R-3896-3
VOLUME II

TECHNICAL MANUAL

MAINTENANCE AND REPAIR

F-1 ROCKET ENGINE

(ROCKETDYNE)

CHANGE NOTICE

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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-2029 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. This information in these manuals was prepared by Logistics Product Support Department of Rocketdyne.

The manuals are used to best advantage when each manual is current and complete (see figure 1) and the purpose and scope of each manual is known. The manuals in this series, and the nature of the data each provides, are found in the manuals' contents and support function chart.

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

The contents and support function 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. Thus, information on the description, operation, and maintenance of ground support equipment is in R-3896-5. However, the instructions for servicing the engine using ground support equipment are in R-3896-3 and R-3896-11.

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-IC 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 Description and Operation II Interface Design Criteria III 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-installation 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	See detailed table of contents for this manual.
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	I General Maintenance and Repair II Hydraulic Pumping Unit G2025 III Hydraulic Pumping Unit G2026 IV Accumulator Unit G2027 V Engine Checkout Console G3142

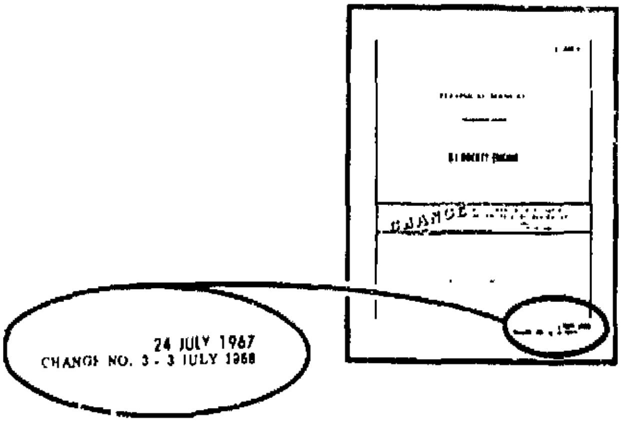
Manual	Contents and Support Function	Section and Title
R-3896-5, Volume I (cont)	maintenance, and parts listings with maintenance-level codes for the F-1 engine ground support equipment covered in this volume. This volume provides data to restore and/or maintain the F-1 rocket engine ground support equipment in an operable condition.	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 XIV Impact Recorder Unit G4090 and 99-9014031 XV Components Welding Sets 9026560, 9026561, and 9026570 XVI Handling and Shipping Equipment
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.	I Test Kits, Sets, and Tools II T-Tools III Dummy Weight T-Tools
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 Repair VII Storage and Handling

Manual	Contents and Support Function	Section and Title
R-3896-8 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
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 Operating Requirements II General Requirements III 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.

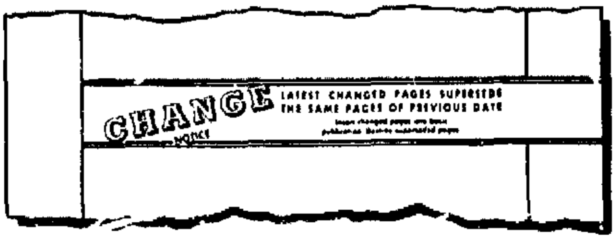


B. DETERMINING COMPLETENESS. To be sure that your manual is complete, make a page-by-page comparison of its pages to those listed in the List of Effective Pages. The List of Effective Pages, which shows the change status since the basic issue or last revision, is found on the alphabetically lettered 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)

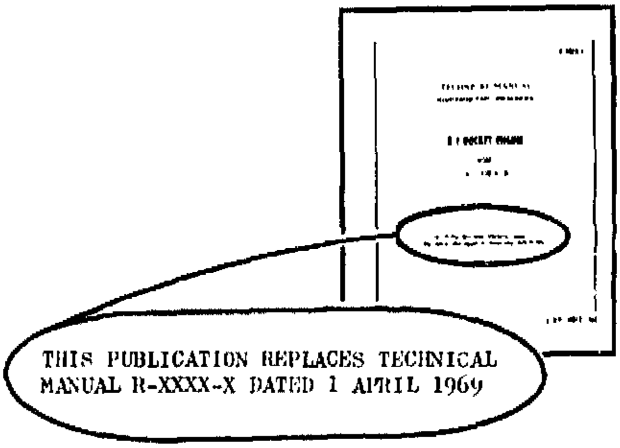
3. If you are unsure of the status of any page or pages, refer to the List of Effective Pages and make sure your manual contains pages (with the corresponding change dates) listed in the List of Effective Pages.

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.

GEN-NASA-2

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

SECTION I

QUICK-DISCONNECT

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

1-1. QUICK-DISCONNECT NA5-260079 AND 308206.

1-2. The following procedures contain cleaning, inspecting, repairing, and testing information required to maintain the quick-disconnects. Disassembly of quick-disconnects for repair or replacement of internal parts is not recommended; therefore, special tools, equipment, and procedures are not provided for disassembly. See figure 1-1 for exterior view of quick-disconnects. See figure 1-2 for test equipment and special tools for testing, and figure 1-3 for protective closures used during these procedures.

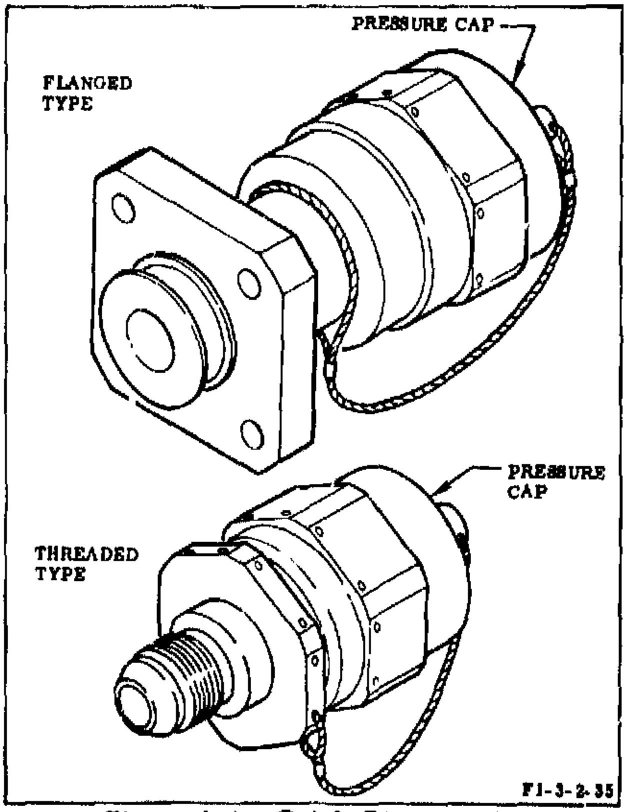


Figure 1-1. Quick-Disconnects (Typical)--Exterior View

Part No.	Nomenclature	Use
T-5039457 (or equivalent)	Pressure Test Fixture	Pressure-tests quick-disconnects.
G3141	Components Test Console	Provides gaseous nitrogen for testing quick-disconnects.
G3143	Components Adapter Set	Provides hardware for pressure-testing quick-disconnects.
G3104	Pneumatic Flow Tester	Measures downstream pneumatic leakage.
NA5-260098T5 (or equivalent)	Ground Half Quick-Disconnect	Tests flight half quick-disconnect NA5-260079T7.

Figure 1-2. Test Equipment and Special Tools for Quick-Disconnects

Part No.	Nomenclature	Use Quick-Disconnect NA5-260079
RD265-5016-0006	Closure	T-1
24[a]	Cap	T-2
236[a]	Cap	T-3
12[a]	Cap	T-4
24[a]	Cap	T-6
24[a]	Cap	T-7

(a) S. S. White Co, Plastics Division

Figure 1-3. Protective Covers and Closures for Quick-Disconnects

1-3. CLEANING

1-4. (Deleted)

WARNING

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

- The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.
- The following procedure uses pressurized gaseous nitrogen or air, which must not be allowed to impinge on the body since it may result in skin inflation. Inflation of the skin can cause serious injury to human tissues.
- Eye protection must be worn to pervent foreign matter from injuring eyes.
- Pressurized gases can hurl objects with sufficient force to cause injury to personnel.

a. Clean exterior surfaces of quick-disconnect by handwiping as outlined in R-3896-3, Volume I.

aA. Remove pressure cap from quick-disconnect; then hand-flush pressure cap with trichloroethylene or cleaning compound.

b. Using a nylon dowel rod or an equivalent rod made of a soft material that is not affected by the cleaner, carefully open quick-disconnect valve.

c. Hand-flush quick-disconnect in both directions with trichloroethylene or cleaning compound.

d. Dry quick-disconnect and pressure cap with low-pressure (approximately 10 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to cleanness and humidity requirements of MIL-P-27401; then close quick-disconnect valve.

1-5. INSPECTING AND REPAIRING.

1-6. Inspecting the quick-disconnects determines if the disconnects have been damaged by mishandling or wear. Since disassembly of the disconnects is not recommended, repair is limited to repairing minor scratches in the mounting flange sealing surfaces and damaged threads. Refer to R-3896-3, Volume I, for thread repair.

1-7. TESTING.

1-8. This procedure outlines requirements for testing quick-disconnects using Components Test Console G3141, Components Adapter Set G3143, and Pneumatic Flow Tester G3104. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install quick-disconnect in the correct panel-mounted test fixture as specified in figure 1-4. Also, refer to figure 1-4 for torque values, valve opening dowels, and adapters used during testing. Prepare components test console for use (figure 1-5), and refer to paragraphs 1-9 and 1-10 for quick-disconnect leak-test procedure. See figure 1-6 for quick-disconnect test setup.

Quick-Disconnect Type	Pressure Cap Torque Value (Foot-Pounds)	Panel-Mounted Test Fixture	Valve Opening Dowel[a]	Adapter[b]
308206	17-19	T-5039457-210	T-5039457-217	T-5039457-220
NA5-260079T-1	30-40	T-5039457-210	T-5039457-217	T-5039457-220
NA5-260079T-2	30-40	T-5039457-212	T-5039457-217	T-5039457-220
NA5-260079T-3	70-75	T-5039457-211	T-5039457-216	T-5039457-221
NA5-260079T-4	30-40	T-5039457-213	T-5039457-217	T-5039457-220
NA5-260079T-6	30-40	T-5039457-215	T-5039457-217	T-5039457-220
NA5-260079T-7[c]	30-40	T-5039457-215	T-5039457-218	T-5039457-220

(a) Holds quick-disconnect valve open when performing leak test of pressure cap.
(b) Used to adapt quick-disconnect to Pneumatic Flow Tester G3104.
(c) Type 7 requires NA5-260098T5 to perform flow and reseat pressure test.

Figure 1-4. Preparing Quick-Disconnects for Testing

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

<u>PRE-POWER TURN ON</u>

Panel	Control	Position	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115 V	At rear of unit.
	100 KΩ STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
	Connectors J701, J702, J704, and J705	Capped	
TEST CELL ELECT. OUTLETS	Connector J703	Resistor Plug 3088-9	Temperature indicator load.

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Figure 1-5. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON.[a] AC INPUT light on.
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	OFF	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 22 +1 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]

(a) If indication is not as specified, press applicable switch-light.

Figure 1-5. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed when working with pressurized systems.

(a) If indication is not as specified, press applicable switch-light.

Figure 1-5. Preparing Components Test Console for Use (Sheet 3 of 3)

Procedure	Result
1-9. LEAK-TEST.	
a. Prepare Components Test Console G3141 and quick-disconnect for use as outlined in paragraph 1-8.	None.
b. Connect quick-disconnect to console for leak-test. (See figure 1-6.) Hand-tighten adapter, and open hand valve 19-9022606-2.	None.
c. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to outlet port (B) as follows:	
(1) Open SHUTOFF valve.	None.

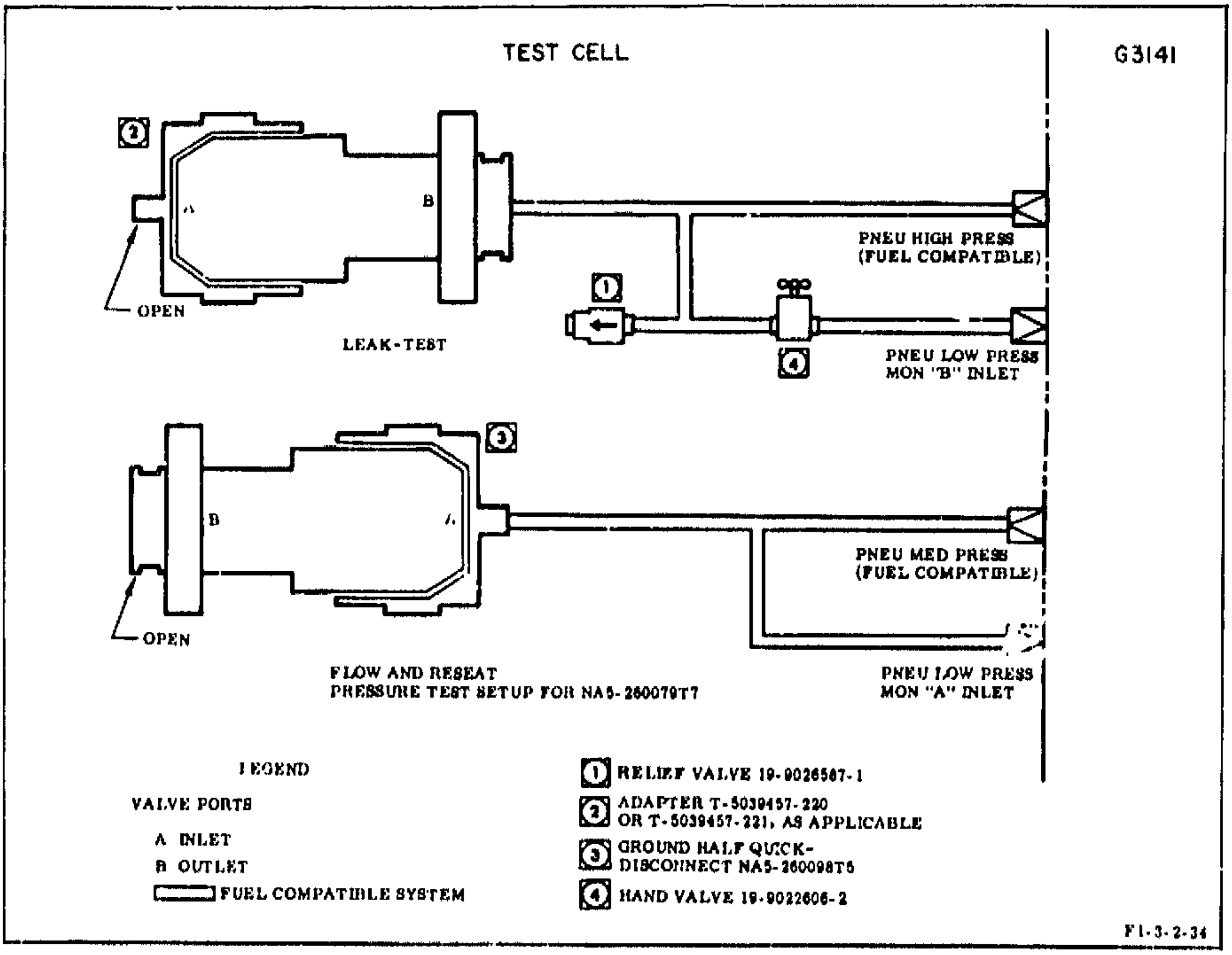


Figure 1-6. Leak-Test and Flow and Reseat Pressure Test Setups

Procedure	Result
(2) Adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 10 ±2 psi.	PRESSURE MONITOR "B" gage must indicate 10 ±2 psi. Outlet port (B) pressurized.
d. Measure and record leakage from inlet port (A).	Maximum allowable leakage past valve is 3 scim.
e. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 100 ±10 psi.	PRESSURE MONITOR "B" gage must indicate 100 ±10 psi. Outlet port (B) pressure increased.
f. Repeat step d.	Same as step d.

Procedure	Result
g. Close hand valve 19-9022606-2; then on HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,000 ±25 psi.	REG SUPPLY PRESS gage must indicate 2,000 ±25 psi. Outlet port (B) pressure increased.
h. Repeat step d.	Same as step d.
i. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to outlet port (B) as follows:	
(1) Close SHUTOFF valve, and open VENT valve.	Outlet port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
j. Remove adapter from quick-disconnect inlet port (A). Open hand valve 19-9022606-2.	None.
k. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to outlet port (B) as follows:	
(1) Open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 10 +2 psi.	PRESSURE MONITOR "B" gage must indicate 10 +2 psi. Outlet port (B) pressurized. HIGH PRESS FUEL COMPATIBLE panel pressurized.
l. Using trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302) as a leak-test solution, check for leakage at the joint between the valve seat and body for 2 minutes.	No leakage is allowable.

WARNING

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

- Cleaning compound is volatile. Use in a well ventilated area since the vapors replace the oxygen in the air, resulting in suffocation.

Procedure	Result
m. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 100 +10 psi.	PRESSURE MONITOR "B" gage must indicate 100 ±10 psi. Outlet port (B) pressure increased.
n. Repeat step l.	Same as step l.

Procedure	Result
o. Close hand valve 19-9022606-2; then on HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,000 +25 psi.	REG SUPPLY PRESS gage must indicate 2,000 +25 psi. Outlet port (B) pressure increased.
p. Repeat step l.	Same as step l.
q. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to outlet port (B) as follows:	
(1) Close SHUTOFF valve, and open VENT valve.	Outlet port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
r. Install proper valve opening dowel as specified in figure 1-4 in inlet port (A); then install pressure cap. Torque pressure cap to minimum value specified in figure 1-4. Open hand valve 19-9022606-2.	None.
s. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to outlet port (B) as follows:	
(1) Open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 10 +2 psi.	PRESSURE MONITOR "B" gage must indicate 10 +2 psi. Outlet port (B) pressurized.
t. Using trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302) as a leak-test solution, check for leakage at joints between coupling and body and between coupling and cap for 2 minutes.	No leakage is allowable.

WARNING

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

- Cleaning compound is volatile. Use in a well ventilated area since the vapors replace the oxygen in the air, resulting in suffocation.

Procedure	Result
u. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 100 +10 psi.	PRESSURE MONITOR "B" gage must indicate 100 +10 psi. Outlet port (B) pressure increased.

Procedure	Result
v. Repeat step t.	Same as step t.
w. Close hand valve 16-9022606-2; then on HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,000 ±25 psi.	REG SUPPLY PRESS gage must indicate 2,000 ±25 psi. Outlet port (B) pressure increased.
x. Repeat step t.	Same as step t.
y. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to outlet port (B) as follows:	
(1) Close SHUTOFF valve, and open VENT valve.	Outlet port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
z. Remove quick-disconnect from test setup.	None.
aa. If quick-disconnect testing is terminated, secure equipment as outlined in paragraph 1-11.	None.
ab. Install closures, as required (figure 1-3).	None.

1-10. FLOW AND RESEAT PRESSURE TEST.

NOTE

This test is required only on quick-disconnects NA5-260079T7.

Procedure	Result
a. Make sure Components Test Console G3141 and quick-disconnect are prepared for use as outlined in paragraph 1-8.	None.
b. Connect quick-disconnect to console for flow and reseat pressure test. (See figure 1-6.)	None.
c. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to inlet port (A) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.

Procedure	Result
(3) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 40 ±2 psi.	PRESSURE MONITOR "A" gage must indicate 40 ±2 psi.
d. Measure and record flow from outlet port (B).	Minimum allowable flow from outlet port (B) is 200 scim.
e. On MED PRESS FUEL COMPATIBLE panel, slowly close SHUTOFF until PRESSURE MONITOR "A" gage indicates 10 ±1 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±1 psi.
f. Measure and record flow from outlet port (B).	Maximum allowable flow from outlet port (B) is 100 scim.
g. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to inlet port (A) as follows:	
(1) Close SHUTOFF valve, and open VENT valve.	Inlet port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
h. Remove quick-disconnect from test setup.	None.
i. If quick-disconnect testing is terminated, secure equipment as outlined in paragraph 1-11.	None.
j. Install closures as required (figure 1-3).	None.

1-11. SECURING TEST EQUIPMENT.

1-12. After quick-disconnect testing is completed and disconnect is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap test cell panel outlets and connectors.

h. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

i. Turn DC POWER SUPPLY off.

j. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION II

GAS GENERATOR

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

2-1. GAS GENERATOR 308301-11 THROUGH 308301-71, 308375 THROUGH 308375-61, AND 309181 THROUGH 309181-51.

2-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the gas generator. See figure 2-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. The following protective closures are subject to the special requirements indicated. Specified lubrication methods are outlined in R-3896-3, Volume I.

a. Closures RX20660 and RX20601: Lubricate (Method A) fasteners with thread compound C-5A (Felt Products).

b. Closures RX20610-281 and RX20607: Lubricate (Method A) fasteners with lubricant grease RB0140-012 (Rocketdyne).

c. Closures RX20845-21: Lubricate (Method A) closure threads and lubricate (Method J) packings with lubricant grease RB0140-012 (Rocketdyne). Torque closures to 20-30 in-lb.

d. Plugs ST3950122RKL001: Torque to 600-650 in-lb and safetywire together. Plug MS9015-08: May be used as an alternate to plug ST3950122RKL001. Torque to 150-200 in-lb.

2-3. DISASSEMBLING.

2-4. Disassemble the gas generator, as required, to accomplish necessary repairs and/or replacement. Refer to figure 2-3 for parts and index numbers and proceed as follows:

a. Install gas generator into assembly jig 8101894.

b. Remove plugs (12, 12A, 14, 15, 17, 19), K-seals (13, 16, 18), gaskets (20), and bolts (21).

c. Remove nuts (3), washers (2), ball valve (1), and seal (4).

d. Remove 2 nuts (7) and housing (11, 11A).

e. Remove remaining nuts (7) and studs (8).

f. Remove retainers (5, 9) and O-rings (6, 10).

g. Remove bolts (22, 23), washers (24), injector (26), seal (28), and bracket (25, 25A).

Part No.	Nomenclature	Use
8101894	Assembly Jig	Holds gas generator during repair.
T-5029642	Special Wrench Adapter	Torques nuts that secure ball valve to injector.
T-5034712	Pressure Test Fixture	Closes open ports of gas generator during testing.

Figure 2-1. Test Equipment and Special Tools for Gas Generator

Figure 2-2 deleted.

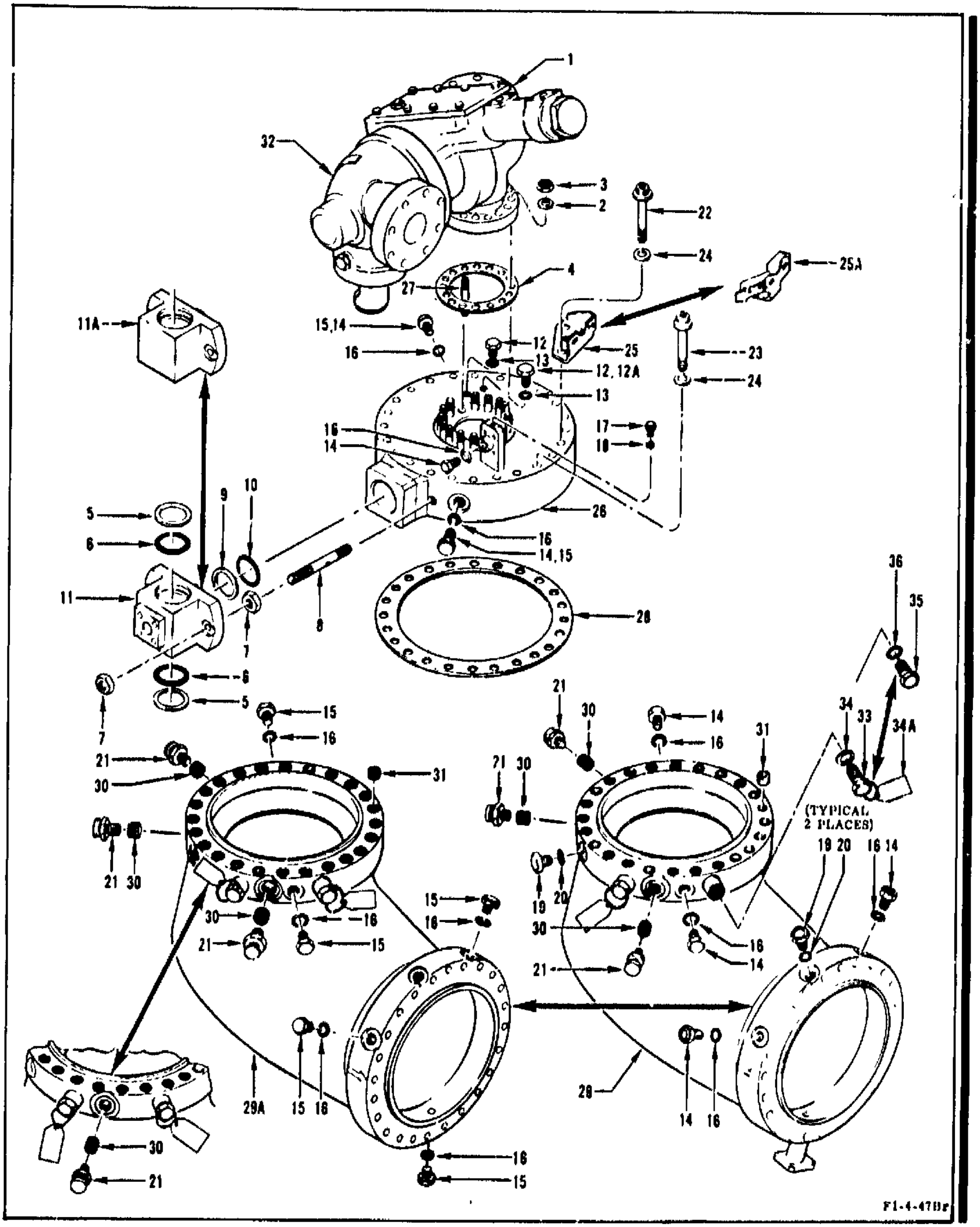


Figure 2-3. Gas Generator--Exploded View (Sheet 1 of 2)

1	Ball Valve	22	Bolt
2	Washer	23	Bolt
3	Nut	24	Washer
4	Seal	25	Bracket(a)
5	Retainer	25A	Bracket(b)(c)
6	O-ring	26	Injector
7	Nut	27	Stud
8	Stud	28	Seal
9	Retainer	29	Combustion chamber(a)
10	O-ring		
11	Housing(a)(b)	29A	Combustion chamber(b)(c)
11A	Housing(c)		
12	Plug	30	Insert
12A	Plug	31	Insert
13	K-seal	32	Plate
14	Plug	33	Plug
15	Plug	34	Washer
16	K-seal	34A	Streamer
17	Plug	35	Plug (alternate for 33)
18	K-seal		
19	Plug(a)	36	Gasket (alternate for 34)
20	Gasket(a)		
21	Bolt		

(a) On gas generator 308301-11
(b) On gas generator 308301-71
(c) On gas generators 308375, -11, -21, -31, -41, 51, and -61

Figure 2-3. Gas Generator--Exploded View (Sheet 2 of 2)

NOTE

Studs (27) need not be removed unless damaged.

gA. Remove plugs (33, 35) and washers (34) or gaskets (36).

h. Remove combustion chamber (29, 29A) from assembly jig.

2-5. CLEANING.

2-6. Clean injector (26) and seal (4) for liquid oxygen service; and combustion chamber (29, 29A) housing (11, 11A) and studs (8) for fuel service as outlined in R-3896-3, Volume I.

2-7. INSPECTING AND REPAIRING.

2-8. Inspecting the gas generator determines if the individual parts have been damaged by mishandling or wear. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Refer to figure 2-4 and inspect individual parts for general condition, damage to threads, corrosion, distortion, nicks, burs, and scratches. Inspecting gas generator insulating covers is limited to determining acceptability only. Tears, nicks, scratches, etc are acceptable if batting material (refrasil) remains within the Inconel foil. Refer to Technical Manual R-3896-6 for thermal insulation repair.

Part Name and Index No.	Inspecting	Repairing
Combustion chamber (29, 29A).	Cracks or broken welds.	Repair welds; replace if parent metal is cracked.
	Internal erosion.	Replace.
	Scratches, dents, or abrasions.	Replace if damage exceeds 0.002 inch in depth on sealing surfaces in primary seal area. Hand blend damage to sealing surface with crocus cloth (600 grit). Buff out other damage.

Figure 2-4. Inspecting and Repairing Gas Generator (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
Combustion chamber (29, 29A) (continued)	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
	Damaged or improperly installed inserts (30, 31).	Replace inserts as outlined in R-3896-3, Volume I.
Injector (26)	Primary sealing surfaces for scratches, dents, or abrasions.	Replace if damage exceeds 0.002 inch in depth on sealing surfaces in primary seal area. Hand-blend damage to sealing surface with crocus cloth (600 grit). Buff out other damage.
	Scratches, dents, or abrasions on noncritical steel surfaces.	Replace injector if damage exceeds 0.030 inch in depth. Rework damaged area by grinding of hand-blending if less than 0.030 inch in depth.
	Erosion.	Replace if erosion exceeds 0.010 inch in depth.
	Cracks.	Replace
	Chamber pressure tube leak within fuel manifold.	Replace injector.
	Plugged orifices.	Clean plugged orifices from the downstream side of the injector with a drill rod the next smaller size than the orifice diameter, then shake the loose particles out of the injector propellant inlets.
	Damaged orifices.	Replace injector if orifices are damaged beyond repair or if average orifice diameters are 5 percent oversize or undersize. Minor damage to orifices may be repaired by running a drill one size smaller than the orifice diameter through the damaged orifices.
Studs (8, 27)	Damaged threads.	Refer to R-3896-3, Volume I for thread repair and replacement of studs (27). Studs (27) must be installed so that large end of stud is 0.010 (+0.010, -0.000) inch below surface of injector.
Housing (11, 11A)	Damaged threads, housing (11).	Refer to R-3896-3, Volume I for thread repair.
	Worn or chipped chromium plating.	Strip and replace to a minimum of 0.002 inch thickness.
	Galling of bearing surfaces.	Replace if damage exceeds 0.010 inch in depth. Repair by hand-blending damaged area if less than 0.010 inch in depth.
Seal (4, 28)	Damaged Teflon seal (4).	Replace seal.
	Imperfections on sealing surface.	Replace seal.
Ball valve (1)	Refer to section III.	

Figure 2-4. Inspecting and Repairing Gas Generator (Sheet 2 of 2)

2-9. ASSEMBLING.

2-10. The lubricants used in this procedure are specified in the procedural steps. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. Refer to figure 2-3 for parts and index numbers and proceed as follows:

a. Install chamber assembly (29, 29A) into assembly jig 8101894.

b. Install seal (28) on chamber assembly (29, 29A).

c. Install injector (26) and bracket (25, 25A), and secure with washers (24) and bolts (22, 23). Torque bolts to 680-700 in-lb.

d. Lubricate (Method L) O-rings (6, 10) and retainers (5, 9) with FS1281 grease (Dow Corning Corp) and install in housing (11, 11A).

e. Install studs (8) in injector (26). Torque studs to 50 ±10 in-lb.

f. Install one nut (7) on each stud (8), then install housing (11, 11A) on injector (26).

g. Install seal (4) and ball valve (1), and secure with washer (2) and nuts (3). Using special wrench adapter T-5029642, torque nuts to 150-172 in-lb.

h. Install remaining 2 nuts (7); then bring all 4 nuts fingertight against housing (11, 11A).

CAUTION

Do not deflect valve post of ball valve (1).

i. Lubricate (Method A) plugs (12, 12A) with lubricant grease RB0140-012 (Rocketdyne). Install K-seals (13) and plugs (12, 12A) in oxidizer ports on top of injector (26). Torque plugs to 80-90 in-lb.

j. Lubricate (Method A) plugs (14, 15) with lubricant grease RB0140-012 (Rocketdyne). Install K-seals (16) and plugs (14, 15) in fuel ports on outer diameter of injector (26). Torque plugs to 200-240 in-lb.

k. Lubricate (Method A) plugs (14, 15, 17, 19) with thread compound C-5A (Felt Products), and install plugs in hot-gas ports on combustion chamber (29, 29A) and top of injector (26) as follows:

(1) Install K-seals (16) and plugs (14, 15). Torque plugs to 200-240 in-lb.

(2) Install K-seal (18) and plug (17). Torque plug to 85-95 in-lb.

(3) Install gaskets (20) and plugs (19). Torque plugs to 130-170 in-lb.

l. Install bolts (21). Torque bolts to 210-280 in-lb.

m. Install washers (34) and plugs (33) in igniter ports. Torque plugs to 600-650 in-lb. See paragraph 2-2 for alternate plugs (35) and gaskets (36) that may be used in the igniter ports. If alternate plugs and gaskets are used; the gasket must be fully seated in the recessed groove during installation and torquing. Torque alternate plugs to 150-200 in-lb.

n. Safetywire external bolts, studs, and plugs with Inconel lockwire MS20995N, as required.

2-11. TESTING.

2-12. This procedure outlines requirements for complete testing of the gas generator, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on gas generator as outlined in figure 2-5. Index letters are assigned to the gas generator ports for ease of identification in illustrations. Prepare components test console for use (figure 2-6). Refer to paragraph 2-13 for gas generator test procedure and see figure 2-7 for test setup.

Index Letter	Valve Port	Test Plate	Port Connection
B	Oxidizer Purge	T-5034712-201	None
K	Fuel Inlet	T-5034712-204	AN815-4C
L	ACT OPENING	T-5034712-209	AN815-4C
N	Warment		AN815-4C
M	ACT CLOSING	T-5034712-206	AN815-4C
R	Oxidizer Inlet	T-5034712-202	AN815-4C

Figure 2-5. Preparing Gas Generator for Testing (Sheet 1 of 2)

Index Letter	Valve Port	Test Plate	Port Connection
S	Fuel Purge	T-5034712-208(a)	None
T	Chamber Outlet	T-5034712-205	None
U	Chamber Drain	T-5034712-207(b)	None
W	Injector	None	Open
X	Igniter	ST3950122RKL001 Plug(c) 651912-3 Washer or	None
		MS9015-08 Plug(d) AN901-8C Gasket(d)	None
GG1B	Instrumentation	T-5034712-308	None
GG1D	Instrumentation	T-5034712-302	None

(a) On gas generators 308301-11 and -71
(b) On gas generator 308301-11
(c) Torque plugs to 600-650 inch-pounds
(d) May be used as an alternate plug and gasket. Torque plugs to 150-200 inch-pounds.

Figure 2-5. Preparing Gas Generator for Testing (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	Off	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	

Figure 2-6. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON.[a] AC INPUT light on.
	VOLTS-RANGE SELECT	D (0-30)	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 24 ±0.4 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]

(a) If indication is not as specified, press applicable switch-light.

Figure 2-6. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	FLOW MONITOR SHUTOFF		CLOSE.[(a)]
	LOW FLOW BYPASS		CLOSE.[(a)]

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen and helium to console.

NOTE

Helium supply is required only for cryogenic tests.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL PANEL, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console pressurizing panels and into test cell. Safety precautions specified in R-3896-3, Volume I must be followed when working with pressurized systems.

(a) If indication is not as specified, press applicable switch-light.

Figure 2-6. Preparing Components Test Console for Use (Sheet 3 of 3)

2-13. PNEUMATIC LEAK-TEST.

Procedure	Result
a. Prepare Components Test Console G3141 for use and gas generator for testing as outlined in paragraph 2-12.	None.
b. Connect gas generator to console. (See figure 2-7). Leave seal monitor port (W) open. Make sure all other ports are pressure capped or plugged.	None.
c. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.

Procedure	Result
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
e. On HIGH PRESS FUEL COMPATIBLE panel, open VENT; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,000 ±20 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 800 ±15 psi.	PRESSURE MONITOR "A" gage must indicate 800 ±15 psi. ACT CLOSING port (M) pressurized and ball valve closed.

g. Using LOW PRESSURE panel, apply pressure to oxidizer inlet port (R) and instrumentation port (GO2) as follows:

Procedure	Result
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 10 ±1 psi.	REG SUPPLY PRESS gage must indicate 10 ±1 psi. Oxidizer inlet port (R) and instrumentation port (GO2) pressurized.

h. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:

Procedure	Result
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 10 ±1 psi.	REG SUPPLY PRESS gage must indicate 10 ±1 psi. Fuel inlet port (K) pressurized.

i. Using leak test compound (MIL-L-25567), check for leakage at the following joints:

Procedure	Result
(1) Between ball valve and injector.	No leakage is allowable.
(2) Between injector and combustion chamber.	No leakage is allowable.
(3) Between ball valve fuel post and fuel inlet housing.	No leakage is allowable.
(4) Between fuel inlet housing and injector.	No leakage is allowable.
(5) Igniter boss welds.	No leakage is allowable.
j. Measure and record leakage from injector-to-combustion chamber seal monitor port.	Maximum allowable leakage is 10 scim.
k. On LOW PRESSURE panel, close SHUTOFF valve, then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LOW PRESSURE panel depressurized

l. Using HIGH PRESSURE panel, increase pressure to oxidizer inlet port (R) and instrumentation port (GO2) as follows:

Procedure	Result
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±50 psi.	REG SUPPLY PRESS gage must indicate 500 ±50 psi. Oxidizer inlet port (R) and instrumentation port (GO2) pressurized.

Procedure	Result
m. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±50 psi.	REG SUPPLY PRESS gage must indicate 500 ±50 psi. Fuel inlet port (K) pressurized.

n. Using leak test compound (MIL-L-25567), check for leakage at the following joints:

Procedure	Result
(1) Between ball valve and injector.	No leakage is allowable.

NOTE

In the following procedure, fuzz leakage is the formation of bubbles that do not increase in size for a period of 5 minutes.

Procedure	Result
(2) Between injector and combustion chamber.	Fuzz leakage is allowable.
(3) Between ball valve fuel post and fuel inlet housing.	No leakage is allowable.
(4) Between fuel inlet housing and injector.	No leakage is allowable.
(5) Igniter boss welds.	No leakage is allowable.
o. Measure and record leakage from injector-to-combustion chamber seal monitor port.	Maximum allowable leakage is 40 scim.

p. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to fuel inlet port (K) as follows:

Procedure	Result
(1) Close SHUTOFF valve and open VENT valve.	Fuel inlet port (K) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
q. On HIGH PRESSURE panel, close SHUTOFF valve.	Pressure to oxidizer inlet port (R) and instrumentation port (GO2) shut off.
r. Slowly open hand valve at instrumentation port (GG2) to reduce gas generator pressure to zero.	Gas generator depressurized.
s. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
t. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
u. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve; and, on HYD MED PRESS MONITOR panel, open vent valve until PRESSURE MONITOR "A" gage indicates zero. Close HIGH PRESS SHUTOFF and vent valve.	PRESSURE MONITOR "A" gage must indicate zero. ACT CLOSING port (M) depressurized.
v. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.

w. Using HYDRAULIC CONTROL panel perform the following:

Procedure	Result
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

wA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).

Procedure	Result
x. Remove gas generator from test setup.	None.
y. If gas generator testing is terminated, secure equipment as outlined in paragraph 2-14.	None.
z. Install protective closures. Refer to paragraph 2-2.	None.

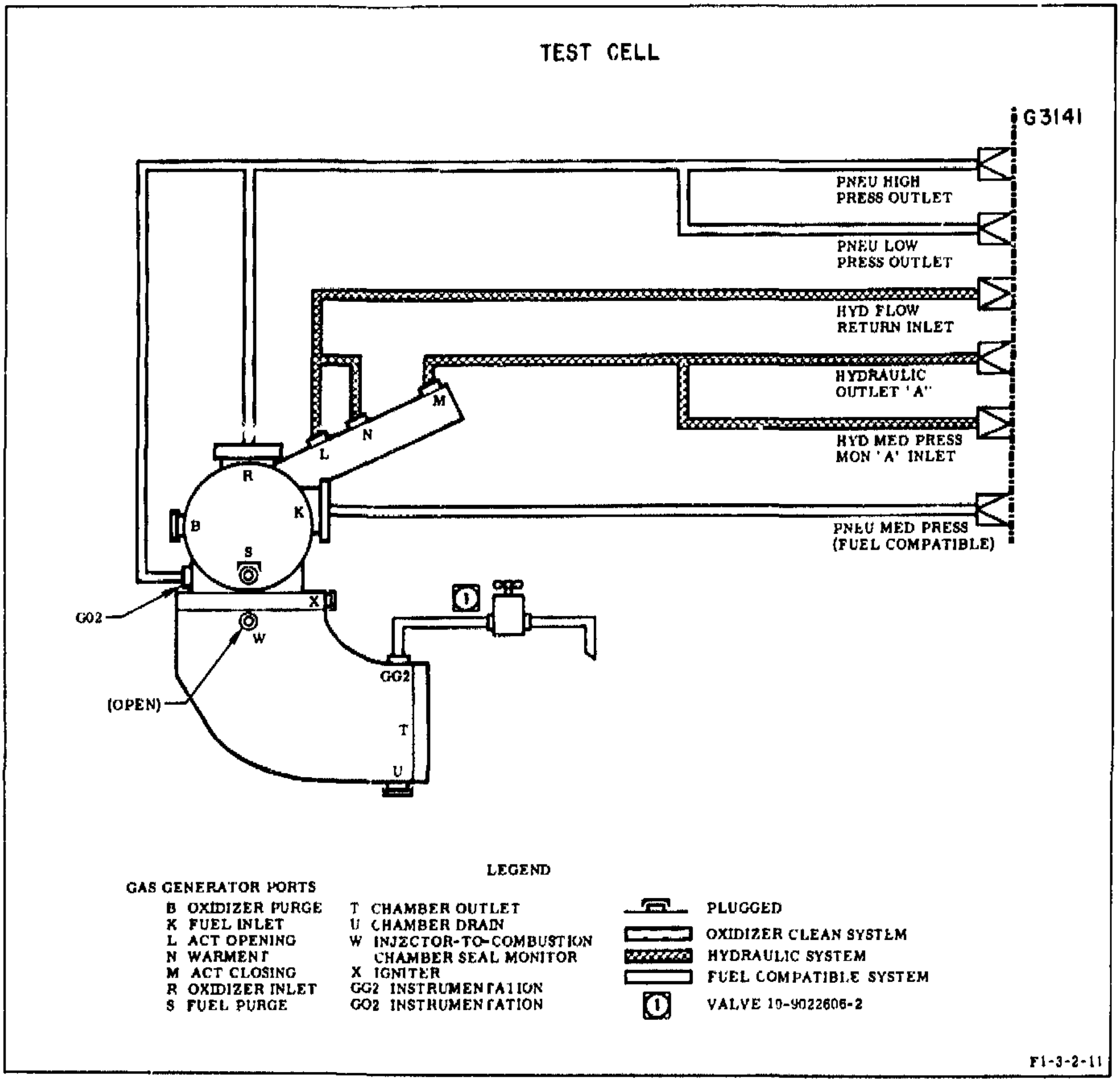


Figure 2-7. Gas Generator Pneumatic Leak-Test Setup

2-14. SECURING TEST EQUIPMENT.

2-15. After gas generator testing is completed and is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves and adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

i. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

j. Turn DC POWER SUPPLY off.

k. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION III

GAS GENERATOR BALL VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, COMPONENTS ADAPTER SET G3143, AND CRYOGENIC SUPPLY UNIT G3146 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

3-1. GAS GENERATOR BALL VALVE 306866, 308888, AND 309110.

3-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the gas generator ball valve. See figure 3-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. The threads of closure RX20845-21 must be lubricated (Method A) and the packing used with the closure lubricated (Method J) using lubricant grease RB0140-012 (Rocketdyne). Specified lubrication methods are outlined in R-3896-3, Volume I.

Part No.	Nomenclature	Use
T-5035249	Spanner Wrench	Torques retainer on fuel housing.
T-5035248	Torque Wrench	Torques nut on oxidizer housing.
T-5035233	Torque Wrench Adapter	Torques nut on ball valve.
T-5035229	Bearing Installer	Installs bearing in housing.
T-5036746	Assembly Jig	Holds ball valve during repair.
T-5035230	Holding Fixture	Holds oxidizer housing during bearing installation.
T-5035218	Holding Fixture	Holds fuel ball assembly during bearing installation.
T-5036700	Spacer	Holds oxidizer ball assembly in place during washer installation.
T-5036725	Check Jig	Aids in determining shim thickness for fuel bellows.
T-5037811	Seal Installation Tool	Holds lip seals in place during assembly.
T-5037832	Inspection Check Fixture	Aids in determining shim thickness for switch arm.
T-5041515	Ball Clocking Tool	Checks setting of fuel and oxidizer balls during assembly.
T-5029737	Pressure Test Fixture	Seals ball valve oxidizer inlet during cryogenic testing.
T-5029360	Pressure Test Fixture	Seals ports of ball valve during testing.

Figure 3-1. Test Equipment and Special Tools for Gas Generator Ball Valve (Sheet 1 of 2)

Part No.	Nomenclature	Use
T-0043P5-3	Piezometer	Provides a means for measuring pressure during testing.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements.
1432-T (General Radio Co), or equivalent	Decade Resistance Box	Used with Triplett 630A for resistance tests.
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests.
G3104	Pneumatic Flow Tester	Measures gas generator ball valve downstream pneumatic leakage.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel for testing gas generator ball valve.
G3143	Components Adapter Set	Provides hardware for gas generator ball valve test setups.
G3146	Cryogenic Supply Unit	Provides liquid nitrogen for cold-testing gas generator ball valve.

Figure 3-1. Test Equipment and Special Tools for Gas Generator Ball Valve (Sheet 2 of 2)

3-3. DISASSEMBLING.

3-4. Disassemble the gas generator ball valve to accomplish necessary repairs and/or replacement. See figure 3-3 for parts and index numbers.

a. Place the ball valve into assembly jig T-5036746 and secure.

b. Remove screws (1) and washers (2). Carefully remove cover (10B, 10D) so that shims (61B) located between finger (62) and foot of switch (6) can be easily removed without dropping them into actuator cavity.

c. Remove pin (61A) from foot of switch (6); then remove screws (3), washers (4), lug (5), switch (6), and packing (7) from cover (10B, 10D). On valve 308888, remove valve (8) and packing (9).

d. Remove screw (12); then remove retainer (14) with spanner wrench T-5035249.

e. Remove screw (15) and washer (16); then remove bellows (18) and ball (13). Remove packing (21) and shim (22) from bellows. Do not remove seal (17) from bellows unless sealing surface has been damaged.

Pages 3-3 and 3-4, figure 3-2 deleted.

Part Number	Nomenclature	Use
RX20123	Plate	Housing, oxidizer port
RX20603-11	Closure	Fuel outlet
RX20605	Closure	Oxidizer outlet
RX20607	Closure	Oxidizer inlet
RX20610-281	Closure	Fuel inlet
RX20633-7	Cover	Fuel and oxidizer housings
RX20660-57	Plate	Closing control port
RX20660-63	Plate	Cover vent port
RX20717-41	Closure	Housing, oxidizer and fuel ports
RX20796	Plate	Actuator housing and cover
RX20845-21	Closure	Vent and drain ports
RX20845-31	Closure	Vent and drain ports
RX20868-21	Plate	Housing, actuator end
RX20911	Plate	Opening control port
RK395-10020-011	Closure	Fuel ball
RK395-10020-021	Closure	Oxidizer ball
RK395-50029	Cap	Fuel and oxidizer ball shaft
RK395-50029-003	Cap	Fuel and oxidizer ball shaft

Figure 3-2. Protective Covers and Closures for Gas Generator Ball Valve

3-3. DISASSEMBLING.

3-4. Disassemble the gas generator ball valve to accomplish necessary repairs and/or replacement. See figure 3-3 for parts and index numbers.

a. Place the ball valve into assembly jig T-5036746 and secure.

b. Remove screws (1) and washers (2). Carefully remove cover (10B, 10D) so that shims (61B) located between finger (62) and foot of switch (6) can be easily removed without dropping them into actuator cavity.

c. Remove pin (61A) from foot of switch (6); then remove screws (3), washers (4), lug (5), switch (6), and packing (7) from cover (10B, 10D). On valve 308888, remove valve (8) and packing (9).

d. Remove screw (12); then remove retainer (14) with spanner wrench T-5035249.

e. Remove screw (15) and washer (16); then remove bellows (18) and ball (13). Remove packing (21) and shim (22) from bellows. Do not remove seal (17) from bellows unless sealing surface has been damaged.

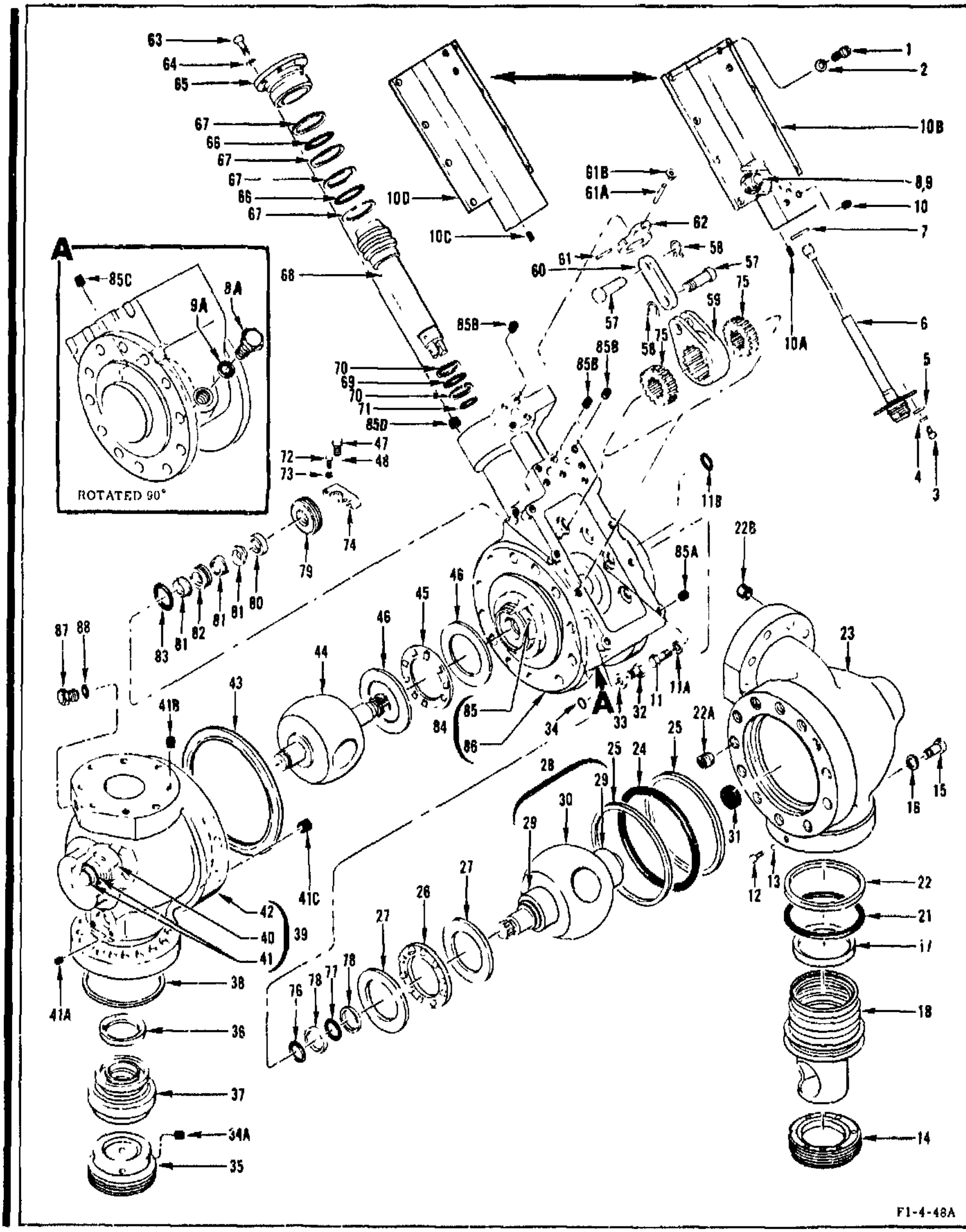


Figure 3-3. Gas Generator Ball Valve--Exploded View (Sheet 1 of 2)

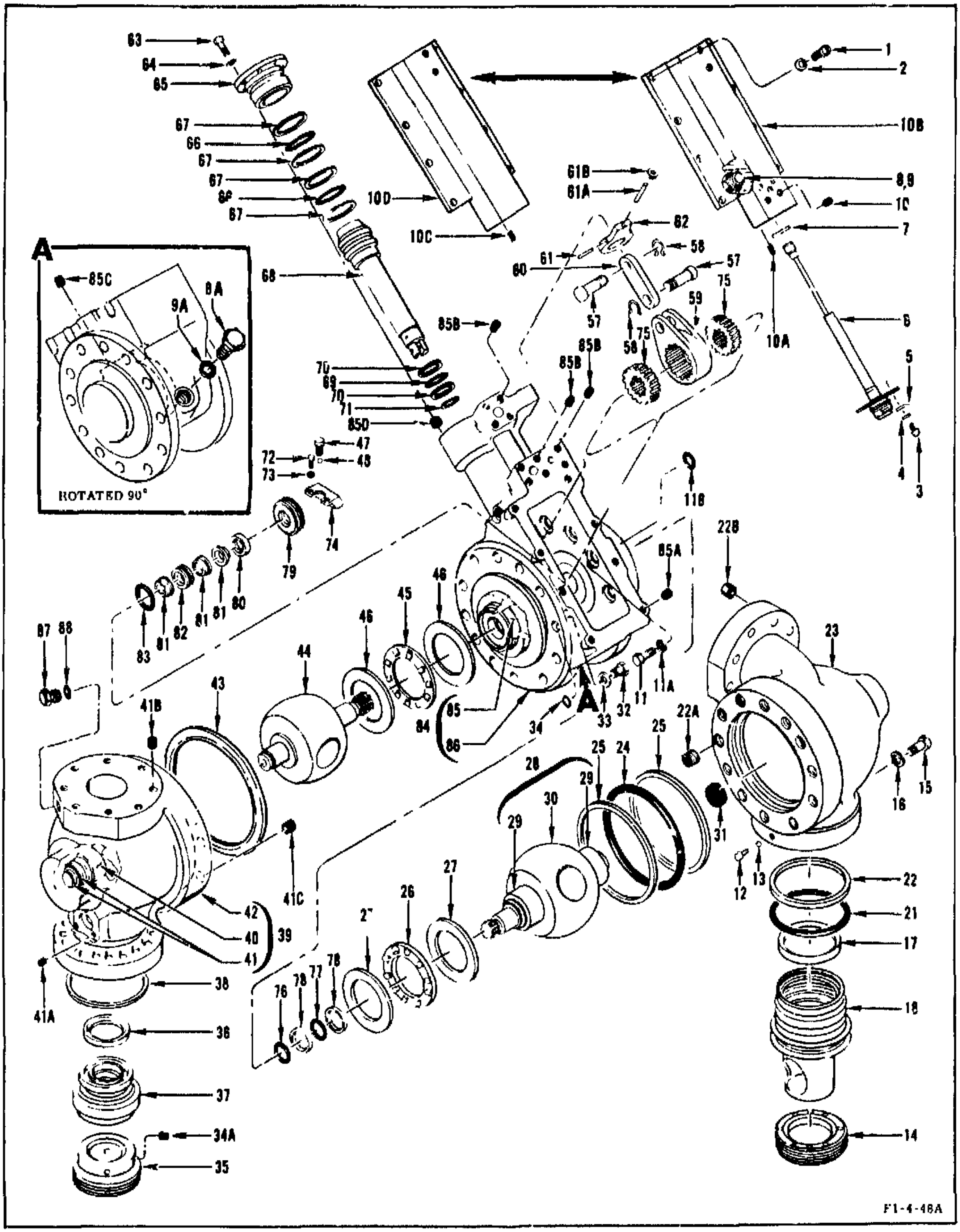


Figure 3-3. Gas Generator Ball Valve--Exploded View (Sheet 1 of 2)

1	Screw	15	Screw	34A	Insert	53	(Deleted	73	Washer
2	Washer	16	Washer	35	Nut	54	(Deleted)	74	Block
3	Screw	17	Seal	36	Seal	55	(Deleted)	75	Insert
4	Washer	18	Bellows	37	Bellows	56	(Deleted)	76	Packing
5	Lug	19	(Deleted)	38	Seal	57	Pin	77	Packing
6	Switch	20	(Deleted)	39	Housing	58	Ring	78	Retainer
7	Packing	21	Packing	40	Bearing	59	Lever	79	Nut
8	Valve[a]	22	Shim	41	Washer	60	Link	80	Spacer
8A	Valve[b][c]	22A	Insert	41A	Insert	61	Pin	81	Lip Seal
9	Packing[a]	22B	Insert	41B	Insert	61A	Pin	82	Ring
9A	Packing[b][c]	23	Housing	41C	Insert	61B	Shim	83	Packing
10	Insert[a]	24	Packing	42	Housing	62	Finger	84	Housing
10A	Insert[a]	25	Retainer	43	Seal	63	Bolt	85	Bearing
10B	Cover[a]	26	Bearing	44	Ball	64	Washer	85A	Insert
10C	Insert[b][c]	27	Race	45	Bearing	65	End Cap	85B	Insert
10D	Cover[b][c]	28	Ball	46	Race	66	Packing	85C	Insert
11	Bolt	29	Bearing	47	Screw	67	Retainer	85D	Insert
11A	Washer	30	Ball	48	Ball	68	Piston	86	Housing
11B	Packing	31	Washer	49	(Deleted)	69	Packing	87	Plug[c]
12	Screw	32	Bolt	50	(Deleted)	70	Retainer	88	Seal[c]
13	Ball	33	Washer	51	(Deleted)	71	Packing		
14	Retainer	34	Packing	52	(Deleted)	72	Screw		

(a) On valve 308888.
(b) On valve 309110.
(c) On valve 306866.

Figure 3-3. Gas Generator Ball Valve--Exploded View (Sheet 2 of 2)

f. Remove nut (35) with torque wrench T-5035248, then remove bellows (37) and seal (38). Do not remove seal (36) from bellows unless sealing surface has been damaged.

g. Remove screw (47), screws (72), washers (73), and block (74).

h. Loosen bolts (11) and remove housing (23). Remove packings (11B), packing (24), retainers (25), and washers (31) from housing.

i. Carefully remove ball (30); then remove bearing (26) and races (27) from ball. Do not remove bearings (29) from ball unless bearings or ball show signs of damage.

j. Loosen bolts (32), remove housing (42); then remove packings (34), washers (41), and seal (43). Do not remove bearing (40) from housing unless bearing shows signs of damage.

k. Carefully remove ball (44); then remove bearing (45) and races (46) from ball. Do not remove bearing (85) from housing (86) unless bearing shows signs of damage.

l. Remove the following parts from housing (86) in the order listed:

(1) Insert (75)
(2) Pin (57)
(3) Ring (58)
(4) Lever (59)
(5) Link (60)
(6) Pin (61)
(7) Bolts (11)
(8) Washers (11A)
(9) Bolts (32)
(10) Washers (33)
(11) Finger (62)

m. Using torque wrench adapter T-5035233, remove nut (79); then remove parts (80) through (83) and (48) from housing (86).

n. Remove the following parts from housing (86) in the order listed:

(1) Bolt (63)
(2) Washers (64)
(3) End Cap (65)
(4) Packing (66)
(5) Retainer (67)
(6) Piston (68)
(7) Packing (69)
(8) Retainer (70)
(9) Packing (71)
(10) Packing (76)
(11) Packing (77)
(12) Retainer (78)

o. On valves 309110 and 306866, remove valve (8A) and packing (9A) from housing (86).

oA. On valve 306866, remove plug (87) and seal (88) from housing (42).

p. Remove housing (86) from assembly jig T-5036746.

3-5. CLEANING.

3-6. The following parts of the gas generator ball valve must be cleaned as outlined in R-3896-3, Volume I:

a. Clean parts (32 through 46, and 79 through 88) for liquid oxygen service.

b. Clean parts (11 through 18,21 through 31, 47, 48, and 57 through 78) for fuel service. Visually inspect cleaned parts as outlined in R-3896-3, Volume I.

c. Clean switch (6) for electrical service as outlined in R-3896-3, Volume I.

3-7. INSPECTING AND REPAIRING.

3-8. Inspecting the gas generator ball valve determines if the individual parts have been damaged by mishandling or wear. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from parts as outlined in R-3896-3, Volume I. See figure 3-4 and inspect parts for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches. See figure 3-5 for dimensional limits.

Part Name and Index No.	Inspecting	Repairing
Cover (10B, 10D)	Damaged seal	Replace.
	Damaged inserts	Replace inserts as outlined in R-3896-3, Volume I.
Retainer (14)	Damaged threads	Refer to R-3896-3, Volume I for thread repair.
Seal (17, 36)	Damage to sealing surface corner	Replace.
Bellows (16, 37)	Any damage to bellows portion	Replace with new assembly.
Shim (22)	Deformed	Replace.
	Diameter (thickness)	See figure 3-5.
Housing (23, 42)	Damage to anodic coating	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damaged threads	Refer to R-3896-3, Volume I for thread repair.
	Damaged inserts	Replace inserts as outlined in R-3896-3, Volume I.
	Damaged sealing surface	Hand-repair and finish to match undamaged adjacent finish.
Ball (30, 44)	Nicks or scratches on sealing surface	Replace ball. Return damaged ball for possible rework.
Nut (35, 79)	Damaged threads	Refer to R-3896-3, Volume I for thread repair.
Switch (6)	Defective switch	Replace switch.
Pin (57)	Chipped or worn solid-film dry lubricant	Replace pin.
	Diameter	See figure 3-5.
Lever (59)	Damaged splines	Replace.
Link (60)	Hole diameters	See figure 3-5.
End Cap (65)	Damaged anodic coating	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Piston (68)	Scoring on shaft sealing surface	Replace.

Figure 3-4. Inspecting and Repairing Gas Generator Ball Valve (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
	Hole diameter	See figure 3-5.
	Shaft sealing surface diameter	See figure 3-5.
	Large diameter	See figure 3-5.
Insert (75)	Damaged splines	Replace.
Spacer (80)	Damaged anodic coating	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damage to sealing surfaces	Hand-polish to remove scratches.
Ring (82)	Damage to sealing surfaces	Hand-polish to remove scratches.
Housing (86)	Damaged anodic coating	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damaged threads	Refer to R-3896-3, Volume I for thread repair.
	Damaged insert	Replace inserts as outlined in R-3896-3, Volume I.
	Cylinder wall for piston scoring	Replace valve assembly.
	Small inside diameter bore lands	See figure 3-5.
	Large diameter of piston bore	See figure 3-5.

Figure 3-4. Inspecting and Repairing Gas Generator Ball Valve (Sheet 2 of 2)

Part Name and Index Number	Dimension	Minimum (Inches)	Maximum (Inches)
Pin (57)	Diameter	0.3741	0.3745
Link (60)	Hole diameters	0.3750	0.3755
Piston (68)	Shaft diameter	0.872	0.873
	Large diameter	1.496	1.497
	Hole diameter	0.3750	0.3755
	Orifice hole diameter	0.019	0.022
Housing (86)	Bore, small diameter for piston (68)	0.876	0.877
	Bore, large diameter for piston (68)	1.500	1.502

Figure 3-5. Dimensional Limits for Gas Generator Ball Valve

3-9. ASSEMBLING.

3-10. The assembly procedure for the gas generator ball valve must be performed in the order listed, and all parts must meet cleaning requirements as outlined in paragraph 3-5. The lubricant used in this procedure is FS1281 grease (Dow Corning Corp), unless otherwise noted. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 3-3 for parts and index numbers, figure 3-6 for seal and shim installation, and figure 3-7 for ball-setting check.

a. Place housing (86) into assembly jig T-5036746 and secure.

b. Lubricate (Method I) packing (69), then insert packing and retainers (70) into groove of housing (86). Groove is located between actuator opening port cavity and actuator vent cavity.

c. Lubricate (Method I) packing (71), then insert packing into groove of housing (86). Groove is adjacent to actuator vent cavity.

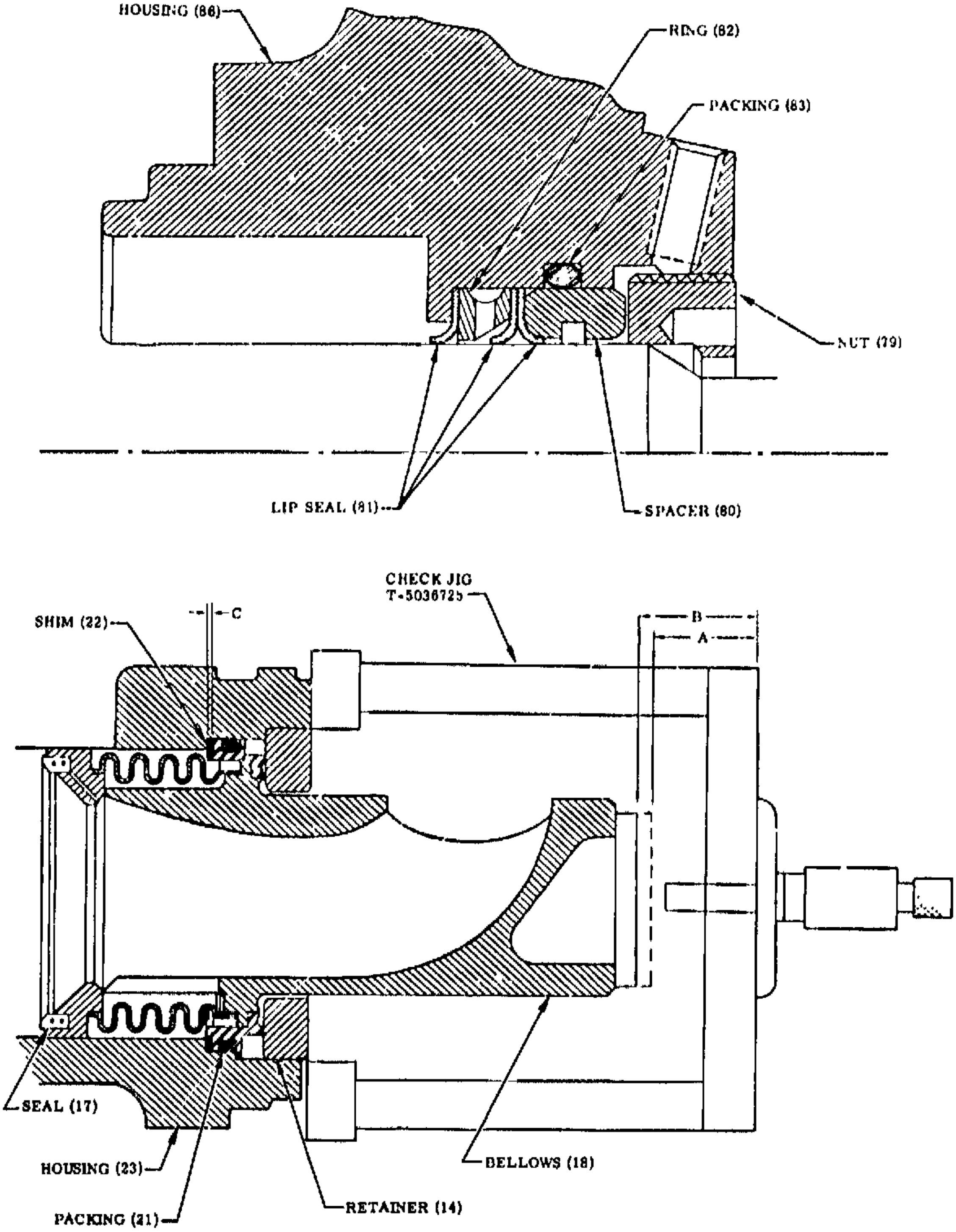


Figure 3-6. Gas Generator Ball Valve Seal and Shim Installation

d. Lubricate (Method L) packing (66), then install packing and retainers (67) in groove of piston (68).

e. Carefully slide piston (68) into actuator end of housing (86); then install finger (62) on end of piston and secure with pin (61).

f. Lubricate (Method J) packing (66) with lubricant grease RB0140-012 (Rocketdyne). Install packing and retainers (67) in groove of end cap (65), and then install end cap in housing (86). Secure end cap to housing with bolts (63) and washers (64). Torque bolts to 60-70 in-lb.

g. Using bearing installer T-5035229, carefully install bearing (85) into oxidizer side of housing (86) with large diameter end of bearing facing out. Distance between face of bearing and housing shoulder for race (46) must be 0.288 to 0.302 inch.

CAUTION

Excessive pressure when installing bearing in housing can damage bearing or housing.

h. Insert lip seals (84) and ring (82) into housing (86). Use seal installation tool T-5037811 to hold lip seals in place. Do not remove tool until after step p is performed (figure 3-6).

i. Lubricate (Method J) packing (83) and spacer (80) with lubricant grease RB0140-012 (Rocketdyne); then insert packing and spacer into housing (figure 3-6).

j. Lubricate (Method A) threads of nut (79) with lubricant grease RB0140-012 (Rocketdyne), and install nut in housing (86) fingertight (figure 3-6).

k. Install link (60) on piston (68) with pin (57), then secure pin with ring (58).

l. Install bolts (32) and washers (33) into oxidizer side of housing (86) and install bolts (11) and washers (11A) into fuel side of housing. Using white cloth tape for liquid oxygen service, hold bolts in place against housing.

NOTE

Bolts are installed in housing and temporarily held in place at this time, since they are extremely difficult to install after lever (59) has been installed.

m. Install lever (59) on link (60) with pin (57); then secure pin with ring (58).

n. Place inserts (75) in lever (59) with scribed lines on inserts and lever alined.

o. Using holding fixture T-5035230, install bearing (40) into housing (42) with large diameter end of bearing facing out. Small diameter end of bearing faces in and bottoms against shoulder in housing.

CAUTION

Excessive pressure when installing bearing in housing can damage bearing or housing.

p. Install one race (46) and bearing (45) on oxidizer side of housing (86). Install other race (46) on ball (44). Remove seal installation tool.

q. Carefully slide shaft of ball (44) into oxidizer side of housing (86) and aline scribed line on shaft with scribed line on lever (59).

CAUTION

Care must be exercised when installing ball into housing since damage to lip seals can result.

r. Hold ball (44) in place with spacer T-5036700. Insert spacer through rectangular opening in housing (86) and install on shaft of ball.

s. Insert washers (41) into housing (42).

t. Lubricate (Method J) packings (34) with lubricant grease RB0140-012 (Rocketdyne) and insert in the 5 recesses on housing (42).

u. Insert seal (43) in groove of housing (42).

v. Position housing (86) so that housing (42) can be installed from bottom up.

w. Remove tape from bolts (32); then carefully install housing (42) on housing (86) and secure with bolts (32). Torque bolts to 244-298 in-lb.

x. Remove spacer T-5036700 from housing (86).

NOTE

Insert (75) must not slip out of lever (59) after removing spacer. Indexing of lever, insert, and shaft is not maintained if insert slips out of place.

y. Lubricate (Method L) packings (76, 77), then insert packing (76) in inner groove of housing (86).

z. Insert packing (77) and retainers (78) in outer groove of housing (86).

aa. Using holding fixture T-5035218, press bearings (29) on each end of ball (30). Large diameter end of bearings must face in and bottom against shoulder of ball.

CAUTION

Excessive pressure when installing bearings on ball can damage bearings or ball.

ab. Lubricate (Method J) packing (24) with lubricant grease RB0140-012 (Rocketdyne), then insert packing and retainers (25) in groove of housing (23).

ac. Insert washers (31) in housing (23).

ad. Lubricate (Method J) packings (11B) with lubricant grease RB0140-012 (Rocketdyne), and insert in the 5 recesses on housing (23).

ae. Install one race (27) and bearing (26) on fuel side of housing (86) and install other race on ball (30).

af. Carefully slide shaft of ball (30) into fuel side of housing (86) and aline scribed line on shaft with scribed line on lever (59).

ag. Position housing (86) so that housing (23) can be installed from bottom up.

ah. Remove tape from bolts (11); then carefully install housing (23) on housing (86) and secure with bolts (11). Torque bolts to 244-298 in-lb.

ai. Loosen nut (79) approximately 2 turns. Using torque wrench T-5035233, torque nut to 350-370 in-lb. Wait approximately 2 minutes; then make sure that torque remains at 350-370 in-lb.

NOTE

Insert (75) must be properly indexed with lever (59) and shaft of ball (44) prior to installing block (74).

aj. Install block (74) in housing (86) and secure with screws (72) and washers (73). Torque screws to 15-19 in-lb. Safetywire screws.

ak. Install ball (48) and screw (47) into housing (86). Torque screw to 27-33 in-lb. Safetywire screw.

NOTE

Steps al and am apply to valves 306866 and 309110 and provide a ball-setting check using ball clocking tool T-5041515.

al. Make sure valve is in open position and ACT CLOSING port (M) is open; then apply 500 ±25 psig gaseous nitrogen to ACT OPENING port (L).

am. Using ball clocking tool T-5041515, check position of balls (30, 44) as follows (figure 3-7):

(1) Tool must seat completely against housing flange when ball is properly positioned.

(2) If ball adjustment is necessary, reduce gaseous nitrogen to zero and disassemble valve to rotate ball.

(3) Rotate ball in insert (75) 5 teeth in correcting direction; then rotate insert (75) in lever (59) 15 teeth in counter-correcting direction. (This provides for approximately 2 degrees of correction.)

(4) Reassemble valve and repeat check until tool seats completely against housing flange.

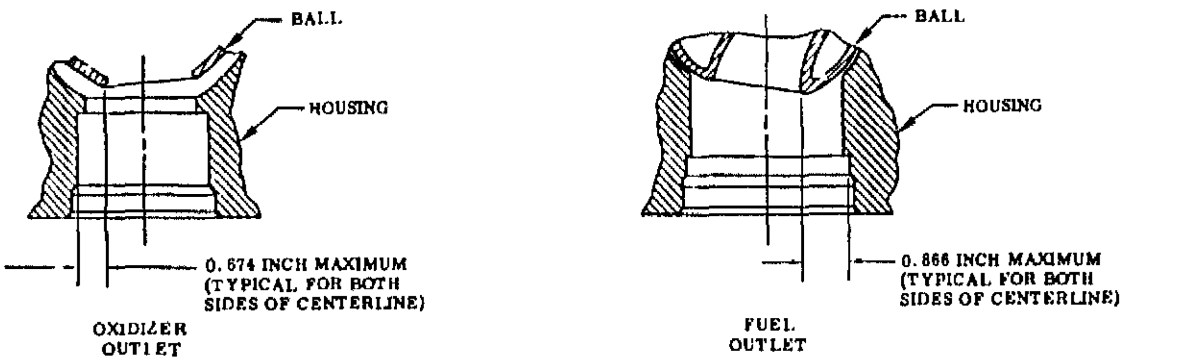


Figure 3-7. Gas Generator Ball Valve Ball Setting Check

an. Make sure stackup of bearing (45), races (46), and ball (44) has not slipped.

ao. Install seal (38) into oxidizer outlet port of housing (42); then install bellows (37) and seal (36) as an assembly into oxidizer outlet port.

ap. Lubricate (Method A) threads of nut (35) and lubricate (Method Z) bearing surface with lubricant grease RB0140-012 (Rocketdyne); then install nut in the oxidizer outlet port of housing (42). Torque nut with torque wrench adapter T-5035248 to 675-700 in-lb. Wait approximately 2 minutes and make sure that torque remains at 675-700 in-lb.

aq. Make sure stackup of bearing (26), races (27), and ball (30) has not slipped.

NOTE

Steps ar through ay determine the correct thickness of shim (22) to be installed for proper deflection of bellows (figure 3-6).

ar. Place shim (22) on bellows(18); then install assembled parts into fuel outlet port of housing (23).

as. Lubricate (Method A) threads of retainer (14) and lubricate (Method Z) bearing surface; then install retainer into fuel outlet port of housing (23) by hand until retainer makes contact with surface of bellows (18). Do not tighten retainer beyond point of making initial contact with bellows.

at. Install check jig T-5036725 on housing (23). Measure and record dimension A.

au. Remove check jig and torque retainer (14) with spanner wrench T-5035249 to 525-550 in-lb.

av. Install check jig T-5036725 on housing (23). Measure and record dimension B.

aw. Remove check jig, retainer (14), and assembled bellows (18), seal (17), and shim (22) from housing (23).

ax. Remove shim (22) from bellows (18). Measure thickness of shim and record as dimension C.

ay. Using the following formula and dimensions obtained in steps at, av, and ax, determine correct thickness of shim (22) to be installed:

$$C - \left[D - (B - A)\right] = T$$

A = Dimension from check jig to center surface of bellows (18).

B = Dimension from check jig to center surface of bellows (18) after retainer (14) is torqued.

C = Thickness of shim.

D = Required bellows deflection: $0.019 \begin{pmatrix} +0.003 \\ -0.002 \end{pmatrix}$

T = Thickness of shim (22) to be installed.

NOTE

Each lamination of shim (22) is approximately 0.002 inch thick.

az. Remove necessary laminations from shim (22) to obtain dimension T, as determined in step ay.

ba. Lubricate (Method J) packing (21) with lubricant grease RB0140-012 (Rocketdyne); then install packing in groove of bellows (18).

bb. Using correct thickness of shim, place shim on bellows (18); then install assembled parts into fuel outlet port of housing (23).

bc. Install screw (15) and washer (16) in housing (23). Torque screw to 7-9 in-lb.

bd. Repeat steps as through av; then subtract dimension A from dimension B to make sure that the bellows deflection is 0.017 to 0.022 inch.

be. Remove check jig and make sure that retainer (14) is torqued to 525-550 in-lb.

bf. Install ball (13) and screw (12) in housing (23). Torque screw to 27-35 in-lb.

bg. Lubricate (Method J) packing (7) with lubricant grease RB0140-012 (Rocketdyne); then insert packing in groove of cover (10B, 10D). Install switch (6) in cover and secure with screws (3), washers (4) and lug (5). Torque screws to 6-8 in-lb.

bh. On valve 308888, install packing (9) on valve (8); then install valve in cover (10B). Torque valve to 40-65 in-lb.

NOTE

Steps bi through bk determine the correct thickness of shims (61B) to be installed between finger (62) and foot of switch (6).

bi. Measure distance between base of cover (10B, 10D) and flat surface of foot on switch (6) with check fixture T-5037832. Record as dimension A.

bj. Measure distance between flat surface of housing (86) and top of surface of finger (62) with check fixture T-5037832. Record as dimension B.

bk. Using the following formula and dimensions obtained in steps bi and bj, determine correct thickness of shim (61B) to be installed:

$$(A-B) - C = T$$

A = Dimension from base of cover (10B, 10D) to flat surface on foot on switch (6).

B = Dimension from flat surface of housing (86) to top surface of finger (62).

C = Required clearance between foot of switch (6) and finger (62): 0.020 ±0.005 inch.

T = Thickness of shim to be installed.

bl. Remove necessary laminations from shims (61B) to obtain dimension T, as determined in step bk.

bm. Press pin (61A) into foot of switch (6); then temporarily install cover (10B, 10D) on housing (86) to determine that pin (61A) is slip-fit into finger (62). Remove cover (10B, 10D).

bn. Place correct number of shims (61B), determined in step bk, on pin (61A). Holding washers in place, install cover (10B, 10D) on housing (86). Secure cover to housing with screws (1) and washers (2). Torque screws to 6-8 in-lb.

bo. On valves 309110 and 306866, lubricate (Method J) packing (9A) and (Method A) threads of valve (8A) with lubricant grease RB0140-012 (Rocketdyne). Install packing on valve then install valve in housing (86). Torque valve to 40-65 in-lb.

bp. On valve 306866, lubricate (Method A) threads of plug (87) with lubricant grease RB0140-012 (Rocketdyne). Install plug (87) and seal (88) in housing (42). Torque plug to 240 ±10 in-lb.

bq. Safetywire screws (1, 3, 15), bolts (11, 12, 32, 63), valve (8A), and plug (87).

3-11. TESTING.

3-12. This procedure outlines requirements for complete testing of the gas generator ball valve, using Components Test Console G3141, Components Adapter Set G3143, and Cryogenic Supply Unit G3146. Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on gas generator ball valve as outlined in figure 3-8. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up Components Test

Console electrical patch-panels (figure 3-9) and prepare console for use (figure 3-10). See figure 3-11 for gas generator ball valve test port identification and figure 3-12 for a cutaway view. Refer to paragraphs 3-13 through 3-34 for gas generator ball valve test procedures and see figures 3-13 through 3-17 for test setups.

CAUTION

During test procedures, the oxidizer portion of the valve and the test equipment used at that part of the valve must be maintained in a liquid-oxygen-clean condition.

Index Letter	Valve Port	Test Plate	Port Connection
A	G05 Instrumentation	AN814-4C (plug)(c)	AN815-4C(a)(c)
B	Oxidizer Purge	T-5029360-312(c)	None
C	Oxidizer Outlet	T-5029360-313(c)	AN815-4C(c)
D	Oxidizer Vent	None	AN815-4C(c)
E	Actuator Housing Vent	None	AN815-4C
F	Actuator Housing Purge Valve 308888	None	AN815-4C
G	Fuel Vent	None	AN815-4C
H	Fuel Outlet	T-5029360-125, -309	AN815-4C
J	Fuel Drain	None	AN815-4C
K	Fuel Inlet	T-5029360-154	AN815-4C
L	ACT OPENING	T-5029360-402	AN815-6C
M	ACT CLOSING	T-5029360-306	AN815-4C
N	Warment	T-5029360-402	AN815-6C
P	Actuator Vent	None	AN815-4C
R	Oxidizer Inlet	T-5029360-153(b)(c)	AN815-4C(c)

(a) When performing cryogenic test, remove plug and install this connector.
(b) When performing cryogenic test, replace this test plate with test plate T-5029737-202.
(c) Maintain item in liquid-oxygen-clean condition.

Figure 3-8. Preparing Gas Generator Ball Valve for Testing

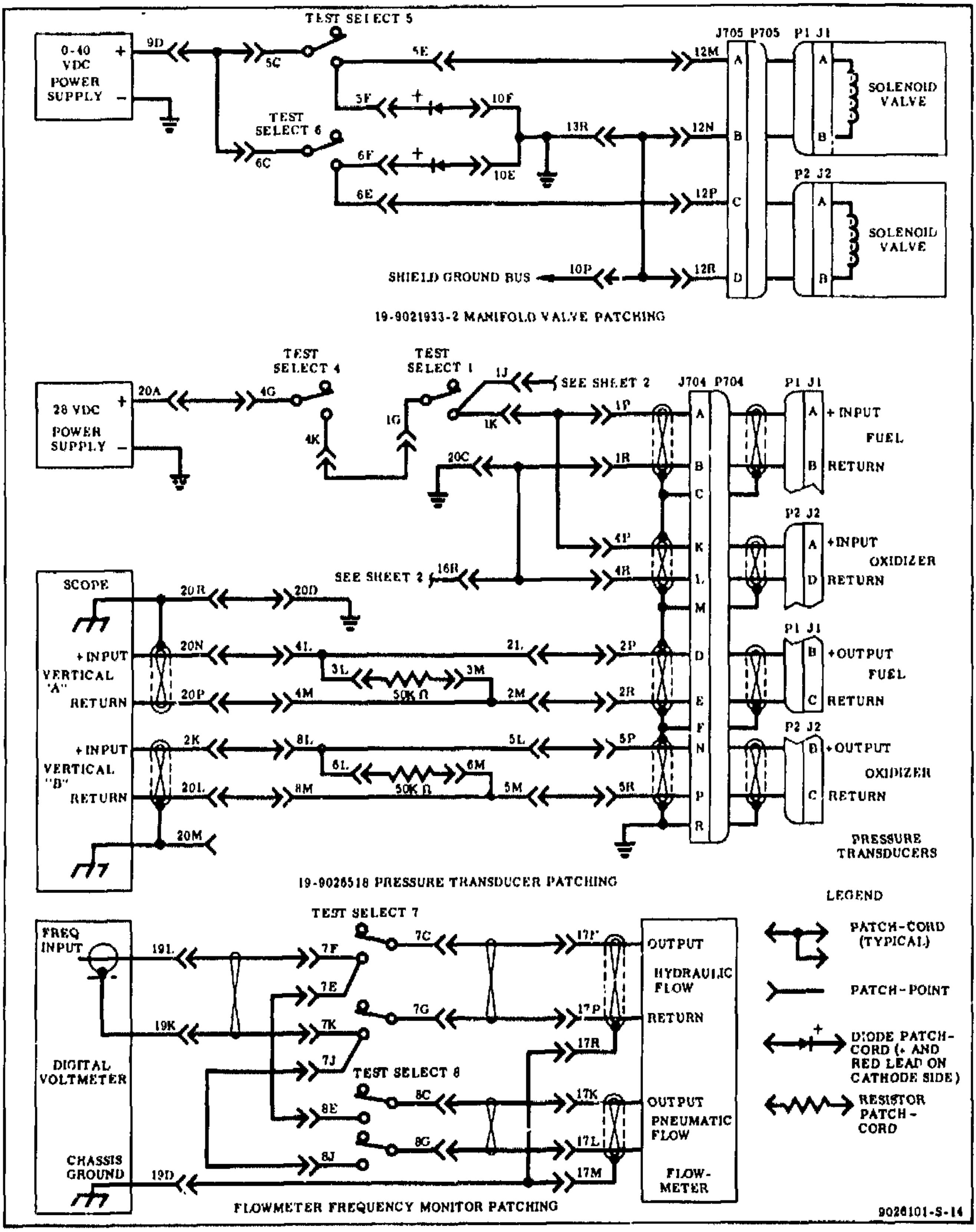


Figure 3-9. Components Test Console Patch-Panel Requirements (Sheet 1 of 3)

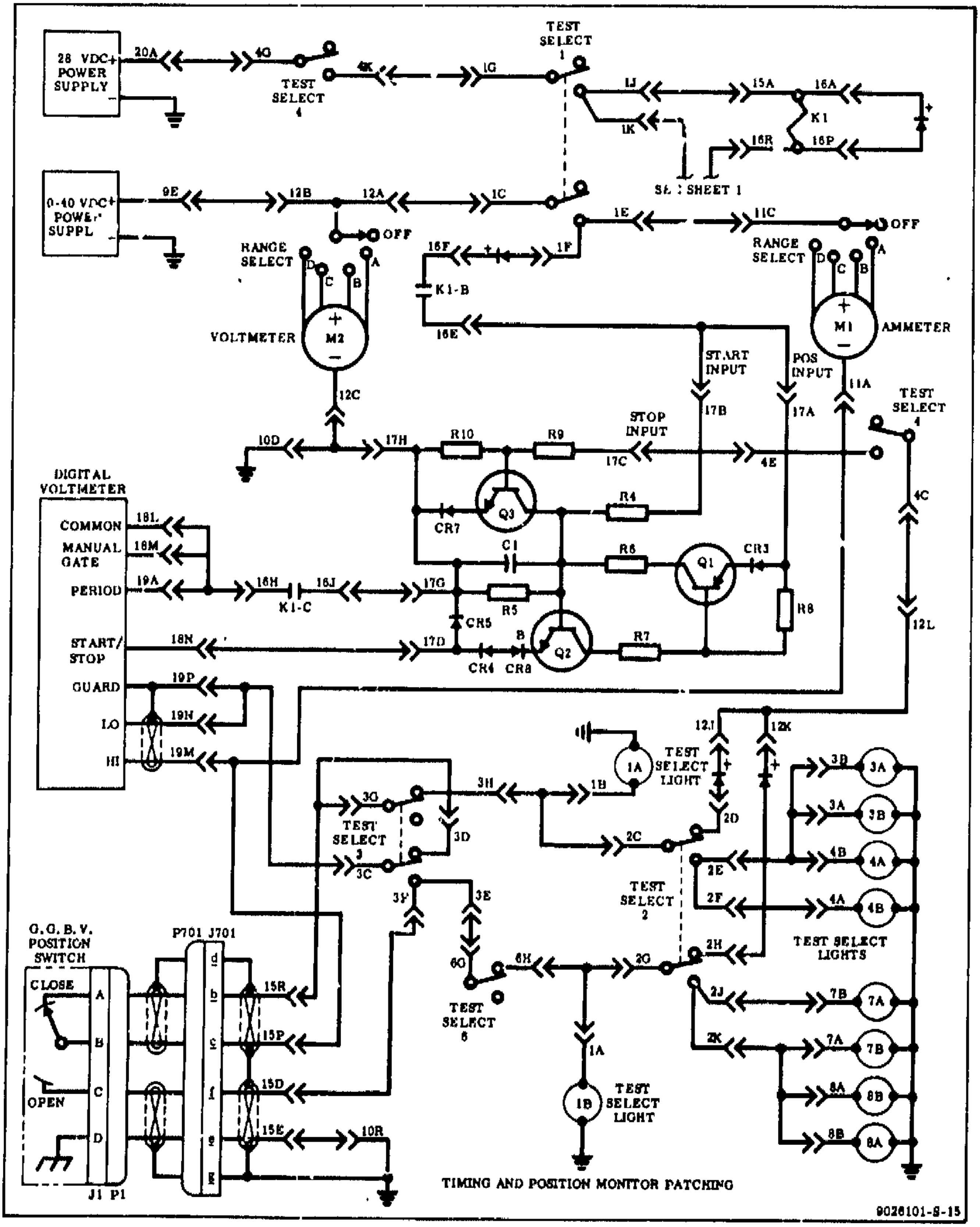


Figure 3-9. Components Test Console Patch-Panel Requirements (Sheet 2 of 3)

Patch-Cord[a]	From J6-	To J6-	Patch-Cord[a]	From J6-	To J6-
K4.09	1A	2G	K4.09	5C	9D
		6H			6C
K4.09	1B	2C	K3.	5E	12M
		3H	3088-17[b]	5F(+)	10F
K3.	1C	12A	K3.	5L	5P
K3.	1E	11C	K3.	5M	5R
3088-17[b]	1F	16F(+)	K3.	6E	12P
K3.	1G	4K	3088-17[b]	6F(+)	10E
K3.	1J	15A	3088-14	6L	6M
K4.09	1P	1K	K3.[c]	7C	17N
		4P	K3.	7E	8E
K5.09	1R	4R	K3.[d]	7F	19L
		16R	K3.[c]	7G	17P
		20C	K3.	7J	8J
3088-17[b]	2D	12J(+)	K3.[d]	7K	19K
K5.09	2E	3A	K3.[e]	8C	17K
		3B	K3.[e]	8G	17L
		4B	K3.	8L	20K
K3.	2F	4A	K3.	8M	20L
3088-17[b]	2H	12K(+)	K3.	9E	12B
K3.	2J	7B	K4.09	10D	12C
K5.09	2K	7A			17H
		8A	K5.09	10P	12N
		8B			12R
K3.	2L	2P			13R
K3.	2M	2R	K3.	10R	15E
K4.09	3C	19N	K4.09	11A	15P
		19P			19M
K4.09	3D	3G	3088-17[b]	16A(+)	16P
		15R	K4.09	16E	17A
K3.	3E	6G			17B
K3.	3F	15D	K5.09	16H	18M
3088-14	3L	3M			18L
K3.	4C	12L			19A
K3.	4E	17C	K3.	16J	17G
K3.	4G	20A	K3.	17D	18N
K3.	4L	20N	K4.09	17M	17R
K3.	4M	20P			19D
			K3.	20D	20R

(a) Use any cable length required on all patch-cords numbered K3.
(b) Diode patch-cord must be connected with red lead on same side as (+).
(c), (d), and (e) Each pair of patch-cords with like coding must be twisted together.

Figure 3-9. Components Test Console Patch-Panel Requirements (Sheet 3 of 3)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

PRE-POWER TURN ON

Panel	Control	Position	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT OUTLETS	Connector J701	Cable 1231001	Connection to ball valve.
	Connector J702	Capped	
	Connector J703	Resistor Plug 3088-9	Temperature indicator load.
	Connector J704	Cable 1231008	For pressure transducers.
	Connector J705	Cable 1231009 or 1231012	For valve manifold control.

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

POWER TURN ON

Panel	Control	Position	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Push in	Console main power on.

Figure 3-10. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	2	Approximately two-thirds way between 0 and 3.
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 OFF. Timing and position monitor control.[a]
	TEST SELECT 2		Light 2 OFF. Contact resistance load control.[a]
	TEST SELECT 3		Light 3 OFF. Digital voltmeter return control.[a]
	TEST SELECT 4		Light 4 OFF. Pressure transducer power control.[a]
	TEST SELECT 5		Light 5 OFF. Solenoid valve control 19-9021933.[a]
	TEST SELECT 6		Light 6 OFF. Solenoid valve control 19-9021933.[a]
	TEST SELECT 7		Light 7 OFF. Hydraulic flow monitor control.[a]
	TEST SELECT 8		Light 8 OFF. Pneumatic flow monitor control.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter 24 ±0.4 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
OSCILLOSCOPE	FOCUS	Arrows up	Adjust later for best focus.
	VERTICAL POSITION	Arrows up	Adjust later for best position.

(a) If indication is not as specified, press applicable switch-light.

Figure 3-10. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks
	HORIZ. POSITION	Arrows up	Adjust later for best position.
	INTENSITY	Arrow horizontal (to left)	Adjust later for best intensity. Allow 30-minute warmup period before use.
	Power light	On	To right of cathode ray tube.
DIGITAL VOLTMETER	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.

NOTE

Allow digital voltmeter to warm up for at least 30 minutes prior to use.

	RANGE	100 V	
	FUNCTION	EXT SEL	
	ATTENUATION	CHECK	Fully counterclockwise.
	SAMPLE PERIOD	EXT SEL	
	SAMPLING RATE	STOP	Fully counterclockwise.

PNEUMATIC AND HYDRAULIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves open (LOW and HIGH PRESSURE panel VENTS closed during cryogenic tests).

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen and helium to console.

NOTE

Helium supply is required only for cryogenic tests.

c. On SYSTEM SUPPLY panel, close VENT valve; then open gaseous nitrogen SHUTOFF valve and helium SHUTOFF valve.

d. On PNEU SOURCE CONTROL panel, open gaseous nitrogen SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I must be followed to ensure safety of personnel working with pressurized systems.

Figure 3-10. Preparing Components Test Console for Use (Sheet 3 of 3)

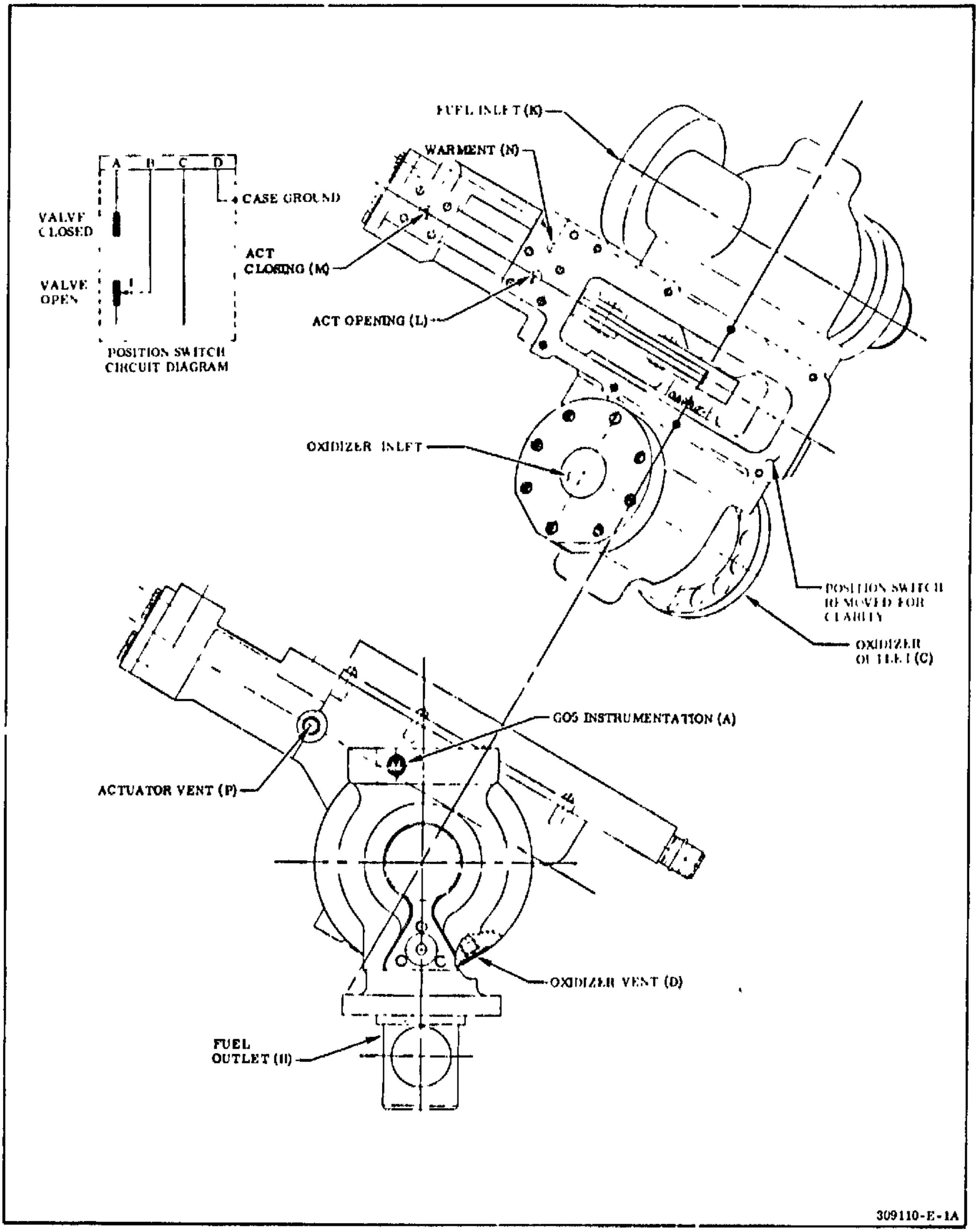


Figure 3-11. Gas Generator Ball Valve External Ports and Electrical Schematic

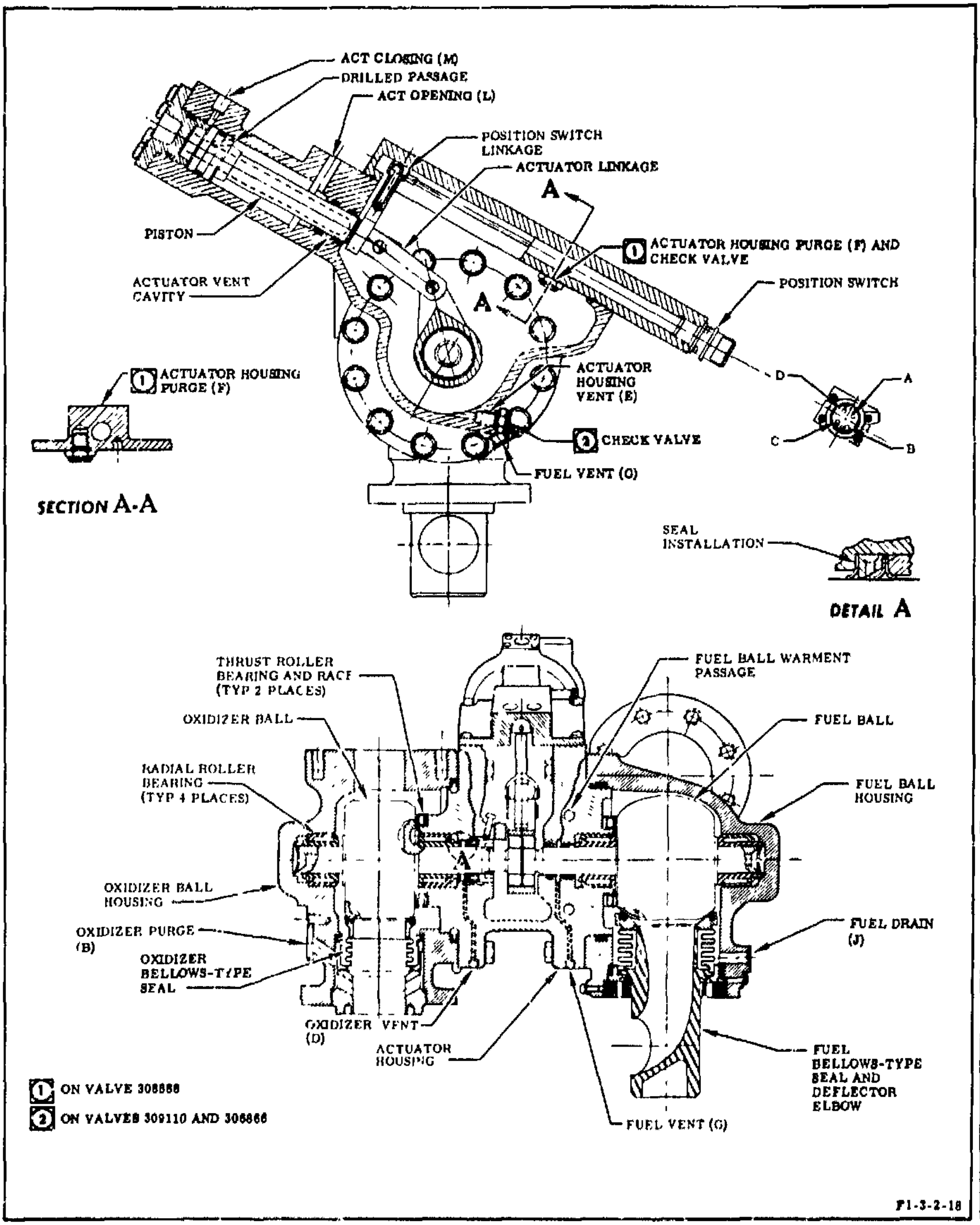


Figure 3-12. Gas Generator Ball Valve--Cutaway View

Procedure	Result
3-13. SWITCH RESISTANCE TEST.	

WARNING

All hydraulic pressure must be off and white room clear of fuel vapor before performing electrical tests, to prevent injury to personnel and damage to equipment.

Procedure	Result
a. Prepare Components Test Console G3141 for use (figure 3-10), and connect ball valve to console (figure 3-13).	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to manifold valve as follows:	
(1) Close VENT valve and SHUTOFF valve, and close VENT valve on PRESS/Δ P MONITOR FUEL COMPATIBLE panel.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±40 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve. PRESSURE REGULATOR may require adjustment to obtain result.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±40 psi.
c. Using ELECTRICAL CONTROL panel, perform the following:	
(1) Turn VOLTS meter RANGE SELECT switch to D (0-30).	VOLTS meter must indicate 24 ±0.4 volts.
(2) Press TEST SELECT 1 and 6 switch-lights.	MILLIAMPERES meter must not exceed 50 milliamperes. Ball valve closes: lights 1, 6, and 1A on.
(3) Turn MILLIAMPERES meter RANGE SELECT switch to C (0-250).	None.

CAUTION

Exceeding 28 volts when turning VOLTAGE ADJUST to INCREASE can damage manifold valve during operation.

Procedure	Result
d. On ELECTRICAL CONTROL panel, press TEST SELECT 5 and 6 switch-lights.	Ball valve opens. Lights 5 and 1B on and lights 6 and 1A off.
e. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	Manifold valve depressurized. TEST CELL MONITOR PRESSURE gage must indicate zero.

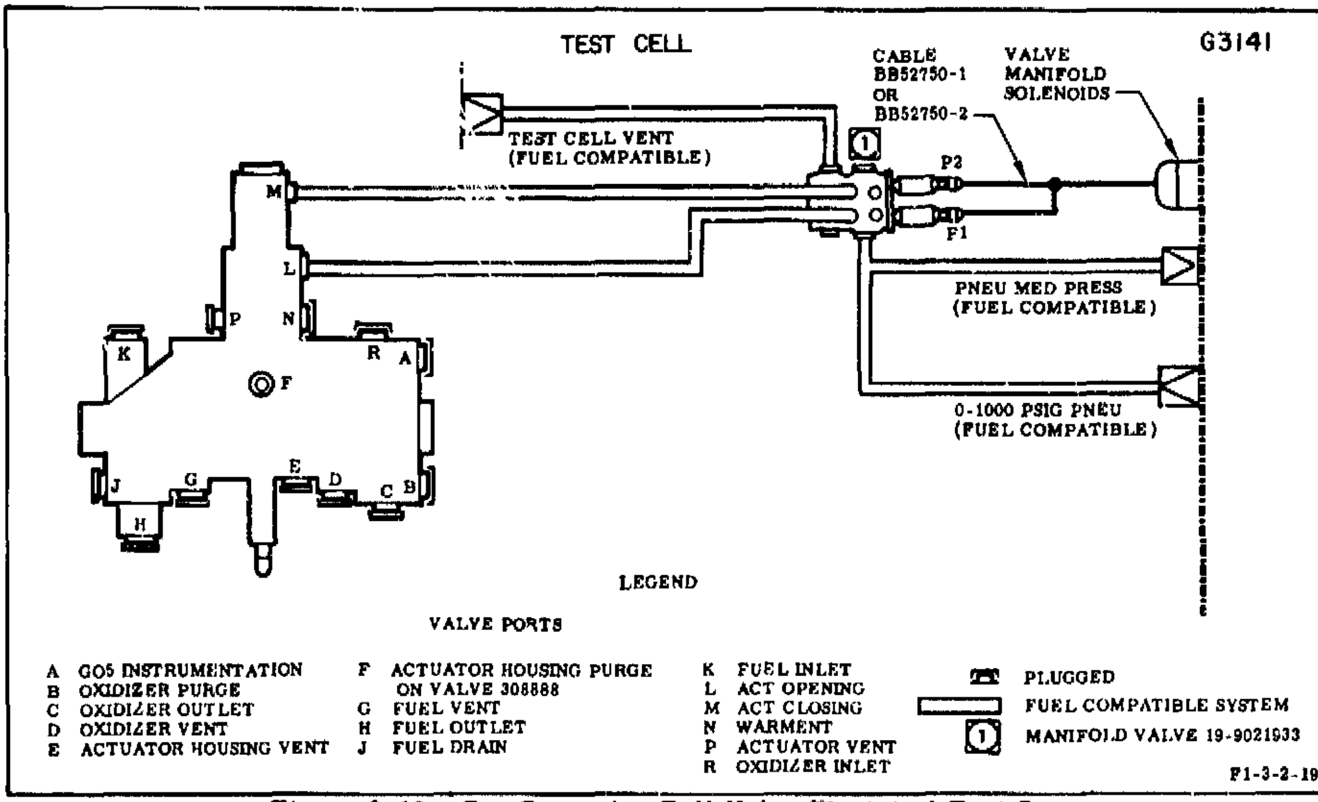


Figure 3-13. Gas Generator Ball Valve Electrical Test Setup

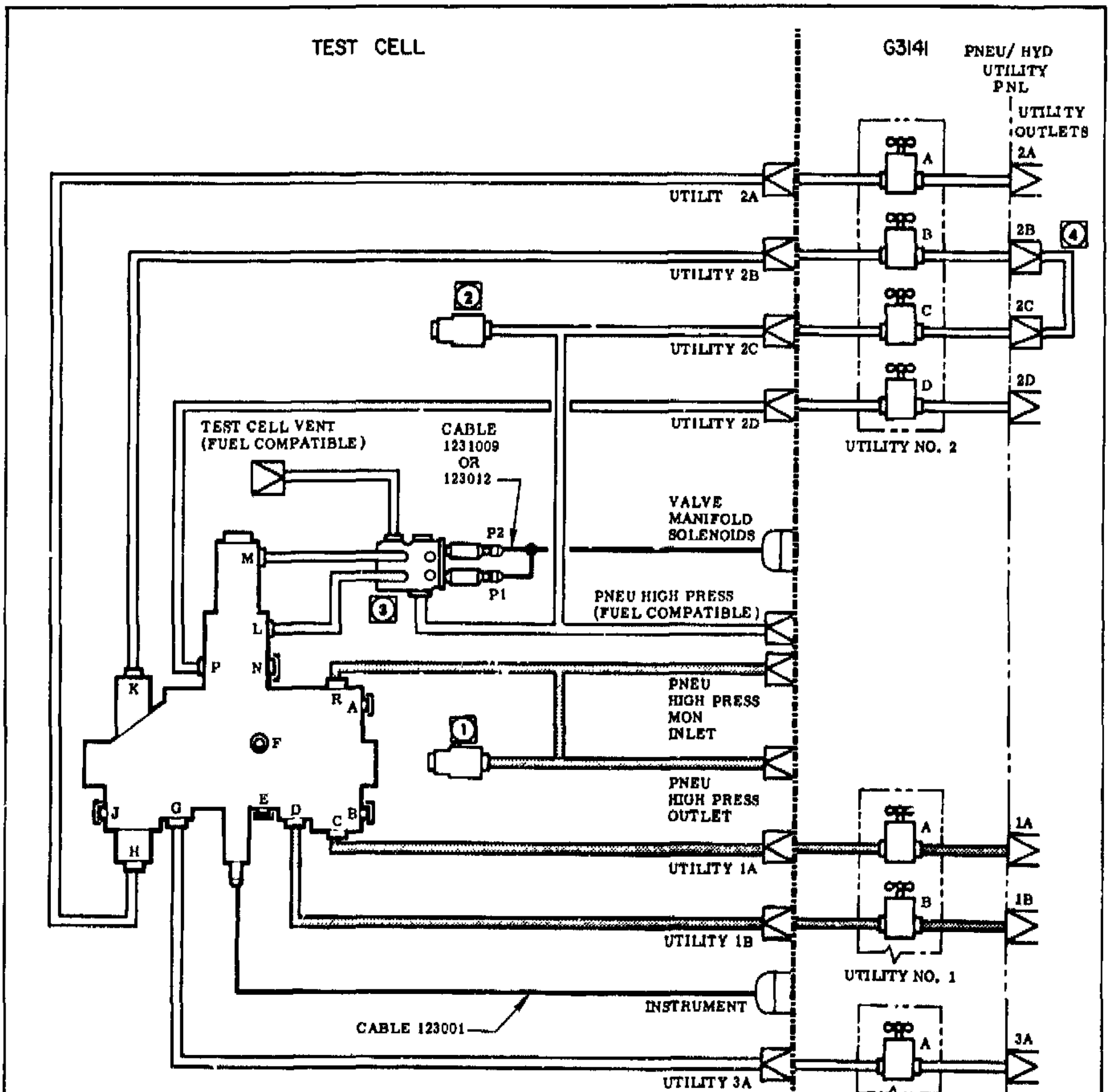
Procedure	Result
f. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note the exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.5 ohm.
g. Using multimeter and decade resistance box, measure resistance between pin D and housing as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.

Procedure	Result
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pin D and housing.	Resistance must not exceed 0.5 ohm.
h. Using megohmmeter, apply 500 ±50 vdc between pins B and D of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
i. Using megohmmeter, apply 500 ±50 vdc between pins A and B of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
j. On MED PRESS FUEL COMPATIBLE panel, close VENT valve and open SHUTOFF valve.	Manifold valve pressurized. TEST CELL MONITOR PRESSURE gage must indicate 500 ±40 psi.
k. Press TEST SELECT 5 and 6 switch-lights.	Ball valve closes. Lights 1B and 5 off. Lights 6 and 1A on.
l. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	Manifold valve depressurized. TEST CELL MONITOR PRESSURE gage must indicate zero.
m. Using multimeter and decade resistance box, measure resistance between pins A and B as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note the exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.5 ohm.
n. Using megohmmeter, apply 500 ±50 vdc between pins B and D of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
o. Using megohmmeter, apply 500 ±50 vdc between pins B and C of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
p. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 6 switch-lights.	Lights 1, 6, and 1A off. MILLIAMPERES meter must indicate zero.

Procedure	Result
q. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to manifold valve as follows:	
(1) Close SHUTOFF valve, and open VENT valve until TEST CELL MONITOR PRESSURE gage indicates zero; then close VENT valve.	Manifold valve depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
r. Remove valve from test setup.	None.
s. If ball valve testing is terminated, install protective closures as outlined in paragraph 3-2, and secure equipment as outlined in paragraph 3-35.	None.

3-14. AMBIENT PNEUMATIC LEAK-TEST.

Procedure	Result
a. Make sure that Components Test Console G3141 is prepared for use as outlined in figure 3-10.	None.
b. Connect ball valve to console (figure 3-14).	None.
c Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to manifold valve as follows:	
(1) Close VENT and SHUTOFF valves.	None.



LEGEND

PLUGGED

OXIDIZER-CLEAN SYSTEM

FUEL COMPATIBLE SYSTEM

1 PNEUMATIC RELIEF VALVE 19-9021937-16

2 PNEUMATIC RELIEF VALVE 19-9021937-18

3 MANIFOLD VALVE 19-9021933

4 HARD LINE, 3,000-PSI OPERATING PRESSURE

VALVE PORTS

- A GOS INSTRUMENTATION
- B OXIDIZER PURGE
- C OXIDIZER OUTLET
- D OXIDIZER VENT
- E ACTUATOR HOUSING VENT
- F ACTUATOR HOUSING PURGE ON VALVE 308668
- G FUEL VENT
- H FUEL OUTLET
- J FUEL DRAIN
- K FUEL INLET
- L ACT OPENING
- M ACT CLOSING
- N WARMENT
- P ACTUATOR VENT
- R OXIDIZER INLET

309110-S-2A

Figure 3-14. Gas Generator Ball Valve Ambient Pneumatic Leak-Test Setup

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±40 psi.	HIGH PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve.	Manifold valve pressurized.

3-15. Fuel Shaft Seal Leak-Test.

Procedure	Result
a. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 5 switch-lights.	Lights 1, 1B, and 5 on, manifold solenoid energizes, and ball valve opens.
b. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 off, manifold solenoid deenergizes, and ball valve remains open.
c. Open UTILITY NO. 2 valves B and C.	None.
d. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,950 (+120, -0) psi.	HIGH PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve.	Fuel inlet port (K) pressurized.
(4) Using SHUTOFF and VENT valves alternately, apply and vent pressure at fuel inlet port (K) 5 times.	None.

CAUTION

Exceeding specified test pressures when applying pressure to the ball valve can damage the valve.

Procedure	Result
e. Maintain pressure at fuel inlet port (K) at 2,950 (+120, -0) psig, for 2 (+1, -0) minutes; then open UTILITY NO. 3 valve A and measure leakage from fuel vent port (G) at outlet 3A.	No leakage is allowable.
f. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to fuel inlet port (K) to zero as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Fuel inlet port (K) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±40 psi.	HIGH PRESS FUEL COMPATIBLE panel pressure reduced.

Procedure	Result
g. Close UTILITY NO. 2 valves B and C and UTILITY NO. 3 valve A.	None.
h. On HIGH PRESS FUEL COMPATIBLE panel, close VENT valve; then open SHUTOFF valve.	Manifold valve pressurized and ball valve remains open.

3-16. Actuator Housing Seals Leak-Test.

Procedure	Result
a. On ELECTRICAL CONTROL panel, press TEST SELECT 6 switch-light; then press switch-light 5 after ball valve is closed as indicated by light 1A on.	Light 1B off and lights 1A, 5, and 6 on. Ball valve closes and both manifold solenoids are energized.
b. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to ACT OPENING port (L) and ACT CLOSING port (M) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 (+110, -0) psi.	HIGH PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve.	ACT OPENING port (L) and ACT CLOSING port (M) pressurized.
(4) Using SHUTOFF and VENT valves, alternately apply pressure and vent pressure at ACT OPENING port (L) and ACT CLOSING port (M) 5 times.	None.

CAUTION

Exceeding specified test pressures when applying pressure to the ball valve can damage the valve.

Procedure	Result
c. Maintain pressure at ACT OPENING port (L) and ACT CLOSING port (M) for 2 (+1, -0) minutes; then open UTILITY NO. 2 valve D and measure leakage from actuator vent port (P) at outlet 2D.	No leakage is allowable.
d. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to ACT OPENING port (L) and ACT CLOSING port (M) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	ACT OPENING port (L) and ACT CLOSING port (M) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,200 psi.	HIGH PRESS FUEL COMPATIBLE panel pressure reduced.
(3) Close VENT valve and open SHUTOFF valve.	ACT OPENING port (L) and ACT CLOSING port (M) pressurized.

Procedure	Result
e. Using leak-test compound (MIL-L-25567), check for leakage at joint between actuator end cap and actuator housing.	No leakage is allowable.
f. Ensure that a sufficient amount of leak-test compound is applied at joint between actuator end cap and actuator housing prior to performing steps g through i.	None.
g. On HIGH PRESSURE FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 (+110, -0) psi. Maintain pressure for a minimum of 5 minutes.	ACT OPENING port (L) and ACT CLOSING port (M) pressure increased.
h. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to ACT OPENING port (L) and ACT CLOSING port (M) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	ACT OPENING port (L) and ACT CLOSING port (M) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,200 psi.	HIGH PRESS FUEL COMPATIBLE panel pressure reduced.
(3) Close VENT valve and open SHUTOFF valve.	ACT OPENING port (L) and ACT CLOSING port (M) pressurized.
i. Check joint between actuator end cap and actuator housing for bubble formation.	No leakage (bubble formation) is allowable.
j. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to ACT OPENING port (L) and ACT CLOSING port (M) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	ACT OPENING port (L) and ACT CLOSING port (M) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

3-17. Fuel Ball Seal Leak-Test.

Procedure	Result
a. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light, then press TEST SELECT 6 switch-light.	Lights 5 and 6 off, manifold solenoids deenergize, and ball valve remains closed.
b. Open UTILITY NO. 3 valve A to vent fuel port (G).	None.
c. Open UTILITY NO. 2 valves B and C.	None.

Procedure	Result
d. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,450 (+100, -0) psi.	HIGH PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve.	Fuel inlet port (K) pressurized.
(4) Using SHUTOFF and VENT valves, alternately apply and vent pressure at fuel inlet port (K) 5 times.	[illegible].

CAUTION

Exceeding specified test pressures when applying pressure to the ball valve can damage the valve.

Procedure	Result
e. Maintain pressure at fuel inlet port (K) at 2,450 (+100, -0) psig for 2 (+1, -0) minutes; then open UTILITY NO. 2 valve A and measure leakage from fuel outlet port (H) at outlet 2A.	Maximum allowable leakage is 20 scim.
f. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to fuel inlet port (K) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Fuel inlet port (K) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
g. Close UTILITY NO. 2 valves B and C and close UTILITY NO. 3 valve A.	None.

3-18. Oxidizer Ball Seal Leak-Test.

Procedure	Result
a. Open UTILITY NO. 1 valve B to vent oxidizer vent port (D).	None.
b. Using HIGH PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT valve and SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,220 (+90, -0) psi.	HIGH PRESSURE panel pressurized.

Procedure	Result
(3) Open SHUTOFF valve.	PRESSURE MONITOR gage indicates 2,220 (+90, -0) psi.
(4) Using SHUTOFF and VENT valves, alternately apply and vent pressure at oxidizer inlet port (R) 5 times.	

CAUTION

Exceeding specified test pressures when applying pressure to the ball valve can damage the valve.

c. Maintain pressure at oxidizer inlet port (R) at 2,220 (+90, -0) psig for 2 (+1, -0) minutes; then open UTILITY NO. 1 valves A and B. Measure leakage from oxidizer outlet port (C) at outlet 1A and oxidizer vent port D at outlet 1B.	Maximum allowable leakage is 20 scim from each port.
d. Using HIGH PRESSURE panel, reduce pressure at oxidizer inlet port (R) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	PRESSURE MONITOR gage indicates zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.
e. Close utility valves.	None.
f. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Lights 1 and 1A off.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

fA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
g. Remove valve from test setup.	None.
h. If ball valve testing is terminated, install protective closures as outlined in paragraph 3-2, and secure equipment as outlined in paragraph 3-35.	None.

3-19. TIMING- AND ACTUATION-TEST.

a. Make sure that Components Test Console G3141 is prepared for use as outlined in figure 3-10.	None.
b. Connect ball valve to console (figure 3-15).	None.
c. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.

Procedure	Result
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on.
d. On UTILITY NO. 2 panel, open shutoff valves B and C.	None.
e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
f. Close UTILITY NO. 2 "C" shutoff valve.	None.
g. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Utility panel depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

3-20. Opening Time Test.

Procedure	Result
a. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 1,500 ±50 psi.	SUPPLY PRESSURE gage must indicate 1,500 ±50 psi.
aA. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close SHUTOFF valve and open VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,100 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
b. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 800 ±15 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 800 ±15 psi. ACT CLOSING port (M) pressurized and ball valve closed.

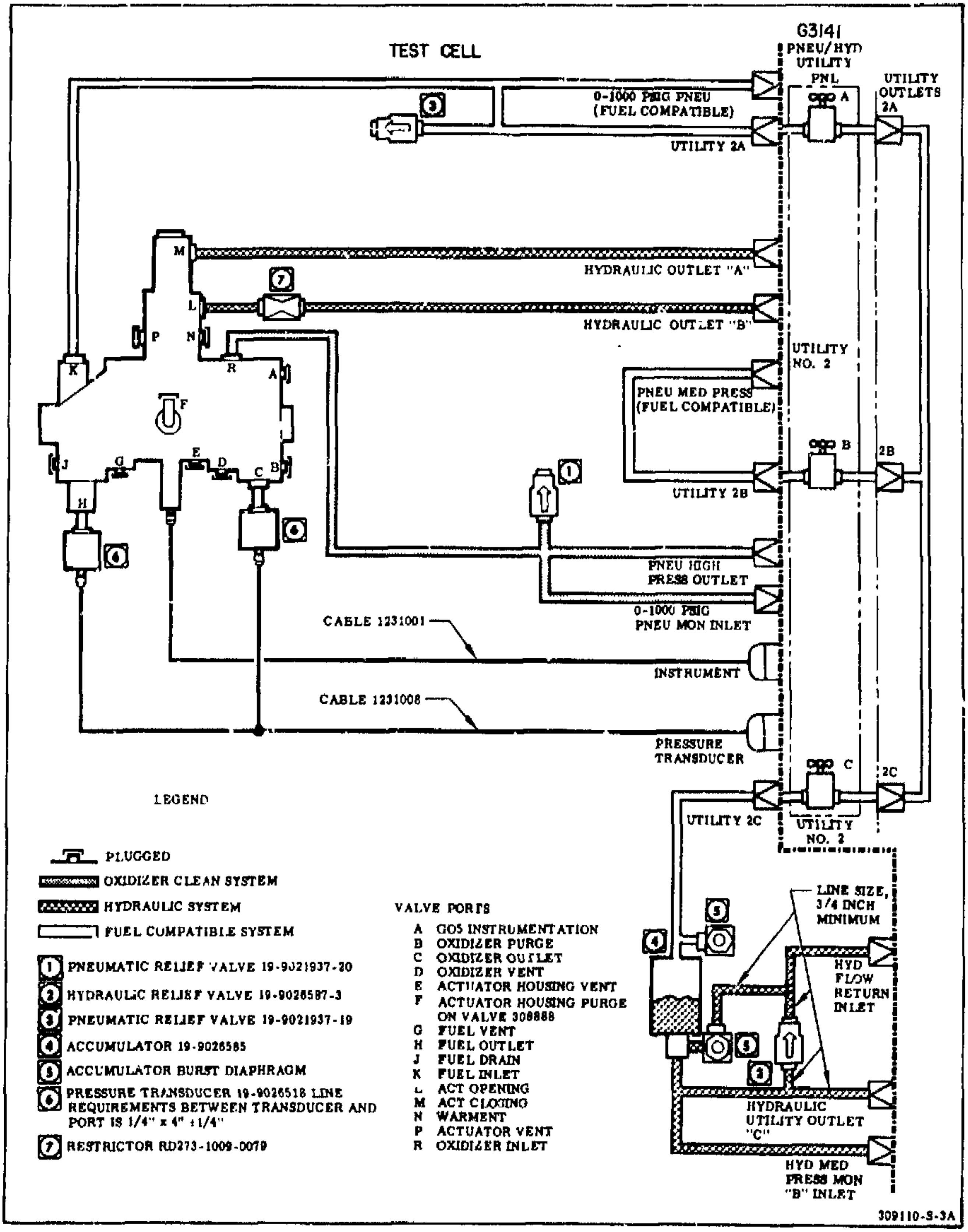


Figure 3-15. Gas Generator Ball Valve Timing- and Actuation-Test Setup

Procedure	Result
c. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 4 switch-lights.	Lights 1, 4, and 1A on.
d. Using DIGITAL VOLTMETER panel, move the following switches:	

NOTE

Allow a 30-minute warmup period before use.

(1) STORE/DISPLAY DURING COUNT switch to STORE.	None.
(2) RANGE switch to 100 V.	None.
(3) FUNCTION switch to EXT SEL.	None.
(4) ATTENUATION switch to CHECK.	None.
(5) SAMPLE PERIOD switch to EXT SEL.	None.
(6) SAMPLING RATE switch to STOP.	None.

e. Using OSCILLOSCOPE panel, perform the following:

NOTE

Allow a 30-minute warmup period before use.

- Leave camera viewing visor closed when in standby condition.

(1) Move A VERT. SENSITIVITY switch to 0.1 V/CM DC.	None.
(2) Move A VERT. SENSITIVITY VERNIER switch to CAL (fully clockwise).	None.
(3) Move B VERT. SENSITIVITY switch to 0.1 V/CM DC position.	None.
(4) Move B VERT. SENSITIVITY VERNIER switch to CAL (fully clockwise).	None.
(5) Move SWEEP TIME HORIZ. SENSITIVITY switch to 10 MILLISEC/CM.	None.
(6) Move SWEEP TIME SENSITIVITY VERNIER switch to CAL (fully clockwise).	None.
(7) Move CHANNEL A POLARITY switch to POS. UP.	None.

Procedure	Result
(8) Move VERT. PRESENTATION switch to CHOP.	None.
(9) Move TRIGGER LEVEL switch to AUTO.	None.
(10) Move TRIGGER LEVEL SYNC. switch to INT + position.	None.
(11) Move DC-AC switch to DC.	None.
(12) Couple GROUND STRAPS (A and B) to ground.	None.
(13) Move X1 SWP. - X5 switch to X1 SWP.	None.
(14) Adjust INTENSITY and FOCUS switches to sharpest trace.	None.
(15) Adjust VERTICAL POSITION A and HORIZ. POSITION switches until vertical A trace is to first grid on left and fourth from bottom.	None.
(16) Adjust VERTICAL POSITION B switch until vertical B trace is at same position as vertical A trace.	None.
f. On digital voltmeter, press DVM RESET switch. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A", and TEST CELL SUPPLY "B" switch-lights simultaneously. Measure and record ball valve opening time on digital voltmeter.	TEST CELL SUPPLY "A" SUPPLY light off and VENT light on; TEST CELL SUPPLY "B" SUPPLY light on and VENT light off. Ball valve opens; light 1A off and light 1B on. Digital voltmeter must indicate MILLISEC 001950-002950.

3-21. Fuel Lead Test.

Procedure	Result
a. On UTILITY NO. 2 panel, open shutoff valve A.	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ± 20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 50 (+10, -0) psi.	Fuel inlet port (K) and transducer are pressurized. TEST CELL MONITOR PRESSURE gage must indicate 50 (+10, -0) psi.

Procedure	Result
c. Ensure that vertical A trace is to first grid on left and fourth from bottom.	None.
d. Adjust TRIGGER LEVEL switch (from AUTO position) until scope triggers.	Vertical A trace moves approximately 1/2 cm above auto position trace.

NOTE

Trigger level of scope must be adjusted just prior to test and, once established, setting of TRIGGER LEVEL switch must not be changed.

Procedure	Result
e. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure at fuel inlet port (K) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	TEST CELL MONITOR PRESSURE gage indicates zero. Fuel inlet port (K) and transducer depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
f. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" and TEST CELL SUPPLY "B" switch-lights simultaneously.	TEST CELL SUPPLY "A" SUPPLY and TEST CELL SUPPLY "B" SUPPLY lights on; VENT light off. Ball valve closes; light 1A on, and light 1B off.
g. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 300 ±15 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve fully open.	Fuel inlet port (K) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 300 ±15 psi.
h. Using HIGH PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 300 ±15 psi.	HIGH PRESSURE panel pressurized.

Procedure	Result
(3) Open SHUTOFF valve until ful y open, PRESSURE REGULATOR may require adjustment to obtain result.	Oxidizer inlet port (R) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 300 ±15 psi.

NOTE

The results of step i are recorded using camera supplied with Components Test Console G3141. Refer to instruction manual for operation.

i. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" and TEST CELL SUPPLY "B" switch-lights simultaneously. Measure and record ball valve fuel lead time on scope camera.	TEST CELL SUPPLY "A" SUPPLY light off and VENT light on; TEST CELL SUPPLY "B" SUPPLY light on and VENT light off. Ball valve opens; light 1A off and light 1B on. Fuel lead time must be 0.060 ±0.020 second as indicated in typical timing trace (figure 3-15A).

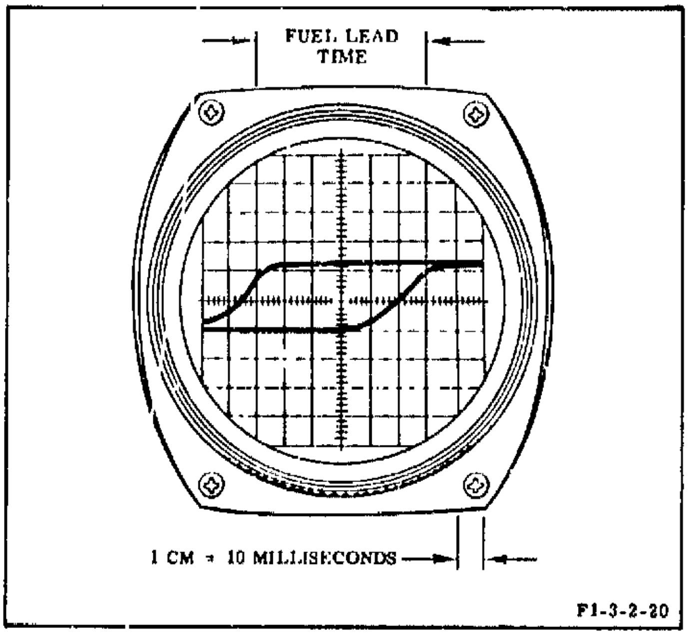


Figure 3-15A. Gas Generator Ball Valve Fuel Lead Timing Trace (Typical)

j. Using HIGH PRESSURE panel, reduce pressure at oxidizer inlet port (R) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Oxidizer inlet port (R) depressurized and TEST CELL MONITOR PRESSURE gage indicates zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.
k. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure at fuel inlet port (K) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Fuel inlet port (K) depressurized and TEST CELL MONITOR PRESSURE gage indicates zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

Procedure	Result
l. On HIGH PRESS FUEL COMPATIBLE panel, ensure that the following condition exists:	
(1) SHUTOFF valve closed and VENT valve open.	None.
(2) REG SUPPLY PRESS gage indicates 1,100 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.

3-22. Closing Time Test.

Procedure	Result
a. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 900 ±20 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 900 ±20 psi. ACT OPENING port (L) pressurized and ball valve remains open.
b. On digital voltmeter panel, press RESET switch. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" and TEST CELL SUPPLY "B" switch-lights simultaneously. Measure and record ball valve closing time on digital voltmeter.	TEST CELL SUPPLY "B" SUPPLY light on; TEST CELL SUPPLY "A" light on and VENT light off. Ball valve closes; lights 1A on and 1B off. Digital voltmeter indicate MILLISEC 001400-002400.
c. On ELECTRICAL CONTROL panel, press TEST SELECT 4 switch-light.	Light 4 off.
d. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.

3-23. Actuation Test.

Procedure	Result
a. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 500 ±10 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 500 ±10 psi, ACT CLOSING port (M) pressurized, and ball valve remains closed.
b. Using HYDRAULIC CONTROL panel, cycle ball valve 10 times and allow 15 seconds minimum time lapse between each actuation as follows:	
(1) Press TEST CELL SUPPLY "A" switch-light; then press TEST CELL SUPPLY "B" switch-light.	Ball valve opens. Light 1A off and light 1B on.
(2) Press TEST CELL SUPPLY "B" switch-light; then press TEST CELL SUPPLY "A" switch-light.	Ball valve closes. Light 1B off and light 1A on.
c. On HYD MED PRESS MONITOR panel, open PRESSURE MONITOR "B" shutoff valve until gage indicates zero; then close valve. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	ACT CLOSING port (M) depressurized and ball valve remains closed.
cA. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.

Procedure	Result
d. Using HYDRAULIC CONTROL panel, press the following switch-lights:	
(1) TEST CELL SUPPLY "A".	VENT light on and SUPPLY light off.
(2) HYDRAULIC SYSTEM SUPPLY.	CLOSE light on and OPEN light off.
(3) HYDRAULIC SYSTEM BYPASS.	OPEN light on and CLOSE light off.
e. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Lights 1 and 1A off.
f. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	None.
g. On UTILITY NO. 2 panel, open shutoff valves B and C to depressurize accumulator, then close valves B and C.	Accumulator depressurized.
h. Close MED PRESS FUEL COMPATIBLE panel VENT valve.	None.
i. Remove valve from test setup.	None.
j. If ball valve testing is terminated, install protective closures as outlined in paragraph 3-2, and secure equipment as outlined in paragraph 3-35.	None.

3-24. HYDRAULIC FLOW-TEST.

Procedure	Result
a. Make sure that Components Test Console G3141 is prepared for use as outlined in figure 3-10.	None.
b. Connect ball valve to console (figure 3-16). Do not connect lines to warment port (N) or piezometers (dotted lines). Plug warment port and cap open ends of piezometers.	None.
c. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on.

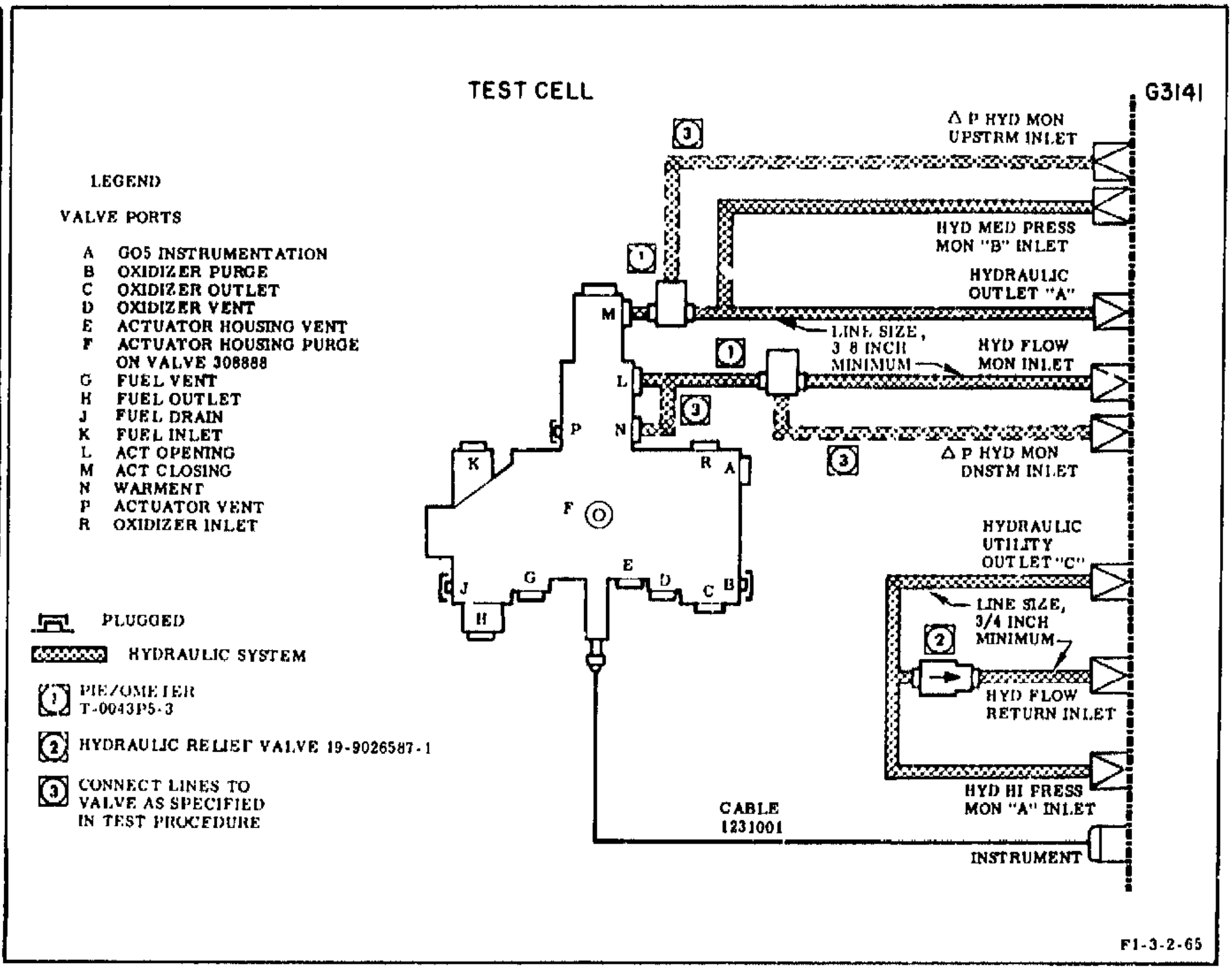


Figure 3-16. Gas Generator Ball Valve Hydraulic Flow-Test Setup

Procedure	Result
(5) Press FLOW MONITOR SHUTOFF switch-light.	OPEN light on.
d. Using DIGITAL VOLTMETER panel, move the following switches:	
(1) STORE/DISPLAY DURING COUNT switch to STORE.	None.
(2) RANGE switch to 100 V.	None.
(3) FUNCTION switch to FREQ.	None.
(4) ATTENUATION switch to midposition. (Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.)	None.
(5) SAMPLE RATE switch to STOP.	None.
(6) SAMPLE PERIOD switch to 1.0 SEC.	None.
e. ON ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.

Procedure	Result
3-25. Piston Orifice Flow-Test.	
a. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 1,800 ±50 psi.	SUPPLY PRESSURE gage must indicate 1,800 ±50 psi.
aA. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close SHUTOFF valve and open VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
b. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. ACT CLOSING port (M) pressurized and ball valve closes.
c. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Lights 1 and 1A on.
d. On digital voltmeter panel, press RESET switch; then measure and record flowrate at ACT OPENING port (L).	Flowrate at ACT OPENING port (L) must be 0.4 ±0.2 gpm.
e. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
f. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates zero.	ACT CLOSING port (M) depressurized and ball valve remains closed.
3-26. Actuator Pressure Drop Test.	
a. Ensure that SYSTEM PRESSURIZED light is off; then change test setup as follows (figure 3-16):	
(1) Disconnect line at ACT OPENING port (L) and connect it to warment port (N). Plug ACT OPENING port (L).	None.
(2) Connect lines from piezometers to Δ P HYD MON UPSTRM INLET and Δ P HYD MON DNSTRM INLET.	None.
b. Using digital voltmeter panel, perform the following:	
(1) Move STORE/DISPLAY DURING COUNT switch to DISPLAY.	None.
(2) Move SAMPLE RATE switch to VERTICAL.	None.

Procedure	Result
(3) Press RESET switch.	
c. On HYDRAULIC CONTROL panel, close HIGH PRESS SHUTOFF valve.	None.
d. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	None.
(1) Close SHUTOFF valve and open VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 400 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve to establish a flowrate of 5.0 ±0.1 gpm through warment passage as indicated on digital voltmeter; then close HIGH PRESS SHUTOFF valve. Record flowrate.	PRESSURE MONITOR "B" gage must indicate 100 psi minimum. ACT CLOSING port (M) pressurized and ball valve remains closed.
f. Measure and record pressure drop as indicated on DIFFERENTIAL PRESSURE gage.	Pressure drop must not exceed 50 psi.
g. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
h. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates zero.	ACT CLOSING port (M) depressurized and ball valve remains closed. Digital voltmeter stops indicating flow.
hA. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
i. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press FLOW MONITOR SHUTOFF switch-light.	CLOSE light on.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on.
(4) Press TEST CELL SUPPLY "A" switch-light.	VENT light on.
(5) Close HIGH PRESS SHUTOFF valve.	None.
j. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 7 switch-lights.	Lights 1, 1A, and 7 off.

Procedure	Result
k. Remove valve from test setup.	None.
l. If ball valve testing is terminated, install protective closures as outlined in paragraph 3-2, and secure equipment as outlined in paragraph 3-35.	None.

3-27. CRYOGENIC AND AMBIENT LEAK-TEST.

Procedure	Result
a. Make sure that Components Test Console G3141 is prepared for use as outlined in figure 3-10.	None.
b. Prepare Cryogenic Supply Unit G3146 for use as outlined in R-3896-5, but fill tank with liquid nitrogen.	None.
c. Connect ball valve to components test console (figure 3-17). Position pressure gage (installed on cryogenic supply unit) so it can be monitored through test cell window. Install relief valves used in liquid nitrogen lines with sufficient line length so that valve does not come in contact with liquid nitrogen.	None.

CAUTION

During all cold-tests, hydraulic flow through the actuator must be maintained, to prevent freezing of O-ring.

Procedure	Result
d. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on.
dA. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,200 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,200 ±50 psi.
e. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close SHUTOFF valve and open VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,400 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.

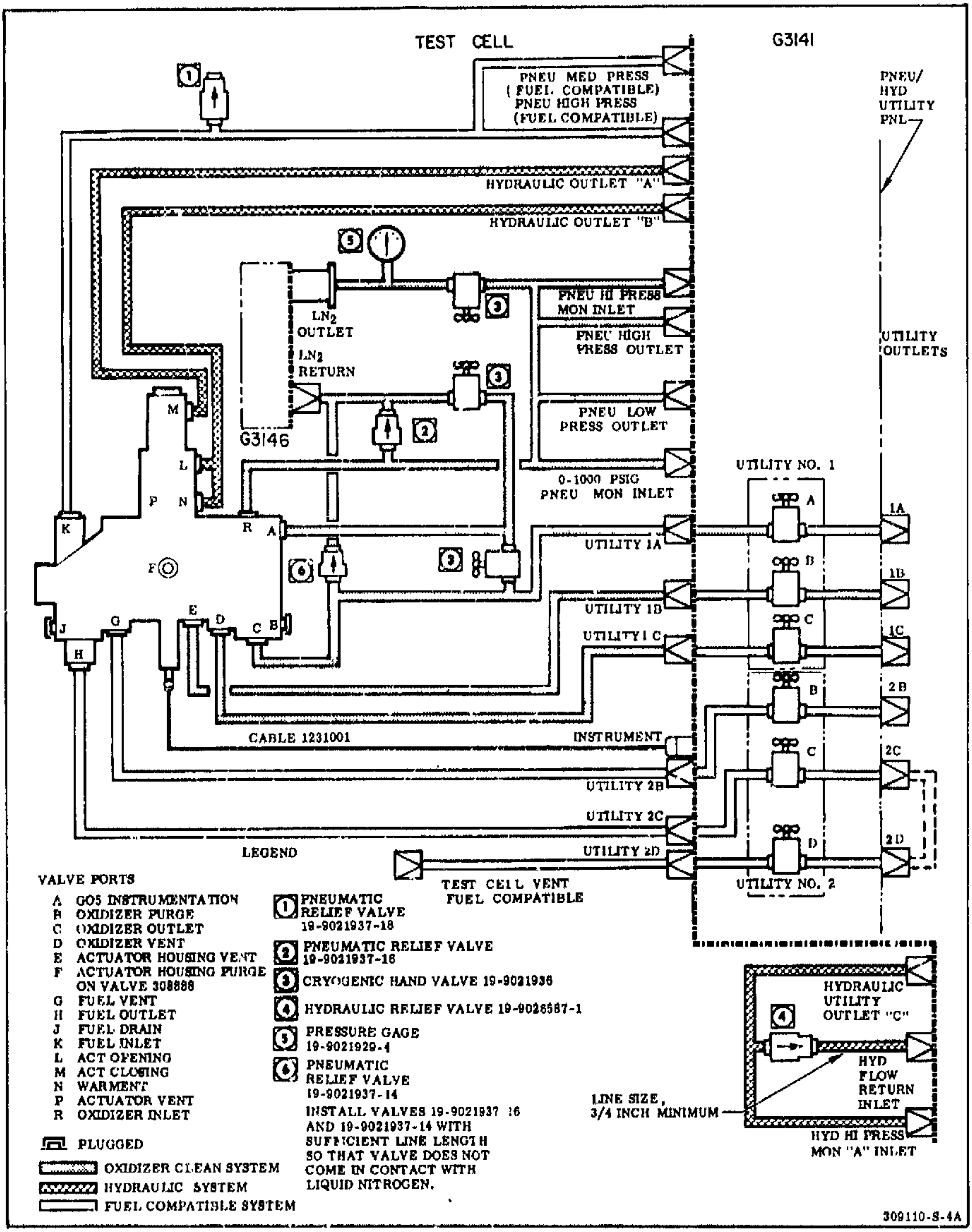


Figure 3-17. Gas Generator Ball Valve Cryogenic and Ambient Leak-Test Setup

Procedure	Result
f. Using HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 2,000 ±40 psi, then close valve.	ACT CLOSING port (M) pressurized and ball valve closes. PRESSURE MONITOR "A" gage must indicate 2,000 ±40 psi.
g. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Lights 1 and 1A on.

WARNING

Ensure that valves on utility panel are closed. If valves are left open, liquid nitrogen can flow through utility panel.

3-28. Low-Temperature Chill-Down.

Procedure	Result
a. Open hand valves at cryogenic supply unit LN_2 OUTLET and LN_2 RETURN ports.	None.
b. Using LN_2 TANK PRESSURE panel, apply pressure to cryogenic supply unit as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±20 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure with SHUTOFF valve until cryogenic supply unit pressure gage indicates pressure (100 psi maximum).	Cryogenic supply unit pressure gage must indicate 100 psi maximum. Liquid nitrogen supplied to oxidizer inlet port (R) and ball valve starts to chill.
c. Maintain liquid nitrogen flow at lowest pressure (100 psig maximum) until ball valve is chilled and liquid flows through instrumentation port (A) for 20 (+5, -0) minutes.	Ball valve chilled.

NOTE

Flow liquid nitrogen at lowest possible pressure, to avoid exhausting supply before completing test.

Procedure	Result
d. Using LN_2 TANK PRESSURE panel, close SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±20 psi; then open VENT valve.	Pressure to G3146 is shut off and LN_2 TANK PRESSURE panel remains pressurized. Pressure decreases as liquid nitrogen continues to flow.
e. Close hand valve at cryogenic supply unit LN_2 RETURN port when gage indicates less than 30 psi.	Liquid nitrogen flow stops.
f. On FLOW/Δ P MONITOR panel, close TEST CELL MONITOR PRESSURE gage VENT valve and open SHUTOFF valve.	TEST CELL MONITOR PRESSURE gage must indicate 30 psi maximum.

Procedure	Result
3-29. Oxidizer Shaft Seals Low-Temperature Leak-Test.	
a. On LN_2 TANK PRESSURE panel, open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±5 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±5 psi. Oxidizer inlet port (R) pressurized.
b. Open UTILITY NO. 1 valves C and A; then measure leakage from oxidizer vent port (D) and oxidizer outlet port (C) at outlets 1C and 1A.	Maximum allowable leakage from each port is 20 scim.
c. Using LN_2 TANK PRESSURE panel, open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 85 ±5 psi; then repeat leak-test in step b.	TEST CELL MONITOR PRESSURE gage must indicate 85 ±5 psi. Same result as step b.
d. Using LN_2 TANK PRESSURE panel, open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±5 psi; then repeat leak-test in step b.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±5 psi. Same result as step b.
e. Using LN_2 TANK PRESSURE panel, reduce pressure at oxidizer inlet port (R) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Oxidizer inlet port (R) depressurized. TEST CELL MONITOR PRESSURE gage must indicate zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LN_2 TANK PRESSURE panel depressurized.
f. Close UTILITY NO. 1 shutoff valves A and C.	None.

WARNING

Shutoff valves A and C must be closed before proceeding with test. If valves are left open, liquid nitrogen can flow through utility panel.

Procedure	Result
g. Press HYDRAULIC CONTROL panel TEST CELL SUPPLY "A" switch-light; then press TEST CELL SUPPLY "B" switch-light.	ACT CLOSING port (M) depressurized, ACT OPENING port (L) pressurized, and ball valve opens. Light 1A off and light 1B on.
h. Open hand valve at LN_2 RETURN port and open hand valve between instrumentation port (A) and oxidizer outlet port (C).	None.

Procedure	Result
i. Using LN_2 TANK PRESSURE panel, apply pressure to cryogenic supply unit as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ± 20 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure with SHUT-OFF valve until cryogenic supply unit pressure gage indicates pressure (100 psi maximum).	Cryogenic supply unit pressure gage must indicate 100 psi maximum. Liquid nitrogen supplied to oxidizer inlet port (R) and ball valve starts to chill.
j. Maintain liquid nitrogen flow at lowest pressure (100 psig maximum) until ball valve is chilled and liquid flows through oxidizer outlet port (C).	Ball valve chilled.

NOTE

Flow liquid nitrogen at lowest possible pressure, to avoid exhausting supply before completing test.

Procedure	Result
k. On FLOW/Δ P MONITOR panel, close TEST CELL MONITOR PRESSURE gage SHUT-OFF valve and open VENT valve.	TEST CELL MONITOR PRESSURE gage indicates zero.
l. Close hand valves at LN_2 RETURN port and LN_2 OUTLET port.	Liquid nitrogen supply to oxidizer inlet port (R) shut off.
m. Using LN_2 TANK PRESSURE panel, reduce pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Cryogenic supply unit depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LN_2 TANK PRESSURE panel depressurized.
n. Using HIGH PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,200 ±200 psi.	HIGH PRESSURE panel pressurized.
(3) Open and control pressure with SHUT-OFF valve until PRESSURE monitor gage indicates 1,800 ±40 psi.	PRESSURE monitor gage must indicate 1,800 ±40 psi. Oxidizer inlet port (R) pressurized.

Procedure	Result
o. Open UTILITY NO. 1 valve C; then measure leakage from oxidizer vent port (D) at outlet 1C.	Maximum allowable leakage is 20 scim.
p. Using HIGH PRESSURE panel, reduce pressure to oxidizer inlet port (R) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Open VENT valve until PRESSURE monitor gage indicates zero.	Oxidizer inlet port (R) depressurized. PRESSURE monitor gage must indicate zero.
q. Open hand valve at LN_2 RETURN port.	None.

3-30. Return to Room Temperature.

Procedure	Result
a. On UTILITY panel NO. 2, connect a line between outlets 2C and 2D, and open valves C and D.	None.
b. Close HIGH PRESSURE FUEL COMPATIBLE panel VENT valve.	None.
c. Using MED PRESS FUEL COMPATIBLE panel, flow gaseous nitrogen through fuel side of ball valve as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 80 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve until fully open.	Gaseous nitrogen flows through fuel side of ball valve.
d. Using LOW PRESSURE panel, flow gaseous nitrogen through oxidizer side of ball valve as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 80 ±20 psi.	LOW PRESSURE panel pressurized.
(3) Open SHUTOFF valve until fully open.	Gaseous nitrogen flows through oxidizer side of ball valve.
e. Continue steps c and d until ball valve returns to ambient temperature.	None.

Procedure	Result
f. Using MED PRESS FUEL COMPATIBLE panel, reduce flow of gaseous nitrogen through fuel side of ball valve as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Gaseous nitrogen flow stops.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurizing.
g. Using LOW PRESSURE panel, reduce flow of gaseous nitrogen through oxidizer side of ball valve as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Gaseous nitrogen flow stops.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LOW PRESSURE panel depressurized.
h. Close UTILITY NO. 2 valves C and D; then remove line from outlets 2C and 2D.	None.
i. Close the following hand valves:	None.
(1) LN_2 OUTLET.	
(2) LN_2 RETURN.	
(3) Between instrumentation port (A) and oxidizer outlet port (C).	
j. Press HYDRAULIC CONTROL panel TEST CELL SUPPLY "B" switch-light; then press TEST CELL SUPPLY "A" switch-light.	ACT OPENING port (L) depressurized, ACT CLOSING port (M) pressurized and ball valve closes. Light 1B off and light 1A on.
k. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.

3-31. Oxidizer Seals Ambient Leak-Test for Valves 308888 and 309110.

Procedure	Result
a. On FLOW/Δ P MONITOR panel, close TEST CELL MONITOR PRESSURE VENT valve and open SHUTOFF valve.	None.
b. Using LOW PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±20 psi.	LOW PRESSURE panel pressurized.
(3) Open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±5 psi.	Oxidizer inlet port (R) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 30 ±5 psi.

Procedure	Result
c. Open UTILITY NO. 1 valves C and A; then measure leakage from oxidizer vent port (D) and oxidizer outlet port (C) at outlets 1C and 1A.	Maximum allowable leakage from each port is 10 scim.
d. Using leak-test compound (MIL-L-25567), check for leakage at joint between oxidizer housing and actuator housing.	No leakage (bubble formation) is allowable.
e. On LOW PRESSURE panel, open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±5 psi; then repeat leak-test in steps c and d.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±5 psi. Same results as in steps c and d.
f. On LOW PRESSURE panel, close SHUTOFF valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Pressure to oxidizer inlet port (R) shut off.
g. On FLOW/Δ P MONITOR panel, close TEST CELL MONITOR PRESSURE gage SHUTOFF valve; then open VENT valve.	None.
h. Using HIGH PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,200 ±200 psi.	HIGH PRESSURE panel pressurized.
(3) Open and control pressure with SHUTOFF valve until PRESSURE monitor gage indicates 1,000 ±20 psi.	Oxidizer inlet port (R) pressurized. PRESSURE monitor gage must indicate 1,000 ±20 psi.
i. Repeat leak-test in step c.	Same result as step c.
j. Using leak-test compound (MIL-L-25567), check for leakage at joint between oxidizer housing and actuator housing.	Fuzz leakage is allowable.

NOTE

Fuzz leakage is the formation of leak-test compound bubbles that do not exhibit growth for a period of 5 minutes.

Procedure	Result
k. On HIGH PRESSURE panel, open and control pressure with SHUTOFF valve until PRESSURE monitor gage indicates 1,275 ±25 psi; then repeat leak-test in step j.	PRESSURE MONITOR gage must indicate 1,275 ±25 psi. Same result as in step j.

Procedure	Result
l. On HIGH PRESSURE panel, open and control pressure with SHUTOFF valve until PRESSURE monitor gage indicates 1,800 ±40 psi; then repeat leak-test in step c.	PRESSURE monitor gage must indicate 1,800 ±40 psi. Same result as in step c.
m. Using HIGH PRESSURE panel, reduce pressure to oxidizer inlet port (R) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Oxidizer inlet port (R) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.

3-31A. Oxidizer Seals Ambient Leak-Test for Valve 306866.

Procedure	Result
a. Disconnect line and fitting from GO5 instrumentation port (A); then install plug (87) and seal (88) in port (A). Torque plug to 240 ±10 inch-pounds. Plug open line.	None.
b. On FLOW/Δ P MONITOR panel, close TEST CELL MONITOR PRESSURE VENT valve and open SHUTOFF valve.	None.
c. Using LOW PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±20 psi.	LOW PRESSURE panel pressurized.
(3) Open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±5 psi.	Oxidizer inlet port (R) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 30 ±5 psi.
d. Open UTILITY NO. 1 valves C and A; then measure leakage from oxidizer vent port (D) and oxidizer outlet port (C) at outlets 1C and 1A.	Maximum allowable leakage from each port is 10 scim.
e. Using leak-test compound (MIL-L-25567), check for leakage at joint between oxidizer housing and actuator housing and at plug (87) installed in GO5 instrumentation port (A).	No leakage (bubble formation) is allowable at either location.
f. On LOW PRESSURE panel, open and control pressure with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±5 psi.	Oxidizer inlet port (R) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 100 ±5 psi.

Procedure	Result
g. Repeat steps d and e	Same results as in steps d and e.
h. On LOW PRESSURE panel, close SHUT-OFF valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Pressure to ozidizer inlet port (R) shut off.
i. On FLOW/Δ P MONITOR panel, close TEST CELL MONITOR PRESSURE gage SHUT-OFF valve; then open VENT valve.	None.
j. Using HIGH PRESSURE panel, apply pressure to oxidizer inlet port (R) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,200 ±200 psi.	HIGH PRESSURE panel pressurized.
(3) Open and control pressure with SHUT-OFF valve until PRESSURE monitor gage indicates 1,000 ±20 psi.	Oxidizer inlet port (R) pressurized. PRESSURE monitor gage must indicate 1,000 ±20 psi.
k. Repeat steps d and e.	Same results as in steps d and e.
l. On HIGH PRESSURE panel, open and control pressure with SHUTOFF valve until PRESSURE monitor gage indicates 1,800 ±40 psi.	PRESSURE monitor gage must indicate 1,800 ±40 psi.
m. Repeat steps d and e.	Same results as in steps d and e.

Procedure	Result
n. Using HIGH PRESSURE panel, reduce pressure to oxidizer inlet port (R) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Oxidizer inlet port (R) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.

3-32. Fuel Seals Ambient Leak-Test.

Procedure	Result
a. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 30 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Open SHUTOFF valve.	Fuel inlet port (K) pressurized.
b. Open UTILITY NO. 2 valves B and C then measure leakage as follows:	
(1) Fuel vent port (G) at outlet 2B. Use leak-test compound.	No leakage (bubble formation) is allowable.
(2) Fuel outlet port (H) at outlet 2C.	Maximum allowable leakage is 20 scim.
(3) Joint between fuel housing and actuator housing. Use leak-test compound.	No leakage (bubble formation) is allowable.
(4) Joint between fuel housing and fuel outlet port retainer. Use leak-test compound.	No leakage (bubble formation) is allowable.
c. On MED PRESS FUEL COMPATIBLE panel PRESSURE REGULATOR, increase pressure until REG SUPPLY PRESS gage indicates 100 ±5 psi.	Fuel inlet port (K) pressure increased.
d. Repeat leak-test in step b.	Same result as in step b.
e. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Pressure to fuel inlet port (K) shut off.

Procedure	Result
f. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to fuel inlet port (K) as follows:	
(1) Close VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates less than 1,000 psi.	HIGH PRESS FUEL COMPATIBLE panel pressure reduced.
(3) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,075 ± 20 psi.	HIGH PRESS FUEL COMPATIBLE panel pressurized.
(4) Open SHUTOFF valve.	Fuel inlet port (K) pressurized.
g. Repeat leak-test in step b.	Same result as in step b.
h Ensure that a sufficient amount of leak-test compound is applied at joint between fuel housing and actuator housing and between fuel housing and fuel outlet port retainer.	None.
i. On HIGH PRESS FUEL COMPATIBLE panel PRESSURE REGULATOR, increase pressure until REG SUPPLY PRESS gage indicates 2,070 ±40 psi. Maintain pressure for a minimum of 5 minutes.	Fuel inlet port (K) pressure increased.
j. Measure leakage at UTILITY NO. 2 panel as follows:	
(1) Fuel vent port (G) at outlet 2B. Use leak-test compound.	No leakage (bubble formation) is allowable.
(2) Fuel outlet port (H) at outlet 2C.	Maximum allowable leakage is 20 scim.
k. Using HIGH PRESSURE FUEL COMPATIBLE panel, reduce pressure at fuel inlet port (K) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Fuel inlet port (K) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,075 ±20 psi.	HIGH PRESSURE FUEL COMPATIBLE panel pressure reduced.
(3) Close VENT valve and open SHUTOFF valve.	Fuel inlet port (K) pressurized.
l. Check joint between fuel housing and actuator housing and between fuel housing and fuel outlet port retainer for bubble formation.	No leakage (bubble formation) is allowable at either joint.

Procedure	Result
m. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure at fuel inlet port (K) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Fuel inlet port (K) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
n. Close UTILITY NO. 2 shutoff valves.	None.

3-33. Inboard Seal Ambient Leak-Test.

Procedure	Result
a. Disconnect line at PNEU LOW PRESS OUTLET; then connect a tee fitting and a line from ball valve actuator housing vent port (E) to PNEU LOW PRESS OUTLET. Cap open lines. Install a hand valve in open end of tee.	None.
b. Using LOW PRESSURE panel, apply pressure to actuator housing vent port (E) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 30 ±5 psi.	LOW PRESSURE panel pressurized.
(3) Open SHUTOFF valve.	Actuator housing vent port (E) pressurized.
c. Open UTILITY NO. 1 valve C and UTILITY NO. 2 valve B; then measure leakage as follows:	
(1) Oxidizer vent port (D) at outlet 1C.	Maximum allowable leakage is 10 scim.
(2) Fuel vent port (G) at outlet 2B. Use leak-test compound.	No leakage (bubble formation) is allowable.
(3) Joint between actuator housing and position switch cover. Use leak-test compound.	No leakage (bubble formation) is allowable.
(4) Joint between position switch and position switch cover. Use leak-test compound.	No leakage (bubble formation) is allowable.
(5) Actuator vent port (P). Use leak-test compound.	No leakage (bubble formation) is allowable.
d. Using LOW PRESSURE panel, reduce pressure at actuator housing vent port (E) as follows:	
(1) Close SHUTOFF valve.	None.

Procedure	Result
(2) Open hand valve at port (E).	Actuator housing vent port (E) depressurized.
(3) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LOW PRESSURE panel depressurized.

3-34. Actuator Seals Ambient Leak-Test.

Procedure	Result
a. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,200 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,200 ±50 psi.
b. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicate 2,400 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
c. Using HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 1,500 ±30 psi; then close valve.	ACT CLOSING port (M) pressurized and ball valve remains closed. PRESSURE MONITOR "A" gage must indicate 1,500 ±30 psi.
d. Press HYDRAULIC CONTROL panel TEST CELL SUPPLY "A" switch-light; then press TEST CELL SUPPLY "B" switch-light.	ACT CLOSING port (M) depressurized. ACT OPENING port (L) pressurized and ball valve opens. Light 1A off and light 1B on.
e. Check for fluid leakage at actuator vent port (P).	No fluid leakage is allowable.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 2,000 ±40 psi; then close valve. Maintain pressure for a minimum of 5 minutes.	ACT OPENING port (L) pressure increased and ball valve remains open. PRESSURE MONITOR "A" gage must indicate 2,000 ±40 psi.
g. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves.	None.
h. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 1,300 ±30 psi; then close valve.	ACT OPENING port (L) pressure reduced.
i. Check for fluid leakage at actuator vent port (P).	No fluid leakage is allowable.
j. Press HYDRAULIC CONTROL panel TEST CELL SUPPLY "A" switch-light	ACT CLOSING PORT (M) pressurized and ACT OPENING port (L) remains pressurized.
k. Check for fluid leakage at junction of actuator housing and actuator housing end cap.	No fluid leakage is allowable.

Procedure	Result
l. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 2,000 ±40 psi; then close valve. Maintain pressure for a minimum of 5 minutes.	ACT OPENING port (L) and ACT CLOSING port (M) pressures increased.
m. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 1,300 ±30 psi.	ACT CLOSING port (M) and ACT OPENING port (L) pressure reduced.
n. Check for fluid leakage at actuator vent port (P).	No fluid leakage is allowable.
o. Press HYDRAULIC CONTROL panel TEST CELL SUPPLY "B" switch-light; then press TEST CELL SUPPLY "A" switch-light after ball valve is closed.	Ball valve closes and ACT OPENING port (L) and ACT CLOSING port (M) depressurized. Light 1B off and light 1A on.
p. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
q. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
r. On HYD HIGH PRESS MONITOR panel, open PRESSURE MONITOR "A" shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR "A" gage must indicate zero.
rA. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
s. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close MED PRESS SHUTOFF valve.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on.
t. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF and VENT valves.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
tA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	
u. Remove ball valve from test setup; then drain and purge control and recirculating passages with gaseous nitrogen. Install protective closures. Refer to paragraph 3-2. Secure equipment as outlined in paragraph 3-35.	None.

3-35. SECURING TEST EQUIPMENT.

3-36. After ball valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen and helium pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close gaseous nitrogen SHUTOFF valve and helium SHUTOFF valve; then open VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel, test cell panel outlets, and connectors.

h. Turn oscillograph power and digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

n. On Cryogenic Supply Unit G3146, make sure LN_2 SUPPLY and TANK LP SHUTOFF valves are closed and that LN_2 VENT valve is open.

3-37. GAS GENERATOR BALL VALVE SWITCH NA5-27332 AND NA5-27443.

3-38. The following procedures contain cleaning, inspecting and repairing, and testing information required to maintain the gas generator ball valve switch. The switch is hermetically sealed and no disassembly or assembly is possible.

3-39. CLEANING.

3-40. Hand-clean switch exterior surfaces for pneumatic service, and clean electrical connector using electrical connector cleaning procedure in R-3896-3, Volume I.

3-41. INSPECTING AND REPAIRING.

3-42. Inspect the switch for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, scratches, and bent electrical connector pins. Refer to R-3896-3, Volume I, for general repair procedures.

3-43. TESTING.

3-44. This test procedure outlines requirements for testing the gas generator ball valve switch.

3-45. RESISTANCE AND INSULATION RESISTANCE TEST.

Procedure	Result
a. Connect a multimeter between pins B and C of electrical connector; then slowly extend shaft until multimeter indicates less than one ohm.	Multimeter must indicate less than one ohm.
b. Using a multimeter and a decade resistance box, measure resistance between pins B and C as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.5 ohm.
c. Using a multimeter and a decade resistance box, measure resistance between pin D and housing as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pin D and housing.	Resistance must not exceed 0.5 ohm.
d. Using megohmmeter, apply 500 ±50 vdc between pins B and D of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
e. Using megohmmeter, apply 500 ±50 vdc between pins A and B of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
f. Connect a multimeter between pins A and B of electrical connector; then slowly retract shaft until multimeter indicates less than one ohm.	Multimeter must indicate less than one ohm.

Procedure	Result
g. Using a multimeter and a decade resistance box, measure resistance between pins A and B as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.5 ohm.
h. Using megohmmeter, apply 500 ±50 vdc between pins B and D of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
i. Using megohmmeter, apply 500 ±50 vdc between pins B and C of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
j. Remove switch from test setup. Package and protect indicator as outlined in R-3896-3, Volume I.	None.

3-46. CONTINUITY VERIFICATION TEST. This test is a preinstallation requirement only.

a. Fully extend shaft; then using a multimeter, continuity test open and closed switches. Record multimeter indication.	Multimeter must indicate infinity between pins A and B and continuity between pins B and C.
b. Fully retract shaft; then using a multimeter, continuity test open and closed switches. Record multimeter indication.	Multimeter must indicate continuity between pins A and B and infinity between pins B and C.

SECTION IV

GAS GENERATOR OXIDIZER PURGE CHECK VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

4-1. GAS GENERATOR OXIDIZER PURGE CHECK VALVE 308915.

4-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the gas generator oxidizer purge check valve. See figure 4-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
T-5034186	Pressure Test Fixture	Pressure-checks valve after repair.
T-5037805	Lapping Tool	Laps gate seat.
T-5041524	Assembly Tool	Removes, replaces, and torques valve seat.
G3104	Pneumatic Flow Tester	Measures purge check valve downstream pneumatic leakage.
G3141	Components Test Console	Provides pneumatic pressure for testing purge check valve.
G3143	Components Adapter Set	Provides hardware for purge check valve test setups.
9013531	Liquid Nitrogen Container	Provides container for liquid nitrogen during check valve cold-testing.

Figure 4-1. Test Equipment and Special Tools for Gas Generator Oxidizer Purge Check Valve

4-3. DISASSEMBLING.

4-4. Disassemble the gas generator oxidizer purge check valve to accomplish necessary repairs and/or replacement. See figure 4-3 for parts and index numbers.

Figure 4-2 deleted.

a. Using assembly tool T-5041524, remove gate seat (1) and seal (2) from body (7). Gate seat (1) is staked in 2 places; staking pops out when gate seat (1) is unscrewed.

b. Remove pin (3), springs (4, 5), and gate (6) from gate seat (1).

4-5. CLEANING.

4-6. Clean all parts of the gas generator oxidizer purge check valve for liquid oxygen service as outlined in R-3896-3, Volume I.

4-7. INSPECTING AND REPAIRING.

4-8. Inspecting the gas generator oxidizer purge check valve determines if the individual parts have been damaged by mishandling or wear. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. See figure 4-4 and inspect individual parts for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches.

4-9. ASSEMBLING.

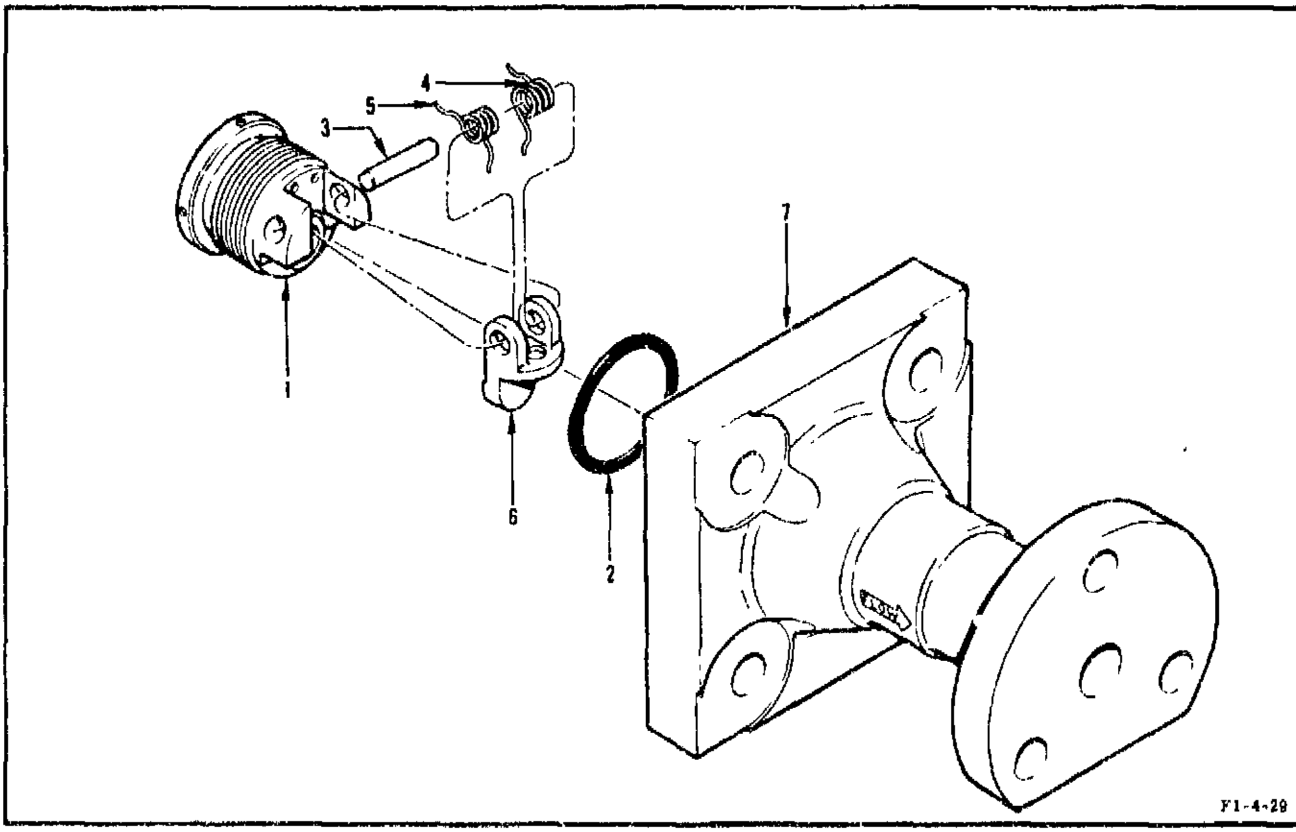
4-10. Assembly of the gas generator oxidizer purge check valve must be performed with care to prevent damage to searing and sealing surfaces. All parts must meet cleaning requirements outlined in paragraph 4-5. See figure 4-3 for parts and index numbers.

a. *Install gate (6), springs (4, 5), and pin (3) on gate seat (1).*

b. Install gate seat (1) and seal (2) in body (7).

