
25	AN6289C24	Nut (F-3)
26	NAS1334A2C33D	Pin (F-3)
	RD191-2002-3312	Cable (M-3)
	28-2-G	Sleeve (F-3)
27	9024170	Bracket (F-1)
27A	3910151A022-009	Strap (F-3)
	MS20392-5C103	Pin (F-3)
	NAS43DD6-24	Spacer (F-3)
	LD153-0010-0014	Washer (F-3)
	MS24665-300	Pin (F-3)
27B	9024169	Bracket (F-1)
	AN3-4A	Bolt (F-3)
	LD153-0010-0007	Washer (F-3)
	NAS679A3W	Nut (F-3)
28	NAS1004-2A	Bolt (F-3)
29	RD153-5004-0004	Washer (F-3)
30	9020504	Frame (F-1)
31	KW-G2B5-300	Gage (F-3)
32	RD262-3001-0004	Gasket (F-3)
33	MS28777-4	Ring (F-3)
34	AN6289C4	Nut (F-3)
35	9020507	Adapter (F-1)
36	AN814-8C	Plug (F-3)
37	RD262-3001-0008	Gasket (F-3)
38	AN814-16C	Plug (F-3)
39	RD262-3001-0016	Gasket (F-3)
40	9020503	Manifold (F-1)
41	9024153	Adapter (F-1)
	R24343	Hose (F-3)
	AN929A12C	Cap (F-3)
	RD191-2001-2108	Cable (F-3)
	28-1-C	Sleeve (F-3)
	RD171-4003-002	Tag (F-3)
	AN919-15C	Reducer (F-3)

Figure 1-2. Oxidizer Dome Flushing Kit (Sheet 3 of 4)

Pages 1-8A and 1-8B deleted.

Index No.	Part No.	Description
	AN929A8C	Cap (F-3)
	RD191-2001-2110	Cable (F-3)
	28-1-C	Sleeve (F-3)
42	9024165	Adapter kit (X-2)
43	9025254(a)	Manifold (F-3)
44	19-9014938-36(a)	Hose (F-3)
	AN919-18C	Reducer (F-3)
	RD262-3001-0012	Gasket (F-3)
	AN833-6C	Elbow (F-3)
	AN6289C6	Nut (F-3)
	MS28777-6	Ring (F-3)
	RD262-3001-0006	Gasket (F-3)
45	9023969(a)	Orifice (F-3)
	RD262-3001-0016	Gasket (F-3)
46	19-9014938-11(a)	Hose (F-3)
	AN919-12C	Reducer (F-3)
	RD262-3001-0008	Gasket (F-3)
	9023934	Diffuser (F-3)
	9023935	Protector (F-3)
	RD191-2002-1210	Wire rope (M-3)
	28-1-C	Sleeve (F-3)
47	9012794(b)	Tube (M-1)
	AN815-8J	Union (F-3)
	RD262-3001-0008	Gasket (F-3)
48	321699-40(b)	Filter (F-1)
	3-12	Seal (F-3)
	3-28	Seal (F-3)
49	9012792(b)	Strut (F-1)
	MS17985C432	Pin (F-3)
	RD191-2002-1108	Wire rope (M-3)
	28-1-C	Sleeve (F-3)
50	9012791(b)	Outer strut (F-2)
	MS17985C416	Pin (F-3)
	RD191-2002-1108	Wire rope (M-3)
	28-1-C	Sleeve (F-3)
	MS20393-3C53	Pin (F-3)
51	9012789(b)	Inner strut (F-2)

(a) Units incorporating MD3 change
(b) Units incorporating MD4 change

Figure 1-2. Oxidizer Dome Flushing Kit (Sheet 4 of 4)

CAUTION

Installation of orifice (13) into any port other than port No. 5 0800 can cause adverse conditions during engine flushing procedures.

b. Install orifice (13) into port No. 5 0800, and install spool (8), ring (7), gasket (6), nut (5), and union (4) into port. Torque nut (5) to 450-650 in-lb.

c. Perform leak test (paragraph 1-12) after assembly.

d. Safetywire nut (5) to frame (30) by placing a double wrap of Inconel lockwire MS20995N20 in notches of nut (5), twisting, and attaching to frame (30).

e. Affix an Alucast No. 67 aluminum seal (Stoffel Seals of California) to ends of lockwire.

f. Check that Quality Control stamp (Rocketdyne) imprinted on seal is legible.

g. Install protective closures on all open ports.

h. Torque B-nuts of hose (3, 9, 10, 11, 12) to 900-1,100 in-lb.

i. Torque nut (21) to 200-250 in-lb and nut (25) to 900-1,100 in-lb.

j. Torque nut of bracket (27B) to 14-18 in-lb.

k. Torque nut (34) to 75-100 in-lb, and apply one wrap of thread sealant tape RB0140-002 (Rocketdyne) to threads of gage (31).

l. Torque plug (36) to 150-200 in-lb.

m. Torque plug (38) or orifice (45) to 450-600 in-lb.

n. Torque nut or elbow of hose (44) to 150-200 in-lb and B-nuts of hose (44, 46) to 270-345 in-lb.

o. Torque unions of tube (47) to 180-230 in-lb and B-nuts of tube (47) to 450-525 in-lb.

1-17. SERVICING. Servicing of the oxidizer dome flushing kit consists of a 6-month periodic calibration check of the pressure gages. Gage accuracy must be within 2 percent of full scale range.

1-18. SHIPPING AND STORING.

1-19. Prepare the oxidizer dome flushing kit for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-20. THERMAL INSULATION INSTALLATION SET G2035.

1-21. DESCRIPTION.

1-22. The thermal insulation installation set consists of six alinement clamps, two flange tab bending tools, two flange tab unbending tools, and a container. The clamps and bending tools are comparable to a pair of pliers and the unbending tools are constructed from tool-steel bars with jaws at the end to mate with the flange tab.

1-23. OPERATION.

1-24. The thermal insulation tools are used to aline insulator flanges and flange holes for installation of fasteners, bending the flange tabs over the mating flange, and unbending the tabs.

1-25. MAINTENANCE.

1-26. Maintenance of the thermal insulation installation set consists of cleaning. See figure 1-3 for index and part numbers.

1-27. CLEANING. Clean the thermal insulation installation set tools as outlined in R-3896-5, Volume I.

1-28. SHIPPING AND STOEING.

1-29. Prepare the thermal insulation installation set for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

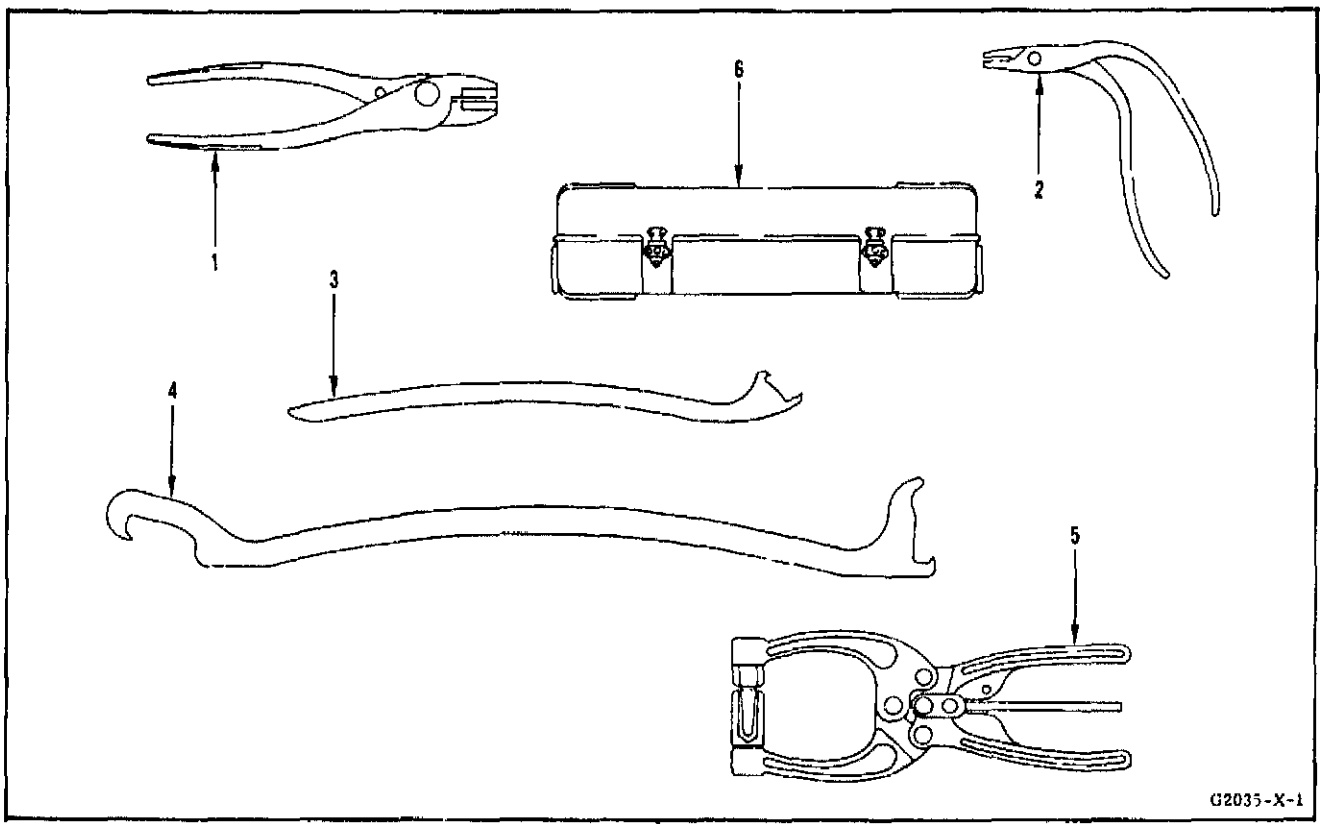
1-30. FUEL DRAINAGE KIT G2037.

1-31. DESCRIPTION.

1-32. The fuel drainage kit consists of four drain tools, 32 gaskets, and a container. The drain tool is an adapter-wrench combination containing a drain adapter, an extension wrench, a drain ring, a retainer ring, and seals. The drain adapter is approximately six inches long and 1-1/2 inches in diameter. The bore of the adapter forms a housing for the extension wrench. One end has internal and external seal grooves and six drain holes equally spaced around the adapter. The other end has internal threads. The extension wrench is approximately 6-1/2 inches long and 0.8 inch in diameter. One end is machined to 9/16-inch wrench flats and the other end is machined to a 5/16-inch hexagon wrench end. A drilled passage through the center has two exits outboard of the hexagon. The drain ring is a collar with a drain port and hose adapter and is installed on the adapter over the drain holes. The retainer ring is a collar, secured with two setscrews, which holds the drain ring in position. The external seals provide a seal between the drain ring and adapter on each side of the drain holes. The internal seals provide a seal between the adapter and the extension wrench.

1-33. OPERATION.

1-34. The fuel drainage kit is used to drain the thrust chamber fuel jacket with or without thermal insulation installed on the thrust chamber. The drain tool is screwed onto the engine drain plug adapter and a drain hose connected to the drain ring hose adapter. The drain ring may be rotated 360 degrees to position the drain hose at the lowest point. The extension wrench is pushed inboard to engage the internal hexagonal head of the drain plug, and the drain plug is unscrewed until the extension wrench stop is reached. Fluid from the fuel jacket flows through a slot in the drain plug, into the adapter, out the six drain holes, into the drain ring cavity, then overboard through the drain hose.



Index No.	Part No.	Description	Index No.	Part No.	Description
1	19-9023618	Flange bending tool (F-3)	4	9023567	Flange unbending tool (F-3)
2	19-9023621	Offset flange bending tool (F-3)	5	9023565	Alinement clamp (F-3)
3	9023624	Offset flange unbending tool (F-3)	6	VD192-0007-0024	Container (F-3)

Figure 1-3. Thermal Insulation Installation Set

1-35. MAINTENANCE.

1-36. Maintenance of the fuel drainage kit consists of inspecting, disassembling, cleaning, assembling with new O-rings, and leak-testing.

1-37. LEAK TESTING.

WARNING

Fuel Drainage Kit G2037 must be operated by authorized personnel trained in the use of the equipment.

a. Remove hose adapter from drain ring and install a pressure plug in drain port.

b. Install a pressure plug in adapter threaded end and secure drain tool to work bench.

c. Connect a regulated source of gaseous nitrogen (MIL-P-27401) to union on extension wrench.

d. Increase source pressure to 30 ±3 psig and apply leak-test compound (MIL-L-25567), or equivalent, to mating surface between adapter flange and drain ring, to retainer ring, and to adapter and extension wrench. Fuzz leakage is allowable.

e. Decrease source pressure to zero and remove test equipment.

1-38. DISASSEMBLING. Disassemble the drain tool, as required, to accomplish necessary repair or replacement. See figure 1-4 for index and part numbers.

1-39. CLEANING. Clean, inspect, handle, and package parts of the fuel drain tool as outlined in R-3896-5, Volume I.

1-40. ASSEMBLING. See figure 1-4 for index and part numbers. The lubricant used on O-rings during assembly is FS1281 grease (Dow Corning Corp).

a. Torque nut on adapter of ring (2) to 200-250 in-lb.

b. Torque union of wrench (4) to 50-75 in-lb, and tighten cap of wrench (4) fingertight.

1-41. SHIPPING AND STORING.

1-42. Prepare fuel drainage kit for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-43. TEMPERATURE TRANSDUCER INSTALLER AND REMOVER KIT G2038.

1-44. DESCRIPTION.

1-45. The temperature transducer installer and remover kit consists of a guide, tap wrench, hand reamer and a pilot housed in a container. The guide assembly consists of a threaded shaft mounted in the guide and incorporating a knob on one end and a shoe secured on the opposite end by a pin. A strap incorporating two dowel pins is secured to the bottom of the guide by screws.

1-46. OPERATION.

1-47. The hand reamer attaches to the tap wrench and is used to clean carbon from the temperature transducer mounting boss. The pilot is substituted for the transducer to aline the guide on the transducer boss. The guide is secured to the transducer boss by the strap and two screws. The transducer when screwed into the guide shoe may be removed or installed into the transducer boss by rotating the shaft knob.

1-48. MAINTENANCE.

1-49. Maintenance of the temperature transducer installer and remover kit consists of disassembling, cleaning, and assembling.

1-50. DISASSEMBLING. Disassemble the guide, as required, to accomplish necessary repair or replacement. See figure 1-5 for index and part numbers.

1-51. CLEANING. Clean parts of temperature transducer installer and remover kit as outlined in R-3896-5, Volume I.

1-52. ASSEMBLING. See figure 1-5 for index and part numbers. Lubricate shaft to shoe interface and shaft threads with lubricant grease RB0140-012 (Rocketdyne).

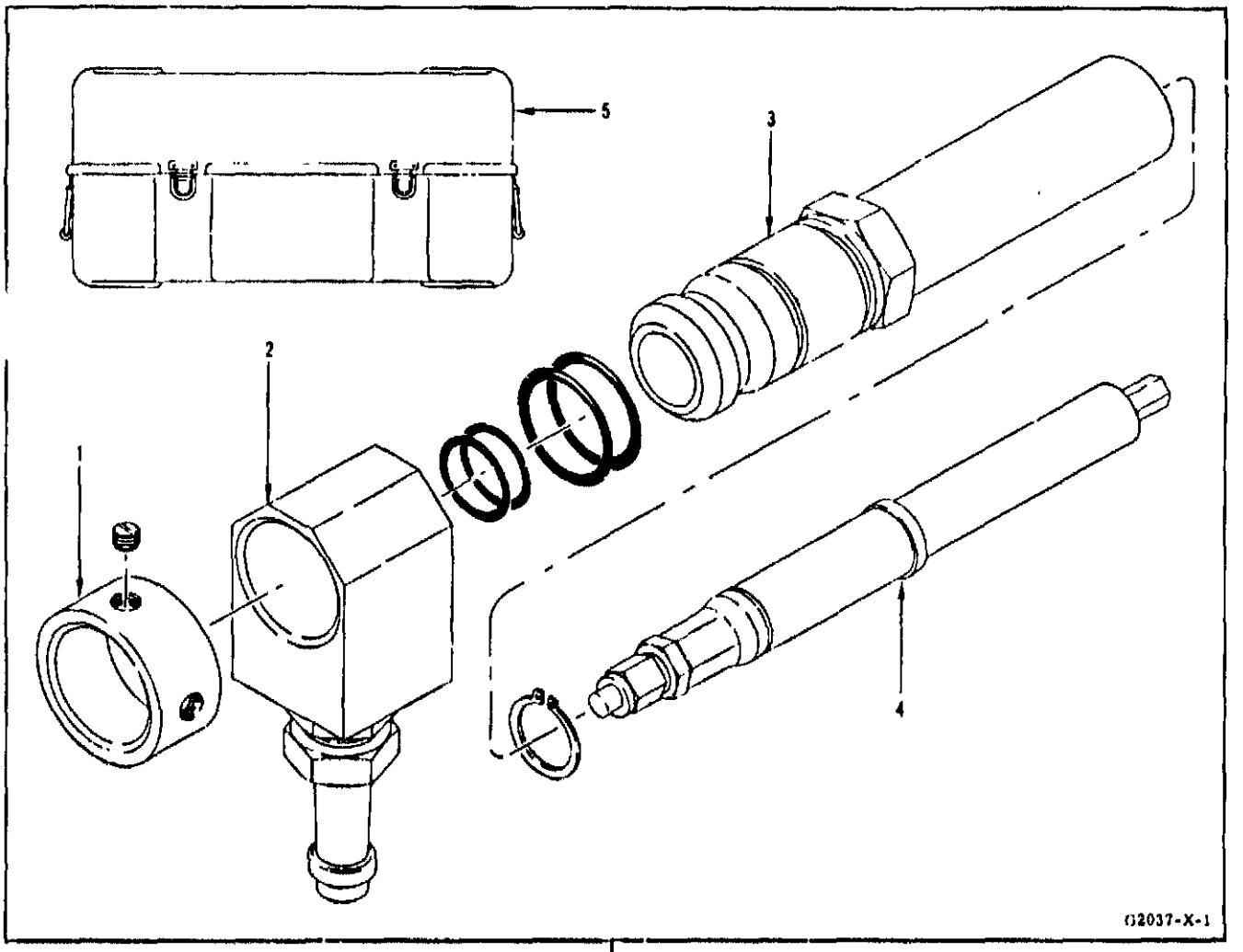
1-53. SHIPPING AND STORING.

1-54. Prepare temperature transducer installer and remover kit for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-54A. SCAVENGE PUMP G2039.

1-54B. DESCRIPTION.

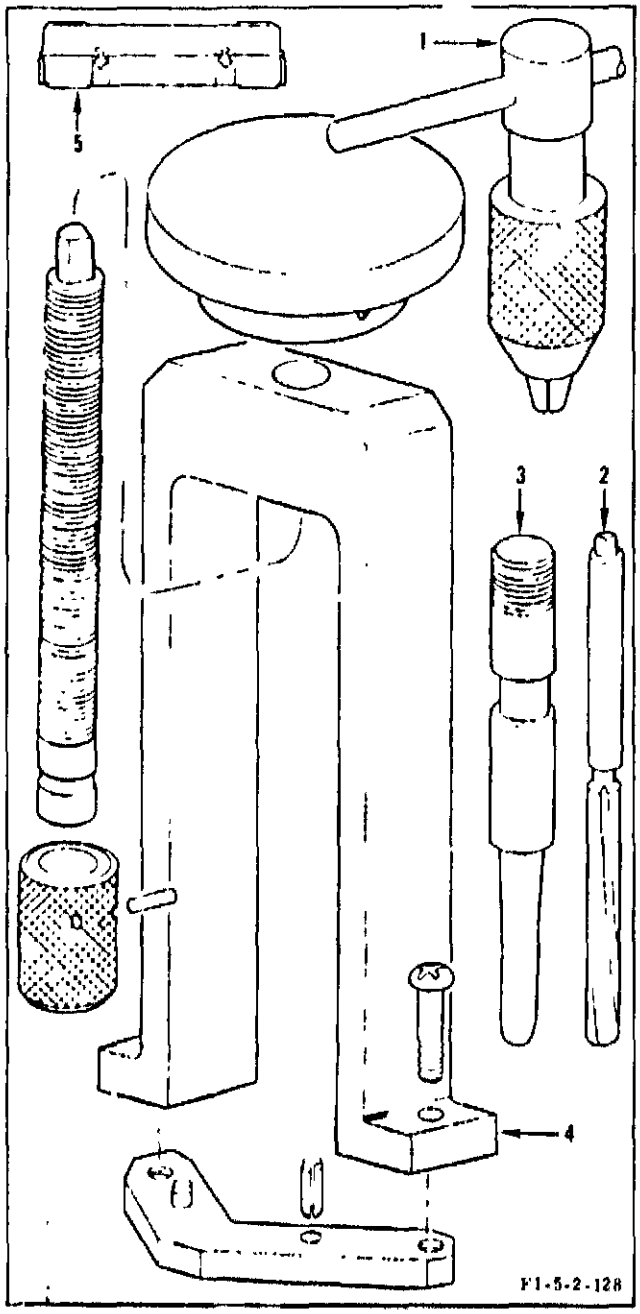
1-54C. The scavenge pump (figure 1-5A) consists primarily of a pump, electric motor, flexible coupling, and starter control box that are mounted on a mobile steel base. The unit also contains a selector valve, hoses, fittings, and a turbopump flange adapter. The pump is a positive-displacement, gear-within-a-gear type pump and is connected directly to the motor through a flexible coupling. The motor is one-half horsepower, 1,200 rpm, and explosive-proof and operates from a 115-volt, 60-cycle, single-phase, power source. An angle bracket attached to the mobile base contains a ball bearing that provides support for the pump shaft. The steel base is equipped with four casters and a U-shaped tubular handle for mobility. The scavenge pump is approximately 34 inches long, 16 inches wide, 35 inches high, and weighs approximately 245 pounds.



Index No.	Part No.	Description
1	9021323	Ring (F-3)
	AN565DC428H4	Setscrew (F-3)
2	9021324	Ring (F-3)
	AN6289C8	Nut (F-3)
	MS9058-08	Ring (F-3)
	RD262-3001-0008	Gasket (F-3)
	AN807-8C	Adapter (F-3)
3	9023571	Adapter (F-3)
	RD262-4006-0121	O-ring (F-3)
	RD262-4006-0116	O-ring (F-3)
4	9021325	Wrench (F-3)
	MS16624-4075	Ring (F-3)
	AN815-3C	Union (F-3)
	RD262-3001-0003	Gasket (F-3)
	AN929-3C	Cap (F-3)
5	VD192-0007-0020	Container (F-3)
	RD262-3001-0010(a)	Gasket (F-3)

(a) Part not illustrated

Figure 1-4. Fuel Drainage Kit



Index No.	Part No.	Description
1	93B	Tap wrench (F-2)
2	1602 (Size 0.3275)	Hand reamer (F-3)
3	9012795	Pilot (F-3)
4	9012800	Guide assembly (F-1)
	S-310-70-BB	Knob (F-3)
	9012796	Guide (F-3)
	9012797	Shaft (F-3)
	9012798	Shoe (F-3)
	RD122-3003-0.09	Pin (F-3)
	9012799	Strap (F-3)
	MS171586	Pin (F-3)
	AN520C10R14	Screw (F-3)
5	VD192-0002-1286	Container (F-3)

Figure 1-5. Temperature Transducer Installer and Remover Kit

1-54D. OPERATION.

1-54E. The scavenge pump is used to remove fuel and preservative compound from the turbopump lubrication system during preservation of the turbopump. An adapter and hose from the selector valve is connected to the turbopump turbine bearing (No. 3 bearing) lube drain line at the fuel drain manifold joint. With the selector valve turned to the VACUUM position and the scavenge pump turned on, the fuel and preservative compound is evacuated through the turbine bearing (No. 3 bearing) lube drain during preservation at a sufficient rate to prevent pressure buildup within the turbine bearing cavity area. The preservative compound or fuel from the outlet port of the scavenge pump flows through a flexible drain tube into a suitable container. After fluid ceases to flow from the drain tube, the scavenge pump is turned off; then the selector valve is turned to the DRAIN position. In this position, any residual preservative compound in the lines is allowed to be purged and drained through another flexible drain tube into a suitable container.

1-54F. MAINTENANCE.

1-54G. Maintenance of the scavenge pump consists of disassembling, cleaning, assembling, and servicing.

1-54H. DISASSEMBLING. Disassemble the scavenge pump, as required, to accomplish necessary repair or replacement. See figure 1-5B for index and part numbers.

1-54J. CLEANING. Clean parts of the scavenge pump as outlined in R-3896-5, Volume I.

1-54K. ASSEMBLING. See figure 1-5B for index and part numbers. The lubricant used for straight threads and O-rings is lubricant grease RB0140-012 (Rocketdyne). For tapered threads, use thread sealant tape RB0140-002 (Rocketdyne). Refer to R-3896-5, Volume I, for lubricant application. The following steps include special instructions required during assembly:

a. Make sure that all threaded parts on mobile base (20) are clean and free of foreign matter.

b. During assembly of pump (15), apply lubricating oil (MIL-L-7870) to inner surface of casing bushing (32) and to rotor and shaft (31).

c. Total thickness of gasket set (28) during installation must be 0.012 to 0.015 inch in order to provide for rotor end clearance.

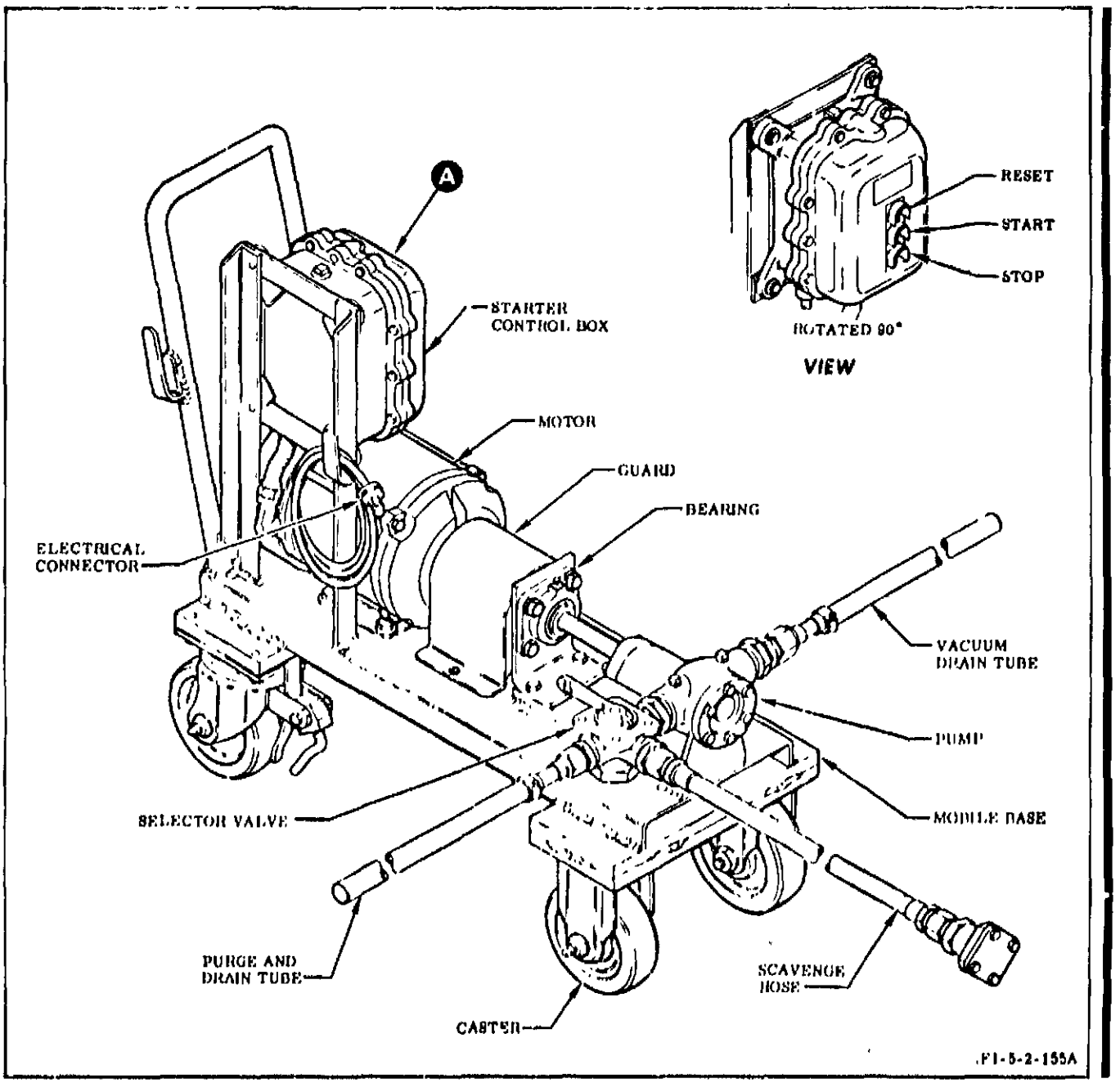


Figure 1-5A. Scavenge Pump

d. After assembly of pump (15), check that rotor and shaft (31) turns freely and does not bind; also, make sure there is no noticeable end play between the rotor and head (27). Addition or removal of gasket set (28) may be necessary in order to provide proper end play.

e. Make sure collar (25) is properly installed and secured to the rotor shaft before installing mechanical seal (24).

f. Install mechanical seal (24) as follows:

(1) Apply lubricating oil (MIL-L-7870) to inner surface of the seal bellows and to pump shaft.

(2) Install spring washer and spring on pump shaft against collar (25).

(3) Make sure pump shaft is free of burs and sharp edges, then install seal rotary member on pump shaft against spring.

(4) Apply lubricating oil (MIL-L-7870) to seal seat, then install seat in end cap (22).

(5) Install end cap (22) on pump shaft, then flush the seal seat and carbon wear ring on rotary member with lubricating oil (MIL-L-7870).

(6) Slide end cap on shaft until seal mating surfaces make contact, then secure with capscrews (21). Wipe oil from exterior surfaces of pump.

g. Install tubes (1) and hose (8) on pump (15), and coil and store tubes and hose on hooks of handle. Torque union (7) to 180-230 in-lb and B-nuts of tubes and hose to 450-525 in-lb.

1-54L. SERVICING. Servicing the scavenge pump consists of lubricating the pump shaft support bearing and casters.

a. Lubricate pump shaft support bearing with gear grease (MIL-G-23827) at 12-month intervals. Apply grease to bearing until clean grease appears at seals. Rotate pump and motor shaft by hand to distribute grease throughout bearing. Wipe off excess grease from bearing and fitting.

b. Lubricate casters (18, 19) with gear grease (MIL-G-23827) at 12-month intervals.

1-54M. SHIPPING AND STORING.

1-54N. Remove tubes (1) and hose (8), cap and plug open ports, and store tubes and hose on hooks provided on handle when not in use. Prepare scavenge pump for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-55. TEST PLATE, PLUG, AND TOOL SET G3132.

1-56. DESCRIPTION.

1-57. The test plate, plug, and tool set consists of six test plates and 10 test plate kits, which are stored in the mobile cart when not in use. All test plates incorporate mounting holes and attaching hardware. The fuel inlet test plates incorporate an inlet and monitor quick-disconnects and relief valves. The fuel and oxidizer valve inlet test plates incorporate an inlet quick-disconnect, a relief valve, and a burst diaphragm. The oxidizer pump inlet test plate is a cast aluminum plate which incorporates an inlet and monitor quick-disconnects, a relief valve, and a burst diaphragm. The turbine exhaust duct test plate is a flat aluminum plate without pressurizing and relief features. All plates have a gasket cemented to the sealing surface, and some plates have a streamer attached to the plate indicating it is not engine hardware. The test plate kits consist of adapters and test plates incorporating relief valves, burst diaphragm, and inlet quick-disconnects. The cart consists of a rectangular steel body, mounted on four casters, with shelves and access doors on both sides and rear. See figure 1-6 for leading particulars.

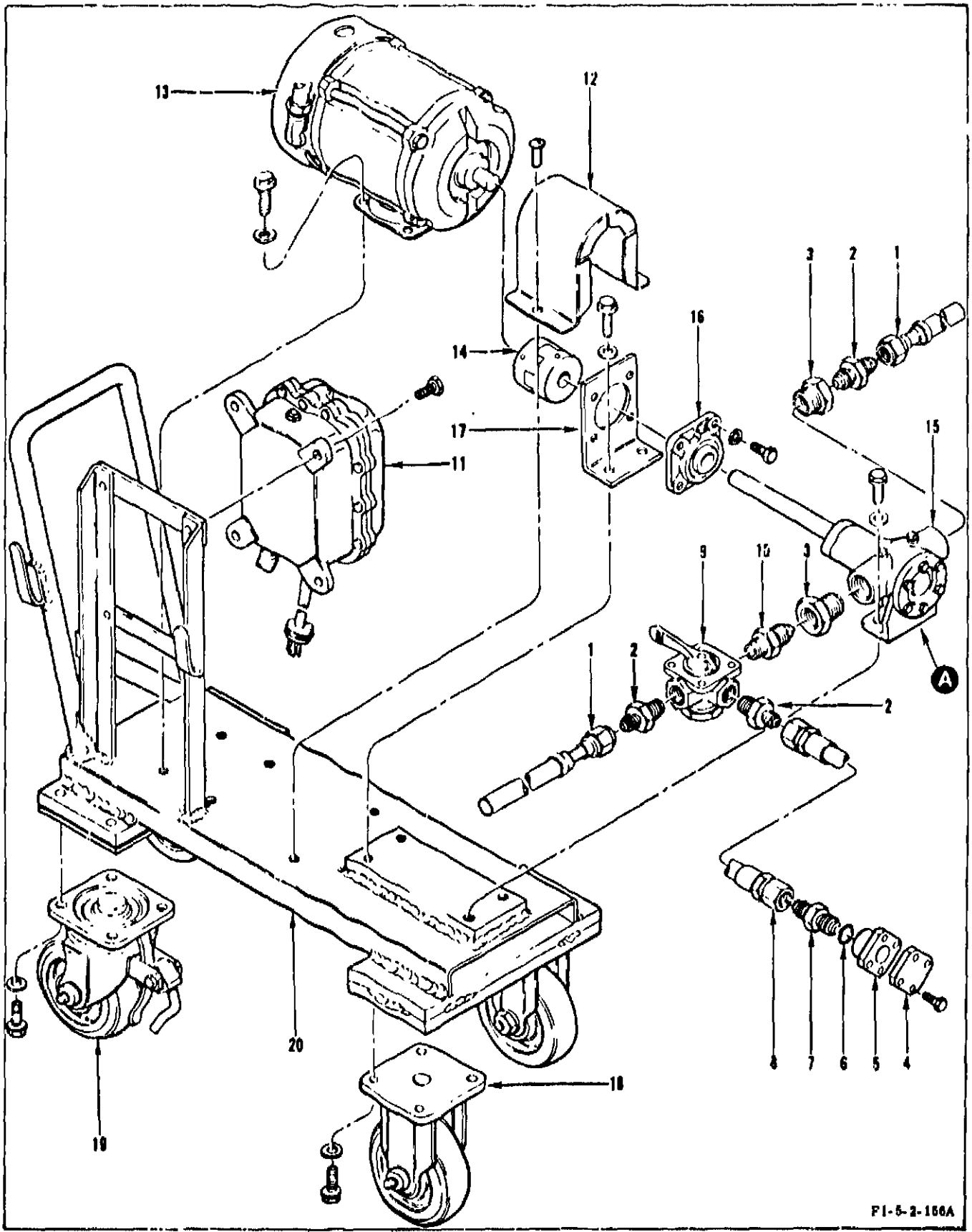
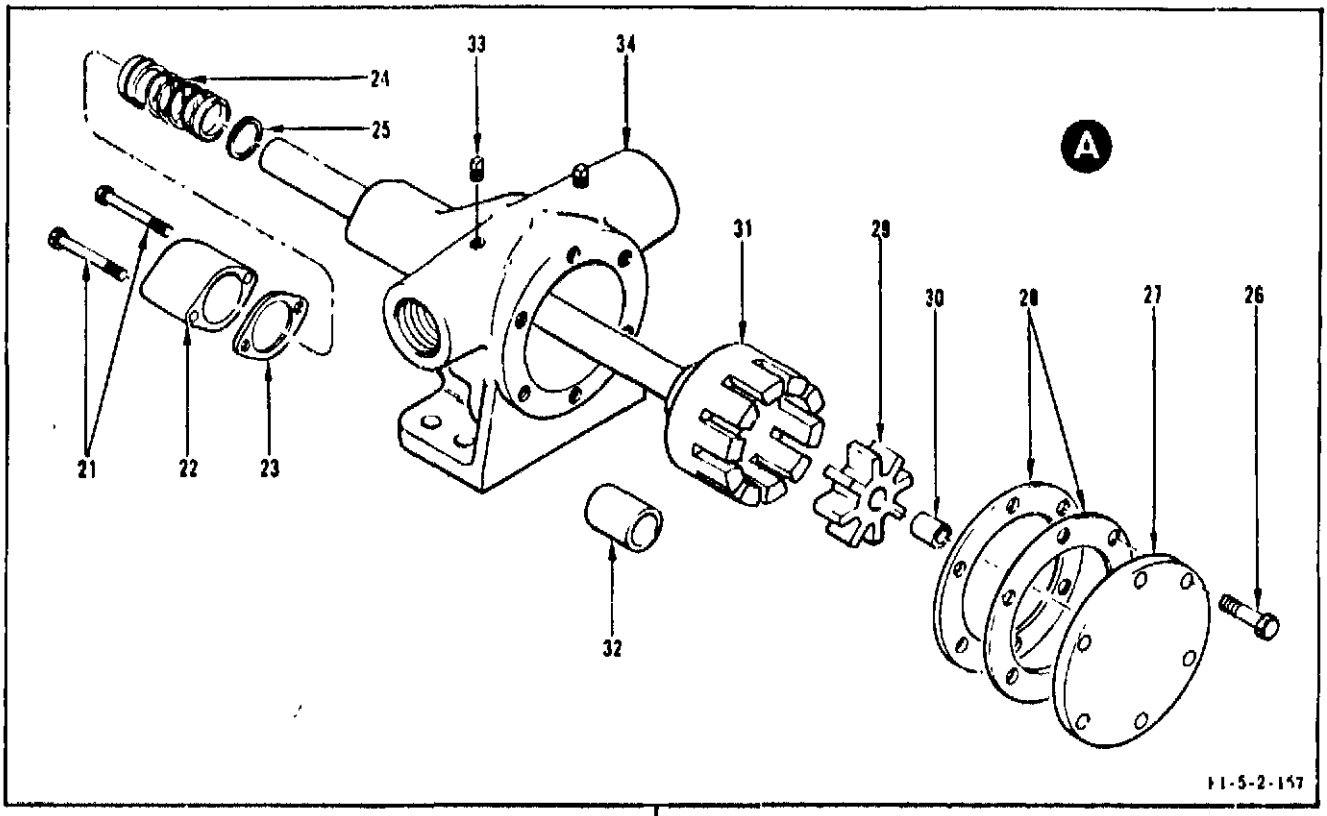


Figure 1-5B. Scavenge Pump--Exploded View (Sheet 1 of 3)



Index No.	Part No.	Description
1	9020910	Tube (F-3)
	V1, 5/8 inch OD x 1/16 inch x 120.00 inches	Tubing (F-3)
	AN737TW24	Clamp (F-3)
2	AP204-8-8	Nipple (F-3)
3	AN912-1161	Bushing (F-3)
4	RX20660-65	Plate (F-3)
	MS35276-280	Screw (F-3)
	LD153-0010-0010	Washer (F-3)
5	9020920	Adapter (F-3)
6	MS28778-8	Packing (F-3)
7	AN815-8J	Union (F-3)
8	1E210A08A08-1200	Hose (F-3)
9	310-3-1/2SS	Selector valve (F-2)
10	AN911-4J	Nipple (F-3)
11	14CA13HA	Starter control and box (F-3)
	7572-G	Electrical plug (F-3)
	6 feet	Electrical cord (F-3)
	5/16-18 NC x 1-1/2 HH	Capscrew (F-3)
	None	Washer (F-3)
12	None	Guard (M-1)
	1/4-20 NC x 1/2	Screw (F-3)
13	L-5005	Motor (F-2)
	5/16-18 NC x 1/2 HH	Capscrew (F-3)
	None	Washer (F-3)
14	L-070	Flexible coupling (F-1)
	None	Setscrew (F-3)
	SOX-070	Spider (F-3)
15	G432	Pump (F-1)
	5/16-18 NC x 3/4 HH	Capscrew (F-3)
	None	Washer (F-3)
16	SC-4	Bearing (series 204) (F-3)
	5/16-18 NC x 3/4 HH	Capscrew (F-3)
	None	Washer (F-3)
17	SC-4706-2	Bearing support bracket (F-3)
	5/16-18 NC x 3/4 HH	Capscrew (F-3)
	None	Capscrew (F-3)
		Washer (F-3)

Figure 1-5B. Scavenge Pump--Exploded View (Sheet 2 of 3)

Index No.	Part No.	Description
18	H6986-2	Caster (F-1)
	5/16-18 NC x 3/4 HH	Capscrew (F-3)
	None	Washer (F-3)
19	BH6996-2X329	Caster (F-1)
	5/16-18 NC x 3/4 HH	Capscrew (F-3)
	None	Washer (F-3)
20	SC-2191	Mobile base (F-1)
21	2-150-003-255	Capscrew (F-3)
22	2-142-001-100	End cap (F-3)
23	2-305-006-804-15	Gasket (F-3)
24	2-472-014-999	Mechanical seal (F-3)
25	3-288-200-740	Collar (F-3)
26	2-150-001-255	Capscrew (F-3)
27	3-365-001-015	Head (F-3)
28	3-310-003-999	Gasket set (F-3)
29	3-417-005-402-42	Idler and bushing (F-3)
30	2-091-005-880	Bushing (F-3)
31	3-564-006-012	Rotor and shaft (F-3)
32	2-093-005-880	Bushing (F-3)
33	2-542-001-376	Plug (F-3)
34	3-180-007-080	Casing and bushing (F-3)

Figure 1-5B. Scavenge Pump--Exploded View (Sheet 3 of 3)

Storage Cart	
Length	78 inches
Width	52 inches
Height	67 inches
Weight (empty)	800 pounds, approximately
Weight (with equipment)	1,500 pounds, approximately

Figure 1-6. Leading Particulars for Test Plate, Plug, and Tool Set

1-58. OPERATION.

1-59. The test plates and test plate kits are used as pressurization closures during checkout of the engine systems, and are designed to protect the systems from overpressurization. The test plates are installed on designated components, and pressure is applied through the plate. Internal pressures, on critical components, are monitored at the test plate. The cart is used to store the test plates and additional space is provided in the cart for other ground support equipment.

1-60. MAINTENANCE.

1-61. Maintenance of the test plate, plug, and tool set consists of proof testing, function testing, disassembling, cleaning, assembling, and servicing.

1-62. PROOF TESTING. Information will be added when available.

1-62A. FUNCTION TESTING. Function testing consists of testing relief and reseat pressures of relief valves and function-testing hand valves and check valves. (See figures 1-6A and 1-6B.) Perform function testing at 12-month intervals and any time misuse or damage is suspected. Pressure must be gradually increased to check relief pressure, and decreased to check reseat pressure. Adjustment of the relief valve must be accomplished with no pressure applied (clockwise to increase, counterclockwise to decrease), and then repressurized to recheck adjustment. After adjustment, the adjusting screw must be held in place when the locknut is being tightened. The safety and general maintenance requirements outlined in R-3896-5, Volume I, apply to this procedure. See figure 1-7 for index and part numbers.

a. Remove relief valves from plates (2, 5, 8, 18, 19, 21, 22) and from adapter (39).

b. Firmly secure relief valve or adapter and connect a source of gaseous nitrogen (MIL-P-27401), with a controlled pressure of 0-2,500 psig, and connect controls and pressure gages suitable to perform test required in figure 1-6A.

c. Increase pressure and record start-to-leak and cracking pressure; then decrease pressure to seal-off pressure, and apply leak-test compound (MIL-L-25567) to valve outlet. No leakage is allowable.

d. Connect a source of RJ-1 fuel (MIL-F-25558) or hydraulic fluid (MIL-H-5606) to adapter 9025274 as shown in figure 1-6B.

e. Open valve 19-9025300, test hand valve, and gage shutoff valve.

f. Crack open supply valve until 10-50 cc/m of fluid is observed at the outlet of valve 19-9025300.

CAUTION

Step g must be performed carefully to prevent over pressurizing the 0-15 psi gage.

g. Slowly increase pressure until flow from valve 19-9025300 stops. Flow must stop between 1-8 psig.

h. Close gage shutoff valve, and increase pressure to 1,500 ±100 psig. Return flow must be through test hand valve.

i. Reduce pressure to zero, disconnect test setup, and connect hydraulic supply to check valve RD284-3003-1002.

j. Open valve 19-9025300 and increase pressure to 100 ±10 psig. Flow from adapter inlet or valve 19-9025300 outlet is not allowable.

k. Secure equipment.

Part No.	Start-to-Leak Pressure (psig minimum)	Cracking Pressure (psig ±5%)	Seal-Off Pressure (psig minimum)
RD284-5007-0650	58.5	65	45.5
RD284-5007-0700	63.0	70	49.0
RD284-5007-1100	99.0	110	88.0
RD284-5007-1300	117.0	130	104.0
RD284-5007-0500	450.0	500	400.0
RD284-5007-0550	495.0	550	440.0
RD284-5007-1950	1755.0	1950	1560.0
RD284-5007-2225	2002.5	2225	1780.0

Figure 1-6A. Relief Valve Function Test

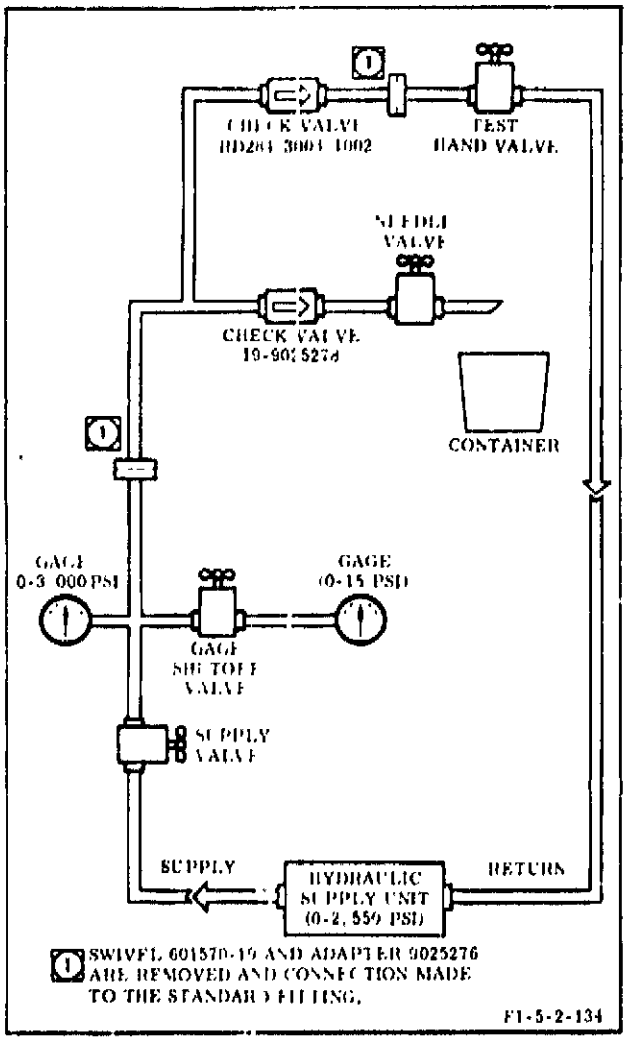


Figure 1-6B. Recommended Function-Test Setup for Ignition Monitor Valve Return Port Adapter

1-63. DISASSEMBLING. See figure 1-7 for index and part numbers. Disassemble test plate, plug, and tool set, as required, to accomplish necessary repair or replacement.

1-64. CLEANING. Each test plate and test plate kit must be cleaned for the same service as the engine system on which it will be used. Refer to R-3896-5, Volume I, for cleaning, handling, and packaging parts.

1-65. ASSEMBLING. See figure 1-7 for index and part numbers. Use cement EC1300L (Minnesota Mining and Mfg) to install gaskets.

1-66. SERVICING. Lubricate the cart casters semi-annually with gear grease (MIL-G-23827), and apply lubricating oil (MIL-L-7870) to the tow bar hinge point, as required.

1-67. SHIPPING AND STORING.

1-68. Prepare test plate, plug, and tool set for shipping or storing in accordance with MIL-P-116, Method III.

1-69. HYPERGOL SYSTEM TOOL KIT G3135.

1-70. DESCRIPTION.

1-71. The hypergol system tool kit consists of a hypergol system tool and a container. The tool consists of a retainer, piston, shaft, push rod, fitting, cap, and lever. The retainer, piston, shaft, and fitting are constructed from aluminum alloy; the push rod, cap, and lever from steel. The container exterior is constructed from plastic and the interior lined with padding. The container is 4.50 inches wide, 4.62 inches high, and 24.50 inches long.

1-72. OPERATION.

1-73. The hypergol system tool kit is used to simulate a hypergol cartridge to actuate the hypergol cartridge installed switch. Installation of the tool into the hypergol cartridge container allows the diaphragm follower rod to protrude through the retainer and come in contact with the piston. The push rod, installed through a drilled passage of the shaft, is in contact with one side of the piston and extends through the cap. Pressing the lever forces the push rod against the piston which, in turn, applies the pressure on the diaphragm follower rod.

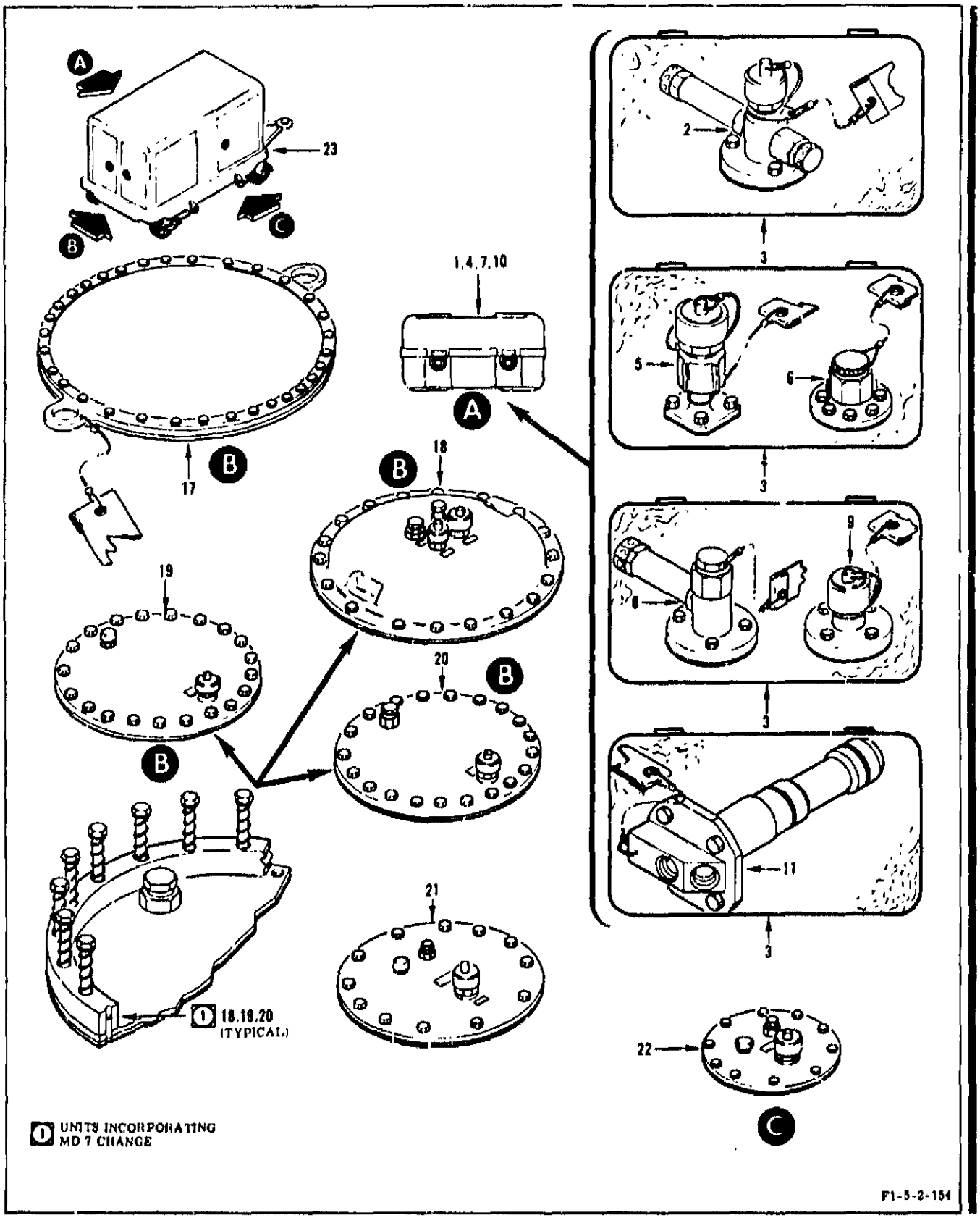


Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 1 of 7)

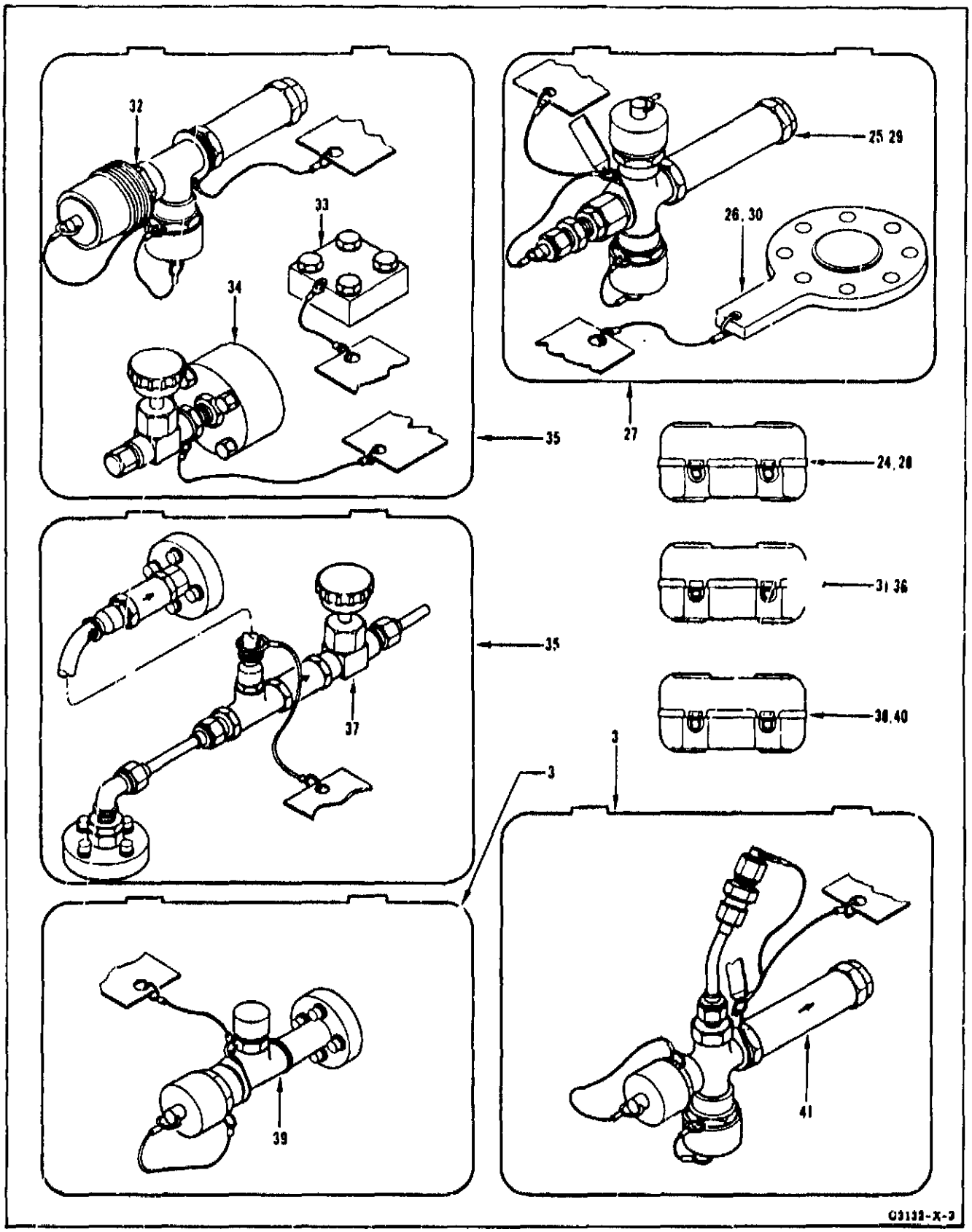


Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 2 of 7)

Index No.	Part No.	Description
1	9024401-61	Heat exchanger GOX line test plate kit (X-1)
2	9024406-61	Test plate (F-1)
	9024415	Plate (X-3)
	AN814-6C	Plug (F-3)
	MS28778-6	Packing (F-3)
	RD284-5007-1300	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	405-00262	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020898-7	Gasket (F-3)
	AN5-13A	Bolt (F-3)
	LD153-0011-0016	Washer (F-3)
	NAS679A5	Nut (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
3	VD192-0002-0884	Container (F-3)
	RD171-6016-0001	Plate (F-3)
4	9020923-51	Gas generator combustor jacket test plate kit (X-1)
5	9020159-21	Inlet test plate (F-1)
	9020889	Plate (F-3)
	RD284-5007-0700	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	405-00290	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020897-13	Gasket (F-3)
	AN4-10A	Bolt (F-3)
	LD153-0011-0014	Washer (F-3)
	NAS679A4W	Nut (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
6	9020160-21	Outlet test plate (F-1)
	9020890	Plate (F-3)
	MS28778-6	Packing (F-3)
	9020897-7	Gasket (F-3)
	AN4-7A	Bolt (F-3)
	LD153-0011-0014	Washer (F-3)
	NAS679A4W	Nut (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
7	9024402-51	Heat exchanger helium line test plate kit (X-1)
8	9024408-31	Outlet test plate (F-1)
	9024417	Plate (F-3)
	9025260	Reducer (F-3)
	MS28778-6	Packing (F-3)
	AN929A4C	Cap (F-3)
	RD191-2002-1110	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
	RD284-5007-1300	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	9020898-7	Gasket (F-3)
	AN5-12A	Bolt (F-3)
	LD153-0011-0016	Washer (F-3)
	NAS679A5	Nut (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
9	9024407-21	Inlet test plate (F-1)
	9024416	Plate (X-3)
	405-00262	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020898-5	Gasket (F-3)
	AN5-12A	Bolt (F-3)
	LD153-0011-0016	Washer (F-3)
	NAS679C5	Nut (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
10	9020909	Fuel seal drain manifold adapter kit (X-1)
11	9020907 ✓	Fuel seal drain manifold adapter (F-1)
	9020908	Adapter (F-3)
	MS29513-119	Packing (F-3)
	9020898-7	Gasket (F-3)
	AN4-5	Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
12 thru 16	(Deleted)	

Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 3 of 7)

Index No.	Part No.	Description
17	9020166	Turbine exhaust duct test plate (F-1)
	9020893	Plate (F-3)
	9020897-5	Gasket (F-3)
	NAS1004-31A	Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	RD153-5001-0004	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9016825	Streamer (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
18	9020163-61	Oxidizer pump inlet test plate (F-1)
	9020163-81(a)	
	9020892(a)	Plate (X-3)
	9014116(a)	Plate (X-3)
	9020892-5(a)	Plate (X-3)
	9014111(a)	Plate (X-3)
	MS171658(a)	Pin (F-3)
	9014106-3(a)	Bolt (F-3)
	9014112(a)	Spring (F-3)
	MS171437(a)	Pin (F-3)
	LD153-0013-0005(a)	Washer (F-3)
	AN814-6C	Plug (F-3)
	MS28778-6	Packing (F-3)
	RD284-5007-1100	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	405-00256	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	405-00286	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020897-15	Gasket (F-3)
	9014115(a)	Gasket (F-3)
	AN7-12A	Bolt (F-3)
	LD153-0011-0020	Washer (F-3)
	RD170-6001-0105	Plate (F-3)
19	9020162-31	Outboard fuel inlet test plate (F-1)
	9020162-51(a)	
	9020891(a)	Plate (X-3)
	9014109(a)	Plate (X-3)
	9020891-3(a)	Plate (X-3)
	9014061(a)	Plate (X-3)
	MS171435(a)	Pin (F-3)
	9014106-5(a)	Bolt (F-3)
	9014064(a)	Spring (F-3)
	LD153-0013-0003(a)	Washer (F-3)
19 (cont)	MS171654(a)	Pin (F-3)
	RD170-6001-0105	Plate (F-3)
	RD170-6002-0002	Plate (F-3)
	RD284-5007-1100	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	405-00290	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020897-11	Gasket (F-3)
	9014108(a)	Gasket (F-3)
	AN5-12	Bolt (F-3)
	LD153-0011-0016	Washer (F-3)
20	9020161-31	Inboard fuel inlet test plate (F-1)
	9020161-51(a)	
	9020891(a)	Plate (X-3)
	9014109(a)	Plate (X-3)
	9020891-3(a)	Plate (X-3)
	9014061(a)	Plate (X-3)
	MS171654(a)	Pin (F-3)
	9014106-5(a)	Bolt (F-3)
	9014064(a)	Spring (F-3)
	MS171435(a)	Pin (F-3)
	LD153-0013-0003(a)	Washer (F-3)
	AN814-6C	Plug (F-3)
	MS28778-6	Packing (F-3)
	405-00259	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020897-11	Gasket (F-3)
	AN5-12	Bolt (F-3)
	LD153-0011-0016	Washer (F-3)
	RD170-6001-0105	Plate (F-3)
	RD170-6002-0002	Plate (F-3)
21	9020156-41	Oxidizer valve inlet test plate (F-1)
	9020886	Plate (X-3)
	AN814-6C	Plug (F-3)
	MS28778-6	Packing (F-3)
	RD284-5007-1100	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	405-00286	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020897-9	Gasket (F-3)
	AN12-10A	Bolt (F-3)
	LD153-0011-0026	Washer (F-3)
	RD170-6001-0105	Plate (F-3)
	RD170-6002-0002	Plate (F-3)
22	9020155-41	Fuel valve inlet test plate (F-1)
	9020885	Plate (X-3)

(a) Units incorporating MD7 change

Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 4 of 7)

Index No.	Part No.	Description
22 (cont)	AN814-6C	Plug (F-3)
	MS28778-6	Packing (F-3)
	RD284-5007-1100	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	405-00290	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	9020897-3	Gasket (F-3)
	AN10-12A	Bolt (F-3)
	LD153-0011-0026	Washer (F-3)
	RD170-6001-0105	Plate (F-3)
	RD170-6002-0002	Plate (F-3)
23	9026731-11	Stowage cart (X-1)
	C4290	Cabinet (X-1)
	9022117	Panel (F-1)
	9022118	Panel (X-3)
	9022119	Panel (F-1)
	9022120	Panel (F-1)
	9022121	Panel (X-1)
	AN507-1032R10	Screw (F-3)
	LD153-0011-0012	Washer (F-3)
	NAS679A3W	Nut (F-3)
	9022124	Retainer (F-3)
	AN6-33	Bolt (F-3)
	LD153-0011-0018	Washer (F-3)
	NAS679A6	Nut (F-3)
	AN520-416R10	Screw (F-3)
	NAS679A4W	Nut (F-3)
	LD153-0011-0014	Washer (F-3)
	NAS3104C16-12	Bolt (F-3)
	NAS679C4W	Nut (F-3)
	LD153-0010-0010	Washer (F-3)
	AN507-1032R12	Screw (F-3)
	NAS679A3W	Nut (F-3)
	LD153-0011-0012	Washer (F-3)
	S-34A	Plunger (F-3)
	9026732-19	Plate (F-3)
	9026732-23	Plate (F-3)
	RD171-6012-0001	Plate (F-3)
	RD171-1022-0001	Plate (F-3)
24	9025268	Gas generator oxidizer feed duct adapter kit (X-1)
25	9025267	Adapter (F-1)
	RD284-5016-1950	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	9015302	Diffuser (F-3)
	405-00262	Nipple half (F-3)
	405-00263	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	AN893-2C	Bushing (F-3)
	MS28778-6	Packing (F-3)

Index No.	Part No.	Description
25 (cont)	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	AN929A4C	Cap (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-4001-0010	Lug (F-3)
	RD191-2002-1110	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
26	9025266	Test plate (F-1)
	9025265	Plate (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
	AN6227-32	Packing (F-3)
27	VD192-0002-1286	Container (F-3)
28	9025272	Gas generator fuel feed duct adapter kit (X-1)
29	9025271	Adapter (F-1)
	RD284-5016-2225	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	9015302	Diffuser (F-3)
	405-00268	Nipple half (F-3)
	405-00265	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	AN937C6	Cross (F-3)
	AN893-2C	Bushing (F-3)
	MS28778-6	Packing (F-3)
	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	AN929A4C	Cap (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-4001-0010	Lug (F-3)
	RD191-2002-1110	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
30	9025270	Test plate (F-1)
	9025269	Plate (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
	MS28775-149	Packing (F-3)
	RD111-1010-6626	Bolt (F-3)
	RD153-5004-0006	Washer (F-3)
31	9025282	Igniter fuel valve shaft and hypergol installed switch adapter kit (X-1)

Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 5 of 7)

Index No.	Part No.	Description
32	9025283	Purge port adapter (F-1)
	RD284-5016-0500	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	9015302	Diffuser (F-3)
	405-00268	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	NA5-260098T5	Coupling (F-3)
	MS28778-6	Packing (F-3)
	AN938C6	Tee (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-4001-0010	Lug (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
33	9025287	Fuel outlet plate (F-1)
	9025286	Plate (F-3)
	MS28775-023	Packing (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
34	9025285	Fuel inlet plate (F-1)
	9025284	Plate (F-3)
	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS9058-04	Ring (F-3)
	19-9025300	Valve (F-3)
	9020150	Diffuser (F-3)
	MS28778-4	Packing (F-3)
	MS28775-025	Packing (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-4001-0004	Lug (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
35	VD192-0007-0014	Container (F-3)
	RD171-6016-0001	Plate (F-3)
36	9025273	Ignition monitor valve return port adapter kit (X-1)
37	9025274	Return port adapter (F-1)
	9025276	Adapter (F-3)
	MS28775-019	Packing (F-3)
	601570-19	Swivel (F-3)
	AN833-4C	Elbow (F-3)
	AN6289C4	Nut (F-3)
37 (cont)	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	9025277	Tube (M-3)
	AN832-4C	Union (F-3)
	MS28778-4	Packing (F-3)
	AN938C4	Tee (F-3)
	19-9025278	Valve (F-3)
	MS28778-4	Packing (F-3)
	19-9025300	Check valve (F-3)
	AN832-4C	Union (F-3)
	MS28778-4	Packing (F-3)
	AN818-4C	Nut (F-3)
	MS20819-4C	Sleeve (F-3)
	9025280	Tube (M-3)
	19-9025275	Hose (F-3)
	MS28778-4	Packing (F-3)
	RD284-3003-1002	Check valve (F-3)
	MS28778-4	Packing (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-2002-1110	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
38	9025288	Turbopump oxidizer intermediate seal adapter kit (X-1)
39	9025289	Interface panel adapter (F-1)
	9025290	Adapter (F-3)
	MS28778-6	Packing (F-3)
	RD284-5007-0650	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	AN938C6	Tee (F-3)
	405-00286	Nipple half (F-3)
	MS28778-6	Packing (F-3)
	MS28775-016	Packing (F-3)
	9016825	Streamer (F-3)
	RD171-4003-0002	Tag (F-3)
	RD191-4001-0010	Lug (F-3)
	RD191-2002-1108	Wire rope (F-3)
	28-1-C	Sleeve (F-3)
40	9025264	Main oxidizer valve rod seal adapter kit (X-1)
41	9025263	Rod seal adapter (F-1)
	RD284-5016-0550	Relief valve (F-3)
	MS28778-6	Packing (F-3)
	9015302	Diffuser (F-3)
	405-00262	Nipple half (F-3)
	405-00253	Nipple half (F-3)
	MS28778-6	Packing (F-3)

Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 6 of 7)

Index No.	Part No.	Description	Index No.	Part No.	Description
41 (cont)	AN937C6	Cross (F-3)	41 (cont)	MS28778-4	Packing (F-3)
	9022042	Tube (M-3)		9016825	Streamer (F-3)
	AN919-6C	Reducer (F-3)		RD171-4003-0002	Tag (F-3)
	MS23778-6	Packing (F-3)		RD191-4001-0010	Lug (F-3)
	AN929A4C	Cap (F-3)		RD191-2002-1110	Wire rope (F-3)
	AN815-4C	Union (F-3)		28-1-C	Sleeve (F-3)

Figure 1-7. Test Plate, Plug, and Tool Set (Sheet 7 of 7)

1-74. MAINTENANCE.

1-75. Maintenance of the hypergol system tool consists of disassembling, cleaning, and assembling.

1-76. DISASSEMBLING. See figure 1-8 for index and part numbers. Disassemble the hypergol system tool, as required, to accomplish necessary repair or replacement.

1-77. CLEANING. Clean, inspect, handle, and package hypergol tool as outlined in R-3896-5, Volume I.

1-78. ASSEMBLING. See figure 1-8 for index and part numbers. Lubricate packings (8, 15) and surfaces of fitting (14) that contact internal surfaces of cap (6) with FS1281 grease (Dow Corning Corp). Torque fitting (14) to 180-220 inch-pounds.

