R-3896-5
VOLUME I

TECHNICAL MANUAL

MAINTENANCE AND OPERATION

F-1 ROCKET ENGINE GROUND SUPPORT EQUIPMENT

(ROCKETDYNE)

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

NOTICE: INSTRUCTIONS FOR THE USE OF THE GSE COVERED HEREIN CAN BE FOUND IN TECHNICAL MANUALS R-3896-3, R-3896-6, R-3896-9, AND R-3896-11.

PUBLISHED UNDER AUTHORITY OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

15 JANUARY 1964
CHANGED 5 OCTOBER 1972

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

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

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 512 CONSISTING OF THE FOLLOWING:

Page No	Issue
*Title	5 Oct 72
*A	5 Oct 72
i thru v	8 Dec 70
vi	26 Oct 71
viA	3 May 72
viB thru viC	26 Oct 71
viD	8 Dec 70
viE	3 May 72
viF	26 Oct 71
*viG	5 Oct 72
viH	26 Oct 71
vii thru viii	26 Oct 71
ix	8 Dec 70
x	3 May 72
xi	26 Oct 71
xii thru xiii	27 May 69
xiv	8 Dec 70
xv/xvi	27 May 69
*1-1	5 Oct 72
1-2 thru 1-3	8 Dec 70
*1-4	5 Oct 72
1-5	26 Oct 71
1-6 thru 1-10	3 May 72
1-11	3 May 72
1-12	8 Dec 70
*1-13	5 Oct 72
1-14	8 Dec 70
*1-15	5 Oct 72
1-16	8 Dec 70
*1-17 thru 1-20	5 Oct 72
1-21 thru 1-23	8 Dec 70
*1-24	5 Oct 72
1-25 thru 1-26	8 Dec 70
*1-27	5 Oct 72
1-28 thru 1-38	8 Dec 70
1-39	3 May 72
1-40 thru 1-43/1-44	8 Dec 70
2-1 thru 2-18	20 Jul 67
2-19	22 Feb 68
2-20	20 Jul 67
2-21 thru 2-23	22 Feb 68
2-24 thru 2-25/2-26	20 Jul 67
3-1 thru 3-14	20 Jul 67
4-1 thru 4-8	20 Jul 67
5-1	23 Mar 72
5-2	11 Apr 67
5-3	3 May 72
5-4 thru 5-9	11 Apr 67
5-10	12 Nov 69
5-11	10 Jun 68
5-12 thru 5-13	11 Apr 67
*5-14	5 Oct 72
5-15 thru 5-16	10 Jun 68
5-17	11 Apr 67
5-18 thru 5-19	10 Jun 68
5-20 thru 5-22	11 Apr 67
5-23 thru 5-24	10 Jun 68
5-25 thru 5-27	11 Apr 67
5-28	12 Nov 69
5-29 thru 5-30	11 Apr 67
5-31	10 Jun 68
5-32 thru 5-37	11 Apr 67
5-38	10 Jun 68
5-39 thru 5-40	11 Apr 67
5-41	10 Jun 68
5-42 thru 5-56B	12 Nov 69
5-57	24 Mar 70
5-58	11 Apr 67
5-59	12 Nov 69
5-60 thru 5-65	22 Feb 68
5-66 thru 5-68	8 Dec 70
5-68A	22 Feb 68
5-68B thru 5-68D	8 Dec 70
5-69	10 Jun 68
5-70	11 Apr 67
5-71 thru 5-72	10 Jun 68
5-73 thru 5-75/5-76	11 Apr 67
6-1	23 Mar 72
6-2 thru 6-4	22 Jun 70
6-5	8 Dec 70
6-6 thru 6-8	22 Jun 70
7-1	23 Mar 72
7-2 thru 7-23	22 Jun 70
7-24	8 Dec 70
7-25 thru 7-26	22 Jun 70
8-1	23 Mar 72
8-2 thru 8-3	22 Jun 70
8-4	8 Dec 70
8-5 thru 8-6	24 Mar 70
8-7	8 Dec 70
8-8	27 May 69
8-9	22 Jun 70
8-10 thru 8-11/8-12	8 Dec 70
9-1 thru 9-9/9-10	20 Jul 67
10-1	23 Mar 72
10-2	11 Apr 67
10-3	26 Oct 71
10-4	11 Apr 67
10-5	10 Jun 68
10-6	24 Mar 70
10-7 thru 10-8	26 Oct 71
10-9 thru 10-15	11 Apr 67
10-16	26 Oct 71
10-17 thru 10-25	11 Apr 67
10-26	9 Oct 68
10-27/10-28	26 Oct 71
10-29	24 Mar 70
10-30 thru 10-42H	12 Nov 69
10-42I thru 10-42L	12 Nov 69
10-42M thru 10-42N	26 Oct 71
10-42P thru 10-42P-19/10-42P-20	26 Oct 71
10-42Q thru 10-42R	24 Mar 70
10-42S	26 Oct 71
10-42T thru 10-42V	8 Dec 70
10-42W	24 Mar 70
10-42X	8 Dec 70
10-42Y	24 Mar 70
10-42Z	8 Dec 70
10-42AA	26 Oct 71
10-42AB thru 10-42AC	8 Dec 70
10-42AD	24 Mar 70
10-42AE	26 Oct 71
10-42AF	24 Mar 70
10-43 thru 10-50	11 Apr 67
10-51	10 Jun 68
10-52 thru 10-55/10-56	11 Apr 67
11-1	23 Mar 72
11-2 thru 11-3	20 Jul 67
11-4 thru 11-8	22 Jun 70
12-1 thru 12-21/12-22	3 May 72
13-1	23 Mar 72
13-2 thru 13-8	22 Feb 68
13-9	3 May 72
13-10	22 Feb 68
14-1 thru 14-4	17 Oct 67
14-5	27 May 69
14-6	10 Jun 68
14-7/14-8	3 May 72
15-1	23 Mar 72
15-2 thru 15-5	10 Jun 68
15-6	8 Dec 70
15-7 thru 15-9	10 Jun 68
15-10	8 Dec 70
15-11 thru 15-18	10 Jun 68
*15-19	5 Oct 72
15-20	10 Jun 68
*15-20A/15-20B	5 Oct 72
15-21 thru 15-22	10 Jun 68
16-1	23 Mar 72
16-2 thru 16-69	8 Dec 70
16-70	26 Oct 71
16-71/16-72	8 Dec 70
A-1	22 Jun 70
*A-2	5 Oct 72

This page reflects the current status of the complete manual. All pages listed must be in the manual to make this publication current and complete.

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

* The asterisk indicates pages changed, added, or deleted by the current change

R-3896-5
VOLUME I

TECHNICAL MANUAL

MAINTENANCE AND OPERATION

F-1 ROCKET ENGINE
GROUND SUPPORT EQUIPMENT

(ROCKETDYNE)

CHANGE NOTICE **LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE**

Insert changed pages into basic publication. Destroy superseded pages.

NOTICE: INSTRUCTIONS FOR THE USE OF THE GSE COVERED HEREIN CAN BE FOUND IN TECHNICAL MANUALS R-3896-3, R-3896-6, R-3896-9, AND R-3896-11.

PUBLISHED UNDER AUTHORITY OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

15 JANUARY 1964
CHANGED 3 MAY 1972

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

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

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 510 CONSISTING OF THE FOLLOWING:

Page No	Issue
*Title	3 May 72
*A	3 May 72
i thru v	8 Dec 70
vi	26 Oct 71
*viA	3 May 72
viB thru viC	26 Oct 71
viD	8 Dec 70
*viE	3 May 72
viF	26 Oct 71
*viG	3 May 72
viH	26 Oct 71
vii thru viii	26 Oct 71
ix	8 Dec 70
*x	3 May 72
xi	26 Oct 71
xii thru xiii	27 May 69
xiv	8 Dec 70
xv xvi	27 May 69
1-1 thru 1-4	8 Dec 70
1-5	26 Oct 71
*1-6 thru 1-10D	3 May 72
*1-11	3 May 72
1-12 thru 1-18	8 Dec 70
*1-19	3 May 72
1-20 thru 1-38	8 Dec 70
*1-39	3 May 72
1-40 thru 1-43/1-44	8 Dec 70
2-1 thru 2-18	20 Jul 67
2-19	22 Feb 68
2-20	20 Jul 67
2-21 thru 2-23	22 Feb 68
2-24 thru 2-25/2-26	20 Jul 67
3-1 thru 3-14	20 Jul 67
4-1 thru 4-8	20 Jul 67
5-1	23 Mar 72
5-2	11 Apr 67
*5-3	3 May 72
5-4 thru 5-9	11 Apr 67
5-10	12 Nov 69
5-11	10 Jun 68
5-12 thru 5-14	11 Apr 67
5-15 thru 5-16	10 Jun 68
5-17	11 Apr 67
5-18 thru 5-19	10 Jun 68
5-20 thru 5-22	11 Apr 67
5-23 thru 5-24	10 Jun 68
5-25 thru 5-27	11 Apr 67
5-28	12 Nov 69
5-29 thru 5-30	11 Apr 67
5-31	10 Jun 68
5-32 thru 5-37	11 Apr 67
5-38	10 Jun 68
5-39 thru 5-40	11 Apr 67
5-41	10 Jun 68
5-42 thru 5-56H	12 Nov 69
5-57	24 Mar 70
5-58	11 Apr 67
5-59	12 Nov 69
5-60 thru 5-65	22 Feb 68
5-66 thru 5-68	8 Dec 70
5-68A	22 Feb 68
5-68B thru 5-68D	8 Dec 70
5-69	10 Jun 68
5-70	11 Apr 67
5-71 thru 5-72	10 Jun 68
5-73 thru 5-75/5-76	11 Apr 67
6-1	23 Mar 72
6-2 thru 6-4	22 Jun 70
6-5	8 Dec 70
6-6 thru 6-8	22 Jun 70
7-1	23 Mar 72
7-2 thru 7-23	22 Jun 70
7-24	8 Dec 70
7-25 thru 7-26	22 Jun 70
8-1	23 Mar 72
8-2 thru 8-3	22 Jun 70
8-4	8 Dec 70
8-5 thru 8-6	24 Mar 70
8-7	8 Dec 70
8-8	27 May 69
8-9	22 Jun 70
8-10 thru 8-11/8-12	8 Dec 70
9-1 thru 9-9/9-10	20 Jul 67
10-1	23 Mar 72
10-2	11 Apr 67
10-3	26 Oct 71
10-4	11 Apr 67
10-5	10 Jun 68
10-6	24 Mar 70
10-7 thru 10-8	26 Oct 71
10-9 thru 10-15	11 Apr 67
10-16	26 Oct 71
10-17 thru 10-25	11 Apr 67
10-26	9 Oct 68
10-27/10-28	26 Oct 71
10-29	24 Mar 70
10-30 thru 10-42H	12 Nov 69
10-42J thru 10-42L	12 Nov 69
10-42M thru 10-42N	26 Oct 71
10-42P thru 10-42P-19/10-42P-20	26 Oct 71
10-42Q thru 10-42R	24 Mar 70
10-42S	26 Oct 71
10-42T thru 10-42V	8 Dec 70
10-42W	24 Mar 70
10-42X	8 Dec 70
10-42Y	24 Mar 70
10-42Z	8 Dec 70
10-42AA	26 Oct 71
10-42AB thru 10-42AC	8 Dec 70
10-42AD	24 Mar 70
10-42AE	26 Oct 71
10-42AF	24 Mar 70
10-43 thru 10-50	11 Apr 67
10-51	10 Jun 68
10-52 thru 10-55/10-56	11 Apr 67
11-1	23 Mar 72
11-2 thru 11-3	20 Jul 67
11-4 thru 11-8	22 Jun 70
*12-1 thru 12-21/12-22	3 May 72
13-1	23 Mar 72
13-2 thru 13-8	22 Feb 68
*13-9	3 May 72
13-10	22 Feb 68
14-1 thru 14-4	17 Oct 67
14-5	27 May 69
14-6	10 Jun 68
*14-7/14-8	3 May 72
15-1	23 Mar 72
15-2 thru 15-5	10 Jun 68
15-6	8 Dec 70
15-7 thru 15-9	10 Jun 68
15-10	8 Dec 70
15-11 thru 15-22	10 Jun 68
16-1	23 Mar 72
16-2 thru 16-69	8 Dec 70
16-70	26 Oct 71
16-71/16-72	8 Dec 70
A-1	22 Jun 70
A-2	26 Oct 71

This page reflects the current status of the complete manual. All pages listed must be in the manual to make this publication current and complete.

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

* The asterisk indicates pages changed, added, or deleted by the current change

TABLE OF CONTENTS

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

SECTION XI
CRYOGENIC SUPPLY UNIT G3146

SECTION XII
PNEUMATIC FLOW TESTERS
G3104 AND G3104MD1

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined numbers denote figures.
Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined titles denote primary paragraphs.

TABLE OF CONTENTS
(Continued)

Underlined Titles denote primary paragraphs.

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

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. The information in these manuals was prepared by Logistics Publications & Training 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 content and support functions chart lists all F-1-series technical manuals, describes the support function each manual serves, and lists the section titles of each manual. The chart also explains how the technical data in each manual relates to the support of the engine and its ground support equipment throughout a normal engine flow, as well as during unscheduled maintenance tasks. Information appearing in one manual is not duplicated in another. 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 is 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-1C of the Saturn V vehicle; and nominal engine performance characteristics, methods for predicting engine variable characteristics, and other pertinent information that can be used as an aid for analyzing and/or determining specific engine performance. The manual serves to familiarize the reader with the design and operation of the F-1 engine and serves as a training aid document.	I 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-maintenance test requirements that will verify the integrity of engine systems affected by the removal of individual engine components and lines. This volume and Volume II provide the necessary maintenance and repair data to perform unscheduled maintenance tasks on an uninstalled engine and the required post-maintenance tests to determine that the engine is in an operable condition.	I	General Maintenance and Repair
		II	Handling
		III	Component Removal and Installation
		IV	Post-Maintenance Test Requirements
R-3896-3, Volume II F-1 Rocket Engine Maintenance and Repair	This manual contains cleaning, inspecting, repairing, and testing procedures for the individual engine components. This manual provides the data to restore and/or maintain components of the engine in an operable condition for reinstallation on the engine or assignment as a spare.	I	Quick-Disconnect
		II	Gas Generator
		III	Gas Generator Ball Valve
		IV	Gas Generator Injector Purge and Pump seal Purge Check Valve
		V	Deleted
		VI	Heat Exchanger
		VII	Heat Exchanger Check Valve
		VIII	Thrust Chamber (Installed)
		IX	Thrust Chamber (Uninstalled)
		X	Thrust OK Pressure Switch
		XI	Inert Prefill Check Valve
		XII	Oxidizer Dome Purge Check Valve
		XIII	Oxidizer Valve
		XIV	Fuel Valve
		XV	Turbopump
		XVA	Turbine
		XVI	Bearing Coolant Control Valve
		XVII	Deleted
		XVIII	Electrical Harness
		XIX	Hypergol Manifold
		XX	Ignition Monitor Valve
		XXI	Checkout Valve
		XXII	Engine Control Valve

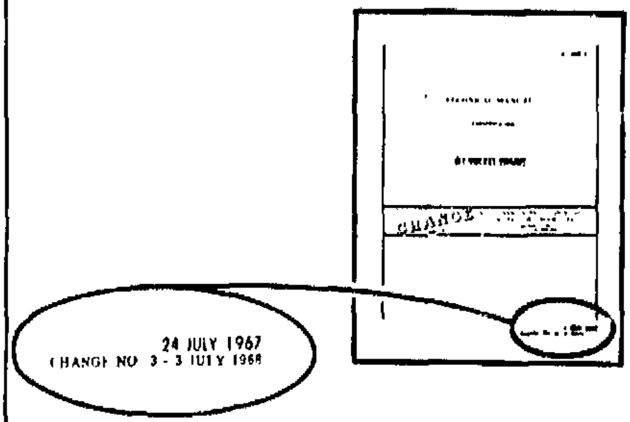
Manual	Contents and Support Function	Section and Title	
R-3896-3, Volume II (cont)		XXIII	Four-Way Solenoid Valve
		XXIV	Thrust Chamber Nozzle Extension
		XXV	Pressure Transducer
		XXVI	Temperature Transducer
		XXVII	Flight Instrumentation Junction Boxes
		XXVIII	Rigid Ducts, Flexible Lines, and Braided Flex Hoses
		XXIX	Redundant Shutdown Valve
		XXX	Volumetric Liquid Oxygen Transducer (Oxidizer Flowmeter)
		XXXI	Gimbal Boot, Insulation Boot, and Insulation Seal
R-3896-4 F-1 Rocket Engine Illustrated Parts Breakdown	This manual contains illustrative and columnar listings of all parts of the engine that can be disassembled, reassembled, repaired, replaced, or overhauled. This manual locates and identifies the interrelationship of parts, aids in the requisition of replacement parts, indicates part usage and interchangeability and recommended repair or replacement for the F-1 engine and its individual components and parts.	I	Introduction
		II	Group Assembly Parts List
		III	Numerical Index
R-3896-5, Volume I F-1 Rocket Engine Ground Support Equipment Maintenance and Operation	This manual contains safety requirements and general maintenance practices peculiar to the equipment covered in this volume and to equipment and T-tools covered in Volume II of this manual; inspection requirements, physical description, operation, intended usage, operating limitations, periodic maintenance, and parts listings with maintenance-level codes for the F-1 engine ground support equipment covered in this volume. This volume provides data to restore and/or maintain the F-1 rocket engine ground support equipment in an operable condition.	See detailed table of contents for this manual.	
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	I	Test Kits, Sets, and Tools
		II	T-Tools
		III	Dummy Weight T-Tools

Manual	Contents and Support Function	Section and Title
R-3896-5, Volume II (cont)	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.	
R-3896-6 F-1 Rocket Engine Thermal Insulation Installation 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
R-3896-9 F-1 Rocket Engine Transportation	This manual contains procedures for preparing the F-1 rocket engine, nozzle extension, thermal insulation, and miscellaneous engine loose equipment for shipment, and procedures for shipping by truck, air, or water. Included are recommended truck-, air-, and water-transport check lists, which may be used to make sure that procedures and in-transit inspection have been performed.	I Preparation for Shipping II Shipping by Truck Transport III Shipping by Air Transport IV Shipping by Water Transport
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.

GEN-NASA-1A

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

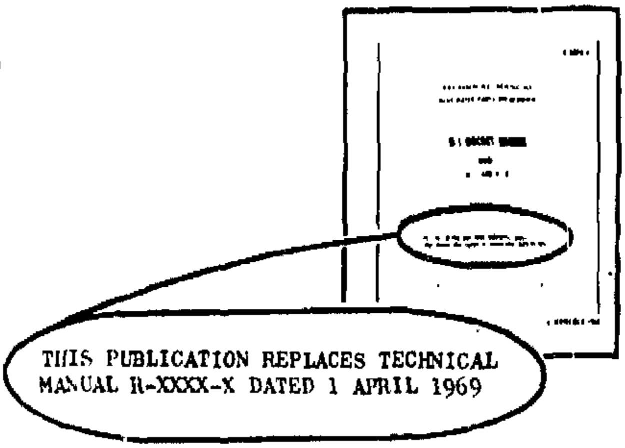
3. If you are unsure of the status of any page or pages, refer to the List of Effective Pages and make sure your manual contains pages (with the corresponding change dates) listed in the List of Effective Pages.

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)

2. CONFIGURATION IDENTIFICATION.

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

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

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

3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

All approved ECPs (Engineering Change Proposals) and associated MD numbers applicable to the equipment covered in this manual are listed in figure 3. The date in the last column is the publication date of the manual during which the change made by the ECP was incorporated. When N/A is entered, the ECP does not change the data in the manual. Ground Support Equipment configuration information is in R-5857, Saturn F-1 Configuration Identification & Status Report.