NOTE

Seal (2) must be centered on gate seat (1).



1 Gate Seat 3 Pin 5 Spring 7 Body
2 Seal 4 Spring 6 Gate

Figure 4-3. Gas Generator Oxidizer Purge Check Valve--Exploded View

Part Name and Index No.	Inspecting	Repairing
Gate Seat (1)	Sealing surface must be free of nicks, scratches, wear, and imperfections that could impair its sealing function.	Repair of gate seat consists of lapping seat with lapping tool T-5037805 to obtain results of paragraphs 4-11 through 4-19.
	Hole diameter for wear.	Replace if diameter exceeds 0.141 ±0.001 inch.
	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
Seal (2)	Sealing surface must be free of nicks, scratches, and imperfections that could impair its sealing capability.	Replace.
Pin (3)	Damage.	Replace.
Springs (4, 5)	Corrosion, cracks, or wear.	Replace.
Gate (6)	Deterioration, damage, or wear.	Replace.

Figure 4-4. Inspecting and Repairing Gas Generator Oxidizer Purge Check Valve (Sheet 1 of 2)

Part Name and Index No.	Inspecting	Repairing
Gate (6) (Cont)	Sealing surface must be free of nicks, scratches, wear, and imperfections that could impair its sealing capability.	Lapping of gate is permissible to obtain results of paragraphs 4-11 through 4-19.
Body (7)	Sealing surface must be free of nicks, scratches, and imperfections that could impair its sealing capability.	Repair of sealing surface consists of lapping surface to obtain results of paragraphs 4-11 through 4-19.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.

Figure 4-4. Inspecting and Repairing Gas Generator Oxidizer Purge Check Valve (Sheet 2 of 2)

c. Using assembly tool T-5041524, torque gate seat (1) to 100-125 in-lb.

WARNING

The following procedure uses liquid nitrogen, which must not be allowed to come in contact with any part of the body. Human tissue will freeze upon contact, causing serious injury. Eye protection and protective clothing must be worn by personnel handling liquid nitrogen. Liquid nitrogen must be used in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

d. Chill down check valve by immersing valve in liquid nitrogen (MIL-P-27401). When boiling stops, remove valve from liquid nitrogen and retorque gate seat (1) immediately to 100-125 in-lb.

e. When check valve has returned to room temperature, stake body (7) tab into gate seat (1) holes, 2 places 180 degrees apart.

4-11. TESTING.

4-12. This procedure outlines requirements for complete testing of gas generator oxidizer purge check valve, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install pressure test fixture on purge check valve as shown in figure 4-5. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up Components Test Console G3141 electrical patch-panel (figure 4-6) and prepare console for use (figure 4-7). See figure 4-8 for a cutaway view and test port identification. Refer to paragraphs 4-14 through 4-19 for purge check valve test procedures and see figures 4-9 through 4-11 for test setups.

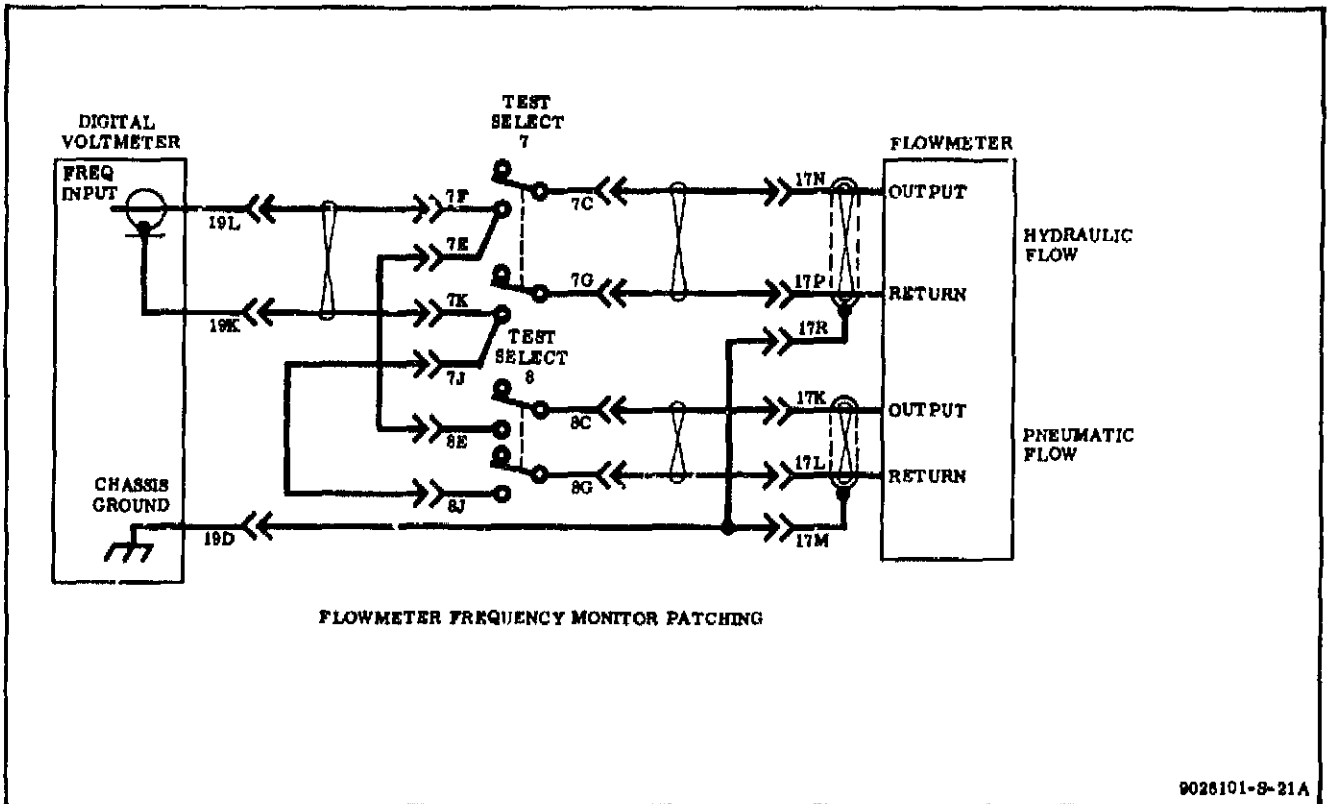
CAUTION

During test procedures, the gas generator oxidizer purge check valve and the test equipment must be maintained in a liquid-oxygen-clean condition.

Index Letter	Valve Port	Test Plate	Port Connection
A	Inlet	T-5034186-116[a]	AN815-6C[a]
B	Outlet	T-5034186-103[a]	AN815-6C[a]

(a) Maintain item in liquid-oxygen-clean condition.

Figure 4-5. Preparing Gas Generator Oxidizer Purge Check Valve for Testing



Patch-Cord[a]	From J6-	To J6-	Patch-Cord[a]	From J6-	To J6-
K3.	7C	17N	K3..	7J	8J
K3.	7E	8E	K3.	8C	17K
K3.	7F	19L	K3.	8G	17L
K3.	7G	17P	K4.09	17M	17R
K3.	7K	19K			19D

(a) Use any cord length required on all patch-cords numbered K3.

Figure 4-6. Components Test Console Patch-Panel Requirements

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	

Figure 4-7. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (Cont)			
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
TEST CELL ELECT. OUTLETS	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	

Figure 4-7. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (Cont)			
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.(a)
	VOLTS-RANGE SELECT	D (0-30)	None.
	TEST SELECT 1		Light 1 off.(a)
	TEST SELECT 2		Light 2 off.(a)
	TEST SELECT 3		Light 3 off.(a)
	TEST SELECT 4		Light 4 off.(a)
	TEST SELECT 5		Light 5 off.(a)
	TEST SELECT 6		Light 6 off.(a)
	TEST SELECT 7		Light 7 off. Hydraulic flow monitor control.(a)
	TEST SELECT 8		Light 8 off. Pneumatic flow monitor control.(a)
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.(a)
	HYDRAULIC SYSTEM SUPPLY		CLOSE.(a)
	TEST CELL SUPPLY "A"		VENT.(a)
	TEST CELL SUPPLY "B"		VENT.(a)
	FLOW MONITOR SHUTOFF		CLOSE.(a)
	LOW FLOW BYPASS		CLOSE.(a)
FLOW-MONITOR-TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100 V	
	FUNCTION	FREQ	

(a) If indication is not as specified, press applicable switch-light.

Figure 4-7. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks
FLOW-MONITOR-TEST			
DIGITAL VOLTMETER (Cont)			
	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	3/4 turn clockwise	
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 is for pneumatic flow. Both switch-lights must not be on at the same time.

- Digital voltmeter must warm up at least 30 minutes.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console. PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates supply pressure.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates supply pressure.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console pressurizing panels and into test cell. Safety precautions outlined in R-3896-3, Volume I must be followed when working with pressurized systems.

Figure 4-7. Preparing Components Test Console for Use (Sheet 4 of 4)

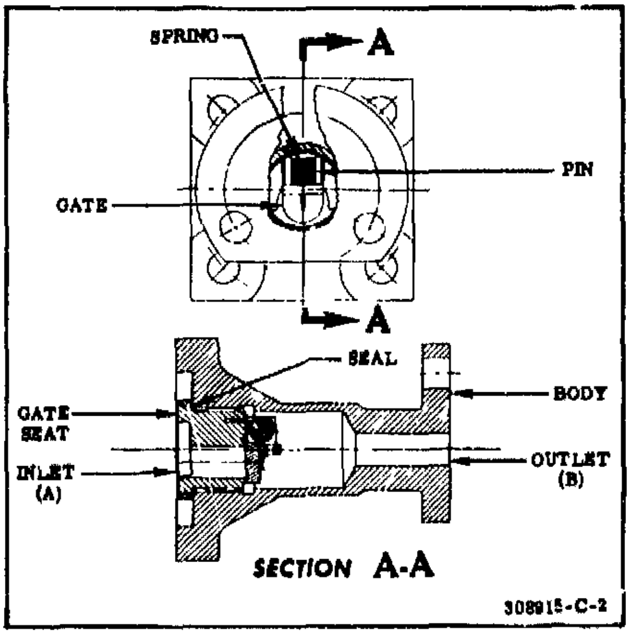


Figure 4-8. Gas Generator Oxidizer Purge Check Valve--Cutaway View

Paragraph 4-13, figure 4-9 deleted.

4-14. AMBIENT TEMPERATURE REVERSE-LEAK-TESTS.

Procedure	Result
a. Make sure Components Test Console G3141 and purge check valve are prepared for use as outlined in paragraph 4-12; then connect purge check valve to console. (See figure 4-10, reverse-leak-test setup.)	None.
b. On FLOW/Δ P MONITOR panel, open TEST CELL INLET SHUTOFF valve.	None.
c. On HIGH PRESSURE panel, apply pressure to purge check valve as follows:	HIGH PRESSURE panel pressurized.
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±1 psi.	HIGH PRESSURE panel pressurized.
(2) Open SHUTOFF valve.	Valve outlet port (B) pressurized. On FLOW/Δ P MONITOR panel, TEST CELL MONITOR gage indicates 50 ±1 psi.
d. Measure at valve inlet port (A) for leakage with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 25 scim.
e. Repeat steps c and d at 100 ±2 and 300 ±5 psig.	Same results as steps c and d.
f. On FLOW/Δ P MONITOR panel, close TEST CELL INLET SHUTOFF valve.	None.
g. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,000 ±20 psi.	Valve outlet port (B) pressurized. On PRESS/TEMP MON panel PRESSURE monitor gage must indicate 1,000 ±20 psi.
h. Measure at valve inlet port (A) for leakage with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 25 scim.
i. Repeat steps g and h at 1,200 ±24 psig.	Same results as steps g and h.
j. On HIGH PRESSURE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Valve outlet port (B) depressurized. On PRESS/TEMP MON panel PRE PRESSURE monitor gage must indicate zero.
k. Remove purge check valve from test setup.	None.

Procedure	Result
l. If purge check valve testing is terminated, secure equipment as outlined in paragraph 4-20.	None.
m. Install protective closures. Refer to paragraph 4-2.	None.

4-15. AMBIENT TEMPERATURE FLOW-TEST.

Procedure	Result
a. Prepare digital voltmeter (DVM) for flow-monitor-tests as shown in figure 4-7.	None.
b. Make sure Components Test Console G3141 and purge check valve are prepared for use as outlined in paragraph 4-12; then connect purge check valve to console. (See figure 4-10, flow-test and reseat test setup.) Fully open hand valve in test cell.	None.
c. On FLOW/Δ P MONITOR panel, open FLOW MONITOR TEST CELL OUTLET SHUTOFF valve and TEST CELL INLET SHUTOFF valve.	None.
d. On PRESSURE/TEMPERATURE MONITOR panel, turn CHANNEL SELECT switch to position 2.	TEMPERATURE indicator on.

e. On HIGH PRESSURE panel, apply pressure to purge check valve as follows:

Procedure	Result
(1) Open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until TEST CELL MONITOR PRESSURE gage indicates 35 ±1 psi. Partially close hand valve in test cell, if necessary, to obtain inlet pressure.	Valve inlet port (A) pressurized to 35 ±1 psig.
f. On ELECTRICAL CONTROL panel, press TEST SELECT 8 switch-light.	Light 8 on.
g. On DIGITAL VOLTMETER panel, press RESET switch. Measure and record flowrate.	DVM must indicate an equivalent of 27 scfm minimum.

h. On PRESSURE/TEMPERATURE MONITOR panel, observe and record temperature.

Procedure	Result
i. On ELECTRICAL CONTROL panel, press TEST SELECT 8 switch-light.	Light 8 off.
j. On PRESSURE/TEMPERATURE MONITOR panel, turn CHANNEL SELECT to OFF.	TEMPERATURE indicator off.
k. On HIGH PRESSURE panel, close SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel and valve inlet port (A) depressurized.
l. On FLOW/Δ P MONITOR panel, close FLOW MONITOR TEST CELL OUTLET SHUTOFF valve.	None.
m. If purge check valve testing is terminated, remove valve from test setup and secure equipment as outlined in paragraph 4-20.	None.
n. Install protective closures. Refer to paragraph 4-2.	None.

4-16. AMBIENT TEMPERATURE RESEAT-LEAKAGE TEST.

Procedure	Result
a. Make sure Components Test Console G3141 and purge check valve are prepared for use as outlined in paragraph 4-12; then connect check valve to console. (See figure 4-10, flow test and reseat-test setup.)	None.
b. On FLOW/Δ P MONITOR panel, close UPSTREAM INLET SHUTOFF valve and uncap 15 Δ P PNEU DOWNSTREAM INLET fitting. Open test cell inlet SHUTOFF valve.	None.

c. On HIGH PRESSURE panel, apply pressure to check valve as follows:

Procedure	Result
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 35 ±1 psi.	HIGH PRESSURE panel pressurized.

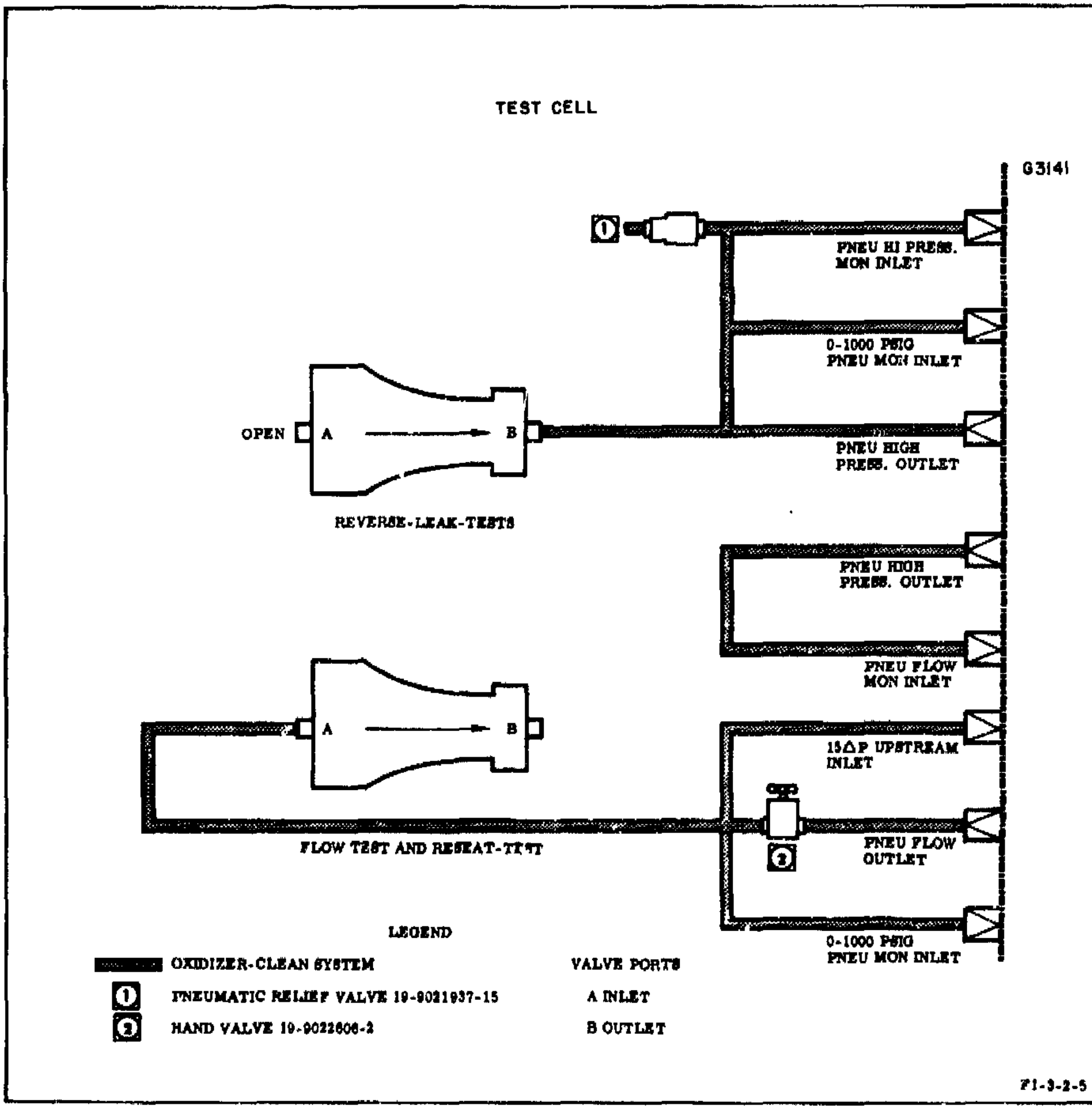


Figure 4-10. Gas Generator Oxidizer Purge Check Valve Ambient Temperature Test Setups

Procedure	Result
(2) Open SHUTOFF valve.	Valve inlet port (A) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 35 ±1 psi.
(3) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 12 psi.	Inlet port (A) pressure reduced to 12 psi.
d. On FLOW/Δ P MONITOR panel, open UPSTREAM INLET SHUTOFF valve.	PRESSURE DIFFERENTIAL gage on FLOW/Δ P MONITOR panel indicates 12 psi.
e. On HIGH PRESSURE panel, slowly reduce pressure to valve inlet port (A) until PRESSURE DIFFERENTIAL gage indicates 0.75 (+0, -0.2) psi.	PRESSURE DIFFERENTIAL gage must indicate 0.75 (+0, -0.2) psi.
eA. Measure for leakage from outlet port (B) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 50 scim.
f. On HIGH PRESSURE panel, close SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel and valve inlet port (A) depressurized.
g. On FLOW/Δ P MONITOR panel, close TEST CELL INLET SHUTOFF and UPSTREAM INLET SHUTOFF valves.	None.
h. Remove valve from test setup.	None.
i. If purge check valve testing is terminated, secure equipment as outlined in paragraph 4-20.	None.
j. Install protective closures. Refer to paragraph 4-2.	None.

4-17. LOW-TEMPERATURE REVERSE-LEAK-TESTS.

Procedure	Result
a. Make sure Components Test Console G3141 and purge check valve are prepared for use as outlined in paragraph 4-12; then connect check valve to console. (See figure 4-11, reverse-leak-test setup.)	None.

NOTE

Gaseous helium (Bureau of Mines, Grade A) is the test medium for low-temperature reverse-leak-tests.

Procedure	Result
b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.	Gaseous nitrogen pressure source shut off.
c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve. Open SYS VENT valve. After pressure decay, close SYS VENT valve.	HIGH PRESSURE and LOW PRESSURE panels gaseous nitrogen supply vented.
d. On PNEU SOURCE CONTROL panel, open HELIUM SOURCE SHUTOFF valve.	Helium supplied to HIGH PRESSURE and LOW PRESSURE panels.
e. On FLOW/Δ P MONITOR panel, open TEST CELL INLET SHUTOFF valve.	None.

f. On HIGH PRESSURE panel, apply pressure to purge check valve as follows:

Procedure	Result
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±1 psi.	HIGH PRESSURE panel pressurized.
(2) Open SHUTOFF valve.	Valve outlet port (B) pressurized and TEST CELL MONITOR PRESSURE gage must indicate 50 ±1 psi.

Procedure	Result
WARNING The following procedure uses liquid nitrogen, which must not be allowed to come in contact with any part of the body. Human tissue will freeze upon contact, causing serious injury. Eye protection and protective clothing must be worn by personnel handling liquid nitrogen. Liquid nitrogen must be used in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.	
g. Fill container with liquid nitrogen. Cold-soak valve until boiling stops.	Valve temperature reduced.
h. Measure for leakage at valve inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 60 scim.
i. Repeat steps f and h at 100 ±2 and 500 ±5 psig.	Same results as steps f and h.
j. On FLOW/Δ P MONITOR panel, close TEST CELL INLET SHUTOFF valve.	None.
k. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,000 ±20 psi.	On PRESS/TEMP MON panel, PRESSURE MONITOR gage must indicate 1,000 ±20 psi.
l. Measure for leakage at valve inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 60 scim.
m. Repeat steps k and l at 1,200 ±24 psig.	Same results as steps k and l.
n. On HIGH PRESSURE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Valve outlet port (B) and HIGH PRESSURE panel depressurized.
o. Remove purge check valve from test setup.	None.
p. If purge check valve testing is terminated, secure equipment as outlined in paragraph 4-20.	None.
q. Install protective closures. Refer to paragraph 4-2.	None.

4-18. LOW-TEMPERATURE FLOW-TEST.

Procedure	Result
a. Prepare digital voltmeter (DVM) for flow-monitor-tests as shown in figure 4-7.	None.
b. Make sure Components Test Console G3141 and purge check valve are prepared for use as outlined in paragraph 4-12; then connect purge check valve to console. (See figure 4-11, flow-test and reseat test setup.) Fully open hand valve in test cell.	None.
NOTE Gaseous helium (Bureau of Mines, Grade A) is the test medium for low-temperature tests. Gaseous nitrogen is an alternate test medium for low-temperature flow-test.	
c. On FLOW/Δ P MONITOR panel, open FLOW MONITOR TEST CELL OUTLET SHUTOFF valve and TEST CELL INLET SHUTOFF valve.	None.
d. On PRESSURE/TEMPERATURE MONITOR panel, turn CHANNEL SELECT switch to position 2.	TEMPERATURE indicator on.
e. On HIGH PRESSURE panel, apply pressure to check valve as follows:	
(1) Open SHUTOFF valve.	
(2) Adjust PRESSURE REGULATOR until TEST CELL MONITOR PRESSURE gage indicates 35 ±1 psi. Partially close hand valve in test cell, if necessary, to obtain inlet pressure.	Valve inlet port (A) pressurized to 35 ±1 psig.
f. On ELECTRICAL CONTROL panel, press test SELECT 8 SWITCH-LIGHT.	Light 8 on.

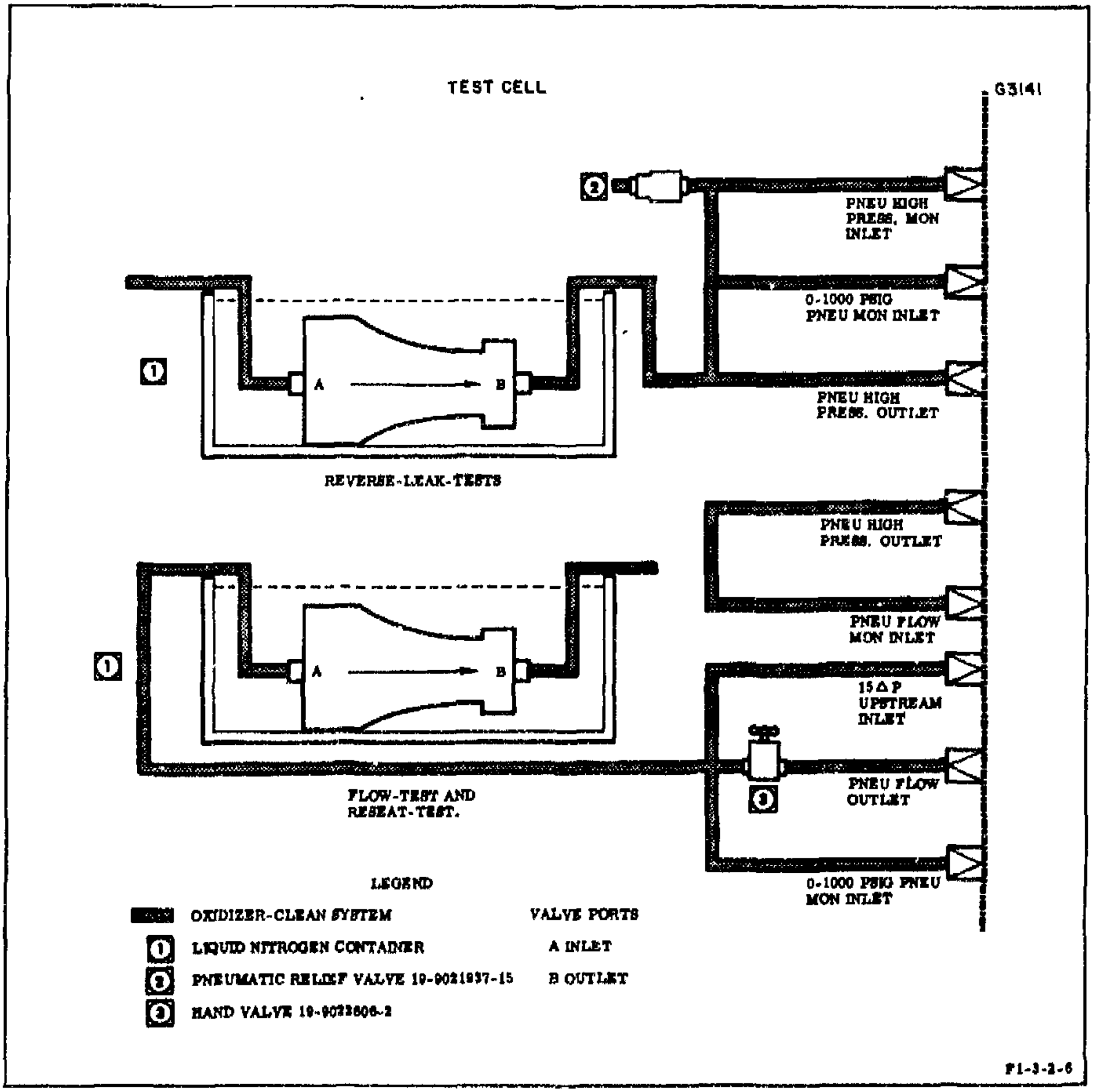


Figure 4-11. Gas Generator Oxidizer Purge Check Valve Low-Temperature Test Setups

Procedure	Result
g. On DIGITAL VOLT-METER panel, press RESET switch. Measure and record flowrate.	DVM must indicate an equivalent of 40 scfm minimum of helium or 27 scfm minimum of gaseous nitrogen.
h. On PRESSURE/TEMPERATURE MONITOR panel, observe and record temperature. Turn CHANNEL SELECT switch to OFF.	TEMPERATURE indicator off.

Procedure	Result
i. On ELECTRICAL CONTROL panel, press TEST SELECT 8 switch-light.	Light 8 off.
j. On HIGH PRESSURE panel, close SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel and valve inlet port (A) depressurized.
k. On FLOW/Δ P MONITOR panel, close FLOW MONITOR TEST CELL OUTLET SHUT-OFF valve.	None.
l. If purge check valve testing is terminated, remove valve from test setup and secure equipment as outlined in paragraph 4-20.	None.
m. Install protective closures. Refer to paragraph 4-2.	None.

4-19. LOW-TEMPERATURE RESEAT LEAKAGE TEST.

Procedure	Result
a. Make sure Components Test Console G3141 and purge check valve are prepared for use as outlined in paragraph 4-12; then connect check valve to console. (See figure 4-11, flow test and reseat-test setup.)	None.

NOTE

Gaseous helium (Bureau of Mines, Grade A) is the test medium for low-temperature reseat-test.

Procedure	Result
b. On FLOW/Δ P MONITOR panel, close UPSTREAM INLET SHUTOFF valve and uncap 15 Δ P PNEU DOWNSTREAM INLET fitting.	None.
c. On HIGH PRESSURE panel, apply pressure to purge check valve as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 35 ±1 psi.	HIGH PRESSURE panel pressurized.
(2) Open SHUTOFF valve.	Valve inlet port (A) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 35 ±1 psi.
(3) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 12 psi.	Inlet port (A) pressure reduced to 12 psi.
d. On FLOW/Δ P MONITOR panel, open UPSTREAM INLET SHUTOFF valve.	PRESSURE DIFFERENTIAL gage on FLOW/Δ P MONITOR panel indicates 12 psi.
e. On HIGH PRESSURE panel, slowly reduce pressure to valve inlet port (A) until PRESSURE DIFFERENTIAL gage indicates 0.75 (+0, -0.2) psi.	PRESSURE DIFFERENTIAL gage must indicate 0.75 (+0, -0.2) psi.
eA. Measure for leakage from outlet port (B) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 120 scim.
f. On HIGH PRESSURE panel, close SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel and valve inlet port (A) depressurized.
g. On FLOW/Δ P MONITOR panel, close TEST CELL INLET and UPSTREAM INLET SHUTOFF valves.	None.
h. Remove valve from test setup.	None.
i. Install protective closures. Refer to paragraph 4-2.	None.

j. If gas generator oxidizer purge check valve testing is terminated, secure equipment (paragraph 4-20).

4-20. SECURING TEST EQUIPMENT.

4-21. After purge check valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen and helium supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF and HELIUM SOURCE SHUTOFF valves.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn off oscilloscope power and digital voltmeter power.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION V

FUEL PURGE CHECK VALVE

This section is deleted.

SECTION VI

HEAT EXCHANGER

6-1. HEAT EXCHANGER 308551-11.

6-2. The following paragraphs provide information for inspecting and repairing the heat exchanger. The heat exchanger is not to be disassembled, and only minor repairs are to be accomplished on the shell. Carbon deposits must be cleaned from the heat exchanger coils if the desired performance cannot be obtained. If it has been determined that the heat exchanger coils require cleaning, return the heat exchanger to Rocketdyne. Refer to R-3896-4 for protective closures.

6-3. DISASSEMBLING.

6-4. Disassembling the heat exchanger is limited to removal of plugs and fittings requiring seals, orifices, orifice retainer washers, and orifice retaining bolts or nuts and cotter pins. Use extreme care during all maintenance operations to protect critical mating surfaces. See figure 6-2 for an exterior view of the heat exchanger.

CAUTION

Parts removed from the heat exchanger must be maintained in a liquid oxygen clean condition.

6-5. INSPECTING AND REPAIRING.

6-6. INSPECTING. Inspecting the heat exchanger is limited to visual and dye-penetrant inspection of the shell as necessary. Inspect parts, that contact liquid oxygen when installed, for evidence of dyed surfaces. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Repairing the heat exchanger is limited to minor repairs, as listed. Assign heat exchanger to overhaul, or contact manufacturer's representative, for any repair not listed in this section.

Figure 6-1 deleted.

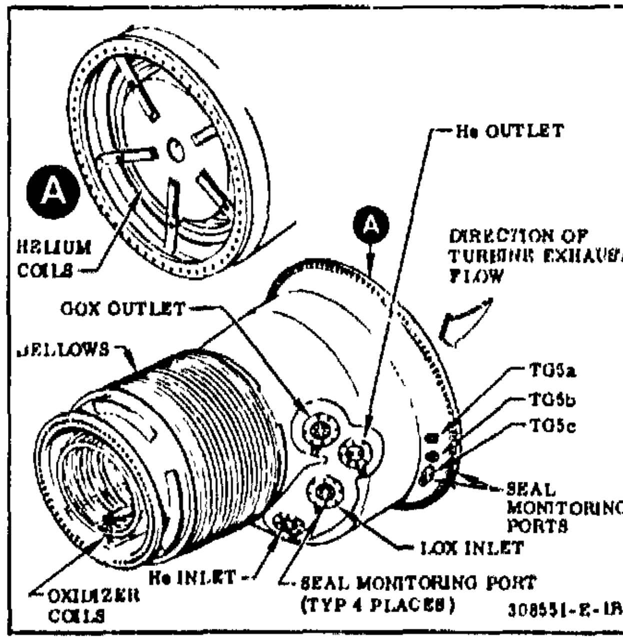


Figure 6-2. Heat Exchanger--Exterior View

6-7. REPAIRING. Nicks and scratches on finished flange surfaces may be repaired by lapping to an 8✓ finish. Waviness requirements are a function of the 18✓ finish (ie, a maximum of 0.00008 inch out-of-flat is permissible within any 0.50-inch distance on flange face, in any direction). This rate is cumulative but must not exceed the flatness requirements in figure 6-3.

Flange	Flatness Requirement	Remarks
Liquid oxygen in (-23, -143)	0.002 Total	Return to manufacturer.
Gaseous oxygen out (-93)	0.002 Total	Return to manufacturer.

Figure 6-3. Surface Finish Requirements (Sheet 1 of 2)

Flange	Flatness Requirement	Remarks
Helium in (-25, -145)	0.002 Total	Return to manufacturer.
Helium out (-95)	0.002 Total	Return to manufacturer.
TG5C	0.0005 Total	
Hot gas in (-3)[a]	0.010 Total	
Hot gas out (-7)[a]	0.010 Total	

(a) Surfaces of flange must be kept parallel, within a 0.06 total.

Figure 6-3. Surface Finish Requirements (Sheet 2 of 2)

6-8. WELDING SHELL.

a. Remove any surface deposits in weld area by scrubbing with a fine-bristle, stainless steel brush until a clean, polished surface is obtained. Hand-wipe cleaned area with acetone (Federal Specification 0-A-51).

WARNING

Acetone 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. Fusion-weld crack by consumable electrode method in an argon (MIL-A-18455) environment, using Hastelloy W welding rod.

c. Penetration and fusion shall be 100 percent for complete length of weld.

d. Dye-penetrant inspect weld. (Refer to R-3896-3, Volume I.)

6-9. ASSEMBLING.

6-10. Assembling heat exchanger is limited to installing plugs, fittings, and orifices, and replacing seals, orifice retainer washers, tab washers, and bolts or nut and cotter pin. Prior to assembly all parts must meet cleaning requirements as outlined in R-3896-3, Volume I. The lubricants used in this procedure are specified in the procedural steps. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.

a. Lubricate (Method A) helium inlet and outlet static seal monitoring port plugs with lubricant grease RB0140-012 (Rocketdyne). Install K-seals and plugs; then torque plugs to 70 ±5 in-lb.

b. Lubricate (Method A) oxidizer inlet and GOX outlet static seal monitoring port plugs with lubricant grease RB0140-012 (Rocketdyne). Install K-seals and plugs; then torque plugs to 70 ±5 in-lb.

c. Lubricate (Method A) TG5a and TG5b instrumentation tap plugs with thread compound C-5A (Felt Products). Install K-seals and plugs; then torque plugs to 135 ±10 in-lb.

d. Lubricate (Method A) TG5c tap static seal monitoring port plug with thread compound C-5A (Felt Products). Install K-seal and plug; then torque plug to 70 ±5 in-lb.

e. Safetywire plugs with Inconel lockwire MS20995N.

f. Install orifice plates, retainer washers, tab washers, and retainer bolts in helium and liquid oxygen inlets.

g. Torque retainer bolts to 61-75 in-lb. Lock with tab washers.

6-11. TESTING.

6-12. Testing of the heat exchanger is performed after installation on the engine. Refer to R-3896-11 for heat exchanger test procedures.

SECTION VII

HEAT EXCHANGER CHECK VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

7-1. HEAT EXCHANGER CHECK VALVE 407840 AND 407870.

7-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the heat exchanger check valve. See figure 7-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
G3104	Pneumatic Flow Tester	Measures downstream leakage.
G3141	Components Test Console	Provides pneumatic and instrumentation for testing valve.
G3143	Components Adapter Set	Provides hardware for check valve test setups.
T-5034041	Pressure Test Fixture	Pressure-tests pressure valve.

Figure 7-1. Test Equipment and Special Tools for Heat Exchanger Check Valve

7-3. DISASSEMBLING.

7-4. Disassembly of the heat exchanger check valve is limited to the removal of the instrumentation plugs and seals.

7-5. CLEANING.

7-6. Clean the heat exchanger check valve and instrumentation plugs for liquid oxygen service as outlined in R-3896-3, Volume I.

Figure 7-2 deleted.

7-7. INSPECTING AND REPAIRING.

7-8. Inspecting the heat exchanger check valve is limited to visual inspection for damage. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Assign the heat exchanger check valve for overhaul for major repairs.

7-9. ASSEMBLING.

7-10. Assembly of the heat exchanger check valve is limited to the installation and/or replacement of the instrumentation plugs and seals. All parts must meet cleaning requirements outlined in paragraph 7-5. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.

a. Install seal on plug with flat surface of seal against plug shoulder.

b. On valve 407840, torque plugs AN814-2CL to 120-180 in-lb and plugs RD265-3004-1002 to 180-276 in-lb. On valve 407870, lubricate (Method A) plugs. Torque plugs to 180 ±10 in-lb.

c. After testing is complete, safetywire plugs with inconel lockwire MS20995N.

7-11. TESTING.

7-12. This procedure outlines requirements for complete testing of the heat exchanger check valve using Components Test Console G3141 and

Components Adapter Set G3143. Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install pressure-test fixture on heat exchanger check valve. Prepare components test console for use (figure 7-3). See figure 7-4 for a cutaway view and test port identification. Refer to paragraphs 7-13 and 7-14 for check valve test procedures and see figure 7-5 for test setups.

CAUTION

During test procedures, the heat exchanger check valve and the test equipment must be maintained in a liquid-oxygen-clean condition.

Panel	Control	Position	Indication/Remarks
NOTE The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.			
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	

Figure 7-3. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	Off	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	
TEST CELL ELECT OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
	Connector J703	Capped	
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Push in	Console main power on.
	CB2 (10 AMP)	Push in	Electrical utility outlets, power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	

Figure 7-3. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter 24 ±0.4 volts.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console. PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates 5,000 ±200 spi supply pressure.

c. On PNEU SOURCE CONTROL panel, open gaseous NITROGEN SOURCE SHUTOFF valve.

d. On SYSTEM SUPPLY panel, close VENT valve; then open TO FUEL COMPATIBLE SYS shutoff valve and TO LN_2 PRESS PANEL shutoff valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console pressurizing panels and into test cell. Safety precautions outlined in R-3896-3, Volume I must be followed when working with pressurized systems.

(a) If indication is not as specified, press applicable switch-light.

Figure 7-3. Preparing Components Test Console for Use (Sheet 3 of 3)

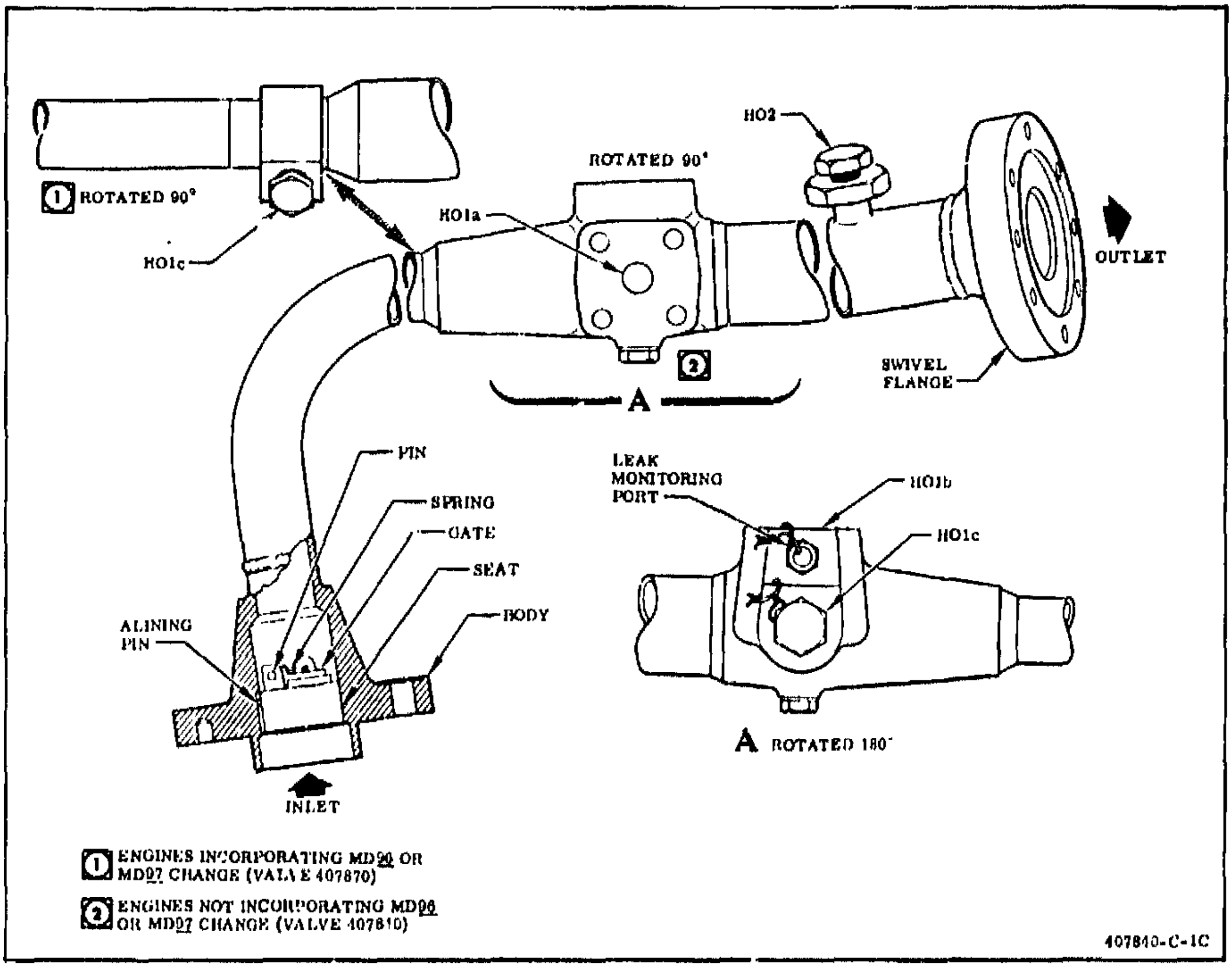


Figure 7-4. Heat Exchanger Check Valve--Cutaway View

Procedure	Result
7-13. GATE OPENING AND CLOSING TESTS.	
a. Make sure that Components Test Console is prepared for use as outlined in figure 7-3.	None.
b. Connect check valve to console for gate opening and closing tests as shown in figure 7-5.	None.
c. On FLOW/Δ P MONITOR panel, open test cell inlet SHUTOFF valve. Uncap 15ΔP DOWNSTREAM INLET fitting.	None.
d. On LOW PRESSURE panel, apply pressure to check valve as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 75 ±25 psi.	Low PRESSURE panel pressurized.
(2) Open SHUTOFF valve.	Heat exchanger check valve inlet port (A), pressurized. TEST CELL MONITOR PRESSURE gage indicates 75 ±25 psi.

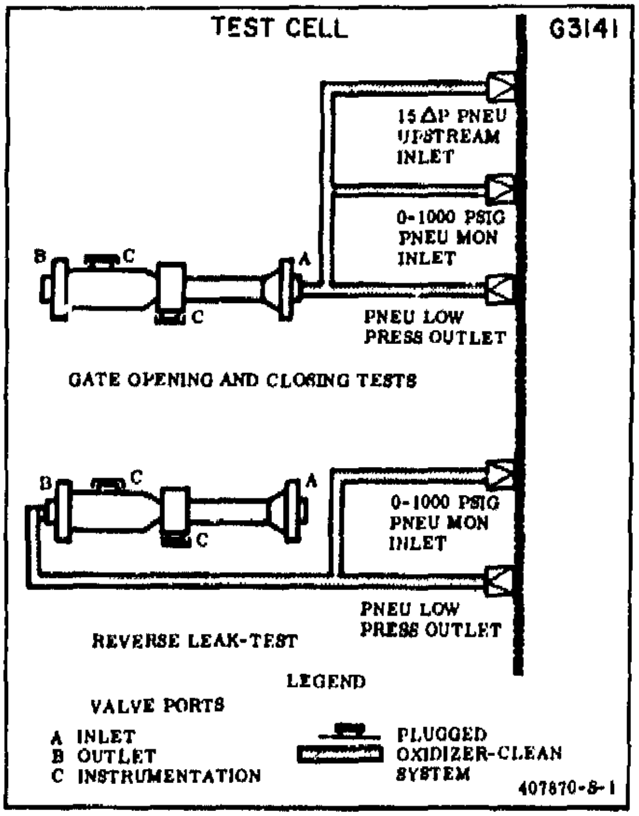


Figure 7-5. Heat Exchanger Check Valve Pneumatic Leak-Test Setups

Procedure	Result
e. Observe check valve outlet port (B).	Valve must flow freely to atmosphere.
f. On LOW PRESSURE panel, slowly decrease pressure by adjusting PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 10 psi.	Pressure to check valve inlet port (A) reduced.
g. On FLOW/Δ P MONITOR panel, open PRESSURE DIFFERENTIAL gage SHUTOFF valve.	PRESSURE DIFFERENTIAL gage indicates 10 psi.
h. On LOW PRESSURE panel, slowly adjust PRESSURE REGULATOR to reduce valve inlet pressure until valve gate closes. Observe FLOW/Δ P MONITOR panel, PRESSURE DIFFERENTIAL gage.	Check valve gate to close at 0.25 psig minimum.
i. Measure leakage at check valve outlet port (B) with Pneumatic Flow Tester G3104.	Maximum allowable leakage 100 scim.
j. On LOW PRESSURE panel, close SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Check valve inlet port depressurized. LOW PRESSURE panel depressurized.
k. On FLOW/Δ P panel, close test cell inlet SHUTOFF valve. Close PRESSURE DIFFERENTIAL gage SHUTOFF valve.	None.

l. Remove check valve from test setup. Cap 15ΔP UPSTREAM INLET and 15ΔP DOWNSTREAM INLET.

7-14. REVERSE LEAK-TESTS.

Procedure	Result
a. Make sure that Components Test Console is prepared for use as outlined in figure 7-3.	None.
b. Connect check valve to console for reverse leak-test as shown in figure 7-5.	None.
c. On FLOW/Δ P MONITOR panel, open test cell INLET SHUTOFF valve.	None.

d. On LOW PRESSURE panel, apply pressure to check valve outlet port (B) as follows:

Procedure	Result
(1) Open SHUTOFF valve.	LOW PRESSURE panel and check valve outlet port (B) pressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 15 ±1 psi.	TEST CELL MONITOR PRESSURE gage indicates 15 ±1 psi.

Procedure	Result
e. Measure valve inlet port (A) leakage with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 50 scim.
f. Repeat steps d and e at 25 ±2, 50 ±5 and 100 ±10 psig.	Maximum allowable leakage at each pressure, from check valve inlet port (A) is 50 scim.
g. On LOW PRESSURE panel, close SHUTOFF valve.	Check valve depressurized.

h. Install pressure cap on check valve inlet port (A) test fixture.

Procedure	Result
i. On LOW PRESSURE panel, open SHUTOFF valve.	Check valve pressurized to 100 ±10 psig.
j. Perform external leak-test on check valve using leak-test compound (MIL-L-25567).	No external leakage is allowable.
k. On LOW PRESSURE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decays. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Check valve depressurized. LOW PRESSURE panel depressurized.
l. On FLOW/Δ P MONITOR panel, close test cell inlet SHUTOFF valve.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

1A. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).

Procedure	Result
m. Remove check valve from test setup.	None.
n. Install protective closures. Refer to paragraph 7-2. Safetywire instrumentation port plugs with inconel lockwire MS20995N.	None.
o. If heat exchanger check valve testing is complete, secure test equipment as outlined in paragraph 7-16.	None.

7-15. SECURING TEST EQUIPMENT.

7-16. After heat exchanger check valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS SHUTOFF valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. On PRESSURE/TEMPERATURE MONITOR panel, turn CHANNEL SELECT switch to OFF.

i. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

j. Turn DC POWER SUPPLY off.

k. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION VIII

THRUST CHAMBER (INSTALLED)

8-1. THRUST CHAMBER ASSEMBLY 208101-31, 209201 THROUGH 209201-121, AND 209717-31 THROUGH 209717-921 (INSTALLED).

8-2. Special welding equipment and certified welding personnel are required to perform repairs on F-1 rocket engine thrust chamber assembly. The following paragraphs establish general requirements for equipment and outline the detail inspection and repair procedures.

8-3. GENERAL REQUIREMENTS.

8-4. WELDER CERTIFICATION. Certification of personnel entails satisfactory completion of the prescribed training on F-1 thrust chamber assembly repairs as established by Rocketdyne. Personnel repairing tubes in the F-1 thrust chamber body must be certified to weld and braze Inconel X material with a tungsten inert gas (TIG) heliarc process and an oxyacetylene torch-brazing process. Personnel welding the thrust chamber exhaust manifold must be certified to weld 347 CRES steel with a TIG heliarc process. Personnel welding the thrust chamber injector must be certified to weld copper with deoxidized copper wire, and braze copper using wire RB0170-065 (Rocketdyne) with a TIG heliarc process.

8-5. RECORDS. Records must be kept of all damage to the thrust chamber assembly. See figure 8-1 for a typical damage record form and figure 8-2 for a thrust chamber damage locator.

NOTE

Raised weld arrows located at the injector end ring, the first nozzle flat band aft of jacket, and the exit end ring identify tube number 1. Tubes number 60 and 120 are also identified in the same locations to aid in tube counting.

8-6. MATERIAL AND EQUIPMENT REQUIREMENTS. (See figures 8-3 and 8-4.)

Date ______________________ Test Number ______________________

Part Number ______________________ Serial Number ______________________

Engine Number ______________________ Inspected by ______________________

Damage Location				Description of Change
Zone	Tube	Weld Joint	Compartment	

Figure 8-1. Thrust Chamber Assembly Damage Record Form (Typical)

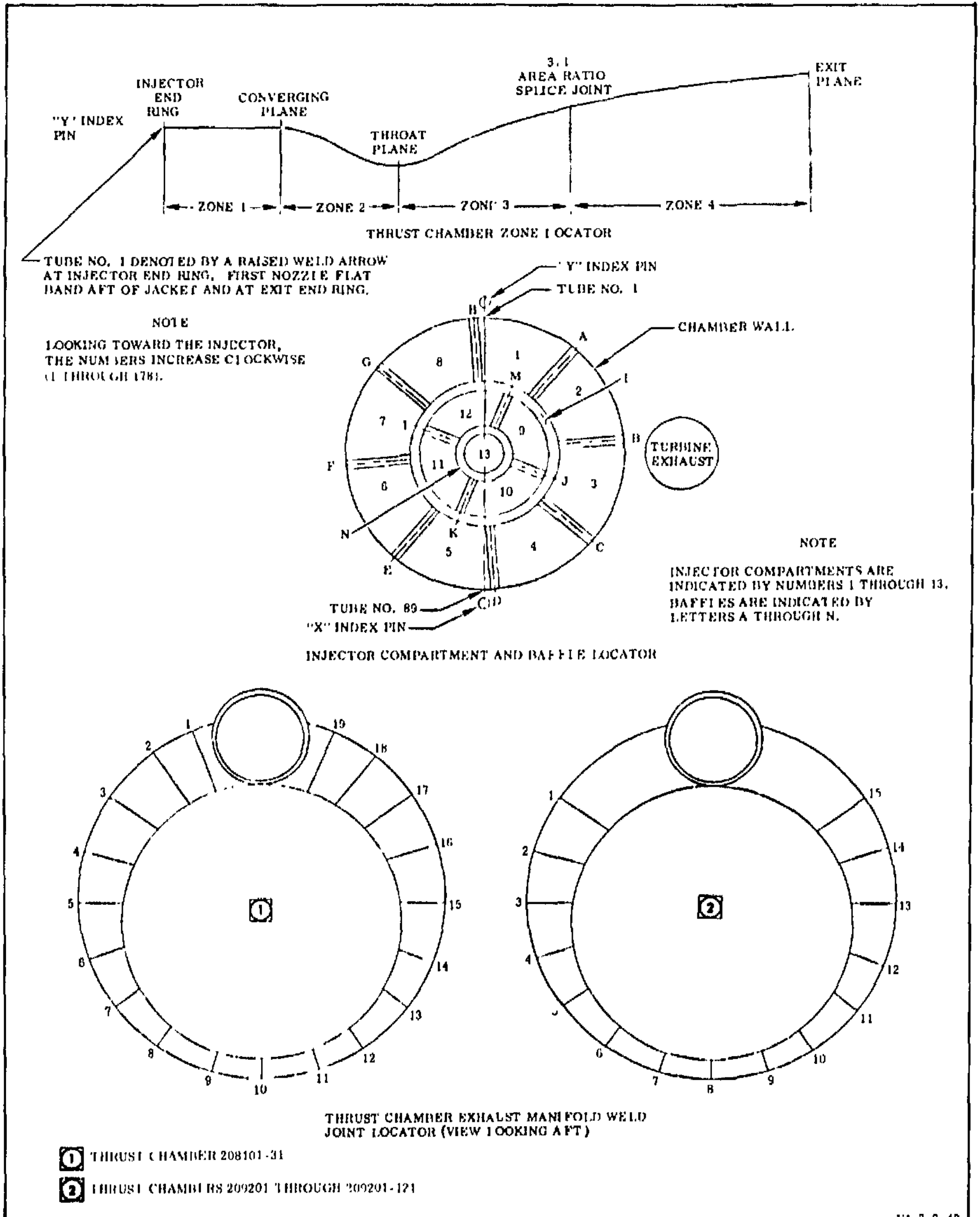


Figure 8-2. Thrust Chamber Assembly Damage Locator

MATERIALS:

Tube assembly 205223 (aged in F-1 braze cycle).

White sealant RTV-102 (General Electric).
(Order sealant in 2-ounce tubes.)

425 aluminum-foil tape (Minnesota Mining and Mfg), one-inch wide.

Emery cloth.

Clean rags.

Nicrobraz flux (Wall Colmonoy).

Trichloroethylene RB0210-003 (Rocketdyne) or trichloroethylene (MIL-T-27602).

Acid brush (commercial grade).

Gaseous nitrogen (MIL-P-27401).

Gaseous oxygen (BB-O-925).

Acetylene (BB-A-106).

Argon (MIL-A-18455).

Acetone (Federal Specification O-A-51).

Methylene chloride (commercial grade).

Helium (commercial welding grade) or 75 He-25 Argon (commercial welding grade).

Emery disks, adhesive backed, 3-inch diameter, #40 and #80 grit.

Plywood, 2 foot x 2 foot x 1/4 inch.

Polyethylene material (commercial grade).

Water dispensing bottle.

FILLER WIRES:

Part Number	Nomenclature	Size
MIL-E-21562, Type MIL-RN62	Inconel 62 Wire	0.040- or 0.045- and 1/16-inch diameter.
RB0170-064 (Rocketdyne), AWS-ASTM Specification BAU-4	Wire (Gold-Nickel)	1/32-, 3/64-, and 1/16-inch diameter.
STD1706 B0001	Deoxidized Copper Wire	1/16- and 3/32-inch diameter.
RB0170-065 (Rocketdyne)	Wire (Copper-Gold-Nickel)	1/32-, 3/64-, and 1/16-inch diameter.
Hastelloy W	Wire	0.040-, 0.045-, and 1/16-inch diameter.
MIL-R-5031	Wire, Type 347 CRES (Corrosion resistant steel)	0.040-, 0.045-, and 1/16-inch diameter.

Figure 8-3. Material Requirements for Thrust Chamber Assembly

WELDING EQUIPMENT.

Model	Part Number	Nomenclature	Size
HW-9[a]	66X44	Heliarc Torch (air-cooled; with 25-foot service cable)	
	84Z35	Electrode Collet	0.040-inch diameter
	45V42	Gas Lens Collet Body	0.040-inch diameter
	84Z33	Electrode Collet	1/16-inch diameter
	45V43	Gas Lens Collet Body	1/16-inch diameter
	53N58	Gas Lens High-Impact Cup	No. 4
	53N59	Gas Lens High-Impact Cup	No. 5
	53N60	Gas Lens High-Impact Cup	No. 6
	45V52	Adapter (for HW-9)	
	53N85	Insulator (for HW-9)	
HW-18[a]	41V31	Heliarc Torch (water-cooled; with 25-foot service cable)	
	10N23	Electrode Collet	1/16-inch diameter
	45V25	Gas Lens Collet Body	1/16-inch diameter
	10N24	Electrode Collet	3/32-inch diameter
	45V26	Gas Lens Collet Body	3/32-inch diameter
	10N25	Electrode Collet	1/8-inch diameter
	45V27	Gas Lens Collet Body	1/8-inch diameter
	45V28	Gas Lens Collet Body	5/32-inch diameter
	54N20	Electrode Collet	5/32-inch diameter
	54N01	Insulator (for HW-18)	1/8-inch diameter
	54N18	High-Impact Gas Cup	No. 4
	54N17	High-Impact Gas Cup	No. 5
	54N16	High-Impact Gas Cup	No. 6
	54N15	High-Impact Gas Cup	No. 7
	54N14	High-Impact Gas Cup	No. 8
HW-20[a]	41V[illegible]	Heliarc Torch (water-cooled; with 25-foot service cable)	
	13N21	Electrode Collet	0.040-inch diameter
	13N26	Electrode Collet Body	0.040-inch diameter
	13N22	Electrode Collet	1/16-inch diameter
	13N27	Electrode Collet Body	1/16-inch diameter
	13N23	Electrode Collet	3/32-inch diameter
	13N28	Electrode Collet Body	3/32-inch diameter
	13N24	Electrode Collet	1/8-inch diameter
	13N29	Electrode Collet Body	1/8-inch diameter
	13N08	High-Impact Gas Cup	No. 4
	13N09	High-Impact Gas Cup	No. 5
	13N10	High-Impact Gas Cup	No. 6
	13N11	High-Impact Gas Cup	No. 7
	13N12	High-Impact Gas Cup	No. 8
	13N13	High-Impact Gas Cup	No. 10
	40V67	Fuse and Hose Assembly (for HW-20)	

(a) Union Carbide Corp. Linde Division (Equivalent equipment may be used.)

Figure 8-4. Equipment Requirements for Thrust Chamber Assembly (Sheet 1 of 2)

WELDING EQUIPMENT: (continued)

Model	Part Number	Nomenclature	Size
	84Z18	Tungsten 2% Thoriated Electrodes	0.040-inch diameter
	84Z19	Tungsten 2% Thoriated Electrodes	1/16-inch diameter
	84Z20	Tungsten 2% Thoriated Electrodes	3/32-inch diameter
	81Z79	Tungsten 2% Thoriated Electrodes	1/8-inch diameter
	81Z80	Tungsten 2% Thoriated Electrodes	5/32-inch diameter
	None	Pressure gages for measuring argon gas during welding and purging	
R-502(a)	04X34	Regulator Flowmeter for argon	
R-503(a)	04X35	Regulator Flowmeter for helium	
DCR-400 HSGW(b)		P & H Power Supply Tungsten Inert Gas Arc Welding Unit (with high-frequency start and capable of operating at a minimum of 4 amperes)	400 amps
FRS-6(b)		Foot-operated remote current and contactor control	
40HP(b)		Hydromount (water supply)	

BRAZING EQUIPMENT:

Oxyacetylene equipment with 2-stage oxygen and acetylene regulators; light aircraft torch; complete set of tips (000 to 5); hose (red and green fused, minimum length of 50 feet); tip cleaners; and igniters

TOOLS:

T-5044956 Check Fixture (to check injector baffle bulges)
T-5047802 Flange Polishing Tool (to rework thrust chamber exhaust manifold inlet flange)
Straightedge, 3 foot long
Feeler gage set
Mini-Grinder (Buckeye Tool Corp)
A9 grinding wheel discs (Craytes Mfg)
Fine wire stainless-steel manual and rotary brushes
Wire cutters and pliers
Hand files (mill and Swiss)

(a) Union Carbide Corp, Linde Division (Equivalent equipment may be used.)
(b) Harnischfeger Corp (Equivalent equipment may be used.)

Figure 8-4. Equipment Requirements for Thrust Chamber Assembly (Sheet 2 of 2)

8-7. SAFETY REQUIREMENTS. All safety requirements in force at the using organization must be strictly observed. In addition, the following minimum safety precautions must be followed:

a. The man lift, if employed, must be capable of operation from the work platform or from ground level.

b. Breathing apparatus must be worn when entering the thrust chamber.

c. The buddy system must be used when personnel enter the thrust chamber. The standby personnel must be qualified in test stand operation, operation of the breathing apparatus, and operation of the lift equipment. The standby personnel must always remain in line-of-sight of the person in the thrust chamber.

d. Isolate the thrust chamber assembly in such a manner that inadvertent pressurant or propellant admission is impossible.

e. Flush and purge the thrust chamber prior to initiating any effort employing a spark-producing device.

f. Make sure that the welders work platform is held rigid during the welding operation.

g. Make sure that other work in the immediate area will not introduce combustibles into the thrust chamber.

8-8. CLEANING.

WARNING

The following procedure uses trichloroethylene, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or loss of life.

a. Flush inside of thrust chamber tubes with trichloroethylene RB0210-003 (Rocketdyne) or trichloroethylene (MIL-T-27602).

b. Clean outside or repair area (a minimum of 3 inches on tubes and 2 inches on the exhaust manifold from all weld points) with a fine steel wire brush.

WARNING

The following procedure uses acetone, which is extremely flammable and must not be used near sparks, heat, or any source of flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or loss of life.

c. Wipe area cleaned in step b with a cloth moistened with acetone (Federal Specification O-A-51).

d. Remove any visible braze alloy from immediate weld area with emery cloth and wire brush and from between tubes as far as practical. Braze alloy should be removed a minimum of 1/4 inch from area to be welded.

e. Make sure that surface to be repaired is free of oxidize discoloration and dry prior to welding.

8-9. WIND SHIELDING. Prevent deflection of torch gases by positioning protective shields around the weld area, as necessary, to deflect gusts of wind. Reposition the protective shields, as required, during the repairs.

8-10. LIGHTING. Illuminate the repair area with suitable lighting equipment that is adjustable and mounted so as not to require holding by personnel.

8-11. BRAZING AND WELDING BACKUP GAS REQUIREMENTS. Purge the thrust chamber tubes through a return manifold drain screw port with gaseous nitrogen (MIL-P-27401) at 290-325 psig for 15 minutes and then with argon (MIL-A-18455) at 90-125 cubic feet/hour for 15 minutes prior to beginning a crack repair of a tube or after a patch is in position ready for tacking and welding. At the conclusion of repair procedures, the oxidizer dome must be decontaminated by flushing the dome as outlined in R-3896-11.

WARNING

Contamination of the oxidizer dome can cause an explosion resulting in serious injury to personnel and damage to equipment.

NOTE

If two drain screw ports are used for the purge, the purge time can be reduced by one-half.

8-12. INSPECTING.

8-13. Visual inspections and leak-tests are performed on the thrust chamber assembly to locate defects. Visual inspection detects large defects that must be repaired before performing leak-tests. Leak-tests as outlined in R-3896-11 detect small defects and determine that previous repairs do not leak. See figure 8-5 for disposition of defects.

Condition	Description	Disposition
Dome, injector, or thrust chamber instrumentation prefill, drain, or purge boss weld cracks.		Weld as outlined in paragraph 8-17.
<u>Injector</u>		
Baffle separation.		Notify manufacturer's representative.
Baffle deformation.	Deformation less than 0.250 inch.	Acceptable.
	Deformation greater than 0.250 inch.	Acceptability and repair requirements to be specified by manufacturer's representative.
Baffle bulges.	Bulges with no leakage and up to and including 0.100 inch in height, as measured with check fixture T-5044956.	Acceptable.
	Leakage resulting from holes or cracks. Maximum width of crack or hole not exceeding 3/16 inch at intersection with coolant passage.	Repair as outlined in paragraph 8-31.
	Defects larger than listed above.	Acceptability and repair requirements to be specified by manufacturer's representative.
Distortion and minor cracks in baffle orifices.		Acceptable.
Distortion of ring orifices.		Acceptable.
Cracks in baffle-to-baffle braze joints.		Repair as outlined in paragraph 8-32.
Cracks in baffle-to-baffle braze joint nuggets.	Cracks that are included in material of TIG brazed nuggets.	Repair as outlined in paragraph 8-32.

Figure 8-5. Thrust Chamber Assembly Damage Limits (Sheet 1 of 5)

Condition	Description	Disposition
Injector (cont)		
Incipient cracks or separations at edges of baffle-to-baffle braze joint nuggets.	A cracked appearance at edges of radial-to-circumferential baffle TIG braze nuggets (where nuggets meet parent metal of baffle system).	Acceptable.
Injector face and baffle erosion.		Acceptability and repair requirements to be specified by manufacturer's representative.
Injector body bowing.	Inspection as outlined in paragraph 8-36 indicates difference between surfaces of inner dome bolt pads and outer dome bolt flange to be 0.030 inch or less.	Acceptable. May be reinstalled in thrust chamber.
	Inspection as outlined in paragraph 8-36 indicates difference between surfaces of inner dome bolt pads and outer dome bolt flange to be greater than 0.030 inch.	Unacceptable. Repair requirements to be specified by manufacturer's representative.
	Inspection as outlined in paragraph 8-36 indicates difference between surfaces of inner dome bolt pads and outer dome bolt flange to be greater than height of inner dome bolt pads.	Unacceptable. Injector must not be reworked: it must be replaced by another unit.
Injector propellant passage for orifice contamination or obstruction.	After each test, systematically check for foreign material. Visually inspect ring through orifices to groove behind. Check each ring in each injector compartment in numerical order. (See figure 8-2.) Visually inspect baffles at trailing edge and into each orifice in alphabetical order. (See figure 8-2.)	Remove foreign material.
Injector to thrust chamber O-ring seal extruding.		No extrusion acceptable. Replace O-ring seal. (Refer to section IX.)
Thrust Chamber Body		
Thrust chamber tube dents (internal).	Dents less than 0.075 inch in depth and less than 12 inches in length.	Acceptable.
	Dents exceeding 0.075 inch in depth or 12 inches in length.	Install a butt patch (paragraph 8-25).

Figure 8-5. Thrust Chamber Assembly Damage Limits (Sheet 2 of 5)

Condition	Description	Disposition
Thrust Chamber Body (cont)		
Thrust chamber tube dents (external).	Dents less than 0.150 inch in depth.	Acceptable.
	Dents exceeding 0.150 inch but less than 0.250 inch in depth.	TIG braze to reinforce area as outlined in paragraph 8-18.
	Dents exceeding 0.250 inch in depth	Acceptability and repair requirements to be specified by manufacturer's representative.
Thrust chamber tube crown burning.	Burned areas greater than 0.005 inch in depth by 3/16 inch in width by 5 inches in length.	Install a butt patch (paragraph 8-25) or a modified butt patch (paragraph 8-26), as applicable.
Thrust chamber tube nicks and scratches.	Nicks and scratches exceeding 0.005 inch in depth by 0.010 inch in width by 5 inches in length.	Install a butt patch (paragraph 8-25) or a modified butt patch (paragraph 8-26), as applicable.
Thrust chamber tube nickel plating peeling.		Record damage in engine logbook.
Thrust chamber tube internal leakage.	Leakage within 6 inches of injector face.	Install a butt patch (paragraph 8-25) or a modified butt patch (paragraph 8-26), as applicable.
	Longitudinal cracks.	Weld as outlined in paragraph 8-17.
	Transverse crack less than 1/2 inch in length, within 1/4 inch of the tube centerline, and more than one inch from another crack on the same tube.	Seal with either white sealant RTV-102 (General Electric) or 425 aluminum-foil tape (Minnesota Mining and Mfg) (paragraph 8-18A).
	Transverse crack exceeding above limits in length.	Weld as outlined in paragraph 8-17.
	More than one crack within one inch of tube length.	Repair as outlined in paragraph 8-25.
	Braze joint leakage at injector end of tube joints.	TIG braze as outlined in paragraph 8-18.
Braze joint leakage at exit end ring of tube joint.	Seepage of test fluid not breaking from wall.	Seal with either white sealant RTV-102 (General Electric) or 425 aluminum-foil tape (Minnesota Mining and Mfg) (paragraph 8-18A).
	Seepage of test fluid breaking from wall.	TIG or torch braze as outlined in paragraph 8-22.
Braze joint leakage at 3:1 expansion ratio plane splice joint.	Seepage of test fluid not breaking from wall.	Seal with either white sealant RTV-102 (General Electric) or 425 aluminum-foil tape (Minnesota Mining and Mfg) (paragraph 8-18A).

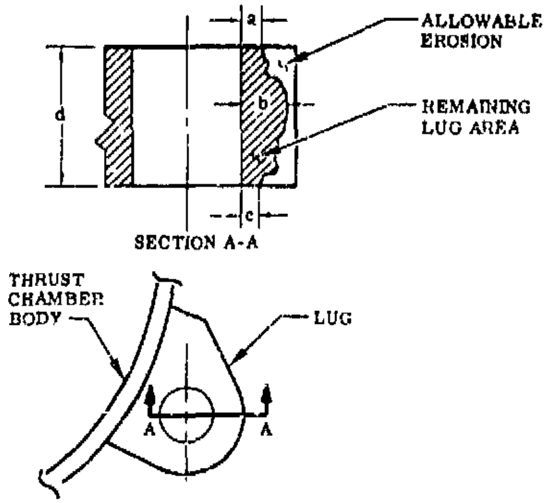
Figure 8-5. Thrust Chamber Assembly Damage Limits (Sheet 3 of 5)

Condition	Description	Disposition
Thrust Chamber Body (cont)		
	Seepage of test fluid breaking from wall.	TIG braze as outlined in paragraph 8-19.
Thrust chamber tube external leakage.	Test fluid seepage under nozzle bands.	Install an insert patch as outlined in paragraph 8-27.
	Test fluid leakage under flame shield.	Install an insert patch as outlined in paragraph 8-27.
Thrust chamber tube pinholes (internal).		
(1) Kennedy Space Center (KSC).	Pinholes through tube wall not closer than 1/8 inch from braze alloy.	Repair by sealing pinholes with either white sealant RTV-102 (General Electric) or 425 aluminum-foil tape (Minnesota Mining and Mfg) (paragraph 8-18A).
	Pinholes through tube wall covered by or within 1/8 inch of braze alloy.	
(2) Pre-static test firing.	Pinholes through tube wall not closer than 1/8 inch from braze alloy.	Acceptability and repair requirements to be specified by manufacturer's representative.
	Pinholes through tube wall covered by or within 1/8 inch of braze alloy.	
(3) Conditions other than KSC or pre-static test firing.	Pinholes through tube wall not closer than 1/8 inch from braze alloy.	Repair as outlined in paragraph 8-17.
	Pinholes through tube wall covered by or within 1/8 inch of braze alloy.	Repair as outlined in paragraph 8-21.
Thrust chamber tube pinholes (external).	Pinholes through tube wall not closer than 1/8 inch from braze alloy.	Repair as outlined in paragraph 8-17.
	Pinholes through tube wall covered by or within 1/8 inch of braze alloy.	Repair as outlined in paragraph 8-21.
Tube split or gate failure in primary upflow tube in vicinity of splice joint at fuel manifold.	Inspection through tube window at injector end ring reveals blown back wall of tube within end ring cavity.	Repair as outlined in paragraph 8-27A or 8-27B.
Braze washout between tubes.		Acceptability and repair requirements to be specified by manufacturer's representative.
Tube-to-tube joint hot-gas leakage.	Combustion gas leakage between tubes, with or without black streaks on outside of thrust chamber.	Repair as outlined in paragraph 8-20.
Defects in welds or in parent material of thrust chamber assembly structure.		Acceptability and repair requirements to be specified by manufacturer's representative.

Figure 8-5. Thrust Chamber Assembly Damage Limits (Sheet 4 of 5)

Condition	Description	Disposition
Thrust Chamber Body (cont)		
Weld failure and cracks in tension band.		Acceptability and repair requirements to be specified by manufacturer's representative.
Deformation to thrust chamber nozzle extension mating flange at 10:1 expansion ratio plane.		Acceptability and repair requirements to be specified by manufacturer's representative.
Deformation of horizontal tension ties between inlet of turbine exhaust manifold and thrust chamber body.	Less than 2 inches above or below horizontal plane.	Acceptable.
	Greater than 2 inches above or below horizontal plane.	Acceptability and repair requirements to be specified by manufacturer's representative.
Erosion of exit end attach lugs. (See figure 8-5A to determine lug area.)	Remaining area of lug equals 0.028 square inch or larger.	Acceptable.
	Remaining area of lug equals less than 0.028 square inch.	Replace lug prior to attaching Turbine Exhaust Exit Pressure Check Fixture G3144.
Damage to thermal insulation mounting studs, brackets, and insulators.	Broken, bent, distorted, missing, or other damage that requires repair of studs, brackets, and insulators.	Refer to R-3896-6 for repair of studs, brackets, and insulators.
Drain adapter leakage on thrust chambers 209201-91 through 209201-121.	Leakage resulting from cracked or defective drain adapter weld.	Acceptability and repair requirements to be specified by manufacturer's representative.
Exhaust Manifold		
Exhaust manifold deformation.	Thermal distortion due to normal hot firing.	Acceptable.
Mechanical deformation due to improper handling.		Acceptability and repair requirements to be specified by manufacturer's representative.
Leakage at exhaust manifold-to-heat exchanger joint as a result of exhaust manifold inlet flange deformation.		Rework inlet flange as outlined in paragraph 8-27C.
Disassembled joint shows significant carbon deposits past primary seal (normally found on heat exchanger side of seal).		

Figure 8-5. Thrust Chamber Assembly Damage Limits (Sheet 5 of 5)



1. MEASURE DIMENSIONS a, b, c, and d. DIMENSIONS MUST BE TAKEN AT MAXIMUM ERODED AREA (i.e., TO OBTAIN MINIMUM REMAINING CROSS SECTION).
2. CALCULATE REMAINING LUG AREA USING FORMULA:

$$\left(\frac{a + 2b + c}{2}\right)\frac{d}{2} = \text{LUG AREA.}$$

3. REMAINING LUG AREA MUST BE 0.028 SQUARE INCH OR LARGER

209202-E-3

Figure 8-5A. Determining Area of Thrust Chamber Lugs

8-14. VISUAL INSPECTION. Record all damage on the thrust chamber assembly damage record form (figure 8-1). Use the thrust chamber assembly damage locator (figure 8-2) when defining area of thrust chamber damage. See figure 8-6 for typical types of baffle deformation and figure 8-7 for typical types of tube damage.

a. Inspect injector for the following types of damage:

(1) Baffle for separation.

(2) Baffle for deformation.

(3) Injector face and baffles for erosion.

(4) Orifices for contamination and obstructions.

(5) Orifices for ring cracks between orifices.

(6) Ring-to-land for separation.

b. Inspect thrust chamber body for the following types of damage:

(1) Tubes for dents, nicks, scratches, cracks, peeling of nickel plating, crown burning, and pinholes.

(2) Tension bands for external weld failures and cracks.

(3) Fuel return manifold braze joints for internal failures.

(4) Tubes for braze washout between tubes.

(5) Exhaust manifold for cracks, dents, and deformation.

(6) Thrust chamber nozzle extension mating flange for deformation.

(7) Injector end ring and exit end ring for braze joint failure.

(8) Splice joint failure.

c. Inspect the oxidizer dome, thrust chamber, and injector instrumentation, prefill, drain, and purge bosses for cracked welds.

d. Inspect the general engine structure for defects in welds or in the parent material.

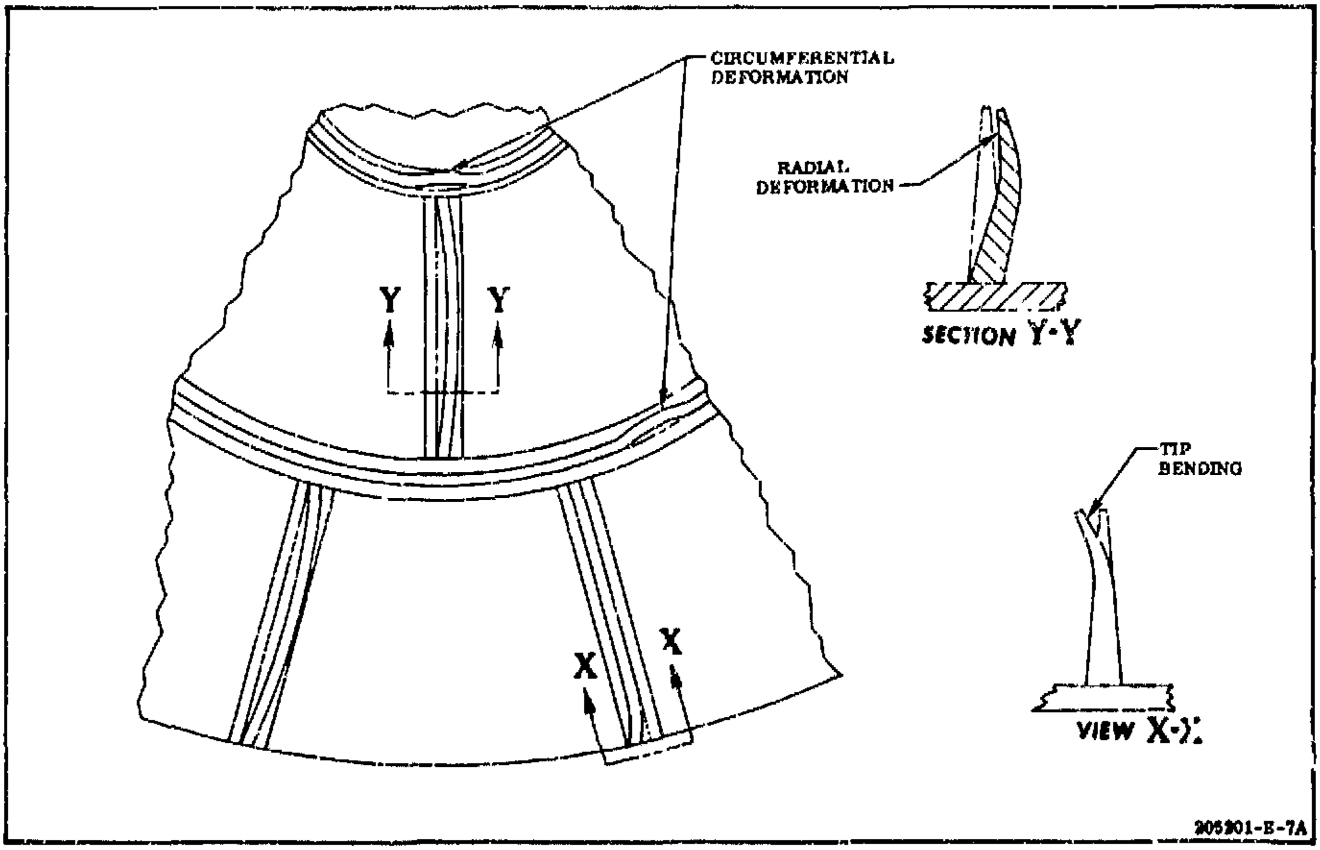


Figure 8-6. Thrust Chamber Injector Baffle Deformation (Typical)

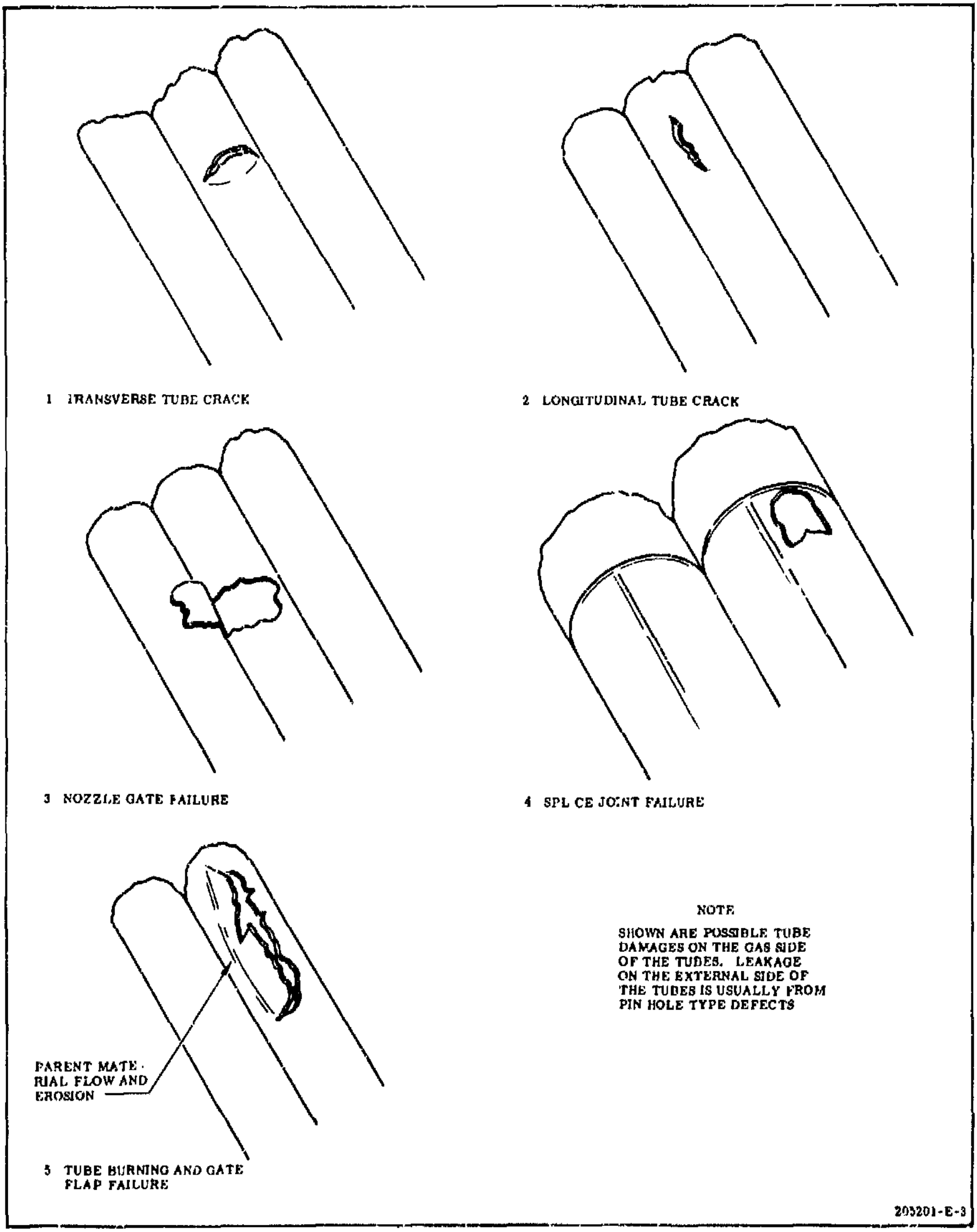


Figure 8-7. Thrust Chamber Tube Damage (Typical)

8-15. THRUST CHAMBER BODY REPAIRS.

8-16. Specific type of repair required for each defect must be determined either by the repair designated in figure 8-5 or as recommended by the manufacturer's representative.

8-17. WELDING. All welding on the thrust chamber utilizes the TIG heliarc welding process with an argon gas backup. Inconel X tube repairs are welded using Inconel 62 wire while repairs on the 347 CRES thrust chamber exhaust manifold are made with type 347 stainless steel filler rod or Hastelloy W filler rod. All welds must be accomplished by a single pass operation, unless otherwise specified below, using a minimum heat while maintaining 100-percent weld penetration. Whenever possible, the weld must extend 1/8 to 1/4 inch beyond the end of the defect. All welds must be dye penetrant inspected. No cracks are acceptable.

CAUTION

Do not weld into a braze fillet, since a porous bond will be produced.

8-18. BRAZING. Repair brazing on the thrust chamber tubes utilizes either the tungsten inert gas process or the oxyacetylene process, as specified. All brazing must be done with an argon gas backup, in accordance with paragraph 8-11. All thrust chamber brazing must be done with wire RBC170-064 (Rocketdyne), as specified. When both welding and brazing are required, always braze into the weld. After completing repair of the thrust chamber or oxidizer dome, the oxidizer dome must be flushed as outlined in R-3896-11.

8-18A. REPAIRING MINOR LEAKS. Repair minor leaks inside thrust chamber with either white sealant RTV-102 (General Electric) or 425 aluminum-foil tape (Minnesota Mining and Mfg) as follows:

a. Using a fine, stainless-steel brush, clean surface at leak location and several inches of surrounding area to remove all loose carbon and foreign residue.

NOTE

Nickel plate must not be removed from tube surface by excessive abrasion.

WARNING

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

b. Wipe leak location and surrounding area with a cloth moistened with trichloroethylene (MIL-T-27602). Allow area to dry.

c. Apply either white sealant RTV-102 (General Electric) or 425 aluminum-foil tape (Minnesota Mining and Mfg) to leak location and surrounding area as follows:

(1) Apply white sealant directly from tube to leak location; then spread sealant over surrounding area until smooth. The sealant should be approximately 1/8 inch thick at the leak location and tapered into the surrounding area.

(2) If aluminum foil tape is to be applied instead of white sealant, apply tape to leak location and surrounding area. Press tape firmly in place to provide a good bond between metal surface and tape.

8-19. REPAIRING CRACKS. The degree of damage resulting from the crack determines the type of repair required. If damage is extensive and requires a patch, proceed to paragraphs 8-25 and 8-26, as applicable. If the crack requires only welding, proceed as follows:

a. Using a mini-grinder, groove crack so it is readily visible.

WARNING

The following procedure uses acetone, which is extremely flammable and must not be used near sparks, heat, or any source of flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

b. Clean around crack with acetone (Federal Specification O-A-51); then dry repaired area.

c. Weld crack using process outlined in paragraph 8-17. Weld longitudinal cracks in a single pass. Use two passes on a transverse crack. Start at one end of the crack and make a pass, stopping at the crown of the tube. Repeat the process, starting at the other end of the crack.

d. If a crack extends into a braze fillet, TIG braze as outlined in paragraph 8-18.

e. Perform dye penetrant inspection on the weld as outlined in R-3896-3, Volume I. No cracks are allowable.

NOTE

If cracks are discovered during the inspection, repeat this procedure one time only. No more than two weld passes shall be made on a transverse crack or three passes on a longitudinal crack, or it will be necessary to remove the welds and install a patch.

f. Flush oxidizer dome as outlined in R-3896-11, at completion of thrust chamber tube repair or oxidizer dome repair.

8-20. TUBE-TO-TUBE REPAIRS. Repairs to eliminate hot-gas leakage must be accomplished as follows:

WARNING

The following procedure uses methylene chloride, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

a. Using a fine, stainless steel brush, clean joint at leak location and several inches of surrounding area to remove all loose carbon and foreign residue.

NOTE

Do not remove nickel plate from tube surface by excessive abrasion.

b. Using a clean acid brush, wash wire brushed area with methylene chloride (commercial grade).

c. Apply a small quantity of Nicrobraz flux (Wall Colmonoy) to a clean, fine, stainless-steel brush. Scrub joint area, flush with hot water, air-dry, and inspect for cleanness.

d. Apply a thin coat of Nicrobraz flux (Wall Colmonoy) to joint area and surrounding heat-affected zone.

e. Apply a thin coat of Nicrobraz flux (Wall Colmonoy) to a 1/32-inch diameter brazing alloy filler wire RB0170-064 (Rocketdyne).

f. Using a size 000 tip, adjust torch to produce a neutral flame of size and shape to properly melt and flow brazing alloy without damaging tube wall.

g. Place torch tip into joint until it contacts and is guided by tube side walls during brazing.

h. Insert flux-coated brazing alloy wire into joint, starting repair not less than 2 inches from leak location, and extending repair fillet at least 2 inches beyond leak location or as far as necessary to seal leak. When leak location is within 3 inches of injector ring, extend repair fillet to injector end ring.

i. Allow repair to air-cool until cool to touch. Using hot water and a fine, stainless-steel brush, remove flux residue from joint and surrounding area.

j. After all flux residue has been removed from repaired area, flush with hot running tap water and air-dry.

k. If leakage persists, repeat steps c through j.

8-21. OXYACETYLENE BRAZE PINHOLE REPAIRS. Repairs to eliminate fuel leakage must be accomplished as follows:

WARNING

The following procedure uses methylene chloride, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

a. Using a fine, stainless-steel brush, clean tube surface at leak location and several inches of surrounding area to remove all loose carbon and foreign residue.

NOTE

Do not remove nickel plate from tube surface by excessive abrasion.

b. Remove oxide or foreign residue from surrounding area with emery cloth until surface appears bright and clean.

c. Using a clean acid brush, wash polished area with methylene chloride (commercial grade).

d. Apply a small quantity of Nicrobraz flux (Wall Colmonoy), to a clean, fine, stainless-steel brush. Scrub area around pinhole, flush with hot water, air-dry, and inspect for cleanness.

e. Apply a thin coat of Nicrobraz flux (Wall Colmonoy) to leak location and surrounding heat-affected zone.

f. Apply a thin coat of Nicrobraz flux (Wall Colmonoy) to a 1/32-inch diameter brazing alloy filler wire RB0170-064 (Rocketdyne).

g. Using a size 000 tip, adjust torch to produce a neutral flame of size and shape to properly melt and flow brazing alloy without damaging wall.

h. Heat area surrounding leak until brazing alloy flows into pinhole and over surrounding tube surface.

i. Allow repair to air-cool until cool to touch. Using hot water and a fine, stainless-steel brush, remove flux residue from tube.

j. After all flux residue has been removed from repaired areas, flush with hot running tap water and air-dry.

8-22. TUBE-TO-EXIT END RING REPAIRS. Repairs to eliminate fuel leakage inside thrust chamber at tube-to-exit end ring (figure 8-8) must be accomplished as outlined in paragraph 8-23 to 8-24 and as follows:

WARNING

The following procedure uses methylene chloride, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

a. Using a fine, stainless-steel brush, clean joint at leak location and several inches of surrounding area to remove all loose carbon and foreign residue.

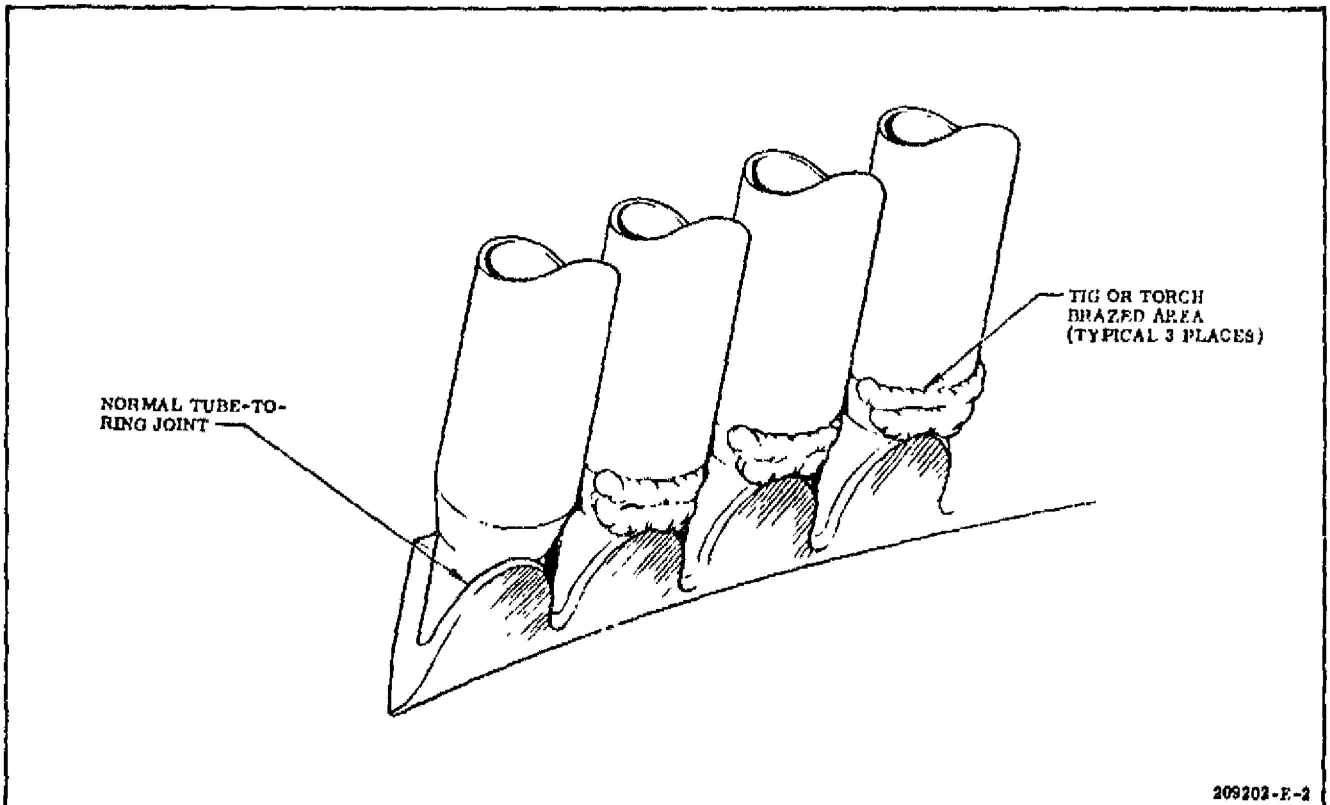


Figure 8-8. Tube-To-Exit End Ring Braze Fillet

NOTE

Do not remove nickel plate from tube surface by excessive abrasion.

b. Using a clean acid brush, wash joint area with methylene chloride (commercial grade).

c. Remove remaining surface contamination, using a fine, stainless steel, rotary brush. Repeat steps a and b. Prepared joint area must be bright and clean before continuing.

d. Apply a small quantity of Nicrobraz flux (Wall Colmonoy) to a clean, fine, stainless-steel brush. Scrub area around leak, flush with hot water, air-dry, and inspect for cleanness.

e. Torch braze or TIG braze as outlined in paragraph 8-23 or 8-24.

8-23. TUBE-TO-EXIT END RING OXY-ACETYLENE TORCH BRAZING.

a. Apply a thin coat of Nicrobraz flux (Wall Colmonoy) to leak location and surrounding heat-affected zone.

b. Apply a coat of Nicrobraz flux (Wall Colmonoy) to several inches of the end of a 1/16-inch diameter brazing alloy filler wire RB0170-064 (Rocketdyne).

c. Using a size 0 tip, adjust torch to produce a low-velocity neutral flame, with inner cone approximately 1/8-inch long. Proper adjustment of flame applies sufficient heat to tube surface and forward end of exit ring to melt and flow brazing alloy without damaging tube wall.

d. Heat surface of exit end ring below leak until flux becomes fluid. Maintain ring surface at dull red heat while concentrating heat along chamfered forward edge of ring and tube surface just above ring.

e. Add flux to ring and tube surface, using end of brazing alloy filler wire as an applicator to maintain good flux cover during brazing.

f. Touch flux-coated tip of brazing alloy filler wire to tube surface just above forward edge of ring. Repeat at rapid intervals until melting and flow of filler wire is observed.

g. Apply alloy in small amounts, flowing each amount deposited each time into tube-to-ring opening.

h. Continue applying alloy around tube-to-ring opening until opening is sealed and a full fillet is generated, as shown in figure 8-8.

i. Allow repair to air-cool to less than 200° F.

j. Remove residual flux with hot water and a fine, stainless-steel brush. Air-dry; then visually inspect for defects using magnification up to 20X.

8-24. TUBE-TO-EXIT END RING TIG BRAZING.

a. TIG braze per applicable portion of paragraph 8-18.

b. Continue alloy application around tube-to-ring opening until full fillet is generated, as shown in figure 8-8.

8-25. INSTALLING BUTT PATCH. A butt patch (figure 8-9) is used when there is no joining of a weld to a braze fillet. Only welding is required on a butt patch.

WARNING

The following procedure uses acetone, which 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.

a. Using a mini-grinder, remove defective section of tubing in an oval shape.

CAUTION

Edges must be filed square, not chamfered.

b. Using a file, remove burs from edges of tube opening.

c. Clean area inside tube with emery cloth and acetone (Federal Specification O-A-51); then dry repair area.

d. Fabricate a patch, the same size and configuration as tube opening, from a piece of tube 205233.

e. Tack two 0.040-inch Inconel 62 wires (approximately 4 inches long) to patch. Position wires approximately 1/4 inch from ends of patch and twist wires together to form a handle.

f. Blend edges of patch to tube opening, maintaining a 0.010- to 0.020-inch gap between patch and sides of opening.

g. Hold patch in position in tube opening and tack it in place using the tack sequence illustrated in figure 8-9. Use a wedge-shaped stainless-steel tool (1/16 x 1/2 inch) to form contour of patch while tacks are being made.

CAUTION

The base metal in the tube must not be ground. The wires may project slightly.

h. Using a mini-grinder, remove installation wire from patch.

hA. Use a high-volume, low-pressure, argon gas purge as backup during weld repair.

i. Weld patch using process outlined in paragraph 8-17 and sequence outlined in figure 8-9.

NOTE

During weld repair, a minimum amount of heat must be used, maintaining 100-percent weld penetration.

j. After each weld pass, check for and remove, if required, cold laps and pinholes.

k. Perform dye-penetrant inspection on weld as outlined in R-3896-3, Volume I. No cracks are allowable.

l. Re-weld cracks found during dye penetrant inspection.

m. If more than 3 passes are required to weld a crack, remove patch and install a new patch. The procedure must then be repeated.

n. Flush oxidizer dome as outlined in R-3896-11, at completion of thrust chamber tube repair or oxidizer dome repair.

8-26. INSTALLING MODIFIED BUTT PATCH. The modified butt patch (figure 8-10) is used to repair a tube defect that is not repairable with an ordinary butt patch. Both welding and brazing techniques are required on the modified butt patch.

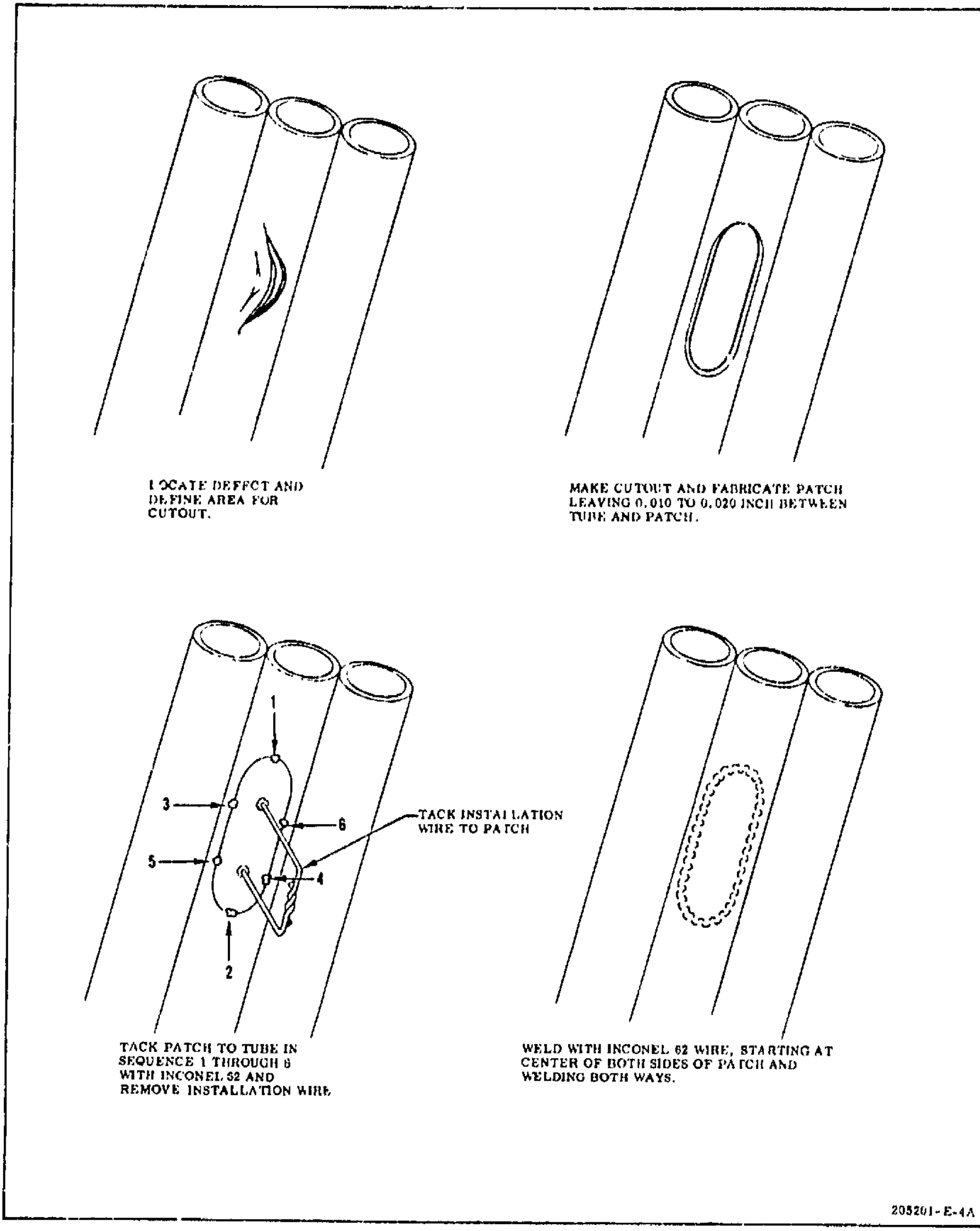


Figure 8-9. Installing Thrust Chamber Butt Patch

a. Remove defective section of tube, cutting the side between tubes straight and the remaining sides oval.

CAUTION

Edges must be filed square, not chamfered.

b. Using a file, remove burs from edges of tube opening.

c. Using emery cloth and a wire brush, remove furnace braze alloy from tube for a distance of 1/8 inch from edge around opening.

d. Using TIG-heliarc brazing process and brazing alloy RB0170-064 (Rocketdyne), build a layer of alloy between tubes and extend alloy 1/4 inch up from fillet and 1/4 inch beyond ends of tube opening.

NOTE

Two or three weld passes may be required to complete the alloy buildup.

e. Using a mini-grinder, remove excessive braze alloy from inside of tube and remove cold laps and pinholes, if required.

f. Fabricate a patch, same size and configuration as tube opening, from a piece of tube 205233.

g. Tack two 0.040-inch Inconel 62 wires (approximately 4 inches long) to patch. Position wires approximately 1/4 inch from ends of patch and twist wires together to form a handle.

h. Blend edges of patch to tube opening, maintaining a 0.010- to 0.020-inch gap between patch and sides of opening.

i. Hold patch in position in tube opening and tack it in place using tack sequence illustrated in figure 8-10. Use a wedged-shape stainless-steel tool (1/16 x 1/2 inch) to form contour of patch while tacks are being made.

CAUTION

The base metal in the tube must not be ground. The wires may project slightly.

j. Using a mini-grinder, remove installation wire from patch.

jA. [illegible] high-volume, low-pressure, argon gas p[illegible] as backup during weld and braze repair.

k. Braze and weld (paragraphs 8-17 and 8-18) patch using sequence outlined in figure 8-10.

NOTE

During weld repair, a minimum amount of heat must be used, maintaining 100-percent weld penetration.

l. After each weld and braze step, use a mini-grinder and remove cold laps and pinholes from weld, if required.

m. Perform dye-penetrant inspection on weld as outlined in R-3896-3, Volume I. No cracks are allowable.

n. Re-weld cracks found during dye-penetrant inspections.

o. If more than 3 passes are required to weld a crack, remove patch and install a new patch. The procedure must then be repeated.

p. Flush oxidizer dome as outlined in R-3896-11, at completion of thrust chamber tube repair or oxidizer dome repair.

8-27. INSTALLING INSERT PATCH. An insert patch (figure 8-11) is required when a tube defect is discovered under a tension band or flame shield. The repair must be made from inside the thrust chamber. An opening is made in the tube opposite the location of the defect and the repair made through this opening.

a. Locate defect by tube number and approximate distance from exhaust manifold.

b. Remove a section of tube from gas side of tube opposite defect in an oval shape.

CAUTION

Edges must be filed square, not chamfered.

c. Using a file, remove burs from edges of tube opening.

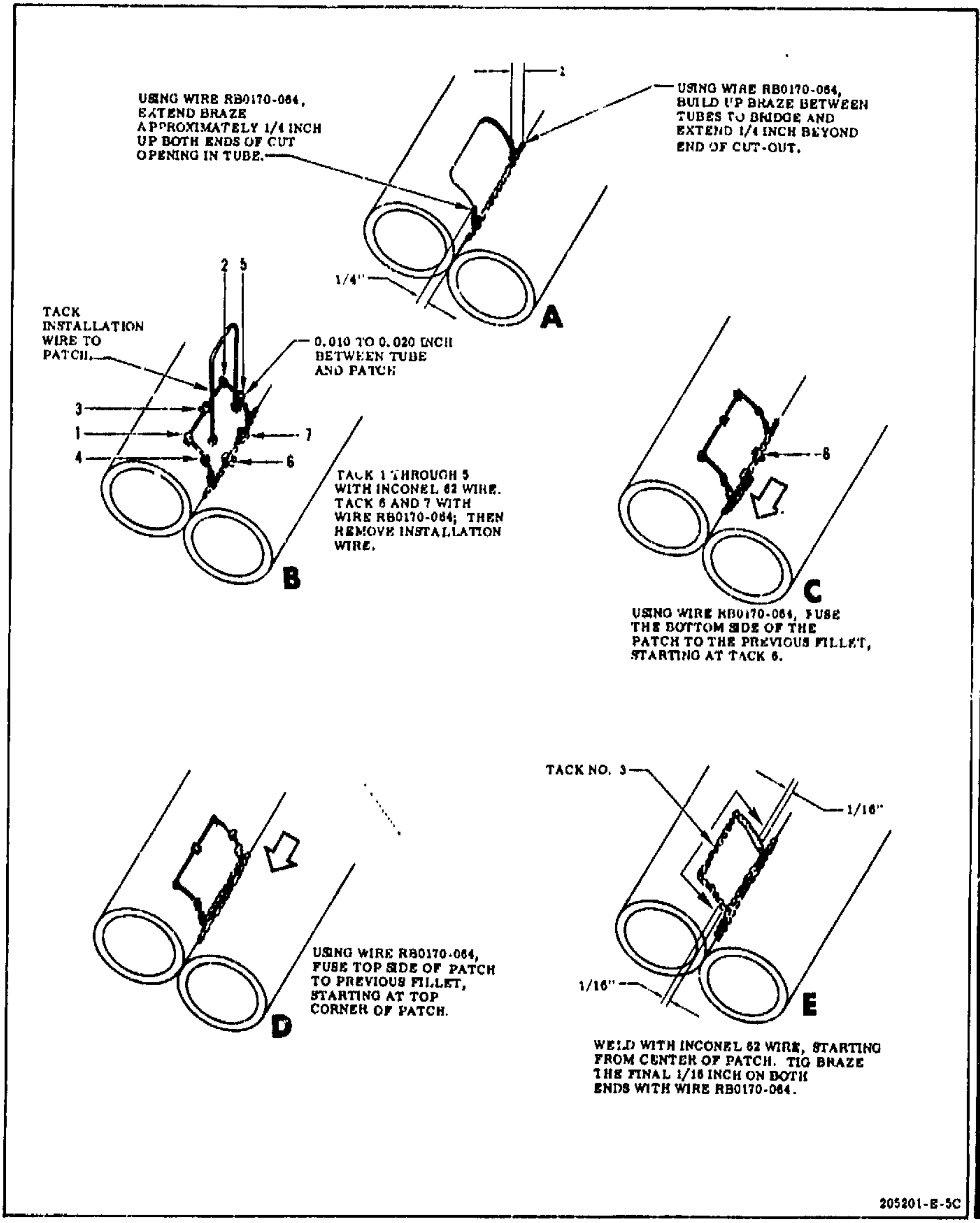


Figure 8-10. Installing Thrust Chamber Modified Butt Patch

WARNING

The following procedure uses acetone, which is extremely flammable and must not be used near sparks, heat, or any source of flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

d. Clean inside of tube around defect by wire brushing and washing with acetone (Federal Specification O-A-51). Dry acetone from tube.

e. Fabricate a patch, which overlaps defect by 0.250 inch, from a piece of tube 205223.

f. Tack two 0.040-inch Inconel 62 wires (approximately 6 inches long) to patch. Position wires approximately 1/4 inch from ends of patch and twist wires together to form a handle.

g. Use a high-volume, low-pressure argon gas purge as backup during weld repair.

h. Hold patch in position in tube opening and tack it in sequence, illustrated in figure 8-11, using a minimum heat input.

i. Weld patch on inside of tube using a minimum amount of heat, maintaining 100-percent weld penetration. Refer to paragraph 8-17 for welding procedure.

j. Perform dye-penetrant inspection on weld as outlined in R-3896-3, Volume I. No cracks are allowable.

k. Re-weld cracks found during dye-penetrant inspection.

l. If more than 3 passes are required to weld a crack, remove patch and install a new patch. The procedure must then be repeated.

m. Install a patch on gas side of tube as outlined in paragraph 8-25 or 8-26, as applicable.

n. Flush oxidizer dome as outlined in R-3896-11, at completion of thrust chamber tube repair or oxidizer dome repair.

8-27A. REPAIRING BLOWN-OUT TUBE WITHIN INJECTOR END RING CAVITY INJECTOR INSTALLED).

a. Remove tube section, starting 3/8 inch below injector end ring, for a length of 2 inches and a minimum width, to allow installation of part number XXX sleeve. See figure 8-12, view A.

b. Seal downstream portion of tube opening with aluminum tape (Minnesota Mining and Mfg), or equivalent, to prevent any material from dropping into flow passage. See figure 8-12, view B.

c. Install part number XXX sleeve with slot alined, as shown in figure 8-12, view B.

d. TIG braze as outlined in paragraph 8-18 and as shown in figure 8-12, view B.

e. Remove aluminum tape.

f. Install butt patch as outlined in paragraph 8-25.

8-27B. REPAIRING BLOWN-OUT TUBE WITHIN INJECTOR END RING CAVITY (INJECTOR REMOVED).

a. Install part number YYY sleeve from top of flow tube. Orient installation as shown in figure 8-12, view C.

b. TIG braze as outlined in paragraph 8-18 and as shown in figure 8-12, view C.

8-27C. THRUST CHAMBER EXHAUST MANIFOLD INLET FLANGE REWORK.

a. Make sure flange polishing tool T-5047802 is ready for use and that filtering bowl and lubricating bowl have been serviced as outlined in R-3896-5.

WARNING

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

b. Clean carbon from inlet flange face and approximately 1 inch down on inside surface. Use a cloth moistened with trichloroethylene (MIL-T-27602) to wipe surface; then allow area to dry. Place polyethylene material in inlet to catch metal shavings and water. Tape polyethylene material to inside surface of flange and make sure tape is approximately 1/8 inch below face of flange.

NOTE

During this procedure, it will be necessary to periodically remove the sharp edges from ID and OD of the flange and boltholes, to prevent burs from damaging flange surface.

c. Place a sheet of plywood (2' x 2' x 1/4"), or equivalent, between inlet flange and thrust

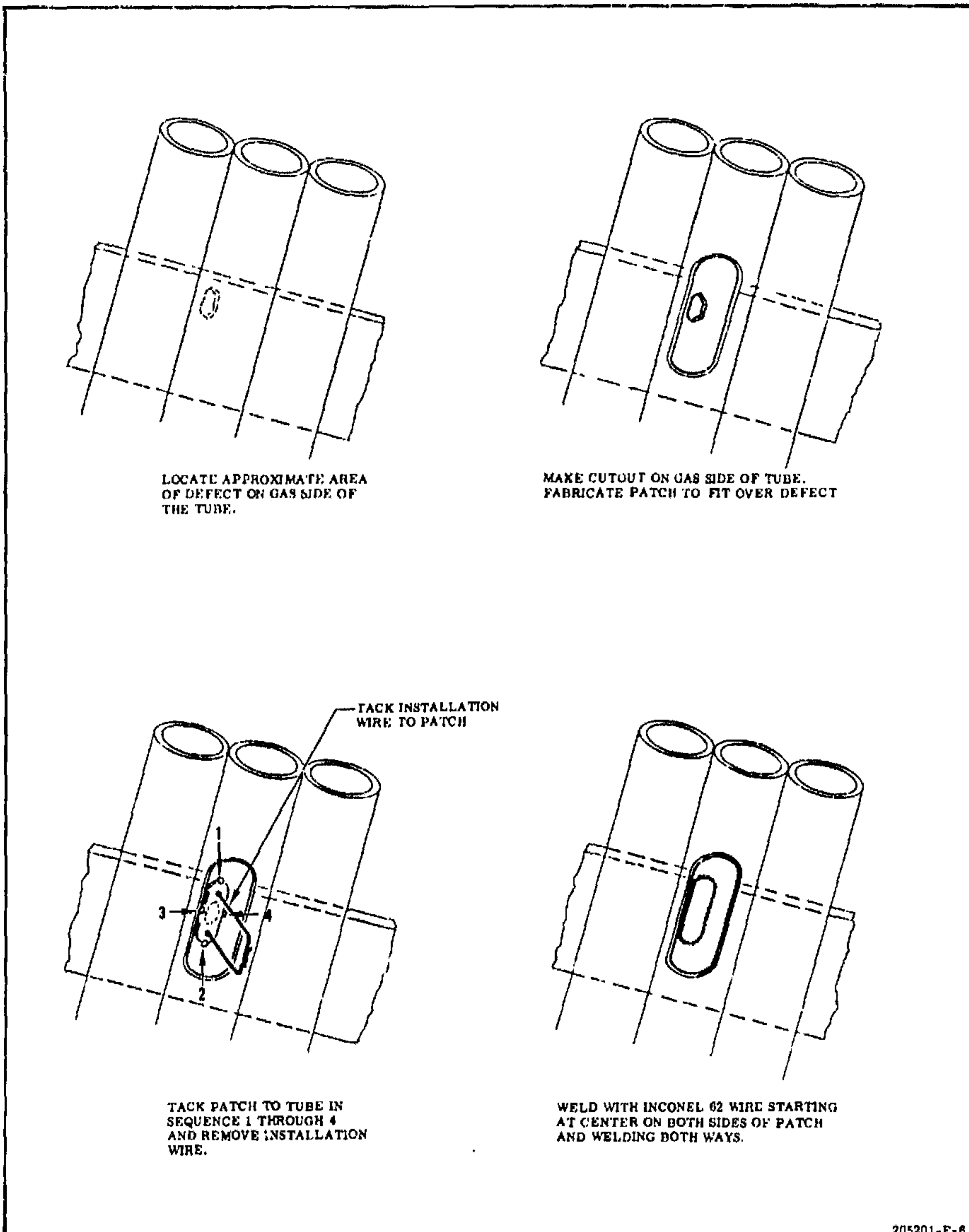


Figure 8-11. Installing Thrust Chamber Insert Patch

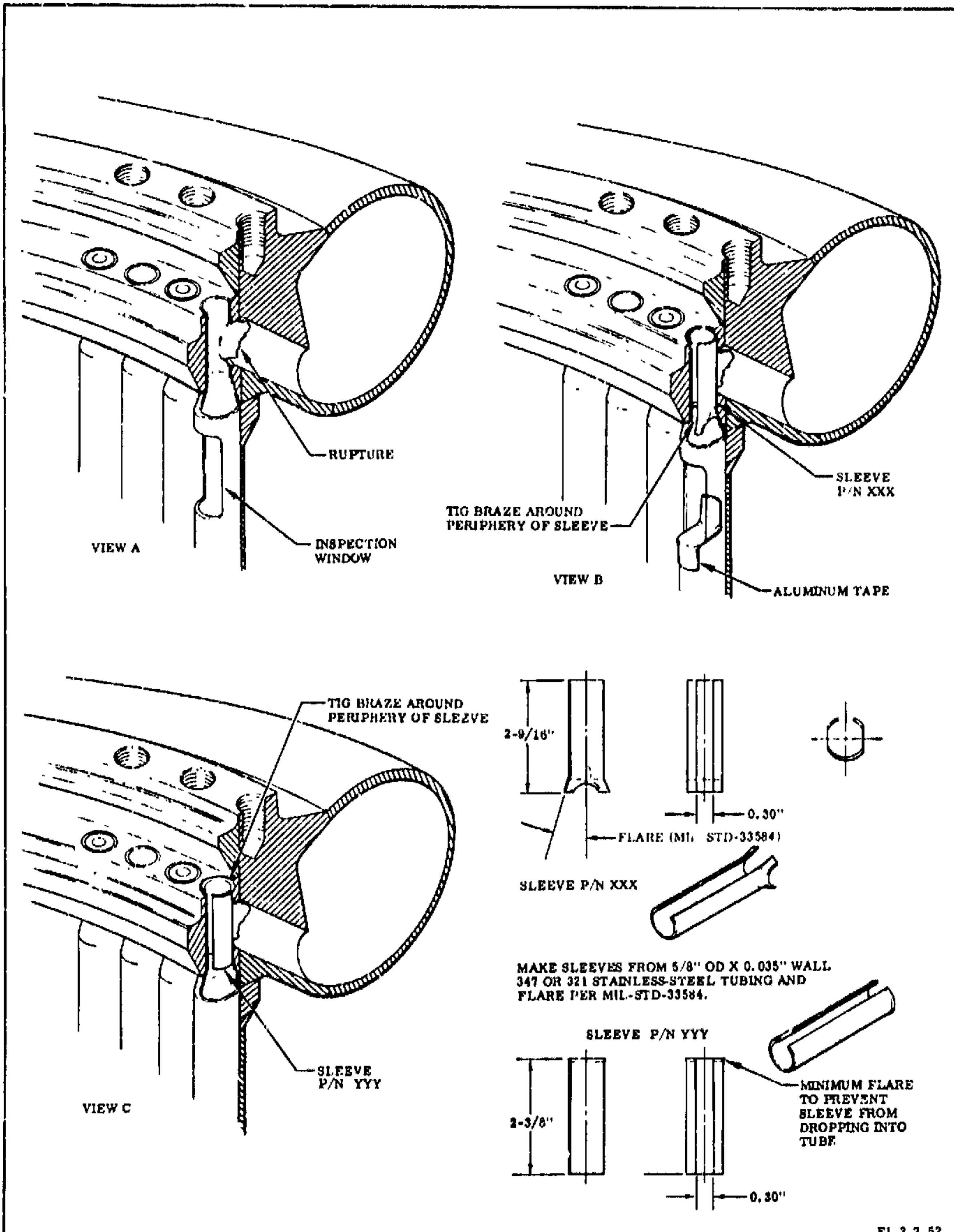


Figure 8-12. Installing Tube Section

chamber body to protect T/C tubes. Maintain clearance between tool roller guides and plywood.

d. Take measurements of inlet flange as follows: (See figures 8-13 and 8-14.)

(1) Use a straightedge and feeler gage.

(2) Take measurements with straightedge across center of flange at bolthole locations 180° apart.

(3) Record measurements on chart.

e. Remove leak monitor port plug.

f. Install handle retaining bracket on No. 1 side tension-tie with bracket and "U" shaped cutout at maximum distance from inlet flange. See figure 8-15. Tighten nuts on clamp evenly so that clamp makes full contact with tension-tie.

g. Check the 3 emery disk mounting pads on tool T-5047802 for flatness by placing a straightedge across pads and measuring gap with a feeler gage. Gap must not exceed 0.001 inch on any pad. Make sure all adhesive is removed and also that pads are smooth and free of surface defects.

h. Prepare #40 grit, 3 inch emery disks by trimming off two edges and folding edges as indicated in figure 8-16.

i. Install #40 grit emery on the 3 mounting pads and press firmly in place. Make sure leading edge of emery is bonded securely.

j. Carefully place tool on flange so that emery seats on flange without sliding. (See figure 8-15.)

k. Install handle on tool and secure with lockpin. Turn air supply valve off; then connect shop air supply. Place handle in retaining bracket and secure with lockpin.

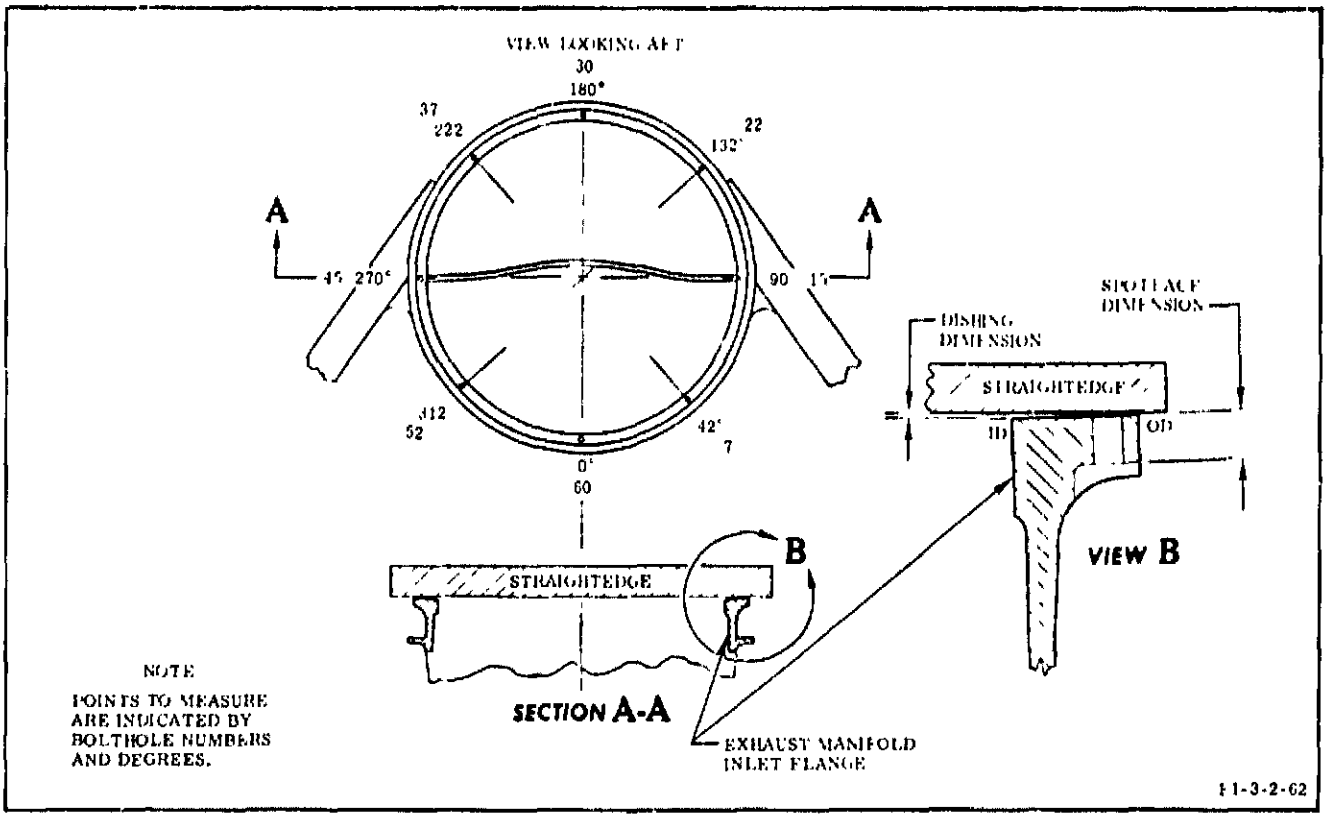


Figure 8-13. Thrust Chamber Exhaust Manifold Inlet Flange Dimension Locator

LOCATION		DISHING AT ID		SPOTFACE DIMENSION[a]	
BOLTHOLE	DEGREES	BEFORE	AFTER	BEFORE	AFTER
7	42				
37	222				
15	90				
45	270				
22	132				
52	312				
30	180				
60	0				

(a) Measure spotface dimension on bolthole diameter centerline and on the same side of hole before and after rework.

Figure 8-14. Thrust Chamber Exhaust Manifold Inlet Flange Dimension Record (Typical)

l. Turn regulator counterclockwise to off position. (Spring tension relieved.)

m. Turn on air supply valve.

n. Wet entire flange surface with water through the lightening holes.

o. Slowly turn regulator on until plate begins to rotate. Adjust speed of plate so that it rotates without chattering, in the range of 12 to 20 rpm (3 to 5 revolutions every 15 seconds) and at an operating pressure of approximately 30 psig. Note tool starting time.

p. Stop tool immediately if chattering or erratic operation occurs. The cause for abnormal operation of the tool must be corrected before proceeding.

CAUTION

Chattering or erratic operation of the tool can cause damage to the flange surface.

q. Adjust air motor lubricator to supply oil to motor at approximately 3 drops a minute.

r. Continually apply ..ater to flange surface to flush away cuttings.

s. Periodically check the following during operation of the tool:

(1) Check that emery disks remain in place on mounting pads.

(2) Observe cutting operation through inspection holes to make sure emery is not galling flange surface.

(3) Check for adequate clearance between roller guides and plywood.

NOTE

If galling does occur during the cutting operation, it may be necessary to change the emery and/or remove sharp edges from ID and OD of flange and boltholes.

t. After approximately 10 minutes of operation, turn off air supply valve, disconnect air supply and handle; then carefully lift tool from flange.

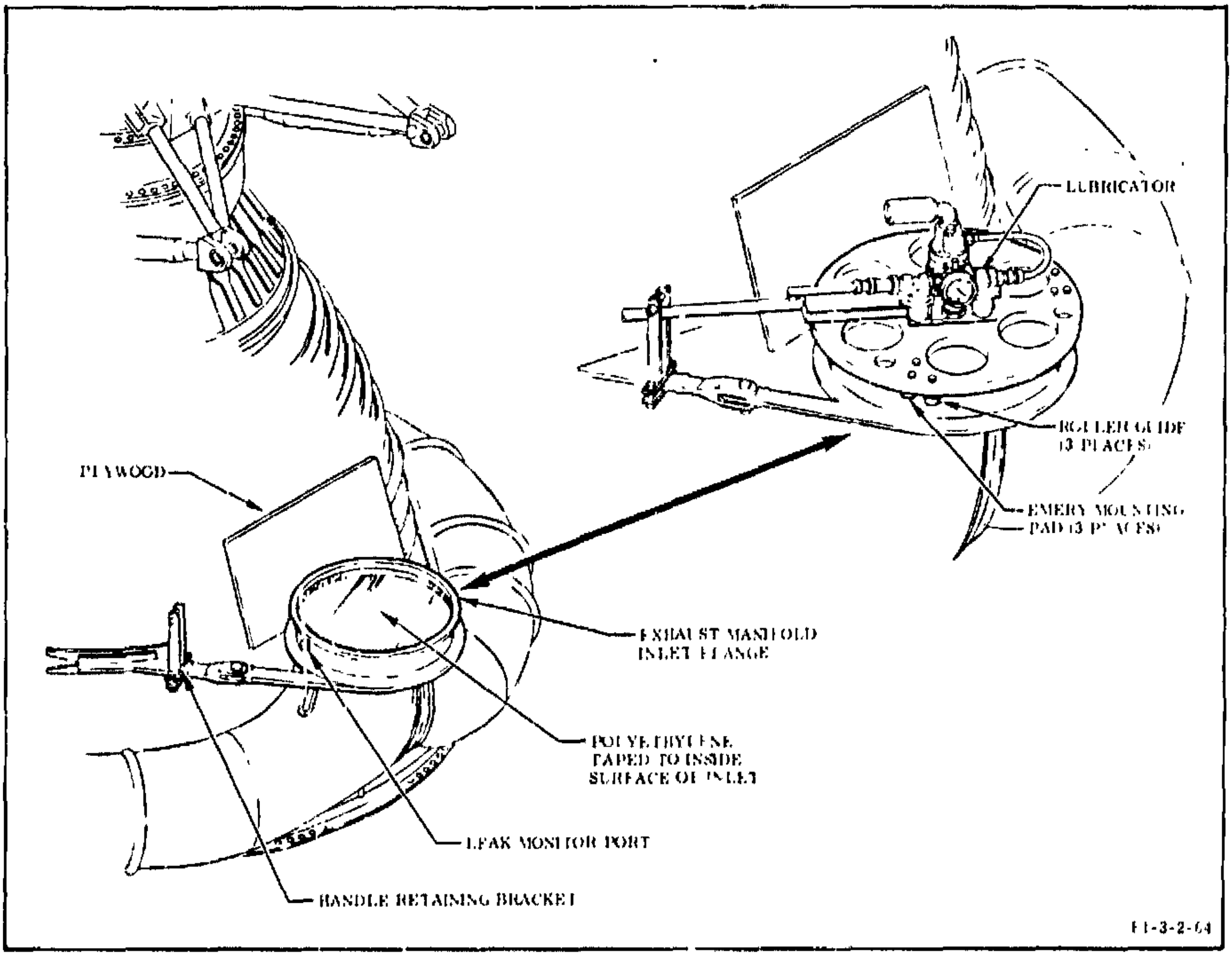


Figure 8-15. Reworking Thrust Chamber Exhaust Manifold Inlet Flange

u. Inspect flange surface for galling, ridges, scratches, etc. It may be necessary to remove sharp edges from ID and OD of flange and bolt-holes.

v. Remove used emery from mounting pads and thoroughly dry pads. Make sure pads are smooth and all adhesive is removed.

w. Install new #40 grit emery on the 3 mounting pads and press firmly in place. Make sure leading edge of emery is bonded securely.

x. Repeat steps j through w as applicable until surface finish indicates emery disks have made contact with entire flange surface.

y. Repeat steps j through w as applicable using #80 grit emery. Continue using #80 grit emery until all surface irregularities from the #40 grit emery have been removed from flange.

z. Turn off air supply valve, disconnect air supply and handle; then carefully lift tool from flange.

aa. Use straightedge and feeler gage to check dishing condition. (See figure 8-13.) Maximum allowable dishing on ID of flange at any location is 0.003 inch. Any dishing noted on the OD of the flange is acceptable.

ab. Continue using #80 grit emery until dishing has been removed to 0.003 inch maximum by repeating steps j through w as applicable.

ac. Turn off air supply valve, disconnect air supply and handle; then carefully lift tool from flange.

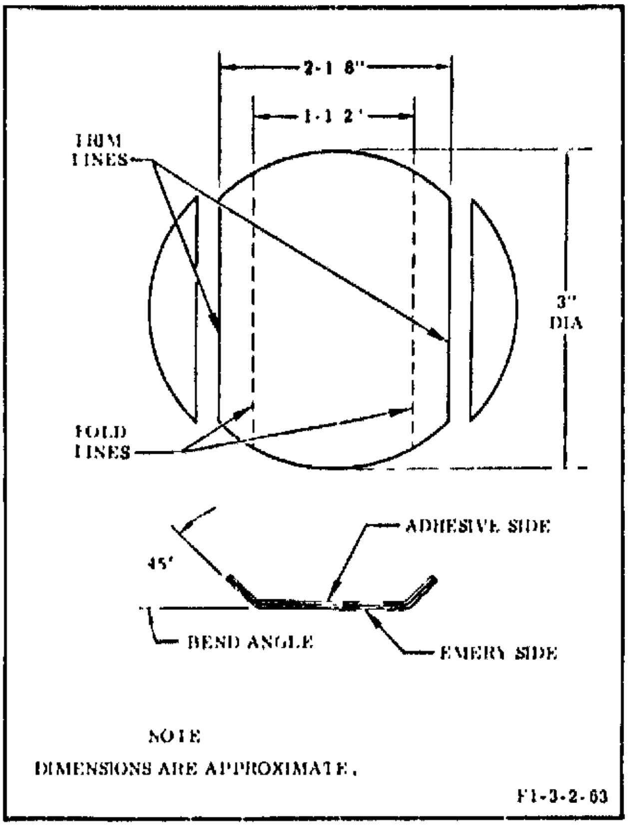


Figure 8-16. Emery Disk Dimensions

ad. Remove emery from mounting pad and open air filter vent to drain any moisture.

ae. Remove sharp edges from ID and OD of flange and boltholes.

af. Polish entire flange surface by hand if required with a fine grit emery cloth, sanding block, and water, to obtain a 32 c finish or better.

ag. Remove plywood and handle retaining bracket.

ah. Remove tape and polyethylene material from exhaust manifold inlet. Do not allow cuttings, water, or other objects to enter inlet.

ai. Take measurements of inlet flange as follows: (See figures 8-13 and 8-14.)

(1) Use a straightedge and feeler gage.

(2) Take measurements with straightedge across center of flange at bolthole locations 180° apart.

(3) Record measurements on record (figure 8-16).

8-28. THRUST CHAMBER INJECTOR REPAIRS.

8-29. WELDING. All welding on the thrust chamber injector utilizes the TIG-heliarc welding process. Copper repairs are made, using deoxidized copper wire (STD170GB0001), while instrumentation and hypergol boss welds are made using 348 CRES filler wire (MIL-R-5031). All welds must be dye-penetrant-inspected as outlined in R-3896-3, Volume I. No cracks resulting from welding are acceptable.

8-30. BRAZING. All brazing on the thrust chamber injector utilizes the TIG-heliarc brazing process. Copper-Gold-Nickel brazing alloy filler wire RB0170-065 (Rocketdyne) must be used as the filler wire.

8-31. REPAIRING BAFFLE CRACKS OR HOLES.

WARNING

The following procedure uses acetone, which 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.

a. Using a mini-grinder, U-groove cracks or holes to a maximum depth of 1/8 inch. Maintain a minimum radius of 1/16 inch at base of groove, with a 30-60 degree included angle. Groove length should be a maximum of one inch.

b. Using a clean, fine, stainless-steel brush, clean area around defect. Wash area with acetone (Federal Specification O-A-51). Air-dry baffle.

c. Weld baffle as outlined in paragraph 8-29. Purge baffle being repaired, with backup gas through a needle inserted in third or fourth orifice hole from repair area. Use 10 CFH argon, argon helium, or helium, and 1/8-inch-minimum diameter tungsten. Do not use a sharp point.

d. Weld buildup on baffle surface must not exceed 1/16 inch, measured from the highest point of area being repaired. Remove excess weld buildup with mini-grinder.

e. Perform a dye-penetrant inspection as outlined in R-3896-3, Volume I. No cracks are acceptable. Cracks discovered during inspection must be re-welded as outlined in reinspected.

f. Flush oxidizer dome as outlined in R-3896-11, at completion of thrust chamber injector repair.

g. Inspect all orifices in area of any baffle repair to make sure that orifices are not blocked or excessively restricted. Insert a 0.010-inch diameter undersized drill blank into each orifice, to a minimum depth of 1-1/4 inches. Re-drill any orifice that does not accept drill blank to drawing dimension.

8-32. REPAIRING BAFFLE-TO-BAFFLE BRAZE CRACKS.

a. Using a mini-grinder, V-groove crack to minimum depth of 1/16 inch.

WARNING

> The following procedure uses acetone, which is extremely flammable and must not be used near sparks, head, or any source of flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

b. Using a clean, fine stainless steel brush, clean area around crack. Wash area with acetone (Federal Specification O-A-51). Air-dry baffle.

c. Braze crack as outlined in paragraph 8-30.

8-33. (Deleted)

8-34. (Deleted)

8-35. (Deleted)

8-36. INJECTOR OUT-OF-FLATNESS INSPECTION WHEN REMOVED FROM THRUST CHAMBER.

a. Place injector in a face-down position on a clean, prepared surface. Surface must be cushioned and covered with polyethylene material to protect face of injector from damage and contamination.

b. Lay a straightedge across 2 diagonal inner dome bolt pads and measure gap between straightedge and outermost part of injector flange. Record gap measurement.

c. Repeat step b across remaining sets of inner dome bolt pads and record gap measurements.

SECTION IX

THRUST CHAMBER (UNINSTALLED)

WARNING

COMPONENT HANDLING FIXTURE SET G4068 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

9-1. THRUST CHAMBER ASSEMBLY 208101-31, 209201 THROUGH 209201-121, AND 209717-31 THROUGH 209717-921 (UNINSTALLED).

9-2. The following procedures contain disassembling, cleaning, inspecting and repairing, and assembling information for the thrust chamber removed from the engine. Repair procedures for the thrust chamber are limited; and in the event of replacement of the injector dome or thrust chamber body, a penalty firing will be required. If weld repairs are required on the thrust chamber, refer to section VIII. See figure 9-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. Screws and bolts used to attach plate RX20610-211, closure RX20615-11, plate RK395-10072-011, and closure RK395-10061 must be lubricated (Method A) with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication methods are outlined in R-3896-3, Volume I.

Part No.	Nomenclature	Use
T-5029611	Alining Pins (4 required)	Alines dome and injector with thrust chamber during assembly.
T-5039247	Torque Adapter	Torques outer dome bolts.
G4068	Component Handling Fixture Set	Supports dome and injector during removal and installation.

Figure 9-1. Test Equipment and Special Tools for Thrust Chamber

Figure 9-2 deleted.

9-3. DISASSEMBLING.

9-4. Disassemble thrust chamber as required to accomplish necessary repairs and/or replacement. See figure 9-3 for parts and index numbers.

NOTE

Approximate weight of dome and injector assembly is 2,800 pounds.

Approximate weight of thrust chamber body is 5,400 pounds.

- Obvious procedures to remove plugs, seals, gaskets, etc, are not included.

a. To remove dome (13) and injector (19) with thrust chamber in either the vertical or horizontal position, attach adapter 9024906 to dome. Torque adapter bolts to 600 in-lb minimum.

b. On thrust chambers in vertical position:

(1) Attach lift fixture 9024912 to adapter 9024906 installed on dome.

(2) Position a facility hoist over thrust chamber; then connect hoist to lifting eye of lift fixture 9024912.

c. On thrust chambers in horizontal position, use a facility hoist to lift and aline lift fixture 9024931 with adapter 9024906 on dome (13); then attach fixture to adapter.

d. Loosen bolts (14); then remove 4 bolts and washers (15) in an equally spaced pattern. Install 4 alining pins T-5029611 in place of bolts that were removed.

e. Remove plugs (10); then loosen bolts (11) until bolt torque is approximately 100 ft-lb. Do not remove bolts at this time.

f. Remove remainder of bolts (14) and washers (15).

g. On thrust chambers in vertical position, use facility hoist and carefully lift dome (13) and injector (19) from body (29).

h. On thrust chambers in horizontal position, use facility hoist and lift fixture to carefully slide dome (13) and injector (19) from body (29).

CAUTION

The facility hoist of lift fixture must support weight of dome and injector without imposing a load on the four alining pins. Slight adjustment of facility hoist height may be necessary to remove dome and injector from body.

i. On thrust chambers in horizontal position, connect a second facility hoist to vertical lifting eye on lift fixture; then rotate fixture, dome, and injector 90 degrees.

j. Using facility hoist, lower dome and injector on a clean, prepared surface. Surface must be cushioned and covered with polyethylene material to protect face of injector from damage and contamination.

k. Remove bolts (11) and seals (12).

l. Using facility hoist, lift dome (13) from injector (19); then lower dome on a clean, prepared surface. Surface must be cushioned and covered with polyethylene material to protect dome from damage and contamination.

m. Remove lift fixture and adapters; then secure facility hoists.

n. Remove 4 alining pins from body (29).

o. Install protective covers and closures as required. Refer to paragraph 9-2 for protective closures.

9-5. CLEANING.

9-6. All parts must be cleaned to enable a more thorough inspection for defects, wear, or damage. All parts must be recleaned after repair. General procedures for cleaning specified items are outlined in R-3896-3, Volume I.

9-7. INSPECTING AND REPAIRING.

9-8. Inspection of the thrust chamber determines if the individual parts are damaged. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Inspect individual parts for general condition, damage to threads, corrosion, distortion, nicks, burs, and scratches. Refer to section VIII for disposition of defects and repair procedures. Replace pins (22, 23) if threads are damaged.

9-9. ASSEMBLING.

9-10. The lubricants used in this procedure are specified in the procedural steps. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 9-3 for parts and index numbers and assemble the thrust chamber as follows:

a. Verify that engine alinement pins 408329 are installed in injector before injector is installed.

NOTE

Approximate weight of dome and injector assembly is 2,800 pounds. Approximate weight of thrust chamber body is 5,400 pounds.

aA. To install dome (13) and injector (19) with thrust chamber in either the vertical or horizontal position, attach adapter 9024906 to dome. Torque adapter bolts to 600 in-lb minimum.

b. On thrust chambers in vertical position:

(1) Attach lift fixture 9024912 to adapter 9024906 installed on dome.

(2) Position a facility hoist over the dome; then connect hoist to lifting eye of lift fixture 9024912.

c. On thrust chambers in horizontal position, use 2 facility hoists to lift and aline lift fixture 9024931 with adapter 9024906 on dome (13); then attach fixture to adapter.

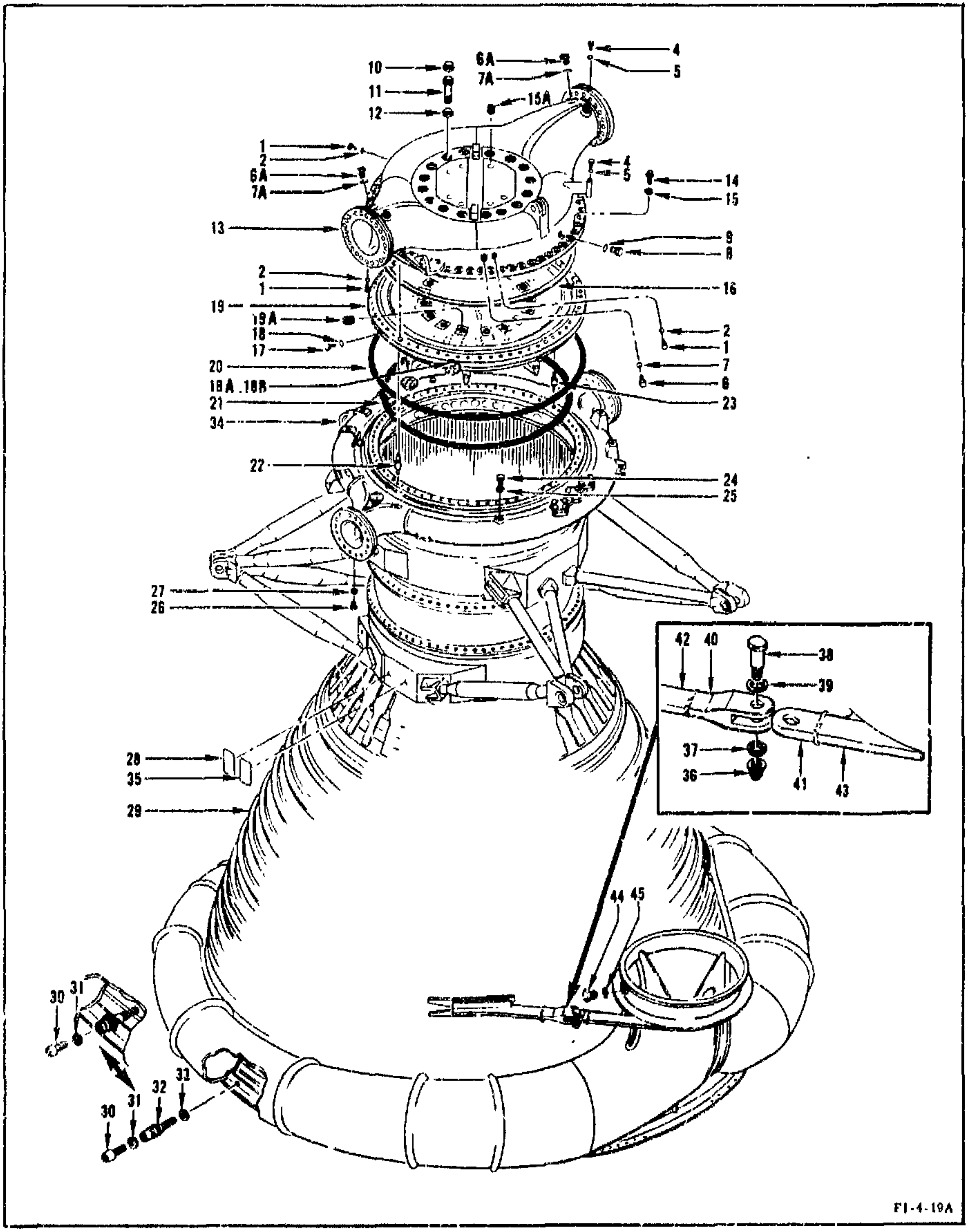


Figure 9-3. Thrust Chamber Assembly--Exploded View (Sheet 1 of 2)

1	Plug	12	Seal	23	Pin (Round)	33	Gasket[(d)]
2	Seal	13	Dome	24	Plug	34	Bearing
3	(Deleted)	14	Bolt[(a)]	25	Seal	35	Nameplate
4	Plug	15	Washer	26	Plug	36	Nut[(e)]
5	Seal	16	Gasket	27	Seal	37	Washer[(e)]
6	Plug	17	Plug	28	Nameplate	38	Pin[(e)]
6A	Plug	18	Seal	29	Body	39	Washer[(e)]
7	Seal	18A	Plug	30	Bolt[(b)]	40	Clevis[(e)]
7A	Seal	18B	Seal	30	Drain Plug[(c)]	41	Tongue[(e)]
8	Plug	19	Injector	31	Washer[(b)]	42	Brace[(e)]
9	Seal	20	O-ring	31	Seal[(c)]	43	Brace[(e)]
10	Plug	21	Seal	32	Drain Adapter[(d)]	44	Plug
11	Bolt	22	Pin (Diamond Shaped)			45	Seal

(a) Bolts (14) are of three different lengths and are installed in the hole positions indicated:

THRUST CHAMBER NO.	BOLTS	HOLE POSITIONS
208101-31	201599-5	11
209201	201599-3	21, 31, 37, 41, 58
	201599	Remaining holes
209201-11 through	201599-5	11, 41
209201-121	201599-3	21, 31, 37, 58
	201599	Remaining holes

(b) On thrust chambers 208101-31, 209201, and 209201-11.
(c) On thrust chambers 209201-31 through 209201-121.
(d) On thrust chambers 209201-31 through 209201-81.
(e) On thrust chambers 209201-41 through 209201-121.

Figure 9-3. Thrust Chamber Assembly--Exploded View (Sheet 2 of 2)

d. Install gasket (16) in groove of injector (19).

e. Using facility hoist, lower dome (13) on injector (19). Aline index hole X on dome with index hole X on injector.

f. Lubricate (Method R) seals (12) with fluorinated oil Krytox 143AZ (Du Pont) or lubricant grease RB0140-012 (Rocketdyne) and install.

NOTE

Bolts (11, 14) are to be torqued alternately in equal steps of 1/3 of their final torque value until final torque is reached. Bolts are torqued in steps g and p.

g. Lubricate (Method A) bolts (11) with lubricant grease RB0140-012 (Rocketdyne) and install. Torque bolts to 230 ft-lb in numerical sequence indicated on dome (13).

h. Install 4 alining pins T-5029611 in dome (13) and injector bolt circle of body (29). Pins must be installed in an equally spaced pattern.

i. Install pin (23) (round) and pin (22) (diamond shaped) in body (29).

j. Using facility hoist, lift dome and injector to a convenient height to install injector-to-body O-rings.

k. Lubricate (Method K) O-ring (20) with FS1281 grease (Dow Corning Corp); then install O-ring on injector (19).

l. Install seal (21) in thrust chamber.

m. On thrust chambers in vertical position:

(1) Using facility hoist, lift and aline dome and injector with index pins (22, 23).

(2) Carefully lower dome and injector on body (29).

n. On thrust chambers in horizontal position:

(1) Using 2 facility hoists, rotate fixture and dome and injector 90 degrees; then remove facility hoist connected to vertical lifting eye.

CAUTION

Injector-to-body O-rings must remain in their proper place so that they will not be damaged.

(2) Aline dome (13) and injector (19) with index pins (22, 23); then install dome and injector in body (29).

o. Lubricate (Method A) bolts (14) and (Method F) washers (15) with lubricant grease RB0140-012 (Rocketdyne); then install bolts and washers. Remove alining pins to install remaining 4 bolts and washers.

NOTE

Bolts (14) must be installed in hole positions indicated in figure 9-3.

p. Torque bolts (11, 14) in numerical sequence indicated on dome (13) as follows:

(1) Using torque adapter T-5039247, torque bolts (14) to 140 ft-lb.

(2) Torque bolts (11) to 460 ft-lb.

(3) Using torque adapter T-5039247, torque bolts (14) to 280 ft-lb.

(4) Torque bolts (11) to 685 +35 ft-lb.

(5) Using torque adapter T-5039247, torque bolts (14) to 425 ±25 ft-lb.

(6) Repeat substeps 4 and 5 in numerical sequence until specified torque is reached.

(7) Following numerical sequence stamped on dome, back off first bolt (14) and retorque to 335 +15 ft-lb. Repeat for next bolt until all bolts (14) are retorqued.

q. Remove handling equipment and secure facility hoist.

r. Lubricate (Method A) plugs (10) with lubricant grease RB0140-012 (Rocketdyne) and install in dome (13). Torque plugs to 105 ±5 ft-lb.

rA. Safetywire bolts (14) and plugs (10).

s. Lubricate and install the following plugs and seals. Lubricate (Method A) plugs with lubricant grease RB0140-012 (Rocketdyne). Lubricate (Method R) seals with fluorinated oil Krytox 143AZ (Du Pont) or lubricant grease RB0140-012 (Rocketdyne). Torque plugs to values indicated and safetywire plugs.

(1) Plugs (1) and seals (2). Torque to 85 ±5 in-lb.

(2) Plug (4) and seal (5). Torque to 70 ±5 in-lb.

(3) Plug (6) and seal (7). Torque to 80 ±10 ft-lb.

(4) Plugs (6A) and seals (7A). Torque to 350 ±15 in-lb.

(5) Plug (8) and seal (9). Torque to 85 ±5 in-lb.

sA. Lubricate and install the following plugs and seals. Lubricate (Method A) plugs with thread compound C-5A (Felt Products). Lubricate (Method R) seals with Brayco 777 hydraulic fluid (Bray Oil Co). Torque plugs to values indicated and safetywire plugs.

(1) Plug (17) and seal (18). Torque to 85 ±5 in-lb.

(2) Plug (18A) and seal (18B). Torque to 70 ±5 in-lb.

(3) Plug (44) and seal (45). Torque to 70 ±5 in-lb.

t. Lubricate and install the following plugs and seals. Lubricate (Method A) plugs with lubricant grease RB0140-012 (Rocketdyne). Lubricate (Method R) seals with fluorinated oil Krytox 143AZ (Du Pont). Torque plugs to values indicated and safetywire plugs.

(1) Plug (24) and seal (25). Torque to 85 ±5 in-lb.

(2) Plug (26) and seal (27). Torque to 70 ±5 in-lb.

u. On thrust chambers 208101-31, 209201, and 209201-11, install bolts (30) and washers (31). Torque bolts to 63-77 ft-lb. Safetywire bolts.

v. On thrust chambers 209201-41 through 209201-121, install pins (38), washers (37, 39), and nuts (36). Torque nuts to 60-80 ft-lb.

NOTE

VB must be stamped on the head of the pins (38). Pins not stamped with VB must not be used because of improper heat treatment.

w. On thrust chambers 209201-31 through 209201-81, install drain adapters (32) and gaskets (33). Torque drain adapters to 47-53 ft-lb. Safetywire adapters.

x. On thrust chambers 209201-31 through 209201-121, install drain plugs (30) and seals (31). Torque drain plugs to 8-12 ft-lb. Safetywire drain plugs.

y. Install protective closures. Refer to paragraph 9-2 for protective closures.

z. Check space between thrust chamber body and exhaust manifold for installation of aluminum-foil tape. If tape is damaged or missing, remove any objects that may be trapped in the space and apply sections of aluminum-foil tape (Minnesota Mining and Mfg) that are 2 or 4 inches wide and approximately 3 feet long.

9-11. TESTING.

9-12. Testing of the assembled thrust chamber is performed after installation on an engine. Refer to R-3896-11 for thrust chamber test procedure.

n. On thrust chambers in horizontal position:

(1) Using 2 facility hoists, rotate fixture and dome and injector 90 degrees; then remove facility hoist connected to vertical lifting eye.

CAUTION

Injector-to-body O-rings must remain in their proper place so that they will not be damaged.

(2) Aline dome (13) and injector (19) with index pins (22, 23); then install dome and injector in body (29).

o. Lubricate (Method A) bolts (14) and (Method F) washers (15) with lubricant grease RB0140-012 (Rocketdyne); then install bolts and washers. Remove alining pins to install remaining 4 bolts and washers.

NOTE

Bolts (14) must be installed in hole positions indicated in figure 9-3.

p. Torque bolts (11, 14) in numerical sequence indicated on dome (13) as follows:

(1) Using torque adapter T-5039247, torque bolts (14) to 140 ft-lb.

(2) Torque bolts (11) to 460 ft-lb.

(3) Using torque adapter T-5039247, torque bolts (14) to 280 ft-lb.

(4) Torque bolts (11) to 685 ±35 ft-lb.

(5) Using torque adapter T-5039247, torque bolts (14) to 425 ±25 ft-lb.

(6) Repeat substeps 4 and 5 in numerical sequence until specified torque is reached.

(7) Following numerical sequence stamped on dome, back off first bolt (14) and retorque to 335 ±15 ft-lb. Repeat for next bolt until all bolts (14) are retorqued.

q. Remove handling equipment and secure facility hoist.

r. Lubricate (Method A) plugs (10) with lubricant grease RB0140-012 (Rocketdyne) and install in dome (13). Torque plugs to 105 ±5 ft-lb.

rA. Safetywire bolts (11) and plugs (10).

s. Lubricate and install the following plugs and seals. Lubricate (Method A) plugs with lubricant grease RB0140-012 (Rocketdyne). Lubricate (Method R) seals with fluorinated oil Krytox 143AZ (Du Pont) or lubricant grease RB0140-012 (Rocketdyne). Torque plugs to values indicated and safetywire plugs.

(1) Plugs (1) and seals (2). Torque to 85 ±5 in-lb.

(2) Plug (4) and seal (5). Torque to 70 ±5 in-lb.

(3) Plug (6) and seal (7). Torque to 80 ±10 ft-lb.

(4) Plugs (6A) and seals (7A). Torque to 350 ±15 in-lb.

(5) Plug (8) and seal (9). Torque to 85 ±5 in-lb.

sA. Lubricate and install the following plugs and seals. Lubricate (Method A) plugs with thread compound C-5A (Felt Products). Lubricate (Method R) seals with Brayco 777 hydraulic fluid (Bray Oil Co). Torque plugs to values indicated and safetywire plugs.

(1) Plug (17) and seal (18). Torque to 85 ±5 in-lb.

(2) Plug (18A) and seal (18B). Torque to 70 ±5 in-lb.

(3) Plug (44) and seal (45). Torque to 70 ±5 in-lb.

t. Lubricate and install the following plugs and seals. Lubricate (Method A) plugs with lubricant grease RB0140-012 (Rocketdyne). Lubricate (Method R) seals with fluorinated oil Krytox 143AZ (Du Pont). Torque plugs to values indicated and safetywire plugs.

(1) Plug (24) and seal (25). Torque to 85 ±5 in-lb.

(2) Plug (26) and seal (27). Torque to 70 ±5 in-lb.

u. On thrust chambers 208101-31, 209201, and 209201-11, install bolts (30) and washers (31). Torque bolts to 63-77 ft-lb. Safetywire bolts.

v. On thrust chambers 209201-41 through 209201-121, install pins (38), washers (37, 39), and nuts (36). Torque nuts to 60-80 ft-lb.

NOTE

VB must be stamped on the head of the pins (38). Pins not stamped with VB must not be used because of improper heat treatment.

w. On thrust chambers 209201-31 through 209201-81, install drain adapters (32) and gaskets (33). Torque drain adapters to 47-53 ft-lb. Safetywire adapters.

x. On thrust chambers 209201-31 through 209201-121, install drain plugs (30) and seals (31). Torque drain plugs to 8-12 ft-lb. Safetywire drain plugs.

y. Install protective closures. Refer to paragraph 9-2 for protective closures.

z. Check space between thrust chamber body and exhaust manifold for installation of aluminum-foil tape. If tape is damaged or missing, remove any objects that may be trapped in the space and apply sections of aluminum-foil tape (Minnesota Mining and Mfg) that are 2 or 4 inches wide and approximately 3 feet long.

9-11. TESTING.

9-12. Testing of the assembled thrust chamber is performed after installation on an engine. Refer to R-3896-11 for thrust chamber test procedure.

SECTION X

THRUST OK PRESSURE SWITCH

WARNING

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

10-1. THRUST OK PRESSURE SWITCH NA5-28183.

10-2. The following paragraphs contain the cleaning, inspecting and repairing, and testing information required to maintain the thrust OK pressure switch. The pressure switch is a sealed unit and no disassembly or assembly is possible. See figure 10-1 for test equipment and special tools.

Part No.	Nomenclature	Use
AT-138-5883	Pressure Adapter	Adapts to switch ports during pressure tests
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements
1432-T (General Radio Co), or equivalent	Decade Resistance Box	Used with Triplett 630A for resistance tests
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests
G3141	Components Test Console	Provides pneumatic pressure for tests
G3143	Components Adapter Set	Provides hardware for pressure test setups

Figure 10-1. Test Equipment and Special Tools for Thrust OK Pressure Switch

10-3. CLEANING.

10-4. Clean the pressure switch by handwiping exterior surface and flushing system and calibration ports with cleaning compound (MIL-C-81302). Refer to R-3896-3, Volume I for cleaning electrical connector.

WARNING

Cleaning compound is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

10-5. INSPECTING AND REPAIRING.

10-6. Inspecting the pressure switch determines if the pressure switch has been damaged by mishandling. Repairing the pressure switch is limited to repairing minor scratches on the mounting flange sealing surface and straightening one connector pin, bent not more then 20 degrees.

10-7. TESTING WHEN USING COMPONENTS TEST CONSOLE.

10-8. This procedure outlines requirements for testing the thrust OK pressure switch when using Components Test Console. See figure 10-1 for test equipment and special tools for thrust OK pressure switch testing. Any deviations, including the use of other equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install pressure adapter on the pressure switch. Index letters are assigned to switch ports for ease of identification in test setup illustrations. Prepare Components Test Console G3141 for use (figure 10-2). Refer to paragraphs 10-9 through 10-11 for pressure switch test procedures and see figure 10-3 for test setups.

WARNING

Pressure switch must be installed in a protective enclosure during all pressure tests.

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counterclockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
	Connector J703	Capped	
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	

Figure 10-2. Preparing Components Test Console for Use (Sheet 1 of 2)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
ELECTRICAL CONTROL	POWER		POWER light ON.[a] AC INPUT light on.
	VOLTS-RANGE SELECT	D (0-30)	
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a] Hydraulic flow monitor control.
	TEST SELECT 8		Light 8 off.[a] Pneumatic flow monitor control.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console. PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates supply pressure.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve. SYSTEM SUPPLY panel SYS SUPPLY PRESS. gage indicates supply pressure.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure down-stream of console pressurizing panels and into test cell. Safety precautions outlines in R-3896-3, Volume I must be followed when working with pressurized systems.

(a) If indication is not as specified, press applicable switch-light.

Figure 10-2. Preparing Components Test Console for Use (Sheet 2 of 2)

10-9. INSULATION RESISTANCE-TEST.

Refer to paragraph 10-16 for test procedure.

10-10. LEAK-TESTS.

Procedure	Result
a. Prepare Components Test Console and pressure switch for tests as outlined in paragraph 10-8; then connect pressure switch to console for system port leak-test as shown in figure 10-3.	None.
b. Submerge switch, except electrical connector in water. Do not allow water to enter calibration port.	None.
c. On HIGH PRESS FUEL COMPATIBLE panel, close VENT valve and open SHUT-OFF valve. Slowly adjust PRESSURE REGULATOR until pressure gage in test cell indicates 1,270 (+25, -0) psi.	System port pressurized.
d. Maintain pressure to system port for three minutes; then check for leakage.	No leakage is allowable from body joints or calibration port hose.

Procedure	Result
e. On HIGH PRESS FUEL COMPATIBLE panel perform the following:	
(1) Close SHUT-OFF valve, and open VENT valve. Close VENT valve after pressure decay.	Panel and switch system port depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	
f. Remove switch from test setup and connect switch to console for calibration port leak-test (figure 10-3).	None.
g. Submerge switch, except electrical connector, in water. Do not allow water to enter system port.	
h. On HIGH PRESS FUEL COMPATIBLE panel, open SHUTOFF valve. Slowly adjust PRESSURE REGULATOR until pressure gage in test cell indicates 1,270 (+25, -0) psi.	Panel and switch calibration port pressurized.
i. Maintain pressure to switch calibration port for three minutes; then check for leakage.	No leakage is allowed from body joints or system port hose.
j. On HIGH PRESS FUEL COMPATIBLE panel perform the following:	
(1) Close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay.	Panel and switch calibration port depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	
k. Remove pressure switch from test setup.	None

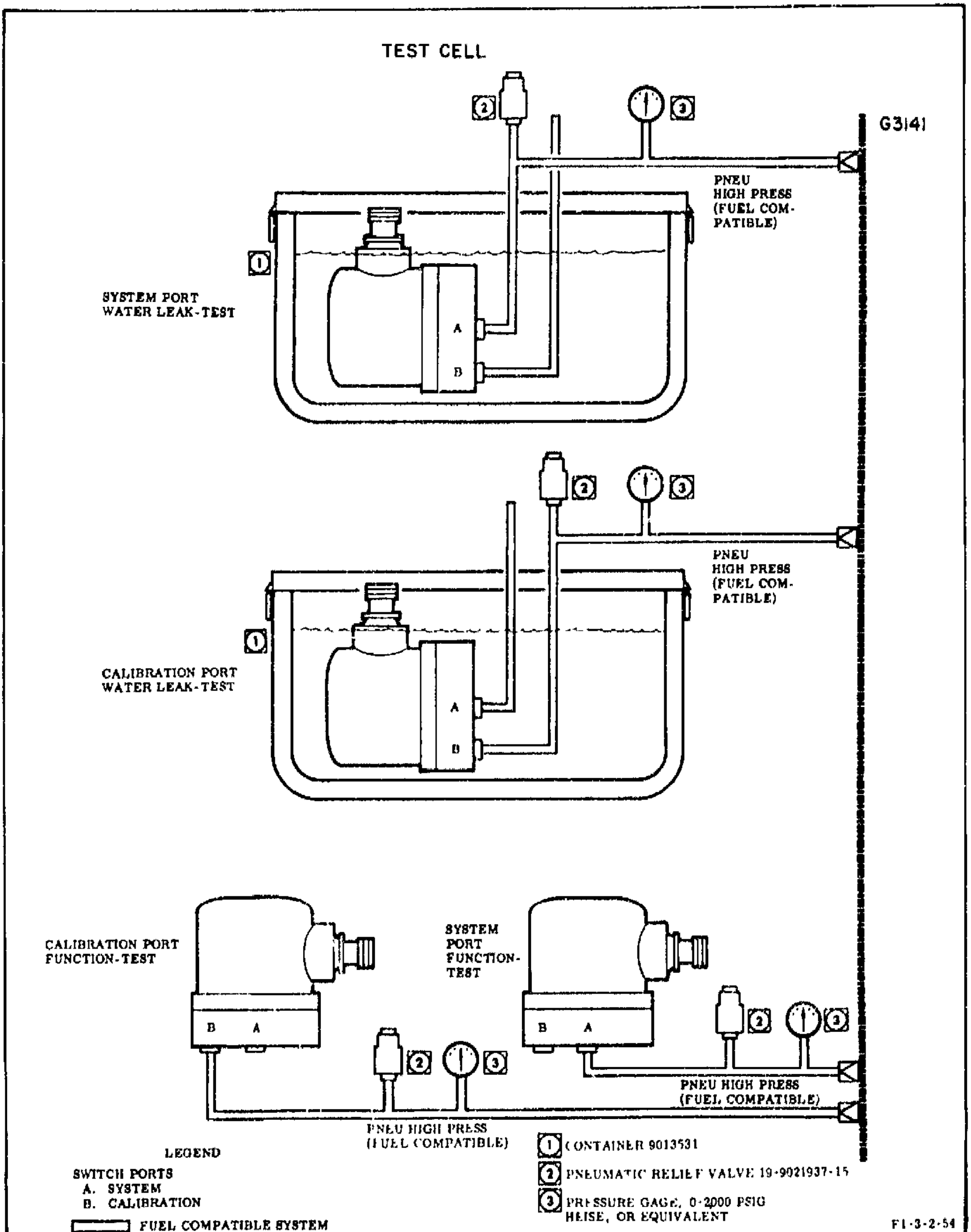


Figure 10-3. Thrust OK Pressure Switch Test Setups When Using Components Test Console

10-11. FUNCTION-TESTS.

Procedure	Result
a. Prepare Components Test Console and pressure switch for tests as outlined in paragraph 10-8; then connect pressure switch to console for system port function-test as shown in figure 10-3.	None.
b. Using multimeter and decade resistance box, measure resistance between pins A and B as follows:	
(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note the exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.15 ohm.
c. Connect multimeter across pins A and B to check continuity.	Multimeter must indicate continuity.
d. On HIGH PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and slowly adjust PRESSURE REGULATOR to increase pressure until switch actuates, as indicated by multimeter.	Panel and system port pressurized. Multimeter must not indicate continuity across pins A and B.
e. Adjust PRESSURE REGULATOR to cycle switch one or more times; then observe and record switch actuation pressure on gage in test cell.	Switch must actuate at 1,060 (+60, -30) psig.
eA. Maintain specified pressure to keep switch in the actuated position, then connect multimeter across pins B and C.	Multimeter must indicate continuity.
eB. Disconnect multimeter.	None.
f. Using a megohmmeter, apply 500 vdc across pins A and B and measure insulation resistance. Disconnect megohmmeter.	Insulation resistance must be 500 megohms minimum.
g. Connect multimeter across pins B and C.	Multimeter must indicate continuity.
gA. Slowly adjust PRESSURE REGULATOR until pressure gage in test cell indicates 1,270 psi maximum.	Panel and switch pressure increased.
gB. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:	
(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.

Procedure	Result
(3) Measure decade box resistance and note the exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.15 ohm.
h. Slowly adjust PRESSURE REGULATOR until switch deactuates as indicated by meter. Record deactuation pressure on gage in test cell.	Switch must deactuate at 75 ±25 psig below actuating pressure recorded in step e.
i. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel and system port depressurized.
j. Repeat step b through i two times.	Same as steps b through i.

k. Disconnect switch from test setup and reconnect switch to console for calibration port function-test. (See figure 10-3.)

Procedure	Result
l. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until gage in test cell indicates 1,270 psi maximum; then decrease pressure to zero.	Switch actuates and deactuates.

m. Using multimeter and decade resistance box, measure resistance between pins A and B as follows:

Procedure	Result
(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note the exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.15 ohm.
n. Connect multimeter across pins A and B to check continuity.	Multimeter must indicate continuity.
o. Adjust PRESSURE REGULATOR to increase calibration port pressure until switch actuates as indicated by multimeter. Observe and record actuation pressure on gage in test cell.	Switch must actuate at 1,060 ±65 psig.
p. Maintain specified pressure to keep switch in the actuated position, then connect multimeter across pins B and C.	Multimeter must indicate continuity.
pA. Slowly adjust PRESSURE REGULATOR until pressure gage in test cell indicates 1,270 psi maximum.	Panel and switch pressure increased.

pB. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:

Procedure	Result
(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.

Procedure	Result
(3) Measure decade box resistance and note the exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.15 ohm.
q. Slowly adjust PRESSURE REGULATOR until switch deactuates as indicated by multimeter. Record deactuation pressure on gage in test cell.	Switch must deactuate at 75 ±25 psig below actuation pressure recorded in step o.
r. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel and calibration port depressurized.
s. Repeat steps m through r one time.	Same as steps m through r.
t. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay.	None.
u. Remove thrust OK pressure switch from test setup.	None.

v. Package and protect switch as directed in R-3896-3, Volume I.

10-12. SECURING TEST EQUIPMENT.

10-13. After thrust OK pressure switch testing is completed and switch is removed from test setup, secure test equipment as follows:

a. Reduce facility gaseous nitrogen and helium supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF and HELIUM SOURCE SHUTOFF valves.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS SHUTOFF valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valve, regulators, and utility valve.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

i. Turn DC POWER SUPPLY off.

j. On POWER DISTRIBUTION panel, pull out circuit breakers.

10-14. TESTING WHEN NOT USING COMPONENTS TEST CONSOLE.

10-15. This procedure outlines requirements for testing the thrust OK pressure switch when not using the Components Test Console. See figure 10-1 for test equipment and special tools. Prior to starting the test, install pressure adapter on the pressure switch. Refer to paragraphs 10-16 through 10-19 for pressure test procedures and see figure 10-4 for test setups.

WARNING

Pressure switch must be installed in a protective closure during all pressure tests.

10-16. INSULATION RESISTANCE-TEST.

WARNING

High-voltage tests are dangerous; therefore, in addition to local and standard safety requirements, the test equipment must be grounded, connectors must be dry, and personnel must be kept to a minimum in the test area.

Procedure	Result
a. Using a megohmmeter, apply 500-600 vdc for one minute between each pin and case, between pins A and C, and between pins B and C. Measure insulation resistance during each application.	Insulation resistance between pins and case and between pins must be 500 megohms minimum.

10-17. LEAK-TESTS.