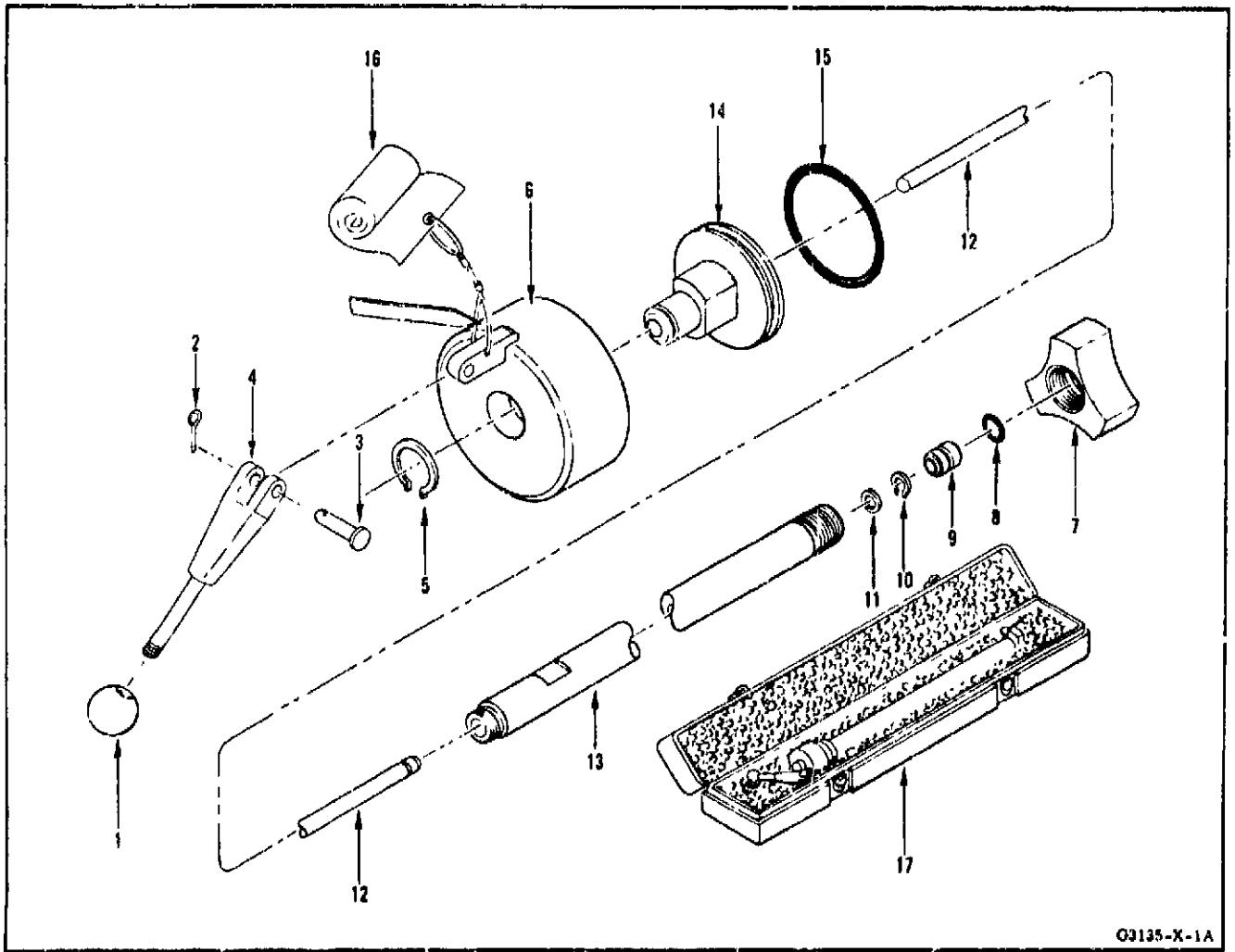
1-79. SHIPPING AND STORING.

1-80. Prepare hypergol system tool kit for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-81. THRUST CHAMBER THROAT PLUG G3136.

1-82. DESCRIPTION.

1-83. The thrust chamber throat plug is a wheel-like device incorporating an expandable seal, support, retainer, shaft, and spacer. The seal incorporates a firm, neoprene rubber material, cemented to the outside circumference of a synthetic rubber tube coated with nylon fabric, and a valve stem vulcanized to the side of the tube. The support and the retainer are constructed of aluminum alloy and incorporate rib and lightening hole construction to reduce weight. A neoprene bead is incorporated on the outer rims of the support and the retainer. The support contains a burst diaphragm and a quick-disconnect. The shaft, containing a collar and a pin, is a solid steel tube threaded on both ends, with wrench flats on one end. The spacer is an aluminum alloy tube. See figure 1-9 for leading particulars.



Index No.	Part No.	Description	Index No.	Part No.	Description
1	R5	Control ball (M-3)	10	MS16624-4031	Retaining ring (F-3)
2	MS24665-151	Cotter pin (F-3)	11	LD153-0010-0011	Washer (F-3)
3	MS20392-3C27	Pin (F-3)	12	9021282	Push rod (F-3)
4	9016833	Lever (F-3)	13	9021281	Shaft (F-3)
5	MS16624-4087	Retaining ring (F-3)	14	9016838	Fitting (F-3)
6	9021280	Cap assembly (X-1)	15	MS29513-228	Packing (F-3)
7	9021283	Retainer (F-3)	16	9016825	Streamer (X-1)
8	MS28775-014	Packing (F-3)	17	VD192-0002-2444	Case (X-3)
9	9016836	Piston (F-3)			

Figure 1-8. Hypergol System Tool Kit

Length	54.75 inches
Diameter	35.6 inches
Weight of individual parts:	
Support	40 pounds
Retainer	37 pounds
Shaft	18.5 pounds
Spacer	1.6 pounds
Nut assembly	4.0 pounds
Seal	33 pounds

Figure 1-9. Leading Particulars for Thrust Chamber Throat Plug

1-84. OPERATION.

1-85. The thrust chamber throat plug is used to seal the thrust chamber throat during leak tests of the downstream side of the fuel and oxidizer valves and the injector and dome mating surfaces. The throat plug is assembled in the thrust chamber, and the tube is pressurized to 50 (+5, -0) psig with gaseous nitrogen. The spacer indicates correct thread engagement of the shaft in the thrust chamber injector. A quick-disconnect, installed on the retainer side of the support, provides a means for monitoring pressure in the thrust chamber; a burst diaphragm, installed on the retainer side of the support, prevents accidental overpressurization of the thrust chamber. The support has a keyhole slot in the hub which corresponds to the pin on the shaft to lock the two together. The support also has studs which correspond to the keyhole slots in the retainer to lock them together. The nut and washer assembly secures the support and retainer on the shaft.

1-86. MAINTENANCE.

1-87. Maintenance of the thrust chamber throat plug consists of proof testing, leak testing, disassembling, cleaning, and assembling.

1-88. PROOF TESTING. Proof-test the thrust chamber throat plug at 12-month intervals or any time it is modified or repaired to the extent of new or changed parts. See figure 1-10 for index numbers.

WARNING

Thrust Chamber Throat Plug G3136 must be operated by authorized personnel trained in the use of the equipment.

- Proof tests are extremely hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

NOTE

Dye-penetrant inspection need only be performed once after delivery. If dye-penetrant inspection has been performed and welds are verified as acceptable, proceed to step aA.

a. Perform dye-penetrant inspection on all welds of retainer (8) and support (9) prior to proof test. No weld cracks are allowable. (Refer to R-3896-5, Volume I.)

aA. Provide pressure test fixture T-5038604. (See figure 1-11.)

b. Remove thread protector (13A) from shaft (12).

c. Apply lubricant grease RB0140-012 (Rocketdyne) to threads of throat plug shaft (12).

d. Install spacer (13) on shaft (12); screw shaft with spacer into test fixture. Torque shaft to 500 ±50 inch-pounds.

e. Measure space between collar on shaft (12) and spacer (13). Maximum allowable space must be 0.195 inch.

f. Apply petrolatum (Federal Specification VV-P-236) to periphery of rubber seal (10) and to throat area of test fixture.

g. Install support (9) on shaft (12) by alining support keyhole slot with shaft pin. Rotate support clockwise to lock.

CAUTION

Care must be taken when installing the seal, to prevent damaging the seal stem.

h. Install seal (10) on support (9) with valve stem facing out and ridges of seal alined with tube contours.

i. Install retainer (8) on shaft (12) by alining retainer keyhole slots with studs on support. Rotate retainer clockwise to lock.

j. Install washer (6) and nut (5) on shaft (12), and tighten nut. Make sure washer is in contact with retainer.

k. Install quick-disconnect (3) in support (9) and torque to 125-145 inch-pounds.

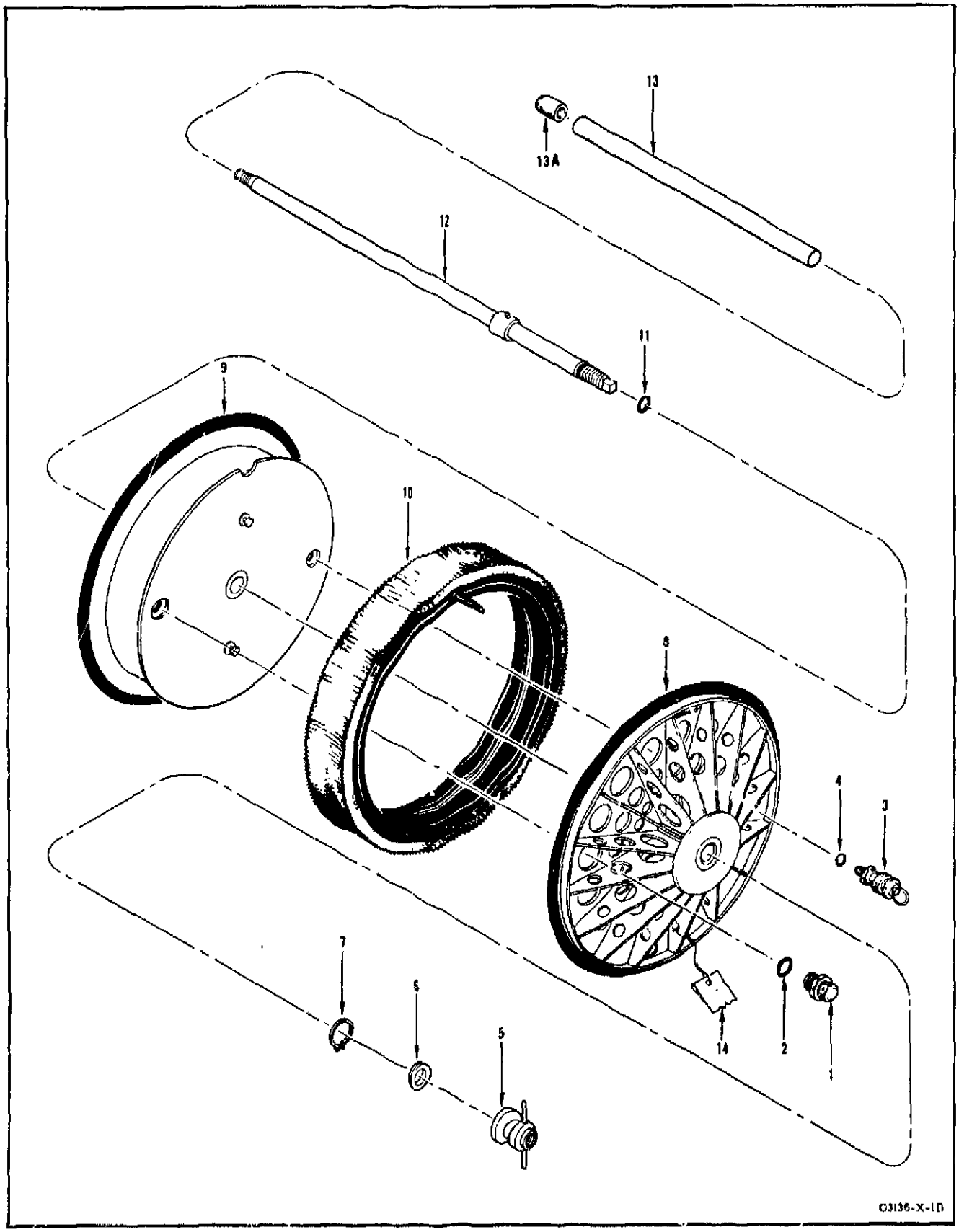


Figure 1-10. Thrust Chamber Throat Plug (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	19-9019853-4	Burst diaphragm (F-3)	9	9020512 9020512-25	Support (F-1) Seal (F-3)
2	MS28778-20	Packing (F-3)	10	9020513-11	Seal (F-3)
3	405-00256	Quick-disconnect (F-3)	11	MS29513-325	Packing (F-3)
4	MS28778-6	Packing (F-3)	12	9020515	Shaft (F-2)
5	9020517	Nut (F-3)	13	9020516	Spacer (F-3)
6	9020518	Washer (F-3)	13A	9020519	Thread protector (F-3)
7	RRT-300	Ring (F-3)	14	9024001	Streamer (F-3)
8	9020511 9020511-11(a) 9020511-15	Retainer (F-1) Retainer (F-1) Seal (F-3)		RD191-2002-1109 28-1-G	Cable (M-3) Sleeve (F-3)

(a) Units incorporating MD2 change

Figure 1-10. Thrust Chamber Throat Plug (Sheet 2 of 2)

l. Install plug in support (9) burst diaphragm port and torque to 40-60 inch-pounds.

CAUTION

The gaseous nitrogen supply hose must be supported to prevent the weight on the seal valve stem from damaging the seal.

1A. Connect a source of gaseous nitrogen (MIL-P-27401) and a calibrated 0-100 psi test gage to throat plug seal valve stem. Using a suitable material, support gaseous nitrogen supply hose to relieve all weight of hose from seal valve stem.

m. Pressurize throat plug seal to 75 (+5, -0) psig.

n. Close seal shutoff valve to lock up pressure in seal; record test gage reading.

o. Wait 30 minutes and record test gage reading again. Maximum allowable pressure decay in seal is 2 psig.

p. Open seal shutoff valve and reduce pressure to zero.

q. Increase gaseous nitrogen pressure in seal to 65 (+10, -0) psig.

NOTE

The pressure source for proof-testing the throat plug in steps r and s may be either water or water and gaseous nitrogen (test fixture filled with water and pressurized with gaseous nitrogen).

r. Connect source of pressure to test fixture.

WARNING

The text fixture exit area must not be observed or visually inspected at any time while it is pressurized. The throat plug can be forced from the text fixture when it is pressurized, causing serious injury or death.

s. Increase pressure to test fixture in 10-psig increments to 60 (+2, -0) psig.

t. Maintain pressure in the test fixture at 60 psig for 5 minutes.

u. Reduce test fixture pressure to zero Drain water.

v. Reduce seal pressure to zero.

w. Remove throat plug from test fixture in the following sequence:

(1) Quick-disconnect (3) and plug

(2) Nut (5), washer (6), and retainer (8)

CAUTION

Care must be taken when removing the seal, to prevent damaging the seal stem.

(3) Seal (10), support (9), shaft (12), and spacer (13)

x. Inspect throat plug for distortion, yielding, or permanent deformation. Install thread protector (13A) onto threads of shaft (12).

WARNING

In the following procedure trichloroethylene, which is a toxic solvent, is used. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

y. Clean petrolatum from throat plug and throat area of test fixture by wiping with trichloroethylene (MIL-T-27602).

1-89. LEAK TESTING. See figure 1-10 for index numbers.

WARNING

Thrust Chamber Throat Plug G3136 must be operated by authorized personnel trained in the use of the equipment.

a. Install throat plug into test fixture (figure 1-11) as outlined in paragraph 1-88, steps a through i. Install burst diaphragm (1) into support (9) and torque to 40-60 inch-pounds.

b. Connect a source of gaseous nitrogen (MIL-P-27401) to seal valve stem; increase pressure to 50 (+5, -0) psig.

WARNING

The test fixture exit area must not be observed or visually inspected at any time while it is pressurized. The throat plug can be forced from the test fixture when it is pressurized, causing serious injury or death

c. Connect a source of gaseous nitrogen (MIL-P-27401) to test fixture; increase pressure to 30 ±1 psig.

d. Close test fixture shutoff valve to lock up pressure in fixture, and record pressure gage reading.

e. Wait one minute, and record pressure gage reading again. Maximum allowable pressure decay through throat plug is 3 psig.

f. Reduce test fixture pressure to zero.

g. Reduce seal pressure to zero.

h. Remove throat plug from test fixture as follows:

(1) Nut (5), washer (6), and retainer (8)

(2) Seal (10), support (9), shaft (12), and spacer (13)

i. Install thread protector (13A) onto threads of shaft (12).

WARNING

In the following procedure trichloroethylene, which is a toxic solvent, is used. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

j. Clean petrolatum from throat plug and throat area of test fixture by wiping with trichloroethylene (MIL-T-27602).

1-90. DISASSEMBLING. Disassemble the thrust chamber throat plug, as required, to accomplish necessary repair or replacement. See figure 1-10 for index and part numbers. The following steps include replacement instructions for seals of retainer (8) and support (9).

a. Remove all of deteriorated or damaged seal.

WARNING

In the following procedure naphtha solvent is used. This solvent is flammable and must not be used near heat, sparks, or open flame. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

b. Thoroughly clean entire bonding area by wiping with a clean, lint-free cloth moistened with naphtha solvent (MIL-N-15178). Before solvent completely evaporates, wipe dry with clean, lint-free cloth.

c. Using pressure-sensitive tape (Federal Specification PPP-T-60), mask off the surface adjacent to the bonding area.

d. Thoroughly mix and apply one thin, even coat of general purpose adhesive (MIL-A-5092, Type II) to each surface to be bonded.

e. Allow adhesive to become tacky (5-15 minutes). To determine proper stage of tackiness, touch a knuckle or a piece of clean cellophane to adhesive and if adhesive adheres to knuckle or cellophane, but does not pull away with knuckle or cellophane, adhesive is ready for bonding.

f. Roll or firmly press both surfaces together to remove any air bubbles. Allow to dry for 48 hours.

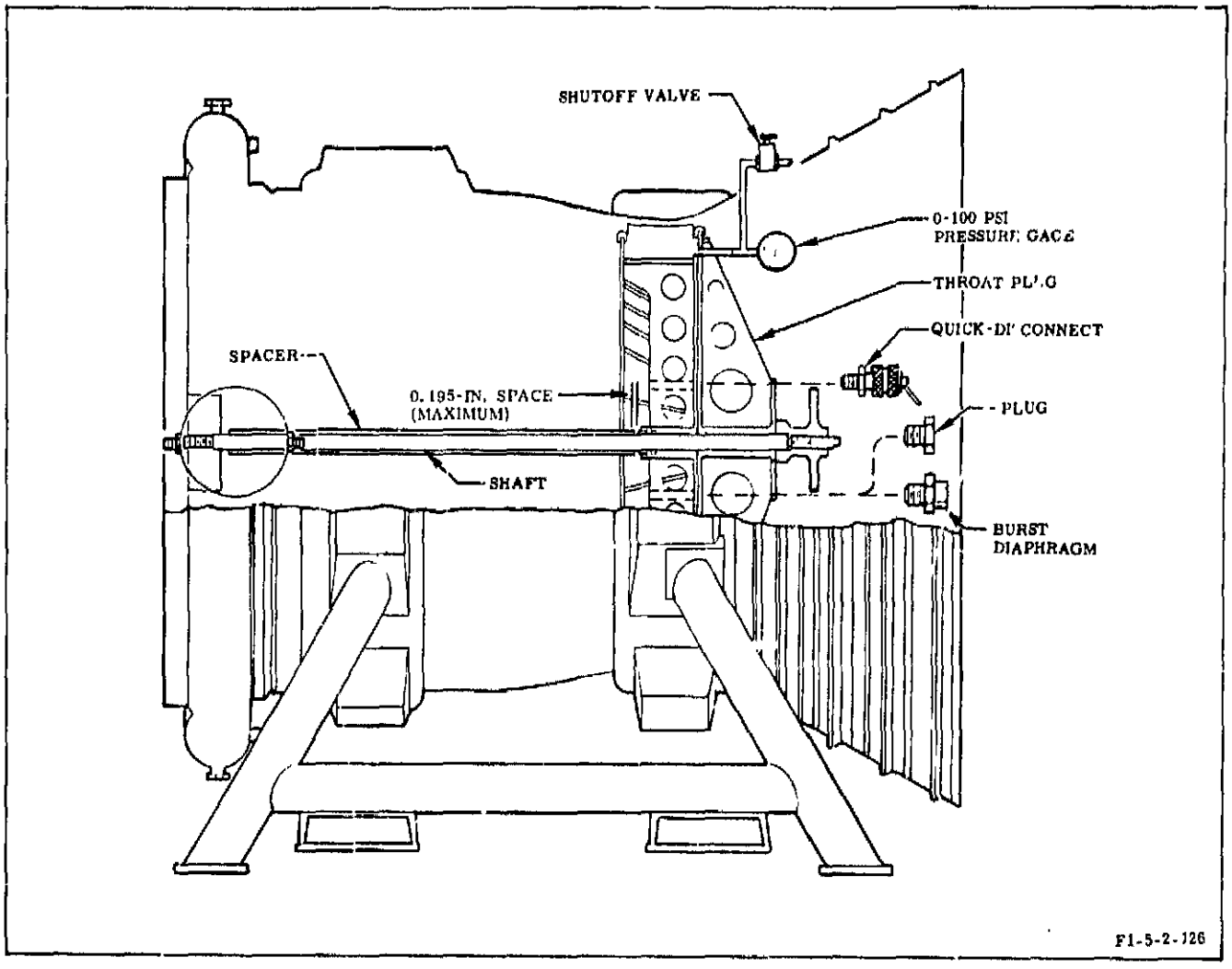


Figure 1-11. Recommended Proof-Test and Leak-Test Setup for Thrust Chamber Throat Plug

WARNING

In the following procedure methyl-ethyl-ketone is used. It is flammable and must not be used near heat, sparks, or open flame. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

g. Remove excess adhesive by carefully wiping with a clean, lint-free cloth moistened with methyl-ethyl-ketone (Federal Specification TT-M-261). Remove masking tape.

1-91. CLEANING. Clean metal and nonmetal parts of throat plug after each usage as outlined in R-3896-5, Volume I.

1-92. ASSEMBLING. See figure 1-10 for index and part numbers. The lubricant used on threads of shaft during installation is lubricant grease RB0140-012 (Rocketdyne).

1-93. SHIPPING AND STORING.

1-94. Prepare thrust chamber throat plug for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-95. TURBINE EXHAUST EXIT PRESSURE CHECK FIXTURE G3144.

1-96. DESCRIPTION.

1-97. The turbine exhaust exit pressure check fixture is made up of eight individual segments and forty clamps. The segment is a curved steel plate with a bonded tube and seal cemented to the plate. The tube has an air-charging valve. The clamp consists of a steel bar, a screw, a clevis bolt, two knurled thumb nuts, and a lockpin. See figure 1-12 for leading particulars.

Segment		
	Height	1 inch
	Width	3.75 inches
	Length	50 inches
	Weight	8.5 pounds
Clamp		
	Height	3 inches (overall)
	Width	1 inch
	Length	5 inches
	Weight	1.88 pounds

Figure 1-12. Leading Particulars for Turbine Exhaust Exit Pressure Check Fixture

1-98. OPERATION.

WARNING

Turbine Exhaust Exit Pressure Check Fixture G3144 must be operated by authorized personnel trained in the use of the equipment.

1-99. The turbine exhaust exit pressure check fixture is used to seal the thrust chamber exhaust exit during leak tests of the gas generator hot gas exhaust system. The clamps attach the segments to the thrust chamber exit, and each additional segment overlaps the previous segment approximately four inches, to provide a satisfactory seal. When all of the segments are installed, the tube of each segment is inflated to 35 ±2 psig in a clockwise direction.

1-100. MAINTENANCE.

1-101. Maintenance consists of inspecting, leak testing, disassembling, cleaning, assembling, and repairing.

101A. INSPECTING. An inspection of the turbine exhaust exit pressure check fixture must be made, within a 12-month period, before equipment use. See figure 1-13 for index and part numbers and inspect as follows:

a. Visually inspect metal parts of fixture (9) for evidence of excessive wear, cracks, distortion, rust/corrosion, or other material defects. A dye-penetrant inspection of metal parts is required when a questionable condition results from visual inspection. Refer to R-3896-5, Volume I, for dye-penetrant application procedure.

b. Visually inspect inflatable seal (8) for deterioration and/or damage. Refer to paragraph 1-105A if seal repair or replacement is required.

1-102. LEAK TESTING. A leak test of the turbine exhaust exit pressure check fixture must be made, within a 12-month period, before equipment use. See figure 1-13 for index and part numbers and perform the leak test as follows:

WARNING

Turbine Exhaust Exit Pressure Check Fixture G3144 must be operated by authorized personnel trained in the use of the equipment.

NOTE

The notation printed on the seals, "DO NOT INFLATE WHEN UNCONTAINED", does not apply for this procedure.

a. With segment in an unrestrained condition, pressurize inflatable seal (8) to 5 ±0.5 psig for a minimum of 5 minutes.

b. With inflatable seal (8) pressurized, visually inspect seal for localized bulging or bubbling. Distortion, resulting from material deterioration or damage, must be corrected.

NOTE

Bulging may appear as a result of separation of the seal from the plate. Corrective action is not required unless separation results in incorrect positioning of the seal on the plate as shown in figure 1-13.

c. With inflatable seal (8) pressurized, apply leak-test compound (MIL-L-25567) to seal or submerge seal in clean water. Leakage is not allowable. Refer to paragraph 1-105A if seal repair or replacement is required.

d. Upon completion of testing, dry inflatable seal (8) with a clean, dry cloth.

1-103. DISASSEMBLING. Disassemble the turbine exhaust exit pressure check fixture, as required, to accomplish necessary repair or replacement. See figure 1-13 for index and part numbers.

1-104. CLEANING. Steam clean turbine exhaust exit pressure check fixture or clean as outlined in R-3896-5, Volume I.

1-105. ASSEMBLING. See figure 1-13 for index and part numbers. Apply dry-film lubricant RB0140-007 (Rocketdyne) to screw (4).

1-105A. REPAIRING. The seal can be repaired when it is installed on the plate if the leak is at the tapered end. If the leak is around the valve stem, the seal must be removed from the plate. The seal on each segment may be repaired or replaced as follows:

NOTE

Steps a through h apply to repairing leak at valve stem or installing new seal; steps i through n apply to repairing tapered end leaks.

a. Remove seal (or all of deteriorated or damaged seal) from plate.

WARNING

In the following procedure toluene is used. It is flammable and must not be used near heat or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

b. Remove all old adhesive from plate and reusable seal using toluene (Federal Specification TT-T-548) and a wooden paddle.

WARNING

In the following procedure trichloroethylene, which is a toxic solvent, is used. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

c. Thoroughly clean entire bonding area of plate and seal by wiping with a clean, lint-free cloth moistened with trichloroethylene (MIL-T-27602).

d. Apply one thin, even coat of Scotch-Grip contact cement 1357 (Minnesota Mining and Mfg) to both plate and seal. (A greater amount of cement may be necessary around the area of the valve stem of the seal to obtain an air-tight seal.)

e. Aline seal with plate before making contact and carefully mate seal to plate.

f. Insert segment into a polyethylene bag. Attach a vacuum pump to bag and seal all openings. Evacuate bag with a minimum vacuum of 18 inches of mercury and maintain for a minimum of 2 hours.

g. Remove segment from bag and allow cement to cure for a minimum of 12 hours.

WARNING

In the following procedure toluene is used. It is flammable and must not be used near heat or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

h. Remove excess cement by carefully wiping with a clean, lint-free cloth moistened with toluene (Federal Specification TT-T-548).

i. To repair a leak at tapered end of seal, separate upper and lower layers of seal at leak. (It may be necessary to enlarge hole for cleaning and applying cement.)

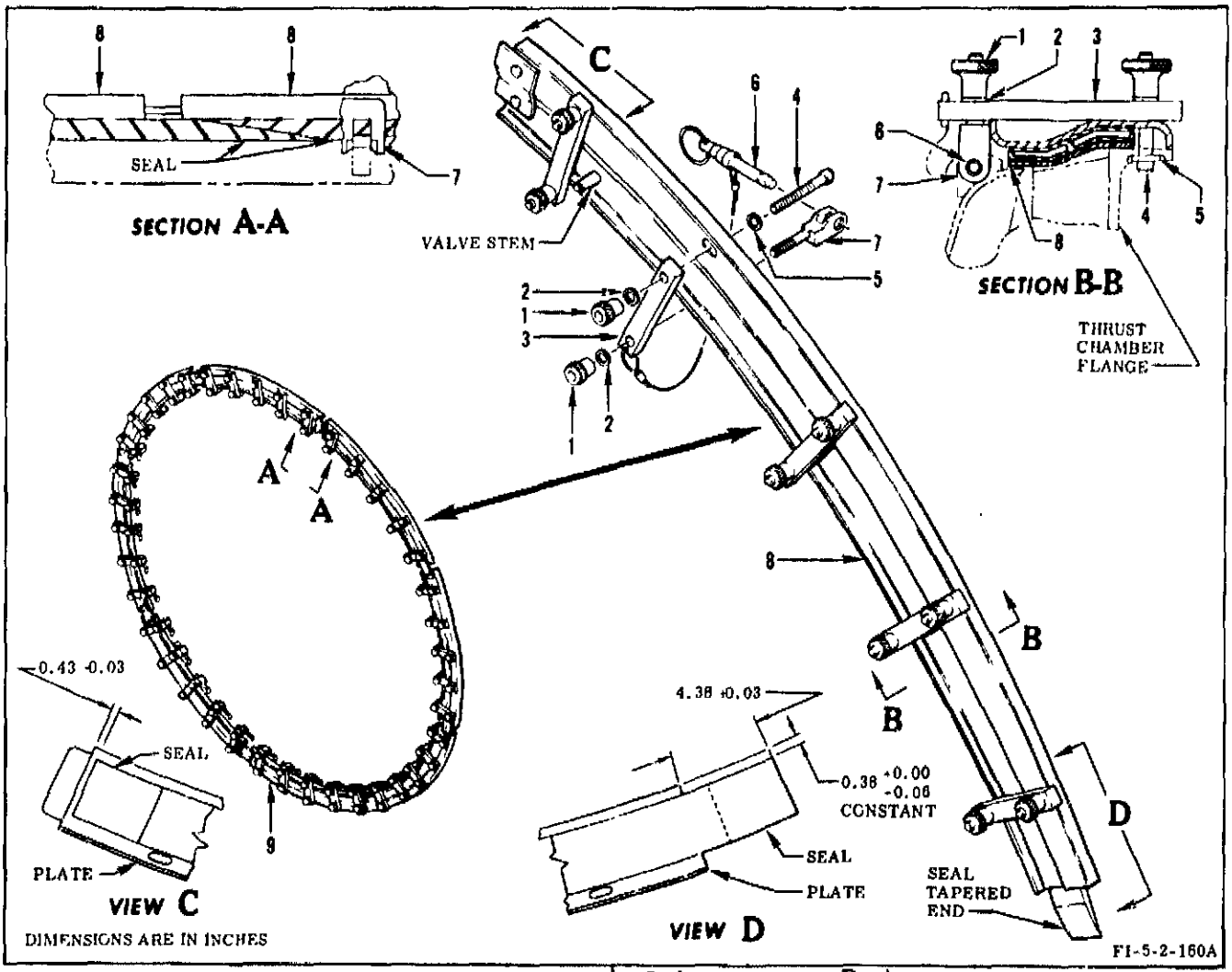
j. Thoroughly clean entire bonding area of seal by wiping with a clean, lint-free cloth moistened with toluene (Federal Specification TT-T-548).

k. Apply Scotch-Grip contact cement 1357 (Minnesota Mining and Mfg) to inside of seal layers.

l. Place repair seal end into smooth jaws of a vise and tighten vise to compress seal end for a minimum of 4 hours.

m. Remove seal from vise, and allow cement to cure for a minimum of 12 hours.

n. Repeat step h.



Index No.	Part No.	Description	Index No.	Part No.	Description
1	601957	Knurled thumbnut (F-3)		RD191-2002-1208	Cable (F-3)
				28-1G	Sleeve (F-3)
2	LD153-0010-0010	Washer (F-3)	7	9024166	Clevis bolt (F-3)
3	9024122	Clamp (F-3)	8	9024116	Segment (F-1)
4	ND112-0001-0627	Screw (F-3)		9024117	Plate (X-3)
5	2W2S-17-18-94	Washer (F-3)		9024127	Seal (F-1)
6	BLC-4-R-10-N	Pin (F-3)	9	9024115	Fixture (F-1)

Figure 1-13. Turbine Exhaust Exit Pressure Check Fixture

1-106. SHIPPING AND STORING.

1-107. Prepare turbine exhaust exit pressure check fixture for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-108. NOZZLE EXTENSION ALINEMENT TOOL G4079.

1-109. DESCRIPTION.

1-110. The nozzle extension alinement tool consists of an upper and lower jaw, a roller arm, a yoke, a sleeve, a handle, and girth and support

straps. The roller arm, handle, and adjustment mechanisms are steel, the remaining metallic parts are aluminum alloy, and the straps are cotton webbing. The upper and lower jaws contain the attaching pins, including an overload shear feature in the lower pins. The roller arm contains the roller bearings and lateral adjustment screws; the yoke houses. the vertical adjustment mechanism; and the sleeve and handle, the horizontal adjustment mechanism. See figure 1-14 for leading particulars.

Length	25 inches, approximately
Weight	23 pounds
Tool Operating Range	
Vertical adjustment stroke	1 inch maximum
Lateral adjustment stroke	0.060 inch maximum
Horizontal adjustment stroke	3.50 inches maximum
Tool Load Capacity	
Adjustment screws	150 inch-pound maximum torque
Lower jaw shear-pins (each)	700-1,000 pounds
Handle-support strap	100 pounds, approximately

Figure 1-14. Leading Particulars for Nozzle Extension Alinement Tool

1-111. OPERATION.

WARNING

Nozzle Extension Alinement Tool G4079 must be operated by authorized personnel trained in the use of the equipment.

1-112. The nozzle extension alinement tool alines the holes of the nozzle extension flange and the thrust chamber flange during installation of the nozzle extension. The alinement is accomplished by moving the lower jaw of the tool in vertical, lateral, and horizontal directions. The upper jaw pins are inserted into holes of the thrust chamber flange, and the lower jaw pins are inserted into holes of the nozzle extension flange. To insert the pins, it may be necessary to adjust the vertical, lateral, and horizontal positions. The girth strap is inserted through the loop-end of the support strap and installed around the thrust chamber just above the manifold tension tie rods. The support strap or hand-pressure maintains the tool in a horizontal position during use. The yoke, which houses the vertical adjustment mechanism, is pinned to the upper jaw and attached to the roller end of the roller arm. The other end of the roller arm is pinned to the upper jaw, and the roller bearings ride on a track of the lower jaw. The vertical adjustment nut applies pressure to the roller arm, which forces the lower jaw to move in a vertical direction. The lateral adjustment screw, located on each side of the roller arm, is adjusted to move the lower jaw in a lateral direction. The sleeve, installed over the handle, is pinned to the end of the lower jaw through a slot in the handle. The handle, which houses the horizontal adjustment mechanism, is pinned to the end of the upper jaw. The horizontal adjustment nut applies pressure to the pin that attaches the sleeve to the lower jaw, forcing the sleeve to slide over the handle and moving the lower jaw in a horizontal direction.

1-113. MAINTENANCE.

1-114. Maintenance of the nozzle extension alinement tool consists of disassembling, cleaning, servicing, and assembling.

1-115. (Deleted)

1-116. DISASSEMBLING. Disassemble the nozzle extension alinement tool, as required, to accomplish necessary repair or replacement. See figure 1-15 for index and part numbers.

1-117. CLEANING. Clean nozzle extension alinement tool as outlined in R-3896-5, Volume I.

1-118. ASSEMBLING. See figure 1-5 for index and part numbers. The following steps include special instructions required during assembly:

a. Lubricate thread of screws (5, 10) with gear grease (MIL-G-23827).

b. Lubricate sliding surfaces of nuts (4, 9), handle (7), felt strip and packing of plate (3), and felt strip of yoke (11) with gear grease (MIL-G-23827).

c. Adjust nut of attaching pin on upper jaw (13) to establish a 0.003- to 0.005-inch gap between nut and upper jaw.

1-119. SERVICING. Lubricate threads of screw (10) and threads of screws on arm (12) every six months with gear grease (MIL-G-23827).

1-120. SHIPPING AND STORING.

1-121. Prepare nozzle extension alinement tool for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

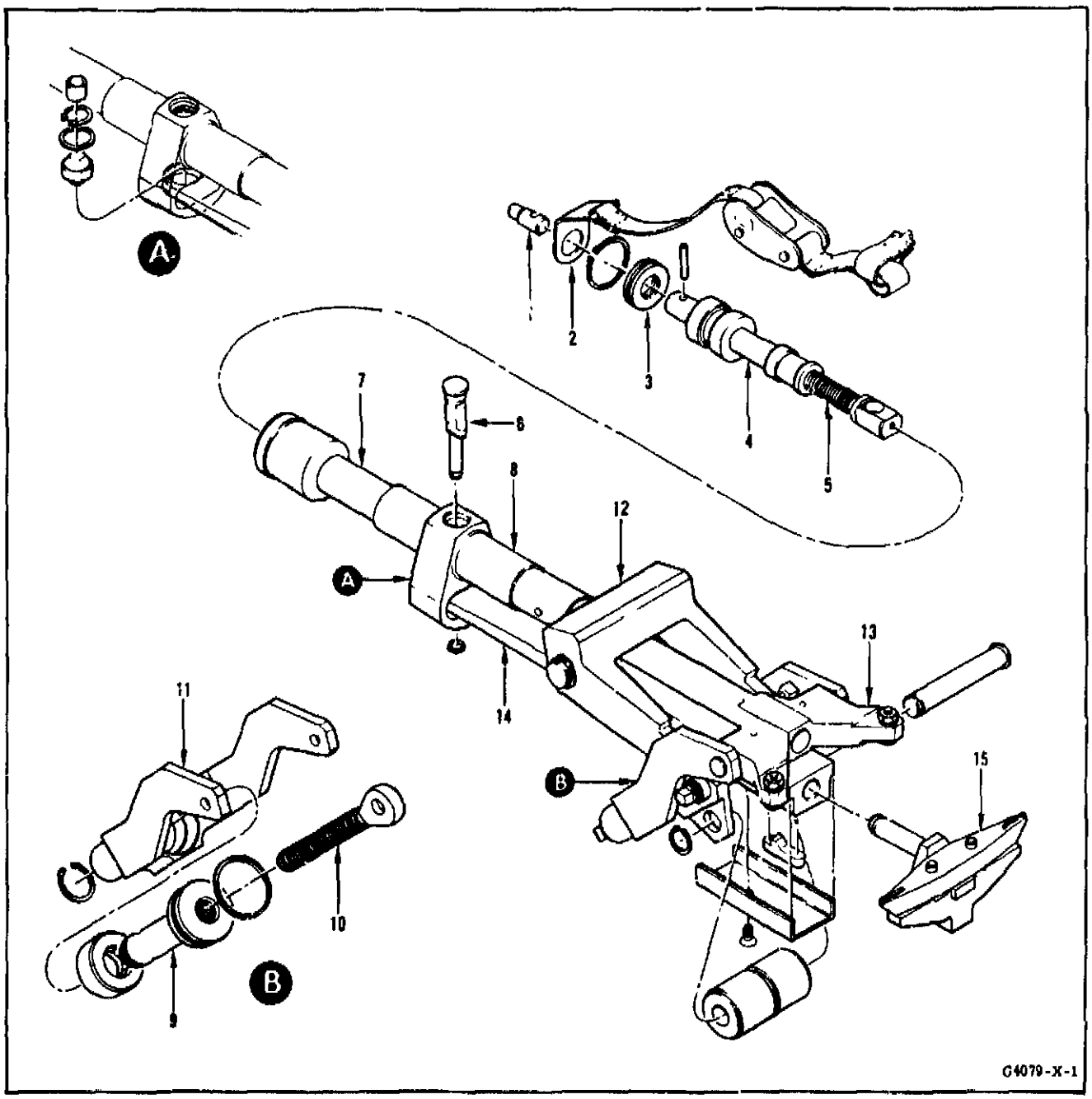


Figure 1-15. Nozzle Extension Alinement Tool (Sheet 1 of 2)

Index No.	Part No.	Description
1	9026780	Stud (F-3)
	MS171655	Pin (F-3)
2	9026805	Clip (F-3)
	NAS1213N10J175	Strap (F-3)
	NAS1213N10J330	Strap (F-3)
3	9026787	Plate (F-3)
	MS16625-4168	Ring (F-3)
	MS28775-221	Packing (F-3)
	MS28932C-03-00	Felt strip (F-3)
4	9026801	Nut (A-1)
	9026779	Sleeve (F-3)
	MS171522	Pin (F-3)
	607	Bearing (F-3)
5	9026782	Screw (F-3)
6	9026783	Pin (F-3)
	MS16624-4037	Ring (F-3)
	ASBY-6SS	Bearing (F-3)
	9026786	Retainer (F-3)
	MS16625-4112	Ring (F-3)
	9026785	Spacer (F-3)
7	9026776	Handle (X-3)
	9026809	Pin (F-3)
8	9026777	Sleeve (F-3)
9	9026810	Nut (F-1)
	MS16624-4100	Ring (F-3)
	9026792	Nut (F-3)
	MS171653	Pin (F-3)
	9026803	Plug (F-3)
10	9026795	Screw (F-1)
	NAS1297-5-12	Bolt (F-3)
	NAS679C5	Nut (F-3)
11	9026790	Yoke (X-3)
	9026797	Pin (F-3)
	MS171559	Pin (F-3)
	MS28932C-06-00	Felt strip (F-3)
	609	Bearing (F-3)
12	9026781	Arm (X-1)
	9026794	Pin (F-3)
	MS16624-4087	Ring (F-3)
	9026798	Screw (F-3)
	9025008-1	Pin (F-3)
	9025008-2	Pin (F-3)
	MS171527	Pin (F-3)
	NAS503-10	Bearing (F-3)
	9026796	Pin (F-3)
	MS16624-4062	Ring (F-3)
13	9026789	Jaw (X-3)
	9026793	Pin (F-3)
	RD153-0113-0054	Washer (F-3)
	NAS679C5	Nut (F-3)
14	9026784	Arm (F-3)
	9026788	Key (F-3)
	9026804	Track (F-3)
	9026799	Crank (X-2)
	AN509C416-15	Screw (F-3)
	1452-048	Nut (F-3)
15	9026800	Jaw (X-2)
	9026804	Pin (F-3)
	MS16624-4037	Ring (F-3)

Figure 1-15. Nozzle Extension Alinement Tool (Sheet 2 of 2)

1-122. TURBOPUMP SUPPORT G4083.

1-123. DESCRIPTION.

1-124. The turbopump support consists of a connector, turnbuckle, bracket, and container. The connector is constructed from steel and consists of a body, handle, lockpin, pin and bolt, thumbwheel, and keeper. The turnbuckle consists of a steel clevis (with one rod end) on each end and a bronze adjustment nut in the center. The bracket is constructed from steel plate and consists of a plate, quick-release pin, and attaching bolts. The container is constructed from plastic and filled with flexible polyurethane foam pads

1-125. OPERATION.

1-126. The turbopump support is used to support the oxidizer end of the turbopump when the oxidizer dome or propellant feed ducts are removed. The support is attached to the turbopump No. 2 oxidizer volute flange and the thrust chamber fuel manifold. The bracket is attached to the fuel manifold and the connector to the No. 2

oxidizer volute flange. The length of turnbuckle is adjusted to insert the quick-release pin through the bracket and the lower clevis, and the locknut is tightened to secure the adjustment nut.

1-127. MAINTENANCE.

1-128. Maintenance of the turbopump support consists of proof testing, disassembling, cleaning, and assembling.

1-129. PROOF TESTING. Proof-test the turbopump support at 12-month intervals, using a 3,750-pound test load. See figure 1-16 for index numbers. The proof load required for proof testing must be a minimum of 150 percent of the working load of the support. The proof-test interval may be extended provided the support is clean, packaged, and stored and provided the support is not used after acceptance of equipment and/or is unused between proof-test intervals. The specified interval begins after first use. Verification of "no use" is substantiated by application of Alucast No. 67 seals after final inspection, prior to acceptance, and following each proof test and inspection.

WARNING

Proof tests are hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Provide a test setup, simulating oxidizer volute flange and fuel manifold brackets and establishing center of gravity (cg), as indicated in figure 1-17.

b. Place test load in position, using a 5,000-pound capacity crane, to establish dimensions indicated in figure 1-17.

c. Install bracket (5) on simulated fuel manifold bracket.

d. Unlock handle and remove pin and handle from connector (1); turn thumbwheel fully clockwise to retract dog.

e. Place connector into simulated oxidizer volute flange spotface and insert pin and handle through hole in connector and flange. Place handle in locked position.

f. Press connector (1) against spotface seat and turn thumbwheel counterclockwise until dog contacts spotface. Tighten fingertight.

g. Adjust length of turnbuckle, as necessary, to insert quick-release pin through lower clevis (4) and bracket (5). Secure adjustment nut (3) with locknut.

h. Slowly relieve tension on crane, observing any movement of connector (1) from its spotface position, and allow weight to remain on support for 3 minutes.

NOTE

The connector may move slightly to seat dog on spotface; however, if excessive movement is evident, steps h through h must be repeated.

i. Assume test load weight with crane and inspect support for any distortion or yielding.

j. Turn thumbwheel fully clockwise and install bolt through flange into end of pin. Torque bolt to 20 ±1 inch-pounds.

k. Repeat steps h and i. On units incorporating MD1 change, repeat steps j and k using long bolt.

l. Remove support from test setup and secure equipment.

1-130. DISASSEMBLING. Disassemble the turbopump support, as required, to accomplish necessary repair or replacement. See figure 1-16 for index and part numbers.

1-131. CLEANING. Clean all parts of turbopump support as outlined in R-3896-5, Volume I.

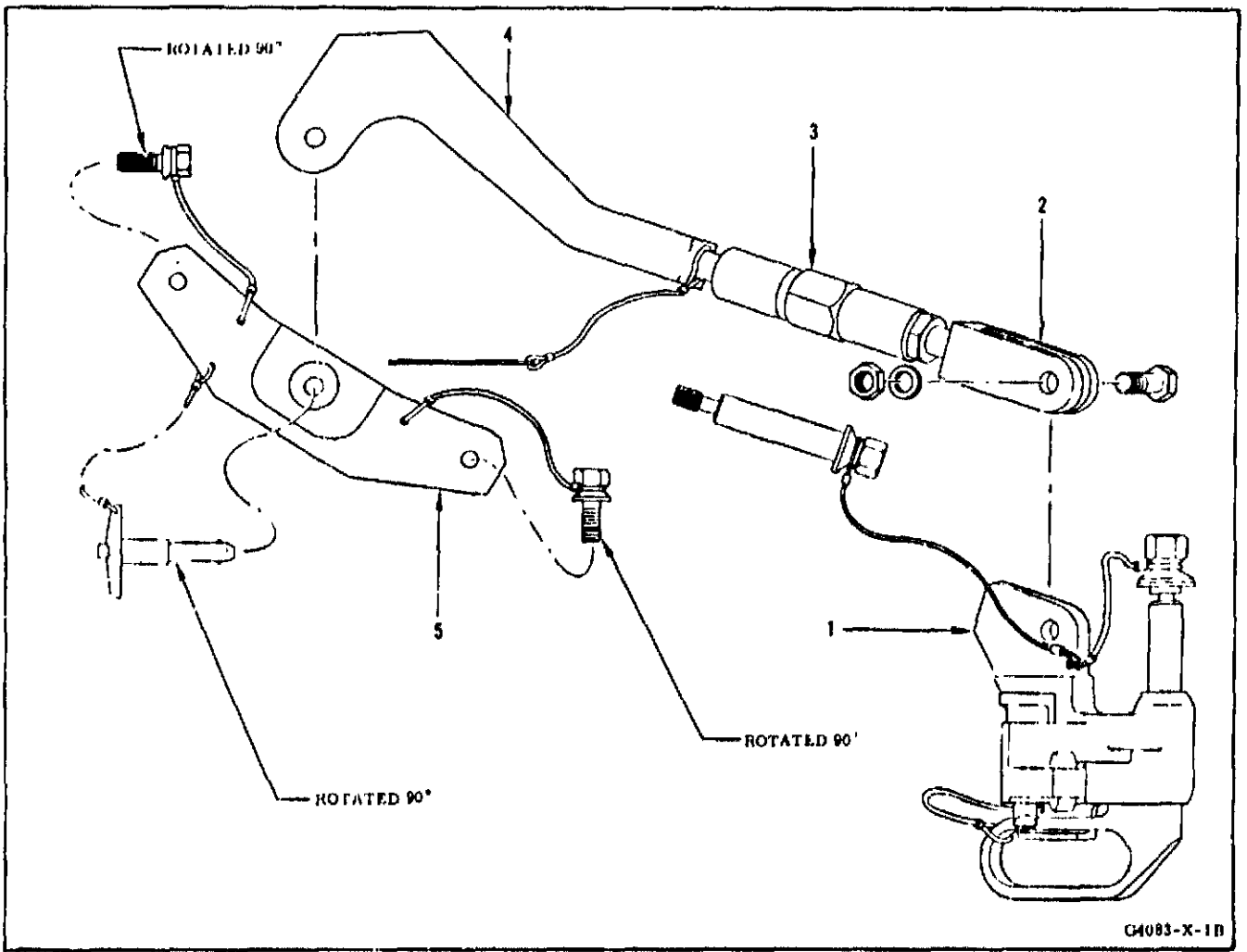
1-132. ASSEMBLING. See figure 1-16 for index and part numbers. The following steps include special instructions required during assembly:

a. Lubricate threads of clevis rod end with Molykote G paste (Dow Corning Corp).

b. Lubricate sliding surfaces of thumbwheel and keeper with gear grease (MIL-G-23827). Do not lubricate handle latch pin.

1-133. SHIPPING AND STORING.

1-134. Prepare turbopump support for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).



Index No.	Part No.	Description
1	9025475	Connector (F-3)
	9025449	Thumbwheel (F-3)
	LD153-0010-0011	Washer (F-3)
	9025448	Keeper (F-3)
	9025451	Handle (F-3)
	9026829	Bolt (F-3)
	9026811[a]	Bolt (F-3)
	9026830	Bushing (F-3)
	RD191-2002-1311	Cable (F-3)
	9025447	Pin (F-3)
	MS171589	Pin (F-3)
	9026828	Pin (F-3)
	RD191-2002-1309	Cable (F-3)
	28-2-G	Sleeve (F-3)
	9026826	Handle (F-3)
	9026827	Spring (F-3)
	MS171527	Pin (F-3)
2	9025474	Clevis (F-3)
	NAS1279-7-16	Bolt (F-3)
	LD153-0010-0016	Washer (F-3)
	MS20500-720	Nut (F-3)
3	9025473	Nut (F-3)
	AN316-10	Nut (F-3)
4	9025472	Clevis (F-3)
	9025450	Instruction plate (F-3)
	9026812[a]	Instruction plate (F-3)
5	9025471	Bracket (F-3)
	9026834	Bolt (F-3)
	RD191-2002-1312	Cable (F-3)
	51357	Pin (F-3)
	RD191-2002-1312	Cable (F-3)

(a) Units incorporating MD1 change

Figure 1-16. Turbopump Support

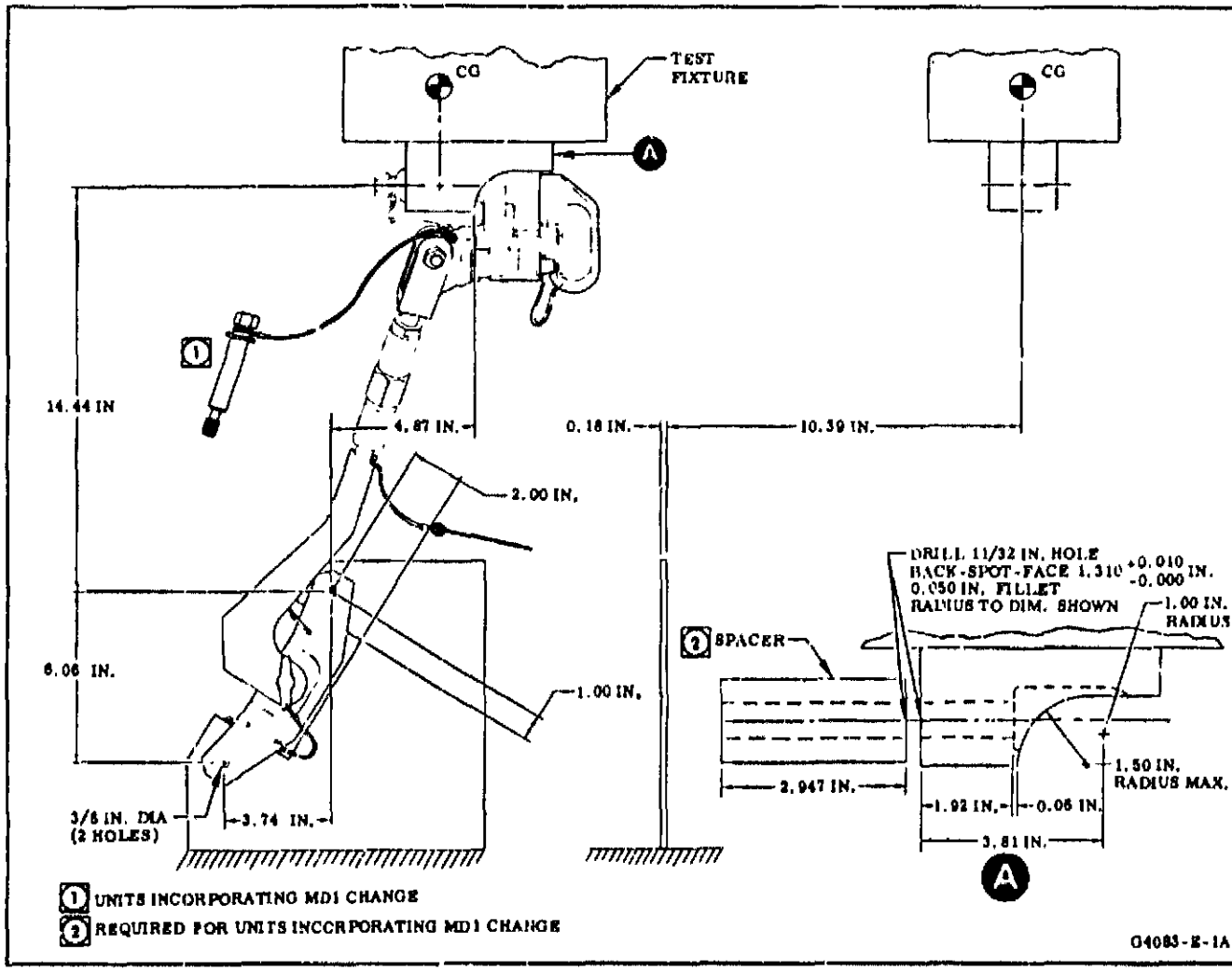


Figure 1-17. Recommended Proof-Test Setup for Turbopump Support

1-135. THERMAL INSULATION ALINEMENT FIXTURE G4084.

1-136. DESCRIPTION.

1-137. The thermal insulation alinement fixture, constructed of aluminum alloy, consists of a base, two supports, two locators, and a spacer. The base is U-shaped and the locators are attached at right angles, forming a cross, to the base. The fixture is approximately 9 inches high, 11 inches wide, and 16 inches long.

1-138. OPERATION.

1-139. The thermal insulation alinement fixture is used to aline thermal insulation brackets. The base is bolted to brackets which are attached to the turbopump fuel inlet, adjacent to the bearing coolant control valve. This positions the locators so that alinement can be accomplished by alining rivets in the brackets with holes in the locators.

1-140. MAINTENANCE.

1-141. Maintenance of the thermal insulation alinement fixture consists of disassembling, cleaning, and assembling.

1-142. DISASSEMBLING. Disassemble the thermal insulation alinement fixture, as required, to accomplish necessary repair or replacement. See figure 1-18 for dimensions and figure 1-19 for index and part numbers.

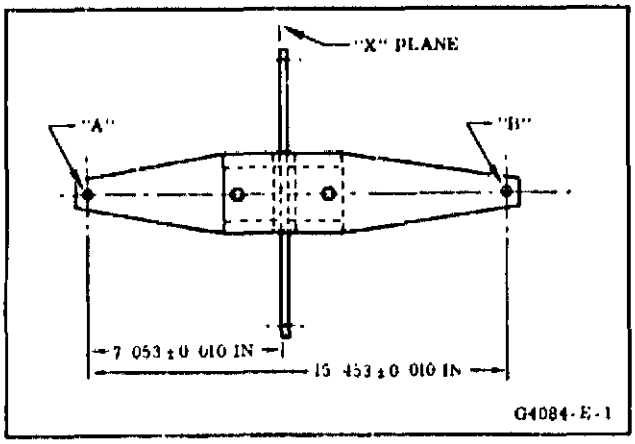
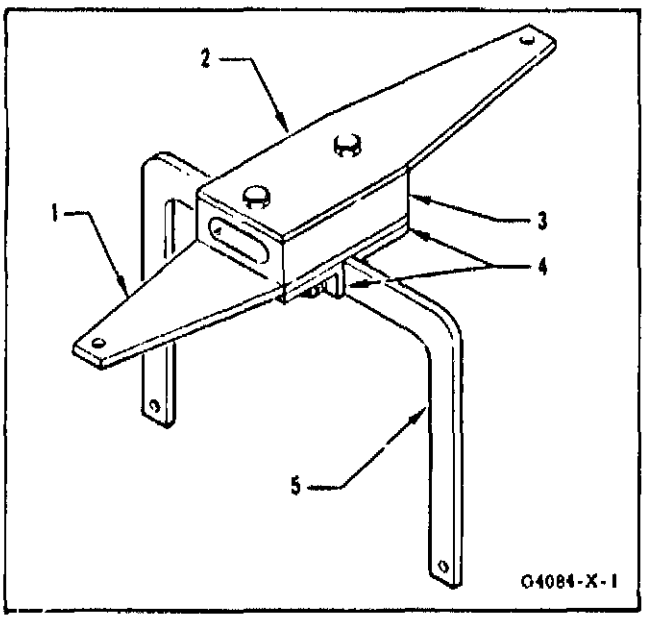


Figure 1-18. Thermal Insulation Alinement Fixture Locators Installation



Index No.	Part No.	Description
1	9025023-3	Locator (F-3)
2	9025023-5	Locator (F-3)
3	9025024	Spacer (F-3)
4	9025025	Support (F-3)
	AN5-24A	Bolt (F-3)
	AN5-11A	Bolt (F-3)
	LD153-0011-0015	Washer (F-3)
	LD153-0011-0016	Washer (F-3)
	NAS679A5	Nut (F-3)
5	9025022	Base (F-3)

Figure 1-19. Thermal Insulation Alinement Fixture

1-143. CLEANING. Clean parts of thermal insulation alinement fixture as outlined in R-3896-5, Volume I.

1-144. ASSEMBLING. See figure 1-18 for dimensions and figure 1-19 for index and part numbers. The following steps include special instructions required during assembly:

a. Install locators with centerline through holes "A" and "B" perpendicular to "X" plane, within 0.010 inch in 10 inches, and dimensions shown in figure 1-18.

b. Torque nuts to 120-155 inch-pounds.

1-145. SHIPPING AND STORING.

1-146. Prepare thermal insulation alinement fixture for shipping or storing in accordance with MIL-P-116, Method III.

1-147. TRUNNION NUT TORQUE WRENCH EXTENSION G4086.

1-148. DESCRIPTION.

1-149. The trunnion nut torque wrench extension consists of a frame, bushing, and instruction plate. The frame is constructed from a steel bar, and is 5 inches high and 13 inches long. The frame is U-shaped with a double-hex hole for the trunnion nut, a round hole for the bushing, and a square hole for a torque wrench. The bushing is a round steel bar 5 inches long with a retaining ring and internal threads in one end and a knurled knob on the other end. The instruction plate is aluminum foil with adhesive backing.

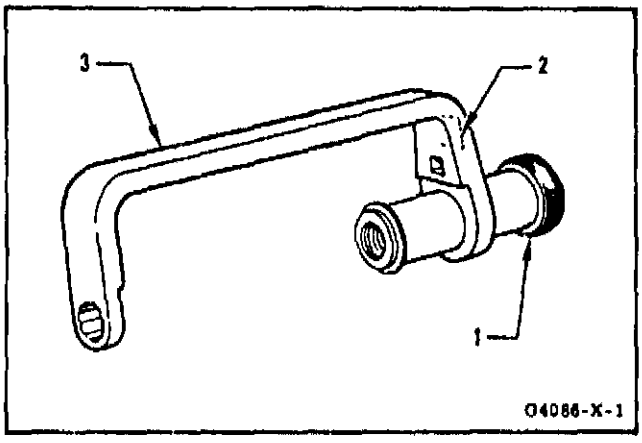
1-150. OPERATION.

1-151. The trunnion nut torque wrench extension is used to remove and install the inner trunnion nut of the turbopump mount, during installation

of thermal insulation brackets. The extension is placed parallel with the trunnion, and the bushing is screwed onto the outboard threads of the trunnion and torqued to 100-200 inch-pounds. The frame is then rotated and slid on the bushing to perform its function. A torque wrench, inserted into the square hole of the frame, provides the turning leverage. To obtain the correct torque value, the handle of the torque wrench must be in the direction of arrows on the instruction plate.

1-152. MAINTENANCE.

1-153. Maintenance of the trunnion nut torque wrench extension consists of disassembling, cleaning, and assembling. There are no special instructions required for disassembling and assembling. See figure 1-20 for index and part numbers.



Index No.	Part No.	Description
1	9026877	Bushing (F-3)
	MS16624-1125	Ring (F-3)
2	9026879	Plate (F-3)
3	9026878	Frame (F-3)

Figure 1-20. Trunnion Nut Torque Wrench Extension

1-154. CLEANING. Clean parts of trunnion nut torque wrench extension as outlined in R-3896-5, Volume I.

1-155. SHIPPING AND STORAGE.

1-156. Prepare trunnion nut torque wrench extension for shipping or storing in accordance with MIL-P-116, Method III.

1-157. BAND CLAMP TOOL KIT G4087.

1-158. DESCRIPTION.

1-159. The band clamp tool kit consists of a band clamp tool and a container. The tool consists of pliers and two jaws. The pliers contain two handles with an overcenter locking feature. The jaws are bolted to the pliers. One jaw contains two plungers to retain the clamp adjusting screw, and the other contains a pin to aline the threaded trunnion with the screw.

1-160. OPERATION.

1-161. The band clamp tool is used to compress band clamps during installation. The clamp adjusting screw is inserted into the jaw containing the plungers. With the tool fully open, the screw is inserted through the unthreaded trunnion and the trunnion is engaged by the jaw. The other jaw engages the threaded trunnion and the handles of the pliers compress, drawing the clamp ends together, until the overcenter lock is engaged. After a minimum of two threads engagement of the adjusting screw, the tool may be removed.

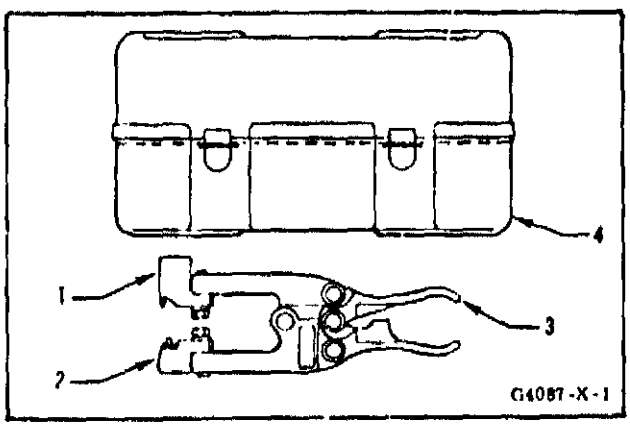
1-162. MAINTENANCE.

1-163. Maintenance of the band clamp tool kit consists of disassembling, cleaning, and assembling. Disassemble the band clamp tool, as required, to accomplish necessary repair or replacement. See figure 1-21 for index and part numbers.

1-164. CLEANING. Clean part of band clamp tool as outlined in R-3896-5, Volume I.

1-165. SHIPPING AND STORING.

1-166. Prepare band clamp tool kit for shipping or storing in accordance with MIL-P-116, Method III.



Index No.	Part No.	Description
1	9023979	Jaw (F-1)
	9023996	Pin (F-3)
2	9023980	Jaw (F-1)
	X13-N	Plunger (F-3)
3	9023978	Pliers (F-1)
	NAS565-37	Bolt (F-3)
	MS35338-45	Washer (F-3)
4	VD192-0002-1286	Case (F-3)

Figure 1-21. Band Clamp Tool Kit

1-167. AIR-POWERED STAPLER 9023569.

1-168. DESCRIPTION.

1-169. The air-powered stapler consists of a stapler, base, and die. The stapler has a hand grip, a staple compartment, and a trigger. The base is U-shaped and made from cold finished steel. The die has four cutouts and mounting holes and is made from tool steel.

1-170. OPERATION.

1-171. The air-powered stapler is used to staple asbestos doors and patches of thermal insulation. The stapler is loaded with the required staples, and a source of compressed air is connected to the stapler. The base is positioned on the material to be stapled; then the stapler is pressed down firmly and the trigger squeezed. The stapler drives the staple through the material and into the die cutouts causing the staple to clinch.

1-172. MAINTENANCE.

1-173. Maintenance of the air-powered stapler consists of disassembling, cleaning, and assembling.

1-174. DISASSEMBLING. Disassemble the air-powered stapler, as required, to accomplish necessary repair or replacement. See figure 1-22 for index and part numbers.

1-175. CLEANING. Clean parts of air-powered stapler as outlined in R-3896-5, Volume I.

1-176. ASSEMBLING.

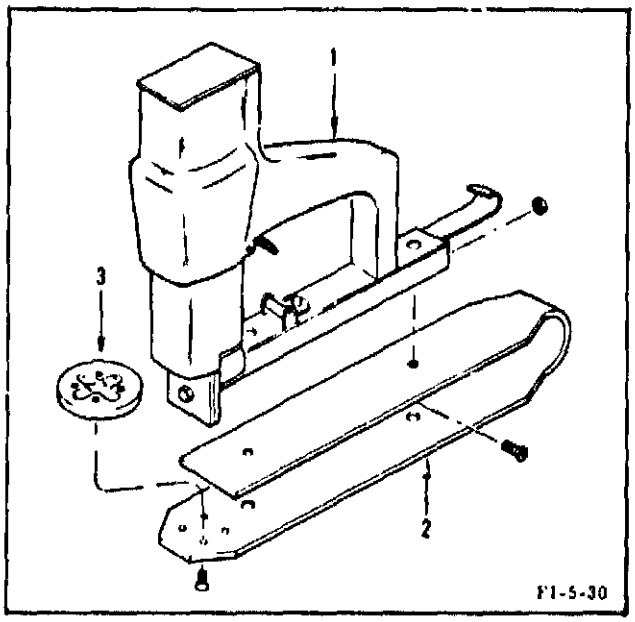
a. Lubricate screws of base (2) with Fluorolube grease GR362 (Hooker Chemical Corp) and torque to 20-26 inch-pounds.

b. Lubricate screws of die (3) with Fluorolube grease GR362 (Hooker Chemical Corp) and torque to 5-6 inch-pounds.

c. Adjust die (3) to aline with head of stapler (1), torque screws, and stake each screw.

1-177. SHIPPING AND STORING.

1-178. Prepare air-powered stapler for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).



Index No.	Part No.	Description
1	9023626	Stapler (F-2)
2	9023627	Base (F-3)
	AN507C428R10	Screw (F-3)
	NAS679C4W	Nut (F-3)
3	9023628	Die (F-3)
	AN507C832R7	Screw (F-3)

Figure 1-22. Air-Powered Stapler

1-179. THERMAL INSULATOR GROMMET TOOL SET 9023570.

1-180. DESCRIPTION.

1-181. The thermal insulator grommet tool set consists of six swage tools, four backing tools, two grommet depressors, a pneumatic hammer, and a container. The swage tool has a shaft and collar on one end that mates with the hammer, and a shaft and collar on the other end that mates with the grommet and backing tool. The tubular backing tool, with a hole drilled through the center to receive the shaft of the swage tool, has a flat surface on one end and a boss on the other. The grommet depressor has a tubular handle and a flat surface forming two prongs. The pneumatic hammer has a hand grip, trigger, barrel, and spring.

1-182. OPERATION.

1-183. The thermal insulator grommet tool set is used to install metal grommets into thermal insulators. Compressed air is connected to the pneumatic hammer, the required swage tool is installed in the barrel of the hammer (retained with spring), and the backing tool is placed under the grommet. A washer is placed over the eyelet and held in place with the depressor tool. Installation of 3/4- and 1/2-inch grommets is accomplished by using two swage tools, one to start the crimp and the other to finish crimping, to prevent cracking of flange.

1-184. MAINTENANCE.

1-185. Maintenance of the thermal insulator grommet tool set consists of disassembling, cleaning, and assembling. There are no special instructions for disassembly or assembly. See figure 1-23 for index and part numbers.

1-186. CLEANING. Clean thermal insulator grommet tool set as outlined in R-3896-5, Volume I.

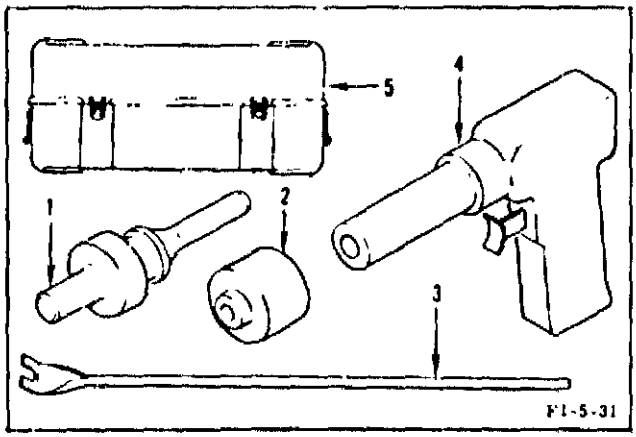
1-187. SHIPPING AND STORING.

1-188. Prepare thermal insulator grommet tool set for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

1-189. FOUR-WAY HYDRAULIC MANIFOLD CHECK VALVE CAP 88-557487.