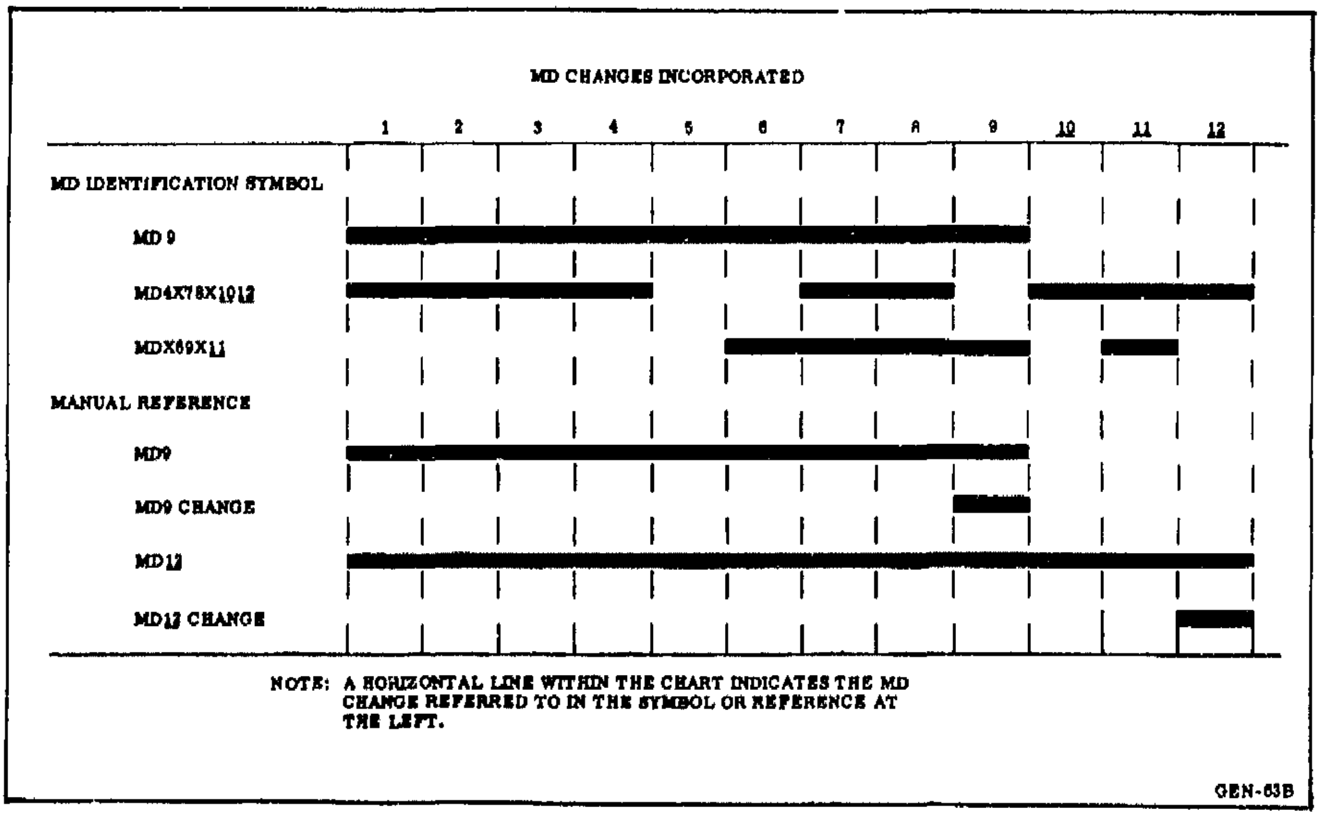


Figure 2. MD System

Approved ECP No.	MD No.	Incorporated in Manual Dated
	G2030	
F1-201	2	9 April 1965
F1-232	1	20 January 1965
F1-433	3	31 August 1966
	G3132	
F1-128	2	4 June 1964
F1-156R1	1	4 June 1964
F1-186	3	2 September 1964
F1-302	4	1 September 1965
F1-440	5	31 August 1966
F1-473	6	3 April 1967
F1-517	7	10 June 1968
	G3136	
F1-295	1	1 September 1965
F1-374R1	2	1 February 1966
	G3141	
F1-501	1	3 April 1967
	G3142	
F1-429	1	31 August 1966
F1-474	2	3 April 1967
F1-492	3	3 April 1967
F1-534	4	10 June 1968
F1-539	5	10 June 1968
F1-563	6	10 June 1968
	G3143	
F1-531	1	10 June 1968
	G3144	
F1-293	1	20 January 1965
	G4044	
F1-151	1	4 June 1964
F1-171	2	4 June 1964
F1-271	3	9 April 1965
F1-300R1	4	1 September 1965
F1-404	5	14 July 1966
F1-469	6	3 April 1967
	G4047	
F1-256	1	20 January 1965
F1-529	2	10 June 1968

Approved ECP No.	MD No.	Incorporated in Manual Dated
	G4049	
F1-157	2	4 June 1964
F1-177	1	2 September 1964
F1-339	3	1 February 1966
F1-403	4	14 July 1966
	G4050	
F1-117	1	15 January 1964
F1-158	2	4 June 1964
F1-536	3	27 May 1969
F1-536R1	4	22 June 1970
	G4051	
F1-159	1	4 June 1964
F1-178	2	2 September 1964
	G4054	
F1-160	1	4 June 1964
F1-376	2	1 February 1966
	G4057	
F1-246	1	20 January 1965
	G4058	
F1-161	1	4 June 1964
	G4059	
F1-231	1	2 September 1964
	G4067	
F1-205	1	4 June 1964
F1-234	2	2 September 1964
F1-301	3	1 September 1965
	G4068	
F1-200	1	20 January 1965
F1-200R1	--	12 January 1965
F1-451	2	3 April 1967
	G4080	
F1-460	1	31 August 1966
	G4081	
F1-461	1	31 August 1966
	G4083	
F1-435	1	3 April 1967

Figure 3. Configuration Changes--Manual Effectivity

SOURCE AND RECOVERABILITY CODE LIST.

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

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

Source Code

A . . . Assembled from component parts

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

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

X . . . Will not be procured

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

Recoverability Code

1 . . . . Field level (using sites)

2 . . . . Depot (Rocketdyne)

3 . . . . Nonrepairable

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

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

SECTION I

GENERAL MAINTENANCE AND REPAIR

1-1. SCOI This section contains GSE general mainte ice and repair information that is applicable to several sections of this manual. Suggested methods of accomplishing tasks are included in this section. Other methods may be used provided they achieve the same results.

1-2. SAFETY PRECAUTIONS.

NOTE

When performing work specified in this manual, all local safety and health directives must be complied with. It is assumed these directives are in compliance with the Occupational and Safety Health Act. When local safety and health directives are more stringent than those specified in this manual, the local directives will prevail.

1-3. Warnings and cautions are used throughout the text to indicate potentially dangerous steps. These warnings and cautions precede the step to which they apply and must be strictly observed by personnel performing the procedures. Specific precautions to follow are listed when a task involves working with potentially dangerous materials or hazardous conditions. The following examples explain warnings and cautions:

WARNING

A warning indicates a procedure or practice that, if not followed correctly, can cause injury or death.

CAUTION

A caution indicates a procedure or practice that, if not followed correctly, can cause damage to equipment.

1-4. ELECTRICAL SYSTEMS.

1-5. Observe the following safety precautions when working with electrical systems:

WARNING

Connecting or disconnecting electrical connectors without turning off electrical power can result in injury to personnel and damage to equipment.

a. Make sure electrical power is off before working on electrical components or cables.

b. Make sure facility outlet and control switch or circuit breaker on electrical equipment are deenergized before connecting power source to electrical equipment.

c. Do not leave controls unattended when an electrical system is energized.

d. Ground all equipment to a common ground point, when required.

1-6. PRESSURIZED SYSTEMS.

1-7. Observe the following safety precautions when working with high-pressure systems:

WARNING

Removing fittings, parts, or components from a pressurized system can result in injury to personnel and damage to equipment.

a. Make sure system is depressurized before disconnecting test equipment lines or hoses and before tightening or loosening any fitting.

b. Do not leave controls unattended while system is pressurized.

c. Secure all test hoses connected between test equipment, facility, or components under test, to prevent whipping if accidently disconnected or in event of line failure.

d. Wear safety glasses or face shield when working on a pressurized system.

e. Make sure connections on all system components are secure.

f. Follow specified requirements for gasket sealants and lubricants.

1-8. CLEANING SOLVENTS.

1-9. Although cleaning solvents specified in this manual are considered the least hazardous of solvents available, specific uses of each solvent require special precautions, as stated in each applicable procedure. Improper use of a solvent can cause injury to personnel or damage to equipment.

1-10. TRICHLOROETHYLENE AND TRICHLOROETHANE. Trichloroethylene and trichloroethane are toxic solvents that are nonexplosive and, under usual conditions of use, nonflammable. These solvents decompose at temperatures above 248° F, releasing toxic products. Observe the following safety precautions when using trichloroethylene (MIL-T-27602), trichloroethane (MIL-T-81533), or trichloroethane ST0210GB0002 (NR, Los Angeles Division):

a. Wear breathing apparatus when using these solvents in confined or unventilated areas. Inhalation of concentrations exceeding 100 ppm of trichloroethylene (350 ppm of trichloroethane) for prolonged periods of time may result in narcosis or unconsciousness. Indications of excessive inhalation exposure are headache, blurring of vision, giddiness, nausea, or vomiting. These effects are completely reversible upon removal of the individual to a well-ventilated area.

b. Do not allow these solvents to contact skin for prolonged periods, as they defat the skin, leaving it susceptible to infection and cracking.

c. Wear safety glasses or a face shield when using these solvents.

1-11. CLEANING COMPOUND. Observe the following safety precautions when using cleaning compound (MIL-C-81302):

a. Avoid inhalation of vapors of cleaning compound since it may cause headaches, dizziness, sleepiness, or unconsciousness due to the oxygen-deficient atmosphere.

b. Do not allow cleaning compound to contact skin for prolonged periods. The liquid chemically dries the skin, leaving it susceptible to infection.

c. Wear safety glasses or a face shield when using cleaning compound.

d. Wear breathing apparatus when using cleaning compound in confined or unventilated areas.

e. Do not subject cleaning compound to temperatures above 248° F.

1-12. ISOPROPYL ALCOHOL. Observe the following safety precautions when using isopropyl alcohol (Federal Specification TT-I-735):

a. Avoid inhalation of vapors of isopropyl alcohol, since inhalation may cause slight intoxication.

b. Wear breathing apparatus when using isopropyl alcohol in confined or unventilated areas.

c. Because of its low vaporizing qualities, use a minimum amount of isopropyl alcohol consistent with performing the task.

d. Wear safety glasses or a face shield when using isopropyl alcohol.

e. Do not use isopropyl alcohol near heat, sparks, or open flame.

1-13. DRYCLEANING SOLVENT. Observe the following safety precautions when using drycleaning solvent (Federal Specification P-D-680):

a. Do not use drycleaning solvent near heat, sparks, or open flame.

b. Wear safety glasses or a face shield when using drycleaning solvent.

c. Make sure that drycleaning solvent is kept away from areas that come in contact with liquid oxygen.

1-14. ACIDS.

1-15. Acids in either concentrated or diluted liquid form will soak through cloths causing severe burns, dissolve metals, give off harmful vapors, generate explosions, and cause fires upon contact with combustible material. Observe the following safety precautions when using acids:

a. Wear rubber or plastic gloves, apron, boots, and chemical-type safety goggles.

b. Avoid inhalation of vapors from liquids and dust from acid powder mixes.

c. Open acid containers, and use acid in well-ventilated areas. Avoid splashing and spilling.

d. Do not pour water into acid; slowly add acid to water, and constantly stir mixture with acid-resistant implement.

e. Cloths, sponges, and brushes used to apply acid solutions must be thoroughly rinsed in tap water. If allowed to dry out without rinsing, they constitute a fire hazard.

f. If acid contacts skin, drench affected area in clean water for a minimum of 5 minutes.

g. Do not store acid near heat, caustics, water, or combustible materials.

1-16. LIQUID NITROGEN.

1-17. Liquid nitrogen is characterized by its extremely low temperature and high vapor pressure. Observe the following safety precautions when using liquid nitrogen:

a. Use only approved containers and storage vessels.

b. Wear safety goggles or face shield and loose, well-ventilated gloves or mittens.

c. Avoid splashing on exposed skin to prevent painful injury (burns).

d. Use in a well-ventilated area to prevent oxygen depletion.

e. Avoid direct contact with liquid or surfaces chilled by liquid.

1-18. INCOMPATIBLE MATERIALS.

1-19. Some materials, such as preservative compounds, lubricating oil, cleaning solvents, and grease, used for maintenance purposes are incompatible with the oxidizer (liquid oxygen) used in the engine. When introduced into an oxidizer system, liquid oxygen mixes with the incompatible materials and becomes impact-sensitive and explosive. The detection of all incompatible materials in test equipment is difficult. Equipment must be protected by the methods outlined in applicable maintenance procedures to avoid the extensive disassembly required for the detection and removal of incompatible materials.

1-20. <u>CONTAMINATION AND DAMAGE PREVENTION REQUIREMENTS.</u>

1-21. Contamination and damage prevention requirements for ground support equipment are listed in paragraphs 1-22 through 1-25.

1-22. CONTAMINATION PREVENTION.

1-23. All maintenance and repair procedures must be performed in such a manner as to prevent contamination of equipment that may be connected or attached to an engine system. These requirements are satisfied when the following conditions are met:

a. Clothing worn by personnel must be free of loose particles and fibers and pockets emptied of foreign objects that could contribute to contamination, when working with internal areas of systems or in controlled areas.

b. Parts, tools, materials, and test equipment actually used in a maintenance task must be accounted for to make sure that none of these items has been left inside a system.

c. All test equipment and tools must be clean if exposed to sealing surfaces or surfaces that contact operating fluid (liquid or gas).

d. Clean nylon or polyethylene gloves must be worn when handling parts or components where hand contact is made with sealing surfaces or surfaces that contact operating fluid (liquid or gas).

e. Necessary measures must be taken to prevent contamination from wind and rain when a system is to be opened outdoors.

f. Areas must be checked above, around, and below the system being opened for operations that may cause or allow contamination of the system. Proper measures must be taken to prevent contamination of other systems from the system being opened.

g. A suitable container must be provided to catch residual fluids when a system is opened, to prevent fluid from contaminating adjacent areas.

h. Only pressure-sensitive tape RB0195-002 (Rocketdyne), or equivalent, must be used to secure Aclar film or bags to components of fluid systems. Tape must not be used on threads, mating faces, or direct fluid surfaces. Tape alone must not be used as a closure and/or cover on openings or on removed components or assemblies.

i. Components and assemblies removed from a system must be immediately provided with suitable protective closures and/or coverings.

j. When the necessary fluid line closures are not available, the closure method shown in figure 1-1 and as follows must be used:

CAUTION

When securing Aclar film or bags to the line with tape, the tape must be wrapped completely around the line and a minimum of 25 percent of the tape width must contact the body of the line to prevent entry of contaminants.

NOTE

The tape used in this procedure is pressure-sensitive tape RB0195-002 (Rocketdyne).

(1) Cover open ends of line with Aclar No. 33C film (0.002-inch minimum thickness) (Allied Chemical Corp). Wrap film over periphery of flange and secure to body of line with tape.

(2) Install a polyethylene bag (0.004-inch minimum thickness) (Cadillac Products) over Aclar film to completely cover and extend beyond film. Hold bag firmly against flange and body of line to exhaust any excess air from bag, and secure bag to body of line with tape.

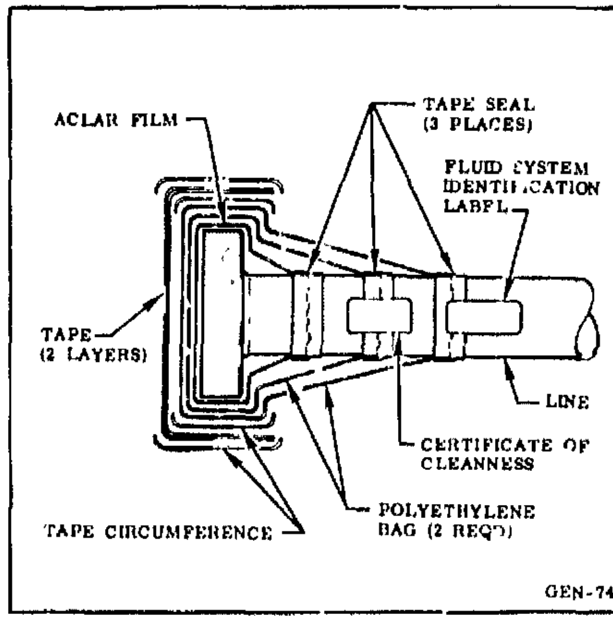


Figure 1-1. Protective Closure for Fluid Lines and Manifolds

(3) Attach a certificate of cleanness to taped area.

(4) Install a second polyethylene bag (0.004 inch minimum thickness) (Cadillac Products) over first bag. Hold bag firmly against flange and body of line to exhaust any excess air from bag, and secure bag to body of line with tape.

(5) Gather and tape bag over periphery of flange to prevent flange from cutting through bag.

(6) Apply 2 layers of tape over outer bag. Tape must cover surface of flange and extend over periphery of flange. Secure ends of tape by applying a layer of tape around periphery of flange.

1-24. DAMAGE PREVENTION.

1-25. All maintenance and repair procedures must be performed in such a manner as to minimize the possibility of damage to equipment. Damage will be greatly reduced by observing the following precautions:

a. Install covers and closures as necessary to protect system sealing surfaces and to protect equipment from the environment.

b. Do not step on or drive over hoses or electrical cables.

c. Inspect all gaskets, O-rings, packings, and seals for usability before installation.

d. Make sure proper lubricant is used on fittings, gaskets, O-rings, packings, and seals when required by applicable procedures and only in amount required.

e. Observe all precautions listed in repair and handling procedures.

f. Before use, inspect ground support and handling equipment for condition, and if equipment is proof-loaded, for evidence of current proof-loading.

g. Make sure electrical equipment is free of debris that might cause an electrical short.

h. Do not exceed handling equipment towing speed, turning radius, ramp angle, or load limits.

i. Use proper tools and equipment correctly. Avoid using adjustable wrenches.

j. Protect adjacent hardware from damage during removal and installation of large components. .

k. Use tools that are free of sharp edges, burs, or other conditions that could damage tubes or fittings.

1-26. PRESSURIZING AND PURGING AGENT REQUIREMENTS.

1-27. Pressurizing and purging agents called out in this manual must conform to the requirements specified in the following paragraphs.

1-28. HELIUM. Helium, when specified in this manual, must conform to the requirements of Bureau of Mines, Grade A, have a water content less than that defined by a dewpoint of minus 80° F at standard atmospheric pressure, and be supplied from a system equipped with a 10-micron-nominal, 50-micron-absolute rated filter.

1-29. GASEOUS NITROGEN. Gaseous nitrogen, when specified in this manual, must conform to the requirements of MIL-P-27401. Air may be substituted for nitrogen if the air meets the cleanness and humidity requirements of MIL-P-27401.

1-30. LIQUID NITROGEN. Liquid nitrogen, when specified in this manual, must conform to the requirements of MIL-P-27401.

1-31. FUEL. Fuel when specified in this manual, must conform to the requirements of MIL-F-25558 (RJ-1) or propellant kerosene (MIL-P-25576).

1-32. HYDRAULIC FLUID. Hydraulic fluid, when specified in this manual, must conform to the requirements of MIL-H-5606.

1-33. MATERIALS AND EQUIPMENT.

1-34. The materials listed in figure 1-2 are required for GSE maintenance, cleaning, paint stripping, repairing, and metal protection. The equipment listed in figure 1-3 is required for the examination of metals, maintenance, cleaning, paint stripping, and corrosion removal. After use, all materials and equipment must be thoroughly cleaned of all chemical and corrosion residue before reuse. All cloths and bristle brushes must be thoroughly washed and rinsed in tap water before reuse. Carbon-steel wool and wire brushes must be used on carbon steel or low-alloy steel materials. Stainless-steel wool and wire brushes must be used on corrosion-resistant steel (CRES) materials. Aluminum wool must be used on aluminum and magnesium. Brass wire brushes must be used to clean copper and copper alloy materials. It is recommended that a color code be established and that the handles of wire brushes be painted different colors to avoid possible misuse. Carborundum paper that is not discarded after use must be marked to indicate the type of metal on which it was used and must not be used on any other type of metal.

Identification	Name	Use
Aclar No. 33C (Allied Chemical Corp)	Film	Protecting parts.
AGMA No. 8A (American Gear Manufacturer's Association)	Compound	Fluid used in the azimuth drive of Engine Vertical Installers G4049 and 75M51505, and in the power gear of Engine Rotating Sling G4050.
Alodine 1200 (Amchem Products)	Powder	Mixed with nitric acid O-N-350 (Federal Specification) to form solution for chemical film touchup of anodic-coated parts.
ANSTAC-2M (Chemical Development Corp)	Solution	Reducing buildup rate of static charge on flow tubes and floats in Engine Checkout Console G3142, Components Test Console G3141, and Pneumatic Flow Testers G3104 and G3104MD1.
ARP No. 2 (Allied Research Products)	Detergent	Mixed with Iridite 14-2 powder to form solution for chemical film touchup of anodic-coated parts.
BB-F-1421, Type 12 (Federal Specification)	Refrigerant	Fluid used in Engine Checkout Console G3142.
Bureau of Mines, Grade A	Helium	Fluid used in Engine Checkout Console G3142, and Components Test Console G3141. Leak testing hoses in Components Adapter Set G3143.
CPR2028 (The Upjohn Co)[(a)]	Isonate adhesive	Adhering foam to protective pad T-8102028.
CPR9811 (The Upjohn Co)[(a)]	Polyurethane foam	Replacing foam on protective pad T-8102028.
EC1099 (Minnesota Mining and Mfg)[(a)]	Adhesive	Repairing waterproof fabric on Engine Cover G4047.
EC1300L (Minnesota Mining and Mfg)(a)	Cement	Bonding gaskets to plates in Test Plate, Plug, and Tool Set G3132.
FGA-32600 (Minnesota Mining and Mfg)(a)	Pressure-sensitive tape	Repairing small tears and holes in Engine Environmental Cover Set 99-9014130.

(a) Compound has limited shelf life. Refer to age controlled compounds in R-3896-3 for usability test.

Figure 1-2. Materials Specified in This Manual (Sheet 1 of 9)

Identification	Name	Use
FS1281 (Dow Corning Corp)	Grease	Lubricating packings in Hydraulic Pumping Unit G2025; O-rings in Engine Checkout Console G3142, Components Test Console G3141, and Fuel Drainage Kit G2037; hand valves in Components Test Console G3141; and packings and cap threads of Hypergol System Test Tool Kit G3135 and hypergol simulator T-5029716.
GR-362 (Hooker Chemical Corp)	Fluorolube grease	Lubricating hand valve O-rings and threads on Engine Checkout Console G3142 and Components Checkout Console G3141; hand valve stem threads on Pneumatic Flow Monitors G3130 and G3131; and base and screw threads of Air Powered Stapler 9023569.
Iridite 14-2 (Allied Research Products)	Powder	Mixed with detergent ARP No. 2 (Allied Research Products) to form solution for chemical film touchup of anodic-coated parts.
Krylon No. 1301 (Borden Chemical Co)	Clear spray	Protecting interior of electrical box and components on Engine Vertical Installers G4049 and 75M51505.
MIL-A-5092, Type II	General purpose adhesive	Bonding flowmeter tube to inlet manifold nipple on Pneumatic Flow Testers G3104 and G3104MD1, and bonding seal to Thrust Chamber Throat Plug G3136.
MIL-C-16173, Grade I	Corrosion-preventive compound	Protecting stationary unpainted carbon steel surfaces from corrosion.
MIL-C-20696, Type II	Nylon waterproof cloth	Repairing waterproof fabric on Engine Cover G4047.
MIL-C-25769	Alkaline cleaning compound	Cleaning corrosion from unpainted aluminum alloys.
MIL-C-5410, Type II	Cleaning compound	Deoxidizing anodic-coated parts before applying chemical film touchup.
MIL-C-5541, Type I	Chemical film	Refinishing aluminum alloy surface after corrosion removal.