CAUTION

If automatic checkout equipment is used to test the pressure switch pickup and dropout value, pressurization rates must be limited to 50 psig/sec from 0-895 psig and 5 psig/sec from 895-1,270 psig. Depressurization rates must be limited to 5 psig/sec from 1,270-895 psig.

NOTE

The fluid used in the following procedure is gaseous nitrogen (MIL-P-27401).

Procedure	Result
a. Install pressure switch in test setup for system port water leak-test as shown in figure 10-4.	None.
b. Submerge pressure switch, except electrical connector, in water. Do not allow water to enter calibration port.	None.
c. Slowly pressurize system port to 1,270 (+25, -0) psig.	System port pressurized.
d. Maintain pressure to system port for 3 minutes; then check for leakage.	No leakage is allowable from body joints or calibration port hose.
e. Depressurize system port to zero.	System port depressurized.
f. Remove pressure switch from test setup and install pressure switch in tes setup for calibration port water leak-test as shown in figure 10-4.	None.
g. Submerge pressure switch, except electrical connector, in water. Do not allow water to enter system port.	None.
h. Slowly pressurize calibration port to 1,270 (+25, -0) psig.	Calibration port pressurized.
i. Maintain pressure to calibration port for 3 minutes; then check for leakage.	No leakage is allowable from body joints or system port hose.
j. Depressurize calibration port to zero.	Calibration port depressurized.
k. Remove pressure switch from test setup.	None.

10-18. FUNCTION-TESTS.

CAUTION

If automatic checkout equipment is used to test the pressure switch pickup and dropout value, pressurization rates must be limited to 50 psig/sec from 0-895 psig and 5 psig/sec from 895-1,270 psig. Depressurization rates must be limited to 5 psig/sec from 1,270-895 psig.

NOTE

The fluid used in the following procedure is gaseous nitrogen (MIL-P-27401).

Procedure	Result
a. Install pressure switch in test setup for system port function-test as shown in figure 10-4.	None.
b. Using multimeter and decade resistance box, measure resistance between pins A and B as follows:	
(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.15 ohm.
c. Connect multimeter between pins A and B to check continuity.	Multimeter must indicate continuity.
d. Slowly pressurize system port to 1,270 psig maximum; then depressurize system port to zero.	Pressure switch actuates and multimeter must indicate infinity between pins A and B; then pressure switch deactuates and multimeter must indicate continuity between pins A and B.
e. Slowly pressurize system port until switch actuates. Record actuation pressure and meter indication.	Switch must actuate at 1,060 (+60, -30) psig. Multimeter must indicate infinity between pins A and B.
f. Slowly pressurize system port to 1,270 psig maximum; then depressurize system port until switch deactuates, and continue to depressurize until system port is zero.	Multimeter must indicate infinity between pins A and B at maximum pressure and must indicate continuity when switch deactuates.
g. Repeat steps e and f one additional time.	Result same as steps e and f.
h. Slowly pressurize system port until pressure switch actuates; then connect a multimeter between pins B and C.	Multimeter must indicate continuity between pins B and C.
i. Disconnect multimeter.	None.
j. Using a megohmmeter, apply 500 vdc across pins A and B and measure insulation resistance. Disconnect megohmmeter.	Insulation resistance must be 500 megohms minimum.
k. Connect multimeter between pins B and C.	Multimeter must indicate continuity between pins B and C.

Procedure	Result
l. Slowly pressurize system port to 1,270 psig maximum.	None.

m. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:

(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.15 ohm.
n. Slowly depressurize system port until switch deactuates as indicated by multimeter; then continue to depressurize until system port is zero. Record deactuation pressure.	Switch must deactuate at 75 ±25 psig below actuating pressure recorded in step e.
o. Repeat steps b through n 2 additional times.	Results same as steps b through n.
p. Remove pressure switch from test setup and install pressure switch in test setup for calibration port function-test as shown in figure 10-4.	None.
q. Slowly pressurize calibration port to 1,270 psig maximum; then depressurize calibration port to zero.	Switch actuates and deactuates.

r. Using multimeter and decade resistance box, measure resistance between pins A and B as follows:

Procedure	Result
(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.15 ohm.
s. Connect multimeter between pins A and B to check continuity.	Multimeter must indicate continuity.
t. Slowly pressurize calibration port until switch actuates. Record actuation pressure and multimeter indication.	Switch must actuate at 1,060 ±65 psig. Multimeter must indicate infinity between pins A and B.
u. Connect multimeter between pins B and C.	Multimeter must indicate continuity between pins B and C.
v. Slowly pressurize calibration port to 1,270 psig maximum.	None.

w. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:

(1) Adjust decade resistance box for 0.15 ohm, and zero multimeter.	None.

Procedure	Result
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.15 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.15 ohm.
x. Slowly depressurize calibration port until switch deactuates as indicated by multimeter; then continue to depressurize until calibration port is zero. Record deactuation pressure.	Switch must deactuate at 75 ±25 psig below actuating pressure recorded in step t.
y. Repeat steps q through x one additional time.	Results same as steps q through x.
z. Remove pressure switch from test setup; then package and protect switch as outlined in R-3893-3, Volume I.	None.

10-19. ACTUATION AND DEACTUATION TEST. This test is a preinstallation requirement only.

CAUTION

If automatic checkout equipment is used to test the pressure switch pickup and dropout value, pressurization rates must be limited to 50 psig/sec from 0-895 psig and 5 psig/sec from 895-1,270 psig. Depressurization rates must be limited to 5 psig/sec from 1,270-895 psig.

NOTE

The fluid used in the following procedure is gaseous nitrogen (MIL-P-27401).

Procedure	Result
a. Install pressure switch in test setup for system port function-test as shown in figure 10-4.	None.
b. Connect a multimeter between pins A and B.	Multimeter must indicate continuity between pins A and B.
c. Slowly pressurize system port until switch actuates. Record actuation pressure and multimeter indication.	Switch must actuate at 1,060 (+60, -30) psig. Multimeter must indicate infinity between pins A and B.
d. Connect a multimeter between pins B and C.	Multimeter must indicate continuity between pins B and C.
e. Slowly increase pressure to system port to 1,270 psig maximum.	Multimeter must indicate continuity between pins B and C.
f. Slowly decrease pressure to system port until switch deactuates. Record deactuation pressure and multimeter indication.	Switch must deactuate at 75 ±25 psig below actuation pressure recorded in step c. Multimeter must indicate infinity between pins B and C.
g. Decrease pressure to system port to zero.	System port depressurized.
h. Perform steps b through g 2 additional times.	Results same as in steps b through g.

Procedure	Result
i. Remove pressure switch from test setup and install pressure switch in test setup for calibration port function-test as shown in figure 10-4.	None.
j. Slowly pressurize calibration port to 1,270 psig maximum; then reduce pressure to zero.	Calibration port depressurized.
k. Connect a multimeter between pins A and B.	Multimeter must indicate continuity between pins A and B.
l. Slowly pressurize calibration port until switch actuates. Record actuation pressure.	Switch must actuate at 1,060 ±65 psig. Multimeter must indicate infinity between pins A and B.
m. Connect a multimeter between pins B and C.	Multimeter must indicate continuity between pins B and C.
n. Slowly increase pressure to calibration port to 1,270 psig maximum.	Multimeter must indicate continuity between pins B and C.
o. Slowly decrease pressure to calibration port until switch deactuates. Record deactuation pressure and meter indication.	Switch must deactuate at 75 ±25 psig below actuation pressure recorded in step l. Multimeter must indicate infinity between pins B and C.
p. Depressurize calibration port to zero.	None.
q. Perform steps k through p one additional time.	Results same as steps k through p.
r. Remove pressure switch from test setup and protect switch as outlined in R-3896-3, Volume I.	None.

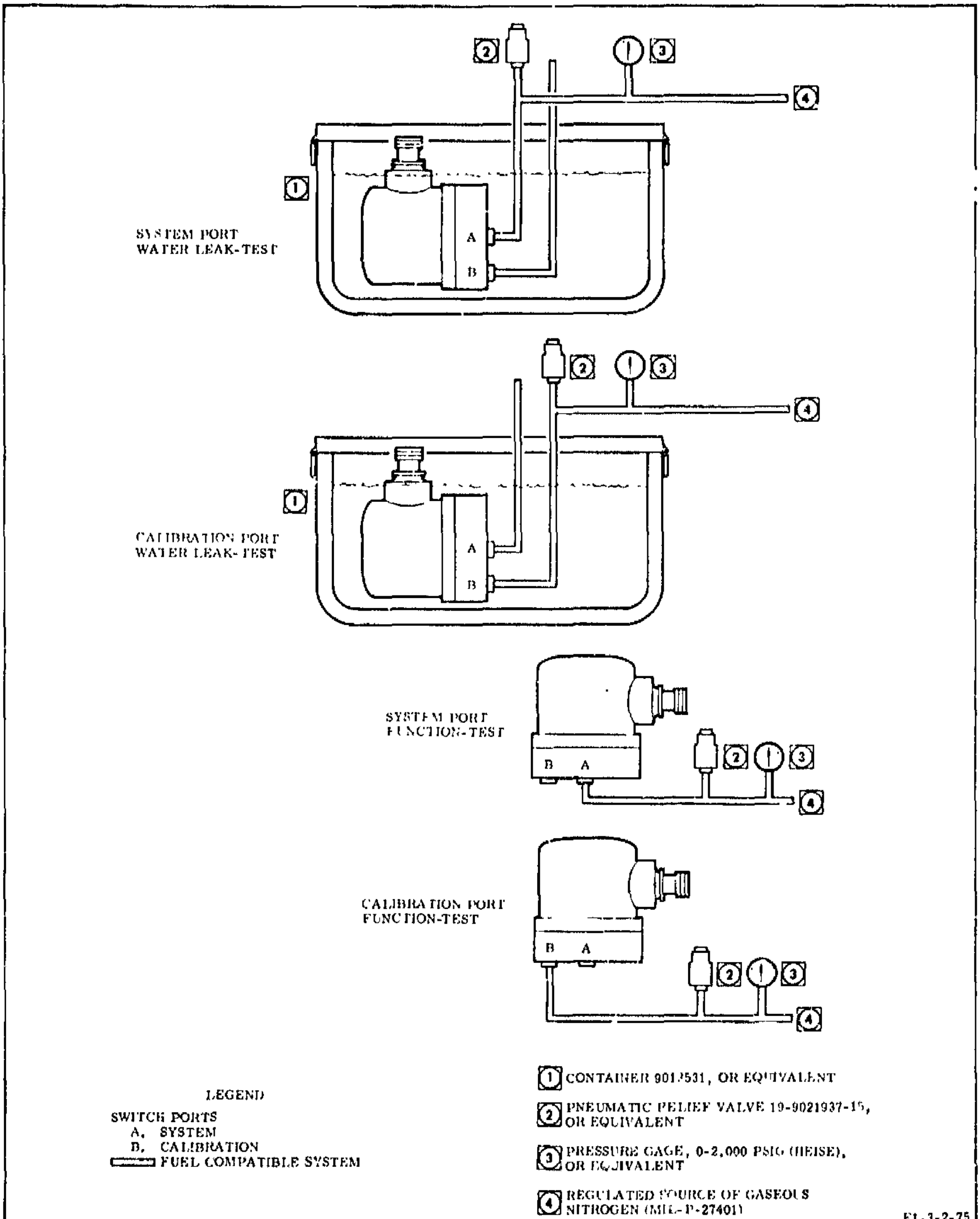


Figure 10-4. Thrust OK Pressure Switch Test Setups When Not Using Components Test Console

SECTION XI

INERT PREFILL CHECK VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

11-1. INERT PREFILL CHECK VALVE 407825.

11-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the inert prefill check valve. See figure 11-1 for test equipment and special tools. No covers or closures are provided for this valve. Package and protect valve as outlined in R-3896-3, Volume I.

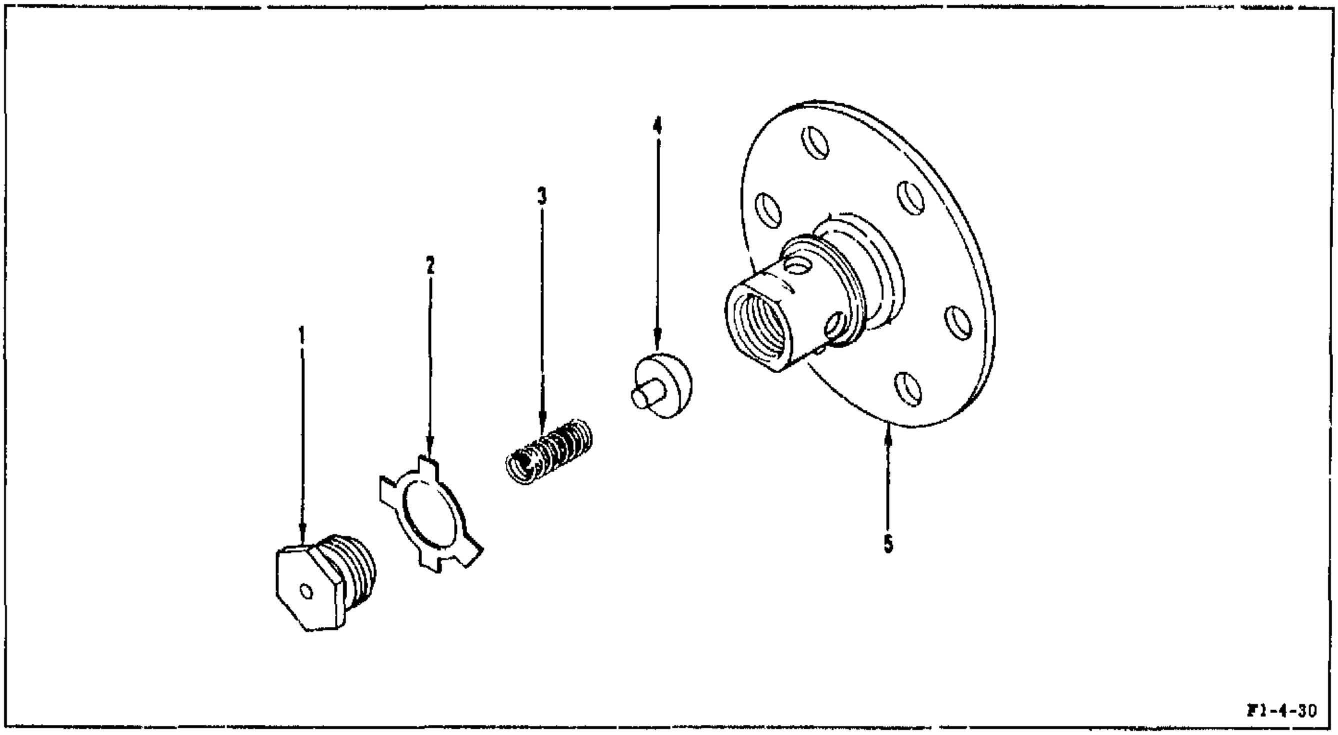
11-3. DISASSEMBLING.

11-4. Disassemble the inert prefill check valve as required to accomplish necessary repairs and/or replacement. Discard washer (2). See figure 11-3 for parts and index numbers.

Part No.	Nomenclature	Use
T-5037801	Pressure Test Fixture	Pressure-checks valve after repair.
T-5037802	Lapping Tool	Laps valve body seat.
G3104	Pneumatic Flow Tester	Measures downstream pneumatic leakage.
G3141	Components Test Console	Provides pneumatic and hydraulic pressure for testing check valve.
G3143	Components Adapter Set	Provides hardware for check valve test setups.

Figure 11-1. Test Equipment and Special Tools for Inert Prefill Check Valve

Figure 11-2 deleted.



1 Cap	2 Washer	3 Spring	4 Ball	5 Body

Figure 11-3. Inert Prefill Check Valve--Exploded View

11-5. CLEANING.

11-6. Clean all parts of the inert prefill check valve for fuel service as outlined in R-3896-3, Volume I.

11-7. INSPECTING AND REPAIRING.

11-8. Inspecting inert prefill check valve determines if the individual parts have been damaged by mishandling or wear. Refer to figure 11-4 and inspect individual parts for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches.

Part Name and Index Number	Inspecting	Repairing
Cap (1)	Damaged threads	Refer to R-3896-3, Volume I for thread repair.
Washer (2)		Replace.
Spring (3)	Corrosion or cracks.	Replace.
Ball (4)	Sealing surface must be free of nicks, scratches, or other imperfections that would impair its sealing surface.	Replace.
Body (5)	Seat sealing surface must be free of nicks, scratches, or other imperfections that would impair its sealing surface.	Repair of seat consists of lapping sealing surface with lapping tool T-5037802 to meet test requirements.
	Damage to flange sealing surface.	Replace.
	Damaged threads	Refer to R-3896-3, Volume I for thread repair.

Figure 11-4. Inspecting and Repairing Inert Prefill Check Valve

11-9. ASSEMBLING.

11-10. Assembly of the inert prefill check valve must be performed with care to prevent damage to seating and sealing surfaces. All parts must meet cleaning requirements as outlined in paragraph 11-5. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 11-3 for parts and index numbers.

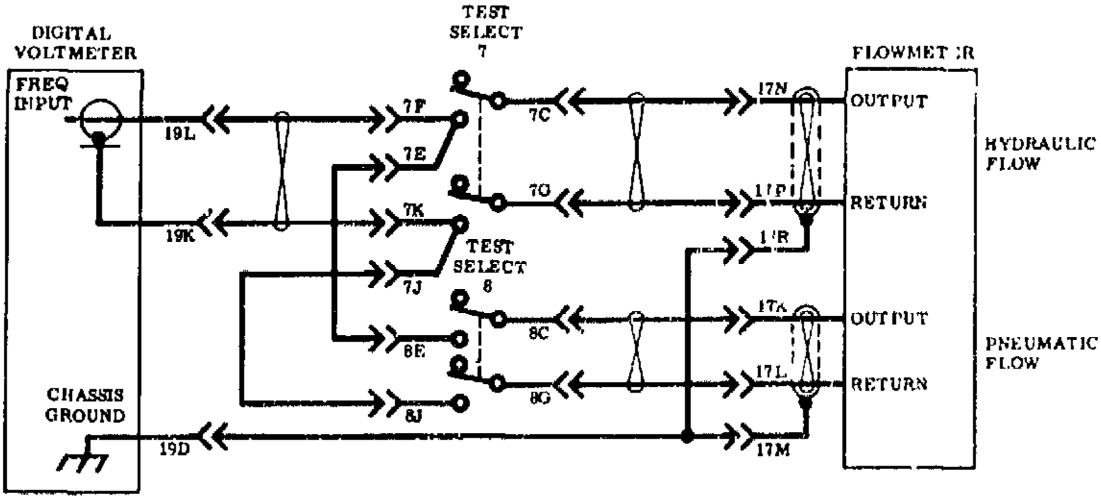
a. Lubricate (Method A) threads of cap (1).

b. Install ball (4), spring (3), washer (2), and cap (1) in body (5). Aline two tabs of washer (2) with flats on body (5). Torque cap (1) to 10-15 in-lb. Torque value may be slightly increased or decreased, as necessary, in order to permit bending of tabs.

c. After torquing cap (1), bend one tab of washer (2) down against one of the valve body (5) flats and bend one tab up against cap (1) hex flat. Bend remaining tabs of washer up or down to lock.

11-11. TESTING.

11-12. This procedure outlines requirements for complete testing of the inert prefill check valve, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3104 is used for pneumatic leak-testing. Any deviations, including the use of other equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install two retainers MS28774-210 and one packing AN6227-15 on check valve, and install pressure test fixture on the valve. Index letters are assigned to valve ports for ease of identification in test illustrations. Set up Components Test Console G3141 electrical patch-panel (figure 11-5) and prepare console for use (figure 11-6). See figure 11-7 for a cutaway view of the inert prefill check valve. Refer to paragraphs 11-12 through 11-17 for check valve test procedures and see figures 11-8 through 11-10 for test setups.



FLOWMETER FREQUENCY MONITOR PATCHING

Patch-Cord[a]	From J6-	To J6-	Patch-Cord[a]	From J6-	To J6-
K3.	7C	17N	K3.	7J	8J
K3.	7E	8E	K3.	8C	17K
K3.	7F	19L	K3.	8G	17L
K3.	7G	17P	K4.09	17M	17R
K3.	7K	19K			19D

(a) Use any cord length required on all patch-cords numbered K3.

Figure 11-5. Components Test Console Patch-Panel Requirements

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressi. - the face of the switch. Make sure switch-lights are pressed only as nec-essary to obtain specified indication.

<u>PRE-POWER TURN ON</u>

POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.

Figure 11-6. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	Off	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Facility pneumatic and hydraulic supplies to console must be off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.

Figure 11-6. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
ELECTRICAL CONTROL	POWER		POWER light ON.[a] AC INPUT light on.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a] Hydraulic flow monitor control.
	TEST SELECT 8		Light 8 off.[a] Pneumatic flow monitor control.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
FLOW MONITOR-TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100 V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1.0 SEC	

(a) If indication is not as specified, press applicable switch-light.

Figure 11-6. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks
FLOW MONITOR-TEST (continued)			
	SAMPLING RATE	3/4 turn clockwise	
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 is for pneumatic flow. Both switch-lights must not be on at the same time.

- Digital voltmeter must warm up at least 30 minutes.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates supply pressure.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates supply pressure.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console pressurizing panels and into test cell. Safety precautions outlined in R-3896-3, Volume I must be followed when working with pressurized systems.

Figure 11-6. Preparing Components Test Console for Use (Sheet 4 of 4)

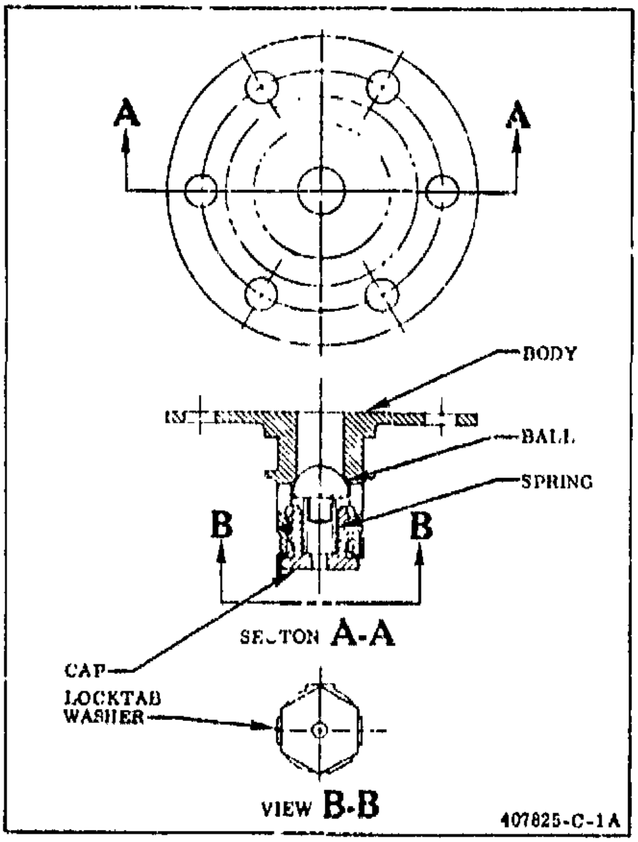


Figure 11-7. Inert Prefill Check Valve--Cutaway View

Paragraph 11-13 and figure 11-8 deleted.

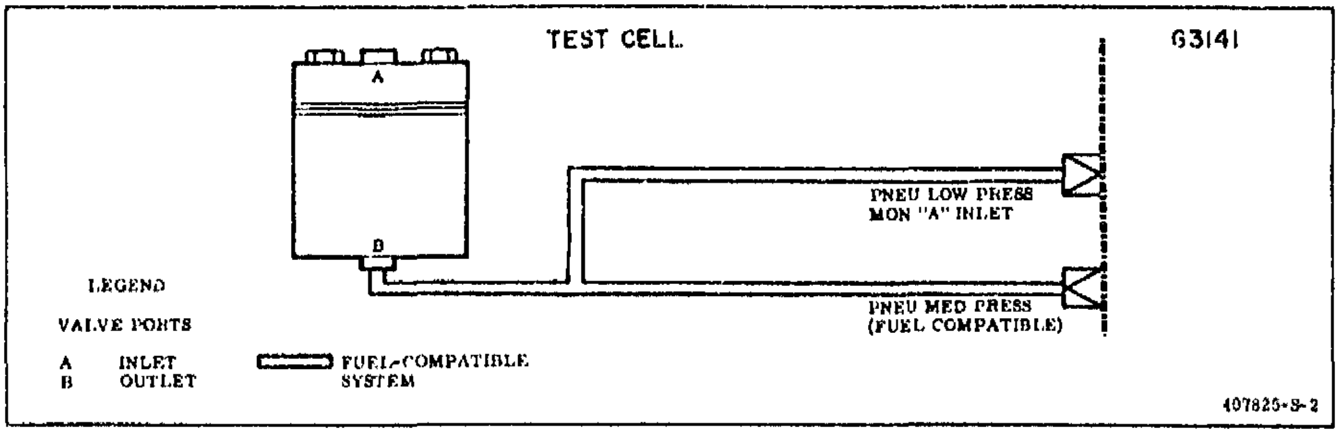


Figure 11-9. Inert Prefill Check Valve Seat Pneumatic Leak-Test Setup

11-14. SEAT PNEUMATIC LEAK-TEST.

Procedure	Result
a. Prepare Components Test Console and inert prefill check valve for testing as outlined in paragraph 11-12; then connect valve inlet port (A) to PNEU MED PRESS (FUEL COMPATIBLE) outlet.	None.
b. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 25-35 psi.	Check valve inlet port (A) pressurized.
c. Purge and cycle check valve for five minutes.	Gas flows through valve.
d. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decays. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel and valve inlet port (A) depressurized.
e. Remove check valve from test setup.	None.
f. Connect check valve to console as shown in figure 11-9, seat pneumatic leak-test.	None.
g. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 30 ±5 psi.	Check valve outlet port (B) pressurized. LOW PRESS MONITOR FUEL COMPATIBLE panel PRESSURE MONITOR "A" gage must indicate 30 ±5 psi.
h. Maintain pressure for 5 (+1, -0) minutes; then measure for leakage at inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 50 scim.
i. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel and check valve depressurized.
j. Remove check valve from test setup.	None.
k. If check valve testing is terminated, secure equipment as outlined in paragraph 11-18.	None.
l. Protect valve as outlined in paragraph 11-2.	None.

11-15. SEAT AND EXTERNAL HYDRAULIC LEAK-TEST.

Procedure	Result
a. Prepare Components Test Console and inert prefill check valve for testing as outlined in paragraph 11-12. Connect check valve to console for seat and external leak-test as shown in figure 11-10.	None
b. Fully open hand valve in HYD MED PRESS MON "A" INLET line.	
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(4) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,500 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,500 ±100 psi.
e. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,100 ±30 psi. Open VENT valve.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until HYD MED PRESS MONITOR panel PRESSURE MONITOR "A" gage indicates 30 ±5 psi; then close HIGH PRESS SHUTOFF valve.	On HYD MED PRESS MONITOR panel, PRESSURE MONITOR "A" gage must indicate 30 ±5 psi. PRESSURE MONITOR "A" gage on HYD HIGH PRESS MONITOR panel also indicates pressure.
g. Maintain pressure for 5 (+1, -0) minutes. Measure for leakage at valve inlet port (A).	Maximum allowable seat leakage is one cc a minute. No visible external leakage is allowable.
h. Repeat steps f and g at 100 ±5 and 500 ±10 psig.	Same results as steps f and g.
i. Fully close hand valve to HYD MED PRESS MON "A" INLET.	PRESSURE MONITOR "A" gage isolated.
j. Repeat steps f and g at 1,000 ±10, 1,500 ±20 and 2,000 ±30 psig.	Same results as steps f and g.
k. On HIGH PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero. Close VENT and SHUTOFF valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
l. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve. Close valve after pressure decays.	HYDRAULIC CONTROL panel depressurized.
m. On HYD MED PRESS MONITOR panel open PRESSURE MONITOR "A" gage shutoff valve.	PRESSURE MONITOR "A" gage must indicate zero.
n. On HYD HIGH PRESS MONITOR panel, open PRESSURE MONITOR "A" gage shutoff valve.	PRESSURE MONITOR "A" gage must indicate zero.
o. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
p. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light off and CLOSE light on.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.

Procedure	Result
(3) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
q. Remove check valve from test setup.	None.
r. If check valve testing is terminated, secure equipment as outlined in paragraph 11-18.	None.
s. Protect valve as outlined in paragraph 11-2.	None.

11-16. HYDRAULIC DIFFERENTIAL PRESSURE-TEST.

Procedure	Result
a. Prepare Components Test Console and in pre-fill check valve for testing as outlined in paragraph 11-12. Connect check valve for differential pressure test as shown in figure 11-10.	None.
b. Prepare DIGITAL VOLTMETER (DVM) for flow-monitor-test (figure 11-6), and press RESET switch.	DVM indicates KC000000-000001
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 400 ±100 psi.	SUPPLY PRESSURE gage must indicate 400 ±100 psi.
e. On MED PRESS COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 300 ±50 psi. Open VENT valve.	MED PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.
g. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	OPEN light on and CLOSE light off.
h. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve to establish a flow of 10 ±1 gpm through the valve and a downstream pressure of 100 psig minimum at outlet port (B); then close SHUTOFF valve. Record flow and downstream pressure.	DVM must indicate an equivalent to 10 ±1 gpm. PRESSURE MONITOR "A" gage must indicate 100 psi minimum.
i. (Deleted)	
j. Record differential pressure across valve ports.	DIFFERENTIAL PRESSURE gage on HYD DIFF PRESS MONITOR panel must indicate 15-35 psi.
k. On MED PRESS COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero. Open VENT and SHUTOFF valves.	MED PRESS FUEL COMPATIBLE panel depressurized.

Procedure	Result
l. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve. Close valve after pressure decays.	HYDRAULIC CONTROL panel depressurized.
m. On HYD DIFF PRESS MONITOR panel, open TEST CELL UPSTREAM INLET valve. Close valve after pressure decays.	DIFFERENTIAL PRESSURE gage indicates zero.
mA. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 off.
n. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF and VENT valves.	None.
o. Remove valve from test setup.	None.
p. If check valve testing is terminated, secure equipment as outlined in paragraph 11-18.	None.
q. Protect valve as outlined in paragraph 11-2.	None.

11-17. HYDRAULIC RESEAT LEAKAGE TEST.

Procedure	Result
a. Prepare Components Test Console and inert pre-fill check valve for testing as outlined in paragraph 11-12. Connect check valve to console for reseat-test as shown in figure 11-10.	None.
b. Fully close hand valve in Δ P HYD MON UPSTREAM INLET line and uncap Δ P HYD MON DOWNSTREAM INLET fitting.	None.
c. Prepare DIGITAL VOLTMETER (DVM) for flow monitor test (figure 11-6), and press RESET switch.	DVM indicates KC000000-000001.
d. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
e. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 200 ±10 psi. Open VENT valve.	MED PRESS FUEL COMPATIBLE panel pressurized.
f. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.
g. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve to obtain a flow of 10 ±1 gpm through valve.	DVM must indicate an equivalent to 10 ±1 gpm.
h. On HIGH PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves.	None.
i. On HYDRAULIC CONTROL panel, adjust HIGH PRESS and MED PRESS SHUTOFF valves to decrease pressure until PRESSURE MONITOR "A" gage on HYD MED PRESS MONITOR panel indicates 30 psi.	PRESSURE MONITOR "A" gage indicates 30 psi.
j. Open hand valve in Δ P HYD MON UPSTREAM INLET line.	PRESSURE DIFFERENTIAL gage indicates 30 psi.

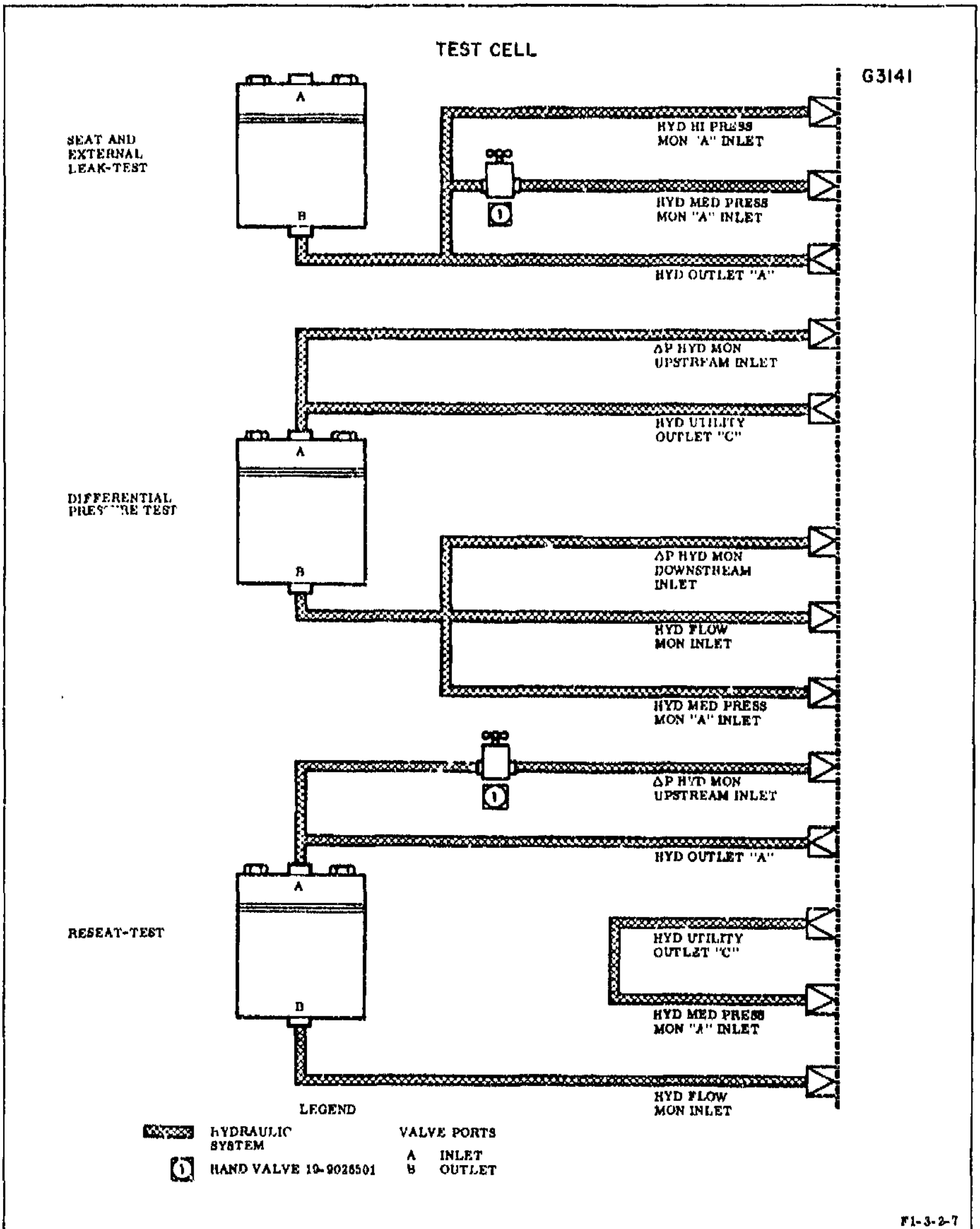


Figure 11-10. Inert Prefill Check Valve Hydraulic-Test Setups

Procedure	Result
k. On HYDRAULIC CONTROL panel, adjust MED PRESS and HIGH PRESS SHUTOFF valves to reduce pressure to valve inlet port (A) until PRESSURE DIFFERENTIAL gage indicates 5.0 ±0.5 psi.	PRESSURE DIFFERENTIAL gage must indicate 5.0 ±0.5 psi.
l. (Deleted)	
m. Disconnect line at check valve outlet port (B) and measure for leakage.	Maximum allowable leakage is 25 cc per minute.
n. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF and VENT valves.	None.
o. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero. Open SHUTOFF valve.	MED PRESS FUEL COMPATIBLE panel depressurized.
p. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve. Close valve after pressure decays.	Check valve inlet port (A) depressurized.
pA. On HYD DIFF PRESS MONITOR panel, open TEST CELL UPSTREAM INLET valve. Close valve after pressure decays.	PRESSURE DIFFERENTIAL gage indicates zero.
q. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 off.
r. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage on HYDRAULIC CONTROL panel must indicate zero.

Procedure	Result
s. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light off and CLOSE light on.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(3) Press FLOW MONITOR SHUTOFF switch-light.	CLOSE light on and OPEN light off.
(4) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
t. Remove inert prefill check valve from test setup.	None.
u. If inert prefill check valve testing is terminated, secure test equipment as outlined in paragraph 11-18.	None.
v. Protect valve as outlined in paragraph 11-2.	None.

11-18. SECURING TEST EQUIPMENT.

11-19. After inert prefill check valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve and open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves and adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero and close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn digital voltmeter power off.

i. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

j. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off, and press POWER ON switch-light.

k. Turn DC POWER SUPPLY off.

l. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION XII

OXIDIZER DOME PURGE CHECK VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

12-1. OXIDIZER DOME PURGE CHECK VALVE 554119.

12-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the oxidizer dome purge check valve. See figure 12-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

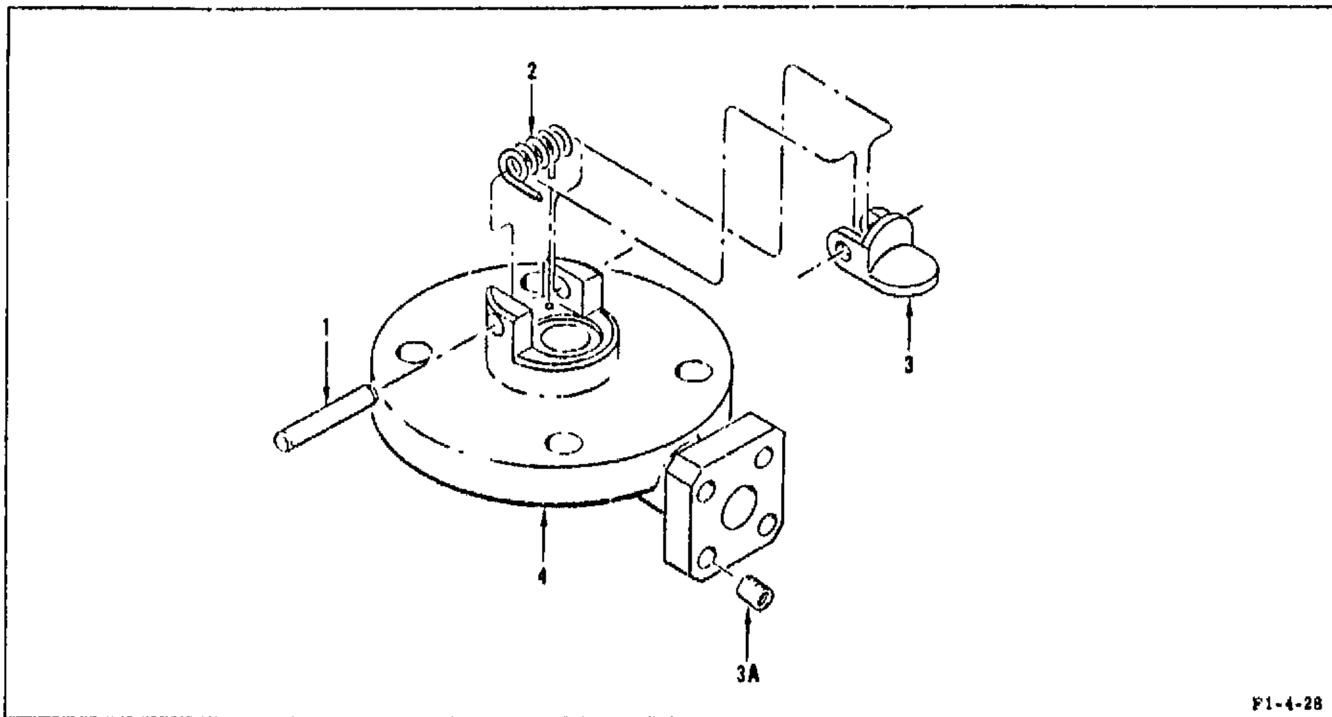
12-3. DISASSEMBLING.

12-4. Disassemble the oxidizer dome purge check valve as required to accomplish necessary repairs and/or replacement. Refer to figure 12-3 for parts and index numbers.

Part No.	Nomenclature	Use
T-5031188	Pressure Test Fixture	Houses oxidizer dome purge check valve.
T-5037824	Lapping Tool	Laps check valve seat.
G3104	Pneumatic Flow Tester	Measures check valve downstream pneumatic leakage.
G3141	Components Test Console	Provides pneumatic pressure and measurements for testing check valve.
G3143	Components Adapter Set	Provides hardware for check valve test setups.

Figure 12-1. Test Equipment and Special Tools for Oxidizer Dome Purge Check Valve

Figure 12-2 deleted.



1 Pin	2 Spring	3 Gate	3A Insert	4 Body

Figure 12-3. Oxidizer Dome Purge Check Valve--Exploded View

12-5. CLEANING.

12-6. Clean all parts of the oxidizer dome purge check valve for liquid oxygen service as outlined in R-3896-3, Volume I.

12-7. INSPECTING AND REPAIRING.

12-8. Inspecting the oxidizer dome purge check valve determines if the individual parts have been damaged by mishandling or wear. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Refer to figure 12-4 and inspect individual parts for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches.

12-9. ASSEMBLING.

12-10. Install spring (2) and gate (3) on body (4) and secure with pin (1). Refer to figure 12-3 for parts and index numbers.

12-11. TESTING.

12-12. This procedure outlines requirements for complete testing of the oxidizer dome purge check valve, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3104 is used for pneumatic leak-testing. Any deviations, including the use of other equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install pressure-test-fixture on valve ports. Index letters are assigned to the valve ports in illustrations, for identification. Prepare components test console for use (figure 12-5). See figure 12-6 for a cutaway view. Refer to paragraphs 12-12 through 12-16 for purge check valve test procedures and see figures 12-7 and 12-8 for test setups.

CAUTION

During testing of the oxidizer dome purge check valve, the test equipment used and the valve must be maintained in a liquid-oxygen-clean condition.

Part Name and Index No.	Inspecting	Repairing
Pin (1)	Damage.	Replace.
Spring (2)	Corrosion or cracks.	Replace.
Gate (3)	Deteriorated or damaged.	Replace.
	Nicks, scratches, or other imperfections in sealing surface that would impair its sealing function and be flat within 0.0001 inch.	Lap sealing surface to acquire allowable leakage and flatness.
Body (4)	Deteriorated or damaged anodic coating.	Replace anodic coating as outlined in R-3896-3, Volume I.
	Nicks, scratches, or other imperfections on sealing surface that would impair its sealing function and be flat within 0.0005 inch.	Using lapping tool T-5037824, lap sealing surface to acquire allowable leakage and flatness.
Insert (3A)	Damaged.	Replace as outlined in R-3896-3, Volume I.

Figure 12-4. Inspecting and Repairing Oxidizer Dome Purge Check Valve

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counterclockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	off	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	
	POWER	Down (off)	
TEST CELL ELECT OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
	Connector J703	Capped	
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Push in	Console main power on.
	CB2 (10 AMP)	Push in	Electrical utility outlets power off.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	

Figure 12-5. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
ELECTRICAL CONTROL	POWER		POWER light ON.[a] AC INPUT light on.
	VOLTS RANGE SELECT	D (0-30).	None
	MILLIAMPERES RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter 24 ±0.4 volts.

PNEUMATIC AND HYDRAULIC PREPARATION

a. Make sure that console is in the following condition:

(1) Vent valves open (LOW and HIGH PRESSURE panel VENTS closed during cryogenic tests).

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous helium to console. PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates supply pressure.

NOTE

Gaseous helium (Bureau of Mines, Grade A) is the test medium used for ambient and low-temperature tests.

c. On SYSTEM SUPPLY panel, close SYS VENT valve.

(a) If indication is not as specified, press applicable switch-light.

Figure 12-5. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks

d. On PNEU SOURCE CONTROL panel, open HELIUM SOURCE SHUTOFF valve. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates supply pressure.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console pressurizing panels and into test cell. Safety precautions specified in R-3896-3, Volume I must be followed to ensure safety of personnel working with pressurized systems.

Figure 12-5. Preparing Components Test Console for Use (Sheet 3 of 3)

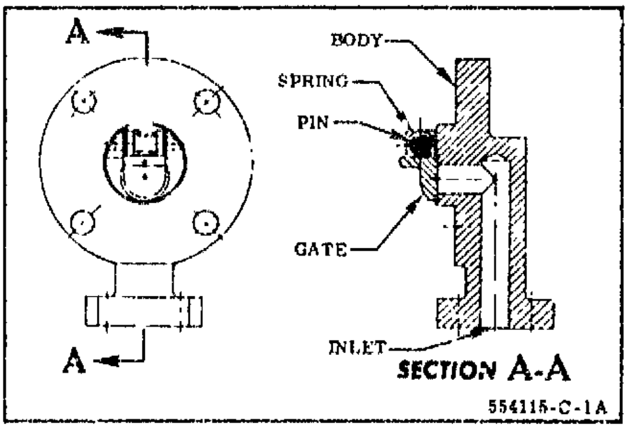


Figure 12-6. Oxidizer Dome Purge Check Valve--Cutaway View

Procedure	Result
12-13. AMBIENT TEMPERATURE REVERSE LEAKAGE TESTS.	
a. Prepare components test console and oxidizer dome purge check valve for tests as outlined in paragraph 12-12; then connect check valve to console for reverse leak-tests as shown in figure 12-7.	None.
b. On FLOW/Δ P MONITOR panel, open TEST CELL INLET SHUTOFF valve.	None.
c. On HIGH PRESSURE panel, apply pressure to check valve as follows:	
(1) Open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 30 ±3 psi.	Check valve outlet (B) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 30 ±3 psi.
d. Measure for leakage from inlet port (A) from Pneumatic Flow Tester G3104.	Maximum allowable leakage is 10 scim.
e. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	Check valve outlet port (B) pressurized. TEST CELL MONITOR PRESSURE gage must indicate 100 ±10 psi.
f. Measure for leakage from inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 10 scim.
g. On FLOW/Δ P MONITOR panel, close TEST CELL INLET SHUTOFF valve.	TEST CELL MONITOR PRESSURE gage isolated.

Procedure	Result
h. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±100 psi.	Check valve outlet port (B) pressurized. On PRESSURE/TEMPERATURE MONITOR panel, PRESSURE gage must indicate 1,500 ±100 psi.
i. Measure for leakage from inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 10 scim.
j. Repeat steps h and i at 2,000 ±100 psig.	Same results as steps h and i.
k. On HIGH PRESSURE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Valve outlet port (B) depressurized. On PRESSURE/TEMPERATURE MONITOR panel, PRESSURE monitor gage must indicate zero.
l. Remove check valve from test setup.	None.
m. If check valve testing is terminated, secure equipment as outlined in paragraph 12-17.	None.
n. Install protective closures. Refer to paragraph 12-2.	None.

12-14. AMBIENT TEMPERATURE RESEAT LEAKAGE TEST.

Procedure	Result
a. Prepare components test console and check valve for test as outlined in paragraph 12-12; then connect valve to console for reseat-test as shown in figure 12-7.	None.
b. On FLOW/Δ P MONITOR panel, open UPSTREAM INLET SHUTOFF valve. Make sure DOWNSTREAM INLET fitting is uncapped.	None.
c. On LOW PRESSURE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 5 psi.	Valve inlet port (A) pressurized. On FLOW/Δ P MONITOR panel PRESSURE DIFFERENTIAL gage indicates 5 psi.
d. On LOW PRESSURE panel, slowly reduce pressure to valve inlet port (A) until PRESSURE DIFFERENTIAL gage indicates 0.25 ±0.10 psi.	PRESSURE DIFFERENTIAL gage must indicate 0.25 ±0.10 psi.
e. Measure for leakage from outlet port (B) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 100 scim.
f. On LOW PRESSURE panel, close SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LOW PRESSURE panel and valve depressurized.
g. On FLOW/Δ P MONITOR panel, close UPSTREAM INLET SHUTOFF valve. Cap 15Δ P DOWNSTREAM INLET fitting.	None.
h. Remove oxidizer dome purge check valve from test setup.	None.
i. If check valve testing is terminated, secure equipment as outlined in paragraph 12-17.	None.
j. Install protective closures. Refer to paragraph 12-2.	None.

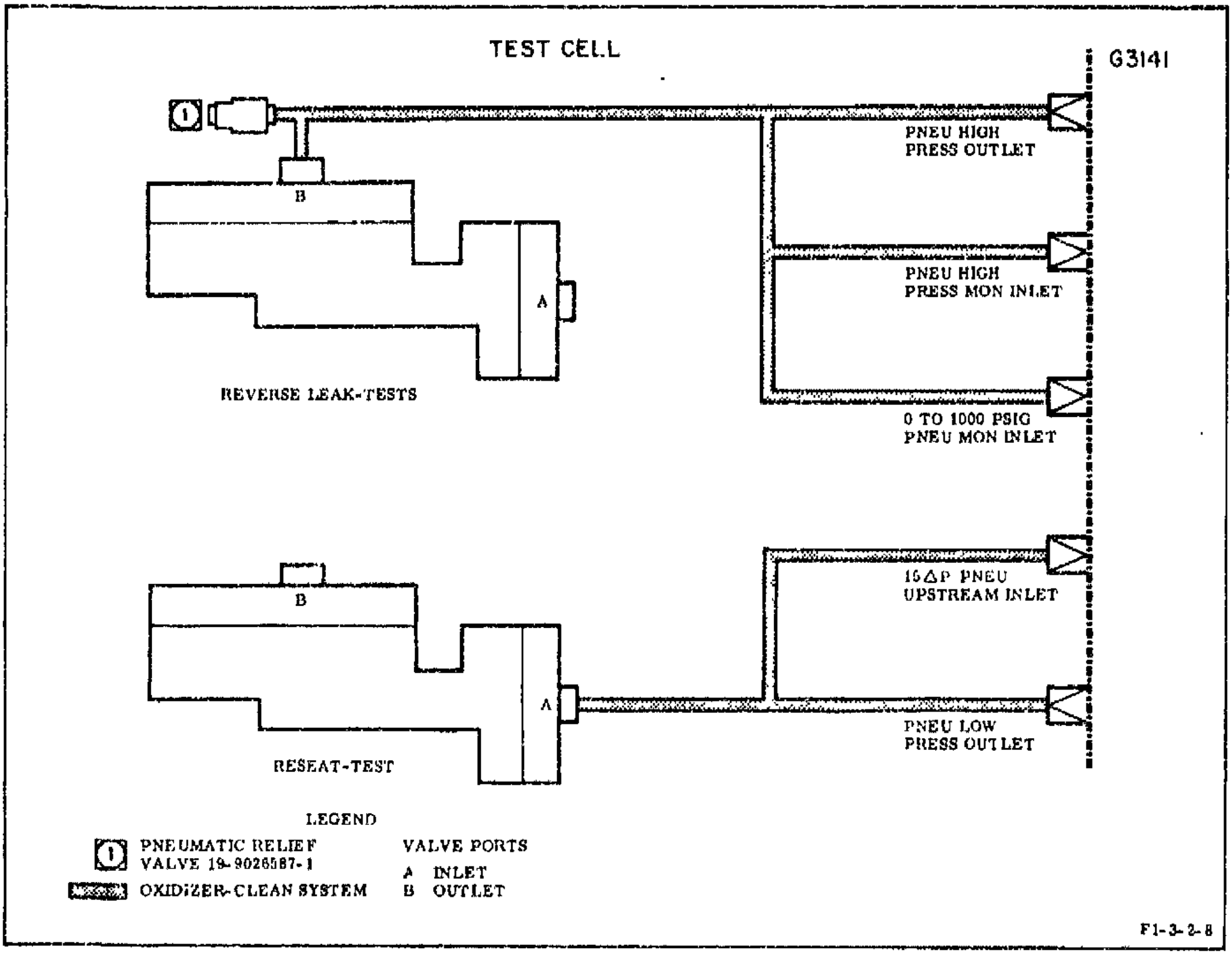


Figure 12-7. Oxidizer Dome Purge Check Valve Ambient Temperature Test Setups

Procedure	Result
12-15. LOW-TEMPERATURE REVERSE LEAKAGE TESTS.	
a. Prepare components test console and check valve for tests as outlined in paragraph 12-12. Connect valve to console for reverse leakage tests as shown in figure 12-8.	None.
b. On FLOW/Δ P MONITOR panel, open TEST CELL INLET SHUTOFF valve.	None.
c. On HIGH PRESSURE panel, open SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 30 +3 psi.	HIGH PRESSURE panel and valve outlet port (B) pressurized.
d. Fill container with liquid nitrogen. Cold-soak valve until boiling stops.	Valve temperature reduced.
e. Measure for leakage from inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 30 scim.

Procedure	Result
f. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	On FLOW/Δ P MONITOR panel TEST CELL MONITOR PRESSURE gage must indicate 100 ±10 psi.
g. Measure for leakage from inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 30 scim.
h. On FLOW/Δ P panel, close TEST CELL INLET SHUTOFF valve.	TEST CELL MONITOR PRESSURE gage isolated.
i. On HIGH PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±100 psi.	HIGH PRESSURE panel and valve outlet port (B) pressurized. On PRESSURE/TEMPERATURE MONITOR panel, PRESSURE gage must indicate 1,500 ±100 psi.
j. Measure for leakage from inlet port (A) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 30 scim.
k. Repeat steps i and j at 2,000 ±100 psig.	Same results as steps i and j.
l. On HIGH PRESSURE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS. gage indicates zero.	Valve outlet port (B) depressurized. On PRESSURE/TEMPERATURE MONITOR panel, PRESSURE monitor gage must indicate zero.
m. Remove valve from test setup.	None.
n. If check valve testing is terminated, secure equipment as outlined in paragraph 12-17.	None.
o. After valve has returned to room temperature, install protective closures. Refer to paragraph 12-2.	None.

12-16. LOW-TEMPERATURE FLOW- AND RESEAT LEAKAGE TESTS.

Procedure	Result
a. Prepare components test console and check valve for tests as outlined in paragraph 12-12. Connect valve to console for flow- and reseat-tests as shown in figure 12-8.	None.
b. On LOW PRESSURE panel, open SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 25 ±1 psi.	LOW PRESSURE panel and valve inlet port (A) pressurized. On FLOW/Δ P MONITOR panel, TEST CELL MONITOR PRESSURE gage must indicate 25 ±1 psi.
c. Observe flow from valve outlet port (B).	Gaseous helium must flow from valve outlet for 5 seconds minimum.
d. On LOW PRESSURE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 5 psi.	Pressure at valve inlet port (A) reduced.
e. On FLOW/Δ P MONITOR panel, open UPSTREAM INLET SHUTOFF VALVE. Uncap 15Δ P PNEU DOWNSTREAM INLET fitting.	PRESSURE DIFFERENTIAL gage must indicate 5 psi.
f. On LOW PRESSURE panel, slowly reduce pressure to valve inlet port (A) until PRESSURE DIFFERENTIAL gage indicates 0.25 ±0.10 psi.	PRESSURE DIFFERENTIAL gage must indicate 0.25 ±0.10 psi.

Procedure	Result
g. Measure for leakage from outlet port (B) with Pneumatic Flow Tester G3104.	Maximum allowable leakage is 200 scim.
h. On LOW PRESSURE panel, close SHUTOFF valve. Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LOW PRESSURE panel and check valve depressurized.
i. On FLOW/Δ P MONITOR panel, close UPSTREAM INLET SHUTOFF valve. Cap 15Δ P PNEU DOWNSTREAM INLET fitting.	None.
j. Remove oxidizer dome purge check valve from test setup.	None.
jA. If check valve testing is terminated, secure equipment as outlined in paragraph 12-17.	None.
k. After valve has returned to room temperature, install protective closures. Refer to paragraph 12-2.	None.

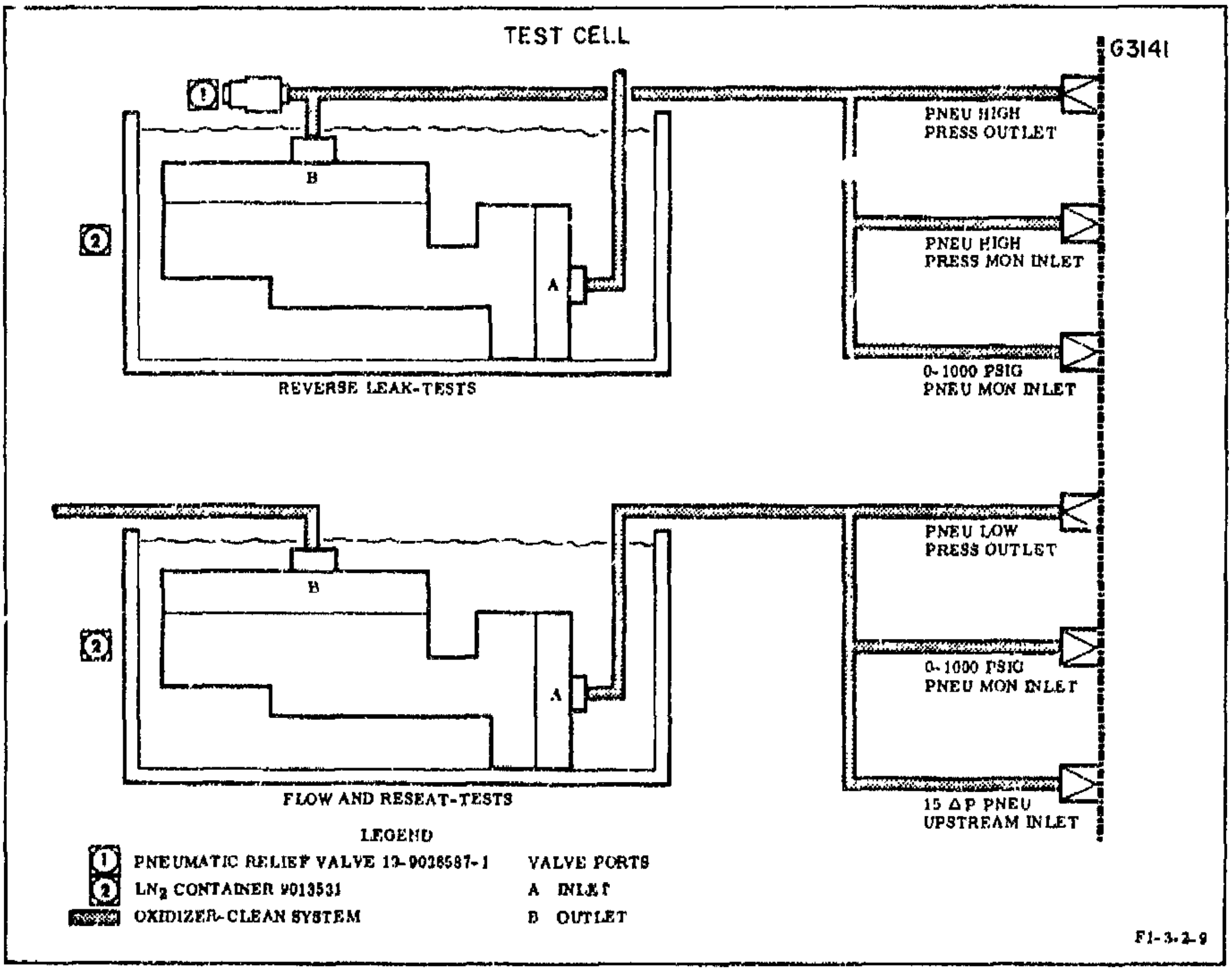


Figure 12-8. Oxidizer Dome Purge Check Valve Low-Temperature Test Setups

12-17. SECURING TEST EQUIPMENT.

12-18. After oxidizer dome purge check valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen and helium supply pressure to zero.

b. On PNEU SOURCE CONTROL panel, close HELIUM SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, verify TO FUEL COMPATIBLE SYS shutoff valve is closed; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

i. Turn DC POWER SUPPLY off.

j. On POWER DISTRIBUTION panel, pull out all circuit breakers.

SECTION XIII

OXIDIZER VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, COMPONENTS ADAPTER SET G3143, AND CRYOGENIC SUPPLY UNIT G3146 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

13-1. <u>OXIDIZER VALVES 408055 AND 409465 THROUGH 409465-51.</u>

13-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the oxidizer valve. See figure 13-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. The threads of closure RX20845-21 must be lubricated (Method A) and the packing used with the closure lubricated (Method J) using lubricant grease RB0140-012 (Rocketdyne). Specified lubrication methods are outlined in R-3896-3, Volume I.

Part No.	Nomenclature	Use
T-5029363	Assembly Stand	Holds oxidizer valve during repair and checkout.
T-5035223[a]	Poppet Removal Tool	Removes oxidizer valve poppet from housing during disassembly.
T-5029251[a]	Piston Torque Wrench	Torques oxidizer valve piston to piston rod.
T-5022671	Poppet Locking Tool	Holds poppet while removing piston bolt.
T-5037837	Piston Installation Tool	Removes and installs piston.
T-5022672	Spring Compressor	Compresses oxidizer valve springs during repair.
T-5036723[a]	Seal Forming Tool	Forms and installs oxidizer valve piston rod seal.
T-5029252	Torque Wrench	Torques oxidizer valve nut on piston rod.
T-5031701[a]	Piston Rod Simulator	Forms and installs oxidizer valve piston rod seal.
T-5022663[a]	Poppet Handling Tool	Handles oxidizer valve poppet during chilling and installation.
T-5036724	Special Socket Wrench	Torques special handling bolts.
T-5029362[a]	Pressure Test Fixture	Leak-tests oxidizer valve with gaseous or liquid nitrogen.
T-5036727[b]	Pressure Test Fixture	Pressure-tests oxidizer valve with liquid nitrogen.
T-5035245	Wrench	Installs closures RX20845.
T-5031188-109[a]	Pressure Test Fixture	Pressure-tests oxidizer valve with liquid nitrogen.
8693 (Leeds Northrup), or equivalent	Temperature Potentiometer	Indicates oxidizer valve temperature during cryogenic testing.
	Thermocouple, Copper-Constantan (6-8 feet long)	Senses oxidizer valve temperature during cryogenic testing.

(a) Maintain item in a liquid-oxygen-clean condition.
(b) Item not used when performing test with Components Test Console.

Figure 13-1. Test Equipment and Special Tools for Oxidizer Valve (Sheet 1 of 2)

Part No.	Nomenclature	Use
17	Pressure Gage 0-15 psig, 0.25% full-scale accuracy, hydraulic service, or equivalent	Measures hydraulic pressure during surface wetting leak-test.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements.
1432-T (General Radio Co), or equivalent	Decade Resistance Box	Used with Triplett 630A for resistance tests.
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests.
G3104	Pneumatic Flow Tester	Measures oxidizer valve downstream pneumatic leakage.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel for testing oxidizer valve.
G3143	Components Adapter Set	Provides hardware for oxidizer valve test setups.
G3146	Cryogenic Supply Unit	Provides liquid nitrogen for cold-testing oxidizer valve.

Figure 13-1. Test Equipment and Special Tools for Oxidizer Valve (Sheet 2 of 2)

Figure 13-2 deleted.

13-3. DISASSEMBLING.

13-4. Disassemble the oxidizer valve, as required, to accomplish necessary repairs and/or replacement. See figure 13-3 for parts and index numbers. Do not remove inserts unless they are damaged.

a. Place oxidizer valve into assembly stand T-5029363 and secure.

b. Remove the following parts from cylinder (71) in the sequence listed: Parts (1) through (14), (15) through (17A) as a subassembly, (26, 27), (28) through (40) as a subassembly, (42) through (44), (45) and (46) as a subassembly, and (47) through (54).

NOTE

If it is necessary to remove arm (36) from the indicator shaft on valve 409465-31, the arm may be heated to 120° F maximum in order to easily remove screw (35) and the arm.

c. Remove nut (18), then remove piston (19), using piston torque wrench T-5029251, piston installation tool T-5037837, and poppet locking tool T-5022671. Remove packings and retainers (20) through (23).

d. Attach spring compressor T-5022672 to housing (114) for removal of cylinder (71); remove bolts (57), washers (58), and bushing (59), then remove cylinder (71).

WARNING

Cylinder (71) is under spring load. Care must be exercised while using spring compressor to remove cylinder. Spring load will be relieved as cylinder is removed.

e. Remove the following parts in the sequence listed:

(1) (24), (25), and (60) through (70) from cylinder (71).

Pages 13-3 through 13-6 deleted.

(2) (72) through (73B) and (75) through (78) from cover (88).

NOTE

Sleeve (73A) may be removed using a suitable gear puller.

(3) Cover (88).

(4) (79) through (87) from cover (88).

f. Remove bolt (93) and washer (94) from piston rod (100), then remove piston rod (100) from poppet (101). Do not remove pins (99) from piston rod (100) unless they are damaged.

g. Remove screws (95) and retainer (96), then remove poppet (101) using poppet removal tool T-5035223.

h. Remove seal (97) from poppet (101).

i. Remove parts (89, 89A, 98), (106) through (109), (111, 112).

j. Remove housing (114) from assembly jig T-5029363, then remove bolts (110) from housing.

k. Place housing (114) in degreaser and heat until housing reaches 140° to 160° F; remove housing from degreaser, then remove parts (90) through (92) from housing.

13-5. CLEANING.

13-6. The oxidizer valve housing containing parts (60) through (68) and (72) through (114) must be cleaned for liquid oxygen service. If bolt (93) and washer (94) have dyed surfaces, the dye must be stripped from the parts before the parts are cleaned. The cylinder assembly containing parts (1) through (8), (10) through (25), (45) through (59), and (69) through (71) must be cleaned for fuel service. Parts for transducer (28) must be cleaned for electrical service. Refer to R-3896-3, Volume I for cleaning procedures.

13-7. INSPECTING AND REPAIRING.

13-8. Inspecting the oxidizer valve determines if the individual parts have been damaged by mishandling or wear. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Refer to figure 13-4 and inspect individual parts for general condition, cleanness, damage of threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits listed in figure 13-5 form the guide to serviceability of parts. Minimum and maximum values are given, beyond which repair or replacement of parts is required.

13-9. ASSEMBLING.

13-10. The assembly procedures for the oxidizer valve must be performed in the sequence listed and all parts must meet cleaning requirements as outlined in paragraph 13-5. The lubricant used in this procedure is FS1281 grease (Dow Corning Corp), unless otherwise noted. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 13-3 for parts and index numbers.

13-10A. INSTALLING SEALS, POPPET, AND PISTON ROD IN HOUSING.

a. Verify that bolt (93) and washer (94) do not have dyed surfaces. If dye is present, the dyed part must be stripped and cleaned, as outlined in R-3896-3, Volume I.

aA. Install bolts (110) into housing (114). Torque bolts to 80-100 in-lb using special socket wrench T-5036724.

b. Place housing (114) in degreaser and heat until housing reaches approximately 180° F; then remove housing.

c. Place housing (114) into assembly stand T-5029363 and secure.

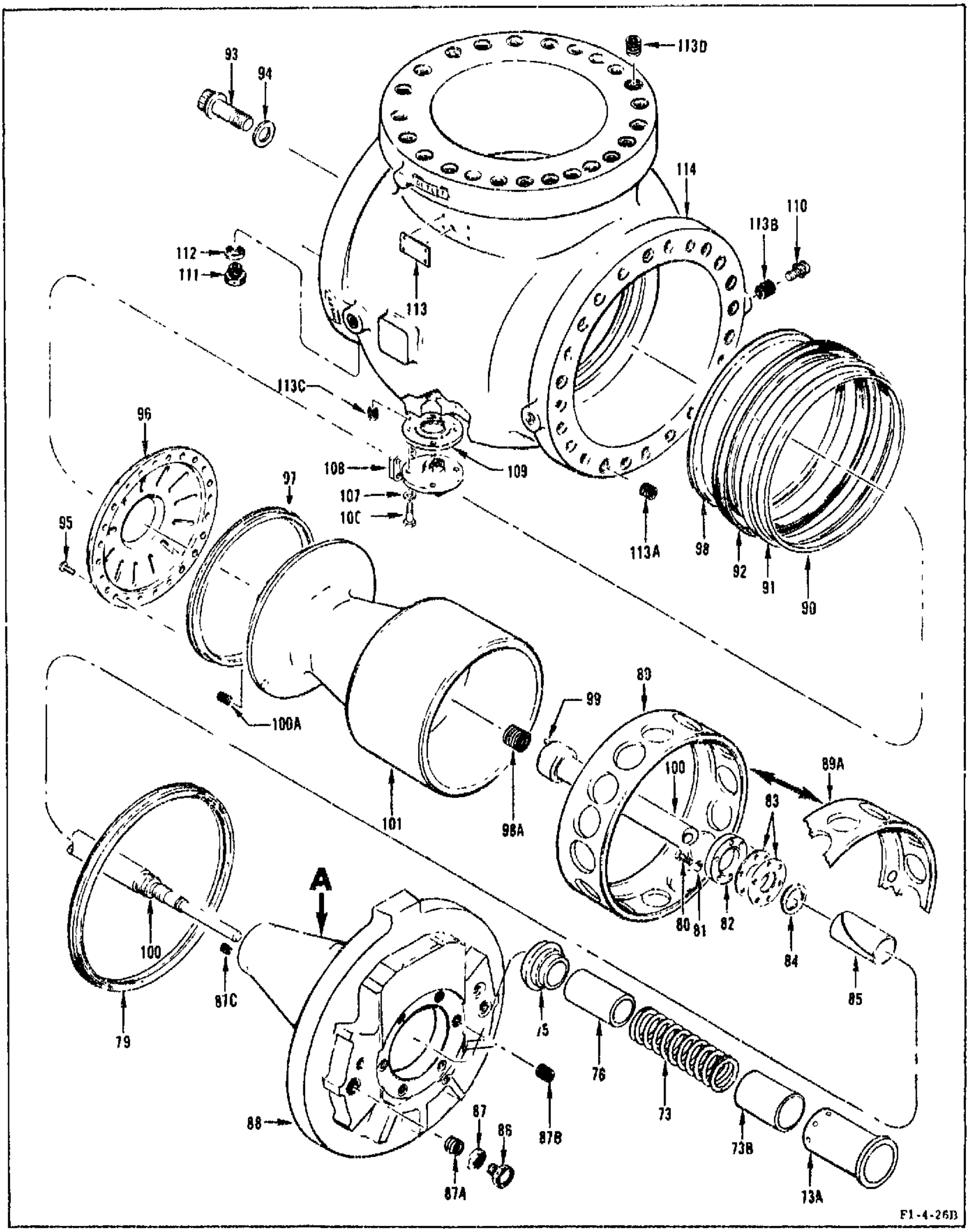


Figure 13-3. Oxidizer Valve--Exploded View (Sheet 1 of 3)

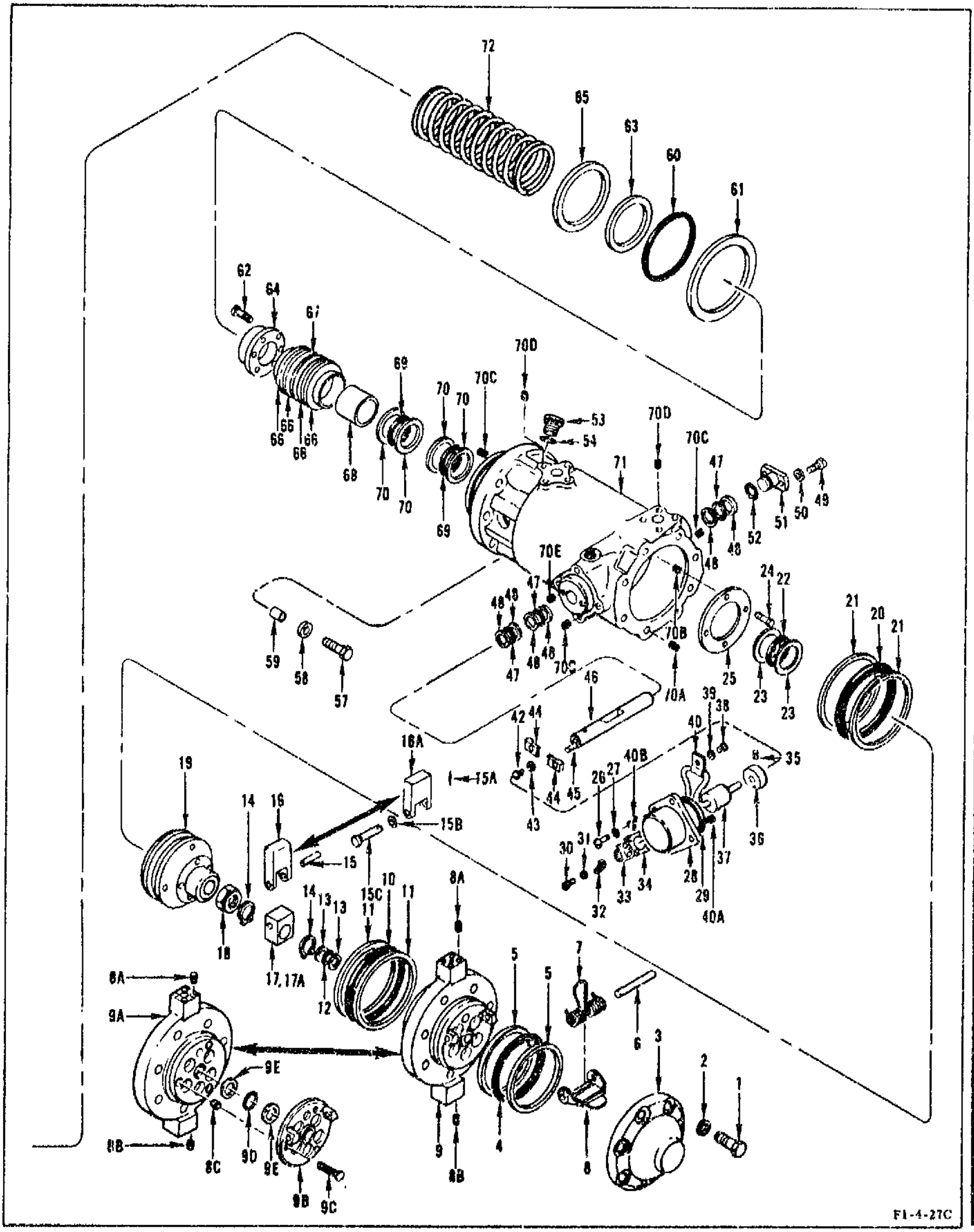
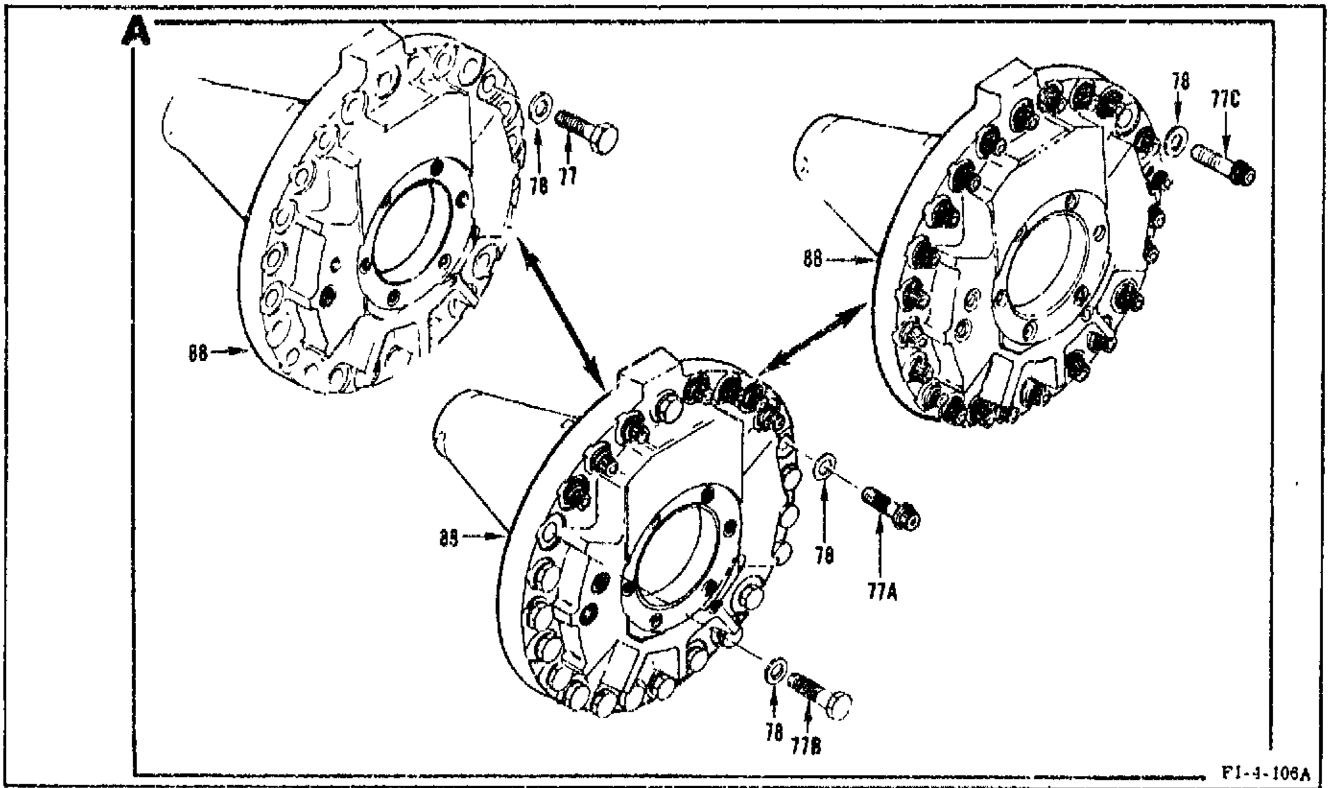


Figure 13-3. Oxidizer Valve--Exploded View (Sheet 2 of 3)



1	Bolt	18	Nut	46	Shaft	71	Cylinder	92	Seal
2	Washer	19	Piston	47	Packing	72	Spring	93	Bolt
3	Cap	20	Packing	48	Retainer	73	Spring	94	Washer
4	Packing	21	Retainer	49	Screw	73A	Sleeve	95	Screw
5	Retainer	22	Packing	50	Washer	73B	Liner	96	Retainer
6	Pin	23	Retainer	51	Plug	74	(Deleted)	97	Seal
7	Spring	24	Screw	52	Packing	75	Seat	98	Ring
8	Gate	25	Washer	53	Plug	76	Bushing	98A	Insert
8A	Insert	26	Screw	54	Seal	77	Bolt	99	Pin
8B	Insert	27	Washer	55	(Deleted)	77A	Bolt	100	Piston Rod
8C	Insert	28	Transducer	56	(Deleted)	77B	Bolt	100A	Insert
9	Cylinder Head	29	Packing	57	Bolt	77C	Bolt	101	Poppet
9A	Cylinder Head	30	Screw	58	Washer	78	Washer	102	(Deleted)
9B	Plate	31	Washer	59	Bushing	79	Seal	103	(Deleted)
9C	Screw	32	Lug	60	Packing	80	Screw	104	(Deleted)
9D	Packing	33	(Deleted)	61	Washer	81	Washer	105	(Deleted)
9E	Retainer	34	(Deleted)	62	Screw	82	Retainer	106	Bolt
10	Packing	35	Screw	63	Washer	83	Lip Seal	107	Washer
11	Retainer	36	Arm	64	Retainer	84	Ring	108	Valve
12	Packing	37	Resistor	65	Washer	85	Bushing	109	Seal
13	Retainer	38	Screw	66	Lip Seal	86	Plug	110	Bolt
14	Ring	39	Washer	67	Washer	87	Seal	111	Plug
15	Pin	40	Clamp	68	Bushing	87A	Insert	112	Seal
15A	Pin	40A	Insert	69	Packing	87B	Insert	113	Nameplate
15B	Washer	40B	Insert	70	Retainer	87C	Insert	113A	Insert
15C	Pin	41	(Deleted)	70A	Insert	88	Cover	113B	Insert
16	Clevis	42	Screw	70B	Insert	89	Retainer	113C	Insert
16A	Clevis	43	Washer	70C	Insert	89A	Retainer	113D	Insert
17	Block	44	Clip	70D	Insert	90	Ring	114	Housing
17A	Block	45	Pin	70E	Insert	91	Ring		

Figure 13-3. Oxidizer Valve--Exploded View (Sheet 3 of 3)

Part Name and Index No.	Inspecting	Repairing
Cap (3), Retainer (64), Washer (67) and Retainer (82)	Damaged sealing surface.	Replace. Refer to figure 13-5 for washer (67).
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Pin (6, 15, 15A, 15C, 45)	Cracks, galling, flat areas, and wear.	Replace.
Spring (7)	Compressed rating.	Refer to figure 13-5.
Gate (8)	Damaged sealing surface.	Replace.
	Hole diameter.	Refer to figure 13-5.
Cylinder Head (9, 9A)	Damaged sealing surfaces.	Replace.
	Hole diameter.	Refer to figure 13-5.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Deteriorated or damaged rubber seal.	Replace cylinder head.
Plate 9B	Damaged sealing surfaces.	Lap sealing surface to meet leakage requirements.
	Outside diameter for cylinder head (9A).	Refer to figure 13-5.
Ring (14)	Nicks, burs, scratches.	Replace.
Clevis (16, 16A) and Block (17, 17A)	Hole diameters.	Refer to figure 13-5.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Piston (19)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Verify that hydraulic flow through bleed holes is 1.45 ±0.10 gpm. (Refer to paragraph 13-26.)	Remove obstruction or replace.
Washer (25), Plug (51), Retainer (89, 89A), and Retainer (96)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Transducer (28)	Damaged connector, bent pins, wiring, sealing surfaces, or variable resistor.	Replace transducer assembly.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.

Figure 13-4. Inspecting and Repairing Oxidizer Valve (Sheet 1 of 3)

Part Name and Index No.	Inspecting	Repairing
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Shaft (46)	Slot dimensions.	Refer to figure 13-5.
Cylinder (71); Cover (88), and Housing (114)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Springs (72, 73)	Compressed rating.	Refer to figure 13-5.
Ring (90)	Inside diameter.	Refer to figure 13-5.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Sleeve (73A)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Scratched outer surface.	Remove raised material; then replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Scratched inner surface.	Blend scratch; then replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Marks from using gear puller.	Remove raised material. After repair, outer diameter of sleeve must be 0.005-inch total indicated reading with small diameter 3.283 inches (minimum) and large diameter 3.628 inches (minimum). Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Circumferential rub marks on top of sleeve at large-diameter end.	Remove raised material; then replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Cracked or broken.	Replace.

Figure 13-4. Inspecting and Repairing Oxidizer Valve (Sheet 2 of 3)

Part Name and Index No.	Inspecting	Repairing
Liner (73B)	Deformation from springs.	Replace.
	Cracked or broken.	Replace.
	Scratches or buffed marks.	Acceptable as is.
Ring (91)	Outside diameter.	Refer to figure 13-5.
	Oxidized surface.	Clean ring to remove oxidization.
Piston Rod (100)	Damage to exterior surface.	Replace.
	Damaged inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Damaged pins (99).	Replace pins.
Poppet (101)	Damage to skirt surface.	Replace.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.

Figure 13-4. Inspecting and Repairing Oxidizer Valve (Sheet 3 of 3)

Part Name and Index No.	Dimension	Minimum (Inches except as noted)	Maximum
Spring (7)	Rotate to 180° in direction of twist.	1.73 in-lb	2.12 in-lb
	Rotate to 270° in direction of twist.	2.60 in-lb	3.18 in-lb
Gate (8)	Hole diameter.	0.227	0.235
Cylinder Head (9)	Hole diameter for pin (6).	0.181	0.187
Plate 9B	Outside diameter for cylinder head (9A).	0.749	0.751
	Hole diameter for pin (6).	0.181	0.187
Clevis (16)	Hole diameter for pin (15).	0.1557	0.1575

Figure 13-5. Dimensional Limits for Oxidizer Valve (Sheet 1 of 2)

Part Name and Index Number	Dimension	Minimum (Inches except as noted)	Maximum
Clevis (16B)	Hole diameter for pin (15C).	0.1557	0.1572
Block (17)	Hole diameter for pin (15).	0.1532	0.1545
	Hole diameter for piston rod (100).	0.500	0.501
Block (17A)	Hole diameter for pin (15C).	0.1544	0.1549
Arm (36)	Hole diameter.	0.250	0.251
	Slot dimension.	0.124	0.126
Shaft (46)	Slot length.	0.873	0.877
	Slot width.	0.312	0.313
Washer (67)	Surfaces to be flat within 0.0005 inch and parallel to each other within 0.001 inch.		
	Sealing lip protrusion.	0.003	0.0045
Cylinder (71)	Bore for piston (19).	4.001	4.0035
	Bore for piston rod (100).	1.129	1.131
	Bore for shaft (46).	0.751	0.7525
Spring (72)	Compress to 7.09 inches.	322 lb	394 lb
Spring (73)	Compress to 6.38 inches.	142 lb	174 lb
Retainer (82)	Sealing lip protrusion.	0.003	0.0045
Cover (88)	Sealing surface ID for cylinder (71).	3.625	3.627
	Sealing surface OD for housing (114).	9.560	9.561
Ring (90)	Inside diameter.	8.5725	8.5755
Ring (91)	Outside diameter.	9.3855	9.3875
Piston Rod (100)	Outside diameter for poppet (101).	1.6842	1.6847
	Outside diameter for cover (88).	1.2465	1.2472
	Outside diameter for cylinder (71).	1.1220	1.227
	Outside diameter for block (17).	0.4973	0.4985
	Outside diameter for cylinder head (9).	0.3717	0.373
Poppet (101)	Skirt outside diameter.	8.4372	8.4385
	Inside diameter for piston rod (100).	1.687	1.6882
	Outside diameter for seal (97).	7.624	7.626
Housing (114)	Inside diameter for skirt seal (92).	9.5615	9.5625

Figure 13-5. Dimensional Limits for Oxidizer Valve (Sheet 2 of 2)

WARNING

The following procedure uses liquid nitrogen, which must not be allowed to come in contact with any part of the body. Human tissue will freeze upon contact, causing serious injury. Eye protection and protective clothing must be worn by personnel handling liquid nitrogen. Liquid nitrogen must be used in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

d. Insert ring (91) into seal (92); then place ring and seal into a container of liquid nitrogen (MIL-P-27401).

dA. Using a heat gun, heat ring (90) to approximately 100° F.

NOTE

Step e must be performed immediately after removing seal and ring from liquid nitrogen to ensure proper diametric clearance between seal and housing.

- Refer to figure 13-6 for correct installation of rings and seals when performing steps e, g, and k.

e. Remove ring (91) and seal (92) from liquid nitrogen and install ring (90) in chilled seal (92); then chill assembled parts (90, 91, 92) and carefully install in heated housing (114). Make sure seal and rings are bottomed in housing. Allow assembly to return to ambient temperature.

f. Insert seal (97) into groove of poppet (101); then attach retainer (96) to poppet (101) with screws (95). Screws must be fingertight only.

g. Insert ring (98) into groove of housing (114).

h. Using poppet handling tool T-5022663, place poppet (101) into a container of liquid nitrogen until thoroughly chilled.

i. Carefully install chilled poppet (101) into housing (114); then remove poppet handling tool.

j. Allow housing (114) and poppet to return to ambient temperature.

k. Install retainer (89, 89A) in housing (114).

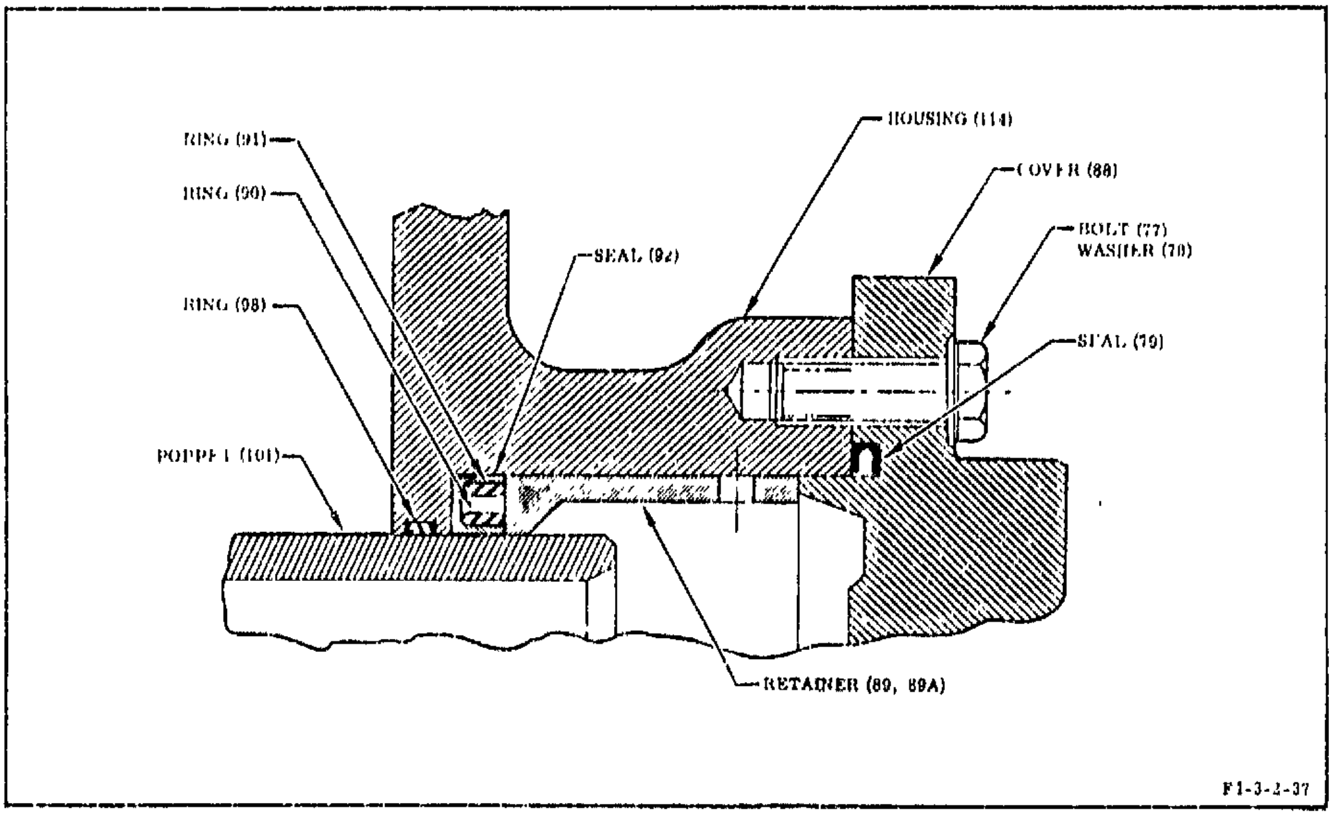


Figure 13-6. Oxidizer Valve Ring and Seal Installation

l. Install pins (99) in piston rod (100); then attach piston rod to poppet (101) with bolt (93) and washer (94). Torque bolt to 160 foot-pounds. Poppet must not rotate during torquing of bolt. If poppet rotates during torquing of bolt, replace defective seal (92) or rings (90, 91). Final torque of bolt (93) will be accomplished after valve is completely assembled as specified in paragraph 13-10E.

13-10E. INSTALLING COVER SEALS AND COVER.

NOTE

Steps a through f are for forming piston rod lip seals (83) and require piston rod simulator T-5031701 for forming.

- Blank lip seals must be free of all flaws and scratches on the sealing surfaces. The ID of the seal blanks have a sharp edge and must be free of nicks and burs and show no evidence of separation of the laminated material.

WARNING

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

a. Clean seal blanks with trichloroethylene (MIL-T-27602) and dry cleaned parts as outlined in R-3896-3, Volume I.

CAUTION

Ring (84) must be assembled in one direction only. Rings assembled backwards must be rejected.

b. Install bushing (85) and ring (84) in nose end of cover as indicated in figure 13-7.

c. Carefully place lip seal (83) onto nose end of cover (88) and ring (84); then install retainer (82) with screws (80) and washers (81). Do not tighten screws at this time.

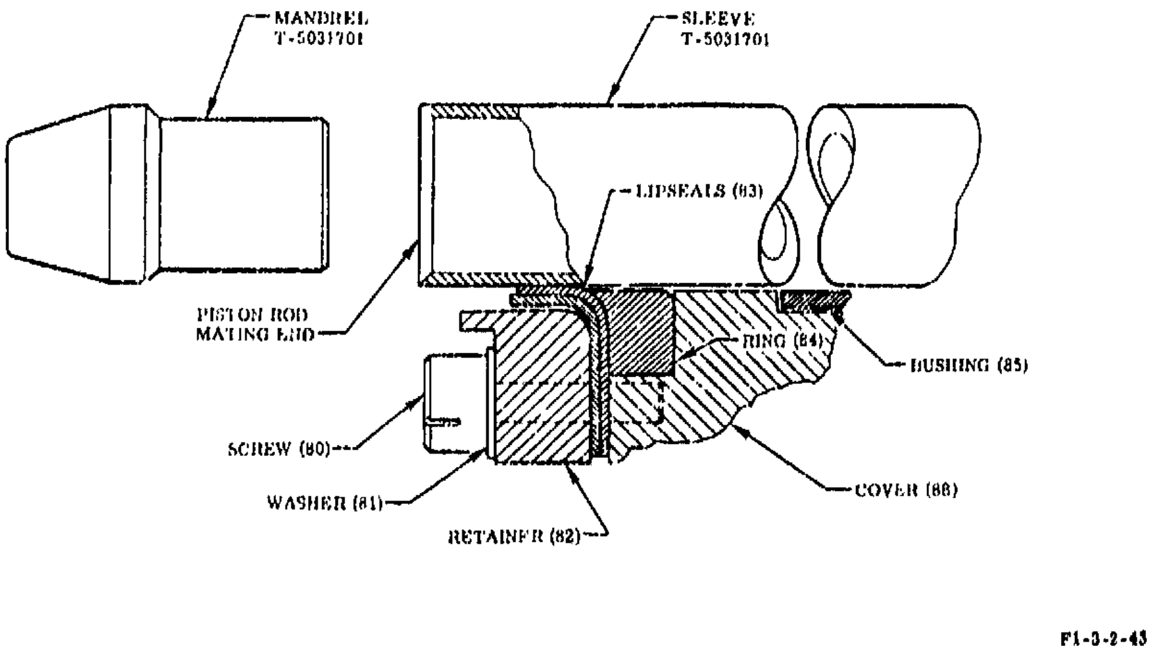


Figure 13-7. Oxidizer Valve Cover Lip Seal Installation

d. Carefully insert mandrel end of tool through large opening in cover (88) until tip of mandrel contacts the seal blank.

e. Using tip of mandrel, center seal blanks in nose of cover. Do not push mandrel through seal blanks.

f. With seal blanks centered, torque retainer screws (80) to 25-35 inch-pounds.

g. Carefully press tool until largest diameter of mandrel and sleeve passes through and forms lip seal.

NOTE

The sleeve portion of the tool must remain in the cover to keep the lip seal in its formed condition until the cover is installed.

h. Remove mandrel, but do not remove sleeve.

CAUTION

The sleeve must maintain contact with the shoulder on the piston rod when the cover is installed, to prevent damage to the sealing surface of lip seals (83).

i. Carefully center seal (79) on housing (114); then carefully slide cover (88) on piston rod (100) until cover flange contacts surface of housing (114). Remove sleeve from piston rod.

j. Secure cover (88) to housing (114) with bolts (77, 77A, 77B, 77C) and washers (78). Bolts must be installed in positions indicated in figure 13-3 and as follows:

Valve	Bolt	Amount
408055 409465	NAS1009-16H	24
409465-21	NAS1009-16H RD111-4012-6918	16 8
409465-11 409465-31	RD111-4012-6918	24

k. Cross-torque bolts (77, 77A, 77B, 77C) in one-third increments until a final torque of 900 to 1,225 inch-pounds is reached.

l. Back off each bolt (77, 77A, 77B, 77C) one full turn and retorque to 900 to 1,225 inch-pounds. Back off and retorque only one bolt at a time.

m. Check for correct installation of retainer (89, 89A) by taking measurements with a 0.078 ±0.005 inch diameter rod as follows: (See figure 13-8.)

(1) Insert rod into OXID BLEED port (W) until rod contacts retainer (89, 89A) and also contacts cover (88) at points A and B. Measurement between retainer (89, 89A) and face of cover (88) must be 2.62 ±0.10 inches.

(2) Insert rod into OXID BLEED port (W) until rod contacts cover (88) at points C and D. Measurement of rod penetration from face of cover (88) must be 3.10 ±0.10 inches.

13-10C. INSTALLING CYLINDER SEALS AND CYLINDER.

WARNING

The following procedure uses liquid nitrogen, which must not be allowed to come in contact with any part of the body. Human tissue will freeze upon contact, causing serious injury. Eye protection and protective clothing must be worn by personnel handling liquid nitrogen. Liquid nitrogen must be used in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

a. Place sleeve (73A) and liner (73B) into a container of liquid nitrogen (MIL-P-27401) until thoroughly chilled.

NOTE

Steps aA and aB must be performed immediately after removing the sleeve and liner from the liquid nitrogen, to make sure they are fully bottomed in the cover.

aA. Install chilled sleeve (73A) in cover (88). Make sure sleeve is bottomed in cover; then allow sleeve to return to ambient temperature.

aB. Install chilled liner (73B) in cover (88). Make sure liner is bottomed in sleeve; then allow sleeve to return to ambient temperature.

aC. Install seat (75) and bushing (76); then install springs (72, 73) on seat.

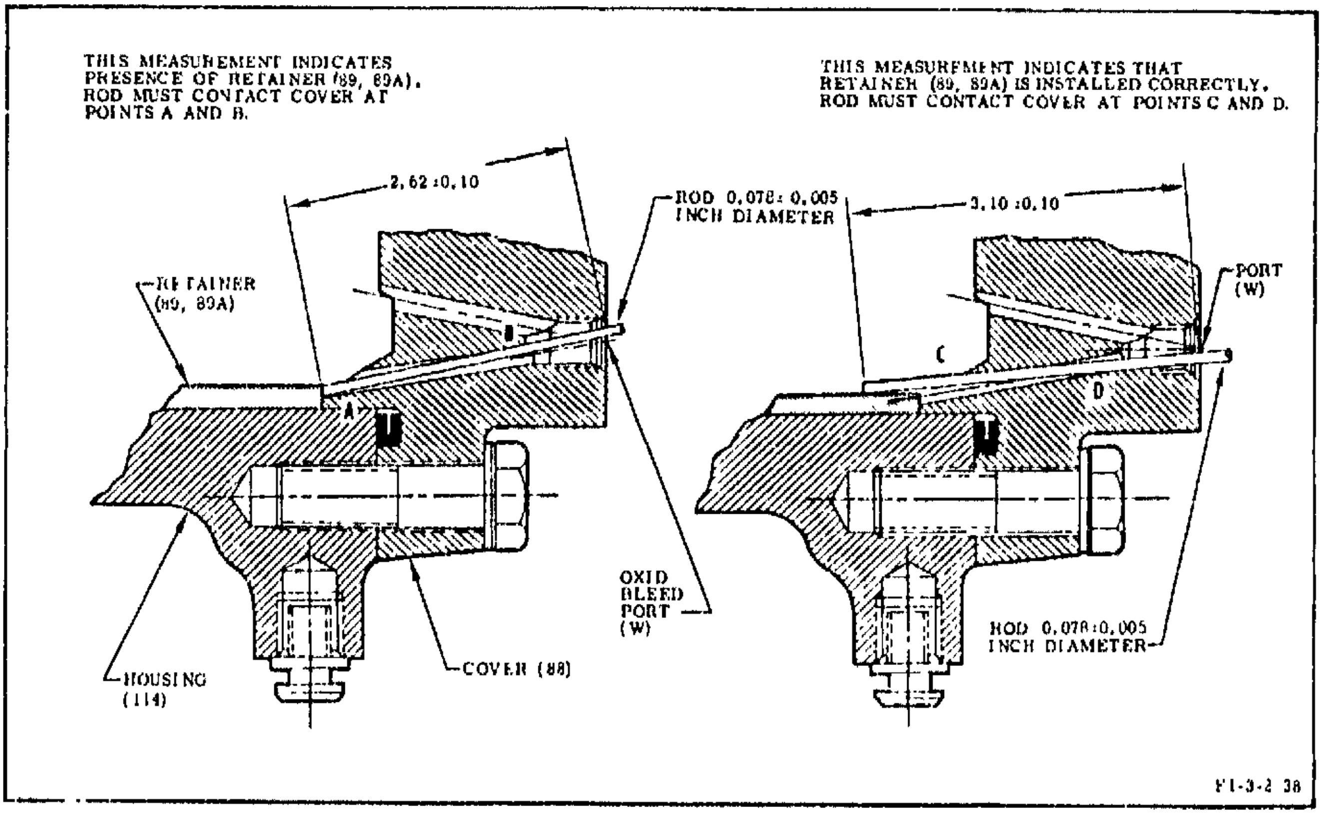


Figure 13-8. Checking Skirt Seal Retainer Installation

b. Install washer (25) in cylinder (71) and secure with screws (24). Torque screws to 14-17 in-lb.

c. Lubricate (Method L) packings (69); then insert packings and retainers (70) into grooves of cylinder (71).

d. Insert bushing (68) into end of cylinder (71).

e. Lubricate (Method L) packings (47); then insert packings and retainers (48) into grooves of cylinder (71).

WARNING

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

NOTE

The following steps f through o are for forming piston rod lip seals (66) and require seal forming tool T-5(36723 for forming.

- Blank lip seals must be free of all flaws and scratches on the sealing surface. The ID of the seal blanks have a sharp edge and must be free of nicks and burs and show no evidence of separation of the laminated material.

f. Clean 4 seal blanks with trichloroethylene (MIL-T-27602) and dry cleaned parts as outlined in R-3896-3, Volume I.

g. Place 2 seal blanks into the 2-piece forming cup over the seal alinement pins; then insert forming block in forming cup (figure 13-9.)

h. Attach holding fixture to the forming cup and tighten by hand until seals are firmly secured.

i. Insert mandrel with either forming nose into holding fixture and forming block; then push mandrel through forming block until largest diameter of mandrel passes into seals.

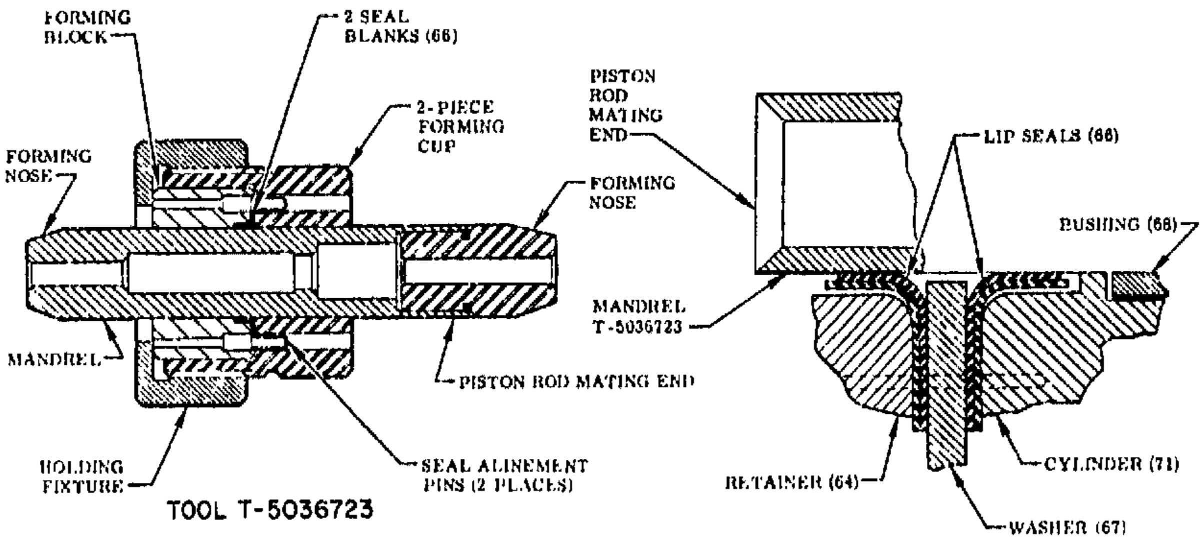


Figure 13-9. Oxidizer Valve Cylinder Lip Seal Installation

j. Remove holding fixture, forming block, and forming cup from mandrel. Do not remove formed seals from mandrel.

CAUTION

The formed lip seals must be free of all defects, nicks, and scratches and must be perfectly centered on mandrel. Lip seals not conforming to these requirements must be rejected.

k. Place 2 seal blanks into the 2-piece forming cup over the seal alinement pins; then insert forming block in forming cup.

l. Attach holding fixture to the forming cup and tighten by hand until seals are firmly secured.

m. Place washer (67) on mandrel against flat surface of previously formed lip seals.

n. Insert mandrel (opposite end as used in step i) into holding fixture and forming block; then push mandrel through forming block until largest diameter of mandrel passes into seals.

o. Remove holding fixture, forming block, and forming cup from mandrel. Do not remove formed seals from mandrel.

CAUTION

The formed lip seals must be free of all defects, nicks, and scratches and must be perfectly centered on mandrel. Lip seals not conforming to these requirements must be rejected.

p. Carefully place lip seals (66), washer (67), and mandrel in end of cylinder (71). Inside chamfered end of mandrel must face out so that proper mating of mandrel to piston rod shoulder is attained. Attach retainer (64) to cylinder (71) with screws (62). Torque screws to 25-35 in-lb.

q. Place washers (63, 65) in position on springs (73, 72).

r. Place washers (61) in position on cylinder (71). Stack of washers must total 0.125 ±0.005 inch thick.

s. Lubricate (Method J) packing (60) with chlorotrifluoroethylene grease RB0140-011, Type I (Rocketdyne); then insert packing into groove of cylinder (71).

t. Install one ring (14) on piston rod (100).

u. Carefully slide cylinder (71) on piston rod (100).

CAUTION

The sleeve must maintain contact with the shoulder on the piston rod to prevent damage to the sealing surfaces of lip seals (66).

v. Attach spring compressor T-5022672 to housing (114) and compress spring (72, 73) until cylinder (71) contacts washers (61). Install bushing (59) on cylinder (71); then secure cylinder (71) to cover (88) with bolts (57) and washers (58). Torque bolts to 100-250 in-lb.

w. Remove spring compressor T-5022672 and remove mandrel from piston rod.

13-10D. INSTALLING PISTON AND INDICATOR.

a. Lubricate (Method L) packing (22); then insert packing and retainers (23) in groove of piston (19).

b. Lubricate (Method L) packing (20); then install packing and retainers (21) in outer groove of piston (19).

c. Slide piston (19) in cylinder (71) with piston installation tool T-5037837. Secure piston to piston rod (100); then remove piston installation tool. Torque piston to 90-120 in-lb using piston torque wrench T-5029251.

d. Install nut (18) on piston rod (100) and torque nut to 600-720 in-lb using torque wrench T-5029252.

e. Install shaft (46), with pin (45) installed.

f. Aline holes in clevis (16) with hole in block (17); then insert round end of pin (15) into clevis and press pin through clevis and block. Pin (15) is a press-fit pin.

fA. On valve 409465-31, aline holes in clevis (16A) with hole in block (17A); then insert pin (15C). Pin (15C) is a press-fit pin, and it can be installed from either direction. Secure pin (15C) with washer (15B) and pin (15A).

g. Aline clevis (16) with slot in shaft (46); then slide block (17) in position on piston rod (100). Secure block to piston rod with a second ring (14).

gA. On valves 409465-31, aline clevis (16A) with slot in shaft (46); then slide block (17A) in position on piston rod (100). Secure block to piston rod with a second ring (14).

h. Lubricate (Method J) packing (52) and install it in groove of plug (51). Install plug (51) in cylinder (71) and secure with screw (49) and washers (50). Torque screws to 20-25 in-lb.

i through k. (Deleted).

l. Lubricate (Method J) packing (29); then insert packing in groove of cover of transducer (28). Do not install cover.

NOTE

The transducer cover will be installed after leak-testing the variable resistor shaft O-ring and plug O-ring as outlined in paragraph 13-23.

m. Attach resistor (37) to cylinder (71) by engaging the slot in arm (36) with pin (45) on shaft (46), then secure resistor with clips (44), screws (42), and washers (43). Tighten screws fingertight.

n. Connect an ohmmeter between pins A and B of connector and check resistance of resistor (37), with the valve in the closed position. Slightly rotate resistor (37) as necessary to obtain a resistance of 482 ±25 ohms; then torque screws (42) to 2.0-2.5 in-lb above torque of locking feature. Do not exceed 9.0 in-lb torque. Safetywire screws (42) on valves 409465-31, -41, and -51.

13-10E. INSTALLING CYLINDER HEAD, SEQUENCE VALVE, AND PURGE CHECK VALVE.

a. Lubricate (Method L) packing (12); then insert packing and retainers (13) into groove of cylinder head (9, 9A).

b. Lubricate (Method J) packing (10); then install packing and retainer (11) in large groove of cylinder head (9, 9A).

c. Lubricate (Method J) packing (4); then install packing and retainers (5) in small groove of cylinder head (9, 9A).

cA. On valves 409465-31, perform the following:

(1) Lubricate (Method L) packing (9D); then install packing and retainer (9E) in large inner groove of cylinder head (9A).

(2) Install plate (9B) on cylinder head (9A) and secure with screws (9C). Torque screws to 20-30 in-lb.

d. Install gate (8) and spring (7) on cylinder head (9, 9A) and secure with pin (6).

NOTE

Spring (7) must be rotated 180 degrees in the direction of twist during installation to hold the gate in the closed position against the cylinder head.

e. Position cylinder head (9, 9A) and cap (3) on cylinder (71) and secure them with bolts (1) and washers (2). Torque bolts to 175-271 in-lb.

eA. Inspect that pin securing gate in valve (108) is installed and secure.

f. Install seal (109) on valve (108); then install valve on housing (114) with bolts (106) and washers (107). Torque bolts to 110-130 in-lb.

g. Install seal (112) on plug (111); then install plug in housing (114). Torque plug (111) to 20-25 in-lb.

h. Install seals (87) on plugs (86); then install plugs in cover (88). Torque plugs to 40-65 in-lb.

i. Install seals (54) on plugs (53); then install plugs in cylinder (71). Torque plugs to 40-65 in-lb.

j. Torque screws (95) to 25-35 in-lb.

k. Install pressure test fixture T-5029362-119 on ACTUATOR CLOSE port (C); then connect a source of gaseous nitrogen (MIL-P-27401) to port (C). ACTUATOR OPEN port (d) must be open.

l. Slowly apply 100 ±10 psig gaseous nitrogen to ACTUATOR CLOSE port (C) to hold poppet firmly against valve seat.

m. Torque bolt (93) to 2,400 to 3,500 in-lb. Make sure that poppet does not rotate while torquing bolt.

CAUTION

Poppet must not rotate while torquing bolt or damage to the poppet skirt seal and/or nose seal can result.

n. Reduce gaseous nitrogen pressure to zero.

o. Remove source of gaseous nitrogen, then remove pressure test fixture.

oA. Safetywire plugs, bolts, and screws equipped with holes for safetywiring.

p. Install protective covers and closures. Refer to paragraph 13-2.

q. Remove valve from assembly stand T-5029363.

WARNING

The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

r. Remove bolts (110) and clean boltholes with cleaning compound (MIL-C-81302). Install bolts and torque to 80-100 in-lb.

13-11. TESTING.

13-12. This procedure outlines requirements for testing the oxidizer valve using Components Test Console G3141, Components Adapter Set G3143, and Cryogenic Supply Unit G3146. The Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used, as applicable, for pneumatic leak-testing. Any deviation including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on oxidizer valve as outlined in figure 13-10. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up components test console electrical patch-panels (figure 13-11) and prepare console for use (figure 13-12). See figure 13-13 for a cutaway view of the oxidizer valve. Refer to paragraphs 13-13 through 13-32 for oxidizer valve test procedures and see figures 13-14 through 13-17 for test setups.

CAUTION

During test procedures, the oxidizer portion of the valve and the test equipment used at that part of the valve must be maintained in a liquid oxygen clean condition.

Index Letter	Valve Port	Test Plate	Port Connection
A	Oxidizer INLET	T-5029362-147[(a) (b)]	AN815-4C[(b)]
B	Oxidizer OUTLET	T-5029362-132[(b)]	AN815-16C[(b)]
C	ACTUATOR CLOSE	T-5029362-119	AN815-4C
D	ACTUATOR OPEN	T-5029362-115	AN815-4C
E	Sequence PRESS IN	T-5029362-120	AN815-4C
F	Sequence PRESS OUT	T-5029362-145	AN815-4C
G	OXID DRAIN	None	AN815-4C[(b)]
L	OXID VENT	None	AN815-4C[(b)]
N	FUEL DRAIN	None	AN815-5C
R	FUEL DRAIN	None	AN815-4C
S	SHAFT DRAIN	None	AN815-4C
W	OXID BLEED	None	AN815-4C[(b)]
Y	Purge check valve	T-5031188-109[(b)]	AN815-4C[(b)]

(a) When performing cryogenic test, replace this test plate with plate 9026576 and handle 9026579.
(b) Maintain item in a liquid oxygen clean condition.

Figure 13-10. Preparing Oxidizer Valve for Testing

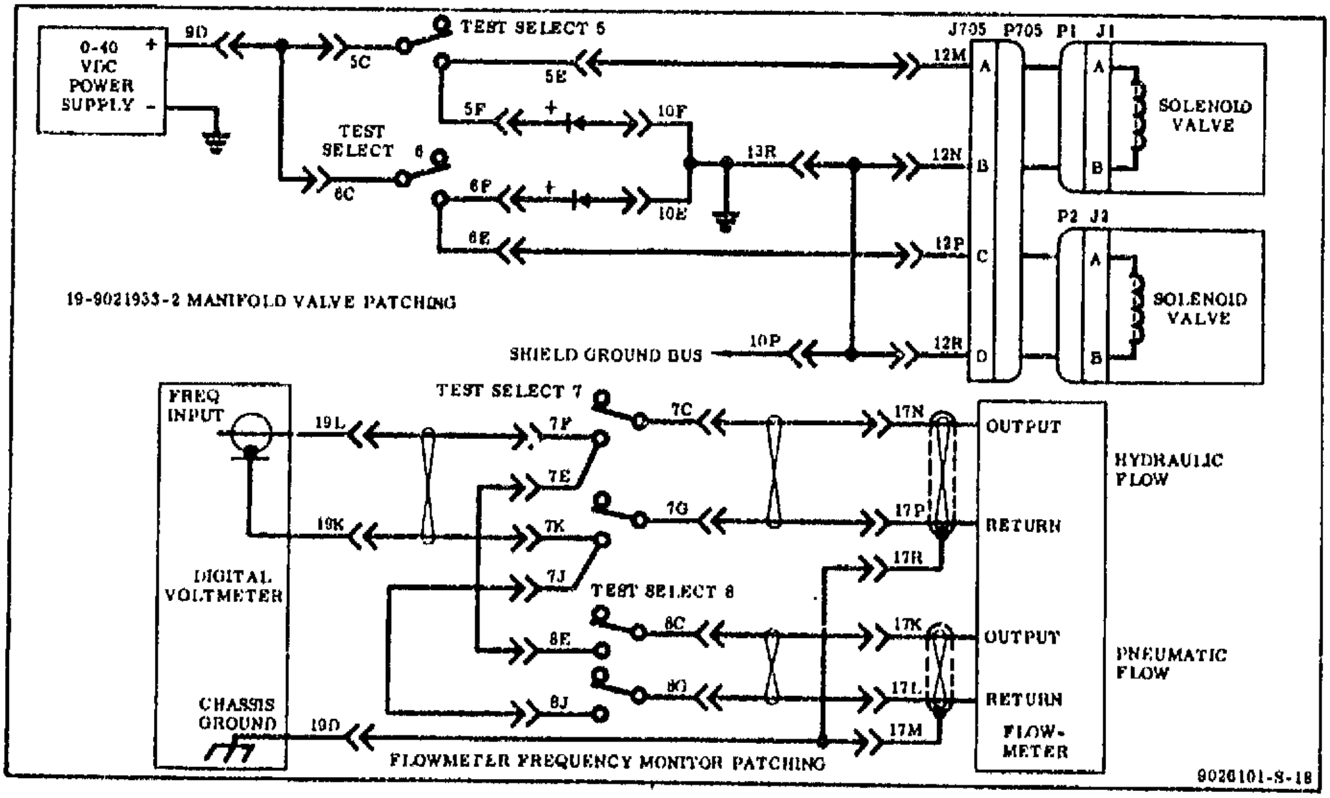


Figure 13-11. Components Test Console Patch-Panel Requirements (Sheet 1 of 3)

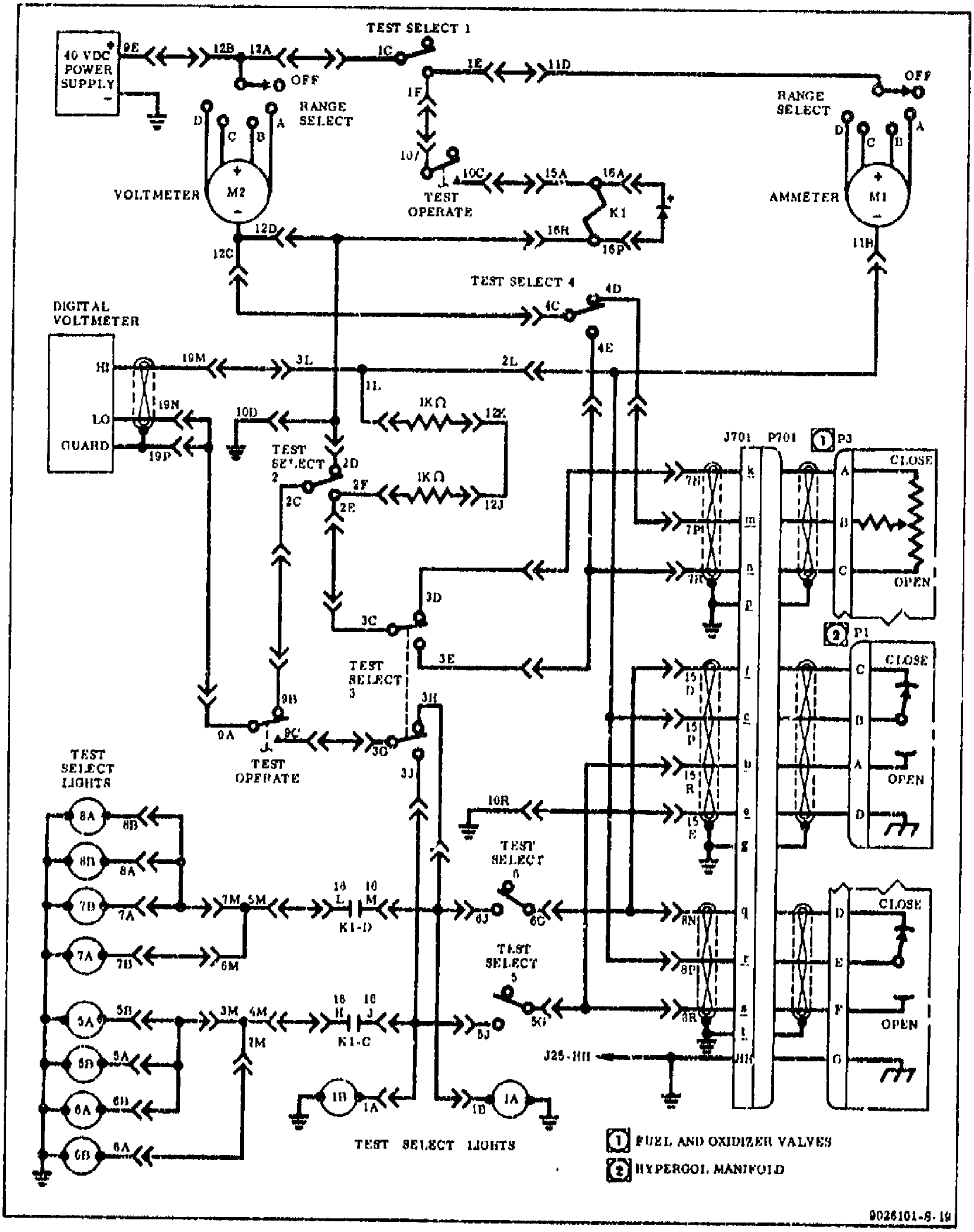


Figure 13-11. Components Test Console Patch-Panel Requirements (Sheet 2 of 3)

Patch-Cord (a)	From J6-	To J6-
K5.09	1A	3J
		5J
		19J
K5.09	1B	3H
		6J
		16M
K3.	1C	12A
K3.	1E	11D
K3.	1F	10A
3088-12	1L	12K
K3.	2C	9B
K5.09	2D	10D
		12D
		16R
K3.	2E	3C
3088-12	2F	12J
K5.09	2L	8P
		11B
		15P
K3.	2M	6A
K3.	3D	7N
K4.09	3E	4E
		7R
K3.	3G	9C
K3.	3L	19M
K5.09	3M	5A
		5B
		6B
K3.	4D	7P
K3.	4C	12C
K3.	4M	16H
K4.09	5C	6C
		9D
K3.	5E	12M
3088-17 (b)	5F(+)	10F
		8R
K4.09	5G	15R
K3.	5M	16L
K3.	6E	12P
3088-17 (b)	6F(+)	10E
K4.09	6G	8N
		15D
K3.	6M	7B
K5.09	7A	7M
		8A
		8B
K3.	7C	17N
K3.	7E	8E
K3.	7F	19L
K3.	7G	17P
K3.	7J	8J
K3.	7K	19K
K3.	8C	17K
K3.	8G	17L
K4.09	9A	19N
		19P
K3.	9E	12B
K3.	10C	15A
K5.09	10P	12N
		12R
		13R
K3.	10R	15E
3088-17 (b)	16A(+)	16P
K4.09	19D	17M
		17R

(a) Use any cord length required on all patch-cords numbered K3.
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 13-11. Components Test Console Patch-Panel Requirements (Sheet 3 of 3)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Cable 1231003 or 1231004	Connection to oxidizer valve.
	Connector J702	Capped	
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	

Figure 13-12. Preparing Components Test Console for Use (Sheet 1 of 5)

Panel	Control	Position	Indication/Remarks
TEST CELL ELECT. OUTLETS (Continued)	Connector J705	Cable 1231012 or 1231009	For valve manifold control.

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

POWER TURN ON

Panel	Control	Position	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	B (0-150)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 OFF. Test power control.[a]
	TEST SELECT 2		Light 2 OFF. DVM return control.[a]
	TEST SELECT 3		Light 3 OFF. Variable resistor monitor control.[a]
	TEST SELECT 4		Light 4 OFF. Variable resistor monitor control.[a]
	TEST SELECT 5		Light 5 OFF. Manifold valve solenoid control.[a]
	TEST SELECT 6		Light 6 OFF. Manifold valve solenoid control.[a]
	TEST SELECT 7		Light 7 OFF. Hydraulic flow monitor control.[a]
	TEST SELECT 8		Light 8 OFF. Pneumatic flow monitor control.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 24 +0.4 volts.

(a) If indication is not as specified, press applicable switch-light.

Figure 13-12. Preparing Components Test Console for Use (Sheet 2 of 5)

Panel	Control	Position	Indication/Remarks
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[(a)]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[(a)]
	TEST CELL SUPPLY "A"		VENT.[(a)]
	TEST CELL SUPPLY "B"		VENT.[(a)]
	FLOW MONITOR SHUTOFF		CLOSE.[(a)]
	LOW FLOW BYPASS		CLOSE.[(a)]
SPRING CLOSING FORCE TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	10V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Allow digital voltmeter to warm up for at least 30 minutes prior to use.

(a) If indication is not as specified, press applicable switch-light.

Figure 13-12. Preparing Components Test Console for Use (Sheet 3 of 5)

Panel	Control	Position	Indication/Remarks
FLOW MONITOR TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENTUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 switch-light is for pneumatic flow. Both switch-lights must not be on at the same time.

PNEUMATIC PREPARATION

a. Ensure that console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen and helium to console.

NOTE

Helium supply is required only for cryogenic tests.

c. On SYSTEM SUPPLY panel open TO FUEL COMPATIBLE SYS shutoff valve and TO LN_2 PRESS PANEL shutoff valve.

Figure 13-12. Preparing Components Test Console for Use (Sheet 4 of 5)

Panel	Control	Position	Indication/Remarks

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed to ensure safety of personnel working with pressurized systems.

Figure 13-12. Preparing Components Test Console for Use (Sheet 5 of 5)

Procedure	Result

13-13. POSITION TRANSDUCER RESISTANCE AND SPRING CLOSING FORCE TEST.

WARNING

All hydraulic pressure must be off and white room clear of fuel vapors before electrical tests are performed, to prevent injury to personnel and damage to equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and oxidizer valve for use as outlined in paragraph 13-12; then connect oxidizer valve to console (figure 13-14). Do not connect cable BB52745-2 to oxidizer valve.	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to manifold valve as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 200 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Open SHUTOFF valve. PRESSURE REGULATOR may require adjustment to obtain result.	PRESSURE MONITOR "B" gage must indicate 200 ±20 psi.

13-14. Resistance Test.

NOTE

All switches used during this test are located on the ELECTRICAL CONTROL panel unless otherwise specified.

Procedure	Result
a. Perform the following:	
(1) Turn VOLTS meter RANGE SELECT switch to D (0-30).	VOLTS meter must indicate 24 ±0.4 volts.

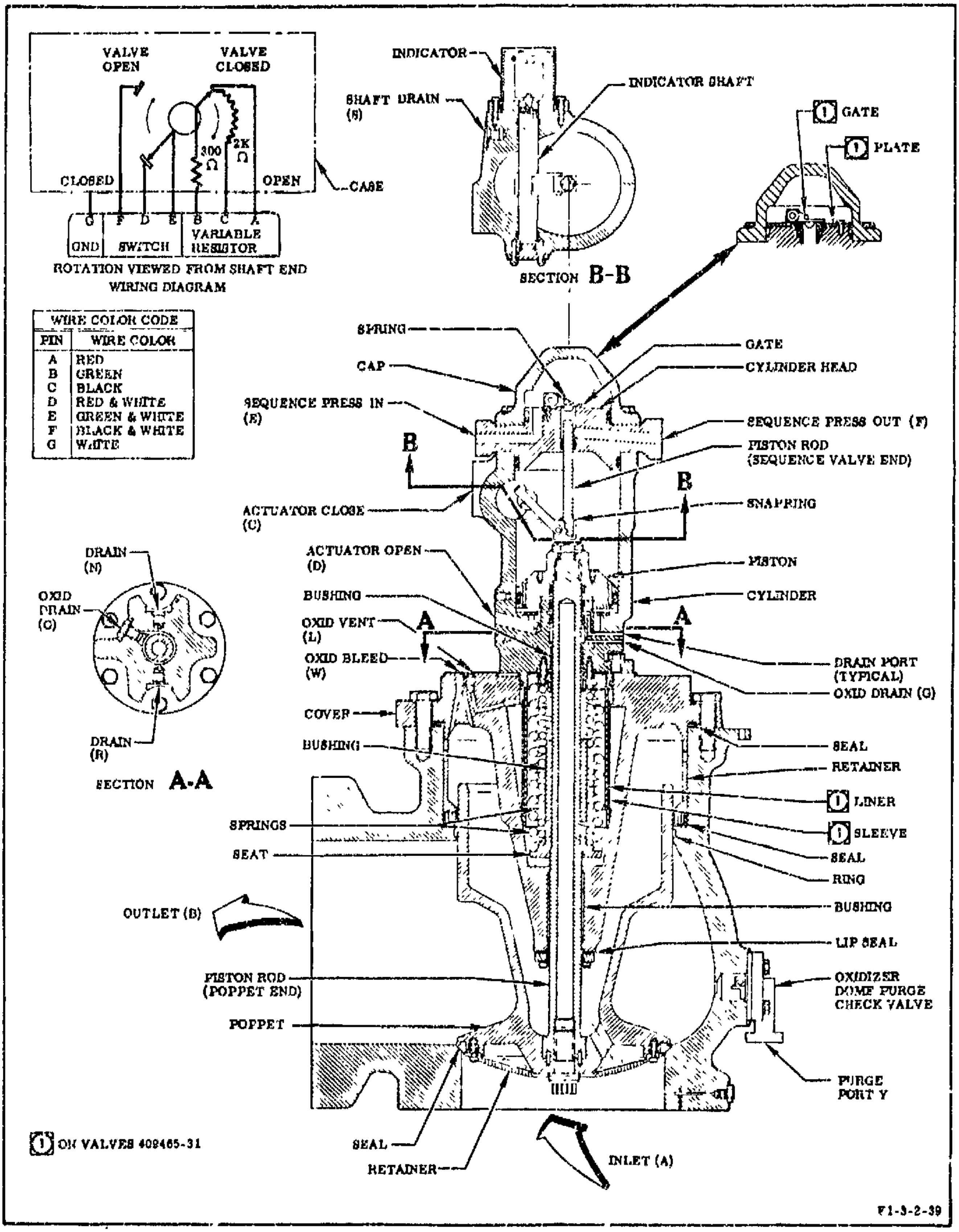


Figure 13-13. Oxidizer Valve--Cutaway View

Procedure	Result
(2) Press TEST SELECT 1 and 6 switch-lights.	MILLIAMPERES meter must not exceed 50 milliamperes.
	Lights 1, 6, and 1A on. Valve fully closes.
(3) Turn MILLIAMPERES meter RANGE SELECT switch to C (0-250).	None.

CAUTION

Exceeding 28 volts when turning VOLTAGE ADJUST to INCREASE can damage manifold valve solenoids.

Procedure	Result
b. Using megohmmeter, apply 500 ±50 vdc between pins E and F of valve electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
c. Using multimeter, measure resistance at valve electrical connector as follows:	
(1) Between pins A and B.	Resistance must be 482 ±75 ohms.
(2) Between pins A and C.	Resistance must be 2,000 ±100 ohms.
(3) Between pins B and C.	Resistance must be 2,120 ±130 ohms.
d. Using multimeter and decade resistance box, measure resistance between pins D and E as follows:	
(1) Adjust decade resistance box for 0.5 ohm and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note the exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins D and E.	Resistance must not exceed 0.5 ohm.
e. Press TEST SELECT 5 and 6 switch-lights.	Lights 5 and 1B on and lights 6 and 1A off. Valve opens.
f. Using megohmmeter, apply 500 ±50 vdc between pins D and E of valve electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
g. Using multimeter, measure resistance at valve electrical connector as follows:	
(1) Between pins A and B.	Resistance must be 2,135 ±265 ohms.
(2) Between pins B and C.	Resistance must be 465 ±180 ohms.

Procedure	Result
h. Using multimeter and decade resistance box, measure resistance between pins E and F as follows:	
(1) Adjust decade resistance box for 0.5 ohm and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note the exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins E and F.	Resistance must not exceed 0.5 ohm.
i. Press TEST SELECT 5 and 6 switch-lights.	Lights 5 and 1B off and lights 6 and 1A on. Valve closes.
j. Press TEST SELECT 1 and 6 switch-lights.	Lights 1, 6, and 1A off.
k. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to manifold valve as follows:	
(1) Close SHUTOFF valve and open VENT valve until PRESSURE MONITOR "B" gage indicates zero; then close VENT valve.	Manifold valve depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.

13-15. Spring Closing Force Test.

NOTE

All switches used during this test are located on the ELECTRICAL CONTROL panel unless otherwise specified.

Procedure	Result
a. Connect cable BB52745-2 to oxidizer valve; then perform the following:	
(1) Turn VOLTS meter RANGE SELECT switch to D (0-30) and turn VOLTAGE ADJUST knob until VOLTS meter indicates 24-25 volts.	VOLTS meter indicates 24-25 volts.
(2) Press TEST SELECT 1 and 6 switch-lights.	MILLIAMPERES meter must not exceed 50 milliamperes. Lights 1, 6, and 1A on.

Procedure	Result
(3) Turn MILLIAMPERES meter RANGE SELECT switch to C (0-250).	None.

CAUTION

Exceeding 28 volts when turning VOLTAGE ADJUST to INCREASE can damage manifold valve solenoids.

Procedure	Result
b. On DVM panel, verify that switches are in the following positions:	
(1) STORE/DISPLAY DURING COUNT switch to STORE.	None.
(2) RANGE switch to 10V.	None.
(3) FUNCTION switch to VOLT.	None.
(4) ATTENUATION switch to midposition.	None.
(5) SAMPLE PERIOD switch to .1 SEC 10 PER.	None.
(6) SAMPLING RATE switch to STOP.	None.
c. On DVM panel, press RESET switch.	DVM must indicate 24.0000 to 25.0000 volts.
d. Press TEST SELECT 6, 2, and 5 switch-lights, in order given.	Lights 6 and 1A off and lights 2 and 5 on. DVM must indicate 19.128 to 21.200 volts. Valve remains closed.
e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ACTUATOR OPEN port (D) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS. gage indicates 220 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until oxidizer valve is fully opened. Record pressure required to open valve.	Valve opens and light 1B on. DVM indicates 008.040 to 011.350 volts. Pressure to open valve must be less than 200 psi, as indicated on PRESSURE MONITOR "B" gage.
f. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	ACTUATOR OPEN port (D) depressurized and light 1B off. Valve may not close fully.
g. Press TEST SELECT 2, 5, and 6 switch-lights.	Lights 2 and 5 off and light 6 on.

Procedure	Result
h. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ACTUATOR CLOSE port (C) as follows:	
(1) Close VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until oxidizer valve is fully closed. Record pressure required to close valve.	Valve closes and light 1A on. DVM indicates 019.128 to 021.200 volts. Pressure to close valve must be less than 75 psi as indicated on PRESSURE MONITOR "B" gage.

NOTE

Pressure required to open valve (step e) must be greater than pressure required to close valve (step h) by 37 psig minimum.

Procedure	Result
i. Press TEST SELECT 1 and 6 switch-lights.	ACTUATOR CLOSE port (C) depressurized. Lights 1, 1A, and 6 off.
j. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure valve as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(2) Close VENT valve.	None.
k. Remove valve from test setup.	None.
l. If oxidizer valve testing is terminated, install protective closures as outlined in paragraph 13-2, and secure equipment as outlined in paragraph 13-33.	None.

13-16. AMBIENT PNEUMATIC LEAK-TEST.

Procedure	Result
a. Make sure that Components Test Console G3141 and oxidizer valve are prepared for use as outlined in paragraph 13-12.	None.
b. See figure 13-15 for partial test setup, and connect lines to oxidizer valve as specified in test procedures.	None.

13-17. Rod Bottom Lip Seal and Bottom O-Ring Leak-Test.

Procedure	Result
a. Connect oxidizer valve to console as follows:	
(1) Connect line from PNEU HIGH PRESS OUTLET to INLET port (A).	None.

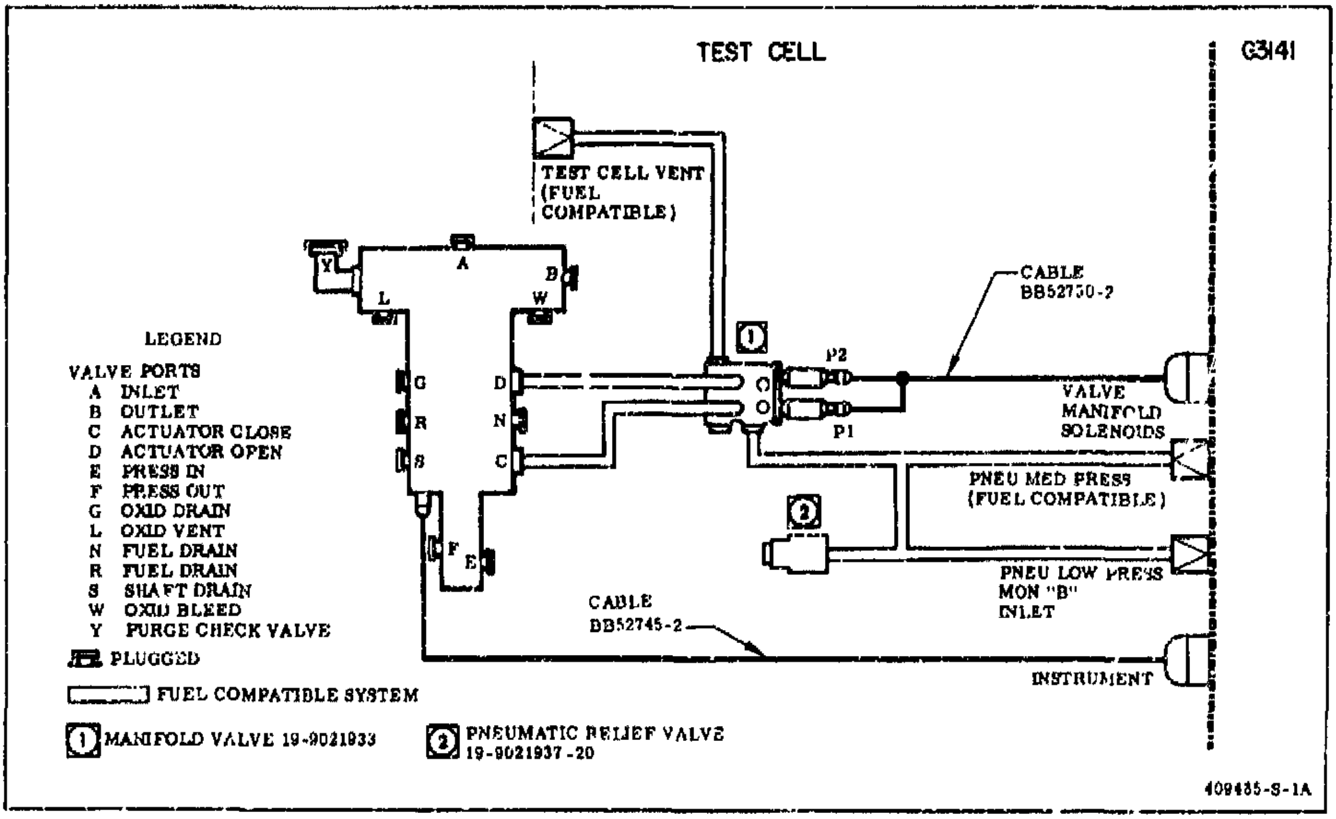


Figure 13-14. Oxidizer Valve Position Indicator Resistance and Spring Closing Force Test Setup

Procedure	Result
(2) Plug FUEL DRAIN port (N) and OXID BLEED port (W).	None.
(3) Open FUEL DRAIN port (R) and OXID VENT port (L).	None.
b. On FLOW/Δ P MONITOR panel, open TEST CELL MONITOR PRESSURE gage SHUTOFF valve.	None.
c. Using HIGH PRESSURE panel, apply pressure in INLET port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	HIGH PRESSURE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. INLET port (A) pressurized.
d. Measure leakage from OXID VENT port (L).	Maximum allowable leakage past bottom lip seal is 30 scim.

Procedure	Result
e. Using HIGH PRESSURE panel, increase pressure to INLET port (A) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	HIGH PRESSURE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. INLET port (A) pressurized.
f. Repeat step d.	Same result as step d.
g. Using HIGH PRESSURE panel, reduce pressure to INLET port (A) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	INLET port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.
h. Connect lines from PNEU HIGH PRESS OUTLET to INLET port (A) and OXID DRAIN port (G).	None.
i. Using HIGH PRESSURE panel, apply pressure to INLET port (A) and OXID DRAIN port (G) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	HIGH PRESSURE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. INLET port (A) and OXID DRAIN port (G) pressurized.
j. Measure leakage from FUEL DRAIN port (R).	Maximum allowable leakage past bottom O-ring is 1 scim.
k. Using HIGH PRESSURE panel, increase pressure to INLET port (A) and OXID DRAIN port (G) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	HIGH PRESSURE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. INLET port (A) and OXID DRAIN port (G) pressurized.

Procedure	Result
l. Repeat step j.	Same result as step j.
m. Using HIGH PRESSURE panel, reduce pressure to INLET port (A) and OXID DRAIN port (G) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	INLET port (A) and OXID DRAIN port (G) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.

13-18. Rod Middle Lip Seal, Cylinder to Cover and Cover to Housing Leak-Test.

Procedure	Result
a. Disconnect line from OXID DRAIN port (G) and connect it to OXID VENT port (L). Open ACTUATOR CLOSE port (C).	None.
b. Using HIGH PRESSURE panel, apply pressure to INLET port (A) and OXID VENT port (L) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 120 ±10 psi.	HIGH PRESSURE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. INLET port (A) and OXID VENT port (L) pressurized.
c. Measure leakage from OXID DRAIN port (G).	Maximum allowable leakage past middle lip seal is 30 scim.
d. Check for leakage at the following joints:	
(1) Between cylinder and cover.	Maximum allowable leakage is 10 scim or fuzz leakage.
(2) Between cover and housing.	Maximum allowable leakage is 1 scim or fuzz leakage.
e. On HIGH PRESSURE panel, slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±2 psi. INLET port (A) and OXID VENT port (L) pressure is increased.
f. Repeat step c.	Same result as step c.
g. Using HIGH PRESSURE panel, increase pressure to INLET port (A) and OXID VENT port (L) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±10 psi.	HIGH PRESSURE panel pressurized.

Procedure	Result
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. INLET port (A) and OXID VENT port (L) pressurized.
h. Repeat step d.	Same result as step d.
i. Using HIGH PRESSURE panel, reduce pressure to INLET port (A) and OXID VENT port (L) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	INLET port (A) and OXID VENT port (L) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.

13-19. Inlet and Outlet Flanges and Purge Check Valve to Housing Leak-Test.

a. Connect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet to ACTUATOR OPEN port (D).	None.
b. Make sure that ACTUATOR CLOSE port (C) is open. Plug OUTLET port (B).	None.
c. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ACTUATOR OPEN port (D) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 200 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 200 ±20 psi.	ACTUATOR OPEN port (D) pressurized and valve poppet opens.
d. Using HIGH PRESSURE panel, apply pressure to INLET port (A) and OXID VENT port (L) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	HIGH PRESSURE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. INLET port (A) and OXID VENT port (L) pressurized.
e. Check for leakage at the following joints:	
(1) Between oxidizer INLET flange and test fixture.	Maximum allowable leakage is 25 scim or fuzz leakage.
(2) Between oxidizer OUTLET flange and test fixture.	Maximum allowable leakage is 25 scim or fuzz leakage.

Procedure	Result
(3) Between housing and purge check valve.	Maximum allowable leakage is 10 scim or fuzz leakage.
f. Using HIGH PRESSURE panel, reduce pressure to INLET port (A) and OXID VENT port (L) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	INLET port (A) and OXID VENT port (L) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.
g. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to ACTUATOR OPEN port (D) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	ACTUATOR OPEN port (D) depressurized and valve poppet closes.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
h. Disconnect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet and ACTUATOR OPEN port (D).	None.
i. Disconnect lines from PNEU HIGH PRESS OUTLET, INLET port (A), and OXID VENT port (L).	None.

13-20. Rod Top Lip Seal Leak-Test.

Procedure	Result
a. Connect line from PNEU HIGH PRESS OUTLET to OXID DRAIN port (G). Open OXID VENT port (L).	None.
b. Using HIGH PRESSURE panel, apply pressure to OXID DRAIN port (G) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	HIGH PRESSURE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. OXID DRAIN port (G) pressurized.
c. Measure leakage from OXID VENT port (L).	Maximum allowable leakage past top lip seal is 30 scim.

Procedure	Result
d. Using HIGH PRESSURE panel, increase pressure to OXID DRAIN port (G) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	HIGH PRESSURE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. OXID DRAIN port (G) pressurized.
e. Repeat step c.	Same result as step c.
f. Using HIGH PRESSURE panel, reduce pressure to OXID DRAIN port (G) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	OXID DRAIN port (G) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.
g. Disconnect line from PNEU HIGH PRESS OUTLET and OXID DRAIN port (G). Plug open ports.	None.

13-21. Drain Passage Flow-Test.

Procedure	Result
a. Connect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet to FUEL DRAIN port (R). Open FUEL DRAIN port (N).	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to FUEL DRAIN port (R) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±2 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. FUEL DRAIN port (R) pressurized.
c. Measure flow from FUEL DRAIN port (N).	Minimum allowable flow is 500 scim.
d. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to FUEL DRAIN port (R) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	FUEL DRAIN port (R) depressurized.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

13-22. Rod Top O-Ring, Variable Resistor Shaft O-Ring, Sequence Rod O-Ring, and Cylinder Head to Cylinder Leak-Test.

a. Disconnect line from FUEL DRAIN port (R) and connect it to ACTUATOR CLOSE port (C).	None.
b. Plug ACTUATOR OPEN port (D) and PRESS IN port (E).	None.
c. Open FUEL DRAIN port (R) and SHAFT DRAIN port (S).	None.
d. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ACTUATOR CLOSE port (C) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±2 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. ACTUATOR CLOSE port (C) pressurized.
e. Measure leakage from FUEL DRAIN port (R).	Maximum allowable leakage past rod top O-ring is 1 scim.
f. Measure leakage from SHAFT DRAIN port (S).	Maximum allowable leakage past variable resistor shaft O-ring is 1 scim.
g. Measure leakage from PRESS OUT port (F)	Maximum allowable leakage past sequence rod O-ring is 1 scim.
h. Check for leakage between cylinder head and cylinder.	Maximum allowable leakage is 1 scim or fuzz leakage.
i. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to ACTUATOR CLOSE port (C) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. ACTUATOR CLOSE port (C) pressurized.
j. Repeat steps e through h.	Same results as steps e through h.

Procedure	Result
k. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to ACTUATOR CLOSE port (C) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	ACTUATOR CLOSE port (C) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
l. Disconnect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet and ACTUATOR CLOSE port (C).	None.

13-23. Variable Resistor Shaft O-Ring and Plug O-Ring Leak-Test.

Procedure	Result
a. Connect lines from PNEU MED PRESS (FUEL COMPATIBLE) outlet to ACTUATOR CLOSE port (C) and SHAFT DRAIN port (S). Plug ACTUATOR OPEN port (D). Make sure cover (41) is removed from cylinder.	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ACTUATOR CLOSE port (C) and SHAFT DRAIN port (S) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 120 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. ACTUATOR CLOSE port (C) and SHAFT DRAIN port (S) pressurized.
c. Check for leakage between variable resistor shaft and cylinder.	Maximum allowable leakage past shaft O-ring is 1 scim or fuzz leakage.
d. Check for leakage between variable resistor shaft plug and cylinder.	Maximum allowable leakage past plug O-ring is 1 scim or fuzz leakage.
e. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±10 psi. ACTUATOR CLOSE port (C) and SHAFT DRAIN port (S) pressurized.
f. Repeat steps c and d.	Same results as steps c and d.
g. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to ACTUATOR CLOSE port (C) and SHAFT DRAIN port (S) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	ACTUATOR CLOSE port (C) and SHAFT DRAIN port (S) depressurized.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
h. Disconnect lines from PNEU MED PRESS (FUEL COMPATIBLE) outlet, ACTUATOR CLOSE port (C), and SHAFT DRAIN port (S).	None.
i. Install transducer cover on cylinder (71) with screws (26) and washers (27). Torque screws to 20-25 in-lb.	

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

iA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).

13-24. Sequence Valve Gate Seal and Cap to Cylinder Head Leak-Test.

Procedure	Result
a. Connect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet to PRESS IN port (E). Open PRESS OUT port (F) and ACTUATOR CLOSE port (C).	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to PRESS IN port (E) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. PRESS IN port (E) pressurized.
c. Measure leakage from PRESS OUT port (F).	Maximum allowable leakage past sequence valve gate seal is 25 scim.
d. Plug PRESS OUT port (F); then check for leakage between cap and cylinder head.	Maximum allowable leakage past cap O-ring is 1 scim or fuzz leakage.
e. Open PRESS OUT port (F).	None.
f. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to PRESS IN port (E) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.

Procedure	Result
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. PRESS IN port (E) pressurized.
g. Repeat steps c and d.	Same results as steps c and d.
h. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to PRESS IN port (E) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	PRESS IN port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
hA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	
i. Disconnect lines from PNEU MED PRESS (FUEL COMPATIBLE) outlet and PRESS IN port (E). Plug open ports.	None.

13-25. Poppet Nose Seal Leak-Test.

Procedure	Result
a. Connect oxidizer valve to console as follows:	
(1) Connect line from PNEU HIGH PRESS OUTLET to INLET port (A).	None.
(2) Connect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet to ACTUATOR CLOSE port (C).	None.
(3) Plug OXID BLEED port (W). Open OUTLET port (B) and ACTUATOR OPEN port (D).	None.
b. Using HIGH PRESSURE panel, apply pressure to INLET port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	HIGH PRESSURE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. INLET port (A) pressurized.

Procedure	Result
c. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ACTUATOR CLOSE port (C) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage on PRESS/Δ P MONITOR FUEL COMPATIBLE panel indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. ACTUATOR CLOSE port (C) pressurized.
d. Measure leakage from OUTLET port (B).	Maximum allowable leakage past poppet nose seal is 56 scim.
e. On HIGH PRESSURE panel, slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage on FLOW/Δ P MONITOR panel indicates 80 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 80 ±10 psi. INLET port (A) pressurized.
f. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage on PRESS/Δ P MONITOR FUEL COMPATIBLE panel indicates 80 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 80 ±10 psi. ACTUATOR CLOSE port (C) pressurized.
g. Repeat step d.	Same result as step d.
h. Using HIGH PRESSURE panel, reduce pressure to INLET port (A) as follows:	
(1) Close SHUTOFF valve; then open VENT valve.	INLET port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.
(3) Close VENT valve.	None.
i. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to ACTUATOR CLOSE port (C) as follows:	
(1) Close SHUTOFF valve: then open VENT valve.	ACTUATOR CLOSE port (C) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
j. Remove oxidizer valve from test setup.	None.
k. If oxidizer valve testing is terminated, secure equipment as outlined in paragraph 13-33.	None.
l. Install protective closures. Refer to paragraph 13-2.	None.

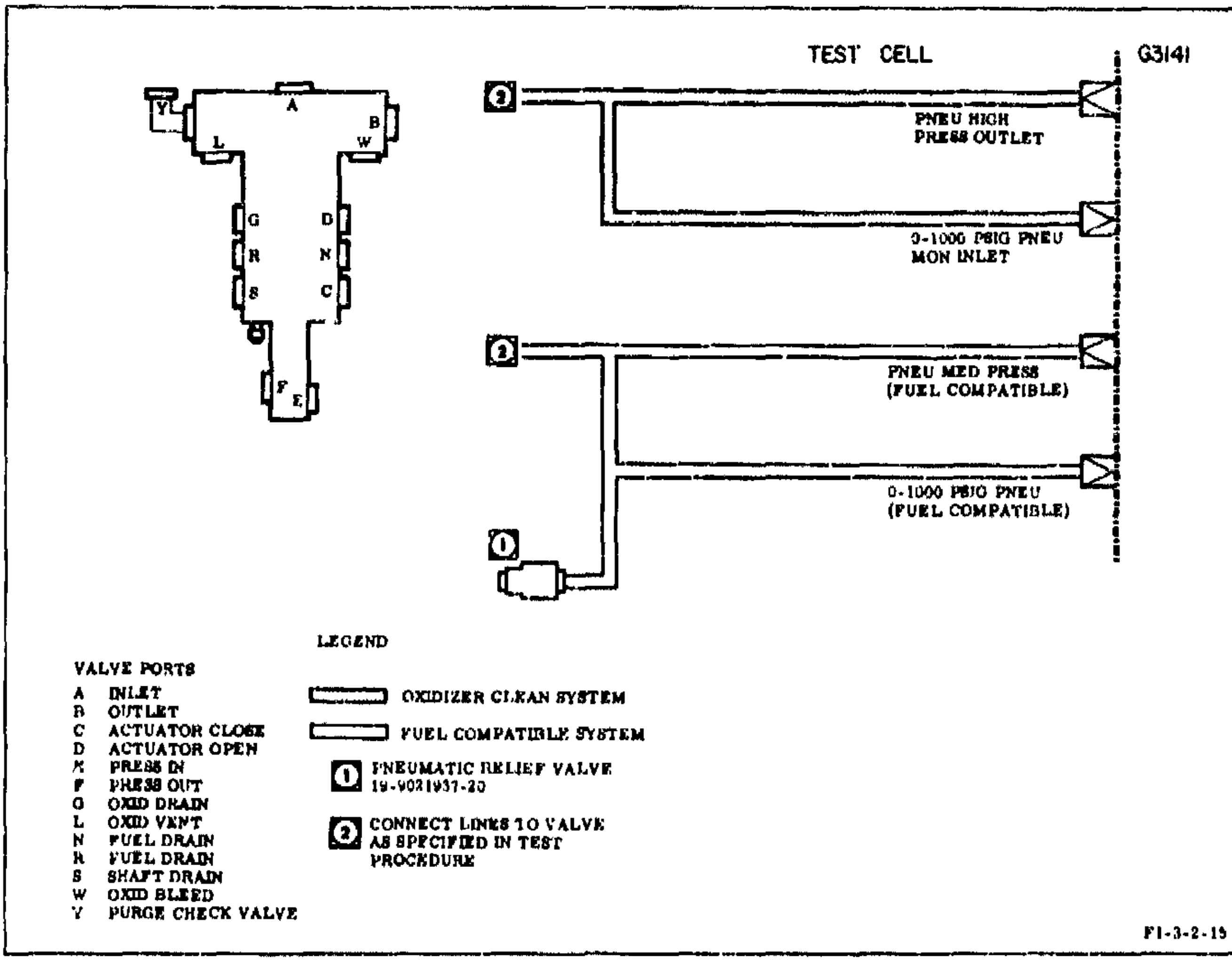


Figure 13-15. Oxidizer Valve Ambient Pneumatic Leak-Test Setup

Procedure	Result
13-25A. SURFACE WETTING LEAK-TEST.	
a. Prepare Components Test Console G3141 and oxidizer valve for use as outlined in paragraph 13-12.	None.
b. Connect oxidizer valve to console (figure 13-15A). Do not connect 0-15 psig pressure gage, and make sure hand valve is closed.	None.
c. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.

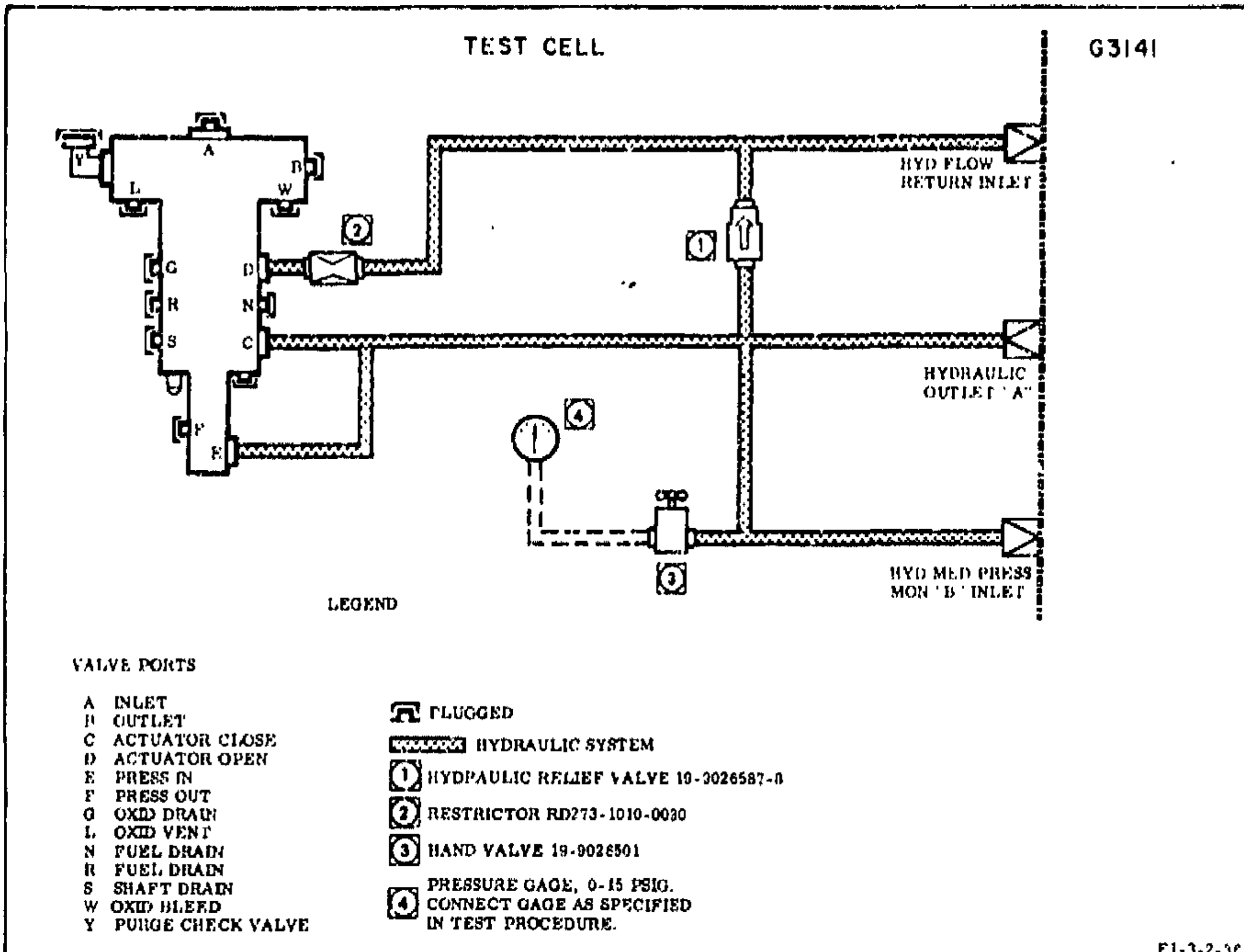


Figure 13-15A. Oxidizer Valve Surface Wetting Leak-Test

Procedure	Result
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
e. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. ACTUATOR CLOSE port (C) and PRESS IN port (E) pressurized.
g. Maintain specified pressure for a minimum of 2 minutes; then perform the following after every 5 pressure cycles:	
(1) Check for surface wetting at cylinder-to-cylinder-head joint and at cylinder-head-to-cap joint.	Surface wetting may occur during the first few pressure cycles.
(2) Wipe joint dry if surface wetting is detected.	None.
h. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	PRESSURE MONITOR "B" gage must indicate zero. ACTUATOR CLOSE port (C) and PRESS IN port (E) depressurized.
i. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. ACTUATOR CLOSE port (C) and PRESS IN port (E) pressurized.
j. Repeat steps g through i 19 additional times.	No surface wetting is allowable after 20 pressure cycles.
k. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
l. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
m. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(2) Open HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate zero. ACTUATOR CLOSE port (C) and PRESS IN port (E) depressurized.

Procedure	Result
(3) Close HIGH PRESS SHUTOFF valve.	None.

NOTE

If surface wetting was not detected after performing the test 20 times, continue with step n. If surface wetting was detected after performing the test 20 times, the cause for leakage must be corrected and the entire test repeated.

Procedure	Result
n. Connect 0-15 psig pressure gage to hand valve in test setup (figure 13-15A); then open hand valve.	None.
o. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
p. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 500 ±50 psi.	SUPPLY PRESSURE gage must indicate 500 ±50 psi.
q. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 15 ±5 psi.	MED PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
r. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until 0-15 psig pressure gage indicates 5 ±2 psi.	0-15 psig pressure gage must indicate 5 ±2 psi. ACTUATOR CLOSE port (C) and PRESS IN port (E) pressurized.
s. Maintain specified pressure for a minimum of 10 minutes; then perform the following:	
(1) Check for surface wetting at cylinder-to-cylinder-head joint and at cylinder-head-to-cap joint.	Surface wetting may occur.
(2) Wipe joints dry if surface wetting is detected.	None.

NOTE

If surface wetting was not detected after the 10-minute interval, continue with step t. If surface wetting was detected, step s must be repeated for an additional 10-minute interval. Step s may be performed a total of 5 times. If surface wetting continues after 5 inspection intervals, the cause for leakage must be corrected and the entire test repeated.

Procedure	Result
t. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
u. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
v. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(2) Open MED PRESS SHUTOFF valve.	0-15 psig pressure gage must indicate zero. ACTUATOR CLOSE port (C) and PRESS IN port (E) depressurized.
(3) Close MED PRESS SHUTOFF valve.	None.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.

Procedure	Result
(5) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
w. Remove oxidizer valve from test setup.	None.

CAUTION

Care must be exercised when removing hydraulic lines from the valve to prevent contamination of the oxidizer section of the valve.

Procedure	Result
x. If oxidizer valve testing is terminated, secure equipment as outlined in paragraph 13-33.	None.
y. Install protective closures. Refer to paragraph 13-2.	None.

13-26. PISTON BLEED HOLE AMBIENT HYDRAULIC FLOW-TEST.

Procedure	Result
a. Ensure that Components Test Console G3141 and oxidizer valve are prepared for use as outlined in paragraph 13-12.	None.
b. Connect oxidizer valve to console (figure 13-16).	None.
c. On PRESSURE/TEMPERATURE MONITOR panel, turn TEMPERATURE CHANNEL SELECT switch to 3.	None.
d. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press FLOW MONITOR SHUTOFF switch-light.	OPEN light on and CLOSE light off.
e. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
f. On DIGITAL VOLTMETER panel, move switches to the following positions:	
(1) STORE/DISPLAY DURING COUNT switch to STORE.	None.
(2) RANGE switch to 100V.	None.
(3) FUNCTION switch to FREQ.	None.
(4) ATTENUATION switch to midposition. (Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.)	None.
(5) SAMPLING RATE switch to STOP.	None.
(6) SAMPLE PERIOD switch to 1 SEC.	None.

Procedure	Result
g. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.
h. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
i. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. ACTUATOR CLOSE port (C) pressurized.
j. On DIGITAL VOLTMETER panel, press RESET switch; then measure and record flowrate through piston bleed holes at ACTUATOR OPEN port (D). On TEMPERATURE MONITOR panel, record temperature.	DVM must indicate an equivalent to 1.45 ±0.10 gpm. TEMPERATURE INDICATOR must indicate 70° to 110° F.
jA. Check for surface wetting at cylinder-to-cylinder-head joint and at cylinder-head-to-cap joint.	No surface wetting is allowable at either joint.
k. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
l. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
m. On HYD MED PRESS MONITOR panel, open PRESSURE MONITOR "B" shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR "B" gage must indicate zero.
n. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
o. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press FLOW MONITOR SHUTOFF switch-light.	CLOSE light on and OPEN light off.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(4) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(5) Close HIGH PRESS SHUTOFF valve.	None.
p. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 off.

Procedure	Result
q. Remove oxidizer valve from test setup.	None.

CAUTION

Care must be exercised when removing hydraulic lines from the actuator to prevent contamination of the oxidizer section of the valve.

r. If oxidizer valve testing is terminated, install protective closures as outlined in paragraph 13-2, and secure equipment as outlined in paragraph 13-33.	None.

13-27. CRYOGENIC LEAK-TEST.

a. Make sure that Components Test Console G3141 and oxidizer valve are prepared for use as outlined in paragraph 13-12.	None.
b. Prepare Cryogenic Supply Unit G3146 for use as outlined in R-3896-5, but completely fill tank with liquid nitrogen.	None.

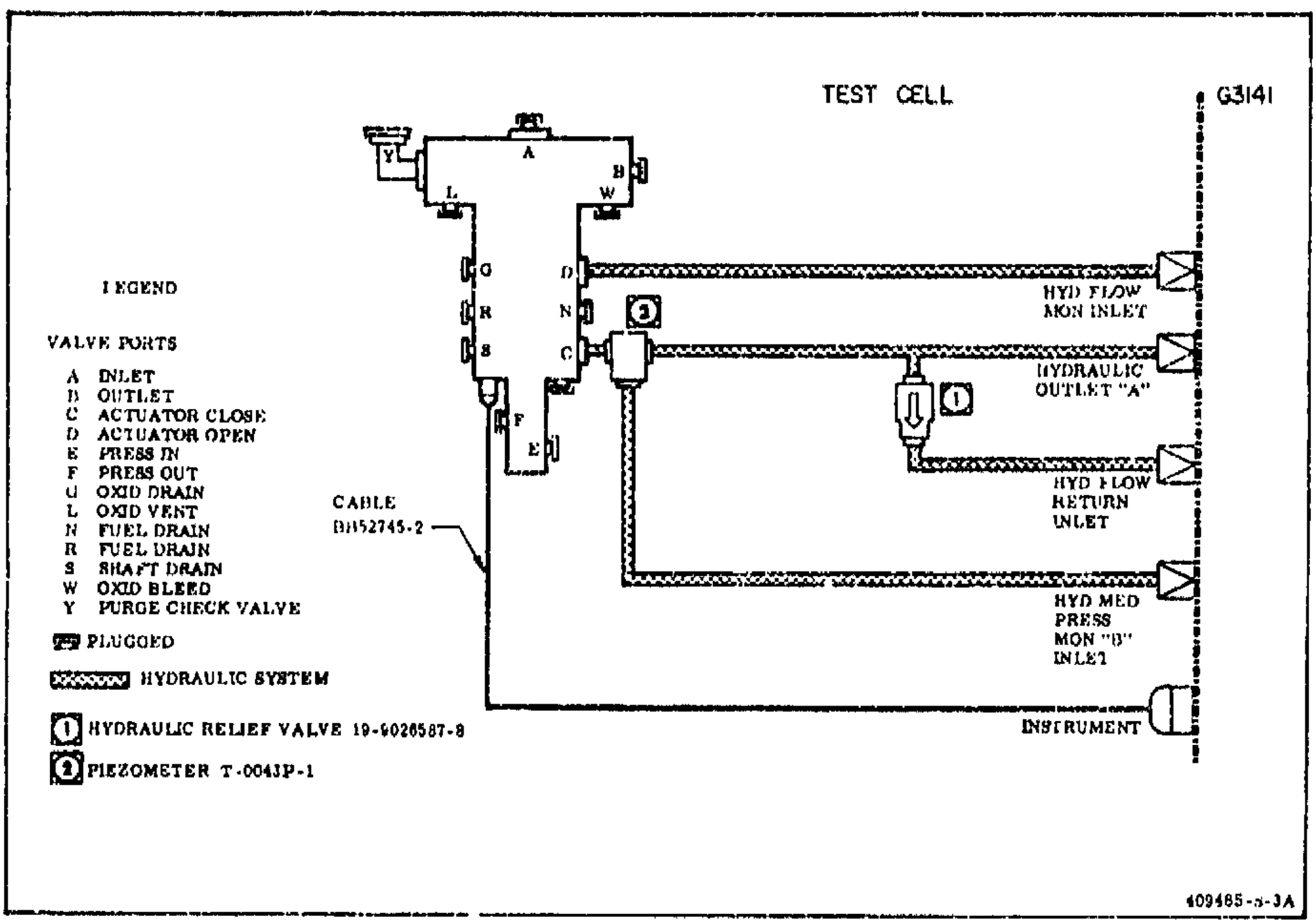


Figure 13-16. Oxidizer Valve Piston Bleed Hole Ambient Hydraulic Flow-Test Setup

Procedure	Result
c. Connect oxidizer valve to console and cryogenic supply unit (figure 13-17). Position pressure gage (installed on cryogenic supply unit) so it can be monitored through test cell window. Install relief valves used in liquid nitrogen lines with sufficient line length so that valve does not come in contact with liquid nitrogen. Close cryogenic hand valves. Attach copper-constantan thermocouple adjacent to OXID BLEED port (W).	None.

CAUTION

During all cold-tests, hydraulic flow through the actuator must be maintained, to prevent freezing of O-rings.

Procedure	Result
d. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
e. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
f. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
g. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. ACTUATOR CLOSE port (C) pressurized.
gA. Check for surface wetting at cylinder-to-cylinder-head joint and at cylinder-head-to-cap joint.	No surface wetting is allowable at either joint.
h. On ELECTRICAL CONTROL panel, perform the following:	
(1) Turn VOLTS meter RANGE SELECT switch to D (0-30).	VOLTS meter must indicate 24 ±0.4 volts.
(2) Press TEST SELECT 1 switch-light.	MILLIAMPERES meter must not exceed 50 milliamperes. Light 1 on.
(3) Turn MILLIAMPERES meter RANGE SELECT switch to C (0-50).	With oxidizer valve closed, MILLIAMPERES meter must indicate 9.8 ±0.2 milliamperes.