1-190. DESCRIPTION.

1-191. The four-way hydraulic manifold check valve cap consists of a single manifold incorporating bolt holes on one end and a threaded boss on the other end. (See figure 1-24.)



Index No.	Part No.	Description
1	9024201	Swage tool (F-3)
	9024202	Swage tool (F-3)
	9024204	Swage tool (F-3)
	9024205	Swage tool (F-3)
	9024207	Swage tool (F-3)
2	9024203	Backing tool (F-3)
	9024206	Backing tool (F-3)
	9024208	Backing tool (F-3)
	9024210	Backing tool (F-3)
3	9023637-3	Grommet depressor (F-3)
	9023637-5	Grommet depressor (F-3)
4	Model 400	Pneumatic hammer (F-2)
5	VD192-0007-0025	Case (F-3)

Figure 1-23. Thermal Insulator Grommet Tool Set

1-192. OPERATION.

1-193. The four-way hydraulic manifold check valve cap is bolted to the engine control valve swing check valve to provide a means for pressure-checking the check valve.

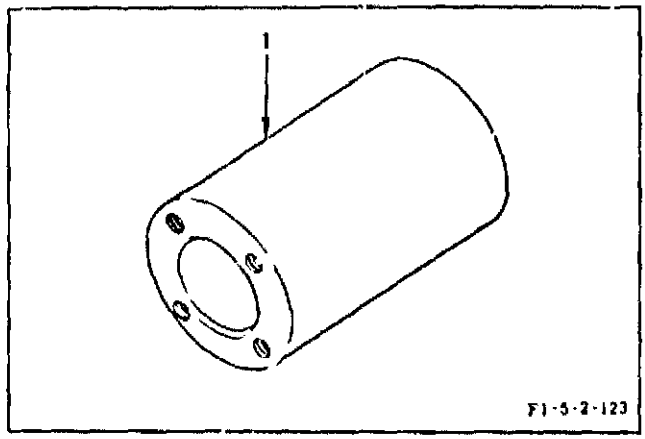
1-194. MAINTENANCE.

1-195. There are no special maintenance requirements for the four-way hydraulic manifold check valve cap. The four-way hydraulic manifold check valve cap may be cleaned as outlined in R-3896-5, Volume I.

1-196. INSULATION MOISTURE DETECTOR 99-9026366.

1-197. DESCRIPTION.

1-198. The insulation moisture detector consists of a pyrometer, lamp, handle, thermocouple, timer, and box. The box houses the



Index No.	Part No.	Description
1	88-557487-3	Housing
	MS124736	Insert

Figure 1-24. Four-Way Hydraulic Manifold Check Valve Cap

pyrometer, lamp, and timer and is approximately 9 inches long, 6 inches wide, and 10 inches high. The handle is shaped like a pistol grip with a pushbutton switch. The thermocouple is a probe-type with an iron (white) and constantan (red) wire cable lead-in. The timer is a time delay relay.

1-199. OPERATION.

1-200. The insulation moisture detector is designed to detect and measure the moisture content trapped within the thermal insulation on the F-1 engine. This nondestructive test, using the heat-sink method, is performed by heating specified areas on the exterior surface of an insulator and measuring the area temperature. Heat is applied for 15 seconds using a quartz-iodide lamp held approximately 2 inches from the insulator; the temperature is measured with an iron-constantan thermocouple and pyrometer. If the insulator is dry, it will not absorb heat and the surface temperature will rise a minimum of 140° F above ambient temperature. If the insulator contains moisture, it will absorb the heat and the temperature will rise less than 140° F above ambient temperature.

1-201. MAINTENANCE.

1-202. Maintenance of the insulation moisture detector consists of function testing, disassembling, cleaning, and assembling.

1-203. FUNCTION TESTING.

WARNING

In the following procedure, dark glasses must be worn by operator and observers to prevent eye damage.

CAUTION

The power source specified in step a must be used or damage to equipment can result.

a. Connect power cable to 115 vac, single-phase facility power source.

WARNING

In the following procedure, the lamp produces extreme heat when illuminated, and nearness or contact with the lamp can cause serious injury.

b. Press and hold button in hand grip. (Lamp illumination timer will turn off lamp automatically.) Timer setting must be 15 ±1.0 seconds. Adjust timer, if necessary, through access hole in box.

c. Using a mercury thermometer, measure accuracy at ambient, 32°, and 212° ±5° F, of pyrometer and thermocouple. Adjust screw on face of meter, if necessary, until meter indicates thermometer reading.

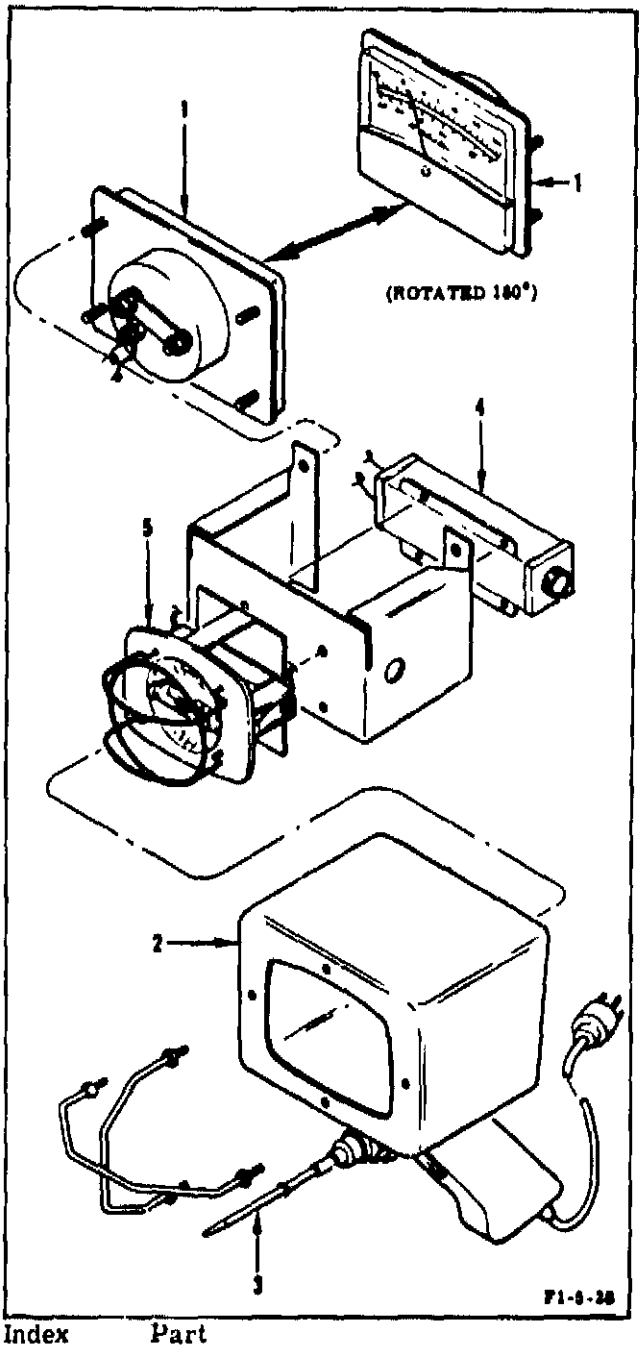
1-204. DISASSEMBLING. Disassemble the insulation moisture detector, as required, to accomplish necessary repair or replacement. See figure 1-25 for index and part numbers.

1-205. CLEANING. No special cleaning is required. Use a clean, lint-free cloth to wipe dust from insulation moisture detector.

1-206. ASSEMBLING. See figure 1-25 for index and part numbers. The only special instruction during assembly is to trim resistor in thermocouple circuit so that total resistance in the circuit is 10 ohms.

1-207. SHIPPING AND STORING.

1-208. Prepare insulation moisture detector for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).



Index No.	Part No.	Description
1	Model 602	Pyrometer (uncompensated for cold junction -75° to +225° F range) (F-3)
2	Z78-104B BA-2R8 BG-175	Box (F-2) Switch (F-3) Cable (F-3)
3	702511	Thermocouple probe (F-3)
4	2112AH1SF	Timer (F-3)
5	Model SG-55T	Lamp (F-3)

Figure 1-25. Insulation Moisture Detector

1-209. FUEL DRAIN VENT ADAPTER KIT 99-9012908.

1-210. DESCRIPTION.

1-211. The fuel drain vent adapter kit consists of a quick-disconnect, check valve, tube, Tygon tube, assorted fittings and packings, and a container. The quick-disconnect is the ground half that mates with the engine-flight half. The check valve is an in-line, swing-gate valve. The tube is constructed of CRES 321 and is a minimum of 2 inches long. The Tygon tubing is transparent yellow, flexible, and approximately 40 inches long. An identification tag containing the name, part number, serial number, and rating is attached to the assembled adapter.

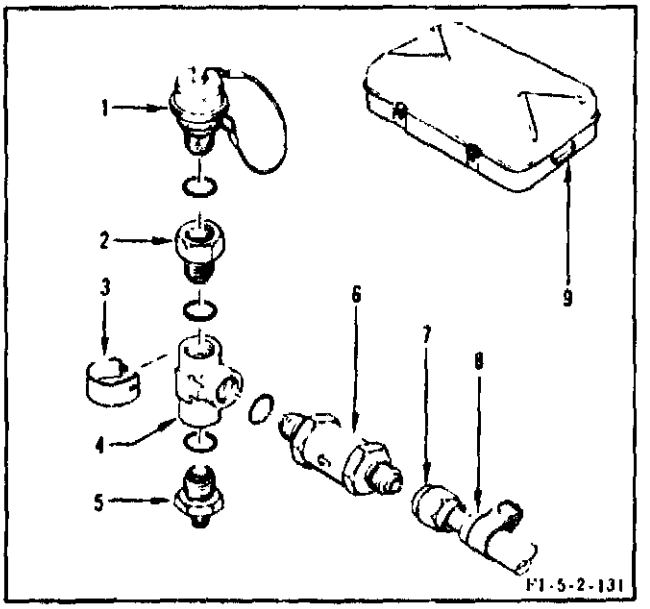
1-212. OPERATION.

1-213. The fuel drain vent adapter kit is used for draining fuel from the F-1 Engines installed in the S1-C stage. The quick-disconnect is connected to the gas generator ball valve fuel drain quick-disconnect and the check valve tube end is raised above the horizontal plane of the check valve. If a negative pressure occurs in the fuel lines during the draining process, the check valve opens and allows the pressure within the lines to equalize to atmospheric pressure. The adapter is rated at one atmosphere.

1-214. MAINTENANCE.

1-215. Maintenance of the fuel drain vent adapter kit consists of disassembling and assembling. Clean adapter as outlined in R-3896-5, Volume I. Store adapter in container provided, and overpack container for shipment.

1-216. DISASSEMBLING. Disassemble the fuel drain vent adapter kit, as required, to accomplish necessary repair or replacement. See figure 1-26 for index and part numbers.



Index No.	Part No.	Description
1	NA5-260098T1	Quick-disconnect (F-2)
	MS29512-06	Packing (F-3)
2	AN893-12J	Bushing (F-3)
	MS29512-08	Packing (F-3)
3	RD171-4004-0002	Identification tag (F-3)
4	AN938J8	Tee (F-3)
5	AN919-12J	Reducer (F-3)
	MS29512-08	Packing (F-3)
6	NA5-26032T1	Check valve (F-1)
	MS29512-08	Packing (F-3)
	20021	Pin (F-3)
	20060-1	Cap (F-3)
	20059-1	Body (F-3)
	20039-6	Spring (F-3)
	30017	Flap (F-3)
7	99-9012909	Tube (M-3)
8	R4000 (3/4 inch outside diameter x 1/2 inch inside diameter x 40 ±2.00 inches long)	Tygon tubing (M-3)
	AN737TW26	Clamp (F-3)
9	VD192-0007-0024	Container (X-3)
	RD171-6018-0001	Plate (F-3)

Figure 1-26. Fuel Drain Vent Adapter Kit

1-217. ASSEMBLING. See figure 1-26 for index and part numbers. The lubricant used during assembly is lubricant grease RB0140-012 (Rocketdyne). The following steps include special instructions required during assembly:

a. Lubricate packing and threads of reducer (2) and install in tee (4). Torque reducer to 180-230 inch-pounds.

b. Lubricate packing and male threads of bushing (5) and install in tee (4). Torque bushing to 180-230 inch-pounds.

c. Lubricate packing and threads of quick-disconnect (1) and install in bushing. Torque quick-disconnect to 100-150 inch-pounds.

CAUTION

When installing check valve (6) in tee (4), torque must be applied at the hexagonal end of the check valve nearest the tee. When attaching tube (7) to the check valve, counter-torque must be applied at the hexagonal end of the check valve nearest the tube. Applying torque otherwise will damage the check valve.

d. Lubricate packing and threads of check valve (6) and install in tee (4). Torque check valve to 180-230 inch-pounds.

e. Lubricate sleeve of tube (7) and threads of check valve (6), and install tube on check valve (6). Torque nut of tube (7) to 300-400 inch-pounds.

f. Install Tygon tubing (8) on tube (7) and secure with clamp.

g. Install identification tag (3) around bushing and tee, and secure.

h. Install protective closures on all open ports, and store adapter in container (9).

SECTION II

MAINTENANCE T-TOOLS

2-1. SCOPE. This section contains inspection, description, operation, and maintenance procedures for maintenance T-tools. The parts list consists of a tabulated listing of all parts required for support of the tool at the field sites. The parts are listed in disassembly order, except where disassembly order does not apply, and are keyed to an associated illustration by index number. The relation of each part to its next higher assembly is indicated by indention. The detail number (consisting of a dash number to the basic tool number) is used instead of a part number to identify the part, because a majority of the parts are made from stock material. The material and dimensions may be found on the tool print.

2-2. INSPECTION.

2-3. Figure 2-1 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspections requirements cannot be accurately predicted, because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions, and that hardware configuration is in accordance with appropriate records. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. See figure 2-1 for inspection and periodic intervals.

Inspection	Periodic (Months)			
	3	6	12	24
Depth micrometer T-5021812				
1. Lubrication and calibration check (paragraph 2-39)	X			
2. Damage to finish of measuring surface	X			
Inducer puller T-5024338				
1. Proof test expiration (paragraph 2-75)			X	
Pressure test fixture T-5026440				
1. Function testing (paragraph 2-118)		X		
Pressure test fixture T-5029362				
1. Function testing (paragraph 2-182)		X		
Assembly stand T-5029363				
1. Proof test expiration (paragraph 2-190)				X
Hydraulic torque tool T-5029452				
1. Proof test expiration (paragraph 2-198)		X		
2. Leak-testing (paragraph 2-199)		X		
3. Function testing (paragraph 2-200)			X	
Torque and inspection tool T-5029467 and adapter T-5035940				
1. Calibration check (paragraph 2-209)		X		

Figure 2-1. Inspection Requirements (Sheet 1 of 2)

Inspection	Periodic (Months) 3	6	12	24
Hypergol simulator T-5029716				
1. Damage to O-ring and O-ring groove		X		
2. Damage to threads of simulator (2)		X		
Pressure test fixture T-5031167				
1. Function testing (paragraph 2-267)		X		
Check jig T-5036725				
1. Flatness and dimensional check (paragraph 2-500)		X		
Assembly jig and inspection check fixture T-5037452				
1. Calibration check (paragraph 2-515)	X			
2. Dimensional check (paragraph 2-515)	X			
Holding fixture T-5037454				
1. Dimensional check (paragraph 2-522)		X		
Inspection check fixture T-5037817				
1. Calibration check (paragraph 2-558)	X			
2. Flatness and dimensional check (paragraph 2-558)		X		
Inspection check fixture T-5037832				
1. Calibration check (paragraph 2-587)	X			
2. Flatness, parallel, and dimensional check		X		

Inspection	Periodic (Months) 3	6	12	24
Alinement tool and inspection check fixture T-5039113				
1. Dimensional check (paragraph 2-616)		X		
Alinement fixture T-5039202				
1. Flatness, parallel, and dimensional check (paragraph 2-624)		X		
2. Calibration check (paragraph 2-624)	X			
Alinement and inspection check fixture T-5039437				
1 Dimensional check (paragraph 2-653)		X		
Torque adapter T-5041242				
1. Calibration check (paragraph 2-695A)				
Clearance pins T-5041812				
1. Dimensional check (paragraph 2-780)				
Alinement gage T-5044743				
1. Dimensional check (paragraph 2-829)		X		
Dolly assembly T-8101595				
1. Proof test expiration (paragraph 2-851)				X
Handling sling T-8102313				
1. Proof test expiration (paragraph 2-866)		X		
Rotating fixture T-8102381				
1. Proof test expiration (paragraph 2-874)		X		
Flange polishing tool T-5047802				
1. Proper lubrication (paragraph 2-843Q)				

Figure 2-1. Inspection Requirements (Sheet 2 of 2)

2-4. PRESSURE ADAPTER AT138-5883.

2-5. DESCRIPTION.

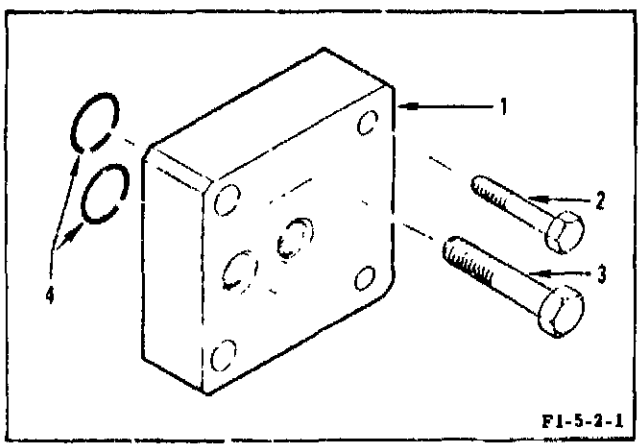
2-6. The pressure adapter consists of a single pressure test plate, bolts, and O-rings. The test plate is constructed from aluminum alloy; it is 3 inches square by 1 inch thick and contains two pressure ports.

2-7. OPERATION.

2-8. The pressure adapter is used to perform pressure tests on the thrust OK pressure switches. With the adapter installed on the pressure switch, pneumatic pressure can be applied to either the system port or the calibration port.

2 9. MAINTENANCE.

2-10. There are no special maintenance instructions for the pressure adapter. For replacement of parts, see figure 2-2 for index and detail numbers. Perform repairs and clean pressure adapter as outlined in R-3896-5, Volume I. Store pressure adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	None	Adapter
2	None	Bolt
3	None	Bolt
4	None	O-ring
	None(a)	Container

(a) Item not illustrated

Figure 2-2. Pressure Adapter AT138-5883

2-11. PIEZOMETER T-0043P5.

2-12. DESCRIPTION.

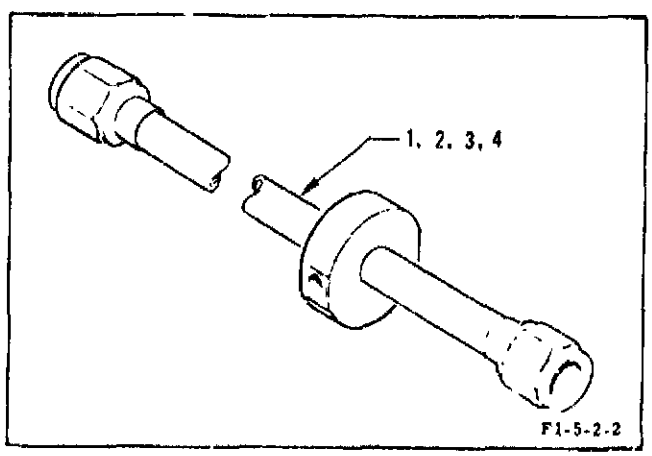
2-13. The piezometer consists of a straight section of tubing with flared tube fittings on each end and two pressure monitoring ports located near the center of the tube. There are four different sizes of piezometers: T-0043P5-1 (1 4-inch diameter), T-0043P5-2 (3/8-inch diameter), T-0043P5-3 (1/2-inch diameter), and T-0043P5-5 (3/4-inch diameter).

2-14. OPERATION.

2-15. The piezometer is an instrument that is used with a pressure gage or pressure measuring system to accurately measure static pressure. The piezometer is the sensing portion of the measuring system: it is designed to sense true static pressure under flow conditions. Piezometers are used in the component test setups that require a higher degree of accuracy in pressure measurements.

2-16. MAINTENANCE.

2-17. There are no special maintenance instructions for the piezometers. See figure 2-3 for index and detail numbers. Perform repairs and clean piezometers as outlined in R-3896-5, Volume I. Store piezometers in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Piezometer (-1)
2	101	Piezometer (-2)
3	101	Piezometer (-3)
4	101	Piezometer (-5)
	None(a)	Container

(a) Item not illustrated

Figure 2-3. Piezometer T-0043P5

2-18. ASSEMBLY JIG T-5014983.

2-19. DESCRIPTION.

2-20. The assembly jig consists of a rectangular platform mounted on four casters with a short vertical section of pipe and a smaller rectangular platform mounted in the center of the large platform. The top of the small platform contains the vertical attach flange and adjustable support for the gas generator. The assembly jig is 48 inches long, 34 inches wide, 33-5/8 inches high, and weighs approximately 269 pounds.

2-21. OPERATION.

2-22. The assembly jig is used to hold and support the gas generator during disassembly, assembly, and testing. The vertical attach flange holds the gas generator at its outlet flange, and the adjustable support is raised to level and provide support at the curved section of the combustion chamber. Since the assembly jig is mounted on casters, it can easily be moved from one maintenance area to another.

2-23. MAINTENANCE.

2-24. There are no special maintenance instructions for the assembly jig. Disassemble the assembly jig, as required, to accomplish necessary repair or replacement. See figure 2-4 for index and detail numbers. Perform repairs, clean, and lubricate threaded and moving parts as outlined in R-3896-5, Volume I.

2-25. RETAINER WRENCH T-5021003.

2-26. DESCRIPTION.

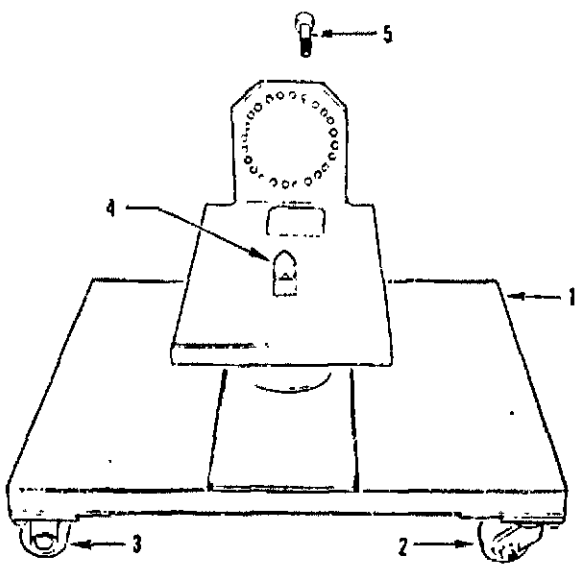
2-27. The retainer wrench is a cylindrically shaped spanner-type wrench with two rectangular keys attached to the outside of the cylinder, 180 degrees apart. Wrench flats are located on top of the cylinder. The wrench is packaged in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately 3 pounds.

2-28. OPERATION.

2-29. The retainer wrench is used to remove and install the fuel valve seat retainer. The two wrench keys engage with the slots in the retainer, and a torque wrench and/or socket wrench is attached to the retainer wrench to remove or install the seat retainer.

2-30. MAINTENANCE.

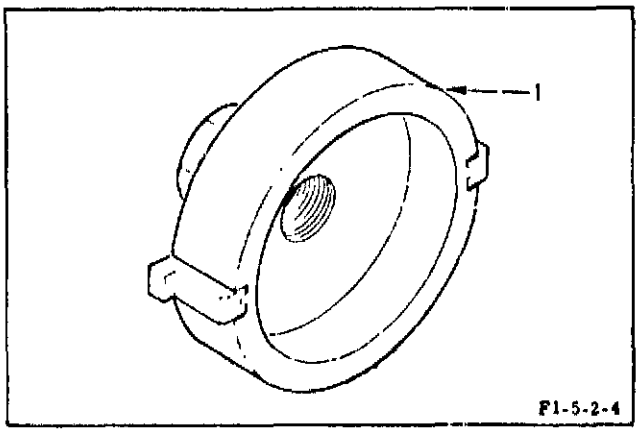
2-31. There are no special maintenance instructions for the retainer wrench. See figure 2-5 for index and detail numbers. Clean retainer wrench as outlined in R-3896-5, Volume I. Store retainer wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Jig
2	123	Swivel caster
	None	Nut
	None	Washer
	None	Bolt
3	124	Rigid caster
	None	Nut
	None	Washer
	None	Bolt
4	109	Support
	108	Adjustment screw
	None	Screw
5	120	Screw
	126(a)	Plate

(a) Item not illustrated

Figure 2-4. Assembly Jig T-5014983



Index No.	Detail No.	Description
1	101	Wrench
	103(a)	Container
	104(a)	Plate

(a) Item not illustrated

Figure 2-5. Retainer Wrench T-5021003

2-32. DEPTH MICROMETER T-5021812.

2-33. DESCRIPTION.

2-34. The depth micrometer set consists of a micrometer, 18 spindles, and a carrying case. The spindles are of different lengths and range in size from a 0-1 inch through 17-18 inches. The carrying case is 24 inches long, 12 inches wide, and approximately 6 inches high.

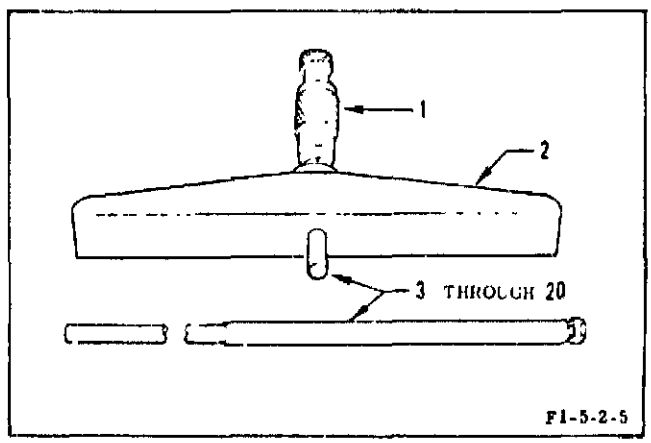
2-35. OPERATION.

2-36. The depth micrometer is used primarily to take depth dimensions of the turbopump during repair. The micrometer is not limited to use on the turbopump only; it can also be used in many other applications on components and hardware.

2-37. MAINTENANCE.

2-38. There are no special maintenance instructions for the depth micrometer, except for servicing. See figure 2-6 for index and detail numbers. Clean micrometer external surfaces with preservative WD-40 (Rocket Chemical Co); then wipe dry with a clean, white nylon cloth. Store depth micrometer in the container provided and overpack container for shipment.

2-39. SERVICING. Servicing the depth micrometer consists of lubricating the threads as required and performing a calibration check. Lubricate threads of micrometer with tool and instrument oil No. 1620 (L. S. Starrett Co); then wipe off excess oil with a clean, white nylon cloth. A calibration check must be performed every 3 months on micrometers that are in use. After lubricating and/or calibration check, clean micrometer as specified in paragraph 2-38.



Index No.	Detail No.	Description
1	101	Micrometer
2	120	Frame
3	102	Spindle
4	103	Spindle
5	104	Spindle
6	105	Spindle
7	106	Spindle
8	107	Spindle
9	108	Spindle
10	109	Spindle
11	110	Spindle
12	111	Spindle
13	112	Spindle
14	113	Spindle
15	114	Spindle
16	115	Spindle
17	116	Spindle
18	117	Spindle
19	118	Spindle
20	119	Spindle
	121(a)	Container

(a) Item not illustrated

Figure 2-6. Depth Micrometer T-5021812

2-40. POPPET HANDLING TOOL T-5022663.

2-41. DESCRIPTION.

2-42. The poppet handling tool consists of a poppet adapter with a tee handle on one end and a quick-release pin on the other end. The tool is packaged in a container that is 24 inches long, 24 inches wide, and 6 inches high. The weight is approximately 7 pounds.

2-43. OPERATION.

2-44. The poppet handling tool is used to handle the oxidizer valve poppet during cryogenic chilling and installation of the poppet. The tapered end of the poppet adapter engages with the inside of the oxidizer valve poppet, and the threaded tee handle is attached to the adapter through the nose end of the poppet. Poppet chilling is performed; then the quick-release pin is attached to the poppet adapter.

2-45. MAINTENANCE.

2-46. There are no special maintenance instructions for the poppet handling tool. Disassemble poppet handling tool, as required, to accomplish necessary repair or replacement. See figure 2-7 for index and detail numbers. Perform repairs and clean poppet handling tool as outlined in R-3896-5, Volume I. Store poppet handling tool in container provided and overpack container for shipment.

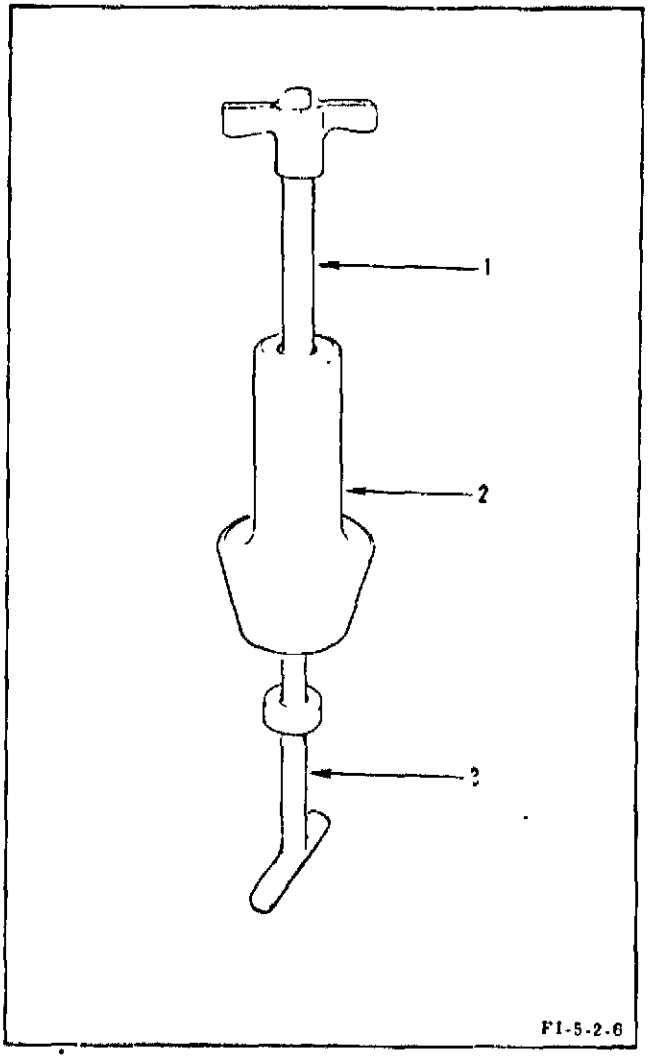
2-47. POPPET LOCKING TOOL T-5022671.

2-48. DESCRIPTION.

2-49. The poppet locking tool is an L-shaped frame with one fixed holding pin and one removable pin. The tool also contains a short extension for clamping in a vise. The tool is 12 inches long, 5 inches wide, and 8-5/8 inches high.

2-50. OPERATION.

2-51. The poppet locking tool is used to hold the oxidizer valve poppet stationary while removing or installing and torquing the piston rod bolt. With the tool secured in a vise, the nose of the poppet is placed over the stationary pin, then the removable pin is inserted through the tool and into the poppet to hold it firmly in the tool.



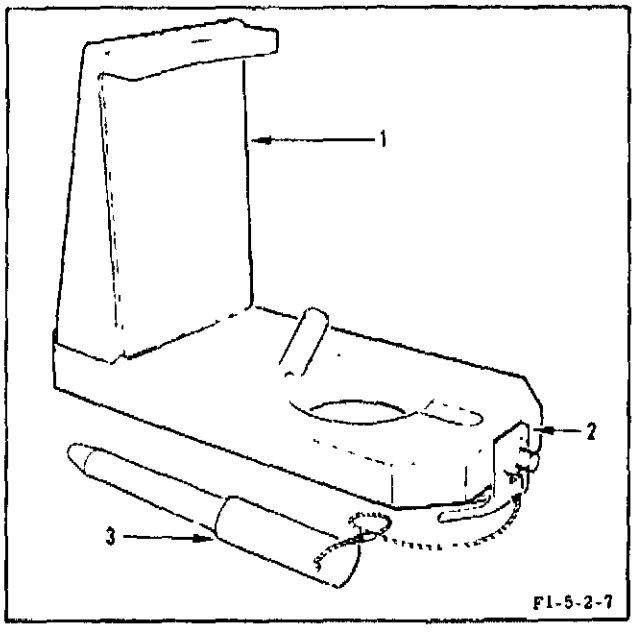
Index No.	Detail No.	Description
1	101	Pin
2	102	Adapter
3	103	Handle
	105	Washer
	107(a)	Container
	108(a)	Plate

(a) Item not illustrated

Figure 2-7. Poppet Handling Tool T-5022663

2-52. MAINTENANCE.

2-53. There are no special maintenance instructions for the poppet locking tool. Disassemble the poppet locking tool, as required, to accomplish necessary repair or replacement. See figure 2-8 for index and detail numbers. Perform repairs and clean poppet locking tool as outlined in R-3896-5, Volume I. Store poppet locking tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Frame
	102	Pin
	109	Tape
2	110	Guide
	None	Screw
	None	Washer
3	104	Pin
	None	Cable
	111(a)	Plate

(a) Item not illustrated

Figure 2-8. Poppet Locking Tool T-5022671

2-54. SPRING COMPRESSOR T-5022672.

2-55. DESCRIPTION.

2-56. The spring compressor consists of a U-shaped frame with two attach points, an acme-threaded shaft and fixture, and attach bolts. The frame also contains protective strips of Teflon at the attach points. The spring compressor is packaged in a container that is approximately 29 inches long, 16 inches wide, and 8 inches high. The weight is approximately 35 pounds.

2-57. OPERATION.

2-58. The spring compressor is used to compress the oxidizer valve poppet closing springs during assembly of the valve. The compressor is also used to relieve the spring load during disassembly of the oxidizer valve. During valve assembly, the springs and cylinder are stacked in the valve cover; then the compressor is attached to the cover with two bolts. The compressor fixture engages with the open end of the valve cylinder and the threaded shaft is used to compress the springs until the cylinder bottoms on the cover.

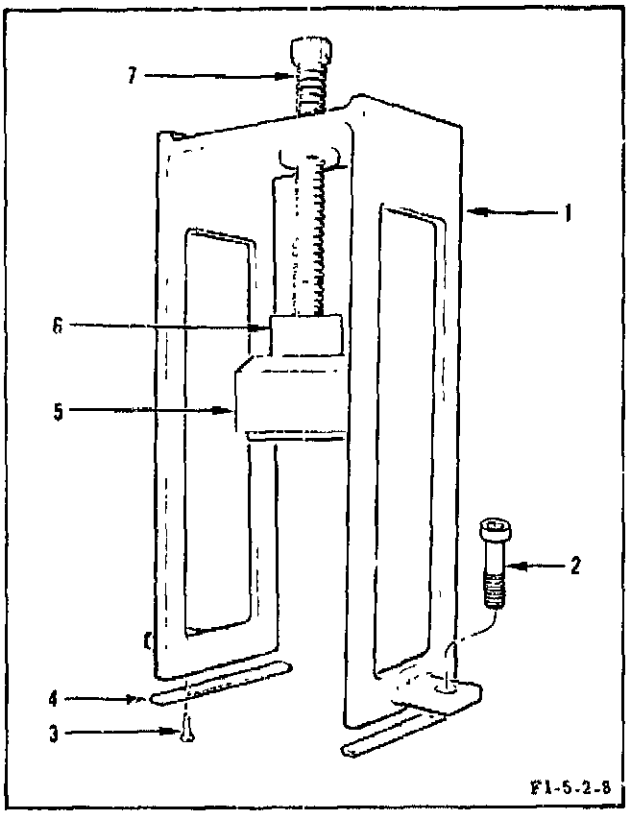
2-59. MAINTENANCE.

2-60. There are no special maintenance instructions for the spring compressor. Disassemble spring compressor, as required, to accomplish necessary repair or replacement. See figure 2-9 for index and detail numbers. Perform repairs and clean spring compressor as outlined in R-3896-5, Volume I. Store spring compressor in container provided and overpack container for shipment.

2-61. SPECIAL WRENCH T-5023955.

2-62. DESCRIPTION.

2-63. The special wrench is an offset 9/16-inch box wrench with a 1/2-inch drive. The wrench is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 1/2 pound.



Index No.	Detail No.	Description
1	216	Frame
	205	Bushing
2	101	Screw
3	213	Screw
4	214	Pad
5	107	Guide
	106	Dowel
	104	Screw
6	204	Adapter
	103	Bolt
	102	Washer
	105	Bearing
7	215	Screw
	109(a)	Container
	111(a)	Plate

(a) Item not illustrated

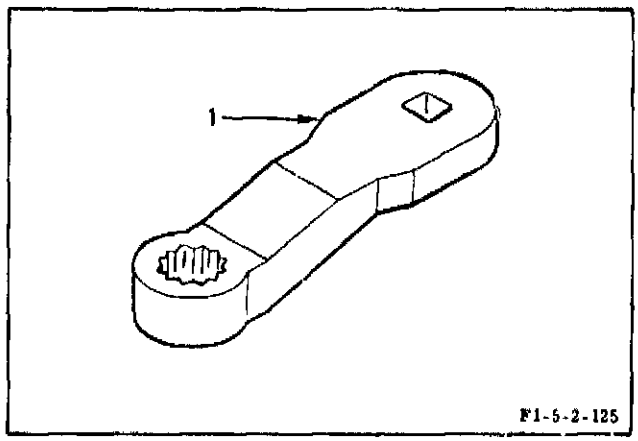
Figure 2-9. Spring Compressor T-5022672

2-64. OPERATION.

2-65. The special wrench is used to install and remove the bolts that secure the gas generator outlet flange to the turbine inlet.

2-66. MAINTENANCE.

2-67. There are no special maintenance instructions for the special wrench. For replacement of parts, see figure 2-10 for index and detail numbers. Clean wrench as outlined in R-3896-5, Volume I. Store wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	207	Wrench
	205(a)	Container
	204(a)	Plate

(a) Item not illustrated

Figure 2-10. Special Wrench T-5023955

2-68. INDUCER PULLER T-5024338.

2-69. DESCRIPTION.

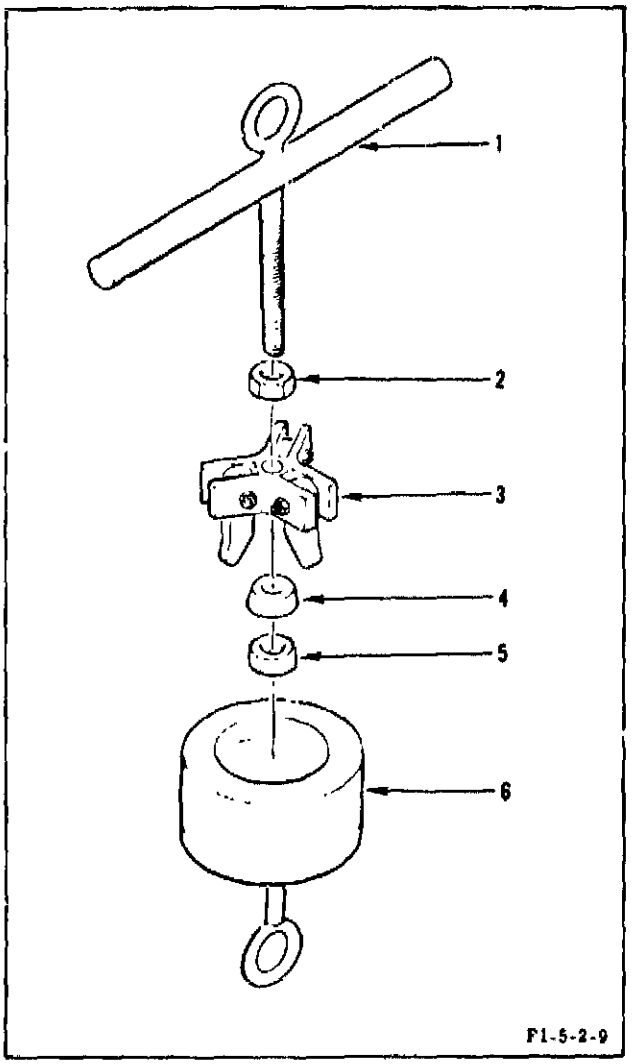
2-70. The inducer puller consists of an inducer lifting fixture, tee handle with an eye bolt, and a proof-load fixture. The inducer puller is packaged in a container that is 14 inches long, 12 inches wide, and 6 inches high. The weight is approximately 3 pounds.

2-71. OPERATION.

2-72. The inducer puller is used to remove and handle the oxidizer inducer from the turbopump shaft. The fixture end of the puller is inserted into the inducer; then the tee handle is turned until three arms open outward against the inducer and hold it securely. The inducer is then pulled from the oxidizer pump with the lifting eye.

2-73. MAINTENANCE.

2-74. There are no special maintenance instructions for the inducer puller, except for proof testing. Disassemble inducer puller, as required, to accomplish necessary repair or replacement. See figure 2-11 for index and detail numbers. Perform repairs and clean inducer puller as outlined in R-3896-5, Volume I. Store inducer puller in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Handle
2	106	Nut
3	202	Y-frame
	105	Nut
	104	Screw
	201	Arm
4	204	Bushing
5	107	Nut
6	301	Fixture
	306	Adapter
	305	Nut
	304	Eye bolt
	108(a)	Container
	109(a)	Plate

(a) Item not illustrated

Figure 2-11. Inducer Puller T-5024338

2-75. PROOF TESTING. Proof-test inducer puller every 12 months with a 300-pound proof load. See figure 2-12 for test setup and perform the following:

WARNING

Proof tests are hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Place fixture (6) over arms of Y-frame (3); then turn handle (1) until arms open outward and firmly secure fixture to Y-frame.

b. Connect overhead hoist, having minimum load capacity of one ton, to lifting eye of inducer puller.

c. Position inducer puller over test load; then connect lifting eye of fixture (6) to test load.

d. Slowly lift test load until it clears floor, and observe inducer puller for any irregularities. Hold test load suspended for 3 minutes.

e. Lower test load to floor and remove fixture (6); then inspect inducer puller for any distortion, cracks, or yielding.

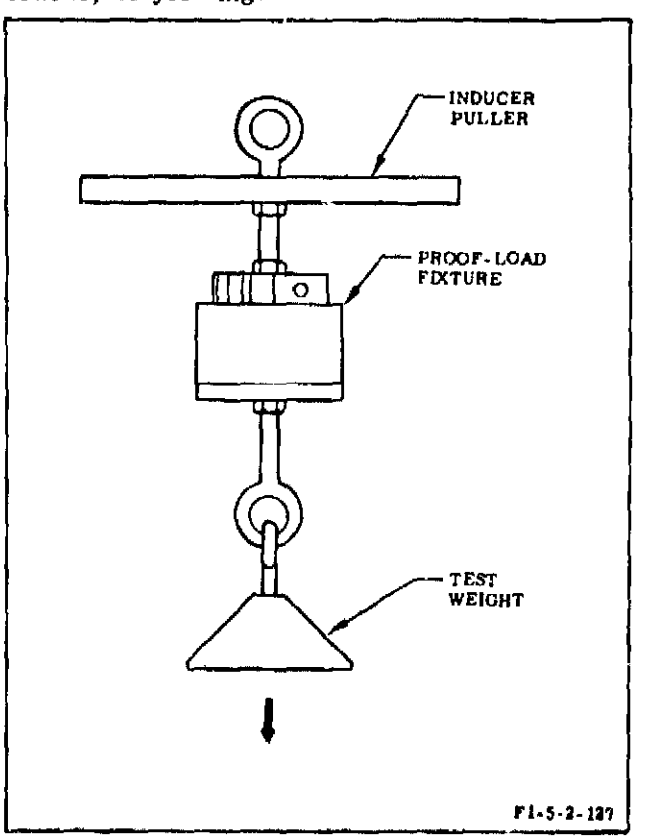


Figure 2-12. Recommended Proof Test for Inducer Puller

2-76. PRESSURE TEST FIXTURE T-5026080.

2-77. DESCRIPTION.

2-78. The pressure test fixture consists of six assorted test plates and fittings for the fuel valve. The fixture set is also equipped with mounting screws, O-rings, and pressure caps. The fixture set is packaged in a container that is 14 inches long, 14 inches wide, and 6 incnes high. The weight is approximately 65 pounds.

2-79. OPERATION.

2-80. The pressure test fixture is used to seal the fuel valve ports during component leak and function testing. With the fixture set installed on the valve, pneumatic and hydraulic pressure is applied to the valve ports through the test plate and fittings.

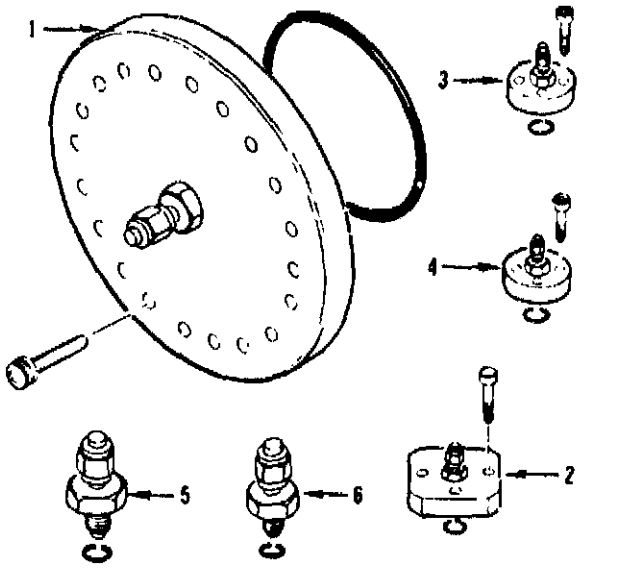
2-81. MAINTENANCE.

2-82. There are no special maintenance instructions for the pressure test fixture. For replacement of parts, see figure 2-13 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-83. PRESSURE TEST FIXTURE T-5026302.

2-84. DESCRIPTION.

2-85. The pressure test fixture consists of a fixture, test plate, and gasket for the engine control valve. The fixture set is also equipped with mounting bolts, O-rings, and fittings. The fixture set is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 10 pounds.



Index No.	Detail No.	Description
1	127	Plate
	111	Screw
	130	O-ring
	113	Cap
1 (cont)	114	Union
	115	O-ring
2	119	Plate
	118	Screw
	117	O-ring
	110	Cap
	114	Union
	115	O-ring
3	120	Plate
	122	Screw
	123	O-ring
	128	Union
	129	O-ring
4	121	Plate
	122	Screw
	123	O-ring
	128	Union
	129	O-ring
5	101	Union
	102	Cap
	103	O-ring
6	107	Union
	108	Cap
	109	O-ring
	116(a)	Container
	126(a)	Plate

(a) Item not illustrated

Figure 2-13. Pressure Test Fixture T-5026080

2-86. OPERATION.

2-87. The pressure test fixture is used to seal the engine control valve ports during component leak and function testing. With the fixture set installed on the valve, hydraulic pressure is applied to the valve through the fixture and hydraulic fluid is returned through the test plate.

2-88. MAINTENANCE.

2-89. There are no special maintenance instructions for the pressure test fixture. For replacement of parts, see figure 2-14 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment

2-90. TORQUE BAR T-5026432.

2-91. DESCRIPTION.

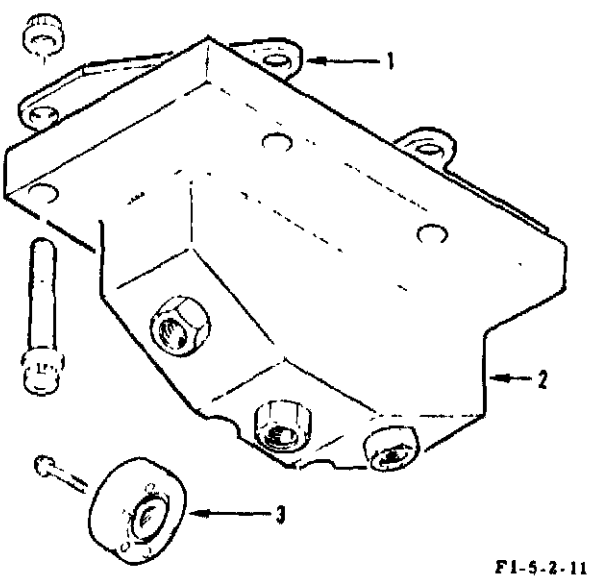
2-92. The torque bar for the second-stage turbine wheel consists of a long, rectangular, flat bar with mounting holes, spacers, and holding pins. The torque bar is packaged in a container that is 44 inches long, 6 inches wide, and 2 inches high. The weight is approximately 35 pounds.

2-93. OPERATION.

2-94. The torque bar is used to hold the turbopump shaft stationary when removing and or installing and torquing the oxidizer inducer retainer bolt. The torque bar is attached to the turbine outlet flange and the two holding pins engage with the second-stage turbine wheel to hold it stationary.

2-95. MAINTENANCE.

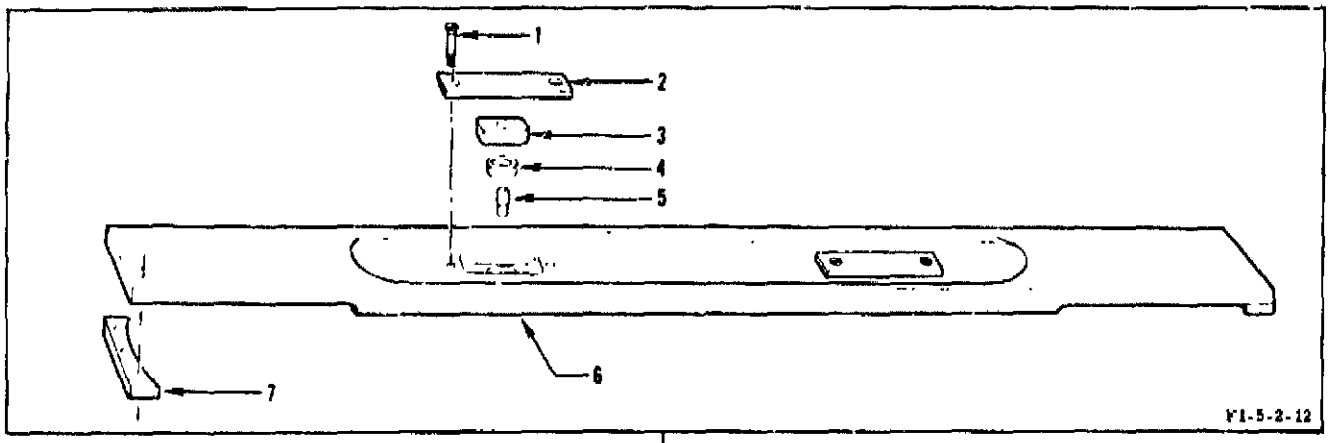
2-96. There are no special maintenance instructions for the torque bar. Disassemble the torque bar, as required, to accomplish necessary repair or replacement. See figure 2-15 for index and detail numbers. Perform repairs and clean torque bar as outlined in R-3896-5, Volume I. Store torque bar in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	103	Gasket
2	301	Fixture
	112	Nut
	110	Bolt
	111	Bolt
	107	Bushing
	108	O-ring
3	114	Plate
	113	Bolt
	102	O-ring
	109(a)	Container
	201(a)	Plate
	202(a)	Plate

(a) Item not illustrated

Figure 2-14. Pressure Test Fixture T-5026302



Index No.	Detail No.	Description	Index No.	Detail No.	Description
1	105	Screw	6	101	Bar
2	104	Retainer	7	106	Spacer
3	102	Plate		108(a)	Container
4	103	Bushing		109(a)	Plate
5	107	Pin			

(a) Item not illustrated

Figure 2-15. Torque Bar T-5026432

2-97. GUIDE PINS T-5026435.

2-98. DESCRIPTION.

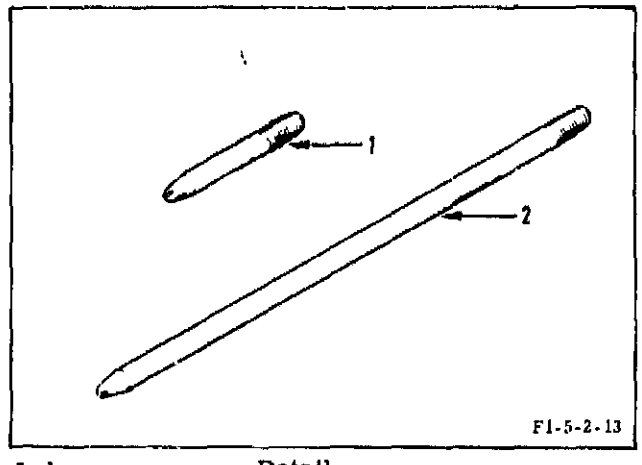
2-99. The two guide pins for the turbine wheel are different lengths and are threaded on one end and tapered on the other end. The tapered end contains a screwdriver slot. The pins are 4-1/2 inches and 12 inches long, respectively, with a diameter of 9/16 inch. The pins are packaged in a container that is 16 inches long, 4 inches wide, and 4 inches high. The weight is approximately 10 ounces.

2-100. OPERATION.

2-101. The guide pins are used to guide the first-stage turbine wheel onto the turbopump shaft. The pins are screwed into the end of the turbopump shaft with the tapered end protruding down.

2-102. MAINTENANCE.

2-103. There are no special maintenance instructions for the guide pins. For replacement of parts, see figure 2-16 for index and detail numbers. Perform repairs and clean guide pins as outlined in R-3896-5, Volume I. Store guide pins in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Pin
2	103	Pin
	105(a)	Container
	104(a)	Plate

(a) Item not illustrated

Figure 2-16. Guide Pins T-5026435

2-104. PROTECTION SLEEVE T-5026436.

2-105. DESCRIPTION.

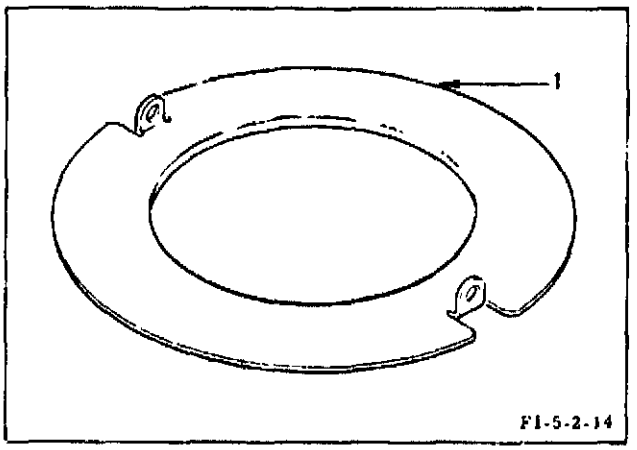
2-106. The turbopump volute protection sleeve is a thin, flat plate with an outside diameter of 19 inches and an inside diameter of approximately 11 inches. The sleeve contains two lifting ears, and it weighs 5 pounds.

2-107. OPERATION.

2-108. The protection sleeve is used to protect the floor of the oxidizer pump volute from tool damage when installing the primary seal screws. The sleeve is placed in the turbopump volute and also removed with the two lifting ears.

2-109. MAINTENANCE.

2-110. There are no special maintenance instructions for the protection sleeve. For replacement of parts, see figure 2-17 for index and detail numbers. Perform repairs and clean protection sleeve as outlined in R-3896-5, Volume I. Store protection sleeve in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Sleeve
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-17. Protection Sleeve T-5026436

2-111. PRESSURE TEST FIXTURE T-5026440.

2-112. DESCRIPTION.

2-113. The turbopump pressure test fixture consists of a hat-shaped fixture, holddown beam, relief valve, O-rings, fittings, and bolts. The fixture set is packaged in a container that is approximately 26 inches long, 15 inches wide, and 15 inches high. The weight is approximately 24 pounds.

2-114. OPERATION.

2-115. The pressure test fixture is used to seal the oxidizer volute area around the primary seal during the leak test of the primary and intermediate seals. The fixture fits over the turbopump shaft and seals on the floor of the oxidizer pump volute. The fixture is held firmly in place with the holddown beam that is attached to the oxidizer pump inlet.

2-116. MAINTENANCE.

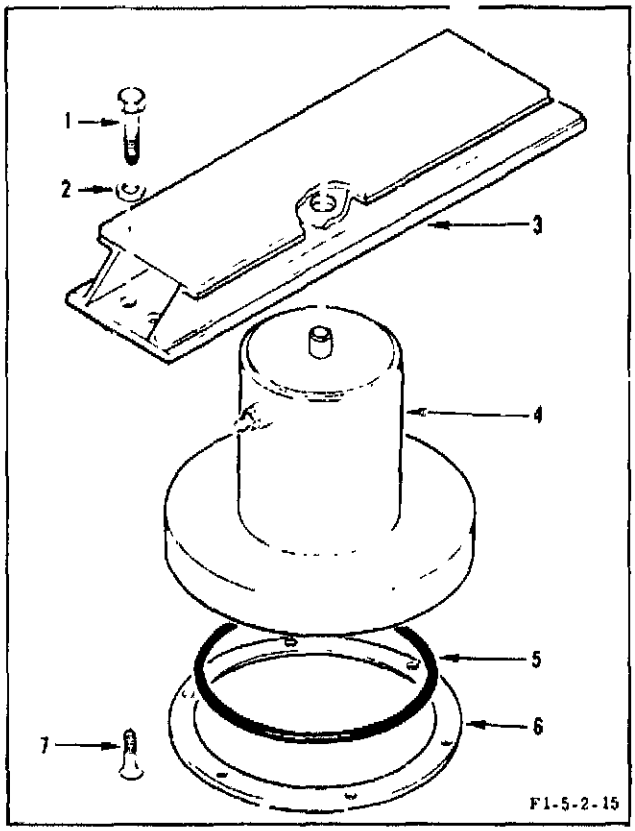
2-117. There are no special maintenance instructions for the pressure-test fixture, except for function testing. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-18 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-118. FUNCTION TESTING. The function test consists of checking the relief valve for proper operation and relief setting. Perform a function test at six-month intervals with normal usage of tool and prior to use with limited usage of tool. Using gaseous nitrogen (MIL-P-27401), slowly increase pressure to check relief setting. The relief setting must be 84 (+2, -0) psig. Adjustment of the relief valve must be accomplished with no pressure applied.

2-119. LIFT AND HOLDING TOOL T-5028673.

2-120. DESCRIPTION.

2-121. The oxidizer pump inlet lift and holding tool consists of a flat plate, guide, guide pins, lifting eyes, clamps, and screws. The tool is packaged in a container that is 24 inches long, 24 inches wide, and 6 inches high. The weight is approximately 100 pounds.



Index No.	Detail No.	Description
1	113	Bolt
2	114	Washer
3	504	Holddown beam
4	None	Fixture
	102	Union
	103	O-ring
	127	Relief valve
	125	O-ring
5	107	O-ring
6	301	Spacer
7	302	Screw
	115(a)	Container
	123(a)	Plate

(a) Item not illustrated

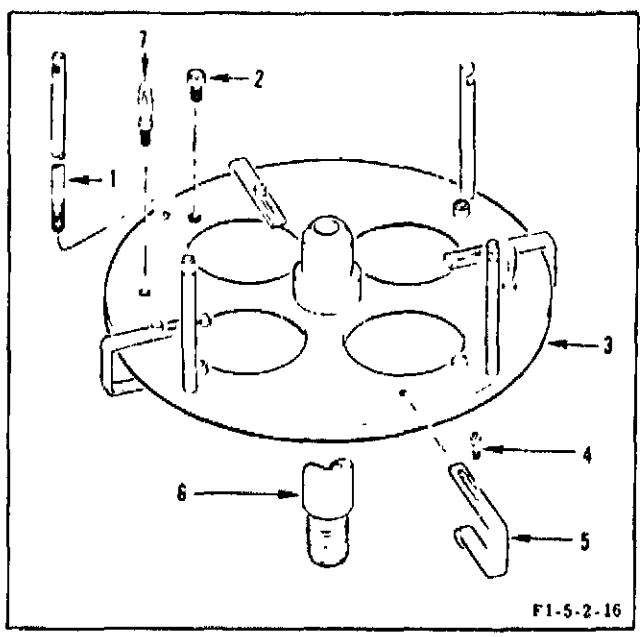
Figure 2-18. Pressure Test Fixture T-5026440

2-122. OPERATION.

2-123. The lift and holding tool is used to lift and handle the oxidizer pump inlet during removal and installation of the inlet. The flat plate attaches to the inlet with clamps and screws, the center guide attaches to the turbopump shaft, and the four guide pins are evenly spaced and attached to the oxidizer pump volute.

2-124. MAINTENANCE.

2-125. There are no special maintenance instructions for the lift and holding tool, except for servicing. Disassemble lift and holding tool, as required, to accomplish necessary repair or replacement. A press is required to remove and install bushing (110). See figure 2-19 for index and detail numbers. Perform repairs and clean lift and holding tool, and apply dry-film lubricant RB0140-007 (Rocketdyne) to threads of guide 6, as outlined in R-3896-5, Volume I. Store lift and holding tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	115	Guide pin
2	103	Screw
3	112	Plate
	110	Bushing
4	105	Screw
5	104	Clamp
6	109	Guide
7	113	Eye bolt
	111(a)	Container
	114(a)	Plate

(a) Item not illustrated

Figure 2-19. Lift and Holding Tool T-5028673

2-126. RING COMPRESSOR T-5028674.

2-127. DESCRIPTION.

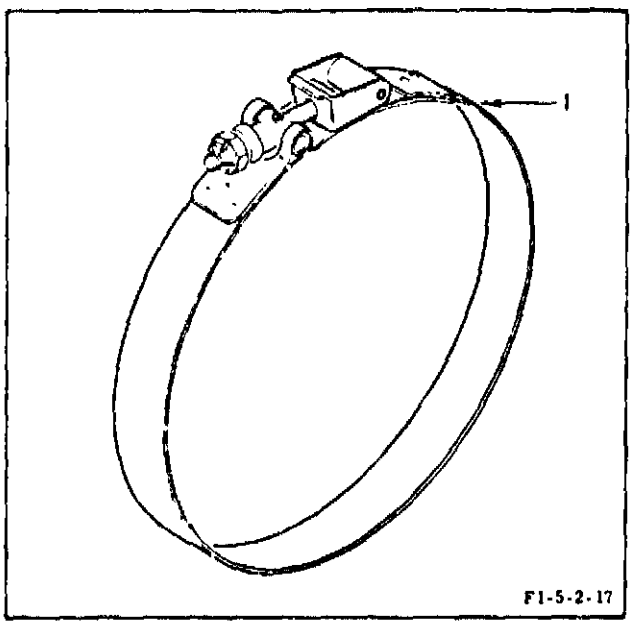
2-128. The ring compressor for the oxidizer pump inlet piston rings is a band-type clamp with a single nut adjustment. The compressor is packaged in a container that is 20 inches long, 20 inches wide, and 2 inches high. The weight is approximately one pound.

2-129. OPERATION.

2-130. The ring compressor is used to compress and hold the oxidizer pump inlet piston rings in place during installation of the inlet.

2-131. MAINTENANCE.

2-132. There are no special maintenance instructions for the ring compressor. See figure 2-20 for index and detail numbers. Clean ring compressor as outlined in R-3896-5, Volume I. Store ring compressor in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Clamp
	103(a)	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-20. Ring Compressor T-5028674

2-133. PRESSURE TEST FIXTURE T-5028675.

2-134. DESCRIPTION.

2-135. The turbopump intermediate seal pressure test fixture consists of a single test plate. The fixture is equipped with mounting screws and nuts, O-rings, and reducer. The fixture is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-136. OPERATION.

2-137. The pressure test fixture is used to pressure-test the turbopump intermediate seal. The fixture connects to the intermediate seal purge inlet flange.

2-138. MAINTENANCE.

2-139. There are no special maintenance instructions for the pressure test fixture. For replacement of parts, see figure 2-21 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

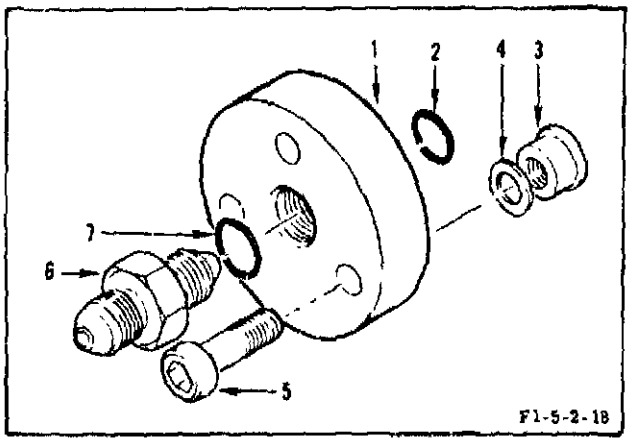
2-140. WRENCH T-5028680.

2-141. DESCRIPTION.

2-142. The wrench for the oxidizer pump mating ring nut is a cylindrically shaped spanner-type wrench. The wrench has four equally spaced square protrusions on one end, a one-inch square drive on the other end, and two internal protective sleeves. The wrench is packaged in a container that is 14 inches long, 12 inches wide, and 6 inches high. The weight is approximately 8 pounds.

2-143. OPERATION.

2-144. The wrench is used to remove and install the oxidizer pump mating ring nut. The four protrusions engage with the four slots in the nut, and a torque wrench and/or socket wrench is attached to the square drive to remove or install and torque the mating ring nut.



Index No.	Detail No.	Description
1	105	Plate
2	106	O-ring
3	104	Nut
4	111	Washer
5	112	Screw
6	101	Reducer
7	102	O-ring
	107(a)	Container
	109(a)	Plate
	110(a)	Plate

(a) Item not illustrated

Figure 2-21. Pressure Test Fixture T-5028675

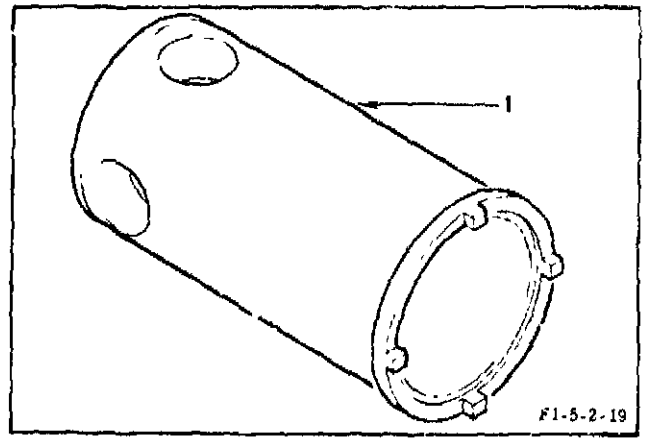
2-145. MAINTENANCE.

2-146. There are no special maintenance instructions for the wrench. For replacement of parts, see figure 2-22 for index and detail numbers. Perform repairs and clean wrench as outlined in R-3896-5, Volume I. Store wrench in container provided and overpack container for shipment.

2-147. PRESSURE TEST FIXTURE T-5028689.

2-148. DESCRIPTION.

2-149. The oxidizer pump outlet pressure test fixture consists of two flat plates. The plates are equipped with gaskets, mounting nuts and bolts, unions, and O-rings. The fixture set is packaged in a container that is 16 inches long, 16 inches wide, and 9 inches high. The weight is approximately 20 pounds.



Index No.	Detail No.	Description
1	105	Wrench
	109(a)	Sleeve
	110(a)	Sleeve
	111(a)	Container
	106(a)	Plate

(a) Item not illustrated

Figure 2-22. Wrench T-5028680

2-150. OPERATION.

2-151. The pressure test fixture is used to seal the oxidizer pump outlet flanges during an oxidizer pump leak test. This fixture set is required for leak-testing the oxidizer pump whenever the high-pressure propellant ducts are removed.

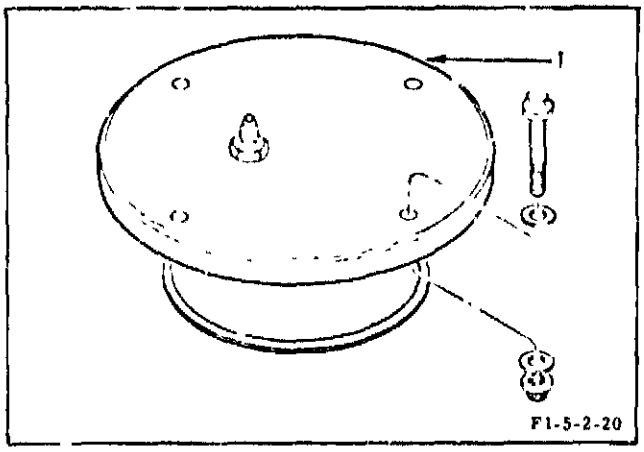
2-152. MAINTENANCE.

2-153. There are no special maintenance instructions for the pressure test fixture. For replacement of parts, see figure 2-23 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-154. PISTON TORQUE WRENCH T-5029251.

2-155. DESCRIPTION.

2-156. The oxidizer valve piston torque wrench is a cylindrically shaped spanner-type wrench. The wrench has two equally spaced round pins protruding from one end and a 1/2-inch square drive on the other end. The wrench is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 3 pounds.



Index No.	Detail No.	Description
1	111	Plate
	113	Nut
	107	Washer
	112	Bolt
	110	Gasket
	102	Union
	103	O-ring
	104(a)	Container
	105(a)	Plate

(a) Item not illustrated

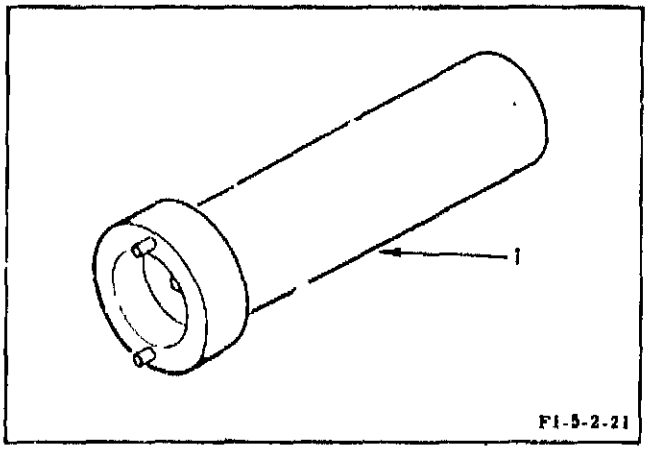
Figure 2-23. Pressure Test Fixture T-5028689

2-157. OPERATION.