Figure 1-2. Materials Specified in This Manual (Sheet 2 of 9)

Identification	Name	Use
MIL-C-81302	Cleaning compound	Handcleaning corroded surfaces, soiled parts, pressure transducers, and 300- and 400-series corrosion-resistant steel. Flushing soiled parts and pressure transducer sense ports.
MIL-D-6998	Dichloromethane	Removing paint from corroded surfaces.
MIL-F-25558	RJ-1 fuel	Fluid used in Hydraulic Pumping Units G2025 and G2026, and Engine Checkout Console G3142. Leak Testing Accumulator Unit G2027 and relief valves in Test Plate, Plug, and Tool Set G3132.
MIL-G-23827	Gear grease	Lubricating chassis, pump motor bearings, and pump-to-motor shaft coupling on Hydraulic Pumping Unit G2025; pump motor bearings and pump-to-motor shaft coupling on Hydraulic Pumping Unit G2026; roller block bearings on Engine Vertical Installers G4049 and 75M51505; bearings, sprockets, and drive wheels on Engine Rotating Sling G4050; caster rig bearings, wheels, and lubrication points specified on decal on Air Transport Engine Handler G4044; caster bearings on Engine Handling Dolly G4058; clevis, wheels and castor bearings on Engine Handler G4069; casters and pump shaft on Scavenge Pump G2039; cart casters on Test Plate, Plug, and Tool Set G3132; screw threads, sliding surface of nuts, felt strip and packing, and arm on Nozzle Extension Alinement Tool G4079; thumb-wheel and keeper on Turbopump Support G4083; and motor bearings on flange polishing tool T-5047802.

Figure 1-2. Materials Specified in This Manual (Sheet 3 of 9)

Identification	Name	Use
MIL-H-5606	Hydraulic fluid	Fluid used in Engine Vertical Installers G4049 and 75M51505, and Components Test Console G3141; lubricating O-rings, seals, and straight threads on Engine Vertical Installers G4049 and 75M51505; proof testing and leak testing hoses on Components Adapter Set G3143; and leak testing relief valves in Test Plate, Plug, and Tool Set G3132.
MIL-L-25567	Leak-test compound	Leak testing joints pressurized with gaseous nitrogen.
MIL-L-7808	Lubricating oil	Lubricating hand valve wiper in Components Checkout Console G3142; case bushing, rotor, shaft, seal bellows, pump shaft, seal, and carbon wear ring on Scavenge Pump G2039; and cart tow bar hinge point on Test Plate, Plug, and Tool Set G3132.
MIL-P-11414	Lacquer primer	Painting carbon steel surfaces.
MIL-P-25576	Propellant kerosene	Fluid used in Hydraulic Pumping Units G2025 and G2026.
MIL-P-27401	Liquid nitrogen	Fluid used in Cryogenic Supply Unit G3136.
MIL-P-27401	Gaseous nitrogen	Fluid used to pressurize hydraulic accumulator in Hydraulic Pumping Unit G2025 and fluid input for Engine Checkout Console G3142 and Components Test Console G3141. Blowing contaminants from parts; purging and drying Pneumatic Flow Testers G3104 and G3104MD1; and drying cleaned parts. Leak testing Accumulator Unit G2027, Engine Checkout Console G3142, Pneumatic Flow Monitors G3130 and G3131 and Components Test Console G3141; hoses in Components Adapter Set G3143; Cryogenic Supply Unit G3146; Pneumatic Flow Testers G3104 and G3104MD1; Thrust Chamber Throat Security Closure G4089 and 99-9026815; Oxidizer Dome Flushing Kit G2030; Fuel Drainage Kit G2037; relief valves in Test Plate, Plug, and Tool Set G3132; Thrust Chamber

Figure 1-2. Materials Specified in This Manual (Sheet 4 of 9)

Identification	Name	Use
		Throat Plug G3136, and hoses for hydraulic torque tool T-5029452. Proof testing hoses for Components Adapter Set G3143; Thrust Chamber Throat Plug G3136; and hydraulic torque tool T-5029452; and proof testing Oxidizer Dome Flushing Kit G2030. Function testing pressure test fixture T-5026440, Cryogenic Supply Unit G3146, and pressure test fixture T-5031167.
MIL-P-8585, Color Y(a)	Zinc chromate primer	Painting carbon steel and aluminum alloy surfaces.
MIL-T-27602	Trichloroethylene	Ultrasonic cleaning fluid for filters; handcleaning CRES and nickel alloys, cadmium-plated, chrome-plated, nickel-plated and silver-plated parts, and 300- and 400-series corrosion-resistant steel; removing petrolatum from Thrust Chamber Throat Plug G3136; cleaning filter elements in Engine Vertical Installers G4049 and 75M51505; cleaning areas requiring bonding on Engine Handling Dolly G4058; cleaning Oxidizer Dome Flushing Kit G2030: and cleaning areas requiring repair on Turbine Exhaust Exit Pressure Check Fixture G3144.
Molykote G (Dow Corning Corp)	Paste	Lubricating mating surfaces of regulator in Engine Checkout Console G3142, screw threads on Nozzle Extension Handling Fixture G4080, pin threads on Nozzle Extension Handling Adapter G4081, and screw threads on Turbopump Shaft Preload Fixture G4088.
MS20995N	Inconel lockwire	Safetywiring fittings and threaded fasteners with lockwire holes.
No Number	Aluminum wool	Removing corrosion from aluminum.
No Number	Carbon-steel wool (Class II Pads)	Removing corrosion from carbon steel materials.

(a) Compound has limited shelf life. Refer to age controlled compounds in R-3896-3 for usability test.

Figure 1-2. Materials Specified in This Manual (Sheet 5 of 9)

Identification	Name	Use
No Number	Carborundum paper (Grit No. 240, 280, 400, and 600)	Removing corrosion.
No Number (Cadillac Products)	Polyethylene bag	Covering open end of lines.
No Number	Polyethylene bag	Packaging lightweight parts.
No Number	Polyethylene foam	Cushioning packaged parts.
No Number	Polyethylene gloves	Protecting hands from cleaning solvents.
No Number	Polyurethane foam	Cushioning packaged parts.
No Number	Rubber gloves	Protecting hands when applying chemical film touchup.
No Number	Silicone grease	Lubricating power module in High Voltage Igniter Tester G3153.
No Number	Vinyl bag	Packaging small, lightweight parts.
O-A-51 (Federal Specification)	Acetone	Cleaning all-metal parts before applying lubricating powder.
Oakite No. 61 (Oakite Products, Inc)	Detergent solution	Cleaning source hose, handle, and adapters of Pneumatic Flow Testers G3104 and G3104MD1.
Oakite No. 61B (Oakite Products, Inc)	Cleaner	Cleaning all-metal parts that do not directly or indirectly contact a pro pellant, pneumatic or hydraulic system.
O-N-350 (Federal Specification)	Nitric acid	Mixed with Alodine 1200 powder (Amchem Products) to form solution for chemical film touchup of anodic-coated parts. Passivating 300- and 400-series corrosion-resistant steel.
Permatex (Permatex Co, Inc)	Sealant	Lubricating flat seals for static service.
P-D-680, Type I (Federal Specification)	Drycleaning solvent	Handcleaning painted areas, carbon steel parts, and case of Impact Recorder Unit G4090 and 99-9014031.
PPP-T-60 (Federal Specification)	Waterproof tape	Masking surfaces to be bonded on Thrust Chamber Throat Plug G3136 and repairing Protective Pad 8102028.

Figure 1-2. Materials Specified in This Manual (Sheet 6 of 9)

Identification	Name	Use
RB0120-034 (Rocketdyne)	Gasket sealant	Lubricating flat seals for static ser.ic~
RB0140-002 (Rocketdyne)	Thread sealant tape	Sealing taper thread fittings in Hydraulic Pumping Unit G2025, Engine Checkout Console G3142, Engine Vertical Installers G4049 and 75M51505, Components Test Console G3141, Oxidizer Dome Flushing Kit G2030, and Scavenge Pump G2039.
RB0140-005 (Rocketdyne)	Sealing and antiseize compound	Lubricating fitting threads in Hydraulic Pumping Unit G2025; static O-rings, seals, straight threads, and sliding surfaces on Engine Checkout Console G3142; and flat seals in relief valves on Components Test Console G3141.
RB0140-007 (Rocketdyne)	Dry-film lubricant	Lubricating sling arms on Turbopump Sling G4057, screw threads on Turbine Exhaust Exit Pressure Check Fixture G3144; guide threads on lift and holding tool T-5028673; shaft plate on alinement fixture T-5039202; alinement pins on alinement pin T-5039454; and plate threads, jack screw, and arm on assembly jig T-5041501.
RB0140-012 (Rocketdyne)	Lubricant grease	Lubricating threads and O-rings on Components Test Console G3141, Pneumatic Flow Monitors G3130 and G3131, Oxidizer Dome Flushing Kit G2030, Scavenge Pump G2039, and Fuel Drain Vent Adapter Kit 99-9012908; lubricating shaft-to-shoe interface and shaft threads on Temperature Transducer Installer and Remover Kit G2038; and lubricating shaft threads on Thrust Chamber Throat Plug G3136.
RB0195-002 (Rocketdyne)	Pressure-sensitive tape	Securing Aclar film or polyethylene bags to components.
RB0210-002	Alkaline cleaner	Cleaning combinations of metal and nonmetal parts that do not directly or indirectly contact a propellant, pneumatic, or hydraulic system.

Figure 1-2. Materials Specified in This Manual (Sheet 7 of 9)

Identification	Name	Use
RB0210-003	Trichloroethylene	Cleaning exterior, exhaust manifold screen, and flowmeter tubes of Pneumatic Flow Testers G3104 and G3104MD1.
RB0210-016 (Rocketdyne)	Corrosion preventative	Protecting unpainted stationary carbon steel surfaces, specified surfaces on Air Transport Engine Handler G4044, and ball joints on Nozzle Extension Handling Fixture G4080 and Nozzle Extension Handling Adapter G4081.
RB0295-001 (Rocketdyne)	Desiccant	Maintaining correct humidity in High-Voltage Igniter Tester G3153.
SKD-NF (Magnaflux Corp)	Spot-check developer	Indicating metal surface defects.
SKL-4 (Magnaflux Corp)	Dye-penetrant	Preparing metal surface for non-destructive testing.
SRGA-0214 (Minnesota Mining and Mfg)	Glass fabric	Repairing engine environmental cover set 99-9014130.
TEC 901 (TEC Chemical Co)	Cleaning agent	Handcleaning aluminum alloys.
TT-E-489 (Federal Specification), color 11136 (Federal Standard 595)	Red gloss enamel	Painting warning notices.
TT-E-489 (Federal Specification), color 13538 (Federal Standard 595)	Orange-yellow gloss enamel	Painting carbon steel and aluminum alloy surfaces.
TT-E-529 (Federal Specification), color 27038 (Federal Standard 595)	Black semi-gloss enamel	Painting lettering and markings.
TT-M-261 (Federal Specification)	Methyl-ethyl-ketone	Cleaning exterior of electrical harnesses; cleaning inlet manifold of Pneumatic Flow Testers G3104 and G3104MD1; and removing excess adhesive after bonding seal on Thrust Chamber Throat Plug G3136.

Figure 1-2. Materials Specified in This Manual (Sheet 8 of 9)

Identification	Name	Use
TT-R-248 (Federal Specification)	Paint and lacquer remover	Removing paint from corroded areas.
TT-I-735 (Federal Specification)	Isopropyl alcohol	Handcleaning interior and exterior of electrical connectors, and exterior of pressure transducer electrical connector.
TT-T-548 (Federal Specification)	Toluene	Removing adhesive from pad and bumpers on Engine Handling Dolly G4058 and plate and seal on Turbine Exhaust Exit Pressure Test Fixture G3144.
Turco 4215 (Turco Products)	Additive	Cleaning fabric material and streamers.
VV-L-800 (Federal Specification)	Lubricating oil	Protecting unpainted carbon steel working surfaces. Fluid used in lubricator bowl of flange polishing tool T-5047802.
VV-P-236 (Federal Specification)	Petrolatum	Lubricating seal and seal mating surface of Thrust Chamber Throat Plug G3136.
WD-40 (Rocket Chemical Co)	Preservative	Protecting plated surfaces; lubricating plated surface of arm 9026370 on Nozzle Extension Handling Fixture G4080; lubricating external surface of depth micrometer T-5021812; lubricating external surfaces of torque and inspection tool T-5029467 and T-5035940; and cleaning parallel bars of hand facing tool T-5043020.
0200 (Minnesota Mining and Mfg)	Fabric cleaner	Cleaning engine environmental cover 99-9014130.
1357 (Minnesota Mining and Mfg)	Contact cement	Repairing seal on Turbine Exhaust Exit Pressure Check Fixture G3144.
1620 (L. S. Starrett Co)	Tool and instrument oil	Lubricating threads of depth micrometer T-5021812.
584 (Coast Pro-Seal)[a]	Adhesive	Bonding pad or bumper on Engine Handling Dolly G4058.
7862 (Victor Gloves, Inc)	Nylon gloves	Handling parts that will contact operating fluids.

(a) Compound has limited shelf life. Refer to age controlled compounds in R-3896-3 for usability test.

Figure 1-2. Materials Specified in This Manual (Sheet 9 of 9)

Part No.	Name	Use	Part No.	Name	Use
253 (Osborne Mfg Co)	Brass-wire brush	Removing corrosion from electrical components, copper, and copper alloys.	Model B (Zonne Industries Tool Co)	Heat gun	Dehydrating fungi on electrical components.
1777 (Osborne Mfg Co)	Carbon-steel-wire brush	Removing corrosion from carbon steel material.	81-34-05-10 (Bausch and Lomb, Inc)	Monocular magnifier	Examining area for corrosion.
263-D (Osborne Mfg Co)	Soft-bristle brush	Applying paint removers and cleaning compounds.	Local purchase	1/2-inch magnet	Distinguishing between low-alloy ferrus metals and stainless steels, or nonferrous metals (except nickel).
1777-SV-48 (Osborne Mfg Co)	Stainless-steel-wire brush	Removing corrosion from CRES material.			
263-A (Osborne Mfg Co)	Stiff-bristle brush	Applying paint removers and cleaning compounds.			

Figure 1-3. Equipment for Maintenance of Metal Surfaces

1-35. CORROSION.

1-36. Corrosion is the destructive conversion of metal to a metallic compound. Temperature, humidity, proximity of dissimilar elements, and electrical factors can retard or accelerate the pace of corrosion. All corrosion products in critical areas must be removed and a protective coating applied immediately to provide maximum protection. Failure to completely remove all corrosion products can leave a corrosion-prone area that may begin to corrode immediately despite the presence of a protective coating.

1-37. CORROSION-PRONE AREAS.

1-38. Certain materials and combinations of materials are more prone to corrosive attack than others. During any inspection for corrosion, particular attention should be paid to parts and areas designated in the following paragraphs.

1-39. NUTS AND BOLTS. When using nuts and bolts or screws of different material than the parts they fasten, either the nut and bolt, or the parts they fasten, are prone to corrosion.

1-40. FLANGES AND CONNECTIONS. Where ducts, lines, and tubes are connected to dissimilar metals, a corrosive potential exists. Moisture from the duct, line, or tube, collecting on the lower flange or connection, becomes the electrolyte that starts the corrosive action.

1-41. WELD AREAS. Corrosion-resistant steel weld areas are corrosion-prone.

1-42. CREVICES AND JOINTS. Dirt and moisture tend to collect and remain in these areas and cause a corrosion-prone area.

1-43. DISSIMILAR METALS. When dissimilar metals are in electrical contact in the presence of an electrolyte, the less noble metal is prone to corrosion.

1-44. REMOVING PAINT FROM CORRODED AREAS.

1-45. All paint must be removed from any corroded area before corrosion removal and control procedures can be applied. Paint must be removed from the corroded area and from at least 2 inches of uncorroded metal around the area. Paint can be removed chemically or with a wire brush. Chemical paint removers must not be used in areas where the remover can become trapped. Paint and lacquer remover (Federal Specification TT-R-248) is not LOX-compatible; use dichloromethane (MIL-D-6998) near surfaces that require LOX-compatible materials.

a. Remove paint from areas where chemical removers can become trapped, with a wire brush and number 280 Carborundum paper. Wipe area clean with a cloth dampened with tap water.

WARNING

The following procedure specifies paint and lacquer remover (Federal Specification TT-R-248), which is corrosive and forms an explosive gel when mixed with liquid oxygen, creating a hazard to both personnel and equipment.

b. Where chemical removers can be used, remove paint as follows: (Use dichloromethane (MIL-D-6998) on areas that have direct or indirect contact with liquid oxygen or where structural complexities make it impossible to use a thickened paint remover. Use paint and lacquer remover (Federal Specification TT-R-248) on areas that do not have direct or indirect contact with liquid oxygen and where a thickened paint remover can be used.)

(1) Using a stiff-bristle brush, apply dichloromethane (MIL-D-6998) or paint and lacquer remover (Federal Specification TT-R-248), as applicable, to paint on corroded area.

(2) Allow chemical to remain on surface until paint softens and lifts.

CAUTION

Paint remover remaining on the surface can cause corrosion.

(3) Wash away loosened paint and remover or wipe from surface with a clean cloth frequently rinsed in tap water.

(4) Repeat substeps 1 through 3 until all paint is removed from surface.

(5) Wipe surface dry with clean, dry cloth.

1-46. CLEANING CORRODED SURFACES.

1-47. Before corrosion removal and control procedures (paragraphs 1-48 through 1-54) are performed, the corroded surfaces must be cleaned as follows:

a. Remove loosely adhering grease, paint, oil, dirt, and other foreign substances by wiping.

WARNING

The following procedure specifies 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.

- 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.

b. See figure 1-4 and clean corroded surfaces using cleaning agent and procedures noted.

c. If it is possible to isolate corroded area, seal off all nearby surfaces from cleaning agent, using moisture-proof cloth, tape, and drip pans.

d. Apply cleaning agent to surface with clean cloth or soft-bristle brush. On large, level surfaces pour cleaning agent directly on surface.

e. Allow cleaning agent to remain on surface for several minutes; then scrub with cloth or bristle brush. Do not allow cleaner to dry on surface.

f. Wipe surface thoroughly with a clean dry cloth.

g. Rinse surface thoroughly with distilled or deionized water before alkaline cleaning compound dries. Allow surface to dry completely.

Material	Cleaning Agent	Paragraph 1-47, Steps
Carbon steel	Drycleaning solvent (Federal Specification P-D-680, Type I)(a)	c through f
CRES and nickel alloys, and cadmium-plated, chrome-plated, nickel-plated, and silver-plated parts	Trichloro-ethylene (MIL-T-27602)	c through f
Aluminum alloy (painted)	Alkaline cleaning compound (MIL-C-25769)	c through e and g
Aluminum alloy (unpainted)	TEC 901 (TEC Chemical Co)	h through j

(a) If use of flammable solvent is prohibited, use cleaning compound (MIL-C-81302).

Figure 1-4. Materials and Procedures for Cleaning Corroded Surfaces

CAUTION

Avoid using excessive amounts of TEC 901 to prevent uncontrolled running or dripping. TEC 901 can remove paint or protective finishes from adjacent surfaces, causing corrosion.

h. Apply TEC 901 (TEC Chemical Co) with a clean, soft cloth. Apply in long strokes to remove all foreign deposits and accumulations of grease and dirt.

i. Repeat step h as necessary, using a fresh application of chemical and a clean cloth until surface is clean.

j. For final wipe, squeeze cloth as dry as possible.

1-48. REMOVING CORROSION FROM CARBON STEEL.

1-49. Remove corrosion from carbon steel as follows:

a. Clean area in accordance with instructions in paragraph 1-46.

b. If surface is painted, remove paint in accordance with instructions in paragraph 1-44.

c. On small or complex components, remove all corrosion products using carbon-steel wool or number 400 Carborundum paper. On large heavy equipment, a carbon-steel-wire brush may be used to remove surface corrosion deposits.

WARNING

The following procedure specifies 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.

d. Rinse area with drycleaning solvent (Federal Specification P-D-680, Type I), and wipe dry.

e. Inspect area for corrosion with a 4-power monocular magnifier. If all corrosion has not been removed, repeat steps c and d.

WARNING

The following procedure specifies corrosion-preventive compound (MIL-C-16173), which 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 compound can cause serious injury.

f. Apply lubricating oil (Federal Specification VV-L-800) to unpainted working surfaces, and corrosion-preventive compound (MIL-C-16173, Grade 1) or corrosion preventative RB0210-016 (Rocketdyne) to unpainted stationary surfaces.

NOTE

Corrosion preventative RB0210-016 must be thoroughly mixed at 70° to 95° F immediately before each application.

g. On painted surfaces, refinish as follows:

(1) Thoroughly mix and apply one coat of lacquer primer (MIL-P-11414) or zinc chromate primer (MIL-P-8585, color Y).

(2) Thoroughly mix and apply 2 coats of orange-yellow gloss enamel (Federal Specification TT-E-489), color 13538 (Federal Standard 595), or match existing color in surrounding area.

1-50. REMOVING CORROSION FROM CORROSION-RESISTANT STEEL, NICKEL, AND NICKEL ALLOYS.