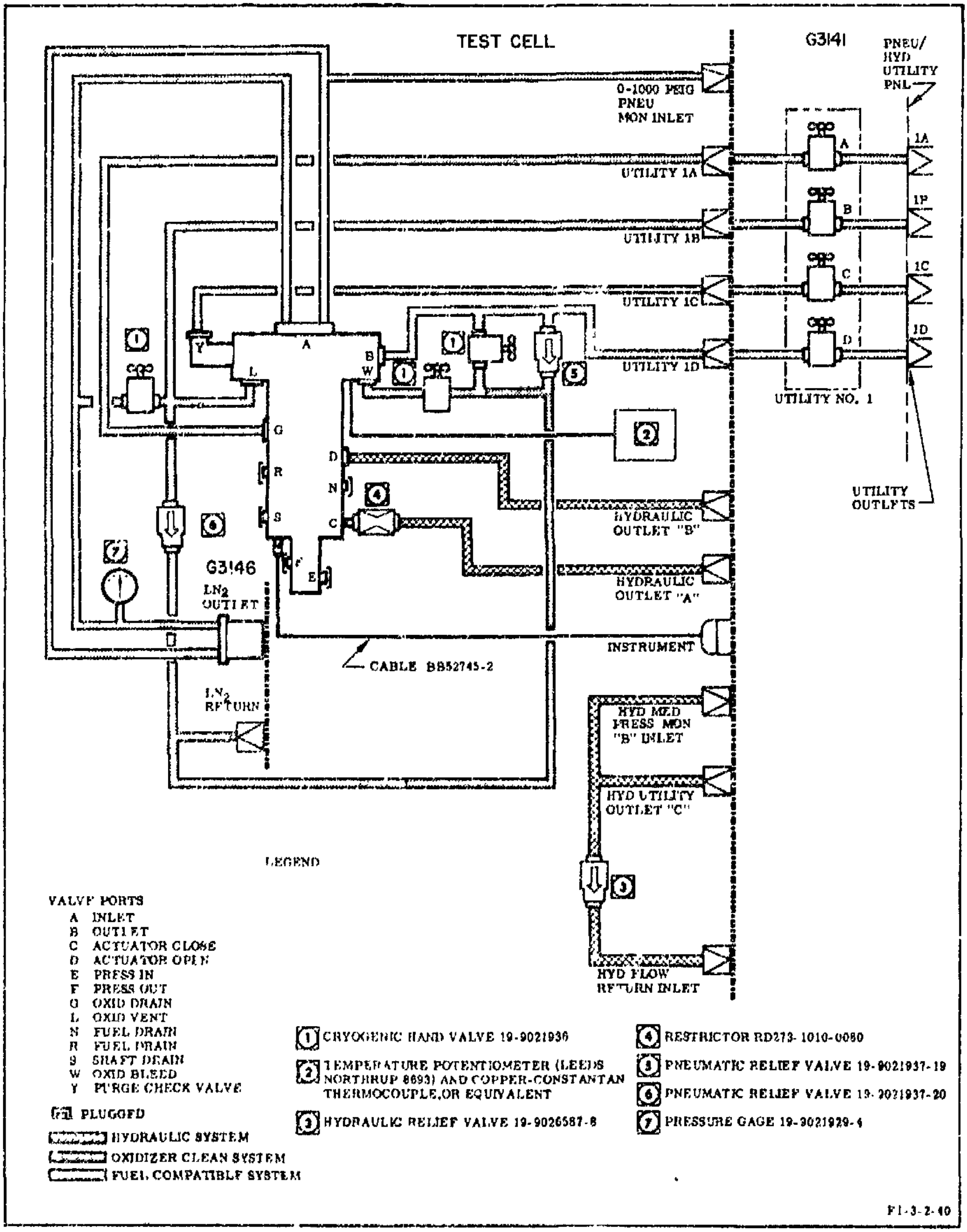


Figure 13-17. Oxidizer Valve Cryogenic Leak-Test Setup

Procedure	Result
13-28. Poppet Skirt Seal and Nose Seal and Rod Bottom Lip Seal Leak-Test During Chill-Down.	
WARNING: Valves on UTILITY NO. 1 panel must be closed. If valves are left open, liquid nitrogen can flow through utility panel. Liquid nitrogen will freeze human tissue upon contact, causing serious injury.	
a. Open cryogenic hand valve at OXID BLEED port (W).	None.
b. On FLOW/Δ P MONITOR panel, open TEST CELL MONITOR PRESSURE gage SHUTOFF valve.	None.
c. Using LN_2 TANK PRESSURE panel, apply pressure to cryogenic supply unit as follows.	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	LN_2 TANK PRESSURE panel pressurized.
NOTE: Pressure may be increased to 150 ±10 psig maximum to decrease chill-down time. Pressure must be reduced to specified value prior to measuring for leakage in steps f and g.	
(2) Open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±10 psi. Liquid nitrogen supplied to INLET port (A), and oxidizer valve starts to chill.
d. Turn on TEMPERATURE POTENTIOMETER.	TEMPERATURE POTENTIOMETER indicates temperature of valve.
e. Maintain liquid nitrogen flow through OXID BLEED port (W).	Oxidizer valve continues to chill.
f. Open UTILITY NO. 1 valve D; then measure leakage from OUTLET port (B) at outlet 1D.	Maximum allowable leakage past poppet skirt seal and nose seal is 600 scim.
g. Open UTILITY NO. 1 valve B; then measure leakage from OXID VENT port (L) at outlet 1B.	Maximum allowable leakage past rod bottom lip seal is 25 scim.
h. Close UTILITY NO. 1 valves B and C.	None.
13-29. Poppet Skirt Seal and Nose Seal, Rod Bottom Lip Seal, and Purge Check Valve Gate Seal Low-Temperature Leak-Test.	
a. On LN_2 TANK PRESSURE panel, control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. Liquid nitrogen supplied to INLET port (A).
b. Maintain a temperature of -240° ±20° F at OXID BLEED port (W) as indicated on TEMPERATURE POTENIOMETER. Close cryogenic hand valve at OXID BLEED port (W), as required, to maintain specified temperature.	TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.

Procedure	Result
c. Open UTILITY NO. 1 valve D; then measure leakage from OUTLET port (B) at outlet 1D.	Maximum allowable leakage past poppet skirt seal and nose seal is 500 scim.
d. Open UTILITY NO. 1 valve B; then measure leakage from OXID VENT port (L) at outlet 1B.	Maximum allowable leakage past rod bottom lip seal is 50 scim.
e. Close UTILITY NO. 1 valves B and D.	None.
f. Close cryogenic hand valve at OXID BLEED port (W).	Liquid nitrogen flow stops.
g. Using LN_2 TANK PRESSURE panel, increase pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,000 ±100 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 750 ±15 psi.	TEST CELL MONITOR PRESSURE gage must indicate 750 ±15 psi. INLET port (A) pressurized. TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.
h. Repeat steps c through e.	Same results as steps c through e.
i. On LN_2 TANK PRESSURE panel, close SHUTOFF valve and open VENT valve.	TEST CELL MONITOR PRESSURE gage must indicate zero.
j. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light; then press TEST CELL SUPPLY "B" switch-light.	ACTUATOR CLOSE port (C) depressurized and TEST CELL SUPPLY "A" VENT light on. ACTUATOR OPEN port (D) pressurized, oxidizer valve opens, and TEST CELL SUPPLY "B" light on. MILLIAMPERES meter must indicate 5.8 ±0.1 milliamperes.
k. Open cryogenic hand valves at OUTLET port (B) and OXID BLEED port (W).	None.
l. On LN_2 TANK PRESSURE panel, open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±10 psi. Liquid nitrogen supplied to INLET port (A).
m. Maintain liquid nitrogen flow through OUTLET port (B) and OXID BLEED port (W) until TEMPERATURE POTENTIOMETER indicates -240° ±20° F.	TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.
n. Close cryogenic hand valves at OUTLET port (B) and OXID BLEED port (W).	Liquid nitrogen flow stops.

Procedure	Result
o. On LN_2 TANK PRESSURE panel, open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 750 ±15 psi.	TEST CELL MONITOR PRESSURE gage must indicate 750 ±15 psi and INLET port (A) pressurized. TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.
p. Open UTILITY NO. 1 valve C, then measure leakage from PURGE CHECK VALVE port (Y) at outlet 1C.	Maximum allowable leakage past purge check valve gate seal is 30 scim.
q. Close UTILITY NO. 1 valve C.	None.
r. Using LN_2 TANK PRESSURE panel, reduce pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Cryogenic supply unit and INLET port (A) depressurized. TEST CELL MONITOR PRESSURE gage must indicate zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LN_2 TANK PRESSURE panel depressurized.
s. Open cryogenic hand valves at OUTLET port (B) and OXID BLEED port (W).	None.
t. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "B" switch-light; then press TEST CELL SUPPLY "A" switch-light.	ACTUATOR OPEN port (D) depressurized and TEST CELL SUPPLY "B" VENT light on. ACTUATOR CLOSE port (C) pressurized, oxidizer valve closes, and TEST CELL SUPPLY "A" SUPPLY light on. MILLIAMPERES meter must indicate 9.8 ±0.2 milliamperes.

13-30. Rod Middle Lip Seal Low-Temperature Leak-Test.

Procedure	Result
a. Open cryogenic hand valve at OXID VENT port (L).	None.
b. Using LN_2 TANK PRESSURE panel, apply pressure to cryogenic supply unit as follows:	
(1) Close VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 10 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 10 ±2 psi. Liquid nitrogen supplied to INLET port (A) and OXID VENT port (L).
c. Maintain liquid nitrogen flow through OXID BLEED port (W) until TEMPERATURE POTENTIOMETER indicates -240° ±20° F.	TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.

Procedure	Result
d. Close cryogenic hand valve at OXID BLEED port (W).	Liquid nitrogen flow stops.
e. Open UTILITY NO. 1 valve A; then measure leakage from OXID DRAIN port (G) at outlet 1A.	Maximum allowable leakage past rod middle lip seal is 25 scim.
f. Close UTILITY NO. 1 valve A.	None.
g. Using LN_2 TANK PRESSURE panel, increase pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF valve.	Pressure to cryogenic supply unit shut off.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 700 ±100 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. INLET port (A) and OXID VENT port (L) pressurized. TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.
h. Repeat steps e and f.	Same results as steps e and f.
i. Using LN_2 TANK PRESSURE panel, reduce pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Cryogenic supply unit, INLET port (A), and OXID VENT port (L) depressurized. TEST CELL MONITOR PRESSURE gage must indicate zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LN_2 TANK PRESSURE panel depressurized.
j. Open cryogenic hand valve at OXID BLEED port (W).	None.

Procedure	Result
13-31. Rod Bottom Lip Seal and Rod Middle Lip Seal Low-Temperature Leak-Test.	
a. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light; then press TEST CELL SUPPLY "B" switch-light.	ACTUATOR CLOSE port (C) depressurized and TEST CELL SUPPLY "A" VENT light on. ACTUATOR OPEN port (D) pressurized, oxidizer valve opens, and TEST CELL SUPPLY "B" SUPPLY light on. MILLIAMPERES meter must indicate 5.8 ±0.1 milliamperes.
b. Using LN_2 TANK PRESSURE panel, apply pressure to cryogenic supply unit as follows:	
(1) Close VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. INLET port (A) pressurized.
c. Maintain liquid nitrogen flow through OXID BLEED port (W) until TEMPERATURE POTENTIOMETER indicates -240° ±20° F.	TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.
d. Close cryogenic hand valve at OUTLET port (B) and OXID BLEED port (W).	Liquid nitrogen flow stops.
e. Open UTILITY NO. 1 valve B; then measure leakage from OXID VENT port (L) at outlet 1B.	Maximum allowable leakage past rod bottom lip seal is 50 scim.
f. Close UTILITY NO. 1 valve B.	None.
g. Open cryogenic hand valve at OXID VENT port (L).	OXID VENT PORT (L) pressurized.
h. Open UTILITY NO. 1 valve A; then measure leakage from OXID DRAIN port (G) at outlet 1A.	Maximum allowable leakage past rod middle lip seal is 25 scim.
i. Close UTILITY NO. 1 valve A.	None.
j. Close cryogenic hand valve at OXID VENT port (L).	None.
k. Using LN_2 TANK PRESSURE panel, increase pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF VALVE.	Pressure to cryogenic supply unit shut off.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,000 ±100 psi.	LN_2 TANK PRESSURE panel pressurized.
(3) Open and control pressure to cryogenic supply unit with SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 750 ±15 psi.	TEST CELL MONITOR PRESSURE gage must indicate 750 ±15 psi. INLET port (A) pressurized. TEMPERATURE POTENTIOMETER must indicate -240° ±20° F.
l. Repeat steps e through i.	Same results as steps e through i.
m. Using LN_2 TANK PRESSURE panel, reduce pressure to cryogenic supply unit as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Cryogenic supply unit, INLET port (A), and OXID VENT port (L) depressurized. TEST CELL MONITOR PRESSURE gage must indicate zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LN_2 TANK PRESSURE panel depressurized.
n. Open cryogenic hand valves at OUTLET port (B) and OXID BLEED port (W).	None.
o. Turn off TEMPERATURE POTENTIOMETER.	None.

13-32. Rod Top O-Ring Leak-Test.

Procedure	Result
a. Remove plugs from FUEL DRAIN ports (N) and (R).	None.
b. Check for fluid leakage at FUEL DRAIN ports (N) and (R).	No fluid leakage past rod top O-ring is allowable.
c. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "B" switch-light; then press TEST CELL SUPPLY "A" switch-light.	ACTUATOR OPEN port (D) depressurized and TEST CELL SUPPLY "B" VENT light on. ACTUATOR CLOSE port (C) pressurized, oxidizer valve closes, and TEST CELL SUPPLY "A" SUPPLY light on. MILLIAMPERES meter must indicate 9.8 ±0.2 milliamperes.
d. Allow oxidizer valve to return to ambient temperature before proceeding.	None.
e. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero, then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
f. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.

Procedure	Result
g. On HYD MED PRESS MONITOR panel, open PRESSURE MONITOR "B" shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR "B" gage must indicate zero.
h. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
i. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
j. Remove oxidizer valve from test setup.	None.

WARNING

Care must be exercised when removing hydraulic lines from actuator to prevent contamination of oxidizer section of valve Contaminated oxidizer valves used in an oxidizer system can cause an explosion, resulting in serious injury to personnel and damage to equipment.

k. Install protective closures. Refer to paragraph 13-2.	None.
l. Secure equipment as outlined in paragraph 13-33.	None.

13-33. SECURING TEST EQUIPMENT.

13-34. After oxidizer valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen and helium pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve and TO LN_2 PRESS PANEL shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Ensure that all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn digital voltmeter power off.

i. On *HYDRAULIC CONTROL* panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

j. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

k. Turn DC POWER SUPPLY off.

l. On POWER DISTRIBUTION panel, pull out circuit breakers.

m. On Cryogenic Supply Unit G3146, ensure that LN_2 SUPPLY and TANK LP SHUTOFF valves are closed and that LN_2 VENT valve is open.

13-35. OXIDIZER VALVE POSITION TRANSDUCERS 408059 AND 408059-11.

13-36. The following procedures contain disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the oxidizer valve position transducer.

13-37. DISASSEMBLING.

13-38. Disassembling the transducer is limited to the removal of screws (30, 35, 38), washers (31, 39), lug (32), arm (36), and clamp (40). See figure 13-3 for parts and index numbers.

NOTE

If it is necessary to remove arm (36) from resistor shaft on transducer 408059-11, the arm may be heated to 120° F maximum in order to easily remove screw (35) and arm.

13-39. CLEANING.

13-40. Hand-clean metallic parts for fuel service, and clean electrical connector using electrical connector cleaning procedure in R-3896-3. Volume I.

13-41. INSPECTING AND REPAIRING.

13-42. Inspect all parts of the transducer for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, scratches, and bent electrical connector pins. Refer to R-3896-3, Volume I, for general repair procedures.

13-43. ASSEMBLING.

13-44. Assembling the transducer is limited to installing screws (30, 35, 38), washers (31, 39), lug (32), arm (36), and clamp (40). See figure 13-3 for parts and index numbers. All parts must meet cleaning requirements as outlined in paragraph 13-39.

a. Attach connector to transducer cover with screws (30), washers (31), and lug (32). Torque screws to 2.0 to 2.4 in-lb.

b. Attach clamp (40) to wiring and secure it to transducer cover with screw (38) and washers (39). Torque screw to 1.0 to 2.0 in-lb.

c. Place arm (36) on shaft of resistor (37) and secure arm with screw (35). Torque screw to 4.8 to 7.3 in-lb above torque of locking feature.

d. On transducer 408059-11, attach arm (36) and screw (35) to shaft of resistor (37) as follows:

WARNING

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

(1) Clean arm and screw with methyl-ethyl-ketone (Federal Specification TT-M-261).

(2) Apply a coat of locking compound primer (MIL-S-22473), grade N, to threads of arm and screw. Allow primer to dry.

(3) Place arm on shaft of resistor; then apply locking compound (MIL-S-22473), grade AV, to threads of arm and screw.

(4) Secure arm to shaft with screw, and torque screw to 8.0 to 10.0 in-lb. Wipe off excess locking compound; then allow parts to cure at 70° F for 24 hours minimum.

13-45. TESTING.

13-46. This procedure outlines requirements for testing the oxidizer valve position transducer.

13-47. RESISTANCE AND INSULATION RESISTANCE TEST.

Procedure	Result
a. Connect a multimeter between pins A and B of electrical connector; then rotate variable resistor shaft until multimeter indicates 482 ±75 ohms.	Resistance must be 482 ±75 ohms.
b. Using multimeter, measure resistance at electrical connector as follows:	
(1) Between pins A and C.	Resistance must be 2,000 ±100 ohms.
(2) Between pins B and C.	Resistance must be 2,120 ±130 ohms.
c. Using multimeter and decade resistance box, measure resistance between pins D and E as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins D and E.	Resistance must not exceed 0.5 ohm.
d. Using megohmmeter, apply 500 ±50 vdc between pins E and F of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
e. Connect multimeter between pins B and C of electrical connector; then rotate variable resistor shaft until multimeter indicates 465 ±180 ohms.	Resistance must be 465 ±180 ohms.
f. Using multimeter, measure resistance between pins A and B.	Resistance must be 2,135 ±265 ohms.
g. Using multimeter and decade resistance box, measure resistance between pins E and F as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.

Procedure	Result
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins E and F.	Resistance must not exceed 0.5 ohm.
h. Using megohmmeter, apply 500 ±50 vdc between pins D and E of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
i. Remove transducer from test setup. Package and protect transducer as outlined in R-3896-3, Volume I.	None.

13-48. CONTINUITY VERIFICATION TEST. This test is a preinstallation requirement only.

Procedure	Result
a. Connect a multimeter between pins A and B and rotate shaft until multimeter indicates 482 ±75 ohms; then using a multimeter, continuity test open and closed switches. Record multimeter indication.	Multimeter must indicate continuity between pins E and D and infinity between pins E and F.
b. Connect a multimeter between pins B and C and rotate shaft until multimeter indicates 465 ±180 ohms; then using a multimeter, continuity test open and closed switches. Record multimeter indication.	Multimeter must indicate infinity between pins E and D and continuity between pins E and F.

SECTION XIV

FUEL VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

14-1. FUEL VALVE 405280, 408050, 408070, 408070-11, 410910, AND 410910-11.

14-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the fuel valve. See figure 14-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
T-5021003	Retainer Wrench	Installs fuel valve retainer nut.
T-5026080	Pressure Test Fixture	Pressure-tests fuel valve.
T-5034154	Spring Compressor	Compresses fuel valve spring during repair.
T-5034179	Wrench	Holds piston while torquing nut.
T-5037819	Torque Wrench Adapter	Torques piston guide bolt.
T-5041507	Flow Test Fixture	Flow-tests actuator piston during testing.
T-5047801	Calibration Standard	Used with Flow Test Fixture T-5041507 to check accuracy of facility hydraulic flow measuring instruments.
T-5041512	Dimpling Tool	Deforms poppet seat retainer washer, which locks retainer in place.
L-5 (Hunter Spring) or equivalent	Pull Gage	Measures pull force of variable resistor shaft.
T-5041520 or equivalent	Position Indicator Gage	Holds position indicator during testing.
8101595	Assembly Stand	Holds fuel valve during repair and checkout.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements.
1432-T (General Radio Co), or equivalent	Decade Resistance Box	Used with Triplett 630A for resistance tests.
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests.
G3104	Pneumatic Flow Tester	Measures downstream pneumatic leakage.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel control for testing fuel valve.
G3143	Components Adapter Set	Provides hardware for fuel valve test setups.

Figure 14-1. Test Equipment and Special Tools for Fuel Valve

Figure 14-2 deleted.

14-3. DISASSEMBLING.

14-4. Disassemble fuel valve, as required, to accomplish necessary repairs and/or replacement. See figure 14-3 for parts and index numbers.

a. Install fuel valve in assembly stand 8101595 and secure.

b. Remove plug (1, 1A) and gasket (2, 2A); then remove retainer (6) using retainer wrench T-5021003. On valves 410910 and 410910-11, remove washer (6A).

c. Remove seat (7), O-ring (8), and retainer (9); then remove screw (4), washer (5), retainer (10), and seal (11).

WARNING

Poppet (14) is under spring-load. Care must be exercised while using spring compressor to remove poppet. Spring load is relieved as poppet is removed.

d. Attach spring compressor T-5034154 to housing (43), remove nut (12) with wrench T-5034179, and then remove washer (13).

e. Remove the following parts in the sequence listed:

(1) Poppet and closing spring parts (14 through 20).

NOTE

Ring (16A) is on valves 410910 and 410910-11 only.

(2) Valve (36) and gasket (37).

(3) Screws (34) and washers (35).

CAUTION

Rotating position transducer more than 1/4-turn during removal can damage electrical leads.

(4) Position transducer (38 through 41) as an assembly.

(5) Guide assembly (21 through 26).

NOTE

Torquing tool T-5037819 is used to remove bolt (21).

f. Remove piston (29) from guide (23); then remove O-ring (27), retainer (28), and packings and retainers (30 through 33). On valves 410910 and 410910-11, remove bushing (27A).

g. Remove bushing (43) from assembly stand 8101595, then remove bolts (3) from housing (43).

14-5. CLEANING.

14-6. The fuel valve must be cleaned for fuel service. (Refer to R-3896-3, Volume I, for cleaning procedures.)

14-7. INSPECTING AND REPAIRING.

14-8. Inspecting the fuel valve determines if the individual parts have been damaged by mishandling or wear. See figure 14-4 and inspect individual parts for general condition, cleanness, damage of threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits are listed in figure 14-5 and form the guide for serviceability of parts. Minimum and maximum values are given which, when exceeded, require repair or replacement of the applicable parts.

14-9. ASSEMBLING.

14-10. The assembly procedures for the fuel valve must be performed in the order listed and all parts must meet cleaning requirements as outlined in paragraph 14-5. The lubricants used in this procedure are specified in the procedural steps. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 14-3 for parts and index numbers.

a. Install bolts (3) into housing (43). Torque bolts to 80-100 in-lb.

b. Place housing (43) in assembly stand 8101595 and secure.

Pages 14-3 and 14-4 deleted.

Part Number	Nomenclature	Use
T-5021003	Retainer Wrench	Installs fuel valve retainer nut.
T-5021044	Assembly Jig	Holds fuel valve during repair and checkout.
T-5026080	Pressure Test Fixture	Pressure-tests fuel valve.
T-5034154	Spring Compressor	Compresses fuel valve spring during repair.
T-5034179	Wrench	Holds piston while torquing nut.
T-5037819	Torquing Tool	Torques piston guide bolt.
~~T-5041507~~[a]	Flow Test Fixture	Flow-tests actuator piston during assembly.
T-5047801[a]	Calibration Standard	Used with Flow Test Fixture T-5041507 to check accuracy of facility hydraulic flow measuring instruments.
T-5041512[a]	Dimpling Tool	Deforms poppet seat retainer washer, which locks retainer in place.
L-5 (Hunter Spring) or equivalent[a]	Pull Gage	Measures pull force of variable resistor shaft.
T-5041520 or equivalent[a]	Position Indicator Gage	Holds position indicator during testing.
8101595	Assembly Stand	Holds fuel valve and assembly jig during repair and checkout.
G3104[a]	Pneumatic Flow Tester	Measures downstream pneumatic leakage.
G3141[a]	Components Test Console	Provides gaseous nitrogen and hydraulic fuel control for testing fuel valve.
G3143[a]	Components Adapter Set	Provides hardware for fuel valve test setups.

(a) Item not illustrated.

Figure 14-1. Test Equipment and Special Tools for Fuel Valve (Sheet 3 of 3)

Part Number	Nomenclature	Use
RX20640-11	Cover	Fuel inlet port (E) and fuel outlet port (F)
RX20660-33	Plate	Purge port (D)
RX20660-57	Plate	Actuator close port (B)
RX20660-65	Plate	Actuator open port (A)
RX20730	Plate	Indicator port (C)
RK395-10006	Closure	Indicator shaft

Figure 14-2. Protective Covers and Closures for Fuel Valve

14-3. DISASSEMBLING.

14-4. Disassemble fuel valve, as required, to accomplish necessary repairs and/or replacement. See figure 14-3 for parts and index numbers.

a. Place fuel valve into assembly jig T-5021044; then install fuel valve and assembly jig in assembly stand 8101595 and secure.

b. Remove plug (1, 1A) and gasket (2, 2A); then remove retainer (6) using retainer wrench T-5021003. On valves 410910 and 410910-11, remove washer (6A).

c. Remove seat (7), O-ring (8), and retainer (9); then remove screw (4), washer (5), retainer (10), and seal (11).

WARNING

Poppet (14) is under spring-load. Care must be exercised while using spring compressor to remove poppet. Spring load is relieved as poppet is removed.

d. Attach spring compressor T-5034154 to housing (43), remove nut (12) with wrench T-5034179, and then remove washer (13).

e. Remove the following parts in the sequence listed:

(1) Poppet and closing spring parts (14 through 20).

NOTE

Ring (16A) is on valves 410910 and 410910-11 only.

(2) Valve (36) and gasket (37).

(3) Screws (34) and washers (35).

CAUTION

Rotating position transducer more than 1/4-turn during removal can damage electrical leads.

(4) Position transducer (38 through 41) as an assembly.

(5) Guide assembly (21 through 26).

NOTE

Torquing tool T-5037819 is used to remove bolt (21).

f. Remove piston (29) from guide (23); then remove O-ring (27), retainer (28), and packings and retainers (30 through 33). On valves 410910 and 410910-11, remove bushing (27A).

g. Remove housing (43) from assembly stand 8101595 and assembly jig T-5021044; then remove bolts (3) from housing (43).

14-5. CLEANING.

14-6. The fuel valve must be cleaned for fuel service. (Refer to R-3896-3, Volume I, for cleaning procedures.)

14-7. INSPECTING AND REPAIRING.

14-8. Inspecting the fuel valve determines if the individual parts have been damaged by mishandling or wear. See figure 14-4 and inspect individual parts for general condition, cleanness, damage of threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits are listed in figure 14-5 and form the guide for serviceability of parts. Minimum and maximum values are given which, when exceeded, require repair or replacement of the applicable parts.

14-9. ASSEMBLING.

14-10. The assembly procedures for the fuel valve must be performed in the order listed and all parts shall meet cleaning requirements as outlined in paragraph 14-5. The lubricants used in this procedure are specified in the procedural steps. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 14-3 for parts and index numbers.

a. Install bolts (3) into housing (43). Torque bolts to 80-100 in-lb.

b. Place housing (43) into assembly jig T-5021044; then install fuel valve and assembly jig in assembly stand 8101595 and secure.

NOTE

Prior to installing piston, make sure piston bleed hole hydraulic flow-test has been performed. Refer to paragraph 14-22 for test procedure and use flow test fixture T-5041507.

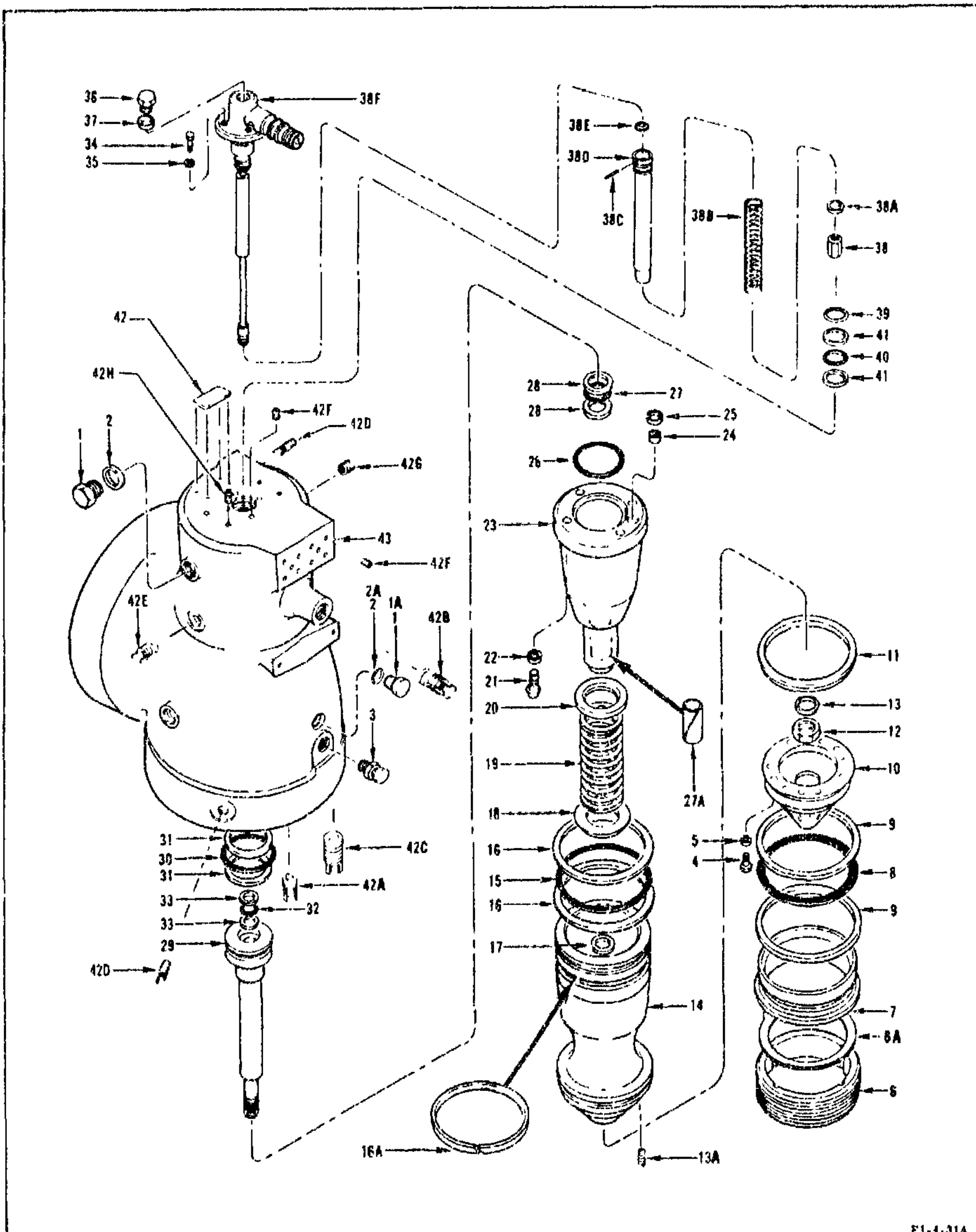


Figure 14-3. Fuel Valve--Exploded View (Sheet 1 of 2)

1	Plug[a]	13A	Insert	27A	Bushing[c]	38E	Washer
1A	Plug[b]	14	Poppet	28	Retainer	38F	Cover
2	Gasket[a]	15	O-ring	29	Piston	39	O-ring
2A	Gasket[b]	16	Retainer	30	Packing	40	Packing
3	Bolt	16A	Ring[c]	31	Retainer	41	Retainer
4	Screw	17	Washer	32	Packing	42	Nameplate
5	Washer	18	Washer	33	Retainer	42A	Insert
6	Retainer	19	Spring	34	Screw	42B	Insert
6A	Washer[c]	20	Washer	35	Washer	42C	Insert
7	Seat	21	Bolt	36	Valve[a]	42D	Insert
8	O-ring	22	Washer	37	Gasket[a]	42E	Insert
9	Retainer	23	Guide	38	Nut	42F	Insert
10	Retainer	24	Guide	38A	Washer	42G	Insert
11	Seal	25	O-ring	38B	Spring	42H	Insert
12	Nut	26	O-ring	38C	Pin	43	Housing
13	Washer	27	O-ring	38D	Housing		

(a) On valve 405280.
(b) On valves 408050, 408070, 408070-11, 410910, and 410910-11.
(c) On valves 410910 and 410910-11.

Figure 14-3. Fuel Valve--Exploded View (Sheet 2 of 2)

Part Name and Index Number	Inspecting	Repairing
Retainer (6)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Damaged or worn locking pellet.	Replace.
Seat (7) Guide (24)	Damaged sealing surface.	Replace.
Retainer (10)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Poppet (14)	Damage to skirt surface.	Replace.
	Damaged or missing inserts.	Replace inserts.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Ring (16A)	Damaged surface.	Replace.
Washer (17) Washer (18) Washer (20)	Damaged surfaces.	Replace.
Spring (19)	Compressed rating.	Refer to figure 14-5.

Figure 14-4. Inspecting and Repairing Fuel Valve (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
Guide (23)	Damaged sealing surfaces.	Replace.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Hole diameter.	Refer to figure 14-5.
Bushing (27A)	Damaged Mating surface.	Replace.
Piston (29)	Damaged exterior surface.	Replace.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Verify that hydraulic flow through bleed holes is 1.45 ±0.10 gpm. (Refer to paragraph 14-22.)	Remove obstruction or replace.
Valve (36)	Damaged threads, spring, or seal	Replace.
Position transducer (38 through 41)	Evidence of O-ring particles (black particles) along shaft.	Assign indicator for overhaul.
	Bent shaft.	Assign indicator for overhaul.
Housing (43)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts.
	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.

Figure 14-4. Inspecting and Repairing Fuel Valve (Sheet 2 of 2)

Part Name and Index Number	Dimension	Minimum (Inches except as noted)	Maximum
Poppet (14)	Skirt outside diameter.	5.496[(a)] 5.490[(b)]	5.498[(a)] 5.493[(b)]
	Inside diameter for piston rod (29).	0.75.0	0.7476
	Outside diameter for retainer (10).	3.371	3.373
	Skirt groove diameter for ring (16A)	5.250[(b)]	5.253[(b)]
Washer (17)	Surfaces to be parallel to each other within 0.005 inch.		

(a) On valves 405280, 408050, 408070, and 408070-11.
(b) On valves 410910 and 410910-11.

Figure 14-5. Dimensional Limits for Fuel Valve (Sheet 1 of 2)

Part Name and Index Number	Dimension	Minimum	Maximum
		(Inches except as noted)	
Spring (19)	Compress to 4.546 inches.	84.5 lb	94.5 lb
Guide (23)	Hole diameter for piston rod (29).	1.0625	1.0635
Piston (29)	Outside diameter for poppet (14).	0.7560	0.7563
	Outside diameter for guide (23).	1.061	1.062
	Hole diameter for piston rod (29).	1.0625[a] 1.069[b]	1.0635[a] 1.071[b]
	Outside diameter surface for guide (23) to be straight within 0 0005 inch.		
	Inside diameter for bushing (27A).	1.1870[b] 5.490[b]	1.1885[b] 5.493[b]
Housing (43)	Inside diameter for poppet (14).	5.502	5.505
	Inside diameter for seat (7).	5.625	5.627

(a) On valves 405280, 408050, 408070, and 408070-11.
(b) On valves 410910 and 410910-11.

Figure 14-5. Dimensional Limits for Fuel Valve (Sheet 2 of 2)

c. Lubricate (Method L) packing (32) with FS1281 grease (Dow Corning Corp); then insert packing and retainers (33) into groove of piston (29).

d. Lubricate (Method L) packing (30) with FS1281 grease (Dow Corning Corp); then install packing and retainers (31) on piston (29).

e. Lubricate (Method L) O-ring (27) with FS1281 grease (Dow Corning Corp); then insert O-ring and retainers (28) into groove of guide (23). On valves 410910 and 410910-11, insert bushing (27A) into guide (23).

f. Carefully slide piston (29) into guide (23) until piston contacts bottom of guide.

g. Lubricate (Method J) O-ring (25) with lubricant grease RB0140-012 (Rocketdyne); then install O-ring and guide (24) into guide (23).

h. Lubricate (Method J) O-ring (26) with lubricant grease RB0140-012 (Rocketdyne); then insert O-ring in housing (43).

hA. Apply a thin coat of FS1281 grease (Dow Corning Corp) to area inside surface of housing (43) that makes contact with poppet O-ring (15).

i. Install guide (23) and piston (29) into housing (43). Make sure guide (24) is alined with drilled passage in housing (43).

j. Secure guide (23) to housing (43) with bolts (21) and washers (22). Torque bolts to 315-385 in-lb using torquing tool T-5037819.

k. Lubricate (Method J) O-ring (39) with lubricant grease RB0140-012 (Rocketdyne); then install O-ring on position transducer.

CAUTION

The spring must be held firmly. If the position transducer is allowed to snap open under spring force, damage to the slider block fastener in the variable resistor will result.

kA. Check position transducer shaft for adequate lubrication. If lubricant on shaft is not visible, apply a thin film of FS1281 grease (Dow Corning Corp) with a lint-free swab inserted between coils of spring. If necessary, compress spring to gain access to shaft. Excess lubricant on shaft is acceptable.

l. Lubricate (Method J) packing (40) with lubricant grease RB0140-012 (Rocketdyne); then install packing and retainers (41) on position transducer.

lA. Make sure spring is centered in washer on end of shaft.

CAUTION

Rotating the position transducer more than 1/4 turn during installation can damage the electrical leads.

m. Carefully slide position transducer into housing (43) until flange on cover (38F) contacts surface of housing.

mA. Prior to securing position transducer to housing (43), check that spring (38B) is not binding by measuring distance cover (38F) springs out away from valve housing (43). Distance must not exceed 0.300 inch.

n. Secure position transducer to housing (43) with screws (34) and washers (35). Torque screws to 60-70 in-lb.

nA. Check that position transducer is fully extended into valve piston and indicates valve is in closed position as follows:

(1) Measure resistance between pins A and C. Resistance must be 2,000 ±100 ohms.

(2) Measure resistance between pins B and C. Resistance must be 2,095 ±325 ohms.

(3) Measure resistance between pins D and E. Resistance must not exceed 0.5 ohm.

o. Lubricate (Method J) gasket (37) with FS1281 grease (Dow Corning Corp); then install gasket on valve (36).

p. Install valve (36) into cover (38F). Torque valve to 40-65 in-lb.

q. Install washer (20) and spring (19) on guide (23); then install washers (18, 17).

r. Lubricate (Method L) O-ring (15) with FS1281 grease (Dow Corning Corp); then install O-ring and retainers (16) on poppet (14). On valves 410910 and 410910-11, install ring (16A) on poppet (14).

s. Carefully slide poppet (14) into housing (43).

t. Compress spring (19) with spring compressor T-5034154; then install washer (13) and nut (12) on stem of piston (29). Make sure nut has full thread engagement on stem of piston; then remove spring compressor T-5034154.

u. Torque nut (12) to 300-350 in-lb. Use wrench T-5034179 to hold piston (29) stationary when torquing nut.

v. Install seal (11) and retainer (10) on poppet (14); then secure retainer to poppet with screws (4) and washers (5). Hand-tighten screws only.

NOTE

Seal (11) must be installed so that chamfered edge will make contact with seat (7).

w. Lubricate (Method J) O-ring (8) with lubricant grease RB0140-012 (Rocketdyne); then install O-ring and retainers (9) on seat (7).

x. Connect a source of gaseous nitrogen (MIL-P-27401) to the OPEN port.

y. Slowly open 100 ±10 psig gaseous nitrogen to the OPEN port to open the valve.

z. On valves 405280, 408050, 408070, and 408070-11, install seat (7) in housing (43); then install retainer (6) by hand until locking insert contacts housing. Torque retainer to 250-300 in-lb above torque of locking feature, using retainer wrench T-5021003.

aa. On valves 410910 and 410910-11, install seat (7) in housing (43); then install washer (6A) and retainer (6). Torque retainer to 600-700 in-lb, using retainer wrench T-5021003.

aaA. Using dimpling tool T-5041512, deform washer (6A) four places, into grooves of retainer (6). Washer must be deformed a minimum of 0.040 inch.

ab. Reduce pressure to zero to close the valve and allow seal (11) to center in proper position against seat (7).

ac. Remove source of gaseous nitrogen from the OPEN port and connect it to the CLOSE port.

ad. Slowly apply 50 ±10 psig gaseous nitrogen to the CLOSE port to obtain proper seating of seal (11); then torque screws (4) to 60-70 in-lb.

ae. Reduce pressure to zero; then remove gaseous nitrogen source from CLOSE port.

af. Lubricate (Method J) gaskets (2, 2A) with lubricant grease RB0140-012 (Rocketdyne); then install gaskets and plugs (1, 1A) into housing (43). Torque plugs to 80-120 in-lb.

ag. Remove valve from assembly stand 8101595.

14-11. TESTING.

14-12. This procedure outlines requirements for complete testing of the fuel valve, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3102 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on fuel valve as outlined in figure 14-6. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up components test console electrical patch-panels (figure 14-7) and prepare console for use (figure 14-8). See figure 14-9 for fuel valve test port identification and a cutaway view. Refer to paragraphs 14-13 through 14-22 for fuel valve test procedures and see figures 14-10 through 14-12 for test setups.

Valve Port	Test Plate	Port Connection
OPEN (A)	T-5026080-121	AN815-6C
CLOSE (B)	T-5026080-120	AN815-6C
VENT (C)	None	AN815-4C
PURGE (D)	T-5026080-119	AN815-4C
INLET (E)	T-5026080-127	AN815-4C
OUTLET (F)	T-5026080-127	AN815-4C

Figure 14-6. Preparing Fuel Valve for Testing

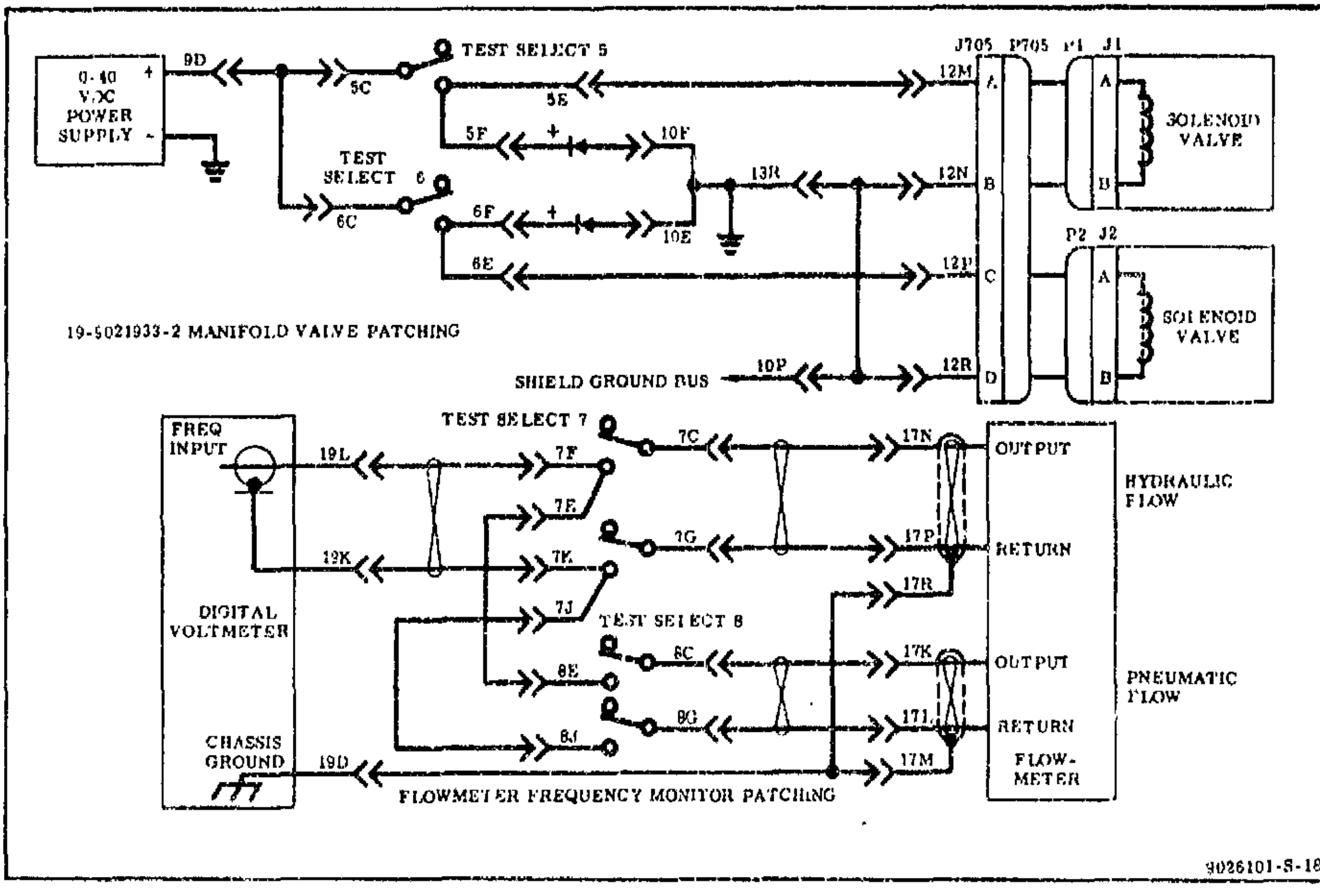


Figure 14-7. Components Test Console Patch-Panel Requirements (Sheet 1 of 3)

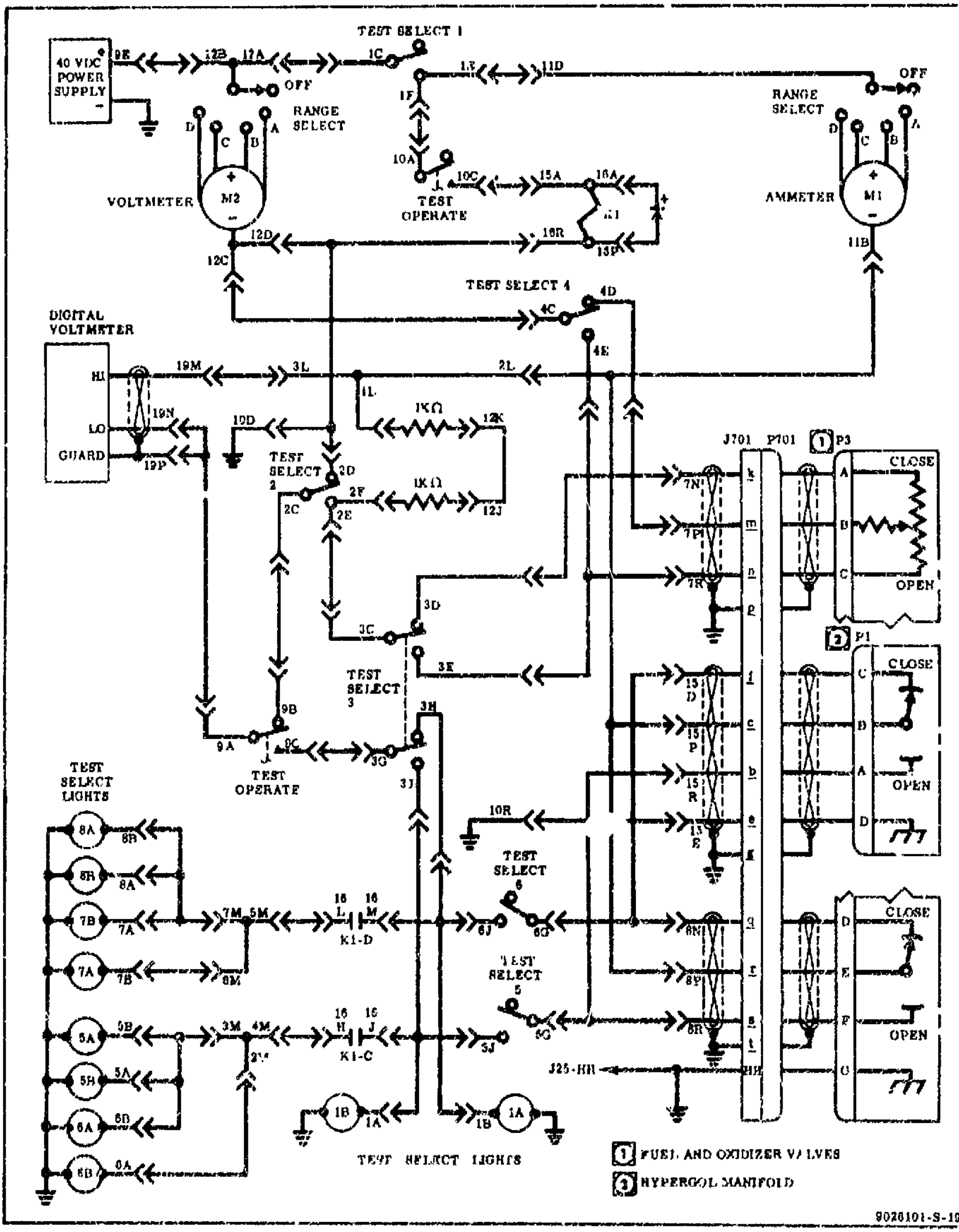


Figure 14-7. Components Test Console Patch-Panel Requirements (Sheet 2 of 3)

Patch-Cord (a)	From J6-	To J6-
K5 09	1A	3J
		5J
		16J
K5.09	1B	3H
		6J
		16M
K3.	1C	12A
K3.	1E	11D
K3.	1F	10A
3088-12	1L	12K
K3.	2C	9B
K5.09	2D	10D
		12D
		16R
K3.	2E	3C
3088-12	2F	12J
K5 09	2L	8P
		11B
		15P
K3.	2M	6A
K3.	3D	7N
K4.09	3E	4E
		7R
K3.	3G	9C
K3.	3L	19M
K5.09	3M	5A
		5B
		6B
K3.	4D	7P
K3.	4C	12C
K3.	4M	16H
K4.09	5C	6C
		9D

Patch-Cord (a)	From J6-	To J6-
K3.	5E	12M
3088-17(b)	5F(+)	10F
K4.09	5G	8R
		15R
K3.	5M	16L
K3.	6E	12P
3088-17 (b)	6F(+)	10E
K4.09	6G	8N
		15D
K3.	6M	7B
K5.09	7A	7M
		8A
		8B
K3.	7C	17N
K3.	7E	8E
K3.	7F	19L
K3.	7G	17P
K3.	7J	8J
K3.	7K	19K
K3.	8C	17K
K3.	8G	17L
K4.09	9A	19N
		19P
K3.	9E	12B
K3.	10C	15A
K5.09	10P	12N
		12R
		13R
K3.	10R	15E
3088-17(b)	16A(+)	16P
K4.09	19D	17M
		17R

(a) Use any cord length required on all patch-cords numbered K3.
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 14-7. Components Test Console Patch-Panel Requirements (Sheet 3 of 3)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary to obtain specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Cable 1231003 or 1231004	Connection to fuel valve.
	Connector J702		

Figure 14-8. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (Continued)			
TEST CELL ELECT. OUTLETS	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Cable 1231012 or 1231009	For valve manifold control.

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on. [a]
	VOLTS-RANGE SELECT	(0-150)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 OFF. Test power control. [a]
	TEST SELECT 2		Light 2 OFF. DVM return control. [a]
	TEST SELECT 3		Light 3 OFF. Variable resistor monitor control. [a]
	TEST SELECT 4		Light 4 OFF. Variable resistor monitor control. [a]
	TEST SELECT 5		Light 5 OFF. Manifold valve solenoid control. [a]
	TEST SELECT 6		Light 6 OFF. Manifold valve solenoid control. [a]
	TEST SELECT 7		Light 7 OFF. Hydraulic flow monitor control. [a]
	TEST SELECT 8		Light 8 OFF. Pneumatic flow monitor control. [a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 24 ±0.4 volts.

(a) If indication is not as specified, press applicable switch-light.

Figure 14-8. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
SPRING CLOSING FORCE TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	10V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.
	RESET		Digital voltmeter indicates 00.0000 to 00.0001 volt.[a]

NOTE

Allow digital voltmeter to warm up for at least 30 minutes prior to use.

Panel	Control	Position	Indication/Remarks
FLOW MONITOR TESTS			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	

(a) If indication is not as specified, press applicable switch-light.

Figure 14-8. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks
FLOW MONITOR TESTS (Continued)			
DIGITAL VOLTMETER	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 switch-light is for pneumatic flow. Both switch-lights must not be on at the same time.

PNEUMATIC PREPARATION.

a. Make sure that console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

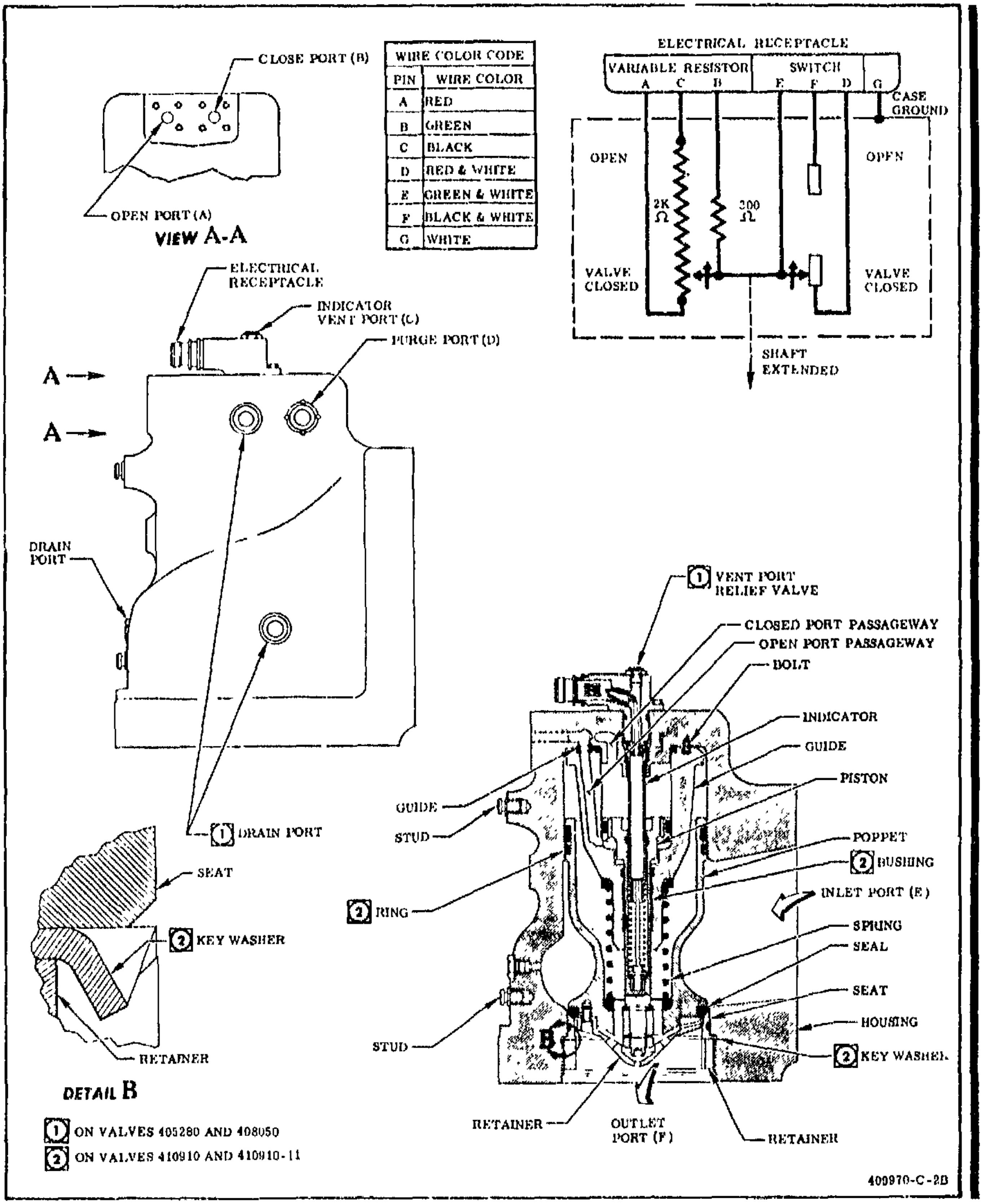
c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed to ensure safety of personnel working with pressurized systems.

Figure 14-8. Preparing Components Test Console for Use (Sheet 4 of 4)



WIRE COLOR CODE	
PIN	WIRE COLOR
A	RED
B	GREEN
C	BLACK
D	RED & WHITE
E	GREEN & WHITE
F	BLACK & WHITE
G	WHITE

Figure 14-9. Fuel Valve--Cutaway View

Procedure	Result

14-13. POSITION TRANSDUCER RESISTANCE AND SPRING CLOSING FORCE TEST.

WARNING

All hydraulic pressure must be off and white room clear of fuel vapors before electrical tests are performed, to prevent injury to personnel and damage to equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and fuel valve for use as outlined in paragraph 14-12; then connect fuel valve to console (figure 14-10). Do not connect cable BB52745-2 to fuel valve.	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to manifold valve as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 200 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Open SHUTOFF valve. PRESSURE REGULATOR may require adjustment to obtain result.	PRESSURE MONITOR "B" gage must indicate 200 ±20 psi.

14-14. Resistance Test.

NOTE

All switches used during this test are located on the ELECTRICAL CONTROL panel unless otherwise specified.

Procedure	Result
a. Perform the following:	
(1) Turn VOLTS meter RANGE SELECT switch to D (0-30).	VOLTS meter must indicate 24 ±0.4 volts.
(2) Press TEST SELECT 1 and 6 switchlights.	MILLIAMPERES meter must not exceed 50 milliamperes. Lights 1, 6, and 1A on. Valve fully closes.
(3) Turn MILLIAMPERES meter RANGE SELECT switch to C (0-250).	None.

CAUTION

Exceeding 28 volts when turning VOLTAGE ADJUST to INCREASE can damage manifold valve solenoids.

Procedure	Result
b. Using megohmmeter, apply 500 ±50 vdc between pins E and F of valve electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.

Procedure	Result
c. Using multimeter, measure resistance at valve electrical connector as follows:	
(1) Between pins A and B.	Resistance must be 500 ±75 ohms.
(2) Between pins A and C.	Resistance must be 2,000 ±100 ohms.
(3) Between pins B and C.	Resistance must be 2,095 ±325 ohms.
d. Using multimeter and decade resistance box, measure resistance between pins D and E as follows:	
(1) Adjust decade resistance box for 0.5 ohm and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins D and E.	Resistance must not exceed 0.5 ohm.
e. Press TEST SELECT 5 and 6 switch-lights.	Lights 5 and 1B on and lights 6 and 1A off. Valve opens.
f. Using megohmmeter, apply 500 ±50 vdc between pins D and E of valve electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
g. Using multimeter, measure resistance at valve electrical connector as follows:	
(1) Between pins A and B.	Resistance must be 2,095 ±325 ohms.
(2) Between pins C and B.	Resistance must be 495 ±160 ohms.
h. Using multimeter and decade resistance box, measure resistance between pins E and F as follows:	
(1) Adjust decade resistance box for 0.5 ohm and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins E and F.	Resistance must not exceed 0.5 ohm.
i. Press TEST SELECT 5 and 6 switch-lights.	Lights 5 and 1B off and lights 6 and 1A on. Valve closes.
j. Press TEST SELECT 1 and 6 switch-lights.	Lights 1, 6, and 1A off.

Procedure	Result
k. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to manifold valve as follows:	
(1) Close SHUTOFF valve and open VENT valve until PRESSURE MONITOR "B" gage indicates zero; then close VENT valve.	Manifold valve depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.

14-15. Spring Closing Force Test.

NOTE

All switches used during this test are located on the ELECTRICAL CONTROL panel unless otherwise specified.

Procedure	Result
a. Connect cable BB52745-2 to fuel valve; then perform the following:	
(1) Turn VOLTS meter RANGE SELECT switch to D (0-30) and turn VOLTAGE ADJUST knob until VOLTS meter indicates 24-25 volts.	VOLTS meter indicates 24-25 volts.
(2) Press TEST SELECT 1 and 6 switch-lights.	MILLIAMPERES meter must not exceed 50 milliamperes. Lights 1, 6, and 1A on.
(3) Turn MILLIAMPERES meter RANGE SELECT switch to C (0-250).	None.

CAUTION

Exceeding 28 volts when turning VOLTAGE ADJUST to INCREASE can damage manifold valve solenoids.

Procedure	Result
b. On DVM panel, verify that switches are in the following positions:	
(1) STORE/DISPLAY DURING COUNT switch to STORE.	None.
(2) RANGE switch to 10V.	None.
(3) FUNCTION switch to VOLT.	None.
(4) ATTENUATION switch to midposition.	None.
(5) SAMPLE PERIOD switch to .1 SEC 10 PER.	None.
(6) SAMPLING RATE switch to STOP.	None.
c. On DVM panel, press RESET switch.	DVM must indicate 24.0000 to 25.0000 volts.
d. Press TEST SELECT 6, 2, and 5 switch-lights, in order given.	Lights 6 and 1A off and lights 2 and 5 on. DVM must indicate 019.400 to 019.776 volts. Valve remains closed.
e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to OPEN port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 220 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.

All data on pages 14-21 and 14-22 deleted.

Procedure	Result
(2) Slowly open SHUTOFF valve until fuel valve is fully opened. Record pressure required to open valve.	Valve opens and light 1B on. DVM must indicate 011.325 to 012.720 volts. Pressure to open valve must be less than 110 psi, as indicated on PRESSURE MONITOR "B" gage.
f. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	OPEN port (A) depressurized and light 1B off. DVM must indicate 019.400 to 019.776 volts. Valve must close fully by spring force only.
g. Press TEST SELECT 2 and 5.	Lights 2 and 5 off.
h. Press TEST SELECT 1 switch-light.	Light 1 off.
i. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(2) Close VENT valve.	None.
j. Remove valve from test setup.	None.
k. If fuel valve testing is terminated, install protective closures as outlined in paragraph 14-2, and secure equipment as outlined in paragraph 14-23.	None.

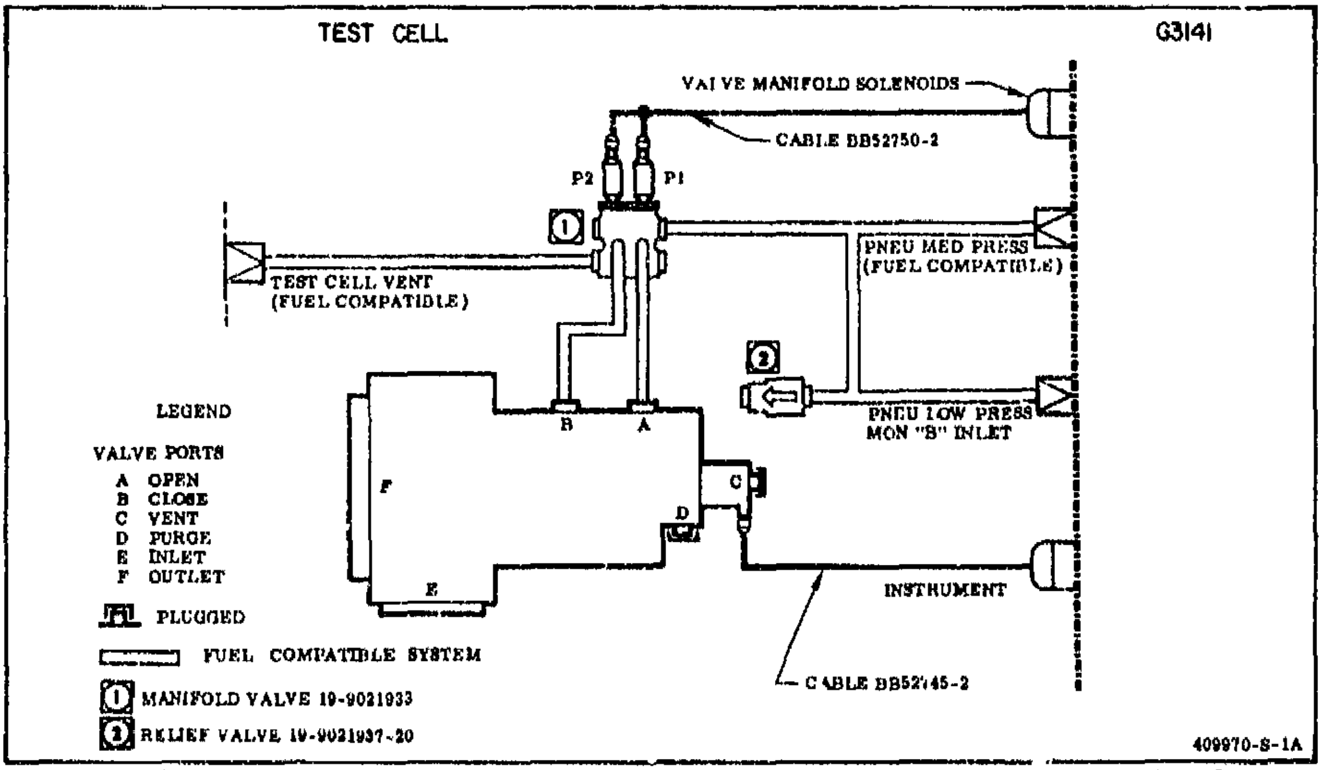


Figure 14-10. Fuel Valve Position Indicator Resistance and Spring Closing Force Test Setup

Procedure	Result
14-16. PNEUMATIC LEAK-TEST	
a. Ensure that Components Test Console G3141 and fuel valve are prepared for use as outlined in paragraph 14-12.	None.
b. Connect fuel valve to console (figure 14-11). Remove plug from HYDRAULIC UTILITY "B" connection.	None.
14-17. Guide to Housing Large and Small O-Rings and Guide to Piston Rod O-Ring Leak-Test.	
a. Open UTILITY NO. 2 valve A.	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CLOSE port (B) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. CLOSE port (B) pressurized.
c. Open UTILITY NO. 3 valve D; then measure leakage from OUTLET port (F) at outlet 3D.	Maximum allowable leakage past O-rings is 3 scim.
d. Close UTILITY NO. 3 valve D.	None.
e. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±2 psi. CLOSE port (B) pressurized.
f. Repeat steps c and d.	Same results as steps c and d.
g. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. CLOSE port (B) pressurized.

Procedure	Result
h. Repeat steps c and d.	Same results as steps c and d.
i. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CLOSE port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CLOSE port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

14-18. Housing to Variable Resistor O-Ring and Piston to Variable Resistor O-Ring Leak-Test.

Procedure	Result
a. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CLOSE port (B) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. CLOSE port (B) pressurized.
b. Open UTILITY NO. 3 valve B; then measure leakage from VENT port (C) at outlet 3B.	Maximum allowable leakage past O-rings is 2 scim.
c. Close UTILITY NO. 3 valve B.	None.
d. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±2 psi. CLOSE port (B) pressurized.
e. Repeat steps b and c.	Same results as steps b and c.
f. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. CLOSE port (B) pressurized.

Procedure	Result
g. Repeat steps b and c.	Same results as steps b and c.
h. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CLOSE port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CLOSE port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

14-19. Variable Resistor Cover O-Ring Leak-Test.

Procedure	Result
a. Open UTILITY NO. 3 valve A.	None.
b. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CLOSE port (B) and VENT port (C) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. CLOSE port (B) and VENT port (C) pressurized.
c. Check for leakage between variable resistor cover and housing.	Maximum allowable leakage is 1 scim or fuzz leakage.
d. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) and VENT port (C) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±2 psi. CLOSE port (B) and VENT port (C) pressurized.
e. Repeat step c.	Same result as step c.
f. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CLOSE port (B) and VENT port (C) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CLOSE port (B) and VENT port (C) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.

Procedure	Result
(3) Close VENT valve.	None.
g. Close UTILITY NO. 3 valve A.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
h. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.

14-20. Poppet Skirt O-Ring, Poppet Nose Seal, and Seat O-Ring Leak-Test.

Procedure	Result
a. Connect a line from tee at HYDRAULIC UTILITY "A" connection to INLET port (E).	None.
b. Open UTILITY NO. 2 valve D to vent OPEN port (A).	None.
c. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CLOSE port (B) and INLET port (E) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. CLOSE port (B) and INLET port (E) pressurized.
d. Open UTILITY NO. 3 valve D; then measure leakage from OUTLET port (F) at outlet 3D.	Maximum allowable leakage past O-rings is 12 scim.
e. Close UTILITY NO. 3 valve D.	None.
f. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) and INLET port (E) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±2 psi. CLOSE port (B) and INLET port (E) pressurized.
g. Repeat steps d and e.	Same results as steps d and e.
h. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to CLOSE port (B) and INLET port (E) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. CLOSE port (B) and INLET port (E) pressurized.

Procedure	Result
i. Repeat steps d and e.	Same results as steps d and e.
j. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CLOSE port (B) and INLET port (E) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CLOSE port (B) and INLET port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
k. Close UTILITY NO. 2 valves A and D and close UTILITY NO. 3 valve D.	None.
l. Remove line between HYDRAULIC UTILITY "A" tee connection and INLET port (E). Install plugs in open fittings.	None.

14-21. Inlet, Outlet, and Purge Port Flange Leak-Test.

a. Open UTILITY NO. 2 valve C and open UTILITY NO. 3 valve C.	None.
b. Open UTILITY NO. 2 valve B to vent CLOSE port (B).	None.
c. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to OPEN port (A) and OUTLET port (F) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±2 psi. OPEN port (A) and OUTLET port (F) pressurized.
d. Check for leakage at the following joints:	
(1) Between INLET port (E) flange and test plate.	No visual leakage allowable for valves 410910 and 410910-11. Maximum allowable leakage for valves 405280, 408050, 408070, and 408070-11 is 2 scims or fuzz leakage.
(2) Between OUTLET port (F) flange and test plate.	No visual leakage allowable for valves 410910 and 410910-11. Maximum allowable leakage for valves 405280, 408050, 408070, and 408070-11 is 2 scims or fuzz leakage.
(3) PURGE port (D) flange.	No visual leakage allowable for valves 410910 and 410910-11. Maximum allowable leakage for valves 405280, 408050, 408070, and 408070-11 is one scim or fuzz leakage.

Procedure	Result
e. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to OPEN port (A) and OUTLET port (F) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±2 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±2 psi. OPEN port (A) and OUTLET port (F) pressurized.
f. Repeat step d.	Same results as step d.
g. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to OPEN port (A) and OUTLET port (F) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±10 psi. OPEN port (A) and OUTLET port (F) pressurized.
h. Repeat step d.	Same result as step d.
i. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to OPEN port (A) and OUTLET port (F) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	OPEN port (A) and OUTLET port (F) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
j. Close UTILITY NO. 2 valves B and C and UTILITY NO. 3 valve C.	None.
k. Disconnect lines from UTILITY OUTLETS.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
kA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
l. Remove fuel valve from test setup.	None.
m. If fuel valve testing is terminated, install protective closures as outlined in paragraph 14-2, and secure equipment as outlined in paragraph 14-23.	None.

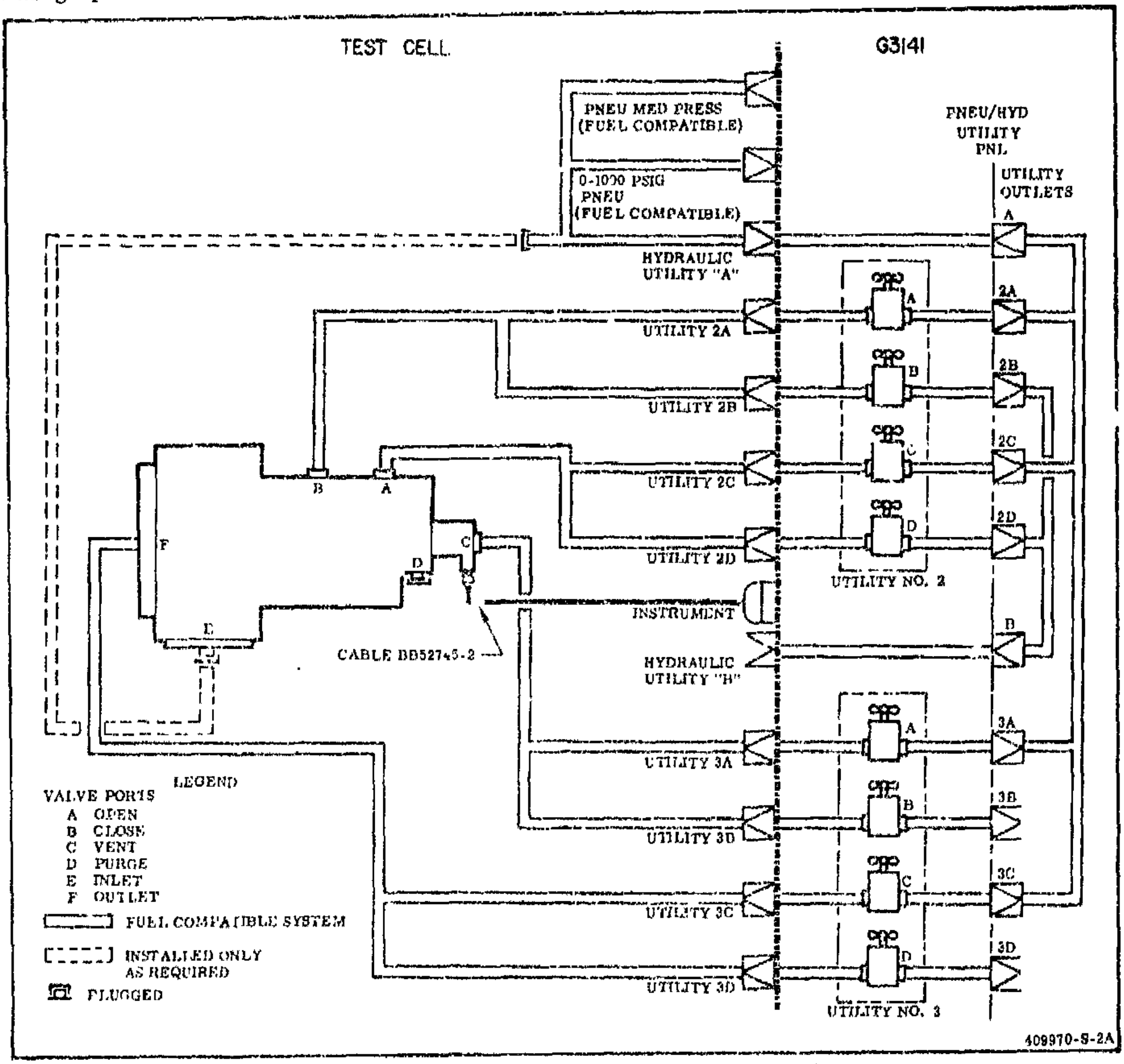


Figure 14-11. Fuel Valve Pneumatic Leak-Test Setup

Procedure	Result
14-22. PISTON BLEED HOLE AMBIENT HYDRAULIC FLOW-TEST.	
a. Ensure that Components Test Console G3141 and fuel valve are prepared for use as outlined in paragraph 14-12.	None.
b. Connect fuel valve to console (figure 14-12, piston bleed hole ambient hydraulic flow test).	None.
c. On PRESSURE/TEMPERATURE MONITOR panel turn TEMPERATURE CHANNEL SELECT switch to 3.	None.
d. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.

Procedure	Result
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press FLOW MONITOR SHUTOFF switch-light.	OPEN light on and CLOSE light off.
e. Slowly increase facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
f. On DIGITAL VOLTMETER (DVM) panel, verify that switches are in the following positions:	
(1) STORE/DISPLAY DURING COUNT switch to STORE position.	None.
(2) RANGE switch to 100V position.	None.
(3) FUNCTION switch to FREQ position.	None.
(4) ATTENUATION switch to midposition. (Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.)	None.
(5) SAMPLING RATE switch to STOP.	None.
(6) SAMPLE PERIOD switch to 1 SEC.	None.
g. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.
h. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
i. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. CLOSE port (B) pressurized.
j. On DVM panel, press RESET switch; then measure and record flowrate through piston bleed holes at OPEN port (A). On TEMPERATURE MONITOR panel record temperature.	DVM must indicate an equivalent to 1.45 ±0.10 gpm. TEMPERATURE INDICATOR must indicate 70° to 110° F.

NOTE

If the DVM does not indicate specified flowrate through piston bleed holes, a calibration check of the flow measuring instrument may be necessary to determine the cause for an out of tolerance flowrate. A calibration check may be performed by using this procedure and test setup, except the Calibration Standard T-5047801 and Flow Test Fixture T-5041507 must be connected to the test setup instead of the fuel valve.

Procedure	Result
k. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.

Procedure	Result
l. Reduce facility hydraulic supply pressure to zero psig and on HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	Facility hydraulic supply and HYDRAULIC CONTROL panel depressurized.
m. On HYD MED PRESS MONITOR panel, open PRESSURE MONITOR "B" shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR "B" gage must indicate zero.
n. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press FLOW MONITOR SHUTOFF switch-light.	CLOSE light on and OPEN light off.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(4) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(5) Close HIGH PRESS SHUTOFF valve.	None.
o. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 off.
p. Install protective closures. Refer to paragraph 14-2.	None.
q. Secure equipment as outlined in paragraph 14-23.	None.

14-22A. NOSE SEAL LIQUID LEAK TEST. This test must be performed on each spare fuel valve one time only and after the valve has been disassembled and reassembled, prior to valve installation on the engine.

Procedure	Result
a. Make sure that Components Test Console G3141 and fuel valve are prepared for use as outlined in paragraph 14-12, except do not install test plate on fuel valve OUTLET port (F).	None.
b. Connect fuel valve to console (figure 14-12, nose seal liquid leak test), but do not connect fuel compatible system hose to INLET port (E) at this time.	None.
c. Using HYDRAULIC CONTROL panel, perform the following:	None.
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press FLOW MONITOR SHUTOFF switch-light.	OPEN light on and CLOSE light off.

Procedure	Result
d. Slowly increase facility hydraulic supply pressure until on HYDRAULIC CONTROL panel, SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
e. On HIGH PRESSURE FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS. gage indicates 1,800 ±200 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until on HYD MED PRESS MONITOR panel, PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi; then close valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. CLOSE port (B) pressurized.
g. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off. CLOSE port (B) depressurized.
h. Position fuel valve with INLET port (E) up and fill INLET port (E) with RJ-1 fuel (MIL-F-25558); then connect fuel compatible system to INLET port (E).	None.
i. Inspect valve nose seal for liquid leakage.	No leakage is allowable.
j. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (E) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS. gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until on LOW PRESS MONITOR FUEL COMPATIBLE panel, PRESSURE MONITOR "A" gage indicates 22 ±2 psi.	INLET port (E) pressurized.
k. Inspect valve nose seal for liquid leakage.	No leakage is allowable.
l. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off. CLOSE port (B) pressurized.
m. Inspect valve nose seal for liquid leakage.	No leakage is allowable.
n. Using MED PRESS FUEL COMPATIBLE panel, depressurize INLET port (E) as follows:	None.
(1) Close SHUTOFF valve; then open VENT valve.	On LOW PRESS MONITOR FUEL COMPATIBLE panel, PRESSURE MONITOR "A" gage indicates zero. INLET port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close vent valve.	

Procedure	Result
o. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS. gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
p. Reduce facility hydraulic supply pressure to zero psig and on HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	Facility hydraulic supply and HYDRAULIC CONTROL panel depressurized.
q. On HYD MED PRESS MONITOR panel, open PRESSURE MONITOR "B" RETURN valve until PRESSURE MONITOR "B" gage indicates zero; then close valve.	PRESSURE MONITOR "B" gage must indicate zero.
r. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press FLOW MONITOR SHUTOFF switch-light.	CLOSE light on and OPEN light off.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(4) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(5) Close HIGH PRESS SHUTOFF valve.	None.
s. Remove fuel valve from test setup and drain RJ-1 fuel from INLET port (E).	None.
t. Install covers and closures. Refer to paragraph 14-2.	None.
u. Secure equipment as outlined in paragraph 14-23.	None.

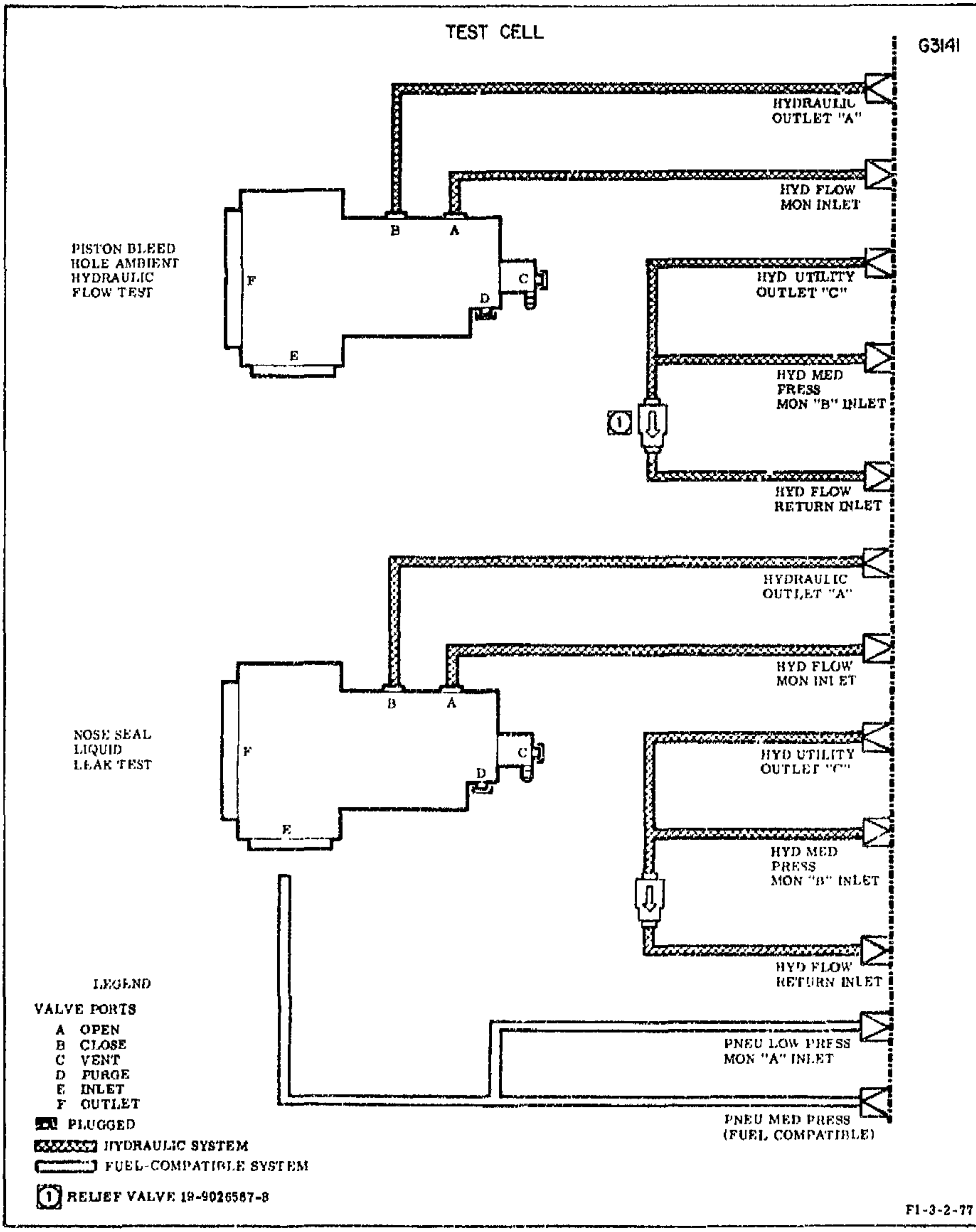


Figure 14-12. Fuel Valve Piston Bleed Hole Ambient Hydraulic Flow Test and Nose Seal Liquid Leak-Test Setups

14-23. SECURING TEST EQUIPMENT.

14-24. After fuel valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero: then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

14-25. FUEL VALVE POSITION TRANSDUCERS 408063 AND 408063-11.

14-26. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the fuel valve position transducer.

14-27. DISASSEMBLING.

14-28. Disassemble the position transducer, as required, to accomplish necessary repairs and/or replacement. (See figure 14-3 for parts and index numbers.)

CAUTION

Spring must be held firmly. If resistor is allowed to snap open under spring force, damage to the slider block fastener in the variable resistor will result.

a. Compress spring (38B) to gain access to wrench flats on shaft; then remove nut (38) from end of shaft.

b. Remove washer (38A) and spring (38B) from shaft of variable resistor.

c. Partially remove pin (38C) that connects housing (38D) to cover (38F) of variable resistor enough to allow housing to be removed from variable resistor.

d. Remove washer (38E) from inside housing (38D).

14-29. CLEANING.

WARNING

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

- Cleaning compound is volatile. Use in a well-ventilated area since the vapors displace air, resulting in suffocation.

CAUTION

Do not immerse variable resistor into cleaning liquid or allow liquid to wet the resistor shaft O-ring, since liquid will remove lubricant from shaft O-ring O-ring.

14-30. Clean position transducer with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302) by handwiping only. Nut (38) washer (38A), spring (38B), and housing (38D) must be cleaned for fuel service. Refer to R-3896-3, Volume I, for cleaning procedures.

14-31. INSPECTING AND REPAIRING.

14-32. Inspecting the position transducer determines if the individual parts have been damaged by mishandling or wear. See figure 14-13 and visually inspect individual parts for the condition to be sought and the disposition as to repair or replacement of the parts.

Part Name	Inspecting	Repairing
Washers (38A, 38E)	Damaged surface.	Replace.
Spring (38B) 405427	Compressed rating: 2.750 inch--8.5 pounds min. 10.5 pounds max. 1.502 inch--15.9 pounds min. 17.9 pounds max.	Replace spring if minimum or maximum values are exceeded.
Spring (38B) 405427-3	Compressed rating: 3.592 inch--7.83 pounds min. 9.83 pounds max. 1.515 inch--29.53 pounds min. 33.53 pounds max.	Replace spring if minimum or maximum values are exceeded.
Housing (38D)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Cover (38F) and variable resistor	Bent or broken pins on electrical connector.	Straighten bent pins if bend is less than 10 degrees. Replace indicator if pins are broken or bend exceeds 10 degrees.
	Threads damaged on shaft of variable resistor.	Refer to R-3896-3, Volume I, for thread repair.
Shaft	Evidence of O-ring particles (black particles) along shaft.	Assign transducer for overhaul.
	Bent.	Assign transducer for overhaul.

Figure 14-13. Inspecting and Repairing Fuel Valve Position Transducer

14-33. ASSEMBLING.

14-34. The assembly procedures must be performed in the order listed and all parts must meet cleaning requirements as outlined in paragraph 14-29. (See figure 14-3 for parts and index numbers.)

a. Lubricate shaft of variable resistor with FS1281 grease (Dow Corning Corp). Gently actuate shaft while applying grease. Friction between variable resistor shaft and O-ring will decrease. When application of additional grease no longer decreases shaft friction, the shaft is sufficiently lubricated. Using pull gage L-5 (Hunter Spring), or equivalent, measure force required to actuate variable resistor shaft. Force to actuate shaft must not exceed 2 pounds.

NOTE

If shaft O-ring and shaft have sufficient lubrication prior to this operation, no change in shaft friction will be noted.

b. Install washer (38E) in bottom of housing (38D).

c. Carefully slide housing (38D) over variable resistor and connect housing to cover (38F) of variable resistor with pin (38C).

d. Install spring (38B) over shaft of variable resistor.

CAUTION

The spring (38B) must be held firmly. If resistor is allowed to snap open under spring force, damage to the slider block fastener in the variable resistor will result.

e. Compress spring (38B) to gain access to wrench flats on variable resistor shaft; then install washer (38A) and nut (38) on end of variable resistor shaft. Torque nut to 6-8 inch-pounds above torque required to install nylok pellet.

14-35. TESTING.

14-36. This procedure outlines the requirements for testing the fuel valve position transducer. Prior to starting test, firmly secure position transducer in a test setup using position indicator gage T-5041520, or equivalent. Test setup must permit the variable resistor shaft to be extended, retracted, and held in specified positions.

14-37. RESISTANCE AND INSULATION RESISTANCE TEST.

CAUTION

The spring (38B) must be held firmly. If resistor is allowed to snap open, damage to the slider block fastener in the variable resistor will result.

Procedure	Result
a. With shaft of variable resistor extended to 11.234 ±0.010 inches (see figure 14-14 for dimensional reference), use a multimeter to measure resistance at electrical connector as follows:	
(1) Between pins A and B.	Resistance must be 500 ±75 ohms.
(2) Between pins A and C.	Resistance must be 2,000 ±100 ohms.
(3) Between pins B and C.	Resistance must be 2,095 ±325 ohms.
b. Using multimeter and decade resistance box, measure resistance between pins D and E as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins D and E.	Resistance must not exceed 0.5 ohm.
c. Using megohmmeter, apply 500 ±50 vdc between pins E and F of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
d. With shaft of variable resistor pushed in to 9.157 ±0.010 inches (see figure 14-14 for dimensional reference), use a multimeter to measure resistance at electrical connector as follows:	
(1) Between pins A and B.	Resistance must be 2,095 ±325 ohms.
(2) Between pins B and C.	Resistance must be 495 ±160 ohms.
e. Using multimeter and decade resistance box, measure resistance between pins E and F as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.

Procedure	Result
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins E and F.	Resistance must not exceed 0.5 ohm.
f. Using megohmmeter, apply 500 ±50 vdc between pins D and E of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
g. Remove position transducer from test setup.	None.
h. Install protective closures. Refer to paragraph 14-2.	None.

14-38. CONTINUITY VERIFICATION TEST. This test is a preinstallation requirement only.

CAUTION

The spring (38B) must be held firmly. If resistor is allowed to snap open, damage to the slider block fastener in the variable resistor will result.

a. Fully extend shaft; then using a multimeter, continuity test open and closed switches. Record multimeter indication.	Multimeter must indicate continuity between pins D and E and infinity between pins E and F.
b. Fully retract shaft; then using a multimeter, continuity test open and closed switches. Record multimeter indication.	Multimeter must indicate infinity between pins D and E and continuity between pins E and F.

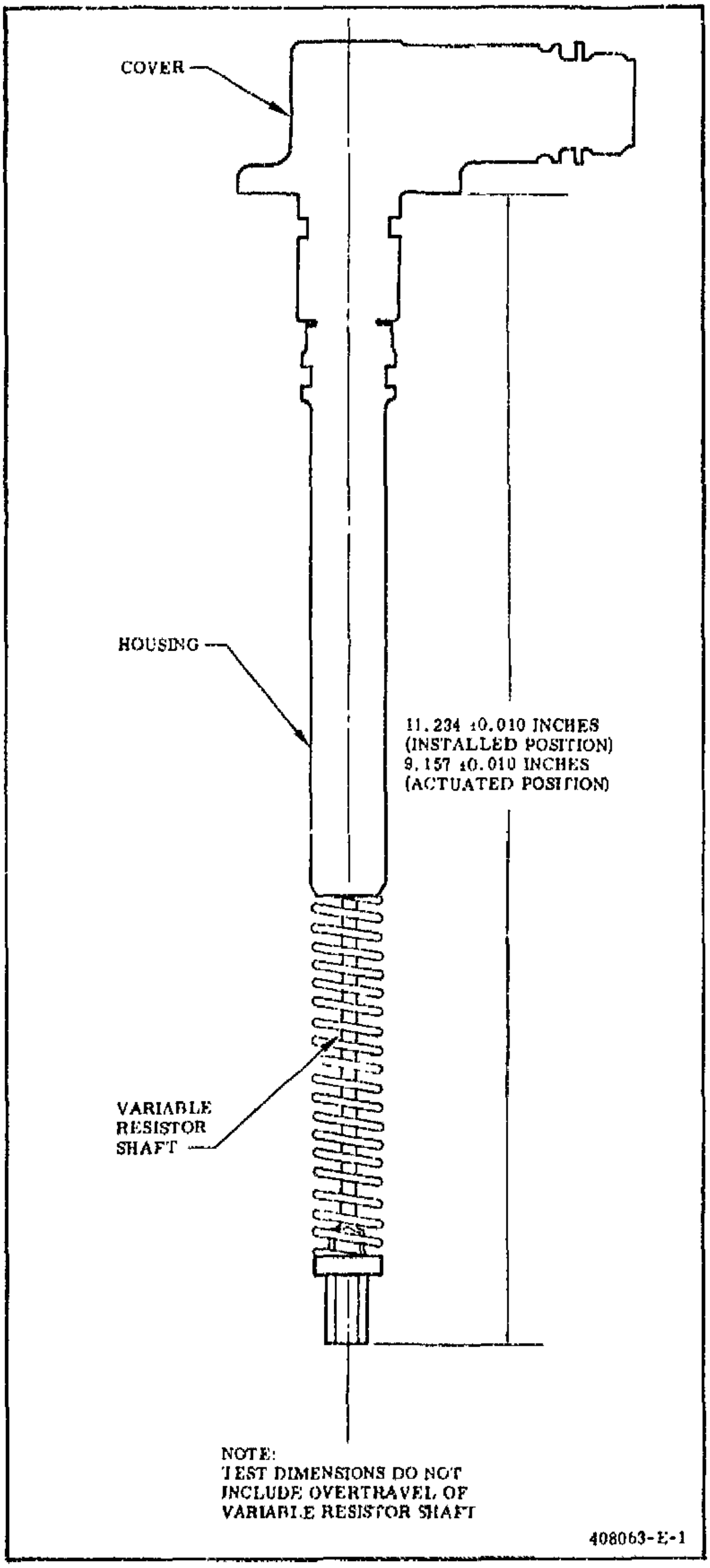


Figure 14-14. Fuel Valve Position Transducer Test Setup

SECTION XV

TURBOPUMP

WARNING

PNEUMATIC FLOW TESTER G3104 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

15-1. <u>TURBOPUMP 458800-11 THROUGH 458800-171 AND 460182 THROUGH 460182-1281</u>.

15-2. Turbopump repair is limited to replacement of the oxidizer impeller, replacement of the No. 1 primary oxidizer seal, minor repair or replacement of those components that must be removed to replace the oxidizer seal, and replacement of the intermediate seal. Turbopump repair may be performed with the turbopump installed or removed from the engine. Repair procedures consist of disassembling, cleaning, inspecting and repairing, and testing. See figure 15-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
T-5035940	Adapter	Measures bolt stretch while torquing inducer locking bolt, when adapter T-5035941 is required.
T-5021812	Depth Micrometer	Takes pump measurements.
T-5035937	LOX Inducer Cap Puller	Removes inducer cap.
T-5035933	Inducer Puller	Removes and installs oxidizer inducer.
T-5029452	Hydraulic Torque Tool	Torques inducer locking bolt to obtain proper bolt stretch.
T-5035934	Impeller Coupling Puller	Removes impeller coupling.
T-5028680	Wrench	Torques mating ring and slinger locking nut.
T-5026436	Protection Sleeve	Protects floor of volute during installation of screws.
T-5026440	Pressure Test Fixture	Checks No. 1 oxidizer primary and intermediate seals for leakage.
T-5028689	Pressure Test Fixture (oxidizer outlets)	Pressure-tests oxidizer pump.
T-5035571 or 9020163	Pressure Test Fixture (oxidizer inlet)	Pressure-tests oxidizer pump.
T-5028673	Lift and Holding Tool	Lifts and holds pump inlet.
T-5028674	Ring Compressor	Compresses piston rings while installing oxidizer inlet.

Figure 15-1. Test Equipment and Special Tools for Turbopump (Sheet 1 of 2)

Part No.	Nomenclature	Use
T-5028675	Pressure Test Fixture	Tests intermediate seal.
T-5029467	Torque and Inspection Tool	Measures bolt stretch while torquing inducer locking bolt. Used with hydraulic torque tool T-5029452 when interface panel does not interfere.
T-5035941	Adapter	Used with hydraulic torque tool T-5029452 and adapter T-5035940 when engine interface panel interferes.
T-5026432	Torque Bar	Holds second stage turbine wheel and shaft when torquing shaft bolt.
T-5035912	Pressure Test Fixture	Pressure-tests No. 1 and No. 2 bearing seals.
T-5041812	Clearance Pins	Measures clearance between oxidizer inlet and inducer.
T-5044645	Seal Installation Tool	Installs intermediate seal.
9020161	Fuel Pump Inlet Test Plate	Pressure-tests fuel pump (No. 2 fuel pump inlet).
9020162	Fuel Pump Inlet Test Plate	Pressure-tests fuel pump (No. 1 fuel pump inlet).
1/4-20 UNC x 1 inch long (3 required)	Jack Screws	Handles primary oxidizer seal and intermediate seal.
G3104	Pneumatic Flow Tester	Measures turbopump downstream pneumatic leakage.
2480 (Magnaflux), or equivalent	Magnetometer	Detects residual magnetism.
SB-911 (Magnaflux), or equivalent	Demagnetizing Unit	Demagnetizes No. 1 oxidizer primary seal mating ring.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements.
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests.

Figure 15-1. Test Equipment and Special Tools for Turbopump (Sheet 2 of 2)

Figure 15-2 deleted.

15-3. CLEANNESS STANDARDS.

15-4. ENVIRONMENT. Procedures to repair the turbopump must be performed in an environmentally controlled, clean room or in an enclosure that will envelop the oxidizer pump and personnel performing the work. Design of an enclosure must prevent entry of foreign objects or contaminants from overhead structures, wind, and adjacent engine areas.

15-5. PERSONNEL. Personnel handling liquid-oxygen-clean parts must wear clean nylon gloves. Asbestos gloves may be required for handling heated parts.

CAUTION

Whenever asbestos gloves are used to handle heated parts, make sure that parts are cleaned after handling.

15-6. TOOLS. All tools used in the oxidizer pump must be thoroughly cleaned with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302). Tools which could trap contaminants must not be used, unless it can be verified that they have not been previously used for other than liquid oxygen service.

WARNING

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

- Cleaning compound (MIL-C-81302) is volatile. Use in a well-ventilated area since the vapors replace the oxygen in the air, resulting in suffocation.

15-7. DISASSEMBLING.

15-8. Disassemble the oxidizer pump, as required, to accomplish necessary repairs and/or replacement. See figure 15-3 for parts and index numbers.

NOTE

Measurements taken during disassembly of the oxidizer pump must be recorded and made available to the Rocketdyne representative for transmittal to Engineering.

a. Cleanness standards contained in paragraph 15-3 must be strictly adhered to.

b. Disconnect heat exchanger to permit installation of torque bar T-5026432. Procedures for disconnecting the heat exchanger are outlined in R-3896-3, Volume I.

NOTE

It is not necessary to disconnect or remove heat exchanger if only the inlet is to be removed and reinstalled.

c. Before removing closure from inlet (11), as specified in paragraph 15-8A or 15-9, perform the following:

(1) Remove safetywire from bolts (9).

WARNING

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

- The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

(2) Clean exterior surfaces of the oxidizer pump inlet and volute with a clean, white, nylon cloth, moistened with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302).

d. All parts removed from the oxidizer pump must be packaged in new clean polyethylene bags to prevent contamination. Parts that are known or suspected to be contaminated must be clearly marked and assigned to be cleaned for liquid oxygen service.

CAUTION

An axial load of 4,000 pounds must not be exceeded while using special tools to pull parts from the turbopump, since damage to the turbopump can result.

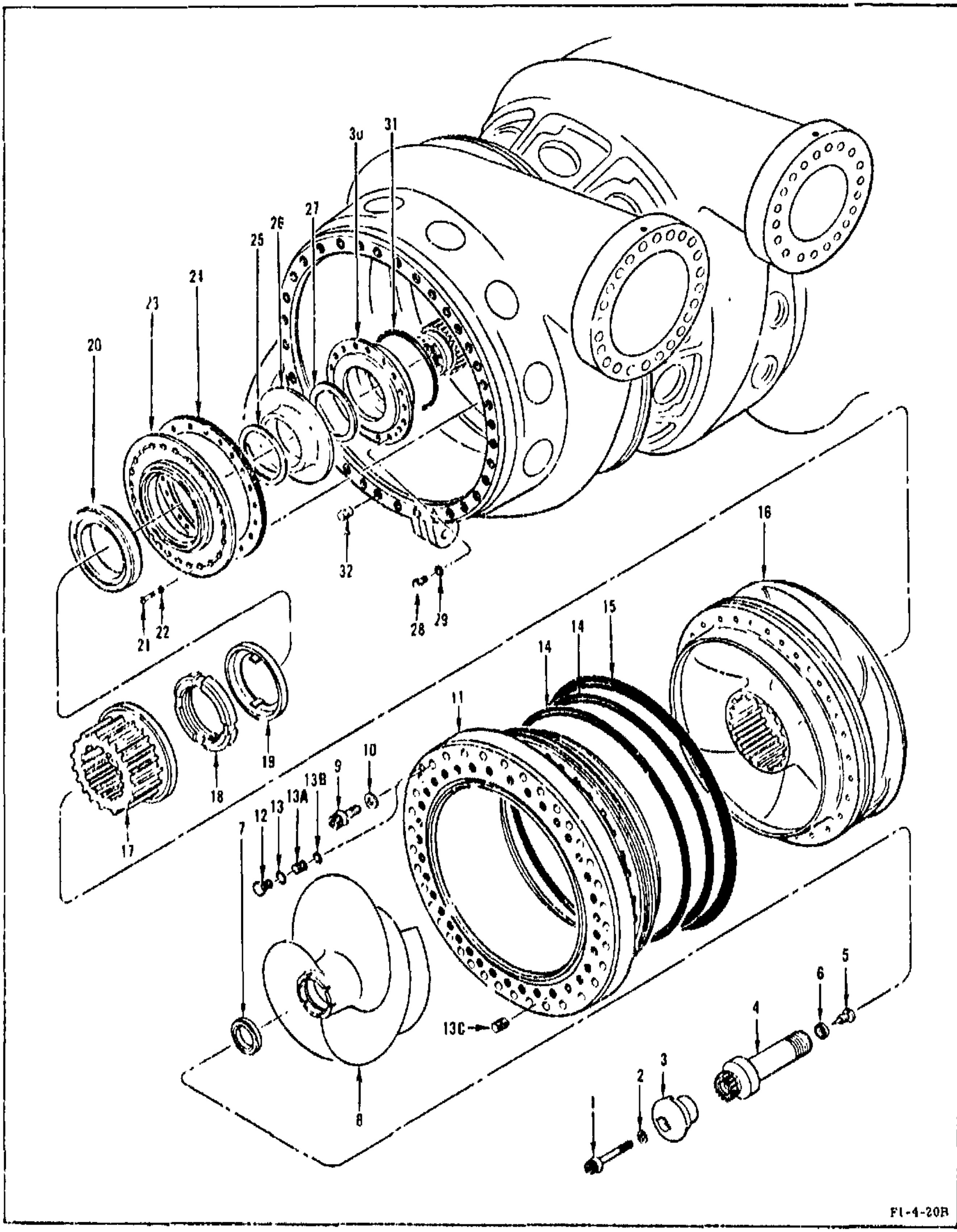


Figure 15-3. Turbopump--Exploded View (Sheet 1 of 2)

1	Bolt	16	Impeller
2	Lockwasher	17	Spline Sleeve
3	Cap	18	Nut
4	Bolt	19	Lock
5	Plug	20	Ring
6	Lockwasher	21	Screw
7	Washer	22	Washer
8	Inducer	23	Primary Oxidizer Seal
9	Bolt	24	Spacer
10	Washer	25	Gasket
11	Inlet	26	Slinger
12	Plug	27	Gasket
13	K-seal	28	Bolt
13A	Insert	29	Washer
13B	K-seal	30	Intermediate Seal
13C	Insert	31	Packing
14	Piston Rings	32	Insert
15	Seal		

Figure 15-3. Turbopump--Exploded View (Sheet 2 of 2)

15-8A. REMOVING INLET. This procedure is required if only the inlet is to be removed.

a. Remove safetywire and clean external surfaces of inlet and volute as specified in paragraph 15-8.

aA. Remove bolts (9) and washers (10); then remove closure from inlet (11).

CAUTION

Side movement while lifting the inlet from the volute can cause damage to the wear-ring if the wear-ring contacts the inducer.

b. Carefully remove inlet (11) with lift and holding tool T-5028673. Make sure inlet is lifted straight from volute without any side movement.

c. Remove piston rings (14) from inlet (11) and assign rings for overhaul. New or overhauled rings will be installed during assembly.

d. Remove seal (15) from volute and assign for overhaul. A new or overhauled seal will be installed during assembly.

e. After removal of parts and tools from oxidizer pump, cover pump opening with new clean polyethylene material to prevent entry of contaminants.

15-9. REMOVING INDUCER, INLET, IMPELLER, AND SPLINE SLEEVE.

a. Remove safetywire and clean external surfaces of inlet and volute as specified in paragraph 15-8.

aA. Remove closure from inlet (11); then remove bolt (1) and lockwasher (2), and discard lockwasher. Using LOX inducer cap puller T-5035937, remove cap (3).

b. Measure and record a dimension from top of inducer (8) at V-mark to top of inlet (11) at 12 o'clock position. (Volute attach lug = 12 o'clock.)

c. Using clearance pins T-5041812, check that clearance between inside diameter of inlet and outside diameter of inducer is greater than 0.167 inch. Clearance must be checked over the full circumference and height of inducer.

cA. Using heavy gage, commercial grade plastic sheet, wrap torque bar T-5026432 to protect flanges during installation; then carefully insert torque bar between flanges of heat exchanger and turbine manifold. After torque bar is in position for installation on turbine wheel, remove plastic sheet from torque bar.

d. Install torque bar T-5026432 on second-stage turbine wheel and turbine manifold. During installation, make sure that torque bar adequately prevents the turbopump shaft from rotating and that torque bar does not force the shaft to move axially.

NOTE

If the turbopump shaft moves axially, measurements taken in relation to the shaft will be incorrect.

e. Install hydraulic torque tool T-5029452 on inlet (11); then install torque and inspection tool T-5029467. Set tool and record dial indication.

NOTE

If turbopump is on engine, it will be necessary to use adapter T-5035941 and adapter T-5035940 with hydraulic torque tool T-5029452, because of engine interface panel interference.

CAUTION

Damage to turbopump can result if 4,000 ft-lb (667 psig actuator pressure) is exceeded when reducing torque on bolt (4).

f. Using hydraulic torque tool T-5029452, reduce stretch on bolt (4) in increments of approximately 0.001 inch until bolt stretch is completely reduced. Record dial indication of bolt stretch and hydraulic torque wrench pressure for each increment. (See figure 15-15.)

g. Remove bolt (4) and washer (7). Do not remove plug (5) and lockwasher (6) from bolt (4) unless bolt is to be replaced.

h. Remove torque and inspection tool T-5029467 and hydraulic torque tool T-5029452.

CAUTION

Side movement while lifting the inlet from the volute can cause damage to the wear-ring if the wear-ring contacts the inducer.

i. Remove bolts (9) and washers (10); then carefully remove inlet (11). Make sure inlet is lifted straight from volute without any side movement.

j. Remove pistor rings (14) from inlet (11) and assign rings for overhaul. New or overhauled rings will be installed during assembly.

jA. Remove plug (12) and K-seal (13) from inlet (11).

k. Remove seal (15) from oxidizer volute and assign seal for overhaul. A new or overhauled seal will be installed during assembly.

l. Measure and record dimension from inlet face of volute to the X mark on face of impeller (16). (See figure 15-13, dimension C.) Record clock position of X mark on impeller. (Volute attach lug = 12 o'clock.)

m. Prepare oxidizer pump for removal of inducer (8) and impeller (16) by heating and chilling the pump as follows:

(1) Using heat lamps, heat the inducer and impeller for 1 to 1-1/2 hours. Remove heat lamps.

WARNING

The following procedure uses liquid nitrogen, which must not be allowed to come in contact with any part of the body. Human tissue will freeze upon contact, causing serious injury. Eye protection and protective clothing must be worn by personnel handling liquid nitrogen. Liquid nitrogen must be used in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

(2) Fill end of shaft with liquid nitrogen (MIL-P-27401) and chill shaft for 5-7 minutes; then proceed to step n.

n. Using inducer puller T-5035933, carefully remove inducer (8). Remove impeller (16); then use impeller coupling puller T-5035934 and remove spline sleeve (17).

WARNING

The following procedure uses pressurized gaseous nitrogen or air, which must not be allowed to impinge on the body since it may result in skin inflation. Inflation of the skin can cause serious injury to human tissues.

- Eye protection must be worn to prevent foreign matter from injuring eyes.
- Pressurized gases can hurl objects with sufficient force to cause injury to personnel.

nA. Remove moisture from oxidizer volute and shaft within 30 minutes after removal of spline sleeve with a clean, white nylon cloth and/or by drying with a regulated source of low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the cleanness and humidity requirements of MIL-P-27401.

nB. Loosen torque bar T-5026432 at turbine manifold until pins are disengaged from second-stage turbine wheel.

o. Measure and record the following dimensions to obtain balance rib clearance: (See figure 15-13.)

A = Dimension from upper face of volute to backface of volute at 12 o'clock position. (Volute attach lug = 12 o'clock.) Use depth micrometer T-5021812.
B = Dimension from top of impeller rib to X mark on balance face.
C = Dimension as recorded in step l.
D = Impeller rib clearance.
A - (B + C) = D

NOTE

Make sure calculated impeller rib clearance is retained if the same impeller and spline sleeve are installed during assembly.

- If additional disassembly of the turbopump is required, proceed to paragraph 15-10.

p. After removal of parts and tools from oxidizer pump, cover pump opening with new clean polyethylene material to prevent entry of contaminants.

15-10. REMOVING PRIMARY OXIDIZER SEAL AND SLINGER.

a. Leak-test primary oxidizer seal (23) as outlined in paragraph 15-19, steps n through t. Record leakage.

aA. Measure and record dimension from upper surface of ring (20) to back face of oxidizer volute at 12 o'clock position. (Volute attach lug = 12 o'clock.)

aB. Engage pins on torque bar T-5026432 into second-stage turbine wheel; then secure torque bar to turbine manifold.

b. Straighten deformed dimples in lock (19) to disengage it from slots in nut (18). Using torque wrench T-5028680, remove nut (18) and lock (19). Discard lock.

c. Remove ring (20) and gasket (25); then assign ring for overhaul. A new or overhauled ring will be installed during assembly.

d. (Deleted)

e. Straighten deformed dimples in washers (22). Remove screws (21) and washers (22). Discard screws and washers.

eA. Remove seal (23) with 3 jack screws (1/4-20 UNC x 1 inch long); then remove spacer (24). Measure and record actual spacer thickness.

eB. Remove slinger (26) and gasket (27).

f. (Deleted)

g. Assign seal (23) and spacer (24) for overhaul. A new or overhauled seal and spacer will be installed during assembly.

h and i. (Deleted)

j. Discard gaskets (25, 27).

NOTE

If additional disassembly of the turbopump is required, continue with paragraph 15-11.

k. After removal of parts and tools from oxidizer pump, cover pump opening with new clean polyethylene material to prevent entry of contaminants.

15-11. REMOVING INTERMEDIATE SEAL.

a. Leak-test intermediate seal (30) as outlined in paragraph 15-18, steps b through g. Record leakage.

b. Remove bolts (28) and washers (29); then disengage intermediate seal (30) from bearing lube seal with 3 jack screws (1/4-20 UNC x 1-inch long). Remove intermediate seal and packing (31) and assign seal for overhaul. Install new or overhauled seal during assembly.

NOTE

If additional disassembly of the turbopump is required, assign turbopump for overhaul.

c. After removal of parts and tools from the oxidizer pump, cover pump opening with clean polyethylene material to prevent entry of contaminants.

15-12. CLEANING.

15-13. All parts must be cleaned to enable a thorough inspection for defects, wear, or damage. Reclean parts after repair. If bolt (1), ring 458255 in inlet (11), bolts (28), or washers (29) have dyed surfaces, the dye must be stripped from the parts before the parts are cleaned. Cleaning procedures for cleaning individual parts for liquid oxygen service are outlined in R-3896-3, Volume I. Handling and packaging procedures for cleaned parts are outlined in R-3896-3, Volume I.

15-14. INSPECTING AND REPAIRING.

15-15. Inspecting the turbopump determines if the individual parts have been damaged by mishandling or wear. Inspect parts, that contact liquid oxygen when installed, for evidence of dye. Parts with dyed surfaces must have dye stripped from part as outlined in R-3896-3, Volume I. Refer to figure 15-4 and inspect individual parts for general condition, cleanness, damage of threads, corrosion, distortion, nicks, burs, and scratches.

15-15A. REPLACING PLASTIC FOAM IN OXIDIZER VOLUTE CAVITIES. The foam fill must be removed and replaced if it is not bonded to the metal, or if it is cracked, deteriorated by moisture, or loose in the cavity.

a. Remove elastomer seal and all foam from cavity.

WARNING

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

b. Clean cavity and immediate exterior surface with a clean, white nylon cloth moistened in trichloroethylene (MIL-T-27602).

c. Mask area as necessary or construct a barrier of 0.008 inch Mylar film (Du Pont), or equivalent, if required.

d. Catalyze Stafoam 308, parts C and R (American Latex Corp), as follows:

(1) Prepare one quart or less by adding approximately 142 parts of C to 100 parts of R, by weight. Follow manufacturer's instructions, if different.

(2) Mix parts C and R thoroughly for 60 seconds.

WARNING

Polyurethane resins and catalysts are skin irritants. Avoid contact and inhalation of vapors. Use in a well-ventilated area.

e. Pour mixture into cavity within 60 seconds after mixing. Fill cavity 1/8 full. The mixture will expand about 8 times to fill remaining space.

f. Foaming will begin approximately 30 seconds after mixing and continue for about 5 minutes. If foaming fails to occur within 15 minutes after mixing, remove mixture from cavity and discard. Reclean cavity and repeat procedure using a new supply of Stafoam 308.

g. If foam does not completely fill cavity, prepare additional foam, as directed in step d, and add it to cavity within 15-45 minutes after original pour. The foam will bond to the previous layer.

h. Allow foam to cure, at room temperature, for at least one hour before handling, cutting, or sawing.

i. Remove excess foam with a file, sharp knife, or abrasive paper. Avoid scratching or marring surface.

j. Remove spilled resin or catalyst with methyl-ethyl-ketone (Federal Specification TT-M-261).

WARNING

Methyl-ethyl-ketone 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.

k. Remove masking tape and Mylar barrier.

l. Allow 24 hours for complete cure. Foam must be rigid and tack-free after cure is complete.

15-15B. REPAIRING PLASTIC FOAM ELASTOMER SEAL. The elastomer seal must be replaced whenever the foam has been removed from the volute cavity and replaced. If the seal is cracked, punctured, or deteriorated and the plastic foam in the cavity is in good condition, only the seal must be repaired or replaced.

a. Mask area surrounding foam-filled cavity as necessary.

b. Prepare Viton elastomer C-328 RTV (Connecticut Hard Rubber Co) as follows:

(1) Add one drop of C-328 catalyst, from a standard eye dropper, to each 12 grams (or one drop per 10 cc) of C-328 base compound.

(2) Mix the catalyzed compound thoroughly for 5 minutes. Do not mix more compound than needed. The pot life is 6-8 hours.

c. Apply compound to the seal being repaired or directly to foam in newly filled cavities, using a brush or spatula. The compound must be smooth, uniform, and approximately 0.030 inch thick.

d. Cure the seal material at room temperature. Seal parts may be handled as soon as the coating has set. Do not expose to solvents for at least 24 hours.

b. Measure and record a dimension from top of inducer (8) at V-mark to top of inlet (11) at 12 o'clock position. (Volute attach lug = 12 o'clock.)

c. Measure and record the following dimensions to verify the actual radial clearance between outside diameter of inducer (8) and inside diameter of inlet (11) in 4 places:

(1) Sweep inlet (11) inside diameter to find point closest to shaft. Identify as point MC (minimum clearance). Record the angular location by degrees clockwise from attach lug.

(2) Turn shaft to rotate inducer (8) and measure with clearance pins T-5041812 to locate point on inducer (8) that sweeps closest to point MC on inlet (11). Identify this point on inducer by applying a small spot of sealant and antiseize dispersion RB0120-017 (Rocketdyne). Record this point as X.

(3) Record actual minimum clearance between points X and MC.

(4) Rotate point X of inducer (8) to a position 90 degrees from point MC and record clearance at MC.

(5) Rotate point X of inducer (8) to a position 180 degrees from point MC and record clearance at MC.

(6) Rotate point X of inducer (8) to a position 270 degrees from point MC and record clearance at MC.

d. Install torque bar T-5026432 on second-stage turbine wheel and turbine manifold.

e. Install hydraulic torque wrench T-5029452 on inlet (11); then install check fixture T-5029467. Set check fixture and record dial indication.

NOTE

If turbopump is on engine, it will be necessary to use torque tool adapter T-5035941 and indicator adapter T-5035940 with hydraulic torque wrench T-5029452, because of engine interface panel interference.

f. Using hydraulic torque wrench T-5029452, reduce stretch on bolt (4) in increments of approximately 0.001 inch until bolt stretch is completely reduced. Record dial indication of bolt stretch and hydraulic torque wrench pressure for each increment. (See figure 15-15.)

CAUTION

Do not exceed 4,000 foot-pounds (867 psig actuator pressure) when reducing torque on bolt (4), since damage to turbopump can result.

g. Remove bolt (4) and washer (7). Do not remove plug (5) and lockwasher (6) from bolt (4) unless bolt is to be replaced.

h. Remove check fixture T-5029467 and hydraulic torque wrench T-5029452.

i. Remove bolts (9) and washers (10); then carefully remove inlet (11) with inlet puller T-5026375. Make sure inlet is lifted straight from volute without any side movement.

CAUTION

Side movement while lifting the inlet from the volute can cause damage to the wear-ring if the wear-ring contacts the inducer.

j. Remove piston rings (12) from inlet (11) and assign rings for overhaul. New or overhauled rings will be installed during assembly

jA. Remove plug (11A) and K-seal (11B) from inlet (11).

k. Remove seal (13) from oxidizer volute and assign seal for overhaul. A new or overhauled seal will be installed during assembly.

kA. Remove torque bar T-5026432 from second-stage turbine wheel and turbine manifold.

l. Measure and record dimension from inlet face of volute at 12 o'clock position to the X mark on face of impeller (14). (See figure 15-13, dimension C.)

lA. Install torque bar T-5026432 on second-stage turbine wheel and turbine manifold.

m. Prepare oxidizer pump for removal of inducer (8) and impeller (14) by heating and chilling the pump as follows:

(1) Using heat lamps, heat the inducer and impeller for 1 to 1-1/2 hours. Remove heat lamps.

(2) Fill end of shaft with liquid nitrogen (MIL-P-27401) and chill shaft for 5-7 minutes; then proceed to step n.

WARNING

Eye protection and protective clothing must be worn by personnel handling liquid nitrogen, to prevent the liquid from coming in contact with any part of the body. Human tissue will freeze upon contact, causing serious permanent injury.

n. Using inducer puller T-5035933, carefully remove inducer (8). Remove impeller (14); then use impeller spline sleeve puller T-5035934 and remove spline sleeve (15).

nA. Remove moisture from pump within 30 minutes after removal of spline sleeve by purging with low-pressure gaseous nitrogen (MIL-P-27401).

nB. Remove torque bar T-5026432 from second-stage turbine wheel and turbine manifold.

o. Measure and record the following dimensions to obtain balance rib clearance: (See figure 15-13.)

A = Dimension from upper face of volute to backface of volute at 12 o'clock position. (Volute attach lug = 12 o'clock.) Use depth micrometer T-5021812.
B = Dimension from top of impeller rib to X mark on balance face.
C = Dimension as recorded in step l.
D = Impeller rib clearance.
A - (B + C) = D

NOTE

Make sure calculated impeller rib clearance is retained if the same impeller and spline sleeve are installed during assembly.

- If additional disassembly of the turbopump is required, proceed to paragraph 15-10.

p. After removal of parts and tools from oxidizer pump, cover pump opening with new polyethylene material to prevent entry of contaminants.

15-10. REMOVING PRIMARY OXIDIZER SEAL AND SLINGER.

a. Leak-test primary oxidizer seal (22) as outlined in paragraph 15-19, steps n through t. Record leakage.

aA. Measure and record dimension from upper surface of ring (19) to back face of oxidizer volute at 12 o'clock position. (Volute attach lug = 12 o'clock.)

aB. Install torque bar T-5026432 on second-stage turbine wheel and turbine manifold.

b. Deform dimples in lock (18) to disengage it from slots in nut (17). Using torque wrench T-5028680 remove nut (17) and lock (18). Discard lock.

bA. Remove torque bar T-5026432 from second-stage turbine wheel and turbine manifold.

c. Remove ring (19) and assign ring for overhaul. A new or overhauled ring will be installed during assembly.

d. Measure and record the following dimensions to determine existing primary seal-to-slinger clearance: (See figure 15-7.)

A = Slinger (25) and gasket (26) seated on shaft.
B = Slinger (25) bottomed against seal (22).
A - B = C or seal-to-slinger clearance. This clearance must be 0.160 inch minimum.

e. Deform dimples in washers (21). Remove screws (20) and washers (21). Discard washers.

eA. Remove seal (22) with 3 jack screws (1/4-20 UNC x 1 inch long); then remove spacer (23). Measure and record actual spacer thickness.

eB. Remove gasket (24), slinger (25), and gasket (26).

f. Measure and record the following dimensions to obtain the spacer (23) thickness and seal (22) wear: (See figure 15-5.)

A = Dimension from volute seal (22) flange to step on shaft.
B = Thickness of slinger (25).
C = C1 + C2. Total thickness of both gaskets (24, 26).
D = Operating length of seal (22).
E = Depth of step on ring (19).
F = Computed thickness of spacer (23).
B + C - (A + D + E) = F

NOTE

Operating length of seal (22) is equal to the free length minus average of compression value marked on top of seal flange.

15-15C. DEMAGNETIZING PRIMARY OXIDIZER SEAL MATING RING.

CAUTION

The magnetometer must not come in direct contact with the sealing surface of ring (20) since the surface can be damaged, destroying its sealing capability.

a. Using magnetometer 2480 (Magnaflux Corp), or equivalent, check ring (20) for residual magnetism. Residual magnetism on any area of ring must not exceed 8 oersteds (magnetometer deflection of ±1 increment). If residual magnetism is greater than 8 oersteds, ring must be demagnetized.

b. Using demagnetizing unit SB-911 (Magnaflux Corp), or equivalent, demagnetize ring (20) as follows:

(1) Turn on demagnetizing unit.

(2) Move ring (approximately one foot per second) back and forth several times through alternating magnetic field of coil.

(3) Move ring at least 3 feet from unit; then turn demagnetizing unit off.

c. Repeat step a to determine if ring has been sufficiently demagnetized.

Part Name and Index Number	Inspecting	Repairing
Cap (3)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Missing or damaged dry-film lubricant.	Assign cap for overhaul.
Bolt (4)	Galling of threads or shoulder.	Replace bolt.
	Missing or damaged dry-film lubricant.	Assign bolt for overhaul.
Inducer (8)	Any indications of cracks appearing on leading or trailing edges of blades; perform dye-penetrant inspection as outlined in R-3896-3, Volume I, on all edges of blades.	Assign turbopump for overhaul if blades are cracked.
	Nicks and scratches.	Hand-polish to remove defects.
	Missing or damaged dry-film lubricant.	Assign inducer for overhaul.
Inlet (11)	Inspect Kel-F seal labyrinth lands for cracks or broken land.	Replace inlet if seal is damaged.
	Inspect bolts and tab washers that hold seal to inlet.	Replace damaged bolts or tab washers. Torque bolts to 36-38 inch-pounds after replacing tab washers or bolts.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Nicks and scratches.	Hand-polish to remove defects; then iridite reworked area as outlined in R-3896-3, Volume I.

Figure 15-4. Inspecting and Repairing Turbopump (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
	Aluminum oxide corrosion around OD of inserts (evidenced by white, powdery substance).	Brush with plastic brush to remove visible corrosion. Mask inlet as necessary to prevent oxidizer pump contamination.
	Minor corrosion on sealing surface (mottled spots on top surface of inlet (11)).	Hand-polish to remove corrosion from sealing area. Remove minimum material and maintain 32 C finish, or equivalent. Iridite reworked area as outlined in R-3896-3, Volume I. Mask inlet as necessary to prevent contamination of oxidizer pump interior.
Spline Sleeve (17)	Inspect for wear or damage.	Replace if damaged or shows signs of wear.
	Missing or damaged dry-film lubricant.	Assign spline sleeve for overhaul.
Impeller (16)	Any indications of cracks appearing on leading or trailing edges of vanes; perform dye-penetrant inspection as outlined in R-3896-3, Volume I, on all edges of vanes.	Replace impeller with spare impeller of same configuration that has been assigned as a replacement if vanes are cracked. Replace spline sleeve (17) if impeller (16) is to be replaced.
Nut (18)	Inspect for nicks, scratches, or damaged threads.	Replace if damaged.
Slinger (26)	Inspect for nicks and scratches.	Hand-polish to remove defects.
	Damaged sealing surfaces.	Replace.
Oxidizer Volute	Inspect elastomer seal on foam-filled cavities for condition and effectiveness.	Repair or replace as outlined in paragraph 15-15B.
	Inspect foam-filled cavities for metal-to-metal and cell-to-cell contact, deterioration, and entry of moisture.	Remove foam and replace as outlined in paragraph 15-15A.

Figure 15-4. Inspecting and Repairing Turbopump (Sheet 2 of 2)

15-16. ASSEMBLING.

15-17. Assembly procedures for the oxidizer pump must be performed in the order listed. An oxidizer pump that only required partial disassembly must be assembled by meeting requirements of this paragraph and performing applicable installation procedures. The lubricants used in this procedure are specified in the procedural steps. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 15-3 for parts and index numbers.

NOTE

Measurements taken during assembly of the turbopump must be recorded and made available to the Rocketdyne representative for transmittal to Engineering.

a. Cleanness standards contained in paragraph 15-3 must be strictly adhered to.

b. (Deleted)

WARNING

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

- The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

c. Clean interior surfaces of oxidizer pump with a clean, white nylon cloth moistened with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302).

NOTE

All new parts that are to be used in the oxidizer pump must be received in packages that certify the parts as being cleaned for liquid oxygen service. Make sure that other parts which are acceptable for reinstallation are in a liquid-oxygen-clean condition.

15-18. INSTALLING INTERMEDIATE SEAL.

a. Verify that bolts (28) and washers (29) do not have dyed surfaces. If dye is present, the dyed part must be stripped and cleaned, as outlined in R-3896-3, Volume I.

aA. Apply (Method V) Molykote Z powder (Dow Corning Corp) to packing (31); then install packing in groove of bearing lube seal.

aA-1. Using seal installation tool T-5044645 and 3 jack screws (1/4-20 UNC x 1 inch long), install intermediate seal (30) on bearing lube seal with washers (29) and bolts (28). Torque bolts to 60 ±10 in-lb.

aB. Remove seal installation tool and jack screws.

b. Install pressure test fixture T-5026440 over pump shaft and intermediate seal (30), then install fixture on oxidizer volute with 4 bolts.

c. Install pressure test fixture T-5028675 on intermediate seal purge inlet and connect a source of gaseous nitrogen (MIL-P-27401) to the fixture.

d. Connect one flowmeter to oxidizer seal drain line and another flowmeter to the bearing lube seal drain line. Cap or plug remaining fittings and openings.

e. Slowly apply 50 ±5 psig gaseous nitrogen to purge inlet; measure and record leakage at oxidizer seal drain and bearing lube seal drain lines. Leakage at either drain line must not exceed 2,500 scim for either a new or overhauled seal.

f. Apply leak-test compound (MIL-L-25567) to fittings and static seals in purge system. No leakage is allowable.

g. Decrease gaseous nitrogen pressure to zero.

WARNING

The following procedures uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

h. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).

i. Remove pressure test fixtures T-5026440 and T-5028675.

15-19. INSTALLING SLINGER AND PRIMARY OXIDIZER SEAL.

a. Make sure that pins of torque bar are disengaged from turbine wheel; then, using depth micrometer T-5021812, measure and record the following dimensions to determine primary seal spacer (24) thickness. (See figure 15-5.)

A = Dimension from volute seal flange to step on shaft.
B = Thickness of slinger (26).
C = C1 + C2. Total thickness of both gaskets (25, 27).
D = Operating length of seal (23).
E = Depth of step on ring (20).
F = Thickness of spacer (24).
B + C - (A + D + E) = F

NOTE

The operating length of seal (23) is equal to the free length minus the average of the compression value marked on top of the seal flange. This allows a tolerance of ±0.010 inch in the selection of spacer (24).

b. Measure and record nose height of seal (23). (See figure 15-5A.)

c. Using depth micrometer T-5021812, measure and record the following dimensions to obtain slinger-to-intermediate seal clearance: (See figure 15-6, view A.)

A = Dimension from slinger seat on shaft to top of seal.
B = Slinger lower gasket thickness.
C = Shaft seat of slinger to bottom of slinger.
A - (C - B) = D or slinger-to-intermediate seal clearance. This clearance must be 0.118 inch minimum.

d. Using depth micrometer T-5021812, measure and record the following dimensions to obtain slinger tip-to-intermediate seal clearance: (See figure 15-6, view B.)

A = Slinger-to-intermediate seal clearance computed in step c.
B = Slinger tip to bottom of slinger.
C = Step dimension of seal.
A + (C - B) = D or slinger tip-to-intermediate seal clearance. This clearance must be 0.118 inch minimum.

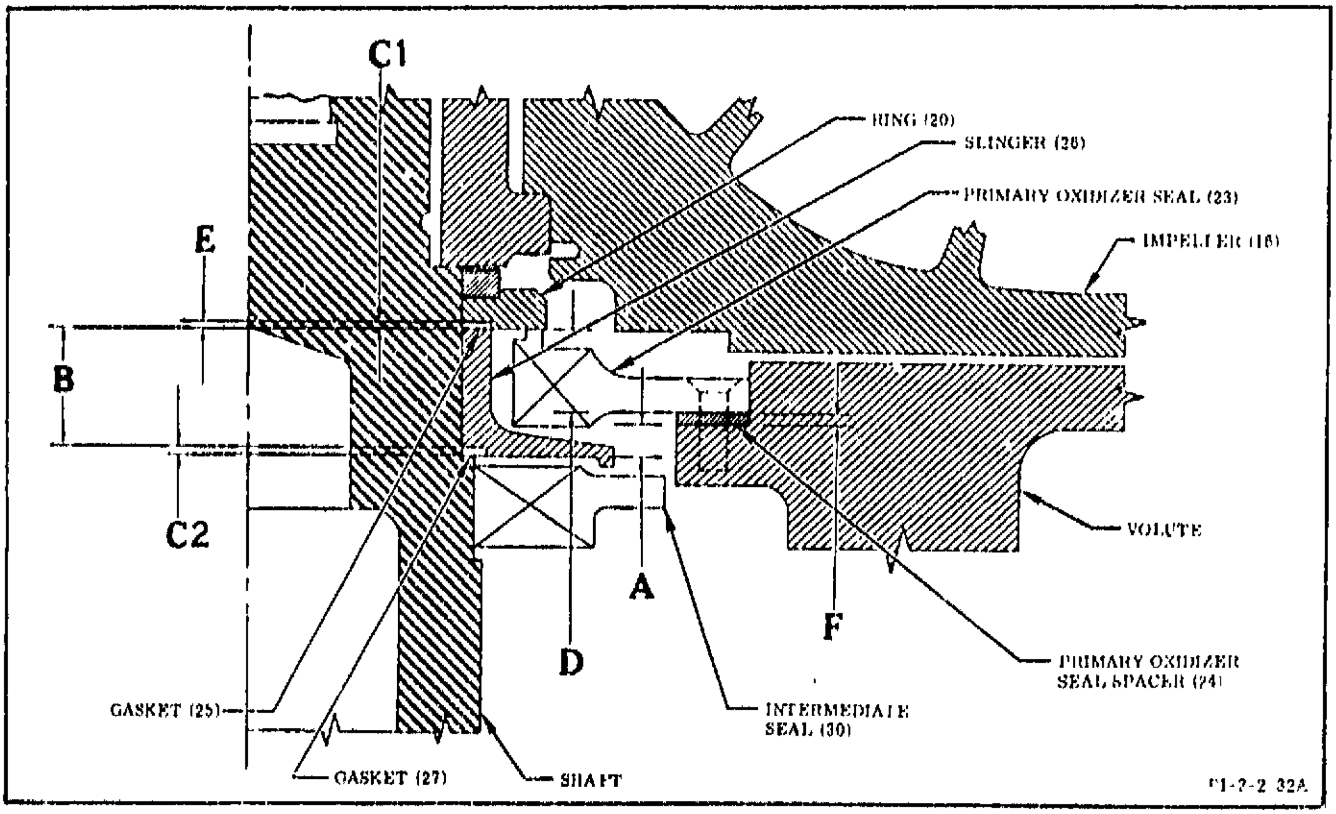


Figure 15-5. Determining Primary Oxidizer Seal Spacer Thickness

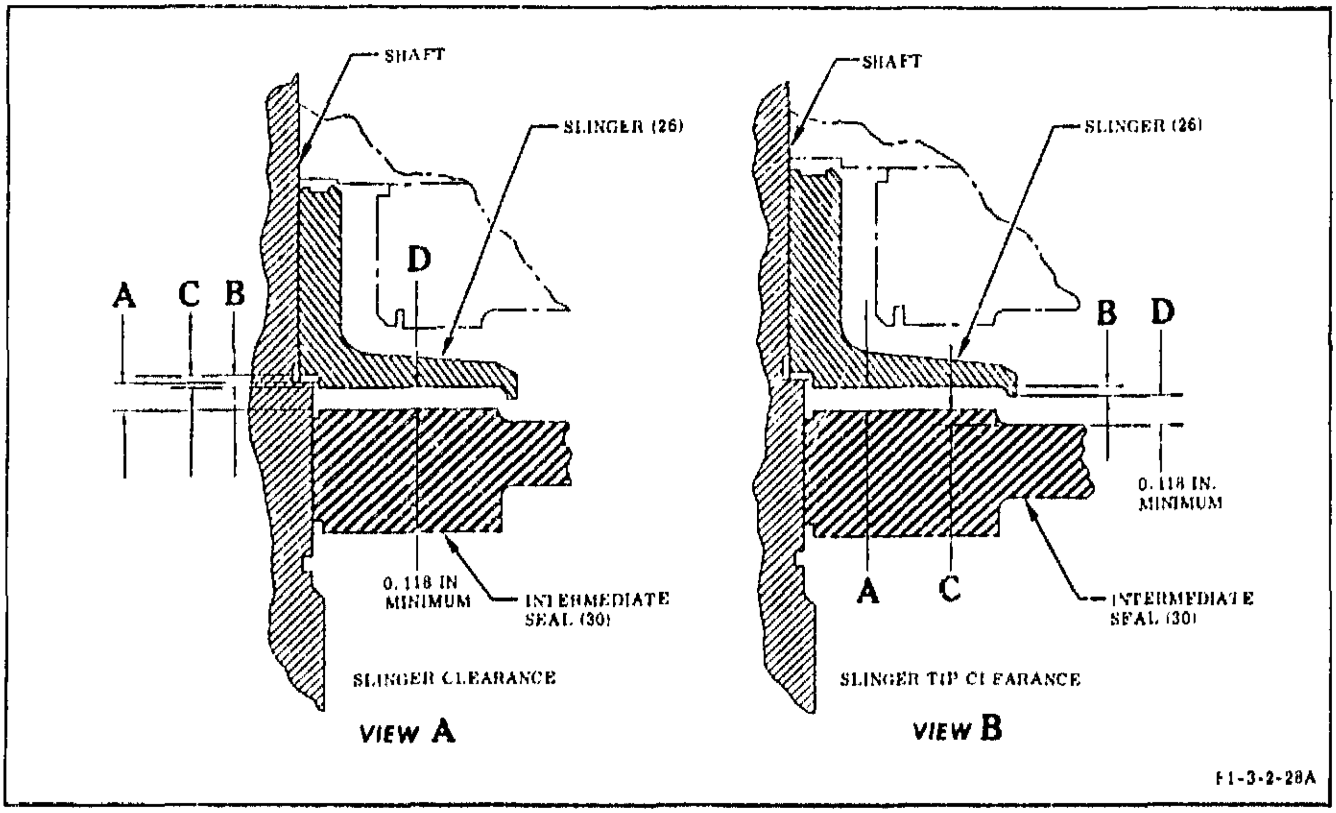


Figure 15-6. Determining Oxidizer Slinger-to-Intermediate Seal Clearance

e. Using protection sleeve T-5026436, install gasket (27) and slinger (26) on turbopump shaft.

f. Install spacer (24) (thickness determined in step a). Make sure that part number of screws (21) is as specified in R-3896-4, that screws are new, and that screw length is 1.0625 (+0.000, -0.002) inches.

CAUTION

Damage to the turbopump can result if the wrong screws are used to install the primary oxidizer seal.

fA. Using 3 jack screws (1/4-20 UNC x 1 inch long), install primary oxidizer seal (23) with 4 washers (22) and 4 screws (21). Torque screws to 120 ±5 inch-pounds.

g. Measure and record the following dimensions to obtain primary oxidizer seal-to-slinger clearance: (See figure 15-7.)

A = Slinger seated (with gasket) on shaft.
B = Slinger raised to bottom against primary oxidizer seal.
A - B = C or primary oxidizer seal-to-slinger clearance. This clearance must be 0.160 inch minimum.

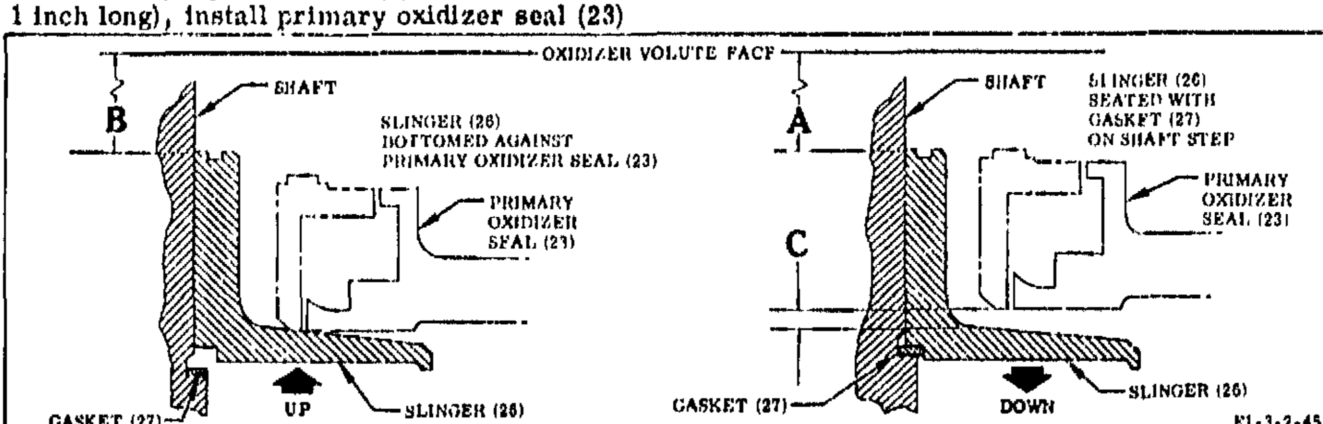


Figure 15-7. Determining Primary Oxidizer Seal-to-Slinger Clearance

h. Remove screws (21), washers (22), primary oxidizer seal (23), slinger (26), and gasket (27) that were installed in steps e and f.

hA. Inspect gasket (27) to make sure it was not damaged while temporarily installed.

NOTE

Make sure that end of turbopump shaft and all parts to be installed in the following steps are cleaned for liquid oxygen service.

i. Using protection sleeve T-5026436, install gasket (27) and slinger (26) on turbopump shaft.

iA. Verify proper seating of gasket (27) by taking 4 equally spaced measurements from inlet mating face of volute to outer land on slinger hub. All measurements must be within 0.002 inch of each other.

iB. Make sure that part number of screws (21) is as specified in R-3896-4, that screws are new, and that screw length is 1.0625 (+0.000, -0.062) inches.

CAUTION

Damage to the turbopump can result if the wrong screws are used to install the primary oxidizer seal.

NOTE

The 4 screws (21) used to temporarily install the primary oxidizer seal can be considered as new screws if acceptable for reinstallation.

j. Measure and record actual spacer (24) thickness; then install spacer and primary oxidizer seal (23) using washers (22) and screws (21). Torque screws (21) to 120 ±5 inch-pounds. Loosen each screw (21) individually; then retorque to 120 ±5 inch-pounds.

jA. Remove protection sleeve and jack screws.

jB. Make sure that ring (20) is demagnetized (paragraph 15-15C) before installation.

jC. Engine pins on torque bar T-5026432 into second-stage turbine wheel; then secure torque bar to turbine manifold.

k. Install gasket (25) and ring (20).

kA. Prepare lock (19) for installation and install lock and nut (18) as follows:

(1) Remove dry-film lubricant from top surface of lock that makes contact with nut, using a nylon bristle brush, borax soap powder (Federal Standard 15), and water. Rinse lock thoroughly with water, then dry.

WARNING

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

- The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

(2) Hand-clean lock with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302).

(3) Using a clean, lint-free nylon cloth, apply a thin uniform film of fluorinated lubricant RB0140-010 (Rocketdyne) to top surface of lock that makes contact with nut.

CAUTION

Lubricant must not be allowed on the threads of the nut or on the bottom side of the lock that makes contact with ring (20). Lubricant on the threads of the nut can cause a higher compressive load to be applied to the lock when the nut is torqued. A high compressive load or lubricant on the bottom side of the lock can cause the lock to rotate and result in bending or shearing the lock tabs.

(4) Install lock and nut. Torque nut with wrench T-5028680 to 250 ±10 ft-lb.

kB. Loosen torque bar T-5026432 at turbine manifold until pins are disengaged from second-stage turbine wheel.

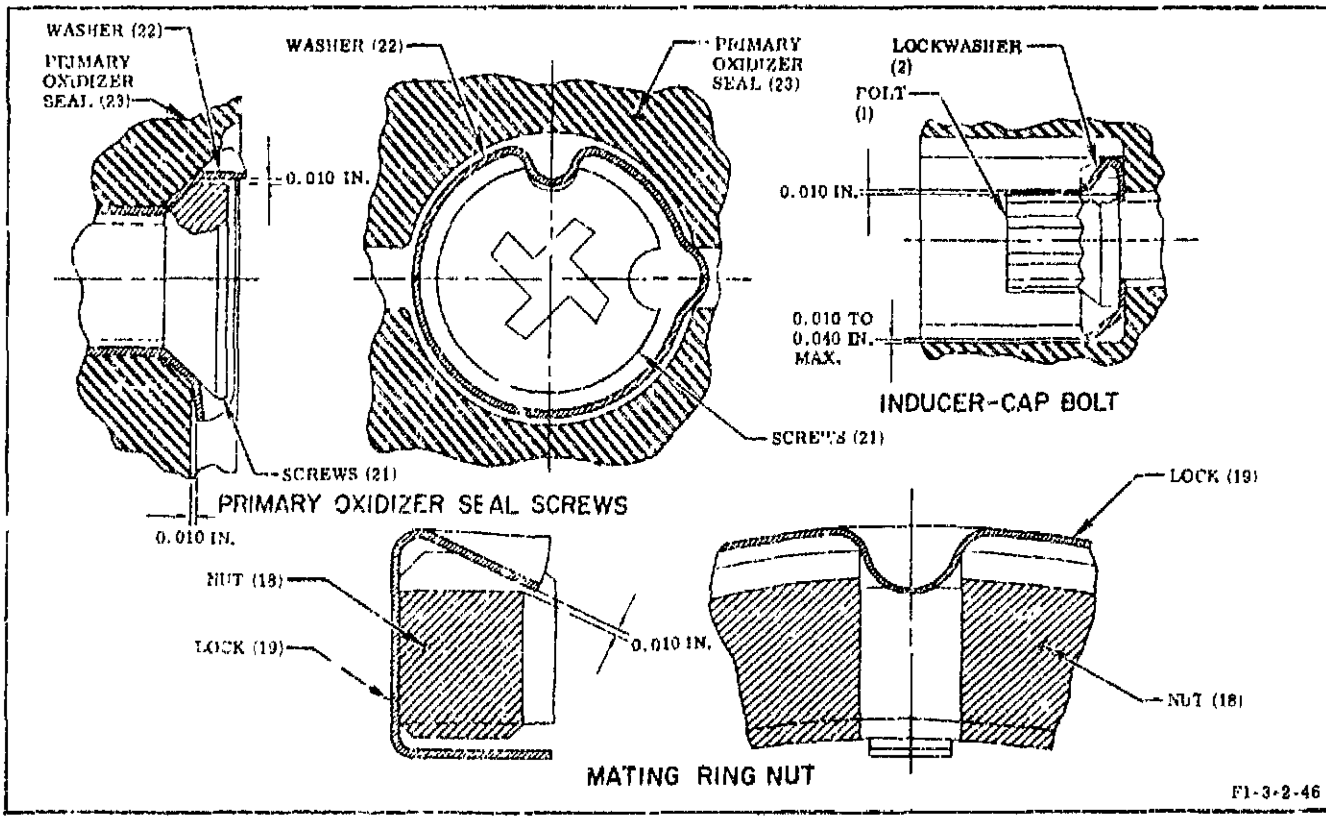


Figure 15-8. Turbopump Locking Device Installation

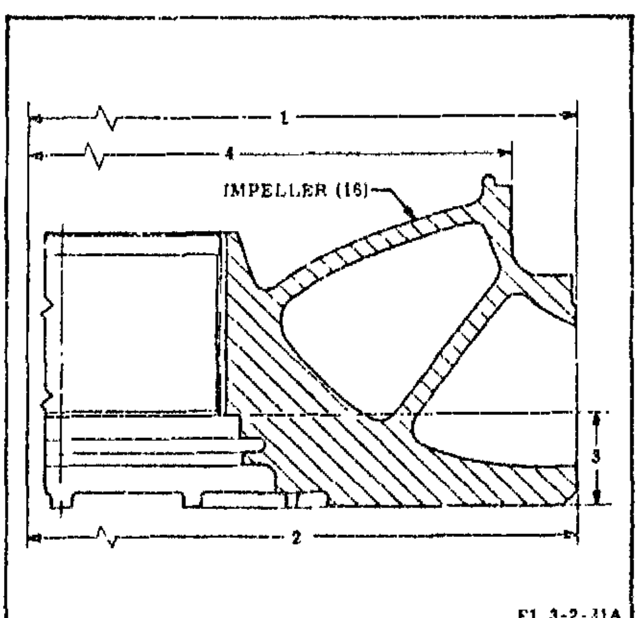


Figure 15-8A. Measuring Oxidizer Impeller Dimensions

l. Measure and record runout of upper surface of ring (20). Maximum runout must not exceed 0.0015 inch.

m. Measure and record dimension from upper surface of ring (20) to back face of oxidizer volute at 12 o'clock position. (Volute attach lug = 12 o'clock.)

n. Install pressure test fixture T-5026440 over pump shaft and primary oxidizer seal (23), then attach fixture to oxidizer volute.

o. Open the oxidizer seal purge drain line.

p. Connect a source of gaseous nitrogen (MIL-P-27401) to pressure test fixture T-5026440.

q. Slowly apply 80 ±5 psig gaseous nitrogen to pressure test fixture and apply leak-test compound (MIL-L-25567) to all pressurized fittings and static seal. No leakage is allowable.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

r. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).

s. Reduce pressure to zero; then repair any leakage before continuing leak-test.

sA. Slowly apply gaseous nitrogen to the pressure test fixture at the following pressures, in the order listed; and measure for leakage past primary oxidizer seal (23) at oxidizer seal purge drain line. Rotate turbopump shaft during leak test a minimum of one revolution in each direction. One revolution of turbopump shaft requires five revolutions of turbopump torque gear. Record minimum and maximum leakage rate for either rotating or stationary. Maximum allowable leakage must not exceed specified amount at each pressure value:

Pressure (psig)	New or overhauled Seal (scim)
3 ±0.5	200
10 ±1	200
80 ±5	400

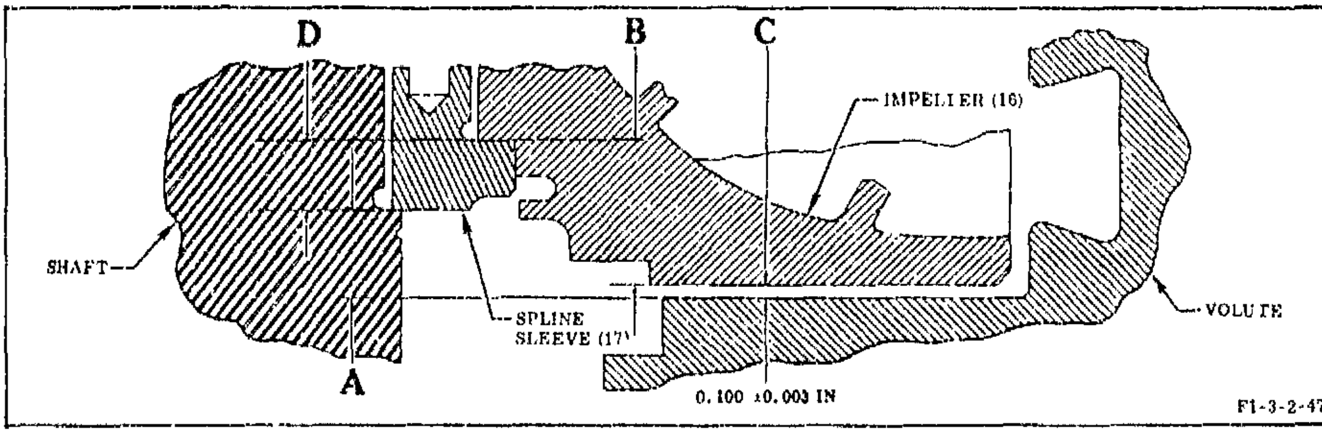


Figure 15-9. Checking Oxidizer Impeller Rib-to-Volute Clearance

t. Decrease gaseous nitrogen pressure to zero and remove pressure test fixture T-5026440.

u. Deform all washers (22) using one indentation in screw (21) and one indentation in primary oxidizer seal (23). (See figure 15-8.) Indentations must close to within 0.010 inch.

v. Deform outer edge of lock (19) into indentations of nut (18). (See figure 15-8.)

15-20. INSTALLING IMPELLER, SPLINE SLEEVE, INDUCER, AND INLET.

a. Verify that ring 458255 in inlet (11) and bolt (1) do not have dyed surfaces. If dye is present, the dyed part must be stripped and cleaned, as outlined in R-3896-3, Volume I.

aA. Measure and record the following dimensions: (See figure 15-8A.)

(1) Outside diameter of impeller (16) at shroud.

(2) Outside diameter of impeller (16) at vane.

(3) Height from upper surface of impeller (16) balance ribs to counterbore for spline sleeve (17).

(4) Impeller OD = impeller maximum diameter at wear-ring surface.

b. If oxidizer pump is being assembled with a different serial-numbered impeller and/or spline sleeve, measure and record the following dimensions to obtain correct spline sleeve (17) flange dimension: (This dimension controls the 0.100 ±0.003 inch impeller rib clearance. (See figure 15-9.) (If same serial-numbered impeller and spline sleeve are being installed, disregard this step and continue with step c.)

A = Dimension from step on shaft to back face of volute.
B = Dimension from impeller rib to counterbore of impeller.
C = Balance rib clearance dimension, 0.100 ±0.003 inch.
(B + C) - A = D or dimension of spline sleeve flange.

c. Install inlet (11) with every third bolt (9) and washers (10). Torque bolts (9) to 488 ±12 inch-pounds.

d. Sweep the oxidizer wear-ring to locate the point closest to the shaft and identify this point as AB. Record its location by degrees clockwise from zero (volute attach lug).

e. Using a dial indicator, set indicator at zero on point AB, sweep 180 degrees clockwise around wear-ring and record indicator reading as B.

f. Remove bolts (9), washers (10), and inlet (11) from turbopump.

g. Measure and record inside diameter of inlet (11) wear-ring center land on a line from AB to B and identify and record this dimension as wear-ring ID.

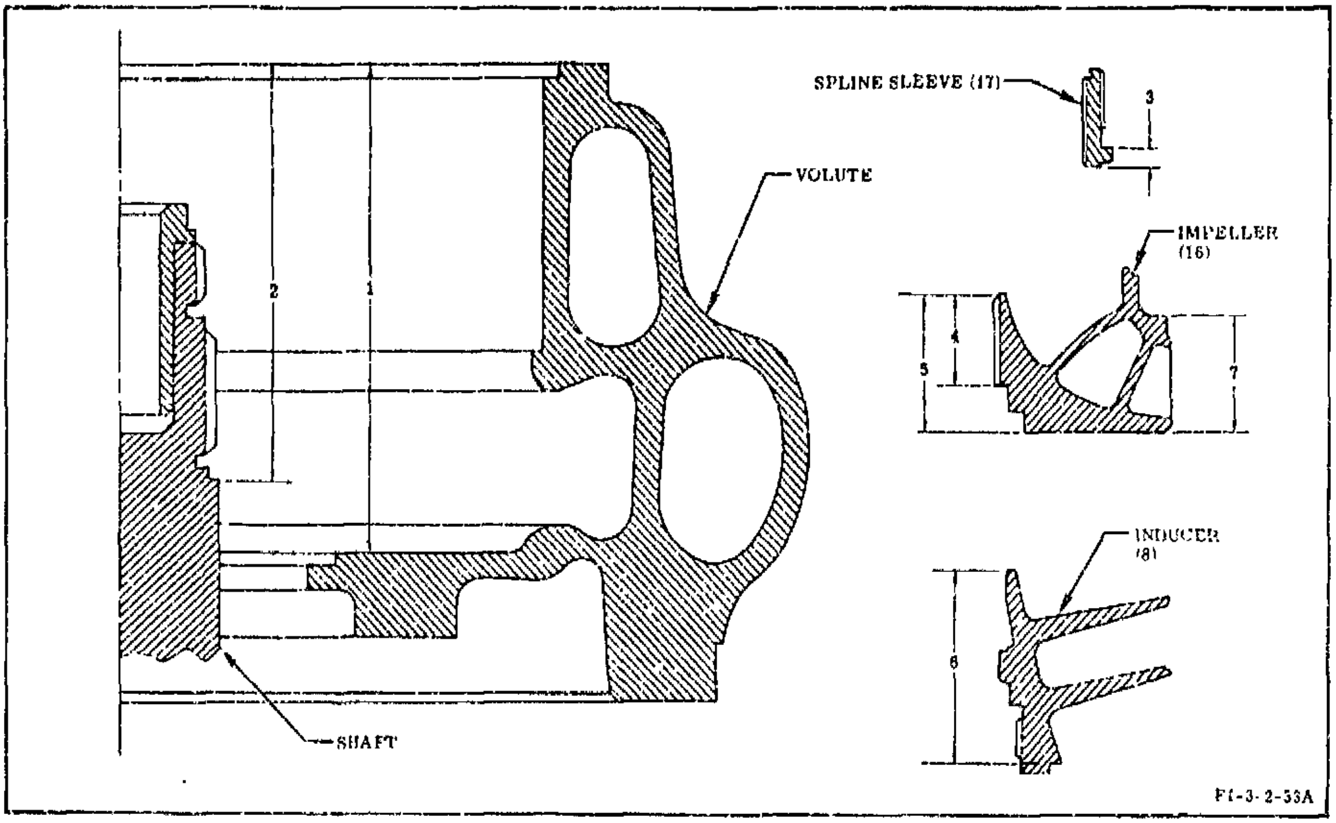


Figure 15-10. Measuring Oxidizer Turbopump Dimensions

h. Measure and record the following dimensions: (See figure 15-10.)

(1) Inlet mating face of volute to back face of volute.

(2) Inlet mating face of volute to spline sleeve seat of shaft.

(3) Dimension of spline sleeve flange.

(4) Impeller from counterbore to inducer mating face.

(5) Impeller from top of rib to inducer mating face.

(6) Inducer from impeller mating face to hub face.

(7) Impeller from top of rib to X mark on opposite face.

NOTE

Items 1 through 6 are measured at the master spline and/or 12 o'clock position, as applicable. (Volute attach lug = 12 o'clock.)

CAUTION

The blind spline of the spline sleeve must line up with the blind spline in the shaft, to establish the correct angular position of impeller to inducer.

i. Heat spline sleeve (17) to 250° F maximum and install over pump shaft.

NOTE

The spline sleeve (17) and shaft must return to ambient temperature before continuing with procedure.

j. Verify bottoming of spline sleeve as follows: (See figure 15-11.)

A = Dimension recorded in step h, substep 2.
B = Dimension recorded in step h, substep 3.
C = Volute face to impeller face of spline sleeve (17), calculated and actual.

Record dimensions and verify that A - B = C, and that C calculated = the actual measurement.

k. Using the V mark on hub face of inducer (8), locate the master spline on inducer. With the inducer V mark at 12 o'clock position, determine clock position of master spline and record.

kA. Engage pins on torque bar T-5026432 into second-stage turbine wheel; then secure torque bar to turbine manifold.

NOTE

All tools, parts, and equipment required to perform steps l through r must be readily available so that the impeller and inducer will be installed within specified time.

l. Heat impeller (16) and inducer (8) to 250° F maximum.

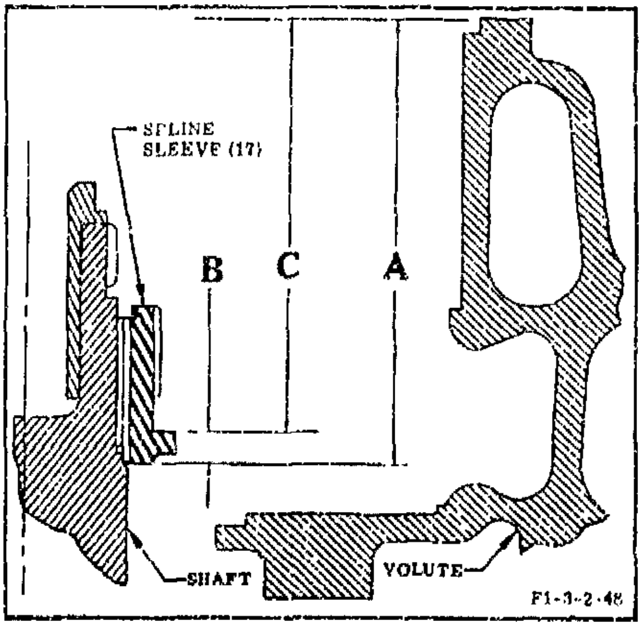


Figure 15-11. Checking Oxidizer Spline Sleeve Installation

NOTE

Steps m through o must be performed immediately (within 5 minutes maximum) after removing impeller and inducer from heat source, to obtain proper diametric clearance between impeller inducer and pump shaft.

m. Install impeller (16) over spline sleeve (17) to its bottomed position using no force other than the weight of the part.

n. Using inducer puller T-5035933 install inducer (8) over shaft using no force. Axial clearance between impeller and inducer mating surfaces must be less than 0.230 inch. Calculate this dimension as follows: (See figure 15-12.)

A = Dimension recorded in step h, substep 4.
B = Dimension recorded in step h, substep 6.
C = Actual dimension recorded in step j.
D = Calculated and actual dimension from volute to inducer hub face.

Record dimensions and calculate D = (A + B) - C. Make sure that D calculated (+0.230, -0.000) equals D actual.

nA. Install plug (5) and lockwasher (6) on bolt (4). Torque plug to 200 ±12 inch-pounds.

nB. Deform lockwasher (6) into one indentation on bolt (4) and one indentation on plug (5).

o. Install bolt (4) and washer (7) to apply axial load on inducer (8) and impeller (16).

NOTE

Step r must be performed immediately (within 5 minutes maximum) after completing step o.

p and q. (Deleted)

r. Apply an axial load of 2,500 pounds (260 foot-pounds torque) to bolt (4) to bottom inducer (8). After inducer (8) is bottomed, apply an axial load of 4,000 ±1,500 pounds (450 ±100 foot-pounds torque) continuously until parts reach ambient temperature.

NOTE

These torque values apply only when torquing through bolt (4).

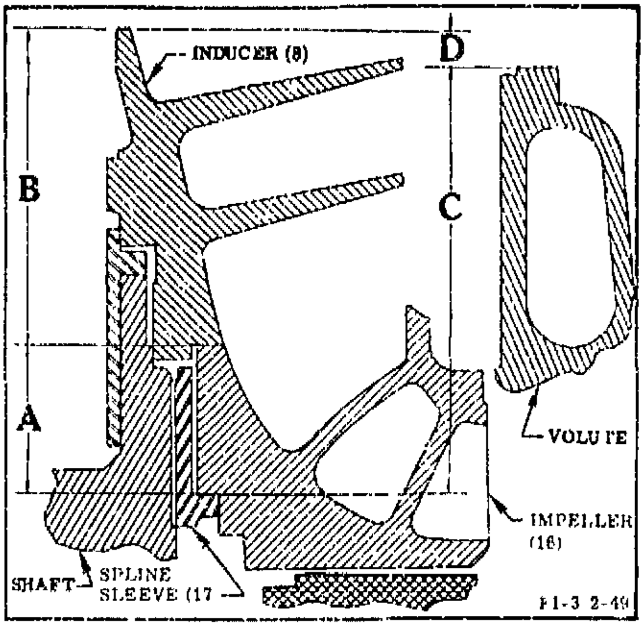


Figure 15-12. Checking Oxidizer Impeller and Inducer

s. Loosen torque bar T-5026432 at turbine manifold until pins are disengaged from second-stage turbine wheel.

t. Verify bottoming of impeller and inducer as follows: (See figure 15-12.)

A = Dimension recorded in step h, substep 4.
B = Dimension recorded in step h, substep 6.
C = Actual dimension recorded in step j.
D = Dimension from volute face to inducer hub face, calculated and actual.

Record dimensions and verify that (A + B) - C = D, and that D calculated = actual measurement.

u. Verify impeller rib clearance as follows: (See figure 15-13.)

A = Dimension recorded in step h, substep 1.
B = Dimension recorded in step h, substep 7.
C = Dimension from inlet mating face of volute to X mark on face of impeller.
D = Impeller rib clearance.

Record dimensions and determine D = A - (B + C).

If the oxidizer pump is being assembled with a different serial-numbered impeller and/or spline sleeve, verify that D = 0.100 ±0.003 inch.

If the oxidizer pump is being assembled with the same serial-numbered impeller and spline sleeve, verify that the above requirements exist or the following:

D = D (dimension recorded in paragraph 15-9, step o) ±0.001 inch and
D = 0.100 (+0.003, - 0.008) inch

v. Using a dial indicator, rotate shaft to indicate impeller outside diameter at wear-ring area. Locate the point of wear-ring area that sweeps closest to volute. Identify this point as CD and record its location in degrees clockwise from zero. (Master spline = zero.)

w. Set dial indicator on zero at point CD; then turn shaft to rotate impeller 180 degrees clockwise and record indicator reading as D.

x. Determine impeller minimum radial clearance as follows:

Wear ring ID = Wear ring inside diameter recorded in step g.
Impeller OD = Impeller outside diameter recorded in step a, substep (4).
B = Dial indicator reading recorded in step e.
D = Dial indicator reading recorded in step w.

$$\frac{\text{Wear ring ID} - \text{Impeller OD} - (D + B)}{2} = \text{Minimum radial clearance.}$$

Verify and record this data.

xA. Engage pins on torque bar T-5026432 into second-stage turbine wheel; then secure torque bar to turbine manifold.

y. Lubricate (Method A) plug (12) with lubricant grease RB0140-012 (Rocketdyne) and install plug and K-seal (13) in inlet (11). Torque plug to 35 ±5 in-lb and safetywire.

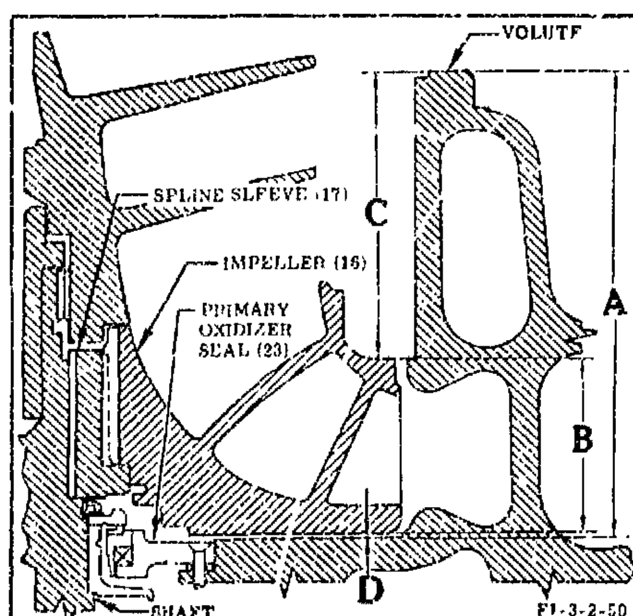


Figure 15-13. Rechecking Oxidizer Impeller Rib Clearance

z. Apply (Method T) sealant and antiseize dispersion RB0120-017 (Rocketdyne) to seal (15), then install seal in groove of volute. (See figure 15-14.)

aa. Install piston rings (14) on inlet (11).

CAUTION

Side movement while lowering inlet onto the volute can cause damage to the wear-ring if the wear-ring contacts the inducer.

ab. Using lift and holding tool T-5028673 and ring compressor T-5028674, install inlet (11) on turbopump volute with washers (10) and bolts (9). Make sure inlet is lowered straight onto volute without any side movement.

NOTE

The inlet must be installed with plug (12) located 140 degrees clockwise from the volute attach lug. (Volute attach lug = zero.)

ac. Torque bolts (9) to 488 ±12 in-lb, and safetywire.

ad through af. (Deleted)

ag. Install hydraulic torque tool T-5029452 on inlet (11); then install torque and inspection tool T-5029467. Set check fixture and record dial indication.

NOTE

If turbopump is on engine, it will be necessary to use adapter T-5035941 and adapter T-5035940 with hydraulic torque tool T-5029452 because of engine interface panel interference.

CAUTION

Damage to turbopump can result if 4,000 ft-lb (651 psig actuator pressure) is exceeded when increasing torque on bolt (4).

ah. Using hydraulic torque tool T-5029452, torque bolt (4) in increments of approximately 0.001 inch until bolt is stretched 0.011 ±0.001 inch. Record dial indication of bolt stretch and hydraulic torque tool pressure for each increment. (See figure 15-15.) When bolt (4) is stretched to 0.010 inch, fit check cap (3) to splines of bolt (4) and slots in inducer (8) so that proper alinement is obtained before reaching maximum bolt stretch.

ai. Remove torque and inspection tool T-5029467 and hydraulic torque tool T-5029452.

aj. Remove fasteners securing torque bar T-5026432 to turbine manifold and disengage pins from second-stage turbine wheel. Using heavy gage, commercial grade plastic sheet, wrap torque bar to protect flanges during removal; then carefully remove torque bar from between flanges of heat exchanger and turbine manifold.

ak. Measure and record a dimension from top of inducer (8) at V-mark to top of inlet (11) at 12 o'clock position. (Volute attach lug = 12 o'clock.) Record actual dimension.

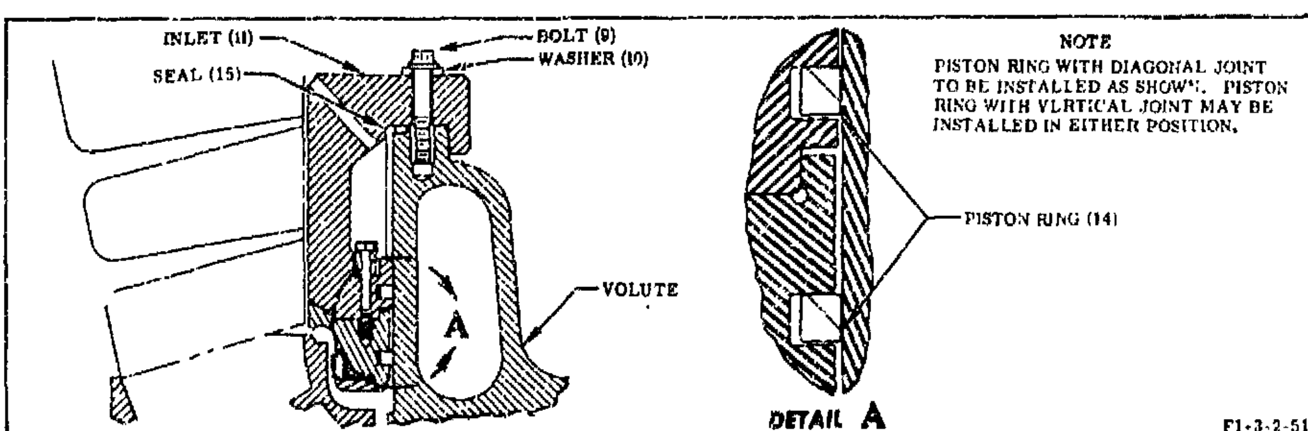
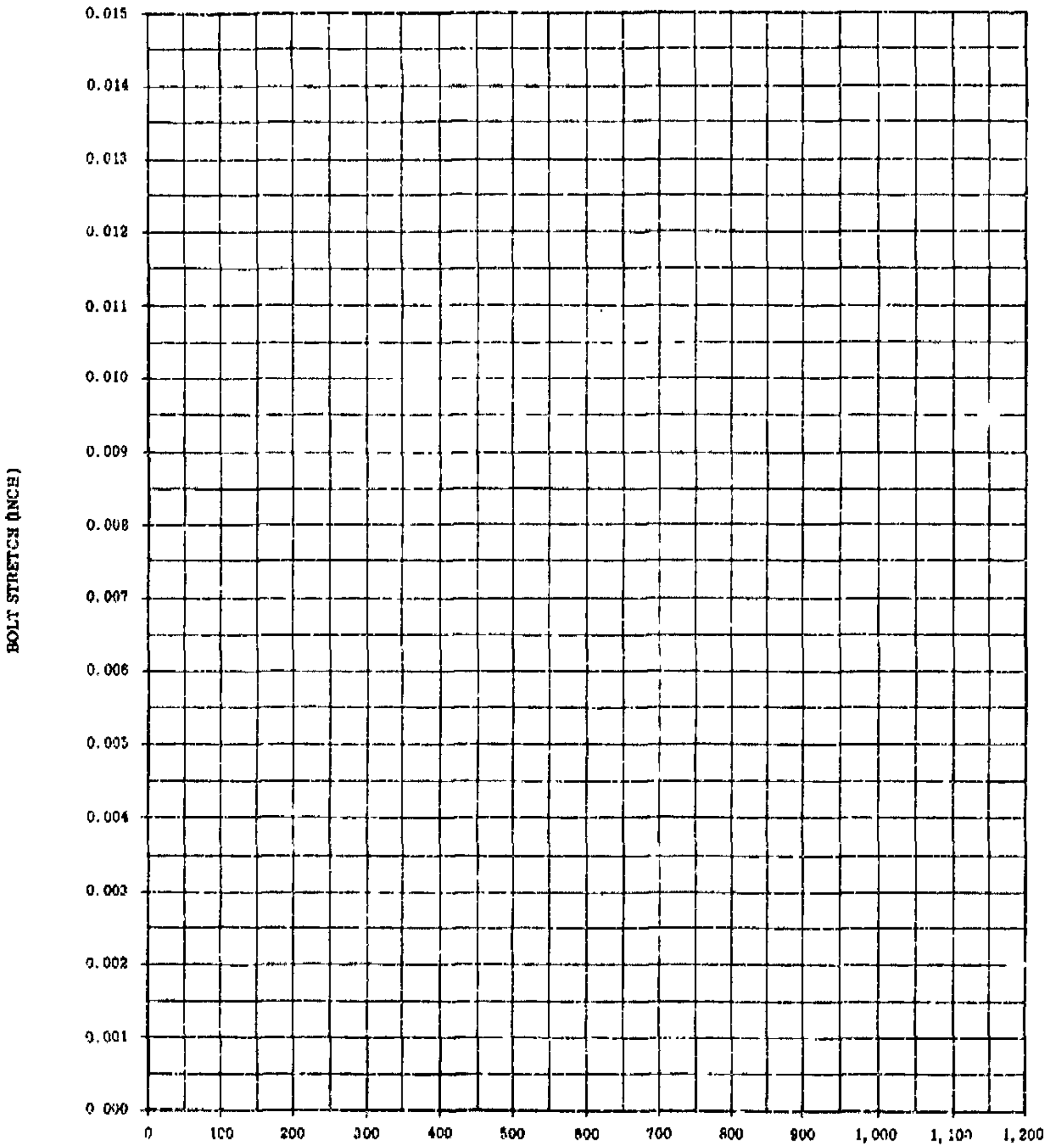


Figure 15-14. Turbopump Oxidizer Inlet Installation

NUMBER EACH POINT OF CURVE IN NUMERICAL SEQUENCE, STARTING WITH 0. (A MINIMUM OF 5 POINTS INCLUDING 0 AND MAXIMUM STRETCH MUST BE PLOTTED.)



NOTE

4,000 FOOT-POUNDS = 651-PSIG ACTUATOR PRESSURE (PUSHING)

4,000 FOOT-POUNDS = 867-PSIG ACTUATOR PRESSURE (PULLING)

453800-G-8A

Figure 15-15. Typical Chart for Plotting Bolt Stretch al. Measure and record the following dimensions to verify the actual radial clearance between outside diameter of inducer (8) and inside diameter of inlet (11) in 4 places.