2-158. The wrench is used to remove and install the oxidizer valve piston. The two protruding pins engage with holes in the piston, and a torque wrench and/or socket wrench is attached to the square drive to remove or install and torque the piston.

2-159. MAINTENANCE.

2-160. There are no special maintenance instructions for the piston torque wrench. See figure 2-24 for index and detail numbers. Perform repairs and clean piston torque wrench as outlined in R-3896-5, Volume I. Store piston torque wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101(a)	Wrench
	104(a)	Container
	105(a)	Plate

(a) Item not illustrated

Figure 2-24. Piston Torque Wrench T-5029251

2-161. TORQUE WRENCH T-5029252.

2-162. DESCRIPTION.

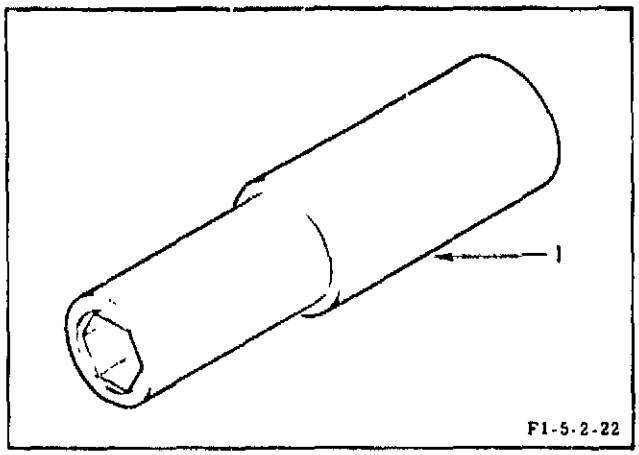
2-163. The oxidizer valve piston rod nut torque wrench is an extra-long 2-inch socket wrench with a 1/2 inch drive. The wrench is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-164. OPERATION.

2-165. The torque wrench is used to remove and install the oxidizer valve piston rod nut The wrench slides over the end of the piston rod to reach the nut, and a torque wrench and/or socket wrench is attached to the square drive to remove or install and torque the piston rod nut.

2-166. MAINTENANCE.

2-167. There are no special maintenance instructions for the torque wrench. See figure 2-25 for index and detail numbers. Clean torque wrench as outlined in R-3896-5, Volume I. Store torque wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Adapter
	104(a)	Container
	105(a)	Plate

(a) Item not illustrated

Figure 2-25. Torque Wrench T-5029252

2-168. PRESSURE TEST FIXTURE T-5029360.

2-169. DESCRIPTION.

2-170. The gas generator ball valve pressure test fixture consists of eight assorted test plates, one fixture, and fittings. The fixture set is also equipped with mounting screws, O-rings, and pressure caps. The fixture set is packaged in a container that is 24 inches long, 12 inches wide, and 6 inches high. The weight is approximately 35 pounds.

2-171. OPERATION.

2-172. The pressure test fixture is used to seal the gas generator ball valve ports during component leak and function testing. With the fixture set installed on the valve, pneumatic and hydraulic pressure is applied to the valve ports through the test plates and fittings.

2-173. MAINTENANCE.

2-174. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-26 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-175. PRESSURE TEST FIXTURE T-5029362.

2-176. DESCRIPTION.

2-177. The oxidizer valve pressure test fixture consists of eight assorted test plates, one fixture, three relief valves, and fittings. The fixture set is also equipped with mounting bolts and screws, O-rings, and pressure caps. The fixture set is packaged in a container that is 30 inches long, 16 inches wide, and 11-1/2 inches high. The weight is approximately 50 pounds.

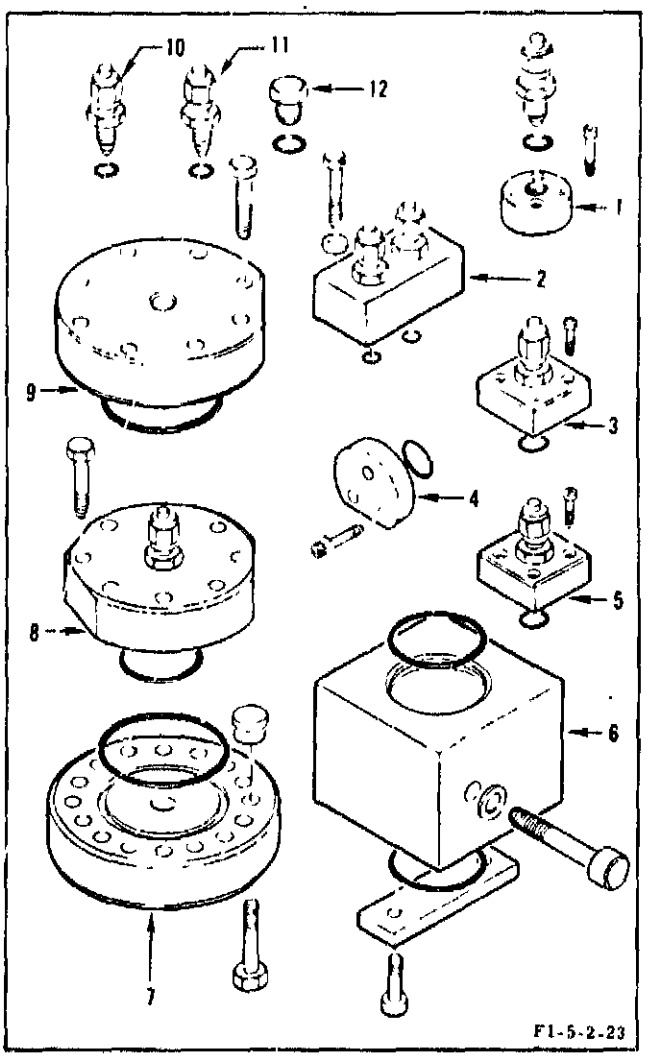


Figure 2-26. Pressure Test Fixture T-5029360 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	507	Plate
	103	Cap
	117	Union
	145	O-ring
	502	Screw
	504	O-ring
2	402	Plate
	407	Cap
	405	Union
	151	O-ring
	401	Bolt
	404	Washer
	403	O-ring
3	306	Plate
	103	Cap
	117	Union
	145	O-ring
	148	Bolt
	150	O-ring
4	312	Plate
	161	Bolt
	160	Seal
5	307	Plate
	103	Cap
	117	Union
	145	O-ring
	148	Bolt
	150	O-ring
6	309	Fixture
	117	Union
	145	O-ring
6 (cont)	137[a]	Screw
	138	Screw
	125	Bar
	136	O-ring
7	313	Plate
	103	Cap
	117	Union
	145	O-ring
	140	Nut
	141	Washer
	156	Bolt
	162	Seal
8	153	Plate
	103	Cap
	117	Union
	145	O-ring
	155	Bolt
	135	O-ring
9	154	Plate
	158	Bolt
	147	O-ring
10	102	Reducer
	103	Cap
	151	O-ring
11	117	Union
	103	Cap
	145	O-ring
12	116	Plug
	145[b]	O-ring
	131[b]	Container
	159[b]	Plate

(a) Use RD260-3010-0010 Naflex seal, or equivalent.
(b) Item not illustrated

Figure 2-26. Pressure Test Fixture T-5029360 (Sheet 2 of 2)

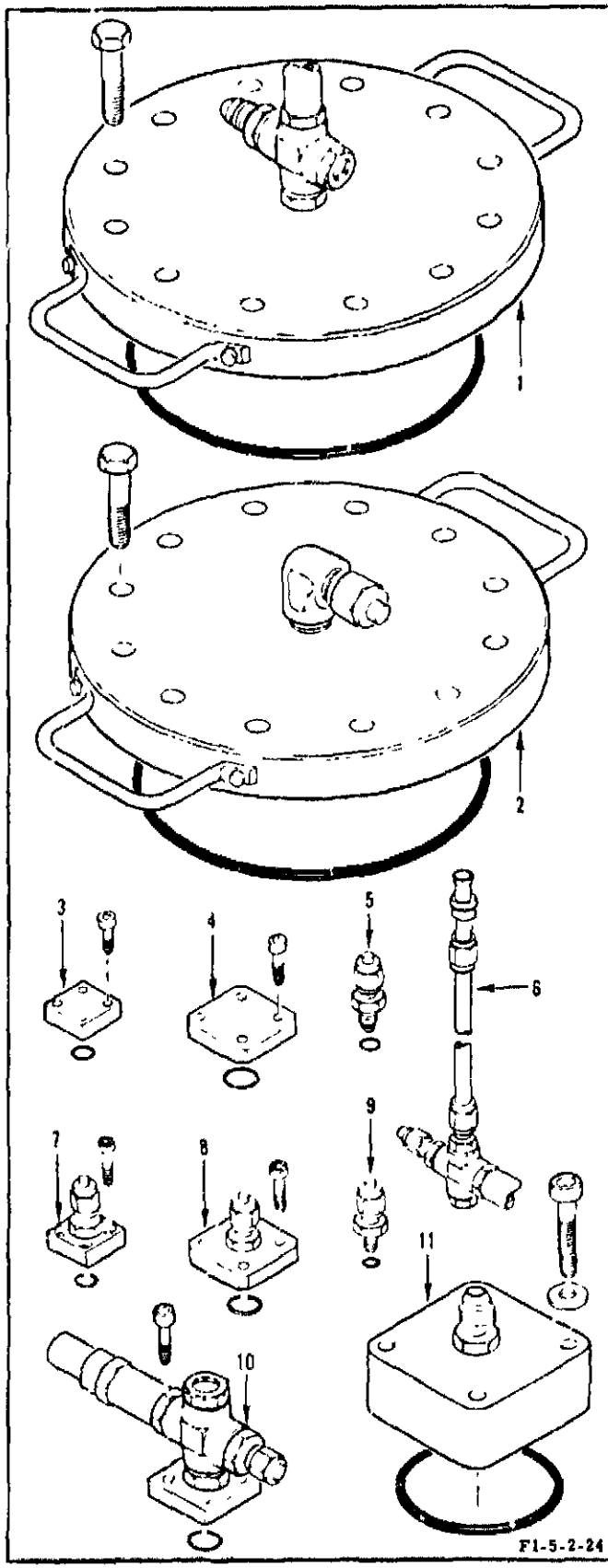
2-178. OPERATION.

2-179. The pressure test fixture is used to seal the oxidizer valve ports during component leak and function testing. With the fixture set installed on the valve, pneumatic and hydraulic pressure is applied to the valve ports through the test plates and fittings.

2-180. MAINTENANCE.

2-181. There are no special maintenance instructions for the pressure test fixture, except for function-testing. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-27 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-182. FUNCTION TESTING. The function test consists of checking the relief valves for proper operation and relief setting. Perform a function test at 6-month intervals with normal usage of tool and prior to use with limited usage of tool. Using gaseous nitrogen (MIL-P-27401), slowly increase pressure to check relief setting. The relief setting must be 600 (+18, -0) psig for relief valve -127 and 900 (+27, -0) psig for relief valve -104. Adjustment of the relief setting must be accomplished with no pressure applied.



Index No.	Detail No.	Description
1	147	Plate
	132	Bolt
	137	Seal
	102	Reducer
	106	O-ring
	104	Relief valve
	106	O-ring
	105	Plug
	106	O-ring
	103	Cross
	106	O-ring
	148(a)	Nipple
	149(a)	Bushing
	153	Screw
	154	Handle
2	147	Plate
	132	Bolt
	137	Seal
	133	Cap
	134(a)	Elbow
	153	Screw
	154	Handle
3	145	Plate
	146	Screw
	117	O-ring
4	130	Plate
	116	Screw
	129	O-ring
5	110	Union
	111	Cap
	107	O-ring
6	127	Relief valve
	123	O-ring
	128	Plug
	123	O-ring
	122	Reducer
	123	O-ring
	126	Tube
	125	Sleeve
	124	Nut
	122	Reducer
	123	O-ring
	121	Cross
7	120	Plate
	118	Screw
	117	O-ring
	111	Cap
	110	Union
	107	O-ring

(a) Thread sealant tape RB0140-002, Type II (Rocketdyne)

Figure 2-27. Pressure Test Fixture T-5029362 (Sheet 1 of 2)

Index No.	Detail No.	Description
8	115	Plate
	116	Screw
	114	O-ring
	111	Cap
	110	Union
	107	O-ring
9	113	Reducer
	111	Cap
	112	O-ring
10	119	Plate
	116	Screw
	114	O-ring
	104	Relief valve
	106	O-ring
	105	Plug
	106	O-ring
	111	Cap
	102	Reducer
	106	O-ring
	103	Cross
	106	O-ring
	102	Reducer
	107	O-ring
11	138	Fixture
	155	Screw
	143	Washer
	151	O-ring
	140	Union
	150 (b)	O-ring
	101 (b)	Container
	131 (b)	Plate
	152 (b)	Plate

(b) Item not illustrated

Figure 2-27. Pressure Test Fixture T-5029362 (Sheet 2 of 2)

2-183. ASSEMBLY STAND T-5029363.

2-184. DESCRIPTION.

2-185. The oxidizer valve assembly stand consists of a tubular and I-beam chassis, mounted on four casters, with a rectangular frame and cradle attached on top of two vertical members. The rectangular frame and cradle rotate about a horizontal axis between the two vertical members by means of a hand-operated gear box. The assembly stand is 45 inches long, 33 inches wide, 48-1/2 inches high, and weighs approximately 220 pounds

2-186. OPERATION.

2-187. The assembly stand is used to hold and support the oxidizer valve during disassembly, assembly, and testing. The oxidizer valve is attached to the assembly stand cradle with four handling fittings that mate with four handling bolts that are part of the valve. With the oxidizer valve installed in the assembly stand, the valve can be rotated to the desired maintenance position with the hand-operated gear box, and it can also be raised or lowered with the vertical screw adjustments on each side of the stand. Since the assembly stand is mounted on casters, it can easily be moved from one maintenance area to another.

2-188. MAINTENANCE.

2-189. There are no special maintenance instructions for the assembly stand, except for proof testing. Disassemble assembly stand, as required, to accomplish necessary repair or replacement. See figure 2-28 for index and detail numbers. Perform repairs, clean, and lubricate threaded and moving parts as outlined in R-3896-5, Volume I.

2-190. PROOF TESTING. Proof-test the assembly stand every 24 months with a 420-pound proof load. See figure 2-29 for test setup and perform the following:

WARNING

Proof tests are extremely hazardous; therefore, special precautions must be taken. In addition to local and standard requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Connect to test load an overhead hoist that has a minimum load capacity of one ton.

b. Slowly lift test load enough to position assembly stand under it.

c. Lower test load into cradle (9); then attach handling fittings to handling bolts on test load. Make sure handling fittings are fully engaged and locked on handling bolts.

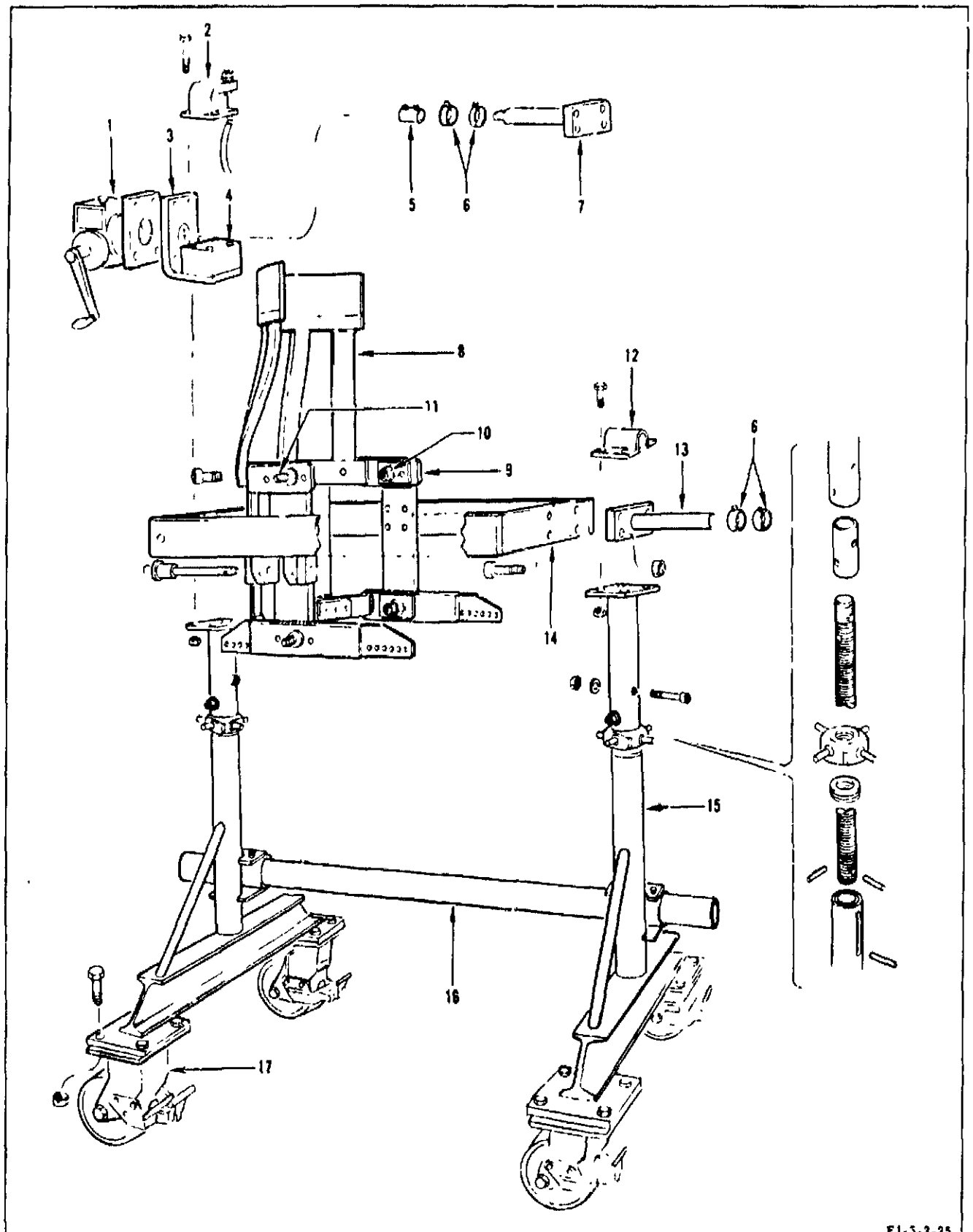


Figure 2-28. Assembly Stand T-5029363 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	107	Gear reducer
	None	Screw
	102	Handle
	103	Screw
2	118	Pillow block
	None	Nut
	None	Bolt
3	104	Angle
4	106	Spacer
5	105	Coupling
6	206	Ring
7	301	Shaft
	126	Nut
	125	Screw
8	502	Protector
	132	Screw
9	401	Cradle
	130	Pin
	None	Screw
10	113	Fitting
	128	Nut
	127	Screw
	131	Lockwasher
	405	Adapter
11	113	Fitting
	403	Bolt
	129	Nut
	127	Screw
	131	Lockwasher
	402	Adapter
12	124	Pillow block
	None	Nut
	None	Bolt
13	302	Shaft
	126	Nut
	125	Screw
14	501	Frame
15	101	Stand
	110	Nut
	109	Washer
	108	Screw
	202	Bushing
	204	Screw
	112	Pin
	203	Nut
	111	Bearing
	120	Pin
16	121	Brace
	None	Screw
17	123	Caster
	None	Nuts
	None	Bolts
	119[a]	Plate

(a) Item not illustrated

Figure 2-28. Assembly Stand
T-5029363 (Sheet 2 of 2)

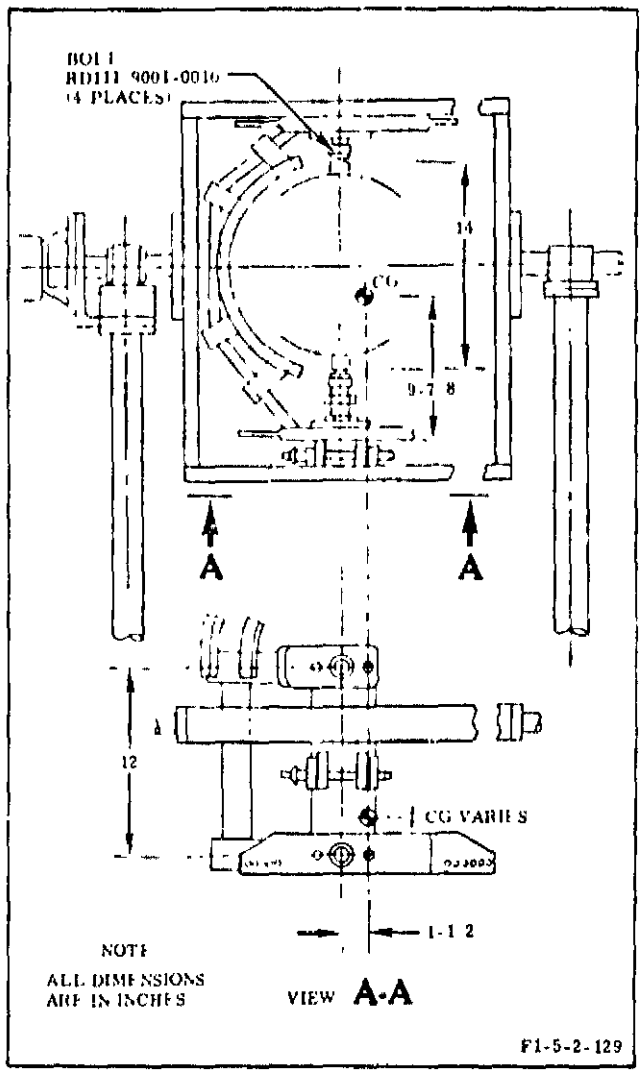


Figure 2-29. Recommended Proof Test for Assembly Stand

d. Slowly lower overhead hoist until full weight of test load is imposed on assembly stand and all tension on hoist is relieved. Maintain this condition for a minimum of 3 minutes and observe assembly stand for any irregularities.

e. Slowly raise overhead hoist to lift test load; then disengage handling fittings and remove test load from assembly stand.

f. Inspect assembly stand for distortion, weld cracks, or yielding.

2-191. HYDRAULIC TORQUE TOOL T-5029452.

2-192. DESCRIPTION.

2-193. The hydraulic torque tool consists of a hand pump, a selector valve, two hydraulic cylinders, two relief valves, a plate, two brackets, an arm, and a socket. The hand pump consists of a manually operated piston-type pump and a 160-cubic-inch reservoir. The selector valve is a manually operated four-way valve. The hand pump and selector valve are mounted on an aluminum plate and plumbed with rigid tubing. Each hydraulic cylinder consists of two pressure plates, a cylinder, and a piston. The pressure plates are attached to the ends of the cylinder and contain the pressure ports. The piston, housed in the cylinder, has a 6-inch stroke. The attach fittings are on one pressure plate and the piston rod. The cylinder pressure ports are connected to the selector valve with hoses. The piston-type relief valves are spring-loaded and contain pressure and relief ports. The plate is circular with cutouts on two sides and 10 holes to match with holes in the oxidizer pump inlet flange. The brackets have 6 holes to match with holes in the oxidizer pump inlet flange and are designed to fit the contour of the cutouts of the plate. The brackets provide mounting for the stationary end of the cylinder, and one of the brackets has a scale scribed on the outer edge in increments of one degree with a range of 0-20 degrees in each direction. The arm is a steel bar with a boss and four setscrews, a pointer on one end, and a bearing in each end. The socket has two dowel pins, four attachment holes at one end, and splines in the other end.

2-194. OPERATION.

2-195. The hydraulic torque tool is used to torque the oxidizer inducer retainer bolt up to 4,000 foot-pounds and is also used to loosen the bolt. The plate and brackets are installed on the oxidizer pump inlet. The socket is attached to the boss of the arm and the arm is positioned over the plate with the socket down over the bolt. The cylinder piston rod end is attached to the arm and the other end attached to the bracket. The selector valve is moved to the applicable position (to loosen or tighten bolt) and the hand pump operated. The cylinders move the arm in a clockwise or counterclockwise direction, and pressure is applied to the bolt with the socket on the bolt.

2-196. MAINTENANCE.

2-197. There are no special maintenance instructions for the hydraulic torque tool, except for proof testing, leak testing, function testing, and servicing. Disassemble the hydraulic torque tool, as required, to accomplish necessary repair or replacement. See figure 2-30 for index and detail numbers. Perform repairs, clean, and lubricate threaded parts, as outlined in R-3896-5, Volume I. Store hydraulic torque tool in container provided and overpack container for shipment.

2-198. PROOF TESTING. The hoses of the hydraulic torque tool must be proof-tested at six-month intervals and any time misuse or damage is suspected. Perform leak-test procedures after proof testing is completed.

WARNING

Proof tests are hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Apply 4,500 psig gaseous nitrogen (MIL-P-27401) to hose for 2 minutes, five successive times.

b. Inspect hose for evidence of permanent deformation or damage.

c. Stamp the proof pressure applied and date on a tag and attach tag to hose.

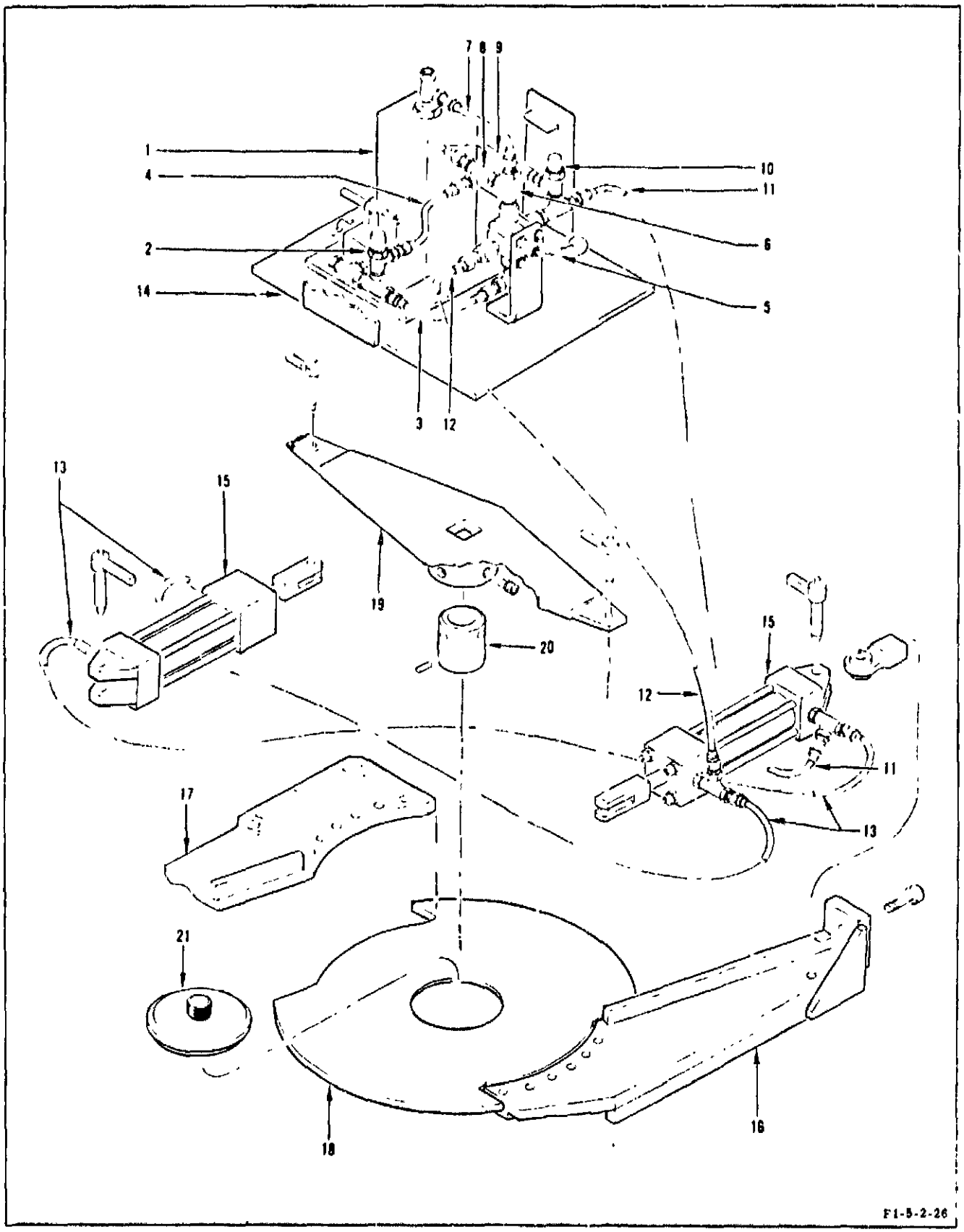


Figure 2-30. Hydraulic Torque Tool T-5029452 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	435	Hand pump
2	449	Relief valve
3	420	Tube
	419	Sleeve
	418	Nut
	417	Elbow
	421	Tee
	444	Nipple
	423	Nipple
	422	O-ring
	424	Plug
4	447	Tube
	446	Sleeve
	445	Nut
	455	Nipple
	453	Nipple
5	413	Valve
6	450	Tee
	452	Nipple
	453	Nipple
	454	O-ring
7	404	Tube
	403	Sleeve
	402	Nut
8	450	Tee
	453	Nipple
	436	Nipple
	451	Plug
	454	O-ring
9	429	Tube
	428	Sleeve
	427	Nut
	425	Nipple
10	414	Relief valve
11	433	Hose
	431	Tee
	443	O-ring
	432	Nipple
	434	Nipple
	430	Nipple
12	410	Hose
	407	Tee
	408	O-ring
	406	Nipple
	411	Nipple
	409	Nipple
13	416	Hose
	415	Nipple
14	437	Plate
	438	Bracket
	439	Bracket
	441	Clevis
	442	Plate
15	412	Cylinder
16	101	Bracket
	121	Bearing
	113	Screw
	122	Pin
	129	Bolt
	128	Washer
	127	Plate
17	135	Bracket
	121	Bearing
	113	Screw
	122	Pin
	129	Bolt
	128	Washer
	127	Plate
18	133	Plate
19	107	Arm
	132	Pointer
	123	Bearing
	130	Setscrew
20	301	Socket
21	134	Cover
	112(a)	Plate
	124(a)	Container

(a) Item not illustrated

Figure 2-30. Hydraulic Torque Tool T-5029452 (Sheet 2 of 2)

2-199. LEAK TESTING. Leak-test hoses with gaseous nitrogen (MIL-P-27401).

a. Apply 1,000 +20 psig to hose for 15 minutes. Total allowable effusion must not exceed 50 cc per 12 inches of hose.

b. Decrease pressure to zero and protect hose from contamination.

2-200. FUNCTION TESTING. The function test must be performed at 6-month intervals with normal usage of tool and prior to use with limited usage of tool.

a. Install a 2,000-psi test gage to tee at outlet of pump and upstream of relief valve.

b. Firmly secure both cylinders at stationary attach fitting.

c. Move selector valve to TO TIGHTEN BOLT position (positions stamped on mounting plate).

d. Slowly operate hand pump until cylinder pistons bottom.

e. Increase pressure until relief valve relieves. The relief valve must relieve at 640 (+20, -0) psig.

NOTE

Adjustment of the relief valve must be accomplished with no pressure applied and repressurized to check adjustment.

f. Move selector valve to TO LOOSEN BOLT position.

g. Repeat steps d and e. The relief valve must relieve at 1,200 (+35, -0) psig.

h. Move selector valve to one position and then the other to decrease pressure.

i. Secure tool and store in container.

2-201. SERVICING. Servicing consists of filling the pump reservoir with distilled water and protecting from freezing temperatures.

2-202. TORQUE AND INSPECTION TOOL T-5029467 AND ADAPTER T-5035940.

2-203. DESCRIPTION.

2-204. The turbopump torque and inspection tool and adapter are similar tools consisting of a housing, dial indicator, and extension rod. The primary difference between the two tools is in the length of the housing and extension rod. On tool T-5029467, the housing is 9-1 2 inches long, and the extension rods are 14-3 4 and 15-3 16 inches long. On tool T-5035940, the housing is 19 inches long and the extension rod is 24-1 4 inches long. The tools are packaged in containers. Container T-5029467 is 24 inches long, 4 inches wide, and 4 inches high, and container T-5035940 is 29 inches long, 16 inches wide, and 8 inches high. The weight of each tool is approximately 1-3 4 pounds.

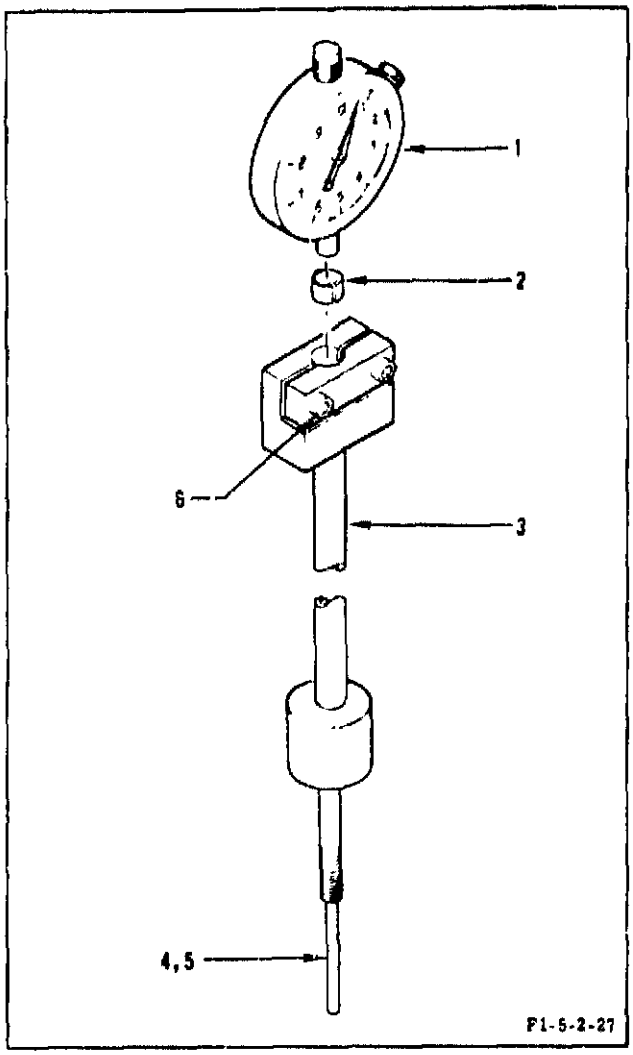
2-205. OPERATION.

2-206. The torque and inspection tool and the adapter are used to measure bolt stretch when torquing the turbopump inducer locking bolt. The tool is screwed into the hollow inducer locking bolt prior to torquing and the indicator is set on zero. As the bolt is torqued, the dial indicator indicates the amount of bolt stretch in thousandths of an inch, which can then be converted to foot-pounds of torque. The longest of the two tools is required whenever the interface panel is installed on the engine.

2-207. MAINTENANCE.

2-208. There are no special maintenance instructions for the torque and inspection tool and adapter, except for servicing. Disassemble the tools, as required, to accomplish necessary repair or replacement. See figure 2-31 for index and detail numbers. Clean external surfaces with preservative WD-40 (Rocket Chemical Co); then wipe dry with a clean, white nylon cloth. Store tools in container provided and overpack container for shipment.

2-209. SERVICING. Servicing the torque and inspection tool and adapter consists of performing a calibration check of the dial indicator. A calibration check must be performed every 6 months on indicators that are in use.



Index No.	Detail No. (a)	Detail No. (b)	Description
1	106	112	Indicator
2	112	106	Adapter
3	101	101	Housing
4	113	107	Rod
5	114	N/A	Rod
6	105	105	Screw
	110(c)	108(c)	Container
	109(c)	110(c)	Plate
	111(c)	113(c)	Plate

(a) On tool T-5029467
(b) On tool T-5035940
(c) Item not illustrated

Figure 2-31. Torque and Inspection Tool T-5029467 and Adapter T-5035940

2-210. ALINING PINS T-5029611.

2-211. DESCRIPTION.

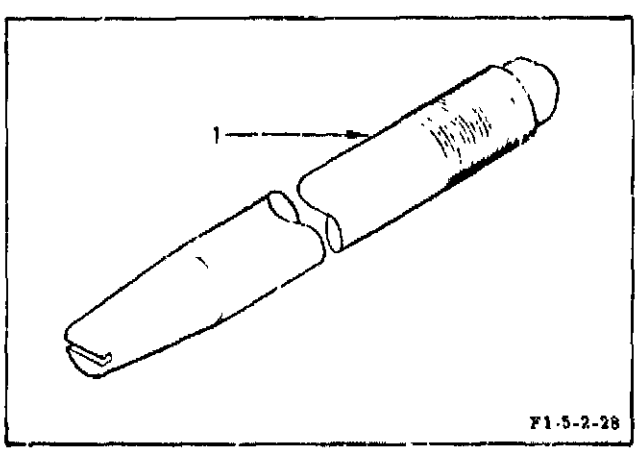
2-212. The thrust chamber alining pins are four pins that are threaded on one end and tapered on the other end. The tapered end contains a screwdriver slot. The pins are packaged in a container that is 24 inches long, 4 inches wide, and 4 inches high. The weight is approximately 4-1/2 pounds.

2-213. OPERATION.

2-214. The alining pins are used to guide the thrust chamber oxidizer dome and injector onto the thrust chamber body during assembly. The four pins are evenly spaced and screwed into the thrust chamber body at the dome and injector attach bolt circle. The dome and injector are partially assembled, then installed and alined to the thrust chamber body with the aid of the alining pins.

2-215. MAINTENANCE.

2-216. There are no special maintenance instructions for the alining pins. For parts replacement, see figure 2-32 for index and detail numbers. Perform repairs and clean alining pins as outlined in R-3896-5, Volume I. Store alining pins in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	104	Alining pin
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-32. Alining Pins T-5029611

2-217. TORQUE ADAPTER T-5029619.

2-218. DESCRIPTION.

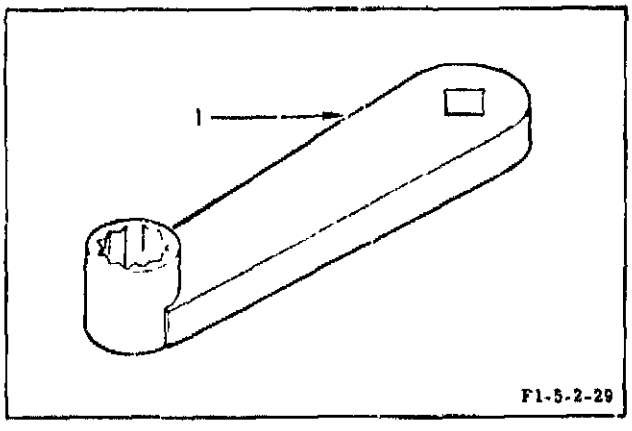
2-219. The torque adapter for the propellant valve and duct attach bolts is an 11/16-inch, 12-point socket with a 5-3/32-inch-long horizontal offset extension and a 1/2-inch-square drive. The adapter is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 2 pounds.

2-220. OPERATION.

2-221. The torque adapter is used primarily to remove, and install and torque the bolts that secure propellant valves and ducts to the engine. The adapter may also be used on any other 11/16-inch external wrenching bolt that requires an offset extension.

2-222. MAINTENANCE.

2-223. There are no special maintenance instructions for the torque adapter. The torque adapter must be calibrated with the torque wrench it is to be used with prior to use. See figure 2-33 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	106	Adapter
	104(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-33. Torque Adapter T-5029619

2-224. SPECIAL WRENCH ADAPTER T-5029642.

2-225. DESCRIPTION.

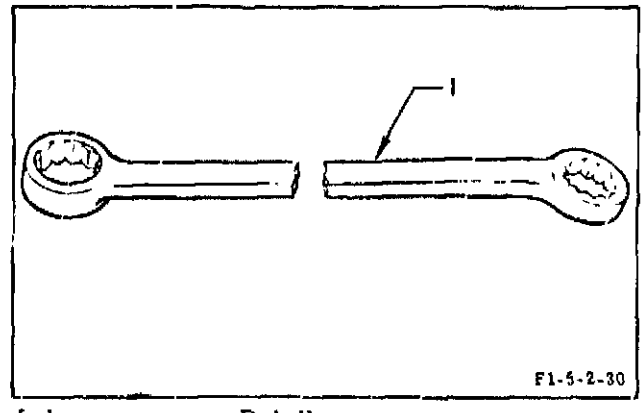
2-226. The gas generator special wrench adapter is a 3/8-inch and 7/16-inch, 12-point box wrench, 7-3/4 inches long. The 3/8-inch box end is machined flat and thin. The wrench is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately one pound.

2-227. OPERATION.

2-228. The special wrench adapter is used to remove and install the nuts that secure the gas generator ball valve oxidizer outlet to the gas generator injector. The 3/8-inch box end, which is machined flat and thin, allows easy access to the hard-to-get-at ball valve to injector nuts.

2-229. MAINTENANCE.

2-230. There are no special maintenance instructions for the special wrench adapter. The special wrench adapter must be calibrated with the torque wrench it is to be used with prior to use. See figure 2-34 for index and detail numbers. Clean special wrench adapter as outlined in R-3896-5, Volume I. Store special wrench adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Wrench
	103(a)	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-34. Special Wrench Adapter T-5029642

2-231. ASSEMBLY PLATE T-5029715.

2-232. DESCRIPTION.

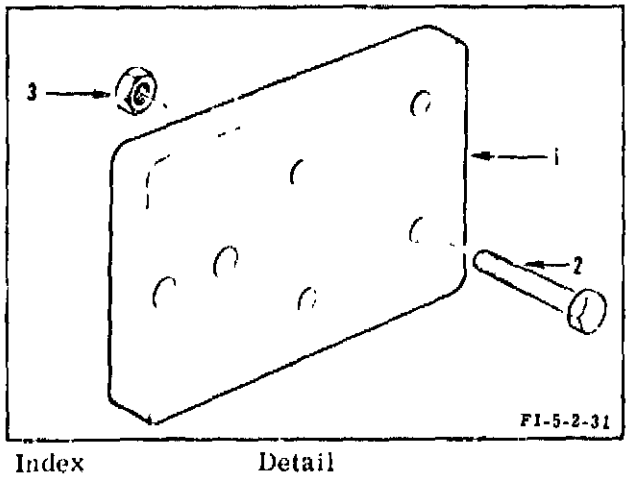
2-233. The hypergol manifold assembly plate consists of a rectangular-shaped flat plate with mounting nuts and bolts. The plate is 5-3/4 inches long, 4 inches wide, and 5/8 inch thick. The plate is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-234. OPERATION.

2-235. The assembly plate is used to hold and support the hypergol manifold during disassembly and assembly. The assembly plate is attached to the hypergol manifold at the ignition monitor valve mounting flange; then the other end of the plate is secured in a vise.

2-236. MAINTENANCE.

2-237. There are no special maintenance instructions for the assembly plate. For replacement of parts, see figure 2-35 for index and detail numbers. Perform repairs and clean assembly plate as outlined in R-3896-5, Volume I. Store assembly plate in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
2	102	Bolt
3	103(a)	Nut
	104(a)	Container
	105(a)	Plate

(a) Item not illustrated

Figure 2-35. Assembly Plate T-5029715

2-238. HYPERGOL SIMULATOR T-5029716.

2-239. DESCRIPTION.

2-240. The hypergol simulator is a two-piece tool consisting of a switch actuating rod and a simulator cap. The simulator cap is equipped with O-rings, union, and pressure cap. The hypergol simulator is packaged in a container that is 24 inches long, 4 inches wide, and 4 inches high. The weight is approximately 10 pounds.

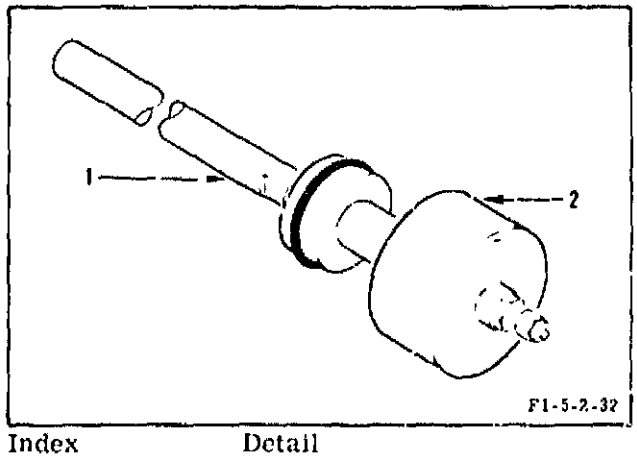
2-241. OPERATION.

2-242. The hypergol simulator is used to simulate the hypergol cartridge and perform leak and function tests on the hypergol manifold. The hypergol simulator can be used either with the actuating rod installed to actuate the hypergol switch and perform pressure and function tests, or with the actuating rod removed to perform pressure tests only.

2-243. MAINTENANCE

2-244. There are no special maintenance instructions for the hypergol simulator except for servicing. Disassemble the hypergol simulator, as required, to accomplish necessary repair or replacement. See figure 2-36 for index and detail numbers. Perform repairs and clean hypergol simulator as outlined in R-3896-5, Volume I. Store hypergol simulator in container provided and overpack container for shipment.

2-245. SERVICING. Servicing consists of applying FS1281 grease (Dow Corning Corp) to threads of simulator (2) prior to each use.



Index No.	Detail No.	Description
1	108	Rod
2	101	Simulator
	104	O-ring
	103	Cap
	102	Union
	None	O-ring
	107(a)	Container
	105(a)	Plate
	106(a)	Plate

(a) Item not illustrated

Figure 2-36. Hypergol Simulator T-5029716

2-246. PRESSURE TEST FIXTURE T-5029717.

2-247. DESCRIPTION.

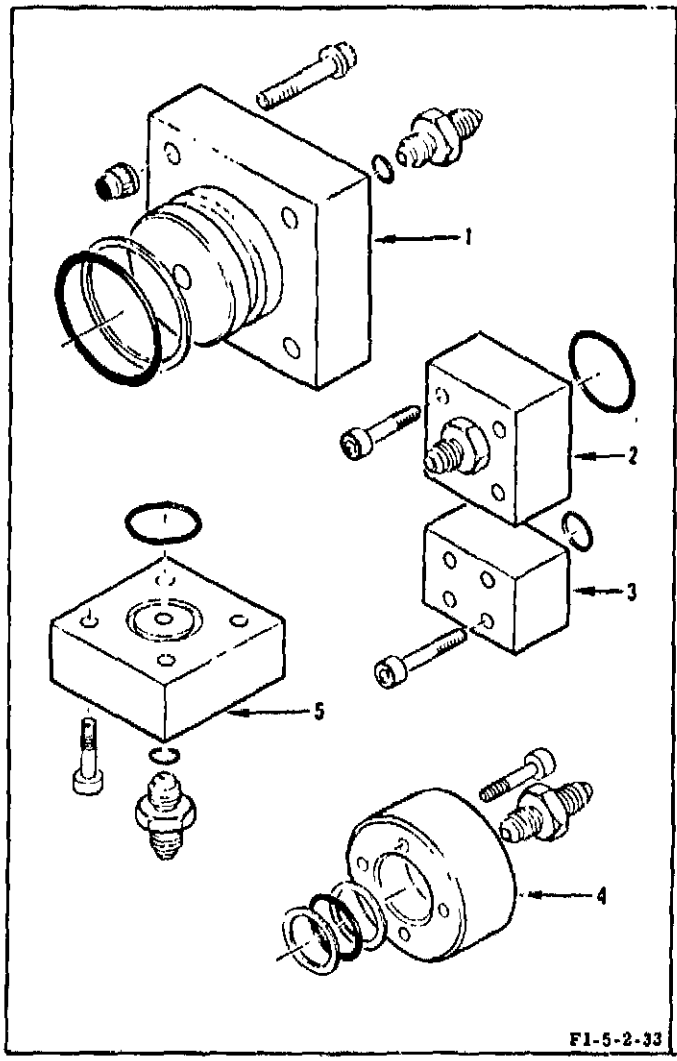
2-248. The hypergol manifold pressure test fixture consists of three test plates and two test fixtures. The fixture set is also equipped with mounting screws and nuts, O-rings, unions, and pressure caps. The fixture set is packaged in a container that is 8 inches long, 4 inches wide and 4 inches high. The weight is approximately 65 pounds.

2-249. OPERATION.

2-250. The pressure test fixture is used to seal the hypergol manifold ports during component leak and function testing. With the fixture set installed on the hypergol manifold, pneumatic and hydraulic pressure is applied to the manifold ports through the test plates and fittings.

2-251. MAINTENANCE.

2-252. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-37 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	204	Fixture
	115	Nut
	114	Bolt
	102	O-ring
	110	Retainer
	106	Union
	105	O-ring
2	201	Plate
	107	Screw
	104	O-ring
	106	Union
	105	O-ring
3	202	Plate
	113	Screw
	103	O-ring
4	301	Fixture
	302	Bolt
	304	Retainer
	305	O-ring
	303	Union
5	203	Plate
	107	Screw
	101	O-ring
	106	Union
	105	O-ring
	108(a)	Container
	109(a)	Plate

(a) Item not illustrated

Figure 2-37. Pressure Test Fixture T-5029717

2-253. PRESSURE TEST FIXTURE T-5029737.

2-254. DESCRIPTION.

2-255. The gas generator ball valve pressure test fixture consists of two test plates. The fixture set is also equipped with mounting bolts, O-rings, fittings, and pressure caps. The fixture set is packaged in a container that is 18 inches long, 18 inches wide, and 18 inches high. The weight is approximately 70 pounds.

2-256. OPERATION.

2-257. The pressure test fixture is used to seal the gas generator ball valve oxidizer inlet port when testing the valve at cryogenic temperatures. With the fixture installed on the valve, liquid nitrogen is admitted to the oxidizer inlet port through the test plate and fittings.

2-258. MAINTENANCE.

2-259. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-38 for index and detail numbers. Perform repairs and clean pressure text fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

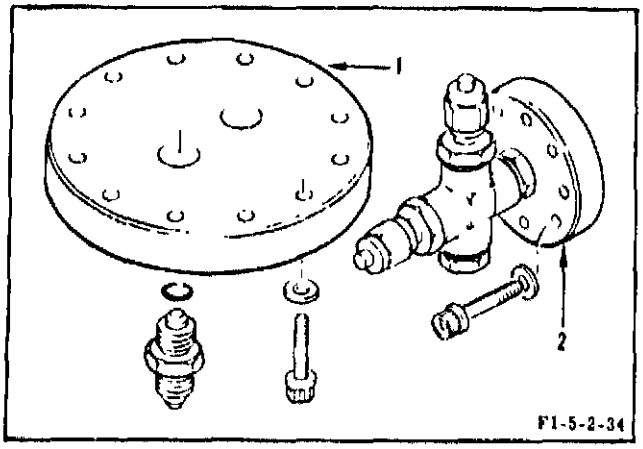
2-260. PRESSURE TEST FIXTURE T-5031167.

2-261. DESCRIPTION.

2-262. The checkout valve pressure test fixture consists of six assorted test plates, two relief valves, and fittings. The fixture set is also equipped with mounting bolts, O-rings, pressure caps, and tube assemblies. The fixture set is packaged in a container. The weight is approximately 60 pounds.

2-263. OPERATION.

2-264. The pressure test fixture is used to seal the checkout valve ports during component leak and function testing. With the fixture set installed on the valve, pneumatic pressure is applied to the valve ports through the test plates and fittings.



Index No.	Detail No.	Description
1	210	Plate
	212	Bolt
	211	Washer
	209	Union
	205	O-ring
2	202	Plate
	204	Bolt
	203	Washer
	201	Seal
	207	Cap
	209	Union
	205	O-ring
	208	Plug
	205	O-ring
	206	Cross
	209	Union
	205	O-ring
	214(a)	Container
	213(a)	Plate

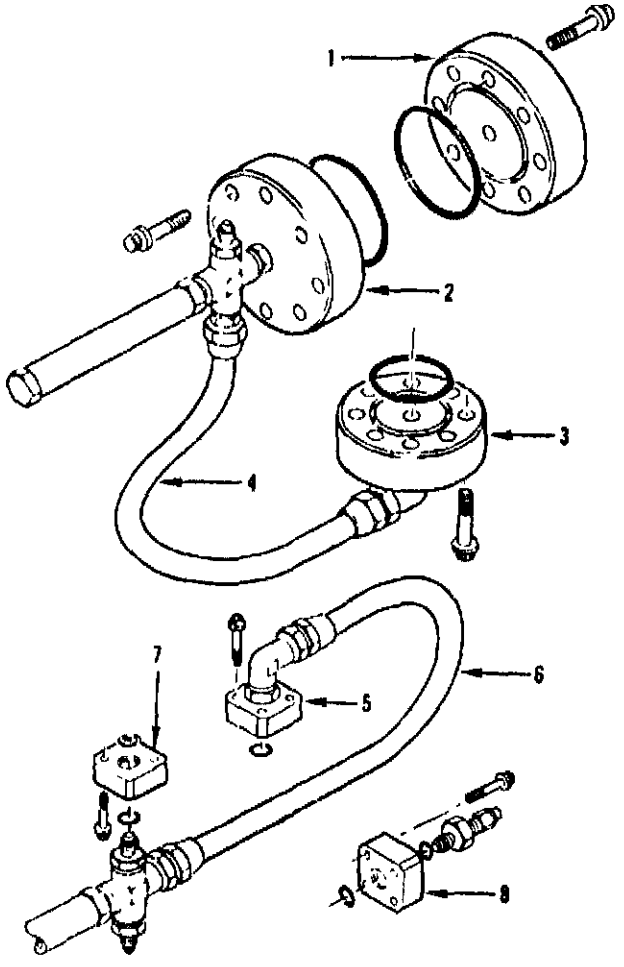
(a) Item not illustrated

Figure 2-38. Pressure Test Fixture T-5029737

2-265. MAINTENANCE.

2-266. There are no special maintenance instructions for the pressure test fixture, except for function testing. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-39 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-267. FUNCTION TESTING. The function test consists of checking the relief valves for proper operation and relief setting. Perform a function test at 6-month intervals with normal usage of tool and prior to use with limited usage of tool. Using gaseous nitrogen (MIL-P-27401), slowly increase pressure to check relief setting. The relief setting must be 1,747 (+52, -0) psig. Adjustment of the relief valve must be accomplished with no pressure applied.



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Index No.	Detail No.	Description
1	201	Plate
	204	Bolt
	205	O-ring
2	201	Plate
	204	Bolt
	205	O-ring
	208	Union
	211	O-ring
	None(a)	Relief valve
	211	O-ring
	212	Reducer
	211	O-ring
	213	Cross
	211	O-ring
	212	Reducer
	210	O-ring
3	203	Plate
	207	Bolt
	206	O-ring
	208	Union
	211	O-ring
	209	Elbow
	211	O-ring
	212	Reducer
	210	O-ring
4	218	Tube
	215	Tubing
	216	B-nut
	214	Sleeve
	217	Plug
	226(b)	Container
	225(b)	Plate
	227(b)	Plate

(a) Relief valve must be set to relieve at 1,747 psig.
(b) Item not illustrated

Figure 2-39. Pressure Test Fixture T-5031167 (Sheet 1 of 2)

Index No.	Detail No.	Description
5	202	Plate
	224	Bolt
	219	O-ring
	208	Union
	211	O-ring
	209	Elbow
	211	O-ring
	212	Reducer
	210	O-ring
6	221	Tube
	220	Tubing
	216	B-nut
	214	Sleeve
7	202	Plate
	224	Bolt
	219	O-ring
	None(a)	Relief valve
	211	O-ring
	2'	Reducer
	211	O-ring
	208	Union
	211	O-ring
	213	Cross
	211	O-ring
	212	Reducer
	210	O-ring
8	202	Plate
	224	Bolt
	219	O-ring
	222	Cap
	223	Union
	210	O-ring

(a) Relief valve must be set to relieve at 1,747 psig.

Figure 2-39. Pressure Test Fixture T-5031167 (Sheet 2 of 2)

2-268. INSPECTION CHECK FIXTURE T-5031172.

2-269. DESCRIPTION.

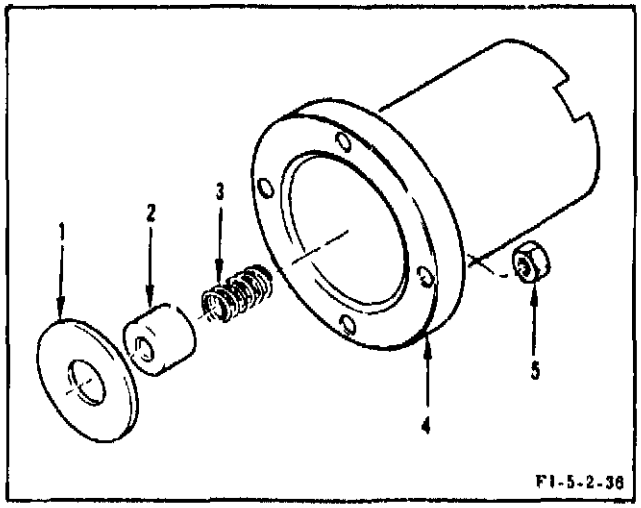
2-270. The ignition monitor valve inspection check fixture consists of a cylindrically shaped fixture with a mounting flange on one end and a retaining washer and spring-loaded seat in the other end. The fixture is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 10 pounds.

2-271. OPERATION.

2-272. The inspection check fixture is used to check the length of the ignition monitor valve cam follower rod. With the check fixture attached to the ignition monitor valve mounting flange, the spring-loaded seat depresses the cam follower rod; then the dimension from the fixture surface to the cam follower rod can be taken.

2-273. MAINTENANCE.

2-274. There are no special maintenance instructions for the inspection check fixture. Disassemble the inspection check fixture, as required, to accomplish necessary repair or replacement. See figure 2-40 for index and detail numbers. Perform repairs and clean inspection check fixture as outlined in R-3896-5, Volume I. Store inspection check fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	102	Washer
2	110	Seat
3	104	Spring
4	109	Fixture
5	101	Nut
	106(a)	Container
	111(a)	Plate
	112(a)	Plate

(a) Item not illustrated

Figure 2-40. Inspection Check Fixture T-5031172

2-275. PRESSURE TEST FIXTURE T-5031175.

2-276. DESCRIPTION.

2-277. The ignition monitor valve pressure test fixture consists of five test plates and one test fixture. The fixture set is also equipped with mounting screws, nuts, O-rings, unions, and pressure caps. The fixture set is packaged in a container that is 14 inches long, 12 inches wide, and 6 inches high. The weight is approximately 5 pounds.

2-278. OPERATION.

2-279. The pressure test fixture is used to seal the ignition monitor valve ports during component leak and function testing. With the fixture set installed on the ignition monitor valve, pneumatic and hydraulic pressure is applied to the valve ports through the test plates and fittings.

2-280. MAINTENANCE.

2-281. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-41 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

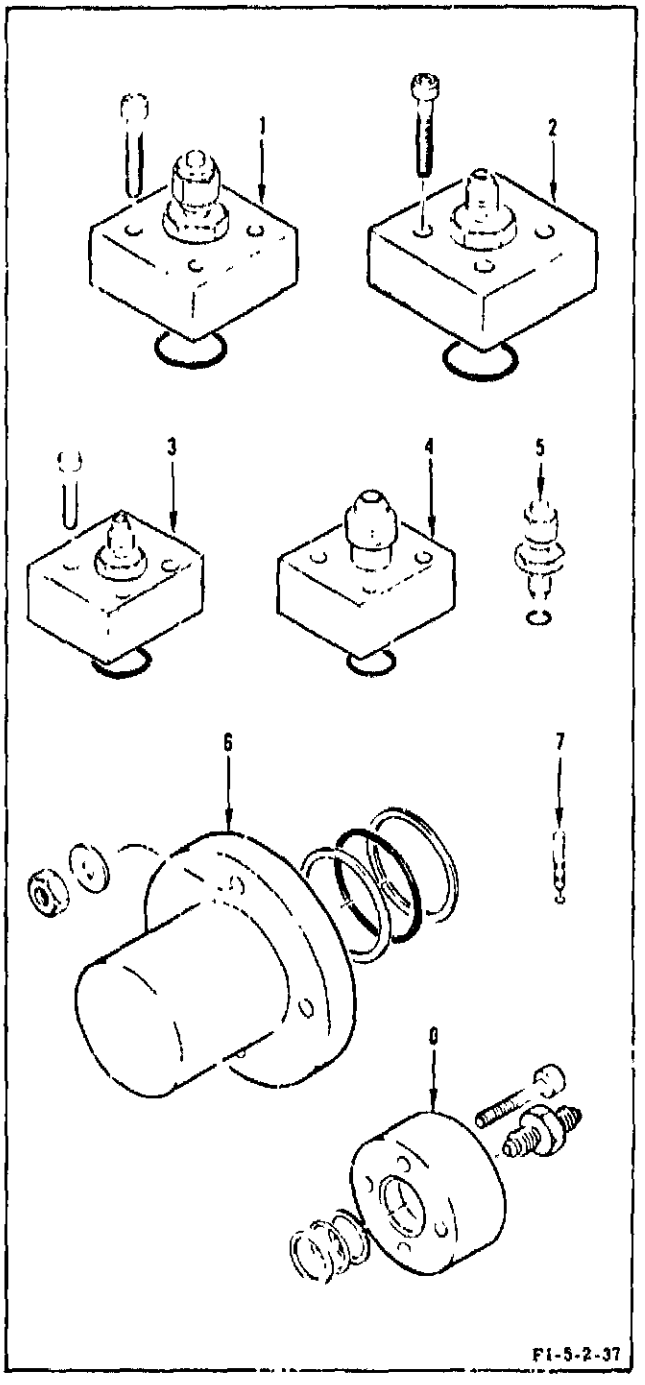
2-282. PRESSURE TEST FIXTURE T-5031188.

2-283. DESCRIPTION.

2-284. The oxidizer dome purge check valve pressure test fixture consists of a plate, fixture, mounting screws, O-rings, and unions. The fixture set is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-285. OPERATION.

2-286. The pressure test fixture is used to seal the oxidizer dome purge check valve ports during component leak and function testing. With the fixture set installed on the valve, pneumatic pressure is applied to the valve ports through the test plate, fixture, and fittings.



Index No.	Detail No.	Description
1	307	Plate
	313	Plate
	311	Screw
	308	O-ring
	321	Cap

Figure 2-41. Pressure Test Fixture T-5031175 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	320	Union
(cont)	322	O-ring
2	206	Plate
	202	Plate
	201	Screw
	205	O-ring
	207	Union
	208	O-ring
3	301	Plate
	306	Plate
	305	Screw
	302	O-ring
	303	Union
	304	O-ring
4	319	Plate
	318	Plate
	317	O-ring
5	103	Union
	109	Cap
	110	O-ring
6	104	Fixture
	108	Nut
	105	Washer
	107	Retainer
	106	O-ring
7	401	Plug
	402	Plug
	403	O-ring
8	501	Plate
	502	Screw
	504	Retainer
	505	O-ring
	503	Union
	101(a)	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-41. Pressure Test Fixture T-5031175 (Sheet 2 of 2)

2-287. MAINTENANCE.

2-288. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-42 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

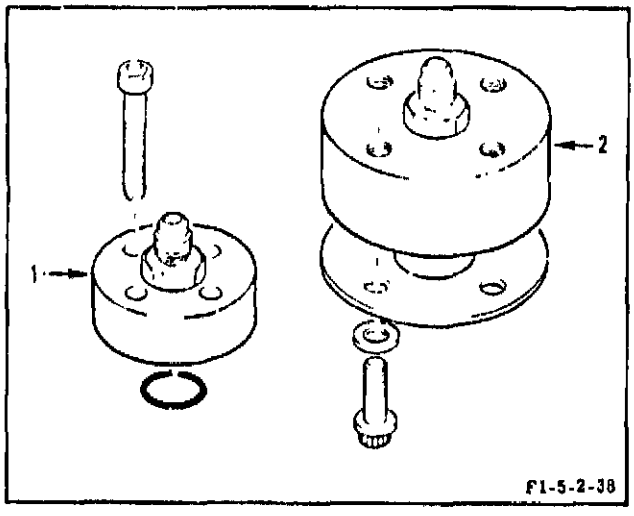
2-289. PRESSURE TEST FIXTURE T-5031700.

2-290. DESCRIPTION.

2-291. The engine control valve pressure test fixture consists of five test fixtures, mounting screws, O-rings, and pressure caps. The fixture set is packaged in a container that is 14 inches long, 12 inches wide, and 6 inches high. The weight is approximately 6 pounds.

2-292. OPERATION.

2-293. The pressure test fixture is used to seal the engine control valve ports during component leak and function testing. With the fixture set installed, hydraulic pressure is applied to the valve ports through the test fixtures and fittings.



Index No.	Detail No.	Description
1	109	Plate
	101	Screw
	119	O-ring
	113	Union
	115	O-ring
	116	O-ring
2	120	Fixture
	117	Bolt
	105	Washer
	121	Seal
	114	Union
	115	O-ring
	116	O-ring
	111(a)	Container
	112(a)	Plate

(a) Item not illustrated

Figure 2-42. Pressure Test Fixture T-5031188

2-294. MAINTENANCE.

2-295. There are no special maintenance instructions for the pressure test fixture. For replacement of parts, see figure 2-43 for index and detail numbers. Perform repairs and clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-296. PISTON ROD SIMULATOR T-5031701.

2-297. DESCRIPTION.

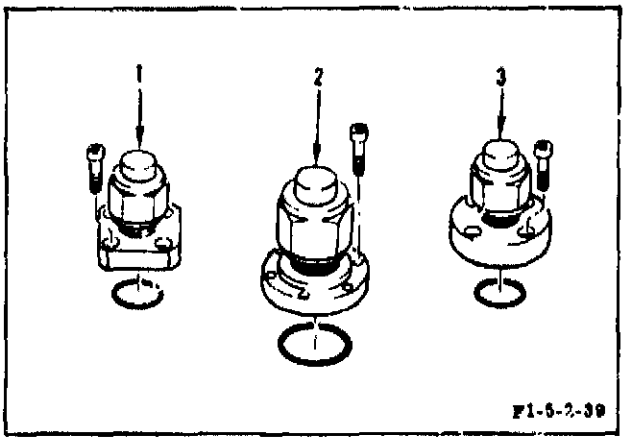
2-298. The oxidizer valve piston rod simulator consists of a long cylindrical sleeve and a solid tapered mandrel that fits in one end of the sleeve. The simulator is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 5 pounds.

2-299. OPERATION.

2-300. The piston rod simulator is used to aid in forming the oxidizer valve piston rod lip seals and also simulate the piston rod during installation of the lip seals. With the seals installed in the valve cover, the mandrel end of the simulator is pressed through the seals to form them; then the sleeve end keeps the seals formed and in place until the piston rod is installed.

2-301. MAINTENANCE.

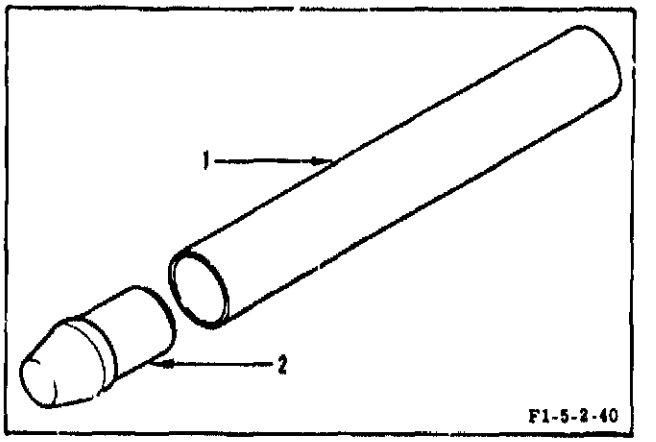
2-302. There are no special maintenance instructions for the piston rod simulator. For replacement of parts, see figure 2-44 for index and detail numbers. Perform repairs and clean piston rod simulator as outlined in R-3896-5, Volume I. Store piston rod simulator in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	302	Fixture
	203	Screw
	204	O-ring
	205	Cap
2	301	Fixture
	203	Screw
	201	O-ring
	202	Cap
3	303	Fixture
	203	Screw
	204	O-ring
	205	Cap
	206(a)	Container
	207(a)	Plate

(a) Item not illustrated

Figure 2-43. Pressure Test Fixture T-5031700



Index No.	Detail No.	Description
1	101	Sleeve
2	102	Mandrel
	104(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-44. Piston Rod Simulator T-5031701

2-303. SPRING COMPRESSOR T-5034154.

2-304. DESCRIPTION.

2-305. The fuel valve spring compressor consists of a U-shaped frame with an attach point on each leg of the frame, a threaded shaft, spring guide, and attach bolts. The compressor is packaged in a container that is 14 inches long, 12 inches wide, and 6 inches high. The weight is approximately 8 pounds.

2-306. OPERATION.

2-307. The spring compressor is used to compress the fuel valve poppet closing spring during disassembly and assembly of the valve. During valve assembly, the spring, washers, and poppet are stacked in the valve; then the compressor is attached to the outlet port with four bolts. The compressor guide engages with the poppet and the threaded shaft is used to compress the spring until the poppet retaining nut is attached.

2-308. MAINTENANCE.

2-309. There are no special maintenance instructions for the spring compressor. Disassemble the spring compressor, as required, to accomplish necessary repair or replacement. See figure 2-45 for index and part numbers. Perform repairs and clean spring compressor as outlined in R-3896-5, Volume I. Store spring compressor in container provided and overpack container for shipment.

2-310 through 2-316 deleted.

2-317. WRENCH T-5034179.

2-318. DESCRIPTION.