1-51. Remove corrosion from CRES, nickel, and nickel alloys as follows:

a. Clean area in accordance with instructions in paragraph 1-46.

b. On small or complex components, clean corroded area with stainless-steel wool or number 400 Carborundum paper until no corrosion is visible.

CAUTION

Vigorous, heavy, continuous rubbing of CRES by a power-driven wire brush can generate enough heat to cause metallurgical changes. Use care to avoid damage to equipment.

c. On large components and heavy equipment, use a stainless-steel wire brush or a power-driven stainless-steel brush attachment to remove surface corrosion deposits.

d. Wipe surface with clean cloth dampened with distilled or deionized water.

e. Inspect area for corrosion with a 4-power monocular magnifier. If all corrosion has not been removed, repeat steps b or c and d.

1-52. REMOVING CORROSION FROM CADMIUM-PLATED, CHROME-PLATED NICKEL-PLATED, AND SILVER-PLATED PARTS.

1-53. When a plated surface has become pitted and pitting is not restricted to small areas, the part or component must be replaced or refinished. The acceptability and repair requirements are to be specified by the manufacturer's representative. For corrosion and small pitted areas, perform the following:

a. Clean area in accordance with instructions in paragraph 1-46.

b. Remove corrosion from plated surface using a wire brush and wool made of same material as base metal or number 400 Carborundum paper.

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.

c. Rinse area with trichloroethylene (MIL-T-27602) and wipe dry.

d. Inspect area for corrosion with a 4-power monocular magnifier. If all corrosion has not been removed, repeat steps b and c.

e. Apply a thin, even coat of preservative WD-40 (Rocket Chemical Co) to plated surface. Do not apply more than one coat.

1-54. REMOVING CORROSION FROM ALUMINUM ALLOY.

1-55. Remove corrosion from aluminum alloy as follows:

a. Clean painted or unpainted aluminum alloy surfaces in accordance with instructions in paragraph 1-46.

b. Remove paint, if necessary, in accordance with instructions in paragraph 1-44.

CAUTION

When abrading clad aluminum, extreme care must be used not to rub through the pure aluminum coat. Without clad coating, some aluminum alloys corrode quickly.

c. Remove all corrosion products using aluminum wool or number 400 Carborundum paper.

d. Rinse with distilled or deionized water and wipe dry.

(MIL-T-27602) through the equipment and collect sample in a clean container.

b. Filter collected sample through a black 0.45-micron filter disk for particle counting. Do not disrupt particle distribution on disk.

c. Count particles. Maximum number of particle larger than 50 microns must not exceed 100. If particles exceed this limit, repeat steps a and b until within accepted limit.

d. Install filter in ultrasonic unit so that fluid will pass through filter in opposite direction of the designed flow.

e. Turn on ultrasonic unit and adjust it to 15-40 kc per second.

f. After 1 ±0.25 minutes, pass 500 milliliters of clean fluid through filter and collect fluid in a clean container.

g. Repeat step f at 4, 7, and 9 minutes and turn ultrasonic unit off. Dispose of backflush fluid.

NOTE

Fluid level in filter container must remain relatively constant at a point near the filter collar.

h. Repeat steps e through g 2 times.

i. Install filter in ultrasonic unit so that fluid will pass through filter in designed direction of flow.

j. Repeat steps a through c. Turn on ultrasonic unit and adjust it to 15-40 kc per second.

k. After 1 ±0.25 minute, and at 4, 7, and 9 minutes, pass 500 milliliters of clean trichloroethylene (MIL-T-27602) through the filter and collect fluid in clean containers.

NOTE

Fluid level in filter container must remain relatively constant at a point near the filter collar.

l. Repeat step k 3 times and turn off ultrasonic unit.

m. Filter the 2,000-milliliter sample through a black 0.45-micron membrane disk, rinsing collection container when approximately 25 milliliters of sample fluid remains to be filtered. Do not disrupt particle distribution on disk.

n. Count particles. 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, without differentiating 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.

o. Dry filter using filtered (25-micron absolute or better) low-pressure gaseous nitrogen MIL-P-27401) or placing filter in an oven at 200 ±10° F for a minimum of 30 minutes.

p. Handle and package cleaned parts as outlined in paragraph 1-46.

1-37. CLEANING ELECTRICAL CONNECTORS.

WARNING

The following procedure specifies isopropyl alcohol, 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. Brush connector lightly using a soft-bristle brush and isopropyl alcohol (Federal Specification TT-I-735).

b. Immediately dry connector surfaces that have been cleaned with alcohol, with low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the requirements of MIL-P-27401, for 2 minutes minimum. (Refer to paragraph 1-30A for drying and safety requirements.)

1-38. CLEANING TRANSDUCERS.

CAUTION

Pressure transducers are delicate instruments and must be handled with extreme care. Solid material must not be inserted in the sensing cavity. Cleaning solution temperatures must not exceed 165° F.

a. Seal sensing port to prevent entrance of solution. Pre-clean by immersing transducer in solution of 50-55 percent nitric acid (Federal Specification O-N-350) for a maximum of 20 minutes. Reduce immersion time by 2 minutes for each 10° above 100° F.

WARNING

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.

b. Flush external surfaces with cleaning compound (MIL-C-81302). A rubber eraser may be used to remove excess carbon.

c. Flush sensing cavity with cleaning compound (MIL-C-81302).

NOTE

The tube used to flush or rinse the sensing cavity must not be inserted more than 1/4 inch.

d. Rinse transducer and cavity with cleaning compound (MIL-C-81302).

e. Repeat steps b through d to remove any remaining residue.

f. Immediately dry transducer with low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the requirements of MIL-P-27401. (Refer to paragraph 1-30A for drying and safety requirements.)

1-39. INSPECTING PARTS FOR CLEANNESS AND DAMAGE.

1-40. Several test methods may be used to determine if parts are clean or damaged. More than one test should be performed if any doubt exists as to the cleanness of the part. Visual inspection is normally a satisfactory method for determining damage. For parts where damage is suspected but not apparent, however, the dye-penetrant or magnetic-particle inspection methods may be used, as applicable. If inspection of a component or part reveals a defect that does not have an acceptability or repair disposition within this manual, the defect must be referred to the manufacturer's representative for acceptability and repair disposition.

1-41. VISUAL INSPECTION. Inspect parts for the presence of moisture, rust, scale, dirt, chips, oil, grease, or other debris. The presence of any of these requires recleaning. Discolorations caused by welding or passivation are not grounds for recleaning unless accompanied by rust or scale. The water-break test and soiling test (paragraphs 1-42 and 1-43) may be used, as required, to aid visual inspection.

1-42. WATER-BREAK TEST. This test is performed on metal parts by pouring a small amount of distilled water over visible and completely accessible cleaned areas of the part. An unbroken water film should form on the metal surface. If the water forms into small droplets, reclean the part. Following testing, remove water from part with low-pressure (50-100 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air conforming to the requirements of MIL-P-27401 (refer to paragraph 1-30A for drying and safety requirements) or by hand-wiping with a clean, hemmed nylon cloth.

NOTE

Some materials, even if clean, do not present a water-break-free surface and require additional tests.

1-43. SOILING TEST. Lightly wipe cleaned part with a clean, lint-free, white cloth. Do not rub hard on soft materials, such as aluminum, since metal removal can occur and be confused with dirt. Any visible deposit on the cloth requires recleaning of the part.

1-44. DYE-PENETRANT INSPECTION. The dye-penetrant inspection method is used for parts treated by chemical film or anodic coatings and parts used for indirect liquid oxygen service. This method of inspection may be used to detect surface defects or indications of possible defects in parts made of nonabsorbent, nonporous material. Dye-penetrant indications are not necessarily cause for rejection. It is the responsibility of a dye-penetrant inspector, certified by MIL-STD-410, to evaluate indications and to determine whether an indication actually represents a defect. Perform the dye-penetrant inspection as follows:

a. Clean part (paragraph 1-27) using appropriate method for type of service in which part is used.

e. Inspect area for corrosion with 4-power monocular magnifier. If all corrosion has not been removed, repeat steps c and d.

f. After removing corrosion, refinish surfaces that are to remain unpainted as follows:

(1) Clean area with TEC 901 (TEC Chemical Co).

(2) Clean area with distilled water. Do not wipe dry.

NOTE

Chemical film solution must be mixed with distilled or deionized water in accordance with manufacturer's instructions.

(3) While surface is still damp, apply chemical film (MIL-C-5541) with a clean brush.

(4) Keep area wet with fresh solution for 15-20 minutes.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

(5) Rinse area with distilled water. Dry area with low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or allow to air dry. Do not wipe dry.

g. On surfaces to be painted, if required, apply zinc chromate primer (MIL-P-8585, color Y) and 2 coats of orange-yellow gloss enamel (Federal Specification TT-E-489), color 13538 (Federal Standard 595). Thoroughly mix both primer and enamel before use.

1-56. CLEANING.

1-57. All control assemblies, tubing, hoses, and tools that are installed in or will come into contact with a propellant, hydraulic, or pneumatic system must be cleaned in accordance with the requirements of Marshall Space Flight Center Specification 164. Components, parts, or equipment removed from a clean system and handled in accordance with the contamination prevention requirements outlined in this manual may be reinstalled without additional cleaning. Lightly soiled parts may be used if cleaned using specified procedures in applicable paragraphs 1-58 through 1-70 and found acceptable when visually inspected in accordance with paragraph 1-74. Before removing a component or part from a system, the surrounding area must be cleaned as follows:

NOTE

Lightly soiled parts are defined as parts that since being cleaned for propellant, pneumatic, or hydraulic service have been exposed to the atmosphere, inadvertently touched by a bare but otherwise clean hand, and/or have come in contact with parts that are not cleaned for the services noted, but are visually clean.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

a. Blow area free of loose contaminants with a regulated source of low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air that conforms to the cleanness and humidity requirements of MIL-P-27401.

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.

b. Wipe area free of visible contaminants with a clean, lint-free cloth dampened with trichloroethylene (MIL-T-27602).

1-58. CLEANING METAL PARTS.

1-59. Clean lightly soiled metal parts in accordance with steps a through c. Clean all other metal parts in accordance with steps a, b, d, and e.

a. During this procedure, observe safety precautions in paragraph 1-2.

b. Wear polyethylene gloves during cleaning operations. Rubber or neoprene gloves must not be worn, since cleaning solvents dissolve these materials and leave a contaminating residue on the surface of the part.

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.

c. Lightly soiled parts may be cleaned by handwiping and flushing with trichloroethylene (MIL-P-27602) or cleaning compound (MIL-C-81302). Dry parts. (Refer to paragraph 1-72 for drying procedure.)

d. Parts that do not come in contact with a propellant, pneumatic, or hydraulic system, either directly or indirectly, may be cleaned as follows:

(1) Prepare a solution of 7-8 ounces of Oakite No. 61B (Oakite Products, Inc) per gallon of water and heat to 120° to 160° F.

(2) Immerse parts in solution. Do not allow parts to remain immersed over 10 minutes.

(3) Immersion-rinse parts in water heated to 130° to 160° F.

(4) Spray-rinse parts with water. Use care to thoroughly rinse crevices and areas where cleaning solution could be trapped.

(5) Dry parts. (Refer to paragraph 1-72 for drying procedure.)

WARNING

The following procedure specifies 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.

e. Clean exterior and interior surfaces of handling equipment, test equipment, and test consoles and panels containing dust or dirt with a clean, lint-free cloth. Clean surfaces containing oil or grease with a clean, lint-free cloth moistened with drycleaning solvent (Federal Specification P-D-680, Type I), and wipe dry with a clean, lint-free cloth.

f. Package cleaned parts that are not to be immediately assembled. (Refer to paragraph 1-76.)

1-60. CLEANING NONMETAL PARTS.

1-61. Clean nonmetal parts, fabric material, and streamers as follows:

a. During this procedure, observe safety precautions in paragraph 1-2.

b. Wear polyethylene gloves during cleaning operations specified in step c. Rubber or neoprene gloves must not be worn, since cleaning solvents dissolve these materials and leave a contaminating residue on the surface of the part.

WARNING

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.

- 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.

c. Clean lightly soiled nonmetal parts and all other nonmetal parts (except fabric material and streamers) by handwiping with clean nylon or lint-free cloth or by scrubbing with a clean nylon-bristle brush dampened with cleaning compound (MIL-C-81302) or trichloroethylene (MIL-T-27602).

d. Dry parts. (Refer to paragraph 1-72 for drying procedure.)

e. Clean fabric material and streamers by immersing in an agitated solution of 4 ounces of additive Turco 4215 (Turco Products), or equivalent, for each gallon of water heated to 130° ±10° F. Immersion-rinse in deionized water heated to 130° to 150° F for at least 2 minutes; then drip dry.

f. Package cleaned parts that are not to be immediately assembled. (Refer to paragraph 1-76.)

1-62. CLEANING COMBINATIONS OF METAL AND NONMETAL PARTS.

1-63. Parts that contain nonmetal items that are incompatible with the solvents used in this procedure must be treated as nonmetal parts (paragraph 1-60). If unable to determine compatibility of parts with solvents used in this procedure, contact manufacturer's representative for cleaning technique.

a. During this procedure, observe safety precautions in paragraph 1-2.

b. Wear polyethylene gloves during cleaning operations specified in step c. Rubber or neoprene gloves must not be worn, since cleaning solvents dissolve these materials and leave a contaminating residue on the surface of the part.

WARNING

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.

- 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.

c. Clean lightly soiled parts by handwiping and flushing with trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302).

d. Dry parts. (Refer to paragraph 1-72 for drying procedure.)

e. Parts that do not come into contact with a propellant, pneumatic, or hydraulic system, either directly or indirectly, may be cleaned as outlined in steps f through j.

f. Immerse and rotate parts for 2 minutes in a solution of 4-6 ounces of alkaline cleaner RB0210-002 (Rocketdyne) to each gallon of water heated to 125° to 140° F.

g. Immersion-rinse a minimum of 2 minutes in deionized water heated to 130° to 160° F.

h. Rinse in deionized water for at least 2 minutes.

i. Dry parts. (Refer to paragraph 1-72 for drying procedure.) If an air-circulating oven is used, dry parts at 160° ±10° F for 3 hours.

WARNING

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.

j. Final-rinse parts in cleaning compound (MIL-C-81302) for 2 minutes and repeat step i.

k. Package cleaned parts that are not to be immediately assembled. (Refer to paragraph 1-76.)

1-64. CLEANING WIRE MESH FILTERS.

1-65. The filter housing is cleaned as outlined in paragraph 1-58. The filter elements are ultrasonically cleaned as outlined in this paragraph. The ultrasonic generator and transducer must be capable of 15-40 kHz (kilocycles 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:

$$\frac{\text{Name tag rating of generator}}{\text{Tank surface area (in}^2)} = \text{Numer of watts/in}^2$$

All equipment used during the cleaning process must be clean and a cleanness check made (steps a through c) before starting the cleaning operation.

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.

a. Pass 2,000 ±200 milliliters of 0.45-micron-filtered trichloroethylene (MIL-T-27602) through equipment, and collect sample in a clean container.

b. Filter collected sample through a black 0.45-micron filter disk for particle counting. Do not disrupt particle distribution on disk.

c. Count particles. Maximum number of particles larger than 50 microns must not exceed 100. If particle count exceeds this limit, repeat steps a and b until within accepted limit.

d. Install filter in ultrasonic unit so that fluid will pass through filter in opposite direction of designed flow.

e. Turn on ultrasonic unit and adjust to 15-40 kHz.

f. After 1 ±0.25 minutes, pass 500 ±25 milliliters of clean fluid through filter.

g. Repeat step f at 4, 7, and 9 (±0.25) minutes, and turn ultrasonic unit off. Dispose of backflush fluid. Fluid level in filter container must remain relatively constant at a point near filter collar.

h. Repeat steps e through g 2 times.

i. Install filter in ultrasonic unit so that fluid will pass through filter in designed direction of flow.

j. Repeat steps a through c. Turn on ultrasonic unit and adjust to 15-40 kHz.

k. After 1, 4, 7, and 9 (±0.25) minutes, pass 500 ±25 milliliters of clean trichloroethylene (MIL-T-27602) through filter and collect fluid in clean container. Fluid level in filter container must remain relatively constant at a point near filter collar.

l. Filter 2,000-milliliter sample through a black 0.45-micron membrane disk, rinsing collection container with a like quantity of 0.45-micron-filtered trichloroethylene (MIL-T-27602) when approximately 25 milliliters of sample fluid remains to be filtered. Do not disrupt particle distribution on disk.

m. Count all particles on effective filter disk area that are 50 microns or over. Do not differentiate between a particle and a fiber. Tabulate particles into two groups, 50-100 microns and over 100 microns. Counts exceeding 1,000 particles in 50-100 micron range or 200 particles in over 100-micron range, requires recleaning of filter.

n. Dry filter. Air-dry, using paragraph 1-72 procedures, except gaseous nitrogen or air must be filtered (25-micron absolute or better), or dry filter in oven at 200°±10° F for a minimum of 30 minutes.

o. Package cleaned filters that are not to be immediately assembled. (Refer to paragraph 1-76.)

1-66. CLEANING ELECTRICAL COMPONENTS.

1-67. Clean electrical components as follows:

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

a. Remove dust, dirt, and foreign matter from electrical components with low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air that conforms to the cleanness and humidity requirements of MIL-P-27401.

WARNING

The following procedure specifies methyl-ethyl-ketone, 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.

b. Remove stains, grease, and foreign materials from exterior surfaces of cables by brushing with a soft-bristle brush or by wiping with a clean, lint-free cloth dampened (not saturated) with methyl-ethyl-ketone (Federal Specification TT-M-261). Do not allow methyl-ethyl-ketone to contact inner surfaces of connectors.

WARNING

The following procedure specifies isopropyl alcohol, 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 interior and exterior surfaces of connectors by brushing lightly with a cotton swab or a soft-bristle brush dipped in isopropyl alcohol (Federal Specification TT-I-735).

d. Immediately blow connector dry. (Refer to paragraph 1-72 for drying procedure.)

e. Install protective closure on connector unless connector is to be connected immediately.

1-68. CLEANING BURST DIAPHRAGM ASSEMBLIES.

1-69. Clean burst diaphragms as follows:

WARNING

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.

CAUTION

The diaphragm disk is fragile. Probing, rubbing, brushing, or applying pressurized gas can damage the diaphragm disk.

a. Clean burst diaphragms with cleaning compound (MIL-C-81302). The burst diaphragm is not to be disassembled for cleaning. Do not probe, wipe, brush, or otherwise contact interior surfaces. Clean interior surfaces by hand-agitating the diaphragm in cleaning compound.

b. Air-dry assembly before use or packaging; do not use pressurized gas.

1-70. CLEANING PRESSURE TRANSDUCERS.

1-71. Pressure transducers are delicate instruments and must be handled with extreme care. Solid material must not be inserted in the sensing cavity. Cleaning solution temperatures must not exceed 165° F. Clean pressure transducers as follows:

WARNING

The following procedure specifies isopropyl alcohol, 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. Clean exterior surfaces of connector by brushing lightly with a natural-fiber brush dipped in isopropyl alcohol (Federal Specification TT-I-735). Install protective cap.

WARNING

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.

b. Clean exterior surface of transducer by handwiping with a clean, lint-free cloth moistened in cleaning compound (MIL-C-81302).

c. Flush sensing port with cleaning compound (MIL-C-81302).

CAUTION

The tube used to flush or rinse the sensing cavity must not be inserted more than 1/4 inch.

d. Rinse transducer in cleaning compound (MIL-C-81302).

e. Immediately dry transducer. (Refer to paragraph 1-72 for drying procedure.)

1-72. DRYING CLEANED PARTS.

1-73. Immediately after cleaning, parts must be thoroughly dried to remove the cleaning solution and remaining moisture. Unless otherwise specified, dry parts as follows:

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

a. Observe facility safety requirements.

b. Thoroughly dry parts with a regulated source of low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or clean, dry air that conforms to the cleanness and humidity requirements of MIL-P-27401, or dry parts in an air-circulating oven at a temperature of 250° ±10° F for one hour (or as specified in applicable maintenance procedure). Apply gaseous nitrogen or air only to surface area to be dried and in a direction away from the body and other personnel.

1-74. INSPECTING FOR CLEANNESS.

1-75. Inspect parts for moisture, rust, scale, dirt, chips, oil, grease, or other foreign materials that require recleaning of parts. Discoloration caused by welding or passivation is not considered grounds for recleaning unless accompanied by rust or scale.

1-76. HANDLING AND PACKAGING CLEAN PARTS.

1-77. Improper handling of clean parts during removal and installation procedures, or after cleaning, can result in unnecessary expenditure of time and effort to reclean parts. It is recommended that clean parts be handled and packaged as follows:

a. Wear clean nylon gloves No. 7862 (Victor Gloves, Inc) or disposable polyethylene gloves where hand contact is made with surfaces that will contact operating fluids (liquid or gas).

b. Upon removal of clean parts or upon completion of cleaning procedure, immediately install suitable closures or covers to prevent contamination of parts or damage to sealing surfaces.

c. Package parts, except when parts are to be assembled, as follows:

(1) Package small, lightweight parts that have external or exposed surfaces that come in contact, directly or indirectly, with propellant, pneumatic, or hydraulic systems, in a clean vinyl or polyethylene (0.004 inch minimum) bag, and heat-seal bag. If part weighs more than 3 pounds, use bags with a minimum wall thickness of 0.006 inch. If part has sharp projections, use 2 bags, one inside the other, to minimize possibility of puncture. If this method is inadequate, use an initial wrap of several layers of polyethylene film instead of inner bag.

(2) Seal decals or labels to plastic bag during sealing operation.