(1) Sweep inlet (11) inside diameter to find point closest to shaft. Identify as point MC (minimum clearance). Record the angular location by degrees clockwise from attach lug.

(2) Record actual location of point MC; then turn shaft to rotate inducer (8) and measure with clearance pins T-5041812 to locate point on inducer (8) that sweeps closest to point MC on inlet (11) and identify as X.

(3) Record actual minimum clearance between points X and MC.

(4) Rotate point X of inducer (8) to a position 90 degrees from point MC and record clearance.

(5) Rotate point X of inducer (8) to a position 180 degrees from point MC and record clearance.

(6) Rotate point X of inducer (8) to a position 270 degrees from point MC and record clearance. The radial clearance between inducer (8) and inlet (11) must be 0.167 inch minimum.

am. Install cap (3). If necessary, to overcome an interference fit, cap may be heated to 250° F maximum for installation.

CAUTION

Do not exceed an axial load of 200 pounds when installing the cap since damage to the cap or inducer can result.

amA. After cap (3), inducer (8), and bolt (4) have returned to ambient temperature, install lockwasher (2) and bolt (1). Torque bolt to 125 ±5 inch-pounds.

an. Deform lockwasher (2) into one indentation on bolt (1) and one indentation on cap (3). (See figure 15-8.)

15-20A. INSTALLING INLET. This procedure is required if only the inlet was removed and the same inlet or a new inlet is to be installed.

a. Verify that ring 458?55 in inlet (11) does not have dyed surfaces. If dye is present, the part must be stripped and cleaned, as outlined in R-3896-3, Volume I.

NOTE

If a new inlet is to be installed, perform the complete procedure. If the same inlet that was removed in paragraph 15-8A is to be installed, omit steps aA through f; then install inlet as outlined in steps g through k.

aA. Using a dial indicator, sweep the pilot inside diameter for volute; then sweep the wear-ring inside diameter to find point where greatest distance exists between both diameters. Idenfity this point as A and record its location. (See figure 15-15A.)

b. Set dial indicator on zero at point A; then sweep wear-ring inside diameter 180 degrees and record indicator reading at this point as B. Disregard dial indicator sign and record magnitude only.

c. Measure and record inside diameter of wear-ring center land on a line from A to B and identify and record this dimension as DWR.

d. Using a dial indicator, rotate shaft to indicate impeller outside diameter at wear-ring area. Locate the point on wear-ring area that sweeps closest to volute. Identify this point as C and record its location.

e. Set dial indicator on zero at point C; then turn shaft to rotate impeller 180 degrees and record indicator reading at this point as D. Disregard dial indicator sign and record magnitude only.

f. Determine impeller minimum radial clearance as follows:

B = dial indicator reading recorded in step b
DWR = wear-ring diameter recorded in step c
D = dial indicator reading recorded in step e

$$\frac{DWR - (16.990 + D + B)}{2} = \text{Minimum radial clearance}$$

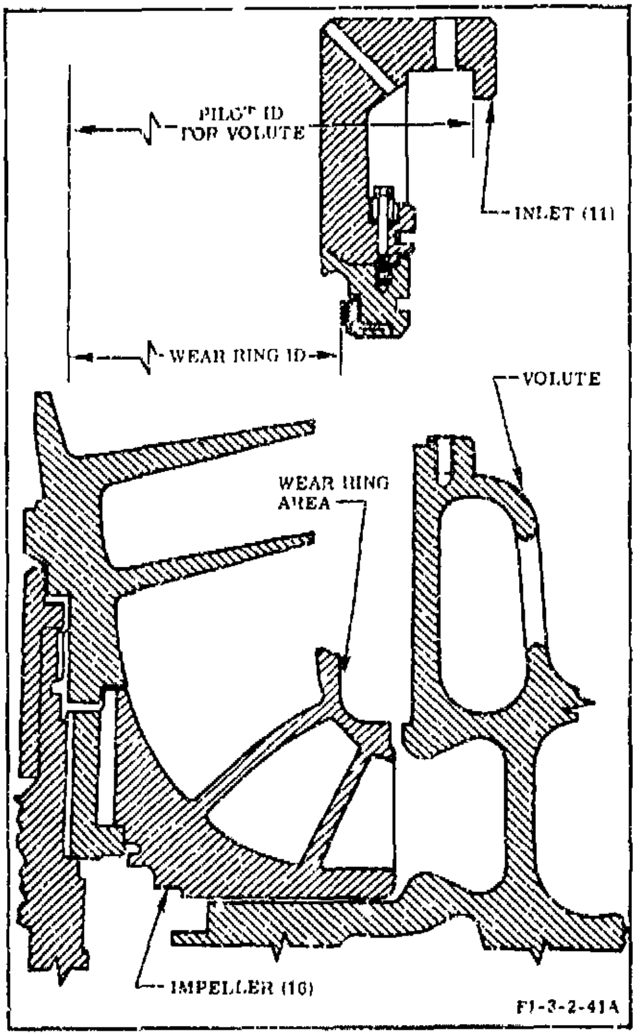


Figure 15-15A. Determining Oxidizer Inlet Minimum Radial Clearance

g. Verify that plug (12) and K-seal (13) are installed and safetywired.

h. Apply (Method T) sealant and antiseize dispersion RB0120-017 (Rocketdyne) to seal (15); then install seal in groove of volute. (See figure 15-14.)

i. Install piston rings (14) on inlet (11).

CAUTION

Side movement while lowering the inlet onto the volute can cause damage to the wear-ring if the wear-ring contacts the inducer.

j. Using lift and holding tool T-5028673 and ring compressor T-5028674, carefully install inlet (11) on volute. Make sure inlet is lowered straight onto volute without any side movement.

NOTE

The inlet must be installed with plug (12) located 140 degrees clockwise from the volute attach lug. (Volute attach lug = zero.)

k. Secure inlet (11) to volute with washers (10) and bolts (9). Torque bolts to 488 ±12 in-lb, and safetywire.

15-21. TESTING.

15-22. Testing of the turbopump after limited repair consists of leak-testing the oxidizer pump primary shaft seal. Additional leak-tests to determine that excess leakage does not exist may be performed on the fuel pump primary and inlet seals, and the No. 1 and No. 2 bearing seals. A turbopump torque-test is performed to determine that breakaway and running torques are within specified values. Volumes of gases measured at the pressure indicated must be corrected to 14.7 psia and 60° F. Leak-test compound (MIL-L-25567) is used to test for static seal leakage. Static seal joints, fittings, and seams must be completely covered with leak-test compound. The lack of bubble formation on joints, fittings, and seams is considered zero leakage. Static seal leakage tests are considered acceptable when specified requirements are obtained within a period of 2-5 minutes. Tests must be performed with the turbopump in the vertical (within 15 degrees) position unless otherwise specified. The pressurant used for leak-tests is gaseous nitrogen (MIL-P-27401).

NOTE

If the turbopump is installed on the engine and the propellant valves are closed, test plates specified to be installed on the oxidizer and fuel pump outlets must not be installed and applicable lines must be removed to obtain specified seal leakages at a point as close to the turbopump as is practical.

- Minimum and maximum leakage values must be recorded and made available to the Rocketdyne Representative for transmittal to Engineering.

Procedure	Result
15-23. PRIMARY OXIDIZER SEAL (NO. 1 SEAL) LEAK-TEST.	
a. Make sure test equipment used for this test has been cleaned for liquid oxygen service.	None.

WARNING

Contaminated parts used in a liquid oxygen system can cause an explosion resulting in serious injury to personnel and damage to equipment.

b. Remove closure from oxidizer pump inlet. Remove outlet closures if oxidizer outlet ducting is removed.	None.
c. Install pressure test fixture T-5035571 or 9020163 on oxidizer pump inlet. Pressure test fixtures T-5028689 are also required on the oxidizer pump outlets if oxidizer outlet ducting is removed.	None.
d. Make sure primary oxidizer seal drain line is open to atmosphere.	None.
e. Slowly pressurize oxidizer pump to 80 ±5 psig and leak-test all fittings, caps, and static seals with leak-test compound. Record locations of leakage.	No fitting, cap, or static seal leakage is allowable.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

eA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
f. Reduce pressure to zero; then repair any leakage before continuing leak-test.	Oxidizer pump is depressurized.

Procedure	Result
g. Slowly pressurize oxidizer pump at the following pressures, in the order listed; and measure for leakage at oxidizer seal purge drain line. Rotate turbopump shaft during leak-test a minimum of one revolution in each direction. One revolution of turbopump shaft requires five revolutions of turbopump torque gear. Record minimum and maximum leakage rate for either rotating or stationary. Maximum allowable leakage must not exceed specified amount for the following conditions and pressure values:	

(1) New or overhauled seal at installation only:

Pressure (psig)	Maximum Leakage (scim)
3 ±0.5	200
10 ±1	200
80 ±5	400

(2) New, overhauled, or existing seal at all other times:

Pressure (psig)	Maximum Leakage (scim)
3 ±0.5	500
10 ±1	500
80 ±5	700

h. Reduce pressure to zero and remove test equipment.	Oxidizer pump is depressurized.
i. Inspect interior areas for contamination and foreign materials; then install protective closures at the oxidizer pump inlet and outlets and cap the primary oxidizer seal drain line.	None.

15-24. INTERMEDIATE SEAL (NO. 2 SEAL) LEAK-TEST.

a. Make sure No. 1 bearing lube seal drain (No. 3 seal) and primary oxidizer seal drain are vented to atmosphere.	None.
b. Install pressure test fixture T-5028675 at the panel-mounted gas purge inlet fitting.	None.
c. Pressurize the intermediate seal through the fixture to 50 ±5 psig.	None.
d. Using two flowmeters, measure and record leakage from the following drains at the same time.	
(1) Primary oxidizer seal drain.	Leakage must not exceed: 2,500 scim for newly installed seal. 3,500 scim for existing seal.

Procedure	Result
(2) No. 3 seal drain.	Leakage must not exceed: 2,500 scim for newly installed seal. 3,500 scim for existing seal.
e. Reduce pressure to zero, remove test equipment, and install protective closures.	Gas purge inlet and intermediate seal cavity is depressurized.

NOTE

If either or both of the drains exhibit zero leakage, an isolation test must be performed as outlined in paragraph 15-24A to determine if purge supply or drain lines are obstructed.

15-24A. INTERMEDIATE SEAL ISOLATION LEAK-TEST. This test is required only if either or both of the drains exhibited zero leakage while performing an intermediate seal leak-test (paragraph 15-24).

Procedure	Result
a. Perform an intermediate seal leak-test at 50 ±5 psig as outlined in paragraph 15-24, except rotate turbopump approximately 2 revolutions (10 revolutions of torque gear drive). Measure and record leakage.	Same results as specified in paragraph 15-24.

NOTE

If either or both drains exhibit zero leakage, step b must be performed.

Procedure	Result
b. Perform an intermediate seal leak-test as outlined in paragraph 15-24, except increase pressure to 80 ±5 psig and rotate turbopump approximately 2 revolutions (10 revolutions of torque gear drive). Measure and record leakage simultaneously from primary and intermediate seal drains.	Maximum allowable leakage at each drain is 5,000 scim.

NOTE

If either or both drains still exhibit zero leakage, backflow pressure across the intermediate seal from the primary oxidizer seal drain side as outlined in steps c through k.

Procedure	Result
c. Make sure test equipment has been cleaned for liquid oxygen service.	None.

WARNING

Contaminated parts used in a liquid oxygen system can cause an explosion resulting in serious injury to personnel and damage to equipment.

Procedure	Result
d. Remove closure from oxidizer pump inlet. Remove outlet closures if oxidizer outlet ducting is removed.	None.

Procedure	Result
e. Install pressure test fixture T-5035571 or 9020163 on oxidizer pump inlet. Pressure test fixtures T-5028689 are also required on the oxidizer pump outlets if oxidizer outlet ducting is removed.	None.
f. Make sure No. 1 bearing lube seal drain is vented to atmosphere.	None.
g. Pressurize oxidizer pump inlet to 30 (+0, -5) psig.	Oxidizer pump inlet pressurized.
h. Pressurize primary oxidizer seal drain cavity to 30 (+0, -5) psig to backflow pressure across the intermediate seal. Observe for pressure venting from No. 1 bearing lube seal drain and intermediate seal purge inlet.	Primary oxidizer seal drain cavity pressurized.

NOTE

Gaseous nitrogen flow from the No. 1 bearing lube seal drain indicates that the primary oxidizer seal drain and No. 1 bearing lube seal drain are not obstructed. Gaseous nitrogen flow at the intermediate seal purge connect indicates an unrestricted inlet condition.

i. Reduce pressure to the primary oxidizer seal drain cavity to zero; then reduce pressure to the oxidizer pump inlet to zero.	Primary oxidizer seal drain cavity and oxidizer pump inlet depressurized.
j. Remove test equipment and install protective closure on the oxidizer pump inlet.	None.
k. Perform an intermediate seal leak-test as outlined in paragraph 15-24 to determine if the purge supply line is clear and not obstructed.	Same results as specified in paragraph 15-24.

15-25. FUEL PUMP PRIMARY SEAL (NO. 5 SEAL) AND INLET SEAL (NO. 6 SEAL) LEAK-TEST.

a. Remove protective closures from fuel pump inlets.	None.
b. Check for presence of liquid fuel and record amount and location; then remove fuel.	None.
c. Install fuel pump inlet test plate 9020162 on No. 1 fuel pump inlet, and fuel pump inlet test plate 9020161 on No. 2 fuel pump inlet.	None.
d. (Deleted)	
e. Cap one of the two primary fuel seal drains and one of the two fuel inlet seal drains.	None.
f. Pressurize pump to 30 ±2 psig; then measure and record leakage from uncapped primary fuel seal and fuel inlet seal drains.	Maximum allowable leakage at each location is 50 scim.

Procedure	Result
g. Increase pressure to 80 ±5 psig; then measure leakage from uncapped primary fuel seal and fuel inlet seal drains. Record actual leackage at each location.	Maximum allowable leakage is 50 scim.
h. Reduce pressure to zero, remove test plates and fixtures, and install protective closures.	Fuel pump is depressurized.

15-26. NO. 1 AND NO. 2 BEARING SEALS (NO. 3 AND NO. 4 SEALS) LEAK-TEST.

Procedure	Result
a. Plug one of the two No. 1 and No. 2 bearing lubrication drain outlets.	None.
b. Disconnect No. 3 bearing lubrication feed line and No. 1 and No. 2 bearing lubrication feed line from bearing coolant control valve; then install pressure test fixture T-5035912 on No. 1 and No. 2 bearing lubrication feed line.	None.
bA. Install pressure test fixture T-5028675 at panel-mounted gas purge inlet fitting.	None.
c. Vent oxidizer-side lubrication seal drain to atmosphere.	None.
d. Make sure primary fuel seal and fuel-side lubrication seal drain ports are open.	None.
dA. Pressurize intermediate seal through test fixture T-5028675 to 80 ±5 psig.	Intermediate seal is pressurized.
e. Connect a flowmeter to unplugged No. 1 or No. 2 bearing cavity drain in fuel volute. Pressurize No. 1 and No. 2 bearing cavities through flowmeter to 30 ±2 psig and measure leakage. Record actual leakage.	Actual leakage.
f. Leak-test static seals, caps, and fittings.	No leakage is allowable.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
fA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
g. Using a flowmeter, measure and record leakage at fuel-side lubrication seal drain.	Maximum allowable leakage is 50 scim.
h. Determine oxidizer-side lubrication seal leakage by subtracting leakage measured in step g from total leakage measured in step e.	Maximum allowable oxidizer-side lubrication seal leakage is 25 scim.
i. Reduce pressure at No. 1 and No. 2 bearing cavities to 15 ±1 psig and measure leakage. Record actual leakage.	Actual leakage.
j. Using a flowmeter, measure leakage at fuel-side lubrication seal drain. Record actual leakage.	Actual leakage.
k. Determine oxidizer-side lubrication seal leakage by subtracting leakage measured in step j from total leakage measured in step i. Record calculated leakage.	None.

Procedure	Result
l. Reduce pressure to No. 1 and No. 2 bearing cavities to zero.	No. 1 and No. 2 bearing cavities are depressurized.
lA. Reduce pressure to intermediate seal to zero.	Intermediate seal is depressurized.
lB. Remove test equipment and install protective closures.	None.
m. Install bearing lubrication feed lines. Torque bolts to 40-50 inch-pounds.	None.

15-27. TURBOPUMP TORQUE-TEST.

Procedure	Result
a. Remove cap on torque gear housing located aft of bearing coolant control valve.	None.
b. Install torque wrench with a suitable extension to hex fitting of torque gear drive.	None.
c. Engage torque gear drive to torque gear by depressing lockpin located at side of torque gear housing and pushing in on extension and torque wrench.	Torque gear drive is engaged with torque gear.
d. With torque gear drive shaft held in, slowly rotate turbopump shaft in both clockwise and counterclockwise directions. One revolution of the turbopump shaft requires five revolutions of the turbopump torque gear. Record maximum breakaway and running torques for each direction	Maximum torque for either breakaway or running is 20 foot-pounds. Binding, rubbing, and scuffing noises, or uneven torque must not occur.

NOTE

If binding, rubbing, and scuffing noises, or uneven torque occurs, the torque gear must be lubricated as outlined in steps h through m.

Procedure	Result
e. Remove torque wrench and extension.	None.
f. Make sure torque gear drive is fully pulled out and is held in this position by lockpin.	None.

CAUTION

If the shaft is not fully pulled out, serious damage to the turbopump can occur.

Procedure	Result
g. Install torque gear housing cover.	None.

NOTE

Steps h through m are applicable only if the turbopump torque gear requires lubrication to reduce binding, rubbing, and scuffing noises, or uneven torque of the torque gear.

Procedure	Result
h. Remove cap from torque gear housing.	None.

Procedure	Result
i. Lubricate torque gear shaft with preservative WD-40 (Rocket Chemical Co). Apply preservative WD-40 by holding the can as close as possible, and concentrating the spray between torque gear shaft and housing.	None.
j. Rotate and move shaft in and out so that preservative WD-40 is worked into all areas between shaft and housing.	None.
k. More than one application of preservative WD-40 may be necessary while performing step j to give maximum penetration between shaft and housing.	None.
l. Perform a turbopump torque-test as outlined in steps a through g to determine if binding, rubbing, and scuffing noises, or uneven torque of the torque gear has been reduced.	Same as steps a through g.

WARNING

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

- The following procedure specifies cleaning compound (MIL-C-81302), which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

m. Clean excess preservative WD-40 from torque gear and housing with a clean, white nylon cloth, moistened with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302).	None.
n. Install heat exchanger and heat exchanger ducts and hoses or connect heat exchanger to turbopump turbine manifold. Applicable procedures are outlined in R-3896-3, Volume I.	

Paragraphs 15-28 through 15-39 and figures 15-16 through 15-19 deleted.

All data on pages 15-27 through 15-32 deleted.

15-40. THERMOSTAT NA5-27311.

15-41. The following procedures contain cleaning, inspecting, repairing, and testing information required to maintain the thermostat. Since the thermostat is hermetically sealed, no disassembly or assembly is possible. See figure 15-20 for test equipment. Refer to R-3896-3, Volume I for protective packaging for the thermostat.

Part Number	Nomenclature	Use
None	Temperature calibration unit, capable of operating and controlling a liquid bath in the range of -20° to +210° F.	Controls liquid bath temperature during actuation testing.
None	Laboratory thermometer, capable of measuring temperatures in the range of -20° to +210° F.	Measures liquid bath temperature during actuation testing.

Figure 15-20. Test Equipment for Thermostat

15-42. CLEANING.

15-43. Clean thermostat electrical connector and exterior surfaces as outlined in R-3896-3, Volume I.

15-44. INSPECTING AND REPAIRING.

15-45. The thermostat is inspected visually; no special tools are required. Inspect thermostat for general condition and for damaged electrical connector, connector pins, and mounting brackets. Repairing the thermostat is limited to repairing minor thread damage, corrosion, nicks, burs, scratches, and bent connector pins. (Refer to R-3896-3, Volume I, for general repair procedures.)

15-46. TESTING.

15-47. This procedure outlines requirements for testing the thermostat using a temperature calibration unit, laboratory thermometer, and ohmmeter. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure.

15-48. SWITCH NO. 1 ACTUATION TEST.

Procedure	Result
a. Connect multimeter across pins A and B of electrical connector.	Multimeter indicates position of contacts.
b. Prepare temperature calibration unit for use with a water bath. Place thermometer in water bath, and adjust unit for a temperature of less than 80° F.	Water bath begins to stabilize at temperature setting.
c. Place sensing end of thermostat in water bath stabilized at a temperature of less than 80° F to make sure contacts are closed.	Multimeter must indicate continuity.
d. Raise temperature of water bath to 99° ±2° F and allow to stabilize for 15 minutes minimum.	Contacts must remain closed as indicated by multimeter.
e. Raise temperature of water bath 3° F every 5 ±1 minutes until thermostat contacts open as indicated by multimeter. Record indication.	Contacts must open at 110° ±8° F.
f. Lower temperature of water bath to 98° ±2° F and allow to stabilize for 15 minutes minimum.	Contacts must remain open as indicated by multimeter.

Procedure	Result
g. Lower temperature of water bath 3° F every 5 ±1 minutes until thermostat contacts close as indicated by multimeter. Record indication.	Contacts must close at 90° ±5° F.
h. Remove thermostat from water bath, disconnect multimeter, and secure equipment.	None.

15-49. SWITCH NO. 2 ACTUATION TEST.

Procedure	Result
a. Connect multimeter across pins A and C of electrical connector.	Multimeter indicates position of contacts.
b. Prepare temperature calibration unit for use with a water bath. Place thermometer in water bath and adjust unit for a temperature of less than 140° F.	Water bath begins to stabilize at temperature setting.
c. Place sensing end of thermostat in water bath stabilized at a temperature of less than 140° F to make sure contacts are closed.	Multimeter must indicate continuity.
d. Raise temperature of water bath to 191° ±2° F and allow to stabilize for 15 minutes minimum.	Contacts must remain closed as indicated by multimeter.
e. Raise temperature of water bath 3° F every 5 ±1 minutes until thermostat contacts open as indicated by multimeter. Record indication.	Contacts must open at 199° ±5° F.
f. Lower temperature of water bath to 158° ±2° F and allow to stabilize for 15 minutes minimum.	Contacts must remain open as indicated by multimeter.
g. Lower temperature of water bath 3° F every 5 ±1 minutes until thermostat contacts close as indicated by multimeter. Record indication.	Contacts must close at 150° ±5° F.
h. Remove thermostat from water bath, disconnect multimeter, and secure equipment.	None.

15-50. SWITCH NO. 3 ACTUATION TEST.

WARNING

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

Procedure	Result
a. Connect multimeter across pins C and D of electrical connector.	Multimeter indicates position of contacts.
b. Prepare temperature calibration unit for use with a methanol (Federal Specification O-M-232) bath. Place thermometer in bath, and adjust unit for a temperature of less than -10° F.	Methanol bath begins to stabilize at temperature setting.
c. Place sensing end of thermostat in bath stabilized at a temperature of less than -10° F to make sure contacts are open.	Multimeter must not indicate continuity.
d. Raise temperature of bath to 7° +2° F and allow to stabilize for 15 minutes minimum.	Contacts must remain open as indicated by multimeter.
e. Raise temperature of bath 3° F every 5 ±1 minutes until thermostat contacts close as indicated by multimeter. Record indication.	Contacts must close at 15° +5° F.
f. Lower temperature of bath to 13° ±2° F and allow to stabilize for 15 minutes minimum.	Contacts must remain closed as indicated by multimeter.
g. Lower temperature of bath 3° F every 5 ±1 minutes until thermostat contacts open as indicated by multimeter. Record indication.	Contacts must open at 0° ±10° F.
h. Remove thermostat from bath, disconnect multimeter, and secure equipment.	None.

15-51. INSULATION RESISTANCE TEST.

CAUTION

The connector must be dry prior to performing the resistance test since moisture could cause the insulation to break down.

Using a megohmmeter, apply 500 ±25 vdc for 5-60 seconds between each pin and case individually and measure resistance.	Resistance must be 50 megohms minimum.

SECTION XVA

TURBINE

15A-1. TURBINE.

15A-2. Turbine repair is limited to replacement of the primary and secondary hot-gas seals, honeycomb seal, and minor repair or replacement of those parts that must be removed to replace the seals. Turbine repair may be performed with the turbopump installed or removed from the engine. Repair procedures consist of disassembling, cleaning, inspecting and repairing, and assembling. See figure 15A-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
8100923, or equivalent	Manifold Sling	Handles turbine manifold.
T-5021831	Seal Installation Tool	Guides seal over ledge of shaft.
T-5018966	Pressure-Test Fixture	Pressurizes seals before installing turbine wheels.
8100047, or equivalent	Turbine Wheel Sling	Handles turbine wheels.
T-5026435	Guide Pins	Guides first-stage turbine wheel onto shaft.
T-5025915	Stator Holder	Holds stator blades while assembling.
~~T-5021812~~	~~Depth Micrometer~~	~~Takes turbine measurements.~~
T-5044634, or equivalent	Stator Retainer Clamps	Clamps stator retainer for taking dimensions.
None	Parallel Bar (48 inches long)	Provides reference plane to take measurements across turbine exhaust.
None	Parallel Bars (12 inches long)	Provides reference plane to measure thickness of stators and wheels.

Figure 15A-1. Test Equipment and Special Tools for Turbine

Figure 15A-2 deleted.

15A-3. DISASSEMBLING.

15A-4. Disassemble the turbine as required to accomplish necessary repairs and replacement. See figure 15A-3 for parts and index numbers. The heat exchanger must be removed prior to disassembly, if the turbopump is installed on the engine. Use depth micrometer T-5021812 to take measurements during this procedure.

NOTE

Measurements taken during disassembly of the turbine must be recorded and made available to the Rocketdyne representative for transmittal to engineering.

- When taking turbine dimensions, the turbine inlet is considered as the 12:00 o'clock position. All other clock positions are clockwise when looking into the turbine exhaust end of the turbopump.

- To accurately measure thickness of stators and wheels at blade shrouds, two parallel bars must be used. The bars must be lightly clamped across the part and the dimension taken between the two bars.

a. Remove insulation (32 through 36) from water shield.

b. Remove clamps (37, 38), then carefully remove covers (39).

c. Remove nuts (18), washers (19), and bolts (27) that hold shields (30,31) together.

d. Remove nuts (18) washers (20,21) and bolts (28,29) then remove shields (30,31).

e. Remove plug (53) and K-seal (54).

f. Measure and record dimension from parallel bar to wheel (3) inner shroud at 4:00 o'clock position. (See figure 15A-8.) Record as dimension C.

g. Attach turbine wheel sling 8100647, or equivalent, and an overhead hoist to wheel (3).

NOTE

Wheel (3) weighs approximately 240 pounds.

h. Remove nuts (1) and lock-tabs (2); then carefully remove wheel (3). Remove spacer (4).

i. Measure and record the following dimensions at 4:00 o'clock position: (See figure 15A-8.)

A = Dimension from parallel bar to segment (7) inner shroud.

B = Thickness of wheel (3) at inner shroud.

NOTE

Stator retainer clamps T-5044634, or equivalent, must be used to hold retainer (6) against flange of manifold (52) when taking dimension A.

- The same parallel bar must be used that was used in step f, to obtain accurate measurements.

j. Using dimensions obtained in steps f and i, determine second-stage wheel-to-segment clearance: A - (B + C) = D wheel clearance. Record calculated clearance for 4:00 o'clock position.

k. Measure and record dimension from manifold exit flange to segment (7) outer shroud at 4:00 o'clock position. (See figure 15A-7.) Record as dimension A. Use stator retainer clamps T-5044634, or equivalent, to hold retainer (6) against flange of manifold (52) when taking this dimension.

l. If turbopump is in the horizontal or vertical position with the turbine end down, stator holder T-5025915 must be securely installed before loosening screws (5).

m. Chalk index segments (7) in a clockwise direction starting at 12:00 o'clock position. Rotate screws (5) into manifold (52) until they clear retainer (6); then remove retainer from manifold.

n. Using stator holder T-5025915, remove segments (7) from manifold (52).

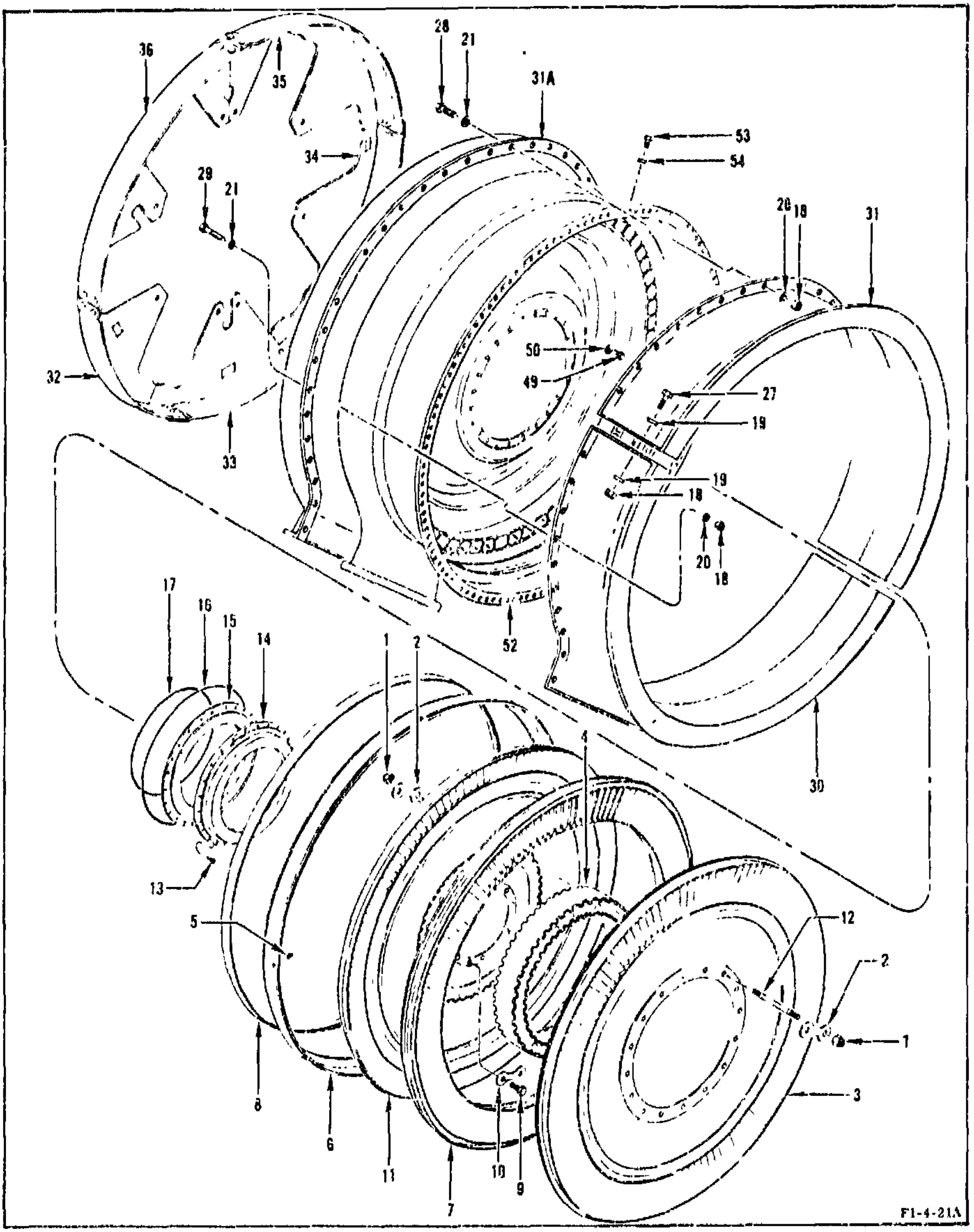
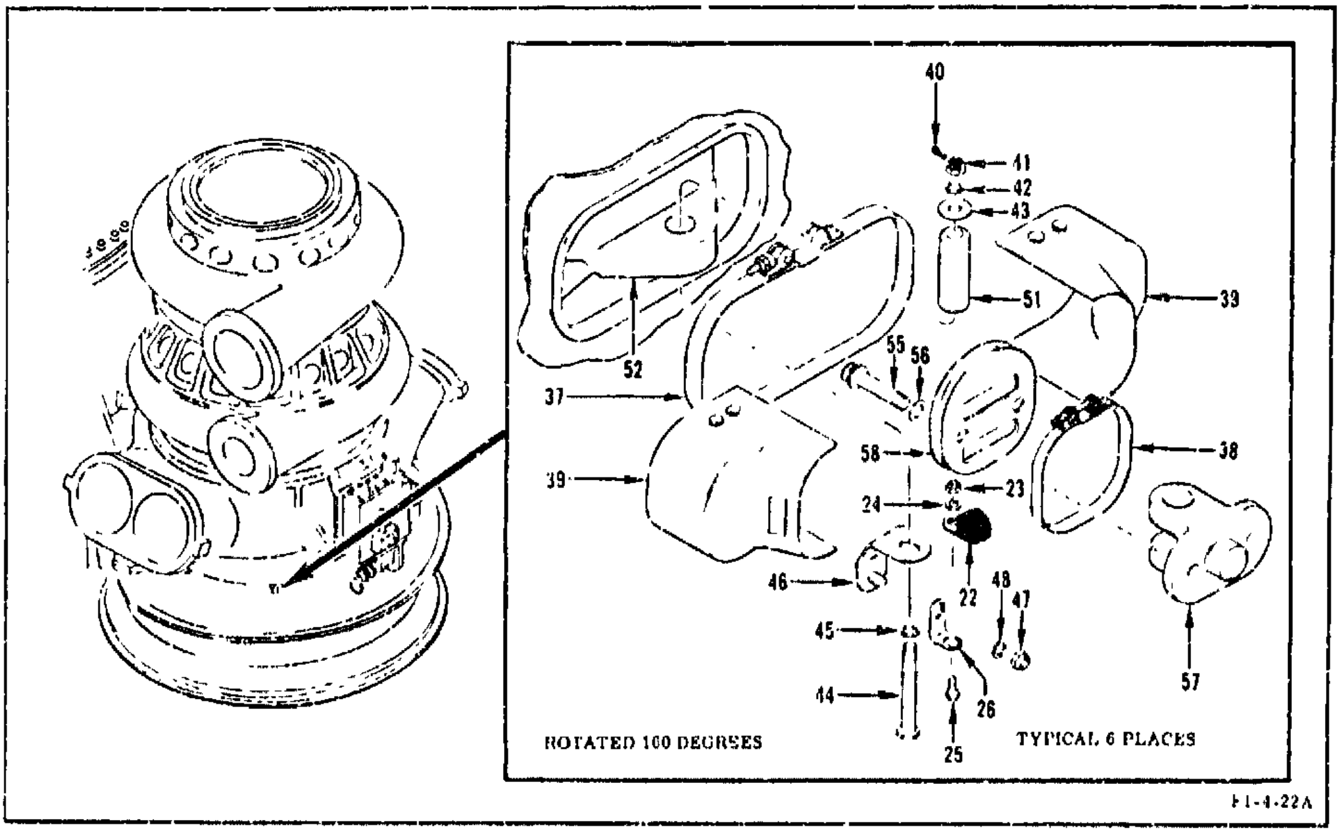


Figure 15A-3. Turbine--Exploded View (Sheet 1 of 2)



1	Nut	16	Seal	31	Shield	45	Washer
2	Lock-Tab	17	Seal	31A	Shield	46	Dampener
3	Wheel	18	Nut	32	Insulation	47	Nut
4	Spacer	19	Washer	33	Insulation	48	Washer
5	Screw	20	Washer	34	Insulation	49	Bolt
6	Retainer	21	Washer	35	Insulation	50	Washer
7	Segment	22	Clamp	36	Insulation	51	Pin
8	Seal	23	Nut	37	Clamp	52	Manifold
9	Bolt	24	Washer	38	Clamp	53	Plug
10	Lock-Tab	25	Screw	39	Cover	54	K-Seal
11	Wheel	26	Bracket	40	Pin	55	Bolt
12	Bolt	27	Bolt	41	Nut	56	Washer
13	Bolt	28	Bolt	42	Washer	57	Clevis
14	Seal	29	Bolt	43	Washer	58	Retainer
15	Seal	30	Shield	44	Bolt		

Figure 15A-3. Turbine--Exploded View (Sheet 2 of 2)

o. Measure and record the following dimensions at 4:00 o'clock position: (See figure 15A-7.)

B = Thickness of segment (7) outer shroud.

C = Dimension from manifold exit flange to wheel (11) shroud.

p. Using dimensions obtained in steps k and o, determine first-stage wheel-to-segment clearance: C - (A + B) = D wheel clearance. Record calculated clearance for 4:00 o'clock position.

q. Measure wheel (11) to seal (8) clearance, 360 degrees around wheel. (See figure 15A-5.) Record actual clearance at 12:00, 4:00, and 8:00 o'clock positions. Also record minimum clearance and clock position.

r. Remove seal (8) from manifold (52).

s. Measure dimension from manifold exit flange to wheel (11) shroud at 4:00 o'clock position. (See figure 15A-5.) Record as dimension C.

t. Attach turbine wheel sling 8100647, or equivalent, and an overhead hoist to wheel (11).

NOTE

Wheel (11) weighs approximately 230 pounds.

u. Remove bolts (9) and lock-tabs (10); then carefully remove wheel (11).

v. Measure and record the following dimensions at 4:00 o'clock position: (See figure 15A-5.)

A = Dimension from manifold exit flange to nozzle.

B = Thickness of wheel (11) at shroud.

w. Using dimensions obtained in steps s and v, determine first-stage wheel-to-nozzle clearance: A - (B + C) = D wheel clearance. Record calculated clearance for 4:00 o'clock position.

x. Remove nuts (1), lock-tabs (2), and bolts (12) from wheel (11).

y. Remove bolts (49) and washers (50) that secure manifold diaphragm to bearing support.

z. Remove bolts (13); then carefully remove seals (14, 15, 17).

aa. Remove nut (23), washer (24), screw (25), and clamp (22).

ab. Remove nuts (47) and washers (48); then remove bracket (26).

ac. Remove cotter pins (40), nuts (41), washers (42, 43, 45) and bolts (44); then remove dampeners (46).

ad. Attach manifold sling 8100923, or equivalent, and an overhead hoist to manifold; then remove pins (51) from clevises (57) and manifold attach lugs. If pins (51) bind, bolts (55) may be loosened slightly to remove pins.

NOTE

Manifold weighs approximately 402 pounds.

ae. Using overhead hoist, carefully remove manifold (52). Remove seal (16) from groove of bearing support.

af. Remove bolts (57) and washers (56); then remove clevises (57) and retainers (58).

15A-5. CLEANING.

15A-6. All parts must be cleaned to enable a thorough inspection for defects, wear, or damage as specified. Re-clean parts after repair. Cleaning procedures for fuel service are outlined in R-3896-3, Volume I.

15A-7. INSPECTING AND REPAIRING.

15A-8. Inspecting the turbine determines whether the individual parts have been damaged by mishandling or wear. Refer to figure 15A-4 and inspect individual parts for the condition to be sought and the dispositions as to repair or replacement of the applicable part. Inspecting turbine thermal insulation is limited to determining acceptability only. Tears, nicks, scratches, etc. are acceptable if batting material (refrasil) remains within the inconel foil. Refer to Technical Manual R-3896-6 for thermal insulation repair.

Part Name and Index Number	Inspecting	Repairing
Wheel (3) Wheel (11) Spacer (4) Manifold (52)	Visually inspect only. Removal of carbon not required. If a discrepancy is noted, clean off carbon to perform a more thorough inspection.	Acceptability and repair requirements to be specified by manufacturer's representative.
Retainer (6) Segment (7)	Visually inspect only. Removal of carbon is not required. If a discrepancy is noted, clean off carbon and perform dye-penetrant inspection as outlined in R-3896-3, Volume I.	Acceptability and repair requirements to be specified by manufacturer's representative.
Seal (8)	Visually inspect honeycomb and anti-rotation stud.	Replace seal if honeycomb is missing from back-up band or if anti-rotation stud is missing. Grooves are acceptable in honeycomb.
Seal (14)	Visually inspect carbon segments. Do not disassemble housing. Make sure that snap-rings are engaged.	Replace seal if snap-ring is disengaged or if carbon segments are cracked.
Pin (51) Clevis (57)	Visually inspect.	Acceptability and repair requirements to be specified by manufacturer's representative.

Figure 15A-4. Inspecting and Repairing Turbine

15A-9. ASSEMBLING.

15A-10. The assembly procedures for the turbine must be performed in the order listed and all parts must meet the cleaning requirements outlined in paragraph 15A-5. See figure 15A-3 for parts and index numbers. Use depth micrometer T-5021812 to take measurements during this procedure. The lubricant used in this procedure is thread compound C-5A (Felt Products) unless otherwise noted. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.

NOTE

Measurements taken during assembly of the turbine must be recorded and made available to the Rocketdyne representative for transmittal to engineering.

- When taking turbine dimensions, the turbine inlet is considered as the 12:00 o'clock position. All other clock positions are clockwise when looking into the turbine exhaust end of the turbopump.

- To accurately measure thickness of stators and wheels at blade shrouds, two parallel bars must be used. The bars must be lightly clamped across the part and the dimension taken between the two bars.

a. Install retainers (58) and clevises (57) (with clevis dash numbers facing outboard) on fuel inlet using washers (56) and bolts (55) Handtighten bolts only.

NOTE

Clevises (57) and pins (51) are machined as matched sets to fit the individual attach lugs on manifold (52) The clevises are also match-marked for correct placement on the fuel inlet and must be installed according to match-marks and numbers.

b. Attach sling 8100923, or equivalent, to manifold (52), then carefully lift manifold with an overhead hoist and aline manifold attach lugs with clevises (57).

c. Install pins (51) (correct number corresponding to clevis number) into clevises (57) and manifold attach lugs. Pin dash numbers must face outboard.

d. Torque bolts (55) that secure clevises to fuel inlet to 600 ±25 in-lb.

e. Remove pins (51) from clevises (57) and manifold attach lugs, then carefully lower manifold (52) with overhead hoist.

f. Safetywire bolts (55) with inconel lockwire MS20995N.

g. Install seal (16) in outer groove of bearing support. If seal does not remain in groove, apply a thin coat of FS1281 grease (Dow Corning Corp) to 4 spots on seal to hold it in groove.

h. Using overhead hoist, carefully lift manifold (52) and aline manifold attach lugs with clevises (57). Make sure that seal (16) is still correctly installed in groove before bottoming manifold in position.

CAUTION

Seal (16) must remain in place so that it will not be damaged.

i. Install pins (51) into clevises (57) and manifold attach lugs. Pin dash numbers must face outboard and match clevis dash numbers.

j. Install dampeners (46), bolts (44), washers (42, 43, 45) and nuts (41). Torque bolts (44) to 10 in-lb, then torque to next slot in nuts (41) and install cotter pins (40).

k. Install bracket (26); then install washers (48) and nuts (47) to secure dampeners to shield. Torque nuts to 60 ±10 in-lb. Install clamp (22) with screw (25), washer (24), and nut (23). Torque nut to 6-8 in-lb.

l. Secure overhead hoist, then remove sling 8100923, or equivalent, from manifold (52).

m. Install seal (17) in bearing support.

n. Using seal installation tool T-5021831, carefully install seals (14, 15) on pump shaft.

o. Lubricate (Method A) bolts (13) then install bolts to secure seals (14, 15). Torque bolts to 35 ±5 in-lb, and safetywire with inconel lockwire MS20995N.

p. Install pressure-test fixture T-5018966 over pump shaft and seals (14, 15).

q. Connect a source of gaseous nitrogen (MIL-P-27401) with an upstream flowmeter to pressure-test fixture.

r. Slowly apply 30 psig gaseous nitrogen to fixture; then measure leakage past seals (14, 15). Combined leakage of seals must not exceed 1,500 scim.

s. Reduce gaseous nitrogen pressure to zero; then remove source of nitrogen and flowmeter from pressure-test fixture.

t. Remove pressure-test fixture.

u. Lubricate (Method A) bolts (49); then install washers (50) and bolts (49) to secure manifold diaphragm to bearing support. Torque bolts to 80 ±10 in-lb, and safetywire with inconel lockwire MS20995N.

v. Lubricate (Method A) bolts (12); then install bolts into wheel (11). Secure bolts to wheel with lock-tabs (2) and nuts (1). Torque nuts to 530 ±15 in-lb; then bend lock-tabs up on 2 sides of each nut.

w. Measure and record the following dimensions at 4:00 o'clock position: (See figure 15A-5.)

A = Dimension from manifold exit flange to nozzle.

B = Thickness of wheel (11) at shroud.

NOTE

These dimensions are used in step ab to determine first-stage wheel-to-nozzle clearance.

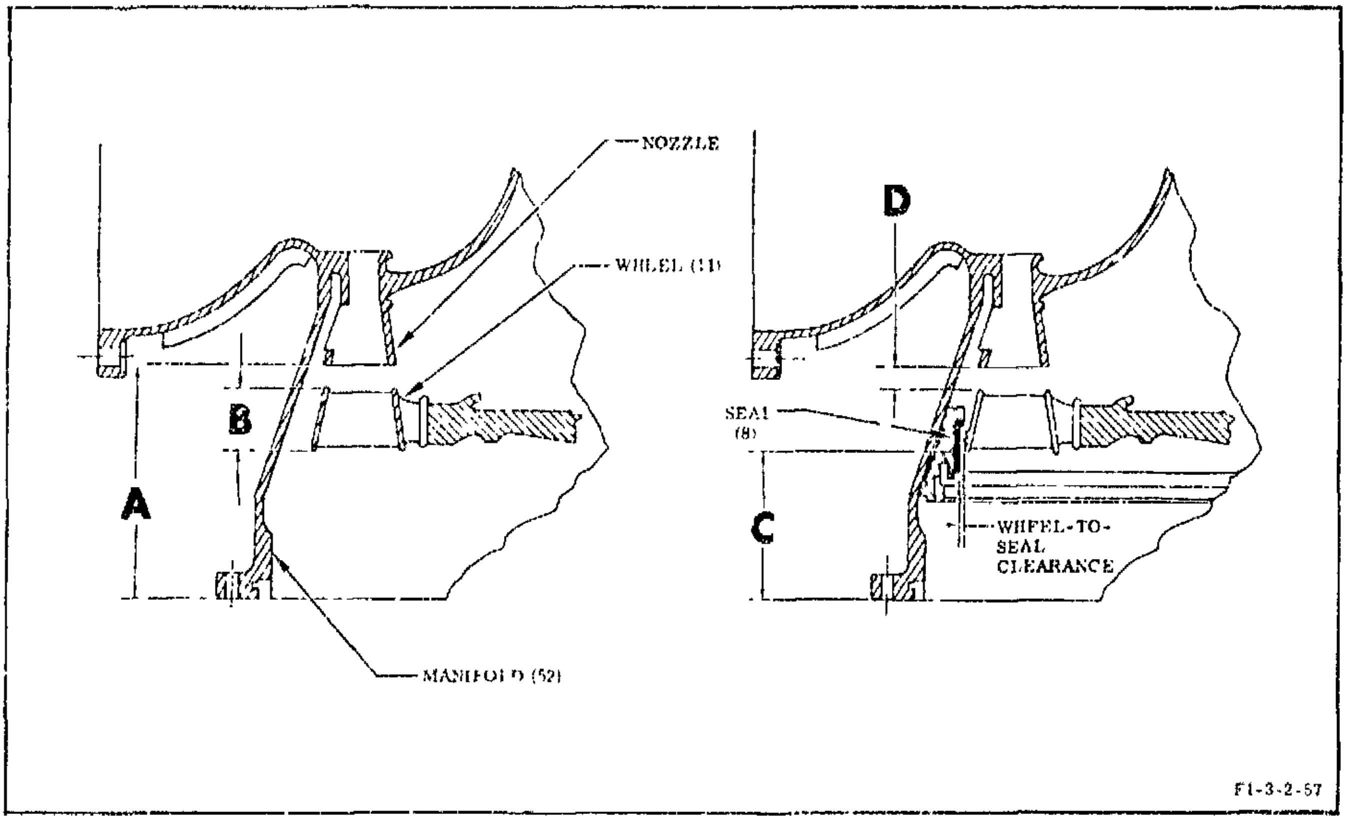


Figure 15A-5. Determining First-Stage Wheel-to-Nozzle Clearance

x. Lubricate (Method I) bolts (9).

y. Using turbine wheel sling 8100647, or equivalent, and an overhead hoist, carefully lift wheel (11); then guide wheel onto pump shaft with guide T-5026435. Wheel (11) must be alined to pump shaft index pin. (See figure 15A-6.)

z. Secure wheel (11) to pump shaft with lock-tabs (10) and bolts (9). Torque bolts to 1,250 +40 inch-pounds; then bend lock-tabs up on 2 sides of each bolt.

aa. Measure dimension from manifold exit flange to wheel (11) at shroud at 4:00 o'clock position. (See figure 15A-5.) Record as dimension C.

ab. Using dimensions obtained in steps w and aa, determine first-stage wheel-to-nozzle clearance: $A - (B + C) \doteq D$ wheel clearance. This clearance must be 0.476 (+0.104, -0) inch. Record calculated clearance for 4:00 o'clock position.

ac. Install seal (8) into manifold (52).

ad. Measure wheel (11) to seal (8) clearance, 360 degrees around wheel. (See figure 15A-5.) This clearance must be 0.002 inch minimum. Record actual clearance at 12:00, 4:00, and 8:00 o'clock positions.

ae. Measure and record dimension from manifold exit flange to wheel (11) shroud at 4:00 o'clock position. (See figure 15A-7.) Record as dimension C.

af. Prepare segments (7) in the order of installation with lowest serial numbered segment at the right, clockwise from turbine inlet 12:00 o'clock position.

NOTE

If serial numbers are not visible, chalk indexing applied during disassembly must be used.

ag. Measure and record thickness of segment (7) shroud at 4:00 o'clock position. (See figure 15A-7.) Record as dimension B.

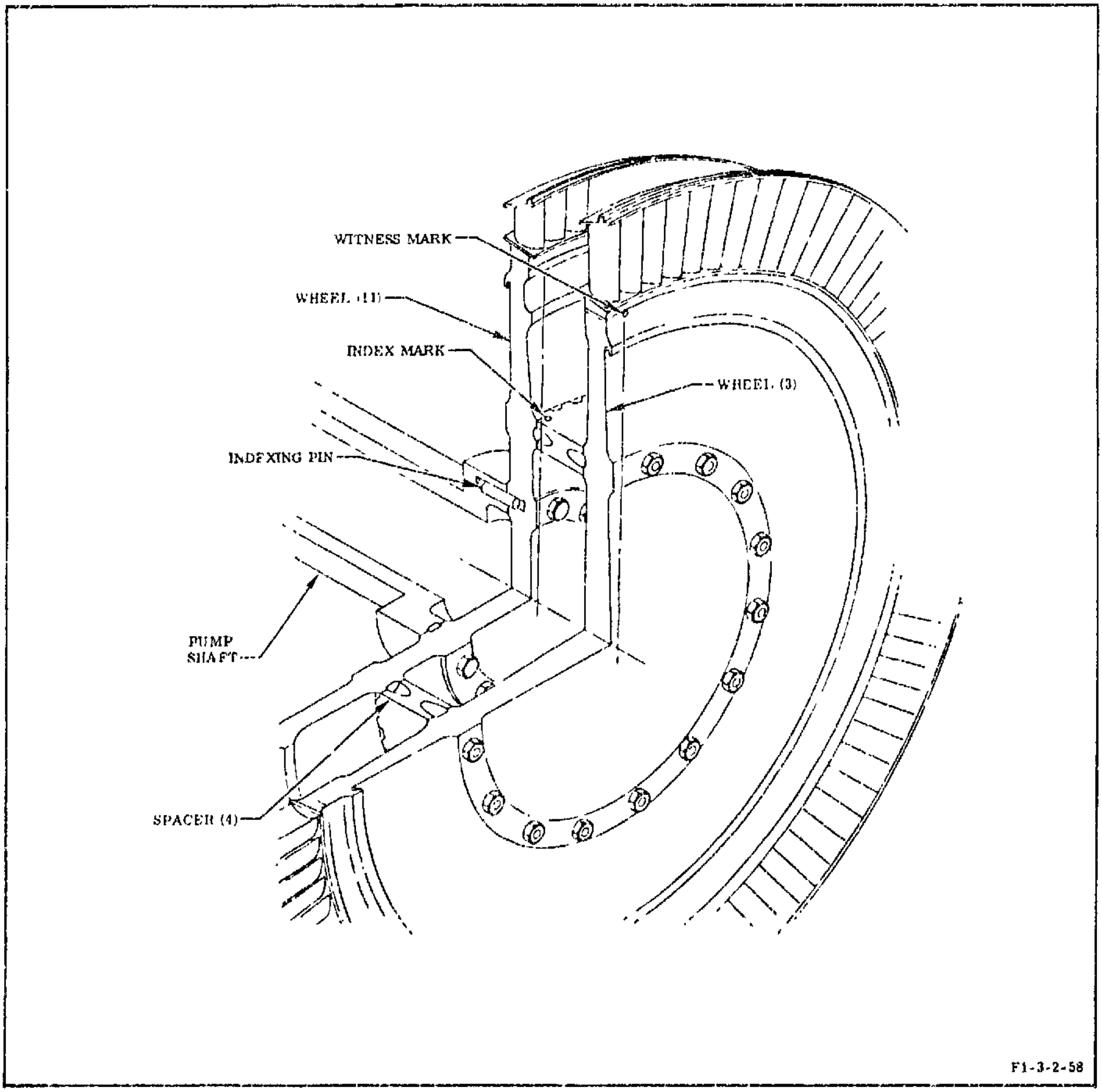


Figure 15A-6. Alining Turbine Wheels and Spacer to Pump Shaft

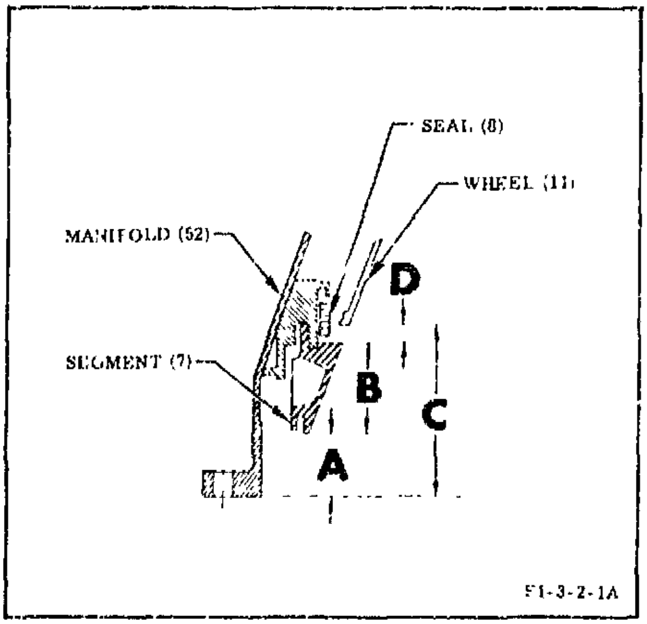


Figure 15A-7. Determining First-Stage Wheel-to-Segment Clearance

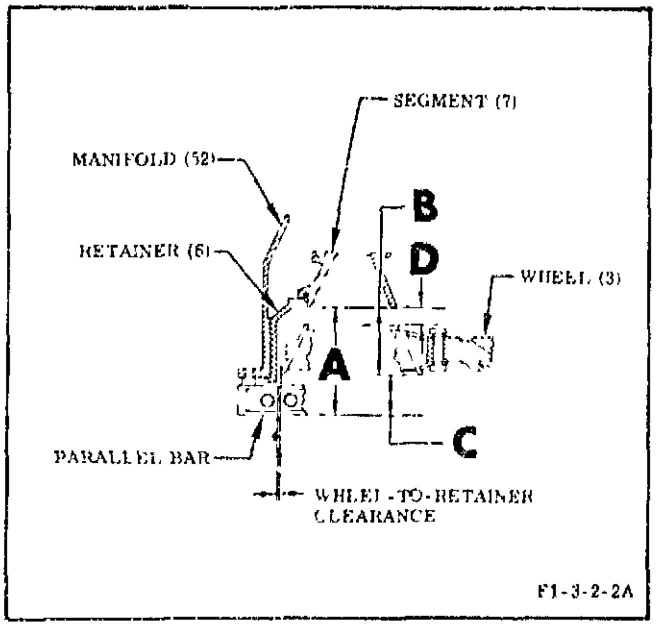


Figure 15A-8. Determining Second-Stage Wheel-to-Segment Clearance

ah. Lubricate (Method A) screws (5).

ai. Using stator holder T-5025915, install segments (7) in the order of serial number sequence or chalk index sequence, starting with lowest number segment at right of turbine inlet 12:00 o'clock position and proceeding in a clockwise direction.

CAUTION

Each segment (7) must be installed so that the anti-rotation lug on the OD of the segment is directly between each set of long and short lugs on the ID of turbine manifold (52). In this position, the segment can be moved axially in and out of position without cocking. In any other position, the segment must be cocked toward the first stage wheel for either removal or installation. Severe damage to the turbopump can result if the anti-rotation lugs are not correctly engaged.

aj. Make sure that screws (5) rotate freely in manifold (52) and that internal wrenching hex is not rounded or worn. Replace worn or damaged screws and chase manifold threads with a 1/4 x 28 tap as necessary. Lubricate (Method I) screws (5) and install in manifold (52).

ak. Install retainer (6), then secure retainer to manifold (52) with screws (5).

al. Make sure segment lugs are fully engaged in slots of manifold.

am. Measure and record dimension from manifold exit flange to segment (7) shroud at 4:00 o'clock position. (See figure 15A-7.) Record as dimension A. Use stator retainer clamps T-5044634, or equivalent, to hold retainer (6) against flange of manifold (52) when taking this dimension.

an. Using dimensions obtained in steps ae, ag, and am, determine first-stage wheel-to-segment clearance: C - (A + B) = D wheel clearance. This clearance must be 0.296 (+0.143, -0.070) inch. Record calculated clearance for 4:00 o'clock position.

ao. Measure and record the following dimensions at 4:00 o'clock position: (See figure 15A-8.)

A = Dimension from parallel bar to segment (7) shroud.

B = Thickness of wheel (3) at inner shroud.

NOTE

Stator retainer clamps T-5044634, or equivalent, must be used to hold retainer (6) against flange of manifold (52) when taking dimension A.

- These dimensions are used in step at to determine second-stage wheel-to-segment clearance.

ap. Install spacer (4) over bolts (12) and against wheel (11). Spacer index mark must be alined to wheel (11). (See figure 15A-6.)

aq. Using turbine wheel sling 8100647, or equivalent, and an overhead hoist, carefully lift wheel (3) over bolts (12) and against spacer (4). Wheel witness mark must be alined to spacer (4). (See figure 15A-6.)

ar. Lubricate (Method A) bolts (12); then secure wheel (3) to spacer (4), wheel (11), and bolts with lock-tabs (2) and nuts (1). Make sure that lock-tabs (2) do not cover the two tooling holes in wheel (3). Torque nuts to 500 ±15 in-lb.

as. Measure and record dimension from parallel bar wheel (3) shroud at 4:00 o'clock position. (See figure 15A-8.) Record as dimension C.

CAUTION

The same parallel bar must be used that was used in step ao, to obtain accurate measurements. Improper assembly can result in serious damage to the turbopump.

at. Using dimensions obtained in steps ao and as, determine second-stage wheel-to-segment clearance: A - (B + C) = D wheel clearance. This clearance must be 0.342 (+0.174, -0) inch. Record calculated clearance for 4:00 o'clock position.

au. Bend lock-tabs (2) up on 2 sides of each nut (1).

av. Perform turbopump torque test as follows:

(1) Remove cap on torque gear housing.

(2) Install torque wrench with a suitable extension to the hex fitting of the torque gear drive.

(3) Engage the torque gear drive to the torque gear by depressing lock-pin located at the side of torque gear housing and pushing in on extension and torque wrench.

(4) With torque gear drive shaft held in, slowly rotate turbopump shaft in both clockwise and counterclockwise directions. Record maximum breakaway and running torque for each direction.

(5) Remove torque wrench and extension and make sure torque gear drive is fully pulled and held in this position by the lockpin.

CAUTION

If the torque gear drive is not fully pulled out, serious damage to the turbopump can occur.

(6) Install torque gear housing cap.

aw. Lubricate (Method A) plug (53); then install K-seal (54) and plug into manifold (52) at 6:00 o'clock position. Torque plug to 40-50 in-lb. Safetywire plug.

ax. Install shields (30,31) on water shield using bolts (28,29), washers (20,21), and nuts (18). Torque nuts to 70 ±10 in-lb.

ay. Attach shields (30,31) together with bolts (27), washers (19), and nuts (18). Torque nuts to 70 ±10 in-lb.

az. Prepare covers (39) for installation by placing both halves of each set together; then safetywire one side only with inconel lockwire MS20995N. (The other side is safetywired after installation.)

ba. Install covers (39) by carefully opening one side and placing them around water shield openings and retainers (58).

bb. Secure covers (39) with clamps (37,38). Torque clamps to 4 ±1 inch-pounds. Safetywire open sides of covers (39) with inconel lockwire MS20995N.

bc. Install insulation (32 through 36) on water shield; then safetywire with inconel lockwire MS20995N.

SECTION XVI

BEARING COOLANT CONTROL VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

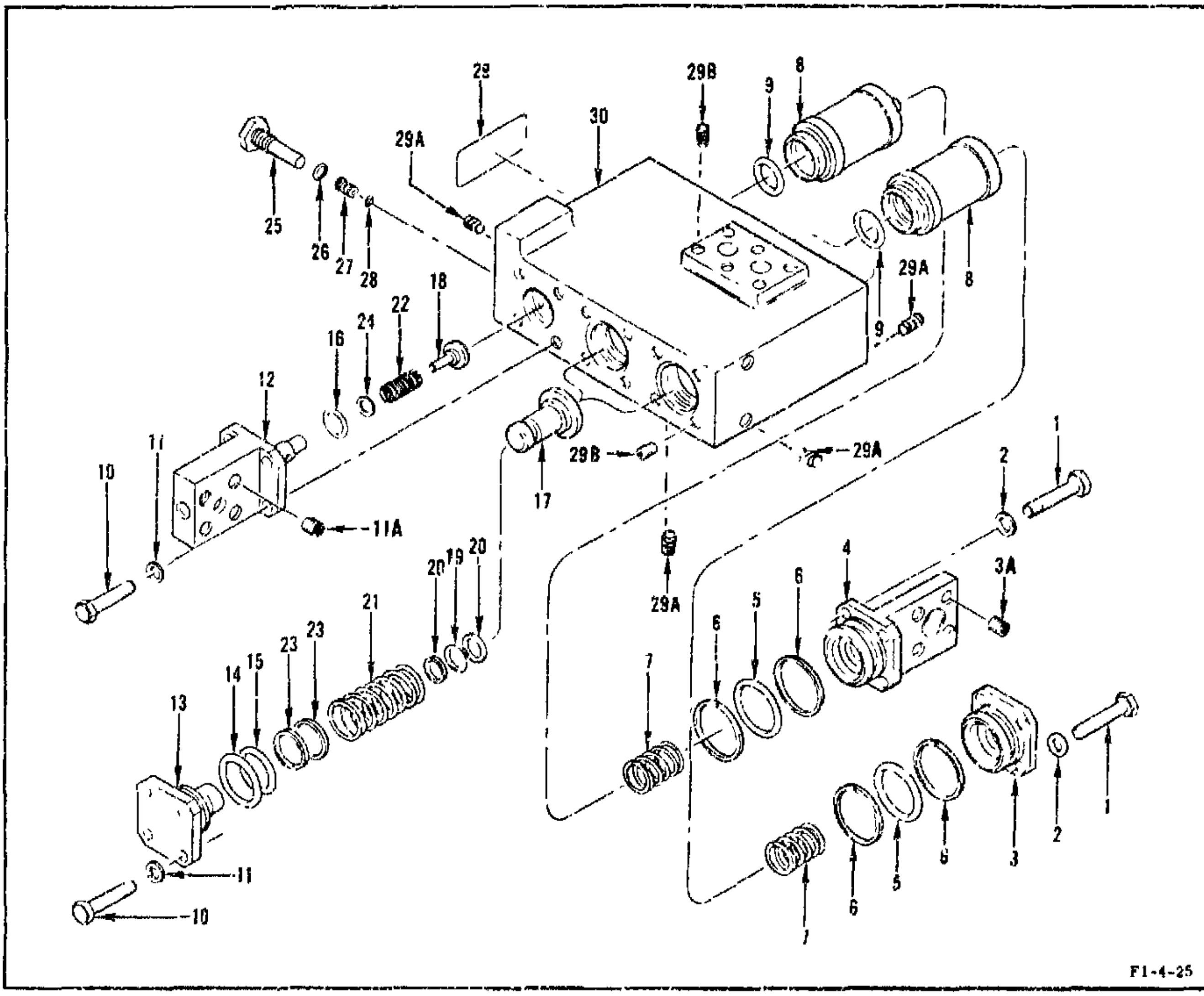
16-1. BEARING COOLANT CONTROL VALVE 557225, 558075, AND 558075-11.

16-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the bearing coolant control valve. See figure 16-1 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
√T-5036722	Pressure Test Fixture	Provides test adapters for bearing coolant control valve.
√T-0043P5-2	Piezometer (2 required)	Provides a means for measuring pressure during testing of bearing coolant control valve.
G3104	Pneumatic Flow Tester	Measures bearing coolant control valve downstream pneumatic leakage.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel for testing bearing coolant control valve.
G3143	Components Adapter Set	Provides hardware for bearing coolant control valve test setups.

Figure 16-1. Test Equipment and Special Tools for Bearing Coolant Control Valve

Figure 16-2 deleted.



1	Bolt	10	Bolt	17	Poppet	25	Nut
2	Washer	11	Washer	18	Poppet	26	Packing
3	Cap	11A	Insert	19	Packing	27	Restrictor [(a)]
3A	Insert	12	Retainer	20	Ring	28	Packing
4	Fitting	13	Guide	21	Spring	29	Nameplate
5	Packing	14	Packing	22	Spring	29A	Insert
6	Ring	15	Packing	23	Shim	29B	Insert
7	Spring	16	Packing	24	Washer	30	Body
8	Filter						
9	Packing						

(a) Restrictor 557224, valve 557225; restrictor RD273-1027-0900, valve 558075; restrictor RD273-1027-0790, valve 558075-11.

Figure 16-3. Bearing Coolant Control Valve--Exploded View

16-3. DISASSEMBLING.

16-4. Disassemble bearing coolant valve, as required, to accomplish necessary repairs and/or replacement. See figure 16-3 for parts and index numbers.

a. Remove bolts (1), washers (2), cap (3), and fitting (4).

b. Remove packings (5) and rings (6) from cap and fitting.

c. Remove springs (7).

d. Remove filters (8) with hook, and remove packings (9) from filters.

e. Remove retainer (12) by removing bolts (10) and washers (11).

f. Remove packing (16), washer (24), spring (22), and poppet (18).

g. Remove two guides (13) by removing bolts (10) and washers (11).

h. Remove packings (14, 15) and shims (23).

NOTE

Shims (23) are used for adjustment for valve operation; quantity (four maximum) for each valve may differ.

i. Remove springs (21) and poppets (17).

j. Remove packings (19) and rings (20) from poppets.

k. Remove nut (25) and packing (26). Remove restrictor (27) with 10-32 threaded T-handle, then remove packing (28).

16-5. CLEANING.

16-6 All parts of the bearing coolant control valve except filters (8) and poppets (17, 18) must be cleaned for hydraulic service as outlined in R-3896-3, Volume I. Clean poppets (17, 18) as outlined in R-3896-3, Volume I, and clean filters (8) as follows:

WARNING

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

a. Using trichloroethylene (MIL-T-27602), clean filters by ultrasonic method for a minimum of 10 minutes at a frequency of 20-40 kc per second. Back-flush filter during cleaning.

b. Clean filters (8) at least 6 more times with clean trichloroethylene (MIL-T-27602) until filters are as clean or cleaner than the following:

(1) 700 particles maximum, at 50-100 micron size.

(2) 200 particles maximum, above 100 micron size.

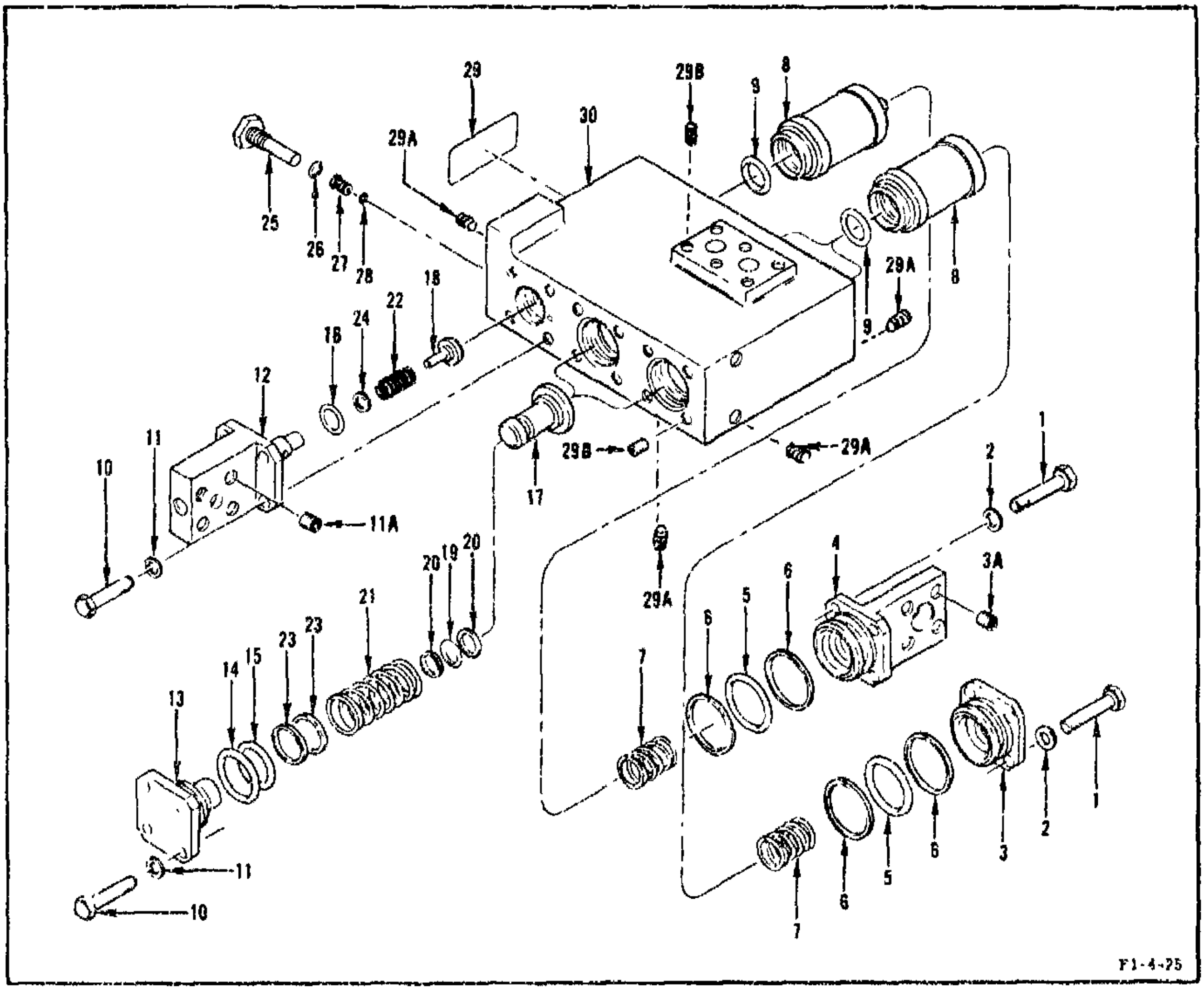
WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

c. Dry filters in an oven at 200° ±10° F for a minimum of 30 minutes or by purging with a regulated source of low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the cleanness and humidity requirements of MIL-P-27401.

16-7. INSPECTING AND REPAIRING.

16-8. Inspecting parts of the bearing coolant control valve (see figure 16-4) determines if the individual parts are damaged. The parts must be inspected for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits are listed in figure 16-5 and form the guide for serviceability of parts. Minimum and maximum dimensional values are given which, when exceeded, require the repair or replacement of the applicable part.



1	Bolt	10	Bolt	17	Poppet	25	Nut
2	Washer	11	Washer	18	Poppet	26	Packing
3	Cap	11A	Insert	19	Packing	27	Restrictor (a)
3A	Insert	12	Retainer	20	Ring	28	Packing
4	Fitting	13	Guide	21	Spring	29	Nameplate
5	Packing	14	Packing	22	Spring	29A	Insert
6	Ring	15	Packing	23	Shim	29B	Insert
7	Spring	16	Packing	24	Washer	30	Body
8	Filter						
9	Packing						

(a) Restrictor 557224, valve 557225; restrictor RD273-1027-0900, valve 558075; restrictor RD273-1027-0790, valve 558075-11.

Figure 16-3. Bearing Coolant Control Valve--Exploded View

16-3. DISASSEMBLING.

16-4. Disassemble bearing coolant valve, as required, to accomplish necessary repairs and/or replacement. See figure 16-3 for parts and index numbers.

a. Remove bolts (1), washers (2), cap (3), and fitting (4).

b. Remove packings (5) and rings (6) from cap and fitting.

c. Remove springs (7).

d. Remove filters (8) with hook, and remove packings (9) from filters.

e. Remove retainer (12) by removing bolts (10) and washers (11).

f. Remove packing (16), washer (24), spring (22), and poppet (18).

g. Remove two guides (13) by removing bolts (10) and washers (11).

h. Remove packings (14, 15) and shims (23).

NOTE

Shims (23) are used for adjustment for valve operation; quantity (four maximum) for each valve may differ.

i. Remove springs (21) and poppets (17).

j. Remove packings (19) and rings (20) from poppets.

k. Remove nut (25) and packing (26). Remove restrictor (27) with 10-32 threaded T-handle, then remove packing (28).

16-5. CLEANING.

16-6 All parts of the bearing coolant control valve except filters (8) and poppets (17, 18) must be cleaned for hydraulic service as outlined in R-3896-3, Volume I. Clean poppets (17, 18) as outlined in R-3896-3, Volume I, and clean filters (8) as follows:

WARNING

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

a. Using trichloroethylene (MIL-T-27602), clean filters by ultrasonic method for a minimum of 10 minutes at a frequency of 20-40 kc per second. Back-flush filter during cleaning.

b. Clean filters (8) at least 6 more times with clean trichloroethylene (MIL-T-27602) until filters are as clean or cleaner than the following:

(1) 700 particles maximum, at 50-100 micron size.

(2) 200 particles maximum, above 100 micron size.

WARNING

The following procedure uses pressurized gaseous nitrogen or air, which must not be allowed to come in direct contact with the body. Inflation of the skin can cause serious injury to human tissues.

- Eye protection must be worn to prevent foreign matter from injuring eyes.
- Pressurized gases can hurl objects with sufficient force to cause injury to personnel.

c. Dry filters in an oven at 200° ±10° F for a minimum of 30 minutes or by purging with a regulated source of low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the cleanness and humidity requirements of MIL-P-27401.

16-7. INSPECTING AND REPAIRING.

16-8. Inspecting parts of the bearing coolant control valve (see figure 16-4) determines if the individual parts are damaged. The parts must be inspected for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits are listed in figure 16-5 and form the guide for serviceability of parts. Minimum and maximum dimensional values are given which, when exceeded, require the repair or replacement of the applicable part.

Part Name and Index Number	Inspecting	Repairing
Cap (3)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Deteriorated or damaged anodic coating.	Apply chemical film touchup as outlined in R-3896-3, Volume I.
Fitting (4)	Damaged threaded inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Apply chemical film touchup as outlined in R-3896-3, Volume I.
Springs (7, 21, 22)	Damage or distortion.	Replace.
	Compressed lengths.	See figure 16-5.
Filters (8)	Damage.	Replace.
Retainer (12)	Damaged threaded inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Apply chemical film touchup as outlined in R-3896-3, Volume I.
Guide (13)	Deteriorated or damaged anodic coating.	Apply chemical film touchup as outlined in R-3896-3, Volume I.
Poppets (17, 18)	Damaged rubber seat.	Replace poppets.
Shim (23)	Burred surfaces or deformation.	Replace.
Washer (24)	Deformation.	Replace.
Nut (25)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
Restrictor (27)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Nicks, scratches, burs or other damage to drilled orifice and chamfered edge.	Replace.
Body (30)	Damaged threaded inserts.	Replace insert as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Apply chemical film touchup as outlined in R-3896-3, Volume I.
	Threads of ports.	Refer to R-3896-3, Volume I, for thread repair.

Figure 16-4. Inspecting and Repairing Bearing Coolant Control Valve

Part Name and Index Number	Dimension	Minimum	Maximum
Spring (7)	Compressed to 0.634 inch	13.0 pounds	16.0 pounds
	Compressed to 0.534 inch	19.9 pounds	23.9 pounds
Spring (21)	Compressed to 0.789 inch	47.5 pounds	52.5 pounds
	Compressed to 0.668 inch	64.2 pounds	71.2 pounds
Spring (22)	Compressed to 0.608 inch	2.24 pounds	2.28 pounds
	Compressed to 0.478 inch	3.61 pounds	3.67 pounds

Figure 16-5. Dimensional Limits for Bearing Coolant Control Valve

16-9. ASSEMBLING.

16-10. The assembly procedures for the bearing coolant control valve must be performed in the sequence listed and all parts must meet cleanness requirements outlined in paragraph 16-5. The lubricant used in this procedure is hydraulic fluid (MIL-H-5606). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 16-3 for part and index numbers.

a. Lubricate (Method M) packing (9) and install on filter (8). Prevent lubricant from contacting mesh of filters.

b. Install filter into COOLANT IN 1 port of body (30).

c. Lubricate (Method M) packing (5) and install with 2 rings (6) on cap (3).

d. Install spring (7) and cap (3) into COOLANT IN 1 port and secure with bolts (1) and washers (2). Tighten but do not torque bolts.

e. Install parts in COOLANT IN 2 port by repeating steps a through d.

f. Install parts in PRESERVATIVE IN port by repeating steps a through d, except use fitting (4) where cap (3) is specified.

g. Lubricate (Method M) packing (28) and install on restrictor (27); install restrictor in body (30). Restrictors are listed for applicable valves as follows:

(1) Restrictor 557224: valve 557225

(2) Restrictor RD273-1027-0900: valve 558075

(3) Restrictor RD273-1027-0790: valve 558075-11

h. Lubricate (Method M) packing (26) and install on nut (25); install nut in body (30) and torque to 40-65 in-lb.

i. Lubricate (Method M) packing (16) and install on retainer (12).

j. Install washer (24), spring (22), and poppet (18) on retainer (12).

k. Install retainer (12) and secure with bolts (10) and washers (11). Tighten but do not torque bolts.

l. Lubricate (Method N) packing (19) and install with two rings (20) on poppet (17).

m. Lubricate (Method M) packings (14, 15) and install on guide (13).

n. Install shims (23) (four maximum), spring (21), and poppet (17) on guide (13).

o. Install guide (13) in COOLANT IN port of body (30) and secure with bolts (10) and washers (11). Tighten but do not torque bolts.

p. Repeat steps l through o for remaining COOLANT IN port.

q. Torque bolts (1) to 50-70 in-lb and bolts (10) to 20-25 in-lb.

r. Safetywire bolts (1, 10) and nut (25) with inconel lockwire MS20995N and install valve port protective closures.

16-11. TESTING.

16-12. This procedure outlines requirements for complete testing of the bearing coolant control valve, using Components Test Console G3141, Components Adapter Set G3143, and Pneumatic Flow Tester G3104. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on bearing coolant control valve as outlined in figure 16-6. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up components test console electrical patch-panels (figure 16-7) and prepare console for use (figure 16-8). See figure 16-9 for port identification and a cutaway view. Refer to paragraphs 16-14 through 16-18 for bearing coolant control valve test procedures and see figures 16-10 and 16-11 for test setups.

Index Letter	Valve Port	Test Plate	Port Connection
A	Coolant In	T-5036722-101	AN815-6C
B	Preservative In	T-5036722-102	AN815-6C
C	Outlet	T-5036722-113	AN815-6C
D	Instrumentation	T-5036722-103	AN815-6C

Figure 16-6. Preparing Bearing Coolant Control Valve for Testing

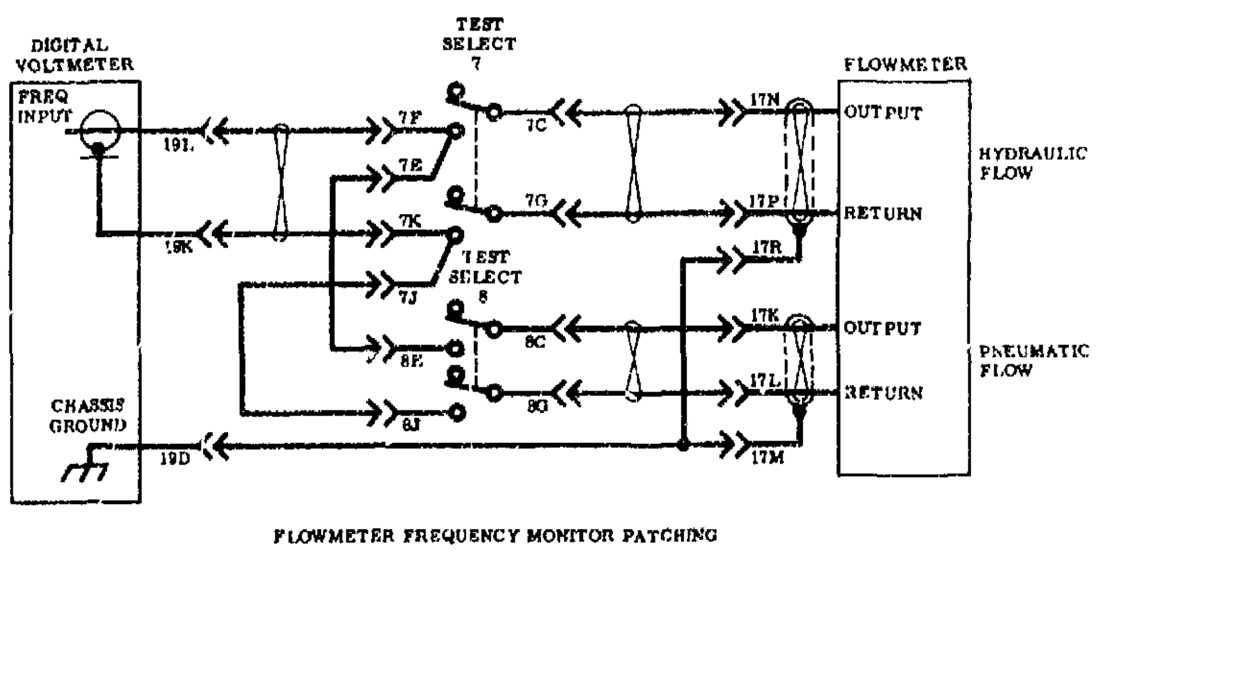


Figure 16-7. Components Test Console Patch-Panel Requirements (Sheet 1 of 2)

Patch Cord[(a)]	From J6-	To J6-	Patch Cord[(a)]	From J6-	To J6-
K3.	7C	17N	K3.	7J	8J
K3.	7E	8E	K3.	8C	17K
K3.	7F	19L	K3.	8G	17L
K3.	7G	17P	K4.09	17M	17R
K3.	7K	19K			19D

(a) Use any cord length required on all patch-cords numbered K3.

Figure 16-7. Components Test Console Patch-Panel Requirements (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	

Figure 16-8. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
TEST CELL ELECT.	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D(0-30)	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a] Hydraulic flow monitor control.

(a) If indication is not as specified, press applicable switch-light.

Figure 16-8. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	TEST SELECT 8		Light 8 off.[a] Pneumatic flow monitor control.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUT-OFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
FLOW-MONITOR-TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	Clockwise 3/4 turn	
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 is for pneumatic flow. Both switch-lights must not be on at the same time.

- Digital voltmeter must warm up at least 30 minutes.

(a) If indication is not as specified, press applicable switch-light.

Figure 16-8. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console. PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates supply pressure.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates supply pressure.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed when working with pressurized systems.

Figure 16-8. Preparing Components Test Console for Use (Sheet 4 of 4)

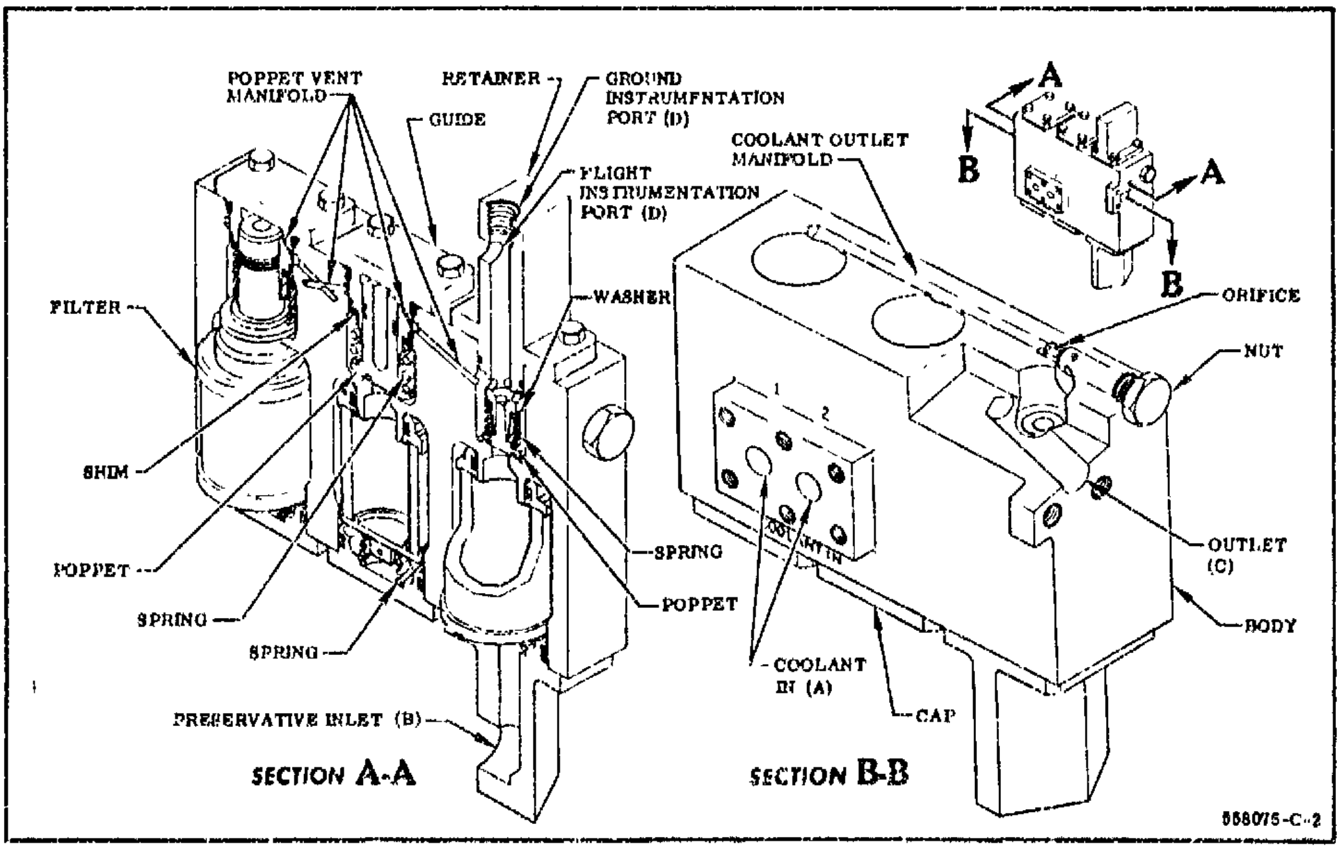


Figure 16-9. Bearing Coolant Control Valve--Cutaway View

Paragraph 16-13 and figure 16-10 deleted.

16-14. COOLANT INLET VALVE LEAKAGE AND CRACKING-PRESSURE TEST.

CAUTION

If proof-pressure test was performed, the valve will contain a small amount of hydraulic fluid. Care must be taken to prevent entrance of the fluid into the pneumatic flowmeter.

Procedure	Result
a. Connect bearing coolant control valve to console. (See figure 16-11, coolant inlet valve leakage and cracking-pressure test.)	None.
b. Disconnect test cell vent (fuel compatible) line from hand valve at OUTLET port (C) and open hand valve.	None.

Procedure	Result
c. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 200 ±5 psi.	COOLANT IN 1 port (A) pressurized.
d. Measure and record leakage at OUTLET port (C).	Maximum allowable leakage is 1 scim.

NOTE

If the results of steps e through g are not obtained, adjustment may be made as outlined in step h.

Procedure	Result
e. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until TEST CELL MONITOR PRESSURE gage indicates 300 ±5 psi.	REG SUPPLY PRESS gage and TEST CELL MONITOR PRESSURE gage indicates 300 ±5 psi and PRESSURE MONITOR "B" gage must indicate 210-240 psi.
f. Alternately close and open hand valve at OUTLET port (C) three times.	With hand valve closed, TEST CELL MONITOR PRESSURE and PRESSURE MONITOR "B" gages indicate 300 ±5 psi; with hand valve open, same results as step e must be obtained.
g. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until TEST CELL MONITOR PRESSURE gage indicates 350 ±5 psi.	PRESSURE MONITOR "B" gage must indicate 210-240 psi.
h. If results of steps e, f and g are not obtained, the test must be discontinued and 0.002-inch shim laminations removed from, or added to, shims (23). Repeat steps c through g until results are obtained.	None.

NOTE

Each 0.002-inch shim lamination changes setting approximately 1 psi. Addition of shims increases pressure reading; removal of shims decreases pressure reading. Shim surfaces must be free of burs and curled edges.

Procedure	Result
i. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until TEST CELL MONITOR PRESSURE gage indicates 100 ±5 psi.	PRESSURE MONITOR "B" gage indicates 100 ±5 psi.
j. Measure and record leakage at OUTLET port (C).	Maximum allowable leakage is 1 scim.
k. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay.	TEST CELL MONITOR PRESSURE and PRESSURE MONITOR "B" gage indicates zero.
l. Disconnect line at COOLANT IN 1 port (A) and connect it to COOLANT IN 2 port (A). Install pressure cap on COOLANT IN 1 port.	None.

Procedure	Result
m. Repeat steps c through k.	Same as steps c through k.
n. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	None.
o. Remove bearing coolant control valve from test setup.	None.
p. If bearing coolant control valve testing is terminated, secure test equipment (paragraph 16-19).	None.
q. Install protective closures. Refer to paragraph 16-2.	None.

16-15. PRESERVATIVE INLET VALVE LEAKAGE AND CRACKING-PRESSURE TEST.

NOTE

If proof-pressure test was performed, a small amount of hydraulic fluid is in the valve. Care must be taken to prevent the fluid from entering the pneumatic flowmeter.

Procedure	Result
a. Connect bearing coolant control valve to console. (See figure 16-11, preservative inlet valve leakage and cracking-pressure test.)	None.
b. Disconnect test cell vent (fuel compatible) line from hand valve at OUTLET port (C) and open hand valve.	None.
c. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 5 ±1 psi.	PRESSURE MONITOR "A" gage indicates 5 ±1 psi.
d. Measure and record leakage at OUTLET port (C).	Maximum allowable leakage is 10 scim.
e. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 20 ±1 psi. Record pressure indicated by PRESSURE MONITOR "A" gage.	PRESSURE MONITOR "A" gage must indicate 9-20 psi.
f. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 50 ±5 psi. Record pressure indicated by PRESSURE MONITOR "A" gage.	PRESSURE MONITOR "A" gage must indicate 9-20 psi.

Procedure	Result
g. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay.	PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages indicate zero.
h. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	None.
i. Remove bearing coolant control valve from test setup.	None.
j. If bearing coolant control valve testing is terminated, secure equipment as outlined in paragraph 16-19.	None.
k. Install protective closures. Refer to paragraph 16-2.	None.

16-16. COOLANT AND PRESERVATIVE VALVES REVERSE-LEAKAGE TEST.

Procedure	Result
a. Connect bearing coolant control valve to console. (See figure 16-11, coolant and preservative valves reverse-leakage test.)	None.
b. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 250 ±5 psi.	PRESSURE MONITOR "B" gage indicates 250 ±5 psi.
c. Measure and record leakage at COOLANT IN 1, COOLANT IN 2, and PRESERVATIVE IN ports.	Maximum allowable leakage at any one port is 10 scim.
d. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve. Close VENT valve after pressure decay.	PRESSURE MONITOR "B" gage indicates zero.
e. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	None.
f. Remove bearing coolant control valve from test setup.	None.
g. If bearing coolant control valve testing is terminated, secure test equipment (paragraph 16-19).	None.
h. Install protective closures. Refer to paragraph 16-2.	None.

16-17. COOLANT INLET VALVES FLOW-TEST.

Procedure	Result
a. Connect bearing coolant control valve to console. (See figure 16-11, coolant inlet valves flow-test.)	None.

Procedure	Result

CAUTION

Orifices must be installed carefully to prevent damage to orifice entrance.

Procedure	Result
b. For valves 557225 and 558075, install orifice AP2057-5.83 at OUTLET port (C). For valve 558075-11, install orifice AP2057-4.70 at OUTLET port (C). Install orifices that have flow arrows with arrow pointing away from OUTLET port C. Install orifices that do not have flow arrows with orificed end at OUTLET port C.	None.

WARNING

Personnel must not be allowed in the test cell during this test. Visual examination of the valve while it is pressurized must be made through the test cell window.

Procedure	Result
c. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	OPEN light on and CLOSE light off.
d. On HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL as follows:	
(1) Open VENT valve and close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,000 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. Slowly apply facility hydraulic supply pressure until HYDRAULIC CONTROL panel SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psi.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,620 ±20 psi; then close HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,620 ±20 psi, and PRESSURE MONITOR "A" gage must indicate 300 ±40 psi for valve 557225, 350 ±40 psi for valve 558075, and 325 ±30 psi for valve 558075-11.
g. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	None.
h. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve. Close valve after pressure decay.	PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages decrease to zero.

Procedure	Result

CAUTION

Orifices must be installed carefully to prevent damage to orifice entrance.

Procedure	Result
i. Remove orifice at OUTLET port (C). For valves 557225 and 558075, install orifice AP2057-5.03 and for valve 558075-11, install orifice AP2057-4.10 at OUTLET port (C). Install orifices that have flow arrows with arrow pointing away from OUTLET port C. Install orifices that do not have flow arrows with orificed end at OUTLET port C.	None.
j. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,000 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
k. For valve 557225, on HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,820 ±20 psi; then close HIGH PRESS SHUTOFF valve. Record pressure indicated on PRESSURE MONITOR "A" gage.	PRESSURE MONITOR "B" gage must indicate 1,820 ±20 psi and PRESSURE MONITOR "A" gage must indicate 425 ±40 psi.
l. For valve 558075, on HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,820 ±20 psi; then close HIGH PRESS SHUTOFF valve. Record pressure indicated on PRESSURE MONITOR "A" gage.	PRESSURE MONITOR "B" gage must indicate 1,820 ±20 psi and PRESSURE MONITOR "A" gage must indicate 540 ±40 psi.
m. For valve 558075-11, on HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,800 ±20 psi; then close HIGH PRESS SHUTOFF valve. Record pressure indicated on PRESSURE MONITOR "A" gage.	PRESSURE MONITOR "B" gage must indicate 1,800 ±20 psi and PRESSURE MONITOR "A" gage must indicate 475 ±40 psi.
n. Maintain pressure of steps k. l, or m, as applicable, for a minimum of 2 minutes and check cap (3) and guide (13) flanges for leakage.	No visible leakage is allowable.
o. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF valve.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
p. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
q. Disconnect line at COOLANT IN 1 port (A) and connect it to COOLANT IN 2 port (A).	None.
r. Repeat steps b through p.	Same as steps b through p.
s. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
t. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF valve.	None.

Procedure	Result
(2) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	CLOSE light on and OPEN light off.
u. Remove bearing coolant control valve from test setup.	None.
v. If bearing coolant control valve testing is terminated, secure test equipment (paragraph 16-19).	None.
w. Install protective closures. Refer to paragraph 16-2.	None.

16-18. PRESERVATIVE INLET VALVE FLOW-TEST.

Procedure	Result
a. Connect bearing coolant control valve to console. (See figure 16-11, preservative inlet valve flow-test.)	None.
b. For valves 557225 and 558075, install orifice AP2057-5.03 at OUTLET port (C) and for valve 558075-11 install orifice AP2057-4.10 at OUTLET port (C).	None.
c. Prepare digital voltmeter (DVM) for flow-monitor-tests. (See figure 16-8.)	None.
d. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	OPEN light on and CLOSE light off.

Procedure	Result
e. On HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Open VENT valve and close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±20 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. Slowly apply facility hydraulic supply pressure until HYDRAULIC CONTROL panel SUPPLY PRESSURE gage indicates 1,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 1,000 ±100 psi.
g. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 200 ±5 psi. Close HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate 200 ±5 psi.
h. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	OPEN light on and CLOSE light off.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.
j. On DIGITAL VOLTMETER panel, press RESET switch. Measure and record flowrate from OULET port (C).	DVM must indicate an equivalent to 3 gpm minimum.
k. Maintain pressure and flow for a minimum of 2 minutes and check fitting (4) and retainer (12) flanges for leakage.	No visible leakage is allowable.
l. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 off.
m. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF valve.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
n. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve and press FLOW MONITOR SHUTOFF switch-light.	HYDRAULIC CONTROL panel depressurized, CLOSE light on and OPEN light off, and PRESSURE MONITOR "A" gage decreases to zero.
o. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
p. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.

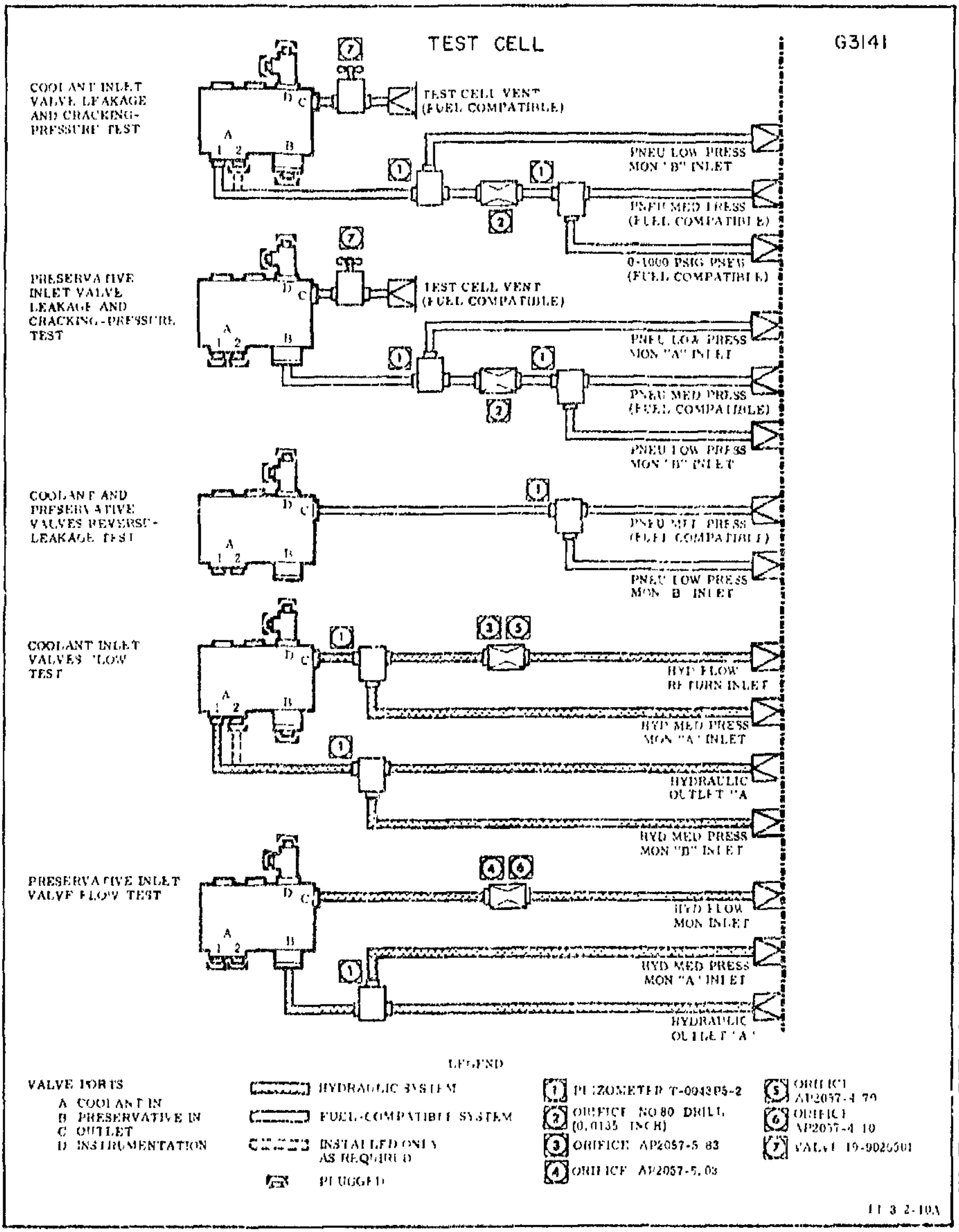


Figure 16-11. Bearing Coolant Control Valve Leak- and Flow-Test Setups

Procedure	Result
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	CLOSE light on and OPEN light off.
q. Remove bearing coolant control valve from test setup.	None.
r. If bearing coolant control valve testing is terminated, secure test equipment (paragraph 16-19).	None.
s. Install protective closures. Refer to paragraph 16-2.	None.

16-19. SECURING TEST EQUIPMENT.

16-20. After bearing coolant control valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve and open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves and adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero and close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn digital voltmeter power off.

i. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

j. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off, and press POWER ON switch-light.

k. Turn DC POWER SUPPLY off.

l. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION XVII

LIQUID LEVEL DETECTOR

This section is deleted.

SECTION XVIII

ELECTRICAL HARNESS

18-1. ELECTRICAL HARNESS.

18-2. The following procedures contain the cleaning, inspecting and repairing, and testing information required to maintain the electrical harness (figure 18-1). The harnesses are permanently assembled, with overmolds, into individual harnesses: no disassembly or assembly is required. See figure 18-2 for torque requirements for electrical connector dust caps, figure 18-3 for materials and special tools, and figure 18-7 for harnesses covered by this procedure. Refer to R-3896-4 for part number of replaceable parts.

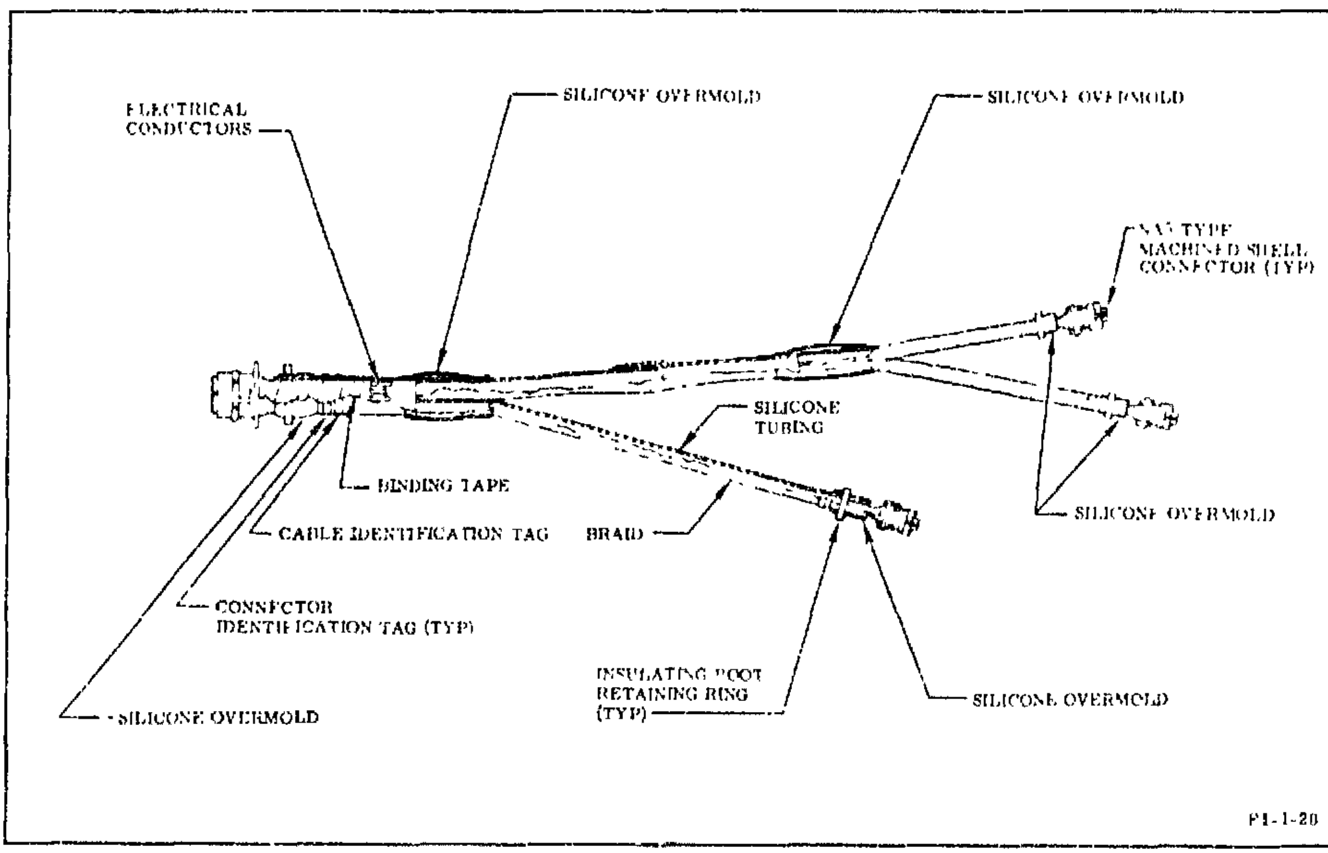


Figure 18-1. Flexible Armored Harness (Typical)--Cutaway View

Connector RDI No.	Torque (in-lbs)	Description
J18	155-185	Interface Panel
J19	90-115	Interface Panel
J20	130-165	Interface Panel
J100	90-115	Interface Panel
J101	130-165	Interface Panel
J102	100-125	Interface Panel
J103	100-125	Interface Panel
J104	90-115	Interface Panel
J106	90-115	Interface Panel
J140	60-80	Interface Panel
J141	155-185	Interface Panel
J142	40-50	Interface Panel
J143	115-145	Interface Panel
J174	40-50	Interface Panel
J470	130-165	Interface Panel
J800	80-100	Interface Panel
P30	60-80	Checkout Valve
P35	40-50	Prefill Level Detector
P43, P44	40-50	Gas Generator Igniter
P45, P46	40-50	Turbine Exhaust Igniter
P47	100-125	Interconnect to Igniters (J47)
P50	40-50	Redundant Shut-down Valve
P51	40-50	Engine Control Valve Start Solenoid
P52	30-40	Engine Control Valve Stop Solenoid
P53	40-50	Gas Generator Ball Valve Position Switch
P56	40-50	Hypergol-Cartridge-Installed Switch
P70	60-80	No. 1 Oxidizer Valve Position Transducer
P71	60-80	No. 2 Oxidizer Valve Position Transducer
P73	40-50	No. 1 Thrust OK Pressure Switch
P74	40-50	No. 3 Thrust OK Pressure Switch
P75	40-50	Turbopump Interface (J75)
P76	60-80	No. 1 Fuel Valve Position Transducer
P77	60-80	No. 2 Fuel Valve Position Transducer
P78	40-50	No. 2 Thrust OK Pressure Switch

Connector RDI No.	Torque (in-lbs)	Description
P85, P86	30-40	Turbopump Heater No. 1
P87, P88	30-40	Turbopump Heater No. 2
P108	80-100	Primary Instrumentation Junction Box
P109	130-165	Primary Instrumentation Junction Box
P110	100-125	Prim ry Instrumentation Junction Box
P111	130-165	Primary Instrumentation Junction Box
P112	115-145	Primary Instrumentation Junction Box
P113	100-125	Primary Instrumentation Junction Box
P114	90-115	Primary Instrumentation Junction Box
P115	100-125	Primary Instrumentation Junction Box
P116	40-50	Fuel Pump Inlet No. 1 (KF6a-1)
P117	40-50	Oxidizer Pump Discharge No. 2 (PO2a-2)
P118	40-50	Oxidizer Pump Bearing Pressure (LB1a)
P119	40-50	Gas Generator Chamber Pressure (GG1d)
P120	40-50	Fuel Pump Discharge No. 2 Pressure (PF2a-2)
P121	40-50	Fuel Pump Inlet No. 2 (KF6c-2)
P121	40-50	Turbine Outlet Pressure (TG5c)
P122	40-50	Common Hydraulic Return Pressure (NH5c)
P123	40-50	Combustion Chamber Pressure (CG1c)
P128	30-40	Engine Control Valve Stop Solenoid and Engine Cutoff Signal to Vehicle (J128)
P129	90-115	Interconnect to Prefill Level Detector (J129)
P130	40-50	Turbopump Interface (J130)
P132	40-50	Heat Exchanger LOX Inlet Flow No. 1 (F16)
P134	30-40	Bearing No. 1 Temperature (LS1)
P135	30-40	Bearing No. 2 Temperature (LS2)
P136	30-40	Turbine Bearing Temperature (LS3)

Figure 18-2. Torque Requirements for Electrical Connector Dust Caps (Sheet 1 of 2)

Specification or Part Number	Nomenclature	Use
Model 630A (Triplett), or equivalent	Multimeter	Testing continuity
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Testing insulation resistance.
Kulgrid or Kulgrid 28 (Sylvania Electric Products, Inc), or equivalent	Wrapping Wire	Repairing armor braid.
Federal Specification TT-I-735	Isopropyl Alcohol	Cleaning repair area of plug protective boot and exterior of connectors.
LB0190-002 (NR, Los Angeles Division), or equivalent	Pressure-Sensitive Tape	Masking off repair area of harness.
Federal Specification TT-M-261	Methyl-Ethyl-Ketone	Cleaning repair area of harness, and overmolds.
STO130RB0078, Type I (Rocketdyne)	Silicone Rubber Tape	Repairing green overmolds.
PR-1553 (black) (Products Research Co)	Potting Compound	Repairing black overmolds.
1200 (Dow Corning Corp) 92-018 (Dow Corning Corp) (3-oz tube)	Primer Aerospace Sealant	Repairing heat-shrinkable overmolds.
No. 500A (Rayclad Tubes, Inc)	Heat-Gun	Shrinking heat-shrinkable overmolds.
Federal Specification QQ-S-571, SN60 or SN63, Type RA	Solder	Repairing armor braid.
MIL-P-27401	Gaseous Nitrogen	Cleaning and drying harness and connectors.

Figure 18-3. Materials and Special Tools for Electrical Harness

18-3. CLEANING.

18-4. The electrical harness must be free of dirt, grease, moisture, and foreign particles prior to inspecting and repairing and testing. Clean electrical harness and connectors as outlined in R-3896-3, Volume I.

18-5. INSPECTING AND REPAIRING.

18-6. Inspecting the electrical harnesses determines if the parts have been damaged by mishandling or wear. See figure 18-4 and 18-5 and inspect part for the condition to be sought and the disposition as to repair or replacement of the applicable part.

Part Name	Inspecting	Repairing
Connector	Pin contacts with one bend but not bent more than 20 degrees from connector axis.	Straighten by using a mating socket contact or equivalent. See figure 18-5. Replace harness if out of tolerance.
	Pin contacts with more than one bend regardless of angularity.	See figure 18-5. Replace harness.
	Pin contacts with one bend greater than 20 degrees.	Replace harness.
	Bent or misalined socket contacts.	Replace harness.
	Length of pin or socket contacts.	See figure 18-5. Replace if out of tolerance.
Connector (continued)	Corroded pin or socket contacts.	Replace harness.
	Cracked or split connector inserts.	Replace harness.
	Cracked, bent, or broken connector shells (includes coupling and clamping nuts).	Replace harness.
	Contamination	Clean as outlined in R-3896-3, Volume I.
	Damaged anodic coating of connectors.	Refer to R-3896-3, Volume I, for applying chemical film touchup.

Figure 18-4. Inspecting and Repairing Electrical Harness (Sheet 1 of 3)

Part Name	Inspecting	Repairing
Connector (continued)	Damaged or missing seals or gaskets.	See figure 18-5. Replace seals or gaskets. (Refer to R-3896-4 for part number.)
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
Harness	Abrasions in armor braid not exceeding one inch of continuous linear length in any one area.	Solder over exposed area with solder specified in figure 18-3.
	Raised braid.	Permissible provided increase in harness diameter does not increase 5 percent in harness cross-sectional area and braid is unbroken.
	Loose metallic braid separated more than 0.150 inch or where more than one percent of rubber tubing is visible through braid in any one linear foot of harness.	Repair as outlined in paragraph 18-11.
Harness (continued)	Broken braid carriers not exceeding 2 at any one point and not more than 5 points within any 2-foot length of harness.	Clip off broken strands flush with braid and solder over exposed area with solder specified in figure 18-3.
	Armor braid damaged beyond the limitations listed above, but the damage does not exceed 3 continuous linear inches.	Repair as outlined in paragraph 18-11.
	Random individual broken strands.	Clip off broken strands flush with braid.
	Cut wire insulation.	Replace harness.
	Contamination.	Clean as outlined in R-3896-3, Volume I.
Green or Black Overmold	Voids or gouges larger than 1/4 inch in diameter.	Repair as outlined in paragraph 18-7 or 18-8.
	Cracks, cuts, or holes that expose armor braid.	Repair as outlined in paragraph 18-7 or 18-8.
	Thermal damage.	Sand charred overmold to a smooth finish. If braid is exposed after sanding, repair as outlined in paragraph 18-7 or 18-8.
Heat-Shrinkable Overmold	Blisters, holes, scratches, or gouges larger than 1/8 inch in diameter.	Replace as outlined in paragraph 18-9.

Figure 18-4. Inspecting and Repairing Electrical Harness (Sheet 2 of 3)

Part Name	Inspecting	Repairing
Heat-Shrinkable Overmold (continued)	Voids larger than 1/4 inch between overmold and armor braid.	Apply aerospace sealant 92-018 (Dow Corning Corp) to affected area.
	Thermal damage.	Sand charred overmold to a smooth finish. If braid is exposed after sanding, replace as outlined in paragraph 18-9.
Plug Protective Boot	Surface scratches, nicks, or gouges exceeding 1/8 inch in diameter and more than 0.030 inch deep.	Replace boot.
	Torn ears on boot.	Repair as outlined in paragraph 18-10.

NOTE

Heat-shrinkable overmold imperfections smaller than listed above are considered acceptable.

Figure 18-4. Inspecting and Repairing Electrical Harness (Sheet 3 of 3)

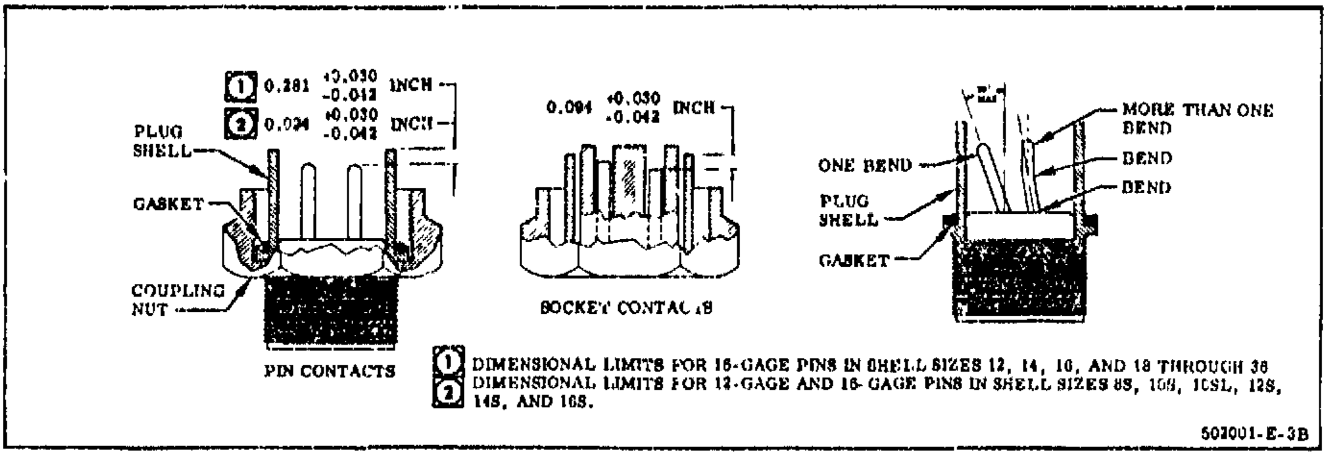


Figure 18-5. Dimensional Limits for Electrical Connectors

18-7. REPAIRING GREEN OVERMOLDS.

WARNING

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

a. Thoroughly clean repair area by wiping with a clean, lint-free cloth dampened with methyl-ethyl-ketone (Federal Specification TT-M-261). Allow solvent to dry completely.

b. Wrap defective or damaged area of overmold with silicone rubber tape STO130RB0078, Type I (Rocketdyne).

c. Apply silicone rubber tape in one even layer with a 50-percent overlap.

d. Extend tape layer from 1/2 to 1 inch beyond defective or damaged area.

18-8. REPAIRING BLACK OVERMOLDS.

WARNING

The following procedure specifies methyl-ethyl-ketone which 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.

a. Thoroughly clean repair area by wiping with a clean, lint-free cloth dampened with methyl-ethyl-ketone (Federal Specification TT-M-261). Allow solvent to dry completely.

b. Thoroughly mix 22 parts of A to 100 parts of B, by weight, of potting compound PR-1553 (black) (Products Research Co), for one minute.

c. Using a spatula, apply and smooth potting compound to damaged area of overmold.

NOTE

The potting compound must be used within 15 minutes after mixing, since it starts to set up after 15 minutes.

d. Allow potting compound to cure at room temperature for approximately 16 hours.

NOTE

Curing may be accelerated by using a hot-air gun or heat lamp not exceeding a maximum temperature of 230° F.

e. Remove any excess compound by carefully trimming or sanding.

18-9. REPAIRING HEAT-SHRINKABLE OVERMOLDS. Repair of heat-shrinkable overmolds consists of replacing the damaged item with a new one of the same part number. Refer to R-3896-4 for overmold part number. (See figure 18-6 for replacing overmolds.)

CAUTION

Extreme care must be used when cutting overmold to prevent damage to armor braid.

a. Verify part number of damaged overmold and carefully remove damaged overmold by cutting with a sharp cutting edge along the axial length of the harness.

b. Peel sufficient sealant from repair area to expose armor braid. Removal of all sealant is not necessary.

WARNING

The following procedure specifies methyl-ethyl-ketone which 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.

c. Clean area to be bonded and inside of new overmold, using a clean, lint-free cloth dampened with methyl-ethyl-ketone (Federal Specification TT-M-261). Allow solvent to dry completely.

d. Using pressure-sensitive tape LB0190-002 (NR, Los Angeles Division), mask off each side of repair area, with 1/2-inch maximum space from ends of overmold.

e. Apply a thin coat of primer 1200 (Dow Corning Corp) to metal surface of repair area; apply only enough primer to give a pink tinge to the metal. Allow to dry for a minimum of 60 minutes.

f. Apply aerospace sealant 92-018 (Dow Corning Corp) 1/32 to 1/8 inch thick over entire repair area.

g. Position new overmold around the harness at repair area. If overmold has a thick end or inside lip, position overmold in correct direction. (See figure 18-6.) If overmold has a plug protective boot retaining ring, the lip must be completely shrunk first.

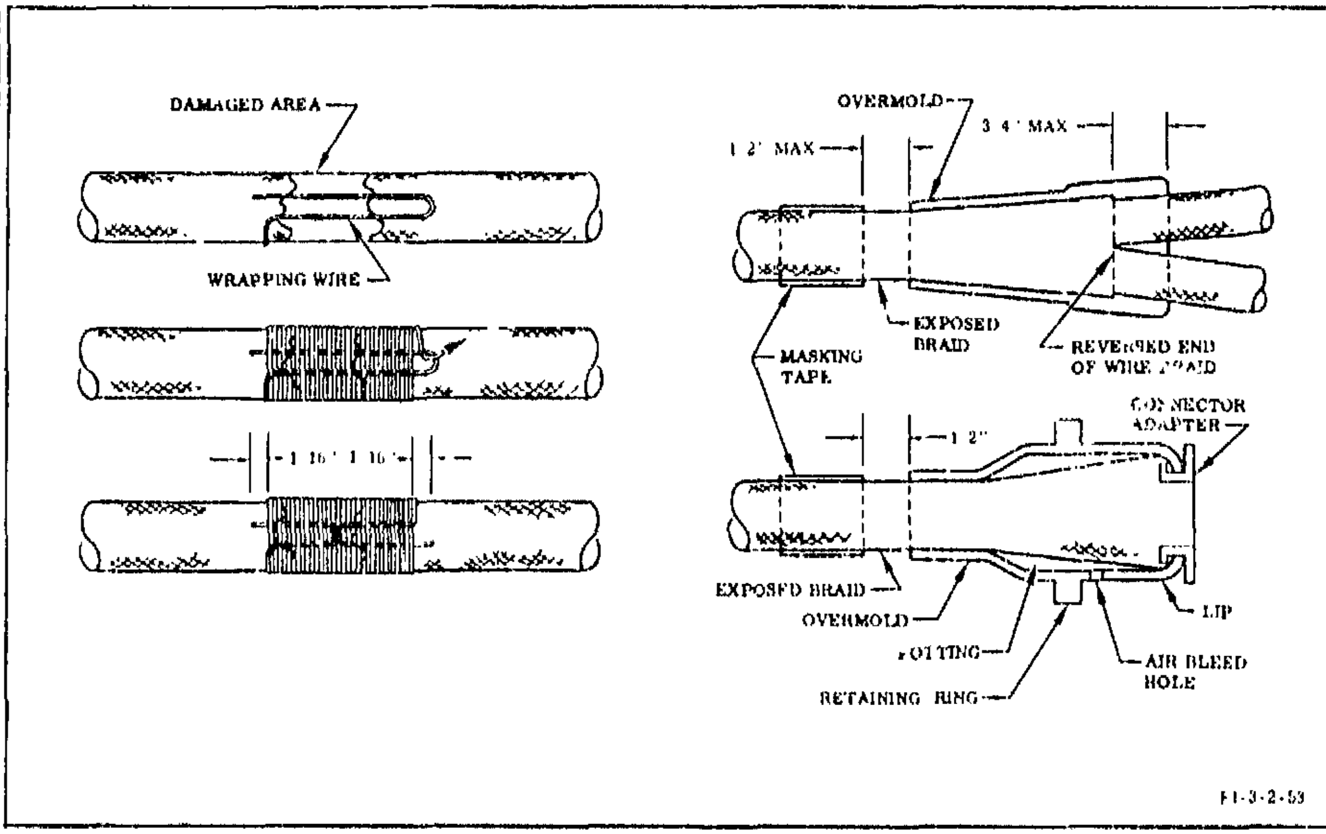


Figure 18-6. Wrapping Armor Braid and Replacing Heat-Shrinkable Overmolds

CAUTION

Application of excessive heat will cause silicone rubber surface to blister.

h. Using a heat gun or equivalent, apply heat evenly around overmold starting at one end and continuing to other. If a reflector is used with gun, shorten time that heat is applied. If a reflector is not used, hold gun approximately 2 inches away from part when applying heat.

WARNING

The following procedure specifies methyl-ethyl-ketone which 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.

i. Immediately remove excess sealant protruding from part, using a natural-bristle brush or clean cloth dampened with methyl-ethyl-ketone (Federal Specification TT-M-261). Remove masking tape.

j. Allow sealant to cure at ambient temperature for a minimum of 16 hours. Do not bend or twist repaired section when handling the harness during the curing period.

k. If voids are detected under the molded part, inject sealant through the part to fill the void.

18-10. REPAIRING PLUG PROTECTIVE BOOT. Repair of the plug protective boot consists of repairing the torn ears.

WARNING

The following procedure specifies isopropyl alcohol which is flammable and must not be used near heat or open flame. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

a. Clean boot damaged area and surfaces to be joined with isopropyl alcohol (Federal Specification TT-I-735) and allow to dry completely.

b. Punch a hole in boot at end of crack or tear.

c. Apply a thin film of aerospace sealant 92-018 (Dow Corning Corp) to surfaces to be joined. Join surfaces; then remove any excess adhesive.

d. Allow sealant to cure at ambient temperature for a minimum of 16 hours.

18-11. REPAIRING ARMOR BRAID.

a. Lay a loop of Kulgrid or Kulgrid 28 (Sylvania Electric Products, Inc) wrapping wire (25 AWG recommended) axially along harness, spanning braid damage area plus 1/4 inch minimum as shown in figure 18-6.

b. Spirally wrap harness with tightly butted coils over wire loop (step a) until loop protrudes from spiral coil 1/16 ±1/32 inch.

c. Pull wrapping end of wire through end of loop and pull the 2 ends in an axial direction to snug the spiral coil, with loop end positioned approximately in center of wrapped area.

d. Trim ends of wire to within 1/16 ±1/16 inch of the wrapped area and solder them to existing braid with solder specified in figure 18-3.

18-12. TESTING.

18-13. The following test procedure outlines requirements for testing of the electrical harness. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Refer to paragraphs 18-14 and 18-15 for electrical harness test procedures. See figure 18-7 for harness part number and wire list.

18-14. CONTINUITY TEST.

a. Using a multimeter, perform continuity test between contacts of connectors. Resistance must not exceed one ohm. See figure 18-7 for wire list.

b. Perform continuity test of shielding only on harnesses where the shields are connected to contacts of connectors. Resistance must not exceed one ohm.

18-15. INSULATION RESISTANCE TEST.

WARNING

High-voltage tests are dangerous; therefore, in addition to local and standard safety requirements, the test equipment must be grounded, connectors must be dry, and personnel must be kept to a minimum in the test area.

- Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

a. Thoroughly dry all harness connectors containing ceramic inserts (P137 and P138), with low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) prior to proceeding with this test.

CAUTION

Voltage applied to both interconnected contacts at the same time creates a short circuit which can result in damage to equipment.

NOTE

Step aA applies only to igniter harnesses 502932.

aA. On harnesses 502932, connect P47-V to connector shells P43, P44, P45, P46, and P47; then perform insulation resistance test as follows: (See figure 18-7 for wire list.)

(1) Using a megohmmeter, apply 500 vdc for 5-60 seconds between each contact in connector P47 (except for P47-V) and shell of connector P47. Resistance must exceed 200 megohms.

(2) Using a megohmmeter, apply 500 vdc for 5-60 seconds between each contact and all other contacts in connector P47 (except for P47-V). Resistance must exceed 200 megohms.

(3) Disconnect P47-V from connector shells P43, P44, P45, P46, and P47.

b. Using a megohmmeter, apply 500 vdc for 5-60 seconds between each contact and connector shell, and each contact and every other contact in the same connector, except those contacts which are interconnected or connected to the shielding. Resistance of each application must exceed 200 megohms. See figure 18-7 for wire list.

c. Remove test equipment, and install and torque dust caps on connectors. See figure 18-2 for torque values.

Harness 502944

From	To
J18-z[a]	Shield
J18-f	P75-A
J18-b	P75-B
J18-a	P75-C
J18-Z	P75-D
P75-E[a]	Shield
J18-p	P30-A
J18-q	P30-B
J18-r	P30-C
J18-s	P30-D
J18-t	P30-E
P30-F	P30-G
J18-n	P51-A
J18-m	P51-B
J20-U[b]	P52-A
P128-C[c]	P52-B
J18-k	P52-C
J20-d	P128-A[c]
J18-g	P128-B[c]
J20-V[b]	J18-j
J20-Y	J18-h
J20-E	P78-A
J20-F	P78-B
J20-G	P78-C
J20-b	Shield

Harness 502941

From	To
J75-A	P175-A
J75-B	P175-B
J75-C	P175-C
J75-D	P175-D
J75-E	Shield

Harness 502948

From	To
J19-C	P56-A
J19-B	P56-B
J19-D	P50-A
J19-L	P50-B
J19-H	P50-C
P50-A[d]	P50-D[d]
J19-M	Shield

Harness 502948-11

From	To
J19-C	P56-A
J19-B	P56-B
J19-D	P50-A
J19-L	P50-B
J19-M	Shield

Harness 502949

From	To
J142-A	P73-A
J142-B	P73-B
J142-C	P73-C
J142-D	Shield

Harness 502947

From	To
J174-A	P74-A
J174-B	P74-B
J174-C	P74-C
J174-E	Shield

Harness 502942

From	To
J470-C	J47-A
J470-a	J47-B
J470-B	J47-C
J470-M	J47-D
J470-J	J47-E
J470-G	J47-F
J470-R	J47-G
J470-D	J47-H
J470-V	J47-J
J470-T	J47-K
J47-M[e]	J47-N[e]
J470-P	J47-R
J470-Y	J47-S
J47-T[f]	J47-U[f]
J47-V[a]	Shield
J47-d[a]	Shield

Harness 502932

From	To
P47-B	P43-B
P47-D	P43-D
P47-C	P43-A
P47-T	P43-C
P47-U	P44-C
P47-A	P44-A
P47-J	P44-D
P47-F	P44-B
P47-K	P45-B
P47-H	P45-D
P47-M	P45-C
P47-R	P45-A
P47-N	P46-C
P47-G	P46-A
P47-S	P46-B
P47-E	P46-D
P47-V	J450
P450	Shield

Harness 502943

From	To
J800-C	P85
J800-D	P86
J800-E	P87
J800-F	P88
J800-J	Shield

Harness 704538

From	To
J100-A	P108-A
J100-B	P108-B
J100-C	P108-C
J100-D	P108-D
J100-E	P108-E
J100-F	P108-F
J100-G	P108-G
J100-H	P108-H
J100-I[a]	Shield
P108-J[a]	Shield

Harness 704529

From	To
J101-A	P109-A
J101-B	P109-B
J101-C	P109-C
J101-D	P109-D
J101-K	P109-K
J101-L	P109-L
J101-M	P109-M
J101-N	P109-N
J101-S	P109-S
J101-T	P109-T
J101-U	P109-U
J101-V	P109-V
J101-W	P109-W
J101-X	P109-X
J101-a	P109-a
J101-b	P109-b
J101-c	P109-c
J101-d	P109-d
J101-e	P109-e
J101-f	P109-f
J101-g	P109-g
J101-h	P109-h
J101-j	P109-j
J101-k	P109-k
J101-m	P109-m
J101-n	P109-n
J101-p	P109-p
J101-r	P109-r
J101-s[a]	Shield
P109-s[a]	Shield

Harness 704530

From	To
J102-B	P110-B
J102-C	P110-C
J102-D	P110-D
J102-E	P110-E
J102-F	P110-F
J102-G	P110-G
J102-H	P110-H
J102-J	P110-J
J102-K	P110-K
J102-N	P110-N
J102-P	P110-P
J102-R	P110-R
J102-S	P110-S
J102-T	P110-T
J102-U	P110-U
J102-V[a]	Shield
P110-V[a]	Shield

(a) Shield-continuity-test between these contacts only.
(b) Bussed together.
(c) Bussed together.
(d) Bussed together.
(e) Bussed together.
(f) Bussed together.

Figure 18-7. Electrical Harness Wire List (Sheet 1 of 3)

<u>Harness 704527</u>

From	To
J103-B	P115-B
J103-C	P115-C
J103-D	P115-D
J103-E	P115-E
J103-F	P115-F
J103-G	P115-G
J103-H	P115-H
J103-J	P115-J
J103-K	P115-K
J103-N	P115-N
J103-P	P115-P
J103-R	P115-R
J103-S	P115-S
J103-T	P115-T
J103-U	P115-U
J103-V[a]	Shield
P115-V[a]	Shield

<u>Harness 704533</u>

From	To
J104-L	P130-A
J104-C	P130-B
J104-M	P130-C
J104-D	P130-D
J104-E	P132-A
J104-F	P132-B
J104-G	P132-C
J104-H	P132-D
J104-N[a]	Shield
P130-E[a]	Shield

<u>Harness 704542</u>

From	To
J130-A	P230-A
J130-B	P230-B
J130-C	P230-C
J130-D	P230-D
J130-E	Shield

<u>Harness 704534-11</u>

From	To
J106-R	P134-A
J106-E	P134-B
J106-D	P134-C
J106-C	P137-A
J106-P	P137-B
J106-N	P137-C
J106-H	P138-A
J106-G	P138-B
J106-F	P138-C
J106-T	Shield

<u>Harness 704528</u>

From	To
P111-g	P116-A
P111-h	P116-B
P111-p	P116-C
P111-n	P116-D
P111-j	P116-E
P111-r	P116-F
P111-X	P117-A
P111-e	P117-B
P111-f	P117-C
P111-Z	P117-D
P111-k	P117-E
P111-m	P117-F
P111-U	P118-A
P111-V	P118-B
P111-c	P118-C
P111-b	P118-D
P111-W	P118-E
P111-d	P118-F
P111-S	P119-A
P111-K	P119-B
P111-T	P119-C
P111-a	P119-D
P111-M	P119-E
P111-L	P119-F
P111-G	P123-A
P111-H	P123-B
P111-P	P123-C
P111-N	P123-D
P111-J	P123-E
P111-R	P123-F
P111-s	Shield

<u>Harness 704526</u>

From	To
P112-E	P120-A
P112-F	P120-B
P112-L	P120-C
P112-K	P120-D
P112-G	P120-E
P112-H	P120-F
P112-R	P121-A
P112-S	P121-B
P112-X	P121-C
P112-W	P121-D
P112-T	P121-E
P112-Y	P121-F
P112-M	P122-A
P112-P	P122-B
P112-U	P122-C
P112-N	P122-D
P112-Q	P122-E
P112-V	P122-F
P112-Z	Shield

<u>Harness 704531</u>

From	To
P113-J	P53-A
P113-K	P53-B
P113-T	P53-C
P113-C	P70-A
P113-P	P70-B
P113-D	P70-C
P113-B	P70-D
P113-N	P70-E
P113-A	P70-F
P113-G	P76-A
P113-S	P76-B
P113-H	P76-C
P113-F	P76-D
P113-R	P76-E
P113-E	P76-F
P113-V	Shield

<u>Harness 704532</u>

From	To
P114-E	P71-A
P114-D	P71-B
P114-F	P71-C
P114-C	P71-D
P114-P	P71-E
P114-N	P71-F
P114-G	P77-A
P114-R	P77-B
P114-H	P77-C
P114-S	P77-D
P114-K	P77-E
P114-J	P77-F
P114-L	J128-A
P114-T	Shield

<u>Harness 704540</u>

From	To
J140-A	P147-A
J140-B	P147-B
J140-D	P147-D
J140-E[a]	Shield
P147-J[a]	Shield

<u>Harness 704541</u>

From	To
J141-A	P148-A
J141-B	P148-B
J141-D	P148-D
J141-T	P148-T
J141-X	P148-X
J141-b	P148-b
J141-N	P148-N
J141-S	P148-S
J141-W	P148-W
J141-F	P148-F
J141-H	P148-H
J141-L	P148-L
J141-J	P148-J
J141-M	P148-M
J141-R	P148-R
J141-E	P148-E
J141-G	P148-G
J141-I	P148-I
J141-c	P148-c
J141-g	P148-g
J141-k	P148-k
J141-a	P148-a
J141-e	P148-e
J141-f	P148-f
J141-Y	P148-Y
J141-d	P148-d
J141-j	P148-j
J141-m	P148-m
J141-p	P148-p
J141-s	P148-s
J141-h	P148-h
J141-n	P148-n
J141-r	P148-r
J141-C	P148-C
J141-K	P148-K
J141-O	P148-O
J141-P	P148-P
J141-V	P148-V
J141-U	P148-U

(a) Shield-continuity-test between these contacts only.

Figure 18-7. Electrical Harness Wire List (Sheet 2 of 3)

From	To	From	To	From	To	From	To
J141-Z	P148-Z	**Harness 704535**		P151-f	P164-C	**Harness 70[illegible]39**	
J141-t	P148-t			P151-e	P164-D		
J141-u	P148-u	P146-A	P155-A	P151-h	P164-E	P152-A	P158-A
J141-v	P148-v	P146-C	P155-B	P151-j	P164-F	P152-C	P158-B
J141-w	P148-w	P146-D	P155-C	P151-m	P165-A	P152-D	P158-C
J141-x	P148-x	P146-B	P155-D	P151-q	P165-B	P152-B	P158-D
J141-y	P148-y	P146-P	P155-E	P151-p	P165-C	P152-P	P158-E
J141-z[a]	Shield	P146-N	P155-F	P151-n	P165-D	P152-N	P158-F
J148-z[a]	Shield	P146-E	P159-A	P151-r	P165-E	P152-E	P160-A
		P146-G	P159-B	P151-s	P165-F	P152-G	P160-B
Harness 704536		P146-H	P159-C	P151-t	P166-A	P152-H	P160-C
		P146-F	P159-D	P151-v	P166-B	P152-F	P160-D
J143-M	P184-A	P146-S	P159-E	P151-y	P166-C	P152-S	P160-E
J143-L	P184-B	P146-R	P159-F	P151-u	P166-D	P152-R	P160-F
J143-K	P184-C	P146-J	P162-A	P151-w	P166-E	P152-V	Shield
J143-P	P185-A	P146-L	P162-B	P151-x	P166-F		
J143-N	P185-B	P146-M	P162-C	P151-Q	J167-A		
J143-J	P185-C	P146-K	P162-D	P151-P	J167-B		
J143-T	P186-A	P146-U	P162-E	P151-V	J167-C		
J143-S	P186-B	P146-T	P162-F	P151-O	J167-D		
J143-R	P186-C	P146-V	Shield	P151-U	J167-E		
J143-V	P187-A			P151-T	J167-F		
J143-U	P187-B	**Harness 704537**		P151-S	J167-G		
J143-Q	P187-C			P151-R	J167-H		
J143-F	J188-A	P151-a	P163-A	P151-N	J167-I		
J143-G	J188-B	P151-Z	P163-B	P151-M	J167-K		
J143-E	J188-C	P151-Y	P163-C	P151-X	J167-L		
J143-W	J188-D	P151-b	P163-D	P151-W	J167-M		
J143-X	J188-E	P151-c	P163-E	P151-z[a]	Shield		
J143-Y	J188-F	P151-k	P163-F	J167-N[a]	Shield		
J143-Z[a]	Shield	P151-d	P164-A				
J188-G[a]	Shield	P151-g	P164-B				

(a) Shield-continuity-test between these contacts only.

Figure 18-7. Electrical Harness Wire List (Sheet 3 of 3)

SECTION XIX

HYPERGOL MANIFOLD

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

19-1. HYPERGOL MANIFOLD 403599, 406159, AND 407791.

19-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the hypergol manifold. See figure 19-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. The following protective closures are subject to the special requirements indicated. Specified lubrication methods are outlined in R-3896-3, Volume I.

a. Plate RX20660-57: Used on manifold 403599.

b. Closure RK395-10042: Used on manifold 406159 and 407791.

c. Plug RD265-2001-0006: Used on manifold 407791.

d. Closure RX20845-31: Lubricate (Method A) closure and lubricate (Method J) packing with lubricant grease RD0140-012 (Rocketdyne). Torque to 20-30 in-lb.

e. Closure RX20841: Lubricate (Method L) O-ring with FS1281 grease (Dow Corning Corp).

Part No.	Nomenclature	Use
T-5029715	Assembly Plate	Holds hypergol manifold during repair.
T-5029716	Hypergol Simulator	Simulates hypergol cartridge during pressure-test.
T-5029717	Pressure Test Fixture	Seals control ports of hypergol manifold during pressure-test.
T-5031175	Pressure Test Fixture	Seals control ports of ignition monitor valve during pressure-test.
T-5035210	Torque Adapter	Torques retainer in piston of hypergol manifold.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements.
1432-T (General Radio Co), or equivalent	Decade Resistance Box	Used with Triplett 630A for resistance test.

Figure 19-1. Test Equipment and Special Tools for Hypergol Manifold (Sheet 2 of 2)

Part No.	Nomenclature	Use
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests.
G3104	Pneumatic Flow Tester	Measures downstream pneumatic leakage.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel control for testing hypergol manifold.
G3143	Components Adapter Set	Provides hardware for hypergol manifold test setups.

Figure 19-1. Test Equipment and Special Tools for Hypergol Manifold (Sheet 2 of 2)

Figure 19-2 deleted.

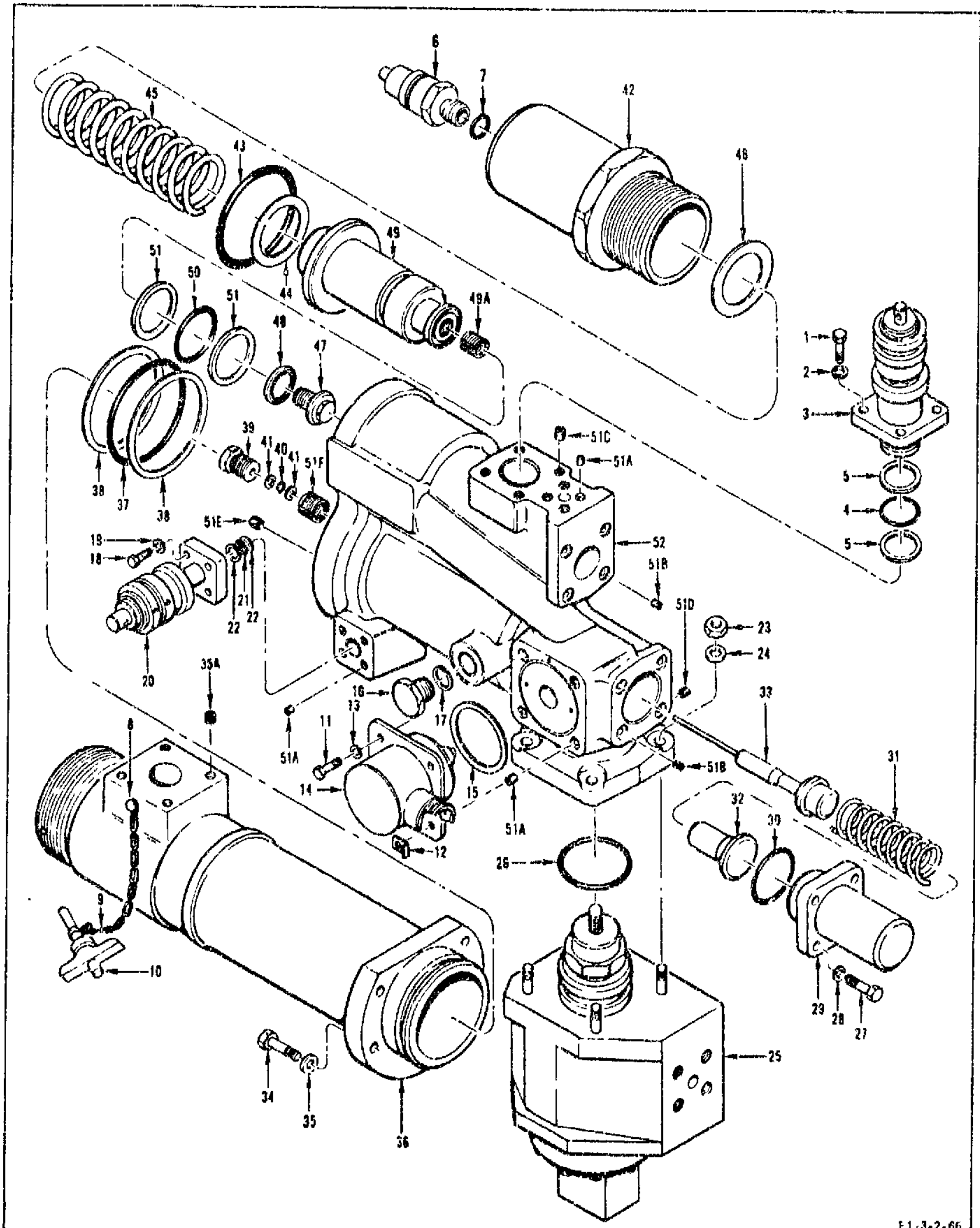


Figure 19-3. Hypergol Manifold--Exploded View (Sheet 1 of 2)

1	Bolt	16	Plug	30	Packing	44	Shim
2	Washer	17	Packing	31	Spring	45	Spring
3	Quick-disconnect	18	Bolt	32	Guide	46	Shim
4	O-ring	19	Washer	33	Rod	47	Retainer
5	Retainer	20	Quick-disconnect	34	Bolt	48	O-ring
6	Check Valve[(a)]	21	O-ring	35	Washer	49	Piston
7	Packing[(a)]	22	Retainer	35A	Insert	49A	Insert
8	Pin	23	Nut	36	Container	50	O-ring
9	Chain	24	Washer	37	O-ring	51	Retainer
10	Pin	25	Ignition Monitor Valve	38	Retainer	51A	Insert
11	Bolt			39	Nut	51B	Insert
12	Lug	26	Packing	40	O-ring	51C	Insert
13	Washer	27	Bolt	41	Retainer	51D	Insert
14	Switch	28	Washer	42	Cap	51E	Insert
15	Packing	29	Cap	43	Packing	51F	Insert
						52	Body

(a) On manifold 403599 and 406159

Figure 19-3. Hypergol Manifold--Exploded View (Sheet 2 of 2)

19-3. DISASSEMBLING.

19-4. Disassemble the hypergol manifold as required to accomplish necessary repair and/or replacement. No special instructions are necessary to disassemble the hypergol manifold, except as noted. See figure 19-3 for parts and index numbers.

a. Secure hypergol manifold in assembly plate T-5029715.

b. Disassemble hypergol manifold. Shims (44) should be removed and retained together so same amount may be installed during assembly.

NOTE

Pin (8), chain (9), or pin (10) must not be removed unless replacement is required.

c. Remove retainer (47) from piston (49), using torque adapter T-5035210.

19-5. CLEANING.

19-6. The hypergol manifold parts must be cleaned for fuel service as outlined in R-3896-3, Volume I.

19-7. INSPECTING AND REPAIRING.

19-8. Inspecting the hypergol manifold determines if the individual parts have been damaged by mishandling or wear. See figure 19-4 and inspect individual parts for general condition, cleanness, damage of threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits, listed in figure 19-5, form the guide to serviceability of parts. Minimum and maximum values are given, beyond which repair or replacement of parts is required.

Part Name and Index No.	Inspecting	Repairing
Quick-disconnect (3)	Damaged sealing and mating surfaces.	Replace.
Check valve (6)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
Pin (10)	Scoring and proper operation.	Replace.
Switch (14)	Damaged threads, receptacle, and sealing surface.	Refer to R-3896-3, Volume I, for thread repair. Replace if receptacle or sealing surface damaged.

Figure 19-4. Inspecting and Repairing Hypergol Manifold (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
Quick-disconnect (20)	Damaged sealing and mating surfaces.	Replace.
Ignition monitor valve (25)	Refer to section XX.	Refer to section XX.
Cap (29)	Damaged mating and sealing surfaces.	Replace.
Guide (32)	Corrosion and excessive wear.	Replace.
Spring (31)	Corrosion, distortion, and tension.	See figure 19-5 for dimensional limits.
Rod (33)	Outside diameter.	See figure 19-5 for dimensional limits.
Container (36)	Damaged threads and sealing surfaces.	Refer to R-3896-3, Volume I, for thread repair. See figure 19-5 for dimensional limits. Replace if sealing surface damaged.
Nut (39)	Damaged threads and smoothness of hole.	Refer to R-3896-3, Volume I, for thread repair.
Cap (42)	Damaged threads and sealing surfaces.	Refer to R-3896-3, Volume I, for thread repair. Replace if sealing surface damaged.
Spring (45)	Corrosion, distortion, and tension.	See figure 19-5 for dimensional limits.
Retainer (47)	Nicks and scratches on sealing surface.	Replace.
Piston (49)	Nicks, scratches, and wear in O-ring groove and on sealing surface.	Replace.
	Outside diameter.	See figure 19-5 for dimensional limits.
Body (52)	Nicks, scratches, and wear on seats, inside diameters of bores, and sealing surfaces.	See figure 19-5 for dimensional limits. Replace if sealing surfaces are damaged.
	Damaged threads and inserts.	Repair threads and replace inserts as outlined in R-3896-3, Volume I.

Figure 19-4. Inspecting and Repairing Hypergol Manifold (Sheet 2 of 2)

Part Name and Index Number	Dimension	Minimum (Inches Except As Noted)	Maximum (Inches Except As Noted)
Spring (31)	Compressed to 2.720 inches	20 lb	22 lb
	Compressed to 1.743 inches	48.1 lb	53.1 lb
Rod (33)	Small end diameter	0.122	0.123
	Center section diameter	0.4990	0.4995
Container (36)	Sealing end diameter	2.809	2.810
	O-ring groove diameter	2.654	2.656
	Bore (inner hypergol cartridge seal)	2.376	2.378

Figure 19-5. Dimensional Limits for Hypergol Manifold (Sheet 1 of 2)

Part Name and Index No.	Dimension	Minimum (Inches Except As Noted)	Maximum
	Bore (outer hypergol cartridge seal)	2.501	2.503
Spring (45)	Compressed to 5.265 inches	223 lb	243 lb
	Compressed to 4.835 inches	313 lb	343 lb
Piston (49)	Sliding surface diameter	1.496	1.497
	O-ring groove diameter	1.256	1.258
	Retainer seal groove outside diameter	0.968	0.970
	Retainer seal groove inside diameter	0.742	0.744
Body (52)	Bore (position switch)	1.877	1.878
	Bore (ignition monitor valve)	1.874	1.876
	Bore (drain port)	0.500	0.502
	Bore (purge port)	0.874	0.876
	Bore (hypergol cartridge container)	2.812	2.814
	Bore (seal (40))	0.234	0.236
	Bore (rod, small end)	0.128	0.129
	Bore (rod, center section)	0.500	0.501
	Bore (piston sealing surface)	1.500	1.502
	Igniter fuel piston seat outside diameter	0.960	0.962
	Igniter fuel piston seat inside diameter	0.900	0.902

Figure 19-5. Dimensional Limits for Hypergol Manifold (Sheet 2 of 2)

19-9. ASSEMBLING.

19-10. Assembly of the hypergol manifold must be performed with care to prevent damage to seating and sealing surfaces. All parts must meet cleaning requirements as outlined in paragraph 19-5. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne), unless otherwise noted. Specified lubrication (methods) are outlined in R-3896-3, Volume I. See figure 19-3 for parts and index numbers.

a. Secure body (52) in assembly plate T-5029715.

b. Install O-ring (48) on end of piston (49) and install retainer (47) into piston. Torque retainer to 175-200 in-lb, using torque adapter T-5035210.

c. Lubricate (Method L) O-ring (50) with FS1281 grease (Dow Corning Corp), and install with retainers (51) on piston (49).

d. Apply thin coat of lubricant (Method Z) on piston (49) and shim (46), then install piston in body (52). Install same amount of shims (44) removed during disassembly.

e. Lubricate (Method J) packing (43); then install packing on cap (42). Lubricate (Method A) threads of cap (42).

f. Install spring (45), shim (46), and cap (42) in body (52). Torque cap to 50-60 ft-lb.

g. Lubricate (Method L) O-ring (40) and install with retainers (41) in body (52); then install nut (39). Torque nut to 40-60 in-lb above amount required to overcome locking feature of insert, but do not exceed 150 in-lb.

h. Apply thin coat of lubricant (Method Z) to rod (33) and install rod into body (52) through O-ring (40) and nut (39), being careful to avoid damage to O-ring, until rod bottoms.

i. Lubricate (Method J) packing (30) and install it on cap (29), and place guide (32) and spring (31) in cap.

j. Apply thin coat of lubricant (Method Z) on exterior surfaces of cap (29), on each side of packing (30), and on interior mating surface of body (52). Install cap and secure with bolts (27) and washers (28). Torque bolts to 72-88 in-lb.

k. Lubricate (Method J) O-ring (37) and install it with retainers (38) in groove of container (36).

l. Apply thin coat of lubricant (Method Z) on exterior surfaces of container (36) and on each side of O-ring (37); install container and secure with bolts (34) and washers (35). Torque bolts to 155-185 in-lb. Remove body (52) from assembly jig T-5029715.

m. Lubricate (Method J) packing (26) and install it in groove of ignition monitor valve (25).

n. Apply thin coat of lubricant (Method Z) on exterior surfaces of ignition monitor valve (25) and on each side of packing (26). Install valve and secure with nuts (23) and washers (24). Torque nuts to 60-80 in-lb.

o. Lubricate (Method J) O-ring (21) and install it with retainers (22) on quick-disconnect (20). Install quick-disconnect in body (52) and secure with bolts (18) and washers (19). Torque bolts to 27-33 in-lb.

p. Lubricate (Method J) packing (17) and (Method A) threads of plug (16), then place packing on plug and install plug into body (52). Torque plug to 40-65 in-lb.

q. Lubricate (Method J) packing (15) and install it in groove of body (52).

r. Install lug (12) on right-hand bottom bolt (11), shown in figure 19-3, and install switch (14) on body (52) with bolts (11) and washers (13). Torque bolts to 27-33 in-lb.

s. On manifolds 403599 and 406159, lubricate (Method J) packing (7) and (Method A) threads of check valve (6); then place packing on check valve, and install check valve in cap (42). Torque check valve to 100-150 in-lb.

t. Lubricate (Method J) O-ring (4) and install it with retainers (5) on quick-disconnect (3); then install quick-disconnect (3) in body (52) with bolts (1) and washers (2). Torque bolts to 72-88 in-lb.

u. Install pin (10) and chain (9) on container (36) with pin (8), if they have been removed. Safetywire bolts (1, 11, 18, 27, 34), nut (23), and cap (42).

v. Install protective closures. Refer to paragraph 19-2.

19-11. TESTING.

19-12. This procedure outlines requirements for complete testing of the hypergol manifold, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on hypergol manifold as outlined in figure 19-6. Index letters are assigned to the manifold ports for ease of identification in illustrations. Set up components test console electrical patch-panel (figure 19-7) and prepare console for use (figure 19-8). See figure 19-9 for hypergol manifold test port identification and a cutaway view. Refer to paragraphs 19-13 through 19-17 for hypergol manifold test procedures and see figures 19-10 through 19-13 for test setups.

Index Letter	Valve Port	Test Plate	Port Connection
A	FUEL IN	T-5029717-203	AN815-4C
B	INLET	T-5031175-206	AN815-8C
C	OUTLET	T-5031175-319	AN815-8C
D	RETURN	T-5031175-307	AN815-10C
E	CONTROL PRESS	T-5031175-301[a] T-5031175-501[b]	AN815-4C AN815-4C
F	HYPERGOL AND FUEL OUTLET	None	None
G	BLEED	T-5029717-202	None
H	PURGE	None	Quick-disconnect
J	INSTR	None	AN815-4C
K	DRAIN	None	Quick-disconnect
L	ATMOS REF	None	AN815-4C
M	CARTRIDGE CONTAINER	T-5029716	None
N	VENT	None	AN815-4C

(a) On manifold 403599
(b) On manifolds 406159 and 407791

Figure 19-6. Preparing Hypergol Manifold for Testing

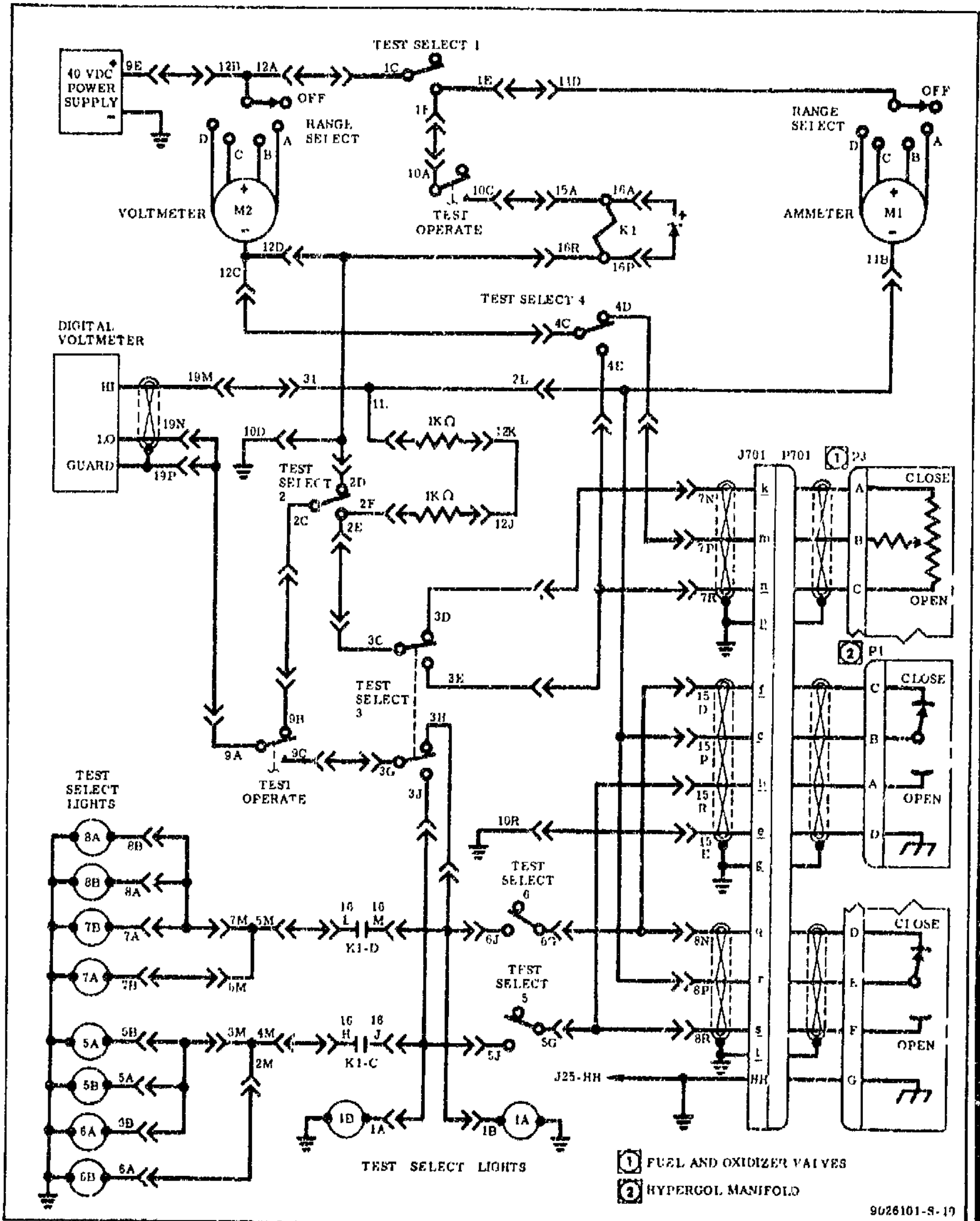
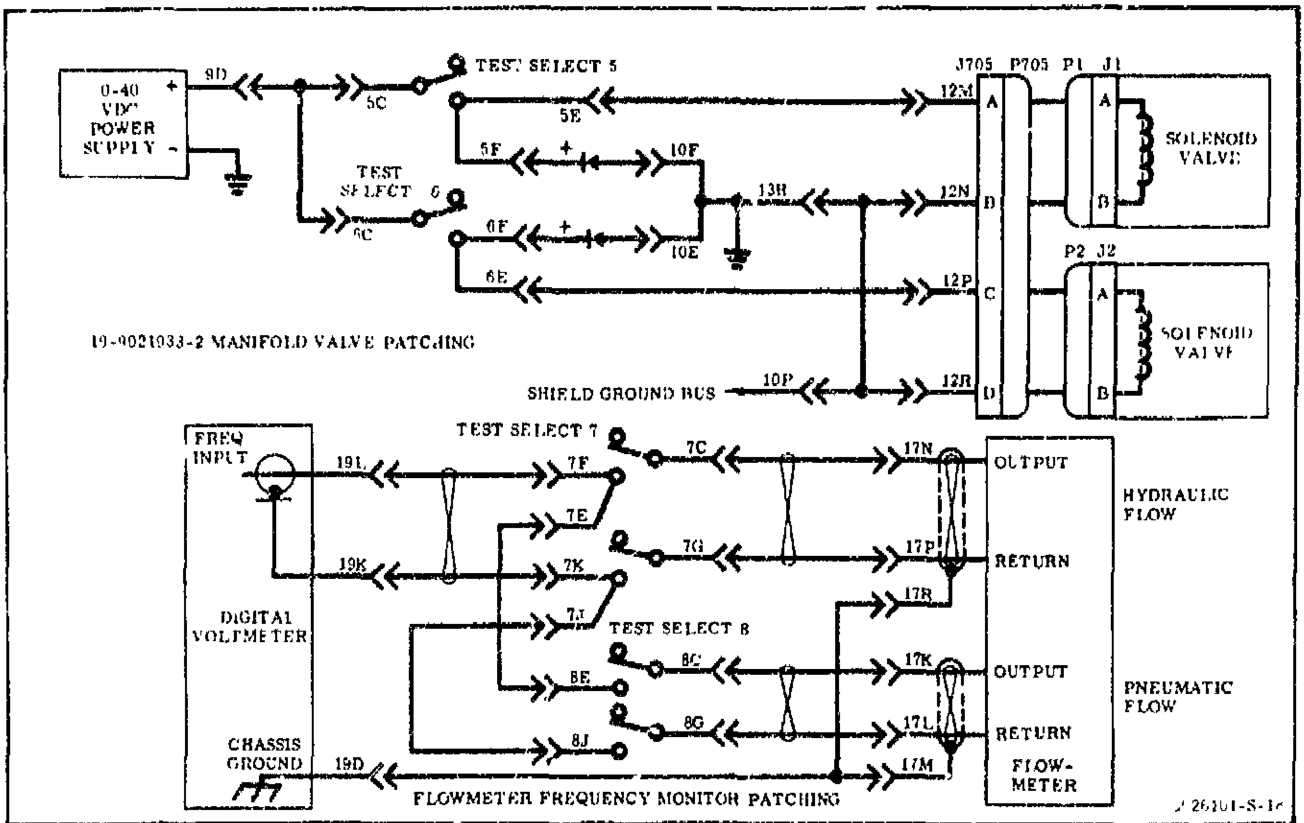


Figure 19-7. Components Test Console Patch-Panel Requirements (Sheet 1 of 2)



Patch-Cord[a]	From J6-	To J6-	Patch-Cord[a]	From J6-	To J6
K5.09	1A	3J	K3.	3G	9C
		5J	K3.	3L	19M
		16J	K5.09	3M	5A
K5.09	1B	3H			5B
		6J			6B
		16M	K3.	4D	7P
K3.	1C	12A	K3.	4C	12C
K3.	1E	11D	K3.	4M	16H
K3.	1F	10A			8R
3088-12	1L	12K	K4.09	5G	15R
K3.	2C	9B	K3.	5M	16L
K5.09	2D	10D	K4.09	6G	8N
		12D			15D
		16R	K3.	6M	7B
K3.	2E	3C	K5.09	7A	7M
3088-12	2F	12J			8A
K5.09	2L	8P			8D
		11B	K4.09	9A	19N
		15P			19P
K3.	2M	6A	K3.	9E	12B
K3.	3D	7N	K3.	10C	15A
K4.09	3E	4E	K3.	10R	15E
		7R	3088-17[b]	10A(+)	16P

(a) Use any cord length required on all patch-cords numbered K3
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 19-7. Components Test Console Patch-Panel Requirements (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise.	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Cable BB52748	Connection to hypergol manifold.
	Connector J702	Capped	
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	

Figure 19-8. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	B (0-150)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 24 +0.4 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	10V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	

(a) If indication is not as specified, press applicable switch-light.

Figure 19-8. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Digital voltmeter must warm up at least 30 minutes.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen and helium to console.

NOTE

Helium supply is required only for cryogenic tests.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed, when working with pressurized systems.

Figure 19-8. Preparing Components Test Console for Use (Sheet 3 of 3)

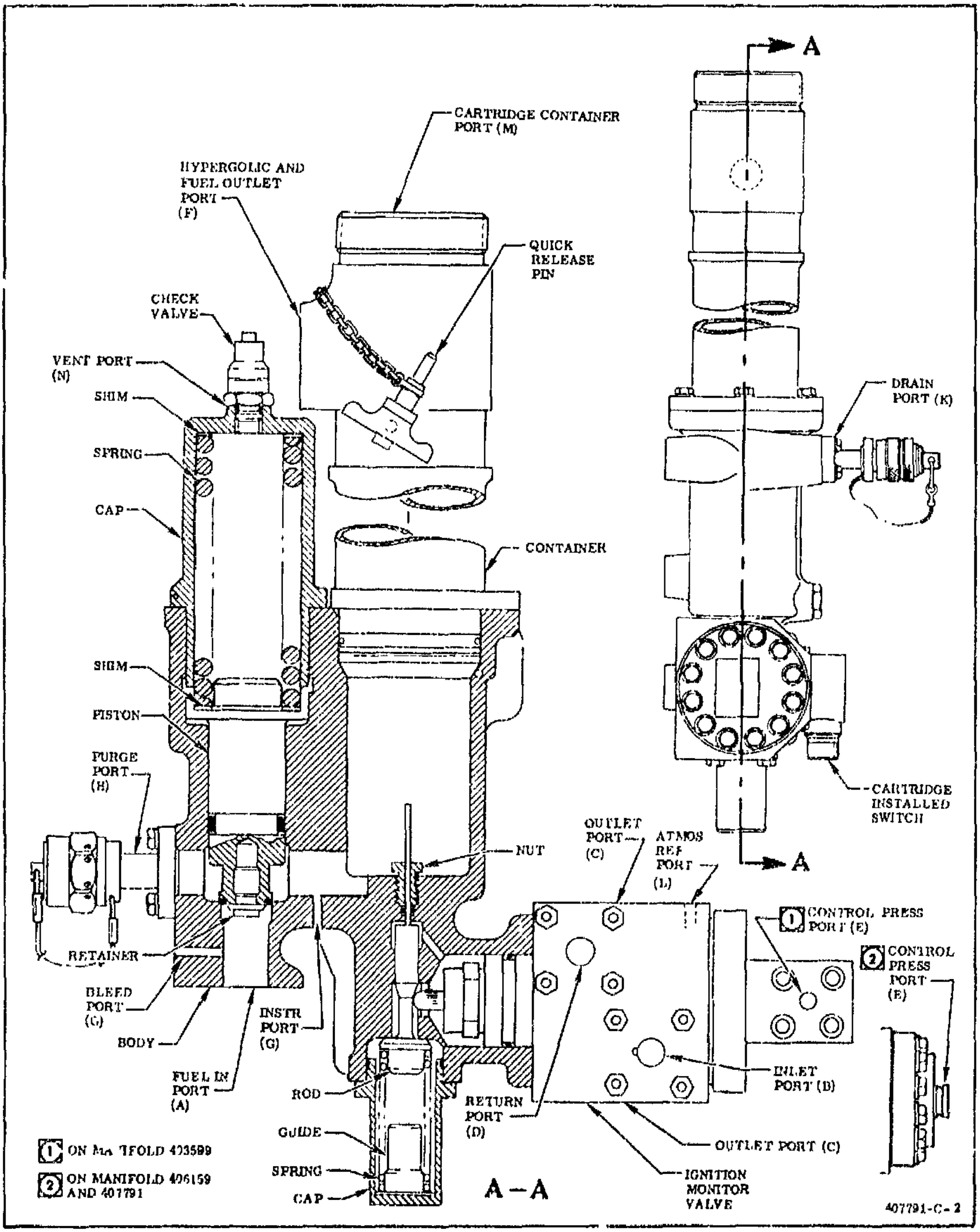


Figure 19-9. Hypergol Manifold--Cutaway View

19-13. SWITCH-RESISTANCE- AND ACTUATION-TEST.

Procedure	Result
a. Prepare Components Test Console G3141 and hypergol manifold for use as outlined in paragraph 19-12.	None.
b. Using megohmmeter, apply 500 ±50 vdc between pins A and B of manifold electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
c. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.5 ohm.
d. Remove O-ring from hypergol simulator T-5029716.	None.

WARNING

The following procedures use drycleaning solvent, which 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.

dA. Clean threads of hypergol manifold cartridge container inlet port with drycleaning solvent (Federal Specification P-D-680). Lubricate (Method A) threads with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.	None.

CAUTION

When installing hypergol simulator into the hypergol manifold cartridge container inlet port, extreme care must be used to prevent damage to the hypergol cartridge follower.

- The threads of the hypergol simulator cap must be clean and free of nicks, to prevent galling the threads of the cap and inlet port.

Procedure	Result
e. Install hypergol simulator T-5029716 and check torque during installation. Continue turning until simulator is bottomed; then check gap between container and simulator cap.	Torque must not exceed 60 in-lb. There must be no gap between container and simulator cap.
f. Using megohmmeter, apply 500 ±50 vdc between pins B and C of manifold electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
g. Using multimeter and decade resistance box, measure distance between pins A and B as follows:	
(1) Adjust decade resistance box for 0.5 ohm and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.5 ohm.
h. Remove hypergol simulator T-5029716.	Diaphragm follower rod extended.
i. Remove manifold from test setup.	None.
j. If hypergol manifold testing is terminated, secure equipment as outlined in paragraph 19-19.	None.
k. Install protective closures. Refer to paragraph 19-2.	None.

19-14. IGNITION MONITOR VALVE LEAK-TEST.

Procedure	Result
a. Make sure Components Test Console G3141 and hypergol manifold are prepared for use as outlined in paragraph 19-12.	None.
b. Connect manifold to console. (See figure 19-10.) Do not install hypergol simulator T-5029716.	None.

Procedure	Result
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CONTROL PRESS port (E) as follows:	
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	PRESSURE MONITOR "A" gage must indicate 50 ±10 psi. CONTROL PRESS port (E) pressurized.
(3) Close SHUTOFF valve.	