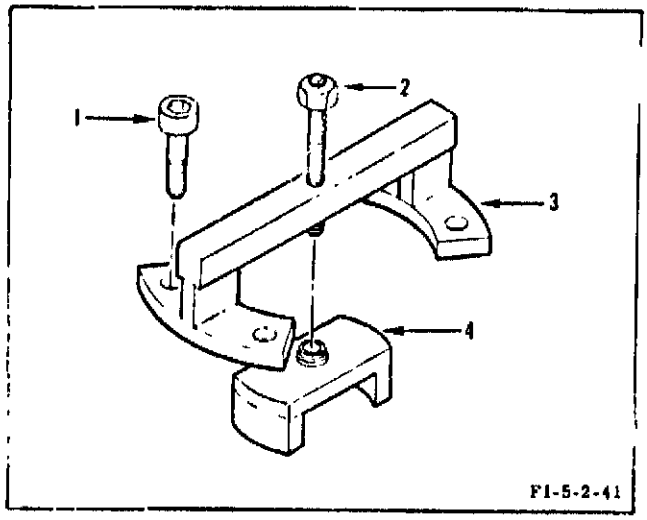
2-319. The fuel valve wrench is an offset, 1/2-inch, open-end wrench approximately 15 inches long. The wrench is packaged in a container that is 24 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2-1/2 pounds.

2-320. OPERATION.

2-321. The wrench is used to hold the fuel valve piston stationary when torquing the poppet retaining nut.

2-322. MAINTENANCE.

2-323. There are no special maintenance instructions for the wrench. For replacement of parts, see figure 2-47 for index and detail numbers. Clean wrench as outlined in R-3896-5, Volume I. Store wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	108	Screw
2	106	Screw
	107	Nut
3	102	Frame
4	101	Guide
	112(a)	Container
	113(a)	Plate

(a) Item not illustrated

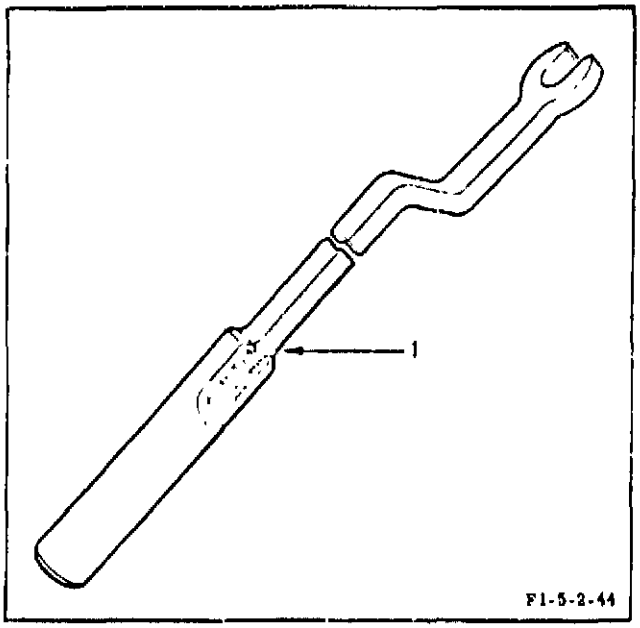
Figure 2-45. Spring Compressor T-5034154

2-324. PRESSURE TEST FIXTURE T-5034186.

2-325. DESCRIPTION.

2-326. The pressure test fixture consists of test plates, unions, bolts, O-rings, and a pressure-actuated seal packaged in a container. The circular test plate incorporates three mount holes, a 1/8-inch hole drilled through the plate, an indentation on the mating side for an O-ring, and a threaded boss on the opposite side for installation of a union. The square test plate incorporates four mount holes, a sealing surface on one side to mate with a pressure-actuated seal, and a threaded boss on the opposite side to mate with a union. Maximum pressure and the bolt torque are stamped on each of the pressure test fixtures. The function of the pressure test fixture is to seal open ports of the turbopump LOX seal purge and gas generator injector purge check valves. The test fixture is packaged in a container that is 11 inches long, 3 inches wide, and 2 inches high. The weight is approximately 5 pounds.

Figure 2-46 deleted.



Index No.	Detail No.	Description
1	101	Wrench
	104(a)	Container
	105(a)	Plate

(a) Item not illustrated

Figure 2-47. Wrench T-5034179

2-327. OPERATION.

2-328. The pressure test fixture is used to pressure-check the turbopump LOX seal purge check valve using a test media of gaseous or liquid nitrogen.

2-329. MAINTENANCE.

2-330. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-48 for index and detail numbers. Clean pressure test fixture, as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

2-331. PRESSURE TEST FIXTURE T-5034641.

2-332. DESCRIPTION.

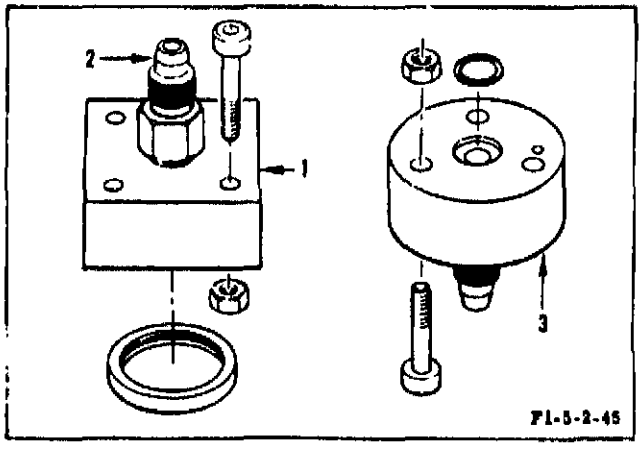
2-333. The pressure test fixture consists of test plates plugs, unions, O-rings, and attaching hardware. The function of the pressure test fixture is to seal openings of the heat exchanger check valve. The fixture is packaged in a container that is 24 inches long, 10 inches wide, and 6 inches high. The weight is approximately 18 pounds.

2-334. OPERATION.

2-335. The pressure test fixture is used to pressure-test the heat exchanger check valve.

2-336. MAINTENANCE.

2-337. There are no special maintenance instructions for the pressure test fixture. Disassemble the pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-49 for index and part numbers. Clean the pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

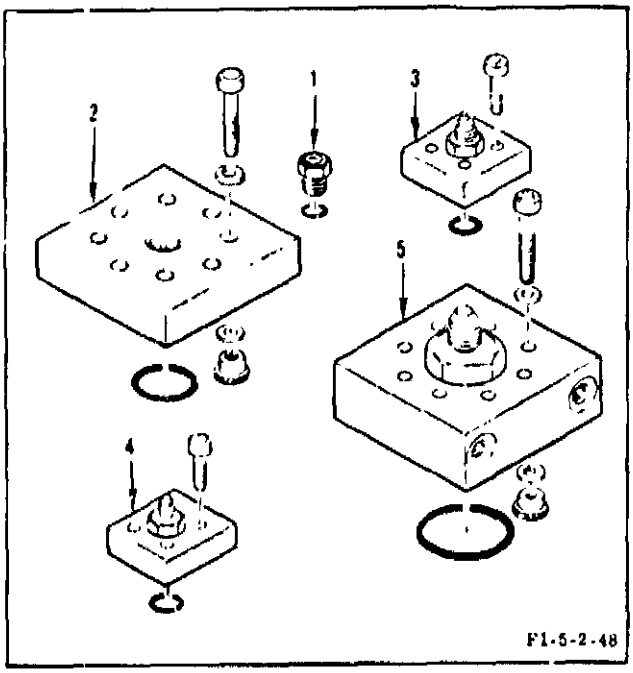


Index No.	Detail No.	Description
1	116	Test plate
	104	Nut
	105	Screw
	115	Seal
2	113	Union
	114	O-ring
3	103	Test plate
	104	Nut
	105	Screw
	106	O-ring
	109(a)	Container
	110(a)	Plate

(a) Item not illustrated

Figure 2-48. Pressure Test Fixture T-5034186

Page 2-40 deleted.



Index No.	Detail No.	Description
1	101	Plug
	102	O-ring
2	107	Plate
	106	O-ring
	103	Screw
	104	Nut
	105	Washer
3	109	Plate
	110	O-ring
	108	Screw
	112	Union
	111	O-ring
4	113	Plate
	110	O-ring
	108	Screw
	112	Union
	111	O-ring
5	117	Plate
	123	O-ring
	116	Screw
	104	Nut
	105	Washer
	118	Reducer
	119	O-ring
	120(a)	Container
	121(a)	Plate
	123(a)	Plate

(a) Item not illustrated

Figure 2-49. Pressure Test Fixture T-5034641

2-338. PRESSURE TEST FIXTURE T-5034712.

2-339. DESCRIPTION.

2-340. The pressure test fixture consists of 11 assorted test plates for the gas generator. The plates are equipped with mounting holes, O-ring grooves, and threaded ports for fittings. The fixture is packaged in a container. The function of the test plate fixture is to seal the open ports of the gas generator. The fixture is packaged in a container that is approximately 17 inches long, 17 inches wide, and 14 inches high. The weight is approximately 57 pounds.

2-341. OPERATION.

2-342. The pressure test fixture is used to seal the ports of the gas generator during component leak and function testing.

2-343. MAINTENANCE.

2-344. There are no special maintenance instructions for the pressure test fixture. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-50 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

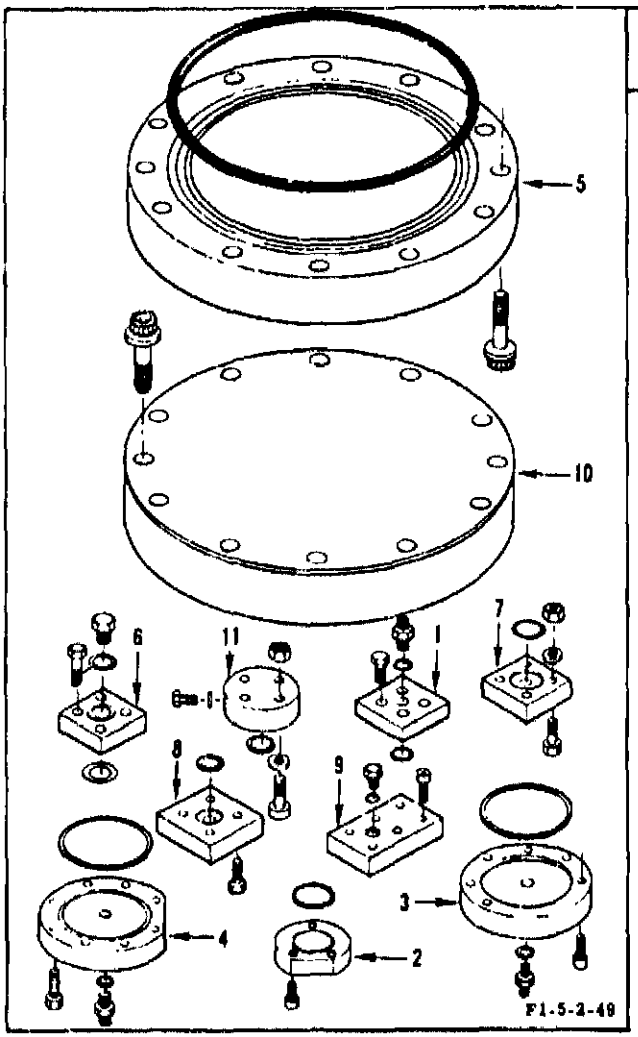
2-345. TORQUE ADAPTER T-5035210.

2-346. DESCRIPTION.

2-347. The torque adapter consists of a steel wrench end designed for use with a 3/8-inch-drive torque wrench. The adapter is packaged in a container that is approximately 6 inches long, 4 inches wide, and 2 inches high.

2-348. OPERATION.

2-349. The torque adapter is installed on a 3/8-inch-drive torque wrench to provide a method to torque a 1/2-inch-diameter retainer on the hypergol manifold.



Index No.	Detail No.	Description
1	124	Plate
	113	Union
	114	O-ring
	133	O-ring
	126	Bolt
2	201	Plate
	109	O-ring
	110	Screw
3	202	Plate
	107	O-ring
	108	Screw
	113	Union
	114	O-ring
4	204	Plate
	105	O-ring
	106	Screw
	113	Union
	114	O-ring
5	205	Plate
	128	O-ring
	131	Bolt
	132	Bolt
6	206	Plate
	122	Plug
	123	O-ring
	114	O-ring
	129	Bolt
7	207	Plate
	118	Washer
	119	Nut
	121	O-ring
	130	Bolt
8	208	Plate
	116	O-ring
	129	Bolt
9	209	Plate
	114	O-ring
	122	Plug
	123	O-ring
	129	Bolt
10	301	Plate
11	302	Plate
	303	Bolt
	304	Washer
	305	Nut
	306	O-ring
	307	O-ring
	308	Plate
	101(a)	Plate
	102(a)	Container
	127(a)	Plate

(a) Item not illustrated

Figure 2-50. Pressure Test Fixture T-5034712

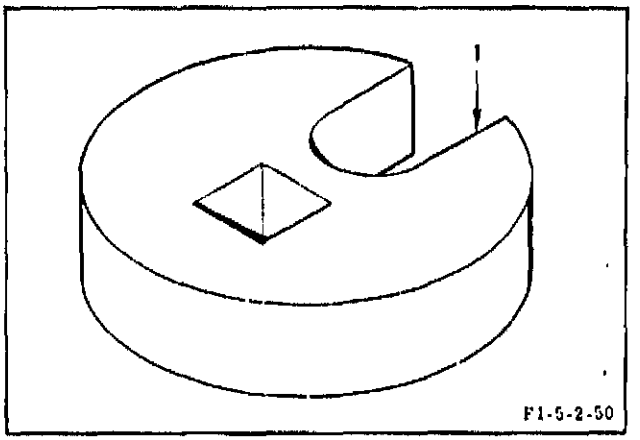
2-350. MAINTENANCE.

2-351. There are no special maintenance instructions for the torque adapter. See figure 2-51 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.

2-352. HOLDING FIXTURE T-5035218.

2-353. DESCRIPTION.

2-354. The holding fixture consists of a rectangular frame with a cutout on top that matches the gas generator ball valve oxidizer bolt, a gasket bonded to the top of the frame, and a tube. The function of the holding fixture is to hold the oxidizer ball during shaft bearing installation. The holding fixture is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 5 pounds.



Index No.	Detail No.	Description
1	104	Adapter
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

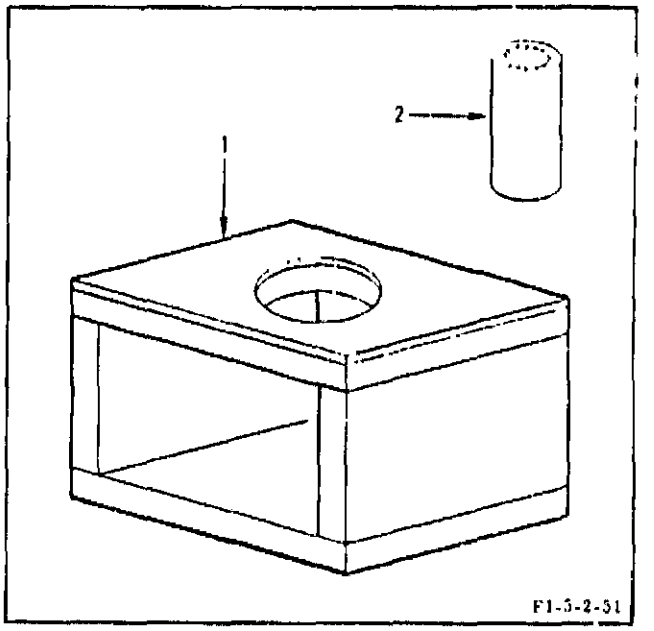
Figure 2-51. Torque Adapter T-5035210

2-355. OPERATION.

2-356. The holding fixture is used to secure the oxidizer ball in position for ball shaft bearing installation, and the tube is used to press the bearing on the shaft.

2-357. MAINTENANCE.

2-358. There are no special maintenance instructions for the holding fixture. Disassemble holding fixture, as required, to accomplish necessary repair or replacement. See figure 2-52 for index and detail numbers. Clean holding fixture as outlined in R-3896-5, Volume I. Store holding fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Holding fixture
2	108	Tube
	105(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-52. Holding Fixture T-5035218

2-359. COMPRESSOR TOOL T-5035222.

2-360. DESCRIPTION.

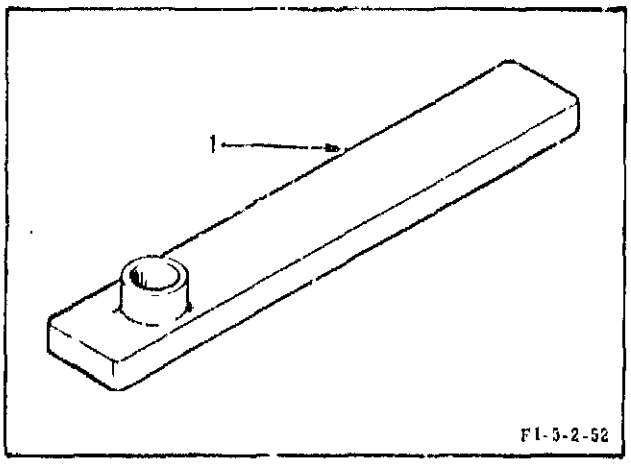
2-361. The compressor tool is a 4340 steel alloy strap that is 5 inches long, 3/4 inch wide, and 1/4 inch thick, incorporating a boss on one end. A hole is drilled through the boss and the strap. The tool is packaged in a plastic box that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-362. OPERATION.

2-363. The compressor tool is used to compress the slide in the ignition monitor valve so that the rod can be adjusted.

2-364. MAINTENANCE.

2-365. There are no special maintenance instructions for the compressor tool. See figure 2-53 for index and detail numbers. Clean compressor tool as outlined in R-3896-5, Volume I. Store compressor tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Tool
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-53. Compressor Tool T-5035222

2-366. POPPET REMOVAL TOOL T-5035223.

2-367. DESCRIPTION.

2-368. The poppet removal tool consists of a frame, threaded shaft, and cap nuts. The shaft has a toggle pad on one end and a tee handle on the opposite end. Gasket material is bonded to the toggle pad and pads of the frame. The function of the tool is to remove a poppet from the oxidizer valve. The tool is packaged in a plastic container that is 14 inches long, 12 inches wide, and 6 inches high. The weight is approximately 5 pounds.

2-369. OPERATION.

2-370. The tool is attached to the valve and the threaded shaft is rotated to press the poppet from the valve.

2-371. MAINTENANCE.

2-372. There are no special maintenance instructions for the poppet removal tool. See figure 2-54 for index and detail numbers. Clean poppet removal tool as outlined in R-3896-5, Volume I. Store poppet removal tool in container provided and overpack container for shipment.

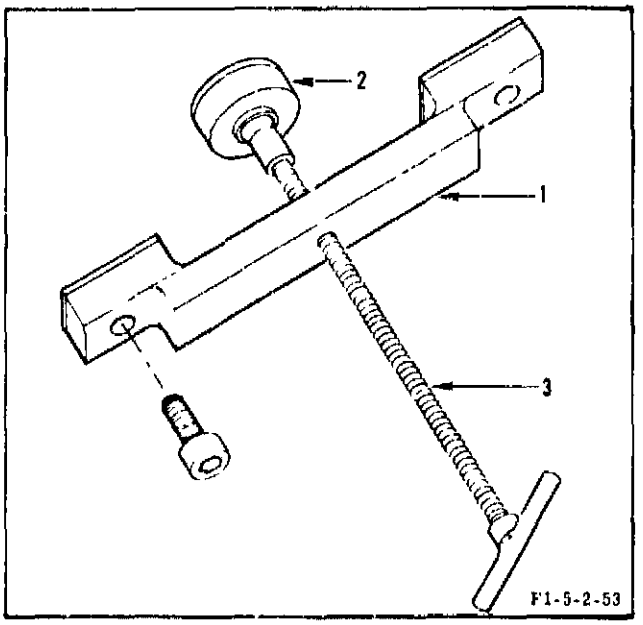
2-373. BEARING INSTALLER T-5035229.

2-374. DESCRIPTION.

2-375. The bearing installer consists of a welded two-legged frame with a bolt threaded and centered through the crossmember of the frame. A rotating pilot is attached to the end of the bolt. The attaching surfaces of the legs are cushioned. The function of the bearing installer is to install a bearing in a housing. The installer is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 3 pounds.

2-376. OPERATION.

2-377. The bearing installer is used to install a bearing in the housing of the gas generator ball valve. With the pilot engaging the bearing, the threaded shaft is rotated, forcing the bearing into place.



Index No.	Detail No.	Description
1	101	Frame
	103	Pad
	104	Screw
2	102	Pad
	108	Gasket
3	106	Screw
	105	Handle
	110(a)	Container
	111(a)	Plate

(a) Item not illustrated

Figure 2-54. Poppet Removal Tool T-5035223

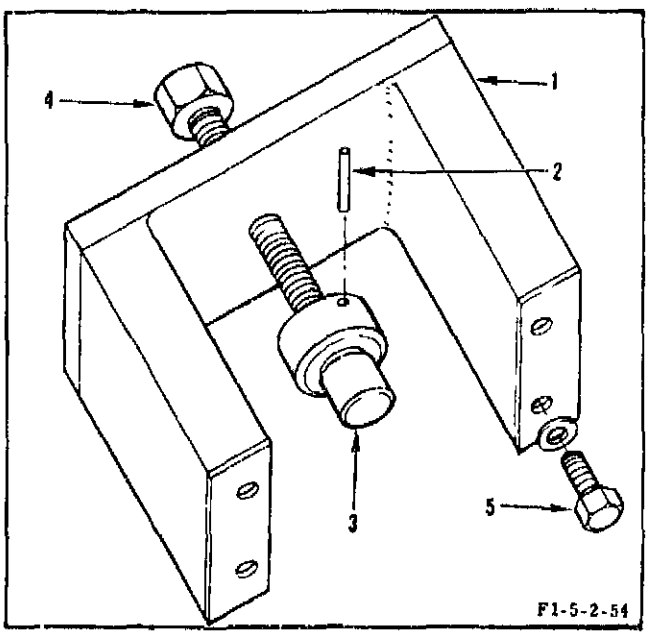
2-378. MAINTENANCE.

2-379. There are no special maintenance instructions for the bearing installer. See figure 2-55 for index and detail numbers. Clean bearing installer as outlined in R-3896-5, Volume I. Store bearing installer in container provided and overpack container for shipment.

2-380. HOLDING FIXTURE T-5035230.

2-381. DESCRIPTION.

2-382. The holding fixture consists of two rectangular facing plates separated by rods at the corners. The plates are approximately 8 inches apart. The rods are welded to the lower plates. The upper plate is attached to the rods with capscrews. The lower plate contains an adjustable screw to support the bearing area of the housing. The upper plate contains holes for bolting the housing in place. A shaft and a guide are provided with the fixture to install the bearing. The function of the holding fixture is to hold a housing for installing a bearing. The fixture is packaged in a container that is 11 inches long, 7 inches wide, and 8 inches high. The weight is approximately 12-1/2 pounds.



Index No.	Detail No.	Description
1	103	Frame
2	102	Roll pin
3	104	Pilot
4	101	Screw
5	107	Screw
	108	Washer
	109(a)	Container
	110(a)	Plate

(a) Item not illustrated

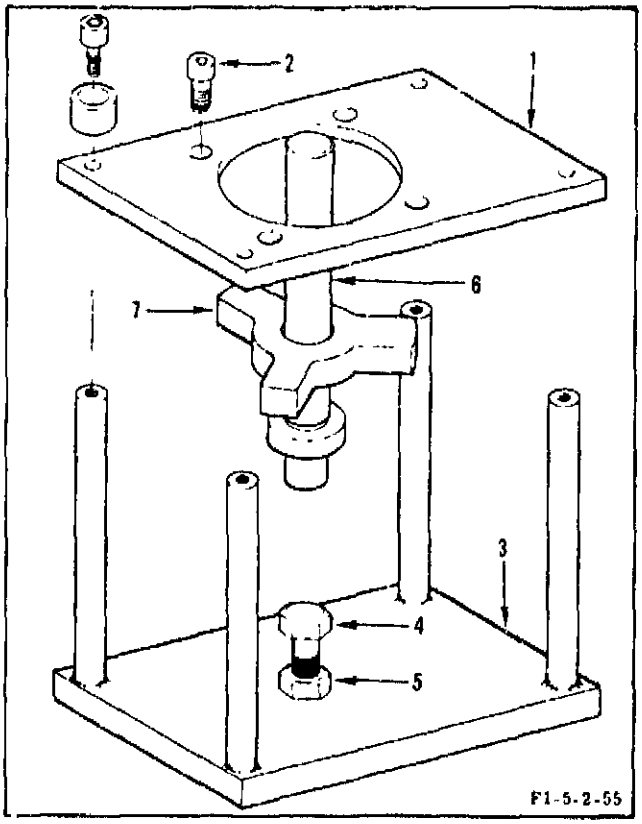
Figure 2-55. Bearing Installer T-5035229

2-383. OPERATION.

2-384. The holding fixture is used to support the gas generator ball valve oxidizer housing to press a bearing in the housing, using the bearing installation shaft and guide.

2-385. MAINTENANCE.

2-386. There are no special maintenance instructions for the holding fixture. Disassemble holding fixture, as required, to accomplish necessary repair or replacement. See figure 2-56 for index and detail numbers. Clean holding fixture as outlined in R-3896-5, Volume I. Store holding fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	102	Plate
	103	Jig foot
	107	Screw
2	104	Screw
3	113	Plate
4	111	Screw
5	112	Nut
6	105	Shaft
7	106	Guide
	114(a)	Container
	109(a)	Plate

(a) Item not illustrated

Figure 2-56. Holding Fixture T-5035230

2-387. TORQUE WRENCH (ADAPTER) T-5035233.

2-388. DESCRIPTION.

2-389. The torque wrench adapter consists of a flat, offset metal strap with two dowel pins in one end for engaging holes in a retaining nut and a square hole in the opposite end for adapting to a torque wrench. The function of the torque wrench adapter is to provide a connection between a torque wrench and a nut in the gas generator ball valve. The adapter is packaged in a container that is 11 inches long, 3 inches wide, and 2 inches high. The weight is approximately 2 pounds.

2-390. OPERATION.

2-391. The torque wrench adapter is used to torque a nut in the gas generator ball valve housing.

2-392. MAINTENANCE.

2-393. There are no special maintenance instructions for the torque wrench adapter. See figure 2-57 for index and detail numbers. Clean torque wrench adapter as outlined in R-3896-5, Volume I. Store torque wrench adapter in container provided and overpack container for shipment.

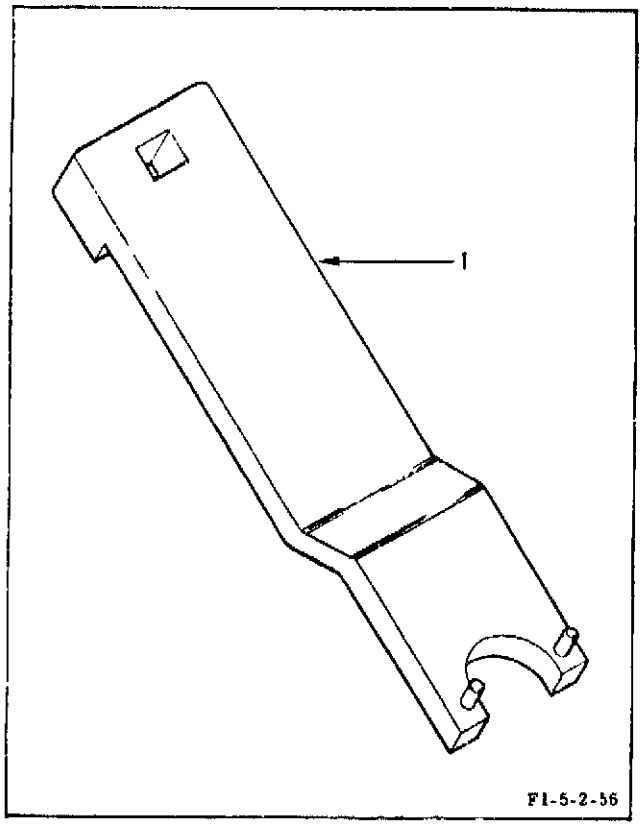
2-394. WRENCH T-5035245.

2-395. DESCRIPTION.

2-396. The wrench consists of an extra-deep standard socket with a portion of the hex wall removed. The function of the wrench is to provide a method for installing vent valves. The wrench is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-397. OPERATION.

2-398. The wrench is used with a suitable handle to install vent valves where clearances prevent the use of a regular socket.



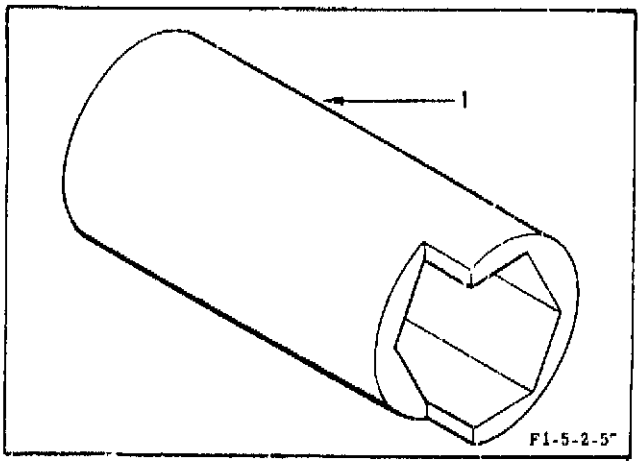
Index No.	Detail No.	Description
1	101	Adapter
	102	Pin
	103(a)	Container
	105(a)	Plate

(a) Item not illustrated

Figure 2-57. Torque Wrench (Adapter) T-5035233

2-399. MAINTENANCE.

2-400. There are no special maintenance instructions for the wrench. See figure 2-58 for index and detail numbers. Clean wrench as outlined in R-3896-5, Volume I. Store wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Wrench
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-58. Wrench T-5035245

2-401. TORQUE WRENCH T-5035248.

2-402. DESCRIPTION.

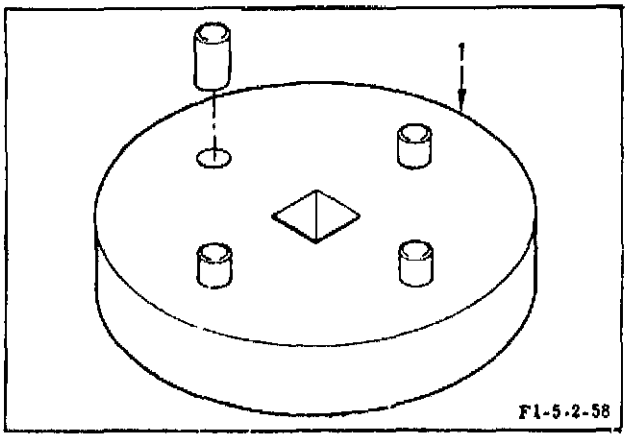
2-403. The torque wrench consists of a disc with a square hole in the center and protruding pins on either side. The function of the torque wrench is to provide a method for installing an externally threaded nut. The torque wrench is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-404. OPERATION.

2-405. The torque wrench is used with a suitable handle to install an externally threaded nut in the gas generator ball valve oxidizer housing.

2-406. MAINTENANCE.

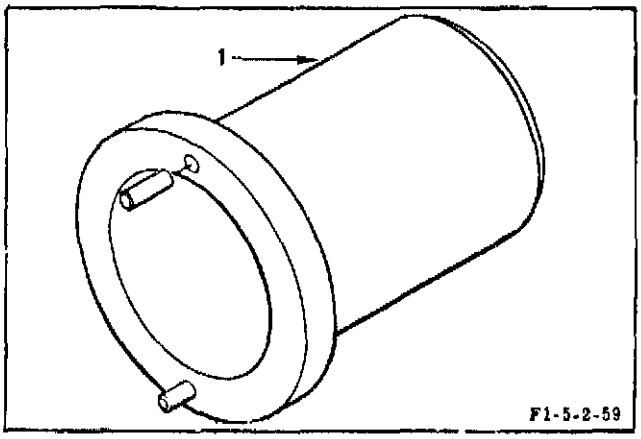
2-407. There are no special maintenance instructions for the torque wrench. See figure 2-59 for index and detail numbers. Clean torque wrench as outlined in R-3896-5, Volume I. Store torque wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Wrench
	102	Pin
	103(a)	Container
	105(a)	Plate

(a) Item not illustrated

Figure 2-59. Torque Wrench T-5035248



Index No.	Detail No.	Description
1	101	Wrench
	102	Pin
	103(a)	Container
	105(a)	Plate

(a) Item not illustrated.

Figure 2-60. Spanner Wrench T-5035249

2-408. SPANNER WRENCH T-5035249.

2-409. DESCRIPTION.

2-410. The spanner wrench consists of a cylinder with one closed end and an external flange on the open end. A square hole is incorporated in the center of the closed end and two dowel pins extend from the surface of the flange at the open end. The function of the spanner wrench is to provide a method for removing and installing an externally threaded retainer. The wrench is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-411. OPERATION.

2-412. The spanner wrench is used to remove or install an externally threaded retainer in the gas generator ball valve fuel housing.

2-413. MAINTENANCE.

2-414. There are no special maintenance instructions for the spanner wrench. See figure 2-60 for index and detail numbers. Clean spanner wrench as outlined in R-3896-5, Volume I. Store spanner wrench in container provided and overpack container for shipment.

2-415. PRESSURE TEST FIXTURE T-5035571.

2-416. DESCRIPTION.

2-417. The pressure test fixture consists of a single pressure test plate with a raised center, bolts for installing the fixture, two ports for pressurizing and monitoring, and a relief valve. Two handles are welded to the outer surface. The fixture is approximately 20 inches in diameter and 2 inches thick. The function of the test plate is to provide a method for closing off the turbopump oxidizer inlet. The fixture is packaged in a container that is 22 inches long, 22 inches wide, and 6 inches high. The weight is approximately 50 pounds.

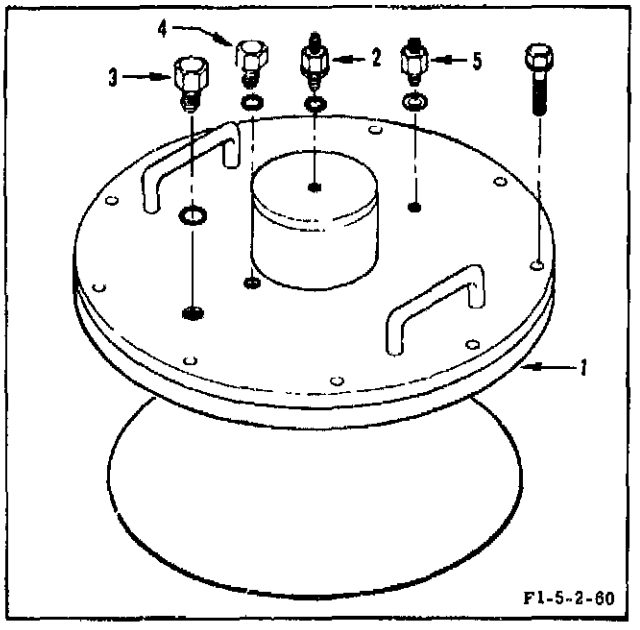
2-418. OPERATION.

2-419. The pressure test fixture is used to perform pressure tests on the propellant feed (oxidizer) system of the engine.

2-420. MAINTENANCE.

2-421. There are no special maintenance instructions for the pressure test fixture. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-61 for index and detail numbers. Clean pressure test fixture as outlined in

R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
	107	Bolt
	110	O-ring
2	103	Union
	102	O-ring
3	111	Plug
	112	O-ring
4	113	Plug
	114	O-ring
5	118	Valve
	114	O-ring
	116(a)	Container
	117(a)	Plate

(a) Item not illustrated

Figure 2-61. Pressure Test Fixture T-5035571

2-422. PRESSURE TEST FIXTURE T-5035912.

2-423. DESCRIPTION.

2-424. The pressure test fixture consists of test plates, unions, O-rings, and attaching hardware. The function of the pressure test fixture is to seal ports of the bearing coolant control valve and the flanged feed tube. The fixture is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 5 pounds.

2-425. OPERATION.

2-426. The pressure test fixture is used to seal ports while pressure testing of the turbopump bearing coolant control valve and the valve to No. 1 and No. 2 bearing lube feed tubes.

2-427. MAINTENANCE.

2-428. There are no special maintenance instructions for the pressure test fixture. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-62 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

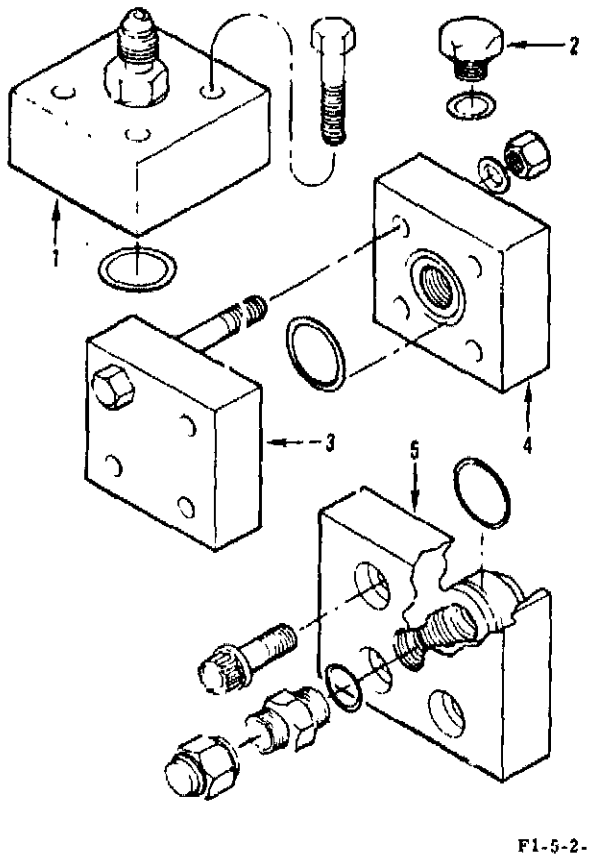
2-429. INDUCER PULLER T-5035933.

2-430. DESCRIPTION.

2-431. The inducer puller is an adjustable, expanding tool consisting of a housing, threaded shaft, collets, guides, and pad. The function of the inducer puller is to provide a method for separating closely fitting parts. The inducer puller is packaged in a container that is 16 inches long, 5 inches wide, and 5 inches high. The weight is approximately 15 pounds.

2-432. OPERATION.

2-433. The inducer puller is used to remove the turbopump oxidizer inducer from the turbopump shaft. The inducer puller is inserted in the internally flared end of the inducer and adjusted to expand to the contour of the flare. The end of the puller bottoms against the internal end of the hollow turbopump shaft. Rotating the threaded shaft of the puller exerts force against the shaft and the inducer, pulling the inducer from the shaft.



Index No.	Detail No.	Description
1	110	Plate
	105	O-ring
	109	Bolt
	107	Union
	108	O-ring
2	106	Plug
	108	O-ring
3	104	Plate
	105	O-ring
4	113	Plate
	105	O-ring
	115	Washer
	114	Bolt
	102	Nut
	107	Union
	108	O-ring
5	118	Plate
	119	Bolt
	108	O-ring
	107	Union
	117	Cap
	116	O-ring
	103(a)	Container
	120(a)	Plate
	121(a)	Plate

(a) Item not illustrated

Figure 2-62. Pressure Test Fixture T-5035912

2-434. MAINTENANCE.

2-435. There are no special maintenance instructions for the inducer puller. Disassemble inducer puller, as required, to accomplish necessary repair or replacement. See figure 2-63 for index and detail numbers. Clean, and apply dry-film lubricant RB0140-007 (Rocketdyne) to all working surfaces of inducer puller as outlined in R-3896-5, Volume I. Store inducer puller in container provided and overpack container for shipment.

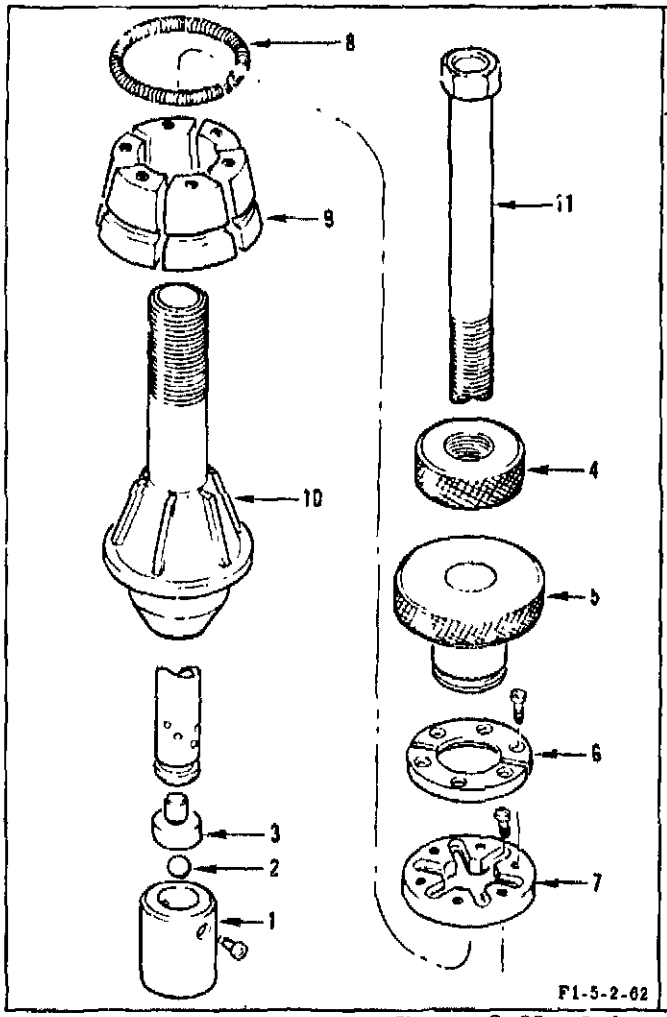
2-436. IMPELLER COUPLING PULLER T-5035934.

2-437. DESCRIPTION.

2-438. The impeller coupling puller consists of a housing, threaded shaft, puller tips, and cap. The function of the impeller coupling puller is to separate a closely fit part from a shaft. The tool is packed in a container that is 28 inches long, 7 inches wide, and 8 inches high. The weight is approximately 75 pounds.

2-439. OPERATION.

2-440. The impeller coupling puller is used to pull the turbopump LOX impeller coupling from the turbopump shaft. The tool is installed with the puller tips following the bayonet slot of the coupling. The tool is then rotated clockwise so that the puller tips engage the flange of the coupling. The shaft is rotated by hand to secure the tool in place and an impact wrench is used to further rotate the shaft to pull the coupling from the shaft.



Index No.	Detail No.	Description
1	205	Pad
	104	Screw
2	105	Ball
3	204	Jig foot
4	208	Knurl nut
5	207	Collar
6	301	Retainer
	109	Screw
7	302	Guide
	102	Screw
8	103	Spring
9	303	Collet
10	401	Housing
	111	Key
11	201	Shaft
	108(a)	Container
	107(a)	Plate
	112(a)	Plate

(a) Item not illustrated

Figure 2-63. Inducer Puller T-5035933

2-441. MAINTENANCE.

2-442. There are no special maintenance instructions for the impeller coupling puller. Disassemble the impeller coupling puller, as required, to accomplish necessary repair or replacement. See figure 2-64 for index and detail numbers. Clean impeller coupling puller as outlined in R-3896-5, Volume I. Store impeller coupling puller in container provided and overpack container for shipment.

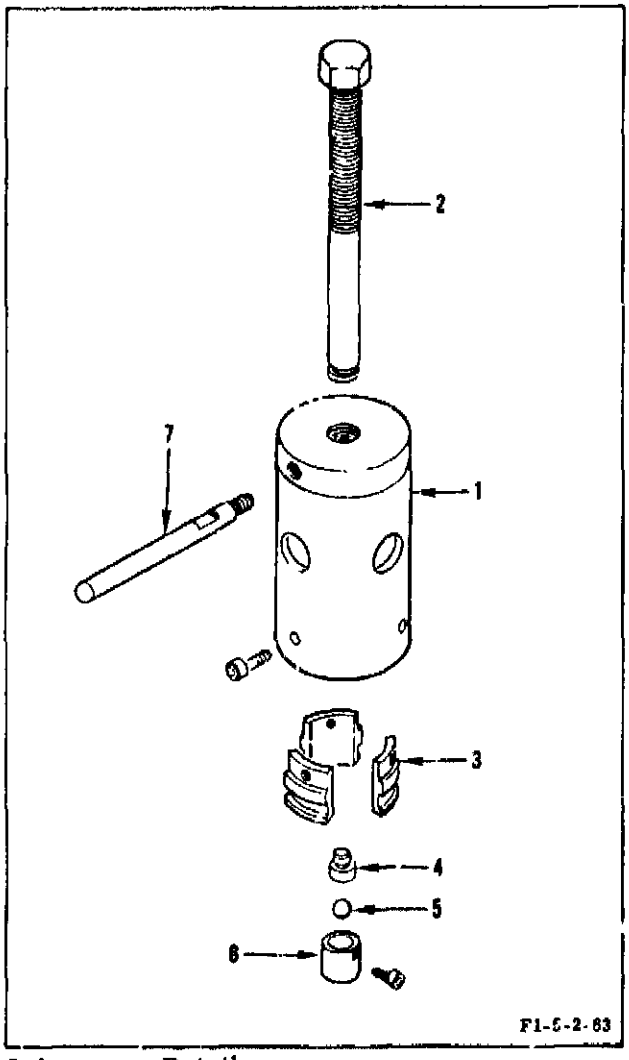
2-443. LOX INDUCER CAP PULLER T-5035937.

2-444. DESCRIPTION.

2-445. The LOX inducer cap puller consists of a frame and an expandable pulling tool. The function of the LOX inducer cap puller is to separate a closely fit cap from a bolt. The tool is packed in a container that is 24 inches long, 12 inches wide, and 6 inches high. The weight is approximately 17 pounds.

2-446. OPERATION.

2-447. The LOX inducer cap puller is used to remove the fairing cap from the bolt in the end of the turbopump shaft. The frame of the tool is installed across the LOX inlet, and the pulling tool is inserted into the opening in the cap. The tool is expanded until the tips engage the internal surface of the cap. The adjustable nut on the externally threaded surface of the puller is then rotated against the frame, backing off the puller and removing the cap.



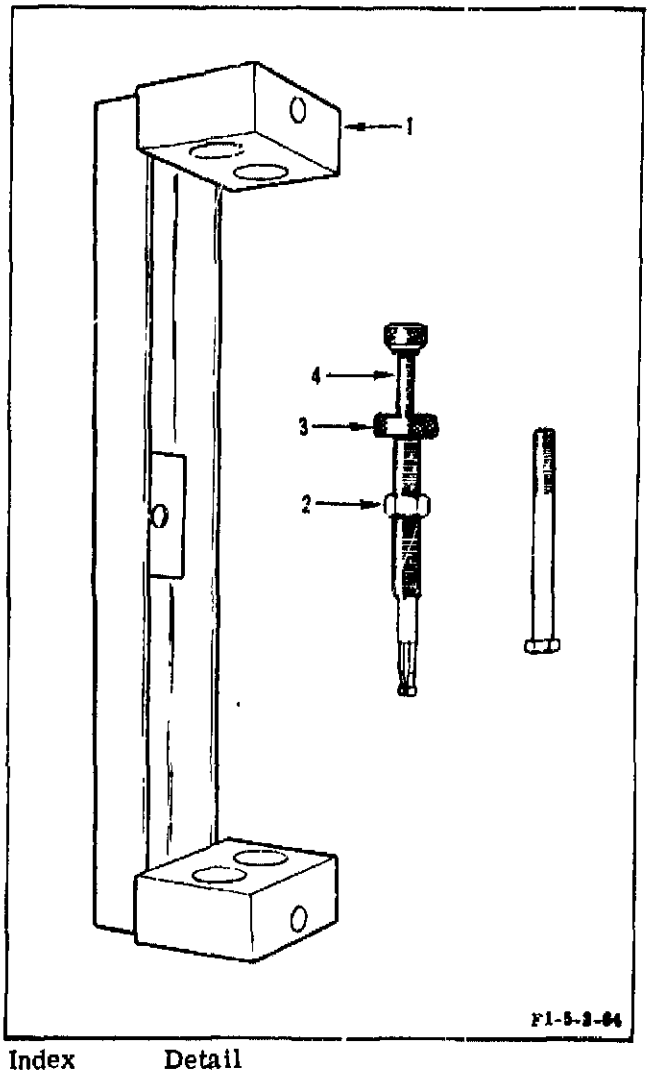
Index No.	Detail No.	Description
1	201	Housing
	103	Screw
2	204	Shaft
3	403	Puller tip
4	302	Jig foot
5	102	Ball
6	207	Cap
	101	Screw
7	205	Bar
	107(a)	Container
	106(a)	Plate

(a) Item not illustrated

Figure 2-64. Impeller Coupling Puller T-5035934

2-448. MAINTENANCE.

2-449. There are no special maintenance instructions for the LOX inducer cap puller. Disassemble the LOX inducer cap puller, as required, to accomplish necessary repair or replacement. See figure 2-65 for index and detail numbers. Clean LOX inducer cap puller as outlined in R-3896-5, Volume I. Store LOX inducer cap puller in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	109	Frame
	112	Screw
2	101	Barrel
3	102	Nut
4	104	Expander
	106(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-65. LOX Inducer Cap Puller T-5035937

2-450. ADAPTER T-5035940.

2-451. This tool is identical (except for length) to torque and inspection tool T-5029467 described in paragraph 2-202.

2-452. ADAPTER T-5035941.

2-453. DESCRIPTION.

2-454. The adapter consists of a circular frame and a pilot. The function of the adapter is to provide an attach point for a hydraulic torque wrench when the engine interface panel is installed. The adapter is packaged in a container that is 24 inches long, 24 inches wide, and 12 inches high. The weight is approximately 60 pounds.

2-455. OPERATION.

2-456. The adapter is used to support the hydraulic torque wrench when the engine interface panel is installed. The adapter is used in conjunction with other tools at the turbopump LOX inlet to torque the inducer bolt.

2-457. MAINTENANCE.

2-458. There are no special maintenance instructions for the adapter. Disassemble adapter, as required, to accomplish necessary repair or replacement. See figure 2-66 for index and detail numbers. Clean adapter as outlined in R-3896-5, Volume I. Store adapter in container provided and overpack container for shipment.

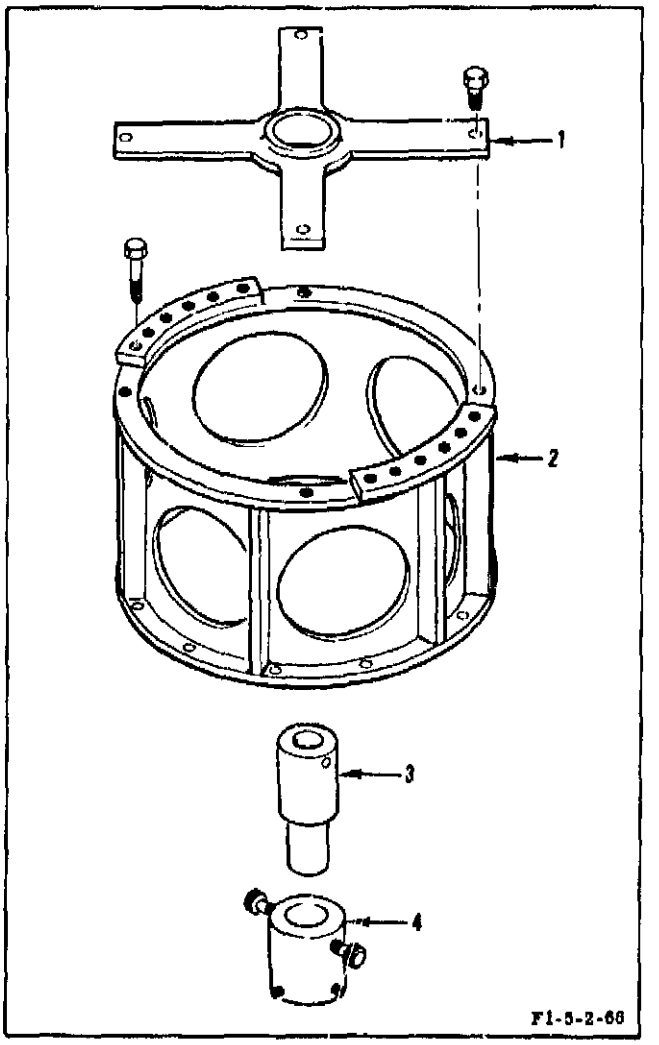
2-459. SPACER T-5036700.

2-460. DESCRIPTION.

2-461. The spacer consists of a flat Micarta bar. A rounded recess is incorporated in one end of the bar. The function of the spacer is to provide a method for holding parts in place during component assembly. The spacer is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 8 ounces.

2-462. OPERATION.

2-463. The spacer is used to hold the oxidizer ball of the gas generator ball valve in place so that washers can be installed. The recess in the end of the spacer fits over the ball shaft.



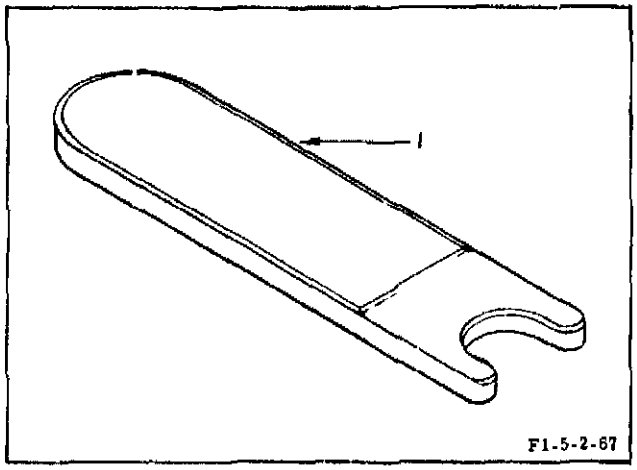
Index No.	Detail No.	Description
1	201	Support
	101	Screw
	103	Screw
2	301	Ring
3	205	Adapter
4	206	Adapter
	102	Screw
	207	Screw
	105(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-66. Adapter T-5035941

2-464. MAINTENANCE.

2-465. There are no special maintenance instructions for the spacer. See figure 2-67 for index and detail numbers. Clean spacer as outlined in R-3896-5, Volume I. Store spacer in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Spacer
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-67. Spacer T-5036700

2-466. ASSEMBLY TOOL T-5036718.

2-467. DESCRIPTION.

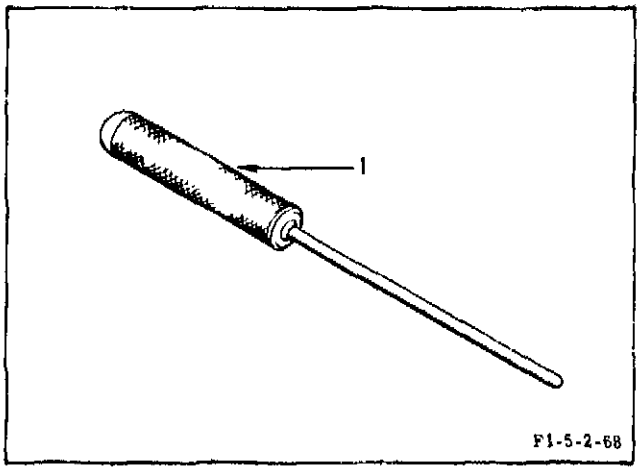
2-468. The tool consists of a 5/8-inch diameter rod with a knurled handle. The tool is 10 inches long. The function of the assembly tool is to provide a means of installing a hydraulic filter. The tool is packaged in a container that is 11 inches long, 3 inches wide, and 2 inches high. The weight is approximately one pound.

2-469. OPERATION.

2-470. The assembly tool is used to install a filter in the control body of the hydraulic control valve. The tool is inserted in the center of the filter.

2-471. MAINTENANCE.

2-472. There are no special maintenance instructions for the assembly tool. See figure 2-68 for index and detail numbers. Clean assembly tool as outlined in R-3896-5, Volume I. Store assembly tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Assembly tool
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-68. Assembly Tool T-5036718

2-473. PRESSURE TEST FIXTURE T-5036722.

2-474. DESCRIPTION.

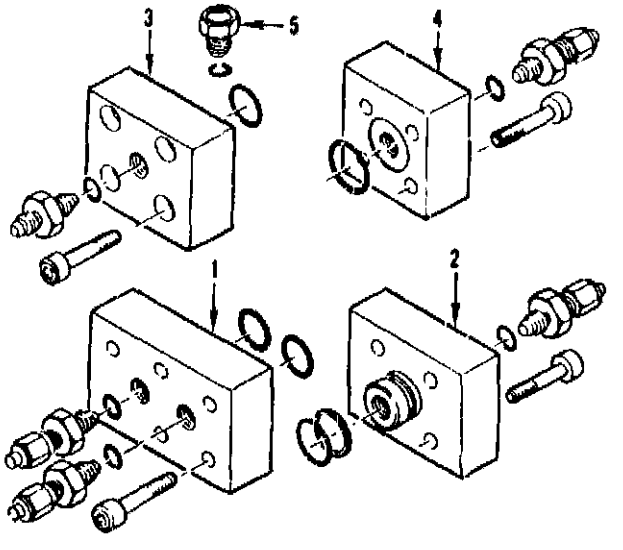
2-475. The pressure test fixture consists of four test plates, fittings, and attaching hardware. The function of the pressure test fixture is to provide a method of sealing component ports during pressure testing. The fixture is packed in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately 5 pounds.

2-476. OPERATION.

2-477. The pressure test fixture test plates and plug are used to seal ports of the bearing coolant control valve body. The plates are installed with bolts. The fittings in the plates are used to supply and monitor pressures.

2-478. MAINTENANCE.

2-479. There are no special maintenance instructions for the pressure test fixture. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-69 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
	109	O-ring
	120	Union
	122	O-ring
1 (cont)	121	Cap
	104	Screw
2	102	Plate
	110	O-ring
	111	Ring
	120	Union
	122	O-ring
	121	Cap
	123	Screw
3	103	Plate
	112	O-ring
	120	Union
	122	O-ring
	123	Screw
4	113	Plate
	114	O-ring
	123	Screw
	120	Union
	122	O-ring
	121	Cap
5	115	Plug
	106	O-ring
	124(a)	Container
	117(a)	Plate
	118(a)	Plate

(a) Item not illustrated

Figure 2-69. Pressure Test Fixture T-5036722

2-480. SEAL FORMING TOOL T-5036723.

2-481. DESCRIPTION.

2-482. The seal forming tool consists of a mandrel, a forming block, cup, and nose. The function of the tool is to form and install seals. The tool is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 10 pounds.

2-483. OPERATION.

2-484. The seal forming tool is used for forming and installing seals during assembly of the oxidizer valve. The seals are installed on the forming nose and formed by the forming block and cup.

2-485. MAINTENANCE.

2-486. There are no special maintenance instructions for the seal forming tool. Disassemble tool, as required, to accomplish necessary repair or replacement. See figure 2-70 for index and detail numbers. Clean tool as outlined in R-3896-5, Volume I. Store tool in container provided and overpack container for shipment.

2-487. SPECIAL SOCKET WRENCH T-5036724.

2-488. DESCRIPTION.

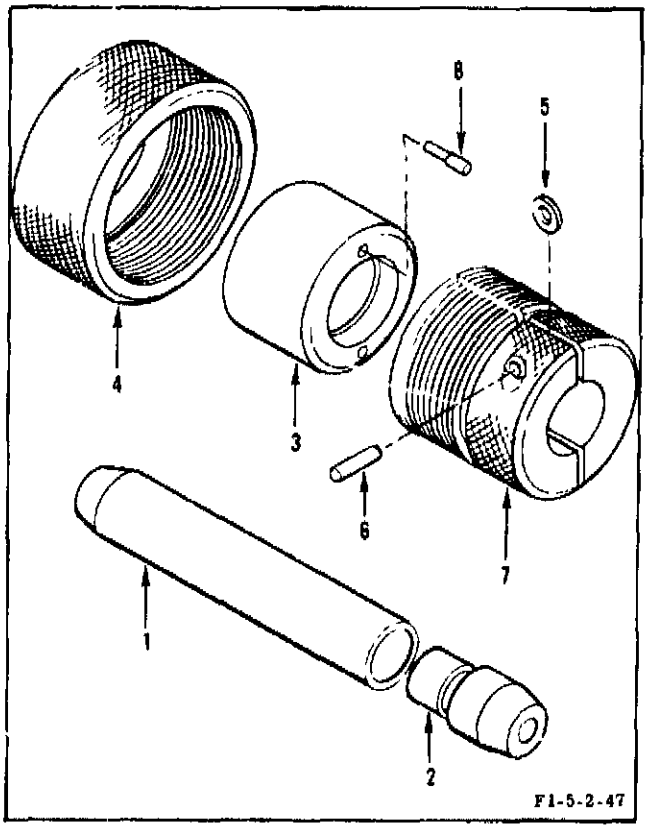
2-489. The special socket wrench consists of a 3/8-inch drive socket shortened to 1/2 inch in depth and a Teflon washer. The function of the socket wrench and washer is to provide a method of torquing a bolt and protect the adjacent surface from tool damage. The socket wrench is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 4 ounces.

2-490. OPERATION.

2-491. The special socket wrench is used to torque the component handling bolts installed in the oxidizer valve body. The Teflon washer is used between the socket and the valve body to prevent damaging the surface finish.

2-492. MAINTENANCE.

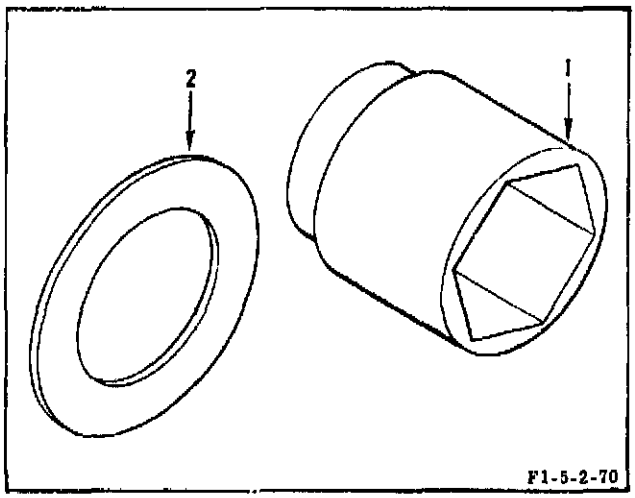
2-493. There are no special maintenance instructions for the special socket wrench. See figure 2-71 for index and detail numbers. Clean socket wrench as outlined in R-3896-5, Volume I. Store socket wrench in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	401	Mandrel
2	402	Forming nose
3	403	Forming block
4	404	Holding fixture
5	405	Spacer
6	406	Pin
7	407	Forming cup
8	408	Alinement pin
	302(a)	Container
	301(a)	Plate

(a) Item not illustrated

Figure 2-70. Seal Forming Toool T-5036723



Index No.	Detail No.	Description
1	102	Socket
2	101	Teflon washer
	103(a)	Container
	104(a)	Plate

(a) Item not illustrated

Figure 2-71. Special Socket Wrench T-5036724

2-494. CHECK JIG T-5036725.

2-495. DESCRIPTION.

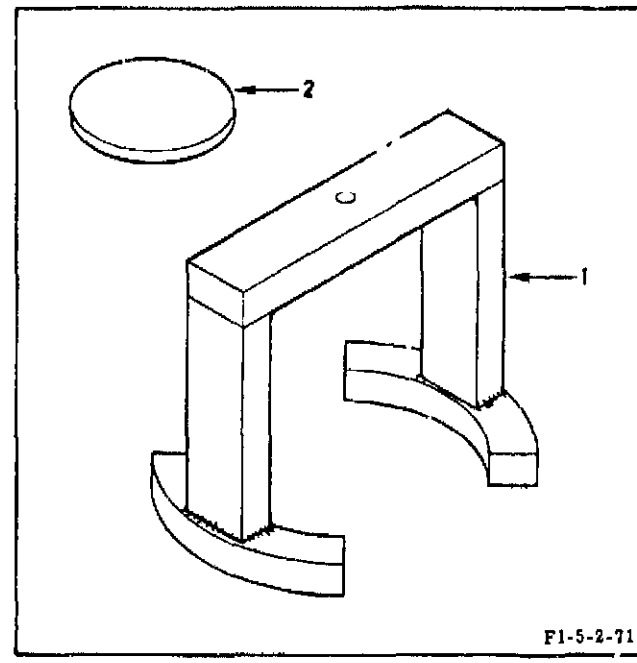
2-496. The check jig consists of a welded frame and a flat, round plate. The function of the check jig is to provide a method for determining the thickness of shims. The check jig is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 2-1/2 pounds.

2-497. OPERATION.

2-498. The check jig is used to determine the thickness of shims for the gas generator ball valve fuel bellows. The plate is installed on the end of the fuel bellows and the frame seated against the housing. A depth micrometer is used to measure through a hole in the frame to the surface of the plate.

2-499. MAINTENANCE.

2-500. There are no special maintenance instructions for the check jig except for a flatness and dimensional check at 6-month intervals. See figure 2-72 for index and detail numbers. The overall dimension of frame (1) must be parallel within 0.002 inch total. The thickness of plate (2) must be flat and parallel within 0.001 inch total. Clean check jig as outlined in R-3896-5, Volume I. Store check jig in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	107	Frame
2	112	Plate
	105(a)	Container
	111(a)	Plate

(a) Item not illustrated

Figure 2-72. Check Jig T-5036725

2-501. ASSEMBLY JIG T-5036746.

2-502. DESCRIPTION.

2-503. The assembly jig consists of an aajustable holding fixture and a plate. The function of the assembly jig is to provide an adjustable base for assembling component parts. The assembly jig is packaged in a container that is 13 inches long, 13 inches wide, and 10 inches high. The weight is approximately 21 pounds.

2-504. OPERATION.

2-505. The assembly jig is used to hold the gas generator ball valve actuator housing and the gas generator ball valve during assembly. The housing is bolted to the plate of the assembly jig.

2-506. MAINTENANCE.

2-507. There are not special maintenance instructions for the assembly jig. See figure 2-73 for index and detail numbers. Clean assembly jig as outlined in R-3896-5, Volume I. Store assembly jig in container provided and overpack container for shipment.

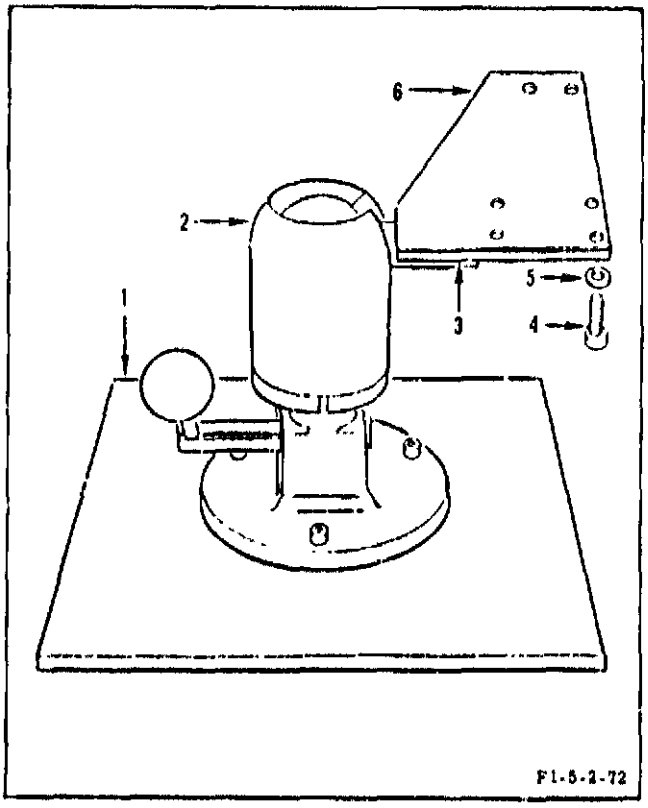
2-508. ASSEMBLY JIG AND INSPECTION CHECK FIXTURE T-5037452.

2-509. DESCRIPTION.

2-510. The assembly jig and inspection fixture consists of a hand wheel, adjustable arm, and two dial indicators. The function of the fixture is to obtain measurements for positioning the gimbal bearing. The assembly jig and inspection check fixture are packaged in a container that is 32 inches long, 30 inches wide, and 11 inches high. The weight is approximately 60 pounds.

2-511. OPERATION.

2-512. The assembly jig and inspection check fixture are used to determine the adjustments required to locate the gimbal bearing centerline in line with the engine centerline. In addition, the fixture is used to parallel the gimbal bearing interface with the injector. The fixture is attached to a tool that is fastened to the gimbal bearing. The fixture wheel and arm are rotated to obtain measurements to the outer surface of four fixed points on the perimeter of the injector. The gimbal bearing is then adjusted on the applicable axis to center it with the engine centerline. The dial indicator is then relocated on the fixture, and the wheel and arm are rotated to the forward surface of the four points; then necessary adjustments are performed to the holding fixtures to parallel the interface of the gimbal bearing with the face of the thrust chamber injector.