(3) For parts with such shape, fragility, finish, or weight that packaging instructions in substep 1 are inadequate, additionally wrap parts in polyurethane or polyethylene foam. For

parts weighing less than 7 pounds, the minimum thickness of the polyurethane foam must be 1/2 inch, and for parts weighing 7-10 pounds, one inch. If polyethylene foam is used, the minimum thickness used must be 1/8 inch for parts less than 7 pounds, 1/4 inch for parts weighing 7-10 pounds, 3/8 inch for parts weighing 10-15 pounds, and 1/2 inch for parts weighing 15-20 pounds.

(4) Pack parts in a suitable, snug-fitting container marked with same information as on part except serial number.

(5) Certify cleanness; identify all parts as to specific service with appropriate seals, labels, or decals. Seals, labels, or decals must not be applied to surfaces that will be in contact with the propellants or pneumatic gases, machined surfaces, or sealing surfaces.

(6) Identify parts that have been lubricated for a specific service, with appropriate labels or decals.

(7) For parts packaged in cartons, certify that part has been cleaned and properly packaged by marking specific service on exterior of package.

1-78. INSPECTING PARTS FOR DAMAGE.

1-79. Several test methods may be used to determine if parts are damaged. Visual inspection is normally a satisfactory method for determining damage. For parts where damage is suspected but not apparent, however, the dye-penetrant or magnetic-particle inspection methods may be used as applicable. If inspection of a component or part reveals a defect that does not have an acceptability or repair disposition within this manual, the defect must be referred to the manufacturer's representative for acceptability and repair disposition.

1-80. VISUAL INSPECTION.

1-81. Visually inspect parts for damage as follows:

a. Threaded inserts for loose inserts, damaged threads, and correct installation depth.

b. Tapped threads for damaged threads. Threads in parent metal must be inspected if the insert is removed.

c. Electrical connectors for fungus, loose and damaged pins, and stripped, burred, and crossed threads; cables for fraying.

d. Dynamic and static sealing surfaces for nicks, burs, and scratches that could impair sealing function.

e. Anodic-coated surfaces for worn or damaged coating.

f. Evidence of corrosion, distortion, or cracked welds.

1-82. DYE-PENETRANT INSPECTION.

1-83. The dye-penetrant inspection method is used for parts treated by chemical film or anodic coatings and parts used for indirect liquid oxygen service. This method of inspection may be used to detect surface defects or indications of possible defects in parts made of nonabsorbent, nonporous material. Dye-penetrant indications are not necessarily cause for rejection. It is the responsibility of a dye-penetrant inspector, certified by MIL-STD-410, to evaluate indications and to determine whether an indication actually represents a defect. Perform the dye-penetrant inspection as follows:

a. Clean part (paragraph 1-56) using appropriate method for type of service in which part is used.

b. Brush or spray a light, even coat of SKL-4 dye-penetrant (Magnaflux Corp) on areas to be inspected.

c. Allow penetrant to remain on part for a minimum of 5 minutes at 60° to 90° F. Parts that have been in an environment of less than 60° F must be preheated to 60° to 150° F and allowed to remain at normal room temperature (60° to 90° F) for a minimum of 30 minutes before application of penetrant.

d. Remove excess penetrant with a clean, dry cloth followed by a water-dampened cloth.

e. Air-dry part for a minimum of one minute or wipe part with clean, dry cloth or paper towel before application of developer.

f. Thoroughly mix SKD-NF spot-check developer (Magnaflux Corp), and spray a thin, even coat on area to be inspected.

g. Wait a minimum of 5 minutes, and inspect area for defects.

h. Clean part after inspection using appropriate method for type of service in which part is used.

1-84. MAGNETIC PARTICLE INSPECTION.

1-85. Magnetic particle inspection is a nondestructive method used to detect cracks, laps, seams, nonmetallic inclusions, or other surface or subsurface discontinuities within 0.004 inch of the surface in ferromagnetic parts. When a part is magnetized by an electric current, a discontinuity that crosses the magnetic field creates magnetic poles on either side of the defect. When magnetic particles are applied to the part, the poles attract the particles and form an indication of the discontinuity. A magnetic particle inspection cannot be performed on aluminum, magnesium, brass, copper, bronze, lead, or titanium. Personnel performing magnetic particle inspections must be certified by MIL-STD-410. Perform inspection as follows:

a. Allow agitator system to circulate inspection medium for a minimum of 15 minutes before starting inspection operations.

b. Warm up black light on fluorescent magnetic particle equipment for a minimum of 15 minutes before using. A minimum of 125 foot-candles of illumination, at a distance of 15 inches from light source, is required.

c. Strip part if surface coating is greater than 0.003 inch thick.

d. Clean part, using appropriate method for type of service in which part is used.

e. Magnetize part in at least 2 directions.

f. Apply magnetic particles to part.

g. Following each magnetization, carefully examine part. The certified magnetic particle inspector must evaluate indications and determine whether an indication actually represents a defect.

h. Demagnetize part. Check part for residual magnetism with standard field indicator.

i. Clean part, using appropriate method for type of service in which part is used. All magnetic particles must be completely removed from part.

j. Reapply surface coating if coating was removed.

1-86. REPAIR.

1-87. Field repair of ground support equipment is authorized when such repair can correct the defect, has no detrimental effect on the safety or performance of the equipment, and has the concurrence of Rocketdyne Engineering. A component or part that cannot be repaired must be replaced with a part bearing the same part number or an approved alternate. If the tolerance for a part cannot be maintained after the removal of nicks, burs, or scratches, the part must be replaced. After repair, all parts must be cleaned, using the appropriate method for the type of service in which the part is used, before assembly and testing.

1-88. REPAIRING THREADS.

1-89. Threads may be repaired if total damage to threads does not exceed 50 percent of one thread. Threads that are considered repairable should be repaired with the correct-size tap or die. Replace parts whenever total thread damage exceeds 50 percent of one thread.

1-90. REPAIRING WELDS OR CRACKS.

1-91. Repair of part or component welds, parent metal cracks and distortion of part, or component surfaces other than specified within this manual, must be referred to the manufacturer's representative for acceptability and repair disposition.

1-92. REPAIRING DAMAGED SEALING SURFACES.

1-93. Field repair is authorized for damaged sealing surfaces that seal to an engine component flange. In each specific instance, contact the manufacturer's representative, who will determine disposition of damage surfaces and provide applicable repair instructions.

1-94. REPAIRING CHEMICAL FILM.

1-95. Either Iridite 14-2 solution (Allied Research Products) or Alodine 1200 (Amchem Products) (steps d and e) may be used in applying chemical film touchup to parts after repair. Apply chemical film touchup as follows:

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.

a. Clean part using trichloroethylene (MIL-T-27602), and wipe part dry with soft, clean cloth.

b. Wearing rubber gloves, deoxidize part by applying a mixture of one part by volume of cleaning compound (MIL-C-5410, Type II) and one part distilled or deionized water at 65° to 95° F. Use a soft-bristle brush or clean cloth to apply mixture, and keep surface wet for 5-10 minutes.

c. Using a spray, rinse part in clean tap water at room temperature, or wipe part with a clean cloth frequently wrung out in clean water.

WARNING

> The following procedure specifies Iridite and Alodine solutions, which are acids. Contact with the solutions can cause serious injury to personnel or damage to equipment.

d. Prepare Iridite solution by mixing 6 ounces of Iridite 14-2 powder and 0.01 ounce of ARP No. 2 detergent (Allied Research Products) in one gallon of water.

WARNING

> The following procedure specifies nitric acid, which must not be allowed to come in contact with any part of the body. Eye protection and protective clothing must be worn by personnel handling nitric acid. Spillage may cause fire. Nitric acid must be used in a well-ventilated area since the vapors are extremely hazardous. Inhalation of the vapors or contact with the liquid can cause serious injury or death. In case of contact, the skin or eyes must immediately be flushed with water for at least 15 minutes and given medical attention.

e. Prepare Alodine solution by mixing 4 ounces of Alodine 1200 powder (Amchem Products) with 0.5 ounce of nitric acid (Federal Specification O-N-350) in one gallon of water.

f. Wearing face shield and rubber gloves and using a soft-bristle brush or clean cloth, coat part with Iridite 14-2 solution for 3-5 minutes or coat part with Alodine 1200 solution for 1-3 minutes. Coat only a small area at a time. If no color develops, repeat steps b, c, and f.

g. Rinse part by flushing with tap water. Avoid hard-rubbing since wet film is easily removed.

WARNING

> Organic material upon which Iridite or Alodine solutions have dried, becomes highly flammable and could result in injury to personnel.

h. Thoroughly rinse solution from brushes and cloths.

1-96. REPAIRING PAINTED SURFACES.

1-97. Painted areas that have been damaged by handling, rework, or corrosion removal must be touched up to eliminate all bare or worn spots as follows:

a. Using number 400 Carborundum paper, feather edges of existing finish adjacent to damaged areas.

WARNING

The following procedure specifies 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.

b. Clean reworked and surrounding area with a clean cloth dampened with drycleaning solvent (Federal Specification P-D-680, Type I).

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 area with low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) or air that conforms to the cleanness and humidity requirements of MIL-P-27401.

d. Within one hour after cleaning, prime area with a thin coat of zinc chromate primer (MIL-P-8585, color Y).

e. Mix thoroughly and apply one coat of enamel of specified type and color.

f. For lettering and other markings, apply one coat of black semigloss enamel (Federal Specification TT-E-529), color 27038 (Federal Standard 595). For warning notices, use red gloss enamel (Federal Specification TT-E-489), color 11136 (Federal Standard 595).

1-98. REPASSIVATING 300-SERIES AND 400-SERIES CORROSION-RESISTANT STEEL.

1-99. Reworked areas on corrosion-resistant steels may be repassivated by swab passivation as described in the following steps. Parts brazed with silver, copper, or nickel alloys must not be passivated. Do not passivate Hastelloy B, 440 A (annealed); Monel 440, 440B (annealed); Monel K-500, 440 C (annealed); Nickel 200, 440 F (annealed); or Nickel 201.

a. If area is corroded, remove corrosion as outlined in paragraph 1-50.

b. If scratched or abraded, brush area to be passivated, with a fine-wire stainless-steel brush.

c. Polish area with crocus cloth.

WARNING

The following procedure specifies trichloroethylene or trichloroethane, which are toxic solvents. Inhalation of their vapors or prolonged contact with the liquids 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.

d. Thoroughly clean area with a clean, hemmed nylon cloth dampened with clean trichloroethylene (MIL-T-27602), trichloroethane (MIL-T-81533), or cleaning compound (MIL-C-81302). Dry area. (Refer to paragraph 1-72 for drying procedures.)

front mounts include support blocks, struts, drag braces, turnbuckles, and socket support blocks. The left front mount also includes a sway bar. The turnbuckles and drag braces secure the engine to the handler. The rear mount includes two yokes, a truss, a truss plug, and a spring-loaded compensator. The truss plug is secured in a bracket mounted on the rear of the chassis. The draw bar is detachable and may be stored during engine transport. Tiedown/lift rings are incorporated on the chassis at each of the corners. Two lift rings are located forward of rear stacking adapters on the chassis, and two lift adapters are stored on the forward platform. (See figure 1-4 for leading particulars for the air transport engine handler.)

Condition	Proof-Test	Loaded	Unloaded	Inspection	Exception
1. Normal usage	Specified		X	Specified	None
2. Proof-test expires, off-site	Extended	X		Visual	Until unloaded or 2 trips (loaded) from site to site or one trip (loaded) from site to Rocketdyne
3. Proof-test expires, off-site	Extended		X	Visual	Two trips (loaded) from site to site or one trip (loaded) from site to Rocketdyne
4. Completion of condition 2 or 3 and before next use	Mandatory		X	Specified	None
5. Not used after acceptance of equipment and/or unused between proof-test interval (equipment stored under controlled environment)	Extended		X	Visual	Specified interval begins after first use. Verification of "no use" is substantiated by application of Alucast No. 67 seals after final inspection, before acceptance, and after each proof-test and inspection.

Figure 1-3A. Proof-Test Conditions and Exceptions

WARNING

The following procedure specifies nitric acid, which must not be allowed to come in contact with any part of the body. Eye protection and protective clothing must be worn by personnel handling nitric acid. Spillage may cause fire. Nitric acid must be used in a well-ventilated area since the vapors are extremely hazardous. Inhalation of the vapors or contact with the liquid can cause serious injury or death. In case of contact, the skin or eyes must immediately be flushed with water for at least 15 minutes and given medical attention.

e. Prepare a 40-50 percent, by volume, solution of nitric acid (Federal Specification O-N-350) and distilled or deionized water. Slowly pour acid into required amount of water.

f. Using a cotton swab, passivate area by swabbing with nitric acid solution at 10-minute intervals for a minimum of 60 minutes. If necessary, provide a barrier to prevent solution from dripping on other equipment.

g. Thoroughly rinse cotton swab and area with tap water.

h. Final-rinse area with deionized or distilled water.

i. Dry area with clean, dry cloth.

1-100. APPLYING LUBRICANTS, SEALANTS, AND COMPOUNDS.

1-101. Lubricants, sealants, and compounds that are contaminated, whose shelf life has expired, or whose container labels are missing or unidentifiable must not be used. Clean nylon or polyethylene gloves must be worn where hand contact is made with sealing surfaces or surfaces that contact operating fluids (liquid or gas). Parts that will be reinstalled must have the original lubricant, sealant, or compound removed from the part and mating surfaces before lubricating. Lubricants, sealants, and compounds must be applied only to the areas designated. All stored containers must be tightly capped, and excess lubricant, sealants, or compounds must not be returned to the original container. All lubricants, sealants, and compounds must be free of grit, dirt, metal chips, and other foreign matter. The methods outlined below, which will be referenced in the applicable procedures, must be used to apply lubricants, sealants, and compounds. The following definitions apply to these methods.

a. O-Ring: A circular packing, gasket, or seal having a torus or doughnut shape. The O-ring cross section is usually round and has a small diameter relative to the inside and outside diameter of the O-ring.

b. Seal: Any sealing device other than an O-ring.

c. Static Condition: When an installed part encounters no movement except for vibrational or load forces.

d. Dynamic Condition: Where an installed part encounters planned movement.

NOTE

Only the lubrication methods used in this manual (Volumes I and II) are listed.

1-102. METHOD A - APPLYING LUBRICANT TO STRAIGHT THREADS (STATIC CONDITION).

a. Apply lubricant in a streak, flush with outside peaks of male threads, and across all threads except leading edge of first thread.

NOTE

The number and width of streaks vary with the outside diameter of threads.

b. Where more than one application is required, apply lubricant in equally spaced streaks around circumference of threads as follows:

(1) Threads up to 1/2 inch in diameter, one application 1/8 to 1/4 inch wide.

(2) Threads 1/2 to 1 inch in diameter, one application 3/8 inch wide.

(3) Threads 1 to 1-3/4 inches in diameter, two applications 1/2 inch wide.

(4) Threads 1-3/4 to 2-1/2 inches in diameter, three applications 1/2 inch wide.

(5) Threads 2-1/2 to 3 inches in diameter, four applications 1/2 inch wide.

(6) Threads over 3 inches in diameter, five applications 1/2 inch wide.

c. Distribute lubricant streaks uniformly around threads with a clean nylon brush. Remove excess lubricant. Make sure there is no lubricant on leading edge of first thread, in fitting openings, or on flared or chamfered sealing surfaces.

1-103. METHOD F - APPLYING LUBRICANT TO WASHERS.

a. Apply a thin film of lubricant to both sides of washer.

b. Remove excess lubricant.

1-104. METHOD G - APPLYING LUBRICANT TO TUBE COUPLING NUTS.

a. Slide coupling nut back on tube and remove any existing lubricant with a clean nylon cloth.

b. Apply a thin uniform film of lubricant to exterior thrust surface of sleeve or machined seat as shown in figure 1-5.

c. Remove all excess lubricant from end face and sealing surface of flare, to prevent contamination of system.

1-105. METHOD I - APPLYING THREAD SEALANT TAPE.

a. Apply thread sealant tape RB0140-002 (Rocketdyne) around external threads in the direction for loosening. Stretch tape slightly to conform tape to threads. Do not apply tape to engaging thread at end of fastener.

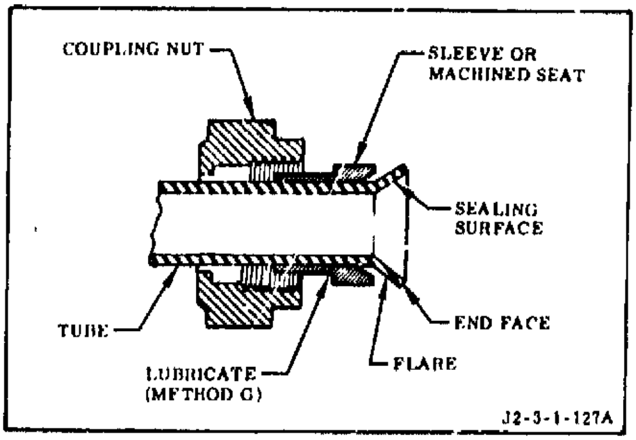


Figure 1-5. Applying Lubricant to Tube Coupling Nut Sleeves

b. Overlap starting turn of tape by approximately 1/2 inch and break tape. If width of threads is one inch or more, use 2 identical wrappings side by side.

1-106. METHOD J - APPLYING LUBRICANT TO O-RINGS (STATIC CONDITION).

a. Distribute lubricant over O-ring surface to form a thin, uniform film.

b. Remove excess lubricant.

1-107. METHOD K - APPLYING LUBRICANT TO O-RINGS FOR RETENTION.

a. Distribute lubricant over O-ring surface to form a thin, uniform film. Remove excess lubricant.

b. Apply a volume of lubricant approximating 10-15 percent of O-ring volume or groove volume on O-ring or in groove during installation of O-ring.

1-108. METHOD L - APPLYING LUBRICANT TO O-RINGS (DYNAMIC CONDITION).

a. Apply a thin, uniform film of lubricant on O-ring surface. Remove excess lubricant.

b. Apply a volume of lubricant approximating 25-30 percent of O-ring volume or groove volume, on O-ring or in groove during installation of O-ring. Apply excess to dynamic surface mating with O-ring, to form a uniform film.

c. Apply additional lubricant, if required, to mating surface to provide a thin, uniform film over the working surface. Remove excess lubricant from mating surface.

1-109. METHOD M - APPLYING OIL TO O-RINGS (STATIC CONDITION).

a. Apply a thin film of oil uniformly over O-ring surface.

b. Remove excess oil.

1-110. METHOD N - APPLYING OIL TO O-RINGS (DYNAMIC CONDITION).

a. Dip O-ring into oil and let excess oil drip from O-ring.

b. Install O-ring while it is thoroughly wet with oil.

1-111. METHOD O - APPLYING SEALANTS TO FLAT SEALS (STATIC CONDITION).

a. Apply sealant to both flat sides of seal until sides are thoroughly wet.

b. Remove excess sealant globules by wiping.

c. Allow applied sealants that contain solvents to air-dry for 3 to 5 minutes before installing part. Sealants containing solvents include gasket sealant RB0120-034 (Rocketdyne) and all Permatex (Permatex Co) sealants.

1-112. METHOD V - APPLYING LUBRICATING POWDER. Parts that have been special-cleaned need not be recleaned as outlined in this procedure. Soiled parts must be cleaned and lubricated as follows:

WARNING

The following procedure specifies 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. Clean all-metal parts with acetone (Federal Specification O-A-51). Dry parts as outlined in paragraph 1-72.

b. Clean and dry nonmetal parts in mild alkaline cleaner as outlined in paragraph 1-60.

c. Using a clean nylon cloth, rub powdered lubricant on surface until a film of uniform luster appears on all surfaces to be lubricated.

NOTE

Pressure-sensitive tape RB0195-002 (Rocketdyne) may be used for masking, if required.

d. Remove loose or caked powder.

e. Rub part with a clean, nylon cloth. The finished film must still appear after rubbing.

1-113. METHOD W - APPLYING LUBRICANTS TO PLAIN BEARING (SLIDING) SURFACES.

a. Apply lubricant to part during installation, or pack clearance volume during assembly.

b. Remove excess lubricant by wiping.

1-114. METHOD X - APPLYING LUBRICANTS WITH GREASE GUN.

CAUTION

Caution must be used when lubricating parts containing positive grease seals to prevent damage to seals.

a. Wipe grease fittings clean before lubricating.

b. Attach grease gun to fitting and inject lubricant until it extrudes between bearing surfaces.

c. Remove extruded lubricant, and lubricant from fittings.

1-115. METHOD Y - APPLYING LUBRICANTS TO BALL, ROLLER, AND NEEDLE BEARINGS.

a. Coat races and bearings with lubricant.

b. Hand-pack approximately 1/3 of clearance volume with lubricant during assembly.

1-116. METHOD Z - APPLYING LUBRICANTS TO METAL SLIDING SURFACES.

a. Apply a uniform coat of lubricant to mating parts.

b. Assemble parts and remove excess lubricant. Make sure that lubricant does not enter vent, pilot, or bleed openings.

1-117. INSTALLING THREADED FASTENERS.

1-118. During maintenance and repair, the installation of threaded fasteners is governed by the following general requirements:

a. Structural bolts or screws one dash number above that called out may be used to join pressurized or load-carrying components provided the thickness of the joint-thinner flange at the bolthole location is 0.125 inch or greater.

b. For structural joints (load-carrying or pressurized), additional washers of the same callout may be added up to a total added thickness of 10 percent of the thickness of the thinner flange at the bolthole location.

c. Deviation of bolt-length dash numbers and the number of washers used in steps a and b is not permitted for bolts and screws used with screw-thread inserts.

d. For nonstructural applications, bolts or screws three dash numbers above or below those called out may be used if there is full thread engagement (fastener penetrates full length of perfect (threads) and if no interference occurs.

e. Single washers, except countersunk washers, are installed at the nut end; however, when more than one is specified, the washers must be evenly divided between the head and nut ends of the bolt.

f. It is desirable that no threads be in bearing in any part of a joint where the threaded fasteners transmit a shear load. However, if unavoidable, a maximum of two threads may be in bearing if the material next to the nut meets the minimum thickness requirements of figure 1-6. Parts having relative movement at the fastener must not have threads in bearing.

g. Bolts used with self-locking nuts or inserts must not have cotter pin holes in the threaded shank.

h. Threaded parts must not be lubricated unless all of the following conditions prevail:

(1) Both parts are bare, corrosion-resistant steel.