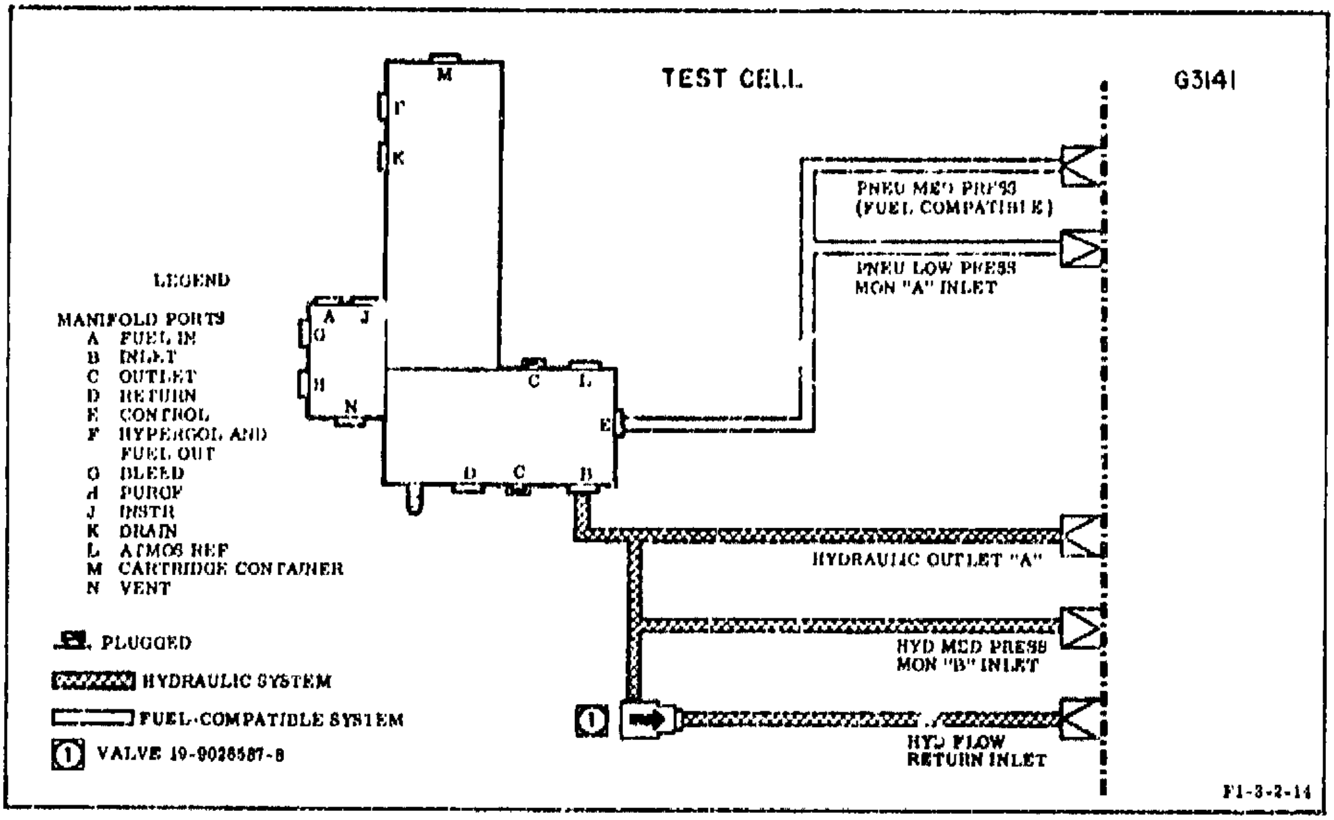


Figure 19-10. Hypergol Manifold Ignition Monitor Valve Leak-Test Setup

Procedure	Result
eA. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,550 ±10 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±30 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±30 psi. INLET port (B) pressurized.
g. Measure and record leakage from RETURN port (D).	Maximum allowable leakage is 5 cc/m.
h. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate zero.
i. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve and, on HYD MED PRESS MONITOR panel, open VENT valve, until PRESSURE MONITOR "B" gage indicates zero. Close HIGH PRESS SHUTOFF and VENT valves.	PRESSURE MONITOR "B" gage must indicate zero. INLET port (B) depressurized.
j. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CONTROL PRESS port (E) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CONTROL PRESS port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
k. On HIGH PRESS FUEL COMPATIBLE panel, close VENT and SHUTOFF valves.	None.
l. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
m. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light off and CLOSE light on.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
n. Remove valve from test setup.	None.
o. If hypergol manifold testing is terminated, secure equipment as outlined in paragraph 19-19.	None.
p. Install protective closures. Refer to paragraph 19-2.	None.

19-15. IGNITION MONITOR VALVE INTERFLOW AND POPPET POSITION VERIFICATION TEST.

Procedure	Result
a. Make sure Component Test Console G3141 and hypergol manifold are prepared for use as outlined in paragraph 19-12.	None.

WARNING

The following procedures use drycleaning solvent, which 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.

Procedure	Result
aA. Clean threads of hypergol manifold cartridge container inlet port with drycleaning solvent (Federal Specification P-D-680). Lubricate (Method A) threads with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.	None.

CAUTION

When installing hypergol simulator into the hypergol manifold cartridge container inlet port, extreme care must be used to prevent damage to the hypergol cartridge follower.

- The threads of the hypergol simulator cap must be clean and free of nicks, to prevent galling the threads of the cap and inlet port.

Procedure	Result
b. Make sure that threads of cap on hypergol simulator T-5029716 are clean and free of nicks; then lubricate (Method L) simulator shaft O-ring with FS1281 grease (Dow Corning Corp), and carefully insert simulator into hypergol manifold cartridge container inlet port. Screw simulator clockwise until it bottoms.	None.
c. Connect manifold to console. (See figure 19-11.)	None.
d. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
e. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
f. On MED PRESS FUEL COMPATIBLE panel, apply pressure to CONTROL PRESS port (E) as follows:	
(1) Close VENT and SHUTOFF valves.	None.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 25 ±2 psi.	PRESSURE MONITOR "A" gage must indicate 25 ±2 psi. CONTROL PRESS port (E) pressurized.
g. On HIGH PRESS FUEL COMPATIBLE panel, open VENT; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,000 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
h. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,800 ±40 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,800 ±40 psi. INLET port (B) pressurized.
i. Maintain specified pressures at CONTROL PRESS port (E) and INLET port (B); then record pressure indication on DIFFERENTIAL PRESSURE gage.	Differential pressure between OUTLET port (C) and RETURN port (D) must not exceed 30 psig.
iA. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CONTROL PRESS port (E) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CONTROL PRESS port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
iB. Remove hypergol simulator T-5029716 from hypergol manifold.	None.
iC. Using a multimeter, continuity test hypergol manifold switch to verify that poppet is closed.	Multimeter must indicate infinity between pins A and B and continuity between pins B and C.
iD. Verify that DIFFERENTIAL PRESSURE gage indication between OUTLET port (C) and RETURN port (D) does not exceed 30 psig.	None.
j. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate zero.
k. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate zero. INLET port (B) depressurized.
l. On HIGH PRESS FUEL COMPATIBLE panel, close VENT and SHUTOFF valves.	None.
m. (Deleted)	

Procedure	Result
n. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
o. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light off and CLOSE light on.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
p. Remove valve from test setup.	None.
q. If hypergol manifold testing is terminated, secure equipment as outlined in paragraph 19-19.	None.
r. Install protective closures. Refer to paragraph 19-2.	None.

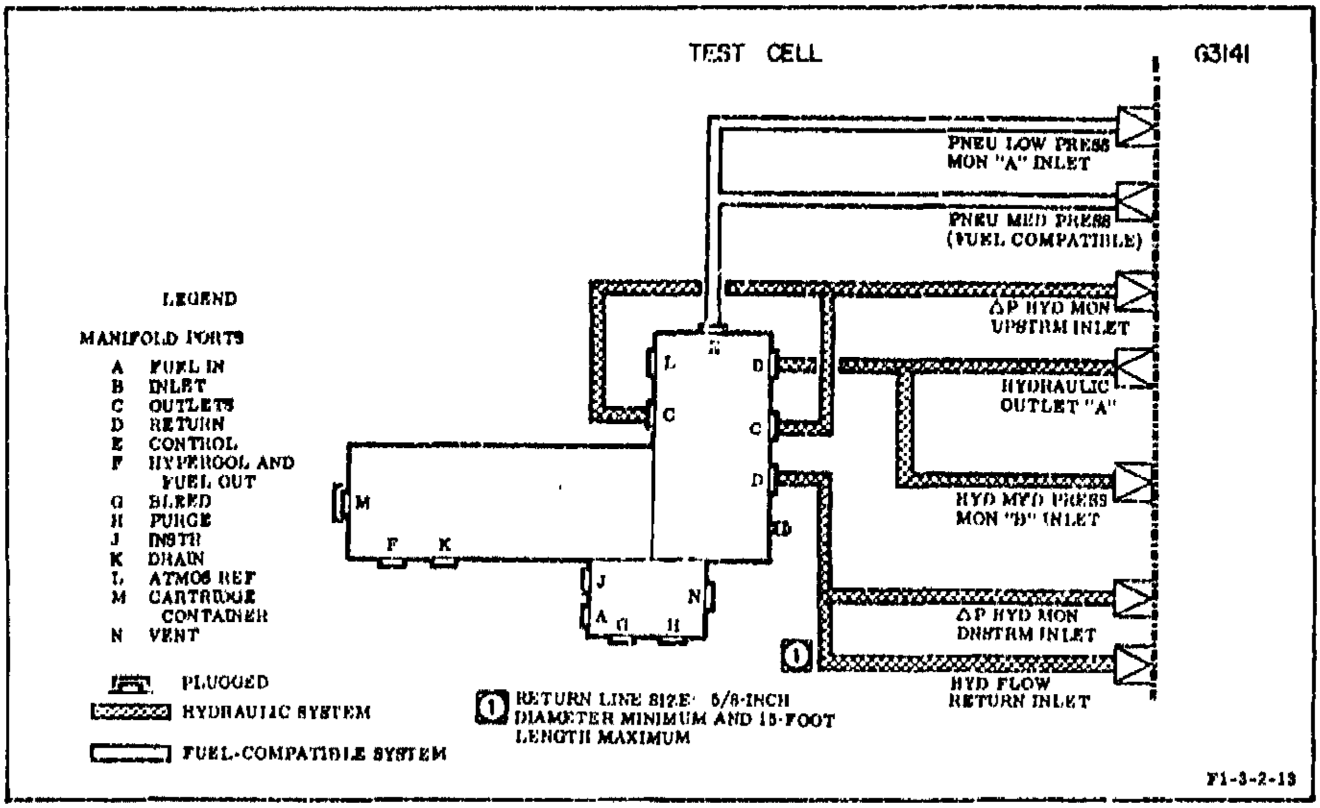


Figure 19-11. Hypergol Manifold Ignition Monitor Valve Interflow-Test Setup

19-16. IGNITER FUEL VALVE PISTON CRACKING-PRESSURE-, SEAT LEAK-, AND RESEAT-PRESSURE-TEST.

Procedure	Result
a. Make sure Component Test Console G3141 and hypergol manifold are prepared for use as outlined in paragraph 19-12.	None.

WARNING

The following procedures use drycleaning solvent, which 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.

Procedure	Result
aA. Clean threads of hypergol manifold cartridge container inlet port with drycleaning solvent (Federal Specification P-D-680). Lubricate (Method A) threads with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.	None.

CAUTION

When installing hypergol simulator into the hypergol manifold cartridge container inlet port, extreme care must be used to prevent damage to the hypergol cartridge follower.

- The threads of the hypergol simulator cap must be clean and free of nicks, to prevent galling the threads of the cap and inlet port.

Procedure	Result
b. Make sure that threads of cap on hypergol simulator T-5029716 are clean and free of nicks; then lubricate (Method L) simulator shaft O-ring with FS1281 grease (Dow Corning Corp), and carefully insert simulator into hypergol manifold cartridge container inlet port. Screw simulator clockwise until it bottoms.	None.
c. Connect manifold to console for hydraulic piston cracking-pressure-test (figure 19-12).	None.
d. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

Procedure	Result
e. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 1,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 1,000 ±100 psi.
f. On MED PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±50 psi.	MED PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
g. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve to apply pressure to FUEL IN port (A). Observe PRESSURE MONITOR "A" gage while applying pressure, to determine piston cracking pressure. Record peak pressure value.	Piston cracking pressure must be 375 ±30 psig.

NOTE

As pressure is applied to FUEL IN port (A), it will reach a peak value then start to decrease. The peak pressure value indicates cracking pressure.

Procedure	Result
h. If piston cracking pressure is not within specified pressure range, the igniter fuel valve must be adjusted by adding or removing shims (44).	None.
i. Reduce pressure as outlined in steps k through o before adding or removing shims.	Same as steps k through o.

NOTE

Shims must be added to increase cracking pressure or removed to decrease cracking pressure. Each shim added or removed affects piston cracking pressure by approximately 4 psig. A total of 17 shims is the maximum amount that may be used.

Procedure	Result
j. After an igniter fuel valve shim adjustment, repeat procedure. Actuate piston 5 times before taking final cracking-pressure reading.	Specified results must be obtained.
k. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate zero.
l. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR "A" gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate zero. FUEL IN port (A) depressurized.
m. On MED PRESS FUEL COMPATIBLE panel, close VENT and SHUTOFF valve.	None.
n. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.

Procedure	Result
o. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light	OPEN light off and CLOSE light on.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
p. Remove manifold from test setup, drain fluid from manifold, then reconnect manifold for pneumatic piston cracking-pressure-, seat leak-, and reseat-pressure-test. (See figure 19-12.)	None.
q. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to FUEL IN port (A) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve and observe TEST CELL MONITOR PRESSURE gage while applying pressure to determine piston cracking pressure. Record peak pressure value.	Piston cracking pressure must be 375 ±35 psig.

NOTE

As pressure is applied to FUEL IN port (A), it will reach a peak value then start to decrease. The peak pressure value indicates cracking pressure.

Procedure	Result
r. If piston cracking pressure is not within specified pressure range, the igniter fuel valve must be adjusted by adding or removing shims (44).	None.
s. Reduce pressure as outlined in step u before adding or removing shims.	Same as step u.

NOTE

Shims must be added to increase cracking pressure or removed to decrease cracking pressure. Each shim added or removed affects piston cracking pressure by approximately 4 psig. A total of 17 shims is the maximum amount that may be used.

Procedure	Result
t. After an igniter fuel valve shim adjustment, repeat procedure. Actuate piston 5 times before taking final cracking-pressure reading.	Specified results must be obtained.

Procedure	Result
u. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to FUEL IN port (A) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	FUEL IN port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
v. Install cap on DRAIN port (K).	None.
w. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to FUEL IN port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 30 ±3 psi.	TEST CELL MONITOR PRESSURE gage must indicate 30 ±3 psi. FUEL IN port (A) pressurized.
x. Open UTILITY NO. 3 valve A, measure leakage from INSTR port (J) at outlet 3A, then close valve A.	Maximum allowable leakage past piston seat is 0.5 scim
y. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to FUEL IN port (A) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 150 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 100 ±5 psi.	TEST CELL MONITOR PRESSURE gage must indicate 100 ±5 psi. FUEL IN port (A) pressurized.
z. Repeat step x.	Same as step x.
aa. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to FUEL IN port (A) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 350 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 300 ±20 psi.	TEST CELL MONITOR PRESSURE gage must indicate 300 ±20 psi. FUEL IN port (A) pressurized.
ab. Open UTILITY NO. 3 valve A, measure leakage from INSTR port (J) at outlet 3A, then close valve A.	Maximum allowable leakage past piston seat is 50 scim.
ac. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF valve; then adjust PRESSURE REGULATOR until TEST CELL MONITOR PRESSURE gage indicates 500 ±20 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±20 psi. FUEL IN port (A) pressurized.
ad. Slowly open UTILITY NO. 3 valve A to throttle flow from INSTR port (J), maintaining 500 ±20 psig at FUEL IN port (A). Measure and record flow from INSTR port (J) at outlet 3A.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±20 psi at FUEL IN port (A). Minimum allowable flow from INSTR port (J) is 1,728 scim.

Procedure	Result
ae. On MED PRESS FUEL COMPATIBLE panel, slowly adjust PRESSURE REGULATOR to reduce pressure until TEST CELL MONITOR PRESSURE gage indicates 125 ±5 psi. Measure and record leakage from INSTR port (J) at outlet 3A.	TEST CELL MONITOR PRESSURE gage must indicate 125 ±5 psi at FUEL IN port (A). Maximum allowable leakage from INST port (J) is 25 scim.
af. Close UTILITY NO. 3 valve A.	None.
ag. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to FUEL IN port (A) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	FUEL IN port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
ah. Remove valve from test setup.	None.
ai. If hypergol manifold testing is terminated, remove hypergol simulator T-5029716 and secure equipment as outlined in paragraph 19-19.	None.
aj. Install protective closures. Refer to paragraph 19-2.	None.

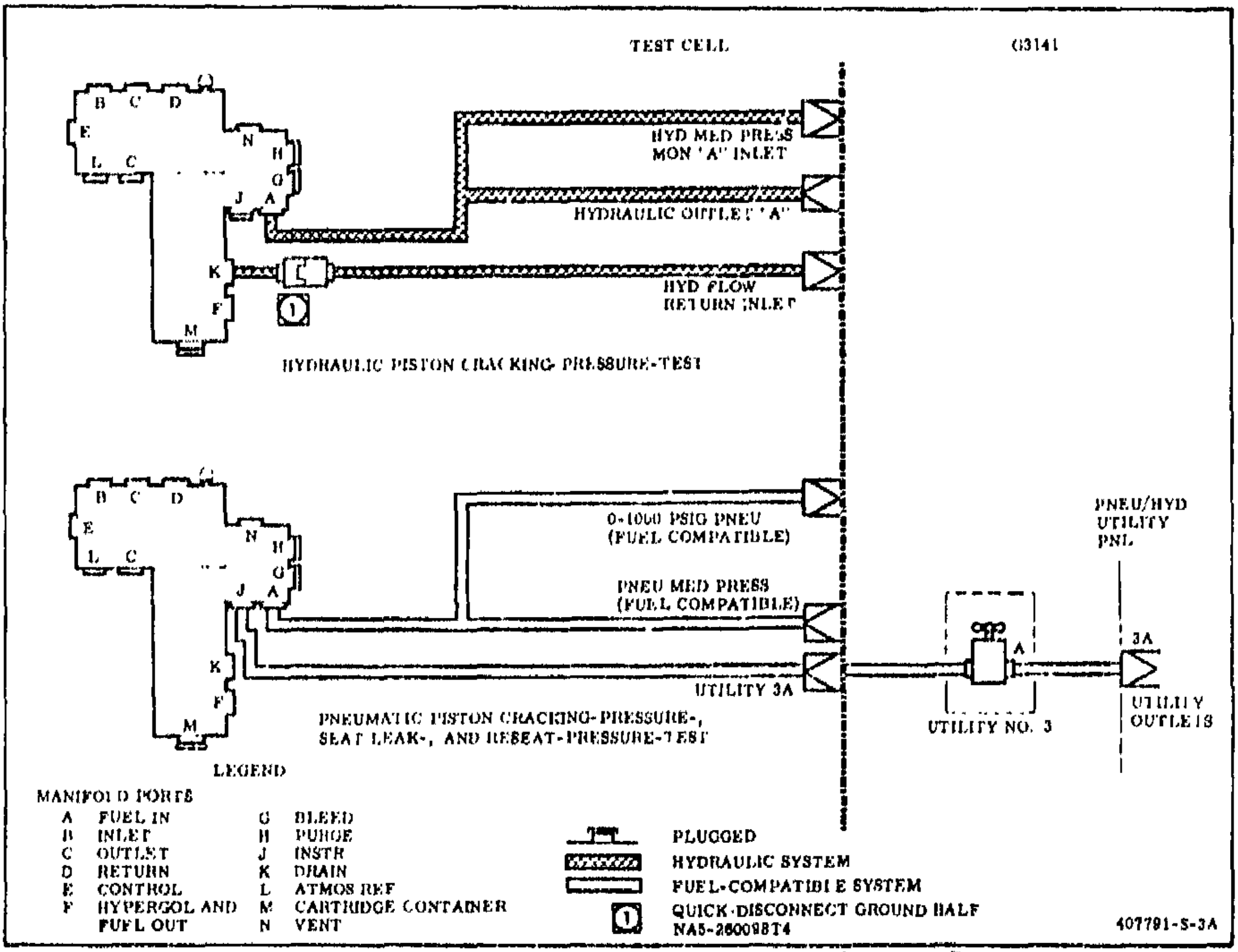


Figure 19-12. Hypergol Manifold Igniter Fuel Valve Test Setup

19-17. FLANGE PACKINGS AND O-RING PNEUMATIC LEAK-TEST.

Procedure	Result
a. Make sure Components Test Console G3141 and hypergol manifold are prepared for use as outlined in paragraph 19-12.	None.

WARNING

The following procedures use drycleaning solvent, which 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.

Procedure	Result
aA. Clean threads of hypergol manifold cartridge container inlet port with drycleaning solvent (Federal Specification P-D-680). Lubricate (Method A) threads with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I.	None.

CAUTION

When installing hypergol simulator into the hypergol manifold cartridge container inlet port, extreme care must be used to prevent damage to the hypergol cartridge follower.

- The threads of the hypergol simulator cap must be clean and free of nicks, to prevent galling the threads of the cap and inlet port.

Procedure	Result
b. Make sure that threads of cap on hypergol simulator T-5029716 are clean and free of nicks; then lubricate (Method L) simulator shaft O-ring with FS1281 grease (Dow Corning Corp), and carefully insert simulator into hypergol manifold cartridge container inlet port. Screw simulator clockwise until it bottoms.	None.
c. Connect manifold to console for igniter fuel valve cap to body leak-test. (See figure 19-13.)	None.
d. Using MED PRESS FUEL COMPATIBLE panel apply pressure to VENT port (N) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 20 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±5 psi. VENT port (N) pressurized.

Procedure	Result
e. Using leak test compound (MIL-L-25567), check for leakage for 3 minutes at joint between igniter fuel valve cap and body.	No leakage is allowable.
f. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure at VENT port (N) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	VENT port (N) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
g through jA. (Deleted)	
k. Remove manifold from test setup; then reconnect manifold for container to body, diaphragm follower rod O-ring, and igniter fuel valve piston O-ring leak-test. (See figure 19-13.)	None.
l. Open hand valve 19-9022606-2.	None.
m. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to PURGE port (H) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 20 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±5 psi. PURGE port (H) pressurized.
n. Measure leakage from ATMOS REF port (L).	Leakage from ATMOS REF port (L) must be zero.
o. Measure leakage from VENT port (N).	Leakage from VENT port (N) must be zero.
oA. Using leak-test compound (MIL-L-25567), check for leakage for 3 minutes at joint between container and body.	No leakage is allowable.
p. Close hand valve 19-9022606-2, open PRESSURE MONITOR "A" gage VENT valve to reduce gage pressure to zero, then close VENT valve.	PRESSURE MONITOR "A" gage depressurized.
q. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to PURGE port (H) as follows:	
(1) Close SHUTOFF valve.	None.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 200 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 180 ±10 psi.	TEST CELL MONITOR PRESSURE gage must indicate 180 ±10 psi. PURGE port (H) pressurized.
r. Repeat steps n through oA.	Same as steps n through oA.
s. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to PURGE port (H) as follows:	
(1) Close SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±20 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±20 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±20 psi. PURGE port (H) pressurized.
t. Repeat steps n through oA.	Same as steps n through oA.
u. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to PURGE port (H) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	PURGE port (H) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
v. Remove hypergol simulator T-5029716 from manifold, remove end of simulator that actuates diaphragm follower rod, then reinstall simulator.	Diaphragm follower rod remains extended.
w. Repeat steps l through o and p through u.	Same as steps l through o and p through u.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
wA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
x. Remove manifold from test setup and remove hypergol simulator T-5029716. Reconnect manifold for diaphragm follower rod end cap packing, electrical switch packing, and ignition monitor valve packing leak-test as shown in figure 19-13.	None.

Procedure	Result
y. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to ATMOS REF port (L) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 20 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±5 psi. ATMOS REF port (L) pressurized.
z. Using leak-test compound (MIL-L-25567), check for leakage for 3 minutes at the following joints:	No leakage is allowable.
(1) Between diaphragm follower rod end cap and body.	
(2) Between electrical switch and body.	
(3) Between ignition monitor valve and body.	
aa. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to ATMOS REF port (L) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	ATMOS REF port (L) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
aaA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
ab. Remove manifold from test setup.	None.
ac. Repeat switch-resistance-test as outlined in paragraph 19-13.	Specified results must be obtained.
ad. If hypergol manifold testing is terminated, secure equipment as outlined in paragraph 19-19.	None.
ae. Install protective closures. Refer to paragraph 19-2.	

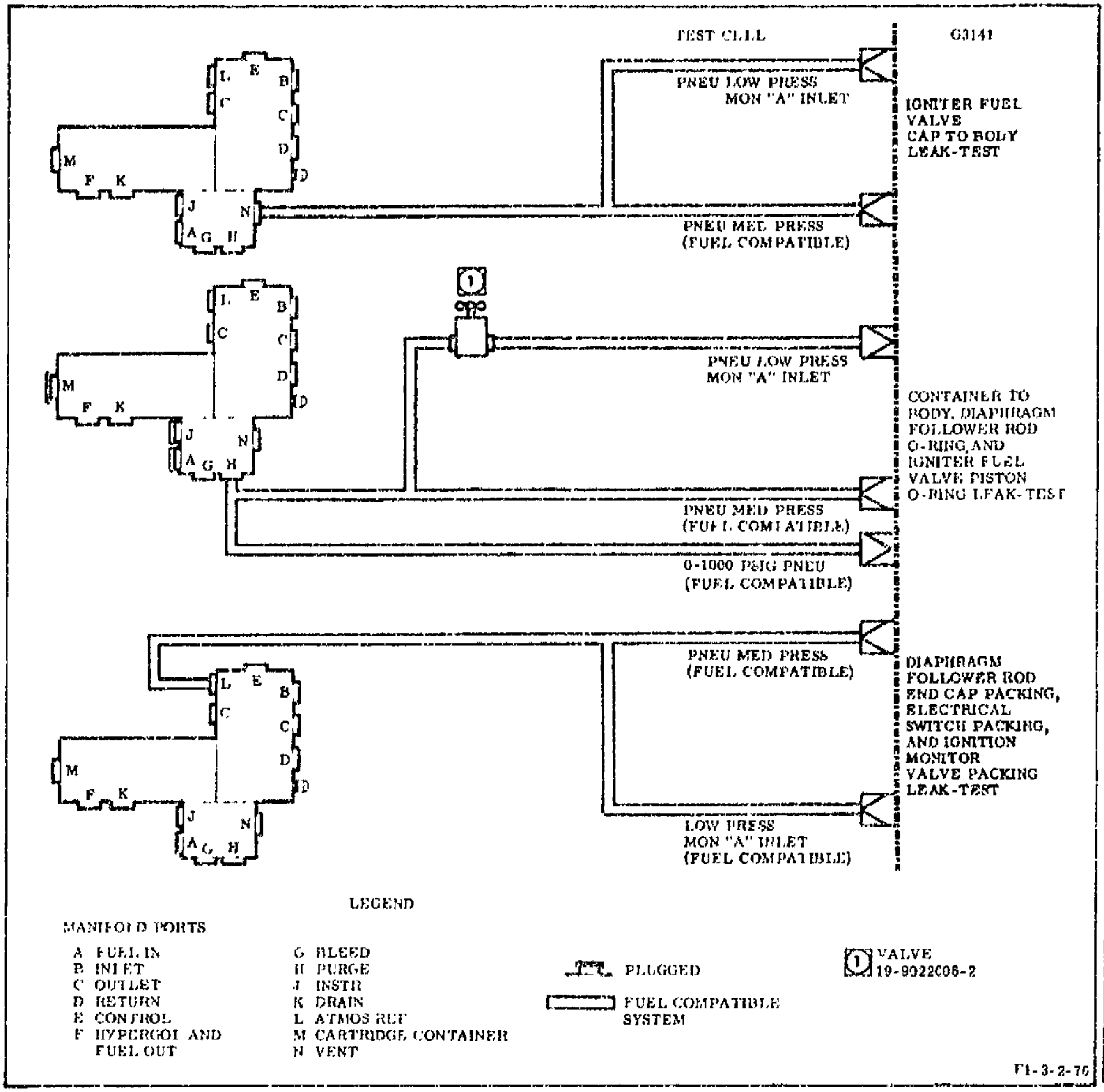


Figure 19-13. Hypergol Manifold Flange Packings and O-Ring Pneumatic Leak-Test Setup

19-18. SECURING TEST EQUIPMENT.

19-19. After hypergol manifold testing is completed and manifold is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves, adjust PRESSURE REGULATOR to VENT valves, then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn oscilloscope power and digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

19-20. <u>HYPERGOL MANIFOLD SWITCH NA5-27395.</u>

19-21. The following procedures contain cleaning, inspecting and repairing, and testing information required to maintain the hypergol manifold switch. The switch is hermetically sealed and no disassembly or assembly is possible.

19-22. CLEANING.

19-23. Hand-clean switch exterior surfaces for fuel service, and clean electrical connector using electrical connector cleaning procedure in R-3896-3, Volume I.

19-24. INSPECTING AND REPAIRING.

19-25. Inspect the switch for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, scratches, and bent electrical connector pins. Refer to R-3896-3, Volume I, for general repair procedures.

19-26. TESTING.

19-27. This procedure outlines requirements for testing the hypergol manifold switch.

Procedure	Result
a. Perform steps b and c with actuator in the free position (deactuated).	None.
b. Using multimeter and decade resistance box, measure resistance between pins B and C as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins B and C.	Resistance must not exceed 0.5 ohm.
c. Using megohmmeter, apply 500 ±50 vdc between pins A and B of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.

Procedure	Result
d. Press actuator and hold in actuated position while performing steps e and f.	Switch actuates.
e. Using multimeter and decade resistance box, measure resistance between pins A and B as follows:	
(1) Adjust decade resistance box for 0.5 ohm, and zero multimeter.	None.
(2) Connect multimeter leads to decade resistance box terminals.	None.
(3) Measure decade box resistance and note exact multimeter indication for 0.5 ohm.	None.
(4) Measure resistance between pins A and B.	Resistance must not exceed 0.5 ohm.
f. Using megohmmeter, apply 500 ±50 vdc between pins B and C of electrical connector and measure insulation resistance.	Resistance must be 100 megohms minimum.
g. Remove switch from test setup. Package and protect switch as outlined in R-3896-3, Volume I.	None.

SECTION XX

IGNITION MONITOR VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

20-1. <u>IGNITION MONITOR VALVE 555700 AND 557200.</u>

20-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the ignition monitor valve. See figure 20-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. Plate RX20660-57 is used on valve 555700. Closure RK395-10042 is used on valve 557200.

Part No.	Nomenclature	Use
T-5035222	Compressor Tool	Used with inspection check fixture T-5031172 to adjust override mechanism.
T-5031172	Inspection Check Fixture	Holds ignition monitor valve when adjusting override mechanism.
T-5031175	Pressure Test Fixture	Seals valve ports during pressure-test.
T-0043P5-1	Piezometer	Facilitates pressure measurements during testing of ignition monitor valve.
T-0043P5-3	Piezometer (2 required)	Facilitates pressure measurements during testing of ignition monitor valve.
None	Pressure Gage, 0-2,000 psig, pneumatic	Monitors pneumatic pressure during testing of ignition monitor valve.
G3104	Pneumatic Flow Tester	Measures ignition monitor valve downstream leakage.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel for testing ignition monitor valve.
G3143	Components Adapter Set	Provides hardware for ignition monitor valve test setups.

Figure 20-1. Test Equipment and Special Tools for Ignition Monitor Valve

Figure 20-2 deleted.

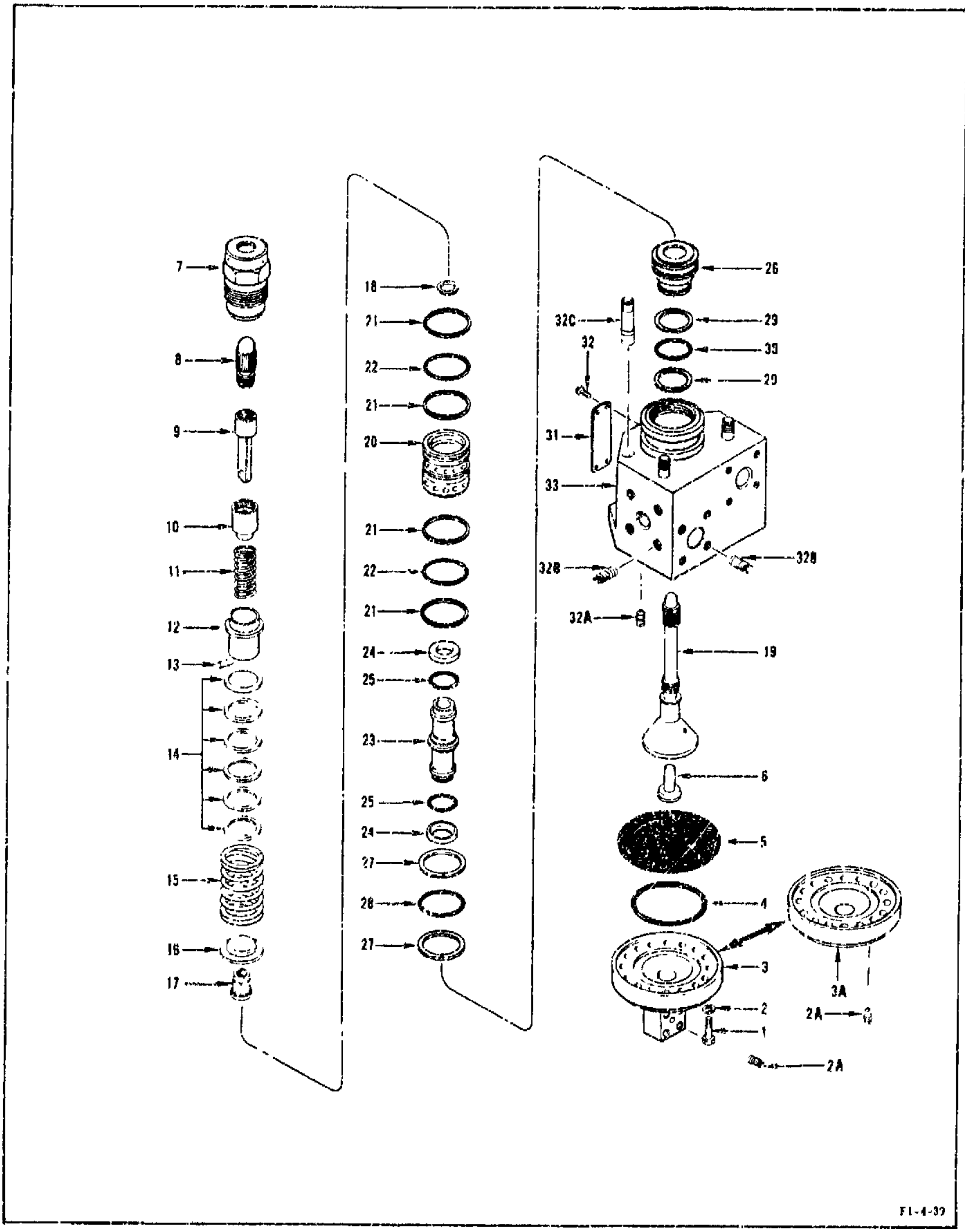


Figure 20-3. Ignition Monitor Valve--Exploded View (Sheet 1 of 2)

1	Bolt	9	Bolt	19	Bolt	29	Retainer
2	Washer	10	Slide	20	Spacer	30	Packing
2A	Insert	11	Spring	21	Retainer	31	Nameplate
3	Cap[(a)]	12	Guide	22	Packing	32	Screw
3A	Cap[(a)]	13	Pin	23	Poppet	32A	Insert
4	Packing	14	Shim	24	Seal	32B	Insert
5	Diaphragm	15	Spring	25	O-ring	32C	Stud
6	Cover	16	Guide	26	Seat	33	Body
7	Cap	17	Nut	27	Retainer		
8	Rod	18	Washer	28	Packing		

(a) On valve 557200

Figure 20-3. Ignition Monitor Valve--Exploded View (Sheet 2 of 2)

20-3. DISASSEMBLING.

20-4. Protect all parts from handling damage. See figure 20-3 for parts and index numbers.

a. Remove bolt (1), washer (2), cap (3, 3A), packing (4), diaphragm (5) and cover (6).

b. Remove cap (7); then remove guide (16), spring (15), shims (14), pin (13), slide (10), spring (11), guide (12), and bolt (9).

c. Remove rod (8) from bolt (9).

d. Remove nut (17), bolt (19), and washer (18).

e. Remove spacer (20), poppet (23), and seat (26) as an assembly.

NOTE

Through cycling and use, the poppet (23), seat (26), and spacer (20) have become semi-matched parts. These parts must not be intermixed with those from another valve, or unnecessary leakage problems may be encountered after reassembly.

f. Remove seal (24) and O-ring (25).

g. Remove retainers (29, 27, 21) and packings (30, 28, 22).

h. Discard diaphragm (5), seals (24), nut (17), and all packings and retainers.

20-5. CLEANING.

20-6. Clean all parts of the ignition monitor valve for fuel service as outlined in R-3896-3, Volume I. Protect all sealing surfaces, threads, and parts from handling damage and contamination.

20-7. INSPECTING AND REPAIRING.

20-8. Inspecting the ignition monitor valve determines if the individual parts have been damaged by mishandling or wear. See figure 20-4 and inspect individual parts for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches. See figure 20-5 for dimensional limits.

Part Name and Index Number	Inspecting	Repairing
Bolt (1)	Damaged threads	Refer to R-3896-3, Volume I, for thread repair.
Cap (3, 3A)	Nicks, scratches, and other imperfections on sealing surface which would impair its sealing function.	Replace.
	Damaged inserts	Replace inserts as outlined in R-3896-3, Volume I.

Figure 20-4. Inspecting and Repairing Ignition Monitor Valve (Sheet 1 of 3)

Part Name and Index Number	Inspecting	Repairing
	Damaged or deteriorated anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Cover (6)	Major diameter.	See figure 20-5.
	Shank diameter.	See figure 20-5.
	Burs on major diameter.	Replace.
	Damaged or deteriorated anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Cap (7)	Damaged or deteriorated anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Small inside diameter.	See figure 20-5.
Rod (8)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Damaged spline.	Replace.
Bolt (9)	Damaged threads.	Replace.
	Guide diameter.	See figure 20-5.
	Shank dimension.	See figure 20-5.
Slide (10)	Inside diameter.	See figure 20-5.
	Damaged bore for bolt (10).	See figure 20-5.
	Damaged internal spline.	Replace.
	Major diameter.	See figure 20-5.
Spring (11, 15)	Compressed lengths.	See figure 20-5.
	Corrosions or cracks.	Replace.
Guide (12)	Inside diameter.	See figure 20-5.
Washer (18)	Inside diameter.	See figure 20-5.
	Major diameter.	See figure 20-5.
Bolt (19)	Damaged threads.	Replace.
	Shank diameter.	See figure 20-5.
	Shoulder diameter.	See figure 20-5.

Figure 20-4. Inspecting and Repairing Ignition Monitor Valve (Sheet 2 of 3)

Part Name and Number	Inspecting	Repairing
	Burs on diaphragm support surface.	Replace.
Spacer (20)	Large inside diameter.	See figure 20-5.
	Bore.	See figure 20-5.
	Scratches on bore.	Replace.
	Major diameter.	See figure 20-5.
	Nicks and scratches on seating chamfer.	Replace.
Poppet (23)	Nicks and scratches on conical seating surfaces.	Replace.
	Land diameter.	See figure 20-5.
	Bore.	See figure 20-5.
Seat (26)	Major diameter.	See figure 20-5.
	Shoulder diameter.	See figure 20-5.
	Scratches on shoulder.	Replace.
	Inside diameter.	See figure 20-5.
	Nicks and scratches on seating corner.	Replace.
Body (33)	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Damaged inserts.	Replace inserts.
	Damaged studs.	Replace studs.
	Damaged or deteriorated anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Inside diameter.	See figure 20-5.
	Small inside diameter.	See figure 20-5.
	Nicks, scratches, and other imperfections on sealing surface which would impair its sealing function.	Replace and assign body to overhaul.
	Nicks and scratches on 2.024-inch diameter bore corner radius that contacts diaphragm (5).	Replace.

Figure 20-4. Inspecting and Repairing Ignition Monitor Valve (Sheet 3 of 3)

Part Name and Index Number	Dimension	Minimum	Maximum
		(Inches Except As Noted)	
Cover (6)	Major diameter	0.381	0.382
	Shank diameter	0.118	0.120
Cap (7)	Small inside diameter	0.6100	0.6105
Bolt (9)	Shank dimension	0.146	0.148
	Guide diameter	0.343	0.345
Slide (10)	Inside diameter	0.3510	0.3515
	Bore for bolt (10)	0.351	0.353
	Major diameter	0.5035	0.5040
Spring (11)	Compressed to 0.560 inch	6.8 lb	8.2 lb
	Compressed to 1.000 inch	2.2 lb	2.6 lb
Guide (12)	Inside diameter	0.5050	0.5055
Spring (15)	Compressed to 1.548 inches	53.6 lb	55.6 lb
	Compressed to 1.341 inches	78.0 lb	81.0 lb
Washer (18)	Inside diameter	0.1857	0.1862
	Major diameter	0.488	0.489
Bolt (19)	Shank diameter	0.184	0.185
	Shoulder diameter	0.1895	0.1900
Spacer (20)	Large inside diameter	1.1350	1.1355
	Bore	0.500	0.501
	Major diameter	1.305	1.307
Poppet (23)	Land diameter	0.496	0.497
	Bore	0.1902	0.1905
Seat (26)	Major diameter	1.305	1.307
	Shoulder diameter	1.1343	1.1348
	Inside diameter	0.500	0.501
Body (33)	Inside diameter	1.312	1.315
	Small inside diameter	0.749	0.751

Figure 20-5. Dimensional Limits for Ignition Monitor Valve

20-9. ASSEMBLING.

20-10. Assembly of the ignition monitor valve must be performed with care, to prevent damage to seating and sealing surfaces. The diaphragm (5) should not be removed from its protective packaging until required, to avoid scratching and damage. All parts must meet cleaning requirements as outlined in paragraph 20-5. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne), unless otherwise noted. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 20-3 for parts and index numbers.

NOTE

Through cycling and use, the poppet (23), seat (26), and spacer (20) have become semi-matched parts. These parts must not be intermixed with those from another valve or unnecessary leakage problems may be encountered after reassembly.

a. Lubricate (Method J) packings (30, 28) and install them with retainers (29, 27) on seat (26).

b. Lubricate (Method J) O-rings (25) and install one on each end of poppet (23).

c. Lubricate (Method J) packings (22) and install them with retainers (21) in grooves on spacer (20).

d. Install poppet (23) into spacer (20) and install seat (26) on poppet. Install seals (24), placing one in seat bore and one in spacer bore, and press into position over O-ring (25) on poppet.

e. Press poppet, seat, and spacer assembly (20 through 30) into body (33) until bottomed.

f. Install bolt (19) through poppet (23) and secure with washer (18) and nut (17). Torque nut (17) to 18-20 in-lb above torque required to overcome locking feature of nut.

g. Check bolt (19) and poppet (23) assembly for freedom of movement within bore. Bolt and poppet must move without excessive drag or binding.

h. Lubricate spherical tip of bolt (19) with centerpoint lube No. 3 (Chicago Mfg and Distributing Co) or extreme-pressure lube No. 3 (Evans Products Co).

i. Install bolt (9) through slide (10), spring (11), and guide (12); then press pin (13) through bolt (9) until centered.

j. Screw rod (8) into bolt (9) until bottomed.

k. Install guide assembly (8 through 13) into cap (7) and lubricate (Method A) cap threads with centerpoint lube No. 3 (Chicago Mfg and Distributing Co) or extreme-pressure lube No. 3 (Evans Products Co). Apply a thin film of lubricant to end of cap that faces body.

l. Measure and record (for use in paragraph 20-15, titled Actuation Pressure-Test) the combined stack height of 6 shims (14) and install them on guide (12). Install spring (15) and guide (16) on guide (12).

m. Install cap assembly (7 through 16) into body (33). Torque cap (7) to 50-60 ft-lb.

mA. Measure and record thickness of diaphragm (5). Minimum allowable thickness is 0.0070 inch.

CAUTION

Laminations of diaphragm must not be separated.

n. Install cover (6) into bolt (19). Lubricate (Method J) packing (4) and install in groove in face of cap (3, 3A), then place diaphragm (5) on cap. Diaphragm convolution must face into body (33).

o. On valve 555700, position body (33) with INLET and RETURN ports facing up and position cap (3) with CONTROL port facing same direction.

p. Aline holes of body (33), diaphragm (5), and cap (3, 3A) and secure with washer (2) and bolts (1). Torque bolts (1) to 50-60 in-lb above torque required to turn through locking device, using cross-torque method and in increments of one-third total torque until all bolts are torqued. Safetywire bolts.

q. Install protective closures. Refer to paragraph 20-2.

20-11. TESTING.

20-12. This procedure outlines requirements for complete testing of the ignition monitor valve, using Components Test Console G3141 and Components Adapter Set G3143. The Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on ignition monitor valve as outlined in figure 20-6. Index letters are assigned to the ignition monitor valve ports for ease of identification in illustrations. Set up components test console electrical patch-panel (figure 20-7) and prepare console for use (figure 20-8). See figure 20-9 for ignition monitor valve test port identification and a cutaway view. Refer to paragraphs 20-13 through 20-18 for ignition monitor valve test procedure and see figures 20-11 through 20-15 for test setups and adjustment.

Index Letter	Valve Port	Test Plate	Port Connection
B	INLET	T-5031175-206	AN815-8C
C	OUTLET	T-5031175-319	AN815-8C
D	RETURN	T-5031175-307	AN815-10C
E	CONTROL PRESS	T-5031175-301(a)	AN815-4C
		T-5031175-501(b)	AN815-4C
L	ATMOS REF	None	AN815-4C
	Manifold Mating Flange	T-5031175-104	None

(a) On valve 555700
(b) On valve 557200

Figure 20-6. Preparing Ignition Monitor Valve for Testing

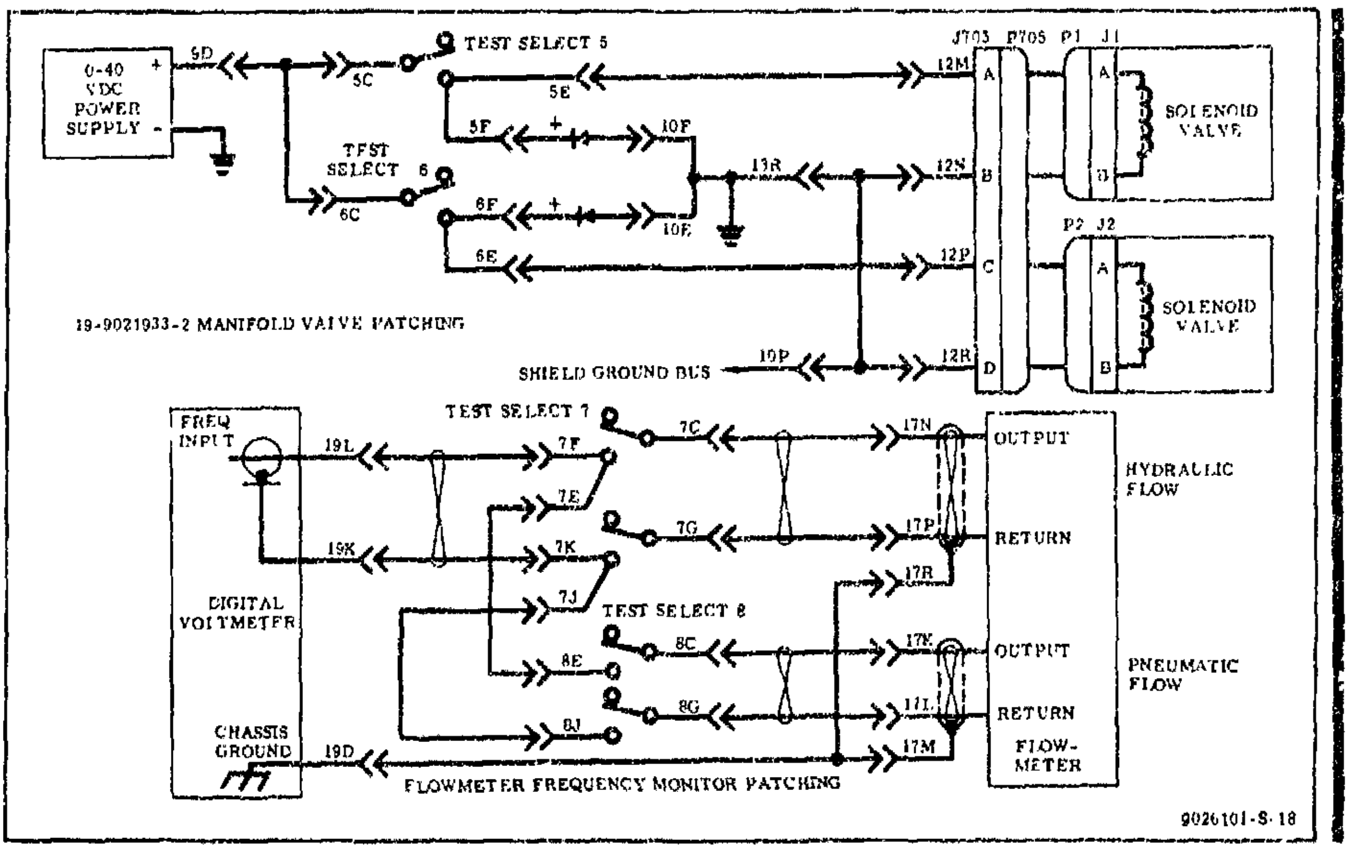


Figure 20-7. Components Test Console Patch-Panel Requirements (Sheet 1 of 2)

Patch Cord[a]	From J6-	To J6-	Patch Cord[a]	From J6-	To J6-
K4.09	5C	6C	K3.	7G	17P
		9D	K3.	7J	8J
K3.	5E	12M	K3.	7K	19K
3088-17[b]	5F(+)	10F	K3.	8C	17K
K3.	6E	12P	K3.	8G	17L
3088-17[b]	6F(+)	10E	K5.09	10P	12N
K3.	7C	17N			12R
K3.	7E	8E			13R
K3.	7F	19L	K4.09	17M	17R
					19D

(a) Use any cord length required on all patch-cords numbered K3.
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 20-7. Components Test Console Patch-Panel Requirements (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks
	NOTE The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.		
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counterclockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	

Figure 20-8. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Capped	
TEST CELL ELECT. OUTLETS	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Cable BB52750-1 or -2	For valve manifold control.

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]

(a) If indication is not as specified, press applicable switch-light.

Figure 20-8. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	TEST SELECT 5		Light 5 off. Manifold valve solenoid control.[a]
	TEST SELECT 6		Light 6 off. Manifold valve solenoid control.[a]
	TEST SELECT 7		Light 7 off. Hydraulic flow monitor control.[a]
	TEST SELECT 8		Light 8 off. Pneumatic flow monitor control.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 24 ±0.4 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
FLOW-MONITOR-TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.

(a) If indication is not as specified, press applicable switch-light.

Figure 20-8. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks
FLOW-MONITOR-TEST (continued)			
	SAMPLE PERIOD	1 SEC 100 PER	
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 is for pneumatic flow. Both switch-lights must not be on at the same time.

- Digital voltmeter must warm up at least 30 minutes.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console. PNEU SOURCE CONTROL panel SOURCE PRESS gage indicates supply pressure.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates supply pressure.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed when working with pressurized systems.

Figure 20-8. Preparing Components Test Console for Use (Sheet 4 of 4)

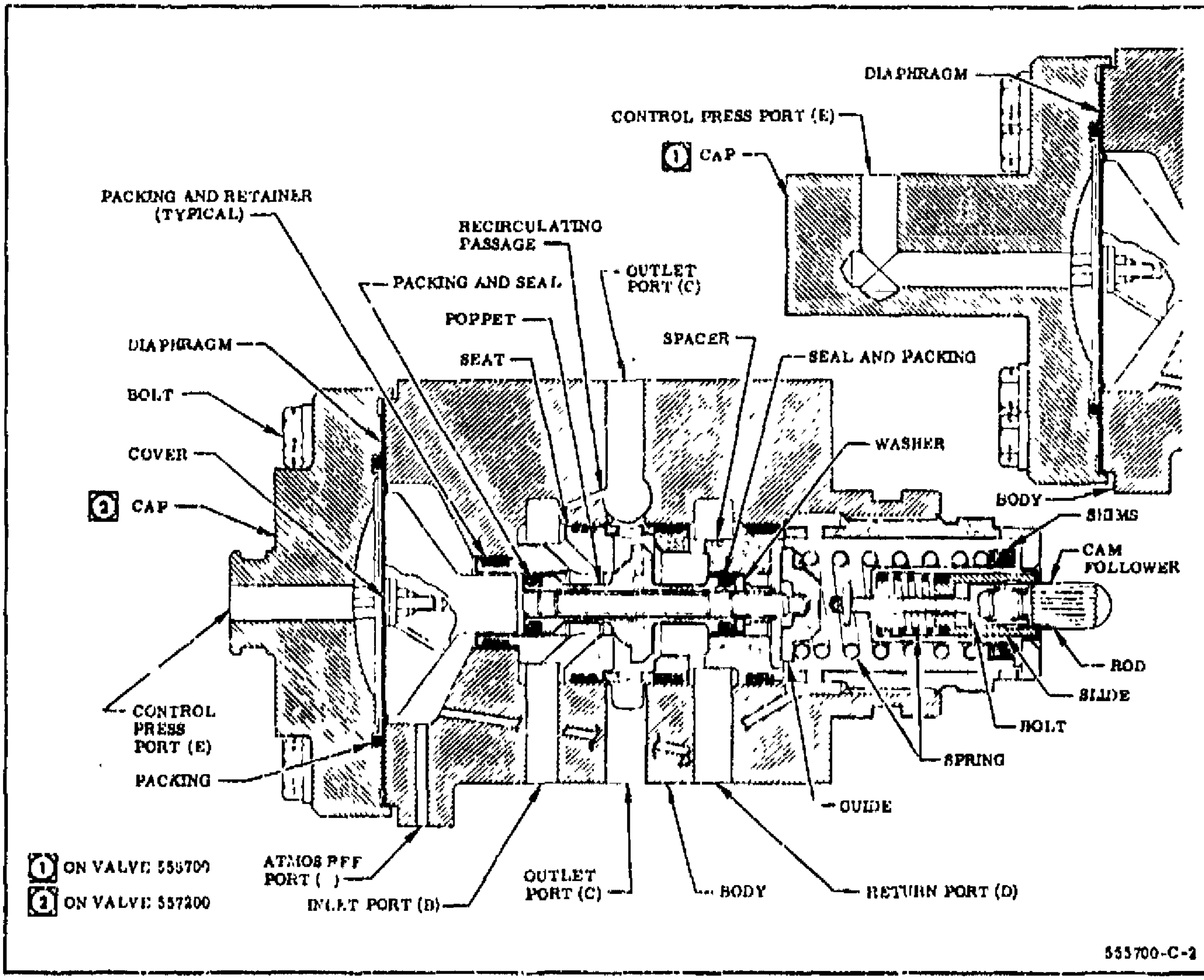


Figure 20-9. Ignition Monitor Valve--Cutaway View

Paragraph 20-13 and figure 20-10 deleted.

All data on pages 20-15 and 20-16 deleted.

Procedure	Result
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,500 ±50 psi.	INLET port (B) pressurized.
j. Measure leakage from ATMOS REF port (L) at UTILITY OUTLET 2A.	Maximum allowable leakage is one scim.
k. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±10 psi.	INLET port (B) pressure reduced.
l. Repeat step j.	Same result as step j.
m. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
n. Disconnect line from INLET port (B) and connect it to CONTROL port (E).	None.
o. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to CONTROL port (E) as follows:	
(1) Open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,160 ±40 psi.	CONTROL port (E) pressurized.
p. Maintain pressure at CONTROL port (E) and check for diaphragm failure as indicated by pressure venting from ATMOS REF port (L) at UTILITY OUTLET 2A.	No evidence of diaphragm failure is allowable.
q. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±40 psi.	CONTROL port (E) pressure reduced.
r. Maintain pressure at CONTROL port (E) and check for leakage between diaphragm cap and body with leak-test compound (MIL-L-25567).	No leakage is allowable.

Procedure	Result
s. Repeat step p.	Same result as step p.
t. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to CONTROL port (E) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CONTROL port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
u. Close UTILITY NO. 2 valve A and cap UTILITY OUTLET 2A.	None.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

uA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
v. Remove ignition monitor valve from test setup.	None.
w. If ignition monitor valve testing is terminated, secure equipment as outlined in paragraph 20-19.	None.
x. Install protective closures. Refer to paragraph 20-2.	

20-13A. PROOF-PRESSURE TEST FOR VALVE 557200. This test is performed if the body (33, figure 20-3), cap (3A), or cap (7) has been replaced or if any valve parts have been exposed to circumstances which could structurally and/or functionally affect the valve. This test does not have to be performed as part of a routine recycle test of the valve.

a. Prepare Components Test Console G3141 and ignition monitor valve for use as outlined in paragraph 20-11.	None.
b. See figure 20-10 for partial test setup of valve 557200 and connect other lines to ignition monitor valve as specified in test procedure.	None.

WARNING

Personnel are not allowed in the test cell when the valve is pressurized unless otherwise specified. Visual examination of the valve while it is pressurized must be made through the test cell window.

Procedure	Result
c. Connect line from PNEU HIGH PRESS (FUEL COMPATIBLE) outlet to INLET port (B). Close hand valve at PNEU LOW PRESS MON "A" INLET.	None.
d. Open UTILITY NO. 2 valve A and remove cap from UTILITY OUTLET 2A.	ATMOS REF port (L) vented.
e. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (B) as follows:	
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 4,200 ±50 psi.	INLET port (B) pressurized.
f. Maintain pressure at INLET port (B) for 2 minutes minimum.	INLET port (B) remains pressurized.
g. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
h. On HIGH PRESS FUEL COMPATIBLE panel, close VENT valve and slowly open SHUTOFF valve.	INLET port (B) pressurized.
i. Repeat steps f through h 4 times (total of 5 cycles).	Same results as steps f through h.
j. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
k. Inspect ignition monitor valve for evidence of failure or permanent set.	No evidence of failure or permanent set is allowable.
l. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (B) as follows:	
(1) Open SHUTOFF valve.	None.

Procedure	Result
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±30 psi.	INLET port (B) pressurized.
m. Measure leakage from ATMOS REF port (L) at UTILITY OUTLET 2A.	Maximum allowable leakage is 3 scim.
n. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
o. Open hand valve at PNEU LOW PRESS MON "A" INLET.	None.
p. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (B) as follows:	
(1) Open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until PRESSURE MONITOR "A" gage indicates 80 ±5 psi.	INLET port (B) pressurized.
q. Measure leakage from ATMOS REF port (L) at UTILITY OUTLET 2A.	Maximum allowable leakage is 2 scim.
r. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
s. Close hand valve at PNEU LOW PRESS MON "A" INLET.	None.
t. Connect line from PNEU MED PRESS (FUEL COMPATIBLE) outlet to CONTROL port (E).	None.

Procedure	Result
u. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CONTROL port (E) as follows:	
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±5 psi.	CONTROL port (E) pressurized.
v. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (B) as follows:	
(1) Open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±30 psi.	INLET port (B) pressurized.
w. Measure leakage from ATMOS REF port (L) at UTILITY OUTLET 2A.	Maximum allowable leakage is 3 scim.
x. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
y. Open hand valve at PNEU LOW PRESS MON "A" INLET.	None.
z. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (B) as follows:	
(1) Open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until PRESSURE MONITOR "A" gage indicates 80 ±5 psi.	INLET port (B) pressurized.
aa. Measure leakage from ATMOS REF port (L) at UTILITY OUTLET 2A.	Maximum allowable leakage is 2 scim.

Procedure	Result
ab. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
ac. Close hand valve at PNEU LOW PRESS MON "A" INLET.	None.
ad. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CONTROL port (E) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CONTROL port (E) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
ae. Disconnect lines from INLET port (B) and CONTROL port (E).	None.
af. Connect line from PNEU HIGH PRESS (FUEL COMPATIBLE) outlet to CONTROL port (E).	None.
ag. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to CONTROL port (E) as follows:	
(1) Close VENT valve and open SHUTOFF valve.	None.
(2) Slowly adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,100 ±40 psi.	CONTROL port (E) pressurized.
ah. Maintain pressure at CONTROL port (E) for 2 minutes minimum.	CONTROL port (E) remains pressurized.
ai. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open VENT valve.	CONTROL port (E) depressurized.

Procedure	Result
20-14. SEATING-CYCLE-TEST. This test is required only if spacer (20), poppet (23), and seat (26) are replaced.	
a. Connect ignition monitor valve to console (figure 20-11).	None.
b. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	OPEN light on and CLOSE light off.
c. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±25 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve	Accumulator precharged to 500 ±25 psig.
(4) Close SHUTOFF valve.	None.
d. On HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±40 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. Slowly apply facility hydraulic supply pressure until HYDRAULIC CONTROL panel SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psig.

Procedure	Result
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until HYD HIGH PRESS MONITOR panel PRESSURE MONITOR "A" gage indicates 1,500 ±15 psi; then close HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate 1,500 ±15 psig. INLET port (B) and accumulator pressurized.
g. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
h. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 on and manifold valve solenoid (P1) energized.
i. On UTILITY NO. 2 panel, open valves A and B.	None.
j. On HIGH PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve.	HYD MED PRESS MONITOR panel PRESSURE MONITOR "B" gage indicates 1,800 ±40 psi.
k. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 off, solenoid (P1) deenergized, and PRESSURE MONITOR "B" gage indicates zero.
l. On UTILITY NO. 2 panel, close valve B approximately 1/2 turn.	None.
m. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light and, using a stop watch, time pressure rise (from 0- 1,800 ±40 psig) on PRESSURE MONITOR "B" gage.	Light 5 on and PRESSURE MONITOR "B" gage indicates pressure rise.
n. Repeat step m and, on UTILITY NO. 2 panel, adjust valve B to establish a pressure rise of 1,200 ±50 psig per second (1,800 psig per 1.5 seconds). Leave TEST SELECT 5 switch-light with light 5 off.	Light 5 alternately on and off. PRESSURE MONITOR "B" gage must indicate 1,200 ±50 psig pressure rise per second.
o. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on, VENT light off, and INLET port (B) pressurized.
p. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 on, CONTROL port (E) pressurized, and ignition monitor valve actuates.
q. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on, SUPPLY light off, and INLET port (B) depressurized.
r. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light 5 seconds after performing step q.	Light 5 off and ignition monitor valve deactuates.
s. Repeat steps o through r 50 times.	Same results as steps o through r.
t. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to manifold valve as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Manifold valve depressurized.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
u. On HYDRAULIC CONTROL panel open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
v. On HYD HIGH PRESS MONITOR panel, open PRESSURE MONITOR "A" shutoff valve. Close shutoff valve after pressure decay.	PRESSURE MONITOR "A" gage decreases to zero.
w. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
x. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	EN light off and CLOSE light on.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
y. On UTILITY NO. 2 panel, close valves A and B.	None.
z. On MED PRESS FUEL COMPATIBLE panel, decrease pressure at accumulator as follows:	
(1) Open VENT valve.	Accumulator pressure decreases to zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	
aa. Remove ignition monitor valve from test setup.	None.
ab. If ignition monitor valve testing is terminated, secure equipment as outlined in paragraph 20-19.	None.
ac. Install protective closures. Refer to paragraph 20-2.	None.

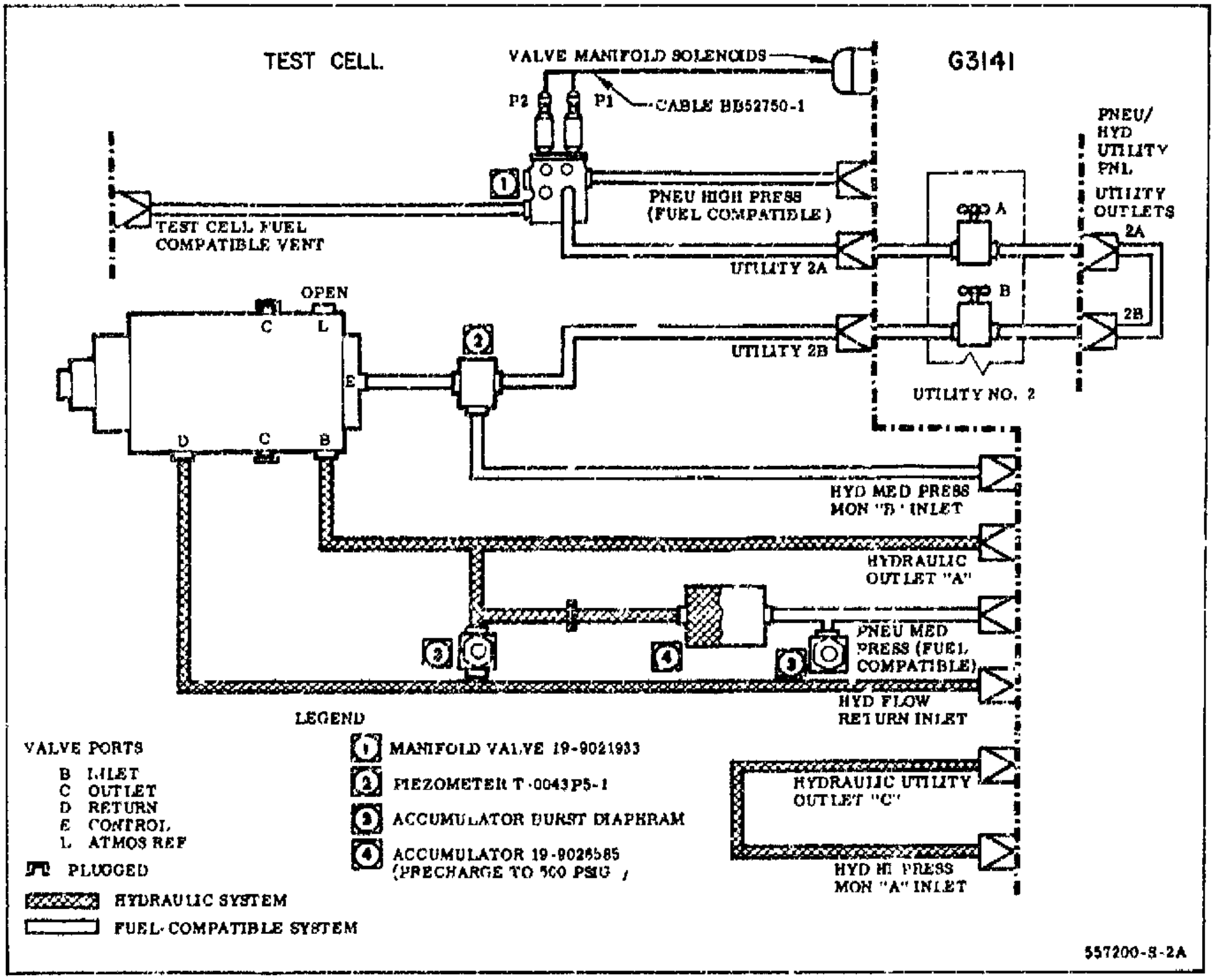


Figure 20-11. Ignition Monitor Valve Seating-Cycle-Test Setup

Procedure	Result
20-15. ACTUATION-PRESSURE-TEST.	
a. Connect ignition monitor valve to console (figure 20-12).	None.
b. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

Procedure	Result
(5) Press LOW FLOW BYPASS switch-light.	OPEN light on and CLOSE light off.
c. On MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 500 ±25 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 500 ±25 psig.
(4) Close SHUTOFF valve.	None.
d. On HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±40 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. Slowly apply facility hydraulic supply pressure until HYDRAULIC CONTROL panel SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psig.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until HYD HIGH PRESS MONITOR panel PRESSURE MONITOR "A" gage indicates 1,500 ±15 psi. Close HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate 1,500 ±15 psig. INLET port (B) and accumulator pressurized.
g. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off. INLET port (B) depressurized.
h. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
i. On UTILITY No. 2 panel, open valves A and B.	None.
j. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 on and manifold valve solenoid (P1) energized.
k. On HIGH PRESS FUEL COMPATIBLE panel, open SHUTOFF valve and adjust PRESSURE REGULATOR until LOW PRESS MONITOR FUEL COMPATIBLE panel PRESSURE MONITOR "B" gage indicates 50 ±5 psi.	PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages indicate 50 ±5 psi. CONTROL port (E) pressurized.

Procedure	Result
l. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 off and solenoid (P1) deenergized. PRESSURE MONITOR "A" gage indicates zero and PRESSURE MONITOR "B" gage indicates 50 ±5 psi.
m. On UTILITY NO. 2 panel, close valve B approximately 1/4 turn.	None.
n. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light and, using a stop watch, time pressure rise on PRESSURE MONITOR "A" gage.	Light 5 on and PRESSURE MONITOR "A" gage indicates pressure rise.
o. Repeat step n and, on UTILITY NO. 2 panel, adjust valve B to establish a pressure rise of 4 ±1 psig per second. Leave TEST SELECT 5 switch-light with light 5 off.	Light 5 alternately on and off and PRESSURE MONITOR "A" gage indicates specified pressure rise.
p. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on, VENT light off, and INLET port (B) pressurized.
q. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light and record valve-actuation pressure.	Light 5 on and PRESSURE MONITOR "A" gage indicates actuation pressure.
r. Repeat steps p and q a minimum of 5 times to obtain consistent actuation-pressure reading.	Light 5 alternately on and off and PRESSURE MONITOR "A" gage indicates actuation pressure.
s. If valve fails to actuate at 20 ±0.5 psig, perform steps t through aa. If valve actuates at 20 ±0.5 psig, perform steps u through y and steps ab through ad.	None.
t. Compute shim stack required to give an actuation pressure of 20 ±0.5 psig by inserting actuation pressure value obtained in step r and shim stack height recorded in paragraph 20-10 into the following equation:	

$$\begin{matrix}\text{Required shim}\\\text{stack height}\end{matrix} = \begin{matrix}\text{Initial stack}\\\text{height}\end{matrix} - \left[0.025\begin{pmatrix}\text{actuation}\\\text{pressure}\\\text{recorded}\\\text{in step r}\end{pmatrix} - 20\right]$$

Example:

Initial shim stack height: 0.372 inches

Actuation pressure: 24.1 psig

Required shims: 0.372 - 0.025 (24.1 - 20)

0.372 - (0.025 x 4.1)

0.372 - 0.103

Required shim stack height = 0.269 inch.

Procedure	Result
u. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off. INLET port (B) depressurized.
v. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light 5 seconds after performing step u.	Light 5 off, ignition monitor valve deactuates, and PRESSURE MONITOR "A" gage indicates zero.
w. On HIGH PRESS FUEL COMPATIBLE panel, simultaneously open VENT valve, and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Manifold valve and HIGH PRESS FUEL COMPATIBLE panel depressurized. PRESSURE MONITOR "B" gage indicates zero.
x. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
y. On HYD HIGH PRESS MONITOR panel, open PRESSURE MONITOR "A" shutoff valve. Close shutoff valve after pressure decay.	PRESSURE MONITOR "A" gage decreases to zero.
z. Unthread cap (7) from body (33) and remove spring (15). Install computed shim stack height, then install spring (15) and cap (7) into body (33). Torque cap to 50-60 foot-pounds.	None.
aa. Repeat steps d through z, omitting steps i and steps m through o, until required actuation pressure is obtained.	Same results as steps d through z.
ab. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
ac. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light off and CLOSE light on.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
(4) Press LOW FLOW BYPASS switch-light.	OPEN light off and CLOSE light on.
ad. On MED PRESS FUEL COMPATIBLE panel, decrease pressure at accumulator as follows:	
(1) Open VENT valve.	Accumulator pressure decreases to zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.

Procedure	Result
ae. Remove ignition monitor valve from test setup.	None.
af. If ignition monitor valve testing is terminated, secure equipment as outlined in paragraph 20-19.	None.
ag. Install protective closures. Refer to paragraph 20-2.	None.

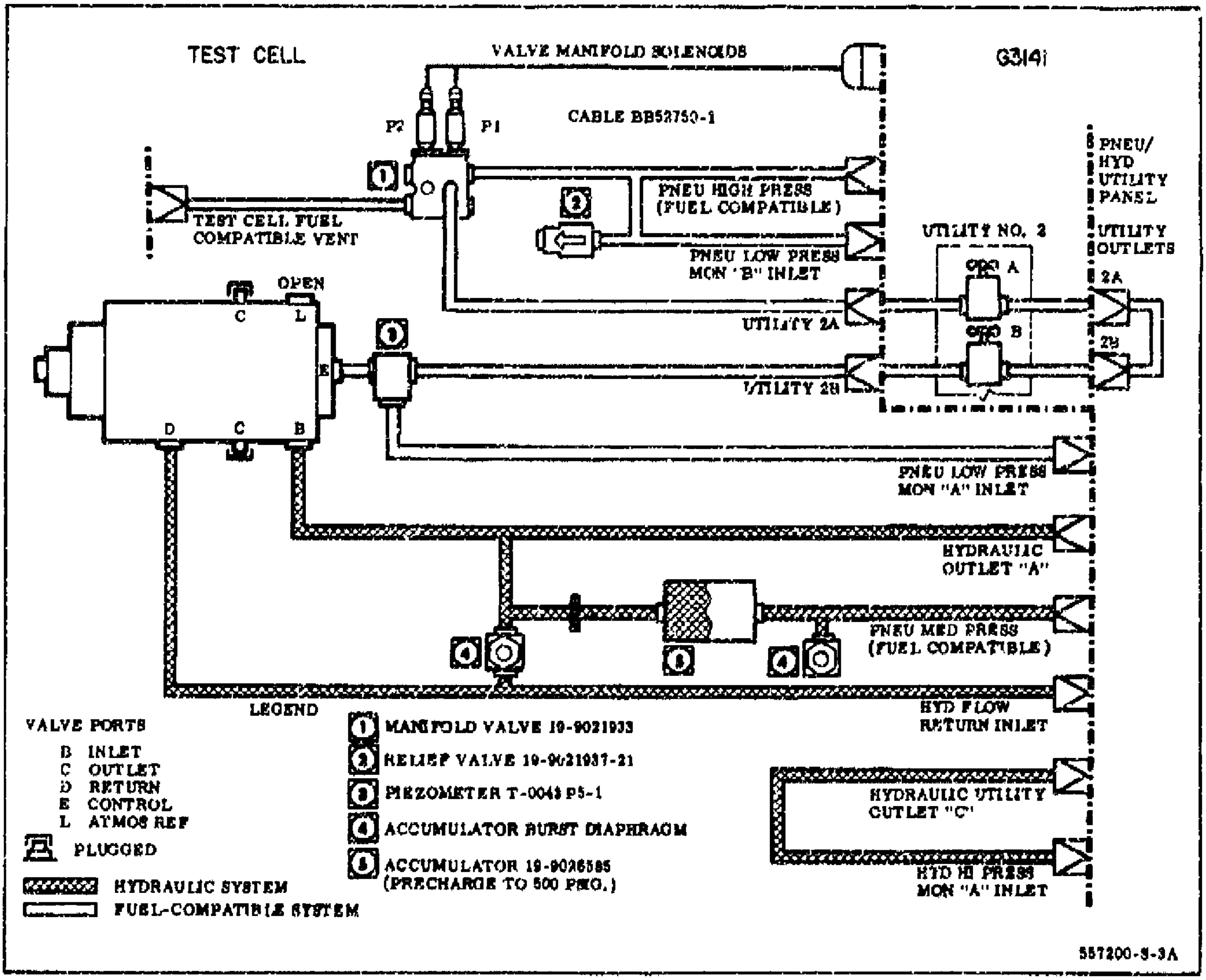


Figure 20-12. Ignition Monitor Valve Actuation-Pressure-Test Setup

Procedure	Result
20-16. INLET SEAT AND VENT SEAT LEAK-TEST.	
a. Remove adapter from INLET port (B). Install plug T-5031175-401 and packing. Reinstall adapter on INLET port (B).	None.
b. Connect ignition monitor valve to components test console as shown in figure 20-13. Position meter 19-9026519 so that it can be monitored through test cell window.	None.
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	OPEN light on and CLOSE light off.
d. On HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±40 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. Slowly apply facility hydraulic supply pressure until HYDRAULIC CONTROL panel SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psig.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until HYD HIGH PRESS MONITOR panel PRESSURE MONITOR "A" gage indicates 1,500 ±15 psi. Close HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate 1,500 ±15 psig. INLET port (B) pressurized.
g. After 3 minutes measure and record leakage from RETURN port (D) on meter 19-9026519.	Maximum allowable leakage is 10 cc per minute.

Procedure	Result
h. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light.	Light 5 on and manifold valve solenoid (P1) energized.
i. On HIGH PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve.	CONTROL port (E) pressurized to 1,800 ±40 psig.
j. Repeat step g.	Maximum allowable leakage is 5 cc per minute.
k. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on, SUPPLY light off and INLET port (B) depressurized.
l. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light 5 seconds after performing step k.	Light 5 off and ignition monitor valve deactuates.
lA. Repeat step g.	Same as step g.
m. On HIGH PRESS FUEL COMPATIBLE panel, simultaneously open VENT valve and adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	Manifold valve and HIGH PRESS FUEL COMPATIBLE panel depressurized.
n. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
o. On HYD HIGH PRESS MONITOR panel, open PRESSURE MONITOR "A" shutoff valve. Close shutoff valve after pressure decay.	PRESSURE MONITOR "A" gage decreases to zero.
p. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
q. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light off and CLOSE light on.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
(4) Press LOW FLOW BYPASS switch-light.	OPEN light off and CLOSE light on.
r. Remove adapter from INLET port (B), remove plug and packing, then reinstall adapter on INLET port (B).	None.
s. Remove ignition monitor valv rom test setup.	None.
t. If ignition monitor valve testing is terminated, secure equipment as outlined in paragraph 20-19.	None.
u. Install protective closures. Refer to paragraph 20-2.	None.

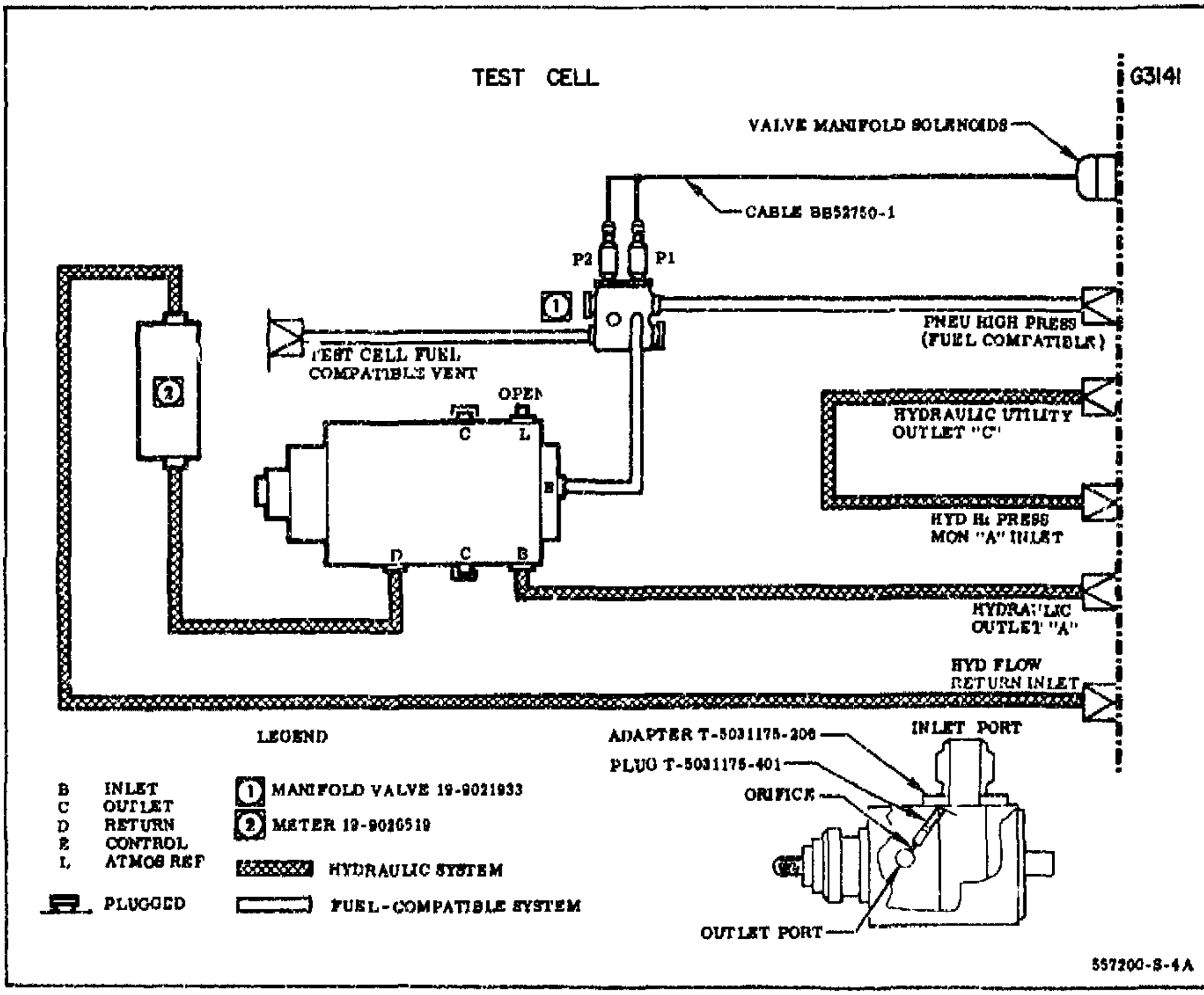


Figure 20-13. Ignition Monitor Valve Inlet Seat and Vent Seat Leak-Test Setup

Procedure	Result
20-17. ORIFICE FLOW-TEST.	
a. Prepare digital voltmeter for flow-monitor-tests (figure 20-8).	None.
b. Connect ignition monitor valve to console (figure 20-14).	None.
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.

Procedure	Result
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
(5) Press LOW FLOW BYPASS switch-light.	OPEN light on and CLOSE light off.
d. On HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±40 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. Close valve 19-9026501 between ports A and B on UTILITY HYD OUTLETS panel.	None.
f. Slowly apply facility hydraulic supply pressure until HYDRAULIC CONTROL panel SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psig.
g. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until HYD HIGH PRESSURE MONITOR "A" gage indicates 1,500 ±15 psi. Close HIGH PRESS SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate 1,500 ±15 psi.
h. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	OPEN light on and CLOSE light off.
i. Slowly open valve 19-9026501 and adjust valve to establish a 1,000 psig differential pressure between HYD MED PRESS MONITOR panel PRESSURE MONITOR "B" gage and PRESSURE MONITOR "A" gage.	
j. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 on.
k. On DIGITAL VOLTMETER panel, press RESET switch. Measure and record flowrate from RETURN port (D).	DVM must indicate an equivalent to 0.22 to 0.41 gpm.
l. On ELECTRICAL CONTROL panel, press TEST SELECT 7 switch-light.	Light 7 off.
m. Close valve 19-9026501 and, on HYD MED PRESS MONITOR panel, open PRESSURE MONITOR "A" and PRESSURE MONITOR "B" shutoff valves. Close shutoff valves after pressure decay.	PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages decrease to zero.

Procedure	Result
n. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" and FLOW MONITOR SHUTOFF switch-lights.	VENT and CLOSE lights on and SUPPLY and OPEN lights off.
o. On HIGH PRESS FUEL COMPATIBLE panel, perform the following:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(2) Open SHUTOFF and VENT valves.	None.
p. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
q. On HYD HIGH PRESS MONITOR panel, open PRESSURE MONITOR "A" shutoff valve. Close shutoff valve after pressure decay.	PRESSURE MONITOR "A" gage decreases to zero.
r. Remove ignition monitor valve from test setup.	None.
s. If ignition monitor valve testing is terminated, secure equipment as outlined in paragraph 20-19.	None.
t. Install protective closures. Refer to paragraph 20-2.	None.

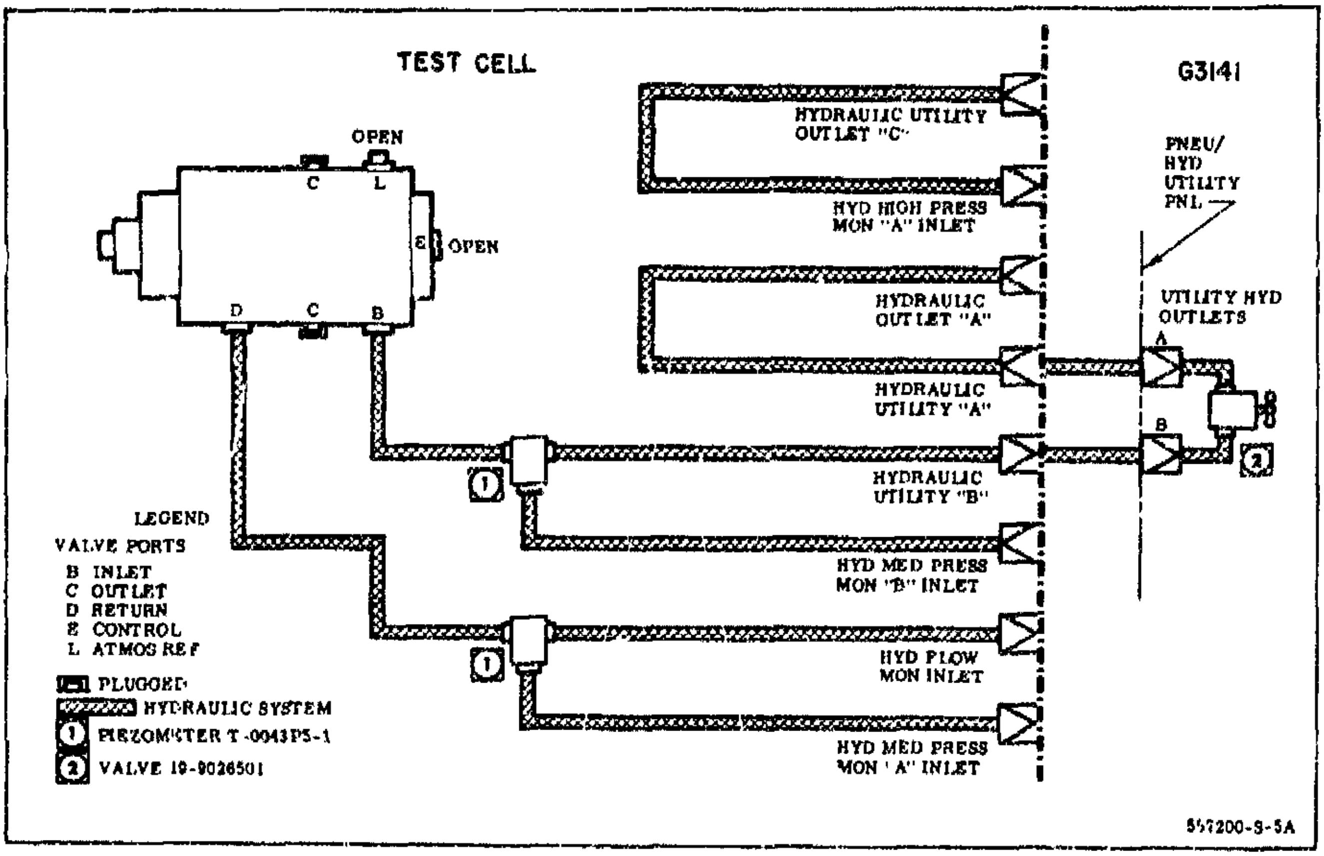


Figure 20-14. Ignition Monitor Valve Orifice Flow-Test Setup

Procedure	Result
20-18. OVERRIDE MECHANISM ADJUSTMENT.	
a. Install inspection check fixture T-5031172 on ignition monitor valve. Torque nuts to 30-40 in-lb.	None.
b. Measure and record dimension "B" (figure 20-15). Compute dimension "A" for applicable valve.	Dimension "A" computed.
c. Measure and record dimension "A" through hole of fixture and compare "A" actual with "A" computed.	"A" actual must be within tolerance of "A" computed.
d. If dimension "A" actual is not equal to dimension "A" computed, within specified tolerance, remove adjustment fixture and adjust rod (8).	Dimension "A" actual is within tolerance to dimension "A" computed.
e. On valves which are not being repaired according to procedures of this section but are being tested only, and "A" actual is out of tolerance, valve must be disassembled and bolts (9, 19) inspected for damage.	None.
f. Using compressor tool T-5035222, hold rod (8) and press slide (10) into body until rod is free of serrations. Rotate rod (clockwise to increase and counterclockwise to decrease length) to obtain dimension "A" computed. (One rotation of rod is equal to approximately 0.036 inch.)	"A" actual is within tolerance of "A" computed.
g. Repeat steps c, d, and f until "A" actual obtained.	Same results as steps c, d, and f.
h. Install protective closures. Refer to paragraph 20-2.	None.

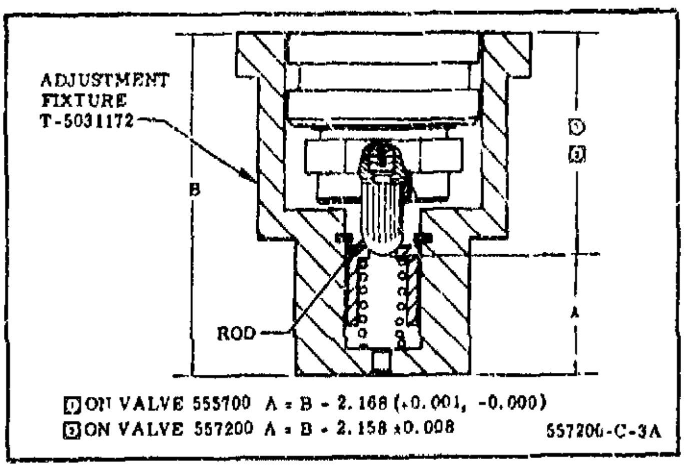


Figure 20-15. Ignition Monitor Valve Override Mechanism Adjustment

20-19. SECURING TEST EQUIPMENT.

20-20. After ignition monitor valve testing is completed and valve is removed from test set-up, secure equipment as follows:

a. Reduce facility gaseous nitrogen pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve and open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves and adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero and close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn digital voltmeter power off.

i. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BY-PASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

j. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off, and press POWER ON switch-light.

k. Turn DC POWER SUPPLY off.

l. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION XXI

CHECKOUT VALVE

WARNING

PNEUMATIC FLOW TESTER G3104, COMPONENTS TEST CONSOLE G3141, AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

21-1. <u>CHECKOUT VALVE 308400, 308770, 309116, 309120, AND 309125.</u>

21-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the checkout valve. See figure 21-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. Lubricate (Method A) closure RX20845-21 and lubricate (Method J) packing used with closure, using lubricant grease RB0140-012 (Rocketdyne). Torque closure to 20-30 in-lb. Specified lubrication methods are outlined in R-3896-3, Volume I.

21-3. DISASSEMBLING.

21-4. Disassemble the checkout valve, as required, to accomplish necessary repairs and/or replacement. See figure 21-3 for parts and index numbers.

a. Remove the following parts from housing (40, 40A) in the numerical sequence listed:

(1) Screws (1, 2), actuator (3), packing (4)

(2) Bolts (28), washer (29), retainer (30), packing (31), retainer (32), packing (33), retainer (34), shim (35), ring (36), spring (37), guide (38), seal (39).

Part No.	Nomenclature	Use
T-5037831	Ball Position Indicator	Indicates position of ball during repair.
T-5037803	Holding Fixture	Presses bearings on ball.
T-5037817	Inspection Check Fixture	Checks the installed load on the ball seals during repair.
T-5031167	Pressure Test Fixture	Adapts to checkout valve ports during pressure tests.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements.
G3104	Pneumatic Flow Tester	Measures downstream pneumatic leakage.
G3141	Components Test Console	Provides gaseous nitrogen for testing checkout valve.
G3143	Components Adapter Set	Provides hardware for checkout valve test setups.
201C (Hewlett Packard)	Oscillator	Provides signal for timing-test.

Figure 21-1. Test Equipment and Special Tools for Checkout Valve

Figure 21-2 deleted.

(3) Bolt (14), washer (15), retainer (16), packing (17), retainer (18), packing (19), retainer (20), shim (21), ring (22), spring (23), guide (24), seal (25).

(4) Bolt (5), washer (6), cover (7), packing (8), ring (9), packing (10), retainer (11), shim (12). Ball (26) with bearings (13, 27) may come out with cover (7). Do not disassemble ball and bearings at this time.

(5) On valves 308770 and 309116: bolt (41), washer (42), cap assembly (43), packing (44), retainer (45).

(6) On valves 308770 and 309116: bolts (50, 51), washer (52), body (53), packing (54), retainer (55).

b. On valves 308770 and 309116, remove poppets (46, 49), springs (47), and rack gear (48) as an assembly from body (53); then disassemble parts.

c. Remove ball (26) and bearings (13, 27) as an assembly from housing (40, 40A), if not removed in step a. Do not remove bearings (13, 27) from ball (26) unless bearings are damaged. If bearing (13) remained in cover (7) during disassembly, remove bearing from cover.

d. On valves 308770 and 309116, remove packing (56) and retainer (57).

21-5. CLEANING.

21-6. Checkout valve parts must be cleaned for fuel service. Refer to R-3896-3, Volume I, for cleaning procedures.

21-7. INSPECTING AND REPAIRING.

21-8. Inspecting the checkout valve determines if the individual parts have been damaged by mishandling or wear. See figure 21-4 and inspect individual parts for general condition, thread damage, corrosion, distortion, nicks, burs, and scratches. Dimensional limits listed in figure 21-5 form the guide to serviceability of parts. Minimum and maximum values are given, beyond which repair or replacement of part is required.

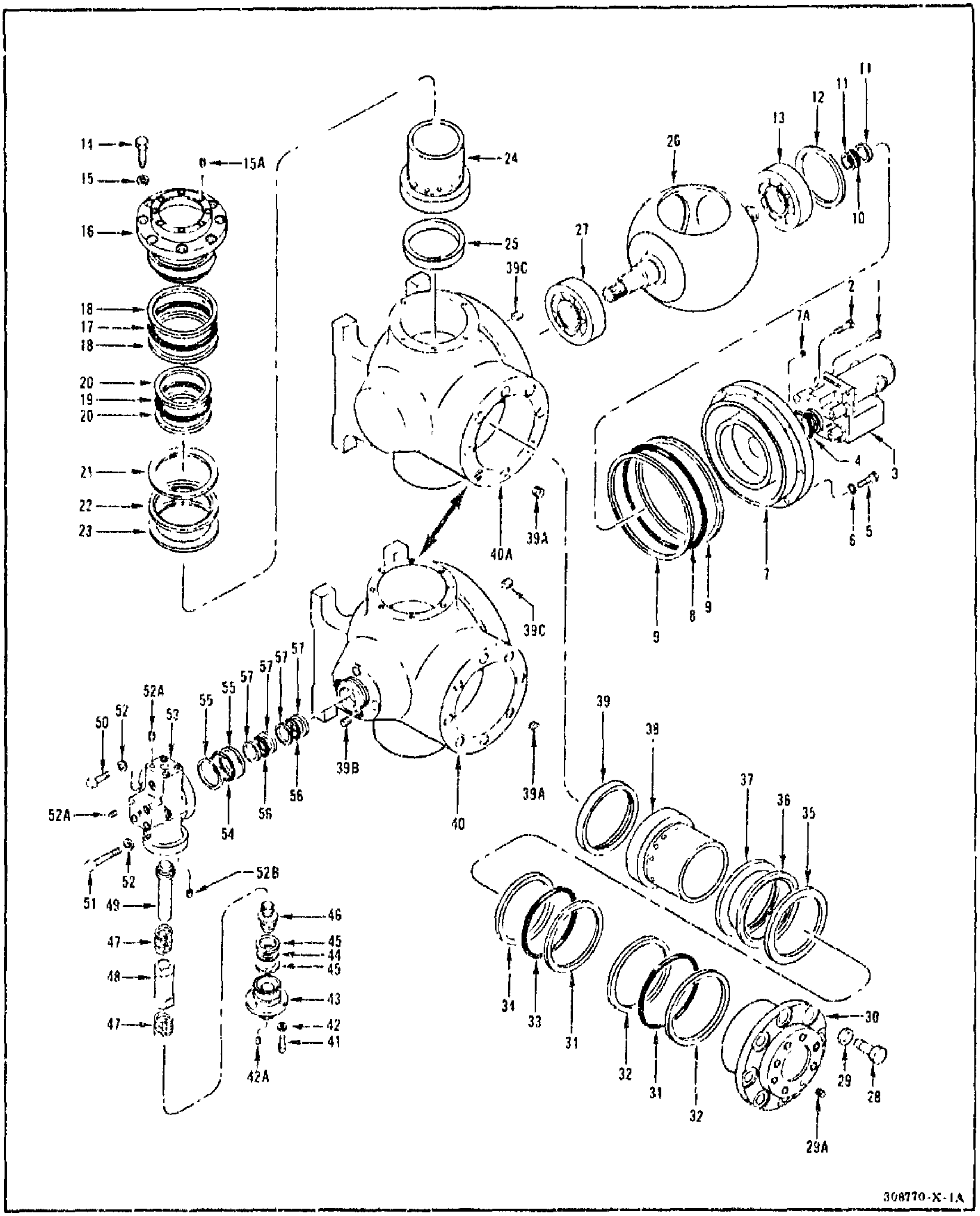


Figure 21-3. Checkout Valve--Exploded View (Sheet 1 of 2)

1	Screw	16	Retainer	32	Retainer	44	Packing[a]
2	Screw	17	Packing	33	Packing	45	Retainer[a]
3	Actuator	18	Retainer	34	Retainer	46	Poppet[a]
4	Packing	19	Packing	35	Shim	47	Spring[a]
5	Bolt	20	Retainer	36	Ring	48	Rack Gear[a]
6	Washer	21	Shim	37	Spring	49	Poppet[a]
7	Cover	22	Ring	38	Guide	50	Bolt[a]
7A	Insert	23	Spring	39	Seal	51	Bolt[a]
8	Packing	24	Guide	39A	Insert	52	Washer[a]
9	Ring	25	Seal	39B	Insert	52A	Insert
10	Packing	26	Ball	39C	Insert	52B	Insert
11	Retainer	27	Bearing	40	Housing[a]	53	Body[a]
12	Shim	28	Bolt	40A	Housing[b]	54	Packing[a]
13	Bearing	29	Washer	41	Bolt[a]	55	Retainer[a]
14	Bolt	29A	Insert	42	Washer[a]	56	Packing[a]
15	Washer	30	Retainer	42A	Insert	57	Retainer[a]
15A	Insert	31	Packing	43	Cap Assembly[a]		

(a) On valves 308770 and 309116.
(b) On valves 308400, 309120, and 309125.

Figure 21-3. Checkout Valve--Exploded View (Sheet 2 of 2)

Part Name and Index Number	Inspecting	Repairing
Actuator (3)	Damage to actuator or electrical connector.	Replace.
Cover (7)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damaged alinement pin.	Replace pin.
Bearing (13, 27)	Damaged races or balls.	Replace bearings.
Retainer (16, 30)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Iridite anodic coating as outlined in R-3896-3, Volume I or replace coating in conformance with LB0125-103, Type II (Rocketdyne).

Figure 21-4. Inspecting and Repairing Checkout Valve (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
Spring (23, 37)	Compressed rating.	Refer to figure 21-5.
Guide (24, 38)	Damaged sealing surfaces.	Replace.
Ball (26)	Damaged sealing surfaces.	Replace ball.
	Damaged gear teeth.	Replace.
	Damaged plating.	Replace.
Cap (43) Body (53)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Iridite anodic coating as outlined in R-3896-3, Volume I or replace coating in conformance with LB0125-103, Type II (Rocketdyne).
Poppet (46, 49)	Damaged or loose seal.	Replace poppet.
	Damaged sealing surface.	Replace.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
Rack (48)	Damaged gear teeth.	Replace.
Housing (40, 40A)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.

Figure 21-4. Inspecting and Repairing Checkout Valve (Sheet 2 of 2)

Part Name and Index Number	Dimension	Minimum (Inches except as noted)	Maximum
Cover (7)	Sealing surface OD for housing (40, 40A)	5.1150	5.1155 (at 70° ±2° F)
	Sealing surface ID for ball (26)	0.879	0.880
	Sealing surface ID for actuator (3)	1.250	1.251
Retainer (16)	Sealing surface OD for housing (40, 40A)	3.621	3.622
	Sealing surface ID for guide (24)	3.001	3.002
Spring (23, 37)	Compress to 0.030 inch	91 lb	137 lb
Guide (24)	Sealing surface diameters for seal (25)	2.949 3.449	2.951 3.451
	Sealing surface OD for retainer (16)	2.996	2.997

Figure 21-5. Dimensional Limits for Checkout Valve (Sheet 1 of 2)

Part Name and Index Number	Dimension	Minimum	Maximum
		(Inches except as noted)	
Ball (26)	Outside diameters for bearing (13, 27)	1.1812	1.1815
	Outside diameters for housing (40A) and cover (7)	0.872	0.873
	Dimension from center line to shoulder for bearing (13)	1.874	1.876
	Dimension from center line to shoulder for bearing (27)	1.872	1.878
Cap (43)	Sealing surface OD for body (53)	0.870	0.872
Rack (48)	Radius from center line to flat surfaces	0.343	0.344
	Hold diameter	0.375	0.376
Poppet (49)	Outside diameter for rack (48)	0.373	0.374
Body (53)	Inside diameter for poppets (46) and (49)	0.843	0.844
	Sealing surface ID for housing (40, 40A)	1.623	1.624
Retainer (30)	Sealing surface ID for guide (38)	3.001	3.002
	Sealing surface OD for housing (40, 40A)	3.621	3.622
Guide (38)	Sealing surface diameters for seal (39)	2.949 3.449	2.951 3.451
	Sealing surface OD for retainer (30)	2.996	2.997
Housing (40, 40A)	Inside diameter for bearing (27)	2.835	2.836
	Inside diameter for shaft of ball (26)	0.879	0.880
	Inside diameter for cover (7)	5.116	5.117
	Inside diameters for retainers (16, 30)	3.623	3.624

Figure 21-5. Dimensional Limits for Checkout Valve (Sheet 2 of 2)

21-9. ASSEMBLING.

21-10. The assembly procedures for the checkout valve must be performed in the order listed and all parts must meet cleaning requirements outlined in paragraph 21-5. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne), unless otherwise noted. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 21-3 for parts and index numbers.

21-11. DETERMINING SHIM THICKNESS FOR BALL ALINEMENT IN HOUSING. (See figure 21-6.)

a. Measure thickness of bearing (13) and record as dimension C.

b. Lubricate (Method Y) bearings (13, 27) with FS1281 grease (Dow Corning Corp). Press bearings on ball (26) shaft using holding fixture T-5037803.

NOTE

Install bearing (13) so that side with the word "THRUST" is toward cap (7).

c. Note dimension as marked on the outboard face of ball (26) and record as dimension A.

d. Note dimension as marked on the flange of housing (40, 40A) and record as dimension B.

e. Measure distance from highest face of cover (7) to the shim mating surface and record dimension D.

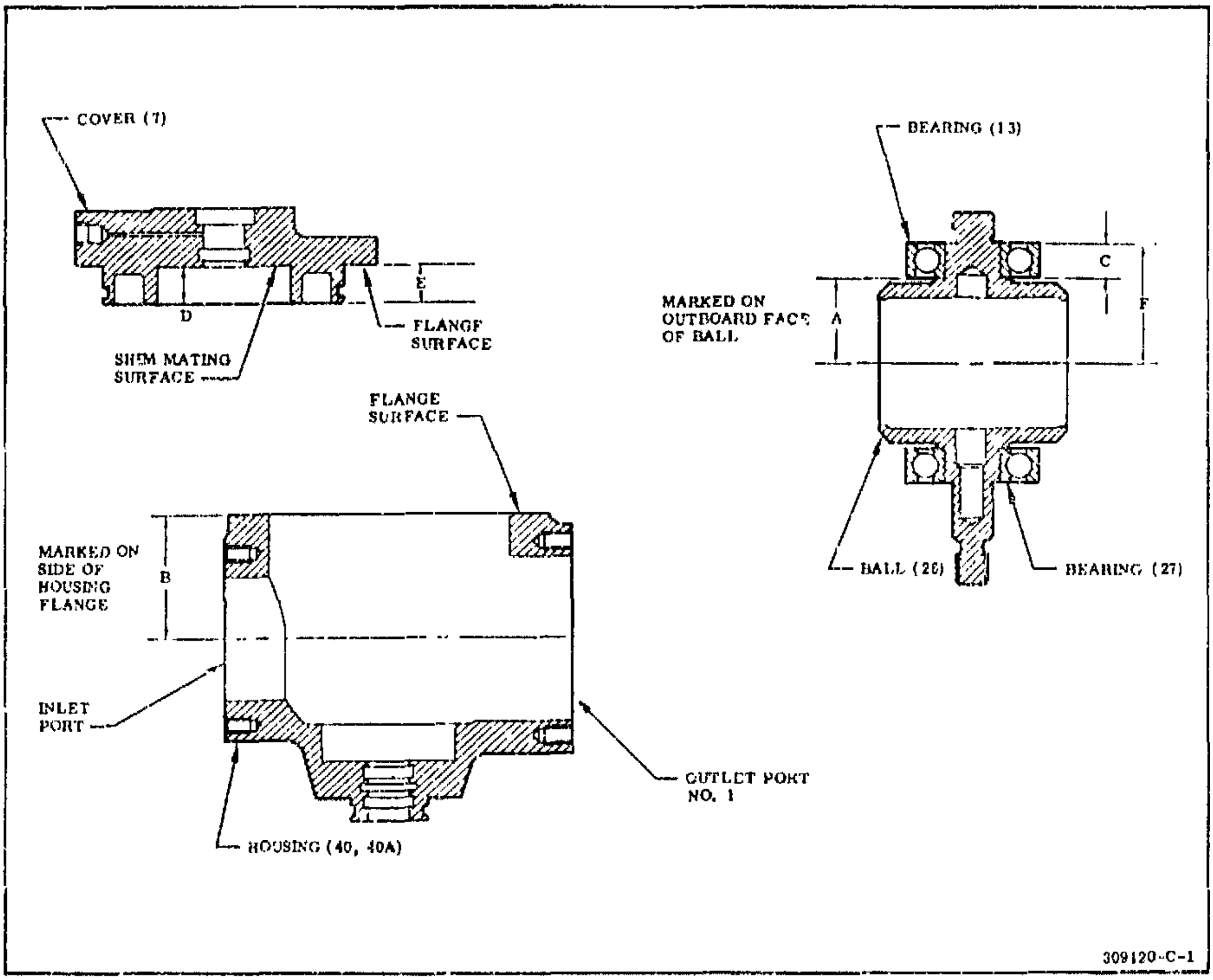


Figure 21-6. Checkout Valve Ball Alinement

f. Measure distance from highest face of cover (7) to the housing mating surface and record as dimension E.

g. Add dimensions A and C (from step a) and record as dimension F.

h. Subtract dimension E from dimension B and record as dimension G.

i. Add dimension D to dimension G and record as dimension H.

j. Subtract dimension F from dimension H and record as dimension I.

NOTE

Dimension I will be the thickness of laminated shim (12) required when cover (7) is installed

21-12. INSTALLING BALL IN HOUSING.

a. On valves 308770 and 309116, lubricate (Method J) packings (56); then insert packings and retainers (57) into grooves of housing (40).

b. On valves 308770 and 309116, lubricate (Method J) packing (54); then install packing and retainers (55) in groove of housing (40).

c. Lubricate (Method Z) spherical surface of ball (26) with FS1281 grease (Dow Corning Corp).

d. Carefully slide ball (26) with bearings (13, 27) into housing (40, 40A).

e. Lubricate (Method J) packing (10); then insert packing and retainers (11) into groove of cover (7).

f. Lubricate (Method J) packing (8); then install packing and rings (9) in groove of cover (7).

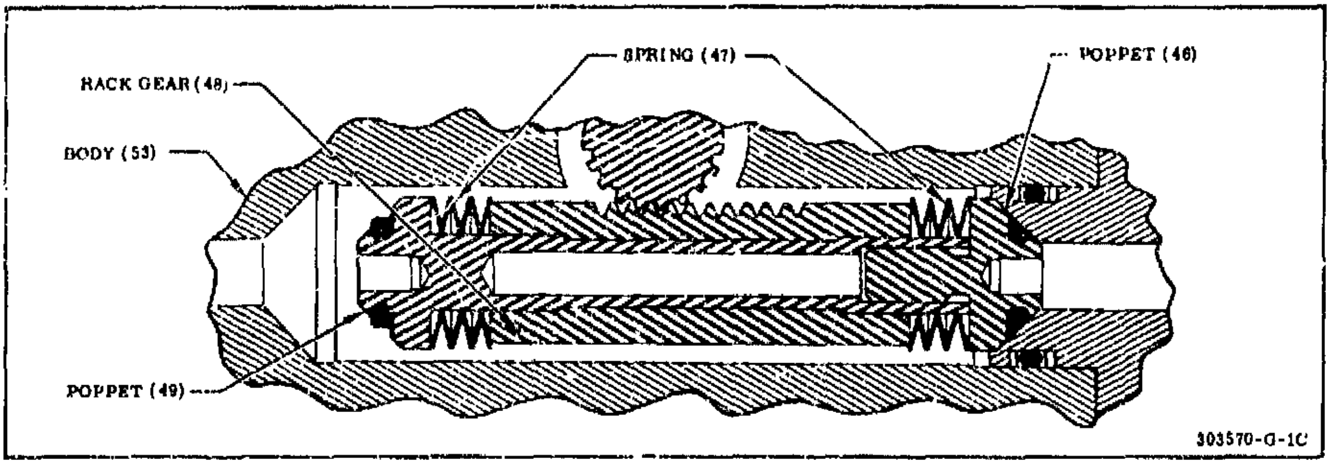


Figure 21-7. Checkout Valve Poppet and Spring Installation

g. Prepare correct thickness of shims (12) as determined in paragraph 21-11 and insert them into cover (7).

gA. Lubricate (Method A) bolts (5).

h. Position cover (7) on housing (40, 40A); then secure cover to housing with bolts (5) and washers (6). Torque bolts to 244-299 in-lb. Safetywire bolts.

21-13. INSTALLING POPPET ON HOUSING.

NOTE

This procedure is required only on checkout valves 308770 and 309116.

a. Place 6 springs (47) on poppet (49); then insert poppet into rack gear (48). See figure 21-7 for installation of springs.

b. Place 6 springs (47) on other end of poppet (49) against rack gear (48); then install poppet (46). See figure 21-7 for installation of springs. Torque poppet (46) to 50 ±10 in-lb.

c. Install poppets (46, 49), spring (47), and rack gear (48) into body (53).

cA. Lubricate (Method A) bolts (50, 51).

d. With the valve in the engine position, open to outlet No. 1, place body (53) on housing (40) with index mark on ball (26) alined with index mark on rack gear (48). Secure body to housing with one short bolt (50) and 3 long bolts (51) and washers (52). Torque bolts to 72-88 in-lb. Safetywire bolts.

dA. Lubricate (Method A) bolts (41).

e. Lubricate (Method J) packing (44) and install packing and retainers (45) in groove of cap (43); then install cap on body (53) with bolts (41) and washers (42). Torque bolts to 72-88 in-lb. Safetywire bolts.

21-14. INSTALLING NO. 1 AND NO. 2 OUTLET SEALS.

a. On valves 308770 and 309116, cap FUEL MANIFOLD port and CHECKOUT port, connect a source of gaseous nitrogen (MIL-P-27401) to IMV port, and slowly apply 100 psig to IMV port.

NOTE

On valves 308770 and 309116, pressure is applied to the IMV port to make sure ball (26) is located properly within housing (40) before installation of assembled guides (24, 38) and seals (25, 39).

b. Install spring (23) on guide (24).

c. Place shim (21) and ring (22) on end of retainer (16); then slide retainer on guide (24).

d. Install seal (25) into groove of guide (24).

NOTE

On valves 308400, 309120, and 309125, position ball (26) against cover (7) by hand (through inlet and outlet ports) to make sure ball is located properly within housing (40A) before installation of assembled guides (24, 38) and seals (25, 39).

dA. Lubricate (Method A) bolts (14).

e. Install assembled guide (24) and retainer (16) into OUTLET NO. 1 with valve ball positioned closed to OUTLET NO. 1 of housing (40, 40A) and temporarily secure with bolts (14) and washers (15). Using inspection check fixture T-5037817, measure solid distance from face of retainer (16) to high point of ball (26).

f. Loosen bolts (14); then use inspection check fixture T-5037817 to measure distance from face of retainer (16) to high point of ball (26).

NOTE

The difference between the two measurements obtained in steps e and f must be 0.014 ±0.002 inch. If the difference is not within tolerance, laminations from shim (21) must be removed.

g. Remove bolts (14), washers (15), retainer (16), and guide (24), from OUTLET NO. 1: then remove required number of laminations from shim (21) to obtain specified tolerances.

h. Lubricate (Method J) packing (19); then insert packing and retainers (20) into groove of retainer (16). Lubricate (Method J) packing (17); then install packing and retainers (18) in outer groove of retainer (16).

i. Repeat steps b through d; then install assembled guide (24) and retainer (16) into OUTLET NO. 1. Secure retainer (16) to housing (40, 40A) with bolts (14) and washers (15). Torque bolts to 155-189 in-lb. Safetywire bolts.

j. Install spring (37) on guide (38).

k. Place shim (35) and ring (36) on end of retainer (30); then slide retainer (30) on guide (38).

CAUTION

Correct seal (39) must be used. On valves 308770 and 309116, the seal is round. On valves 308400, 309120, and 309125 the seal has flats located 90 degrees apart on the outside diameter.

l. Install seal (39) into groove of guide (38).

lA. Lubricate (Method A) bolts (28).

m. Install assembled guide (38) and retainer (30) into OUTLET NO. 2, with valve ball positioned closed to OUTLET NO. 2, of housing (40, 40A) and temporarily secure with bolts (28) and washers (29). Using inspection check fixture T-5037817, measure solid distance from face of retainer (30) to high point of ball (26).

n. Loosen bolts (28); then use inspection check fixture T-5037817 to measure distance from face of retainer (30) to high point of ball (26).

NOTE

The difference between the two measurements obtained in steps m and n must be 0.014 ±0.002 inch. If the difference is not within tolerance, laminations from shim (35) must be removed.

o. Remove bolts (28), washers (29), retainer (30), and guide (38) from OUTLET NO. 2; then remove required number of laminations from shim (35) to obtain specified tolerance.

p. Lubricate (Method J) packing (33); then insert packing and retainers (34) into inner groove of retainer (30). Lubricate (Method J) packing (31); then install packing and retainers (32) in outer groove of retainer (30).

q. Repeat steps j through l; then install assembled guide (38) and retainer (30) into OUTLET NO. 2. Secure retainer (30) to housing (40, 40A) with bolts (28) and washers (29). Torque bolts (28) to 155-189 in-lb. Safetywire bolts.

r. On valves 308770 and 309116, reduce gaseous nitrogen pressure at IMV port to zero; then remove source of gaseous nitrogen.

21-15. INSTALLING ACTUATOR.

a. Check rotating torque of ball (26) for 90-degree travel clockwise and counterclockwise using ball position indicator T-5037831. Breakaway torque, running torque, and seating torque must not exceed 100 in-lb.

NOTE

Leave ball (26) in ground position at completion of step a. Ground position is when there is free flow from INLET port to OUTLET NO. 2 port.

b. Lubricate (Method J) packing (4); then install packing in groove of actuator (3).

c. Connect a 28 vdc electrical power source to actuator electrical connector (positive (+) to pin B and negative (-) to pin E).

CAUTION

The 28 vdc electrical power must not be applied to pins A and B simultaneously, since damage to equipment will result.

NOTE

The power supply panel located on Components Test Console G3141 may be used as a source for 28 vdc.

d. Apply 28 vdc to pins B and E to make sure actuator is in ground position.

e. Deenergize 28 vdc electrical power source; then remove power source from electrical connector.

eA. Lubricate (Method A) screws (1, 2).

f. Carefully install actuator (3) on cover (7) making sure that protruding pin on actuator fits into hole in cover. Secure actuator to cover with screws (1, 2). Torque screws to 4-5 in-lb. Safetywire screws.

21-16. TESTING.

21-17. This procedure outlines requirements for complete testing of the checkout valve, using Components Test Console G3141 and Components Adapter Set G3143. Pneumatic Flow Tester G3104 and leak-test compound (MIL-L-25567) are used for pneumatic leak-testing. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on checkout valve as outlined in figure 21-8. Index letters are assigned to the checkout valve ports for ease of identification in illustrations. Set up components test console electrical patchpanel (figure 21-9) and prepare console for use (figure 21-10). See figure 21-11 for checkout valve test port identification and a cutaway view. Refer to paragraphs 21-18 through 21-23 for checkout valve test procedures and see figures 21-12 and 21-13 for test setups.

Index Letter	Valve Port	Test Plate	Port Connection
A	Inlet	T-5031167-130	AN919-6C
B	Outlet No. 1	T-5031167-130	AN815-4C
C	Outlet No. 2	T-5031167-131	AN919-6C
D	Fuel Manifold	T-5031167-112[(a)]	AN919-6C
E	Ignition Monitor Valve	T-5031167-112[(a)]	AN815-4C
F	Checkout	T-5031167-112[(a)]	AN919-6C

(a) On valves 308770 and 309116.

Figure 21-8. Preparing Checkout Valve for Testing

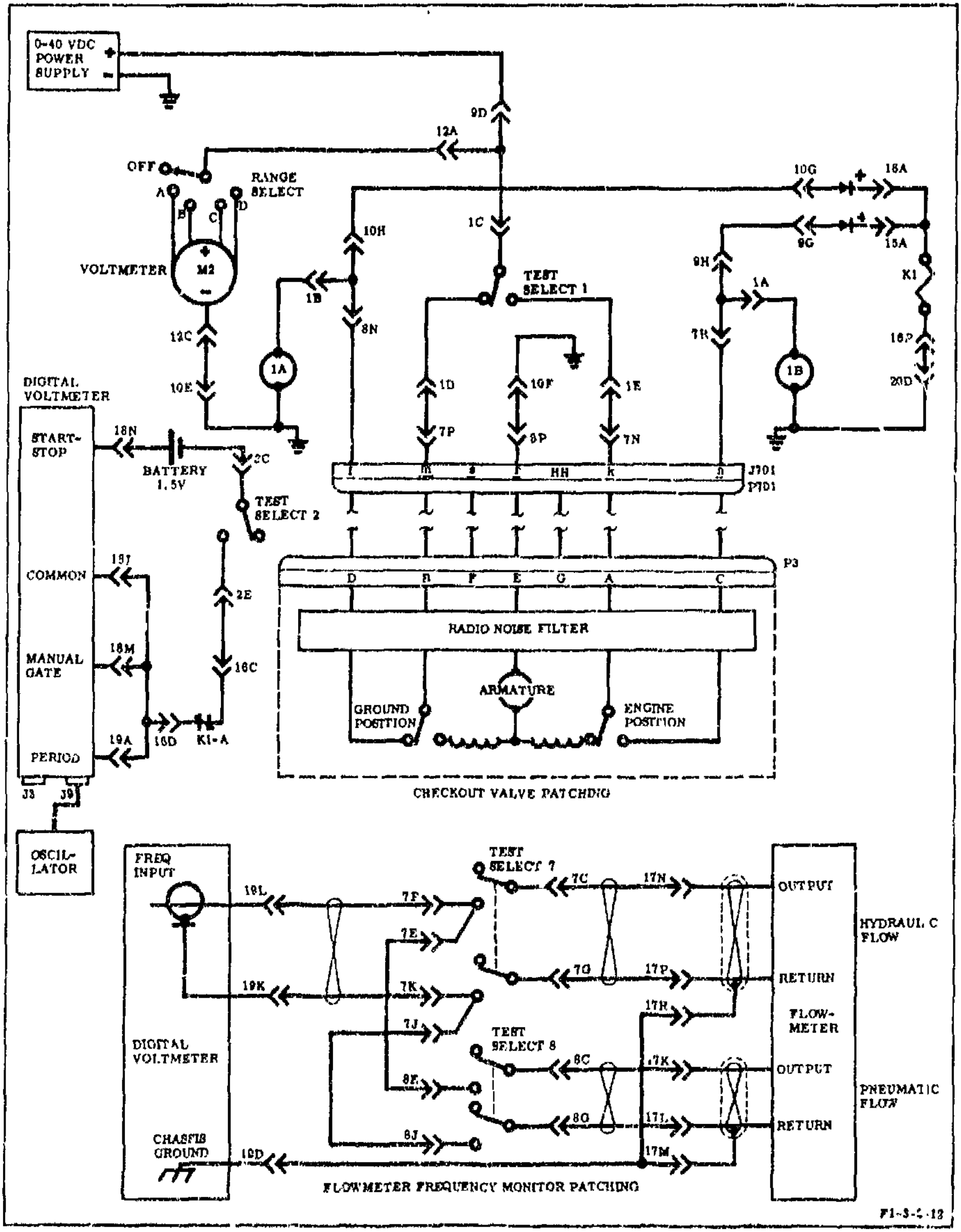


Figure 21-9. Components Test Console Patch-Panel Requirements (Sheet 1 of 2)

Patch-Cord[a]	From J6-	To J6-
K4.09	1A	7R
		9H
K4.09	1B	8N
		10H
K4.09	1C	9D
		12A
K3.	1D	7P
K3.	1E	7N
K3.	2C	Battery Negative
K3.	2E	16C
K3.	7C	17N
K3.	7E	8E
K3.	7F	19L
K3.	7G	17P
K3.	7J	8J
K3.	7K	19K

Patch-Cord[a]	From J6-	To J6-
K3.	8C	17K
K3.	8G	17L
K3.	8P	10F
3088-17[b]	9G	15A (+)
K3.	10E	12C
3088-17[b]	10G	16A (+)
K5.09	16D	18L
		18M
		19A
K3.	16P	20D
K4.09	17M	17R
		19D
K3.	18N	Battery Positive

(a) Use any cord length required on all patch-cords numbered K3.
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 21-9. Components Test Console Patch-Panel Requirements (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks
	NOTE The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.		
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Full DECREASE	

Figure 21-10. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (cont)			
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Cable BB52745-2	Connection to check-out valve.
	Connector J702	Capped	
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D (0-30)	None.
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]

(a) If indication is not as specified, press applicable switch-light.

Figure 21-10. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (cont)			
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 24 ±0.4 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.(a)
	HYDRAULIC SYSTEM SUPPLY		CLOSE.(a)
	TEST CELL SUPPLY "A"		VENT.(a)
	TEST CELL SUPPLY "B"		VENT.(a)
	FLOW MONITOR SHUTOFF		CLOSE.(a)
	LOW FLOW BYPASS		CLOSE.(a)
TIMING-TEST			
OSCILLATOR	RANGE	X100	Connect oscillator output to DVM FREQ/INPUT receptacle J9 (at rear of unit).
	Frequency vernier	100	
	ATTENUATION	10DB	
	POWER	ON	

NOTE

Oscillator must warm up at least 30 minutes.

Panel	Control	Position	Indication/Remarks
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	Midposition	
	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.

(a) If indication is not as specified, press applicable switch-light.

Figure 21-10. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (cont)			
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Digital voltmeter must warm up at least 30 minutes.

Panel	Control	Position	Indication/Remarks
FLOW-MONITOR-TEST			
DIGITAL VOLTMETER	115 V/230V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	INCREASE	3/4 turn from STOP
	POWER	ON	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 is for pneumatic flow. Both switch-lights must not be on at the same time.

- Digital voltmeter must warm up at least 30 minutes.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen and helium to console.

NOTE

Helium supply is required only for cryogenic tests.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed when working with pressurized systems.

Figure 21-10. Preparing Components Test Console for Use (Sheet 4 of 4)

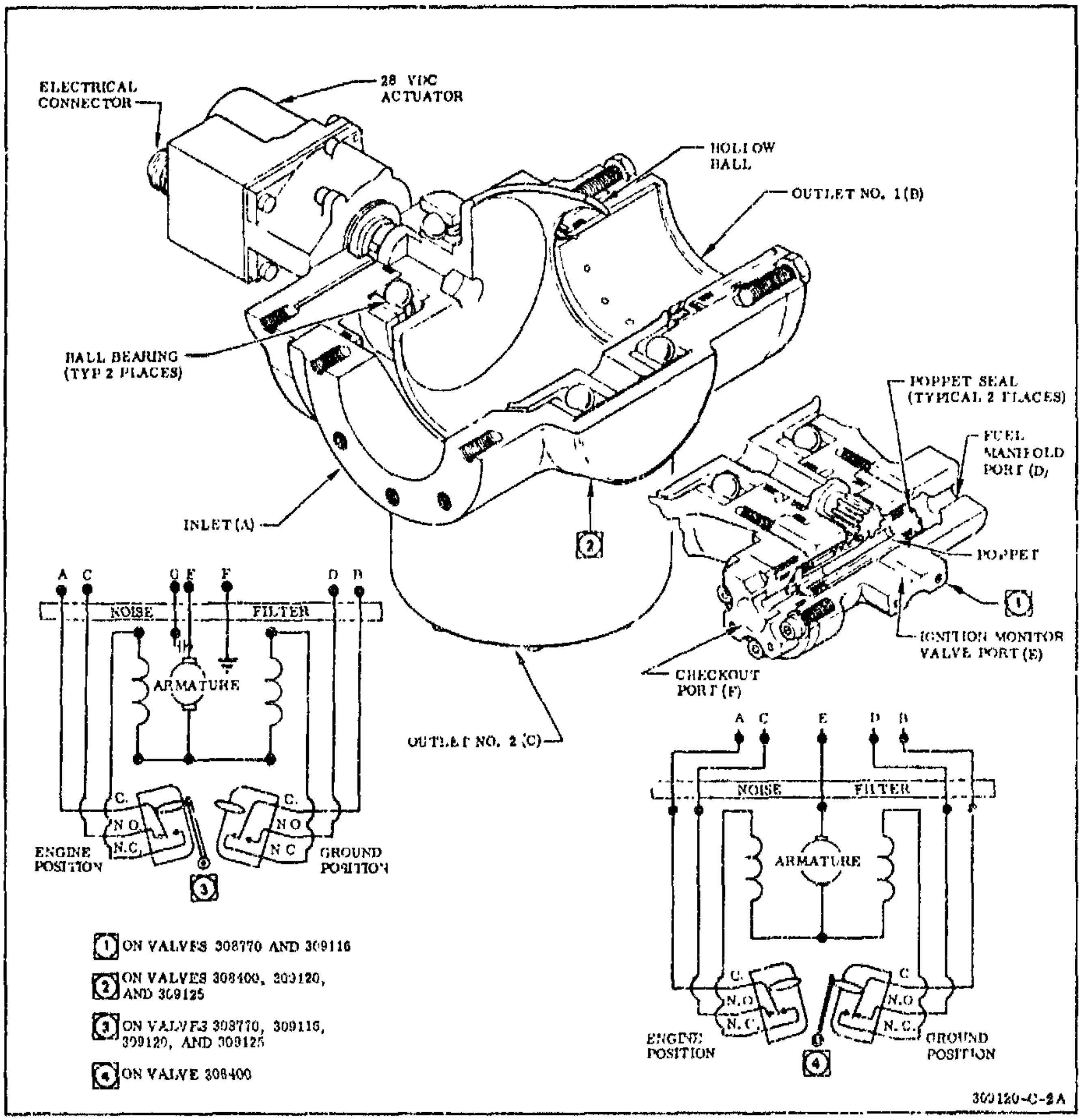


Figure 21-11. Checkout Valve--Cutaway View

Procedure	Result

21-18. SEAL SEATING.

NOTE

This procedure is required after valve assembly to properly seat seals (25, 39) on ball (26).

- Switches used for valve cycling are located on the ELECTRICAL CONTROL panel.

Procedure	Result
a. Prepare Components Test Console and checkout valve for use as outlined in paragraph 21-17.	None.
b. Press POWER switch-light.	POWER and AC INPUT lights off.
c. Connect cable BB52745-2 to INSTRUMENT outlet in test cell; then connect other end to checkout valve.	None.
d. Press POWER switch-light.	Power light ON and AC INPUT light on. Valve moves to ground position and light 1A on.
e. Press TEST SELECT 1 switch-light.	Valve moves to engine position. Light 1A off and lights 1 and 1B on.
f. Press TEST SELECT 1 switch-light.	Valve moves to ground position. Lights 1 and 1B off and light 1A on.
g. Repeat steps e and f a minimum of 10 times to properly seat seals (25, 39).	Same as steps e and f.
h. Press POWER switch-light.	POWER and AC INPUT lights off.

21-19. OUTLET NO. 1 SEAL REVERSE-LEAK-TEST.

NOTE

This test is required only on checkout valves 308400, 309120, and 309125.

Procedure	Result
a. Make sure Components Test Console G3141 and checkout valve are prepared for use as outlined in paragraph 21-17.	None.
b. On ELECTRICAL CONTROL panel, press POWER switch-light.	Power and AC INPUT lights off.
c. Connect checkout valve to console for outlet No. 1 seal reverse-leak-test. (See figure 21-12.)	None.
d. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER light ON and AC INPUT light on. Valve moves to ground position and light 1A on.

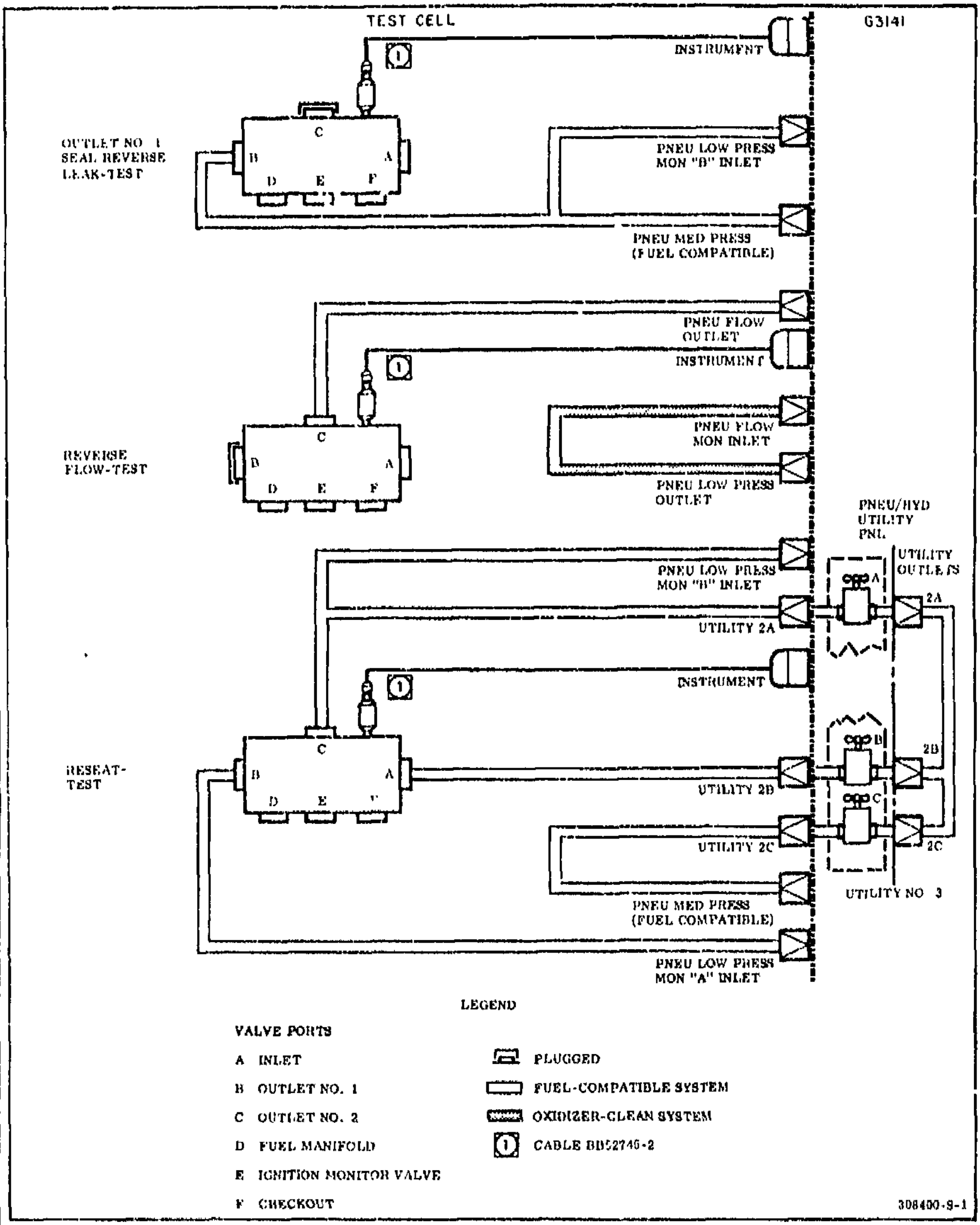


Figure 21-12. Checkout Valve Seal Reverse-Leak- and Flow-Test and Reseat-Test Setup

Procedure	Result
e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to OUTLET No. 1 port (B) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 25 ±3 psi.	PRESSURE MONITOR "B" gage must indicate 25 ±3 psi. OUTLET No. 1 port (B) pressurized.
f. Measure and record leakage from INLET port (A).	Maximum allowable leakage past OUTLET No. 1 seal is 500 scim.
g. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 80 ±8 psi.	PRESSURE MONITOR "B" gage must indicate 80 ±8 psi. OUTLET No. 1 port (B) pressurized.
h. Repeat step f.	Same as step f.
i. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 100 ±10 psi.	PRESSURE MONITOR "B" gage must indicate 100 ±10 psi. OUTLET No. 1 port (B) pressurized.
j. Repeat step f.	Same as step f.
k. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to OUTLET NO. 1 port (B) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	OUTLET No. 1 port (B) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
l. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.
m. Remove checkout valve from test setup.	None.
n. If checkout valve testing is terminated, secure equipment as outlined in paragraph 21-24.	None.
o. Install protective closures. Refer to paragraph 21-2.	None.

21-20. REVERSE-FLOW- AND RESEAT-TEST.

NOTE

This test is required only on checkout valves 308400, 309120, and 309125.

Procedure	Result
a. Make sure Components Test Console G3141 and checkout valve are prepared for use as outlined in paragraph 21-17.	None.
b. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.
c. Connect checkout valve to console for reverse-flow-test. (See figure 21-12.)	None.
d. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER light ON and AC INPUT light on. Valve moves to ground position and light 1A on.
e. Prepare digital voltmeter (DVM) for flow monitor tests (figure 21-10).	None.
f. On Flow/ΔP MONITOR panel, open flow SHUTOFF valve and make sure other valves are closed.	None.
g. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 8 switch-lights.	Valve moves to engine position. Light 1A off and lights 1, 1B, and 8 on.
h. On DVM panel, press RESET switch.	DVM indicates 000000-000001 KC.
i. Using LOW PRESSURE panel, apply pressure to OUTLET No. 2 port (C) as follows:	
(1) Close VENT and open SHUTOFF valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±5 psi.	REG SUPPLY PRESS gage must indicate 100 ±5 psi. OUTLET No. 2 port (C) pressurized.

NOTE

Flow past seal (39) is evident by the audible sound of gaseous nitrogen flowing from INLET port (A).

j. On DVM panel, press RESET switch; then record flow past seal (39).	DVM must indicate an equivalent to 5 scfm minimum.
k. Using LOW PRESSURE panel, reduce pressure to OUTLET No. 2 port (C) as follows:	
(1) Close SHUTOFF valve and allow pressure to be reduced through seal (39).	Pressure at OUTLET No. 2 port (C) must be reduced to zero.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	LOW PRESSURE panel depressurized.
l. On ELECTRICAL CONTROL panel, press TEST SELECT 8 switch-light.	Light 8 off.
m. On FLOW/ΔP MONITOR panel, close flow SHUTOFF valve.	None.

Procedure	Result
n. Remove checkout valve from test setup; then reconnect valve for reseat test (figure 21-12). Make sure valve is in engine position.	None.
o. Open UTILITY No. 2 valves B and C.	None.
p. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (A) as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 80 ±8 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 20 ±5 psi; then close SHUTOFF valve.	PRESSURE MONITOR "A" gage must indicate 20 ±5 psi. INLET port (A) pressurized.
q. Close UTILITY No. 2 valve B.	Pressure at INLET port (A) is locked up.
r. Open UTILITY No. 2 valve A.	OUTLET No. 2 port (C) pressurized.
s. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve and continue applying pressure to OUTLET No. 2 port (C) until pressure at OUTLET No. 1 port (B) is 50 ±10 psi as indicated on PRESSURE MONITOR "A" gage.	PRESSURE MONITOR "A" gage must indicate 50 ±10 psi.
t. Close UTILITY No. 2 valve A.	Pressure at OUTLET No. 2 port (C) is locked up.
u. Maintain pressure in the valve for one (+1, -0) minute; then compare pressure at OUTLET No. 2 port (C) with pressure at OUTLET No. 1 port (B).	Pressure at OUTLET No. 2 port (C) must be a minimum of 5 psig greater than the pressure at OUTLET No. 1 port (B).
v. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure as follows:	
(1) Close SHUTOFF valve and open VENT valve.	Utility panel depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
w. Open UTILITY No. 2 valves A and B.	Checkout valve depressurized.
x. Close UTILITY No. 2 valves A and B; then close MED PRESS FUEL COMPATIBLE panel VENT valve.	None.
y. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Valve moves to ground position. Lights 1 and 1B off and light 1A on.
z. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.
aa. Remove checkout valve from test setup.	None.
ab. If checkout valve testing is terminated, secure equipment as outlined in paragraph 21-24.	None.
ac. Install protective closures. Refer to paragraph 21-2.	None.

Procedure	Result
21-21. TIMING-TEST.	
a. Make sure Components Test Console G3141 and checkout valve are prepared for use as outlined in paragraph 21-17.	None.
b. Prepare oscillator and digital voltmeter (DVM) for timing-test. (See figure 21-10.)	None.

NOTE

All switches used during this test are located on the ELECTRICAL CONTROL panel unless otherwise specified.

Procedure	Result
c. Turn VOLTAGE ADJUST knob to full DECREASE position.	VOLTS meter must indicate less than 5 volts.
d. Adjust oscillator frequency vernier until DVM indicates 010.000 ±000.005 KC.	DVM must indicate 010.000 ±000.005 KC.
e. After 5 minutes, check that DVM indicates specified reading. Oscillator may require adjustment.	Same as step d.
f. Disconnect oscillator test lead from DVM receptacle J9 and connect it to receptacle J3.	None.
g. On digital voltmeter panel, perform the following:	
(1) Move 100 KC STD INT/EXT switch to the EXT position (rear of unit).	None.
(2) Turn FUNCTION switch to EXT SEL.	None.
(3) Turn SAMPLE PERIOD switch to EXT SEL.	None.
h. Connect cable BB52745-2 to INSTRUMENT outlet in test cell; then connect other end to checkout valve.	None.
i. Turn VOLTAGE ADJUST knob until VOLTS meter indicates 18 ±1/2 volts.	VOLTS meter must indicate 18 ±1/2 volts. Valve moves to ground position, and light 1A on (dim).
j. Press TEST SELECT 2 switch-light	Light 2 on.
k. On DVM panel, press RESET switch.	DVM must indicate 000000 MILLI-SEC.
l. Press TEST SELECT 1 switch-light; then record DVM indication.	Valve moves to engine position. Light 1A off, light 1 on, and light 1B on (dim). DVM indication must not exceed 006000 MILLI-SEC.
m. On DVM panel, press RESET switch.	DVM must indicate 000000 MILLI-SEC.

Procedure	Result
n. Press TEST SELECT 1 switch-light; then record DVM indication.	Valve moves to ground position. Lights 1 and 1B off and light 1A on (dim). DVM indication must not exceed 006000 MILLI-SEC.
o. Turn VOLTAGE ADJUST knob until VOLTS meter indicates 24 ±1/2 volts.	VOLTS meter must indicate 24 ±1/2 volts.
p. On DVM panel, press RESET switch.	DVM must indicate 000000 MILLI-SEC.
q. Press TEST SELECT 1 switch-light; then record DVM indication.	Valve moves to engine position. Light 1A off and lights 1 and 1B on. DVM indication must not exceed 003500 MILLI-SEC
r. On DVM panel, press RESET switch.	DVM must indicate 000000 MILLI-SEC.
s. Press TEST SELECT 1 switch-light; then record DVM indication.	V e moves to ground position. Lights 1 and 1B off and light 1A on. DVM indication must not exceed 003500 MILLI-SEC.
t. Turn VOLTAGE ADJUST knob until volts meter indicates 28 ±1/2 volts.	Volts meter must indicate 28 ±1/2 volts.
u. On DVM panel, press RESET switch.	DVM must indicate 000000 MILLI-SEC.
v. Press TEST SELECT 1 switch-light; then record DVM indication.	Valve moves to engine position. Light 1A off and lights 1 and 1B on. DVM indication must not exceed 003000 MILLI-SEC.
w. On DVM panel, press RESET switch.	DVM must indicate 000000 MILLI-SEC.
x. Press TEST SELECT 1 switch-light; then record DVM indication.	Valve moves to ground position. Lights 1 and 1B off and light 1A on. DVM indication must not exceed 003000 MILLI-SEC.
y. Press TEST SELECT 2 and POWER switch-light.	Lights 1A and 2 off and POWER and AC INPUT lights off.
z. Turn off oscillator; then remove oscillator and checkout valve from test setup.	None.
aa. If checkout valve testing is terminated, secure equipment as outlined in paragraph 21-24.	None.
ab. Install protective closures. Refer to paragraph 21-2.	None.

21-22. LEAK-TEST.

Procedure	Result
a. Make sure Components Test Console G3141 and checkout valve are prepared for use as outlined in paragraph 21-17.	None.
b. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.

Procedure	Result
c. Connect checkout valve to console for seal leak-test. (See figure 21-13.)	None.
d. Open hand valve 19-9022606-1.	None.
e. On ELECTRICAL CONTROL panel, press POWER switch-light; then press TEST SELECT 1 switch-light.	POWER light ON and AC INPUT light on. Valve moves to engine position and lights 1 and 1B on.
f. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±1 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±1 psi. INLET port (A) pressurized.
g. Measure and record leakage from OUTLET No. 2 port (C).	Leakage from OUTLET No. 2 port (C) must not exceed 20 scim.
h. Measure and record leakage from vent port.	Leakage from vent port must not exceed 5 scim.
i. Using leak-test compound (MIL-L-25567), check flange joints for leakage for 2 ±1 minutes.	No leakage is allowable.
j. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 30 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 30 ±5 psi. INLET port (A) pressurized.
k. Repeat steps g through i.	Same as steps g through i.
l. Close hand valve 19-9022606-1; then open PRESSURE MONITOR "A" gage VENT valve.	PRESSURE MONITOR "A" gage depressurized.
m. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 100 ±10 psi.	PRESSURE MONITOR "A" gage must indicate 100 ±10 psi. INLET port (A) pressurized.
n. Repeat steps g through i.	Same as steps g through i.
o. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to INLET port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±50 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±50 psi. INLET port (A) pressurized.
p. Repeat steps g through i.	Same as steps g through i.

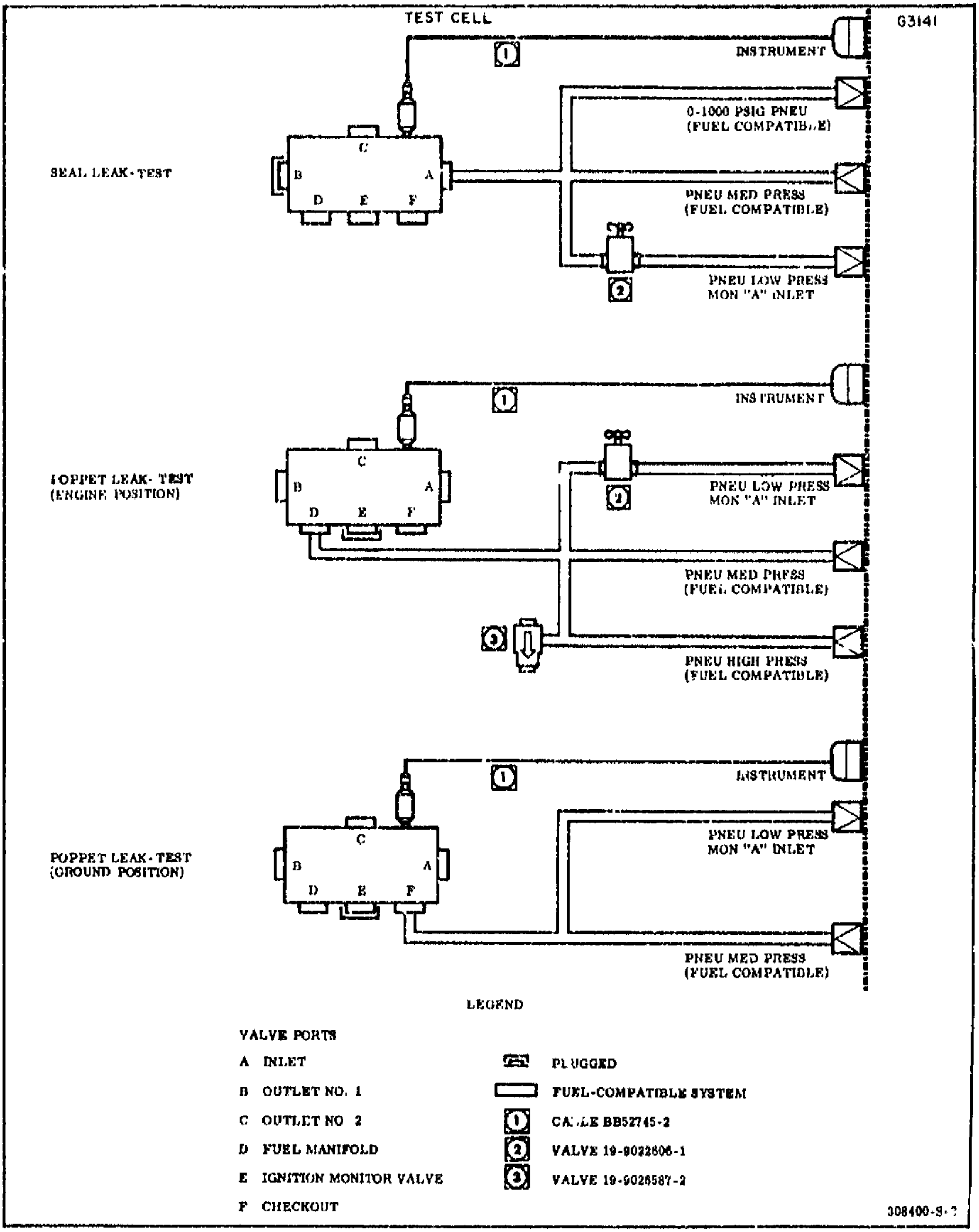


Figure 21-13. Checkout Valve Leak-Test Setup

Procedure	Result
q. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (A) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
r. Remove plug from OUTLET No. 1 port (B); then install a plug in OUTLET No. 2 port (C).	None.
s. Open hand valve 19-9022606-1; then close PRESSURE MONITOR "A" gage VENT valve.	None.
t. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Valve moves to ground position. Lights 1 and 1B off and light 1A on.
u. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to INLET port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±1 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±1 psi. INLET port (A) pressurized.
v. Measure and record leakage from OUTLET No. 1 port (B).	Leakage from OUTLET No. 1 port (B) must not exceed 10 scim.
w. Measure and record leakage from vent port.	Leakage from vent port must not exceed 5 scim.
x. Using leak-test compound (MIL-L-25567), check flange joints for leakage for 2 +1 minutes.	No leakage is allowable.
y. On MED PRESS, FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 30 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 30 ±5 psi. INLET port (A) pressurized.
z. Repeat steps v through x.	Same as steps v through x.
aa. Close hand valve 19-9022606-1; then open PRESSURE MONITOR "A" gage VENT valve.	PRESSURE MONITOR "A" gage depressurized.
ab. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 100 ±10 psi.	PRESSURE MONITOR "A" gage must indicate 100 ±10 psi. INLET port (A) pressurized.
ac. Repeat steps v through x.	Same as steps v through x.

Procedure	Result
ad. Using MED PRESS FUEL COMPATIBLE panel, increase pressure to INLET port (A) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 550 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until TEST CELL MONITOR PRESSURE gage indicates 500 ±50 psi.	TEST CELL MONITOR PRESSURE gage must indicate 500 ±50 psi. INLET port (A) pressurized.
ae. Repeat steps v through x.	Same as steps v through x.
af. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to INLET port (A) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	INLET port (A) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
ag. On ELECTRICAL CONTROL panel, press POWER switch-light.	Light 1A, POWER, and AC INPUT lights off.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
agA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
ah. Remove checkout valve from test setup.	None.
ai. If checkout valve testing is terminated, secure equipment as outlined in paragraph 21-24.	None.
aj. Install protective closures. Refer to paragraph 21-2.	None.

21-23. POPPET LEAK-TEST.

NOTE

This test is required only on checkout valves 308770 and 309116.

Procedure	Result
a. Make sure Components Test Console G3141 and checkout valve are prepared for use as outlined in paragraph 21-17.	None.
b. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.
c. Connect checkout valve to console for poppet leak-test (engine position). (See figure 21-13.)	None.
d. Open hand valve 19-9022606-1.	None.
e. On ELECTRICAL CONTROL panel, press POWER switch-light; then press TEST SELECT 1 switch-light.	POWER light ON and AC INPUT light on. Valve moves to engine position and lights 1 and 1B on.

Procedure	Result
f. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to FUEL MANIFOLD port (D) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±5 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±1 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±1 psi. FUEL MANIFOLD port (D) pressurized.
g. Measure and record leakage from CHECKOUT port (F).	Leakage from CHECKOUT port (F) must not exceed 10 scim.
h. Using leak-test compound (MIL-L-25567), check flange joints for leakage for 2 ±1 minutes.	No leakage is allowable.
i. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 30 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 30 ±5 psi. FUEL MANIFOLD port (D) pressurized.
j. Repeat steps g and h.	Same as steps g and h.
k. On MED PRESS FUEL COMPATIBLE panel, close SHUTOFF valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
l. Close hand valve 19-992606-1; then open PRESSURE MONITOR "A" gage VENT valve.	PRESSURE MONITOR "A" gage depressurized.
m. Using HIGH PRESS FUEL COMPATIBLE panel, increase pressure to FUEL MANIFOLD port (D) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,400 ±50 psi.	HIGH PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate 1,400 ±50 psi. FUEL MANIFOLD port (D) pressure increased.
n. Repeat steps g and h.	Same as steps g and h.
o. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,900 ±50 psi.	REG SUPPLY PRESS gage must indicate 2,900 ±50 psi. FUEL MANIFOLD port (D) pressure increased.
p. Repeat steps g and h.	Same as steps g and h.
q. Using HIGH PRESS FUEL COMPATIBLE panel, reduce pressure to FUEL MANIFOLD port (D) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	FUEL MANIFOLD port (D) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
r. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light; then press POWER switch-light.	Valve moves to ground position and lights 1 and 1B off. POWER and AC INPUT lights off.

Procedure	Result
s. Remove checkout valve from test setup; then reconnect valve for poppet leak-test (ground position). (See figure 21-13.)	None.
t. On ELECTRICAL CONTROL panel, press POWER switch light.	POWER light ON and AC INPUT light on. Valve moves to ground position and light 1A on.
u. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to CHECKOUT port (F) as follows:	
(1) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 100 ±10 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(2) Slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 10 ±1 psi.	PRESSURE MONITOR "A" gage must indicate 10 ±1 psi. CHECKOUT port (F) pressurized.
v. Measure and record leakage from FUEL MANIFOLD port (D).	Leakage from FUEL MANIFOLD port (D) must not exceed 10 scim.
w. Using leak-test compound (MIL-L-25567), check flange joints for leakage for 2 ±1 minutes.	No leakage is allowable.
x. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 50 ±5 psi.	PRESSURE MONITOR "A" gage must indicate 50 ±5 psi. CHECKOUT port (F) pressurized.
y. Repeat steps v and w.	Same as steps v and w.
z. On MED PRESS FUEL COMPATIBLE panel, slowly open SHUTOFF valve until PRESSURE MONITOR "A" gage indicates 100 ±10 psi.	PRESSURE MONITOR "A" gage must indicate 100 ±10 psi. CHECKOUT port (F) pressurized.
aa. Repeat steps v and w.	Same as steps v and w.
ab. Using MED PRESS FUEL COMPATIBLE panel, reduce pressure to CHECKOUT port (F) as follows:	
(1) Close SHUTOFF valve and open VENT valve.	CHECKOUT port (F) depressurized.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	MED PRESS FUEL COMPATIBLE panel depressurized.
(3) Close VENT valve.	None.
ac. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.

WARNING

The following procedure uses cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
acA. Remove all leak-test compound from joints and fittings with a clean, dry cloth, or by flushing inaccessible areas with cleaning compound (MIL-C-81302).	None.
ad. Remove checkout valve from test setup.	None.
ae. If checkout valve testing is terminated, secure equipment as outlined in paragraph 21-24.	None.
af. Install protective closures. Refer to paragraph 21-2.	None.

21-23A. ENGINE RETURN SWITCH DEACTUATED POSITION VERIFICATION TEST.

Procedure	Result
a. Using a multimeter, continuity test position switch. Record multimeter indication.	Multimeter must indicate infinity between pins A and C and continuity between pins B and D.
b. Install protective closures. Refer to paragraph 21-2.	None.

21-24. SECURING TEST EQUIPMENT.

21-25. After checkout valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves and adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn oscilloscope and digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

21-26. CHECKOUT VALVE ACTUATOR 308399.

21-27. The following procedures contain cleaning, inspecting and repairing, and testing information required to maintain the checkout valve actuator. Disassembly and assembly of the checkout valve actuator is not recommended. See figure 21-14 for special test equipment used during these procedures.

21-28. CLEANING.

21-29. Clean electrical connector and hand-wipe exterior surfaces of filter and actuator as outlined in R-3896-3, Volume I.

Part Number	Nomenclature	Use
Model 630 (Triplett), or equivalent	Multimeter	Makes electrical measurements
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests

Figure 21-14. Special Test Equipment for Checkout Valve Actuator

21-30. INSPECTING AND REPAIRING.

21-31. Inspecting the checkout valve actuator determines if the individual parts have been damaged by mishandling or wear. See figure 21-15 and inspect individual parts for general condition, thread damage, corrosion, distortion, nicks, burs, scratches, and bent electrical pins.

21-32. TESTING.

21-33. This procedure outlines requirements for testing the checkout valve actuator. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Refer to paragraphs 21-34 and 21-35 for checkout valve actuator test procedures.

Part Name	Inspecting	Repairing
Filter	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Bent or broken pins on electrical connector.	Replace actuator.
Actuator	Damaged sealing surface.	Replace actuator.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Damaged shaft.	Replace actuator.

Figure 21-15. Inspecting and Repairing Checkout Valve Actuator

Procedure	Result
21-34. RESISTANCE TEST.	
a. Connect a 28-vdc electrical power source to actuator electrical connector (positive (+) to pin A and negative (-) to pin E). Make sure power source is turned off.	None.

CAUTION

The 28 vdc must not be applied to pins A and B simultaneously, since damage to the equipment will result.

- The correct polarity must be maintained or the filter diodes will be damaged when voltage is applied.

NOTE

The power supply panel located on Components Test Console G3141 may be used as a source for 28 vdc.

Procedure	Result
b. Apply 28 vdc to pins A and E to move actuator to OPEN (engine) position.	Actuator moves to OPEN (engine) position.
c. Deenergize 28-vdc electrical power source; then remove power source from electrical connector.	None.
d. With actuator in OPEN (engine) position, use multimeter to measure resistance, as follows:	
(1) Between pins A and C.	Resistance must be less than 10 ohms.
(2) Between pins B and E.	Resistance must be less than 10 ohms.

Procedure	Result
e. Connect 28 vdc to actuator electrical connector (positive (+) to pin B and negative (-) to pin E). Make sure power source is turned off.	None.

CAUTION

The 28 vdc must not be applied to pins A and B simultaneously, since damage to equipment will result.

- The correct polarity must be maintained or the filter diodes will be damaged when voltage is applied.

Procedure	Result
f. Apply 28 vdc to pins B and E to move actuator to CLOSED (ground) position.	Actuator moves to CLOSED (ground) position.
g. Deenergize 28-vdc electrical power source; then remove power source from electrical connector.	None.
h. With actuator in CLOSED (ground) position, use multimeter to measure resistance, as follows:	
(1) Between pins B and D.	Resistance must be less than 10 ohms.
(2) Between pins A and E.	Resistance must be less than 10 ohms.
i. Leave actuator in CLOSED (ground) position.	None.

21-35. INSULATION RESISTANCE TEST.

Procedure	Result
a. Using megohmmeter, apply 50 vdc for 2.0 (+0.5, -0.0) minutes between each pin and case individually, and measure resistance. Connect positive (+) to pins and negative (-) to case.	Insulation resistance between pins and case must exceed 50 megohms.

CAUTION

The electrical connector must be dry prior to performing test, since moisture can cause the insulation to break down.

- The correct polarity must be maintained or the filter diodes will be damaged when voltage is applied.

NOTE

Initial low-resistance readings due to charging of the filter capacitors must not be the cause for rejecting the actuator.

SECTION XXII

ENGINE CONTROL VALVE

WARNING

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

22-1. ENGINE CONTROL VALVE 601875.

22-2. The following procedures contain the disassembling, cleaning, inspecting, and repairing, assembling, and testing information required to maintain the engine control valve. See figure 22-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. Lubricate (Method A) all closure fasteners used in valve inserts with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication methods are outlined in R-3896-3, Volume I.

Part No.	Nomenclature	Use
T-5031700	Pressure Test Fixture	Adapts to valve ports during pressure test.
G3141	Components Test Console	Provides gaseous nitrogen and hydraulic fuel for testing engine control valve.
G3143	Components Adapter Set	Provides hardware for engine control valve test setups.
Model 521CR (Hewlett Packard Co), or equivalent	Electronic Counter	Provides a means for measuring flow during timing and actuation tests.
MT-109 (Waugh), or equivalent	Flowmeter (3/4-inch inlet and outlet)	Provides a means for measuring flow during timing and actuation tests.
Model G-12 (Triad Transformer Corp), or equivalent	Transformer	Provides voltage compatibility between flowmeter and electronic counter during timing and actuation tests.
	Pressure Gage 0-15 psig, 0.25% full-scale accuracy, hydraulic service, or equivalent	Measures hydraulic pressure during surface wetting leak-test.

Figure 22-1. Test Equipment and Special Tools for Engine Control Valve

Figure 22-2 deleted.

22-3. DISASSEMBLING.

22-4. Disassemble engine control valve, as required, to accomplish necessary repairs and/or replacement. See figure 22-3 for parts and index numbers.

a. Remove plugs (1), gaskets (2), and bolts (3).

b. Remove bolts (4), washers (5), valves (6), retainers (7), and packings (8).

c. Remove bolts (9, 10), washers (11), solenoid valve (12), and seal (13).

d. Remove bolts (15), washer (16), and cover (17).

e. Remove filters (18, 24) with a 3/8-24 threaded T-handle, then remove retainers (19, 25) and packings (20, 23, 26, 27) from filters.

NOTE

Plate (28) and pins (29, 30) need not be removed unless damaged.

22-5. CLEANING.

22-6. Clean filter of engine control valve as outlined in paragraphs 22-7 through 22-10. Clean remaining valve parts for hydraulic service as outlined in R-3896-3, Volume I.

22-7. CLEANING FILTERS. Engine control valve filters must be cleaned ultrasonically. The ultrasonic generator and transducer must be capable of 15-40 kc per second, 5 watts per square inch minimum and 7.5 watts per square inch maximum (calculated) power input for particle counting, and 3 watts per square inch minimum power input for cleaning. The power of the unit (input into tank) may be calculated as follows:

$$\frac{\text{Nametag rating of generator}}{\text{Tank surface area (in}^2\text{)}} = \text{Number of watts/in}^2$$

22-8. PRE-CLEANING FILTERS.

a. Prepare a solution of the following ingredients. Solution must be thoroughly mixed and heated to 110° to 120° F. Increased equivalent amounts may be used for larger volumes.

(1) 1,000 milliliters distilled or deionized water.

(2) 30 grams EDTA (ethylenediamine tetra-acetic acid).

(3) 225 grams DSP (disodium phosphate heptahydrates $N0_2HP0_47H_20$).

(4) 5 milliliters triton X-100.

b. Filter solution through a filter disk (10.0-micron maximum) and collect in a clean stainless steel container.

NOTE

Solution must be continuously recirculated through 25-micron (absolute) stainless steel filters when ultrasonic unit is not turned on.

c. Suspend filter to be cleaned with open end up in solution and soak for 10-15 minutes. Solution temperature must be 120° ±15° F.

d. Following soaking period, operate ultrasonic unit at a minimum of 3.0 watts per square inch for 10-12 minutes.

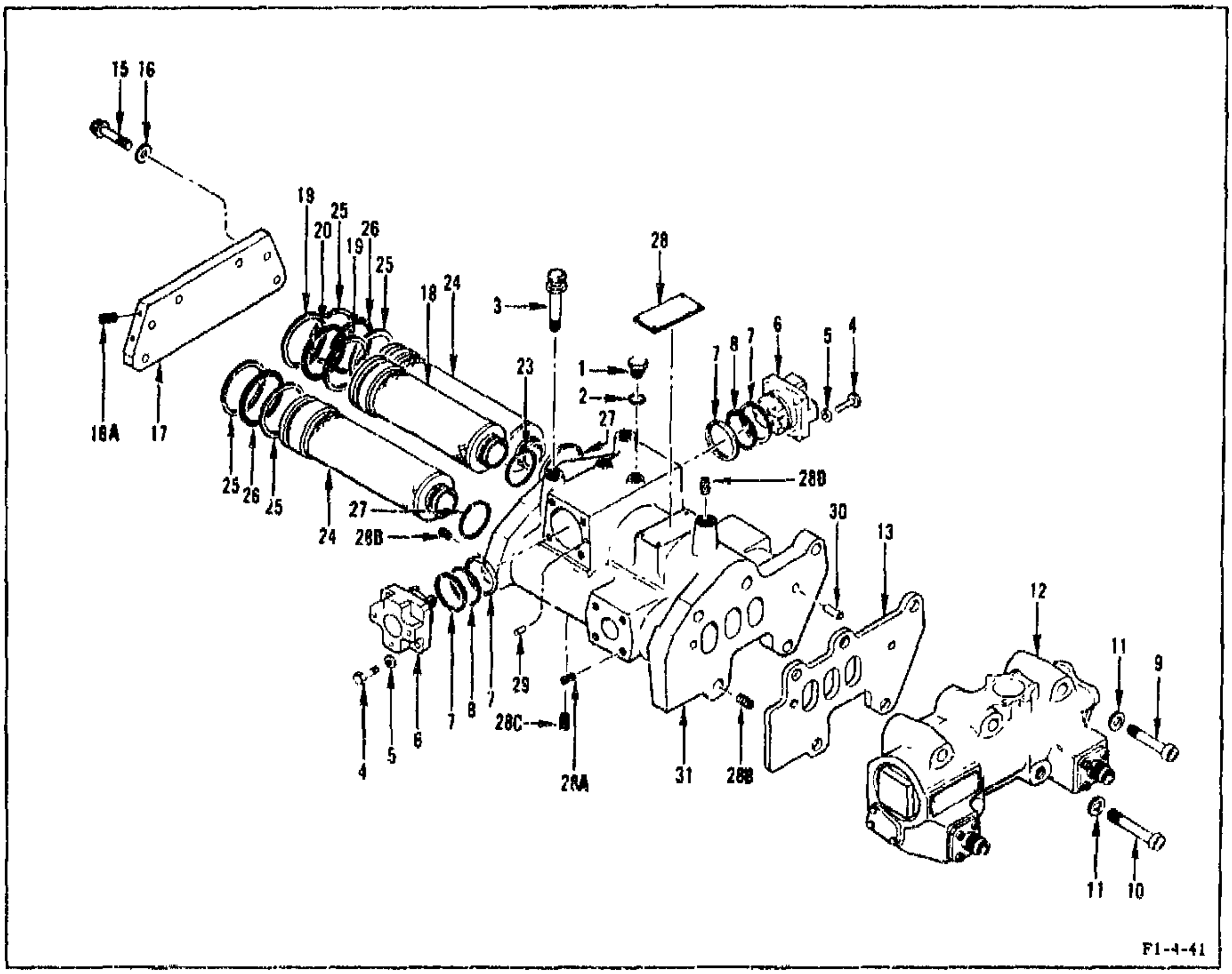
e. Remove filter and suspend (open end up) in a clean glass container containing filtered tap water (25-micron absolute) heated to 140 ±10° F. Operate ultrasonic unit for 2-4 minutes at minimum of 3.0 watts per square inch.

f. Change water in container and repeat step e.

g. Repeat steps c and d, increasing times by 5-6 minutes.

h. Rinse filters with filtered (25-micron absolute) deionized water (ambient) at full flow for 3-5 minutes.

i. Repeat steps e and f.



1	Plug	10	Bolt	18	Filter	27	Packing
2	Gasket	11	Washer	19	Retainer	28	Plate
3	Bolt	12	Solenoid Valve	20	Packing	28A	Insert
4	Bolt	13	Seal	21	(Deleted)	28B	Insert
5	Washer	14	(Deleted)	22	(Deleted)	28C	Insert
6	Valve	15	Bolt	23	Packing	29	Pin
7	Retainer	16	Washer	24	Filter	30	Pin
8	Packing	16A	Insert	25	Retainer	31	Manifold
9	Bolt	17	Cover	26	Packing		

Figure 22-3. Engine Control Valve--Exploded View

j. Repeat steps e and f using filtered (25-micron absolute) distilled or deionized water at ambient temperature. Check pH of water bath and water bath source. Readings must agree within 0.2. Repeat steps as necessary until balance desired is achieved.

WARNING

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

- Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

k. Dry filters in an oven at 200° ±10° F for a minimum of 30 minutes or by purging with a regulated source of low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the cleanness and humidity requirements of MIL-P-27401.

22-9. CLEANNESS OF EQUIPMENT.

WARNING

The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

a. Check cleanness of equipment (without installing filter to be cleaned) with 200 milliliters of cleaning compound (MIL-C-81302) filtered through a 0.45-micron filter. Pass filtered cleaning compound through equipment and collect in a clean container.

b. Filter collected fluid through a black 0.45-micron filter disk for particle counting. Do not disrupt particle distribution on disk.

c. Perform particle count. Maximum number of particles larger than 50 microns must not exceed 100. If particles exceed this limit, repeat procedure until within accepted limit.

22-10. CLEANNESS TEST.

a. Install filter in ultrasonic unit so that fluid will pass through filter in designed direction of flow.

b. Turn on ultrasonic unit (5-7 watts per square inch).

WARNING

The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

c. After 1 ±0.25 minutes and at intervals of 4, 7, and 9 minutes, pass 500 milliliters of cleaning compound (MIL-C-81302) through the filter and collect approximately 2,000 milliliters of fluid in a clean container.

NOTE

Fluid level in filter container must remain relatively constant at a point near the filter collar.

d. Turn off ultrasonic unit.

e. Filter the sample through a black 0.45-micron membrane disk, rinsing collection container with clean fluid when approximately 25 milliliters of sample fluid remains to be filtered.

f. Perform particle count. For particles 50 microns in size and larger, the entire effective filter disk area must be counted and all particles of 50-100 microns and over must be counted and recorded, with no differentiation between particles and fibers. Contamination collected for a 2,000-milliliter sample must not exceed 1,000 particles in 50-100 micron range and 200 particles in excess of 100 microns (including fibers). Filters not meeting these requirements must be recleaned as outlined in this paragraph.

WARNING

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

- Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

g. Dry filters in an oven at 200° ±10° F for a minimum of 30 minutes or by purging with a regulated source of low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the cleanness and humidity requirements of MIL-P-27401.

22-11. INSPECTING AND REPAIRING.

22-12. Inspecting the engine control valve determines if the individual parts have been damaged by mishandling or wear. See figure 22-4 and inspect individual parts for general condition, damage of threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits are listed in figure 22-4A and form the guide for serviceability of parts. Minimum and maximum values are given that, when exceeded, require repair or replacement of the applicable parts.

22-13. ASSEMBLING.

22-14. The assembly procedures for the engine control valve must be performed in the order listed and all parts must meet cleaning requirements as outlined in paragraph 22-5. The lubricant used in this procedure is hydraulic fluid (MIL-H-5606). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 22-3 for parts and index numbers.

a. Lubricate (Method M) packings (26, 27) and install packings and retainers (25) in grooves of filters (24). Install filters (24) with a 3/8-24 threaded T-handle in manifold (31).

Part Name and Index No.	Inspecting	Repairing
Valve (6)	Damage to sealing surfaces or gate.	Replace.
Solenoid Valve (12)	Refer to section XXIII.	
Seal (13)	Deteriorated or damaged sealing surfaces.	Replace seal.
Filters (18, 24)	Damage to element or sealing surfaces.	Replace filter.
Manifold (13)	Damaged inserts.	Replace inserts. Refer to R-3896-3, Volume I.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damaged sealing surfaces.	Replace manifold.
	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.

Figure 22-4. Inspecting and Repairing Engine Control Valve

Part Name and Index No.	Dimension	Minimum (Inches)	Maximum (Inches)
Manifold (31)	Check valve (6) bore diameter	1.687	1.689
	Filter (24) bore inner diameter	1.380	1.383
	Filter (24) bore outer diameter	2.249	2.251
	Filter (18) bore inner diameter	1.755	1.758
	Filter (18) bore outer diameter	2.312	2.314
Valve (6)	Packing (8) groove diameter	1.509	1.511
	Packing (8) land diameter	1.684	1.185
Filter (24)	Inner end land diameter	1.366	1.369
	Outer end land diameter	2.246	2.247
Filter (18)	Inner end land diameter	1.741	1.744
	Outer end land diameter	2.308	2.309
Seal (13)	Thickness	0.182	0.192
	Flat within 0.010 inch total		

Figure 22-4A. Dimensional Limits for Engine Control Valve

b. Lubricate (Method M) packings (20, 23) and install packings and retainers (19) in grooves of filter (18). Install filter (18) with a 3/8-24 threaded T-handle in manifold (31).

c. Position cover (17) on manifold (31); then secure cover to manifold with bolts (15) and washers (16). Torque bolts to 320-390 in-lb.

d. Position seal (13) and solenoid valve (12) on manifold (31); then secure solenoid valve to manifold with bolts (9, 10) and washers (11). Torque bolts to 320-390 in-lb.

e. Lubricate (Method M) packings (8) and install packings and retainers (7) in grooves of valves (6). Install valves (6) in manifold (31), then secure valves to manifold with bolts (4) and washers (5). Torque bolts to 80-100 in-lb.

f. Install bolts (3) in manifold (31). Torque bolts to 80-100 in-lb.

g. Lubricate (Method M) gaskets (2), and lubricate plugs (1) by thoroughly wetting the threads. Place gaskets (2) on plugs (1), then install plugs in manifold (31). Torque plugs to 40-65 in-lb.

h. Safetywire bolts (4, 9, 10, 15) and plugs (1).