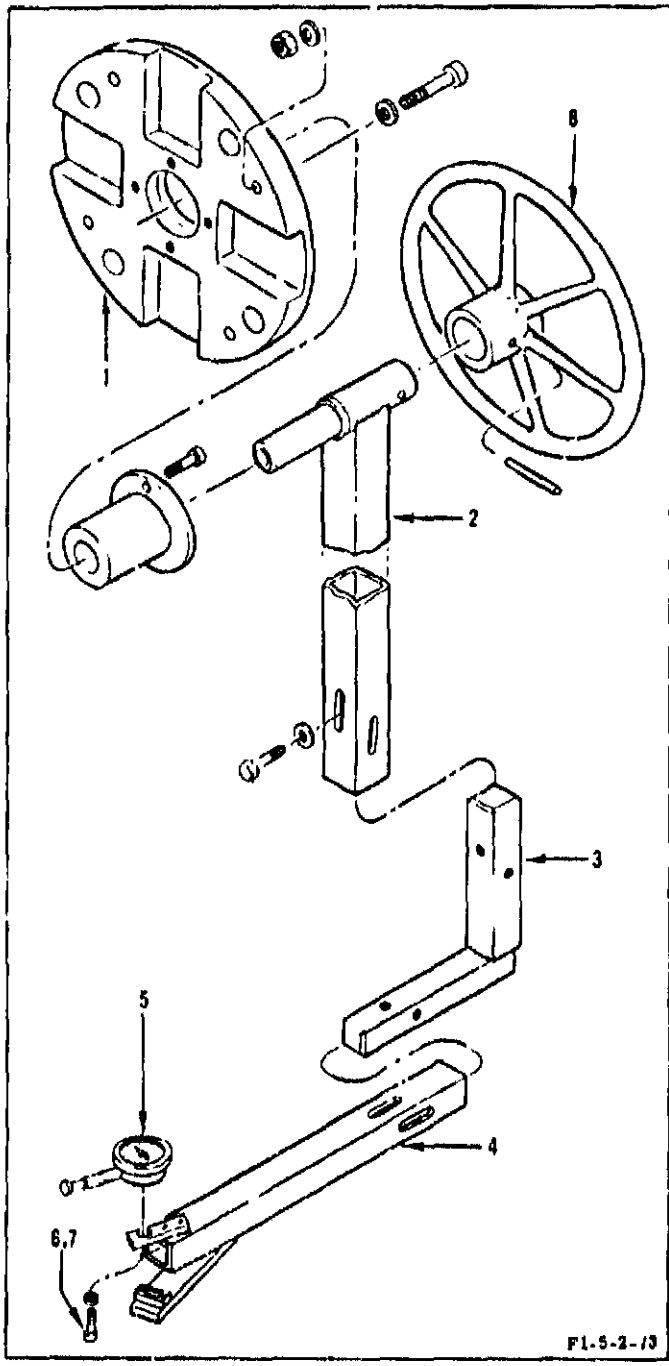
Index No.	Detail No.	Description
1	106	Plate
2	105	Mechanical arm
3	102	Plate
4	107	Screw
5	108	Washer
6	101	Gasket
	110(a)	Container
	109(a)	Plate

(a) Item not illustrated

Figure 2-73. Assembly Jig T-5036746

2-513. MAINTENANCE.

2-514. There are no special maintenance instructions for the assembly jig and inspection check fixture, except for servicing. Disassemble assembly jig and inspection check fixture, as required, to accomplish necessary repair or replacement. See figure 2-74 for index and detail numbers. Clean assembly jig and inspection check fixture as outlined in R-3896-5, Volume I. Store assembly jig and inspection check fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	133	Plate
	101	Plate
	102	Shaft
	103	Screw
	104	Screw
	105	Washer
	106	Washer
	107	Nut
2	130	Fixed arm
	108	Frame
	119	Bolt
	105	Washer
3	131	Angle
	113	Frame
	129	Nut
4	132	Adjustable arm
	116	Frame
	119	Bolt
	105	Washer
	122	Bracket pin
5	126	Dial indicator
	127	Contact
	128	Bracket
6	123	Screw
	124	Washer
7	125	Screw
	124	Washer
8	137	Hand wheel
	138	Pin
	136(a)	Container
	120(a)	Plate
	134(a)	Plate
	135(a)	Plate

(a) Item not illustrated

Figure 2-74. Assembly Jig and Inspection Check Fixture T-5037452

2-515. SERVICING. Servicing the jig and inspection check fixture consists of a dimensional check and a calibration check of the indicator at 3-month intervals for indicators in normal use and prior to use for indicators in limited use. Bottom surface of plate (1) must be flat within 0.001 inch total. Cutouts in plate (1) must be normal to bottom surface within 0.001 inch total and sides of cutout parallel to each other within 0.001 inch total.

2-516. HOLDING FIXTURE T-5037454.

2-517. DESCRIPTION.

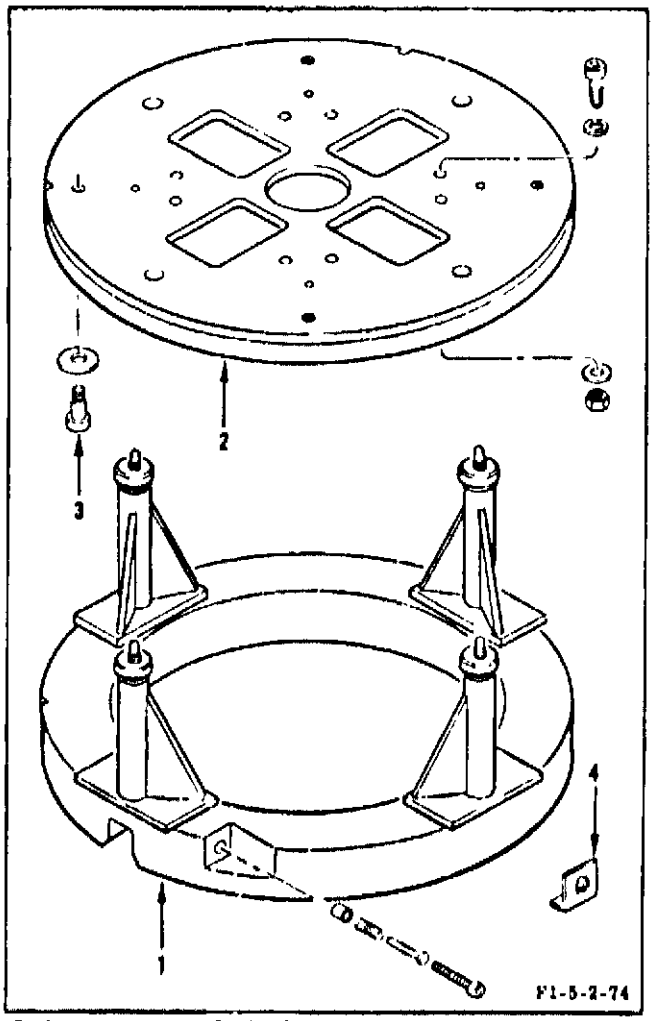
2-518. The holding fixture consists of a ring, plate, screw jacks, check fixture, and attaching hardware. The fixture is approximately 20 inches in diameter. The function of the holding fixture is to adjust and maintain the position of the gimbal bearing interface and to provide an attaching surface for an additional tool that is 28 inches long, 28 inches wide, and 15 inches high. The weight is approximately 120 pounds.

2-519. OPERATION.

2-520. The holding fixture is used to hold the gimbal bearing interface parallel to the injector during engine alinement. In addition, it provides a mounting surface for additional alining tools. The ring is attached at the base of the gimbal bearing. The plate is attached to the interface of the gimbal bearing. Four screw jacks attached to the ring contact the back of the plate. Adjusting the screw jacks adjusts the gimbal bearing interface parallel with the injector. A template is also provided to check the serrations of the gimbal bearing axis adjusting bolt to verify that the gimbal bearing lock can be installed.

2-521. MAINTENANCE.

2-522. There are no special maintenance instructions for the holding fixture except for a dimensional check of critical surfaces, which must be conducted at 6-month intervals. See figure 2-75 for index and detail numbers. Top surface of plate (1) must be flat within 0.001 inch total. Cutouts in plate (1) must be normal to top surface within 0.001 inch total and sides of cutout parallel to each other within 0.001 inch total. Disassemble holding fixture, as required, to accomplish necessary repair or replacement. Clean holding fixture as outlined in R-3896-5, Volume I. Store holding fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
	116	Screw
	117	Keensert
	118	Spring
	119	Plate
	215	Pin
	120	Plate
	201	Screw jack
2	104	Adapter
	105	Plate
	106	Plate
	107	Screw
	108	Washer
	109	Washer
	110	Nut
3	111	Screw
4	121	Template
	113(a)	Container
	114(a)	Plate
	122(a)	Plate

(a) Item not illustrated

Figure 2-75. Holding Fixture T-5037454

2-523. PRESSURE TEST FIXTURE T-5037801.

2-524. DESCRIPTION.

2-525. The pressure test fixture consists of a plate, fixture, seal plate, two unions, O-rings, and attaching bolts. The plate is circular, with six mounting holes and a threaded hole in the center. The fixture is circular, with six threaded holes, a cavity in the center of one end, and a threaded hole in the other end. The seal plate is circular, with six mounting holes and a molded rubber seal on each side. The cavity forms a housing for a check valve, and the seal plate and plate seals the check valve in the cavity. The pressure test fixture is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 7 pounds.

2-526. OPERATION.

2-527. The pressure test fixture is used to proof-, leak-, and function-test the inert prefill check valve. The check valve being tested is placed in the cavity of the fixture, and the seal plate and plate are installed on the fixture.

2-528. MAINTENANCE.

2-529. There are no special maintenance instructions for the pressure test fixture. See figure 2-76 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

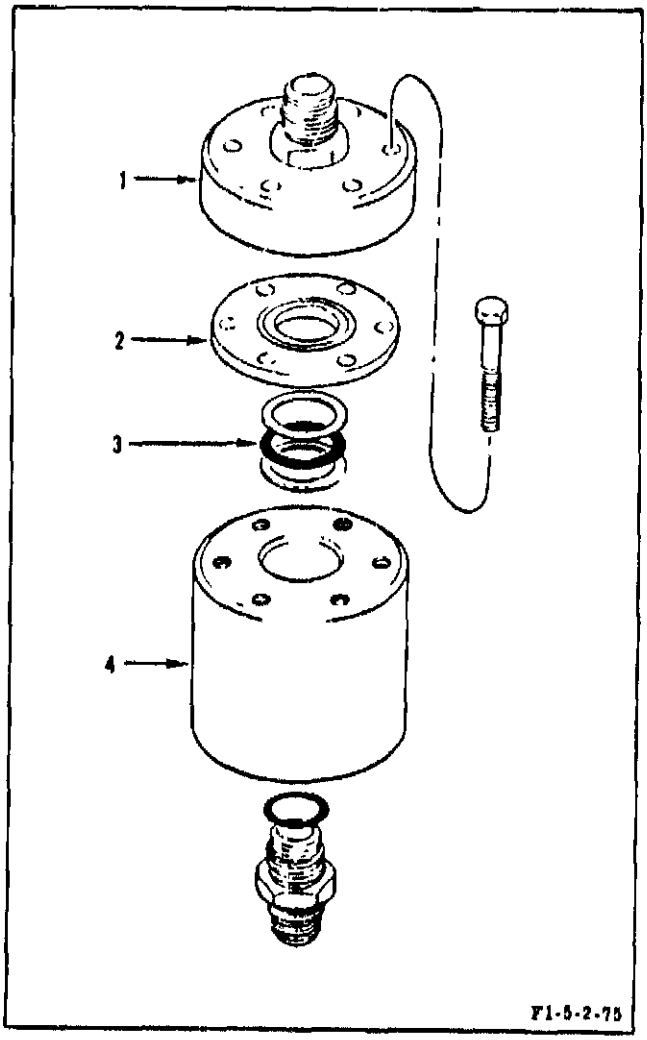
2-530. HOLDING FIXTURE T-5037803.

2-531. DESCRIPTION.

2-532. The holding fixture consists of a plate and an adapter. The plate is circular, with a hole in the center and a bronze bushing pressed into the hole. The adapter is tubular, with a cavity in one end and a bronze bushing pressed into the cavity. The holding fixture is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 12 pounds.

2-533. OPERATION.

2-534. The holding fixture is used to press the bearings onto the ball shafts of the checkout valve. The plate is positioned on a hydraulic press with the flange of the bushing up. The ball shaft bearing is centered on the bushing flange, with the short shaft of the ball inserted through the bearing and alined with the hole in the bushing. Another bearing is placed on the long shaft, and the adapter is placed over the shaft contacting the bearing. Pressure is applied to the press, forcing the bearings onto the shafts.



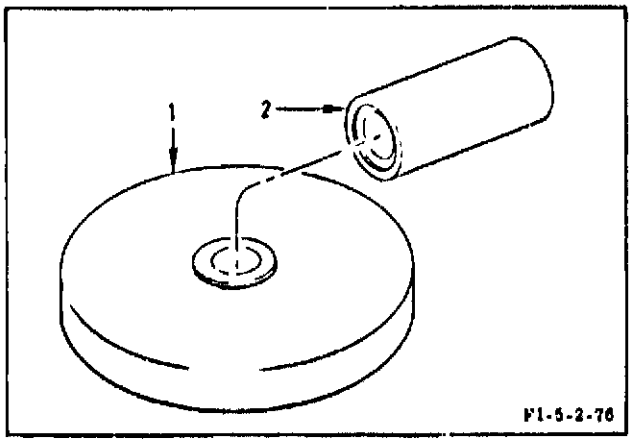
Index No.	Detail No.	Description
1	107	Plate
	108	Bolt
	102	Union
	101	O-ring
2	106	Seal plate
3	104	O-ring
	103	Retainer
4	105	Fixture
	102	Union
	101	O-ring
	109(a)	Container
	110(a)	Plate

(a) Item not illustrated

Figure 2-76. Pressure Test Fixture T-5037801

2-535. MAINTENANCE.

2-536. There are no special maintenance instructions for the holding fixture. Disassemble holding fixture, as required, to accomplish necessary repair or replacement. A press is required to remove and install bushings from plate and adapter. See figure 2-77 for index and detail numbers. Clean holding fixture as outlined in R-3896-5, Volume I. Store holding fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	102	Plate
	103	Body
	104	Bushing
2	105	Adapter
	107	Body
	106	Bushing
	109(a)	Container
	108(a)	Plate

(a) Item not illustrated

Figure 2-77. Holding Fixture T-5037803

2-537. LAPPING TOOL T-5037805.

2-538. DESCRIPTION.

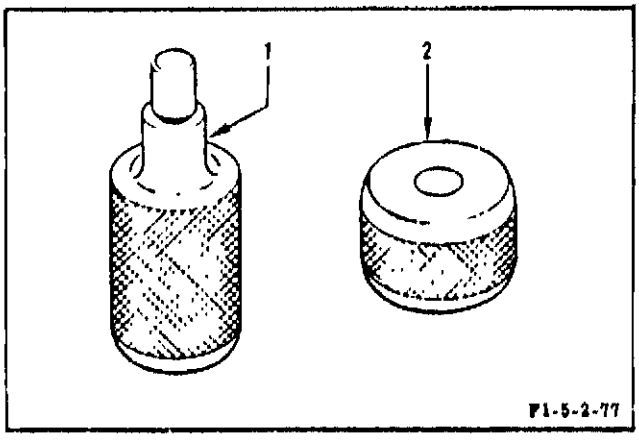
2-539. The lapping tool consists of a male lapping tool and a female lapping tool. The tool has knurls for gripping. The tool refinishes the sealing surface of a specific seat. The lapping tool is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-540. OPERATION.

2-541. The lapping tool is used to lap the gate seat of the gas generator injector purge and pump seal purge check valves. The female tool is used to resurface the cutting surface of the male tool. The end of the male tool is inserted into the port of the check valve with the cutting surface resting on the seat. With light pressure applied, the tool is rotated clockwise and counterclockwise until the seating surface is refinished.

2-542. MAINTENANCE.

2-543. There are no special maintenance instructions for the lapping tool. The male tool cutting surface is resurfaced prior to each use. See figure 2-78 for index and detail numbers. Clean lapping tool as outlined in R-3896-5, Volume I. Store lapping tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Male tool
2	102	Female tool
	104(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-78. Lapping Tool T-5037805

2-544. SEAL INSTALLATION TOOL T-5037811.

2-545. DESCRIPTION.

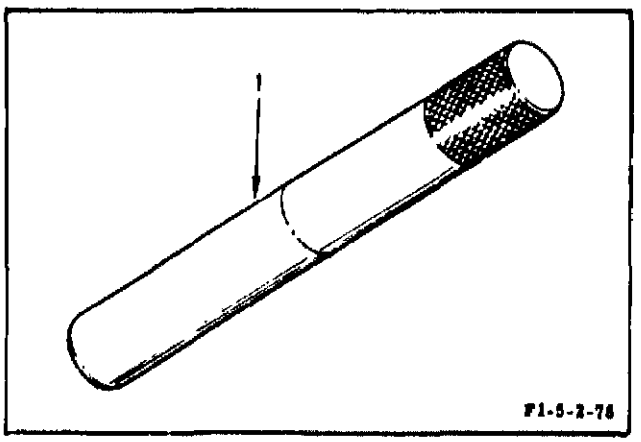
2-546. The seal installation tool is a drill rod with a knurl on one end and a smooth finish on the other end. The tool takes the place of the oxidizer ball shaft during assembly of ball valve. The seal installation tool is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately one pound.

2-547. OPERATION.

2-548. The seal installation tool is used to hold the lip seals, ring, and spacer in position while the retaining nut is installed in the gas generator ball valve. The tool is inserted into the housing and the finished surface of the tool rests against the lip seals, ring, and spacer.

2-549. MAINTENANCE.

2-550. There are no special maintenance instructions for the seal installation tool. See figure 2-79 for index and detail numbers. Clean seal installation tool as outlined in R-3896-5, Volume I. Store seal installation tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Drill rod
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-79. Seal Installation Tool T-5037811

2-551. INSPECTION CHECK FIXTURE T-5037817.

2-552. DESCRIPTION.

2-553. The inspection check fixture consists of a fixture and an indicator. The fixture is hot-rolled, carburized-hardened steel, consisting of a center plate, with a land and elongated hole, and two end plates. The end plates attach to the center plate with pins and screws, and the large end is ground to a smooth, flat surface. The indicator has a dial (0-100) and a point with a Teflon cap cemented to the point. The fixture takes measurements in 0.001 of an inch. The inspection check fixture is packaged in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately 5 pounds.

2-554. OPERATION.

2-555. The inspection check fixture is used to measure distance from retainer to ball to establish shim thickness on the assembling checkout valve. The fixture is placed on a flat, smooth surface, and the indicator is positioned on the land by loosening the attaching screw and moving the indicator in the elongated hole until the point contacts the surface to be measured.

2-556. MAINTENANCE.

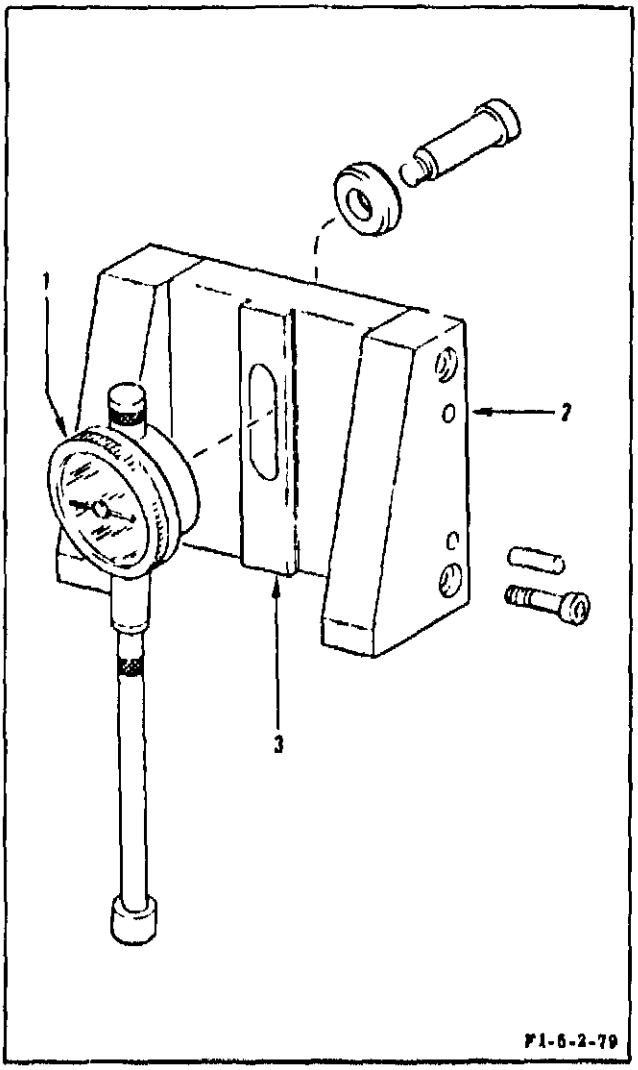
2-557. There are no special maintenance instructions for the inspection check fixture, except for servicing. Disassemble inspection check fixture, as required, to accomplish necessary repair or replacement. See figure 2-80 for index and detail numbers. Clean inspection check fixture as outlined in R-3896-5, Volume I. Store inspection check fixture in container provided and overpack container for shipment.

2-558. SERVICING. Servicing the inspection check fixture consists of a calibration check of the indicator at 3-month intervals for indicators in normal use and prior to use for indicators in limited use, and a dimensional check of critical surfaces, which must be conducted at 6-month intervals. The land of plate (3) must be normal and parallel within 0.001 inch total. The bottom surfaces of plates (2,3) must be normal within 0.001 inch total.

2-559. TORQUE WRENCH ADAPTER T-5037819.

2-560. DESCRIPTION.

2-561. The torque wrench adapter consists of a 5/16-inch hex rod that is 14 inches long, with a 5/16-inch socket and a 3/8-inch drive. The socket is welded to the rod. The adapter is an extension for a torque wrench drive. The torque wrench adapter is packaged in a container that is 24 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.



Index No.	Detail No.	Description
1	101	Indicator
	104	Washer
	105	Screw
	106	Teflon cap
	107	Point
2	102	Plate
	None	Screw
	None	Pin
3	103	Plate
	109(a)	Container
	108(a)	Plate
	110(a)	Plate

(a) Item not illustrated

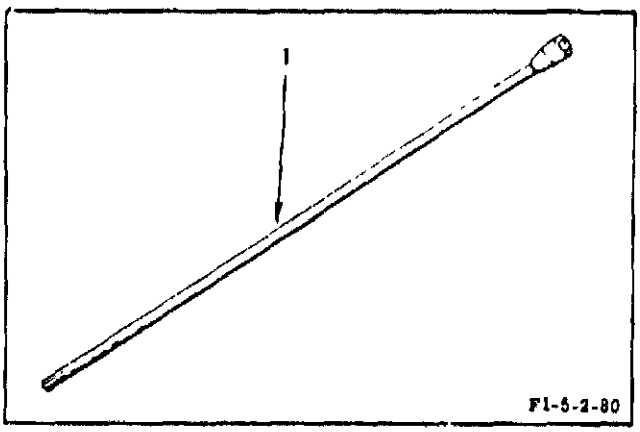
Figure 2-80. Inspection Check Fixture T-5037817

2-562. OPERATION.

2-563. The torque wrench adapter is used to torque the piston guide bolts in the fuel valve housing. A torque wrench is inserted into the socket and the hex rod is inserted into the bolt.

2-564. MAINTENANCE.

2-565. There are no special maintenance instructions for the torque wrench adapter. See figure 2-81 for index and detail numbers. Clean torque wrench adapter as outlined in R-3896-5, Volume I. Store torque wrench adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Rod
	103(a)	Container
	104(a)	Plate

(a) Item not illustrated

Figure 2-81. Torque Wrench Adapter T-5037819

2-566. LAPPING TOOL T-5037824.

2-567. DESCRIPTION.

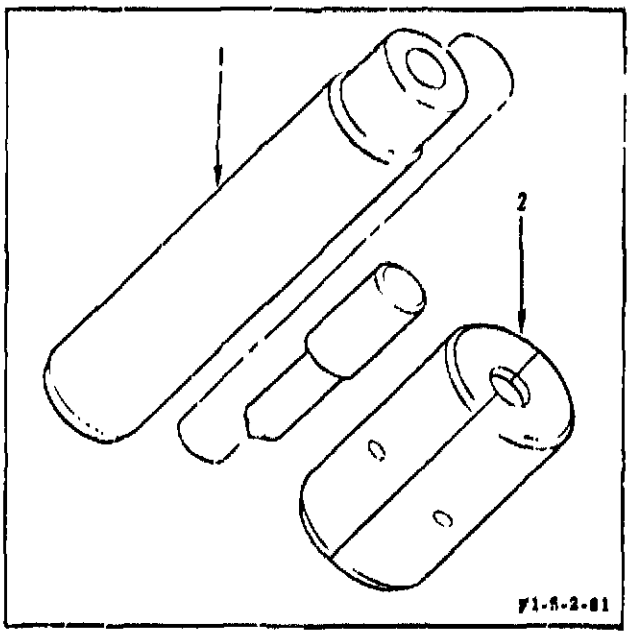
2-568. The lapping tool consists of a male and a female lapping tool. A pin is pressed into the end of the male tool to act as a guide. The female tool is a split sleeve held together by two pins. The pins are pressed into one of the halves with a slip fit in the other. The tool refinishes the sealing surface of a specific seat. The lapping tool is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 10 pounds.

2-569. OPERATION.

2-570. The lapping tool is used to lap the gate seat of the oxidizer dome purge check valve. The female tool is used to resurface the cutting surface of the male tool. The pin of the male tool is inserted into the port of the check valve with the cutting surface resting on the seat. With light pressure applied, the tool is rotated clockwise and counterclockwise until the seating surface is refinished.

2-571. MAINTENANCE.

2-572. There are no special maintenance instructions for the lapping tool. The male tool cutting surface is resurfaced prior to each use. See figure 2-82 for index and detail numbers. Clean lapping tool as outlined in R-3896-5, Volume I. Store lapping tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Male tool
	102	Handle
	103	Pin
2	104	Female tool
	105	Sleeve
	106	Pin
	108(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-82. Lapping Tool T-5037824

2-573. BALL POSITION INDICATOR T-5037831

2-574. DESCRIPTION.

2-575. The ball position indicator consists of a plate, an adapter, and a pin. The plate is flat, with four mounting holes, a hole in the center, and 0-, 90-, and 180-degree numbers and marks scribed on one side. The adapter has a 3/8-inch square drive on one end and a shoulder and rectangular point machined on the other end. The pin is a standard dowel pin with a 60-degree point machined on one end. The ball position indicator engages the end of the shaft of the ball and indicates the position of the ball. The ball position indicator is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-576. OPERATION.

2-577. The ball position indicator is used to adapt a torque wrench to the ball shaft and indicate the position of the ball during torque check of the checkout valve. The indicator is installed in place of the actuator with the point of the adapter alined with the slot in the ball shaft and the plate attached to the cover. A torque wrench is inserted into the square hole of the adapter to rotate the ball.

2-578. MAINTENANCE.

2-579. There are no special maintenance instructions for the ball position indicator. See figure 2-83 for index and detail numbers. Clean ball position indicator as outlined in R-3896-5, Volume I. Store ball position indicator in container provided and overpack container for shipment.

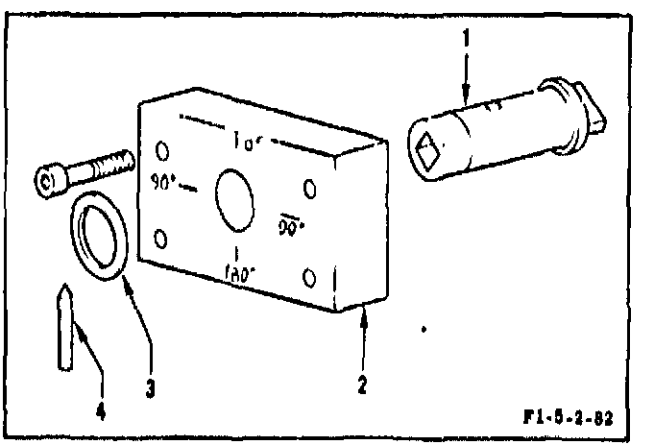


Figure 2-83. Ball Position Indicator T-5037831 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	101	Adapter
2	107	Plate
	106	Screw
3	104	Washer
4	105	Pin
	108(a)	Container
	109(a)	Plate

(a) Item not illustrated

Figure 2-83. Ball Position Indicator T-5037831 (Sheet 2 of 2)

2-580. INSPECTION CHECK FIXTURE T-5037832.

2-581. DESCRIPTION.

2-582. The inspection check fixture consists of an indicator, housing, slide, and plate. The indicator has a dial graduated from 0-100 with a standard contact point. The housing is T-shaped, with a round and a rectangular end and a hole through the center. The round end has knurls and an elongated hole in one side. The slide consists of a bushing and pin. The bushing is installed in the housing and the pin pressed into the bushing through the elongated hole. The plate is rectangular, with a groove across one side. The fixture takes measurements in 0.001 of an inch. The inspection check fixture is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-583. OPERATION.

2-584. The inspection check fixture is used to measure the gap between the cover and switch foot and the housing and finger to determine the thickness of the shim during installation of the switch into the gas generator ball valve. The indicator is set to zero by placing the housing on the plate with the slide resting in the groove of the plate. The fixture is placed on a flat, smooth surface and the slide contacts another surface, which forces the slide against the point, resulting in the indication on the dial.

2-585. MAINTENANCE.

2-586. There are no special maintenance instructions for the inspection check fixture, except for servicing. Disassemble the inspection check fixture, as required, to accomplish necessary repair or replacement. See figure 2-84 for index and detail numbers. Clean inspection check fixture as outlined in R-3896-5, Volume I. Store inspection check fixture in container provided and overpack container for shipment.

2-587. SERVICING. Servicing the inspection check fixture consists of a calibration check of the indicator at 3-month intervals for indicators in normal use and prior to use for indicators in limited use, and a dimensional check of critical surfaces, which must be conducted at 6-month intervals. The bottom surface of plate (3) must be normal and flat within 0.001-inch total. The top surface and groove of plate (5) must be parallel within 0.001 inch total and depth of groove to be 0.5000 ±0.0005 inch.

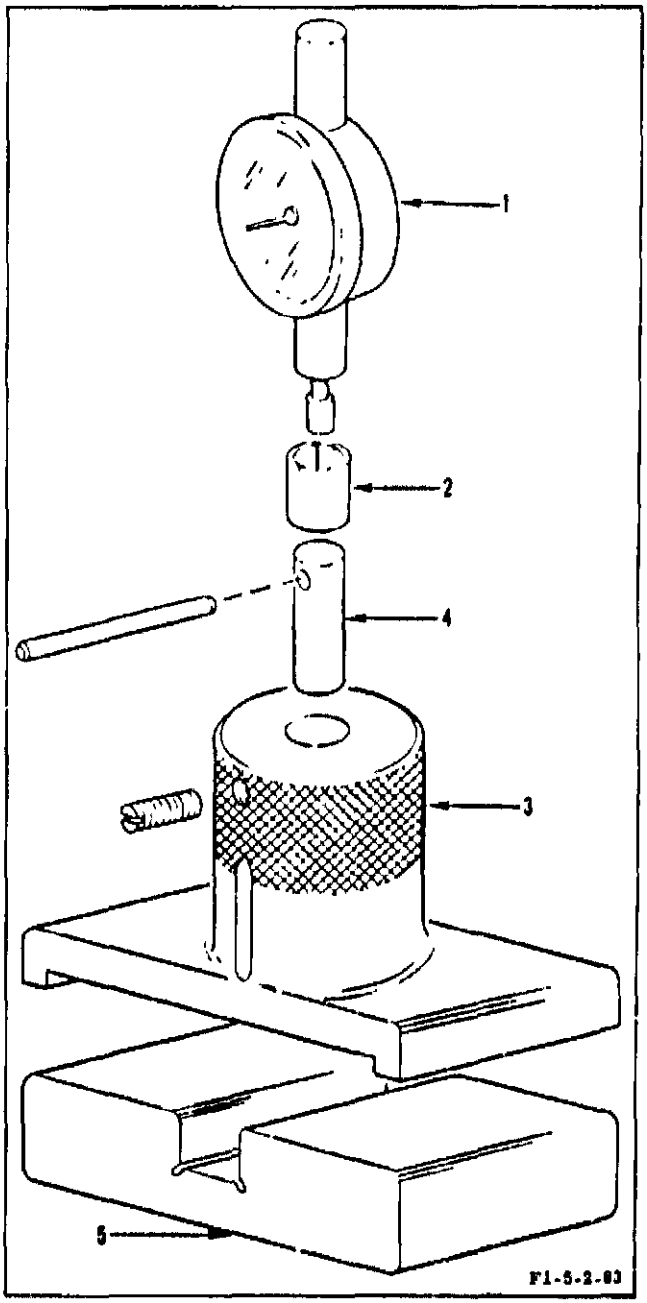
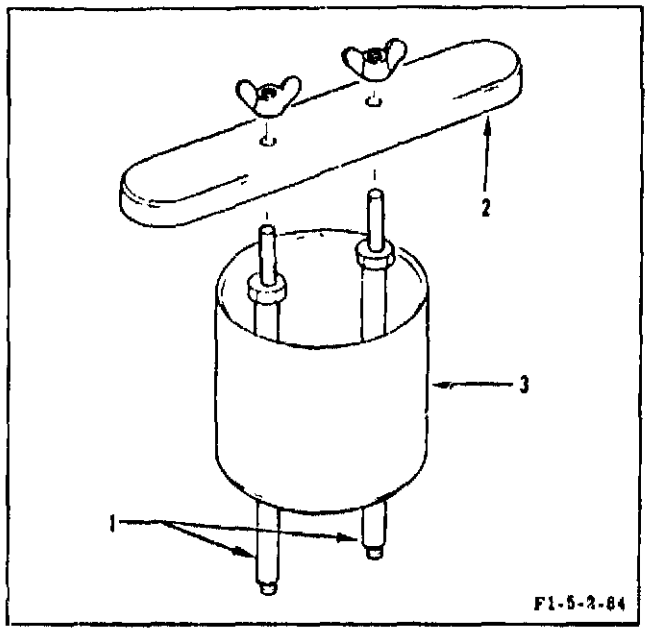


Figure 2-84. Inspection Check Fixture T-5037832 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	105	Indicator
2	104	Bushing
3	101	Housing
	106	Setscrew
4	102	Slide
	103	Bushing
	107	Pin
5	108	Plate
	110(a)	Container
	109(a)	Plate
	111(a)	Plate

(a) Item not illustrated

Figure 2-84. Inspection Check Fixture T-5037832 (Sheet 2 of 2)



Index No.	Detail No.	Description
1	101	Rod
	104	Wingnut
2	103	Handle
3	105	Sleeve
	107(a)	Container
	106(a)	Plate

(a) Item not illustrated

Figure 2-85. Piston Installation Tool T-5037837

2-588. PISTON INSTALLATION TOOL T-5037837.

2-589. DESCRIPTION.

2-590. The piston installation tool consists of a handle, two rods, and a sleeve. The handle is a flat bar with rounded ends and edges and two holes equally spaced from the center. The rods are threaded on each end, and one end has a piece of steel welded at the base of the threads with 5/16-inch wrench flats. The sleeve is a nylon tube. The tool protects the cylinder walls and attaches to the piston. The piston installation tool is packaged in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-591. OPERATION.

2-592. The piston installation tool is used to remove and install the piston in the cylinder of the oxidizer valve. The sleeve is inserted into the cylinder and the rods are screwed into holes in the piston. The handle is placed on the rods and secured with wingnuts.

2-593. MAINTENANCE.

2-594. There are no special maintenance instructions for the piston installation tool. See figure 2-85 for index and detail numbers. Clean piston installation tool as outlined in R-3895-5, Volume I. Store piston installation tool in container provided and overpack container for shipment.

2-595. SEAT REMOVAL TOOL T-5037841.

2-596. DESCRIPTION.

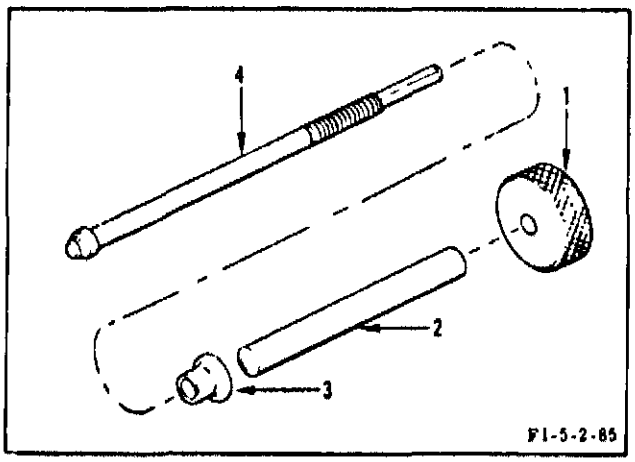
2-597. The seat removal tool consists of a knurled nut, sleeve, rubber tube (pure gum), and rod. The tool grips the seat internally. The seat removal tool is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 1-1/2 pounds.

2-598. OPERATION.

2-599. The seat removal tool is used to remove the poppet seats from the start and stop sides of the four-way solenoid valve. The tool is inserted into the cylinder and the knurled nut tightened until the rubber tube expands against the inner wall of the seat.

2-600. MAINTENANCE.

2-601. There are no special maintenance instructions for the seat removal tool. Disassemble seat removal tool, as required, to accomplish necessary repair or replacement. See figure 2-86 for index and detail numbers. Clean seat removal tools as outlined in R-3896-5, Volume I. Store seat removal tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	104	Nut
2	103	Sleeve
3	102	Rubber tube
4	105	Rod
	107(a)	Container
	106(a)	Plate

(a) Item not illustrated

Figure 2-86. Seat Removal Tool T-5037841

2-602. PRESSURE TEST FIXTURE T-5038604.

2-603. DESCRIPTION.

2-604. The pressure test fixture consists of a modified F-1 thrust chamber. The chamber is cut off 24 inches from the throat and all tubes are filled with resin and hardener. Steel plates are welded on all openings, and a steel plate with threads tapped in the center is welded in the injector end of the chamber. Unions and plugs installed in the fuel manifold provide the pressure and monitor the ports. The fixture is welded to a tubular frame which contains channels for a forklift truck. The fixture is 70 inches long, 70 inches wide, and 64 inches high. The weight is approximately 3,000 pounds.

2-605. OPERATION.

2-606. The pressure test fixture is used to proof-test Thrust Chamber Throat Plug G3136. The throat plug is installed and the fixture filled with water and pressurized. Monitor and safety relief devices are installed at the unions and plugs provided in the fuel manifold.

2-607. MAINTENANCE.

2-608. There are no special maintenance instructions for the pressure test fixture. See figure 2-87 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Cover pressure test fixture with a tarp during storage or shipment.

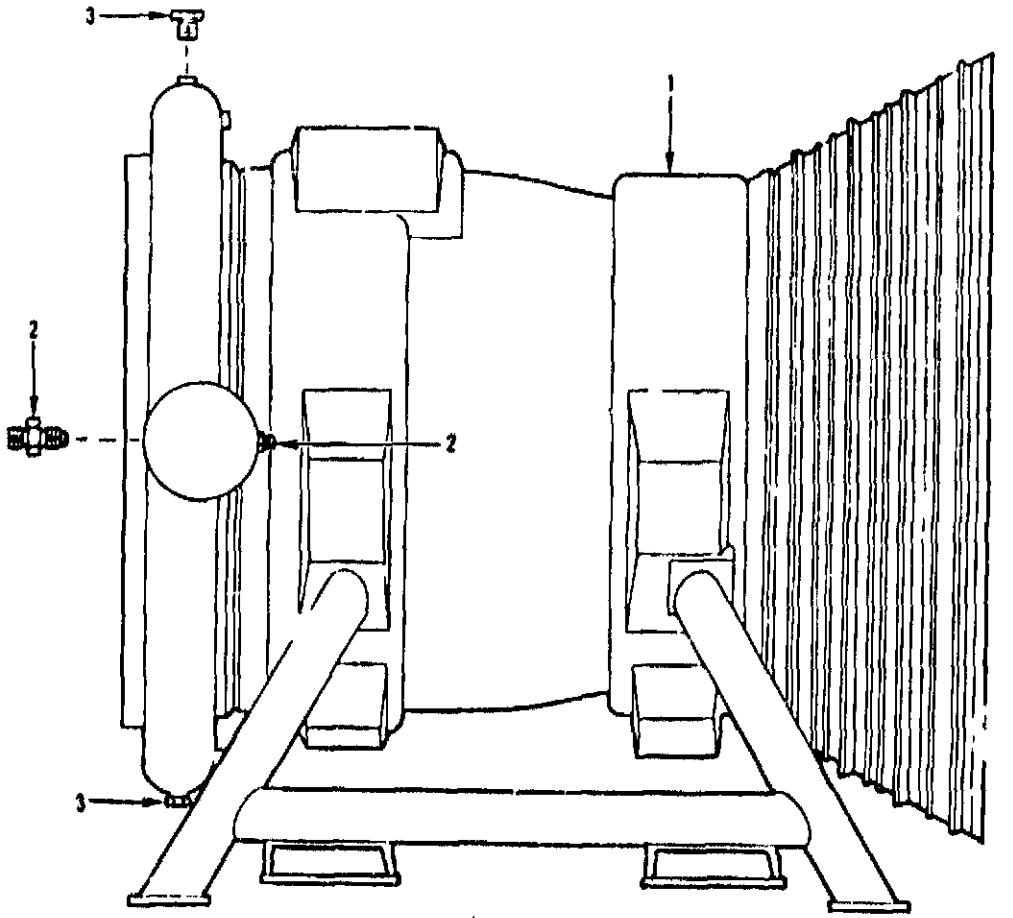
2-609. ALINEMENT TOOL AND INSPECTION CHECK FIXTURE T-5039113.

2-610. DESCRIPTION.

2-611. The alinement tool and inspection check fixture consist of a plate, two fixtures, and nine guides. The plate is similar to a parallelogram that has cutouts to mate with the gimbal bearing body. The fixtures are L-shaped and have mounting plates for guides. The guides are tubes with a mounting flange welded to one end. The alinement tool and inspection check fixture are packaged in a container that is 40 inches long, 24 inches wide, and 18 inches high. The weight is approximately 135 pounds.

2-612. OPERATION.

2-613. The alinement tool and inspection check fixture are used to aline the heat exchanger ducts, hydraulic ducts, purge lines, and support brackets during installation. The plate is installed on a tool that is already installed on the gimbal bearing interface. The fixtures are installed on the plate and the guides attached to the fixtures. The support brackets are adjusted to fit the guides. The guides are removed and the duct or line is attached to the fixture in place of the guide.



Index No.	Detail No.	Description	Index No.	Detail No.	Description
1	None	Fixture	3	115	Plug
2	110	Union		114(a)	Plate
	109	Cap			
	204(a)	Cover			

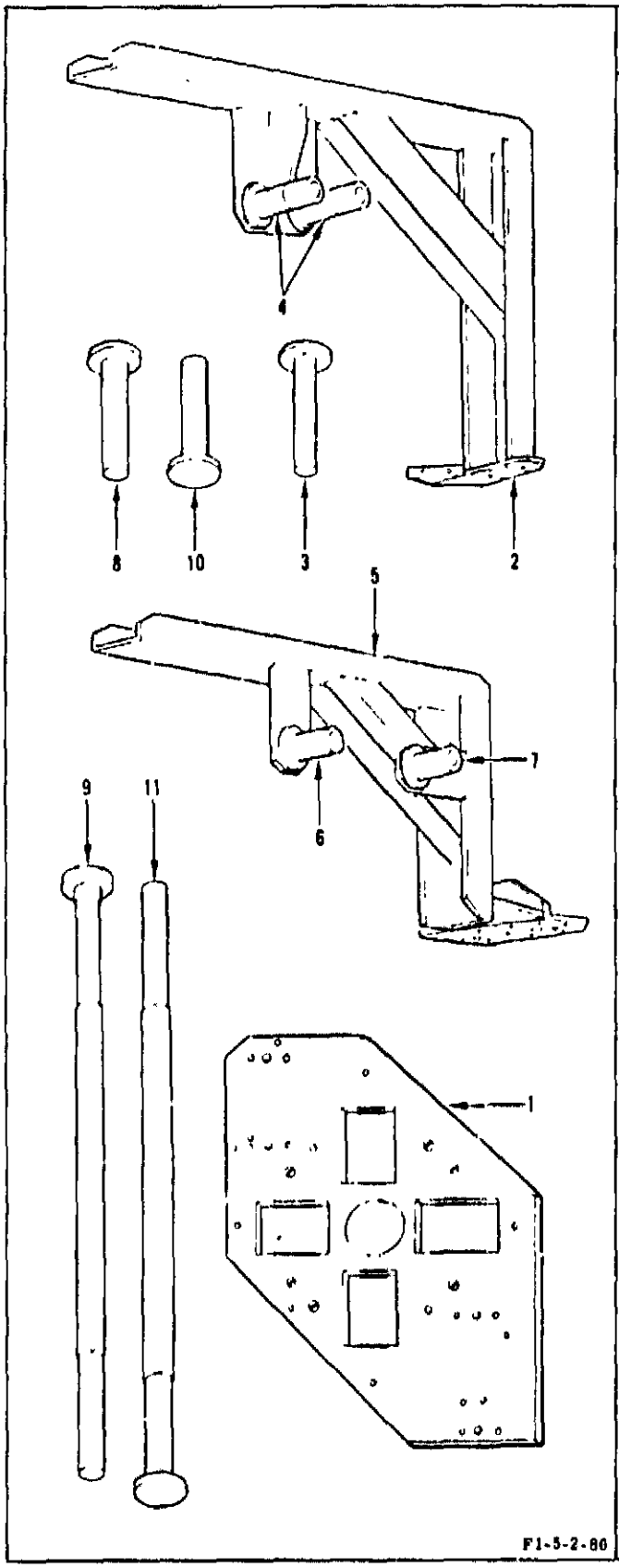
(a) Item not illustrated

Figure 2-87. Pressure Test Fixture T-5038604

2-614. MAINTENANCE.

2-615. There are no special maintenance instructions for the alinement tool and inspection check fixture, except for servicing. Disassemble alinement tool and inspection check fixture, as required, to accomplish necessary repair or replacement. See figure 2-88 for index and detail numbers. Clean alinement tool and inspection check fixture as outlined in R-3896-5, Volume I. Store alinement tool and inspection check fixture in container provided and overpack container for shipment.

2-616. SERVICING. Servicing consists of a dimensional check of the alinement tool and inspection check fixture, which must be conducted at 6-month intervals. The centerlines through cutouts of plate (1) must be normal within 0.001 inch total.



Index No.	Detail No.	Description
1	101	Plate
	102	Nut
	103	Washer
	104	Screw
	105	Pin
2	201	Fixture
	202	Frame
	107	Screw
	106	Washer
	223	Pad
	224	Pad
	222	Screw
	218	Bushing
3	219	Guide
4	210	Guide
	215	Screw
	216	Pin
5	301	Fixture
	302	Frame
	107	Screw
	106	Washer
	108	Pin
	336	Pad
	222	Screw
6	303	Guide
	109	Screw
7	306	Guide
	109	Screw
8	322	Guide
	109	Screw
9	323	Guide
	109	Screw
10	327	Guide
	109	Screw
11	328	Guide
	109	Screw
	110(a)	Container
	111(a)	Plate
	113(a)	Plate

(a) Item not Illustrated

Figure 2-88. Alinement Tool and Inspection Check Fixture T-5039113

2-617. ALINEMENT FIXTURE T-5039202.

2-618. DESCRIPTION.

2-619. The alinement fixture consists of two plates, two collars, two arms, and two indicators. The plates have a shaft and four crossmembers welded to the top and a nylon pad bonded to the bottom. The collars are hard, rolled steel, with a threaded hole for a setscrew. The arm is tubular, with a clevis welded on one end and a short tube welded at a right angle to the other tube. A bronze bearing is pressed into the short tube. The indicator has a dial with a standard point that is graduated from 0-100. The fixture sweeps 360 degrees and measures in increments of 0.001 inch. The alinement fixture is packaged in a container that is 36 inches long, 20 inches wide, and 12 inches high. The weight is approximately 61 pounds.

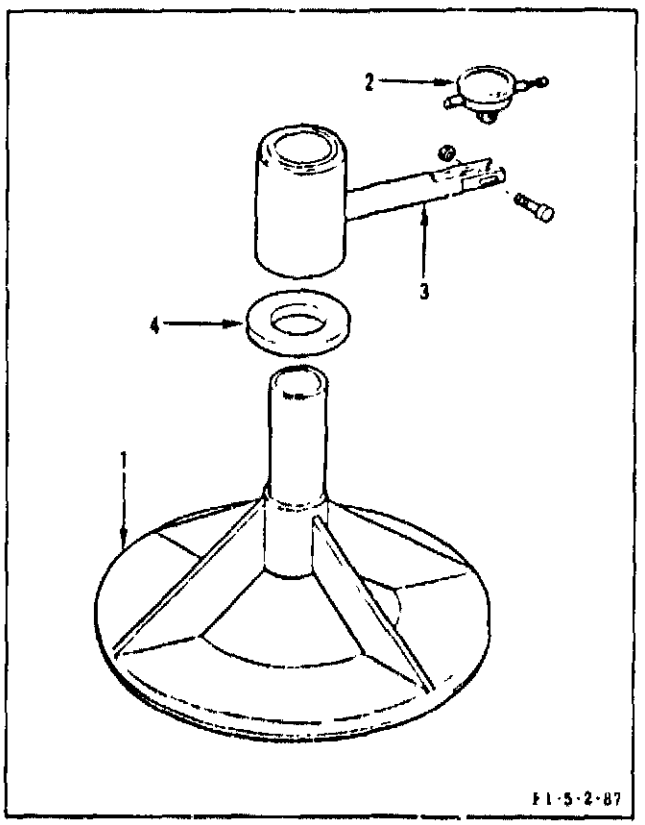
2-620. OPERATION.

2-621. The alinement fixture is used to locate the holes of the interface panel within 0.060 inch of the center line of the fuel inlet elbows. The plates are mounted on the fuel inlet elbows, and the collar and indicator are placed on the shaft of the plate. The arm pivots on the shaft, sweeping the indicator 360 degrees.

2-622. MAINTENANCE.

2-623. There are no special maintenance instructions for the alinement fixture, except for servicing. Disassemble alinement fixture, as required, to accomplish necessary repair or replacement. See figure 2-89 for index and detail numbers. Clean alinement fixture as outlined in R-3896-5, Volume I. Store alinement fixture in container provided and overpack container for shipment.

2-624. SERVICING. Servicing the alinement fixture consists of lubrication, calibration check, and dimensional check of critical surfaces. Apply dry-film lubricant RB0140-007 (Rocketdyne) to shaft of plate after cleaning plate or when film is removed by wear or damage. The dial indicator requires a calibration check at 3-month intervals for indicators in normal use and prior to use for indicators in limited use. The dimensional check is conducted at 6-month intervals. The bottom surface, with pad removed, of plate (1) must be flat within 0.002 inch total. The shaft and bottom surface of plate (1) must be normal within 0.002 inch total.



Index No.	Detail No.	Description
1	201	Plate
	105	Screw
	104	Washer
	101	Pad
2	209	Indicator
	212	Screw
	213	Nut
3	205	Arm
	210	Bearing
4	102	Collar
	103	Setscrew
	107(a)	Container
	106(a)	Plate
	108(a)	Plate

(a) Item not illustrated

Figure 2-89. Alinement Fixture T-5039202

2-625. PRESSURE TEST FIXTURE T-5039241.

2-626. DESCRIPTION.

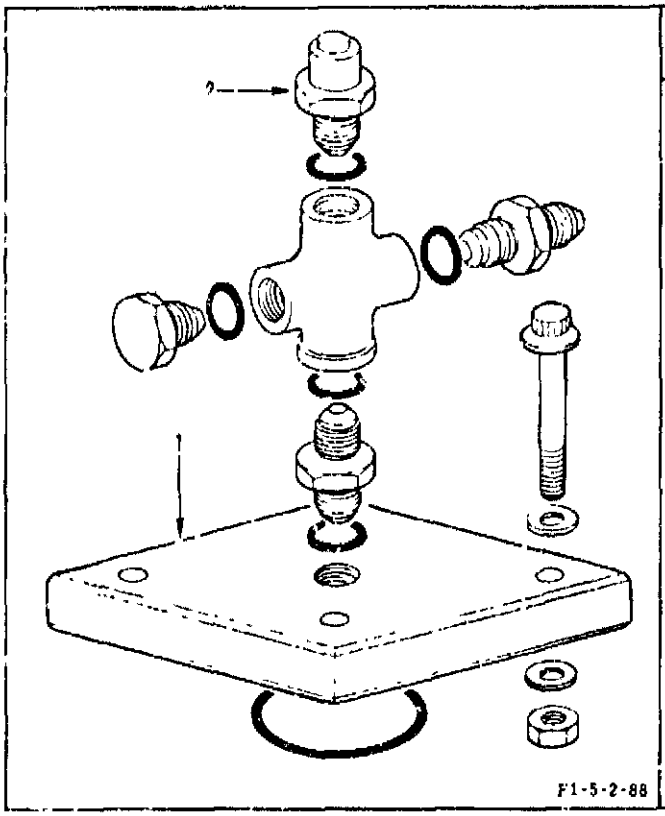
2-627. The pressure test fixture consists of a plate and a relief valve. The plate is square, with a seal groove on one side, four mounting holes, and a threaded port in the center. The relief valves relieve at 15 psig. The pressure test fixture is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 2 pounds.

2-628. OPERATION.

2-629. The pressure test fixture is used to seal the fuel overboard drain lines during the leak test of the bearing coolant system. The plate is installed on the fuel overboard drain line, and the relief valve is connected to the plate through a cross.

2-630. MAINTENANCE.

2-631. There are no special maintenance instructions for the pressure test fixture. See figure 2-90 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
	103	Bolt
	104	Washer
	105	Nut
	114	Washer
	102	O-ring
2	108	Relief valve
	107	O-ring
	106	Cross
	109	Union
	110	Reducer
	111	Plug
	113(a)	Container
	112(a)	Plate

(a) Item not illustrated

Figure 2-90. Pressure Test Fixture T-5039241

2-632. TORQUE ADAPTER T-5039247.

2-633. DESCRIPTION.

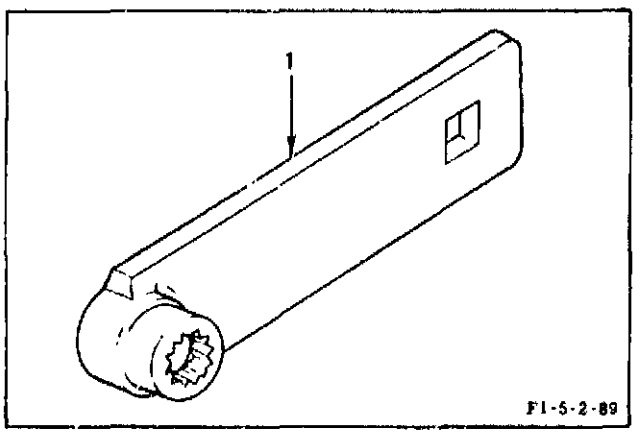
2-634. The torque adapter consists of a 13/16-inch heavy-duty apex socket welded to one end of a rectangular tool steel bar with a 3/4-inch square drive in the other end. The torque adapter is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-635. OPERATION.

2-636. The torque adapter is used to adapt a torque wrench for torquing the outer bolts of the oxidizer dome.

2-637. MAINTENANCE.

2-638. There are no special maintenance instructions for the torque adapter. The torque adapter must be calibrated with the torque wrench it is to be used with prior to use. See figure 2-91 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	103	Adapter
	105(a)	Container
	104(a)	Plate

(a) Item not illustrated

Figure 2-91. Torque Adapter T-5039247

2-639. TORQUE ADAPTER T-5039436.

2-640. DESCRIPTION.

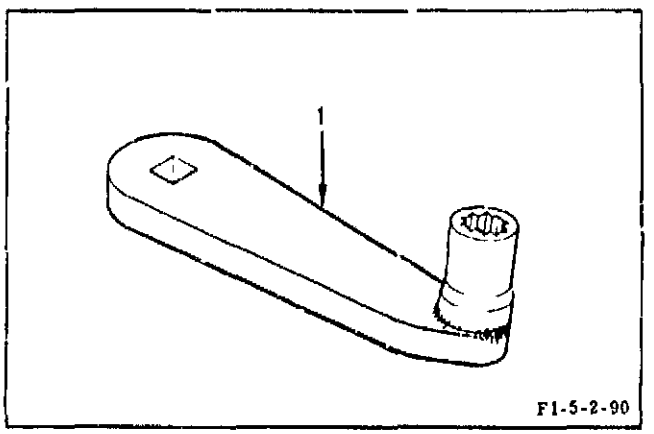
2-641. The torque adapter consists of a 7/16-inch flank drive socket welded to one end of a rectangular bar with a 3/8-inch square drive in the other end. The socket is offset 68 degrees from the bar. The torque adapter is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately one pound.

2-642. OPERATION.

2-643. The torque adapter is used to adapt a torque wrench for torquing the bolts of the fuel inlet elbows.

2-644. MAINTENANCE.

2-645. There are no special maintenance instructions for the torque adapter, except the torque adapter must be calibrated with the torque wrench it is to be used with prior to use. See figure 2-92 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Adapter
	105(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-92. Torque Adapter T-5039436

2-646. ALINEMENT AND INSPECTION CHECK FIXTURE T-5039437.

2-647. DESCRIPTION.

2-648. The alinement and inspection check fixture consists of a plate and six pins. The plate has three cutouts to mate with three heat exchanger lines on one side and an elongated hole to serve as a handhold on the other side. Bushings are pressed into the holes that receive the pins. The fixture is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 6 pounds.

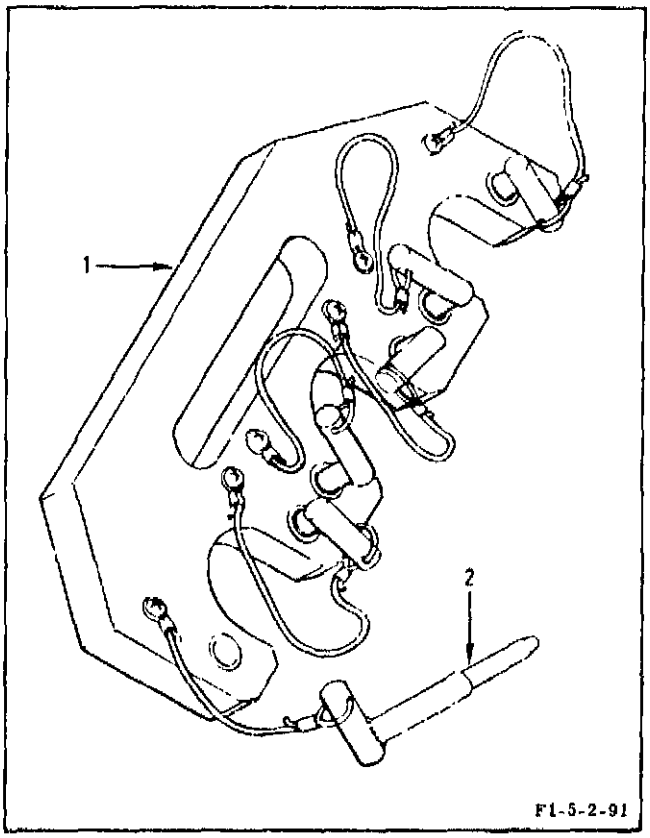
2-649. OPERATION.

2-650. The alinement and inspection check fixture is used to aline and check the radial location of the flange boltholes at the interface of the heat exchanger lines. The fixture is placed on the heat exchanger lines and the pins are inserted through the holes of the fixture and into the holes in the flanges.

2-651. MAINTENANCE.

2-652. There are no special maintenance instructions for the alinement and inspection check fixture, except for servicing. See figure 2-93 for index and detail numbers. Clean alinement and inspection check fixture as outlined in R-3896-5, Volume I. Store alinement and inspection check fixture in container provided and overpack container for shipment.

2-653. SERVICING. Servicing of the alinement and inspection check fixture consists of an alinement check of the bushings, which must be conducted at 6-month intervals. The centerlines of all bushings in plate (1) must be in line within 0.003 inch.



Index No.	Detail No.	Description
1	102	Plate
	101	Bushing
2	103	L-Pin
	105(a)	Container
	104(a)	Plate
	106(a)	Plate

(a) Item not illustrated

Figure 2-93. Alinement and Inspection Check Fixture T-5039437

2-654. ALINEMENT PIN T-5039454.

2-655. DESCRIPTION.

2-656. There are two alinement pins. Each pin consists of a stud, seven sleeves, a nut, and a washer. The stud has a spherical end and a 12-point internal wrenching end with threads on both ends. The seven sleeves (three outer and four inner) expand and contract when pressed together. The alinement pins are packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 4 pounds.

2-657. OPERATION.

2-658. The alinement pins are used to aline the oxidizer dome and injector to the thrust chamber. The nuts are backed off; then the pins are inserted through the dome and injector and screwed into the thrust chamber. The nuts are tightened, forcing the outer sleeves over the inner sleeves, causing the outer sleeve to expand and the inner sleeve to contract.

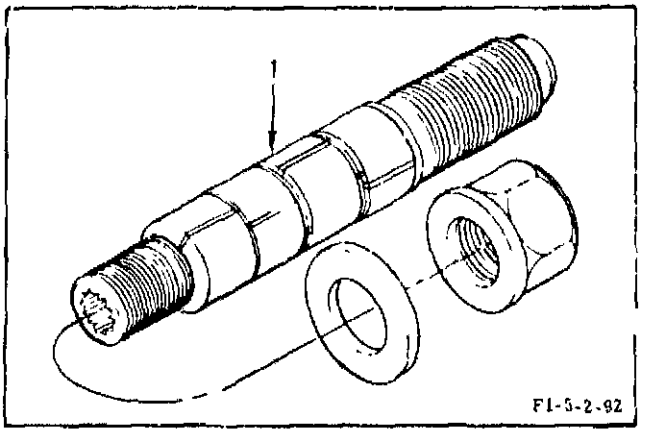
2-659. MAINTENANCE.

2-660. There are no special maintenance instructions for the alinement pins. See figure 2-94 for index and detail numbers. Clean alinement pins and apply dry-film lubricant RB0140-007 (Rocketdyne) to stud after cleaning or when film is removed by wear or damage, as outlined in R-3896-5, Volume I. Store alinement pins in container provided and overpack container for shipment.

2-661. PRESSURE TEST FIXTURE T-5039457.

2-662. DESCRIPTION.

2-663. The pressure test fixture consists of eight fixtures, five couplings, two adapters, three bushings, a panel, and a frame. The fixtures are circular, with a threaded port in one side and a thread or smooth cavity in the other side. The diameter of the cavity varies from 1/2 inch to 1-1/4 inches. All the fixtures have mounting holes on the threaded port side, and five of the fixtures have mounting holes for the quick-disconnect on the cavity side. The couplings are a mating-test fixture for the quick-disconnect. The panel is mounted on the frame and provides the mounting for the fixtures. The pressure test fixture is packaged in a container that is 22 inches long, 20 inches wide, and 16 inches high. The weight is approximately 45 pounds.



Index No.	Detail No.	Description
1	101	Stud
	None	Washer
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

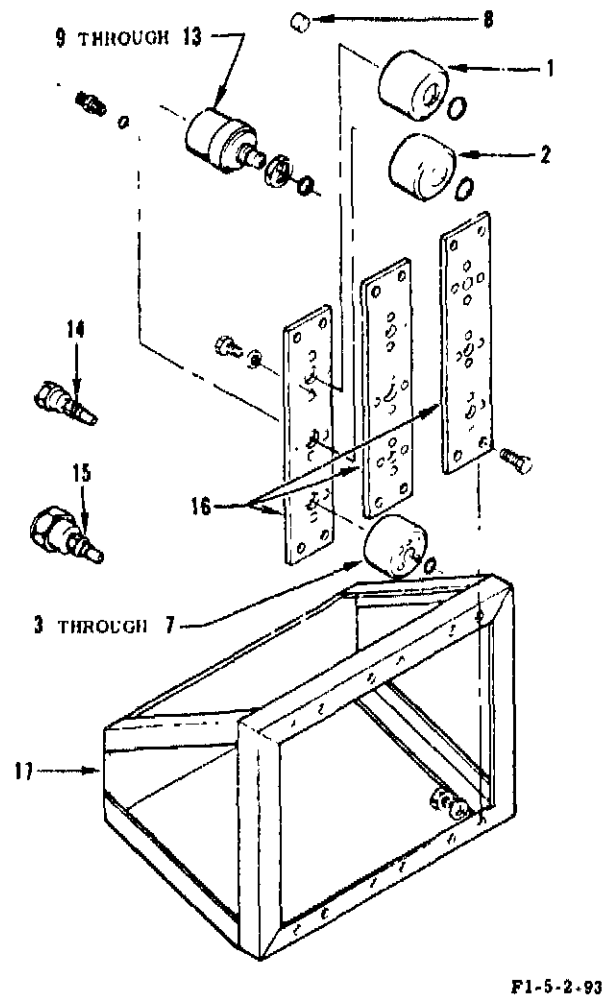
Figure 2-94. Alinement Pin T-5039454

2-664. OPERATION.

2-665. The pressure test fixture is used to pressure-test the engine half of the quick-disconnects. The fixture is mounted on the panel and the applicable engine-half quick-disconnect is mounted on the fixture. Pressure is applied at the pressure port of the fixture.

2-666. MAINTENANCE.

2-667. There are no special maintenance instructions for the pressure test fixture. See figure 2-95 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume 1. Store pressure test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	208	Fixture
	219	O-ring
	108	Union
	107	O-ring
	109	Screw
2	209	Fixture
	210	Fixture
	108	Union
	107	O-ring
	109	Screw
3	211	Fixture
	123	O-ring
	127	Ring
	108	Union
	107	O-ring
	109	Screw
	115	Bolt
	114	Washer
4	212	Fixture
	124	O-ring
	128	R ng
	108	Union
	107	O-ring
	109	Screw
	117	Bolt
	116	Washer
5	213	Fixture
	126	O-ring
	130	Ring
	108	Union
	107	O-ring
	109	Screw
	119	Screw
	118	Washer
6	214	Fixture
	125	O-ring
	129	Ring
	108	Union
	107	O-ring
	109	Screw
	117	Bolt
	116	Washer
7	215	Fixture
	124	O-ring
	128	Ring
	108	Union
	107	O-ring
	109	Screw
	117	Bolt
	116	Washer
8	216	Bushing
	217	Bushing
	218	Bushing
9	201	Coupling
	206	O-ring
10	202	Coupling
	207	O-ring
11	203	Coupling
	206	O-ring
12	204	Coupling
	206	O-ring
13	205	Coupling
	206	O-ring
14	301	Adapter
	302	Nut
	303	Orifice
	304	Nut
	305	Sleeve
	306	Tube

Figure 2-95. Pressure Test Fixture T-5039457 (Sheet 1 of 2)

Index No.	Detail No.	Description
15	307	Adapter
	308	Nut
	309	Orifice
	304	Nut
	305	Sleeve
	306	Tube
16	110	Panel
	111	Screw
	112	Washer
	113	Nut
17	101	Frame
	121(a)	Container
	120(a)	Plate
	122(a)	Plate

(a) Item not illustrated

Figure 2-95. Pressure Test Fixture T-5039457 (Sheet 2 of 2)

2-668. TORQUE ADAPTER T-5039499.

2-669. DESCRIPTION.

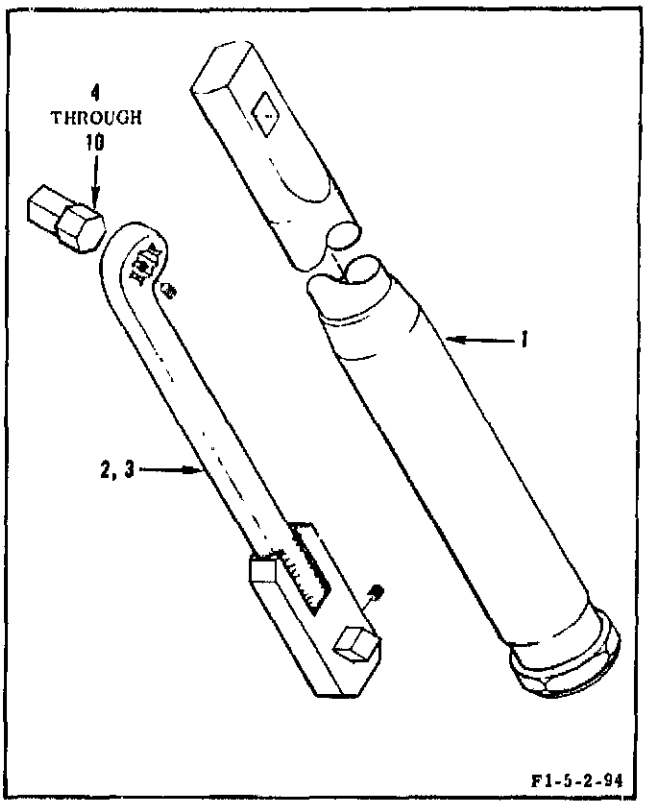
2-670. The torque adapter consists of a wrench, two extensions, and seven adapters. The torque wrench is a standard 1/4-inch drive wrench. The extensions have a 5/16-inch 12-point box on one end and a flat plate, with a 1/4-inch square hole welded to the other end. The adapters, varying in length, have a 5/16-inch hex on both ends with the hex rotated 15 degrees from each other. The torque adapter is packaged in a container with an overall size of 16 inches long, 4 inches wide, and 4 inches high. The weight is approximately 5 pounds.

2-671. OPERATION.

2-672. The torque adapter is used to torque the attaching bolts of the turbopump balance line hose at the turbopump fuel volute.

2-673. MAINTENANCE.

2-674. There are no special maintenance instructions for the torque adapter, except the torque wrench must be calibrated with both extensions prior to use. Disassemble the torque adapter, as required, to accomplish necessary repair or replacement. See figure 2-96 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	201	Wrench
2	207	Extension
	203	Setscrew
	212	Setscrew
3	208	Extension
	203	Setscrew
	212	Setscrew
4	206	Adapter
5	209	Adapter
6	213	Adapter
7	214	Adapter
8	215	Adapter
9	216	Adapter
10	217	Adapter
	211(a)	Container
	210(a)	Plate

(a) Item not illustrated

Figure 2-96. Torque Adapter T-5039499

2-675. HOLDING FIXTURE T-5039534.

2-676. DESCRIPTION.

2-677. The holding fixture consists of two jaws, a handle, and an adapter. The jaws are pinned together with two pins pressed into one jaw and a slip fit in the other. The handle is a rectangular steel bar with a threaded hole in one end. The adapter is a steel rod with external threads on one end, internal threads on the other, and a knurled grip in the center. The holding fixture is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately 2 pounds.

2-678. OPERATION.

2-679. The holding fixture is used to perform a pull test of percussion-welded studs on the thrust chamber and thermal insulation. The jaws are clamped over the plate, the adapter is screwed onto the stud, and the handle is screwed onto the adapter.