(2) A lubricant for the service encountered is specified.

(3) A specific torque value is given.

i. Torquing of fasteners is performed by applying specified torque to the fastener. Fastener groups utilize the cross-torque method outlined in paragraph 1-125.

j. When a fastener is installed in a nut (except castellated nuts), at least one full thread must protrude through the top of the nut. Fasteners installed in inserts must penetrate the full length of the perfect threads of the insert.

1-119. INSTALLING COUNTERSUNK HIGH-STRENGTH AND HIGH-BEARING WASHERS.

1-120. Whenever countersunk washers RD153-5003-XXXX or MS20002 are required, the washer countersunk side must be installed adjacent to the bolt fillet radii. Where requirements are for two washers, the second washer must be installed under the nut. Figure 1-7 shows a high-tensile-strength bolt and nut installation using countersunk, high-bearing washers.

Material Next to Nut				Number of Threads in Bearing	Minimum Material Thickness (Inch) Next to Nut For Standard Fasteners Having a Tensile Strength of 125,000-140,000 PSI — Fastener Size (Inch)									Minimum Material Thickness (Inch) Next to Nut For High-Strength Fasteners Having a Tensile Strength of 160,000 PSI and Over — Fastener Size (Inch)							
					No. 10, 3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4
Aluminum Alloy	Sheet and Tubing	Alclad	2024-T4	1	0.156	0.250	0.250	0.312	0.375	0.375	0.438	0.500	0.625	0.250	0.312	0.375	0.438	0.500	0.625	0.625	0.750
				2	0.250	0.312	0.375	0.375	0.438	0.438	0.500	0.625	0.625	0.312	0.375	0.438	0.500	0.625	0.625	0.625	0.750
			7075-T6	1	0.125	0.156	0.138	0.250	0.250	0.312	0.312	0.375	0.438	0.188	0.250	0.250	0.312	0.375	0.375	0.438	0.500
				2	0.250	0.312	0.375	0.375	0.438	0.438	0.500	0.500	0.500	0.312	0.375	0.375	0.438	0.438	0.500	0.500	0.625
		Bare	2024-T4	1	0.156	0.250	0.250	0.312	0.375	0.375	0.438	0.500	0.625	0.250	0.312	0.375	0.438	0.438	0.500	0.625	0.750
				2	0.250	0.312	0.375	0.375	0.438	0.438	0.500	0.500	0.625	0.312	0.375	0.375	0.500	0.500	0.625	0.625	0.750
			7075-T6	1	0.125	0.156	0.188	0.250	0.250	0.250	0.312	0.312	0.375	0.188	0.250	0.250	0.312	0.312	0.375	0.375	0.438
				2	0.250	0.312	0.375	0.375	0.438	0.438	0.500	0.500	0.500	0.312	0.375	0.375	0.438	0.438	0.500	0.500	0.500
	Bar and Extrusion	2014-T6		1	0.128	0.163	0.201	0.232	0.272	0.304	0.343	0.373	0.444	0.196	0.244	0.283	0.332	0.372	0.418	0.458	[illegible]
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.506	0.286	0.334	0.334	0.400	0.422	0.473	0.513	0.607
		2024-T4		1	0.153	0.197	0.243	0.283	0.331	0.371	0.419	0.459	0.546	0.250	0.312	0.375	0.438	0.500	0.625	0.625	0.750
				2	0.250	0.286	0.334	0.334	0.400	0.421	0.414	0.514	0.608	0.312	0.375	0.438	0.500	0.625	0.625	0.625	0.750
		7075-T6		1	0.125	0.151	0.186	0.215	0.251	0.280	0.316	0.344	0.408	0.181	0.225	0.261	0.306	0.342	0.384	0.421	0.500
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.476	0.562
	Forgings	2014-T6		1	0.125	0.159	0.195	0.226	0.264	0.295	0.333	0.343	0.431	0.191	0.236	0.275	0.322	0.361	0.406	0.455	0.529
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.411	0.461	0.500	0.591
		7075-T6		1	0.125	0.151	0.186	0.215	0.251	0.280	0.316	0.344	0.408	0.181	0.225	0.261	0.306	0.342	0.384	0.421	0.500
				2	0.250	0.266	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.476	0.562
	Castings	195-T6, 356-T6		1	0.217	0.281	0.349	0.410	0.479	0.540	0.610	0.669	0.800	0.346	0.432	0.509	0.595	0.672	0.755	0.833	0.996
				2	0.250	0.316	0.390	0.451	0.529	0.590	0.665	0.724	0.862	0.381	0.473	0.550	0.645	0.722	0.810	0.888	1.058
		220-T4		1	0.201	0.259	0.321	0.377	0.440	0.496	0.560	0.614	0.733	0.318	0.396	0.467	0.546	0.616	0.692	0.763	0.911
				2	0.250	0.294	0.362	0.418	0.490	0.546	0.615	0.669	0.795	0.353	0.437	0.508	0.596	0.666	0.747	0.818	0.973
Magnesium	Castings	Heat-treated		1	0.255	0.330	0.410	0.484	0.564	0.638	0.721	0.792	0.947	0.408	0.509	0.603	0.703	0.796	0.895	0.989	1.182
				2	0.287	0.365	0.451	0.525	0.614	0.688	0.776	0.847	1.009	0.443	0.550	0.644	0.573	0.846	0.950	1.044	1.244
		Heat-treated and aged		1	0.238	0.309	0.383	0.451	0.527	0.595	0.671	0.738	0.882	0.381	0.475	0.561	0.656	0.741	0.832	0.920	1.099
				2	0.270	0.344	0.424	0.492	0.577	0.645	0.726	0.793	0.944	0.416	0.516	0.602	0.706	0.791	0.887	0.975	1.161
Steel	1020 or equiv			1	0.155	0.200	0.246	0.287	0.336	0.377	0.426	0.465	0.554	0.243	0.301	0.353	0.414	0.465	0.523	0.574	0.684
				2	0.250	0.286	0.334	0.334	0.400	0.427	0.481	0.520	0.616	0.286	0.342	0.394	0.464	0.515	0.578	0.629	0.746
	4130, 4140, 4340 8735 8740, or equiv	Normalized		1	0.125	0.143	0.173	0.200	0.234	0.260	0.294	0.319	0.379	0.159	0.208	0.242	0.284	0.316	0.356	0.389	0.463
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.525
		Heat-treated to 125,000 psi min		1	0.125	0.143	0.167	0.168	0.200	0.218	0.246	0.267	0.316	0.143	0.175	0.202	0.237	0.263	0.290	0.323	0.383
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500
		Heat-treated to 140,000 psi min		1	0.125	0.143	0.167	0.167	0.200	0.210	0.237	0.256	0.303	0.143	0.169	0.194	0.228	0.253	0.284	0.310	0.367
				2	0.250	0.286	0.334	0.344	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500
		Heat-treated to 160,000 psi min		1	0.125	0.143	0.167	0.167	0.200	0.202	0.228	0.247	0.292	0.143	0.167	0.187	0.219	0.243	0.273	0.298	0.353
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500
		Heat-treated to 180,000 psi min		1	0.125	0.143	0.167	0.167	0.200	0.200	0.222	0.240	0.284	0.143	0.167	0.182	0.214	0.237	0.266	0.269	0.343
				2	0.250	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500	0.286	0.334	0.334	0.400	0.400	0.444	0.444	0.500

Figure 1-6. Minimum Material Thickness Next to Nut for Threaded Fasteners Having Threads in Bearing

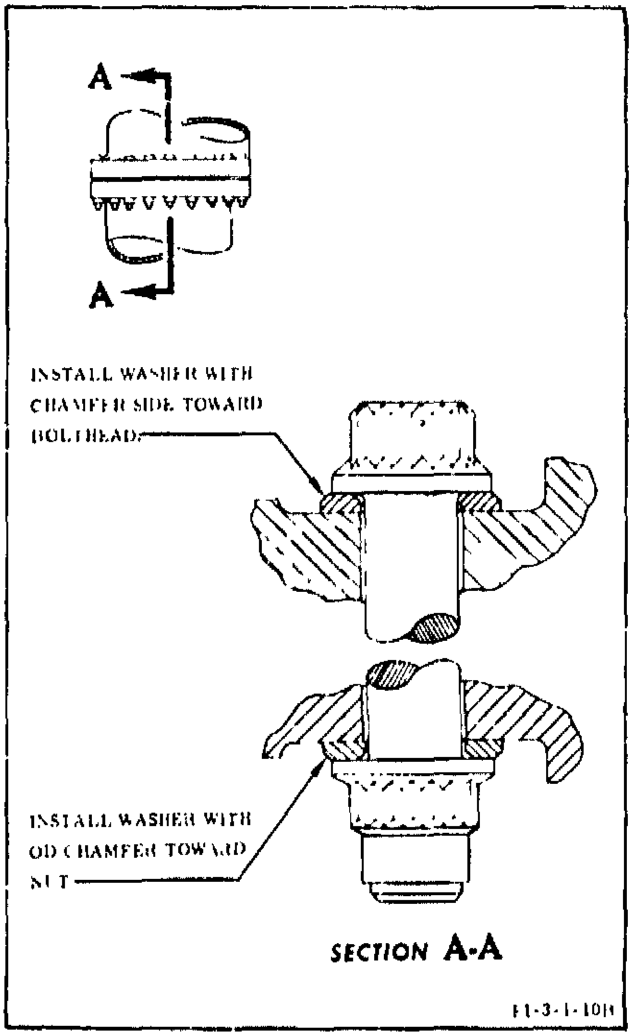


Figure 1-7. Installing Countersunk High-Strength and High-Bearing Washers

1-121. TORQUING.

1-122. Torque is a twisting force used to apply tension to fasteners. To achieve proper tension and accurate torque readings, the parts must be clean and (when required) correctly lubricated. The torque values called out in procedures in other sections of this manual are design requirements that result in maximum strength and sealing characteristics of the parts.

1-123. USING TORQUE WRENCH.

1-124. Torque wrenches are precision tools and must not be subjected to abuse or misuse. The use of an extension or adapter (figure 1-8) on a torque wrench will result in greater torque application than indicated on the dial. To obtain correct torque readings, the following steps must be strictly adhered to:

a. All torque wrenches must meet the calibration requirements of Federal Specification GGG-W-00686. Do not use torque wrenches after void date shown on each wrench, and never keep them in tool boxes or line supply cabinets.

b. Select correct torque wrench so that wrench will be operated in its upper range (20-100 percent).

NOTE

Torque values in this manual are based on the use of torque wrenches which in the upper 80 percent of their range are accurate to ±4 percent. Torque wrenches calibrated to Federal Specification GGG-W-00686 meet this requirement.

c. Take torque readings only while tightening fastener. Do not overtighten and then loosen to desired torque value.

d. Never jerk torque wrench. Apply force slowly and at 90 degrees to torque wrench handle for an accurate indication of torque being applied to fastener.

e. Do not attempt to use torque wrench to tighten fastener to a higher value than maximum value shown on torque wrench indicator.

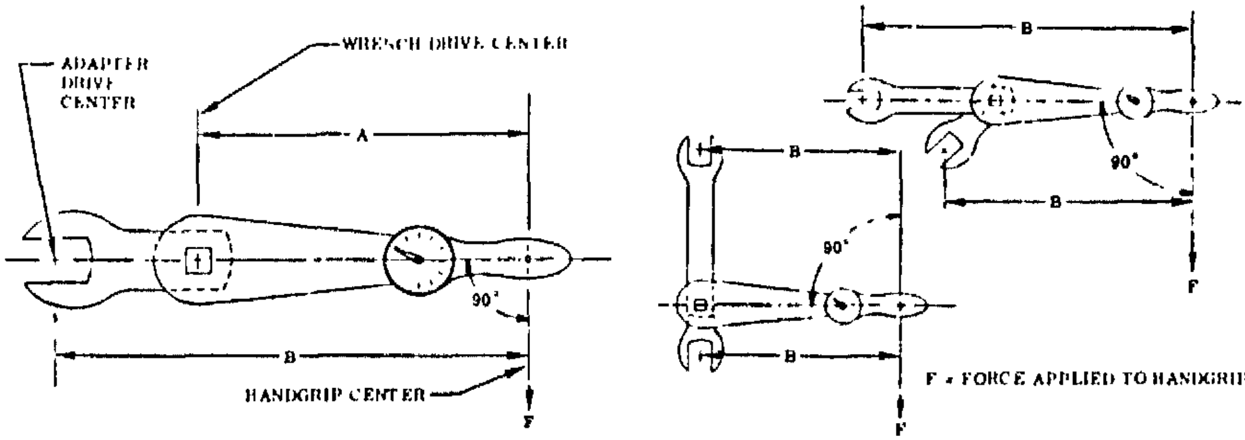
f. Install sockets fully on nut or bolt. Maintain a slight inload on tool to lessen chances of damage to fastener.

1-125. FASTENER CROSS-TORQUING METHOD.

1-126. Figure 1-9 is to be used as a guide for torquing bolted flanges or any bolted joint to apply an evenly distributed axial load to seals and gaskets. The following procedure is to be used when a definite method of torquing is not specified:

a. Cross-torque all bolts, following a numerical sequence similar to applicable pattern in figure 1-9, and continue diagonally until all bolts are torqued to one-third of total torque to be applied.

b. Repeat this procedure, torquing bolts in three increments until total specified torque is obtained.



When using an extension adapter on a torque wrench, the actual torque value applied may be widely different from the indicated torque value and may be above or below the allowable tolerance unless the proper conversion is used. When the adapter is used at right angles to the torque wrench centerline, dimensions A and B are equal, the conversion factor is 1.00, and the indicated and applied torque values are the same. When the adapter is attached to the torque wrench to effectively lengthen or shorten the moment of applied force, the B dimension changes, and the indicated torque value must be converted to make sure that the proper torque value is applied as follows.

1. Measure length of torque wrench from handgrip center to wrench drive center. This is dimension A.
2. With adapter attached to torque wrench in position for use, measure length of torque wrench and adapter. This measurement (dimension B) is taken from handgrip center to adapter drive center.
3. Divide dimension A by dimension B to obtain conversion factor.
4. Multiply required torque value (applied) by conversion factor to obtain torque reading (indicated) that must be used with adapter on wrench. For example:

> Dimension A on torque wrench is 12 inches. With adapter installed, dimension B is 17.365 inches. A ÷ B = 12 ÷ 17.365 = 0.691. Assuming the torque wrench with the adapter installed as a straight extension is to be used to tighten a bolt for which the torque value is 570-630 in-lb, 0.691 x 570 = 393.87 and 0.691 x 630 = 435.33. The torque reading (indicated) to be used when this particular adapter is installed on the torque wrench is 394-435 in-lb. If this adapter were installed on the torque wrench in any other position, dimension B would be different and a different torque reading would apply.

J2-3-1-95

Figure 1-8. Computing Torque Values When Using an Extension or Adapter

1-127. TORQUE VALUE REQUIREMENTS.

1-128. Torque values for threaded fasteners, coupling nuts, and fittings must be as specified in the following paragraphs.

1-129. TORQUE VALUES FOR FASTENERS IN PHENOLIC BLOCK AND LOOP-TYPE CLAMPS. When threaded fasteners are installed in phenolic block and loop-type clamps, nuts must be torqued to 24-30 in-lb (27-33 in-lb if torque is applied to fastener head) unless otherwise specified in the applicable procedure.

1-130. TORQUE VALUES FOR NONLOCKING, FLARED-TUBE COUPLING NUTS. (See figure 1-10.)

1-131. TORQUE VALUES FOR GASKETED AND NONGASKETED FITTINGS. (See figure 1-11.)

1-132. TORQUE VALUES FOR BOLTS, NUTS, AND SCREWS. To obtain proper torque value for bolts, nuts, and screws, determine part number of item: then see figure 1-12 for tensile strength and figure 1-13 for type. With tensile strength and type established, see figure 1-14 for required torque.

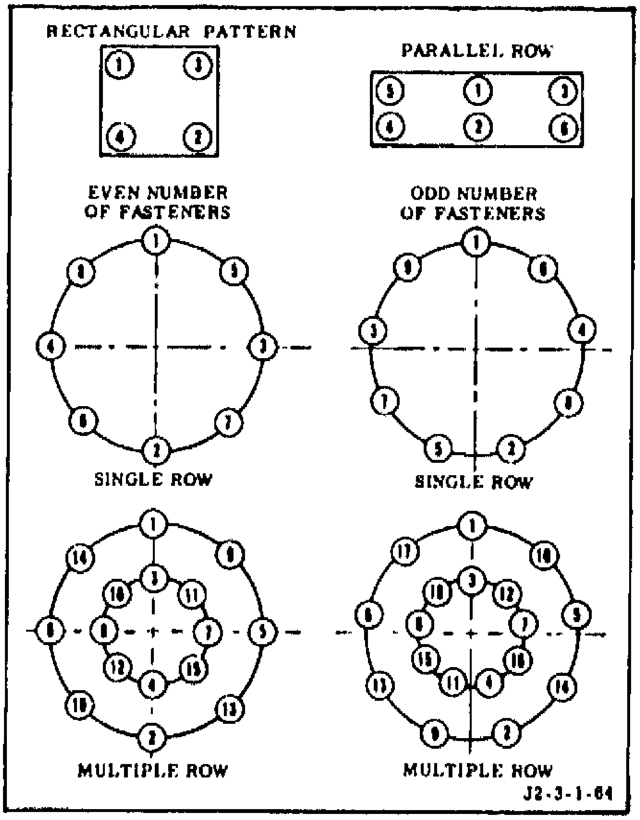


Figure 1-9. Fastener Cross-Torquing Method

CRES Tubing (MIL-T-6845)		
Tube OD (Inches)	Inch-Pounds	
	Minimum	Maximum
1/8	35	40
3/16	90	140
1/4	135	185
5/16	180	230
3/8	270	345
1/2	450	525
5/8	650	750
3/4	900	1,100
1	1,200	1,400
1-1/4	1,500	1,800
1-1/2	2,000	2,300
1-3/4	2,600	2,900
2	3,200	3,600

Figure 1-10. Torque Values for Non-Locking, Flared-Tube Coupling Nuts

1-133. SAFETYWIRING.

1-134. Safetywiring is the securing together of two or more parts with a wire that is installed in such a manner that the lockwire will be put in tension on at least one side of the bolt or screw head when the part tends to loosen.

1-135. SAFETYWIRING METHODS.

1-136. The lockwire must be as short as possible and attached in the most direct manner. A pigtail of 1/4 to 1/2 inch (3-6 twists) must be made at the end of the wiring and bent back or under in a direction that increases tension and prevents snagging. Any lockwire application that complies with Military Standard MS33540 and meets the requirements of this paragraph is acceptable. Typical safetywiring methods are shown in figure 1-15. The single-wire method may be used for small screws in a closely spaced, closed geometrical pattern, on parts in electrical systems and in places that are difficult to reach. When safetywiring widely spaced (maximum spacing is 6 inches) multiple groups by the double-twist method, three units is the maximum number in series. When safetywiring closely spaced multiple groups, the number of units that can be safetywired by a 24-inch length of wire is the maximum number in series. Caution must be used during the twisting operation to keep the wire tight without overstressing. Abrasions caused by commercially available wire-twisting pliers are acceptable, but nicks, kinks, and other mutilations caused by improper tooling and wiring techniques are not acceptable. Lockwire must be installed only one time; destroy wire if removed for any reason. Upon installation in the fastener, the lockwire must be anchored to the wire hole provided. In the event that no wire hole is provided, wiring must be to a convenient adjacent part in a manner so as not to interfere with the function of the part. Inconel lockwire MS20995N is used.

Torque Values for Gasketed Aluminum or Steel Fittings[a] (Inch-Pounds)								Torque Values for Jamnuts and Fittings Without Gaskets[b] (Inch-Pounds)			
Tube OD (Inches)	Fittings Thread Size	Nut AN924 Union AN815		Plug AN814		Nut AN6289		Aluminum		Steel	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1/8	5/16-24	25	35	10	16	25	35	35	50	--	--
3/16	3/8-24	50	75	30	40	50	75	65	80	70	90
1/4	7/16-20	55	80	40	65	75	100	90	105	110	130
5/16	1/2-20	75	100	60	80	90	120	105	125	140	160
3/8	9/16-18	100	150	80	120	150	200	125	145	225	275
1/2	3/4-16	180	230	150	200	200	250	240	280	400	450
5/8	7/8-14	250	350	200	350	275	400	330	370	550	650
3/4	1.1/16-12	420	600	300	500	450	650	540	660	800	960
1	1.5/16-12	600	840	450	600	650	900	840	960	1,000	1,200
1-1/4	1.5/8-12	720	960	600	720	800	1,000	960	1,200	--	--
1-1/2	1.7/8-12	840	1,080	600	800	900	1,100	1,200	1,440	--	--

(a) For use with O-rings and aluminum, asbestos, leather, Teflon, etc, gaskets or washers.
(b) For combinations of materials (either jamnut, fitting, or boss), use the lowest applicable values shown.

Figure 1-11. Torque Values for Gasketed and Nongasketed Fittings

Bolt or Screw Number	Tensile Strength (psi, min)	Identification	
		Type Head	Markings and Materials[a]
AN101001 thru AN101800	125,000	Hex	Head marked E11.
AN103701 thru AN104600	125,000	Hex	Drilled head marked E11.
AN104601 thru AN105500	125,000	Hex	Head marked EC3.