22-15. TESTING.

22-16. This procedure outlines requirements for testing the engine control valve using Components Test Console G3141 and Components Adapter Set G3143. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test fixtures on the engine control valve as specified in figure 22-5. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up components test console electrical patch panel as specified in figure 22-6 and prepare console for use (figure 22-6A). See figure 22-7 for engine control valve cutaway view. Refer to paragraphs 22-17 through 22-18 for engine control valve test procedures, and see figures 22-7A through 22-11 for test setups. Refer to figure 22-8C for a typical valve timing trace. The engine control valve must be firmly secured during testing.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to either the GSE or ENG supply port; otherwise, damage to the spool can result.

Index Letter	Valve Port	Fixture	Port Connection
A	GSE SUPPLY	T-5031700-303	MS33656-16
B	ENG SUPPLY	T-5031700-303	MS33656-16
C	OPENING	T-5031700-302	MS33656-16
D	CLOSING	T-5031700-302	MS33656-16
E	RETURN	T-5031700-301	MS33656-20
F	OVERRIDE	None	AND10050-8
	NH1a and NH1b	None	AN815-4C

Figure 22-5. Preparing Engine Control Valve for Test

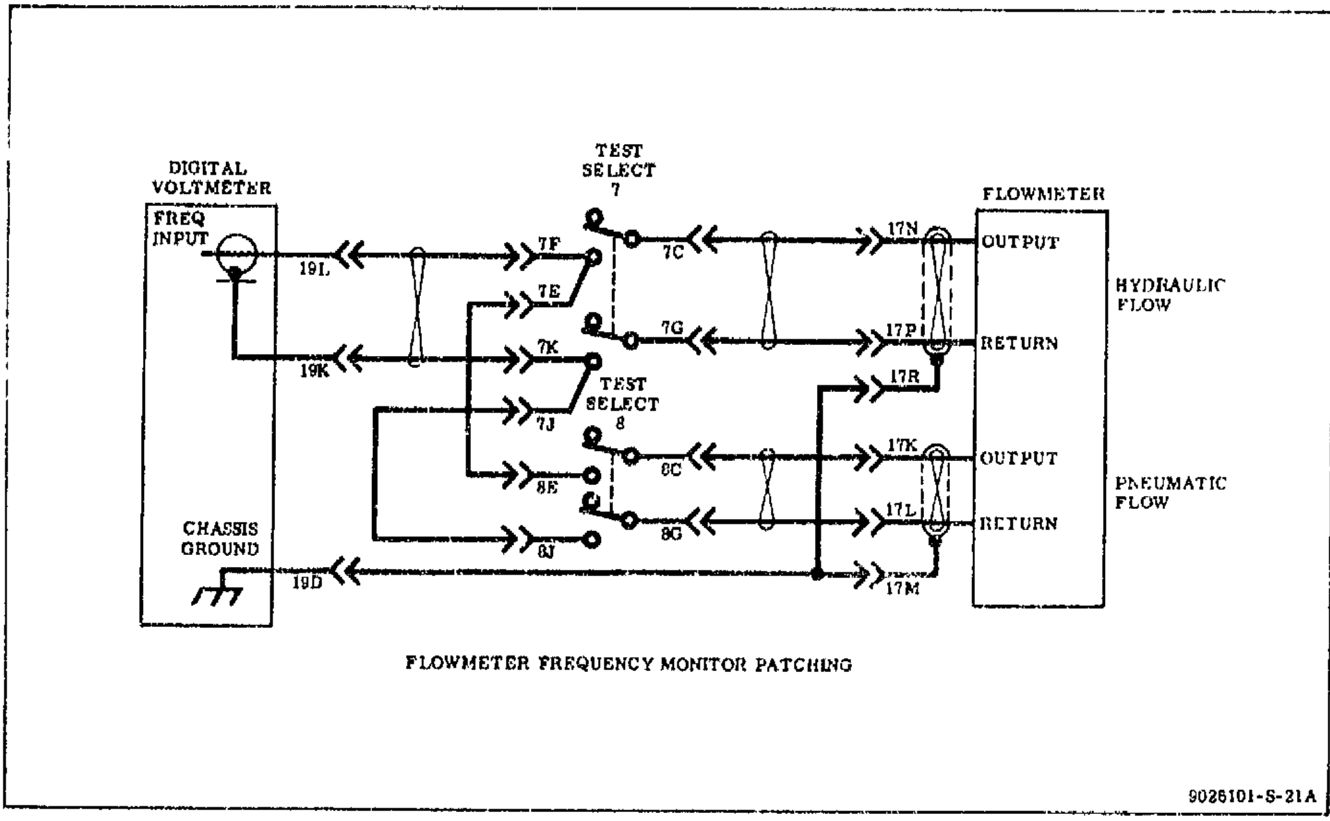


Figure 22-6. Components Test Console Patch-Panel Requirements (Sheet 1 of 3)

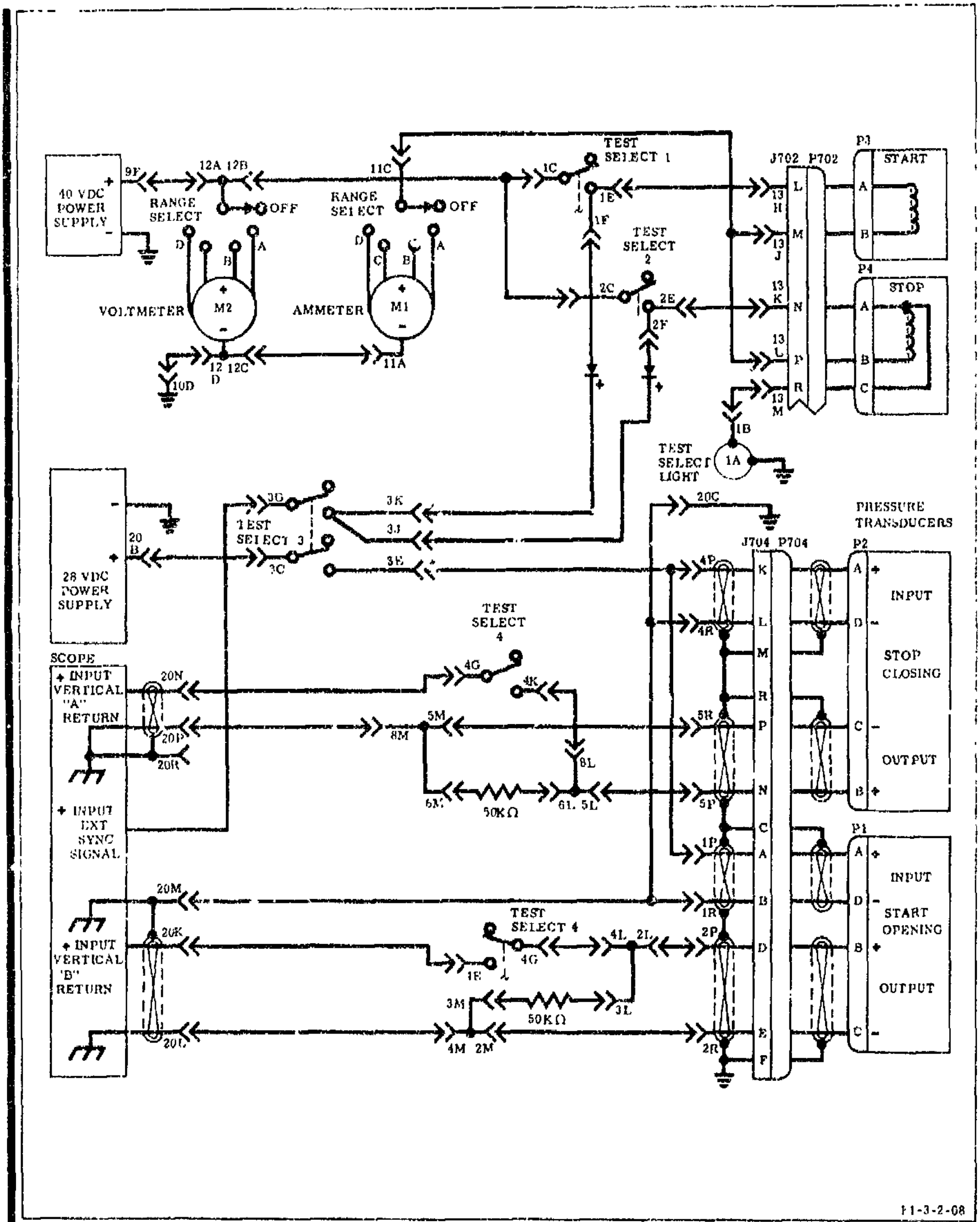


Figure 22-6. Components Test Console Patch-Panel Requirements (Sheet 2 of 3)

Patch-Cord	From J6-	To J6-	Patch-Cord	From J6-	To J6-
K3.[a]	1B	13M	K3.[a]	4K	8L
K4.09	1C	2C	K3.[a]	4M	20L
		12B	K3.[a]	4E	20K
K3.	1E	13H	K3.[a]	5L	5P
3088-17[b]	1F	3K(+)	K3.[a]	5M	5R
K4.09	1P	3E	3088-14	6L	6M
		4P	K3.[a]	7C	17N
K5.09	1R	4R	K3.[a]	7E	8E
		20C	K3 [a]	7F	19L
		20M	K3.[a]	7G	17P
K3.[a]	2E	13K	K3.[a]	7J	8J
3088-17[b]	2F	3J(+)	K3.[a]	7K	19K
K3.[a]	4C	4L	K3.[a]	8C	17K
K3.[a]	2L	2P	K3.[a]	8G	17L
K3.[a]	2M	2R	K5.09	8M	20P
K3.[a]	3C	20B	K3.[a]	9F	12A
K3.[a]	3G	+ Input	K3.[a]	10D	12D
		Ext Sync	K3.[a]	11A	12C
		(on Scope)	K4.09	11C	13J
3088-14	3L	3M			13L
K3.[a]	4G	20M	K4.09	17M	17R
					19D

(a) Use any cable length required.
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 22-6. Components Test Console Patch-Panel Requirements (Sheet 3 of 3)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.

PRE-POWER TURN ON

Panel	Control	Position	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	

Figure 22-6A. Preparing Components Test Console for Use (Sheet 1 of 6)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	FULL DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115V/230V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Cable BB52752	For start and stop solenoids.
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Cable BB52751	For pressure transducers.
	Connector J705	Capped	

CAUTION

Facility pneumatic and hydraulic supplies to console must be off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.

Figure 22-6A Preparing Components Test Console for Use (Sheet 2 of 6)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	2	Approximately two-thirds of way between 0 and 3.
ELECTRICAL CONTROL	POWER		POWER light on, AC INPUT light on.(a)
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 OFF. START SOLENOID control.(a)
	TEST SELECT 2		Light 2 OFF. Timing and STOP SOLENOID control.(a)
	TEST SELECT 3		Light 3 OFF. Digital voltmeter return and transducer power control.(a)
	TEST SELECT 4		Light 4 OFF. Timing power control.(a)
	TEST SELECT 5		Light 5 OFF. Transducer signal and oscilloscope input control.(a)
	TEST SELECT 6		Light 6 OFF. (Not used.)(a)
	TEST SELECT 7		Light 7 OFF. Hydraulic flow monitor control.(a)
	TEST SELECT 8		Light 8 OFF. Pneumatic flow monitor control.(a)
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 28 ±0.5 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.(a)
	HYDRAULIC SYSTEM SUPPLY		CLOSE.(a)

(a) If indication is not as specified, press switch-light.

Figure 22-6A. Preparing Components Test Console for Use (Sheet 3 of 6)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
OSCILLOSCOPE	FOCUS	Arrow up	Adjust later for best focus.
	VERTICAL POSITION	Arrows up	Adjust later for best position.
	HORIZ. POSITION	Arrow up	Adjust later for best position.
	INTENSITY	Arrow horizontal (to left)	Adjust later for best intensity. Allow 30-minute warmup period before use.
	Power light	On	To right of cathode ray tube.
DIGITAL VOLTMETER	115V/230V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.

(a) If indication is not as specified, press switch-light.

Figure 22-6A. Preparing Components Test Console for Use (Sheet 4 of 6)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Allow digital voltmeter to warm up for at least 30 minutes prior to use.

Panel	Control	Position	Indication/Remarks
FLOW MONITOR TEST			
DIGITAL VOLTMETER	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	Arrow up	
OSCILLOSCOPE	A VERT. SENSITIVITY	1 VOLT/CM/DC	
	A VERT. SENSITIVITY VERNIER	Arrow horizontal to right	
	B VERT. SENSITIVITY	1 VOLT/CM/DC	
	B VERT. SENSITIVITY VERNIER	Arrow up	
	SWEEP TIME HORIZ. SENS.	5 MILLISEC/CM	
	SWEEP TIME HORIZ. SENS. VERNIER	CAL	Fully clockwise.
	CHANNEL A POLARITY	POS. UP	

Figure 22-6A. Preparing Components Test Console for Use (Sheet 5 of 6)

Panel	Control	Position	Indication/Remarks
FLOW MONITOR TEST (continued)			
	VERT. PRESENTATION	CHOP	
	TRIGGER LEVEL	AUTO	
	TRIGGER LEVEL SYNC.	EXT	
	DC-AC	DC	
	GROUND STRAPS (A and B)	Ground	
	X1 SWP. - X5 EXP.	X1 SWP.	

PNEUMATIC PREPARATION

a. Make sure that console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED light (located on console and in test cell) comes on to indicate pressure downstream of console regulators when individual panel SHUTOFF valves are opened. Safety precautions specified in R-3896-3, Volume I, must be followed to make sure of safety of personnel working with pressurized systems.

Figure 22-6A. Preparing Components Test Console for Use (Sheet 6 of 6)

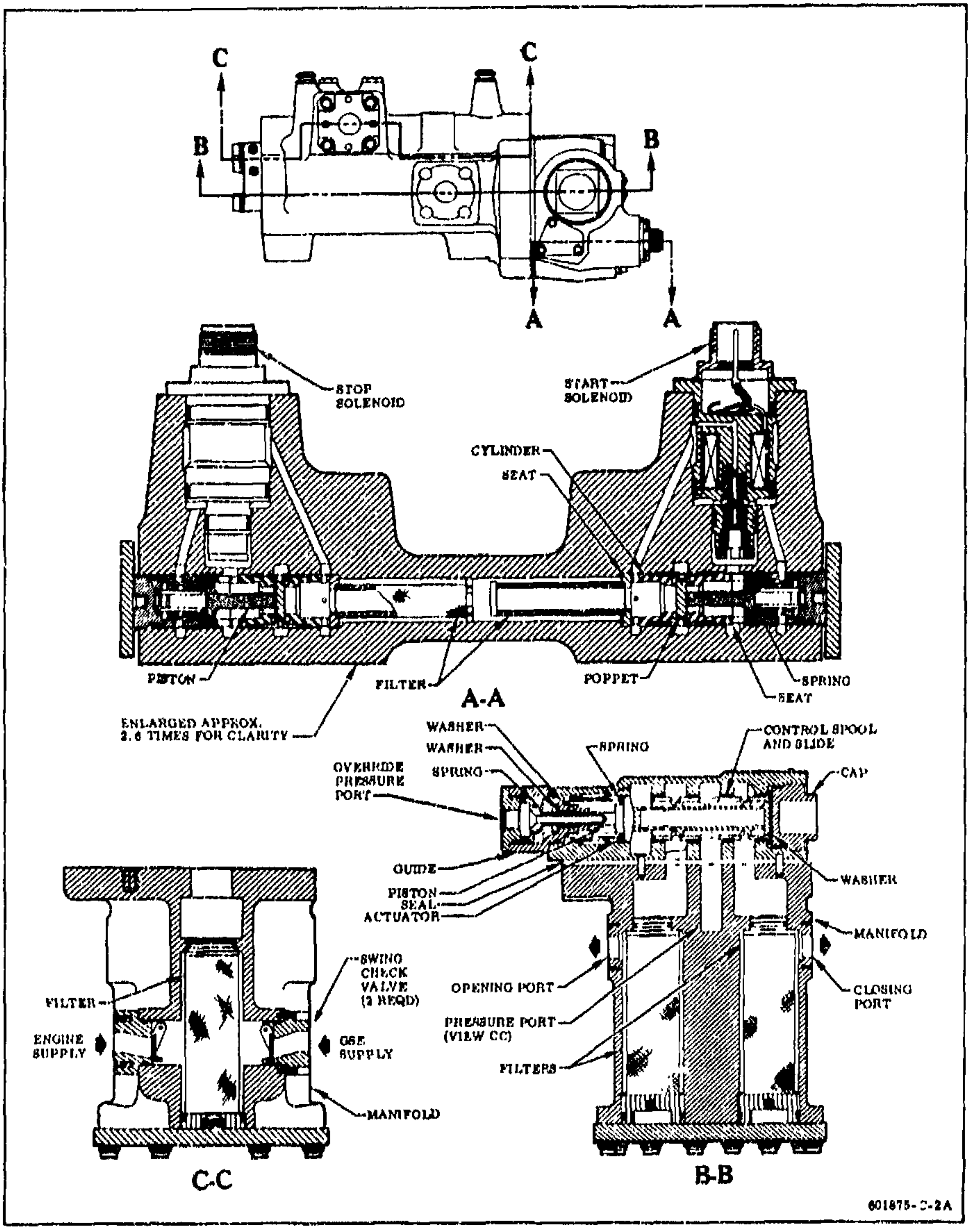


Figure 22-7. Engine Control Valve--Cutaway View

22-17. LEAK-TEST.

22-17A. O-Ring Seating Test. This test is not required if it was performed on the four-way solenoid valve as outlined in section XXIII nor is this test required as part of a routine recycle test of the valve.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and engine control valve for use as outlined in paragraph 22-16; then connect engine control valve to console (figure 22-7A). Close hand valve between OPENING port (C) and CLOSING port (D). Open hand valve at RETURN port (E).	None.

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to GSE SUPPLY port (A); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

bA. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

Procedure	Result
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESSURE gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psi.
d. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
e. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,700 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.

Procedure	Result
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until on HYD DIFF PRESS MONITOR panel, PRESSURE MONITOR gage indicates 1,500 ±100; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 1,500 ±100 psi.
g. On ELECTRICAL CONTROL panel, make sure that VOLTS meter indicates 28 ±0.5 volts.	VOLTS meter must indicate 28 ±0.5 volts.
h. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on and START SOLENOID energized.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 2 switch-lights.	Light 1 off and START SOLENOID deenergized. Lights 2 and 1A on and STOP SOLENOID energized.

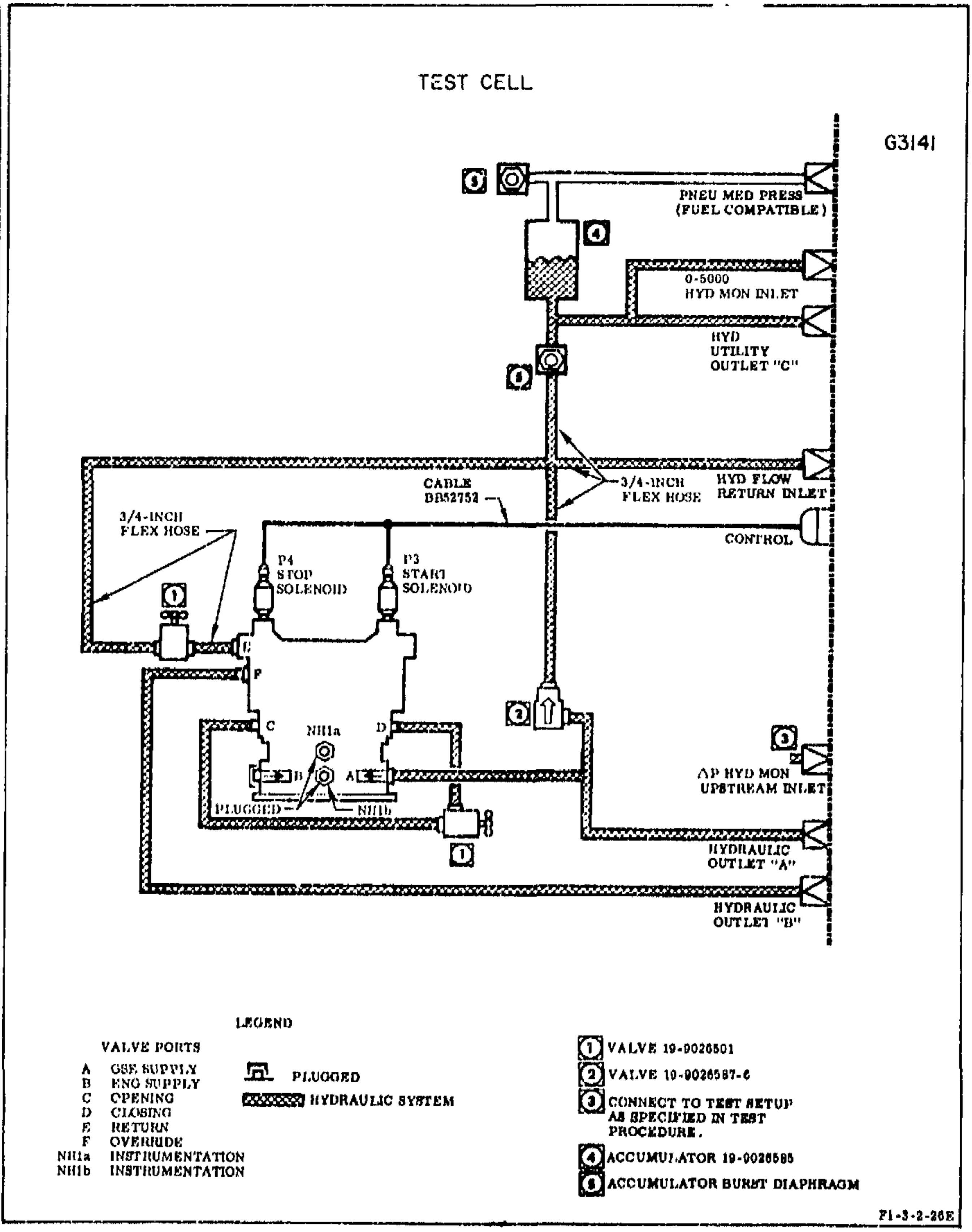


Figure 22-7A. Engine Control Valve External Leak-Test Setup

Procedure	Result
j. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light.	Lights 2 and 1A off and STOP SOLENOID deenergized.
k. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
l. Perform steps d and g through k 20 times. These steps constitute one cycle. Duration of each cycle must be approximately 2 minutes.	Same as steps d and g through k.

WARNING

The following procedure specifies cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
m. After 5th, 10th, and 15th cycle, inspect valve for external leakage. If leakage is observed, wipe wetted area clean with a cloth dampened with cleaning compound (MIL-C-81302), or equivalent.	None.
n. After 20th cycle, inspect valve for external leakage.	Reject valve if leakage exists.
o. If there is no external leakage after completion of 20 cycles, depressurize valve as outlined in steps p through t, then perform surface wetting leak-test.	None.
p. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
q. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
r. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR gage must indicate zero.
s. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
t. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
u. If testing is being terminated for the day, on MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.

22-17B. Surface Wetting Leak-Test.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and engine control valve for use as outlined in paragraph 22-16; then, except as noted, connect engine control valve to console (figure 22-7A). Change test line from 0-5000 PSIG HYD MON INLET fitting to △P HYD MON UPSTREAM INLET fitting and uncap △P HYD MON DOWNSTREAM INLET. Close hand valve between OPENING port (C) and CLOSING port (D).	None.

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to GSE SUPPLY port (A); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 500 ±25 psi.	SUPPLY PRESSURE gage must indicate 500 ±25 psi.
d. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
e. On MED PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 25 ±5 psi.	MED PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until on HYD DIFF PRESS MONITOR panel, DIFFERENTIAL PRESSURE gage indicates 3 to 7 psi, then close SHUTOFF valve.	DIFFERENTIAL PRESSURE gage must indicate 3-7 psi.
g. Hold pressure on valve for a 10-minute interval; then on HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on and supply light off. Valve depressurized.

Procedure	Result
h. Inspect valve exterior for wet surfaces.	If valve surfaces are dry, proceed to functional tests (paragraphs 22-17C through 22-18). If valve surfaces are wet, proceed to step i.

WARNING

The following procedure specifies cleaning compound, which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
i. Wipe wetted surfaces dry with a clean cloth dampened with cleaning compound (MIL-C-81302).	None.
j. Repeat steps d and g through i a maximum of 5 times.	Reject valve if wet surfaces are observed after the fifth 10-minute pressure interval.
k. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
l. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
m. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR gage must indicate zero.
n. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

o. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.

p. Open hand valve between OPENING port (C) and CLOSING port (D).

Procedure	Result
q. Change test line from ΔP HYD MON UPSTREAM INLET to 0-5000 PSIG MON INLET. Cap ΔP HYD MON DOWNSTREAM INLET fitting.	None.

22-17C. External Leak Test.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and engine control valve for use as outlined in paragraph 22-16; then connect engine control valve to console (figure 22-7A). Close hand valve between OPENING port (C) and CLOSING port (D). Open hand valve at RETURN port (E).	None.

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to GSE SUPPLY port (A); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

Procedure	Result
b. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
bA. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:	
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 3,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 3,000 ±50 psi.
d. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light off and SUPPLY light on.
e. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,475 ±25 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,475 ±25 psi. Valve pressurized.
g. Maintain 2,475 ±25 psi at GSE SUPPLY port (A) and check for external leakage.	No leakage is allowable.
h. On ELECTRICAL CONTROL panel, make sure that VOLTS meter indicates 28 ±0.5 volts.	VOLTS meter must indicate 28 ±0.5 volts.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on and START SOLENOID energized.
j. Maintain 2,475 ±25 psi pressure at GSE SUPPLY port (A) and check for external leakage.	No leakage is allowable.
k. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 2 switch-lights.	Light 1 off and START SOLENOID deenergized. Lights 2 and 1A on and STOP SOLENOID energized.

Procedure	Result
l. Maintain 2,475 ±25 psi pressure at GSE SUPPLY port (A) and check for external leakage.	No external leakage is allowable.
m. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 600 ±10 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 600 ±10 psi. Valve pressure reduced.
n. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±10 psi.	HIGH PRESS FUEL COMPATIBLE panel pressure reduced.
o. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light.	Lights 2 and 1A off and STOP SOLENOID deenergized.
p. Open hand valve between OPENING port (C) and CLOSING port (D). Close hand valve at RETURN port (E).	None.
q. Maintain 600 ±10 psi pressure at GSE SUPPLY port (A) for 2 minutes minimum; then check for leakage. Open hand valve at RETURN port (E).	No external leakage is allowable.
r. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. Valve depressurized.
s. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,475 ±25 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
t. Using HYDRAULIC CONTROL panel, apply pressure to OVERRIDE port (F) as follows:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on. GSE SUPPLY port "A" depressurized.
(2) Press TEST CELL SUPPLY "B" switch-light.	VENT light off and SUPPLY light on. OVERRIDE port (F) pressurized.
u. Maintain 2,475 ±25 psi pressure at OVERRIDE port (F) for 2 minutes minimum; then check for leakage.	No external leakage is allowable.
v. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. OVERRIDE port (F) depressurized.
w. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
x. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

Procedure	Result
y. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "B" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
y4. On MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.
z. Remove engine control valve from external leak-test setup.	None.

22-17D. Internal Leak-Test. This test is not required if it was performed on the four-way solenoid valve as outlined in section XXIII nor is this test required as part of a routine recycle test of the valve.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Connect engine control valve to console (figure 22-8).	None.

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to GSE SUPPLY port (A); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

Procedure	Result
b. Prepare digital voltmeter (DVM) for flow monitor test (figure 22-6A) and press RESET switch.	DVM indicates KC000000-000001.
c. Open hand valves at RETURN port (E) and between OVERRIDE port (F) and HYDRAULIC OUTLET "B." Close hand valve at OVERRIDE port (F).	None.
d. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

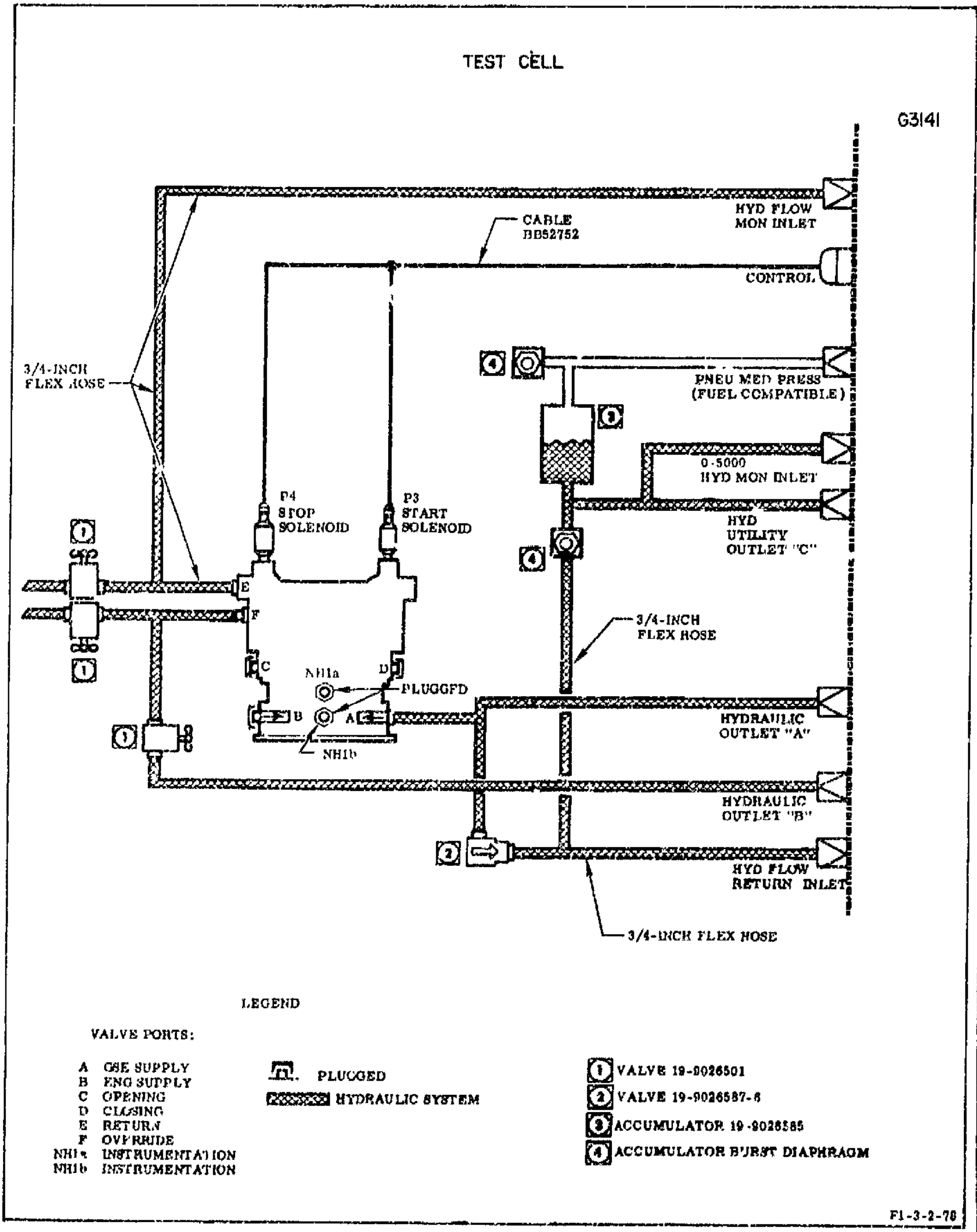


Figure 22-8. Engine Control Valve Internal Leak-Test Setup

dA. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

Procedure	Result
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESSURE FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharge to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.

Procedure	Result
e. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 3,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 3,000 ±50 psi.
f. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light off and SUPPLY light on.
g. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
h. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,475 ±25 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,475 ±25 psi. Valve pressurized.
i. On HYDRAULIC CONTROL panel, press LOW FLOW BYPASS switch-light.	CLOSE light off and OPEN light on.

NOTE

For all leakage tests (steps j, l, p, s, and aa), start leakage measurements 3 minutes after pressurization and continue for 1 minute.

- A graduated cylinder 24-464-51 may be used to measure fluid.

Procedure	Result
j. Measure and record leakage from RETURN port (E).	Maximum allowable leakage is 200 cc/m.
k. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on and START SOLENOID energized.
l. Measure and record leakage from RETURN port (E).	Maximum allowable leakage is 200 cc/m.
m. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	CLOSE light off and OPEN light on.
n. Close hand valve at RETURN port (E).	None.
o. On ELECTRICAL CONTROL panel, press TEST SELECT 2 and 7 switch-lights.	Lights 2, 7, and 1A on and STOP SOLENOID energized.
p. On digital voltmeter (DVM) panel, press RESET switch; then record leakage from RETURN port (E).	DVM indication must not exceed an equivalent of the maximum allowable leakage of 1.5 gpm.
q. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
r. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,000 ±20 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,000 ±20 psi. Valve pressure reduced.
s. Close hand valve between OVERRIDE port (F) and HYDRAULIC OUTLET "B" and slowly open hand valve at OVERRIDE port (F); then measure and record leakage.	Maximum allowable leakage is 5 cc/m.
t. Close hand valve at OVERRIDE port (F).	None.
u. On ELECTRICAL CONTROL panel, press TEST SELECT 2 and 7 switch-lights.	Lights 2, 7, and 1A off and STOP SOLENOID deenergized.
v. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. Valve depressurized.
w. Open hand valve at RETURN port (E).	None.
x. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	OPEN light off and CLOSE light on.
y. Open hand valve between OVERRIDE port (F) and HYDRAULIC OUTLET "B."	None.

z. Using HYDRAULIC CONTROL panel, apply pressure to OVERRIDE port (F) as follows:

Procedure	Result
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press TEST CELL SUPPLY "B" switch-light.	VENT light off and SUPPLY light on.
(3) Slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 1,500 ±15 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 1,500 ±15 psi. OVERRIDE port (F) pressurized.
aa. Measure and record leakage from RETURN port (E).	Maximum allowable leakage is 5 cc/m.
ab. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
ac. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
ad. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR gage must indicate zero.
ae. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

af. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "B" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
afA. On Med PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.
ag. Remove valve from test setup.	None.
ah. If engine control valve testing is terminated, secure equipment as outlined in paragraph 22-20.	None.
ai. Install protective closures. Refer to paragraph 22-2.	None.

22-17E. TIMING- AND ACTUATION-TEST. This test is not required if it was performed on the four-way solenoid valve as outlined in section XXIII nor is this test required as part of a routine recycle test of the valve.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Make sure that Components Test Console G3141 and engine control valve are prepared for use as outlined in paragraph 22-16.	None.
b. Connect engine control valve to console (figure 22-8A). Close hand valve between OPENING port (C) and CLOSING port (D). On PNEU/HYD UTILITY PNL, close hand valve between outlets A and B.	None.

CAUTION

The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

Procedure	Result
c. Prepare external flowmeter, transformer, and electronic counter for operation as outlined in instruction manuals with each unit.	None.

d. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUT-OFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HY-DRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HY-DRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

Procedure	Result
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGU-LATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
(4) Close SHUT-OFF valve; then close PRESSURE REGU-LATOR.	REG SUPPLY PRESS gage decreases to zero.
f. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.

22-17F. Timing Test.

a. Using ELECTRICAL CONTROL panel, perform the following:

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to GSE SUPPLY port (A); otherwise, damage to the spool can result.

Procedure	Result
(1) Adjust VOLTAGE ADJUST knob until VOLTS meter indicates 15-17 volts.	None.
(2) Turn MILLIAMPERES meter RANGE SELECT switch to B (0-500).	None.
b. Open hand valve between OPENING port (C) and CLOSING port (D).	None.

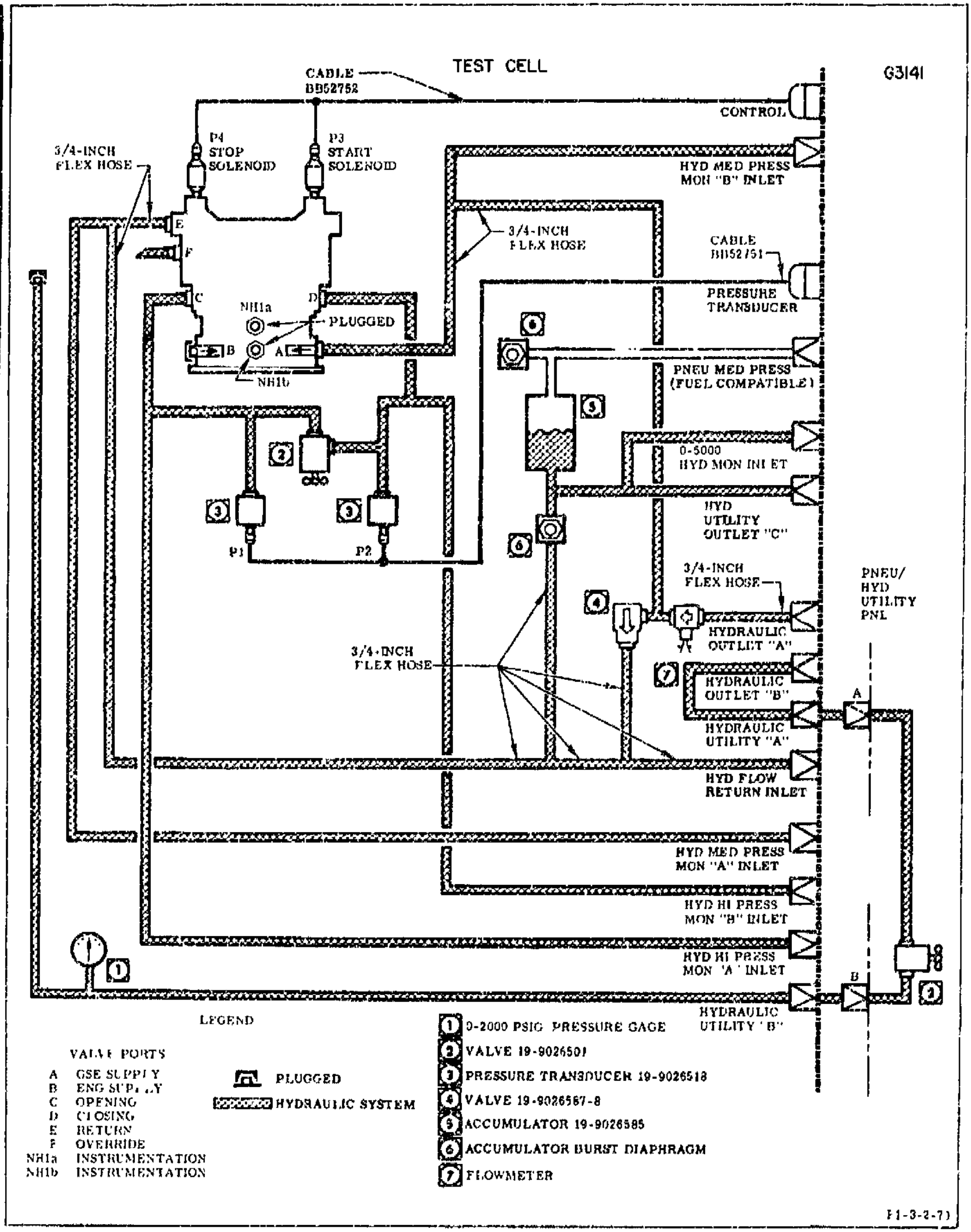


Figure 22-8A. Engine Control Valve Timing- and Actuation-Test Setup

c. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:

Procedure	Result
(1) Close SHUT-OFF valve and open VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
d. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve to establish 1,150 ±20 psig differential pressure between GSE SUPPLY port (A) and RETURN port (E), and simultaneously adjust hand valve between CLOSING port (D) and OPENING port (C) to establish 10 ±0.25 gpm. Close HIGH PRESS SHUT-OFF valve. Record flow. Monitor OPENING port (C) and CLOSING port (D) pressure.	HYD MED PRESS MONITOR panel PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages must indicate 1,150 ±20 psi differential pressure. External flowmeter counter must indicate an equivalent to 10 ±0.25 gpm. CLOSING port (D) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.
e. On PRESSURE/TEMPERATURE MONITOR panel, turn CHANNEL SELECT switch to 3. Record temperature.	TEMPERATURE INDICATOR indicates hydraulic flow temperature.

f. Using ELECTRICAL CONTROL panel, perform the following:

Procedure	Result
(1) Press TEST SELECT 1 switch-light. Monitor OPENING port (C) and CLOSING port (D) pressure.	Light 1 on and START SOLENOID energized. OPENING port (C) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and CLOSING port (D) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

If OPENING port (C) pressure and CLOSING port (D) pressure are nearly equal, the main spool has not fully shuttled.

Procedure	Result
(2) Adjust VOLTAGE ADJUST knob until MILLIAMPERES meter indicates 300 ±50 milliamperes.	None.
(3) Wait 10 seconds and press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
(4) Press TEST SELECT 2 switch-light. Monitor OPENING port (C) and CLOSING port (D) pressure.	Lights 2 and 1A on and STOP SOLENOID energized. CLOSING port (D) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.
(5) Adjust VOLTAGE ADJUST knob until MILLIAMPERES meter indicates 300 ±50 milliamperes.	None.
(6) Wait 10 seconds and press TEST SELECT 2 switch-light.	Lights 2 and 1A off and STOP SOLENOID deenergized.
g. Repeat step f nine times.	Same result as step f.

h. Make sure that differential pressure and flow requirements specified in step d are maintained. Readjust, as necessary, to obtain results of step d.

i. Prepare oscilloscope for timing- and actuation-test (figure 22-6A) and perform the following:

Procedure	Result
(1) Adjust INTENSITY and FOCUS switches to sharpest trace.	None.
(2) Adjust VERTICAL POSITION A and HORIZ. POSITION switches until vertical A trace is to first grid on left and fourth from bottom.	None.
(3) Adjust VERTICAL POSITION B switch until vertical B trace is at same position as vertical A trace.	None.
(4) Adjust TRIGGER LEVEL switch to arrow just off of AUTO position.	None.

NOTE

Oscilloscope sensitivity may have to be readjusted to obtain suitable trace.

j. On ELECTRICAL CONTROL panel, press TEST SELECT 3 and 4 switch-lights.	Lights 3 and 4 on.

NOTE

The results of steps k and m are recorded using camera supplied with Components Test Console G3141. Refer to instruction manual for operation.

- Camera viewing visor to be closed when in standby condition.

Procedure	Result
k. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light. Measure and record operating time. Monitor OPENING port (C) and CLOSING port (D) pressure.	Light 1 on and START SOLENOID energized. MILLIAMPERES meter must indicate 300 ±50 milliamperes. Operating time must not exceed 50 milliseconds. OPENING port (C) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and CLOSING port (D) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

If OPENING port (C) pressure and CLOSING port (D) pressure are nearly equal, the main spool has not fully shuttled.

- The operating time is measured from start of traces to end of pressure buildup at OPENING port (C). (Figure 22-8B shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

l. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
m. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light. Measure and record operating time. Monitor OPENING port (C) and CLOSING port (D) pressure.	Lights 2 and 1A on and STOP SOLENOID energized. MILLIAMPERES meter must indicate 300 ±50 milliamperes. Operating time must not exceed 50 milliseconds. CLOSING port (D) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

The operating time is measured from start of traces to end of pressure buildup at CLOSING port (D). (Figure 22-8B shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

Procedure	Result
n. On ELECTRICAL CONTROL panel, press TEST SELECT 2, 3, and 4 switch-lights.	Lights 2, 3, 4, and 1A off and STOP SOLENOID deenergized.

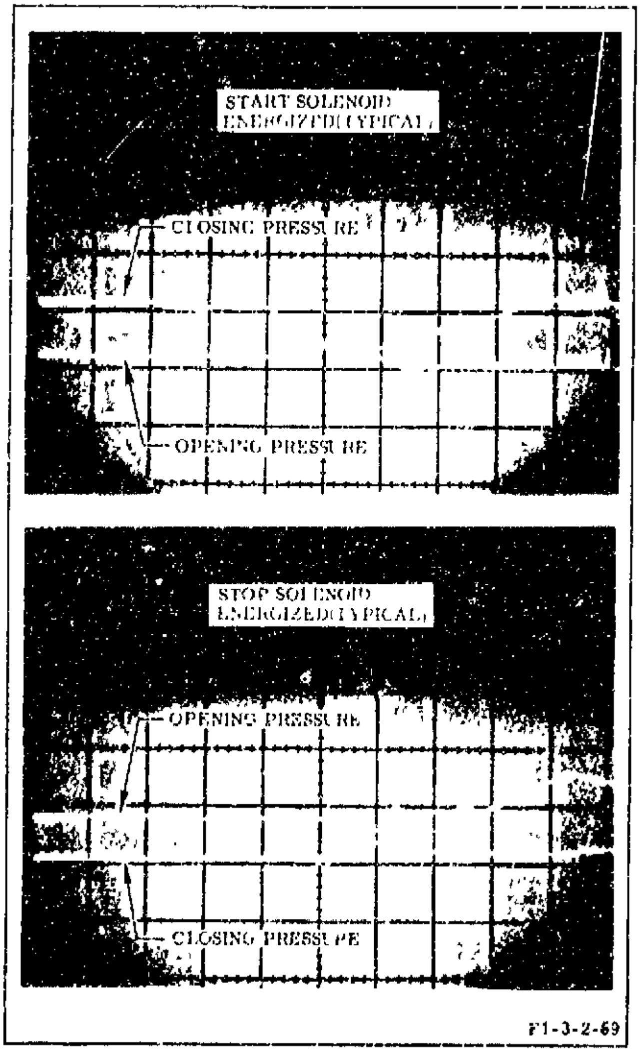


Figure 22-8B. Engine Control Valve Timing Traces (Typical)

22-17G. Actuation-Test.

a. On ELECTRICAL CONTROL panel, perform the following:

CAUTION

The engine control valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to GSE SUPPLY port (A); otherwise, damage to the spool can result.

Procedure	Result
(1) Adjust VOLTAGE ADJUST knob until VOLTS meter indicates 28 ±0.5 volts.	None.
(2) Turn MILLIAMPERES meter RANGE SELECT switch to A (0-500) x 2.	None.
b. (Deleted)	
c. Do not change adjustment of hand valve between OPENING port (C) and CLOSING port (D).	None.
d. On HIGH PRESS FUEL COMPATIBLE panel, close PRESSURE REGULATOR and open SHUTOFF valve.	REG SUPPLY PRESS gage indicates zero.
e. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve to establish 800 ±10 psig differential pressure between GSE SUPPLY port (A) and RETURN port (E); then close HIGH PRESS SHUTOFF valve.	HYD MED PRESS MONITOR panel, PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages must indicate 800 ±10 psi differential pressure.

eA. On ELECTRICAL CONTROL panel, perform the following:

Procedure	Result
(1) Press TEST SELECT 1 switch-light. After a minimum of one minute, record current required to energize START SOLENOID.	Light 1 on and START SOLENOID energized. Current required to energize START SOLENOID must not exceed 550 milliamperes.
(2) Press TEST SELECT 1 and 2 switch-lights, in order listed. After a minimum of one minute, record current required to energize STOP SOLENOID.	Light 1 off and START SOLENOID deenergized. Light 2 on and STOP SOLENOID energized. Current required to energize STOP SOLENOID must not exceed 550 milliamperes.
(3) Press TEST SELECT 2 switch-light.	Light 2 off and STOP SOLENOID deenergized.

f. Prepare oscilloscope for timing- and actuation-test (figure 22-6A) and perform the following:

Procedure	Result
(1) Turn SWEEP TIME HORIZ. SENS. switch to 10 MILLISEC/CM.	None.
(2) Turn SWEEP TIME HORIZ. SENS. VERNIER switch to CALIB.	None.

NOTE

The results of steps g and i are recorded using camera supplied with Components Test Console G3141. Refer to instruction manual for operation.

- Camera viewing visor is to be closed when in standby condition.

Procedure	Result
g. On ELECTRICAL CONTROL panel, press TEST SELECT 3, 4, and 1 switch-lights, in order listed. Measure and record pressure actuation time from CLOSING port (D) to OPENING port (C). Record current required to energize solenoid.	Lights 3, 4, and 1 on and START SOLENOID energized. CLOSING port (D) and OPENING port (C) pressures must reverse within one second. Current required to energize solenoid must not exceed 550 milliamperes.

NOTE

Pressure reversal time is measured from start of traces to end of pressure buildup at CLOSING port (D). (Figure 22-8B shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

Procedure	Result
h. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light. Measure and record pressure actuation time from OPENING port (C) to CLOSING port (D).	Lights 2 and 1A on and STOP SOLENOID energized. OPENING port (C) and CLOSING port (D) pressures must reverse within one second.

NOTE

Pressure reversal time is measured from start of traces to end of pressure buildup at OPENING port (C). (Figure 22-8B shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

Procedure	Result
j. On ELECTRICAL CONTROL panel, press TEST SELECT 2, 3, and 4 switch-lights.	Lights 2, 3, 4, and 1A off and STOP SOLENOID deenergized.

Procedure	Result
k. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
l. On PNEU/HYD UTILITY PNL, verify that hand valve between outlets A and B is closed.	None.
m. Remove plug from hose connected to HYDRAULIC UTILITY "B" and connect hose to valve OVERRIDE port (F).	None.
n. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "B" switch-light and slowly open HIGH PRESS SHUTOFF valve until on HYD MED PRESS MONITOR panel, PRESSURE MONITOR "B" gage indicates 1,350 (+20, -0) psi; then close HIGH PRESS SHUTOFF valve.	GSE SUPPLY port (A) and HYDRAULIC OUTLET "B" pressurized. SUPPLY light on and VENT light off.
o. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light. Monitor OPENING port (C) and CLOSING port (D) pressure.	Light 1 on and START SOLENOID energized. OPENING port (C) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and CLOSING port (D) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

If OPENING port (C) pressure and CLOSING port (D) pressure are nearly equal, the main control spool has not fully shuttled.

Procedure	Result
p. On PNEU/HYD UTILITY PNL, slowly open hand valve between outlets A and B until OPENING port (C) and CLOSING port (D) pressures reverse. Record pressure. Monitor OPENING port (C) and CLOSING port (D) pressure.	On HYD DIFF PRESS MONITOR panel, PRESSURE MONITOR gage must not exceed 1,350 psi. CLOSING port (D) pressure must be within 50 psi of GSE SUPPLY port (A) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.
q. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
r. On HIGH PRESS FUEL COMPATIBLE panel, close PRESSURE REGULATOR and open SHUTOFF valve.	REG SUPPLY PRESS gage decreases to zero.
s. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
t. On HYDRAULIC CONTROL panel, perform the following:	
(1) Slowly open HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(3) Press TEST CELL SUPPLY "B" switch-light.	VENT light on and SUPPLY light off.

Procedure	Result
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(5) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
u. On HYD HIGH PRESS MONITOR panel, open return shutoff valve.	PRESSURE MONITOR "A" gage decreases to zero.
v. On MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.
w. Remove valve from test setup.	None.
x. If engine control valve testing is terminated, secure equipment as outlined in paragraph 22-19.	None.
y. Install protective closures. Refer to paragraph 22-2.	None.

22-18. CHECK VALVE SEAT LEAK-TEST.

a. Connect engine control valve to console (figure 22-8C) and open hand valve to ΔP HYD MON UPSTREAM INLET. Uncap ΔP HYD MON DOWNSTREAM INLET.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

Procedure	Result
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,700 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,700 ±100 psi.
d. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 50 ±10 psi.	HIGH PRESS FUEL COMPATIBLE panel and HYDRAULIC CONTROL panels pressurized.
e. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until DIFFERENTIAL PRESSURE gage indicates 5 ±1 psi.	Valve port NH1-a pressurized.
f. Measure leakage at GSE SUPPLY (A) and ENG SUPPLY (B) ports.	Leakage at each port must not exceed 0.5 cc/m.
g. Close hand valve ΔP HYD MON UPSTREAM INLET, cap ΔP HYD MON DOWNSTREAM INLET. Open DIFFERENTIAL PRESSURE gage shutoff valve.	DIFFERENTIAL PRESSURE gage isolated.
h. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 ±50 psi.	REG SUPPLY PRESS gage indicates 2,700 ±100 psi.
i. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,500 ±50 psi.	HYD DIFF PRESS MONITOR panel PRESSURE MONITOR gage indicates 2,500 ±50 psi. Valve pressurized.

Procedure	Result
j. Measure leakage at valve GSE SUPPLY (A) and ENG SUPPLY (B) ports.	Leakage at each port must not exceed 0.5 cc/m.
k. On HIGH PRESSURE FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero. Close VENT valve.	HIGH PRESS FUEL COMPATIBLE panel depressurized
l. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR gage shutoff valve until gage indicates zero. Close DIFFERENTIAL PRESSURE gage and PRESSURE MONITOR gage shutoff valve.	Gage pressure reduced.
m. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

n. On HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
o. Remove engine control valve from test setup, and open all ports. Purge each port with filtered gaseous nitrogen (MIL-P-27401) at low pressure while valve drains.	Only a thin film of fluid remains after valve is drained and purged.
p. Install plug and gasket in NH1a port. Install protective closures. Refer to paragraph 22-2.	None.

q. If engine control valve testing is terminated, secure equipment as outlined in paragraph 22-19.

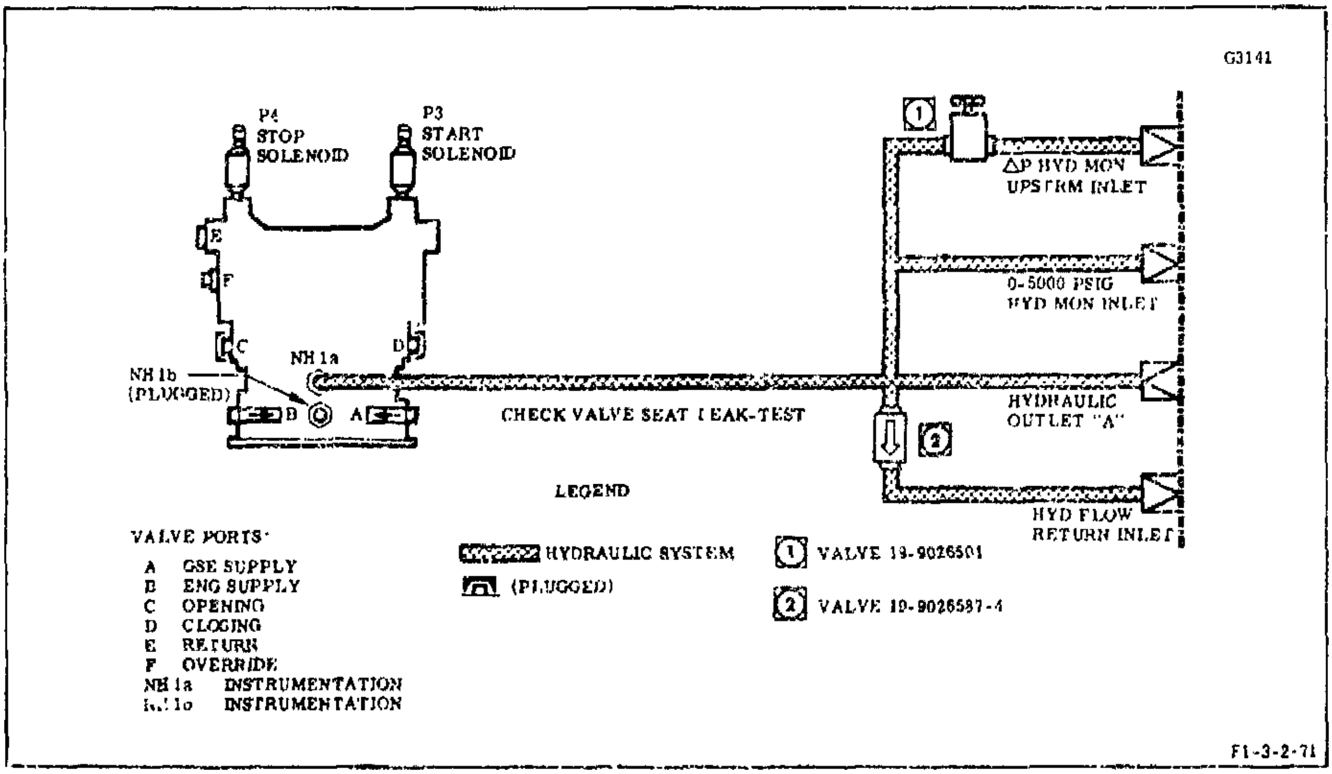


Figure 22-8C. Check Valve Seat Leak-Test Setup

22-19. SECURING TEST EQUIPMENT.

22-20. After engine control valve testing is complete and valve is removed from test setup, secure test equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure that all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn oscilloscope power and digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

22-21. ENGINE CONTROL VALVE CHECK VALVE 601094.

22-22. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the engine control valve check valves. See figure 22-9 for test equipment and special tools. Refer to R-3896-4 for protective closures.

Part Number	Nomenclature	Use
G3141	Components Test Console	Provides pneumatic and hydraulic pressure for testing check valve.
G3143	Components Adapter Set	Provides hardware for check valve test setups.
88-557487	Pressure Test Fixture	Pressure-checks valve after repair.

Figure 22-9. Test Equipment and Special Tools for Engine Control Valve Check Valve

22-23. DISASSEMBLING.

22-24. Disassemble the check valve, as required, to accomplish necessary repairs and/or replacement.

22-25. CLEANING.

22-26. Clean all parts of check valve for hydraulic service as outlined in R-3896-3, Volume I.

Figure 22-10 deleted.

22-27. INSPECTING AND REPAIRING.

22-28. Inspecting the engine control check valve determines if the individual parts have been damaged by mishandling or wear. Refer to figure 22-11 and inspect each part for general condition, cleanness, thread damage, corrosion, distortion, nicks, burs, and scratches.

Part Name	Inspecting	Repairing
Pin	Damage or wear.	Replace.
Spring	Corrosion or cracks.	Replace.
Gate	Damaged.	Replace.
	Nicks, scratches, and other imperfections which would impair its sealing capability. Sealing surface to be flat within 0.0005 inch total.	Lap sealing surface to meet leakage and flatness requirements.
Body	Damaged or deteriorated anodic coating.	Replace a anodic coating as outlined in R-3896-3, Volume I.
	Nicks, scratches, and other imperfections which would impair its sealing capability. Sealing surface to be flat within 0.0005 inch total.	Lap gate seat to meet leakage and flatness requirements.
	Damaged inserts.	Replace inserts as outlined in R-3896-3, Volume I.

Figure 22-11. Inspecting and Repairing Engine Control Valve Check Valve

22-29. ASSEMBLING.

22-30. Assembly of the check valve must be performed with care to prevent damage to the gate and seat sealing surfaces. All parts must meet cleaning requirements of paragraph 22-25. See figure 22-12 for parts identification. Install spring and gate on body and secure with hinge pin.

22-31. TESTING.

22-32. This procedure outlines requirements for complete testing of the engine control valve check valve using Components Test Console G3141 and Component Adapter Set G3143. Any deviations, including the use of other equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting this test, install test fixture on check valve outlet, and prepare console for use as outlined in figure 22-6A, except cable BB52752 is not required and connector J702 is to be capped. Refer to paragraph 22-34 for check valve test procedure, and see figure 22-13 for test setup.

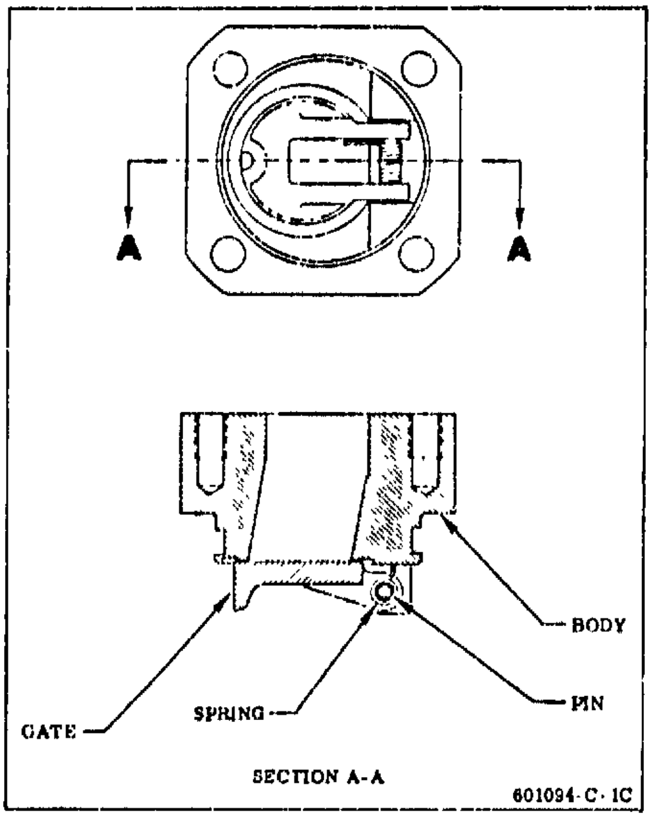


Figure 22-12. Engine Control Valve Check Valve--Cutaway View

22-33. (Deleted)

22-34. REVERSE LEAKAGE TEST.

Procedure	Result
a. Prepare Components Test Console G3141 and check valve for use as outlined in paragraph 22-31; then connect check valve to console (figure 22-13). Open hand valves to HYD MED PRESS MON "B" INLET and ΔP HYD MON UPSTREAM INLET. Uncap ΔP HYD MON DOWNSTREAM INLET.	None.
b. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,600 ±50 psi.	SUPPLY PRESSURE gage indicates 2,600 ±50 psi.
d. On MED PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 25 ±5 psi.	MED PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until DIFFERENTIAL PRESSURE gage indicates 5 ±0.5 psi.	Check valve outlet port (B) pressurized.
f. Inspect check valve and measure leakage at inlet port (A).	Maximum allowable leakage at inlet port (A) is 0.15 cc/m.
g. Close hand valve to ΔP HYD MON UPSTREAM INLET; then open DIFFERENTIAL PRESSURE shutoff valve.	DIFFERENTIAL PRESSURE gage isolated.
h. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressure increased.
i. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until HYD MED PRESS MONITOR panel PRESSURE MONITOR "B" gage indicates 100 ±1 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage indicates 100 ±1 psi.

Procedure	Result
j. Measure leakage at inlet port (A).	Maximum allowable leakage is 0.15 cc/m.
k. Repeat steps i and j at 500 ±5 psig.	Same as steps i and and j.
l. Close hand valve to HYD MED PRESS MON "B" INLET and open PRESSURE MONITOR "B" gage shutoff valve.	HYD MED PRESS MONITOR panel, PRESSURE MONITOR "B" gage isolated.
m. On MED PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero. Close VENT valve.	MED PRESS FUEL COMPATIBLE panel depressurized.
n. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,600 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
o. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 1,500 ±15 psi. Close SHUTOFF valve.	Check valve outlet port (B) pressurized to 1,500 ±15 psig.
p. Measure leakage at inlet port (A).	Maximum allowable leakage is 0.15 cc/m.
q. Repeat steps o and p at 2,500 ±25 psig.	Same as steps o and p.
r. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero. Close VENT valve.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
s. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
t. On HYDRAULIC CONTROL panel, perform the following:	
(1) Open HIGH PRESS SHUTOFF valve.	HYD CONTROL panel depressurized.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(5) Close HIGH PRESS SHUTOFF valve.	None.
u. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR gage shutoff valve until gage indicates zero; then close shutoff valve.	Pressure reduced at PRESSURE MONITOR gage.
v. Remove check valve from test setup. Install protective closures. Refer to paragraph 22-22.	None.

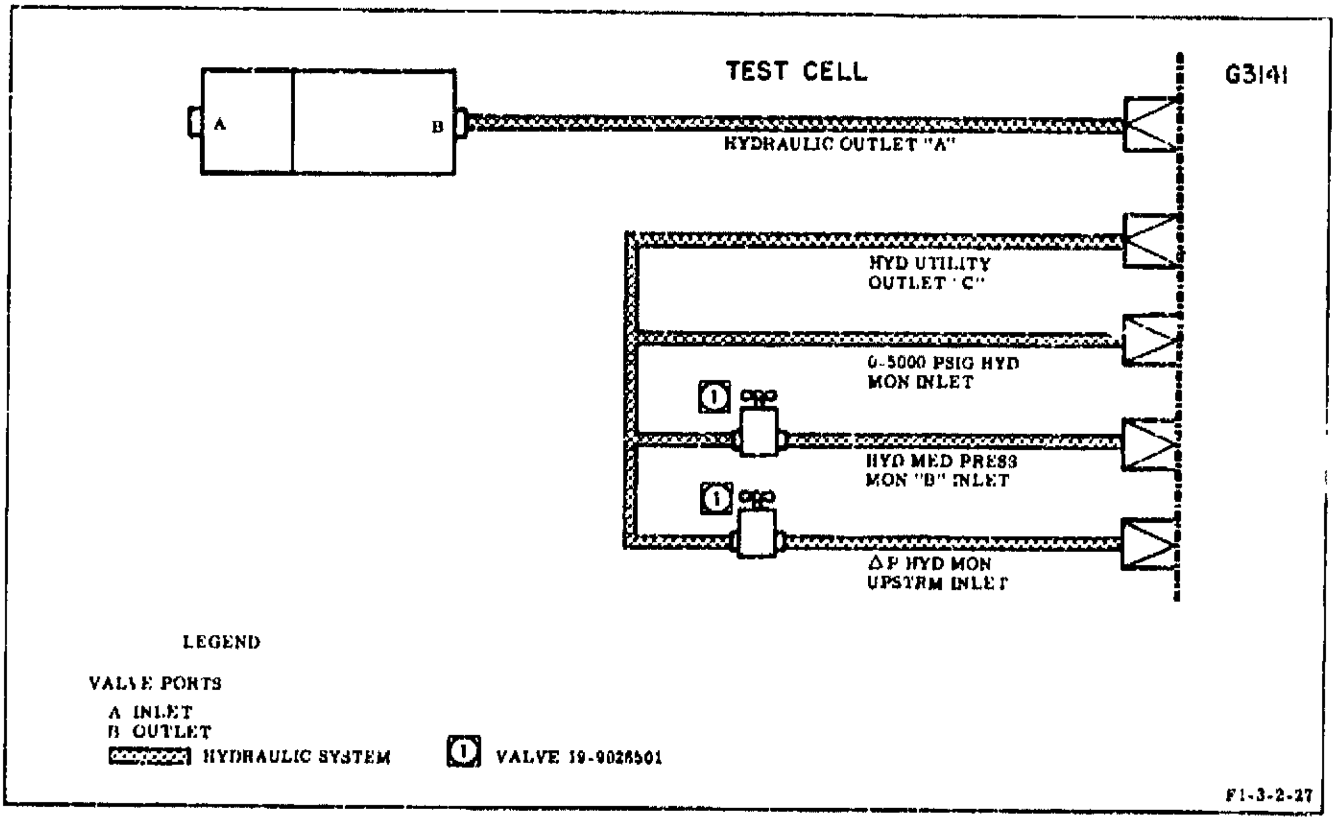


Figure 22-13. Engine Control Valve Check Valve Test Setup

22-35. SECURING TEST EQUIPMENT.

22-36. After engine control valve check valve testing is completed and check valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen pressure to zero.

b. On PNEU SOURCE CONTROL panel, close gaseous nitrogen SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve and open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves and adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero, and close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn digital voltmeter power off.

i. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

j. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off, and press POWER ON switch-light.

k. Turn DC POWER SUPPLY off.

l. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION XXIII

FOUR-WAY SOLENOID VALVE

WARNING

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

23-1. FOUR-WAY SOLENOID VALVE 556966.

23-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the four-way solenoid valve. See figure 23-1 for test equipment and special tools. Refer to R-3896-4 for protective closures. Lubricate (Method A) all closure fasteners used in valve inserts with lubricant grease RB0140-012 (Rocketdyne). Specified lubrication methods are outlined in R-3896-3, Volume I.

23-3. DISASSEMBLING.

23-4. Protect all parts from handling damage. Refer to figure 23-3 for parts and index numbers.

NOTE

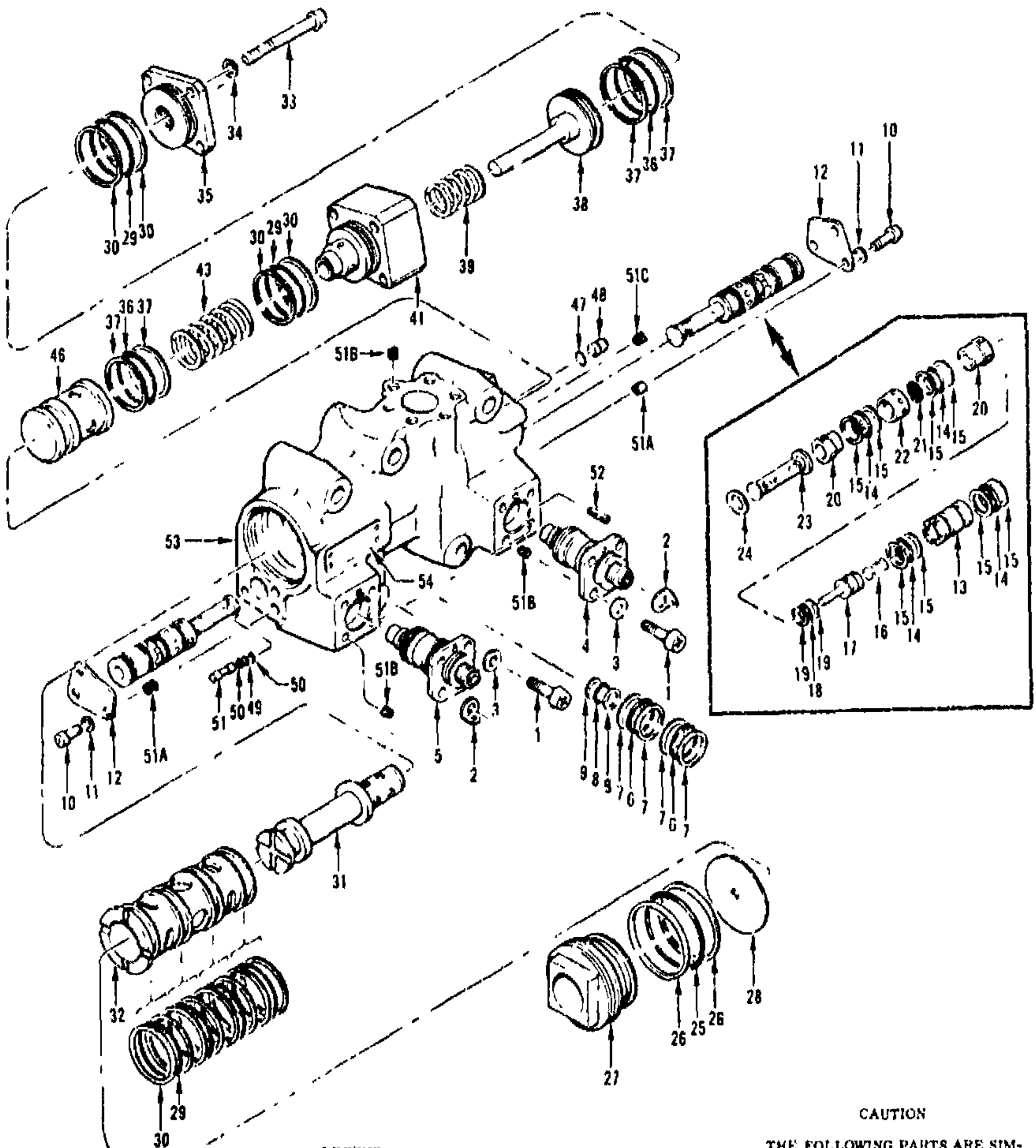
When removing internal parts of the valve that cannot be easily removed by hand, tapered, nylon drift rods or equivalent must be used to facilitate the removal and prevent damage to parts.

a. Remove screws (1), lugs (2), washers (3); then using solenoid removal and installation tool T-5018259, remove valves (4, 5); then remove packings (6, 8) and retainers (7, 9) from valves.

Part No.	Nomenclature	Use
T-5026302	Pressure Test Fixture	Adapts to four-way solenoid valve ports during pressure tests.
T-5036718	Assembly Tool	Installs filter during assembly.
T-5037841	Seal Removal Tool	Removes seat during disassembly.
T-5041500	Actuator Installation Tool	Removes and installs actuator during repair.
T-5041501	Assembly Jig	For assembly of override component parts.
T-5048259	Solenoid Removal and Installation Tool	Removes and installs four-way start and stop valves.
MT-109 (Waugh), or equivalent	Flowmeter (3/4-inch inlet and outlet)	Provides a means for measuring flow during timing and actuation tests.
Model 521CR (Hewlett Packard Co), or equivalent	Electronic Counter	Provides a means for measuring flow during timing and actuation tests.
Model G-12 (Triad Transformer Corp), or equivalent	Transformer	Provides voltage compatibility between flowmeter and electronic counter during timing and actuation tests.
G3141	Components Test Console	Provides hydraulic fuel control for testing four-way solenoid valve.
G3143	Components Adapter Set	Provides hardware for four-way solenoid valve test setups.

Figure 23-1. Test Equipment and Special Tools for Four-Way Solenoid Valve

Figure 23-2 deleted.



CAUTION

THE FOLLOWING PARTS ARE SIMILAR IN SIZE AND APPEARANCE. MAKE SURE CORRECT PART NUMBER PACKINGS AND RETAINERS ARE INSTALLED IN LOCATIONS SHOWN:

PACKING (29) P/N MS29513-129
RETAINERS (30) P/N MS21774-129
PACKING (36) P/N MS29513-222
RETAINER (37) P/N MS28774-222

LEGEND

1 SCREW	11 WASHER	21 POPPET	31 SPOOL	41 GUIDE	51 PLUG
2 LUG	12 PLATE	22 SPACER	32 SLEEVE	42 (DELETED)	51A INSERT
3 WASHER	13 CYLINDER	23 FILTER	33 SCREW	43 SPRING	51B INSERT
4 VALVE	14 PACKING	24 WASHER	34 WASHER	44 (DELETED)	51C INSERT
5 VALVE	15 RETAINER	25 PACKING	35 STOP	45 (DELETED)	52 PIN
6 PACKING	16 SPRING	26 RETAINER	36 PACKING	46 ACTUATOR	53 BODY
7 RETAINER	17 PISTON	27 CAP	37 RETAINER	47 PACKING	54 NAMEPLATE
8 PACKING	18 PACKING	28 WASHER	38 PISTON	48 PLUG	
9 RETAINER	19 RETAINER	29 PACKING	39 SPRING	49 PACKING	
10 SCREW	20 SEAT	30 RETAINER	40 (DELETED)	50 RETAINER	

556906-X-2

Figure 23-3. Four-Way Solenoid Valve--Exploded View

b. Remove the following parts from the start side of body (53):

(1) Screws (10), washers (11), plate (12), cylinder (13), and spring (16).

(2) Remove packing (14) and retainers (15) from cylinder (13).

(3) Piston (17), packing (18), and retainers (19).

(4) Seat (20), packing (14), retainers (15), and poppet (21).

(5) Spacer (22), seat (20), packing (14), retainers (15), filter (23), and washer (24).

c. Repeat step b on the stop side of body (53).

d. Remove 2 screws (33) from stop (35) (diagonally opposite); then use assembly jig (T-5041501), as a spring compressor, to remove the other 2 screws (33), washers (34), and stop (35). Remove packing (29) and retainers (30) from stop (35).

WARNING

Stop (35), piston (38), and guide (41) are under spring load. Care must be exercised when using assembly jig as a spring compressor to remove stop (35). Spring load will be relieved as stop is removed.

e. Remove piston (38), packing (36), retainers (37), spring (39), guide (41), packing (29), and retainers (30).

f. Remove spring (43), actuator (46), packing (36), and retainers (37).

CAUTION

Cap (27) must not be removed with plate (12) installed, since the cap may contact the plate, resulting in damage to the cap.

g. Remove cap (27), packing (25), retainers (26), and washer (28); then remove spool (31) and sleeve (32). Remove packings (29) and retainers (30) from sleeve.

NOTE

Spool (31) and sleeve (32) are matched parts and must be retained as an assembly.

h. Remove plug (48), packing (47), plug (51), packing (49), and retainers (50).

i. Pins (52) and nameplate (54) need not be removed unless damaged.

23-5. CLEANING.

23-6. Clean all parts of four-way solenoid valve for fuel service as outlined in R-3896-3, Volume I, except as follows:

WARNING

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

- Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

NOTE

Protective covers must be installed on all sealing surfaces, threads, and parts to protect from handling damage and contamination.

a. Ultrasonically clean filters (23) in trichloroethylene (MIL-T-27602) as follows:

(1) Install filter in ultrasonic unit so flushing fluid will pass through filter in reverse of the design direction of flow.

(2) Turn on ultrasonic unit at a frequency of 20-40 kc.

(3) Clean filters for a minimum of 10 minutes. Flush filter 4 times during the cleaning cycle, at approximate 2-minute intervals, with a minimum of 500 milliliters of fluid.

(4) Turn off ultrasonic unit.

b. Inspect filter for cleanness as follows:

(1) Install filter in ultrasonic unit so flushing fluid will pass through filter, in design direction of flow.

(2) Turn on ultrasonic unit at a frequency of 20-40 kc.

(3) During a 10-minute cycle at approximately 2-minute intervals, pass fluid through filter and collect four 500 milliliter samples of fluid in a clean container.

(4) Turn off ultrasonic unit.

(5) Perform a particle count of a minimum representative 500 milliliter sample of the 2 liters of fluid collected. Categorize all particles, regardless of shape, size, ratio, composition, etc in 50-100 micron and 101-300 micron size ranges with no differentiation between a particle and a fiber. Acceptance criteria for a 2 liter sample is as follows:

Micron size	Maximum allowable number of particles
50-100	550
101-300	40

c. Repeat steps a and b as required to obtain filter cleanness acceptability.

Part Name and Index No.	Inspecting	Repairing
Valve (4, 5)	Damage.	Replace.
Plate (12)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Cylinder (13)	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
	Major diameter.	Refer to figure 23-5.
	Major inside diameter.	Refer to figure 23-5.
Spring (16)	Compressed lengths.	Refer to figure 23-5.
	Corrosion or cracks.	Replace.
Piston (17)	Major diameter.	Refer to figure 23-5.
Seat (20)	Sealing surface must be free of nicks, scratches, and other imperfections which would impair its sealing function.	Replace.
	Major diameter.	Refer to figure 23-5.
	Shank diameter.	Refer to figure 23-5.
	Small inside diameter.	Refer to figure 23-5.
Poppet (21)	Diameter.	Refer to figure 23-5.
	Thickness.	Refer to figure 23-5.

Figure 23-4. Inspecting and Repairing Four-Way Solenoid Valve (Sheet 1 of 3)

Part Name and Index No.	Inspecting	Repairing
	Sharp corners.	Replace.
	Sealing surface must be free of nicks, scratches, and other imperfections which would impair its sealing function.	Replace.
Spacer (22)	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Major diameter.	Refer to figure 23-5.
	Inside diameter.	Refer to figure 23-5.
	Small inside diameter.	Refer to figure 23-5.
Filter (23)	Damage.	Replace.
	Cleanness.	Refer to paragraph 23-5.
Cap (27)	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Spool (31)	Major diameter.	Refer to figure 23-5.
	Cracked braze.	Replace.
Sleeve (32)	Inside diameter.	Refer to figure 23-5.
	Land diameter.	Refer to figure 23-5.
Piston (38)	Piston head.	Refer to figure 23-5.
	Piston shank.	Refer to figure 23-5.
Spring (39)	Compressed lengths.	Refer to figure 23-5.
	Corrosion or cracks.	Replace.
Guide (41)	Inside small diameter.	Refer to figure 23-5.
	Inside large diameter.	Refer to figure 23-5.
Spring (43)	Compressed lengths.	Refer to figure 23-5.
	Corrosion or cracks.	Replace.
Actuator (46)	Major diameter.	Refer to figure 23-5.

Figure 23-4. Inspecting and Repairing Four-Way Solenoid Valve (Sheet 2 of 3)

Part Name and Index No.	Inspecting	Repairing
Plug (48, 51)	Major diameter.	Refer to figure 23-5.
	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
	Deteriorated or damaged anodic coating	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Body (53)	Damaged threads.	Refer to R-3896-3, Volume I for thread repair.
	Deteriorated or damaged anodic coating.	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
	Damaged inserts.	Replace inserts as outlined in R-3896-3, Volume I.
	Spool sliding surface.	Refer to figure 23-5.
	Valve mating surface.	Refer to figure 23-5.

Figure 23-4. Inspecting and Repairing Four-Way Solenoid Valve (Sheet 3 of 3)

Part Name and Index No.	Dimension	Minimum (Inches except as noted)	Maximum
Cylinder (13)	Major diameter.	0.746	0.747
	Major inside diameter.	0.499	0.501
Spring (16)	Compressed to 0.943 inch.	1.8 lb	2.2 lb
	Compressed to 0.660 inch.	9.0 lb	11.0 lb
Piston (17)	Major diameter.	0.496	0.497
Seat (20)	Major diameter.	0.746	0.747
	Shank diameter.	0.637	0.639
	Small inside diameter.	0.375	0.377
Poppet (21)	Diameter.	0.497	0.500
	Thickness.	0.1245	0.1250
Spacer (22)	Major diameter.	0.746	0.747
	Inside diameter.	0.640	0.641
	Small inside diameter.	0.562	0.564
Spool (31)	Major diameter.	1.250	1.251
Sleeve (32)	Inside diameter.	1.249	1.250
	Land diameter.	1.746	1.747
Piston (38)	Piston head.	1.746	1.747
	Piston shank.	0.499	0.500
Spring (39)	Compressed to 0.910 inch.	10.8 lb	13.2 lb
	Compressed to 0.610 inch.	13.17 lb	16.17 lb

Figure 23-5. Dimensional Limits for Four-Way Solenoid Valve (Sheet 1 of 2)

Part Name and Index No.	Dimension	Minimum	Maximum
		(Inches except as noted)	
Guide (41)	Inside small diameter.	0.502	0.504
	Inside large diameter.	1.750	1.752
Spring (43)	Compressed to 2.082 inches.	133 lb	147 lb
	Compressed to 1.832 inches.	150 lb	166 lb
Actuator (46)	Major diameter.	1.746	1.747
Plug (48)	Major diameter.	0.372	0.373
Plug (51)	Major diameter.	0.246	0.247
Body (53)	Spool sliding surface.	1.749	1.751
	Valve mating surface.	1.124	1.126

Figure 23-5. Dimensional Limits for Four-Way Solenoid Valve (Sheet 2 of 2)

d. Dry filters in an oven at 200° ±10° F for a minimum of 30 minutes or by purging with a regulated source of low pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the cleanness and humidity requirements of MIL-P-27401.

23-7. INSPECTING AND REPAIRING.

23-8. Inspecting the four-way solenoid valve consists mainly in determining that individual parts have not been damaged by mishandling or wear. Refer to figure 23-4 and inspect individual parts for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits listed in figure 23-5 form the guide to serviceability of parts. Minimum and maximum values are given, beyond which repair or replacement of parts is required.

NOTE

Spool (31) and sleeve (32) listed in figures 23-4 and 23-5 are matched parts and must be retained as an assembly.

23-9. ASSEMBLING.

23-10. The assembly procedures for the four-way solenoid valve must be performed in the order listed, and all parts must meet cleaning requirements outlined in paragraph 23-5. The lubricant used in this procedure is hydraulic fluid (MIL-H-5606) unless otherwise specified. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. Refer to figure 23-3 for parts and index numbers.

CAUTION

The following parts are similar in appearance and size. The correct part number packings and retainers must be installed in the locations shown in figure 23-3.
Packing (29), PN MS29513-129
Retainer (30), PN MS28774-129
Packing (36), PN MS29513-222
Retainer (37), PN MS28774-222

- Make sure close diametral clearance parts are alined with body (53) bores when parts are installed, since excessive assembly force of misalined parts can damage bore surfaces and produce contaminants that will result in incorrect operation of the four-way solenoid valve.

NOTE

To install internal parts of the valve that cannot be easily installed by hand, use tapered nylon rods, or equivalent, to facilitate installation and to prevent damage to parts.

- The spool (31) and sleeve (32) must be retained as matched parts.

a. Lubricate (Method M) packings (29) and install packings and retainers (30) on sleeve (32). Lubricate spool and sleeve and install spool (31) in sleeve.

b. Lubricate (Method M) packing (25) and install packing and retainer (26) on cap (27).

CAUTION

Plate (12) must not be installed when installing cap (27), since the cap may contact the plate, resulting in damage to the cap.

bA. Lubricate (Method A) cap (27) with lubricant grease RB0140-012 (Rocketdyne).

CAUTION

Care must be used when installing sleeve (32) into body (53) to avoid shearing packings (29).

c. Install sleeve (32), washer (28), and cap (27) into body (53). Torque cap to 80-120 ft-lb.

d. Lubricate (Method N) packing (36) and install packing and retainers (37) on actuator (46). Lubricate actuator.

dA. Lubricate (Method M) packing (29) and install packing and retainers (30) on guide (41).

CAUTION

Care must be used when installing actuator (46) to avoid shearing packing (36).

e. Aline actuator (46) with a holding tool and slide actuator past internal shoulders of body (53); then install spring (43).

f. Install legs of assembly jig (T-5041501) into 2 diagonal stud holes of body (53).

g. Slide guide (41) down over legs into body (53).

h. Lubricate (Method N) packing (36) and install packing and retainers (37) on piston (38).

i. Lubricate (Method M) packing (29) and install packing and retainers (30) on stop (35).

j. Install spring (39) and piston (38) into guide (41) and stop (35) over assembly jig legs into guide (41).

CAUTION

Springs (43, 49) must be compressed in alinement to prevent damage to packings and parts.

k. Lubricate (Method A) screws (33) with lubricant grease RB0140-012 (Rocketdyne). Install top plate and jackscrew on assembly jig legs, center leveling foot on stop (35), and compress springs (43, 39); then install 2 washers (34) and 2 screws (33). Tighten screws.

kA. Remove assembly jig and install remaining 2 washers (34) and 2 screws (33). Torque 4 screws to 100-140 in-lb.

l. Lubricate (Method M) packing (49) and install packing and retainers (50) on plug (51). Install plug into body (53) on start solenoid end.

m. (Deleted)

n. Install washer (24) and filter (23) with assembly tool T-5036718 into body (53) at the start solenoid end, with valve in the horizontal position. Center washer on filter using a tapered nylon drift rod.

o. Lubricate (Method M) packings (14), assemble seats (20), spacer (22), poppet (21), packings (14), and retainers (15), and using a drift rod for handling and applying steady pressure, install assembly in start solenoid end of valve. Observe installation through start solenoid port.

p. Lubricate (Method M) packings (14) and (Method N) packing (18). Assemble cylinder (13), packings (14), retainers (15), piston (17), spring (16), retainers (19), and packing (18), and install in start solenoid end of valve as an assembly.

q. Lubricate (Method A) screws (10) with lubricant grease RB0140-012 (Rocketdyne). Install plate (12) on start solenoid end of valve using washers (11) and screws (10). Torque screws to 20-25 in-lb.

r. Repeat steps n through p for installation of parts indexed (13 through 24) into the stop solenoid end of valve.

rA. Lubricate (Method M) packing (47) and install packing on plug (48). Install plug in body (53).

rB. Repeat step q to install parts indexed (10 through 12) on stop solenoid end of valve.

s. Lubricate (Method M) packings (6, 8). Install retainers (7, 9) and packings (6, 8) on valves (4, 5).

t. Lubricate (Method A) screws (1) with lubricant grease RB0140-012 (Rocketdyne). Using solenoid removal and installation tool T-5048259, install valves (4, 5) in body (53) and secure with lugs (2), washers (3), and screws (1). Torque screws to 50-70 in-lb; then safetywire screws (1, 10, 32) and cap (27).

23-11. TESTING.

NOTE

The four-way solenoid valve tests may be omitted if the equivalent tests are performed on the engine control valve as outlined in section XXII.

23-12. This procedure outlines requirements for complete testing of the four-way solenoid valve, using Components Test Console G3141 and Components Adapter Set G3143. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install test plates on four-way solenoid valve as outlined in figure 23-6. Index letters are assigned to the valve ports for ease of identification in illustrations. Set up components test console electrical patch-panels (figure 23-7) and prepare console for use (figure 23-8). Refer to paragraphs 23-13 through 23-18 for four-way solenoid valve test procedures and see figures 23-9 and 23-10 for test setups. Refer to figure 23-11 for a typical valve timing trace. Refer to section XXII for four-way solenoid valve cutaway view.

CAUTION

The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.

Index Letter	Valve Port	Fixture	Port Connection
A-B	PRESSURE	T-5026302-301	AN893-18D
C	OPENING	T-5026302-301	AN893-18D
D	CLOSING	T-5026302-301	AN893-18D
E	RETURN	T-5026302-113	AND 10050-12
F	OVERRIDE	None	AND 10050-8

Figure 23-6. Preparing Four-Way Solenoid Valve for Testing

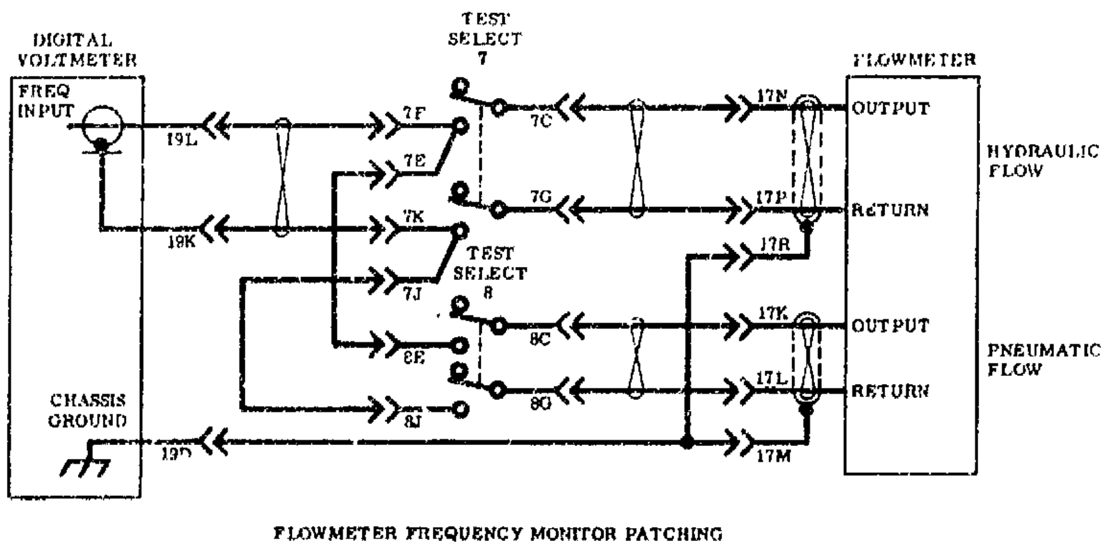


Figure 23-7. Components Test Console Patch-Panel Requirements for Four-Way Solenoid Valve Testing (Sheet 1 of 3)

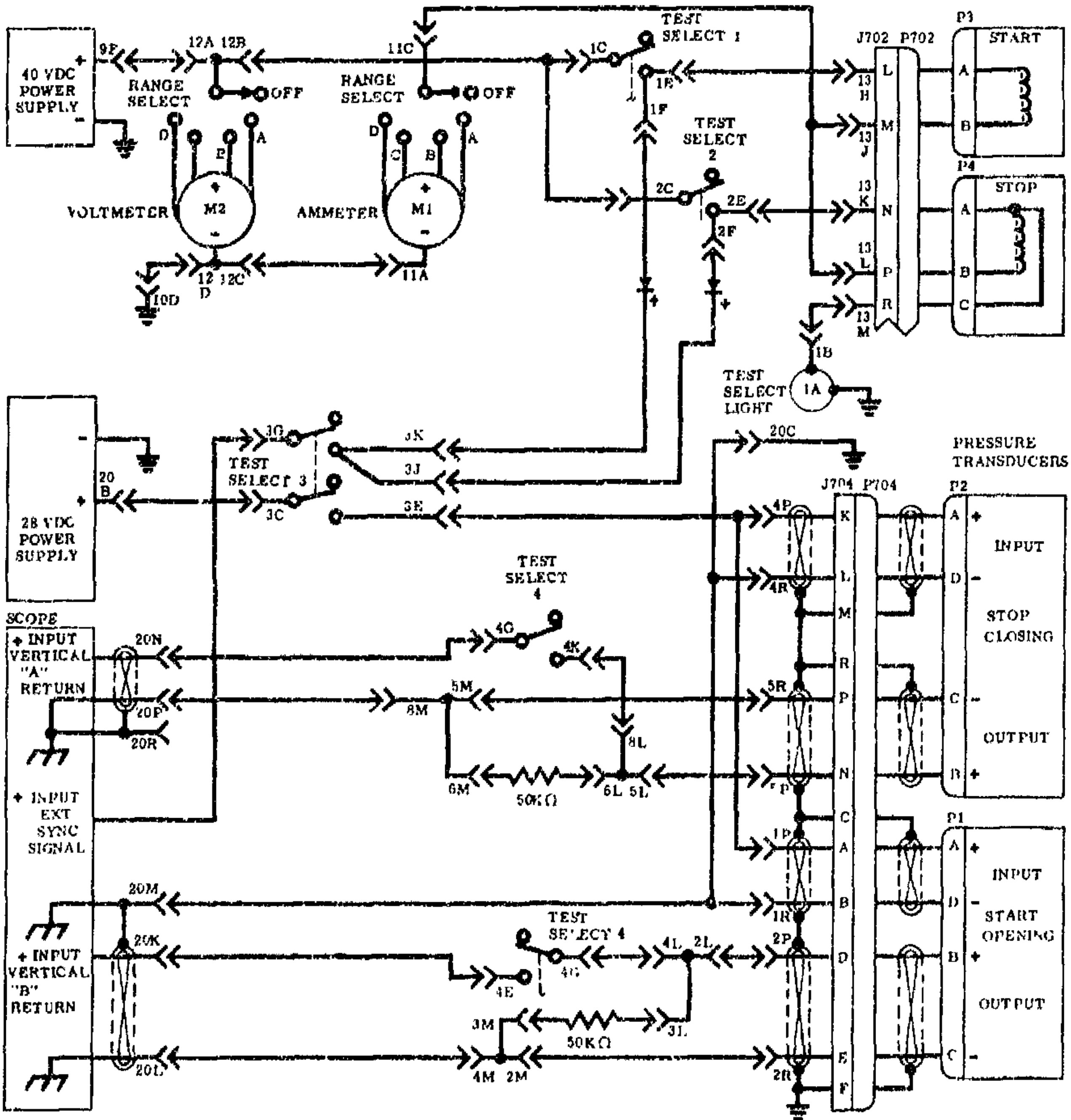


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Figure 23-7. Components Test Console Patch-Panel Requirements for Four-Way Solenoid Valve Testing (Sheet 2 of 3)

Patch-Cord	From J6-	To J6-
K3.[a]	1B	13M
K4.09	1C	2C
		12B
K3.	1E	13H
3088-17[b]	1F	3K(+)
K4.09	1P	3E
		4P
K5.09	1R	4R
		20C
		20M
K3.[a]	2E	13K
3088-17[b]	2F	3J(+)
K3.[a]	4C	4L
K3.[a]	2L	2P
K3.[a]	2M	2R
K3.[a]	3C	20B
K3.[a]	3G	+ Input Ext Sync (on Scope)
3088-14	3L	3M
K3.[a]	4G	20M
K3.[a]	4K	8L

Patch-Cord	From J6-	To J6-
K3.[a]	4M	20L
K3.[a]	4E	20K
K3.[a]	5L	5P
K3.[a]	5M	5R
3088-14	6L	6M
K3.[a]	7C	17N
K3.[a]	7E	8E
K3.[a]	7F	19L
K3.[a]	7G	17P
K3.[a]	7J	8J
K3.[a]	7K	19K
K3.[a]	8C	17K
K3.[a]	8G	17L
K5.09	8M	20P
K3.[a]	9F	12A
K3.[a]	10D	12D
K3.[a]	11A	12C
K4.09	11C	13J
		13L
K4.09	17M	[illegible]R
		19D

(a) Use any cable length required.
(b) Diode patch-cord must be connected with red lead on same side as (+).

Figure 23-7. Components Test Console Patch-Panel Requirements for Four-Way Solenoid Valve Testing (Sheet 3 of 3)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counterclockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	FULL DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Cable BB52752	For start and stop solenoids.
	Connector J703	Resistor plug 3088-9	Temperature indicator load.
	Connector J704	Cable BB52751	For pressure transducers.
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Figure 23-8. Preparing Components Test Console for Use for Four-Way Solenoid Valve Testing (Sheet 1 of 6)

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Push in	Console main power on.
	CB2 (10 AMP)	Push in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	2	Approximately two-thirds of way between 0 and 3.
ELECTRICAL CONTROL	POWER		POWER light on. AC INPUT light on.(a)
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 off. Timing and START SOLENOID control.(a)
	TEST SELECT 2		Light 2 OFF. Timing and STOP SOLENOID control.(a)
	TEST SELECT 3		Light 3 off. Digital voltmeter return and transducer power control.(a)
	TEST SELECT 4		Light 4 OFF. Timing power control.(a)
	TEST SELECT 5		Light 5 OFF. Transducer signal and oscilloscope input control.(a)
	TEST SELECT 6		Light 6 OFF. (Not used.)(a)

(a) If indication is not as specified, press switch-light.

Figure 23-8. Preparing Components Test Console for Use for Four-Way Solenoid Valve Testing (Sheet 2 of 6)

Panel	Control	Position	Indication/Remarks
	TEST SELECT 7		Light 7 OFF. Hydraulic flow monitor control.[(a)]
	TEST SELECT 8		Light 8 OFF. Pneumatic flow monitor control.[(a)]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 28 ±0.5 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[(a)]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[(a)]
	TEST CELL SUPPLY "A"		VENT.[(a)]
	TEST CELL SUPPLY "B"		VENT.[(a)]
	FLOW MONITOR SHUT-OFF		CLOSE.[(a)]
	LOW FLOW BYPASS		CLOSE.[(a)]
OSCILLOSCOPE	FOCUS	Arrow up	Adjust later for best focus.
	VERTICAL POSITION	Arrows up	Adjust later for best position.
	HORIZ. POSITION	Arrow up	Adjust later for best position.
	INTENSITY	Arrow horizontal (to left)	Adjust later for best intensity. Allow 30-minute warmup period before use.
	Power light	On	To right of cathode ray tube.
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.

(a) If indication is not as specified, press switch-light.

Figure 23-8. Preparing Components Test Console for Use for Four-Way Solenoid Valve Testing (Sheet 3 of 6)

Panel	Control	Position	Indication/Remarks
	RANGE	100V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	If digital voltmeter indicates OVER-LOAD, wait at least one minute before resetting.
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Allow digital voltmeter to warm up for at least 30 minutes prior to use.

FLOW MONITOR TEST

Panel	Control	Position	Indication/Remarks
DIGITAL VOLTMETER	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	RANGE	100V	
	FUNCTION	FREQ	
	ATTENTUATION	Midposition	Readjustment may be necessary during test to obtain consistent readings. Refer to digital voltmeter manual.
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	Arrow up	

Figure 23-8. Preparing Components Test Console for Use for Four-Way Solenoid Valve Testing (Sheet 4 of 6)

Panel	Control	Position	Indication/Remarks
OSCILLOSCOPE	A VERT. SENSITIVITY	1 VOLT/CM/DC	
	A VERT. SENSITIVITY VERNIER	Arrow horizontal to right	
	B VERT. SENSITIVITY	1 VOLT/CM/DC	
	B VERT. SENSITIVITY VERNIER	Arrow up	
	SWEEP TIME HORIZ. SENS.	5 MILLISEC/CM	
	SWEEP TIME HORIZ. SENS. VERNIER	CAL	Fully clockwise.
	CHANNEL A POLARITY	POS. UP	
	VERT. PRESENTATION	CHOP	
	TRIGGER LEVEL	AUTO	
	TRIGGER LEVEL SYNC.	EXT	
	DC-AC	DC	
	GROUND STRAPS (A and B)	Ground	
	X1 SWP. - X5 EXP.	X1 SWP.	

PNEUMATIC PREPARATION

a. Make sure that console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

Figure 23-8. Preparing Components Test Console for Use for Four-Way Solenoid Valve Testing (Sheet 5 of 6)

Panel	Control	Position	Indication/Remarks

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. ON PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators when individual panel SHUTOFF valves are opened. Safety precautions specified in R-3896-3, Volume I, must be followed to make sure that personnel are safe when working with pressurized systems.

Figure 23-8. Preparing Components Test Console for Use for Four-Way Solenoid Valve Testing (Sheet 6 of 6)

23-13. LEAK-TEST.

23-13A. O-Ring Seating Test.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and four-way solenoid valve for use as outlined in paragraph 23-12; then connect four-way solenoid valve to console (figure 23-9). Close hand valve between OPENING port (C) and CLOSING port (D). Open hand valve at RETURN port (E).	None.

CAUTION

The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

bA. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

Procedure	Result
(1) Close VENT and SHUTOFF valves.	None.

Procedure	Result
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESSURE gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±100 psi.
cA. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
d. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,700 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.

Procedure	Result
e. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until on HYD DIFF PRESS MONITOR panel, PRESSURE MONITOR gage indicates 1,500 ±100; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 1,500 ±100 psi.
f. (Deleted)	
g. On ELECTRICAL CONTROL panel, make sure that VOLTS meter indicates 28 ±0.5 volts.	VOLTS meter must indicate 28 ±0.5 volts.
h. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on and START SOLENOID energized.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 2 switch-lights.	Light 1 off and START SOLENOID deenergized. Lights 2 and 1A on and STOP SOLENOID energized.
j. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light.	Lights 2 and 1A off and STOP SOLENOID deenergized.
k. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
l. (Deleted)	
m. Perform steps eA and g through k 20 times. These steps constitute one cycle. Duration of each cycle must be approximately 2 minutes.	Same as steps eA and g through k.

WARNING

The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
n. After 5th, 10th, and 15th cycle, inspect valve for external leakage. If leakage is observed, wipe wetted area clean with a cloth dampened with cleaning compound (MIL-C-81302), or equivalent.	None.
o. After 20th cycle, inspect valve for external leakage.	Reject valve if leakage exists.
p. If there is no external leakage after completion of 20 cycles, depressurize valve as outlined in steps q through u, then perform surface wetting leak-test.	None.
q. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
r. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
s. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR gage must indicate zero.

Procedure	Result
t. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

u. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
v. If testing is being terminated for the day, on MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.

23-13B. Surface Wetting Leak-Test.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and four-way solenoid valve for use as outlined in paragraph 23-12; then, except as noted, connect four-way solenoid valve to console (figure 23-9). Change test line from 0-5000 PSIG HYD MON INLET fitting to ΔP HYD MON UPSTREAM INLET fitting and uncap ΔP HYD MON DOWNSTREAM INLET. Close hand valve between OPENING port (C) and CLOSING port (D).	None.

CAUTION

- The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.
- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 500 ±25 psi.	SUPPLY PRESSURE gage must indicate 500 ±25 psi.
cA. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
d. On MED PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 25 ±5 psi.	MED PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.

Procedure	Result
e. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until on HYD DIFF PRESS MONITOR panel, DIFFERENTIAL PRESSURE gage indicates 3 to 7 psi, then close SHUTOFF valve.	DIFFERENTIAL PRESSURE gage must indicate 3-7 psi.
f. (Deleted)	
g. Hold pressure on valve for a 10-minute interval; then on HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light on and supply light off. Valve depressurized.
h. Inspect valve exterior for wet surfaces.	If valve surfaces are dry, proceed to functional tests (paragraph 23-14 through 23-18). If valve surfaces are wet, proceed to step i.

WARNING

The following procedure uses cleaning compound which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

Procedure	Result
i. Wipe wetted surfaces dry with a clean cloth dampened with cleaning compound (MIL-C-81302).	None.
j. Repeat steps cA and g through i a maximum of 5 times.	Reject the valve if wet surfaces are observed after the fifth 10-minute pressure interval.
jA. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
jB. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
jC. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR shutoff valve until gage indicates zero; then close valve.	PRESSURE MONITOR gage must indicate zero.
jD. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
jE. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
k. Change test line from ΔP HYD MON UPSTREAM INLET to 0-5000 PSIG MON INLET. Cap ΔP HYD MON DOWNSTREAM INLET fitting.	None.

23-14. External Leak Test.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

Procedure	Result
a. Prepare Components Test Console G3141 and engine control valve for use as outlined in paragraph 23-12; then connect four-way solenoid valve to console (figure 23-9). Close hand valve between OPENING port (C) and CLOSING port (D). Open hand valve at RETURN port (E).	None.

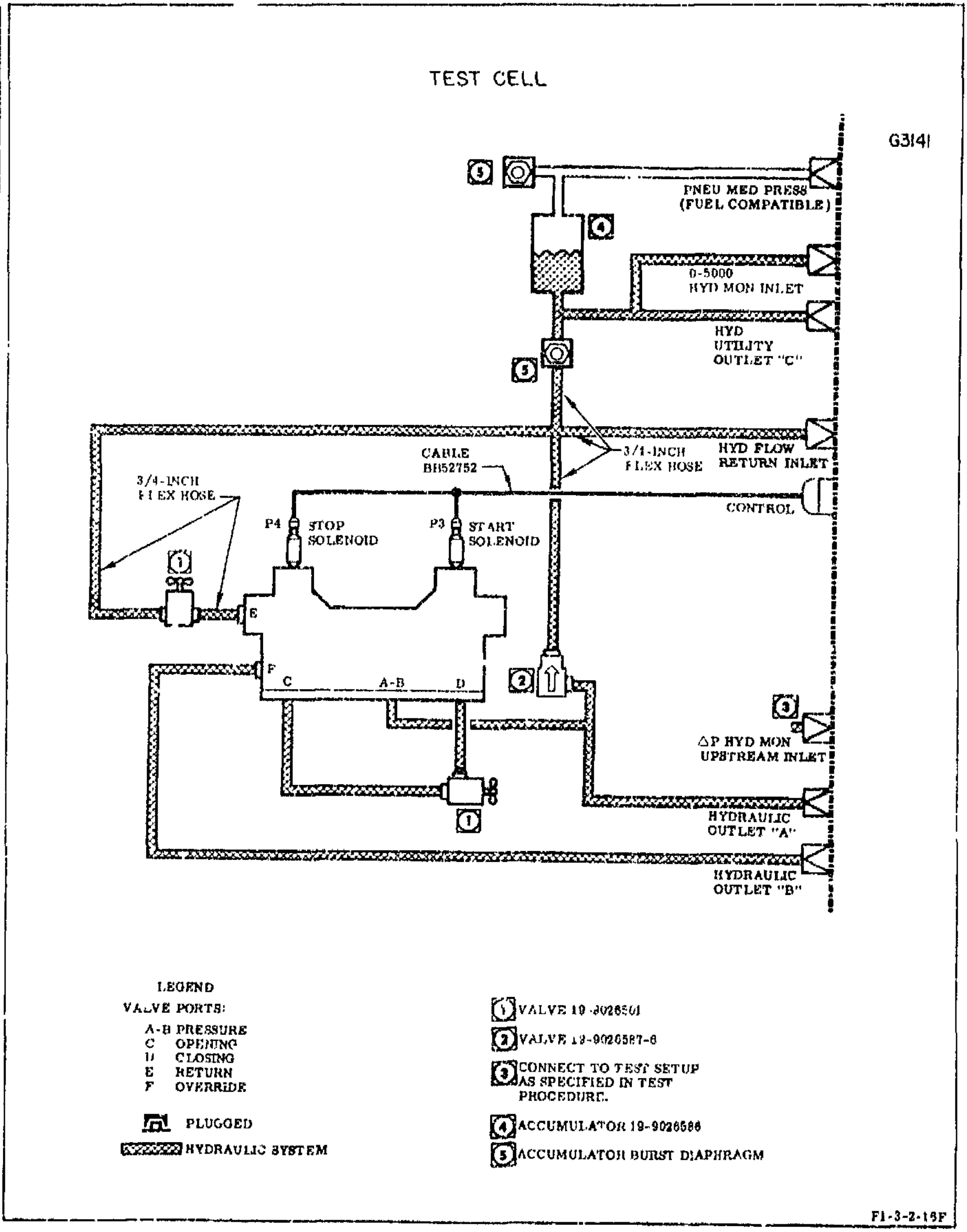


Figure 23-9. Four-Way Solenoid Valve External Leak-Test Setup

CAUTION

The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

bA. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

Procedure	Result
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.

Procedure	Result
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 3,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 3,000 ±50 psi.
d. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light off and SUPPLY light on.
e. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,475 ±25 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,475 ±25 psi. Valve pressurized.
g. Maintain 2,475 ±25 psi at PRESSURE port (A-B) and check for external leakage.	No leakage is allowable.
h. On ELECTRICAL CONTROL panel, make sure that VOLTS meter indicates 28 ±0.5 volts.	VOLTS meter must indicate 28 ±0.5 volts.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on and START SOLENOID energized.
j. Maintain 2,475 ±25 psi at PRESSURE port (A-B) and check for external leakage.	No leakage is allowable.
k. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 2 switch-lights.	Light 1 off and START SOLENOID deenergized. Lights 2 and 1A on and STOP SOLENOID energized.
l. Maintain 2,475 ±25 psi pressure at PRESSURE port (A-B) and check for external leakage.	No external leakage is allowable.

Procedure	Result
m. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 600 ±10 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 600 ±10 psi. Valve pressure reduced.
n. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±10 psi.	HIGH PRESS FUEL COMPATIBLE panel pressure reduced.
o. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light.	Lights 2 and 1A off and STOP SOLENOID deenergized.
p. Open hand valve between OPENING port (C) and CLOSING port (D). Close hand valve at RETURN port (E).	None.
q. Maintain 600 ±10 psi pressure at PRESSURE port (A-B) for 2 minutes minimum; then check for leakage. Open hand valve at RETURN port (E).	No external leakage is allowable.
r. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. Valve depressurized.
s. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,475 ±25 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
t. Using HYDRAULIC CONTROL panel, apply pressure to OVERRIDE port (F) as follows:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on. PRESSURE port (A-B) depressurized.
(2) Press TEST CELL SUPPLY "B" switch-light.	VENT light off and SUPPLY light on. OVERRIDE port (F) pressurized.
u. Maintain 2,475 ±25 psi pressure at OVERRIDE port (F) for 2 minutes minimum; then check for leakage.	No external leakage is allowable.
v. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. OVERRIDE port (F) depressurized.
w. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
x. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

y. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Press TEST CELL SUPPLY "B" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
yA. On MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.
z. Remove engine control valve from external leak-test setup.	None.

23-15. Internal Leak-Test.

WARNING

Components Test Console G3141 and Components Adapter Set G3143 must be operated by authorized personnel trained in the use of the equipment.

a. Connect four-way solenoid valve to console (figure 23-9A).	None.

CAUTION

The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.

- The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test results.

Procedure	Result
b. Prepare digital voltmeter (DVM) for flow monitor test (figure 23-8) and press RESET switch.	DVM indicates KC000000-000001.
c. Open hand valves at RETURN port (E) and between OVERRIDE port (F) and HYDRAULIC OUTLET "B". Close hand valve at OVERRIDE port (F).	None.

d. Using HYDRAULIC CONTROL panel, perform the following:

(1) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

dA. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESSURE FUEL COMPATIBLE panel pressurized.

Procedure	Result
(3) Slowly open SHUTOFF valve.	Accumulator precharge to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.
e. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 3,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 3,000 ±50 psi.
f. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "A" switch-light.	VENT light off and SUPPLY light on.
fA. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,700 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
fB. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,475 ±25 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,475 ±25 psi. Valve pressurized.
fC. On HYDRAULIC CONTROL panel, press LOW FLOW BYPASS switch-light.	CLOSE light off and OPEN light on.

NOTE

For all leakage tests (steps g, i, m, p, and v), start leakage measurements 3 minutes after pressurization and continue for 1 minute.

- A graduated cylinder 24-464-51 may be used to measure fluid.

Procedure	Result
g. Measure and record leakage from RETURN port (E).	Maximum allowable leakage is 200 cc/m.
h. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on and START SOLENOID energized.
i. Measure and record leakage from RETURN port (E).	Maximum allowable leakage is 200 cc/m.
j. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	CLOSE light off and OPEN light on.
k. Close hand valve at RETURN port (E).	None.
l. On ELECTRICAL CONTROL panel, press TEST SELECT 2 and 7 switch-lights.	Lights 2, 7, and 1A on and STOP SOLENOID energized.
m. On digital voltmeter (DVM) panel, press RESET switch; then record leakage from RETURN port (E).	DVM indication must not exceed an equivalent of the maximum allowable leakage of 1.2 ±0.3 gpm.
n. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
o. On HYDRAULIC CONTROL panel, slowly open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,000 ±20 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,000 ±20 psi. Valve pressure reduced.
p. Close hand valve between OVERRIDE port (F) and HYDRAULIC OUTLET "B" and slowly open hand valve at OVERRIDE port (F); then measure and record leakage.	Maximum allowable leakage is 5 cc/m.

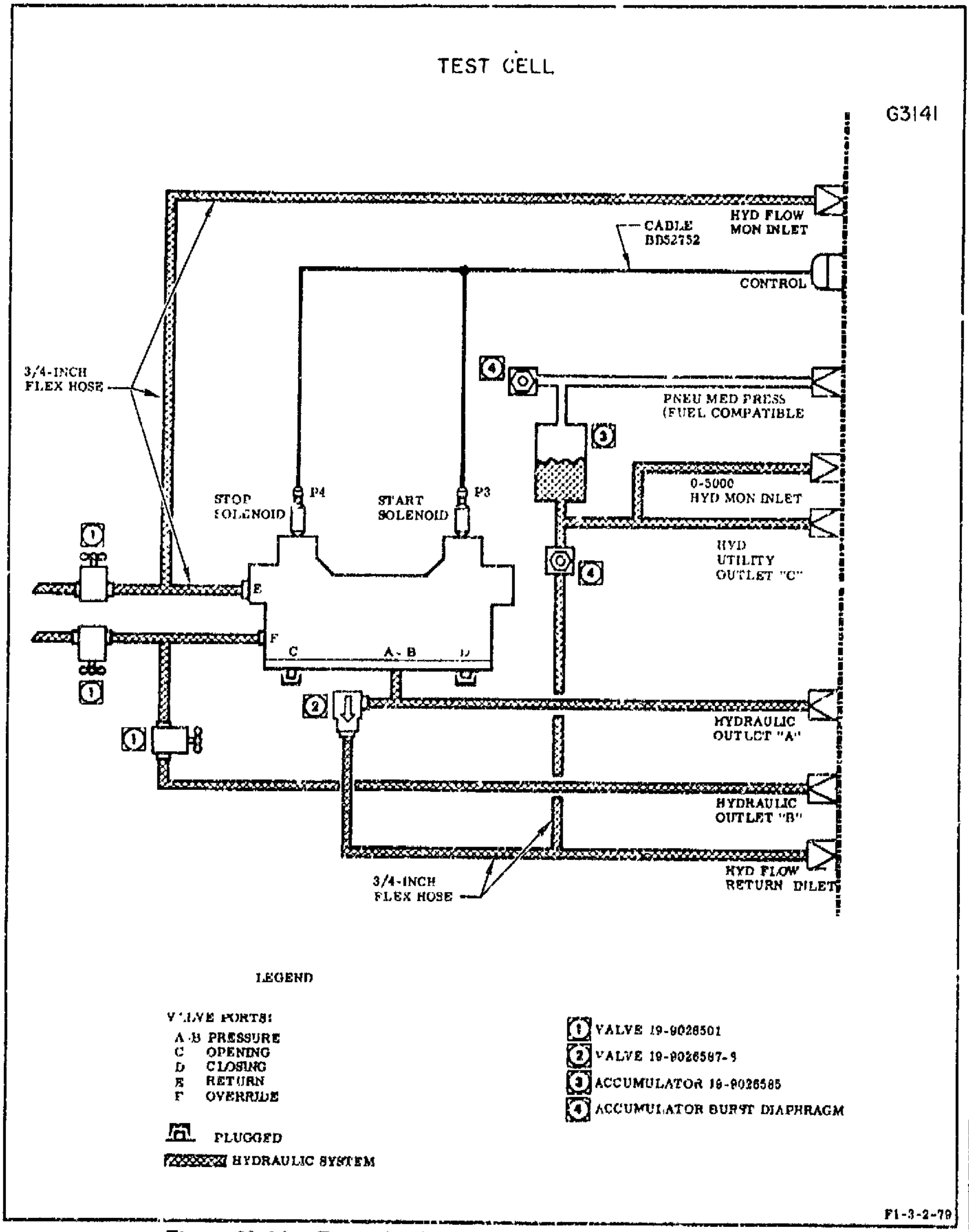


Figure 23-9A. Four-Way Solenoid Valve Internal Leak-Test Setup

Procedure	Result
q. Close hand valve at OVERRIDE port (F).	None.
r. On ELECTRICAL CONTROL panel, press TEST SELECT 2 and 7 switch-lights.	Lights 2, 7, and 1A off and STOP SOLENOID deenergized.
s. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. Valve depressurized.
t. Open hand valve at RETURN port (E).	None.
tA. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light.	OPEN light off and CLOSE light on.
tB. Open hand valve between OVERRIDE port (F) and HYDRAULIC OUTLET "B".	None.
u. Using HYDRAULIC CONTROL panel, apply pressure to OVERRIDE port (F) as follows:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press TEST CELL SUPPLY "B" switch-light.	VENT light off and SUPPLY light on.
(3) Slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 1,500 ±15 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 1,500 ±15 psi. OVERRIDE port (F) pressurized.
v. Measure and record leakage from RETURN port (E).	Maximum allowable leakage is 5 cc/m.
w. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF and VENT valves.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
x. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve.	HYDRAULIC CONTROL panel depressurized.
y. On HYD DIFF PRESS MONITOR panel, open PRESSURE MONITOR shutoff valve until gage indicates zero: then close valve.	PRESSURE MONITOR gage must indicate zero.
z. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
aa. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "B" switch-light.	SUPPLY light off and VENT light on.
(3) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
aaA. On MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.
ab. Remove valve from test setup.	None.
ac. If four-way solenoid valve testing is terminated, secure equipment as outlined in paragraph 23-19.	None.
ad. Install protective closures. Refer to paragraph 23-2.	None.

23-16. TIMING- AND ACTUATION-TEST.

Procedure	Result
a. Make sure that Components Test Console G3141 and four-way solenoid valve are prepared for use as outlined in paragraph 23-12.	None.
b. Connect four-way solenoid valve to console (figure 23-10). Close hand valve between OPENING port (C) and CLOSING port (D). On PNEU/HYD UTILITY PNL, close hand valve between outlets A and B.	None.

CAUTION

The lines used in the test setup are 1/2-inch flex hose unless otherwise specified. The correct line sizes, without any restrictions, must be used in the test setup. Any restrictions or the use of lines smaller than specified in the test setup can cause damage to the valve during testing or can give unacceptable test result.

Procedure	Result
c. Prepare external flowmeter, transformer, and electronic counter for operation as outlined in instruction manuals supplied with each unit.	None.

d. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.

e. Using MED PRESS FUEL COMPATIBLE panel, apply pressure to accumulator as follows:

Procedure	Result
(1) Close VENT and SHUTOFF valves.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 600 ±50 psi.	MED PRESS FUEL COMPATIBLE panel pressurized.
(3) Slowly open SHUTOFF valve.	Accumulator precharged to 600 ±50 psig.
(4) Close SHUTOFF valve; then close PRESSURE REGULATOR.	REG SUPPLY PRESS gage decreases to zero.
f. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.

23-17. Timing-Test.

a. Using ELECTRICAL CONTROL panel, perform the following:

CAUTION

The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.

Procedure	Result
(1) Adjust VOLTAGE ADJUST knob until VOLTS meter indicates 15-17 volts.	None.
(2) Turn MILLIAMPERES meter RANGE SELECT switch to B (0-500).	None.

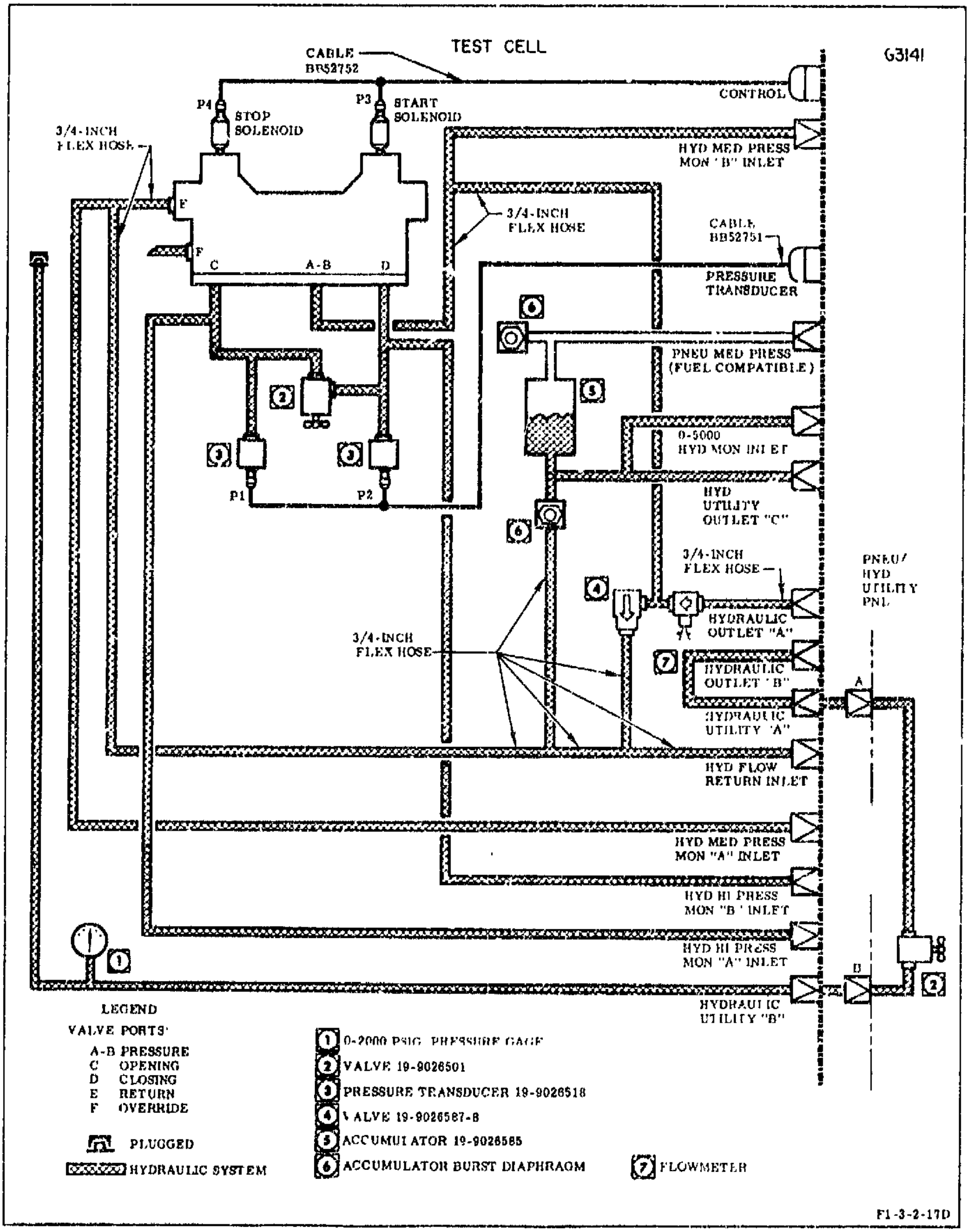


Figure 23-10. Four-Way Solenoid Valve Timing- and Actuation-Test Setup

b. and c. (Deleted)

Procedure	Result
d. Open hand valve between OPENING port (C) and CLOSING port (D).	None.

e. Using HIGH PRESS FUEL COMPATIBLE panel, apply pressure to HYDRAULIC CONTROL panel as follows:

Procedure	Result
(1) Close SHUTOFF valve and open VENT valve.	None.
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve to establish 1,150 ±20 psig differential pressure between PRESSURE port (A-B) and RETURN port (E), and simultaneously adjust hand valve between CLOSING port (D) and OPENING port (C) to establish 10 ±0.25 gpm. Close HIGH PRESS SHUTOFF valve. Record flow. Monitor OPENING port (C) and CLOSING port (D) pressure.	HYD MED PRESS MONITOR panel PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages must indicate 1,150 ±20 psi differential pressure. External flowmeter counter must indicate an equivalent to 10 ±0.25 gpm. CLOSING port (D) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.
g. On PRESSURE/TEMPERATURE MONITOR panel, turn CHANNEL SELECT switch to 3. Record temperature.	TEMPERATURE INDICATOR indicates hydraulic flow temperature.

h. Using ELECTRICAL CONTROL panel, perform the following:

Procedure	Result
(1) Press TEST SELECT 1 switch-light. Monitor OPENING port (C) and CLOSING port (D) pressure.	Light 1 on and START SOLENOID energized. OPENING port (C) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and CLOSING port (D) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

If OPENING port (C) pressure and CLOSING port (D) pressure are nearly equal, the main spool has not fully shuttled.

Procedure	Result
(2) Adjust VOLTAGE ADJUST knob until MILLIAMPERES meter indicates 300 ±50 milliamperes.	None.
(3) Wait 10 seconds and press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
(4) Press TEST SELECT 2 switch-light. Monitor OPENING port (C) and CLOSING port (D) pressure.	Lights 2 and 1A on and STOP SOLENOID energized. CLOSING port (D) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.
(5) Adjust VOLTAGE ADJUST knob until MILLIAMPERES meter indicates 300 ±50 milliamperes.	None.

Procedure	Result
(6) Wait 10 seconds and press TEST SELECT 2 switch-light.	Lights 2 and 1A off and STOP SOLENOID deenergized.
i. Repeat step h nine times.	Same result as step h.

iA. Make sure that differential pressure and flow requirements specified in step f are maintained. Readjust, as necessary, to obtain results of step f.

j. Prepare oscilloscope for timing- and actuation-test (figure 23-8) and perform the following:

Procedure	Result
(1) Adjust INTENSITY and FOCUS switches to sharpest trace.	None.
(2) Adjust VERTICAL POSITION A and HORIZ. POSITION switches until vertical A trace is to first grid on left and fourth from bottom.	None.
(3) Adjust VERTICAL POSITION B switch until vertical B trace is at same position as vertical A trace.	None.
(4) Adjust TRIGGER LEVEL switch to arrow just off of AUTO position.	None.

NOTE

Oscilloscope sensitivity may have to be readjusted to obtain suitable trace.

Procedure	Result
k. On ELECTRICAL CONTROL panel, press TEST SELECT 3 and 4 switch-lights.	Lights 3 and 4 on.

NOTE

The results of steps l and n are recorded using camera supplied with Components Test Console G3141. Refer to instruction manual for operation.

- Camera viewing visor to be closed when in standby condition.

Procedure	Result
l. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light. Measure and record operating time. Monitor OPENING port (C) and CLOSING port (D) pressure.	Light 1 on and START SOLENOID energized. MILLIAMPERES meter must indicate 300 ±50 milliamperes. Operating time must not exceed 50 milliseconds. OPENING port (C) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and CLOSING port (D) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

If OPENING port (C) pressure and CLOSING port (D) pressure are nearly equal, the main spool has not fully shuttled.

- The operating time is measured from start of traces to end of pressure buildup at OPENING port (C). (Figure 23-11 shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

Procedure	Result
m. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
n. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light. Measure and record operating time. Monitor OPENING port (C) and CLOSING port (D) pressure.	Lights 2 and 1A on and STOP SOLENOID energized. MILLIAMPERES meter must indicate 300 ±50 milliamperes. Operating time must not exceed 50 milliseconds. CLOSING port (D) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and OPENING port (C)

Procedure	Result
	pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

The operating time is measured from start of traces to end of pressure buildup at CLOSING port (D). (Figure 23-11 shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

o. On ELECTRICAL CONTROL panel, press TEST SELECT 2, 3, and 4 switch-lights.	Lights 2, 3, 4, and 1A off and STOP SOLENOID deenergized.

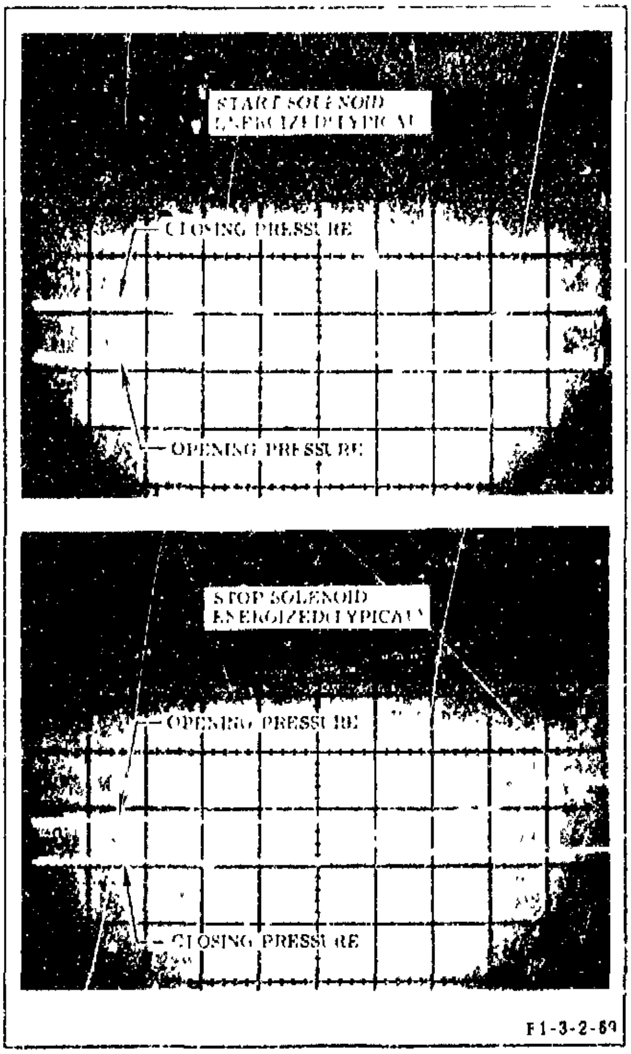


Figure 23-11. Four-Way Solenoid Valve Timing Traces (Typical)

23-18. Actuation-Test.

a. On ELECTRICAL CONTROL panel, perform the following:

CAUTION

The four-way solenoid valve start solenoid must not be actuated until 800 psig minimum pressure has been applied to PRESSURE port (A-B); otherwise, damage to the spool can result.

Procedure	Result
(1) Adjust VOLTAGE ADJUST knob until VOLTS meter indicates 28 ±0.5 volts.	None.
(2) Turn MILLIAMPERES meter RANGE SELECT switch to A (0-500) x 2.	None.

b. (Deleted)

c. Do not change adjustment of hand valve between OPENING port (C) and CLOSING port (D).	None.
d. On HIGH PRESS FUEL COMPATIBLE panel, close PRESSURE REGULATOR and open SHUTOFF valve.	REG SUPPLY PRESS gage indicates zero.
e. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve to establish 800 ±10 psig differential pressure between PRESSURE port (A-B) and RETURN port (E); then close HIGH PRESS SHUTOFF valve.	HYD MED PRESS MONITOR panel, PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages must indicate 800 ±10 psi differential pressure.

eA. On ELECTRICAL CONTROL panel, perform the following:

(1) Press TEST SELECT 1 switch-light. After a minimum of one minute, record current required to energize START SOLENOID.	Light 1 on and START SOLENOID energized. Current required to energize START SOLENOID must not exceed 550 milliamperes.

Procedure	Result
(2) Press TEST SELECT 1 and 2 switch-lights, in order listed. After a minimum of one minute, record current required to energize STOP SOLENOID.	Light 1 off and START SOLENOID deenergized. Light 2 on and STOP SOLENOID energized. Current required to energize STOP SOLENOID must not exceed 550 milliamperes.
(3) Press TEST SELECT 2 switch-light.	Light 2 off and STOP SOLENOID deenergized.

f. Prepare oscilloscope for timing and actuation test (figure 23-8) and perform the following:

Procedure	Result
(1) Turn SWEEP TIME HORIZ. SENS. switch to 10 MILLISEC/CM.	None.
(2) Turn SWEEP TIME HORIZ. SENS. VERNIER switch to CALIB.	None.

g. and h. (Deleted)

NOTE

The results of steps i and k are recorded using camera supplied with Components Test Console G3141. Refer to instruction manual for operation.

- Camera viewing visor is to be closed when in standby condition.

Procedure	Result
i. On ELECTRICAL CONTROL panel, press TEST SELECT 3, 4, and 1 switch-lights, in order listed. Measure and record pressure actuation time from CLOSING port (D) to OPENING port (C).	Lights 3, 4, and 1 on and START SOLENOID energized. CLOSING port (D) and OPENING port (C) pressures must reverse within one second.

NOTE

Pressure reversal time is measured from start of traces to end of pressure buildup at OPENING port (C). (Figure 23-11 shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the eventual stabilized pressure.

Procedure	Result
j. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
k. On ELECTRICAL CONTROL panel, press TEST SELECT 2 switch-light. Measure and record pressure actuation time from OPENING port (C) to CLOSING port (D).	Lights 2 and 1A on and STOP SOLENOID energized. OPENING port (C) and CLOSING port (D) pressures must reverse within one second.

NOTE

Pressure reversal time is measured from start of traces to end of pressure buildup at CLOSING port (D). (Figure 23-11 shows a typical trace.) End of pressure buildup is defined as the initial time the pressure trace reaches the initial stabilized pressure.

Procedure	Result
l. On ELECTRICAL CONTROL panel, press TEST SELECT 2, 3, and 4 switch-lights.	Lights 2, 3, 4, and 1A off and STOP SOLENOID deenergized.
m. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF valve and open PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,500 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
n. On PNEU/HYD UTILITY PNL, verify that hand valve between outlets A and B is closed.	None.

Procedure	Result
nA. Remove plug from hose connected to HYDRAULIC UTILITY "B" and connect hose to valve OVERRIDE port (F).	None.
o. On HYDRAULIC CONTROL panel, press TEST CELL SUPPLY "B" switch-light and slowly open HIGH PRESS SHUTOFF valve until on HYD MED PRESS MONITOR panel, PRESSURE MONITOR "B" gage indicates 1,350 (+20, -0) psi; then close HIGH PRESS SHUTOFF valve.	PRESSURE port (A-B) and HYDRAULIC OUTLET "B" pressurized. SUPPLY light on and VENT light off.
p. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light. Monitor OPENING port (C) and CLOSING port (D) pressure.	Light 1 on and START SOLENOID energized. OPENING port (C) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and CLOSING port (D) pressure must be within 50 psi of RETURN port (E) pressure.

NOTE

If OPENING port (C) pressure and CLOSING port (D) pressure are nearly equal, the main control spool has not fully shuttled.

Procedure	Result
q. On PNEU/HYD UTILITY PNL, slowly open hand valve between outlets A and B until OPENING port (C) and CLOSING port (D) pressures reverse. Record pressure. Monitor OPENING port (C) and CLOSING port (D) pressure.	On HYD DIFF PRESS MONITOR panel, PRESSURE MONITOR gage must not exceed 1,350 psi. CLOSING port (D) pressure must be within 50 psi of PRESSURE port (A-B) pressure, and OPENING port (C) pressure must be within 50 psi of RETURN port (E) pressure.
r. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 off and START SOLENOID deenergized.
s. On HIGH PRESS FUEL COMPATIBLE panel, close PRESSURE REGULATOR and open SHUTOFF valve.	REG SUPPLY PRESS gage decreases to zero.
t. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.

u. On HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Slowly open HIGH PRESS SHUTOFF valve.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	VENT light on and SUPPLY light off.
(3) Press TEST CELL SUPPLY "B" switch-light.	VENT light on and SUPPLY light off.
(4) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
(5) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
v. On HYD HIGH PRESS MONITOR panel, open return shutoff valve.	PRESSURE MONITOR "A" gage decreases to zero.
w. On MED PRESS FUEL COMPATIBLE panel, open VENT valve.	Accumulator precharge decreases to zero.

Procedure	Result
x. Remove valve from test setup.	None.
y. If four-way solenoid valve testing is terminated, secure equipment as outlined in paragraph 23-19.	None.
z. Install protective closures. Refer to paragraph 23-2.	None.

23-19. SECURING TEST EQUIPMENT.

23-20. After four-way solenoid valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure that all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn oscilloscope power and digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BYPASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

23-21. START AND STOP SOLENOID VALVES 556508 AND 556511.

23-22. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the start and stop solenoid valves. Refer to R-3896-4 for protective closures. See figure 23-12 for test equipment and special tools.

Part No.	Nomenclature	Use
G3141	Components Test Console	Provides electrical power and hydraulic pressure for testing start and stop solenoid valves.
G3143	Components Adapter Set	Provides hardware for testing start and stop solenoid valves.
No number	In-line filter (10 micron nominal, 25 micron absolute, and 2,500 psig operating pressure)	Filters hydraulic fluid used for pressurizing start and stop solenoid valves.
555309	Fixture (Seat) (Modified)	Used for flushing cleaning compound through solenoids.
88-555267, or equivalent	Housing	Provides manifold for leak testing start and stop solenoid valves.

Figure 23-12. Test Equipment and Special Tools for Start and Stop Solenoid Valves

23-23. DISASSEMBLING.

23-24. See figure 23-13 and disassemble start or stop solenoid valves to required level as follows:

a. Hold valve with receptacle down to prevent armature (4) and springs (5) from falling out; then remove seat (1) from solenoid (6).

b. Remove rings (2) and packing (3) from seat (1).

c. Visually inspect installed armature (4), cavity, and passages for any contamination, discoloration, corrosion, or damage to determine if solenoid valve will require further disassembly.

d. If further disassembly of the solenoid valve is required to clean armature, springs, and internal passages of the solenoid, or to replace parts, perform steps e and f.

NOTE

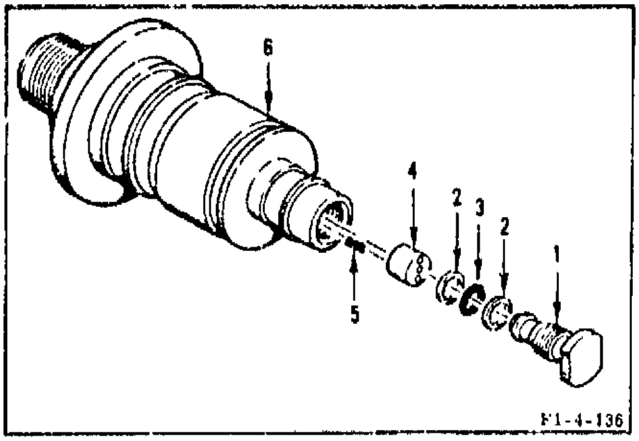
Armature (4) is functionally mated to solenoid (6) and seat (1) during normal operation of the valve. The armature, solenoid, and seat should be kept as a matched set. The armature should also be kept in the same position as it was removed, with the ends oriented to the mated solenoid end and seat end.

e. Remove armature (4) from solenoid (6).

f. Using tweezers, remove 3 springs (5) from spring cavities in solenoid (6).

23-25. CLEANING

23-26. Cleaning solenoid valves is divided into two parts, depending on the depth of disassembly. If only the seat (1), rings (2), and packing (3) were removed, perform steps a through c. If the entire solenoid valve was disassembled, perform the complete cleaning procedure.



1 Seat	3 Packing	5 Springs
2 Ring	4 Armature	6 Solenoid

Figure 23-13. Start and Stop Solenoid Valves--Exploded View

WARNING

The following procedure uses cleaning compound (MIL-C-81302), which is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

a. Hand-clean exterior of valve before disassembling and seat (1) after disassembling with a lint-free cloth or brush moistened with cleaning compound (MIL-C-81302).

b. Dry valve and seat as outlined in R-3896-3, Volume I.

c. Clean new rings (2) and packing (3), before assembling, as follows:

(1) Immerse rings and packing in a 3.0 to 3.5 percent by volume solution of cleaning compound Turco 4215 (Turco Products) or cleaner 101A (Leeder Chemicals, Inc) in water heated to 130° to 150° F and scrub each part with a nylon-bristle brush for a minimum of one minute.

(2) Immersion-rinse each part in deionized water, heated to 130° to 150° F, for a minimum of 2 minutes.

(3) Spray-rinse each part with filtered deionized water for a minimum of one minute.

(4) Dry each part as outlined in R-3896-3, Volume I for a minimum of 2 minutes.

NOTE

Steps d through aa are only required if the armature (4) and springs (5) were removed from the solenoid (6).

d. Install electrical plug on solenoid valve as follows:

(1) NA5-27556 T103S on the 556509 stop solenoid using RD261-2006-0010 gasket.

(2) NA5-27556 T123S on the 556511 start solenoid using an RD261-2006-0012 gasket.

NOTE

The electrical plug RD gaskets must be used only once (to clean one solenoid valve); then replaced.

e. Install fixture (modified seat 555309) in solenoid (6). Do not use rings (2) and packing (3).

WARNING

The following procedure specifies trichloroethylene (MIL-T-27602), cleaning compound (MIL-C-81302), or chemical agent (RB0210-013). Trichloroethylene is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death. Cleaning compound and chemical agent are volatile solvents. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

f. Connect a source of cleaning solvent (trichloroethylene MIL-T-27602, cleaning compound MIL-C-81302, or chemical agent RB0210-013 Rocketdyne) to fixture; then flush solvent through solenoid internal passages for a minimum of one minute.

g. Remove fixture (modified seat 555309) from solenoid (6).

CAUTION

Parts must be handled carefully and must not contact each other or hard objects during handling or ultrasonic cleaning, since damage to parts can result.

h. Clean solenoid (6), springs (5), armature (4), and seat (1) ultrasonically for a minimum of 5 minutes at a frequency of 20-40 kc using cleaning solvent. Rotate solenoid (6) periodically during ultrasonic cleaning to get effective cleaning throughout all internal passages.

i. Remove solenoid (6), springs (5), armature (4), and seat (1) from ultrasonic unit.

j. Connect source of cleaning solvent to solenoid inlet passage (0.062 inch diameter hole). A 10 micron absolute filter is recommended for use in end of line that connects to solenoid, to keep any particles in flushing system from entering solenoid.

k. Using cleaning solvent, flush solenoid internal passages from inlet passage for a minimum of one minute.

l. Install fixture (modified seat 555309) in solenoid (6). Do not use rings (2) and packing (3).

m. Connect source of cleaning solvent to fixture; then flush solenoid internal passages for a minimum of one minute.

n. Remove fixture (modified seat 555309) from solenoid (6).

o. Hold solenoid (6) with electrical connector up; then flush large internal cavity, spring cavities, and threaded area with cleaning solvent.

p. Connect source of cleaning solvent to solenoid inlet passage (0.062 inch diameter hole); then flush solvent through solenoid internal passages for a minimum of one minute. Collect last 50 ±5 milliliters of solvent from solenoid outlet passage (internally threaded end) in a clean millipore filtration apparatus.

q. Clean fixture (modified seat 555309) with cleaning solvent; then install it in solenoid (6). Do not use rings (2) and packing (3).

r. Connect source of cleaning solvent to fixture; then flush solvent through solenoid internal passages for a minimum of one minute. Collect last 50 ±5 milliliters of solvent from solenoid inlet passage (0.062 diameter hole) in a clean millipore filtration apparatus.

s. Process and perform a particle count on combined fluid samples (100 milliliters) collected in steps p and r to determine if internal passages of solenoid (6) meet the following cleanness requirements:

Size Range Microns	Maximum Number of Particles Allowed Per 100 Milliliters of Fluid Sample (a)
10 25	100
26 - 50	20
51 - 100	5
101 - 300	1
> 300	0

(a) The allowable number of particles in a given size range may exceed the value specified if there is an equal or greater reduction in number in the larger size range.

t. Repeat solenoid valve cleaning process outlined in steps f through t as required to meet solenoid valve cleanness requirements specified in step s.

u. Remove fixture (modified seat 555309) from solenoid (6).

v. Hold solenoid (6) with electrical connector up; then flush large internal cavity, spring cavities, and threaded area with cleaning solvent.

w. Remove electrical plug from solenoid.

x. Thoroughly rinse springs (5), armature (4), and seat (1) with cleaning solvent for a minimum of one minute.

y. Dry solenoid (6), springs (5), armature (4), and seat (1) in a vacuum oven (approximately 26 inches of Hg) at 170° ±20° F for a minimum of 15 minutes, or purge dry with filtered gaseous nitrogen (MIL-P-27401) for a minimum of 2 minutes.

z. Inspect solenoid (6), springs (5), armature (4), and seat (1) as follows:

(1) Visually inspect all fluid contacting surfaces, drilled passages, and threaded areas using a 60-watt (minimum) bulb at a distance of 24 inches maximum for any particles not removed during cleaning.

(2) Using a stereomicroscope with a magnification of 20-30x, inspect the following solenoid (6) drilled passages for any particles not removed during cleaning:

(a) Inlet passage (0.062 inch diameter) at right angle to solenoid centerline.

(b) Threaded insert (0.030 inch diameter) along solenoid centerline.

(c) Inlet passage (0.059 inch diameter) upstream of insert along centerline.

(d) Three spring cavities (0.053 inch diameter).

(e) Two common passages (0.062 inch diameter) downstream of insert at right angles to centerline.

aa. Package parts immediately after cleaning, drying, and inspecting and apply appropriate decals or labels indicating cleanness condition of parts.

23-27. INSPECTING AND REPAIRING.

23-28. Inspect and repair start or stop solenoid valves as follows:

a. Inspect exterior of valve before disassembling for general condition, cleanness, distortion, corrosion, nicks, burs, and scratches.

b. Inspect valve parts after disassembly as follows:

(1) Visually inspect seating surfaces of solenoid (6), armature (4), and seat (1) for general condition, cleanness, corrosion, nicks, burs, and scratches.

(2) Visually inspect solenoid (6), armature (4), and seat (1) flow passages for any obstructions or contaminants; also inspect other surfaces and threads for general condition, cleanness, distortion, corrosion, nicks, burs, and scratches.

(3) Visually inspect springs (5) for burs, contamination, and feathered ends.

c. Replace or repair damaged parts as follows:

(1) Replace seat (1) or armature (4) if damaged.

(2) Debur springs (5) as necessary to remove burs or feathered ends that could break off and become a contaminant.

(3) Return valve or solenoid (6) to manufacturer for disposition, if damaged.

(4) Remove corrosion as outlined in R-3896-3, Volume I, section I.

NOTE

Solenoid disassembly, visual inspection, corrosion removal, repair, parts replacement, and reassembly must be performed by Rocketdyne in a controlled area.

23-29. ASSEMBLING.

23-30. The assembly procedures for the start or stop solenoid valves must be performed in the order listed and all parts must meet the cleaning requirements outlined in paragraph 23-25. The lubrication used in this procedure is hydraulic fluid (MIL-H-5606). Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. Refer to figure 23-13 for parts and index numbers.

NOTE

Armature (4) is functionally mated to solenoid (6) and seat (1) during normal operation of the valve. The armature, solenoid, and seat should be kept as a matched set. The armature should also be kept in the same position as it was removed, with the ends oriented to the mated solenoid end and seat end.

a. Position solenoid (6) with receptacle down.

b. Install 3 springs (5) in spring cavities of solenoid (6) with tweezers.

c. Carefully install armature (4) in solenoid (6) with armature resting on springs.

d. Lubricate (Method M) packing (3) and install packing and rings (2) in groove of seat (1).

e. Lubricate (Method B) seat (1) and install seat in solenoid (6). Torque seat to 110-125 in-lb.

23-31. TESTING.

23-32. This procedure outlines requirements for testing the start and stop solenoid valves using Components Test Console G3141 and Components Adapter Set G3143. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Prior to starting the test, install valve in housing as specified in figure 23-14. Refer to paragraph 23-33 for test procedure, and see figures 23-15 through 23-17 for test setups.

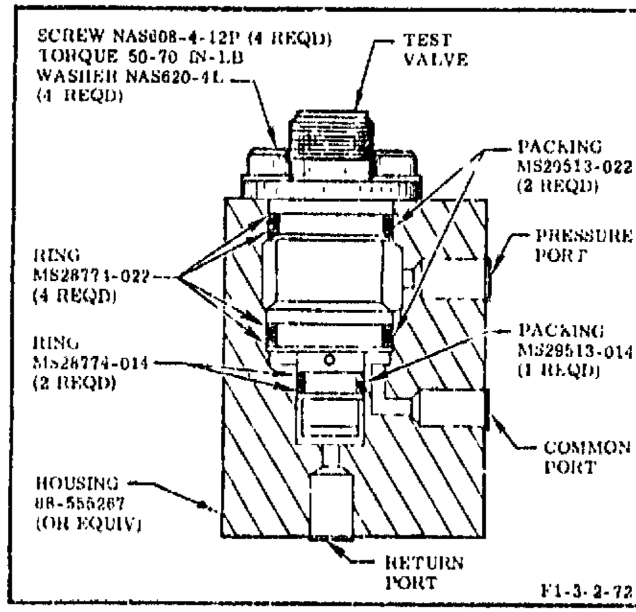
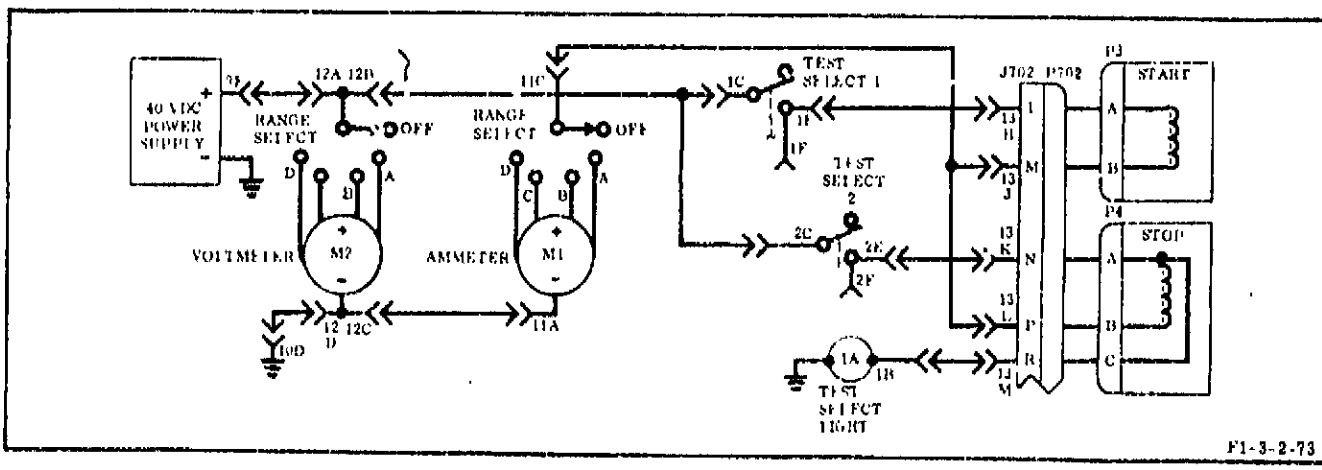


Figure 23-14. Preparing Start and Stop Solenoid Valves for Testing



Patch-Cord	From J6-	To J6-
K3.(a)	1B	13M
K4.09	1C	2C
		12B
K3.(a)	1E	13H
K3.(a)	2E	13K
K3.(a)	9F	12A
K3.(a)	11A	12C
K3.(a)	10D	12D
K4.09	11C	13J
		13L

(a) Use any cable length required.

Figure 23-15. Components Test Console Patch-Panel Requirements for Start and Stop Solenoid Valves

Panel	Control	Positio	Indication/Remarks

NOTE

The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.

PRE-POWER TURN ON

Panel	Control	Positio	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESS/TEMP MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	FULL DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Capped	
	Connector J702	Cable BB52752	For start and stop solenoids.
	Connector J703	Capped	

Figure 23-16. Preparing Components Test Console for Use for Start and Stop Solenoid Valves Testing (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Facility pneumatic and hydraulic supplies to console must be off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	2	Approximately two-thirds of way between 0 and 3.
ELECTRICAL CONTROL	POWER		POWER light on, AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	A (0-500) x 2	None.
	TEST SELECT 1		Light 1 OFF. START SOLENOID control.[a]
	TEST SELECT 2		Light 2 OFF. STOP SOLENOID control.[a]
	TEST SELECT 3		Light 3 OFF. (Not used)[a]
	TEST SELECT 4		Light 4 OFF. (Not used)[a]
	TEST SELECT 5		Light 5 OFF. (Not used)[a]
	TEST SELECT 6		Light 6 OFF. (Not used)[a]

(a) If indication is not as specified, press switch-light.

Figure 23-16. Preparing Components Test Console for Use for Start and Stop Solenoid Valves Testing (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	TEST SELECT 7		Light 7 OFF. Hydraulic flow monitor control.[a]
	TEST SELECT 8		Light 8 OFF. Pneumatic flow monitor control.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 28 ±0.5 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]

PNEUMATIC PREPARATION

a. Make sure that console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

(a) If indication is not as specified, press switch-light.

Figure 23-16. Preparing Components Test Console for Use for Start and Stop Solenoid Valves Testing (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks

POWER TURN ON
(continued)

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED light (located on console and in test cell) comes on to indicate pressure downstream of console regulators when individual panel SHUTOFF valves are opened. Safety precautions specified in R-3896-3, Volume I, must be followed to make sure of safety of personnel working with pressurized systems.

Figure 23-16. Preparing Components Test Console for Use for Start and Stop Solenoid Valves Testing (Sheet 4 of 4)

23-33. LEAK TEST.

a. Prepare Components Test Console G3141 and valve under test for use as outlined in paragraph 23-31; then connect valve under test to console (figure 23-17).

WARNING

Personnel must not be allowed in the test cell during this test. Visual examination of the valve while it is pressurized must be made through the test cell window.

CAUTION

The lines used in the test setup are 1/4-inch flex hose unless otherwise specified.

b. Using HYDRAULIC CONTROL panel, perform the following:

Procedure	Result
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
c. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 3,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 3,000 ±50 psi.
d. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 3,000 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
e. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,475 ±25 psi; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate 2,475 ±25 psi. Valve pressurized.

Procedure	Result
f. Maintain 2,475 ±25 psi pressure at pressure port for 2 minutes minimum; then check for external leakage.	No external leakage in excess of a slightly wetted surface is allowable.
g. After a minimum wait of 20 seconds, monitor and record leakage at return port.	Maximum allowable leakage is 20 cc/m.
h. On ELECTRICAL CONTROL panel, make sure that VOLTS meter indicates 28 ±0.5 volts.	VOLTS meter must indicate 28 ±0.5 volts.
i. On ELECTRICAL CONTROL panel, press TEST SELECT 1 (START) or 2 (STOP) switch-light.	Light 1 or 2 on as applicable and valve energized. When testing stop solenoid valve, light 1A will also be on.
j. After a minimum wait of 20 seconds, monitor and record leakage at return port.	Maximum allowable leakage is 20 cc/m.
k. On ELECTRICAL CONTROL panel, press TEST SELECT 1 (START) or 2 (STOP) switch-light.	Light 1 or 2 off as applicable and valve deenergized. When testing stop solenoid valve, light 1A will also go off.
l. On HYDRAULIC CONTROL panel, open MED PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR gage must indicate zero. Valve port depressurized.
m. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESS FUEL COMPATIBLE panel depressurized.
n. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage indicates zero.
o. Using HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	OPEN light on and CLOSE light off.
p. Remove valve from leak-test setup.	
q. Drain valve to drip point; then package valve as outlined in R-3896-3, Volume I.	
r. Install protective closures. Refer to paragraph 23-22.	

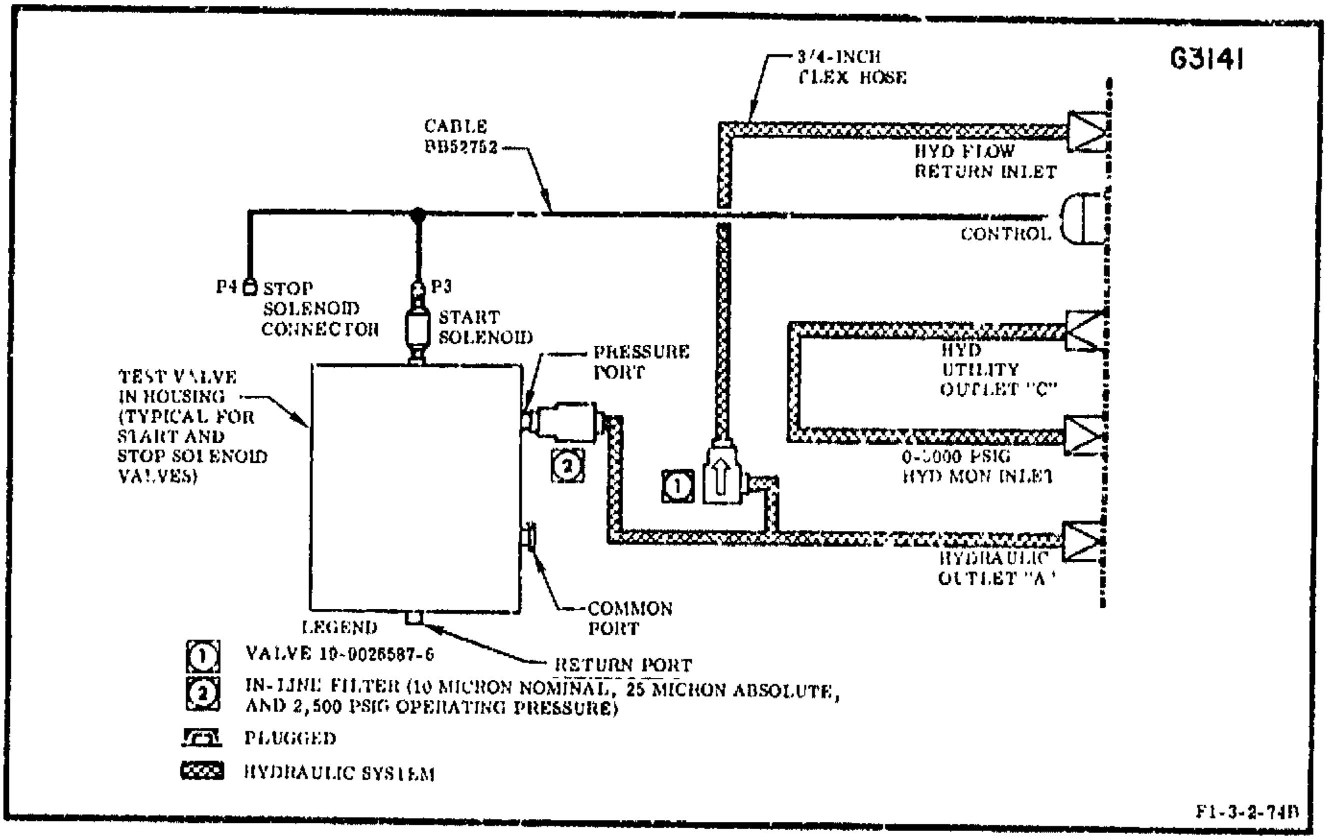


Figure 23-17. Start and Stop Solenoid Valves Testing

SECTION XXIV

THRUST CHAMBER NOZZLE EXTENSION

24-1. THRUST CHAMBER NOZZLE EXTENSION 209210 THROUGH 209210-31.

24-2. Repair of the thrust chamber nozzle extension requires special welding equipment and certified welding personnel. The following paragraphs establish requirements for equipment and personnel and outline detail repair procedures.

24-3. GENERAL REQUIREMENTS.

24-4. WELDER CERTIFICATION. Personnel performing repair welding on the nozzle extension must be certified to weld Hastelloy C and 347 and 321 CRES materials.

24-5. RECORDS. Records must be kept of all damage occurring to the nozzle extension. See figure 24-1 for a typical damage record form and figure 24-2 for nozzle extension damage locator.

Date	Test Number	
Part Number	Serial Number	
Engine Number	Inspected by	
Component Identification	Angular Location in Degrees	Description of Damage
Shingle No.		
Band No.		
Outer Shell Segment No.		
Nut Plate Band Loc.		

Figure 24-1. Thrust Chamber Nozzle Extension Damage Record Form (Typical)

24-6. MATERIAL AND EQUIPMENT REQUIREMENTS. See figure 24-3. Additional material and equipment requirements are in section VIII.

24-7. SAFETY REQUIREMENTS. All safety requirements in force at the using organization must be strictly observed. In addition, the following minimum safety precautions must be followed:

a. The man lift, if employed, must be capable of operation from the work platform or from ground level.

b. Breathing apparatus must be worn when entering the thrust chamber.

c. The buddy system must be used when personnel enter the thrust chamber. The standby personnel must be qualified in test stand operation, operation of the breathing apparatus, and operation of the lift equipment. The standby personnel must remain in line-of-sight of the person in the thrust chamber.

d. The thrust chamber assembly must be isolated in such a manner that inadvertent pressurant or propellant admission is impossible.

e. Flush and purge the thrust chamber prior to initiating any effort employing a spark-producing device.

f. Make sure welder's work platform is held rigid during the welding operation.

g. Make sure other work in the immediate area will not introduce combustibles into the thrust chamber.

24-8. REPAIRING.

24-9. Specific type of repair required for each defect must be determined either by the repair designated in figure 24-4 or as recommended by the manufacturer's representative.

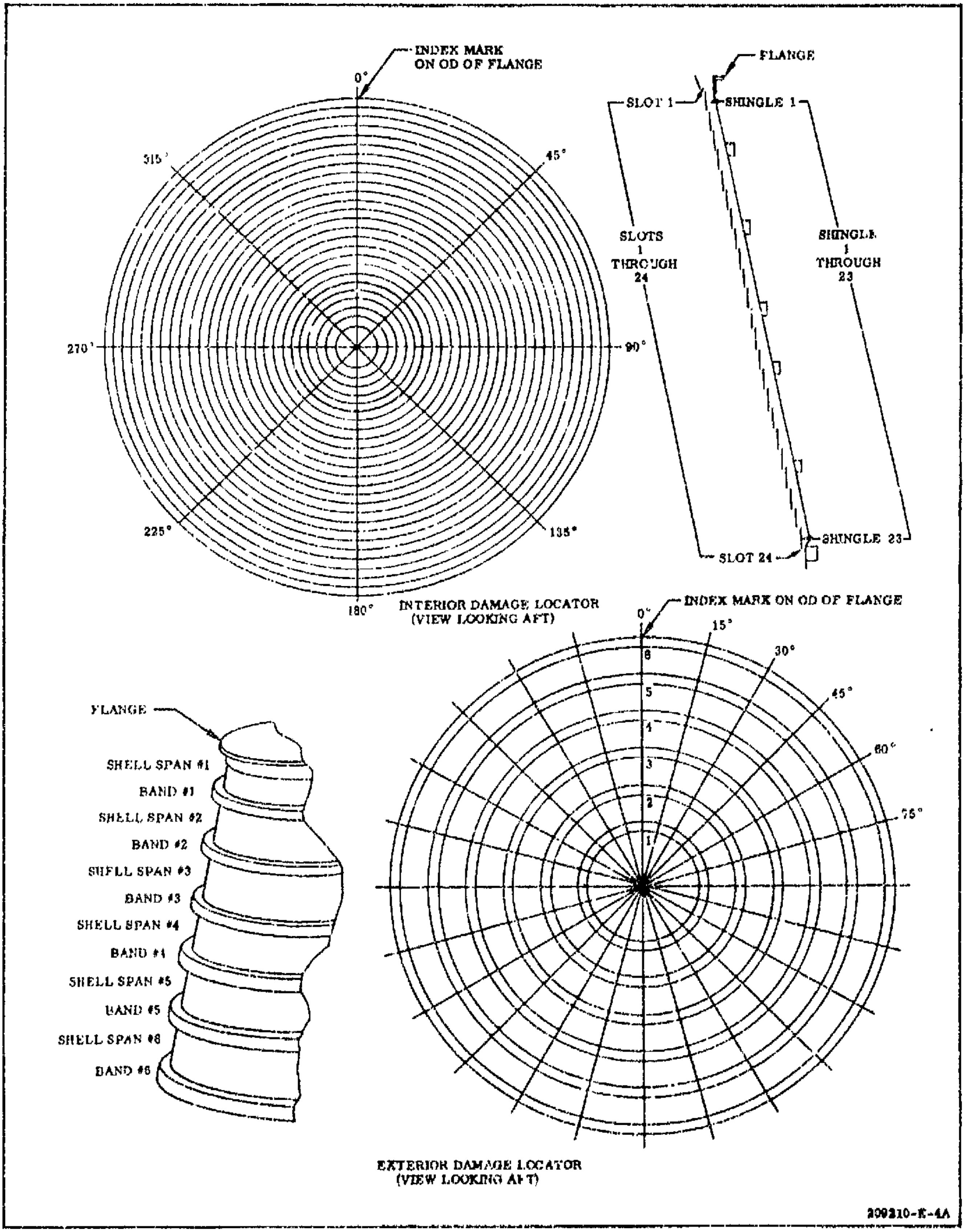


Figure 24-2. Thrust Chamber Nozzle Damage Locator

MATERIALS:

Hastelloy C sheet 0.034-inch thickness.

Clean Cloth

347 CRES sheet 0.125-inch thickness (or 321 CRES sheet)

Argon (MIL-A-18455) and acetone (Federal Specification O-A-51).

Blind Nut BN523-1032-1 (Hi-Shear Corp)

FILLER WIRES:

Hastelloy C&W welding rods 0.040-, 0.047- and 3/32-inch diameter.

CRES welding rods 0.040- and 0.045-inch diameter.

EQUIPMENT:

Electrical-hydraulic power unit BP4000, gun BG2500, anvil A27-1032, chuck C2-1032, and mandrel C2-1032 (Hi-Shear Corp)

Portable hand drill, mini-grinder, grinding disks, fine stainless-steel wire brush, and heliarc welding equipment.

Figure 24-3. Materials and Equipment Requirements for Thrust Chamber Nozzle Extension

NOTE

See figure 24-5 for nozzle extension interior damage and figure 24-6 for exterior damage.

Condition	Description	Disposition
Thermal buckling of shingle.		Acceptable.
Slot locally opened due to buckling.		Acceptable.
Slot locally closed due to buckling.		Acceptable.
Slot partially closed.		Acceptable.
Shingle axial overlap opened.		Acceptable.
Erosion of axial shingle overlap.	Remaining overlap not less than 0.030 inch.	Acceptable.
Erosion of axial shingle overlap.	No overlap remaining.	Repair as outlined in paragraph 24-10.
Erosion of shingle.	Holes 0.375 inch or less, measured across major dimension.	Acceptable.
Erosion of shingle.	Holes greater than 0.375 inch measured across major dimension.	Repair as outlined in paragraph 24-10 or 24-11, whichever is applicable.
Shingles pulled away from Z-bars.	Two or less adjacent Z-bars.	Acceptable.
	More than 2 adjacent Z-bars.	Install reinforcing rods as outlined in paragraph 24-11, steps e through g.
Distortion of outer shell.	Bulging of shell between outer bands.	Acceptable.
	Axial ripples in outer shell.	Acceptable.
Buckles or local distortion in outer surface (parallel to centerline of thrust) of external reinforcing bands resulting from testing.	Buckles or local distortion greater than 0.200 inch from normal surface contour within a circumferential span of 3 inches.	Repair as outlined in paragraph 24-12.

Figure 24-4. Thrust Chamber Nozzle Extension Damage Limits (Sheet 1 of 2)

Condition	Description	Disposition
Cracks in outer band at outer shell.	Cracks in welded joint of band to outer shell.	Repair as outlined in paragraph 24-13.
Cracks in outer shell.	Cracks in outer shell of parent material or outer shell welds.	Repair as outlined in paragraph 24-14.
Damaged gasket.	Gasket torn or out of cavity.	Reinstall new gasket.
Elongation of boltholes in attach flange.		Acceptable.
Damaged nut plates.	Damaged threads in insulation attach nut plates.	Replace nut plate as outlined in paragraph 24-15.
Loose blind nut.	Blind nut loose in hole in band.	Repair as outlined in paragraph 24-16.
Defects in welds or parent material not listed above.		Acceptability and repair requirements to be specified by manufacturer's representative.
Damaged blind nut.	Damaged threads.	Replace as outlined in paragraph 24-17.
Damage to thermal insulation mounting studs, brackets, and insulators.	Broken, bent, distorted, missing, or otherwise damaged studs, brackets, and insulators.	Refer to R-3896-6 for repair of studs, brackets, or insulators.

Figure 24-4. Thrust Chamber Nozzle Extension Damage Limits (Sheet 2 of 2)

24-10. ERODED SHINGLE (NARROW EROSION). See figure 24-5. When erosion in the shingle is not wider than the span between 2 adjacent Z-bars, repair as follows:

a. Using a mini-grinder, cut around eroded area to obtain clean edges for patch fitup.

b. Using a fine wire brush, clean at least a 3/4-inch strip surrounding area where welding is to be performed; then wipe area clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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.

c. Prepare a 0.034-inch thick Hastelloy C patch to fit removed area.

d. Fit patch in place and weld using Hastelloy C or W welding rod. Weld must be of full penetration. Weld buildup must not exceed 0.03 inch. Grind off excess weld.

NOTE

Use an argon gas backup, if feasible.

e. Perform dye-penetrant inspection of weld as outlined in R-3896-3, Volume I. Cracks are not allowable.

24-11. ERODED SHINGLE (WIDE EROSION). See figure 24-5. When erosion in the shingle extends in width more than the distance between 2 adjacent Z-bars, repair as follows:

a. Using a mini-grinder, cut around eroded area to obtain clean edges for patch fitup.

b. Using a fine wire brush, clean at least a 3/4-inch strip surrounding area where welding is to be performed, then wipe area clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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.