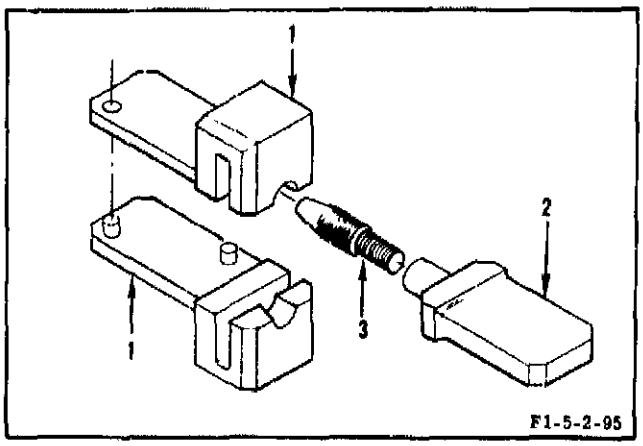
2-680. MAINTENANCE.

2-681. There are no special maintenance instructions for the holding fixture. Disassemble holding fixture, as required, to accomplish necessary repair or replacement. See figure 2-97 for index and detail numbers. Clean holding fixture as outlined in R-3896-5, Volume I. Store holding fixture in container provided and overpack container for shipment.

2-682. GIMBAL YOKE ALINEMENT T-5041233.

2-683. DESCRIPTION.

2-684. The gimbal yoke alinement consists of a bracket, pin, magnet, and handle. The bracket is U-shaped, with a hole through the center and a key on one edge. The pin consists of a rod with a 60-degree point, a spring, and a knurled nut. The magnet is square, with mounting holes and a threaded hole in the center. The handle is hollowed out and a sight glass is glued in the hollow. Three scribed lines run the length of the sight glass. The gimbal yoke alinement is packaged in a container that is 24 inches long, 4 inches wide, and 4 inches high. The weight is approximately 8 pounds.



Index No.	Detail No.	Description
1	202	Jaw
	201	Pin
2	203	Handle
3	204	Adapter
	207	Adapter
	206(a)	Container
	205(a)	Plate

(a) Item not illustrated

Figure 2-97. Holding Fixture T-5039534

2-685. OPERATION.

2-686. The gimbal yoke alinement is used to aline the gimbal sections of the hydraulic and pressurization system wrap-around lines. The bracket is placed against the end of the gimbal bearing shaft, with the conical pin in the shaft countersink, the key in the shaft locking plug, and the magnet pressed against the end of the shaft. The alinement is checked by sighting through the sight glass.

2-687. MAINTENANCE.

2-688. There are no special maintenance instructions for the gimbal yoke alinement. Disassemble gimbal yoke alinement, as required, to accomplish necessary repair or replacement. See figure 2-98 for index and detail numbers. Clean gimbal yoke alinement as outlined in R-3896-5, Volume I. Store gimbal yoke alinement in container provided and overpack container for shipment.

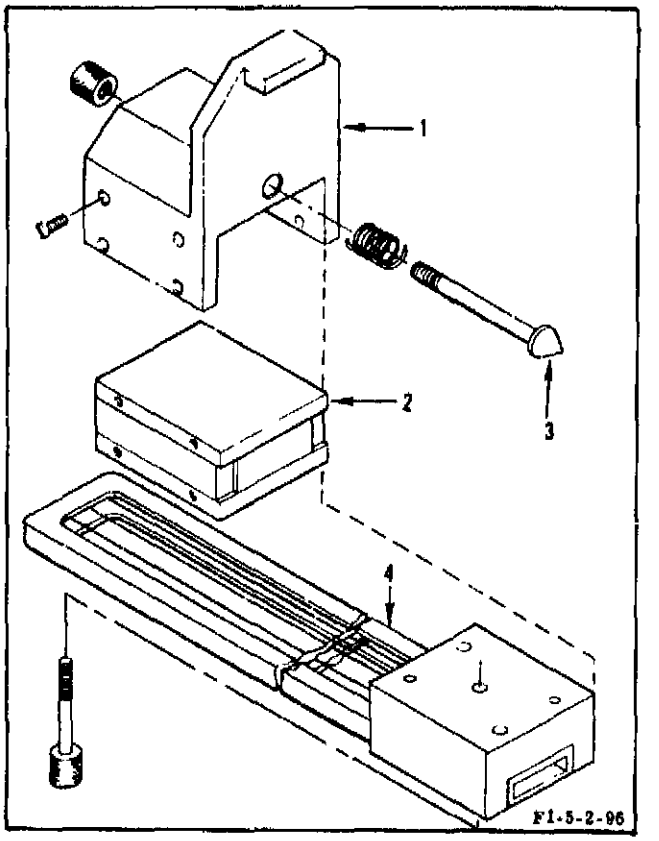
2-689. TORQUE ADAPTER T-5041242.

2-690. DESCRIPTION.

2-691. The torque adapter consists of an offset adapter and a torque handle. The adapter has a rounded end and a 7/16-inch, double hex box end. The torque handle is riveted to the adapter. The torque adapter is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately one pound.

2-692. OPERATION.

2-693. The torque adapter is used to torque the purge check valve mounting bolts on the gas generator.



Index No.	Detail No.	Description
1	201	Bracket
	108	Screw
2	104	Magnet
	204	Pin
3	107	Pin
	203	Rod
	202	Nut
	105	Spring
4	101	Handle
	106	Screw
	110(a)	Container
	109(a)	Plate

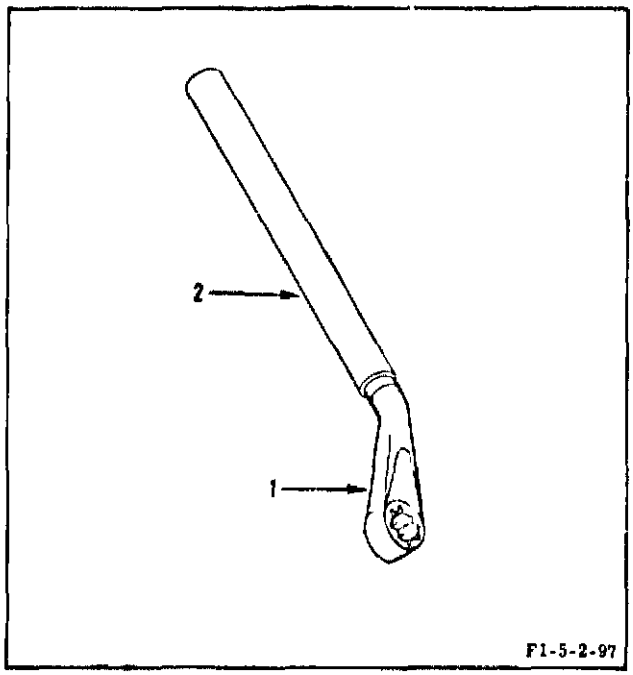
(a) Item not illustrated

Figure 2-98. Gimbal Yoke Alinement T-5041233

2-694. MAINTENANCE.

2-695. There are no special maintenance instructions for the torque adapter, except for servicing. Disassemble torque adapter, as required, to accomplish necessary repair or replacement. See figure 2-99 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.

2-695A. SERVICING. Servicing the torque adapter consists of a calibration check at 6-month intervals for adapters in normal use, and prior to use for adapters in limited use.



Index No.	Detail No.	Description
1	102	Adapter
2	103	Handle
	104(a)	Container
	105(a)	Plate
	106(a)	Plate

(a) Item not illustrated

Figure 2-99. Torque Adapter T-5041242

2-696. DUMMY SEAL SET T-5041258.

2-697. DESCRIPTION.

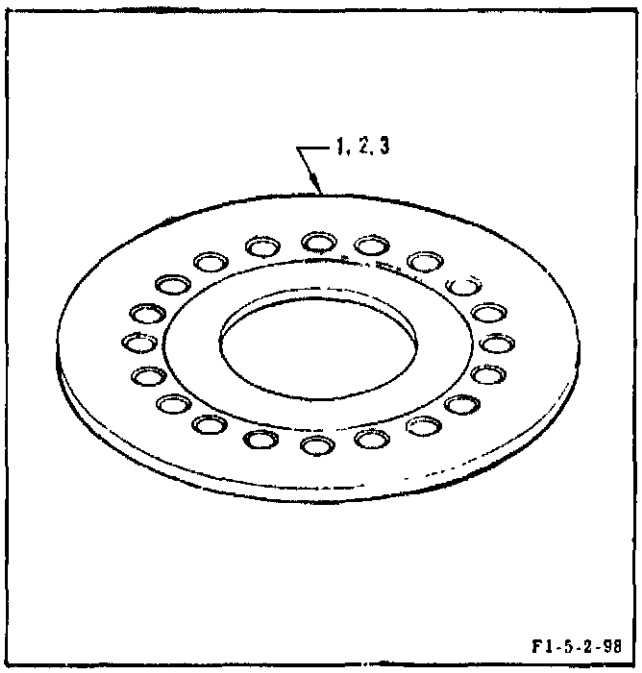
2-698. The dummy seal set consists of three round plates that vary in thickness, diameter, and number of mounting holes. The dummy seal set is packaged in a container that is 14 inches long, 14 inches wide, and 3 inches high. The weight is approximately 20 pounds.

2-699. OPERATION.

2-700. The dummy seal set is used to simulate the seal plates during a fit check of the fuel and oxidizer high-pressure ducts. The dummy seal is inserted between the turbopump outlet flange and the duct and between the fuel or oxidizer valve flange and the duct.

2-701. MAINTENANCE.

2-702. There are no special maintenance instructions for the dummy seal set. See figure 2-100 for index and detail numbers. Clean dummy seal set as outlined in R-3896-5, Volume I. Store dummy seal set in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
2	102	Plate
3	105	Plate
	104(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-100. Dummy Seal Set T-5041258

2-703. TORQUE ADAPTER T-5041277.

2-704. DESCRIPTION.

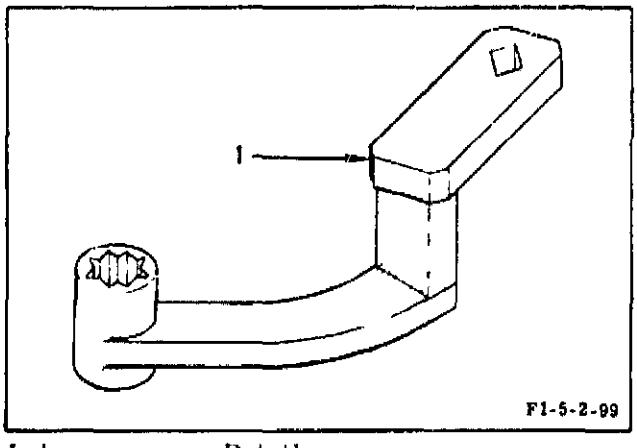
2-705. The torque adapter consists of a wrenching socket welded to the end of a curved steel bar that has two steel bars welded, in a step arrangement, on the other end. The torque adapter is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately one pound.

2-706. OPERATION.

2-707. The torque adapter is used to torque the mounting bolts of the fuel high-pressure ducts to turbopump volutes.

2-708. MAINTENANCE.

2-709. There are no special maintenance instructions for the torque adapter. See figure 2-101 for index and detail numbers. Clean torque adapter as outlined in R-3896-5, Volume I. Store torque adapter in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Adapter
	106(a)	Container
	107(a)	Plate

(a) Item not illustrated

Figure 2-101. Torque Adapter T-5041277

2-710. ACTUATOR INSTALLATION TOOL T-5041500.

2-711. DESCRIPTION.

2-712. The actuator installation tool consists of a threaded shaft with a tee handle and a nylon plug. The function of the actuator installation tool is to remove a part from inside a cylinder. The tool is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-713. OPERATION.

2-714. The actuator installation tool is used to remove and install the actuator from a cylinder of the four-way solenoid valve. The tool is installed in the actuator and the handle rotated while holding the nut on the threaded shaft. This compresses the nylon plug of the tool, expanding the plug against the inner wall of the actuator. The actuator can then be removed from or installed in the cylinder of the valve.

2-715. MAINTENANCE.

2-716. There are no special maintenance instructions for the actuator installation tool. Disassemble actuator installation tool, as required, to accomplish necessary repair or replacement. See figure 2-102 for index and detail numbers. Clean actuator installation tool as outlined in R-3896-5, Volume I. Store actuator installation tool in container provided and overpack container for shipment.

2-717. ASSEMBLY JIG T-5041501.

2-718. DESCRIPTION.

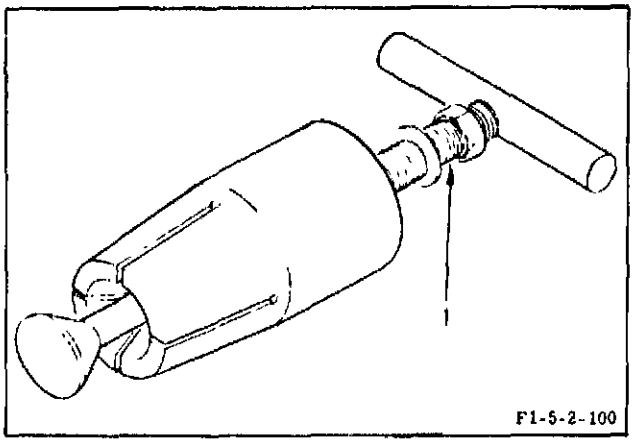
2-719. The assembly jig consists of a jack screw, support, and leveling foot. The function of the assembly jig is to press parts into a cylinder. The assembly jig is packaged in a container that is 12 inches long, 4 inches wide, and 4 inches high. The weight is approximately 3 pounds.

2-720. OPERATION.

2-721. The assembly jig is used to install parts in a cylinder of the engine control valve. The legs of the support are threaded into holes in the body of the valve. The parts are assembled and pressed into the cylinder by rotating the screw jack.

2-722. MAINTENANCE.

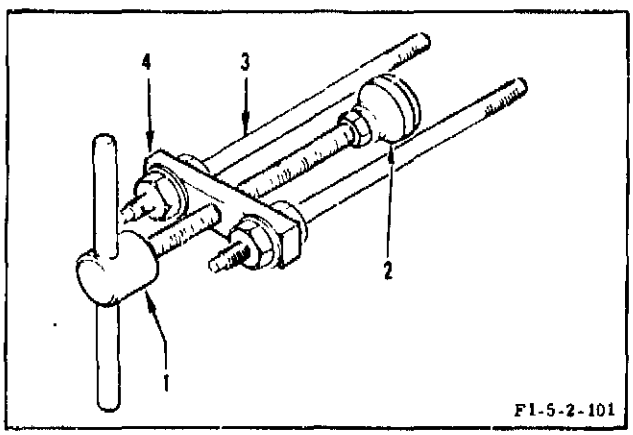
2-723. There are no special maintenance instructions for the assembly jig. Disassemble assembly jig, as required, to accomplish necessary repair or replacement. See figure 2-103 for index and detail numbers. Clean assembly jig and apply dry-film lubricant RB0140-007 (Rocketdyne) to threads of plate (4), jack screw (1), and leg (3) after cleaning or when film is removed by wear or damage, as outlined in R-3896-5, Volume I. Store assembly jig in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	104	Shaft
	105	Nut
	106	Washer
	107	Plug
	102(a)	Container
	101(a)	Plate

(a) Item not illustrated

Figure 2-102. Actuator Installation Tool T-5041500



Item No.	Detail No.	Description
1	207	Jack screw
2	202	Foot
	201	Pad
	None	Screw
3	203	Leg
4	205	Plate
	204	Nut
	206	Washer
	211(a)	Container
	210(a)	Plate

(a) Item not illustrated

Figure 2-103. Assembly Jig T-5041501

2-724. FLOW TEST FIXTURE T-5041506.

2-725. DESCRIPTION.

2-726. The flow test fixture consists of a flat plate, hat section, seals, fittings, and attaching hardware. The function of the flow test fixture is to enclose a component during flow testing. The flow test fixture is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 30 pounds.

2-727. OPERATION.

2-728. The flow test fixture is used to enclose the oxidizer valve piston for flow testing. The piston is placed inside the hat section of the fixture and retained in place by attaching the plate of the fixture to the flange of the hat section. Hydraulic fluid flows into the piston through fittings on the fixture.

2-729. MAINTENANCE.

2-730. There are no special maintenance instructions for the flow test fixture. Disassemble flow test fixture, as required, to accomplish necessary repair or replacement. See figure 2-104 for index and detail numbers. Clean flow test fixture as outlined in R-3896-5, Volume I. Store flow test fixture in container provided and overpack container for shipment.

2-731. FLOW TEST FIXTURE T-5041507.

2-732. DESCRIPTION.

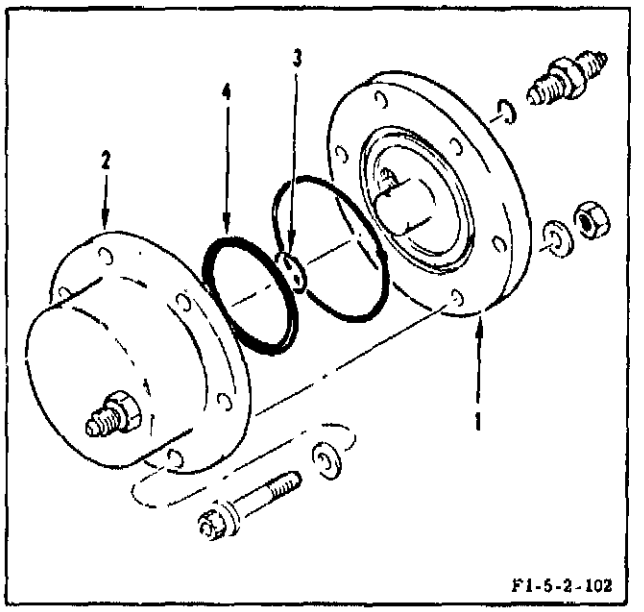
2-733. The flow test fixture consists of a plate, hat section, fittings, and attaching hardware. The function of the flow test fixture is to enclose a component during flow testing. The flow test fixture is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 8 pounds.

2-734. OPERATION.

2-735. The flow test fixture is used to enclose the fuel valve piston for flow testing. The piston is placed inside the hat section and retained in place by attaching the plate of the fixture to the flange of the hat section. Hydraulic fluid flows into the piston through fittings on the fixture.

2-736. MAINTENANCE.

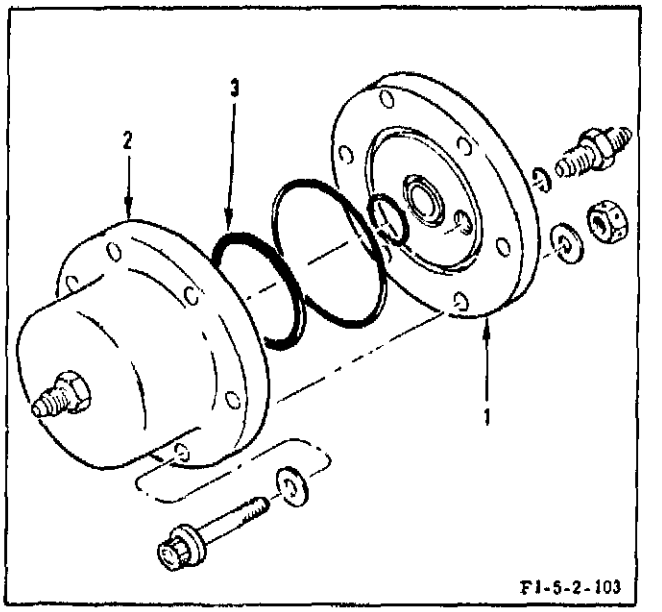
2-737. There are no special maintenance instructions for the flow test fixture. Disassemble flow test fixture, as required, to accomplish necessary repair or replacement. See figure 2-105 for index and detail numbers. Clean flow test fixture as outlined in R-3896-5, Volume I. Store flow test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
	103	Union
	104	O-ring
	107	O-ring
2	102	Hat section
	103	Union
	104	O-ring
	108	Nut
	109	Washer
	110	Bolt
3	105	O-ring
4	106	O-ring
	112(a)	Container
	111(a)	Plate

(a) Item not illustrated

Figure 2-104. Flow Test Fixture T-5041506



Index No.	Detail No.	Description
1	101	Plate
	103	Union
	104	O-ring
	110	O-ring
	111	O-ring
2	102	Hat section
	103	Union
	104	O-ring
	105	Bolt
	106	Washer
	107	Washer
	108	Nut
3	109	O-ring
	113(a)	Container
	112(a)	Plate

(a) Item not illustrated

Figure 2-105. Flow Test Fixture T-5041507

2-738. DIMPLING TOOL T-5041512.

2-739. DESCRIPTION.

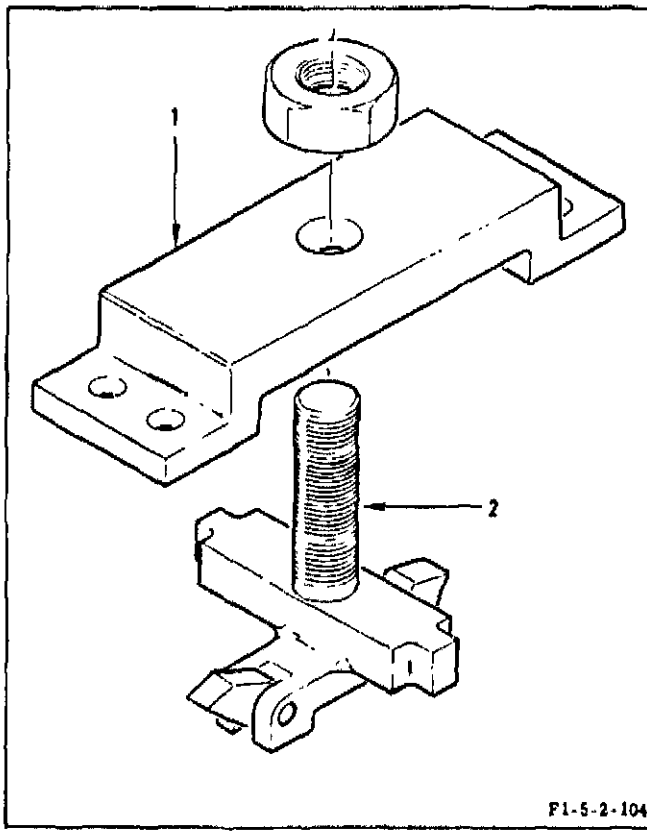
2-740. The dimpling tool consists of a frame and a threaded, tee-shaped shaft with rotating wedges at each end of the tee. The function of the dimpling tool is to deform an internal part of a component. The dimpling tool is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 5 pounds.

2-741. OPERATION.

2-742. The dimpling tool is used to deform a washer in the fuel valve so that the deformations engage slots in an adjacent retainer. The tool is installed in the opening of the valve with the frame resting on the flange. The shaft length is adjusted with a nut so that the ends of the wedges are positioned at the lower edge of the washers and in line with two of the slots in the retainer. As the shaft nut is tightened, the wedges deform the washer, pressing the washer material into the slots of the retainer.

2-743. MAINTENANCE.

2-744. There are no special maintenance instructions for the dimpling tool. Disassemble dimpling tool, as required, to accomplish necessary repair or replacement. See figure 2-106 for index and detail numbers. Clean dimpling tool as outlined in R-3896-5, Volume I. Store dimpling tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Frame
2	105	Tee
	102	Pin
	104	Wedge
	103	Nut
	109(a)	Container
	108(a)	Plate
	110(a)	Plate

(a) Item not illustrated

Figure 2-106. Dimpling Tool T-5041512

2-745. BALL CLOCKING TOOL T-5041515.

2-746. DESCRIPTION.

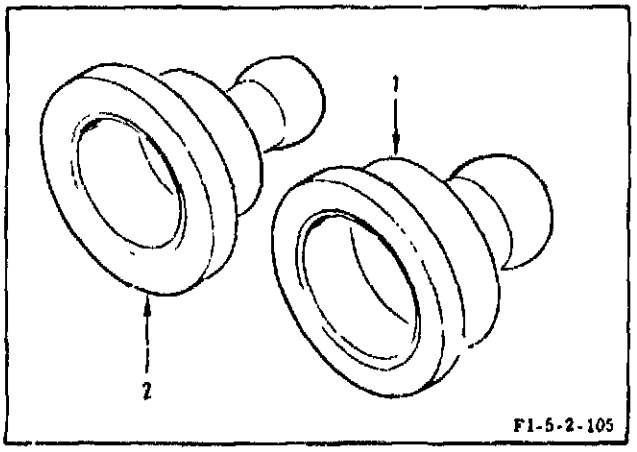
2-747. The ball clocking tool consists of two flanged tools with spherical ends. The function of the ball clocking tool is to provide a means of determining the position of an internal part. The ball clocking tool is packaged in a container that is 8 inches long, 4 inches wide, and 4 inches high. The weight is approximately 2 pounds.

2-748. OPERATION.

2-749. The ball clocking tool is used to determine the alinement of the fuel and LOX balls of the gas generator ball valve. The tools are inserted into the valve housing openings so that the spherical ends engage the openings in the respective ball valves.

2-750. MAINTENANCE.

2-751. There are no special maintenance instructions for the ball clocking tool. Disassemble ball clocking tool, as required, to accomplish necessary repair or replacement. See figure 2-107 for index and detail numbers. Clean ball clocking tool as outlined in R-3896-5, Volume I. Store ball clocking tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Clocking tool (fuel)
2	102	Clocking tool (LOX)
	104(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-107. Ball Clocking Tool T-5041515

2-752. PRESSURE TEST FIXTURE T-5041516.

2-753. DESCRIPTION.

2-754. The pressure test fixture consists of three test plates. Two plates are equipped with a capped fitting. The function of the pressure test fixture is to provide a method to seal openings of a hydraulic line during pressure testing. The fixture is packaged in a container that is 12 inches long, 8 inches wide, and 6 inches high. The weight is approximately 12 pounds.

2-755. OPERATION.

2-756. The pressure test fixture is used to close openings of the hydraulic return line during pressure testing of the line. The test plates are bolted to the line flanges. Pressure is introduced through the fittings of the larger test plate.

2-757. MAINTENANCE.

2-758. There are no special maintenance instructions for the pressure test fixture. Disassemble pressure test fixture, as required, to accomplish necessary repair or replacement. See figure 2-108 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.

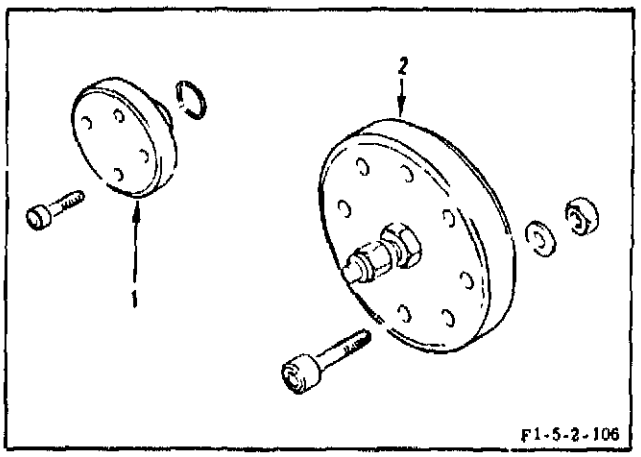


Figure 2-108. Pressure Test Fixture T-5041516 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	107	Plate
	108	Screw
	109	O-ring
2	110	Plate
	101	O-ring
	102	Cap
	103	Union
	104	Nut
	105	Washer
	106	Bolt
	111	O-ring
	112(a)	Container
	113(a)	Plate

(a) Item not illustrated

Figure 2-108. Pressure Test Fixture T-5041516 (Sheet 2 of 2)

2-759. PRESSURE TEST FIXTURE T-5041521.

2-760. DESCRIPTION.

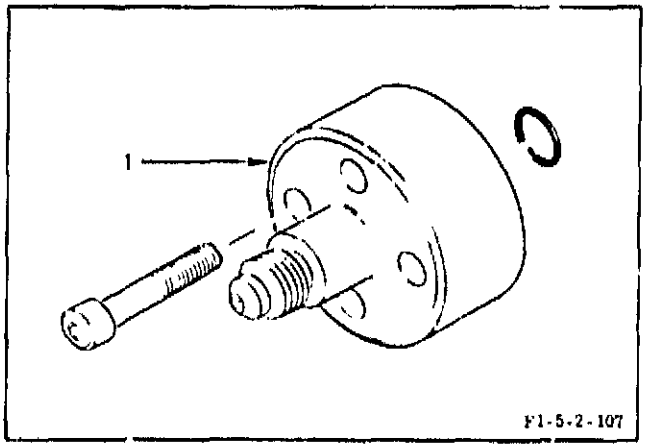
2-761. The pressure test fixture consists of two test plates. Each plate is 1-1/2 inches in diameter and contains a threaded boss. The function of the pressure test fixture is to seal openings of a component for pressure testing. The pressure test fixture is packaged in a container. Each test plate is 1-1/2 inches long, 1-1/2 inches wide, and 1-3/4 inches high. The weight is approximately 4 pounds.

2-762. OPERATION.

2-763. The pressure test fixture test plates are used to seal openings of the three-way solenoid valve for pressure testing. The plates are bolted to the valve openings and test fluid is applied at the test plate boss.

2-764. MAINTENANCE.

2-765. There are no special maintenance instructions for the pressure test fixture. See figure 2-109 for index and detail numbers. Clean pressure test fixture as outlined in R-3896-5, Volume I. Store pressure test fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Plate
	102	O-ring
	103	Screw
	None(a)	Container
	104(a)	Plate

(a) Item not illustrated

Figure 2-109. Pressure Test Fixture T-5041521

2-766. ASSEMBLY TOOL T-5041524.

2-767. DESCRIPTION.

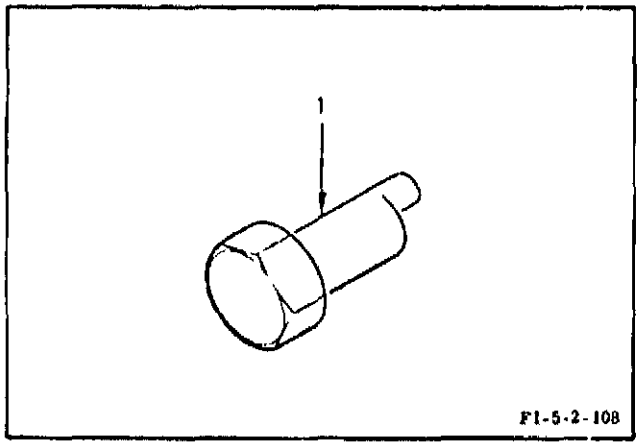
2-768. The assembly tool consists of a hex-head adapter 1-1/2 inches in length. The shank end is milled off center. The function of the tool is to provide an adaptation for wrenches. The assembly tool is packaged in a container that is 1-1/2 inches long 3/4 inch wide, and 7/8 inch high. The weight is 4 ounces.

2-769. OPERATION.

2-770. The assembly tool is used to install or remove the seat of the LOX purge check valve. The tool is installed in the seat and a wrench is attached to the tool.

2-771. MAINTENANCE.

2-772. There are no special maintenance instructions for the assembly tool. See figure 2-110 for index and detail numbers. Clean assembly tool as outlined in R-3896-5, Volume I. Store assembly tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Tool
	None(a)	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-110. Assembly Tool T-5041524

2-773. CLEARANCE PINS T-5041812.

2-774. DESCRIPTION.

2-775. The clearance pins consist of 21 pins with handles. Each pin is 11-1/2 inches long. Pin diameters range from 0.1600 ±0.0005 inch to 0.2000 ±0.0005 inch in 0.0020-inch increments. The function of the clearance pins is to measure a clearance inside the turbopump. The clearance pins are packaged in a container that is 14 inches long, 4 inches wide, and 4 inches high.

2-776. OPERATION.

2-777. The clearance pins are used to measure the clearance between the turbopump oxidizer inducer and the wall of the oxidizer inlet.

2-778. MAINTENANCE.

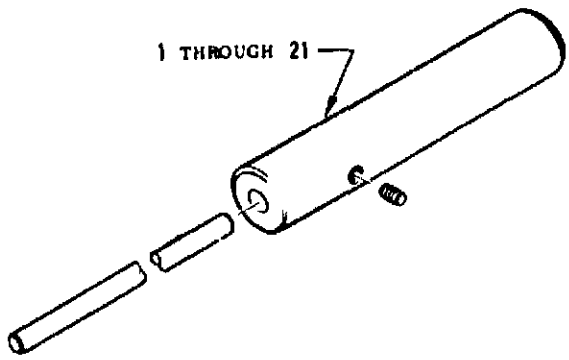
2-779. There are no special maintenance instructions for the clearance pins. Disassemble clearance pins, as required, to accomplish necessary repair or replacement. See figure 2-111 for index and detail numbers. Clean clearance pins as outlined in R-3896-5, Volume I. Store clearance pins in container provided and overpack container for shipment.

2-780. SERVICING. Servicing the clearance pins consists of a dimensional check using a micrometer, performed by Quality Control prior to use. The dimensional check must be substantiated by application of a calibration decal on the periodic inspection record plate. See figure 2-112 for dimensions.

2-781. HAND FACING TOOL T-5043020.

2-782. DESCRIPTION.

2-783. The hand facing tool consists of a frame and a rotating sanding disc that slides across the bars of the frame. The functions of the tool are to abrasively remove metal and parallel the surfaces. The hand facing tool is packaged in a container that is 20 inches long, 12 inches wide, and 10 inches high. The weight is approximately 52 pounds.



Index No.	Detail No.	Description
1	101	Clearance pin
	122	Pin
	143	Handle
	164	Screw
2	102	Clearance pin
	123	Pin
	144	Handle
	164	Screw
3	103	Clearance pin
	124	Pin
	145	Handle
	164	Screw
4	104	Clearance pin
	125	Pin
	146	Handle
	164	Screw
5	105	Clearance pin
	126	Pin
	147	Handle
	164	Screw
6	106	Clearance pin
	127	Pin
	148	Handle
	164	Screw
7	107	Clearance pin
	128	Pin
	149	Handle
	164	Screw
8	108	Clearance pin
	129	Pin
	150	Handle
	164	Screw
9	109	Clearance pin
	130	Pin
	151	Handle
	164	Screw
10	110	Clearance pin
	131	Pin
	152	Handle
	164	Screw
11	111	Clearance pin
	132	Pin
	153	Handle
	164	Screw
12	112	Clearance pin
	133	Pin
	154	Handle
	164	Screw
13	113	Clearance pin
	134	Pin
	155	Handle
	164	Screw
14	114	Clearance pin
	135	Pin
	156	Handle
	164	Screw
15	115	Clearance pin
	136	Pin
	157	Handle
	164	Screw
16	116	Clearance pin
	137	Pin
	158	Handle
	164	Screw
17	117	Clearance pin
	138	Pin
	159	Handle
	164	Screw
18	118	Clearance pin
	139	Pin
	160	Handle
	164	Screw
19	119	Clearance pin
	140	Pin
	161	Handle
	164	Screw
20	120	Clearance pin
	141	Pin
	162	Handle
	164	Screw

Figure 2-111. Clearance Pins T-5041812 (Sheet 1 of 2)

Index No.	Detail No.	Description
21	121	Clearance pin
	142	Pin
	163	Handle
	164	Screw
	None[a]	Container
	165[a]	Plate
	166[a]	Plate

(a) Item not illustrated

Figure 2-111. Clearance Pins T-5041812 (Sheet 2 of 2)

Detail No.	Diameter (±0.0005 Inch)
122	0.1600
123	0.1620
124	0.1640
125	0.1660
126	0.1680
127	0.1700
128	0.1720
129	0.1740
130	0.1760
131	0.1780
132	0.1800
133	0.1820
134	0.1840
135	0.1860
136	0.1880
137	0.1900
138	0.1920
139	0.1940
140	0.1960
141	0.1980
142	0.2000

Figure 2-112. Clearance Pin Dimensions

2-784. OPERATION.

2-785. The hand facing tool is used to parallel and finish the interface surfaces of the thrust chamber that are used for mounting the three thrust OK pressure switches. The tool is attached to the dome bolts when the dome and injector are installed. An additional plate is used to simulate the dome and injector thickness when they are not installed. The tool contains slotted holes for adjustment, and a collar on the sanding disc shaft is adjusted in relation to the amount of metal removal desired. A drill motor is attached to the shank of the sanding disc, and the sanding disc is moved across the interfaces on the parallel bars of the tool.

2-786. MAINTENANCE.

2-787. There are no special maintenance instructions for the hand facing tool. Disassemble hand facing tool, as required, to accomplish necessary repair or replacement. See figure 2-113 for index and detail numbers. Clean external surfaces of tool parallel bars with preservative WD-40 (Rocket Chemical Co); then wipe surfaces dry with a clean, white nylon cloth. Store hand facing tool in container provided and overpack container for shipment.

2-788. SHIM T-5043413.

2-789. DESCRIPTION.

2-790. The shim consists of two flat, circular steel plates. One plate is 11 inches in diameter and 0.375 inch thick. The other plate is 13 inches in diameter and 0.173 inch thick. The function of the shim is to simulate engine seal plates. The shim is packaged in a container that is 15 inches long, 15 inches wide, and 3-1/2 inches high. The weight is approximately 8 pounds.

2-791. OPERATION.

2-792. The applicable shim is used to simulate the fuel-valve-to-fuel-manifold seal plate or the oxidizer-valve-to-oxidizer-dome seal plate during alinement of engine propellant valves and ducts.

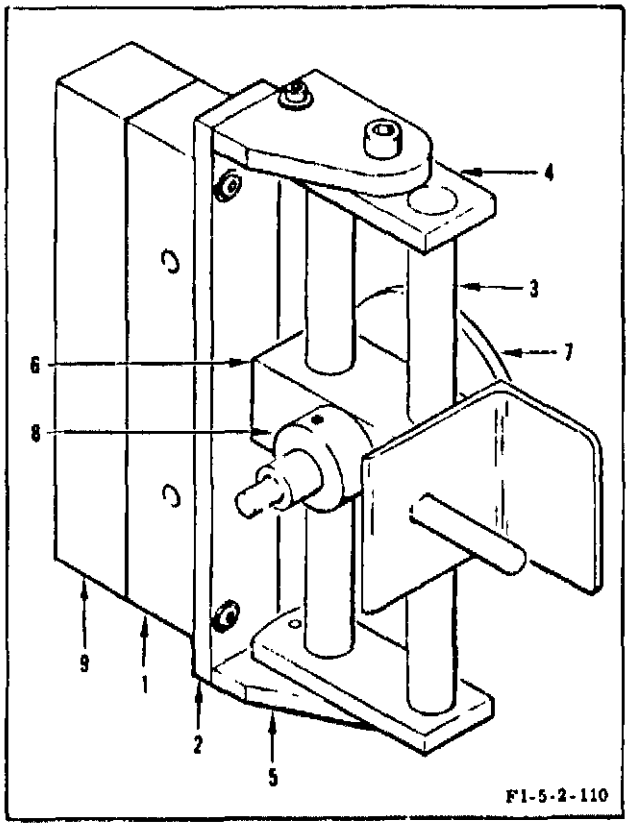
2-793. MAINTENANCE.

2-794. There are no special maintenance instructions for the shims. See figure 2-114 for index and detail numbers. Clean shims for applicable service as outlined in R-3896-5, Volume I. Store shim in container provided and overpack container for shipment.

2-795. APPLY JIG T-5043430.

2-796. DESCRIPTION.

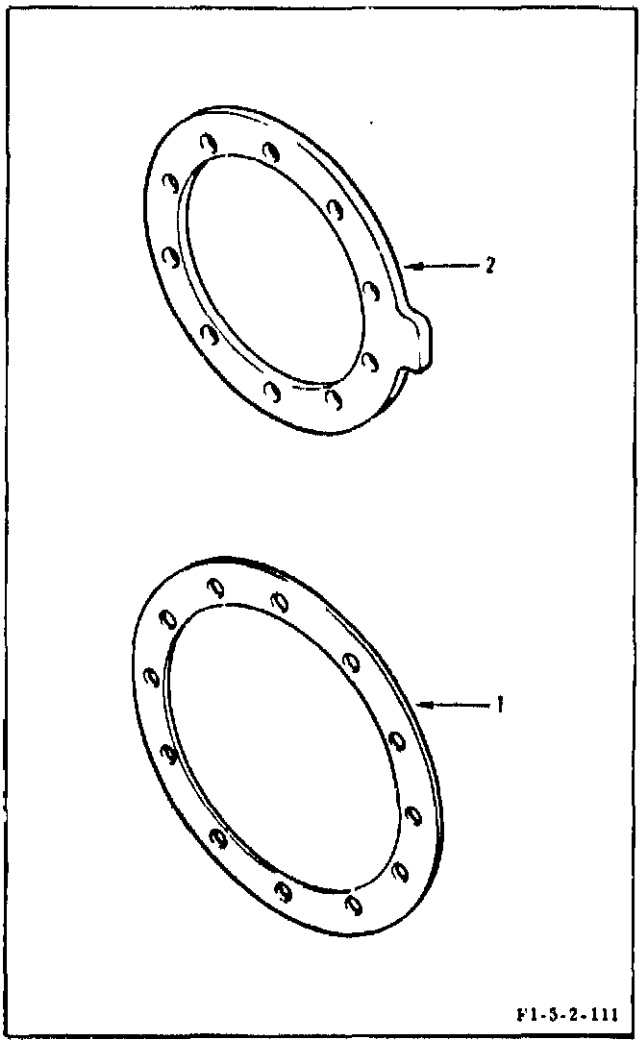
2-797. The apply jig consists of a curved plate and a flat plate fastened together to form a shallow arc. Knurled screws and bushings are attached to the plates. The jig is approximately 33 inches long. The function of the apply jig is to locate areas in which holes are to be drilled. The apply jig is packaged in a container that is 36 inches long, 8 inches wide, and 6 inches high. The weight is approximately 10 pounds.



Index No.	Detail No.	Description
1	101	Plate
2	102	Plate
	107	Screw
	112	Washer
	116	Pin
3	105	Bar
4	104	Plate
5	111	Plate
	103	Screw
	106	Screw
	112	Washer
6	110	Block
7	113	Disc
8	115	Collar
	114	Screw
9	117	Plate
	119(a)	Container
	118(a)	Plate
	120(a)	Plate

(a) Item not illustrated

Figure 2-113. Hand Facing Tool T-5043020



Index No.	Detail No.	Description
1	101	Shim (LOX)
2	102	Shim (Fuel)
	104(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-114. Shim T-5043413

2-798. OPERATION.

2-799. The apply jig is used to locate areas for drilling holes in a hatband of the nozzle extension. The jig is fastened over the hatband using knurled, threaded screws and a clamp. Holes are then drilled in the hatband through the pilot holes in the jig.

2-800. MAINTENANCE.

2-801. There are no special maintenance instructions for the apply jig. Disassemble apply jig, as required, to accomplish necessary repair or replacement. See figure 2-115 for index and detail numbers. Clean apply jig as outlined in R-3896-5, Volume I. Store apply jig in container provided and overpack container for shipment.

2-802. SEAL INSTALLATION TOOL T-5044645.

2-803. DESCRIPTION.

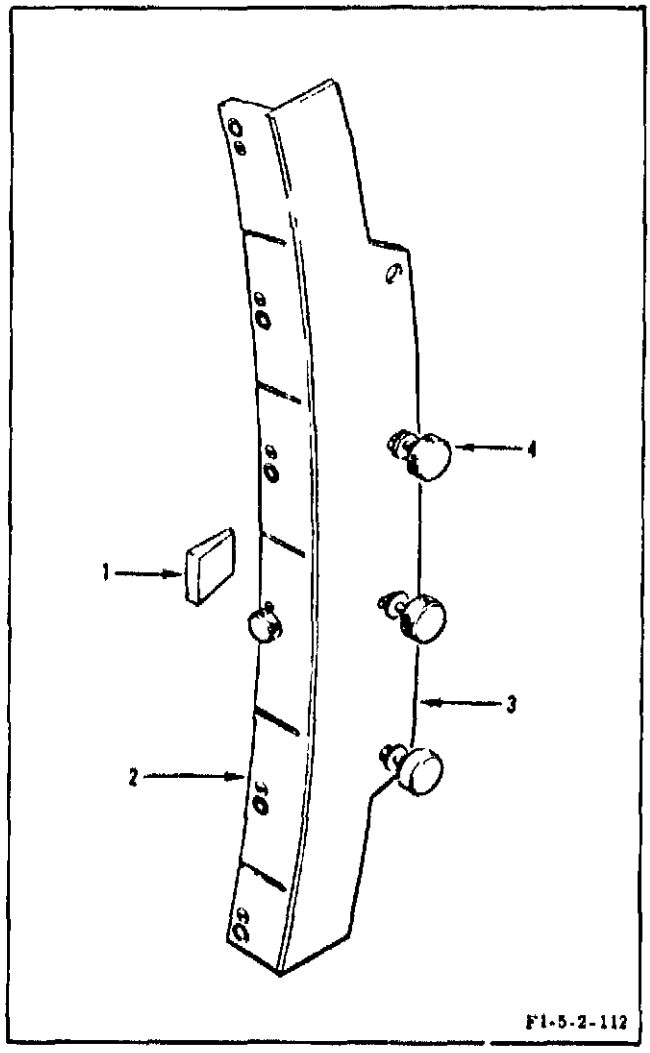
2 804. The seal installation tool consists of a sleeve 5-1/8 inches in diameter and 2 inches in height. The function of the tool is to provide a method for installing a seal. The tool is packaged in a container that is 8 inches long, 6 inches wide, and 4 inches high. The weight is approximately 4 pounds.

2-805. OPERATION.

2-806. The seal installation tool is used to install a tool on the turbopump oxidizer shaft. The recessed end of the tool fits over the perimeter of the seal and the seal and tool fit around the shaft.

2-807. MAINTENANCE.

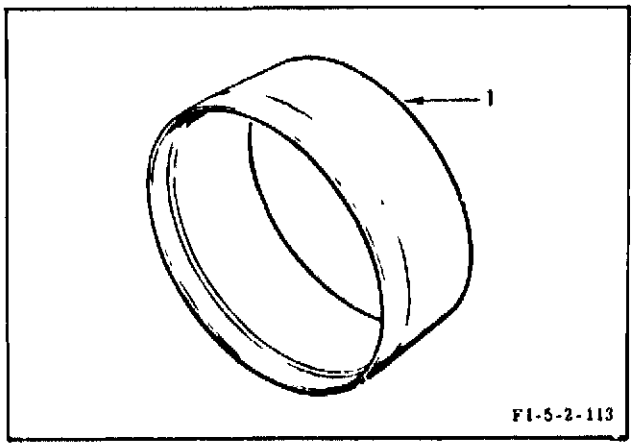
2-808. There are no special maintenance instructions for the seal installation tool. See figure 2-116 for index and detail numbers. Clean seal installation tool as outlined in R-3896-5, Volume I. Store seal installation tool in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Pad
2	106	Side plate
	102	Screw
	103	Bushing
	107	Bushing
3	111	Top plate
	None	Screw
	114	Block
4	108	Screw
	109	Screw
	110	Washer
	116(a)	Container
	117(a)	Plate

(a) Item not illustrated

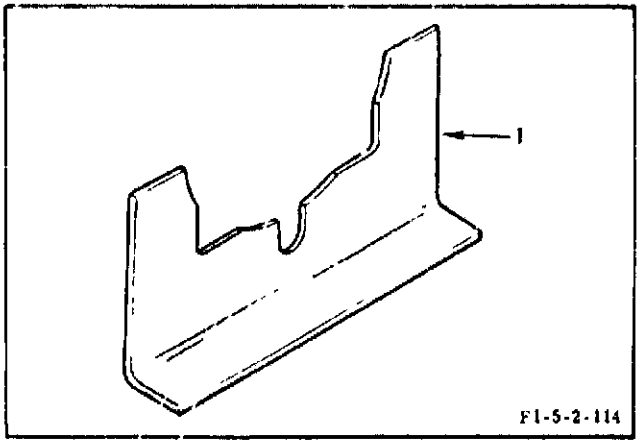
Figure 2-115. Apply Jig T-5043430



Index No.	Detail No.	Description
1	101	Tool
	None	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-116. Seal Installation Tool T-5044645



Index No.	Detail No.	Description
1	101(a)	Template
	103(a)	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-117. Template T-5044716

2-809. TEMPLATE T-5044716.

2-810. DESCRIPTION.

2-811. The template consists of a sheet-aluminum-alloy angle, 6-1/2 inches wide and 3-1/2 inches high. The function of the template is to position seals. The template is packaged in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately one pound.

2-812. OPERATION.

2-813. The template is used to position seals at the heat exchanger LOX-in and GOX-out flanges when installing the heat exchanger ducts and hoses.

2-814. MAINTENANCE.

2-815. There are no special maintenance instructions for the template. See figure 2-117 for index and detail numbers. Clean template as outlined in R-3896-5, Volume I. Store template in container provided and overpack container for shipment.

2-816. TEMPLATE T-5044717.

2-817. DESCRIPTION.

2-818. The template consists of a sheet-aluminum-alloy angle 6 inches wide and 3-1/2 inches high. The function of the template is to position seals. The template is packaged in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately one pound.

2-819. OPERATION.

2-820. The template is used to position the seal at the helium outlet flange of the heat exchanger when installing the helium return duct.

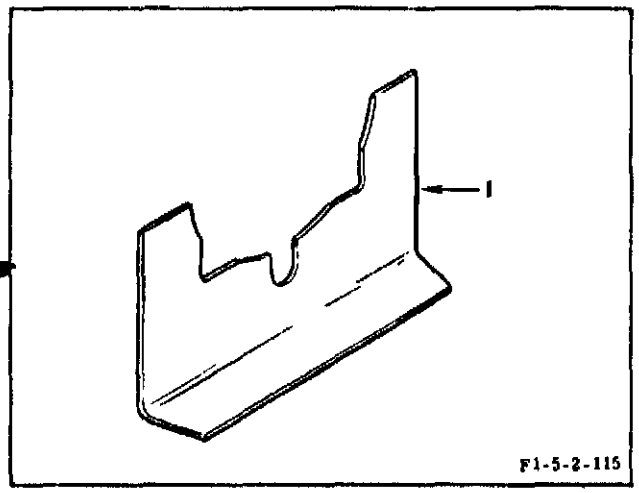
2-821. MAINTENANCE.

2-822. There are no special maintenance instructions for the template. See figure 2-118 for index and detail numbers. Clean template as outlined in R-3896-5, Volume I. Store template in container provided and overpack container for shipment.

2-823. ALINEMENT GAGE T-5044743.

2-824. DESCRIPTION.

2-825. The alinement gage consists of 13 flat steel plates. Each plate is approximately 4-1/2 inches long, 1-3/4 inches wide, and 1/10 inch thick and incorporates scribed lines and a button for alinement purposes. Location of use is stamped on each gage. The function of the gage is to determine alinement of interfaces. The gage is packaged in a container that is 8 inches long, 8 inches wide, and 4 inches high. The weight is approximately 3 pounds.



Index No.	Detail No.	Description
1	101	Template
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

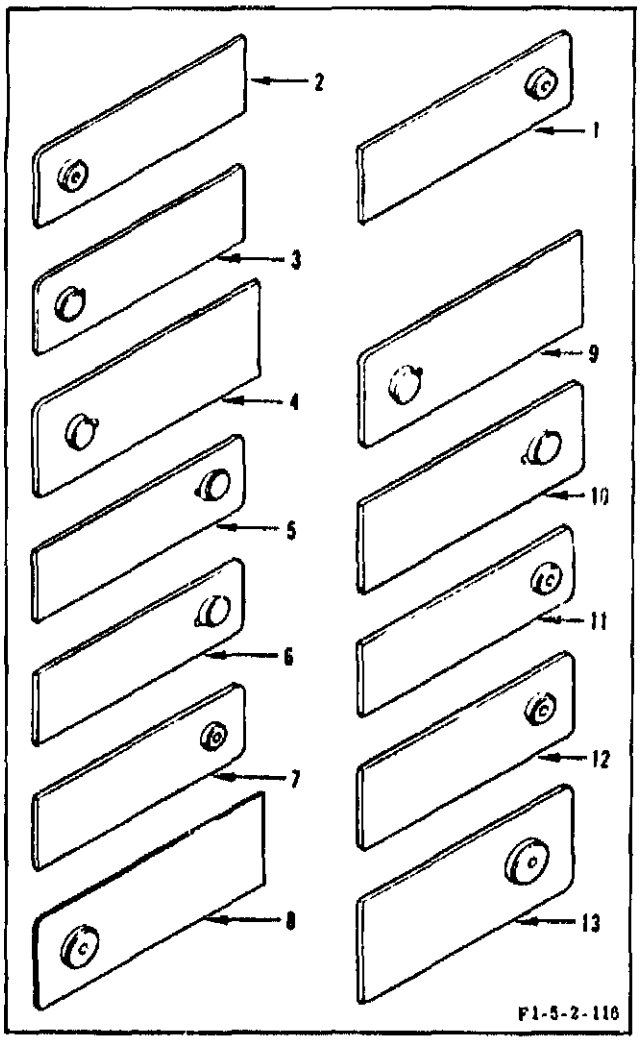
Figure 2-118. Template T-5044717

2-826. OPERATION.

2-827. The alinement gage is used to determine that the allowable lateral misalinement of line flanges is not exceeded. The applicable gage is inserted between interfaces with the button in the opening of the boss. The line flange must fall within the scribed circle on the gage.

2-828. MAINTENANCE.

2-829. There are no special maintenance instructions for the alinement gage except for a dimensional check of critical surfaces, which must be conducted at 6-month intervals. All gages must be flat and parallel within 0.0005 inch total. See figure 2-119 for index and detail numbers. Clean alinement gage as outlined in R-3896-5, Volume I. Store alinement gage in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	201	Gage
2	202	Gage
3	203	Gage
4	207	Gage
5	211	Gage
6	215	Gage
7	219	Gage
8	220	Gage
9	301	Gage
10	305	Gage
11	309	Gage
12	310	Gage
13	311	Gage
	102(a)	Container
	101(a)	Plate
	103(a)	Plate

(a) Item not illustrated

Figure 2-119. Alinement Gage T-5044743

2-830. CHECK FIXTURE T-5044956.

2-831. DESCRIPTION.

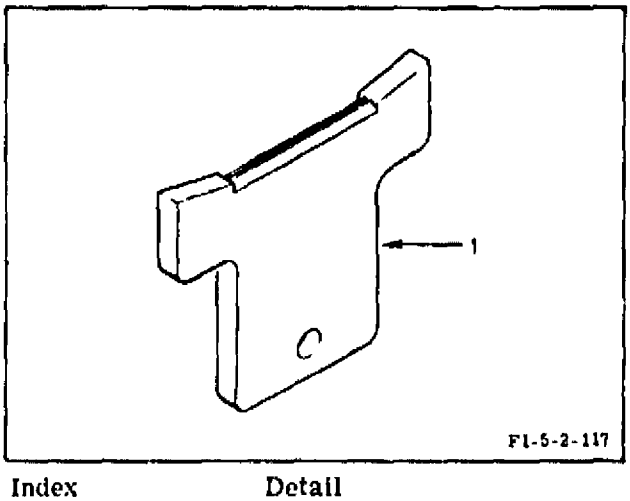
2-832. The check fixture consists of a metal plate 2-3/4 inches wide, 2-3/8 inches high, and 1/4 inch thick. The function of the gage is indicated on the limit of deformation of a port. The check fixture is packaged in a container that is 6 inches long, 4 inches wide, and 2 inches high. The weight is approximately one pound.

2-833. OPERATION.

2-834. The check fixture is used to check deformations (bulges) of the thrust chamber injector baffles after hot-firing. The gage is applied at the deformed area. The bulge cannot exceed the depth of the recessed area of the check fixture.

2-835. MAINTENANCE.

2-836. There are no special maintenance instructions for the check fixture. See figure 2-120 for index and detail numbers. Clean check fixture as outlined in R-3896-5, Volume I. Store check fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101(a)	Fixture
	102(a)	Container
	103(a)	Plate

(a) Item not illustrated

Figure 2-120. Check Fixture T-5044956

2-837. WASHER T-5046431.

2-838. DESCRIPTION.

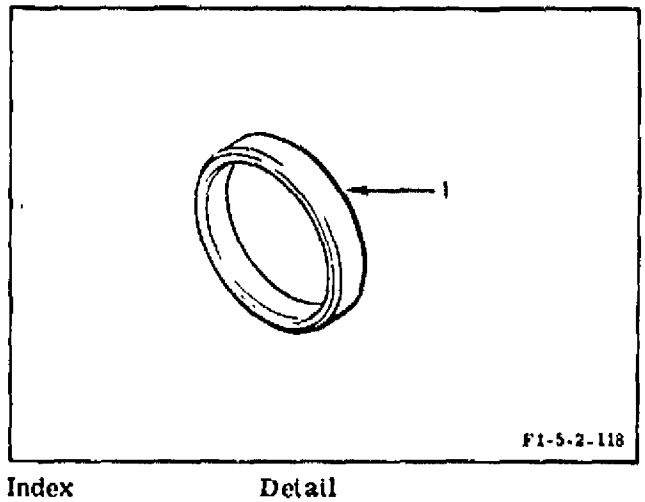
2-839. The washer consists of a steel ring with the following dimensions: thickness, 0.245 inch; outer diameter, 1.312 inches; inner diameter, 1.020 inches. The function of the washer is to act as a spacer. The washer is packaged in a container that is 1-5/16 inches in diameter and 1/4 inch thick. The weight is approximately 3 ounces.

2-840. OPERATION.

2-841. The washer is used to obtain acceptable axial dimensions between the collar of the shaft and the tubular spacer of the thrust chamber throat plug when the throat plug is being installed in the thrust chamber.

2-842. MAINTENANCE.

2-843. There are no special maintenance instructions for the washer. See figure 2-121 for index and detail numbers. Clean washer as outlined in R-3896-5, Volume I. Store washer in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	101	Washer
	None	Container
	102(a)	Plate

(a) Item not illustrated

Figure 2-121. Washer T-5046431

2-843A. CALIBRATION STANDARD T-5047801.

2-843B. DESCRIPTION.

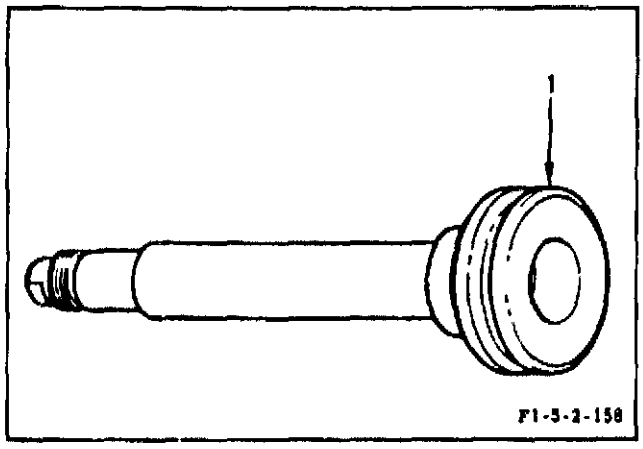
2-843C. The calibration standard consists of a machined piston with threads on one end and a seal groove on the other end. Four close-tolerance passages are drilled through the seal end. The piston is 9.5 inches long and 2.623 inches in diameter. The piston weighs approximately 2 pounds.

2-843D. OPERATION.

2-843E. The calibration standard is used to verify required flow from facility hydraulic system. The piston is installed into fixture T-5041507, and the calibrated flow through the piston is checked against the flow-measuring instruments to verify accuracy.

2-843F. MAINTENANCE.

2-843G. There are no special maintenance instructions for the calibration standard. Clean calibration standard as outlined in R-3396-5, Volume I. Store calibration standard in container provided, and overpack container for shipment. See figure 2-121A for index and detail numbers.



Index No.	Detail No.	Description
1	101	Piston
	102(a)	Plate

(a) Item not illustrated

Figure 2-121A. Calibration Standard T-5047801

2-843H. FLANGE POLISHING TOOL T-5047802.

2-843J. DESCRIPTION.

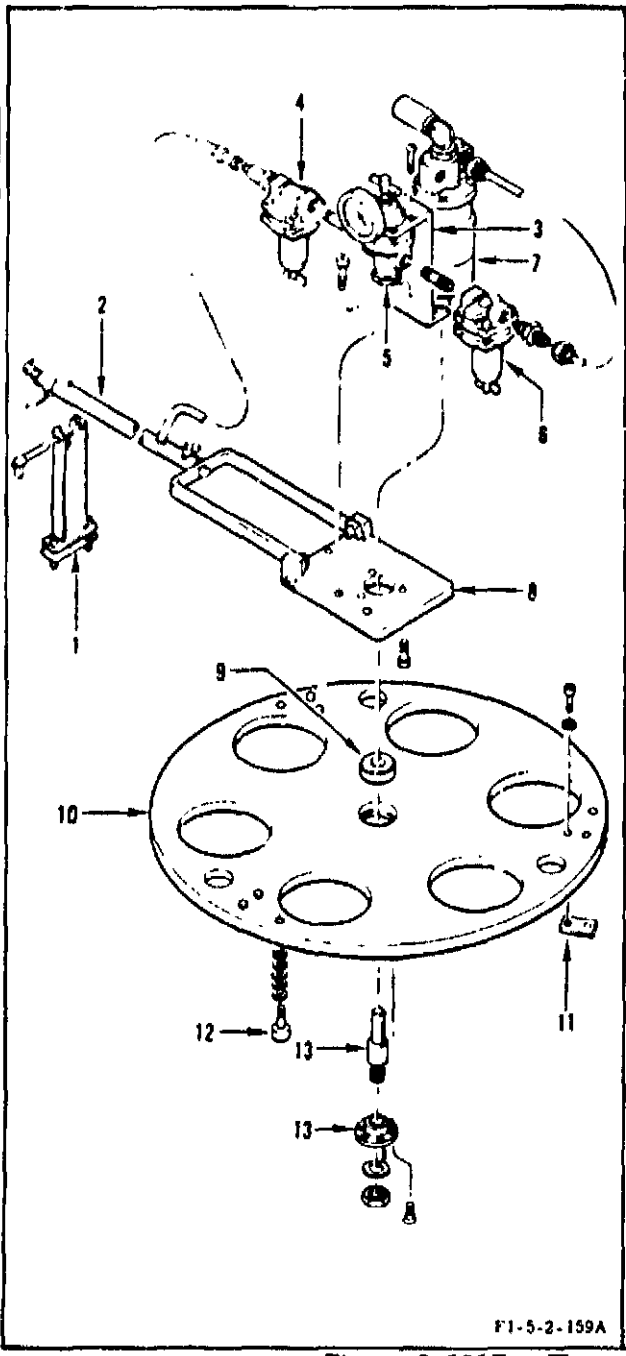
2-843K. The flange polishing tool consists of an air cock, an air system, a motor, a handle and support, a base plate, and a tooling plate. The air cock is a two-way, spring-loaded, plug-type valve that contains no packings and maintains proper bearing between the plug and body by spring tension. The air system consists of a filter, regulator, gage, and lubricator. The air system has flow capacity of 135 cfm and is mounted on a bracket attached to the base plate. The motor is an axial-piston air motor consisting of a housing, 5 pistons, a wobble plate, reduction gears, and spindle and bearings. The motor has a gear ratio of 46.4 to 1 and develops 0.9 hp at 46 rpm with 90 psig pressure. The motor has lube fittings for the bearings and is bolted to the base plate. The base plate is a rectangular aluminum plate with three mounting holes for the motor and one hole to retain the bearing. The tooling plate is aluminum with sight holes, lightening holes, and a hole in the center to pin the motor shaft. Three guide rollers, located 120 degrees apart, are attached to the underside of the plate to hold the tool on the flange. Three abrasive mounting pads, located 120 degrees apart, are attached to the underside of the plate to contact the flange during the polishing operation. The tool weighs approximately 70 pounds and is 15 inches high and 29 inches in diameter.

2-843L. OPERATION.

2-843M. The flange polishing tool is used to polish the thrust chamber exhaust inlet flange. The tool is placed on the flange, the support is attached to the thrust chamber tension tie, and the handle is secured to the support. A supply of shop air (100 psig maximum) is connected to the air cock inlet, the air cock is opened, the regulator is adjusted to the required operating pressure as indicated on the pressure gage, and the lubricator is adjusted so that the required amount of lubricant is supplied to the motor. The tooling plate rotates, and with the three abrasive mounting pads in contact with the flange, the polishing action occurs.

2-843N. MAINTENANCE.

2-843P. There are no special maintenance instructions for the flange polishing tool, except for replacing covering on roller (12) and servicing. Disassemble tool, as required, to accomplish necessary repair or replacement. Replace covering on roller (12) when it becomes worn or loose. Secure roller shaft in a vise and manually press hose (detail No. 408) at room temperature, over roller. Trim excess hose flush with edges of roller. See figure 2-121B for index and detail numbers. Clean external surfaces of tool using a clean, dry cloth. Store tool in container provided, and overpack container for shipment.



Index No.	Detail No.	Description
1	531	Support
	525	Nut
	526	Washer
	528	Pin
2	501	Handle
	502	Coupling
	503	Coupler
	504	Hose
	508	Air cock
	509	Adapter
	511	Coupler
	513	Weld assembly
	507	Tube
	208	Rod
	116	Pin
	201	Fork
	110	Screw
3	601	Bracket
4	518	Filter
	517	Coupler
	516	Adapter
5	519	Regulator
	516	Adapter
6	532	Lubricator
	521	Union
	520	Tubing
7	523	Motor
	522	Muffler
	212	Screw
8	219	Plate
	204	Bar
	203	Screw
9	213	Bearing
10	407	Plate
11	406	Pad
	405	Washer
	404	Screw
12	402	Roller
	408	Hose
	409	Washer
13	209	Shaft
	111	Key
	216	Plug
	217	Screw
	114	Washer
	115	Nut
	210	Set screw

Figure 2-121B. Flange Polishing Tool T-5047802

2-843Q. SERVICING. Servicing the flange polishing tool consists of lubricating bearings of the motor (one stroke of grease gun at each fitting) before use or every 8-hours of continuous operation, with gear grease (MIL-G-23827). The filter must be drained of moisture after each use, and the lubricator bowl filled with lubricating oil (Federal Specification VV-L-800) before use. The air filter element and bowl and lubricator filter element and bowl must be cleaned after approximately 30 hours of operation. (Refer to R-3896-5, Volume I for cleaning information.)

2-844. DOLLY ASSEMBLY T-8101595.

2-845. DESCRIPTION.

2-846. The dolly assembly consists of a hand-operated gear box and a cradle mounted on a tubular frame. The frame is mounted on four casters. The function of the dolly is to provide support for the fuel valve during maintenance. The dolly assembly is approximately 40 inches long, 40 inches high, and 35 inches wide. The weight is approximately 105 pounds.

2-847. OPERATION

2-848. The dolly assembly is used to hold and support the fuel valve during disassembly, assembly, and testing. The fuel valve is attached to the dolly cradle with handling fittings that attach to handling bolts that are a part of the valve. The valve can be rotated to various positions using the hand-operated gear box. Mobility for the dolly is provided by the casters.

2-849. MAINTENANCE.

2-850. There are no special maintenance instructions for the dolly except for proof testing. Disassemble the dolly, as required, to accomplish necessary repair or replacement. See figure 2-122 for index and detail numbers. Perform repairs, clean, and lubricate moving parts as outlined in R-3896-5, Volume I.

2-851. PROOF TESTING. Proof-test the dolly every 24 months with a 400-pound proof load. See figure 2-123 for test setup and perform the following:

WARNING

Proof tests are hazardous; therefore, special precautions must be taken. In addition to local and standard requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Connect an overhead hoist that has a minimum load capacity of one ton, to test load.

b. Slowly lift test load enough to position dolly under it.

c. Lower test load into cradle (7, figure 2-122); then secure test load to cradle using cradle fittings. Make sure fittings are fully engaged and locked.

d. Slowly lower overhead hoist until full weight of test load is imposed on dolly and all tension on hoist is relieved. Maintain this condition for a minimum of 3 minutes, observing assembly stand for any irregularities.

e. Slowly raise overhead hoist to lift test load; then disengage fittings and remove test load from dolly.

f. Inspect dolly for distortion, weld cracks, or yielding.

2-852. PROTECTIVE PAD T-8102028.

2-853. DESCRIPTION.

2-854. The protective pad consists of six fan-shaped pad sections of graduated sizes. Each section is covered with vinyl-coated nylon cloth and contains 1-1/2-inch-thick polyurethane foam and sheet aluminum strips. The sections are joined by cord ties to form the pad. The function of the pad is to protect the inner wall of the thrust chamber. The pad is 95 inches long, 124 inches wide at the lower end, and 44 inches wide at the upper end.

2-855. OPERATION.

2-856. The protective pad is used to protect the inner wall of the thrust chamber when work is being performed in the thrust chamber, with the engine or thrust chamber in the horizontal position.

2-857. MAINTENANCE.

WARNING

The following procedure uses polyurethane resins and catalysts, which are skin irritants. Avoid contact and inhalation of vapors. Use in a well-ventilated area.