(a) Material may be considered carbon or alloy steel unless otherwise indicated.

Figure 1-12. Classification of Bolts and Screws (Sheet 1 of 5)

Bolt or Screw Number	Tensile Strength (psi, min)	Identification	
		Type Head	Markings and Materials[a]
AN107301 thru AN108200	125,000	Hex	Drilled head marked EC3.
AN117041	70,000	Oval fillister	Drilled head marked E4.
AN173 thru AN178	125,000	Hex	Head marked X in center of triangle.
AN3 thru AN8	125,000	Hex	Head marked with one X in center of head with or without single hole drilled in head and/or shank.
AN3C thru AN8C	125,000	Hex	Head marked with one dash (-) (off center).
AN500	60,000	Fillister	Alloy steel (cadmium plated), coarse thread.
AN500B	55,000	Fillister	Brass (unplated), coarse thread.
AN500C	70,000	Fillister	CRES (passivated).
AN501	60,000	Fillister	Alloy steel (cadmium plated) with or without drilled head.
AN501B	55,000	Fillister	Brass (unplated), fine thread.
AN501C	70,000	Fillister	CRES (passivated), with or without drilled head.
AN502 and AN503	125,000	Fillister	Head marked with raised or indented X, steel (MIL-S-6050).
AN505	55,000	82° flush	Alloy steel (cadmium plated).
AN505B	55,000	82° flush	Brass (black oxide finish).
AN505C	70,000	82° flush	CRES (passivated).
AN507	55,000	100° flush	Alloy steel (cadmium plated).
AN507C	70,000	100° flush	CRES (passivated).
AN509	125,000	100° flush	Head marked with 1 or 2 Xs (off center).
AN510	55,000	82° flush	Alloy steel (cadmium plated), fine thread.

(a) Material may be considered carbon or alloy steel unless otherwise indicated.

Figure 1-12. Classification of Bolts and Screws (Sheet 2 of 5)

Bolt or Screw Number	Tensile Strength (psi, min)	Identification	
		Type Head	Markings and Materials[a]
AN510B	55,000	82° flush	Brass (black oxide finish).
AN515	55,000	Round	Alloy steel (cadmium plated), coarse thread.
AN515B	55,000	Round	Brass (black oxide finish), coarse thread.
AN515C	70,000	Round	CRES (passivated), coarse thread.
AN510C	70,000	82° flush	CRES (passivated).
AN520	55,000	Round	Alloy steel (cadmium plated).
AN520C	70,000	Round	One or two dashes (-) on head.
AN526	55,000	Truss	Alloy steel (cadmium plated).
AN526C	70,000	Truss	CRES (passivated).
AN73 thru AN78	125,000	Hex	Head marked with one X (off center), 3 holes in head.
EWB22-4 thru EWB22-24	220,000	External, 12-point	Head marked Hi PSI EWB22 plus applicable dash number.
MS20004 thru MS20024	160,000	Internal hex	Head marked with basic MS part number.
MS20033 thru MS20046	75,000	Hex	Head marked 1200.
MS20073	125,000	Hex	Head marked with one X (off center), fine thread.
MS20074	125,000	Hex	Head marked with one X (off center), coarse thread.
MS21250	180,000	12-point	Head marked with basic part number.
MS9033 thru MS9038	130,000	External wrenching	A-286 CRES, head marked EH19.
MS9088 thru MS9094	125,000	External wrenching	Alloy steel, head marked E11.
MS9224	130,000	External wrenching	A-286 CRES, head marked EH19.

(a) Material may be considered carbon or alloy steel unless otherwise indicated.

Figure 1-12. Classification of Bolts and Screws (Sheet 3 of 5)

Bolt or Screw Number	Tensile Strength (psi, min)	Identification	
		Type Head	Markings and Materials[a]
NAS1003 thru NAS1020	140,000	Hex	A-286 CRES, head marked with basic part number and applicable dash number.
NAS1100	160,000	Pan	Head marked with complete part number.
NAS1101	160,000	Fillister	Alloy steel and CRES, head marked with complete part number.
NAS1102	160,000	100° flush	Head marked with complete part number.
NAS1103 thru NAS1120	160,000	Hex	Head marked with complete part number and manufacturer's trade mark.
NAS1202 thru NAS1207	160,000	100° flush	Head marked with complete part number, and manufacturer's trade mark (optional).
NAS1303	160,000	Hex	Head marked with complete part number and manufacturer's trade mark.
NAS334 thru NAS340	160,000	100° flush	Head marked with dot in a triangle plus basic part number.
NAS501	75,000	Hex	Head marked with one dash (-) off center), part number, and single hole in head or shank optional.
NAS563 thru NAS572	160,000	Hex	Head marked with complete part number.
NAS624 thru NAS644	180,000	External, 12-point	Head marked with basic part number.
RD111-1001	140,000	Hex	A-286 CRES, head marked with basic part number.
RD111-1004 and RD111-1005	140,000	Hex	A-286 CRES, silver plated; head marked with basic part number.
RD111-1006 thru RD111-1008	180,000	Hex	Inconel X, head marked with raised or indented part number.

(a) Material may be considered carbon or alloy steel unless otherwise indicated.

Figure 1-12. Classification of Bolts and Screws (Sheet 4 of 5)

Bolt or Screw Number	Tensile Strength (psi, min)	Identification	
		Type Head	Markings and Materials[a]
RD111-1009 thru RD111-1012	140,000	Hex	A-286 CRES, head marked with basic part number.
RD111-3001 and RD111-3002	165,000	Internal wrenching	Inconel X, head marked with basic part number.
RD111-3003 and RD111-3004	140,000	Internal wrenching	A-286 CRES, head marked with basic part number.
RD111-3005 and RD111-3006	140,000	Internal wrenching	Head marked with first dash number.
RD111-4001 and RD111-4002	180,000	External, 12-point	K-Monel CRES, head marked with basic part number.
RD111-4003 and RD111-4004	180,000	External, 12-point	Rene' 41 CRES, head marked with basic part number.
RD111-4005 and RD111-4006	180,000	External, 12-point	Alloy steel, head marked with basic part number.
RD111-4008 thru RD111-4012	200,000	12-point	A-286 CRES, silver plated (optional); head marked with complete part number.

(a) Material may be considered carbon or alloy steel unless otherwise indicated.

Figure 1-12. Classification of Bolts and Screws (Sheet 5 of 5)

Nut Part No.	Tensile Type	Shear Type	Nut Part No.	Tensile Type	Shear Type
AN310	X		MS20364		X
AN315	X		MS20365	X	
AN316		X	MS20500	X	
AN320		X	NAS509	X	
AN340	X		NAS679	X	
AN363	X		RD114-1001	X	
AN364		X	RD114-1002	X	
AN365	X		RD114-8001	X	
IN7 and LD114-0005 through -0008		X	RD114-8002	X	
MS20341	X		RD114-8003	X	

Figure 1-13. Classification of Nuts

Bolt, Stud, or Screw Size	Shear-Type Fasteners		Tensile-Type Fasteners		
	55,000-89,000 psi (in-oz)	90,000 psi and Greater (in-oz)	55,000-89,000 psi (in-oz)	90,000-124,000 psi (in-oz)	125,0 159,0 (in-
0-80	2 to 2.5	5 to 6	3.5 to 4.5	8 to 10	10.5 t
1-72	4 to 5	9.5 to 12	6.5 to 8.5	15.5 to 20	20 to
2-56	6 to 7.5	14 to 17.5	10 to 12.5	23.5 to 29	30 to
2-64	7 to 8.5	16 to 20.5	11.5 to 14.5	26.5 to 34	34.5 t
3-48	9 to 11.5	21.5 to 26.5	15.5 to 19	35.5 to 44.5	46 to
3-56	10.5 to 13.5	24.5 to 31.5	17.5 to 22.5	41 to 52	53 to
4-40	15 to 19	35.5 to 44.5	25 to 32	59 to 74.5	75.5 t
5-40	19 to 24	45 to 56.5	32 to 40	75 to 94	96.5 t
5-44	21.5 to 27	50 to 63	35.5 to 45	83 to 105.5	106.5 t
6-32	24 to 29.5	56 to 69	40 to 49.5	93 to 115	120 to
6-40	29 to 36.5	67.5 to 85.5	48 to 61	112.5 to 142.5	144.5 t

Bolt, Stud, or Screw Size	Shear-Type Fasteners		Tensile-Type Fasteners					
	125,000 psi and Greater		55,000 to 89,000 psi		90,000 to 124,000 psi		125,000 to 159,000 psi	
	in-lb	ft-lb	in-lb	ft-lb	in-lb	ft-lb	in-lb	ft-l
8-32	8-11		5-6		11-14		14-18	
8-36	9-12		5-6		12-15		16-20	
10-24	12-15		7-8		15-19		20-25	
10-32	14-18		8-10		19-24		24-30	
1/4-20	31-39		17-22		40-50		52-65	
1/4-28	36-47		20-26		47-61		61-75	
5/16-18	63-80		35-45		80-105		105-135	
5/16-24	71-90		40-51		90-120		120-155	
3/8-16	110-140		62-80		145-130		180-230	
3/8-24	125-160		70-90		160-210		210-280	
7/16-14	180-230		100-130		230-300		300-380	
7/16-20	200-260		110-145		250-330		330-430	
1/2-13	270-350		150-190		350-450		450-580	
1/2-20	310-410		170-230		400-530		520-680	40-55
9/16-12	400-510		220-290		520-670	40-55	670-860	55-70
9/16-18	450-590		250-330		580-770	45-65	750-990	60-80
5/8-11	550-700		300-390		710-910	60-75	910-1,180	75-95
5/8-18	620-830	50-70	350-460		810-1,070	65-90	1,040-1,360	85-115
3/4-10	960-1,240	80-100	530-690		1,250-1,610	105-135	1,600-2,080	130-17
3/4-16	1,080-1,430	90-120	600-790	50-65	1,400-1,850	115-155		150-19
7/8-14		140-190	960-1,270	80-105		185-240		240-31
1-12		210-290	1,450-1,930	120-160		280-370		360-48
1-14		210-290	1,460-1,960	120-160		280-380		360-49
1 1/8-12		310-410		170-230		400-540		520-69
1 1/4-12		430-580		240-320		560-750		720-97

NOTE: When tightening fasteners from the head side, torque to within ±10 percent of the high side of the specified torque range.

	Tensile-Type Fasteners			
si er	55,000- 89,000 psi (in-oz)	90,000- 124,000 psi (in-oz)	125,000- 159,000 psi (in-oz)	160,000 psi and Greater (in-oz)
	3.5 to 4.5	8 to 10	10.5 to 13	14.5 to 18
	6.5 to 8.5	15.5 to 20	20 to 25.5	28 to 35.5
	10 to 12.5	23.5 to 29	30 to 37.5	41.5 to 52
	11.5 to 14.5	26.5 to 34	34.5 to 43.5	47.5 to 60.5
.5	15.5 to 19	35.5 to 44.5	46 to 57	63.5 to 79.5
.5	17.5 to 22.5	41 to 52	53 to 67	73.5 to 93
.5	25 to 32	59 to 74.5	75.5 to 95.5	105 to 133
	32 to 40	75 to 94	96.5 to 120.5	133.5 to 167.5
	35.5 to 45	83 to 105.5	106.5 to 135.5	148 to 188
	40 to 49.5	93 to 115	120 to 148	166.5 to 205.5
5	48 to 61	112.5 to 142.5	144.5 to 183.5	201 to 255

Tensile-Type Fasteners						
0 to 0 psi	90,000 to 124,000 psi		125,000 to 159,000 psi		160,000 psi and Greater	
ft-lb	in-lb	ft-lb	in-lb	ft-lb	in-lb	ft-lb
	11-14		14-18		19-24	
	12-15		16-20		22-28	
	15-19		20-25		28-35	
	19-24		24-30		33-42	
	40-50		52-65		72-90	
	47-61		61-75		85-110	
	80-105		105-135		145-180	
	90-120		120-155		160-210	
	145-180		180-230		250-330	
	160-210		210-280		290-390	
	230-300		300-380		420-530	
	250-330		330-430		460-600	35-50
	350-450		450-580		630-810	50-65
	400-530		520-680	40-55	720-950	60-80
	520-670	40-55	670-860	55-70	920-1,190	75-100
	580-770	45-65	750-990	60-80	1,040-1,380	85-115
	710-910	60-75	910-1,180	75-95	1,270-1,630	105-135
	810-1,070	65-90	1,040-1,380	85-115	1,450-1,920	120-160
	1,250-1,610	105-135	1,600-2,080	130-170		185-240
50-65	1,400-1,850	115-155		150-195		200-270
80-105		185-240		240-310		330-440
120-160		280-370		360-480		500-670
120-160		280-380		360-490		500-680
170-230		400-540		520-690		720-960
240-320		560-750		720-970		1,000-1,350

l side, torque to within ±10 percent of the high side of

Figure 1-14. Torque Values for Threaded Fasteners

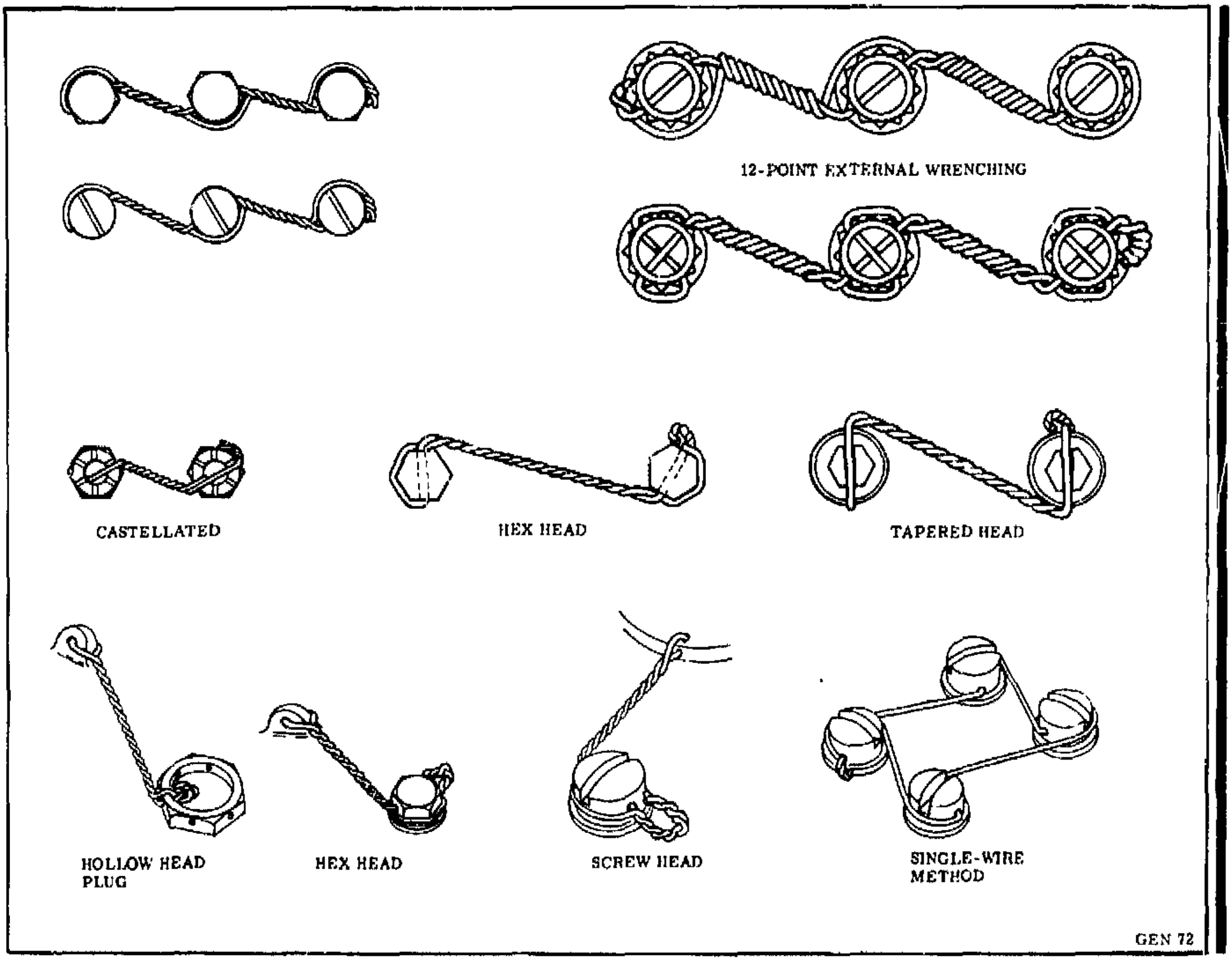


Figure 1-15. Safetywiring Methods

1-137. INSTALLING RIGID TUBING.

1-138. During installation of rigid tubing, clamps and line blocks must be positioned to meet the maximum allowable distance between supports, as applicable for tubing (line) size. When specified in installation procedures, coupling nut sleeves and/or fittings must be lubricated before securing rigid tubing.

a. Place tubing (line) in position, loosely supported by clamps and blocks. Tubing (line) must be able to float in clamps and blocks without restraint.

b. Aline both flared ends with sealing surfaces of fittings.

c. Tighten coupling nuts fingertight to seat flares.

d. Hold fittings with wrench and torque coupling nuts.

e. Tighten line clamps and blocks after tube (line) is secured at both ends.

f. Make sure maximum spacing between line supports is as follows:

Diameter of Tubing (Lines) (Inch)	Maximum Spacing (Inches)
1/4 to 3/8	18
1/2 to 3/4	25-1/2
1 or over	30

g. When either of 2 parts is designed for dynamic motion (independent of vibration), make sure 1/2-inch clearance is maintained between tubing (line) and adjacent part.

h. Make sure tubing (lines) under static conditions has a minimum of 1/8-inch clearance between tubing (line) and any adjacent part except as specified in applicable installation procedure.

1-139. INSTALLING FLEXIBLE HOSE.

1-140. During installation, flexible hoses must be supported and prevented from flexing beyond the minimum bend radii used in final installation. When specified in installation procedures, end fittings must be lubricated before securing flexible hoses. Flexible hoses must not be twisted (torsionally deflected) during installation.

a. Position hose between end fittings. Hose must not be stretched between fittings; allow 5 percent of hose length for slack.

b. Route and support hose to provide a minimum clearance of 1/2 inch between hose and adjacent parts.

c. Avoid sharp bends, distortion, or strain at hose ends or supports.

d. Position clamps and supports to provide hose clearance, routing, and loose support during installation.

e. Place hose in clamps and aline; hand-tighten coupling nut at one end. Hold fitting with wrench and torque hose coupling nut.

f. Make sure hose is not twisted, is free from binds and restraints, and floats in clamps and supports.

NOTE

Evidence of twisting can be ascertained by observing the stripe on the hose.

g. Hand-tighten coupling nut on opposite end of hose. Hold fitting with a wrench and torque coupling nut.

h. Check hose for evidence of twists or sharp bends. Tighten clamps and supports.

1-141. INSTALLING ELECTRICAL HARNESS OR CABLE.

1-142. Electrical harnesses or cables must be supported and protected during installation, and bend radius and clearances must be maintained. The following requirements are applicable during installation:

WARNING

Connecting electrical connectors without turning off electrical power can result in injury to personnel and damage to equipment.

a. Make sure that electrical power source is turned off.

b. Position harness on equipment, routing to respective connect points.

c. Whenever possible, connect electrical connectors to their respective connect points before installing support clamps, to prevent possible preloading to connectors.

d. Install support clamps, making sure that harness bend radius is not less than outside diameter of harness and distance between support clamps does not exceed 18 inches.

e. Position support clamps to maintain the following acceptable clearances:

(1) A 1/2-inch clearance must be maintained between harness and adjacent structure, if possible. Harness must not touch, chafe, or abrade against adjacent surface, except that two or more harnesses routed side by side may touch one another. See figure 1-16 for support and separation clamping.

(2) Harnesses routed adjacent to tubing (lines) that carry flammable fluids or gases must be clamped in place to maintain a minimum clearance of 1/2 inch.