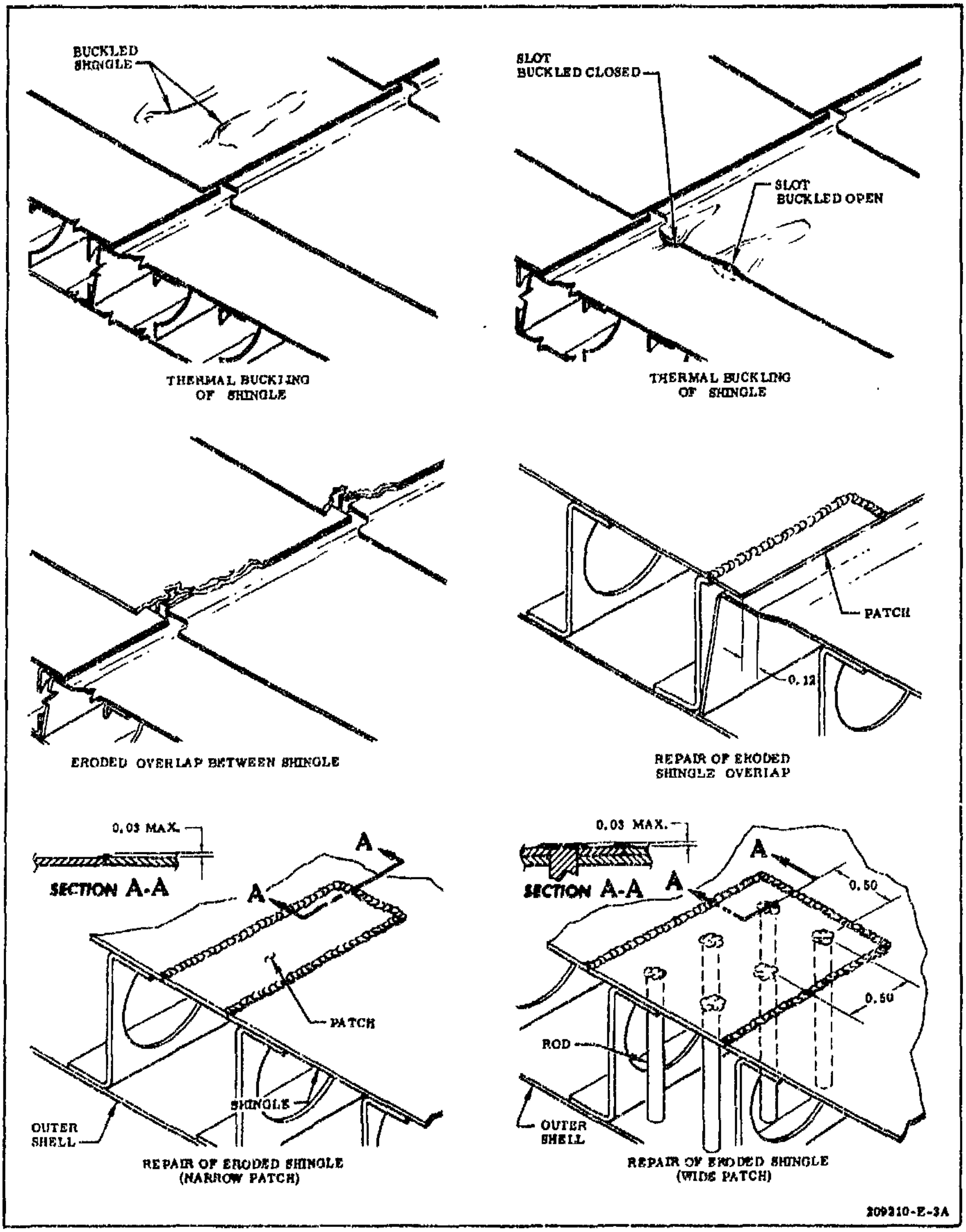


Figure 24-5. Thrust Chamber Nozzle Extension Interior Damage

c. Prepare a 0.034-inch thick Hastelloy C patch to fit removed area.

d. Fit patch in place and tack weld.

e. Using a No. 40 drill (0.098-inch) drill holes in line through patch and outer shell. Center-to-center of hole spacing should be 1/2 inch.

f. Using Hastelloy C or W welding wire, fit 3/32-inch diameter rods in holes.

g. Weld rods in place in patch and outer shell using Hastelloy C or W wire.

h. Complete welding of patch. Weld shall be of full penetration. Weld buildup on inner surface of shingle must not exceed 0.03 inch. Grind off excess weld.

NOTE

An argon gas backup may be used, if feasible.

i. Perform dye-penetrant inspection of weld as outlined in R-3896-3, Volume I. Cracks are not allowable.

24-12. BUCKLES OR LOCAL DISTORTION IN EXTERNAL REINFORCING BAND. See figure 24-6. Buckles or local distortion in the outer surface (surface parallel to centerline of thrust) of external reinforcing bands, resulting from engine hot-fire testing, that exceed limits in figure 24-4, require repair as follows:

a. Using a fine wire brush, clean area where welding is to be performed, then wipe area clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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. Fabricate a reinforcing piece out of 321 or 347 CRES, 0.125-inch thick by 2-inches wide, that extends 2.5 inches minimum past buckle or distortion at each end. Add full radius to each end of reinforcing piece.

c. Place reinforcing piece on top of band where buckling or distortion occurred, centering piece over buckle or distortion.

d. If the buckle or distortion does not allow the reinforcing piece to contact the normal surface contour of the band on each side of the buckle or distortion, reform the band in the distortion area to permit contact of the reinforcing piece and the normal band surface contour.

e. Using a CRES welding rod completely weld the reinforcing piece to the band. Fill points of gap between the reinforcing piece edge and band buckle or distortion with weld. The weld must be a 0.12-inch fillet at all points of junction of the reinforcing piece to the normal band surface contour.

f. Perform dye-penetrant inspection of weld as outlined in R-3890-3, Volume I. Cracks are not allowable.

24-13. CRACK IN WELD JOINT OF BAND TO OUTER SHELL. See figure 24-6. If cracking occurs in weld or adjacent area of band or outer shell, repair as follows:

a. Using a fine wire brush, clean area where welding is to be performed, then wipe area clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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. After area is thoroughly dry, use a Hastelloy C or W welding rod to weld crack. Use a single pass to achieve 100 percent penetration. Weld must extend 1/8-inch beyond end of crack.

c. Perform dye-penetrant inspection of weld as outlined in R-3896-3, Volume I. Cracks are not allowable.

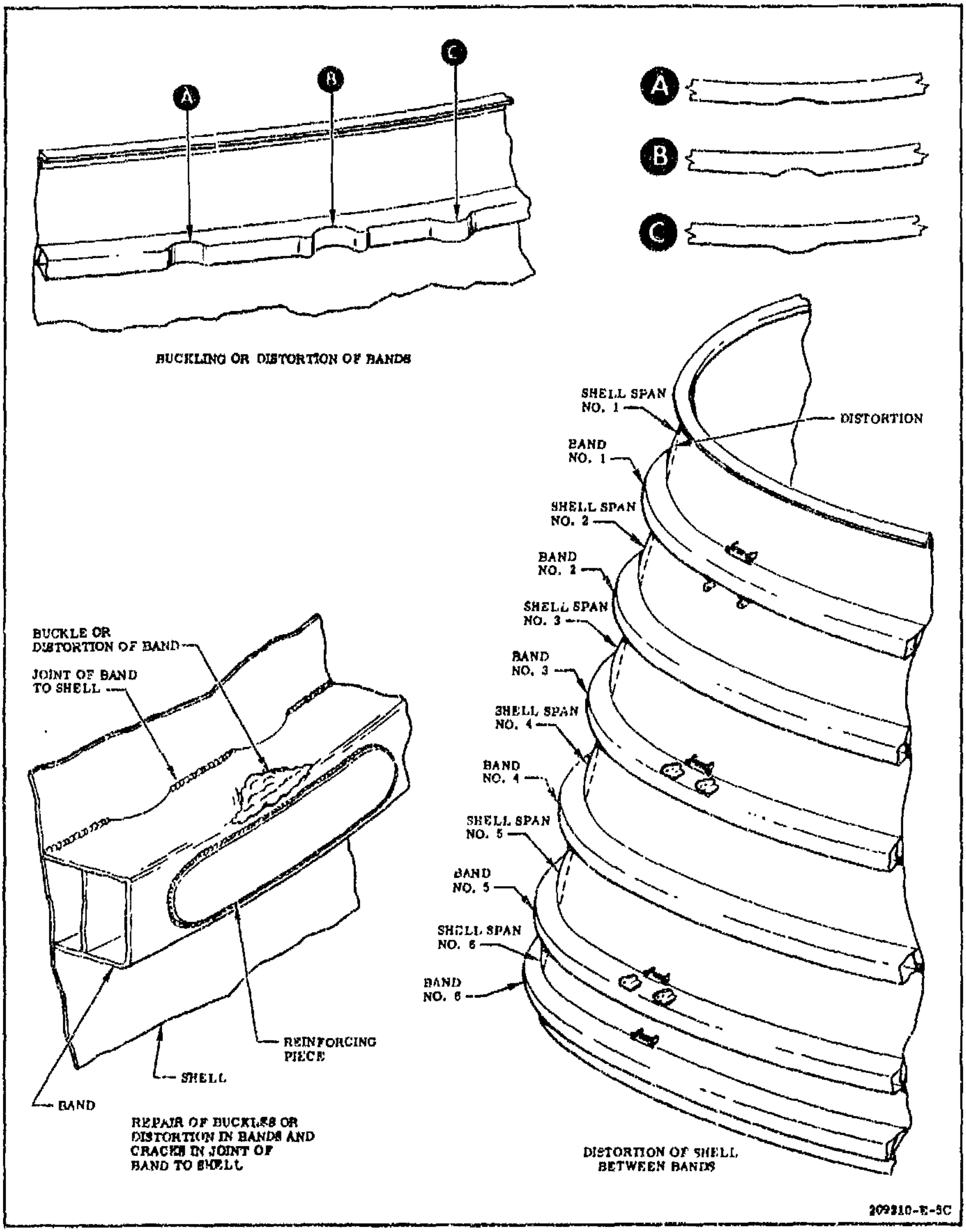


Figure 24-6. Thrust Chamber Nozzle Extension Exterior Damage

24-14. CRACK IN OUTER SHELL OR OUTER SHELL WELDS.

a. Using a fine wire brush, clean area to be welded, then wipe clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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. After area is thoroughly dry, weld crack, using Hastelloy C or W filler rod. Make single-pass weld for 100 percent penetration, starting at least 1/4 inch beyond each end of crack, wherever possible. Weld toward center portion of crack.

c. Perform dye-penetrant inspection of weld as outlined in R-3896-3, Volume I. Cracks are not allowable.

24-15. REPLACEMENT OF NUT PLATE. When threads of nut plate are damaged, the nut plate must be replaced.

a. Using a mini-grinder, remove damaged nut plate.

b. Using a fine wire brush, clean area where new nut plate is to be installed, then wipe area clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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.

c. After area is thoroughly dry, locate new nut plate SPS 12700-02 PW in place and tack weld with CRES welding rod.

24-16. SECURING LOOSE BLIND NUT. When blind nut becomes loose in its hole in band, it should be tack welded to the band.

a. Using a fine wire brush, clean area around blind nut. Wipe area clean with acetone (Federal Specification O-A-51).

WARNING

Acetone 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. After area is thoroughly dry, tack-weld nut with CRES welding rod in at least 4 places. Nut must withstand 24-30 inch-pounds torque.

24-17. REPLACING BLIND NUTS. Replacement of blind nuts is accomplished as follows:

a. Using a mini-grinder, grind off flange of blind nut and allow remaining portion to fall inside hat section.

b. Using applicable tools indicated in figure 24-3, install new blind nut BN523-1032-1 by installing sleeve and expander on mandrel.

c. Actuate gun using instructions on hydraulic unit.

d. If new blind nut is loose, secure it by tack-welding (paragraph 24-16).

SECTION XXV

PRESSURE TRANSDUCER

WARNING

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

25-1. PRESSURE TRANSDUCER NA5-27316, NA5-27412, AND NA5-27440.

25-2. The following procedures contain cleaning, inspecting, repairing, and testing information required to maintain the pressure transducer. The transducer is a sealed unit; no disassembly or assembly is possible. See figure 25-1 for test equipment and figure 25-2 for a typical pressure transducer.

Part Number	Nomenclature	Use
G3141	Components Test Console	Provides electrical control for testing pressure transducers.
G3143	Components Adapter Set	Provides hardware for pressure transducer test setup.

Figure 25-1. Test Equipment for Pressure Transducers

25-3. CLEANING.

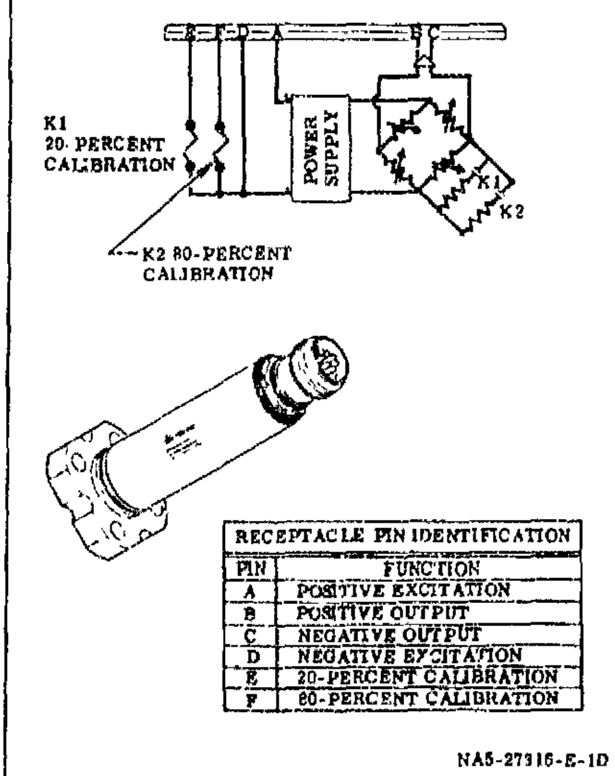
25-4. Clean all parts of the pressure transducer for the same type of service in which the transducer will be used. Refer to R-3896-3, Volume I for applicable cleaning procedures.

25-5. INSPECTING AND REPAIRING.

25-6. Inspecting the pressure transducers determines if the transducers have been damaged by mishandling. Repair is limited to straightening bent electrical connector pins and repairing minor scratches in the mounting flange sealing surface.

25-7. TESTING.

25-8. This procedure outlines requirements for testing pressure transducers with or without using Components Test Console G3141 and Components Adapter Set G3143. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure.



RECEPTACLE PIN IDENTIFICATION	
PIN	FUNCTION
A	POSITIVE EXCITATION
B	POSITIVE OUTPUT
C	NEGATIVE OUTPUT
D	NEGATIVE EXCITATION
E	20-PERCENT CALIBRATION
F	80-PERCENT CALIBRATION

Figure 25-2. Pressure Transducer (Typical)--Exterior View

Procedure	Result
25-9. INSULATION RESISTANCE-TEST.	
Apply 50 vdc between each pin and case individually for one minute and measure resistance.	Insulation resistance between pin and case must exceed 100 megohms when measured with a 50 vdc megger.
25-10. ISOLATION RESISTANCE-TEST.	
a. At room temperature, apply 50 vdc between pins C (+) and D (-) and measure resistance.	Isolation resistance between pins C and D must exceed 100 megohms.
b. Apply 50 vdc between pins C (-) and D (+) and measure resistance.	Isolation resistance between pins C and D must exceed 100 megohms.

25-11. PREPARATION FOR FUNCTION-TEST WHEN USING COMPONENTS TEST CONSOLE.

Set up components test console electrical patch-panel (figure 25-3) and prepare components test console (figure 25-4). Refer to paragraph 25-12 for pressure transducer function-test procedure.

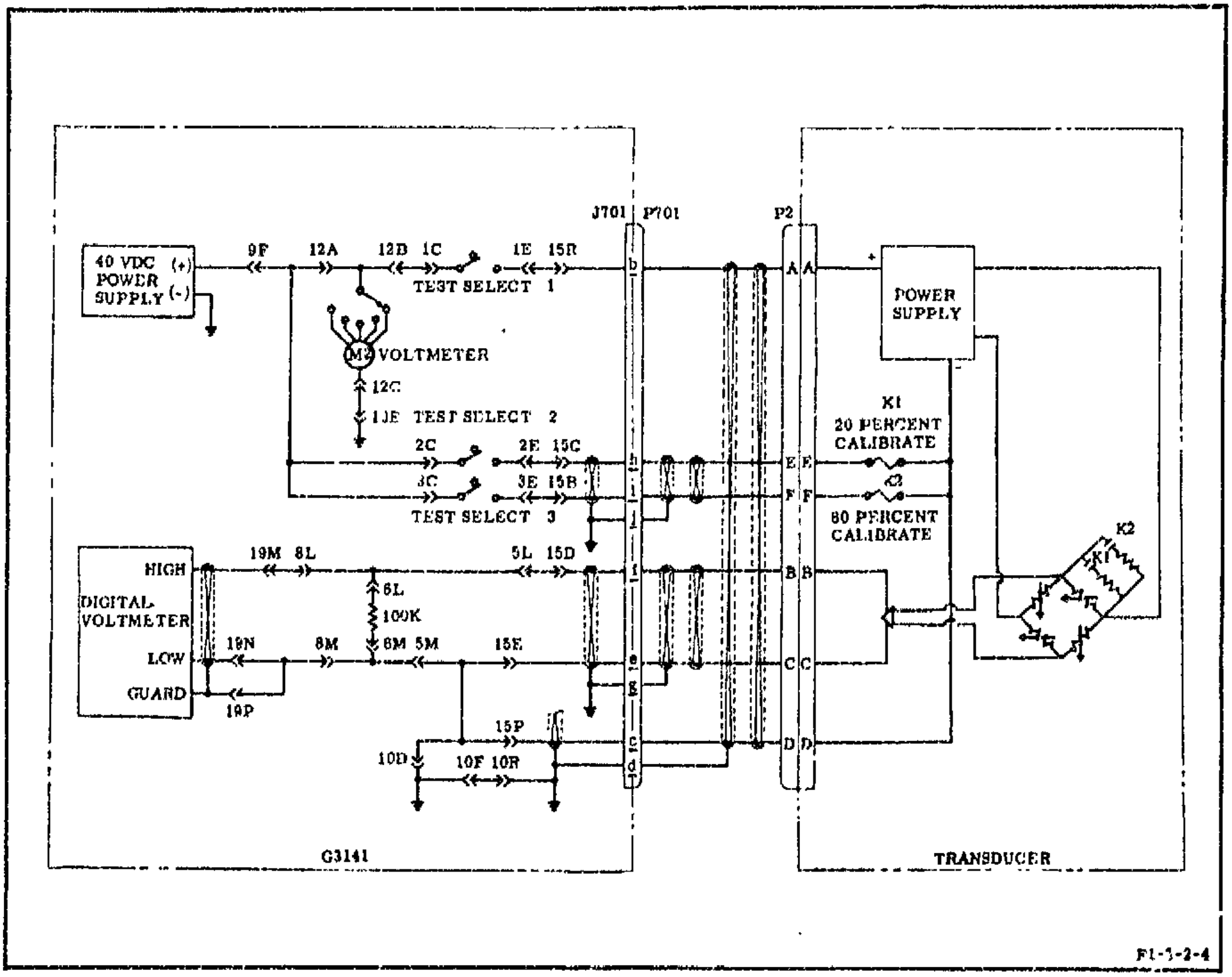


Figure 25-3. Components Test Console Patch-Panel Requirements (Sheet 1 of 2)

Patch-Cord[a]	From J6-	To J6-	Patch-Cord[a]	From J6-	To J6-
K5.09	9F	12A	K3	1E	15R
		2C	K3	2E	15C
		3C	K3	3E	15B
K5.09	5M	15E	K3	5L	15D
		15P	K3	19M	8L
		10D	K3	10F	10R
K4.09	19N	8M	K3	12C	10E
		19P	3088-15	6L	6M
K3	12B	1C			

(a) Use any cable length required.

Figure 25-3. Components Test Console Patch-Panel Requirements (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counterclockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	Off	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
DIGITAL VOLTMETER	115 V/230V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	POWER	Down (off)	

Figure 25-4. Preparing Components Test Console for Use (Sheet 1 of 3)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
TEST CELL ELECT OUTLETS	Connector J701	Cable BB52747	Connection to pressure transducer.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Push in	Console main power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	2	Approximately two-thirds way between 0 and 3.
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS RANGE SELECT	D (0-30)	None.
	TEST SELECT 1		Light 1 off. (Ambient Output)[a]
	TEST SELECT 2		Light 2 off. (20% Output)[a]
	TEST SELECT 3		Light 3 off. (80% Output)[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter 28 ±1 volts.
DIGITAL VOLTMETER	POWER	ON	If digital voltmeter indicates OVERLOAD, wait at least one minute before resetting.

(a) If indication is not as specified, press applicable switch-light.

Figure 25-4. Preparing Components Test Console for Use (Sheet 2 of 3)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Allow digital voltmeter to warm up for at least 30 minutes prior to use.

Panel	Control	Position	Indication/Remarks
	RANGE	10V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC.	
	SAMPLING RATE	INCREASE	3/4 turn from STOP.

Figure 25-4. Preparing Components Test Console for Use (Sheet 3 of 3)

NOTE

During the following procedures make sure that correct output voltage requirements (figure 25-5) are used with the specified transducer range.

25-12. FUNCTION-TEST WHEN USING COMPONENTS TEST CONSOLE.

Procedure	Result
a. On ELECTRICAL CONTROL panel, press TEST SELECT 1 switch-light.	Light 1 on.
b. Adjust VOLTAGE ADJUST knob if required to maintain 28 ±1 vdc.	VOLTS meter indicates 28 ±1 vdc.
c. Record DVM indication.	DVM must indicate value as shown in figure 25-5, column I.
d. Press TEST SELECT 2 switch-light.	Light 2 on.
e. Record DVM indication.	DVM must indicate value as shown in figure 25-5, column II.
f. Press TEST SELECT 2 switch-light.	Light 2 off.
g. Press TEST SELECT 3 switch-light.	Light 3 on.
h. Record DVM indication.	DVM must indicate as shown in figure 25-5, column III.
i. Press TEST SELECT 1 and 3 switch-lights.	Lights 1 and 3 off.
j. On ELECTRICAL CONTROL panel press POWER ON switch-light.	POWER ON light off.
k. Turn DC POWER SUPPLY off.	None.
l. On POWER DISTRIBUTION panel, pull out circuit breakers.	None.

Transducer Range Psia	Type	I Ambient Output[(a)] (vdc)		II 20% Output[(a)] (vdc)		III 80% Output[(a)] (vdc)	
		Min.	Max.	Low Min.	Calibrate Max.	High Min.	Calibrate Max.
0-50	T05	1.150	1.850	2.150	2.850	5.150	5.850
0-100	T1	0.500	1.000	1.500	2.000	4.500	5.000
0-200	T2	0.150	0.600	1.150	1.600	4.150	4.600
0-500	T5	-0.050	0.350	0.950	1.350	3.950	4.350
0-1000	T10	-0.125	0.275	0.875	1.275	3.875	4.275
0-1500	T15	-0.150	0.250	0.850	1.250	3.850	4.250
0-2000	T20	-0.160	0.240	0.840	1.240	3.840	4.240
0-2500	T25	-0.170	0.230	0.830	1.230	3.830	4.230

(a) Voltage limits on pressure transducers are specified above assuming 14.7 ±1 psia on the transducer during checkout. If pressure outside of these limits is applied, nominal indications must be changed as follows:

$$\text{New Nominal} = \text{Old Nominal} + \frac{(\text{Actual psia} - 15.0) \times 5.0}{\text{Upper Transducer Range}}$$

This new nominal must be used in lieu of that given above. The same tolerances apply.

Figure 25-5. Pressure Transducer Output Voltage Requirements

25-13. FUNCTION-TEST WHEN NOT USING COMPONENTS TEST CONSOLE. This test is a preinstallation requirement only.

a. Vent transducer pressure port to ambient.

b. Provide electrical circuitry for measuring output voltage from pins B and C within ranges specified in figure 25-5 and provide a 100K ohm load in the circuit between pins B and C.

Procedure	Result
c. Apply and maintain 28 ±1 vdc to pins A (+) and (D) (-); then measure and record ambient output voltage from pins B and C.	Output voltage must be within limits specified for transducer in figure 25-5.
d. Apply 28 ±1 vdc to pins E (+) and D (-); then measure and record 20% output voltage from pins B and C. Remove voltage from pins E (+) and D (-).	Output voltage must be within limits specified for transducer in figure 25-5.
e. Apply 28 ±1 vdc to pins F (+) and D (-); then measure and record 80% output voltage from pins B and C. Remove voltage from pins F (+) and D (-).	Output voltage must be within limits specified for transducer in figure 25-5.

f. Remove voltage from pins A (+) and D (-).

g. Remove electrical circuitry from pins B and C.

SECTION XXVI

TEMPERATURE TRANSDUCER

26-1. TEMPERATURE TRANSDUCERS NA5-27215, NA5-27333, AND NA5-27414.

26-2. The following procedures contain cleaning, inspecting and repair, and testing information required to maintain the temperature transducers. The transducers are hermetically sealed and no disassembly or assembly is possible. See figure 26-1 for temperature transducer exterior view.

26-3. CLEANING.

26-4. Clean temperature transducer electrical connector and exterior surfaces as outlined in R-3896-3, Volume I.

26-5. INSPECTING AND REPAIRING.

26-6. The temperature transducer is inspected visually, and no special tools are required. Inspect transducers for damaged electrical connector, connector pins, and for nicks or scratches in mounting flange sealing surface. Transducer NA5-27414 must also be inspected for damaged or deformed copper rings. Transducer repair is limited to repairing minor nicks or scratches in the mounting flange sealing surface and on transducer NA5-27414, the reforming of copper rings. Transducers that exhibit damage other than listed must be returned to Rocketdyne.

NOTE

Transducers NA5-27414 that have been refurbished and have had the copper rings re-formed may exhibit minor imperfections in the copper rings due to re-swaging of the copper. These minor imperfections due to re-swaging are considered acceptable.

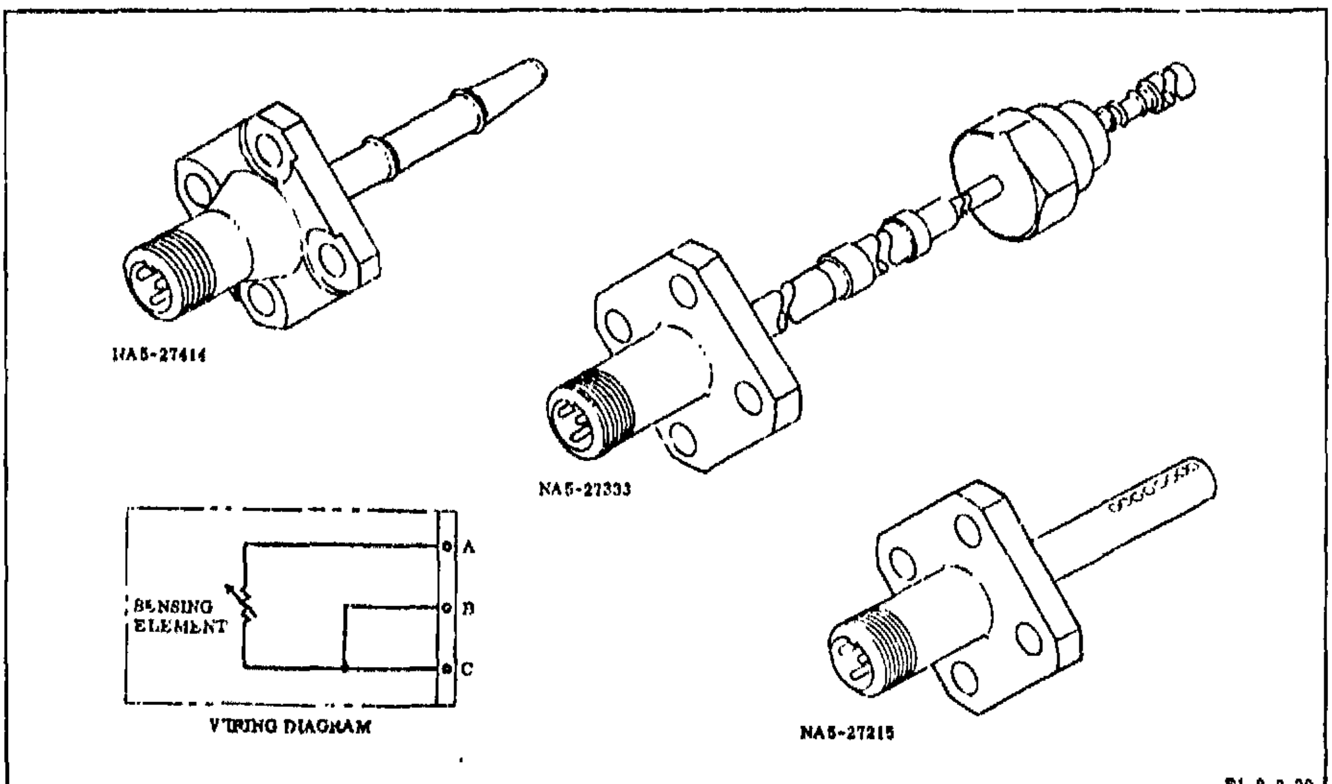


Figure 26-1. Temperature Transducers--Exterior View

26-7. REFORMING COPPER RINGS.

NOTE

This procedure is applicable to temperature transducers NA5-27414 that require reforming of the copper rings.

CAUTION

Only a minimum amount of pressure must be applied to the copper rings if a micrometer is used to take the following measurement. Copper rings are extremely soft, and the edge can be damaged if too much pressure is applied.

a. Measure diameter of each copper ring in at least 3 places. Copper rings with a minimum diameter of 0.330 inch are acceptable and do not require reforming. Copper rings that are not acceptable must be reformed as outlined in steps b through n.

b. Install swagging tool 99-9010480 on transducer upper copper ring (closest to flange) as follows: (See figure 26-2.)

(1) Place thrust bearing and 2 races on flange side of upper ring.

(2) Assemble -3 and -5 stationary die around upper ring with 2 screws; then slide thrust bearing and races over stationary die.

(3) Assemble -13 and -15 housing around thrust bearing, races, and stationary die with 2 screws. Apply a slight pressure against housing to make sure thrust bearing and races do not slip off stationary die.

(4) Assemble -17 and -19 forming die with 4 screws; then attach forming die to housing by hand until stationary die and forming die make contact with upper copper ring.

c. Place housing in a vise with jaws that are covered with a soft protective material. Secure housing firmly in vise on housing flats; then torque forming die to 15-20 in-lb.

d. Remove housing from vise; then place transducer flange in vise and secure firmly on flange flats.

e. Reform copper ring by turning forming die by hand 4 revolutions.

f. Remove transducer flange from vise; then place housing in vise and secure firmly on housing flats. Loosen forming die; then remove housing from vise.

g. Remove swaging tool 99-9010480 from upper copper ring as follows.

(1) Remove forming die from housing and remove 4 forming die screws; then remove forming die.

(2) Remove 2 housing screws; then remove housing. Remove 2 stationary die screws; then remove stationary die.

(3) Remove thrust bearing and 2 races.

h. Install swaging tool 99-9010480 on transducer lower copper ring (closest to tapered tip) as follows: (See figure 26-2.)

(1) Place thrust bearing and 2 races on flange side of lower ring.

(2) Assemble -7 and -9 stationary die around lower ring with 2 screws; then slide thrust bearing and races over stationary die.

(3) Assemble -13 and -15 housing around thrust bearing, races, and stationary die with 2 screws. Apply a slight pressure against housing, to make sure thrust bearings and races do not slip off stationary die.

(4) Assemble -17 and -19 forming die with 4 screws; then attach forming die to housing by hand until stationary die and forming die make contact with lower copper ring.

i. Place housing in a vise with jaws that are covered with a soft protective material. Secure housing firmly in vise on housing flats; then torque forming die to 15-20 in-lb.

j. Remove housing from vise; then place transducer flange in vise and secure firmly on flange flats.

k. Reform copper ring by turning forming die by hand 4 revolutions.

l. Remove transducer flange from vise; then place housing in vise and secure firmly on housing flats. Loosen forming die; then remove housing from vise.

m. Remove swaging tool 99-9010480 from lower copper ring as follows:

(1) Remove forming die from housing and remove 4 forming die screws; then remove forming die.

(2) Remove 2 housing screws; then remove housing. Remove 2 stationary die screws; then remove stationary die.

(3) Remove thrust bearing and 2 races.

CAUTION

Only a minimum amount of pressure must be applied to the copper rings if a micrometer is used to take the following measurement. Copper rings are extremely soft and the edge can be damaged if too much pressure is applied.

n. Measure new diameter of each copper ring in at least 3 places. Copper rings with a minimum diameter of 0.330 inch are acceptable. If minimum diameter is still below 0.330 inch, repeat reforming operation by turning forming die by hand at 2-revolution intervals with measurement after each 2 revolutions until minimum dimension is obtained.

o. Perform a dye-penetrant inspection on copper ring-to-transducer stem junctions as outlined in R-3896-3, Volume I. An indication of a crack at the upper ring junction closest to the flange is acceptable. No cracks are permitted at the other copper ring-to-transducer junctions.

26-8. TESTING.

26-9. This test procedure requires a Wheatstone bridge that limits current to less than 10 milliamperes. See figure 26-1 for temperature transducer electrical schematic and paragraphs 26-10 through 26-12 for test procedures.

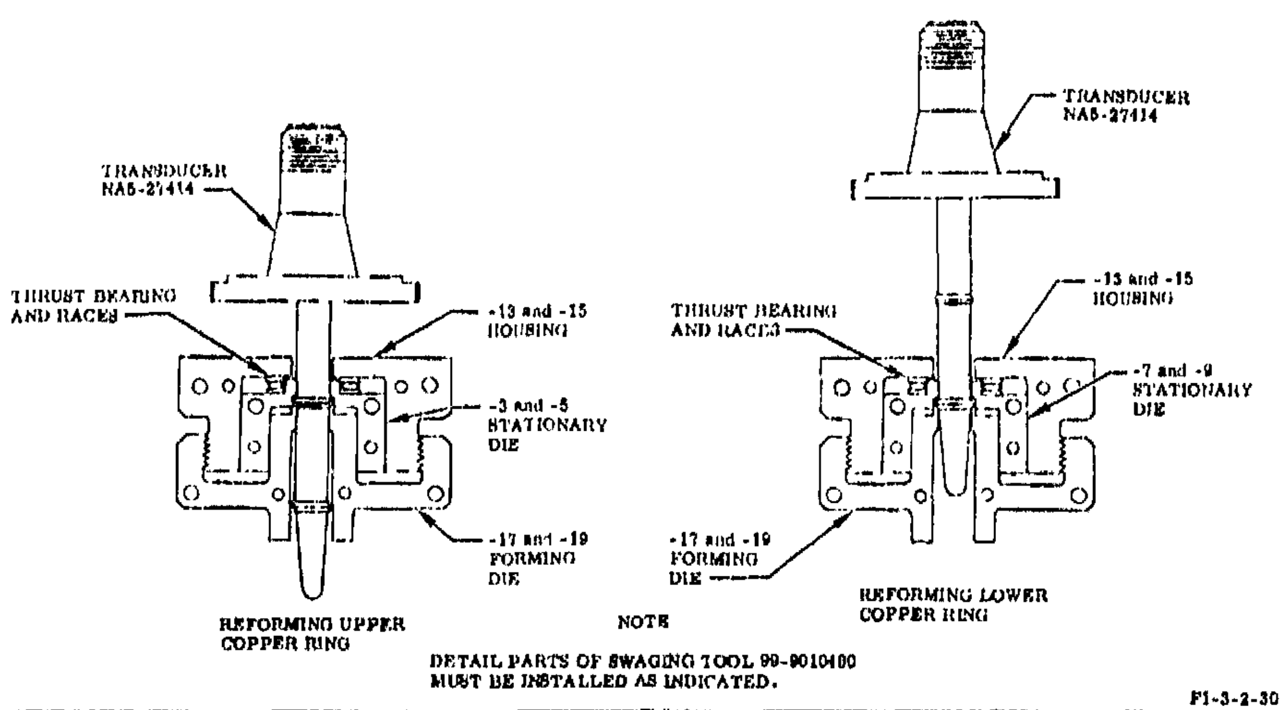


Figure 26-2. Reforming Temperature Transducer Copper Rings

26-10. INSULATION RESISTANCE TEST.

CAUTION

Connector must be dry prior to performing resistance test since moisture could cause the insulation to break down.

Procedure	Result
Apply 50 vdc between each pin and case individually and measure resistance.	Insulation resistance between pins and case must exceed 100 megohms.

26-11. RESISTANCE TEST FOR TRANSDUCERS NA5-27215 AND NA5-27333. With the transducer at a temperature of 75° ±30° F, use a Wheatstone bridge and measure resistance as follows:

a. Between pins A and B on transducers NA5-27333 and NA5-27215-T6.	Resistance must be 465 ±34 ohms.
b. Between pins A and B on transducers NA5-27215-T3.	Resistance must be 1,370 ±100 ohms.
c. Between pins B and C.	Resistance must be less than 5 ohms.

26-12. RESISTANCE TEST FOR TRANSDUCER NA5-27414. With the transducer at a temperature of 75° ±30° F, use a Wheatstone bridge and measure resistance as follows:

a. Measure and record element and lead resistance between pins A and B.	None.
b. Measure and record lead resistance between pins B and C.	None.
c. Subtract resistance in step b from resistance obtained in step a to determine element resistance.	Element resistance must be 54.6 ±4 ohms.

SECTION XXVII

FLIGHT INSTRUMENTATION JUNCTION BOXES

27-1. FLIGHT INSTRUMENTATION JUNCTION BOXES 702810, 702810-11, 702810-21, 702820, 702820-21, and 702820-31.

27-2. The following procedures contain the cleaning, inspecting and repairing, and testing information required to maintain the flight instrumentation junction boxes (figures 27-1 and 27-2). See figure 27-3 for torque requirements for electrical connector dust caps and figure 27-4 for materials and special tools. Refer to R-3896-4 for electrical connector dust cap part numbers. The junction boxes are sealed and pressurized units and no disassembly or assembly is required.

WARNING

Junction box must not be opened while pressurized, since escaping gas or rupture of the box can result in injury to personnel.

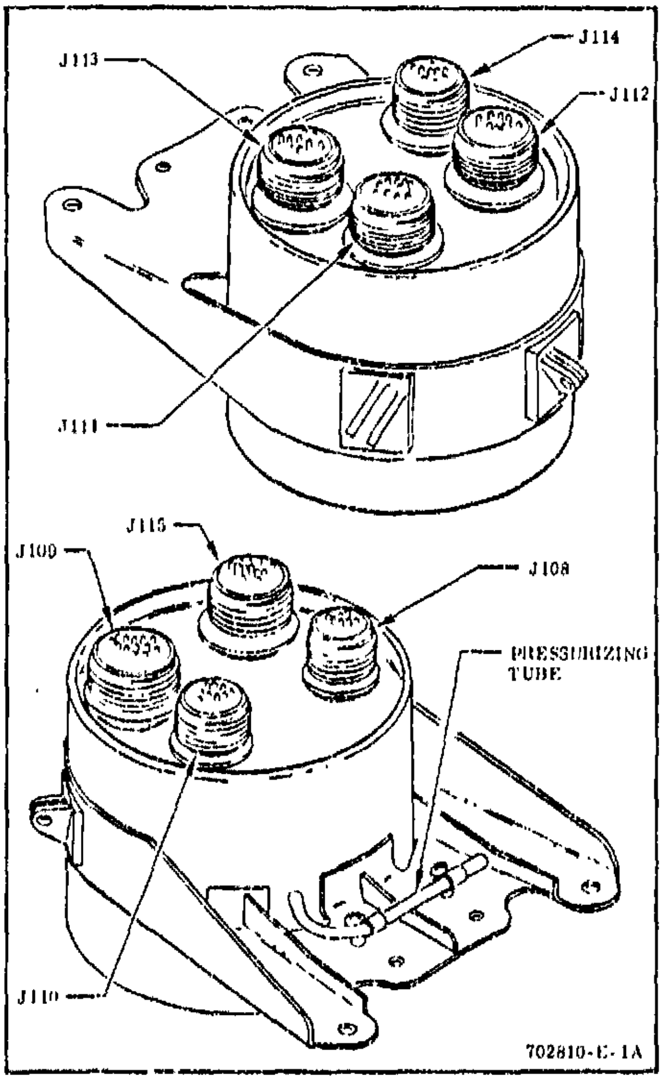


Figure 27-1. Flight Instrumentation Primary Junction Box

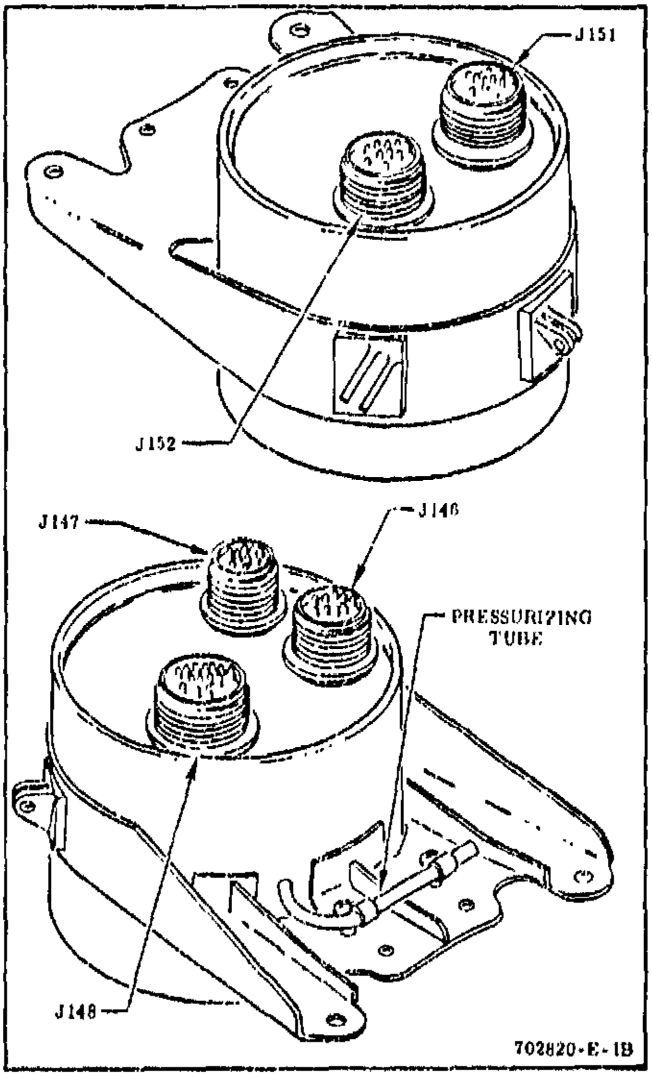


Figure 27-2. Flight Instrumentation Auxiliary Junction Box

Connector RDI No.	Torque (Inch-Pounds)	Description
J108	80-100	Primary Instrumentation Junction Box
J109	130-165	Primary Instrumentation Junction Box
J110	100-125	Primary Instrumentation Junction Box
J111	130-165	Primary Instrumentation Junction Box
J112	115-145	Primary Instrumentation Junction Box
J113	100-125	Primary Instrumentation Junction Box
J114	90-115	Primary Instrumentation Junction Box
J115	100-125	Primary Instrumentation Junction Box
J146	100-125	Auxiliary Instrumentation Junction Box
J147	80-100	Auxiliary Instrumentation Junction Box
J148	155-185	Auxiliary Instrumentation Junction Box
J151	155-185	Auxiliary Instrumentation Junction Box
J152	100-125	Auxiliary Instrumentation Junction Box

Figure 27-3. Torque Requirements for Electrical Connector Dust Caps

Specification or Part Number	Nomenclature	Use
AN/PSM-6	Multimeter	Continuity-tests
Model 1620C (Freed Transformer Co), or equivalent.	Megohmmeter	Insulation-resistance-tests.
Federal Specification TT-I-735	Isopropyl Alcohol	Cleans exterior of connectors and potted end of junction box.
MIL-T-27602	Trichloroethylene	Cleans exterior of junction box.
MIL-P-27401	Gaseous Nitrogen	Cleans and dries connectors.
RTV-615A (General Electric Co)	Silicone Resin	With RTV-615B makes potting compound.
RTV-615B (General Electric Co)	Curing Agent	With RTV-615A makes potting compound.
RTV-108 (General Electric Co)	Adhesive Sealant	Repairs potting compound.
SS-4120 (General Electric Co)	Silicone Primer	Primes potting area.

Figure 27-4. Materials and Special Tools for Junction Boxes

27-3. CLEANING.

27-4. The flight instrumentation junction boxes must be free of dirt, grease, moisture, and foreign particles prior to inspecting, repairing, or testing.

WARNING

The following procedure uses pressurized gaseous nitrogen or air, which must not be allowed to impinge on the body since it may result in skin inflation. Inflation of the skin can cause serious injury to human tissues.

- Eye protection must be worn to prevent foreign matter from injuring eyes.
- Pressurized gases can hurl objects with sufficient force to cause injury to personnel.

a. Remove dust, moisture, and foreign particles from junction box and connectors using low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to cleanness and humidity requirements of MIL-P-27401.

WARNING

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

b. Remove dirt, grease, etc from exterior surfaces of junction box, except potted end, by brushing or wiping with a natural-bristle brush or clean, lint-free cloth dampened (not saturated) with trichloroethylene (MIL-T-27602). Immediately remove any cleaning solvent that contacts potting compound on end of junction boxes.

c. Remove carbon from exterior surfaces of junction box by wiping with a clean, lint-free cloth dampened with a mild soap and water solution.

WARNING

The following procedure uses isopropyl alcohol, which is flammable and must not be used near heat, sparks, or open flame. Inhalation of the vapors or prolonged contact with the liquid can cause serious injury.

d. Clean exposed surfaces of connectors by brushing lightly with a natural-bristle brush dipped in isopropyl alcohol (Federal Specification TT-I-735).

e. Immediately dry connector with low-pressure gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to cleanness and humidity requirements of MIL-P-27401.

27-5. INSPECTING AND REPAIRING.

27-6. Inspecting the junction boxes determines if the parts have been damaged by mishandling or wear. See figures 27-5 and 27-6 and inspect the part for the condition to be sought and the disposition of the part.

Nomenclature	Inspecting	Repairing
Connector	Pin contacts with one bend but not bent more than 20 degrees from connector axis.	Straighten by using a mating socket contact or equivalent. See figure 27-6. Replace junction box if out of tolerance.
	Pin contacts with more than one bend, regardless of angularity.	See figure 27-6. Replace junction box.
	Pin contacts with one bend greater than 20 degrees.	Acceptability and repair requirements to be specified by manufacturer's representative.
	Bent or misalined socket contacts.	Replace junction box.
	Length of pin or socket contacts.	See figure 27-6. Replace junction box if out of tolerance.
	Corroded pin or socket contacts (determined by analysis of substance).	Replace junction box.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.
	Damaged sealing surface.	Hand-polish to remove nicks and scratches. Flatness of sealing surface must be within 0.004-inch total of shell ID, and surface maintained to an $\sqrt{8}$ or $\sqrt{32}$ c finish. Height of sealing surface (measured from top of key) must be 0.011 inch minimum. CAUTION Care must be used when hand-polishing, to prevent damage to inserts.

Figure 27-5. Inspecting and Repairing Junction Boxes (Sheet 1 of 2)

Nomenclature	Inspecting	Repairing
	Cracked, chipped, or split glass inserts.	Replace junction box.
	Cracked, bent, or broken shells.	Replace junction box.
	Contamination.	Clean as outlined in paragraph 27-3.
Box	Blisters, holes, scratches, or gouges larger than 1/8 inch in diameter in potting.	Repair as outlined in paragraph 27-7.
	Deteriorated potting.	Replace as outlined in paragraph 27-7.
	Cracked welds or cracked mounting brackets.	Replace junction box.

Figure 27-5. Inspecting and Repairing Junction Boxes (Sheet 2 of 2)

27-7. REPAIRING POTTING COMPOUND.

NOTE

Steps a through c outline repairing potting and steps d through l outline replacing potting.

a. Clean damaged area by wiping with a clean, lint-free cloth dampened with isopropyl alcohol (Federal Specification TT-I-735). Allow solvent to dry completely.

WARNING

Isopropyl alcohol is flammable and must not be used near heat, sparks, or open flame. Inhalation of the vapors or prolonged contact with the liquid can cause serious injury.

b. Apply adhesive sealant RTV-108 (General Electric Co) to damaged area and, using a spatula, smooth out sealant and remove excess material.

c. Allow sealant to cure at room temperature for approximately 16 hours.

d. Remove all potting compound from end of junction box. Take care to avoid removal of markings on junction box.

e. Thoroughly clean repair area by wiping with a clean, lint-free cloth dampened with isopropyl alcohol (Federal Specification TT-I-735). Allow solvent to dry completely.

WARNING

Isopropyl alcohol is flammable and must not be used near heat sparks, or open flame. Inhalation of the vapors or prolonged contact with the liquid can cause serious injury.

f. Apply a thin, even coat of silicone primer SS-4120 (General Electric Co), to surface of repair area. Allow primer to dry for a minimum of 30 minutes.

g. Thoroughly mix 100 parts of silicone resin RTV-615A to 10 ±0.5 parts of curing agent RTV-615B (General Electric Co) by weight, for a minimum of 3 minutes. Potting life is approximately 8 hours. Use only clean-metal or non-waxed containers with a capacity 3 times as large as potting mix.

h. Place potting mix in a vacuum chamber and pull a minimum vacuum of 27 inches of mercury for approximately 10 minutes to remove air.

i. Place a nylon cast on each lockwire hole of connectors to form a groove 0.12 inch deep from lockwire flange, 0.12 inch wide, and 0.25 inch long after potting is cured.

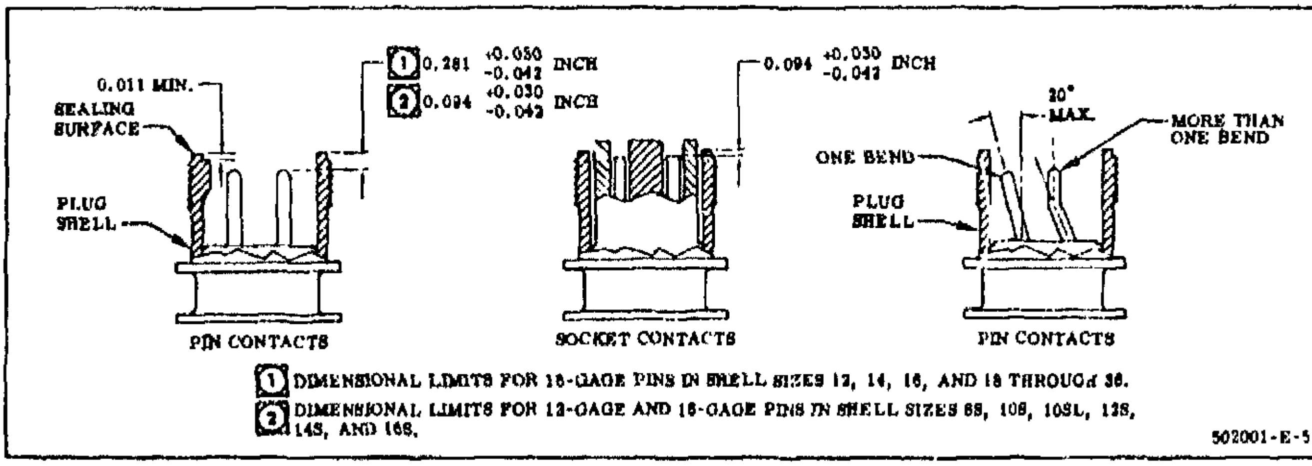


Figure 27-6. Dimensional Limits for Electrical Connectors

j. Fill recess in end of junction box (primary box ends J108, J109, J110, and J115; auxiliary box ends J146, J147, and J148) level with potting mix.

k. Allow potting mix to cure at room temperature for a minimum of 24 hours. Do not cure in an area where unreacted amines or other curing agents are present. Avoid touching surface until fully cured, since imprints on surface hinder transparency.

l. Carefully remove casts installed in step i and remove any excess potting compound.

27-8. TESTING.

27-9. The following test procedure outlines requirements for testing the junction boxes. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Refer to paragraphs 27-10 and 27-11 for junction box test procedures. See figures 27-7 and 27-8 for junction box contact connections.

From	To/From	To	From	To/From	To
J108-A	TB1 (a)	J109-A		TB3	J112-K
	TB1	J111-A		TB3	J112-N
	TB1	J111-G		TB3	J112-W
	TB1	J111-S	J108-C	TB4 (c)	J109-C
	TB1	J111-U		TB4	J113-K
	TB1	J111-X		TB4	J113-N
	TB1	J111-g		TB4	J113-R
	TB1	J112-E		TB4	J114-K
	TB1	J112-M		TB4	J114-P
	TB1	J112-R	J108-D	TB5 (d)	J109-D
J108-B	TB3 (b)	J109-B		TB5	J111-F
	TB3	J111-E		TB5	J111-P
	TB3	J111-N		TB5	J111-T
	TB3	J111-Z		TB5	J111-c
	TB3	J111-a		TB5	J111-f
	TB3	J111-b		TB5	J111-p
	TB3	J111-n		TB5	J112-L

(a) Internal bus E102
(b) Internal bus E104N
(c) Internal bus E103
(d) Internal bus E106N

Figure 27-7. Primary Junction Box Contact Connections (Sheet 1 of 2)

From	To/From	To	From	To/From	To
J108-D (cont)	TB5	J112-U	J109-p		J111-e
	TB5	J112-X	J109-r		J112-H
J108-J		J111-s	J109-s		J112-Z
J109-K		J112-V	J110-B		J113-S
J109-L		J111-H	J110-C		J113-H
J109-M		J111-J	J110-D		J114-R
J109-N		J111-R	J110-E		J113-P
J109-P		J111-B	J110-F		J113-D
J109-R		J111-C	J110-G		J113-C
J109-S		J112-Q	J110-H		J114-D
J109-T		J112-S	J110-J		J114-F
J109-U		J112-T	J110-P		J113-G
J109-V		J112-Y	J110-R		J114-H
J109-W		J111-M	J110-S		J114-G
J109-X		J111-L	J110-T		J114-E
J109-Z		J111-D	J110-V		J113-V
J109-a		J112-P	J115-C		J113-T
J109-b		J111-V	J115-D		J113-J
J109-c		J111-W	J115-E		J113-E
J109-d		J111-d	J115-F		J113-F
J109-e		J111-h	J115-G		J114-J
J109-f		J111-K	J115-H		J114-S
J109-g		J111-k	J115-J		J114-N
J109-h		J112-F	J115-P	E1-E2-E3[c]	J114-L
J109-j		J112-G	J115-R		J113-B
J109-k		J111-j	J115-S		J113-A
J109-m		J111-r	J115-T		J114-C
J109-n		J111-m	J115-V		J114-T

(c) Internal terminals and diodes

Figure 27-7. Primary Junction Box Contact Connections (Sheet 2 of 2)

From	To/From	To	From	To/From	To
J147-A	TB1[a]	J146-A	J147-A (cont)	TB1	J151-W
	TB1	J146-E		TB1	J152-A
	TB1	J146-J		TB1	J152-E
	TB1	J147-C		TB1	J152-J
	TB1	J148-A	J147-B	TB4[b]	J146-B
	TB1	J151-T		TB4	J146-F
	TB1	J151-a		TB4	J146-K
	TB1	J151-d		TB4	J148-B
	TB1	J151-m		TB4	J148-C
	TB1	J151-t		TB4	J151-U

(a) Internal bus E102
(b) Internal bus E104N

Figure 27-8. Auxiliary Junction Box Contact Connections (Sheet 1 of 2)

From	To/From	To	F om	To/From	To
J147-B (cont)	TB4	J151 b	J148-M		J152-S
	TB4	J151-e	J148-N		J152-C
	TB4	J151-n	J148-O		J151-P
	TB4	J151-u	J148-P		J151-M
	TB4	J151-X	J148-R		J152-R
	TB4	J152-B	J148-S		J152-P
	TB4	J152-F	J148-T		J146-C
	TB4	J152-K	J148-U		J151-V
J147-D	TB5 (c)	J146-D	J148-V		J151-N
	TB5	J146-H	J148-W		J152-N
	TB5	J146-M	J148-X		J146-P
	TB5	J148-D	J148-Y		J151-g
	TB5	J151-R	J148-Z		J151-O
	TB5	J151-Y	J148-a		J151-Z
	TB5	J151-Q	J148-b		J146-N
	TB5	J151-f	J148-c		J146-L
	TB5	J151-p	J148-d		J151-h
	TB5	J151-y	J148-e		J151-c
	TB5	J152-D	J148-f		J151-k
	TB5	J152-H	J148-g		J146-U
	TB5	J152-M	J148-h		J151-v
J147-J	J152V	J146V	J148-j		J151-j
J148-E		J152-L	J148-k		J146-T
J148-F		J146-G	J148-m		J151-q
J148-G		J152-U	J148-n		J151-w
J148-H		J146-S	J148-p		J151-r
J148-I		J152-T	J148-r		J151-x
J148-J		J152-G	J148-s		J151-s
J148-K		J151-S	J148-z		J151-z
J148-L		J146-R			

(c) Internal bus E106N

Figure 27-8. Auxiliary Junction Box Contact Connections (Sheet 2 of 2)

27-10. CONTINUITY-TEST.

a. Using a multimeter, continuity-test between connectors J114, contact L (+), and connector J115, contact P(-). See figure 27-7.) Resistance must be a minimum of 200 ohms.

b Reverse ohmmeter leads of step a. Resistance must be a minimum of 20K ohms.

c. Continuity-test remaining connector contacts. (See figures 27-7 and 27-8.) Resistance must not exceed one ohm.

27-11. INSULATION-RESISTANCE-TEST.

WARNING

High-voltage tests are dangerous; therefore, in addition to local and standard safety requirements, the test equipment must be grounded, connectors must be dry, and personnel must be kept to a minimum in the test area.

- The following procedure uses pressurized gaseous nitrogen or air, which must not be allowed to impinge on the body since it may result in skin inflation. Inflation of the skin can cause serious injury to human tissues.

- Eye protection must be worn to prevent foreign matter from injuring eyes.

- Pressurized gases can hurl objects with sufficient force to cause injury to personnel.

a. Using low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to cleanness and humidity requirements of MIL-P-27401, thoroughly dry all connectors containing ceramic inserts.

CAUTION

The circuit between contact L of connector J114 and contact P of connector J115 contains blocking diodes. Application of high voltage can damage the diodes.

b. Using a megohmmeter, apply 500 vdc for 5-60 seconds between each contact and case, and between each contact and every other contact of each connector in figure 27-7, except contact L of connector J114 and contact P of connector J115. Resistance of each application must exceed 200 megohms.

c. Repeat step b for connectors in figure 27-8, except contacts A and C of connector J147. The same results as step b must be obtained.

d. Remove test equipment and install and torque dust caps on connectors. See figure 27-3 for torque requirements.

SECTION XXVIII

RIGID DUCTS AND LINES, FLEXIBLE LINES, AND BRAIDED FLEX HOSES

28-1. RIGID DUCTS AND LINES, FLEXIBLE LINES, AND BRAIDED FLEX HOSES.

28-2. The following procedures contain cleaning, inspecting and repairing, and dimensional limits for rigid ducts and lines, flexible lines (gimbal-jointed lines), and braided flex hoses. Repair of damaged areas not covered in this section must be referred to the manufacturer's representative for acceptability and repair disposition.

28-3. CLEANING.

28-4. The rigid ducts and lines, flexible lines, and braided flex hoses must be cleaned according to the cleaning instructions in R-3896-3, Volume I and recleaned after repair. Protective covers and closures listed in R-3896-4 must be used to protect the hardware from contamination.

28-5. INSPECTING AND REPAIRING.

28-6. Inspecting the rigid ducts, lines, and hoses determines if the parts have been damaged by mishandling. Refer to figure 28-2 and inspect the rigid ducts, lines, and hoses for general condition and damage which may require repair or replacement. Dimensional limits are listed in figures 28-3, 28-3A, and 28-4.

Figure 28-1 deleted.

Part Name	Inspecting	Repairing
Rigid Ducts:		
External nicks and scratches on the propellant feed ducts may be reworked without affecting the structural integrity of the ducts if the minimum wall and flange thickness requirements of figures 28-3 and 28-4 are not less than specified after rework is done. Wall thicknesses will be measured when a marginal condition exists and when specified by Rocketdyne Field Engineering. An ultrasonic VIDI Gage (portable) Model 12B (Branson Instruments Inc), Sonoray Digital Caliper Model 101 (Branson Instruments Inc), or equivalent, may be used for measuring.		
Oxidizer and Fuel High-Pressure Ducts	Damage to exterior walls.	Provide Rocketdyne Field Engineering with duct description; serial number; and type, location, and dimensions of damage for determination of remaining wall thickness. Rework repairable damage using applicable method outlined in paragraph 28-7.

Figure 28-2. Inspecting and Repairing Ducts, Lines, Tubes, and Hoses (Sheet 1 of 5)

Pages 28-3 and 28-4 deleted.

Part Name	Inspecting	Repairing
Rigid Ducts: (continued)		
	Damage to flange sealing surfaces.	Hand-polish to remove scratches. Reworked surface must be $\sqrt[32]{}_c$ finish or better. Measure flange thickness for verification of minimum remaining material (figure 28-3).

Flexible Lines (Gimbal-Jointed Lines):

Inspection and repair of the flexible lines is essentially the same for all lines. See figure 28-3 for dimensional limits of specific lines. Inspect and rework lines as follows.

NOTE

Polish all reworked sealing surface areas to a minimum $\sqrt[32]{}_c$ finish or better.

Part Name	Inspecting	Repairing
Flanges	Damage to flange sealing surface.	Hand-polish to remove scratches. Measure depth of flange sealing groove or flange thickness for verification of minimum remaining material (figure 28-3).
	Cracks in flange.	Dye-penetrant inspect welds as outlined in R-3896-3, Volume I if cracks are suspected. Replace line if cracks are found in welds.
Gimbal Joint	Leakage in bellows.	Replace line.
	Dents or deep nicks in bellows.	Replace line.
	Broken lockwire on gimbal pins.	Replace lockwire. Make sure torque of pin-retaining screws is 9-12 inch-ounces prior to installing lockwire. NOTE: Torque for screws in gas generator flexible lines is 13-16 inch-ounces.

Figure 28-2. Inspecting and Repairing Ducts, Lines, Tubes, and Hoses (Sheet 2 of 5)

Part Name	Inspecting	Repairing

Braided Flex Hoses:

Inspection and repair of the braided flex hoses is essentially the same for all flex hoses. See figure 28-3 for dimensional limits of specific hoses. Inspect and rework hoses as follows:

NOTE

Polish all reworked sealing surface areas to a minimum $\sqrt[32]{}$ c finish or better.

Part Name	Inspecting	Repairing
Flanges	Damage to flange sealing surface.	Hand-polish to remove scratches. Measure depth of flange sealing groove or flange thickness for verification of minimum remaining material (figure 28-3).
	Cracks in flange.	Dye-penetrant inspect welds as outlined in R-3896-3, Volume I if cracks are suspected. Replace line if cracks are found in welds.
Braid	One or more broken (or chafed) braid wires within one inch of braid retaining collar.	Replace flex hose.
	More than one broken (or chafed) braid wire per carrier.	Replace flex hose.
	One or more broken (or chafed) braid wires in adjacent parallel carriers.	Replace flex hose.
	More than 6 broken (or chafed) braid wires in a flex section.	Replace flex hose.

NOTE

Broken wire is defined as a wire that is either completely severed or one that is chafed or worn away more than 30 percent of the wire diameter.

- A braid wire carrier consists of a number of parallel wires grouped together, and is woven in and out of other carriers from one braid collar to the other.

Part Name	Inspecting	Repairing
	Any evidence of braid damage, apparently caused by impact, e.g.: a. Severe kinking of a group of braid wires in same or other carriers. b. Dents in braid wire as evidenced by abnormal depressions.	Coordinate with Rocketdyne representative for disposition.
	A bulge that extends beyond the outside diameter or the hex flat dimension of braid retaining collar.	Replace flex hose.

Figure 28-2. Inspecting and Repairing Ducts, Lines, Tubes, and Hoses (Sheet 3 of 5)

Part Name	Inspecting	Repairing

Drain Lines:

Inspection and repair of rigid-tubing drain lines that have a working pressure of less than 100 psi, is essentially the same for all drain lines. See figure 28-3A for dimensional limits of specific line sizes. Inspect and rework lines as follows:

NOTE

Polish all reworked sealing surface areas to a minimum $\sqrt{32}$ finish or better.

- Drain lines that are not repairable must be replaced. Refer to paragraph 28-9 for drain line fabrication.

Part Name	Inspecting	Repairing
Tubing	Surface scratches or defects.	Replace line if damage exceeds a depth of 10 percent of the nominal wall thickness in straight unformed areas and compression areas (inside bends); also, replace line if damage exceeds a depth of 5 percent of the nominal wall thickness in tension areas (outside bends). For lines that are acceptable hand-blend damaged area smooth with adjacent parent material. Dye-penetrant-inspect reworked area as outlined in R-3896-3, Volume I. Measure wall thickness at reworked area for verification of minimum remaining material thickness.
B-nut, sleeve, or flare	Damaged threads, sleeve, or scratches in flare.	Replace line, or repair if there is sufficient length to permit making a new flare in order to replace B-nut, sleeve, or flare. All tube ends must be single flared in accordance with MS33584.
Flanges	Minor damage to flange sealing surface.	Hand-polish to remove scratches or surface defects.
	Cracks in flange.	Dye-penetrant-inspect welds as outlined in R-3896-3, Volume I, if cracks are suspected. Replace line if cracks are found in welds.

Figure 28-2. Inspecting and Repairing Ducts, Lines, Tubes, and Hoses (Sheet 4 of 5)

Part Name	Inspecting	Repairing
Hydraulic and Purge Rigid Tubes and Lines:		
All hydraulic and purge rigid tubes and lines are inspected and repaired essentially the same. See figure 28-3 for dimensional limits for specific tubes and lines. Inspect and repair tubes and lines as follows:		
Tubing	Surface scratches or defects.	Replace line if damage exceeds a depth of 10 percent of the nominal wall thickness in straight unformed areas and compression areas (inside bends); also, replace line if damage exceeds a depth of 5 percent of the nominal wall thickness in tension areas (outside bends).
Flanges	Minor damages to flange sealing surface.	Hand-polish to remove surface defects. Surface finish must be $\sqrt{32}_c$ or better.
	Cracks in flange.	Dye-penetrant inspect welds as outlined in R-3896-3, Volume I if cracks are suspected. Replace line if cracks are found in welds.
Inserts	Loose or damaged.	Replace inserts as outlined in R-3896-3, Volume I.
Threaded ports	Damaged threads.	Repair threads as outlined in R-3896-3, Volume I.

Figure 28-2. Inspecting and Repairing Ducts, Lines, Tubes, and Hoses (Sheet 5 of 5)

Part Name	Dimension	Minimum	Part Name	Dimension	Minimum
Rigid Ducts:			Flexible Ducts (Gimbal-Jointed):		
Oxidizer High-Pressure Ducts	Wall thickness (straight and transition sections).	0.340	Gas Generator Oxidizer Duct (Valve end)	Depth of flange sealing grooves. (0.150 maximum)	
	Flange thickness.	1.690	Gas Generator Oxidizer Duct (Duct end)	Depth of flange sealing grooves. (0.150 maximum)	
Fuel High-Pressure Ducts	Wall thickness (straight and transition sections).	0.240	Gas Generator Fuel Duct	Flange thickness.	0.640
	Flange thickness.	1.690			

Figure 28-3. Dimensional Limits for Ducts, Lines, Tubes, and Hoses (Sheet 1 of 4)

Part Name	Dimension	Minimum
Flexible Ducts (Gimbal-Jointed) (continued):		
GOX Wrap-around Duct	Flange thickness.	0.240
Hydraulic Supply Wrap-around Duct	Flange thickness (inlet).	0.240
	Flange thickness (outlet).	0.490
Hydraulic Return Wrap-around Duct	Flange thickness (inlet).	0.240
	Flange thickness (outlet).	0.690
Helium Supply Wrap-around Duct	Flange thickness.	0.240
Helium Return Wrap-around Duct	Flange thickness.	0.240
Heat Exchanger End Helium Supply Duct	Flange thickness (inlet).	0.340
	Flange thickness (outlet).	0.374
Heat Exchanger End Helium Return Duct	Flange thickness (inlet).	0.350
	Flange thickness (outlet).	0.319
Heat Exchanger End GOX Return Duct	Flange thickness (inlet).	0.470
	Flange thickness (outlet).	0.624
Braided Flex Hoses:		
Helium Bypass Hose	Depth of sealing groove (inlet flange).	0.150
	Flange thickness (inlet).	0.465
	Flange thickness (outlet).	0.250
Oxidizer Bypass Hose	Depth of sealing groove (inlet flange).	0.150
	Flange thickness (inlet).	0.465
	Flange thickness (outlet).	0.302
Oxidizer Supply Hose	Flange thickness (outlet).	0.490
	Flange thickness (inlet).	0.350
Hypergol Manifold Outlet Hose	Flange thickness (inlet).	0.240
	Flange thickness (outlet).	0.365
Turbine Bearing Lube Drain Hose	Flange thickness (fixed end).	0.540
	Flange thickness (swivel end).	0.240
Turbopump Fuel Bleed Hose	Flange thickness.	0.240
Redundant Shutdown Valve Override Hose	Flange thickness.	0.990
Turbine Outlet Pressure Hose	Flange thickness (fixed flange).	0.365
	Flange thickness (swivel flange).	0.240
Cocoon Purge Wrap-around Hose	Flange thickness.	0.240
Turbopump Oxidizer Intermediate Seal Purge Wrap-around Hose	Flange thickness.	0.240
Oxidizer Dome Purge Wrap-around Hose	Flange thickness.	0.240

Figure 28-3. Dimensional Limits for Ducts, Lines, Tubes, and Hoses (Sheet 2 of 4)

Part Name	Dimension	Minimum
Braided Flex Hoses (continued):		
Pre-fill Wrap-around Hose	Flange thickness.	0.240
Engine Control Valve Ground Hydraulic Supply Hose	Flange thickness.	0.240
Hydraulic and Purge Rigid Tubes and Lines:		
Engine Control Valve Supply Tube	Flange thickness for swivel end connector (small end).	0.690
	Flange thickness for fixed connector.	0.470
Propellant Valves Open Tube	Flange thickness for end connectors.	0.240
Propellant Valves Close Tube	Flange thickness for end connectors.	0.240
No. 1 Oxidizer Dome Purge Tube	Flange thickness for swivel end connectors.	0.240
	Flange thickness for fixed end connector.	0.365
No. 2 Oxidizer Dome Purge Line	Flange thickness for swivel end connector.	0.240
	Flange thickness for fixed end connector.	0.365
Turbopump Seal Purge Line	Flange thickness for swivel end connector.	0.240
	Flange thickness for fixed end connector.	0.365
Turbopump Oxidizer Seal Purge Tube, Pump End	Flange thickness for swivel end connector.	0.240
	Flange thickness for fixed end connector.	0.365
Gas Generator Oxidizer Purge Flanged Tube	Flange thickness for swivel end connector.	0.240
	Thickness for fixed flange.	0.678
System Return Line	Flange thickness for end connectors.	0.240
Actuator Return Line	Flange thickness for small flange of manifold (measured at spotfacing).	0.470
	Flange thickness for flange at curved section of manifold (measured at spotfacing).	0.678
	Flange thickness for large flange of manifold (measured at spotfacing).	0.502
	Flange thickness for fixed flange (measured at spotfacing).	0.678
	Flange thickness for fixed flange at mid-tube (measured at spotfacing).	0.370
Ignition Monitor Valve Return Line	Flange thickness for end connectors.	0.240

Figure 28-3. Dimensional Limits for Ducts, Lines, Tubes and Hoses (Sheet 3 of 4)

Part Name	Dimension	Minimum	Part Name	Dimension	Minimum
Hydraulic and Purge Rigid Tubes and Lines (continued):			No. 2 Fuel Valve Open Control Tube	Flange thickness for end connectors.	0.240
Sequence Valve to Sequence Valve Line	Flange thickness for end connectors.	0.240		Flange thickness for dual port connector (measured at spotfacing).	0.302
Gas Generator System Close Tube	Flange thickness for end connectors.	0.240			
Ignition Monitor Valve Sense Tube	Flange thickness for swivel end connector.	0.240			
	Thickness of orificed flange.	0.865			

Figure 28-3. Dimensional Limits for Ducts, Lines, Tubes, and Hoses (Sheet 4 of 4)

Tube OD (inches)	Nominal Wall Thickness (inches)	Minimum Wall Thickness (inches)
1/4	0.028	0.0252
3/8	0.035	0.0315
1/2	0.042	0.0378
	0.049	0.0441
5/8	0.049	0.0441
3/4	0.049	0.0441
1	0.065	0.0585

Figure 28-3A. Dimensional Limits for Drain Lines

28-7. REWORKING RIGID PROPELLANT HIGH-PRESSURE DUCTS.

28-8. The following procedures must be used to rework exterior wall surfaces of propellant high-pressure ducts that have incurred repairable damage in the form of nicks and scratches. Minimum wall thicknesses are specified in figures 28-3 and 28-4.

NOTE

> Step a is performed when repairable damage does not exceed 0.015 inch in depth. Steps b through f are performed when repairable damage exceeds 0.015 inch in depth.

a. Anodize damaged area using chromic acid (Type I) as directed in R-3896-3, Volume I.

b. Blend damaged area to match adjacent parent material, using a mini-grinder or by hand-blending. Blending must remove a minimum of material and be sufficient to remove entire discrepancy.

c. Blend area to a 1.00-inch-minimum spherical radius.

d. Polish blended area to obtain a smooth surface.

e. Dye-penetrant-inspect reworked area as outlined in R-3896-3, Volume I.

f. Anodize blended area using chromic acid (Type I) as directed in R-3896-3, Volume I.

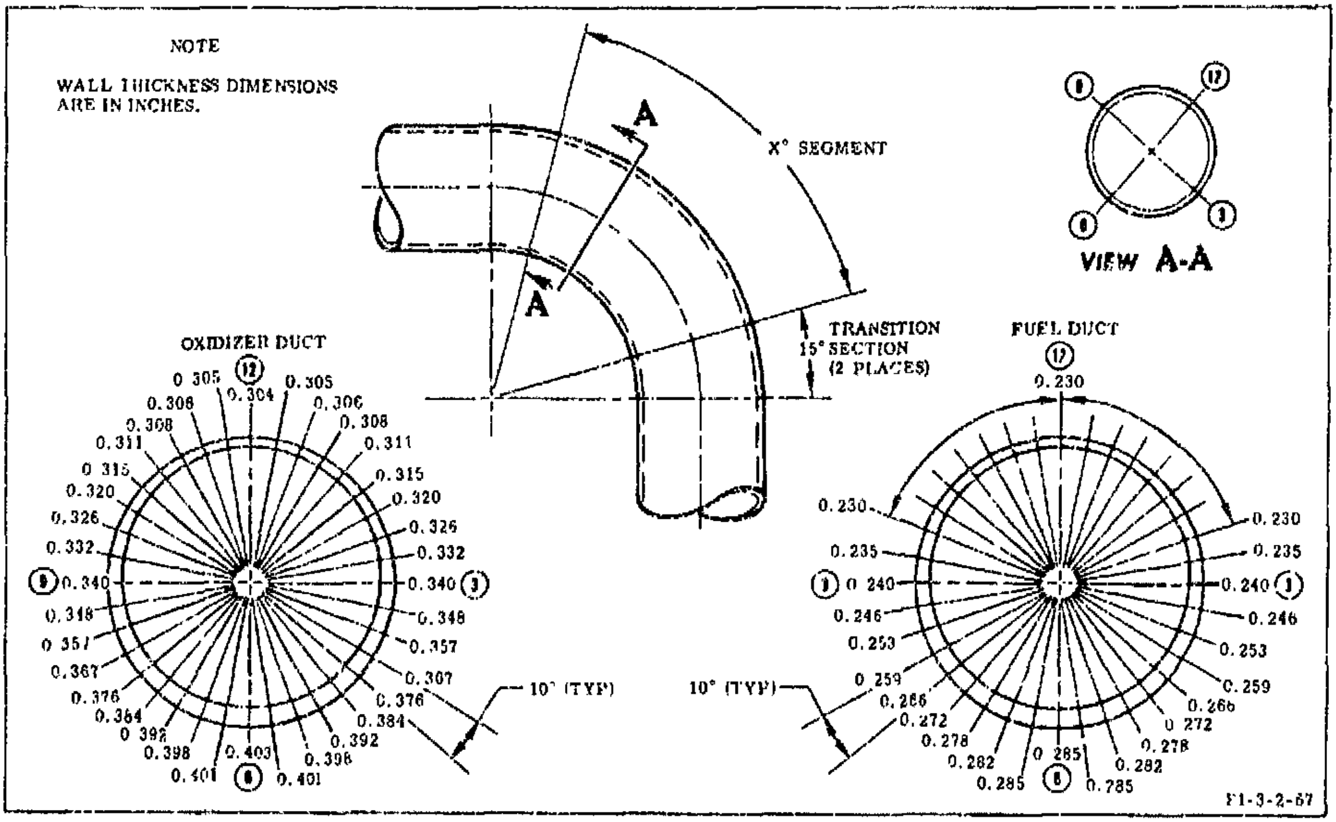


Figure 28-4. Minimum Allowable Wall Thickness for Curved Segment of Rigid Ducts

28-9. FABRICATING DRAIN TUBE ASSEMBLIES.

28-10. Drain tube assemblies listed in figure 28-5 may be fabricated at MAF from CRES 321 tubing (Type I, MIL-T-8808), B-nuts, and sleeves supplied by the Engine Contractor. These tube assemblies are small-diameter tubes with single-flared ends and are used in low-pressure systems. Fabrication and acceptance of the completed tube assemblies must be in accordance with the following requirements:

a. Tube fabrication must be performed by qualified personnel on qualified tube-bending equipment.

b. Tube forming must be accomplished using an identical part as a template.

c. Tube ends must be cut square to the centerline within 1/2 degree and must be burred to remove all sharp edges.

d. Minor distortions of tube details as a result of normal fabrication processes, such as ovality, wrinkling, or superficial marring of surfaces, is permissible within the following limitations:

NOTE

The following references to tube dimensions represent nominal outside diameters and nominal wall thicknesses.

(1) Tube ovality must not exceed 10 percent. Ovality of tubing is defined by the following formula: (Minimum and maximum dimensions must be taken from actual measurements.)

$$\text{Ovality (percent)} = \frac{(\text{max OD} - \text{min OD})}{\text{nominal OD}} \times 100$$

(2) Tube wrinkling must not exceed a depth of 2 percent of the nominal tube OD. Wrinkle pitch/depth ratio must be less than 10 to 1. This ratio is defined as the ratio between dimensions B and A (see figure 28-6). B (pitch) = dimension between the top of one crest to the top of an adjacent crest. A (depth) = dimension from the top of 2 adjacent crests to the bottom of the convolution.

(3) Scratches or surface defects must not exceed 10 percent of the nominal tube wall thickness.

(4) Surface discontinuities may be removed from the tube details by acceptable fabrication practices provided specified surface conditions and wall thicknesses are retained.

e. All tube ends must be single-flared in accordance with Military Standard MS33584.

f. A fabricated tube assembly must be inspected and verified to be in accordance with fabrication requirements of figure 28-5 before the tube assembly is cleaned.

g. The tube assembly must be cleaned as specified in R-3896-3, Volume I. The completed assembly must not be acid-descaled or passivated.

h. Inspecting and handling of the cleaned tube assembly must be accomplished as specified in R-3896-3, Volume I.

i. Identifying part numbers must be the same as those used on the template and applied on the tube assembly using the preferred electrochemical etch method.

j. Identification tapes specified in figure 28-5 must be installed on the tube assembly. (See figure 28-7 for typical tape installation.)

k. An acceptable fabricated tube assembly must be acceptance-etched by authorized Quality Assurance personnel prior to installation.

Part Number	Nomenclature	Size(a) (inch)	Sleeve MS20819 (2 reqd)	Nut AN818 (2 reqd)	Minimum Wall Thickness (inch)	Minimum Center-line Bend Radius (inches)	Identification Tapes
308223	Gas generator fuel seal vent tube	3/8 OD x 0.035 x 76.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
308223-11		3/8 OD x 0.035 x 96.00	-6J	-6J	0.028	1.19	
308646	Gas generator ball valve actuator purge drain tube	1/4 OD x 0.028 x 80.00	-4J	-4J	0.020	0.75	RD172-0007-0001 RD172-0014-0030 RD172-0014-0039 RD172-0014-0040
308672	Gas generator ball valve actuator fuel seal vent tube	1/4 OD x 0.028 x 10.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
308673	Gas generator ball valve shaft fuel seal vent tube	1/4 OD x 0.028 x 20.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
408242	Ignition monitor valve vent drain tube	3/8 OD x 0.035 x 10.00	-6J	-6J	0.028	1.19	RD172-0006-0001 RD172-0014-0011 RD172-0014-0040
408246	No. 1 oxidizer valve actuator rod seal vent tube	1/4 OD x 0.028 x 61.00	-4J	-4J	0.020	0.75	RD172-0001-0001 RD172-0014-0027
408248-11	No. 2 oxidizer valve actuator rod seal vent tube	1/4 OD x 0.028 x 60.00	-4J	-4J	0.020	0.75	RD172-0001-0001 RD172-0014-0027
408306	Fuel overboard drain tube	1 OD x 0.065 x 18.00	-16J	-16J	0.028	1.5	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
408312	Fuel overboard drain tube	3/4 OD x 0.049 x 21.00	-12J	-12J	0.028	1.12	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
408333	Igniter fuel valve vent overboard drain tube	3/8 OD x 0.035 x 12.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040

(a) Approximate length in inches; actual length to be determined using identical part for template.

Figure 28-5. Drain Tube Fabrication Requirements (Sheet 1 of 4)

Part Number	Nomenclature	Size[a] (inch)	Sleeve MS20819 (2 reqd)	Nut AN818 (2 reqd)	Minimum Wall Thickness (inch)	Minimum Center-line Bend Radius (inches)	Identification Tapes
408335	Fuel overboard drain tube (No. 1 side)	1/2 OD x 0.042 x 36.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
408336	No. 1 oxidizer valve actuator seal fuel drain tube	1/4 OD x 0.028 x 18.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
408337	No. 1 oxidizer valve shaft seal fuel drain tube	1/4 OD x 0.028 x 14.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
408338	Fuel overboard drain tube	5/8 OD x 0.049 x 31.00	-10J	-10J	0.035	1.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
408339	Fuel overboard drain tube (No. 2 side)	1/2 OD x 0.049 x 13.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0039
408340	No. 2 oxidizer valve shaft seal fuel drain tube	1/4 OD x 0.028 x 13.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039
408341-11	No. 2 oxidizer valve actuator fuel seal drain tube	1/4 OD x 0.028 x 20.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
408346	No. 1 oxidizer valve fuel overboard drain tube	3/8 OD x 0.035 x 12.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
408348	No. 2 oxidizer valve fuel overboard drain tube	3/8 OD x 0.035 x 14.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039
408836	Checkout valve actuator vent overboard drain tube	3/8 OD x 0.035 x 24.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040

(a) Approximate length in inches; actual length to be determined using identical part for template.

Figure 28-5. Drain Tube Fabrication Requirements (Sheet 2 of 4)

Part Number	Nomenclature	Size(a) (inch)	Sleeve MS20819 (2 reqd)	Nut AN818 (2 reqd)	Minimum Wall Thickness (inch)	Minimum Center-line Bend Radius (inches)	Identification Tapes
408837	Fuel inlet seal drain tube (No. 1 side)	1/2 OD x 0.042 x 47.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
408838	Fuel inlet seal drain tube (No. 2 side)	1/2 OD x 0.042 x 39.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
408839	Nitrogen purge overboard drain tube	1/2 OD x 0.042 x 36.00	-8J	-8J	0.035	1.38	RD172-0007-0001 RD172-0014-0030 RD172-0014-0040
408840	Nitrogen purge overboard drain tube	3/8 OD x 0.035 x 90.00	-6J	-6J	0.028	1.19	RD172-0007-0001 RD172-0014-0030 RD172-0014-0040
408841	Nitrogen overboard drain tube	1/2 OD x 0.042 x 144.00	-8J	-8J	0.035	1.38	RD172-0007-0001 RD172-0014-0030 RD172-0014-0040
408845	Primary fuel seal drain tube (No. 1 side)	1/2 OD x 0.042 x 50.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
408847	Oxidizer vent overboard drain tube	1/4 OD x 0.028 x 52.00	-4J	-4J	0.020	0.75	RD172-0001-0001 RD172-0014-0027
409212	No. 1 fuel valve position transducer vent drain tube	1/4 OD x 0.028 x 27.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039
409215	No. 2 fuel valve position transducer vent drain tube	1/4 OD x 0.028 x 26.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
410080	Oxidizer overboard drain tube	1/2 OD x 0.049 x 40.00	-8J	-8J	0.035	1.38	RD172-0001-0001 RD172-0014-0027
410082	Oxidizer overboard drain tube	1/2 OD x 0.049 x 16.00	-8J	-8J	0.035	1.38	RD172-0001-0001 RD172-0014-0027

(a) Approximate length in inches; actual length to be determined using identical part for template.

Figure 28-5. Drain Tube Fabrication Requirements (Sheet 3 of 4)

Part Number	Nomenclature	Size(a) (inch)	Sleeve MS20819 (2 reqd)	Nut AN818 (2 reqd)	Minimum Wall Thickness (inch)	Minimum Center-line Bend Radius (inches)	Identification Tapes
410086	Primary fuel seal drain tube (No. 2 side)	1/2 OD x 0.042 x 39.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
410099	Oxidizer over-board drain tube	1/2 OD x 0.049 x 36.00	-8J	-8J	0.035	1.38	RD172-0001-0001 RD172-0014-0039 RD172-0014-0040
410638-11	Engine control valve override drain tube	1/4 OD x 0.028 x 18.00	-4J	-4J	0.020	0.75	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
410644-11	Fuel overboard drain tube	1/2 OD x 0.049 x 10.00	-8J	-8J	0.035	1.38	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
410807	Fuel inlet seal drain tube (No. 1 side)	3/8 OD x 0.035 x 48.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0040
410819	Gas generator fuel seal vent tube	3/8 OD x 0.035 x 20.00	-6J	-6J	0.028	1.19	RD172-0002-0001 RD172-0014-0033 RD172-0014-0039 RD172-0014-0040
651295	Nitrogen purge overboard drain tube	1/2 OD x 0.042 x 115.00	-8J	-8J	0.035	1.38	RD172-0007-0001 RD172-0014-0030 RD172-0014-0039 RD172-0014-0040

(a) Approximate length in inches; actual length to be determined using identical part for template.

Figure 28-5. Drain Tube Fabrication Requirements (Sheet 4 of 4)

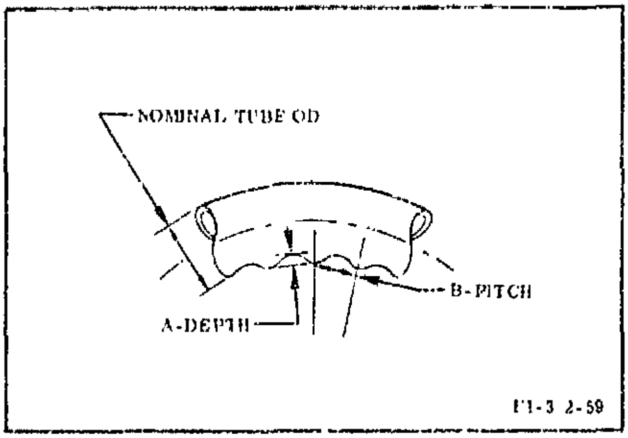


Figure 28-6. Measuring Tube Wrinkle Depth

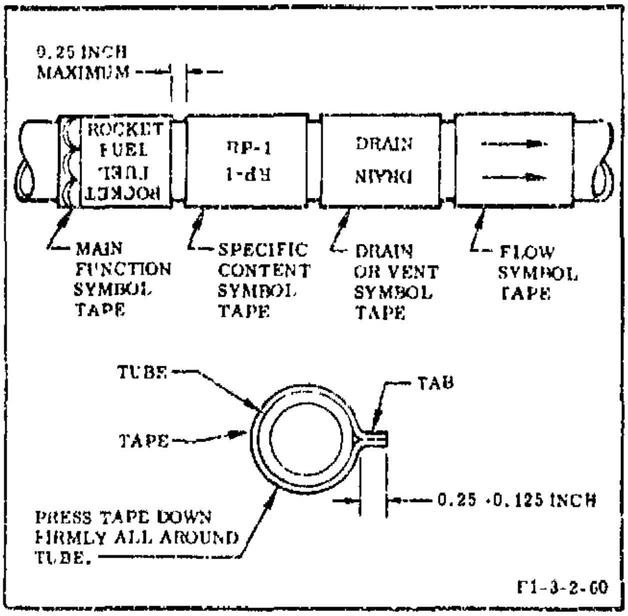


Figure 28-7. Identification Tape
Installation (Typical)

SECTION XXIX

REDUNDANT SHUTDOWN VALVE

WARNING

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

29-1. REDUNDANT SHUTDOWN VALVE 558350.

29-2. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the redundant shutdown valve. See figure 29-1 for test equipment and special tools. No covers or closures are provided for this valve. Protect valve as outlined in R-3896-3, Volume I.

Part No.	Nomenclature	Use
T-5041521	Pressure Test Plate	Pressure-tests redundant shutdown valve.
G3141	Components Test Console	Provides hydraulic fuel control and electrical control for testing redundant shutdown valve.
G3143	Components Adapter Set	Provides hardware for redundant shutdown valve test setups.

Figure 29-1. Test Equipment and Special Tools for Redundant Shutdown Valve

Figure 29-2 deleted.

29-3. DISASSEMBLING.

29-4. Disassemble redundant shutdown valve, as required, to accomplish necessary repairs and/or replacement. See figure 29-3 for parts and index numbers.

a. Remove bolts (1) and washers (2); then remove solenoid (3) and packing (4).

b. Remove stop (5), armature (6), spring (7), and retainer (8) from solenoid (3).

c. Remove stem (9), seat (10), spacer (13), poppet (15), and packing (14); then remove packing (12) and retainers (11) from seat (10).

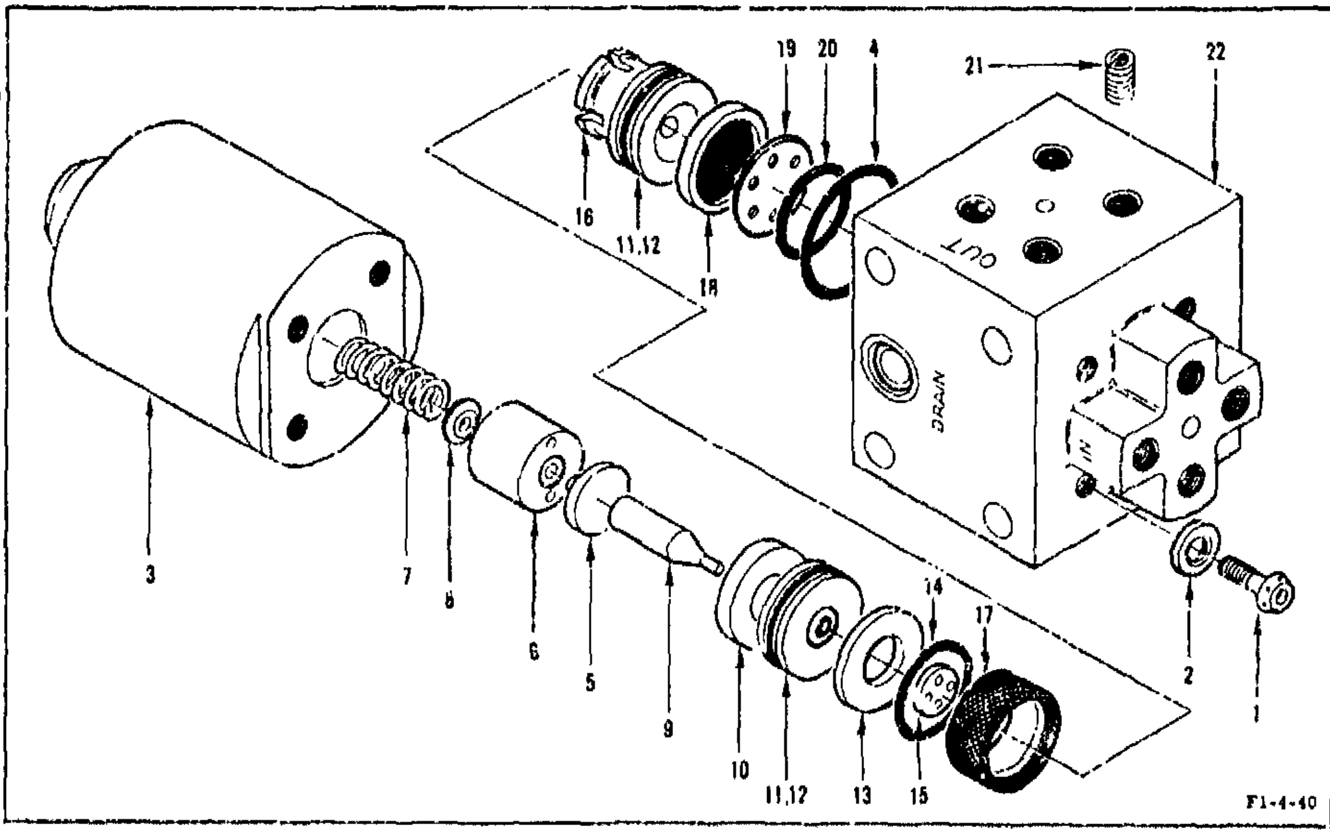
d. Remove seat (16), filter (18), baffle (19), and O-ring (20); then remove filter (17), packing (12), and retainers (11) from seat (16).

29-5. CLEANING.

29-6. Clean all parts of the redundant shutdown valve for fuel service, except solenoid (3), which must be cleaned for electrical service. Refer to R-3896-3, Volume I, for cleaning procedures.

29-7. INSPECTING AND REPAIRING.

29-8. Inspecting the redundant shutdown valve determines if the individual parts have been damaged by mishandling or wear. See figure 29-4 and inspect individual parts for general condition, cleanness, damage of threads, corrosion, distortion, nicks, burs, and scratches. Dimensional limits listed in figure 29-5 form the guide for serviceability of parts. Minimum and maximum values are given, beyond which repair or replacement of parts is required.



1	Bolt	7	Spring	12	Packing	17	Filter
2	Washer	8	Retainer	13	Spacer	18	Filter
3	Solenoid	9	Stem	14	Packing	19	Baffle
4	Packing	10	Seat	15	Poppet	20	O-Ring
5	Stop	11	Retainer	16	Seat	21	Insert
6	Armature					22	Body

Figure 29-3. Redundant Shutdown Valve--Exploded View

Part Name and Index Number	Inspecting	Repairing
Solenoid (3)	Damaged solenoid or electrical connector.	Replace.
Stop (5)	Damaged surfaces.	Replace.
Armature (6)	Deteriorated or damaged plating.	Replace.
	Obstruction in holes.	Remove obstruction.
Spring (7)	Compressed rating.	See figure 29-5.
Retainer (8)		
Stem (9)		

Figure 29-4. Inspecting and Repairing Redundant Shutdown Valve (Sheet 1 of 2)

Part Name and Index Number	Inspecting	Repairing
Seat (10), Spacer (13), Poppet (15), Seat (16), Baffle (19), and	Damaged sealing surfaces.	Replace.
Body (22)	Damaged sealing surfaces.	Replace.
	Damaged or missing inserts.	Replace inserts.
	Damaged threads.	Refer to R-3896-3, Volume I, for thread repair.

Figure 29-4. Inspecting and Repairing Redundant Shutdown Valve (Sheet 2 of 2)

Part Name and Index Number	Dimension	Minimum (Inches Except As Noted)	Maximum
Solenoid (3)	Armature (6) inside diameter	0.683	0.684
	Case flange inside diameter	1.876	1.877
Stop (5)	Stem outside diameter	0.108	0.109
	Thickness of large diameter	0.093	0.095
Armature (6)	Outside diameter	0.6800	0.6814
	Stop (5) inside diameter	0.112	0.113
	Length	0.599	0.600
Spring (7)	Compressed to 0.459 inch	26.6 lb	29.4 lb
Retainer (8)	Thickness	0.064	0.066
Stem (9)	Large diameter	0.214	0.216
	Small diameter	0.059	0.061
	Length	0.865	0.867
Seat (10)	Outside diameter	0.872	0.873
	Retainer (11) and packing (12) diameters	0.769	0.771
	Inside diameter	0.218	0.220
	Length	0.779	0.780
	Sealing surface inside diameter	0.079	0.081
	Sealing surface outside diameter	0.089	0.091

Figure 29-5. Dimensional Limits for Redundant Shutdown Valve (Sheet 1 of 2)

Part Name and Index Number	Dimension	Minimum (Inches Except As Noted)	Maximum (Inches Except As Noted)
Spacer (13)	Outside diameter	0.871	0.873
	Inside diameter	0.377	0.379
	Thickness	0.079	0.080
Poppet (15)	Outside diameter (spherical)		
	Thickness	0.059	0.060
	Surfaces, flat within 0.00001 inch		
Seat (16)	Outside diameter	0.872	0.873
	Retainer (11) and packing (12) diameters	0.769	0.771
	Length	0.779	0.781
	Sealing surface inside diameter	0.079	0.081
	Sealing surface outside diameter	0.089	0.091
Baffle (19)	Outside diameter	0.871	0.873
	Thickness	0.091	0.093
Body (21)	Seats (10, 16) inside diameters	0.875	0.877
	Solenoid (3) outside diameter	1.871	1.874

Figure 29-5. Dimensional Limits for Redundant Shutdown Valve (Sheet 2 of 2)

29-9. ASSEMBLING.

29-10. The assembly procedures for the redundant shutdown valve must be performed in the order listed and all parts must meet cleaning requirements as outlined in paragraph 29-5. The lubricant used in this procedure is hydraulic fluid (MIL-H-5606), unless otherwise noted. Specified lubrication procedures (methods) are outlined in R-3896-3, Volume I. See figure 29-3 for parts and index numbers.

a. Install O-ring (20), baffle (19), and filter (18) in body (22).

b. Lubricate (Method M) packing (12); then install packing and retainers (11) on seat (16).

c. Install seat (16) and filter (17) in body (22).

d. Lubricate (Method M) packing (14); then install packing, spacer (13), and poppet (15) in body (22).

e. Lubricate (Method M) packing (12); then install packing and retainers (11) on seat (10). Install seat (10) in body (22).

f. Lubricate (Method Z) stem (9); then install stem in seat (10).

g. Lubricate (Method M) packing (4) and insert packing in recess in body (22).

h. Lubricate (Method A) bolts (1) with lubricant grease RB0140-012 (Rocketdyne).

i. Lubricate (Method Z) armature (6); then install spring (7), retainer (8), armature (6), and stop (5) in solenoid (3).

j. Carefully install solenoid (3) on body (22) with the electrical connector key in same clock position as drain port. Make sure packing (4) remains in body; then secure solenoid to body with bolts (1) and washers (2). Torque bolts to 30-35 in-lb. Safetywire bolts.

29-11. TESTING.

29-12. This procedure outlines requirements for testing the redundant shutdown valve using Components Test Console G3141 and Components Adapter Set G3143. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure. Set up components test console electrical patch-panel (figure 29-6) and prepare console for use (figure 29-7). See figure 29-8 for redundant shutdown valve port identification and cutaway view. Refer to paragraphs 29-14 through 29-17 for redundant shutdown valve test procedures and see figure 29-10 for test setup. Install pressure test plates T-5041521 on valve IN and OUT ports and install a union in DRAIN port.

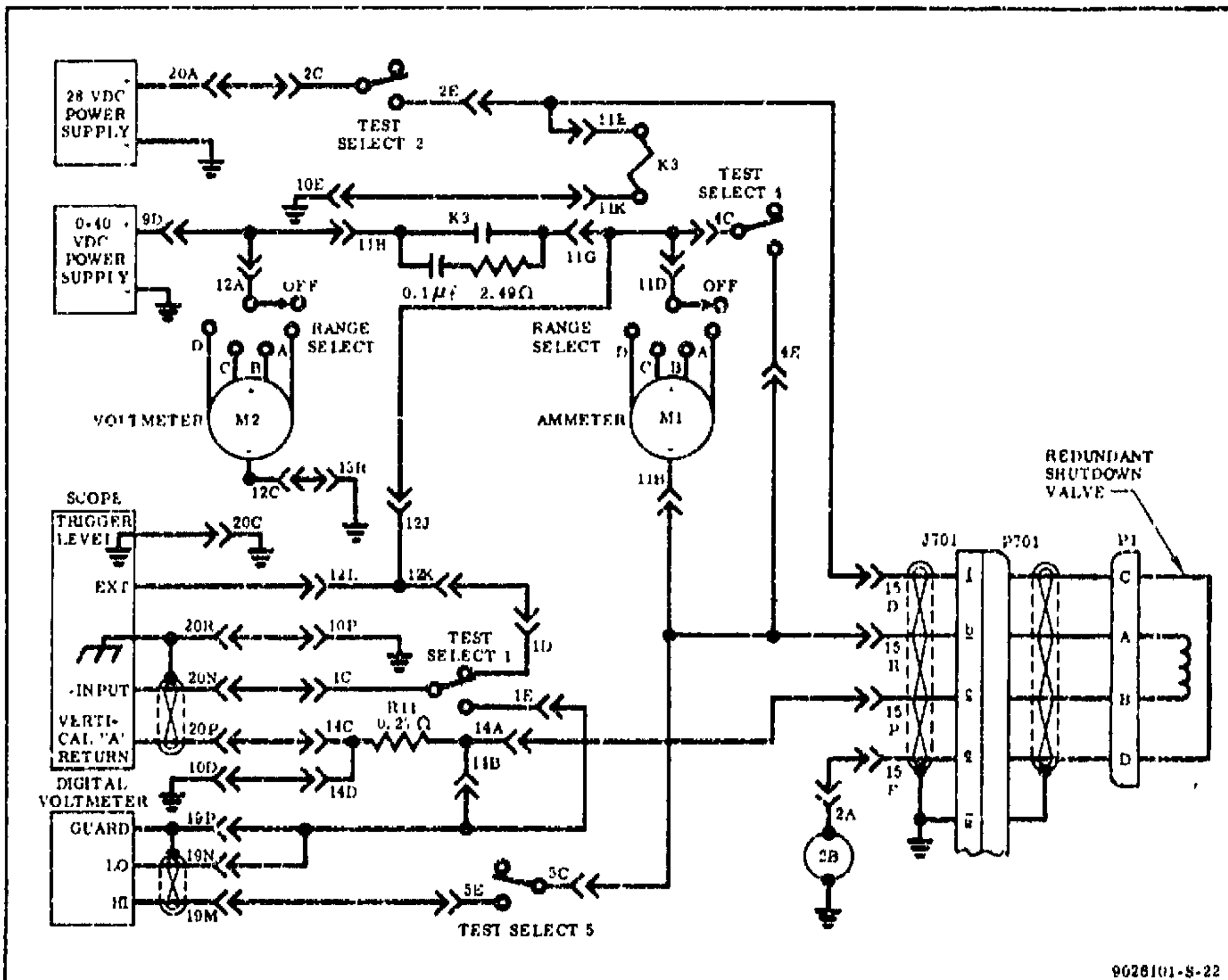


Figure 29-6. Components Test Console Patch-Panel Requirements (Sheet 1 of 2)

Patch-Cord[a]	From J6-	To J6-
K3.	1C	20N
K3.	1D	12K
K5.09	1E	14B 19N 19P
K3.	2A	15E
K3.	2C	20A
K4.09	2E	11E 15D
K5.09	4C	11D 11G 12J
K5.09	4E	5C 11B 15R
K3.	5E	19M
K4.09	9D	12A 11H
K3.	10D	14D
K3.	10E	11K
K3.	10P	20R
K3.	12C	13R
K3.	14A	15P
K3.	14C	20P
K3.	12L	EXT[b]
K3.	20C	GND[b]

(a) Use any cable length required on all patch-cords numbered K3.
(b) Connect point is located on front of scope.

Figure 29-6. Components Test Console Patch-Panel Requirements (Sheet 2 of 2)

Panel	Control	Position	Indication/Remarks

NOTE

The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.

PRE-POWER TURN ON

Panel	Control	Position	Indication/Remarks
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
PRESSURE/TEMPERATURE MONITOR	CHANNEL SELECT	OFF	
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counter-clockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	

Figure 29-7. Preparing Components Test Console for Use (Sheet 1 of 5)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (continued)			
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
OSCILLOSCOPE	INTENSITY	POWER OFF	
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KD STD INT/EXT	INT	At rear of unit.
	POWER	Down (off)	
TEST CELL ELECT. OUTLETS	Connector J701	Cable BB52748	Connection to redundant shutdown valve.
	Connectors J702, J704, and J705	Capped	
TEST CELL ELECT. OUTLETS	Connector J703	Resistor plug 3088-9	Temperature indicator load.

CAUTION

Check that facility pneumatic and hydraulic supplies to console are off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
	CB2 (10 AMP)	Pushed in	Electrical utility outlets power on.
DC POWER SUPPLY	AC INPUT	Up	None.
	CURRENT LIMIT	3	
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	VOLTS-RANGE SELECT	D (0-30)	None.
	MILLIAMPERES-RANGE SELECT	OFF	None.
	TEST SELECT 1		Light 1 off.[a]

(a) If indication is not as specified, press applicable switch-light.

Figure 29-7. Preparing Components Test Console for Use (Sheet 2 of 5)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (continued)			
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
	VOLTAGE ADJUST	INCREASE	VOLTS meter indicates 22 ±1 volts.
HYDRAULIC CONTROL	HYDRAULIC SYSTEM BYPASS		OPEN.[a]
	HYDRAULIC SYSTEM SUPPLY		CLOSE.[a]
	TEST CELL SUPPLY "A"		VENT.[a]
	TEST CELL SUPPLY "B"		VENT.[a]
	FLOW MONITOR SHUTOFF		CLOSE.[a]
	LOW FLOW BYPASS		CLOSE.[a]
OSCILLOSCOPE	FOCUS	Arrow up	Adjust later for best focus.
	VERTICAL POSITION	Arrows up	Adjust later for best position.
	HORIZ. POSITION	Arrow up	Adjust later for best position.
	INTENSITY	Arrow horizontal (to left)	Adjust later for intensity.
	POWER light	On	To right of cathode ray tube.

NOTE

Oscilloscope must warm up at least 30 minutes.

(a) If indication is not as specified, press applicable switch-light.

Figure 29-7. Preparing Components Test Console for Use (Sheet 3 of 5)

Panel	Control	Position	Indication/Remarks
TIMING-TEST			
DIGITAL VOLTMETER	115 V/230 V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	STORE	At rear of unit.
	RANGE	100V	
	FUNCTION	VOLT	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	STOP	
	POWER	ON	If digital voltmeter indicates OVER-LOAD, wait at least one minute before resetting.
	RESET	Press	Digital voltmeter indicates 00.0000 to 00.0001 volt.

NOTE

Digital voltmeter must warm up at least 30 minutes.

Panel	Control	Position	Indication/Remarks
OSCILLOSCOPE	A VERT. SENSITIVITY	0.1 VOLTS/CM DC	
	A VERT. SENSITIVITY VERNIER	CAL	Fully clockwise.
	B VERT. SENSITIVITY	OFF	
	B VERT. SENSITIVITY VERNIER	Arrow up	
	SWEEP TIME HORIZ. SENS.	10 MILLISEC/CM	
	SWEEP TIME HORIZ. SENS. VERNIER	CAL	Fully clockwise.
	CHANNEL A POLARITY	POS. UP	
	VERT. PRESENTATION	CHANNEL A	
	VERTICAL POSITION	A	

Figure 29-7. Preparing Components Test Console for Use (Sheet 4 of 5)

Panel	Control	Position	Indication/Remarks
TIMING-TEST (continued)			
	SINC.	EXT	
	TRIGGER LEVEL	Arrow up	
	DC-AC	DC	
	GROUND STRAPS (A and B)	Ground	
	X1 SWP. - X5 EXP.	X1 SWP.	

NOTE

On ELECTRICAL CONTROL panel, TEST SELECT 7 switch-light is for hydraulic flow and TEST SELECT 8 switch-light is for pneumatic flow. Both switch-lights must not be on at the same time.

PNEUMATIC PREPARATION

a. Make sure console is in the following condition:

(1) Vent valves closed.

(2) Shutoff valves closed.

(3) Utility valves closed.

(4) Regulators closed.

(5) Utility and test cell outlets capped.

b. Supply facility gaseous nitrogen to console.

c. On SYSTEM SUPPLY panel, open TO FUEL COMPATIBLE SYS shutoff valve.

d. On PNEU SOURCE CONTROL panel, open NITROGEN SOURCE SHUTOFF valve.

WARNING

SYSTEM PRESSURIZED lights (located on console and in test cell) come on to indicate pressure downstream of console regulators and into test cell. Safety precautions specified in R-3896-3, Volume I, must be followed, when working with pressurized systems.

Figure 29-7. Preparing Components Test Console for Use (Sheet 5 of 5)

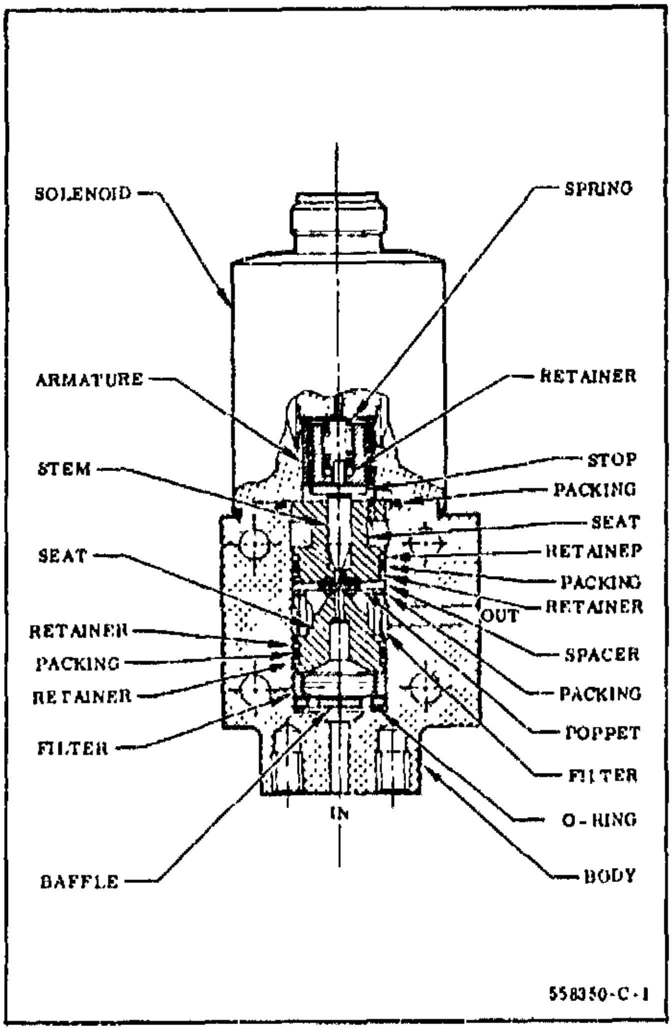


Figure 29-8. Redundant Shutdown Valve--Cutaway View

Paragraph 29-13 and figure 29-9 deleted.

29-14. RESISTANCE-TEST.

a. Using a multimeter, measure valve resistance between the following pins:

Procedure	Result
(1) A and B.	Resistance must be 17-20 ohms.
(2) C and D.	Resistance must be zero.
(3) A and C.	Resistance must be infinite.
b. Connect an electrical jumper between pins A and B.	None.
c. Using megohmmeter, measure valve insulation resistance as follows:	
(1) Apply 500 ±50 vdc between pin A and receptacle shell.	Resistance must be 1,000 megohms minimum.
(2) Apply 500 ±50 vdc between pins A and C.	Resistance must be 1,000 megohms minimum.
(3) Apply 500 ±50 vdc between pin C and receptacle shell.	Resistance must be 1,000 megohms minimum.
d. Remove jumper from pins A and B.	None.

Procedure	Result
29-15. PULL-IN AND DROP-OUT CURRENT-TEST.	
a. Make sure Components Test Console G3141 and redundant shutdown valve are prepared for use as outlined in paragraph 29-12.	None.
b. Connect valve to console. (See figure 29-10.)	None.
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.
e. On ELECTRICAL CONTROL panel, perform the following:	
(1) Press TEST SELECT 4 switch-light.	Light 4 on.
(2) Turn MILLIAMPERES meter RANGE SELECT switch to A (0-500) X2.	Disregard reading.
(3) Press TEST SELECT 1 and 2 switch-lights.	Lights 1, 2, and 2B on. Valve energized.
f. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
g. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±25 psi; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±25 psi. Valve pressurized.
h. On ELECTRICAL CONTROL panel, check pull-in and drop-out current as follows:	
(1) Press TEST SELECT 4 switch-light.	Light 4 off.

Procedure	Result
(2) Turn VOLTAGE ADJUST knob until MILLIAMPERES meter indicates 870 ±20 milliamperes.	MILLIAMPERES meter must indicate 870 ±20 milliamperes.
(3) Press TEST SELECT 1 and 2 switch-lights to deenergize valve; then press 1 and 2 again to energize valve.	Valve must drop out then pull in at current setting of 870 ±20 milliamperes.
(4) Slowly turn VOLTAGE ADJUST knob to DECREASE until valve deenergizes.	Valve drop-out current must be greater than 100 milliamperes.
(5) Turn VOLTAGE ADJUST knob to INCREASE until valve energizes.	Valve energized.
i. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero; then open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate zero.
j. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates zero; then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate zero. Valve depressurized.
k. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
l. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 2 switch-lights.	Lights 1, 2, and 2B off. Valve deenergized.
m. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
n. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF and VENT valves.	None.
o. Remove valve from test setup.	None.
p. If redundant shutdown valve testing is terminated, secure equipment as outlined in paragraph 29-18.	None.
q. Drain fluid from valve; then protect valve as outlined in paragraph 29-2.	None.

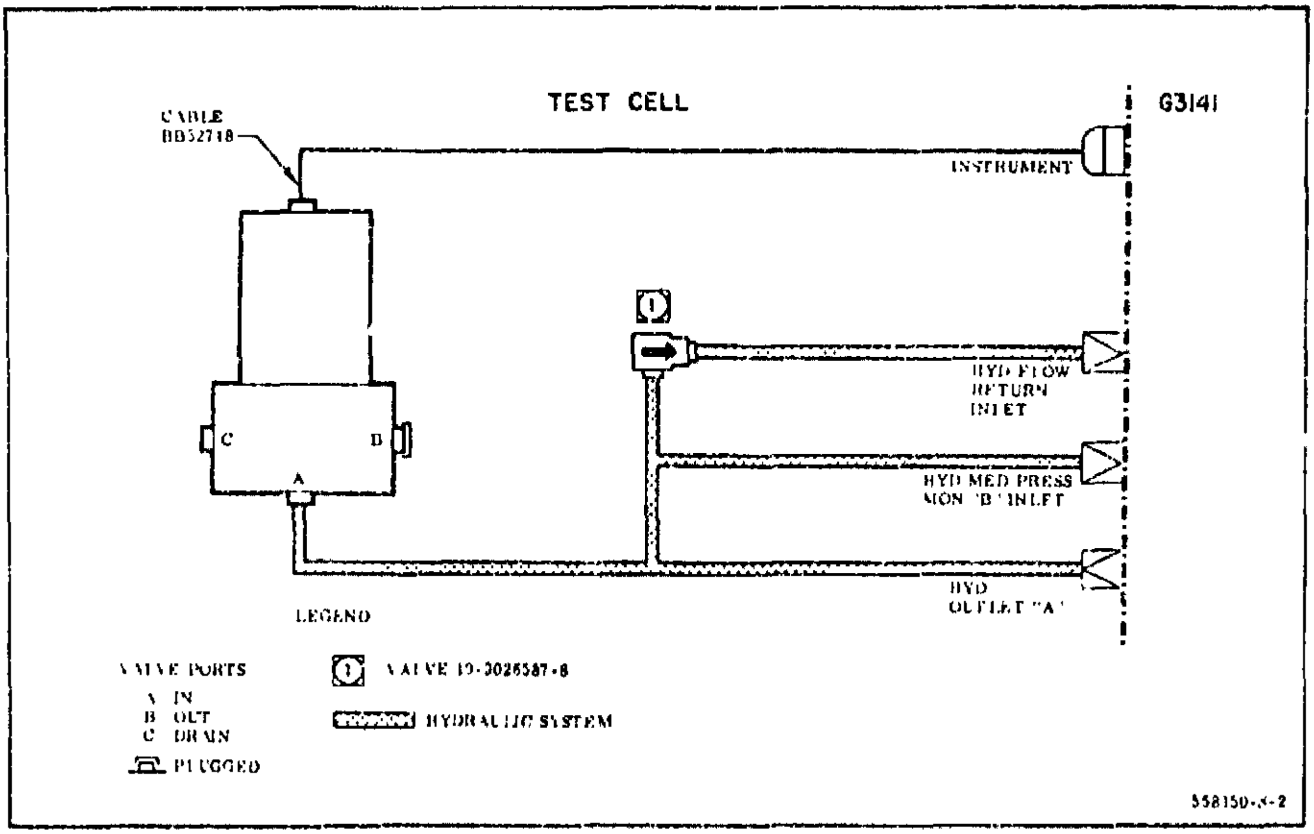


Figure 29-10. Redundant Shutdown Valve Current- and Timing-Test Setup

Procedure	Result
29-16. TIMING-TEST.	
a. Make sure Components Test Console G3141 and redundant shutdown valve are prepared for use as outlined in paragraph 29-12.	None.
b. Connect valve to console (figure 29-10).	None.
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 2,000 ±50 psi.	SUPPLY PRESSURE gage must indicate 2,000 ±50 psi.

Procedure	Result
e. On ELECTRICAL CONTROL panel, perform the following:	
(1) Press TEST SELECT 2 switch-light.	Lights 2 and 2B on.
(2) Press TEST SELECT 4 switch-light.	Light 4 on.
(3) Press TEST SELECT 5 switch-light.	Light 5 on.
(4) Turn VOLTAGE ADJUST knob until DVM indicates 22.0000 ±00.5000 volts.	DVM must indicate 22.0000 ±00.5000 volts.
(5) Press TEST SELECT 5 switch-light.	Light 5 off.
f. Prepare oscilloscope for timing-test and perform the following: (See figure 29-7.)	
(1) Turn TRIGGER LEVEL to AUTO.	None.
(2) Adjust VERTICAL POSITION A and HORIZ. POSITION until vertical A trace is to first grid on left and sixth grid from bottom.	None.
(3) Adjust FOCUS and INTENSITY as required to obtain sharpest trace.	None.
g. Press TEST SELECT 2 switch-light.	Lights 2 and 2B off.
h. On HIGH PRESS FUEL COMPATIBLE panel, open VENT; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 1,800 ±50 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
i. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates 1,500 ±25 psi, then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate 1,500 ±25 psi. Valve pressurized.
j. Obtain an energized timing trace as follows:	
(1) Press TEST SELECT 1 switch-light.	Light 1 on.
(2) Press TEST SELECT 2 switch-light and observe trace.	Light 2 and 2B on and scope indicates valve energized.
(3) Press TEST SELECT 2 switch-light.	Light 2 and 2B off and valve deenergized.
(4) Repeat substeps 2 and 3 and adjust scope as required until a typical trace is obtained (figure 29-11).	Same as substeps 2 and 3.
(5) Turn TRIGGER LEVEL knob with arrow up.	None.

Procedure	Result
(6) Press TEST SELECT 2 switch-light and record trace with camera.	Light 2 and 2B on and valve energized. Valve energized time must not exceed 50 milliseconds.
(7) Press TEST SELECT 1 and 2 switch-lights.	Lights 1, 2, and 2B off and valve deenergized.
k. Prepare oscilloscope for deenergized timing trace as follows:	
(1) Turn A VERT. SENSITIVITY to 10 VOLTS/CM DC.	None.
(2) Turn SWEEP TIME HORIZ. SENS. to 10 MILLISEC/CM.	None.
l. Obtain a deenergized timing trace as follows:	
(1) Press TEST SELECT 2 switch-light.	Light 2 and 2B on and valve energized.
(2) Press TEST SELECT 2 switch-light and observe trace.	Light 2 and 2B off and scope indicates valve deenergized.
(3) Repeat substeps 1 and 2 and adjust scope as required until a typical trace is obtained (figure 29-11).	Same as substeps 1 and 2.
(4) Press TEST SELECT 2 switch-light.	Light 2 and 2B on and valve energized.
(5) Turn TRIGGER LEVEL knob with arrow up.	None.
(6) Press TEST SELECT 2 switch-light and record trace with camera.	Light 2 and 2B off and valve deenergized. Valve deenergized time must not exceed 50 milliseconds.
m. On HIGH PRESS FUEL COMPATIBLE panel adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero, then open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate zero.
n. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates zero, then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate zero. Valve depressurized.
o. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
p. On ELECTRICAL CONTROL panel, press TEST SELECT 4 switch-light.	Light 4 off.
q. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.

Procedure	Result
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
r. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF and VENT valves.	None.
s. Remove valve from test setup.	
t. If redundant shutdown valve testing is terminated, secure test equipment as outlined in paragraph 29-18.	
u. Drain fluid from valve; then protect valve as outlined in paragraph 29-2.	None.

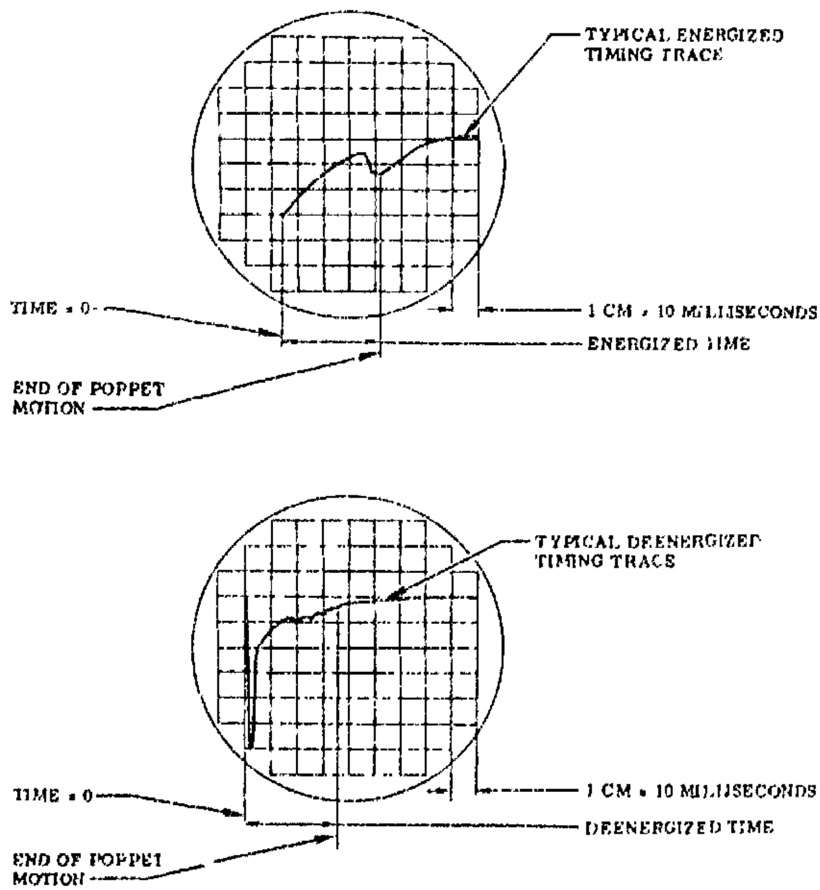


Figure 29-11. Redundant Shutdown Valve Timing Trace (Typical)

Procedure	Result
29-17. LEAK-TEST.	
a. Prepare Components Test Console G3141 and redundant shutdown for use as outlined in paragraph 29-12.	None.
b. Connect valve to console. (See figure 29-12.)	None.
c. On HYDRAULIC CONTROL panel, perform the following:	
(1) Close HIGH PRESS SHUTOFF and MED PRESS SHUTOFF valves.	None.
(2) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light on and VENT light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light on and OPEN light off.
(4) Press HYDRAULIC SYSTEM SUPPLY switch-light.	OPEN light on and CLOSE light off.
d. Slowly apply facility hydraulic supply pressure until SUPPLY PRESSURE gage indicates 3,000 ±100 psi.	SUPPLY PRESSURE gage must indicate 3,000 ±100 psi.
e. On HIGH PRESS FUEL COMPATIBLE panel, open VENT valve; then adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates 2,800 ±100 psi.	HIGH PRESS FUEL COMPATIBLE and HYDRAULIC CONTROL panels pressurized.
f. On HYDRAULIC CONTROL panel, slowly open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR gage indicates 2,475 ±25 psi.	PRESSURE MONITOR gage must indicate 2,475 ±25 psi. Valve pressurized.
g. Maintain pressure at IN port (A) for 10 minutes minimum, then measure leakage from DRAIN port (C).	Leakage must be less than 2.0 cc/min.
h. On ELECTRICAL CONTROL panel, press TEST SELECT 2 and 4 switch lights.	Lights 2, 2B, and 4 on. Valve energized.
i. Maintain pressure at IN port (A) for 10 minutes minimum, then measure leakage from DRAIN port (C).	Leakage must be less than 2.0 cc/min.
j. On HIGH PRESS FUEL COMPATIBLE panel, adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero, then open SHUTOFF valve.	REG SUPPLY PRESS gage must indicate zero.
k. On HYDRAULIC CONTROL panel, open HIGH PRESS SHUTOFF valve until PRESSURE MONITOR "B" gage indicates zero, then close SHUTOFF valve.	PRESSURE MONITOR "B" gage must indicate zero. Valve depressurized.

Procedure	Result
l. Reduce facility hydraulic supply pressure to zero.	SUPPLY PRESSURE gage must indicate zero.
m. On ELECTRICAL CONTROL panel, press TEST SELECT 2 and 4 switch-lights.	Lights 2, 2B, and 4 off. Valve deenergized.
n. On HYDRAULIC CONTROL panel, perform the following:	
(1) Press TEST CELL SUPPLY "A" switch-light.	SUPPLY light off and VENT light on.
(2) Press HYDRAULIC SYSTEM SUPPLY switch-light.	CLOSE light on and OPEN light off.
(3) Press HYDRAULIC SYSTEM BYPASS switch-light.	CLOSE light off and OPEN light on.
o. On HIGH PRESS FUEL COMPATIBLE panel, close SHUTOFF and VENT valve.	None.
p. Remove valve from test setup.	None.
q. If redundant shutdown valve testing is terminated, secure equipment as outlined in paragraph 29-18.	None.
r. Drain fluid from valve; then protect valve as outlined in paragraph 29-2.	None.

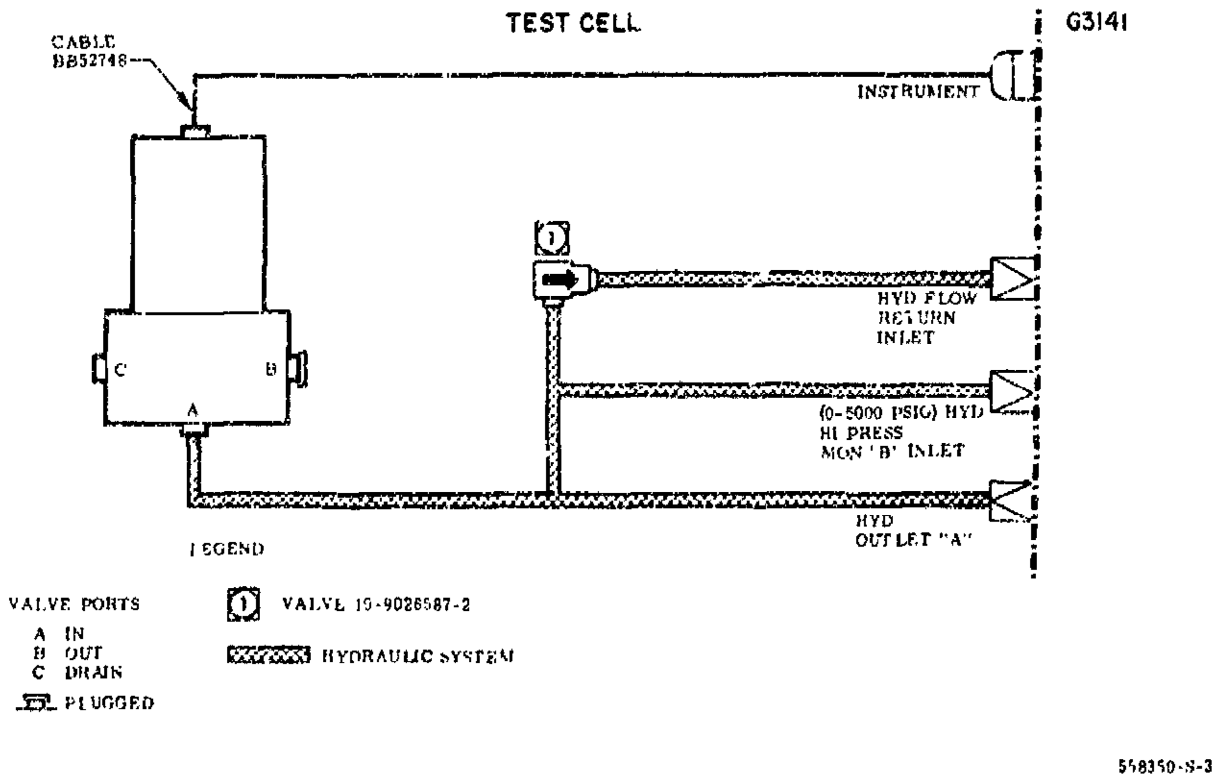


Figure 29-12. Redundant Shutdown Valve Leak-Test Setup

29-18. SECURING TEST EQUIPMENT.

29-19. After redundant shutdown valve testing is completed and valve is removed from test setup, secure equipment as follows:

a. Reduce facility gaseous nitrogen supply to zero.

b. On PNEU SOURCE CONTROL panel, close NITROGEN SOURCE SHUTOFF valve.

c. On SYSTEM SUPPLY panel, close TO FUEL COMPATIBLE SYS shutoff valve; then open SYS VENT valve.

d. On MED PRESS FUEL COMPATIBLE panel, open SHUTOFF and VENT valves; then adjust PRESSURE REGULATOR to vent trapped pressure.

e. Close all shutoff valves, regulators, and utility valves.

f. Make sure all pressure gages indicate zero; then close all vent valves.

g. Cap utility panel and test cell panel outlets and connectors.

h. Turn oscilloscope power and digital voltmeter power off.

i. Move TEMPERATURE indicator switch to OFF.

j. On HYDRAULIC CONTROL panel, press switch-lights so that HYDRAULIC SYSTEM BY-PASS light indicates OPEN and remaining lights indicate CLOSE or VENT.

k. On ELECTRICAL CONTROL panel, press TEST SELECT switch-lights so that all lights are off; then press POWER ON switch-light.

l. Turn DC POWER SUPPLY off.

m. On POWER DISTRIBUTION panel, pull out circuit breakers.

SECTION XXX

VOLUMETRIC LIQUID OXYGEN TRANSDUCER

WARNING

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

30-1. VOLUMETRIC LIQUID OXYGEN TRANSDUCER NA5-27299.

30-2. The following procedures contain disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the transducer. See figure 30-1 for test equipment. Refer to R-3896-4 for protective closures.

Part No.	Nomenclature	Use
G3141	Components Test Console	Provides electrical control for testing transducers.
G3143	Components Adapter Set	Provides hardware for transducer test setup.
Model 630A (Triplett Electrical Instrument Co), or equivalent	Multimeter	Makes electrical measurements
Model 1620C (Freed Transformer Co), or equivalent	Megohmmeter	Makes insulation resistance tests
HP201C (Hewlett Packard), or equivalent	Oscillator	Provides signal for output voltage test.

Figure 30-1. Test Equipment for Volumetric Liquid Oxygen Transducer

30-3. DISASSEMBLING.

30-4. Disassembling the transducer is limited to the removal of magnetic pickup coils, plugs, and K-seals.

Figure 30-2 deleted.

30-5. CLEANING.

30-6. Clean the transducer exterior surfaces, plugs, and K-seals for liquid oxygen service, and clean electrical connector using electrical connector cleaning procedure in R-3896-3, Volume I.

30-7. INSPECTING AND REPAIRING.

30-8. Inspect the transducer for general condition, cleanness, damage to threads, corrosion, distortion, nicks, burs, scratches, and bent electrical connector pins. Refer to R-3896-3, Volume I, for general repair procedures.

30-9. ASSEMBLING.

30-10. Assembling the transducer is limited to installing plugs, K-seals, and magnetic pickup coils. All parts must meet cleaning requirements as outlined in paragraph 30-5.

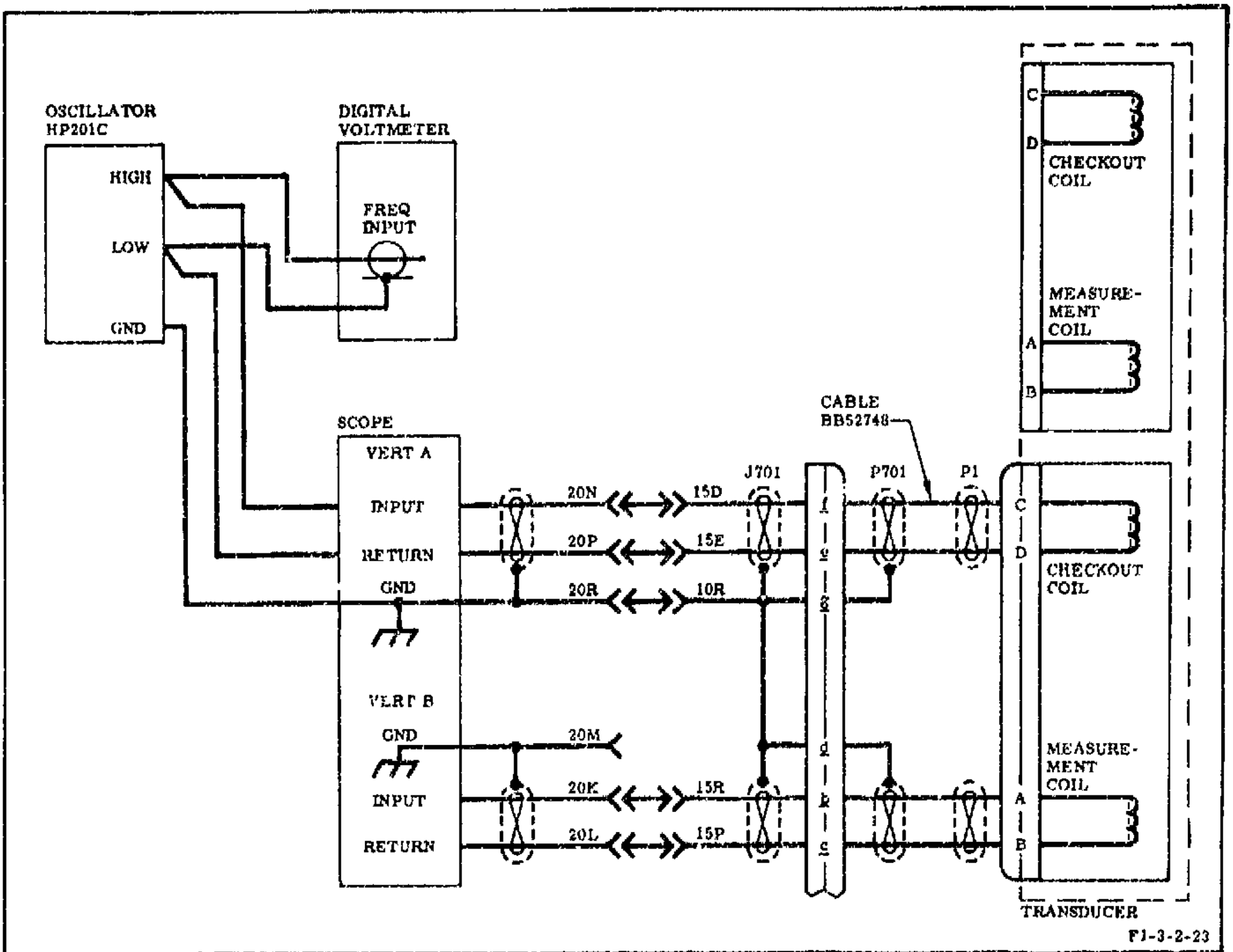
a. Install plugs and K-seals. Torque plugs to 45 ±5 inch-pounds.

b. Install magnetic pickup coils with bolts and washers. Torque bolts to 45 ±5 inch-pounds.

30-11. TESTING.

30-12. This procedure outlines requirements for testing the transducer using Components Test Console G3141, Components Adapter Set G3143, and Oscillator HP201C. Any deviations, including the use of other test equipment, must be equivalent to the test requirements, safety standards, and equipment specified in this procedure.

Procedure	Result
30-13. INSULATION RESISTANCE TEST.	
a. Connect electrical jumpers between all pins of electrical connector.	All pins shorted together.



Patch cord[(a)]	From J6-	To J6-	Patch cord[(a)]	From J6-	To J6-
K3.	10R	20R	K3.	15P	20L
K3.	15D	20N	K3.	15R	20K
K3.	15E	20P			

(a) Use any cord length required.

Figure 30-3. Components Test Console Patch-Panel Requirements

Procedure	Result
b. Using megohmmeter, apply 500 ±25 vdc between all pins and receptacle shell.	Resistance must be 100 megohms minimum.
c. Remove electrical jumpers.	None.
d. Repeat steps a through c on other magnetic pickup coil.	Same as steps a through c.

Procedure	Result
30-14 ISOLATION RESISTANCE TEST.	
a. Connect electrical jumpers to magnetic pickup coil as follows:	
(1) Between pins A and B.	Measurement coil pins A and B shorted together.
(2) Between pins C and D.	Checkout coil pins C and D shorted together.

Procedure	Result
b. Using megohmmeter, apply 50 vdc maximum between electrical jumpers connected to pins A and B and pins C and D.	Resistance must be 50 megohms minimum.
c. Remove electrical jumpers.	None.
d. Repeat steps a through c on other magnetic pickup coil.	Same as steps a through c.

30-15. PREPARATION FOR OUTPUT VOLTAGE AND FREQUENCY TEST. Set up components test console electrical patch-panel (figure 30-3) and prepare console for use (figure 30-4). Refer to paragraph 30-16 for transducer output voltage and frequency test procedure.

NOTE

The press-to-operate switch-lights located on the Components Test Console G3141 operate on and off by alternately pressing the face of the switch. Make sure switch-lights are pressed only as necessary in order to obtain the specified indication.

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pulled out	Console main power off.
	CB2 (10 AMP)	Pulled out	Electrical utility outlets power off.
DC POWER SUPPLY	AC INPUT	Down (off)	
	VOLTAGE VERNIER	Midposition	
	VOLTAGE ADJUST	Fully counterclockwise	
	CURRENT LIMIT	0	
	AC INPUT INDICATOR	OFF	
ELECTRICAL CONTROL	MILLIAMPERES RANGE SELECT	OFF	
	VOLTS RANGE SELECT	OFF	
	VOLTAGE ADJUST	Fully DECREASE	
DIGITAL VOLTMETER	115V/230V	115V	At rear of unit.
	100 KC STD INT/EXT	INT	At rear of unit.
	STORE/DISPLAY DURING COUNT	DISPLAY	At rear of unit.
	POWER	Down (off)	

Figure 30-4. Preparing Components Test Console for Use (Sheet 1 of 4)

Panel	Control	Position	Indication/Remarks
PRE-POWER TURN ON (cont)			
OSCILLOSCOPE	INTENSITY	POWER OFF	
TEST CELL ELECT OUTLETS	Connector J701	Cable BB52748	Connection to transducer.
	Connector J704	Capped	
	Connector J705	Capped	

CAUTION

Facility pneumatic and hydraulic supplies to console must be off.

Panel	Control	Position	Indication/Remarks
POWER TURN ON			
POWER DISTRIBUTION	CB1 (30 AMP)	Pushed in	Console main power on.
ELECTRICAL CONTROL	POWER		POWER light ON. AC INPUT light on.[a]
	TEST SELECT 1		Light 1 off.[a]
	TEST SELECT 2		Light 2 off.[a]
	TEST SELECT 3		Light 3 off.[a]
	TEST SELECT 4		Light 4 off.[a]
	TEST SELECT 5		Light 5 off.[a]
	TEST SELECT 6		Light 6 off.[a]
	TEST SELECT 7		Light 7 off.[a]
	TEST SELECT 8		Light 8 off.[a]
DIGITAL VOLTMETER	RANGE	100 V	
	FUNCTION	FREQ	
	ATTENUATION	Midposition	
	SAMPLE PERIOD	1 SEC 100 PER	
	SAMPLING RATE	Midposition	
	POWER	ON	If digital voltmeter indicates OVER-LOAD, wait at least one minute before resetting.

NOTE

Digital voltmeter must be allowed to warm up for at least 30 minutes prior to use.

(a) If indication is not as specified, press applicable switch-light.

Figure 30-4. Preparing Components Test Console for Use (Sheet 2 of 4)

Panel	Control	Position	Indication/Remarks
POWER TURN ON (cont)			
OSCILLOSCOPE	FOCUS	Arrow up	Adjust later for best focus.
	INTENSITY	Arrow horizontal (to left)	Power light on. Adjust later for best intensity.

NOTE

Oscilloscope must be allowed to warm up for at least 30 minutes prior to use.

Panel	Control	Position	Indication/Remarks
OSCILLATOR	RANGE	X10	Connect oscillator to oscilloscope and digital voltmeter (front of console). See figure 30-3.
	Frequency vernier	20	
	ATTENUATION	MIN	Adjust later to obtain 5 volts peak on oscilloscope.

NOTE

Oscillator must be allowed to warm up at least 30 minutes prior to use.

Panel	Control	Position	Indication/Remarks
OSCILLOSCOPE (Calibration Check)	A VERT. SENSITIVITY	CAL. (6 CM)	
	A VERT. SENSITIVITY VERNIER	CAL.	
	B VERT. SENSITIVITY	CAL. (6 CM)	
	B VERT. SENSITIVITY VERNIER	CAL.	
	SWEEP TIME HORIZ. SENS.	.5 MILLISEC/CM	
	SWEEP TIME HORIZ. SENS. VERNIER	CAL.	
	SWEEP TIME HORIZ. SENS. SWP. EXP. switch	X1 SWP.	
	DC AC switch	AC	

Figure 30-4. Preparing Components Test Console for Use (Sheet 3 of 4)

Panel	Control	Position	Indication/Remarks
OSCILLOSCOPE (Calibration Check) (cont)	TRIGGER LEVEL	AUTO	
	SYNC.	INT +	
	VERT. PRESENTATION	CHOP	
	VERTICAL POSITION A	Adjust as required.	Channel A trace must indicate 6 cm.
	VERTICAL POSITION B	Adjust as required.	Channel B trace must indicate 6 cm.
OSCILLOSCOPE	A VERT. SENSITIVITY	10 VOLTS/CM DC	
	A VERT. SENSITIVITY VERNIER	CAL	Fully clockwise.
	B VERT. SENSITIVITY	.1 VOLT/CM DC or 1 VOLT/CM DC	Select position to obtain greatest clarity.
	B VERT. SENSITIVITY	CAL	Fully clockwise.
	SWEEP TIME HORIZ. SENS.	1 MILLISEC/CM	
	SWEEP TIME HORIZ. SENS. VERNIER	CAL	
	SWEEP TIME HORIZ. SENS. SWP. EXP. Switch	X1 SWP.	
	DC AC switch	AC	
	TRIGGER LEVEL	AUTO	Adjust to obtain a steady single trace.
	SYNC.	INT +	
	VERT. PRESENTATION	CHOP	

Figure 30-4. Preparing Components Test Console for Use (Sheet 4 of 4)

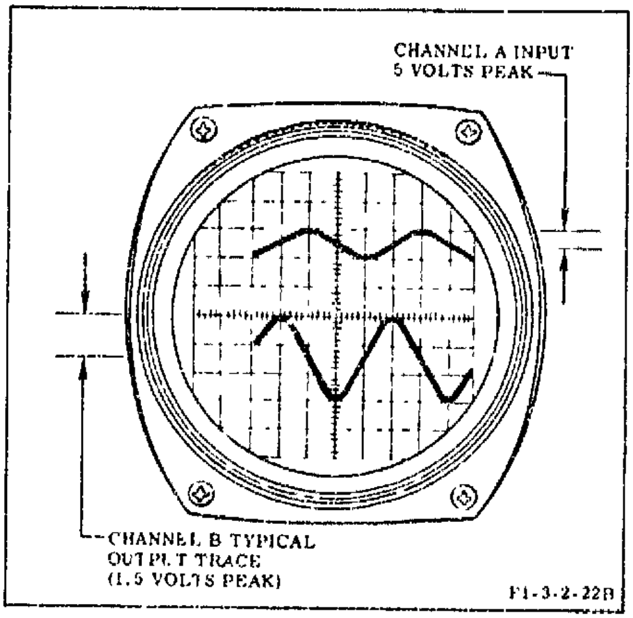


Figure 30-5. Volumetric Liquid Oxygen Transducer Input/Output Voltage Trace at 200 Cycles (Typical)

30-16. OUTPUT VOLTAGE AND FREQUENCY TEST.

Procedure	Result
a. Make sure Components Test Console G3141 and transducer are prepared for use as outlined in paragraph 30-15.	None.
b. Adjust oscillator frequency vernier until DVM indicates 000.200 ±000.001 kc.	DVM must indicate 000.200 ±000.001 kc.
c. Adjust oscillator ATTENUATION control until oscilloscope channel A indicates 5.0 to 7.5 volts peak. (See figure 30-5.)	Channel A must indicate 5.0 to 7.5 volts peak.
d. Record peak output voltage on oscilloscope channel B.	Transducer output voltage must be 0.2 volt peak minimum to 3.0 volts peak maximum.
e. Disconnect DVM electrical leads from OSCILLATOR; then reconnect them to OSCILLOSCOPE vertical B input on front of console.	DVM must indicate 000.200 ±000.001 kc.
f. Move OSCILLATOR power switch to off.	Power off.
g. Disconnect cable BB52748 from magnetic pickup coil and connect it to the other coil.	None.
h. Move OSCILLATOR power switch to on.	Power on.
i. Disconnect DVM electrical leads from OSCILLISCOPE vertical B input; then reconnect them to OSCILLATOR.	None.
j. Repeat steps b through e.	Same results as steps b through e.
k. On DIGITAL VOLTMETER panel, move POWER ON switch to off.	Power off.
l. On OSCILLOSCOPE panel, turn INTENSITY control to POWER OFF.	Power light off.
m. Move OSCILLATOR power switch to off.	Power off.
n. On ELECTRICAL CONTROL panel, press POWER switch-light.	POWER and AC INPUT lights off.
o. On POWER DISTRIBUTION panel, pull out circuit breakers.	Console main power off.
p. Remove transducer from test setup and install protective closures. Refer to paragraph 30-2.	None.

30-17. COIL CONTINUITY TEST. This test is a preinstallation requirement only.

Procedure	Result
a. Using a multimeter, continuity-test coils in each magnetic pickup. Record multimeter indication.	Multimeter must indicate continuity between pins A and B and between pins C and D.

SECTION XXXI

GIMBAL BOOT, INSULATION BOOT, AND INSULATION SEAL

31-1. GIMBAL BOOT, INSULATION BOOT, AND INSULATION SEAL.

31-2. The following paragraphs provide information for inspecting and repairing the gimbal bearing boot, fuel inlet elbow-to-interface panel insulation boot, and interface panel oxidizer inlet insulation seal.

31-3. INSPECTING AND REPAIRING.

31-4. Inspection and repair of the boots and seals is limited to visual inspection and minor repair and/or replacement. Inspect individual parts for general condition, cleanness, damage to threads, and corrosion. (Refer to figure 31-1.)

Part Name	Inspecting	Repairing
Gimbal Bearing Boot and Fuel Inlet Elbow-to-Interface Panel Insulation Boot		
Cap screw	Galled threads	Replace cap screw, ring, and trunnion assembly.
Clamps	Bent	Straighten to original position.
	Broken	Replace boot.
Band	Cracked or broken welds	Replace boot.
Snap buttons and studs	Torn loose from boot	Replace boot.
Band and boot	Band separated from boot at clamp end. Separation less than 3 inches.	Acceptable
	Band separated from boot at clamp end. Separation more than 3 inches.	Replace boot.
Boot	Holes in side wall of boot or aluminized fabric	Replace boot.
	Molded seal separated from boot sidewalls. Separation less than one inch.	Acceptable
	Molded seal separated from boot sidewalls. Separation more than one inch.	Replace boot.
	Aluminized coating missing or flaking	Acceptable
	Separation of aluminized fabric from silicone-rubber fiberglass	Acceptable
	Loss of bond between aluminized fabric and silicone-rubber fiberglass	Acceptable

Figure 31-1. Inspecting and Repairing Gimbal Boot, Insulation Boot, and Insulation Seal (Sheet 1 of 2)

Part Name	Inspecting	Repairing
	Aluminized fabric separated from silicone-rubber fiberglass due to missing thread. Separation less than one inch.	Acceptable
	Aluminized fabric separated from silicone-rubber fiberglass due to missing thread. Separation more than one inch.	Replace boot.
Interface Panel Oxidizer Inlet Insulation Seal		
Insulation channel	Bent	Straighten to original position.
	Broken	Replace.
	Deteriorated or damaged anodic coating	Replace anodic coating or iridite as outlined in R-3896-3, Volume I.
Insulation seal	Bent supports or doublers	Straighten to original position.
	Broken supports or doublers	Replace insulation seal.
	Support or doubler separated from seal	Replace insulation seal.
	Deteriorated or damaged seal	Replace insulation seal.
	Missing rivets	Replace insulation seal.

Figure 31-1. Inspecting and Repairing Gimbal Boot, Insulation Boot, and Insulation Seal
(Sheet 2 of 2)

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-3896-3. Supplements which have been incorporated into the volume shall be removed from the Appendix and destroyed.

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-1	2 May 1966	Lists established requirements for component maintenance and repair in a controlled area.	Incorporated
R-3896-3 Vol II-2	10 June 1966	Lists correct handling, removing, and installation procedures for pressure-actuated (Naflex) seals.	Incorporated
R-3896-3 Vol II-3	14 July 1966	Lists increased pressure tolerance for thrust OK pressure switch and repair material change for nozzle extension.	Incorporated
R-3896-3 Vol II-4	15 September 1966	Provides a procedure and a list of equipment required to replace damaged blind nuts on the thrust chamber nozzle extension.	Incorporated
R-3896-3 Vol II-5	13 October 1966	Adds a wire list for high-voltage igniters.	Incorporated
R-3896-3 Vol II-6	20 December 1966	Provides a procedure for the repair of the fuel valve position indicator.	Incorporated

MANUAL DATA SUPPLEMENT RECORD
(continued)

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-7	16 January 1967	Provides damage limits and disposition for electrical harness overmolds.	Incorporated
R-3896-3 Vol II-8	16 February 1967	Provides inspection and repair information for the improved main fuel valve position indicator spring.	Incorporated
R-3896-3 Vol II-9	31 March 1967	Corrects the list of effective pages and adds deletion information where necessary.	Incorporated
R-3896-3 Vol II-10	20 April 1967	Adds preface page to call out change in use of lubricants.	Incorporated
R-3896-3 Vol II-11	2 May 1967	Provides inspection and repair information for oxidizer inlet and increases inducer cap bolt lockwasher dimension.	Incorporated
R-3896-3 Vol II-12	12 May 1967	Adds part numbers for field-modified turbopumps and adds use of sealant and antiseize dispersion.	Incorporated
R-3896-3 Vol II-13	25 May 1967	Deletes requirement to perform a location check of turbopump oxidizer inlet after repair.	Incorporated
R-3896-3 Vol II-14	5 June 1967	Provides information to update turbopump repair procedures.	Incorporated
R-3896-3 Vol II-15	16 June 1967	Provides impeller rib clearance information for oxidizer pumps that are reassembled with the same impeller and spline sleeve.	Incorporated
R-3896-3 Vol II-16	9 July 1967	Provides improvements to lubrication method and installation and testing procedures for fuel valve position indicator, and provides detailed information on installation of 4-way solenoid valve O-rings and retainers that are similar in size and appearance.	Incorporated
R-3896-3 Vol II-17	16 October 1967	Simplifies electrical test procedures for oxidizer valve, fuel valve, and hypergol manifold.	Incorporated

MANUAL DATA SUPPLEMENT RECORD
(continued)

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-18	20 October 1967	Replaces section XXV, and incorporates revised testing procedures and requirements.	Incorporated
R-3896-3 Vol II-19	15 December 1967	Adds maintenance and test procedures for volumetric liquid oxygen transducer.	Incorporated
R-3896-3 Vol II-20	15 December 1967	Provides maintenance and test procedures for gas generator ball valve switch, main oxidizer valve switch, and hypergol manifold switch. Also simplifies electrical test procedure for main fuel valve indicator.	Incorporated
R-3896-3 Vol II-21	15 December 1967	Provides maintenance and test procedures for turbopump speed transducer.	Incorporated
R-3896-3 Vol II-22	28 December 1967	Adds requirement for lubricating turbopump torque gear.	Incorporated
R-3896-3 Vol II-23	16 January 1968	Permits an alternate repair of rigid-duct curved sections by hand blending.	Incorporated
R-3896-3 Vol II-24	8 March 1968	Provides maintenance and test procedures for temperature transducers NA5-27215, NA5-27333, and NA5-27414.	Incorporated
R-3896-3 Vol II-25	13 May 1968	Provides procedures for removing the turbopump oxidizer inlet without removing the inducer, and for installing the same inlet that was removed.	Incorporated
R-3896-3 Vol II-26	14 June 1968	Changes equipment used to measure oxidizer valve temperature during cryogenic testing.	Incorporated
R-3896-3 Vol II-27	15 October 1968	Deletes the procedure for re-forming temperature transducer copper rings.	Incorporated
R-3896-3 Vol II-28	1 November 1968	Changes the thrust OK pressure pickup pressure tolerance.	Incorporated

MANUAL DATA SUPPLEMENT RECORD
(continued)

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-29	6 December 1968	Defines the repairs that are required for both internal and external pin-holes in the wall of the thrust chamber tubes.	Incorporated
R-3896-3 Vol II-30	8 November 1968	Provides the criteria for acceptability of damaged flex hoses.	Incorporated
R-3896-3 Vol II-31	15 January 1969	Supersedes supplement R-3896-3 Vol II-27, dated 15 October 1968, which deleted the procedure for re-forming temperature transducer copper rings.	Incorporated
R-3896-3 Vol II-32	4 March 1969	Deletes the requirement to use an upstream flowmeter when pressure testing the turbopump intermediate seal.	Incorporated
R-3896-3 Vol II-33	20 March 1969	Adds a low-pressure (3 and 10 psig) leak-test of the turbopump primary oxidizer seal. The 30-psig leak-test has been deleted.	Incorporated
R-3896-3 Vol II-34	2 April 1969	Provides inspection and repair information for the gimbal bearing boot, fuel inlet elbow insulation boot, and oxidizer inlet insulation seal.	Incorporated
R-3896-3 Vol II-35	24 April 1969	Changes the lubricant used on parts in the oxidizer side of the gas generator ball valve.	Incorporated
R-3896-3 Vol II-36	10 June 1969	Changes the lubricant used on internal parts of the hypergol manifold.	Incorporated
R-3896-3 Vol II-37	8 September 1969	Specifies the length of primary oxidizer seal screws to be used during installation and gives the disposition of screws that have been used.	Incorporated
R-3896-3 Vol II-38	26 September 1969	Adds the requirement to substitute lubricant grease RB0140-012 (Rocketdyne) for lubricant KEL-F 90 on certain thrust chamber plugs, seals, and gaskets.	Incorporated
R-3896-3 Vol II-39	29 October 1969	Changes the lubricant used on internal parts of the redundant shutdown valve.	Incorporated
R-3896-3 Vol II-40	18 December 1969	Changes the torque value of the gas generator igniter port plug.	Incorporated with deviations from original issue.
R-3896-3 Vol II-41	19 June 1970	Adds part numbers for bearing coolant control valve restrictors.	Incorporated

MANUAL DATA SUPPLEMENT RECORD
(continued)

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-42	23 September 1970	Adds requirement to use a Wheatstone bridge for transducer testing.	Incorporated
R-3896-3 Vol II-43	16 October 1970	Adds inspection criteria for oxidizer valve sleeve and lines.	Incorporated
R-3896-3 Vol II-44	28 October 1970	Changes requirements for inspecting, repairing, and dimensional limits for propellant ducts.	Incorporated
R-3896-3 Vol II-45	5 November 1970	Deletes test equipment and changes test procedures for oxidizer valves, fuel valves, bearing coolant control valve, engine control valve, and four-way solenoid valve.	Incorporated
R-3896-3 Vol II-46	13 January 1971	Adds requirement for disconnecting heat exchanger from turbopump to permit installation of torque tool.	Incorporated
R-3896-3 Vol II-47	15 January 1971	Adds inspection and repair information and dimensional limits for hydraulic and purge tubes and lines.	Incorporated
R-3896-3 Vol II-48	21 January 1971	Changes hydraulic pressure required for engine control valve actuation.	Incorporated
R-3896-3 Vol II-49	28 January 1971	Adds inspection requirements for oxidizer dome purge check valve and ignition monitor valve diaphragm, and corrects a part name in engine control valve assembly procedure.	Superseded by R-3896-3 Vol II-51
R-3896-3 Vol II-50	18 February 1971	Changes damage limits for thrust chamber nozzle extension external reinforcing bands.	Incorporated
R-3896-3 Vol II-51	14 April 1971	Adds inspection requirements for oxidizer dome purge check valve and ignition monitor valve diaphragm, and corrects a part name in engine control valve assembly procedure.	Incorporated
R-3896-3 Vol II-52	29 April 1971	Adds a requirement to inspect that specified parts in the oxidizer valve and the turbopump are not dyed.	Incorporated

MANUAL DATA SUPPLEMENT RECORD
(continued)

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-53	30 April 1971	Revises the test requirements and limits for the turbopump speed transducer and the volumetric liquid oxygen transducer, and changes the oscillator control and position settings for checkout valve testing.	Incorporated
R-3896-3 Vol II-54	15 July 1971	Adds a procedure for performing a fuel valve nose seal liquid leak test.	Incorporated
R-3896-3 Vol II-55	2 August 1971	Adds procedures for repair of the engine control valve start and stop solenoid valves.	Incorporated
R-3896-3 Vol II-56	3 August 1971	Reverses the open and close port callouts in specified steps when the stop solenoid valve is energized or override port is pressurized during engine control valve and four-way solenoid valve testing.	Incorporated
R-3896-3 Vol II-57	16 August 1971	Adds preinstallation test procedures.	Incorporated
R-3896-3 Vol II-58	13 October 1971	Replaces engine control valve and four-way solenoid valve high-pressure test with an external leak test.	Incorporated
R-3896-3 Vol II-59	20 October 1971	Deletes proof-test procedures for the gas generator oxidizer purge check valve, the inert prefill check valve, the bearing coolant control valve, and the ignition monitor valve; deletes high-pressure test procedures for the engine control valve start and stop solenoids, the engine control valve check valve, and the redundant shut-down valve; adds procedures for testing the thrust OK pressure switch when not using Components Test Console G3141; and adds a procedure for reforming copper rings on temperature transducer NA5-27414.	Incorporated
R-3896-3 Vol II-60	3 January 1972	Adds a caution specifying the sequence of removal and installation of parts required to prevent damage to parts when the four-way solenoid valve is partially disassembled.	Incorporated

MANUAL DATA SUPPLEMENT RECORD
(continued)

Supplement Number	Dated	Description	Supplement Status
R-3896-3 Vol II-61	25 April 1972	Adds a requirement for a filter in the hydraulic supply to the pressure port on housing 88-555267 for testing start and stop solenoid valves.	Incorporated
R-3896-3 Vol II-62	3 May 1972	Expands cleaning requirements and adds cleanness acceptability criteria for four-way solenoid valve filters.	Incorporated
R-3896-3 Vol II-63	13 June 1972	Changes the pressure limit for low-pressure gases.	Incorporated
R-3896-3 Vol II-64	14 June 1972	Adds a caution when installing close diametral parts in body of four-way solenoid valve and adds a minimum leakage requirement at four-way solenoid valve return port when both start and stop solenoid valves are energized.	Incorporated
R-3896-3 Vol II-65	5 July 1972	Provides additional procedures for the start and stop solenoid valves, which includes complete disassembly of the valves and special cleaning procedures for the solenoids.	Incorporated

This supplement affects the data in Technical Manual R-3896-3, 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 changes the requirements specifying use of start and stop solenoid optical inspection equipment.

<u>On page 23-36B, paragraph 23-36, step z, change substep 2 as follows:</u>

(2) Visually inspect the following solenoid (6) drilled passages (use of a stereomicroscope with magnification of 20 - 30x is recommended) for any particles not removed during cleaning:

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This supplement adds a time requirement that must be observed when inspecting fuel valve nose seal for liquid leakage, and changes the reverse-flow and reseat test for the checkout valve.

On page 14-32A, paragraph 14-22A, Procedures column, change step k and m as follows:

Inspect valve nose seal for liquid leakage for 10 minutes minimum.

On page 21-18, replace figure 21-12 with the attached figure.

On page 21-20, paragraph 21-20, change step c and result to read:

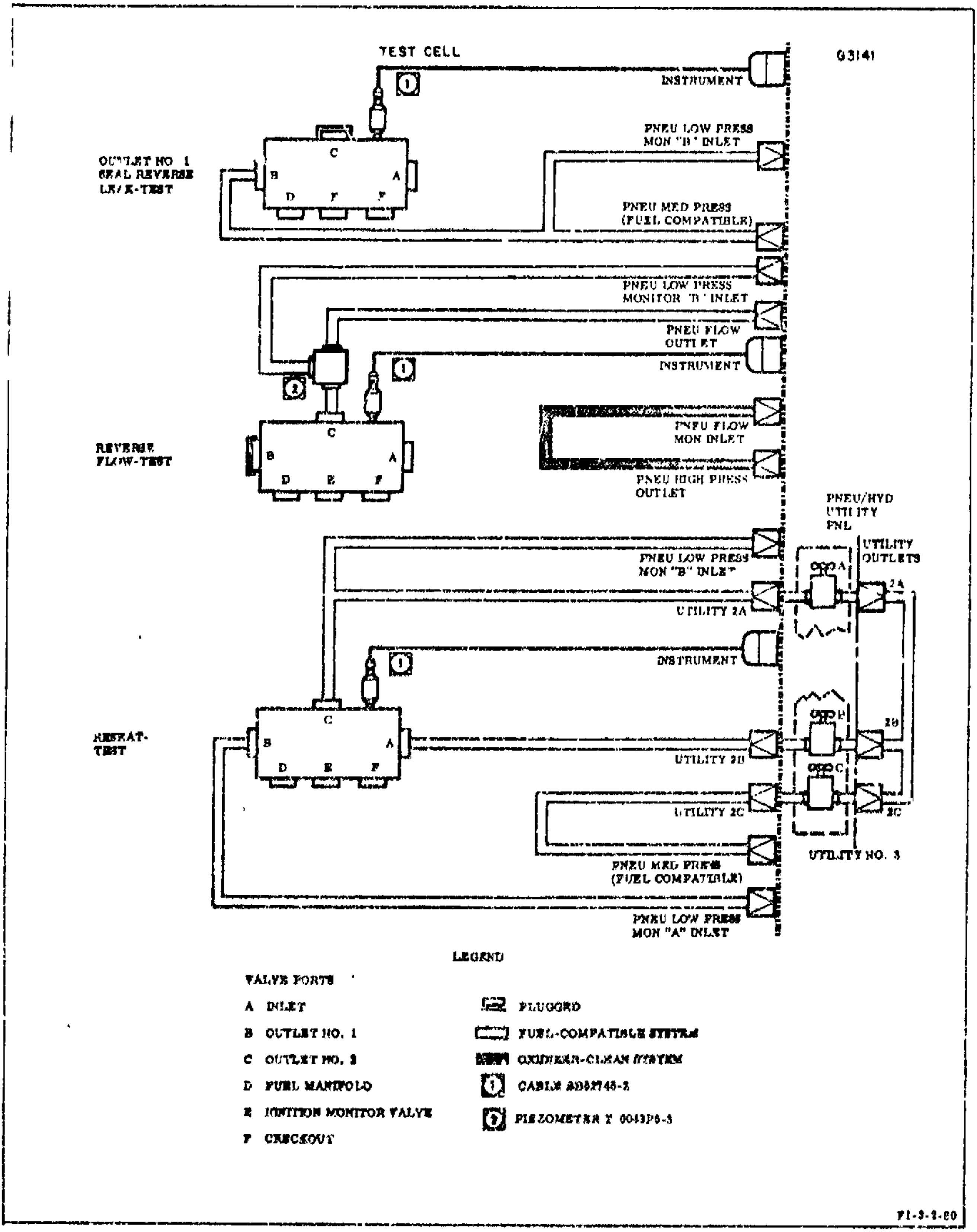
c. Connect checkout valve to console for reverse-flow-test. Make sure piezometer is located within 6 inches of OUTLET No. 2 port (C). (See figure 21-12).	None

On page 21-20, paragraph 21-20, change step i and substep 2 and result to read:

i. Using HIGH pressure panel, apply pressure to OUTLET No. 2 port (C) as follows:	
(2) Adjust PRESSURE REGULATOR until PRESSURE MONITOR "B" gage indicates 100 ±5 psi.	OUTLET No. 2 port (C) pressurized and PRESSURE MONITOR "B" page indicates 100 ±5 psi.

On page 21-20, paragraph 21-20, change step k and substep 2 and result to read:

k. Using HIGH PRESSURE panel, reduce pressure to OUTLET No. 2 port (C) as follows:	
(2) Adjust PRESSURE REGULATOR until REG SUPPLY PRESS gage indicates zero.	HIGH PRESSURE panel depressurized.


G3141
TEST CELL
INSTRUMENT
PNEU LOW PRESS
MON "B" INLET
OUTLET NO. 1
SEAL REVERSE
LEAK-TEST
PNEU MED PRESS
(FUEL COMPATIBLE)
PNEU LOW PRESS
MONITOR "B" INLET
PNEU FLOW
OUTLET
INSTRUMENT
REVERSE
FLOW-TEST
PNEU FLOW
MON INLET
PNEU HIGH PRESS
OUTLET
PNEU/HYD
UTILITY
PNL
UTILITY
OUTLETS
PNEU LOW PRESS
MON "B" INLET
UTILITY 2A
2A
INSTRUMENT
REPEAT-
TEST
UTILITY 2B
2B
UTILITY 2C
2C
UTILITY NO. 3
PNEU MED PRESS
(FUEL COMPATIBLE)
PNEU LOW PRESS
MON "A" INLET
LEGEND
VALVE PORTS
A INLET
B OUTLET NO. 1
C OUTLET NO. 2
D FUEL MANIFOLD
E IGNITION MONITOR VALVE
F CHECKOUT
PLUGGED
FUEL-COMPATIBLE SYSTEM
OXIDIZER-CLEAN SYSTEM
CABLE
PIEZOMETER
FI-3-2-60

This supplement affects the data in Technical Manual R-3896-3, 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 changes electrical harness connector inspection and repair requirements to permit cleaning of corroded pin contacts.

On page 18-4, figure 18-4, under Inspecting and Repairing, replace

"Corroded pin or socket contacts."	"Replace harness."

with the following:

Corroded pin contact.	Clean as outlined in R-3896-3, Volume I.
Corroded socket contacts.	Replace harness.

This supplement affects the data in Technical Manual R-3896-3, 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 warnings for handling specific materials used in the manual.

On page 8-13, paragraph 8-18A, add the following warning before step c:

WARNING

White sealant RTV-102 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 sealant can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

On page 15-8, paragraph 15-15B, add the following warning before step b:

WARNING

Viton elastomer C-328 RTV 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 curing agent can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

On page 18-7, paragraph 18-8, add the following warning before step b:

WARNING

Potting compound PR-1553 is toxic. Inhalation of its vapors or contact with the material can cause serious bodily harm. It must be used in a well-ventilated area. In case of contact, wash skin with soap and water.

On page 18-7, paragraph 18-8, change step b to read:

b. Thoroughly mix 22 parts of A to 100 parts of B, by weight, of potting compound PR-1553 (black) (Products Research and Chemical, Semco) for one minute.

On page 18-7, paragraph 18-9, add the following warning before step c:

WARNING

Primer 1200 RTV 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 primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

On page 18-7, paragraph 18-9, add the following warning before step e:

WARNING

Primer 1200 RTV 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 primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

On page 18-7, paragraph 18-9, change step e to read:

e. Apply a thin coat of primer 1200 RTV (Dow Corning Corp) to metal surface of repair area; apply only enough primer to give a pink tinge to the metal. Allow to dry for a minimum of 60 minutes.

On page 27-4, paragraph 27-7, change procedure to read:

27-7. REPAIRING POTTING COMPOUND.

WARNING

Isopropyl alcohol is flammable and must not be used near heat, sparks, or open flame. Inhalation of the vapors or prolonged contact with the liquid can cause serious injury.

NOTE

Steps a through c outline repairing potting and steps d through l outline replacing potting.

a. Clean damaged area by wiping with a clean, lint-free cloth dampened with isopropyl alcohol (Federal Specification TT-I-735). Allow solvent to dry completely.

WARNING

Adhesive sealant RTV-108 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 sealant can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

b. Apply adhesive sealant RTV-108 (General Electric) to damaged area and using a spatula, smooth out sealant and remove excess material.

c. Allow sealant to cure at room temperature for approximately 16 hours.

d. Remove all potting compound from end of junction box. Take care not to remove markings on junction box.

e. Thoroughly clean repair area by wiping with a clean, lint-free cloth dampened with isopropyl alcohol (Federal Specification TT-I-735). Allow solvent to dry completely.

WARNING

Silicone primer SS-4120 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 primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

f. Apply a thin, even coat of silicone primer SS-4120 (General Electric) to surface of repair area. Allow primer to dry for a minimum of 30 minutes.

WARNING

Silicone resin RTV-615 contains an alkaline catalyst that may cause burns. It must not be allowed to contact skin or clothes. In case of contact, wash skin with soap and water and treat injured area as a burn.

g. Thoroughly mix 100 parts of silicone resin RTV-615A to 10 ±0.5 parts of curing agent RTV-615B (General Electric) by weight, for a minimum of 3 minutes. Potting life is approximately 8 hours. Use only clean-metal or non-waxed containers with a capacity 3 times as large as potting mix.

h. Place potting mix in a vacuum chamber and pull a minimum vacuum of 27 inches of mercury for approximately 10 minutes to remove air.

i. Place a nylon cast on each lockwire hole of connectors to form a groove 0.12 inch deep from lockwire flange, 0.12 inch wide, and 0.25 inch long after potting is cured.

MANUAL DATA SUPPLEMENT NO. R-3896-3 VOL II-70
Sheet 1 of 1 16 April 1973

This supplement affects the data in Technical Manual R-3896-3, 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
2-6	2-12	
2-10	2-13	i
2-11	2-13	n
3-14	3-12	
3-31	3-16	e
3-52	3-31	d and j
3-52A	3-31A	e
4-3/4-4	4-12	
7-7/7-8	7-14	j
13-20A/13-20B	13-12	
14-9	14-12	
15-11	15-18	f
15-14B	15-19	q
15-22	15-22	
19-7	19-12	
19-26A/19-26B	19-17	oA
19-28	19-17	z
20-8A/20-8B	20-12	
21-10	21-17	
21-28	21-23	h
21-29	21-23	w