2-858. There are no special maintenance instructions for the protective pad, except for repairing holes, tears, and deterioration of the polyurethane foam. Repair holes or tears in pad using 2-inch-wide pressure-sensitive tape (Federal Specification PPP-T-60). Repair foam by removing all deteriorated foam and applying 3-pound density, or equivalent,

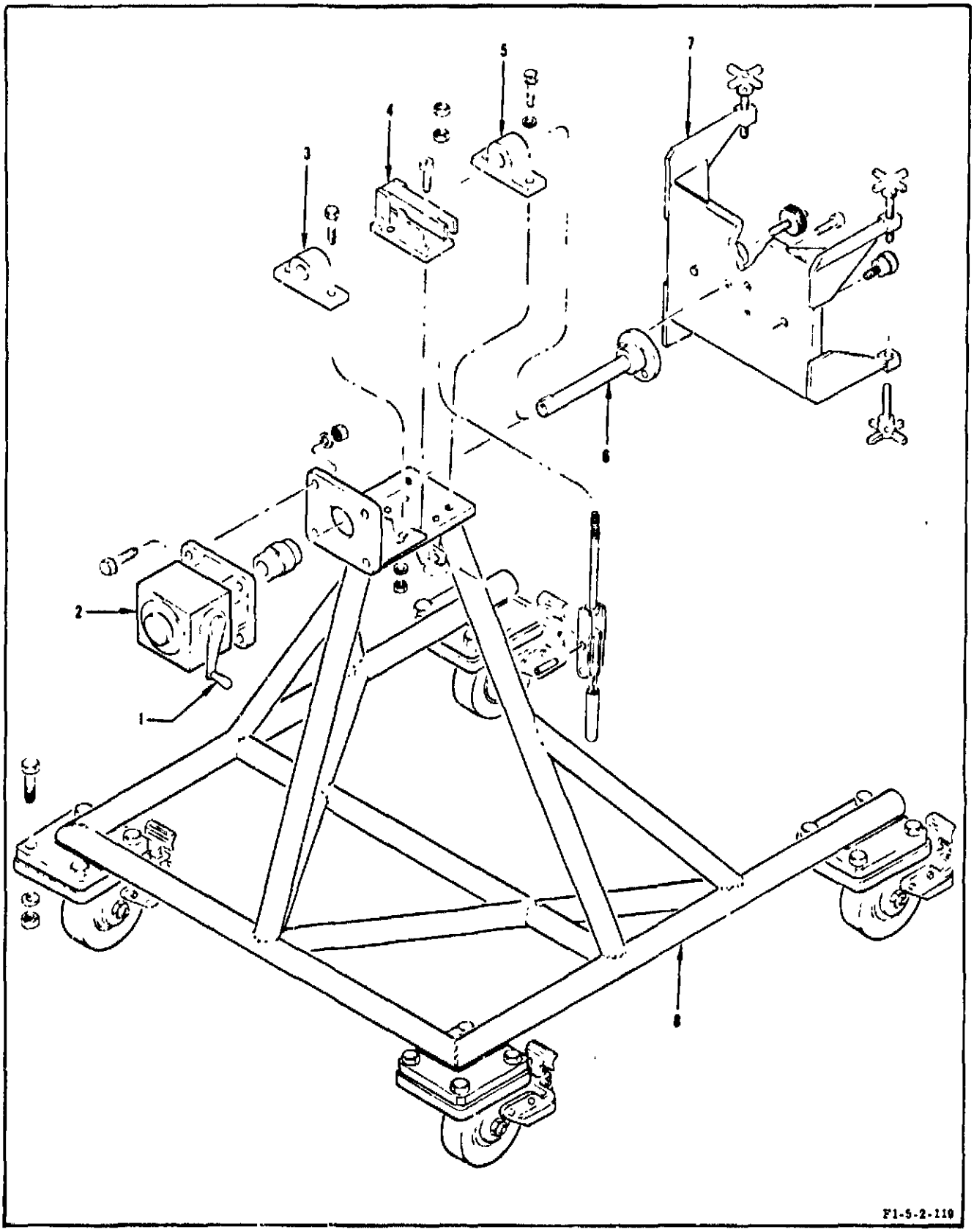


Figure 2-122. Dolly Assembly T-8101595 (Sheet 1 of 2)

Index No.	Detail No.	Description
1	233	Handle
2	214	Gear reducer
	215	Bolt
	216	Nut
	217	Lockwasher
	213	Coupling
3	221	Pillow block
	218	Bolt
	219	Nut
	220	Lockwasher
4	500	Brake
	502	Clamp
	504	Pin
	505	Plate
	None	Screw
	507	Handle
	None	Pin
5	221	Pillow block
	220	Lockwasher
	234	Bolt
6	300	Shaft
	301	Key
	302	Bar
	303	Flange
	305	
	304	Pin
7	400	Cradle
	413	Screw
	403	Fitting
	407	Knob
	410	Shaft
	411	Pin
	412	Knob
8	200	Stand
	232	Caster
	224	Bolt
	225	Nut
	226	Lockwasher

Figure 2-122. Dolly Assembly T-8101595 (Sheet 2 of 2)

polyurethane foam CPR9811 (The Upjohn Co) with Isonate CPR2028 (The Upjohn Co) as the adhesive. The Isonate must be mixed and applied and the new foam installed within one minute. See figure 2-124 for index and detail numbers. Clean protective pad as outlined in R-3896-5, Volume I.

2-859. HANDLING SLING T-8102313.

2-860. DESCRIPTION.

2-861. The handling sling consists of a T-shaped tubular frame. The sling is equipped with fittings and a lifting ring. The function of the sling is to handle heavy equipment. The sling is 53-3/4 inches long, 24 inches wide, and 12-1/2 inches high. The weight is approximately 12 pounds.

2-862. OPERATION.

2-863. The handling sling is used to remove and install control panels of the engine check-out console. The sling is attached to panel attach points, using the quick-disconnect fittings of the sling. The sling and panel are handled by an overhead lifting method.

2-864. MAINTENANCE.

2-865. There are no special maintenance instructions for the handling sling, except for proof testing. Disassemble handling sling, as required, to accomplish necessary repair or replacement. See figure 2-125 for index and detail numbers. Clean handling sling as outlined in R-3896-5, Volume I.

2-866. PROOF TESTING. Proof-test handling sling every 6 months with a 400-pound proof load. See figure 2-126 for test setup and perform the following:

WARNING

Proof tests are extremely hazardous; therefore, special precautions must be taken. In addition to local and standard requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Attach handling sling fittings to test load. Make sure fittings are fully engaged and locked.

b. Connect an overhead hoist that has a minimum load capacity of one ton, to handling sling.

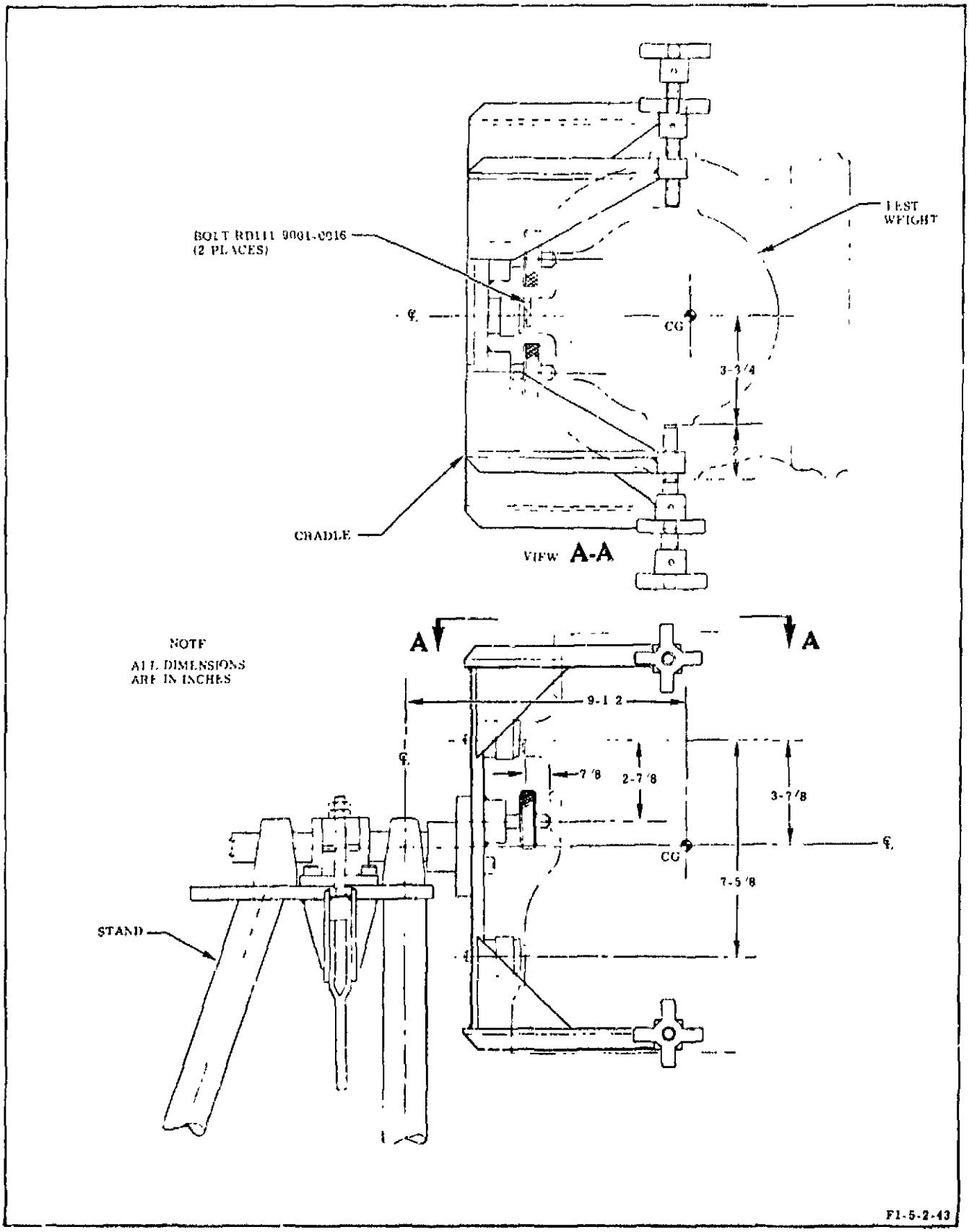
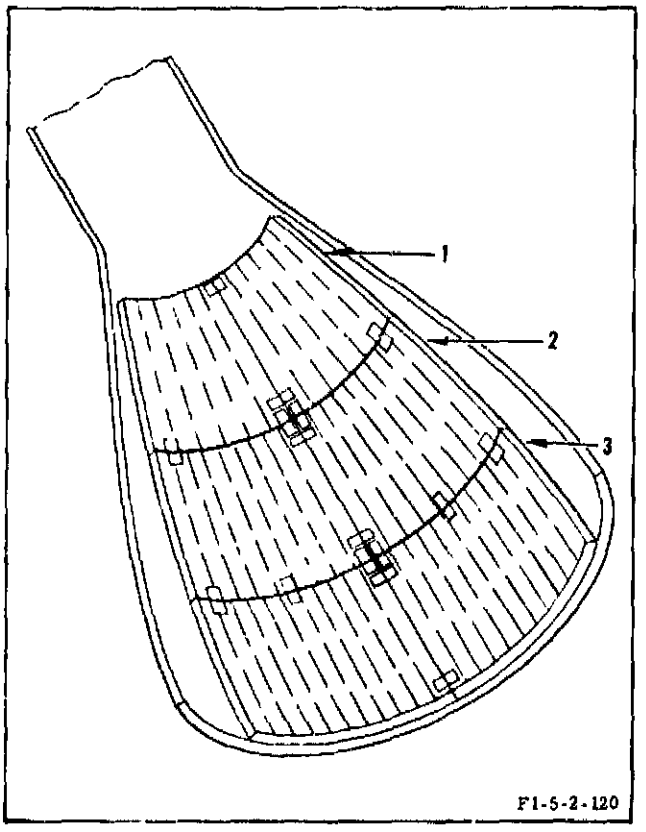


Figure 2-123. Recommended Proof Test for Dolly Assembly



Index No.	Detail No.	Description
1	115	Pad
2	109	Pad
3	102	Pad
	121(a)	Plate

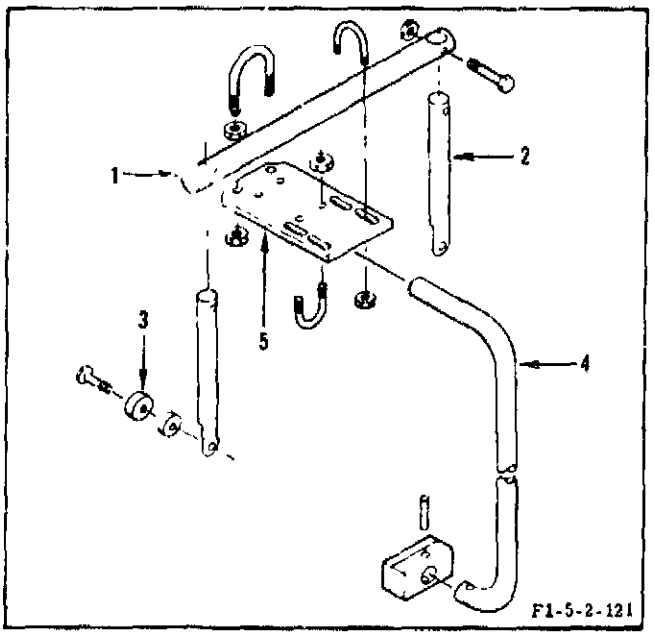
(a) Item not illustrated

Figure 2-124. Protective Pad T-8102028

c. Slowly raise overhead hoist until full weight of test load is supported by handling sling. Maintain this condition for a minimum of 3 minutes, observing assembly sling for any irregularities.

d. Slowly lower overhead hoist to lower test load; then disengage fittings and remove sling from test load.

e. Inspect sling for distortion or yielding.



Index No.	Detail No.	Description
1	101	Tube
	102	U-bolt
	103	Washer
	105	Plug
2	106	Arm
	110	Washer
	118	Nut
	120	Screw
3	107	Fitting
4	109	Tube
	114	U-bolt
	110	Plug
	111	Cup
	108	Pin
	112	Stop
5	117	Plate
	113	U-bolt
	104(a)	Nut
	115(a)	Plate
	116(a)	Plate

(a) Item not illustrated

Figure 2-125. Handling Sling T-8102313

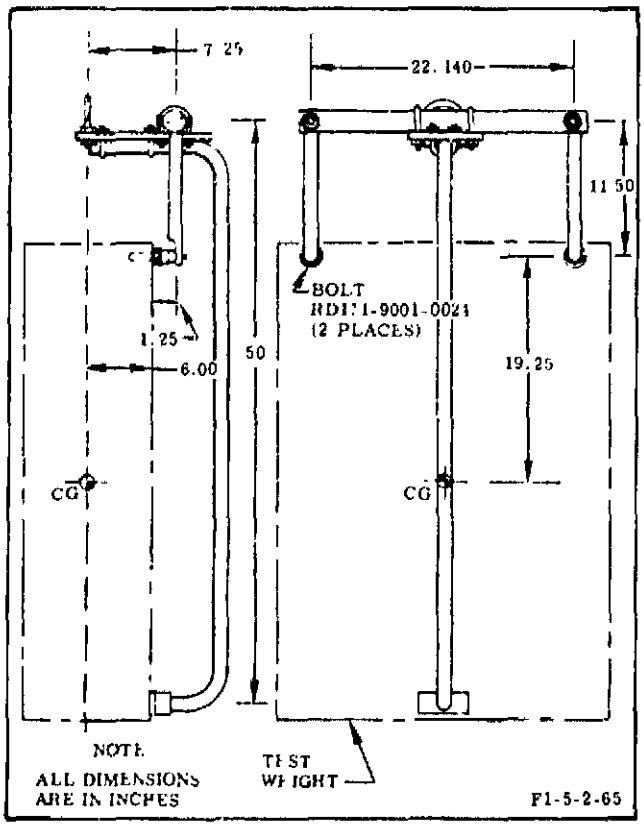


Figure 2-126. Recommended Proof Test for Handling Sling

2-867. ROTATING FIXTURE T-8102381.

2-868. DESCRIPTION.

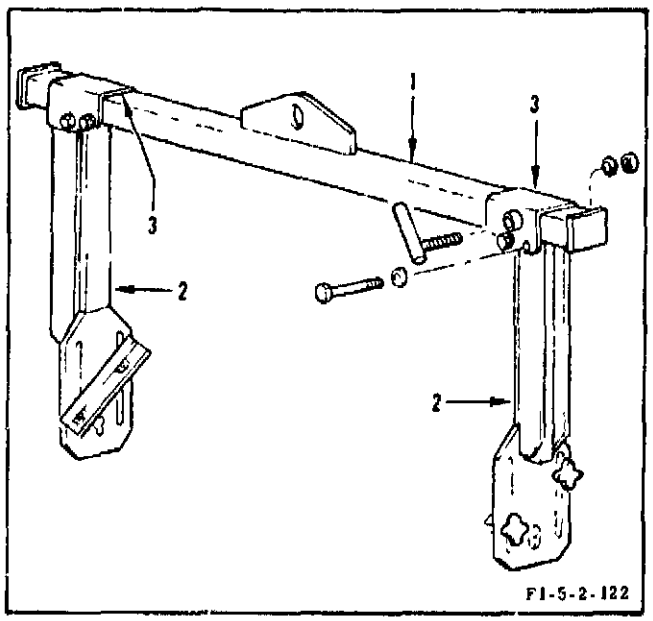
2-869. The rotating fixture consists of a box beam with a centered lifting point and two adjustable arms. The arms are at right angles to the beam. The function of the rotating fixture is to provide a method of lifting and rotating the thrust chamber injector. The fixture is packaged in a container that is 60 inches long, 36 inches wide, and 9 inches high. The weight is approximately 100 pounds.

2-870. OPERATION.

2-871. The rotating fixture is used to lift the thrust chamber injector and allow the injector to be rotated between the arms of the fixture. Closures RX19145-11 and RX19146-11 must be installed on the injector to provide attaching points for the fixture.

2-872. MAINTENANCE.

2-873. There are no special maintenance instructions for the rotating fixture, except for proof testing. Disassemble rotating fixture, as required, to accomplish necessary repair or replacement. See figure 2-127 for index and detail numbers. Clean rotating fixture as outlined in R-3896-5, Volume I. Store rotating fixture in container provided and overpack container for shipment.



Index No.	Detail No.	Description
1	113	Beam
2	209	Arm
	112	Spacer
	206	Knob
	207	Nut
	109	Channel
3	107	Clamp
	108	Lock
	104	Screw
	105	Nut
	106	Washer
	114(a)	Plate
	115(a)	Plate
	116(a)	Container

(a) Item not illustrated

Figure 2-127. Rotating Fixture T-8102381

2-874. PROOF TESTING. Proof-test the rotating fixture every 6 months with a 3,000-pound proof load. See figure 2-128 for test setup and perform the following:

WARNING

Proof tests are extremely hazardous; therefore, special precautions must be taken. In addition to local and standard requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Connect an overhead hoist that has a minimum load capacity of 5 tons, to rotating fixture.

b. Attach fixture fittings to test load. Make sure fittings are fully engaged and locked.

c. Slowly raise overhead hoist until full weight of test load is supported by rotating fixture. Maintain this condition for a minimum of 3 minutes, observing fixture for any irregularities.

d. Slowly lower overhead hoist to lower test load; then disengage fittings and remove fixture from test load.

e. Inspect rotating fixture for distortion, weld cracks, or yielding.

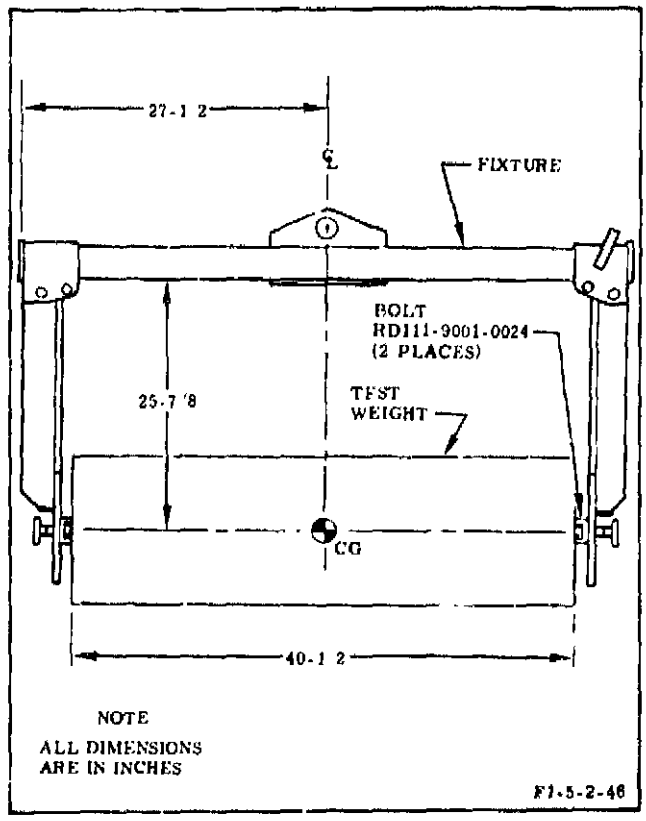


Figure 2-128. Recommended Proof Test for Rotating Fixture

SECTION III

DUMMY WEIGHT T-TOOLS

3-1. SCOPE. This section contains inspection, description, use, and maintenance procedures for dummy weight T-tools. (Refer to R-3896-5, Volume I, for safety precautions and general maintenance procedures.) The parts list consists of a tabulated listing of all parts required for support of the tool at the field sites. The parts are listed in disassembly order, except where disassembly order does not apply, and are keyed to an associated illustration by index number. The relation of each part to its next higher assembly is indicated by indention. The detail number (consisting of a dash number to the basic tool number) is used instead of a part number to identify the part, because a majority of the parts are made from stock material. The material and dimensions may be found on the tool print.

3-2. INSPECTION.

3-3. Figure 3-1 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions and that the hardware configuration is in accordance with appropriate records. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. See figure 3-1 for inspection and periodic intervals.

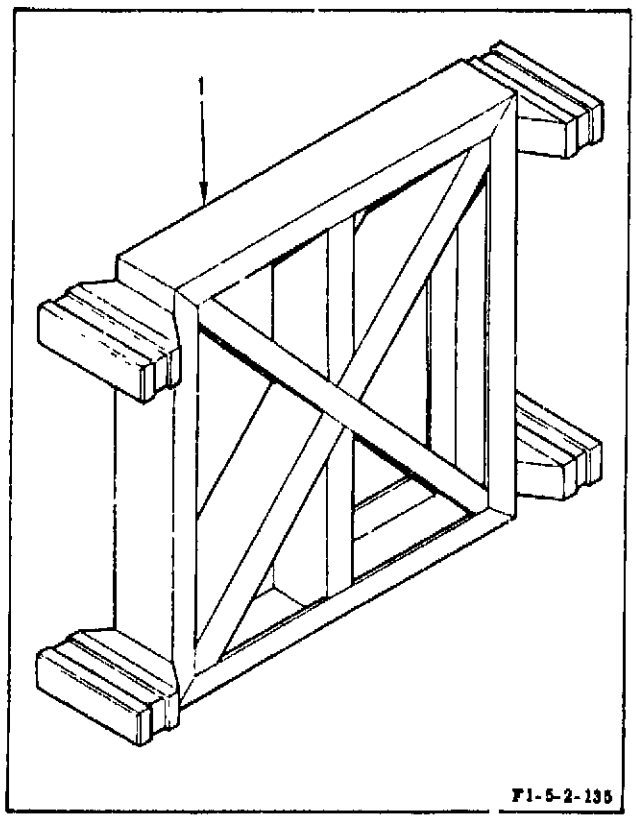
Inspection	Periodic (Months)			
	3	6	12	24
Visual inspections for all units				
1. Obvious signs of damage to all structural members				
2. Damage to threaded fasteners, inserts, and studs				
3. Cracks in welds and parent metal				

Inspection	Periodic (Months)			
	3	6	12	24
Dummy sling T-5047381				
1. Broken strands, frays, and kinks in cables			X	
2. Proof-test expiration			X	
Dummy weight harness T-5047382				
1. Broken strands, frays, and kinks in cables			X	
2. Proof-test expiration			X	

Figure 3-1. Inspection Requirements

3-4. DUMMY WEIGHT FIXTURE T-5039391.

3-5. The dummy weight fixture is a rectangular welded frame 42 inches long, 34 inches wide, and 11 inches high. The fixture weighs 226 pounds. The fixture, with added weight, is used to proof-load the interface panel sling. See figure 3-2 for index and detail numbers.



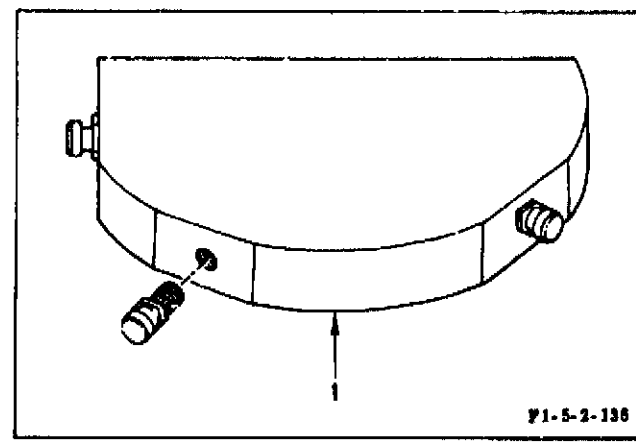
Index No.	Detail No.	Description
1	101	Fixture
	111(a)	Plate

(a) Item not illustrated

Figure 3-2. Dummy Weight Fixture T-5039391

3-6. DUMMY WEIGHT FIXTURE T-5039392.

3-7. The dummy weight fixture is a half-moon-shaped plate 12 inches long, 7 inches wide, and 4 inches high. The fixture weighs 29 pounds. The fixture, with attachment stud bolts, is used to proof-load the gas generator adapter. See figure 3-3 for index and detail numbers.



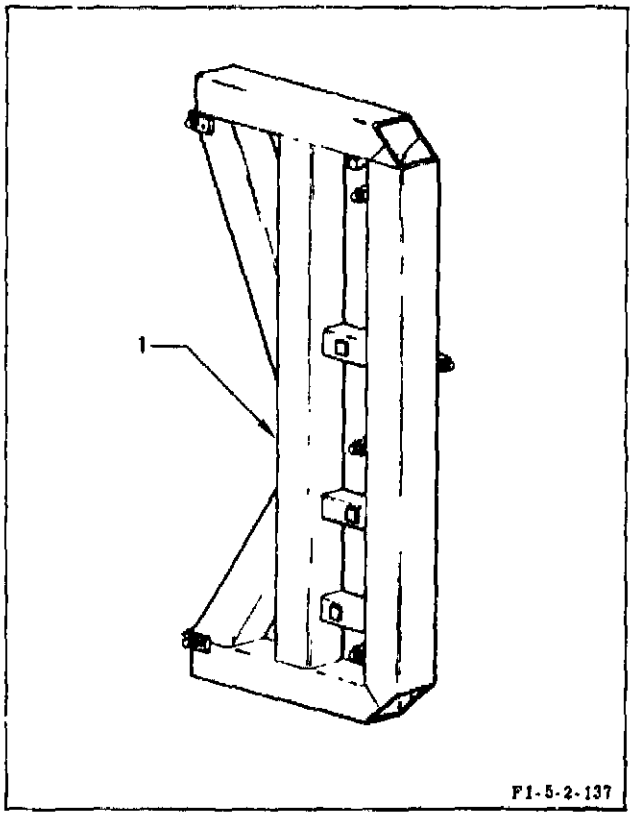
Index No.	Detail No.	Description
1	101	Fixture
	103(a)	Bolt
	104(a)	Plate

(a) Item not illustrated

Figure 3-3. Dummy Weight Fixture T-5039392

3-8. DUMMY WEIGHT FIXTURE T-5039393.

3-9. The dummy weight fixture is a welded frame 64.5 inches long, 8 inches wide, and 24 inches high. The fixture weighs 130 pounds. The fixture is used to proof-load the oxidizer and fuel line adapters. See figure 3-4 for index and detail numbers.



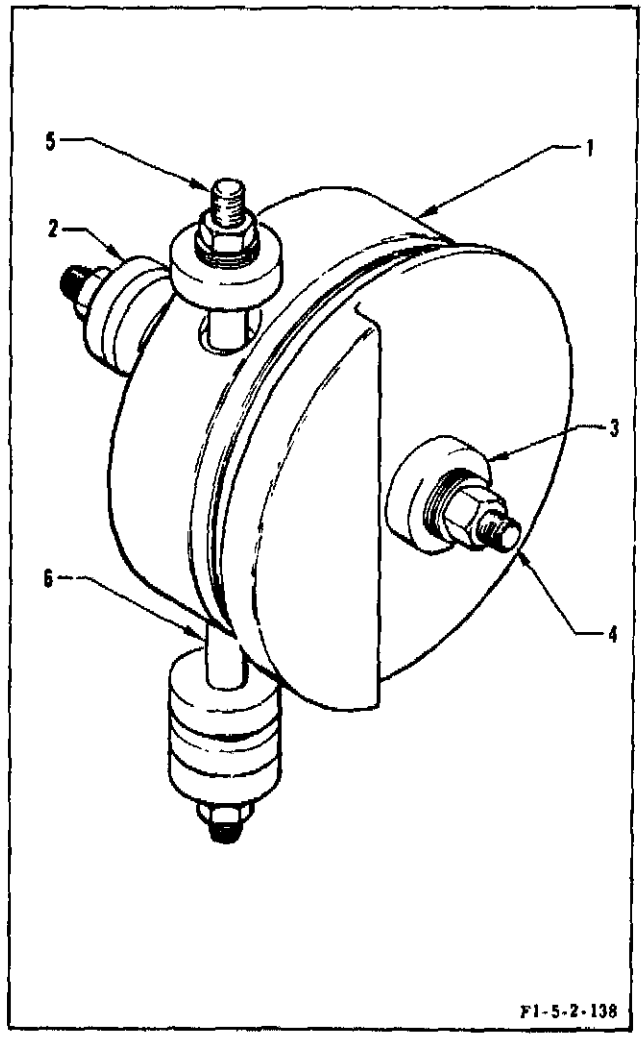
Index No.	Detail No.	Description
1	101	Fixture
	103(a)	Bolt
	116(a)	Plate

(a) Item not illustrated

Figure 3-4. Dummy Weight Fixture T-5039393

3-10. DUMMY WEIGHT FIXTURE T-5039394.

3-11. The dummy weight fixture is a casted weight, with adjustable weights to establish center of gravity, and is 49 inches long, 38 inches wide, and 30 inches high. The fixture weighs 2,150 pounds. The fixture is used to proof-test the heat exchanger sling. See figure 3-5 for index and detail numbers.



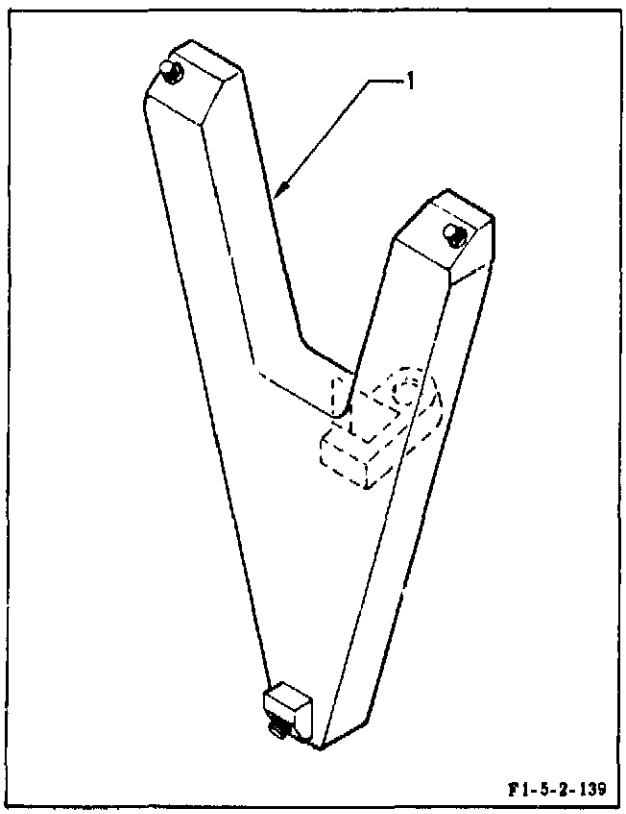
Index No.	Detail No.	Description
1	101	Weight
2	102	Bushing
3	104	Bushing
4	105	Tubing
	106	Nut
5	107	Tubing
6	108	Tubing
	109(a)	Washer
	110(a)	Plate

(a) Item not illustrated

Figure 3-5. Dummy Weight Fixture T-5039394

3-12. DUMMY WEIGHT T-5040101.

3-13. The dummy weight is a triangular steel frame 22 inches long, 14 inches wide, and 7 inches high. The weight weighs 70 pounds. The weight is used to proof-load the fuel inlet elbow adapter. See figure 3-6 for index and detail numbers.



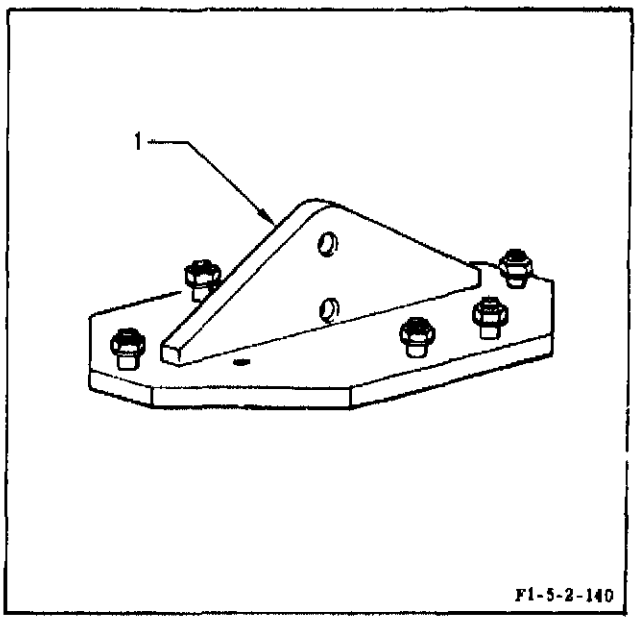
Index No.	Detail No.	Description
1	104	Fixture
	105(a)	Bolt
	106(a)	Plate

(a) Item not illustrated

Figure 3-6. Dummy Weight T-5040101

3-14. DUMMY WEIGHT T-5040107.

3-15. The dummy weight is a welded assembly 24 inches long, 16 inches wide, and 7.5 inches high. The weight weighs 131 pounds. The weight is used to proof-load the dome and gimbal block lifting adapter and injector lifting adapter. See figure 3-7 for index and detail numbers.



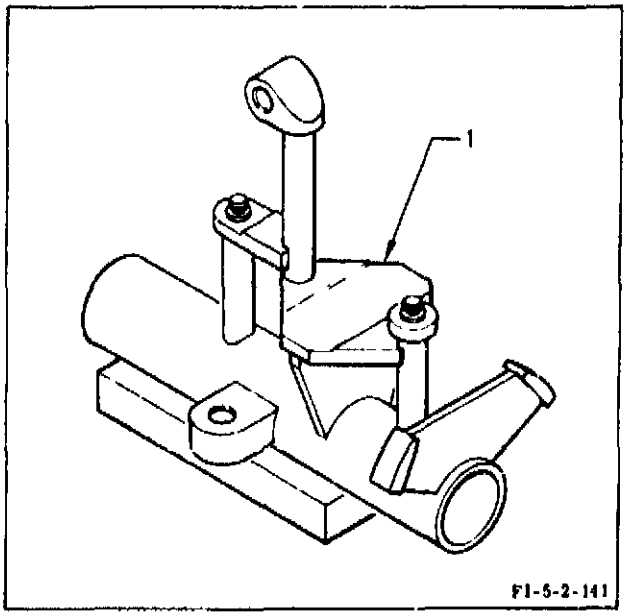
Index No.	Detail No.	Description
1	101	Fixture
	103	Bolt
	104	Washer
	105	Nut
	106	Bolt
	107	Washer
	108	Nut
	109(a)	Plate

(a) Item not illustrated

Figure 3-7. Dummy Weight T-5040107

3-16. DUMMY WEIGHT FIXTURE T-5040110.

3-17. The dummy weight fixture is a welded assembly 15 inches long, 7 inches wide, and 15 inches high. The fixture weighs 35 pounds. The fixture is used to proof-load the main fuel valve adapter. See figure 3-8 for index and detail numbers.



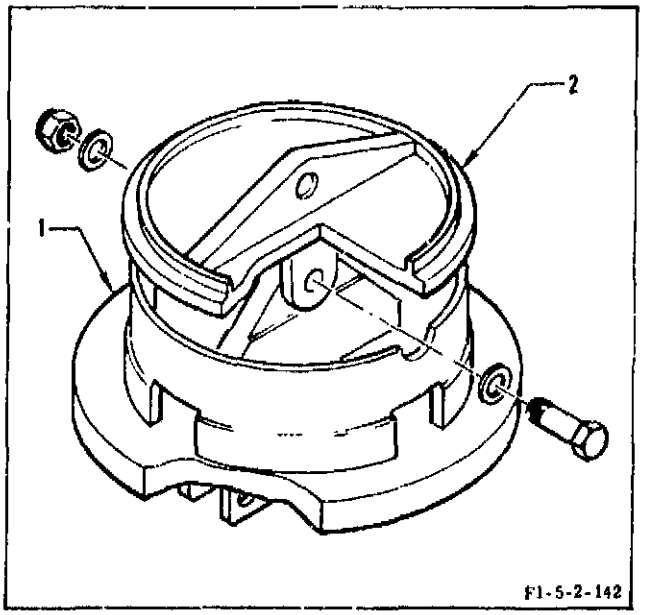
Index No.	Detail No.	Description
1	101	Fixture
	106(a)	Bolt
	114(a)	Plate

(a) Item not illustrated

Figure 3-8. Dummy Weight Fixture T-5040110

3-18. DUMMY WEIGHT FIXTURE T-5040112.

3-19. The dummy weight fixture is a circular, 2-piece, welded assembly 11.5 inches long and 14.5 inches in diameter. The fixture weighs 114 pounds. The two pieces are bolted together providing a hinge point to proof-load the gimbal support. See figure 3-9 for index and detail numbers.



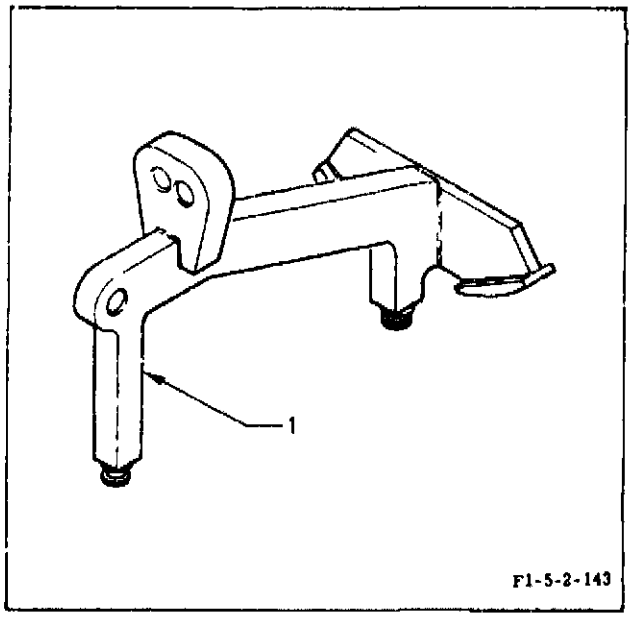
Index No.	Detail No.	Description
1	101	Weld assembly
	106	Nut
	107	Washer
	108	Bolt
2	113(a)	Weld assembly
	114(a)	Plate

(a) Item not illustrated

Figure 3-9. Dummy Weight Fixture T-5040112

3-20. DUMMY WEIGHT T-5040113.

3-21. The dummy weight is a welded assembly 16 inches long, 11 inches wide, and 9.5 inches high. The weight weighs 16 pounds. The weight is used to proof-load the main oxidizer valve adapter. See figure 3-10 for index and detail numbers.



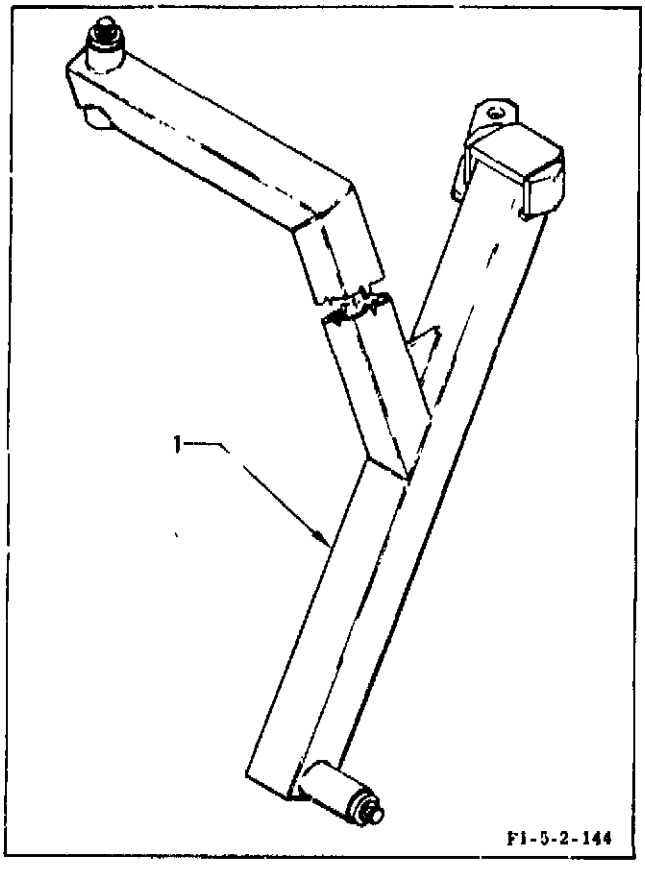
Index No.	Detail No.	Description
1	101	Weld assembly
	102	Bolt
	107(a)	Plate

(a) Item not illustrated

Figure 3-10. Dummy Weight T-5040113

3-22. DUMMY WEIGHT T-5041024.

3-23. The dummy weight is a welded assembly 72 inches long, 31 inches wide, and 27 inches high. The weight weighs 82 pounds. The weight is used to proof-load the No. 1 rigid fuel duct adapter. See figure 3-11 for index and detail numbers.



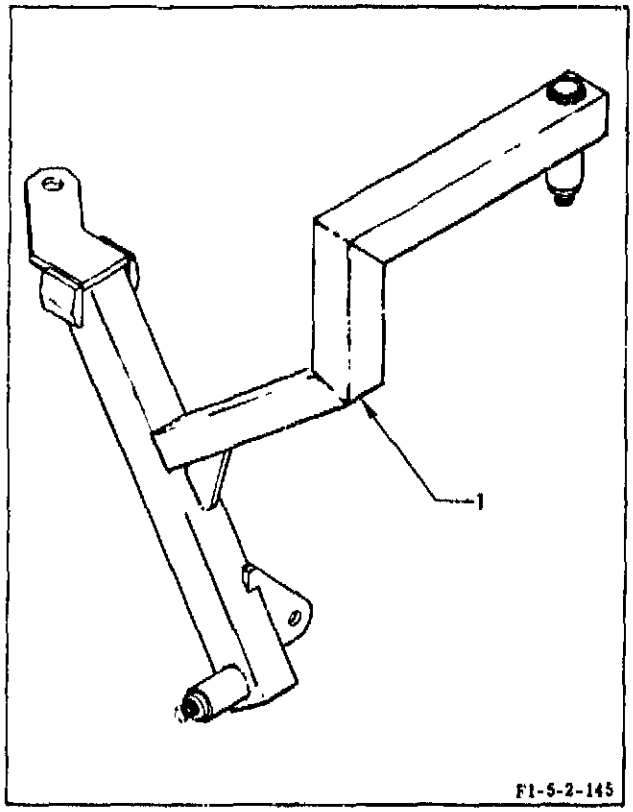
Index No.	Detail No.	Description
1	114	Weld assembly
	103	Bolt
	115(a)	Plate

(a) Item not illustrated

Figure 3-11. Dummy Weight T-5041024

3-24. DUMMY WEIGHT FIXTURE T-5041025.

3-25. The dummy weight fixture is a welded assembly 40.5 inches long, 28 inches wide, and 32 inches high. The fixture weights 70 pounds. The fixture is used to proof-load the No. 2 rigid fuel duct adapter. See figure 3-12 for index and detail numbers.



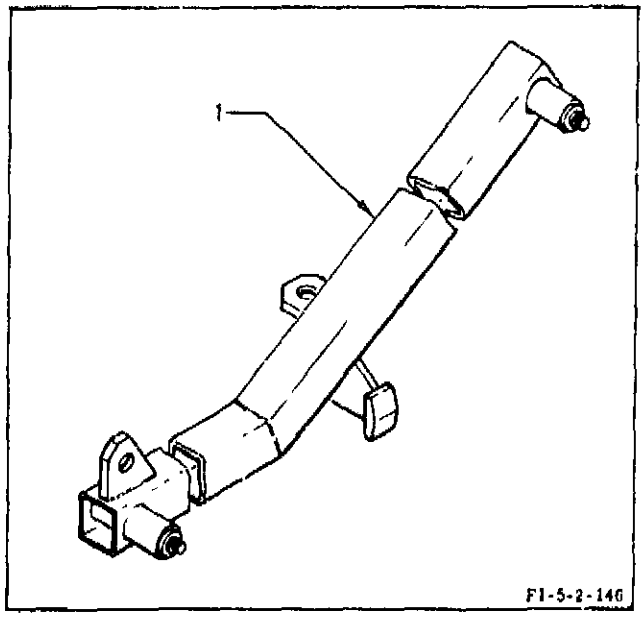
Index No.	Detail No.	Description
1	112	Weld assembly
	113	Washer
	114	Bolt
	115(a)	Plate

(a) Item not illustrated

Figure 3-12. Dummy Weight Fixture T-5041025

3-26. DUMMY WEIGHT FIXTURE T-5041026.

3-27. The dummy weight fixture is a welded assembly 54 inches long, 18 inches wide, and 9 inches high. The fixture weights 47 pounds. The fixture is used to proof-load the No. 1 rigid oxidizer duct adapter. See figure 3-13 for index and detail numbers.



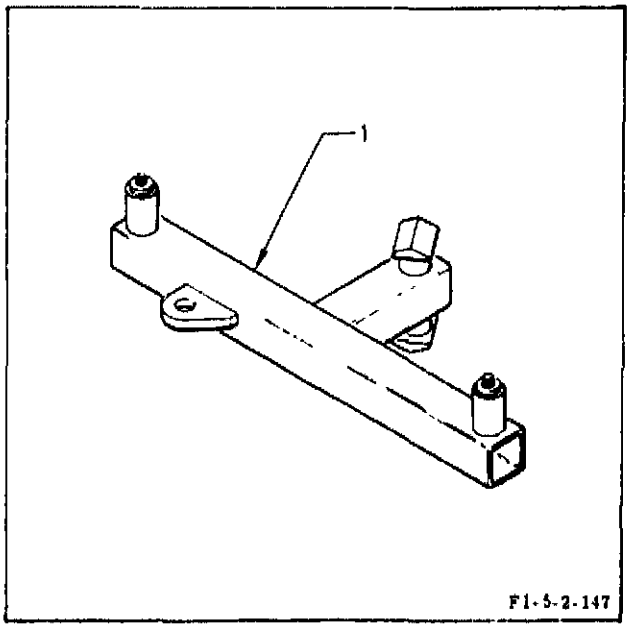
Index No.	Detail No.	Description
1	101	Weld assembly
	110	Bolt
	111	Washer
	113(a)	Plate

(a) Item not illustrated

Figure 3-13. Dummy Weight Fixture T-5041026

3-28. DUMMY WEIGHT FIXTURE T-5041027.

3-29. The dummy weight fixture is a welded assembly 33.5 inches long, 11 inches wide, and 15.5 inches high. The fixture weighs 39 pounds. The fixture is used to proof-load the No. 2 rigid oxidizer duct adapter. See figure 3-14 for index and detail numbers.



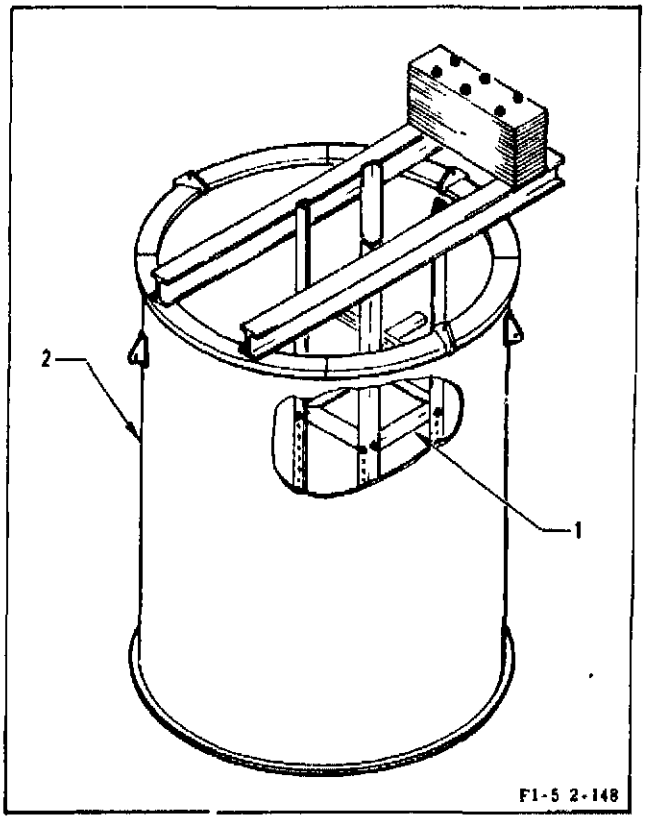
Index No.	Detail No.	Description
1	101	Fixture
	109	Bolt
	110	Washer
	111(a)	Plate

(a) Item not illustrated

Figure 3-14. Dummy Weight Fixture T-5041027

3-30. DUMMY WEIGHT T-5047380.

3-31. The dummy weight is a round steel casing with I-beams and channels welded inside to secure additional weights. The weight is 120 inches in diameter and 182 inches in height with added weights on top. The weight weighs 15,500 pounds; additional weights may be added to obtain a 45,000-pound load. The weight is used to proof-load the Roadable Vertical Engine Dolly G4051, Engine Handling Dolly G4058, and Engine Vertical Installer G4049. See figure 3-15 for index and detail numbers.



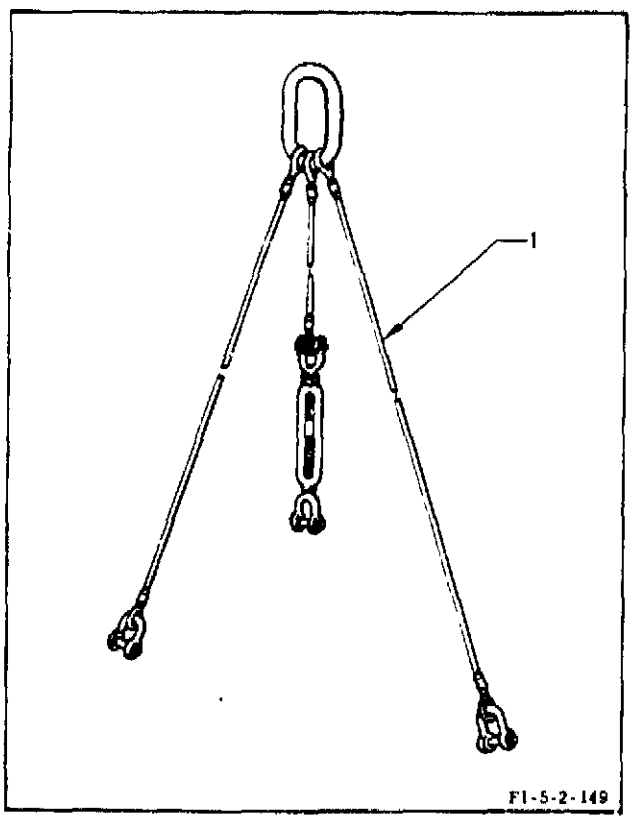
Index No.	Detail No.	Description
1	101	Subassembly
	102	Steel angle
	103	Bolt
	104	Washer
	105	Nut
	106	Washer
2	136	Subassembly
	130	Plate
	131	Nut
	132	Bar
	135	Plate
	137(a)	Plate

(a) Item not illustrated

Figure 3-15. Dummy Weight T-5047380

3-32. DUMMY SLING T-5047381.

3-33. The dummy sling is a simple cable assembly consisting of three cables. One cable has a turnbuckle and the other two cables have shackles on one end. The three cables are centrally connected to a lift ring. The sling working load is 40,000 pounds and proof load is 120,000 pounds. The sling is 107 inches long and weighs approximately 112 pounds. The sling is used to lift dummy weight T-5047380. See figure 3-16 for index and detail numbers.



Index No.	Detail No.	Description
1	101	Sling
	102	Shackle
	103	Turnbuckle
	107(a)	Nut
	108(a)	Plate
	109(a)	Tag

(a) Item not illustrated

Figure 3-16. Dummy Sling T-5047381

3-34. PROOF TESTING. Proof-test dummy sling at 12-month intervals with a proof load of 120,000 pounds.

WARNING

Proof tests are hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Provide three solid test loads of 40,000 pounds each.

NOTE

An alternate method of proof testing may be accomplished by hydraulic loading, to provide straight-line pull of 40,000 pounds for each leg in unison.

b. Connect an overhead hoist that has a minimum load capacity of 60 tons to sling lifting eye.

c. Position sling over test load, and connect sling legs to test loads.

d. Slowly lift test load until load clears floor, observing sling for any irregularities, and hold test load for 3 minutes.

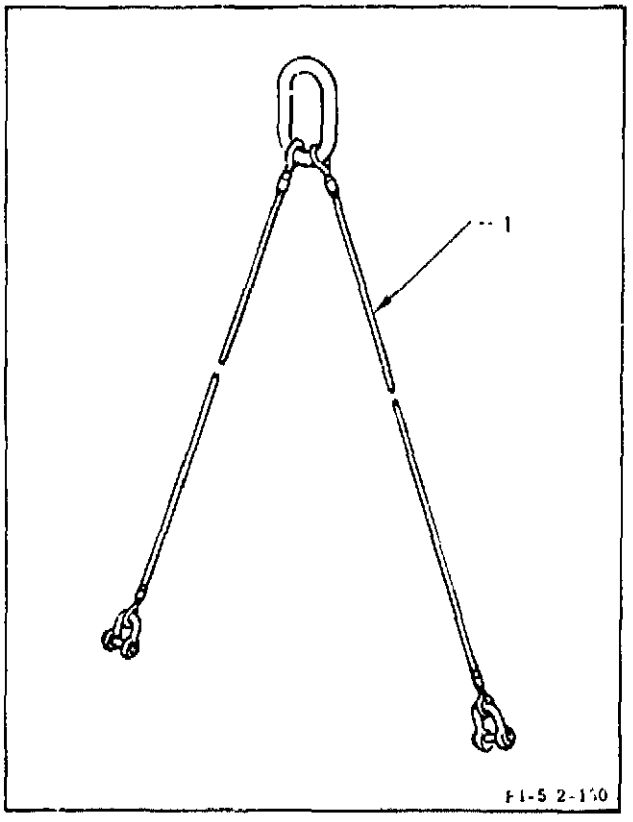
e. Lower test load to floor, and inspect sling for any distortion and cables for broken strands, frays, and kinks.

f. Disconnect sling, and secure equipment.

g. Remove existing proof-load tag RD171-4009-0001, and using a 1/8 inch metal impression stamping set, transfer all information to new proof-load tag, including new inspection date. Install new tag where old tag was removed.

3-35. DUMMY WEIGHT HARNESS T-5047382.

3-36. The dummy weight harness is a simple two-cable sling centrally connected to a lift ring. The harness working load is 20,000 pounds and proof load is 40,000 pounds. The harness is 83 inches long and weighs approximately 50 pounds. The harness is used to apply a side load on dummy weight T-5047380 during proof testing of Engine Vertical Installer G4049. See figure 3-17 for index and detail numbers.



Index No.	Detail No.	Description
1	102	Shackle
2	103	Sling
3	104	Link
	105(a)	Plate
	101(a)	Tag

(a) Item not illustrated

Figure 3-17. Dummy Weight Harness T-5047382

3-37. PROOF TESTING. Proof-test dummy weight harness at 12-month intervals with a proof load of 40,000 pounds.

WARNING

Proof tests are hazardous; therefore, special precautions must be taken. In addition to local and standard safety requirements, the test area must be cleared and adequate protection provided for test personnel.

a. Provide three solid test loads of 20,000 pounds each.

NOTE

An alternate method of proof testing may be accomplished by hydraulic loading, to provide straight-line pull of 20,000 pounds for each leg in unison.

b. Connect an overhead hoist that has a minimum load capacity of 25 tons to sling lifting eye.

c. Position sling over test load, and connect sling legs to test loads.

d. Slowly lift test load until load clears floor, observing sling for any irregularities, and hold test load for 3 minutes.

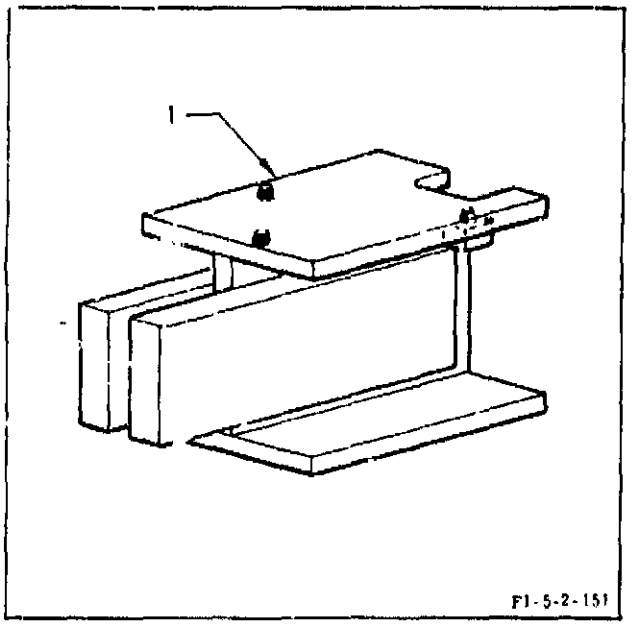
e. Lower test load to floor, and inspect sling for any distortion and cables for broken strands, frays, and kinks.

f. Disconnect sling, and secure equipment.

g. Remove existing proof-load tag RD171-4009-0001, and using a 1/8 inch metal impression stamping set, transfer all information to new proof-load tag, including new inspection date. Install new tag where old tag was removed.

3-38. WEIGHT FIXTURE T-5047384.

3-39. The weight fixture is a welded assembly approximately 20 inches long, 10 inches wide, and 10 inches high. The fixture weighs 221 pounds. The fixture is used to proof-load the main fuel valve solid-line adapter. See figure 3-18 for index and detail numbers.



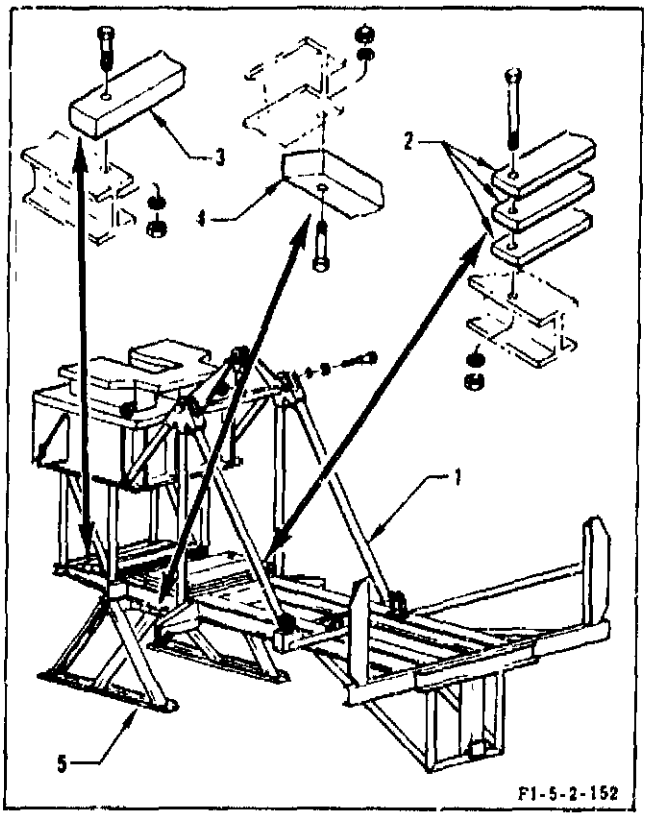
Index No.	Detail No.	Description
1	101	Weld assembly
	107	Bolt
	108(a)	Plate

(a) Item not illustrated

Figure 3-18. Weight Fixture T-5047384

3-40. ENGINE DUMMY WEIGHT FRAME 88-9017417.

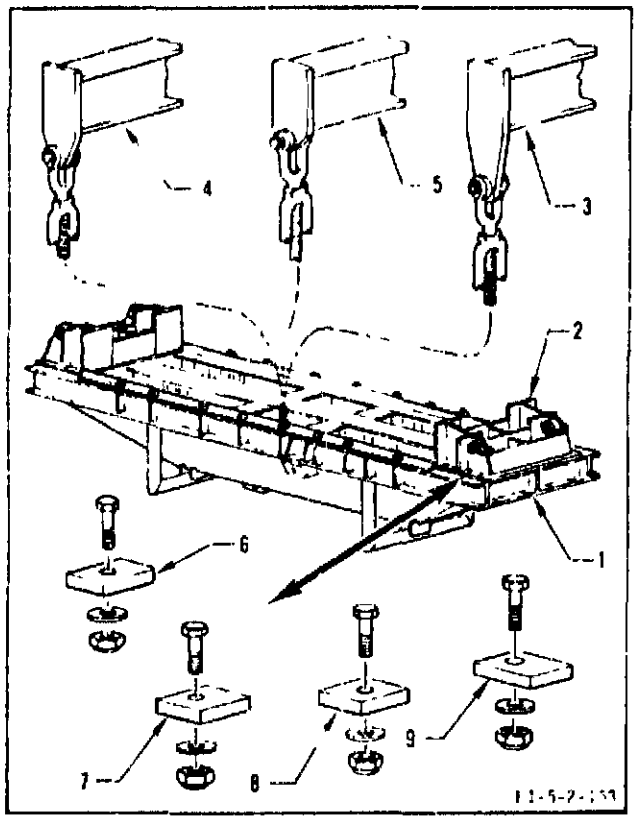
3-41. The engine dummy weight frame is a rectangular welded assembly with provision for adding weights and attaching handling equipment. The frame is approximately 183 inches long, 110 inches wide, and 116 inches high. The frame weighs approximately 9,000 pounds. The frame is used in conjunction with engine dummy weight 88-9014883 to proof-load the Air Transport Engine Handler G4044, Engine Vertical Sling G4054, and Engine Handling Sling G4050. See figure 3-19 for index and part numbers.



Index No.	Part No.	Description
1	-101	Frame
	405541(a)	Pin
	402377(a)	Washer
	MS20500-1216	Nut
	-85	U-bolt
	LD153-0010-0024	Washer
	AN121534	Nut
	NAS1042-16	Shackle
	AN16-33C	Bolt
	LD153-0010-0027	Washer
	MS20365-1614C	Nut
2	-99	Bar
	AN12-73C	Bolt
	LD153-0010-0024	Washer
	AN121534	Nut
3	-103	Bar
	AN12-43C	Bolt
	LD153-0010-0024	Washer
	AN121534	Nut
4	-105	Bar
	AN12-43C	Bolt
	LD153-0010-0024	Washer
	AN121534	Nut
5	88-9013483	Support

(a) Engine hardware

Figure 3-19. Engine Dummy Weight Frame 88-9017417



Index No.	Part No.	Description
1	-11	Frame
2	-21	Support
	G209	Shackle
3	-31	Tiedown
4	-41	Tiedown
5	-51	Tiedown
	NAS1047-12-090	Turnbuckle
6	-77	Washer
7	-79	Washer
8	-81	Washer
9	-83	Washer
	AN16-32A	Bolt
	LD153-0010-0027	Washer
	MS20364-1614C	Nut

Figure 3-20. Engine Dummy Weight 88-9014883

3-42. ENGINE DUMMY WEIGHT 88-9014883.

3-43. The engine dummy weight is a welded assembly with provisions for installing additional weights. The weight consists of a frame, two supports, and three sizes of tiedowns. The weight is approximately 170 inches long, 40 inches wide, and 40 inches high. The weight weighs approximately 4,000 pounds. The weight is used, with additional weights, to proof-load the Engine Handler G4069. See figure 3-20 for index and part numbers.

MANUAL DATA SUPPLEMENTS

Manual Data Supplements are issued from time to time to communicate important and urgent information concerning the equipment covered in this volume. These supplements bear an identifying number and should be filed in this Appendix.

Manual Data Supplements directly affect the data in this volume and will be incorporated into this volume during a future updating effort.

A Supplement Record is issued periodically to indicate the status of supplements issued for this volume. The status of each supplement is indicated in the "Supplement Status" column. For active supplements, no status is entered. For incorporated supplements, "Incorporated" is entered.

Upon receipt of a Manual Data Supplement make an appropriate reference to the supplement in the margin next to the data supplemented and enter the number, date, and subject matter of the supplement on the Manual Data Supplement Record.

MANUAL DATA SUPPLEMENT RECORD

This Supplement Record indicates the status of supplements issued for Technical Manual R-3896-5. Supplements which have been incorporated into the volume shall be removed from the Appendix and destroyed.

Supplement Number	Dated	Description	Supplement Status
R-3896-5 Vol II-1	16 January 69	Adds repair procedures for seal of Turbine Exhaust Exit Pressure Check Fixture G3144.	Incorporated
R-3896-5 Vol II-2	17 January 69	Additional installation procedures for orifice and nut of Oxidizer Dome Flushing Kit G2030.	Incorporated
R-3896-5 Vol II-3	24 February 1969	Adds additional proof-test requirements and an alternate method for proof-testing a single segment of Turbine Exhaust Exit Pressure Check Fixture G3144, and adds inspection requirements after proof test.	Incorporated
R-3896-5 Vol II-4	23 May 1969	Adds requirements to perform dye-penetrant inspection on all welds of retainer 9020511-11 and support 9020512 prior to and after proof-testing Thrust Chamber Throat Plug G3136.	Incorporated

Supplement Number	Dated	Description	Supplement Status
R-3896-5 Vol II-5	30 June 1969	Adds proof-test frequency, and revises existing proof-test procedures for Oxidizer Dome Flushing Kit G2030.	Incorporated
R-3896-5 Vol II-6	1 July 1969	Deletes existing proof-test procedures for Turbine Exhaust Exit Pressure Check Fixture G3144.	Incorporated
R-3896-5 Vol II-7	17 September 1969	Changes calibration-check accuracy of Oxidizer Dome Flush-in Kit G2030 pressure gases.	Incorporated
R-3896-5 Vol II-8	8 October 1969	Adds calibration-check requirements for torque adapter T-5041242.	Incorporated
R-3896-5 Vol II-9	10 November 1969	Provides proof-test conditions and exceptions for handling and shipping equipment, and establishes minimum proof-load requirements.	Incorporated
R-3896-5 Vol II-10	30 December 1969	Changes dimensional check interval and method of performing dimensional check for clearance pins T-5041812.	Incorporated
R-3896-5 Vol II-11	31 March 1970	Revises repair procedures for seals of Turbine Exhaust Exit Pressure Check Fixture G3144.	Incorporated
R-3896-5 Vol II-12	18 August 1970	Changes cleaning method for Turbine Exhaust Exit Pressure Check Fixture G3144.	Incorporated
R-3896-5 Vol II-13	5 November 1970	Adds a method for supporting pressurizing hose attached to thrust chamber throat plug seal.	Incorporated
R-3896-5 Vol II-14	13 November 1970	Adds a periodic inspection procedure, a leak-test procedure, and assembly dimensions for the seal and plate for Turbine Exhaust Pressure Check Fixture G3144.	Incorporated
R-3896-5 Vol II-15	17 March 1971	Changes inspection requirements for Fuel Drainage Kit G2037 from a periodic time requirement to a prior-to-use requirement, and adds a requirement to replace O-rings after the kit is used. This supplement also deletes the proof-test requirement for Nozzle Extension Alinement Tool G4079.	Incorporated

Supplement Number	Dated	Description	Supplement Status
R-3896-5 Vol II-16	23 August 1971	Deletes detail 131 from pressure test fixture T-5039457.	Incorporated
R-3896-5 Vol II-17	25 August 1971	Deletes the requirement to perform dye-penetrant inspection on welds of the thrust chamber throat plug prior to each proof test.	Incorporated

This supplement affects the data in Technical Manual R-3896-5, Volume II. Make a reference to this supplement in the margin next to the data being supplemented; enter the number, date, and subject matter of the supplement on the Manual Data Supplement Record; and file this supplement in the Appendix to this manual.

This supplement replaces an existing warning with a more comprehensive warning about potential hazards when using polyurethane foam.

On page 2-95, paragraph 2-857, replace existing warning with the following:

WARNING

The following procedure specifies polyurethane foam, the components of which, must not be allowed to contact any part of the body. Face shield and gloves must be worn by personnel handling polyurethane foam. Polyurethane foam must be mixed and applied in a well-ventilated area since the vapors are extremely hazardous. Part A in the uncured condition can react as soon as the container is opened. In case of contact, the skin or eyes must be immediately flushed with water for at least 15 minutes and given medical attention.

MANUAL DATA SUPPLEMENT NO. R-3896-5 VOL II-19
Sheet 1 of 1 22 February 1973

This supplement affects the data in Technical Manual R-3896-5, Volume II. Make a reference to this supplement in the margin next to the data being supplemented; enter the number, date, and subject matter of the supplement on the Manual Data Supplement Record; and file this supplement in the Appendix to this manual.

This supplement corrects the part number of four relief valves in Test Plate, Plug and Tool Set G3132.

On page 1-15, figure 1-6A, last four part numbers, change 5007 to 5016.

This supplement affects the data in Technical Manual R-3896-5, Volume II. Make a reference to this supplement in the margin next to the data being supplemented; enter the number, date, and subject matter of the supplement on the Manual Data Supplement Record; and file this supplement in the Appendix to this volume.

This supplement adds a warning for handling a specific material used in the manual.

On page 1-16, add the following warning after paragraph 1-65:

WARNING

Cement EC1300L is flammable and must not be used near heat, sparks or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the cement can cause serious bodily harm. In case of prolonged exposure immediately obtain fresh air and wash skin with soap and water.

This supplement affects the data in Technical Manual R-3896-5, Volume II. Make a reference to this supplement in the margin next to the data being supplemented; enter the number, date, and subject matter of the supplement on the Manual Data Supplement Record; and file this supplement in the Appendix to this manual.

This supplement changes leak-test compound (MIL-L-25567) to leak-test compound (MSFC-SPEC-384).

Change leak-test compound (MIL-L-25567) to leak-test compound (MSFC-SPEC-384) in the following places:

Page No.	Paragraph No.	Step
1-5	1-12	d
1-15	1-62A	c
1-30A	1-102	c