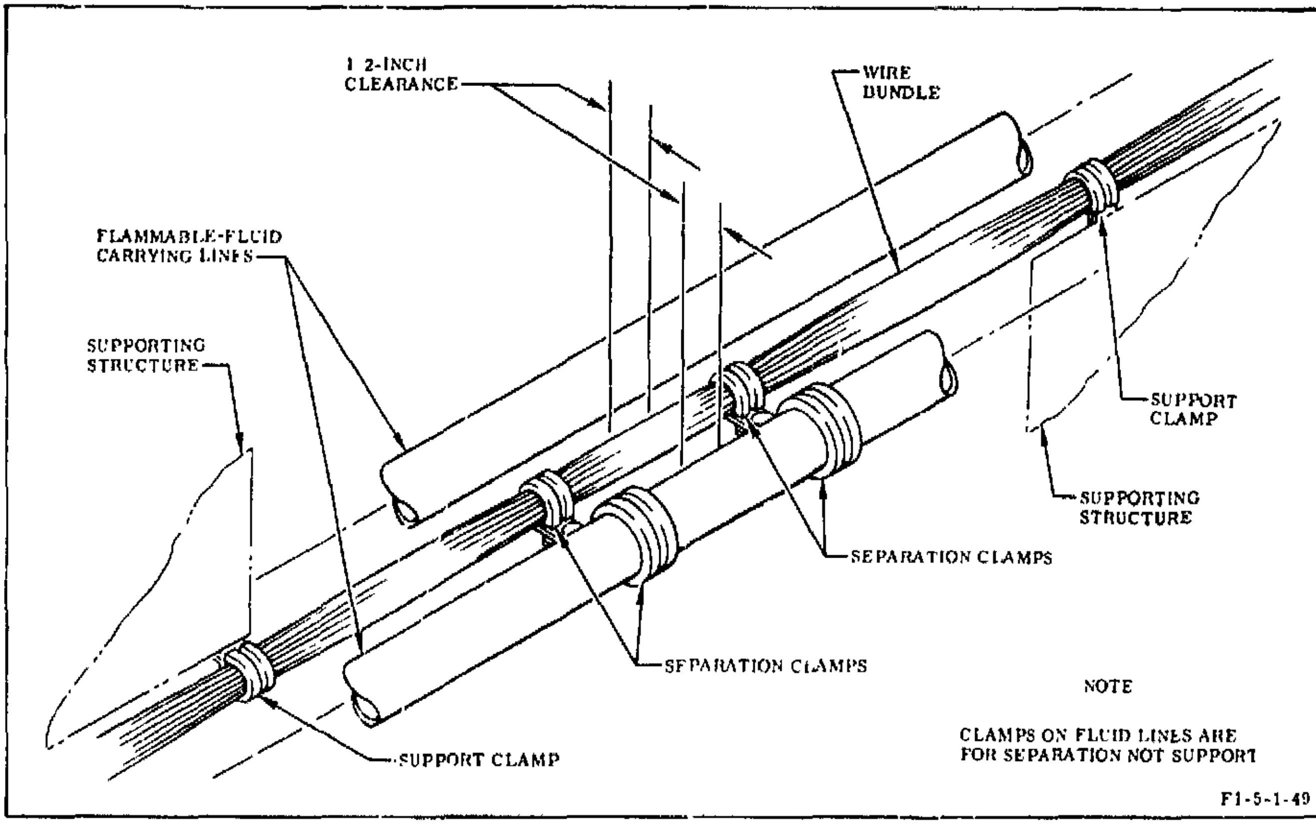


Figure 1-16. Electrical Harness or Cable Support and Separation Clamping

f. Install bonding and ground returns so that vibration, movement, and expansion or contraction of abraded objects will not break or loosen connectors.

NOTE

The bonding contact area must be free of dirt, grease, paint, and protective finish. Bonding must be a bare metal-to-metal contact.

g. After installation of bonding and ground returns, protect bonding contact area with blue-tinted lacquer ST0125RB0003 (Rocketdyne).

1-143. SHIPPING AND STORING.

1-144. Shipping and storing of ground support equipment components or parts must be accomplished in accordance with requirements specified in the Rocketdyne Automated Packaging System (RAPS). Components or parts must meet the following requirements before packaging for storage or shipping:

a. All protective closures, caps, and plugs must be properly installed on the component or part, and the level of cleanness and service must be indicated on each closure.

b. The bags in which components or parts are packaged must be sealed; the level of cleanness and service must be indicated on the exterior of the package.

c. The component or part must be packaged using the Rocketdyne Automated Packaging System or an equivalent procedure.

1-145. ROCKETDYNE AUTOMATED PACKAGING SYSTEM.

1-146. The Rocketdyne Automated Packaging System (RAPS) is an IBM tabulation report listing the part number, preservation method, cleaning requirements, packaging and packing requirements, and supplemental data. Code characters (alphabetical or numerical) are assigned to the shipping and storage requirements (tabulated on the cover page of RAPS) to minimize printout of the RAPS report. Column headings and code characters are as follows:

a. Federal stock numbers, where applicable, are listed in the first column. Part numbers are listed in the second column in alphanumerical sequence.

b. The preservation method (MIL-P-116) is designated by a two-character code in the PRES/METH column:

PRES/ METH	Method	PRES/ METH	Method
10	III	3Q	IA-14
11	I	4G	IIC
2E	IC1	4H	IIa
3G	IA-8	4Q	IIb
3H	IA-16	4V	IId
3P	IA-15	BJ	III

c. The quantity-per-unit pack is designated by a one-character code in the QUP column:

QUP	Quantity
1	1
5	5
A	10
H	25

d. Clean and dry is designated by a one-character code in the CLN/DRY column:

CLN/ DRY	Clean and Dry Process
0	Any applicable process for general cleanness
1	Any applicable process for general cleanness
3[a]	Petroleum solvent, 2-step, Method C-3, RA0116-027 (Rocketdyne)
5[a]	Petroleum solvent, fingerprint remover, Method C-5, RA0116-027 (Rocketdyne)
Z[a]	Special requirement. (See supplemental data.)

(a) Not essential for shipments from field sites.
(b) Desiccant and bag LK390-00002 or LK390-00064 may substitute for preservatives for shipments from field sites.

e. The preservation material is designated by a two-character code in the PRES/MATL column:

PRES/ MATL	Preservation Material
00	No requirement
11[b]	Grease, Type 11, RA0116-027 (Rocketdyne)
17[b]	Oil, Type 17, RA0116-027 (Rocketdyne)
89[b]	Normal operating lubricant
ZZ	Special requirements (See supplemental data.)

f. Wrapping material is designated by a two-character code shown in the WRAP column:

WRAP	Wrapping Material
OO	No requirement
AA	Polyethylene foam, 1/8 inch thick
DA	Tissue paper (Federal Specification UU-P-553)
EA	Neutral paper (MIL-P-17667)
FA	Laminated and creped paper (MIL-P-130)
GB	Grade A wrap (MIL-B-121, Grade A)
JA	Polyethylene film (Federal Specification L-P-378)
ZZ	Special requirement. (See supplemental data.)

g. Cushion or dunnage is a two-character code shown in the CUSH/DUNN column:

CUSH/ DUNN	Cushion or Dunnage
OO	No requirement
AA	Polyethylene foam
FL	Hair latex (MB0295-003 and MIL-C-7769)
GA	Polyurethane foam (MIL-P-26514, Type I, Class 2)

CUSH/ DUNN	Cushion or Dunnage
JA	Fiberboard stiffener, one side (Federal Specification PPP-F-320)
JB	Fiberboard stiffener, 2 sides (Federal Specification PPP-F-320)
JC	Fiberboard pads, cells, sleeves, etc (Federal Specification PPP-F-320)
LK	Wood blocking and bracing, and/or steel strapping
ZZ	Special requirement

h. Cushion thickness is a one-character code shown in the THK column:

THK	Cushion Thickness
O	Not applicable
A	1/4 inch
B	1/2 inch
D	1 inch
F	1-1/2 inches
H	2 inches
M	3 inches
R	4 inches
X	Thickness (dunnage) as required to restrict movement within container
Z	Special requirement. (See supplemental data.)

i. Supplemental data is shown to the right of essential data and on successive lines. Supplemental data includes specific unit container requirements, reinspection data, and other special data.

j. Reinspection data will be characterized by REINSP at its beginning. The type of reinspection required and the reinspection interval will be designated.

SECTION II

HYDRAULIC PUMPING UNIT G2025

2-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance, and inspection for Hydraulic Pumping Unit G2025.

2-2. DESCRIPTION AND LEADING PARTICULARS.

2-3. The pumping unit (figure 2-1) is a mobile, electrical-powered hydraulic source capable of supplying hydraulic fluid to the engine at flowrates and pressures required during engine checkout. The pumping unit may be started or stopped either locally or remotely. See figure 2-2 for leading particulars of the pumping unit. The pumping unit is a cart-mounted unit supported by 4 semi-elliptical springs mounted on pneumatic rubber-tired wheels. Foot-operated brakes are incorporated on the rear wheels and a tow bar is attached to the front wheels. There are 3 panels on the pumping unit. The disconnect and fluid sample panels are located at the rear and the control panel on the left side of the pumping unit. All external connections to the pumping unit are made at the disconnect panel (figure 2-3).

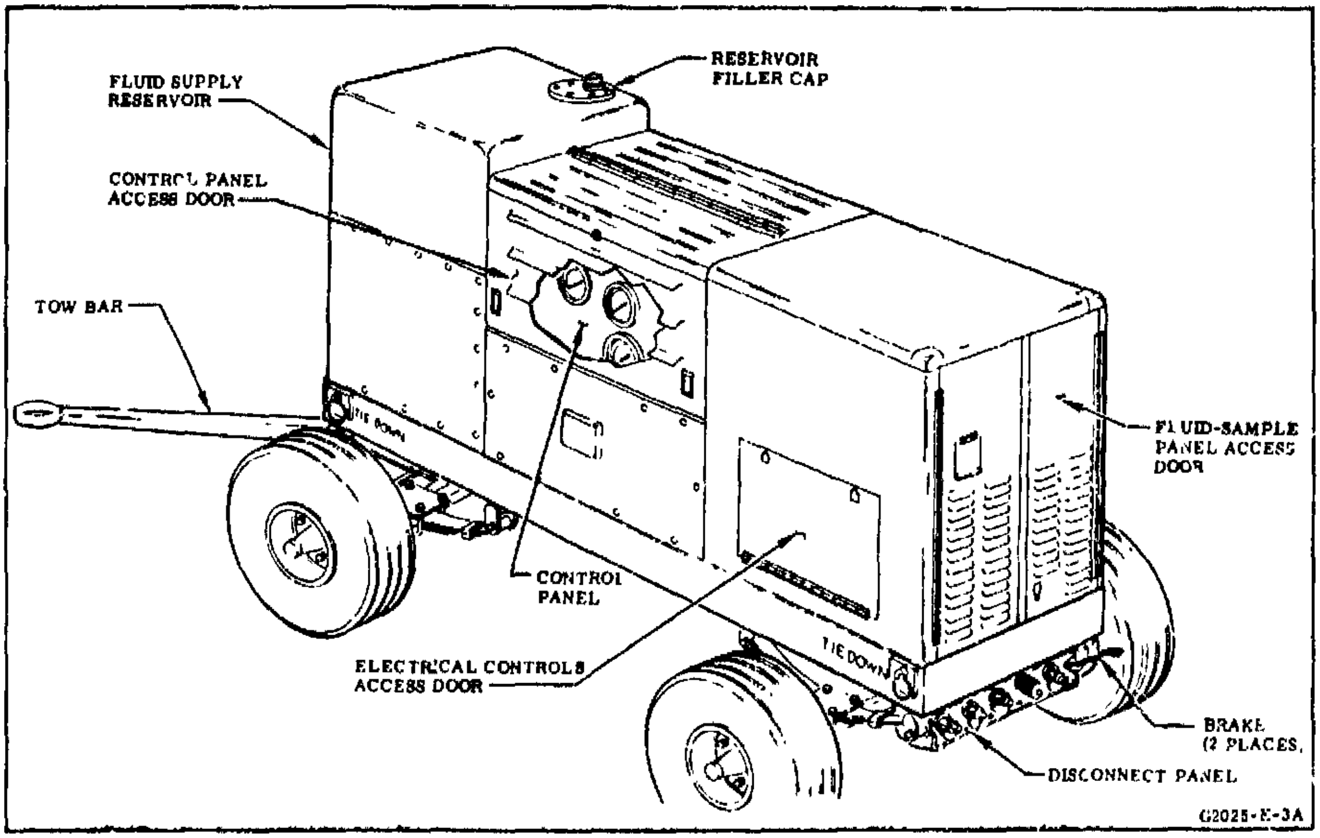


Figure 2-1. Hydraulic Pumping Unit G2025

Length (tow bar up)	109 inches	Fluid Requirements	Fuel RJ-1 (MIL-F-25558), RP-1 fuel (MIL-R-25576), or hydraulic fluid (MIL-H-5606) (Do not mix fluids.)
Width (hub to hub)	68 inches	Pneumatic Requirements	Gaseous nitrogen (MIL-P-27401)
Height	64 inches	Water Requirements	25 gpm at 30-100 psig
Gross Weight (without fluid)	3,200 pounds approximately	Tire Size	6.00 x 9.00 6 ply
Gross Weight (with fluid)	3,600 pounds approximately	Tire Pressure	45 psig
Electrical Requirements	440-vac, 60-cycle, 3-phase, 32-ampere power	Towing Speed	20 miles per hour maximum

Figure 2-2. Leading Particulars for Hydraulic Pumping Unit G2025

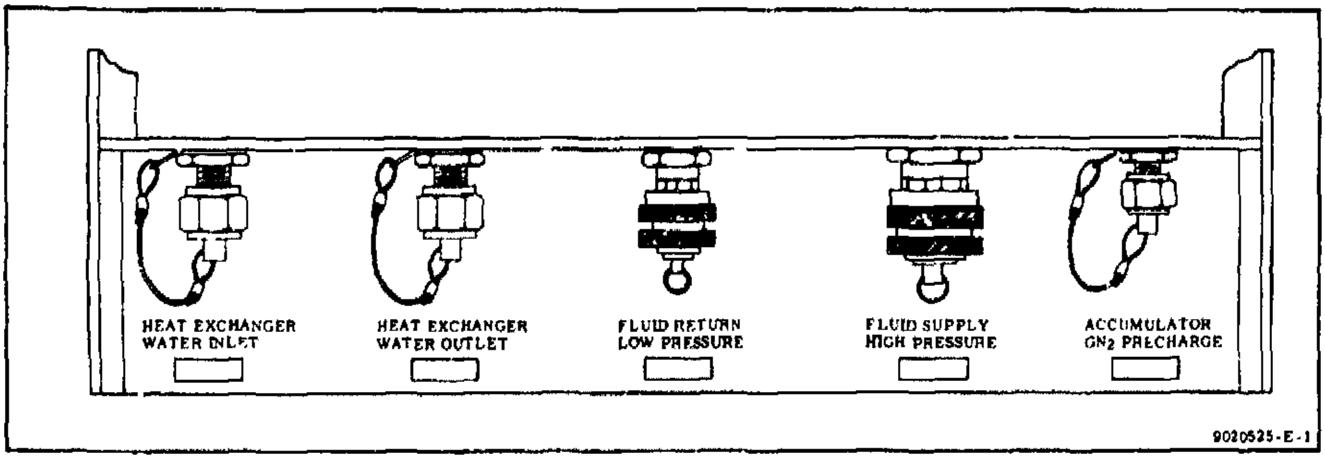


Figure 2-3. Disconnect Panel

2-4. FLUID SUPPLY RESERVOIR.

2-5. The fluid supply reservoir (figure 2-4) is a rectangular, baffled, stainless steel reservoir mounted on the forward end of the pumping unit above the hydraulic pump motor. The reservoir has a fluid capacity of approximately 50 gallons. Fluid is prevented from sloshing in the reservoir by both transverse and longitudinal baffles. The reservoir incorporates the pump inlet filter element which is mounted inside the reservoir on the outlet port. Provisions for filling and venting the reservoir are incorporated in the cover plate. A hand valve, located at the bottom of the sump, is provided for draining of the reservoir. The level of fluid in the reservoir is indicated on a gage mounted on the side of the reservoir.

2-6. **PUMP INLET FILTER.** The pump inlet filter is a paper-type, single-element filter mounted on the inside of the fluid supply reservoir. All fluid routed from the fluid supply reservoir to the inlet port of the hydraulic pump passes through the filter.

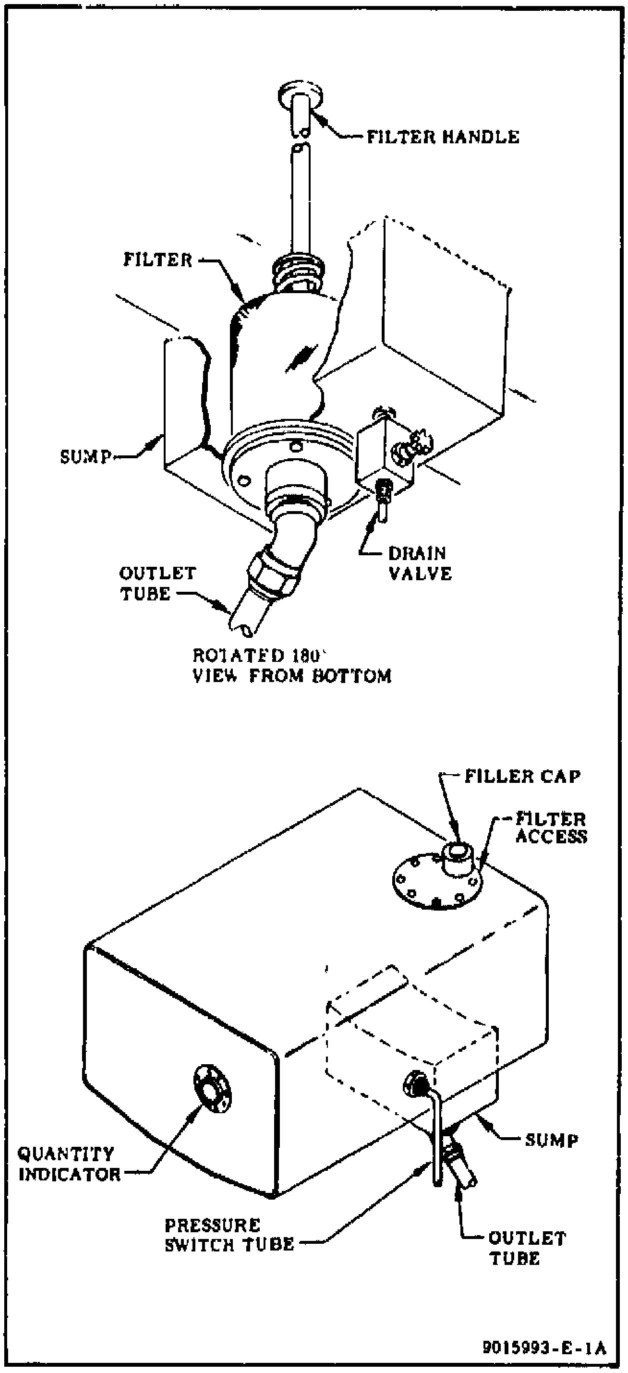


Figure 2-4. Fluid Supply Reservoir

2-7. FLUID LEVEL INDICATOR GAGE. The fluid level indicator gage (figure 2-5) is a float-actuated gage mounted on the side of the fluid supply reservoir. The gage has a white dial face with black numerals and graduation lines. The range is from empty to full with numerals for 1/4, 1/2, and 3/4 levels. The pointer and dial face are protected from damage by a glass shield. The body of the gage is of anodized gray aluminum, the actuating mechanism of zinc anodized aluminum, and the float of nickel-plated brass.

2-8. CONTROL PANEL.

2-9. The control panel (figure 2-6) contains pressure gages, valves, lights, and switches. The pressure gages monitor the accumulator precharge pressure, pump inlet and outlet pressures, hydraulic return flowrate, and pump inlet fluid temperature. The valves include a pressure relief, a bypass, accumulator shutoff, accumulator bleed, and pressure compensator. The lights when illuminated indicate main power on, control power on, phase reversed, temperature high, and service filter elements.

2-10. PUMP OUTLET PRESSURE AND ACCUMULATOR PRESSURE GAGES. The pump outlet pressure and the accumulator pressure gages are identical. The gage (figure 2-7) is used for either fuel or pneumatic service. The gage has a 4-1/2 inch mirrored dial which is protected by shatterproof glass. The glass is held in place by a black enamel steel ring that is hinged at the top and secured at the bottom with a screw. The face of the dial is white with black numerals and graduation lines. The dial has a range from 0 to 5,000 psi. The gage pointer is knife-edged and turned to a 90-degree angle. The gage incorporates a silicone lubricated, stainless-steel movement actuated by a stainless-steel bourdon tube. The movement and the bourdon tube are housed in a drawn steel case incorporating a front flange for mounting. The flange has three equally spaced, countersunk holes, drilled to receive #10 screws. The case incorporates a solid front wall directly behind the gage dial and a safety release disk over the back. The safety release automatically opens and relieves pressure should case pressure exceed 1/2 psi. Gage adjustment is performed using the recalibrator-type adjustment screw located on the front of the gage dial.

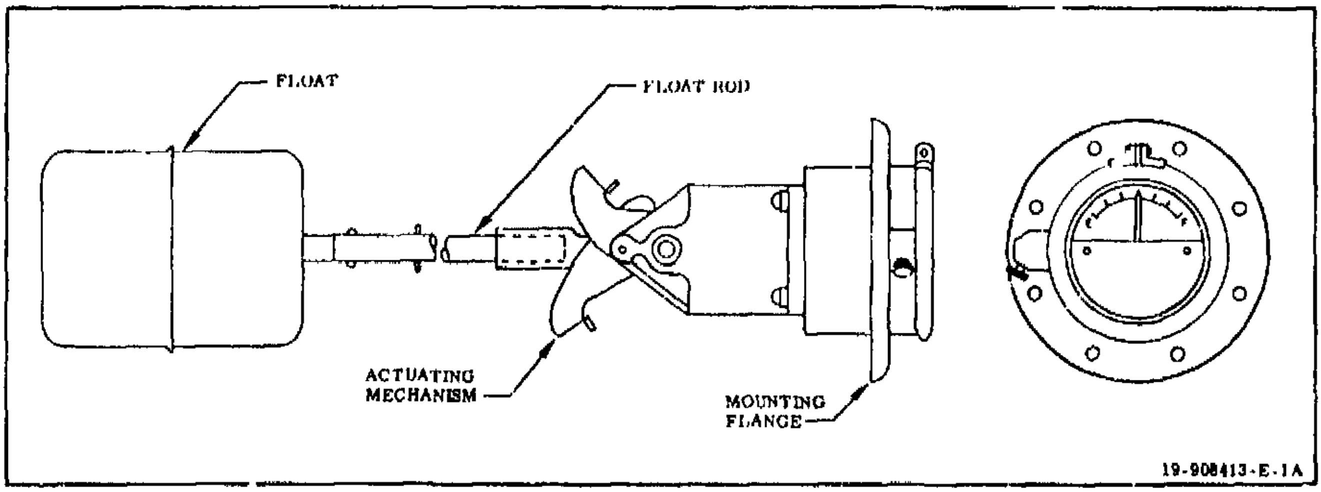


Figure 2-5. Fluid Level Indicator Gage

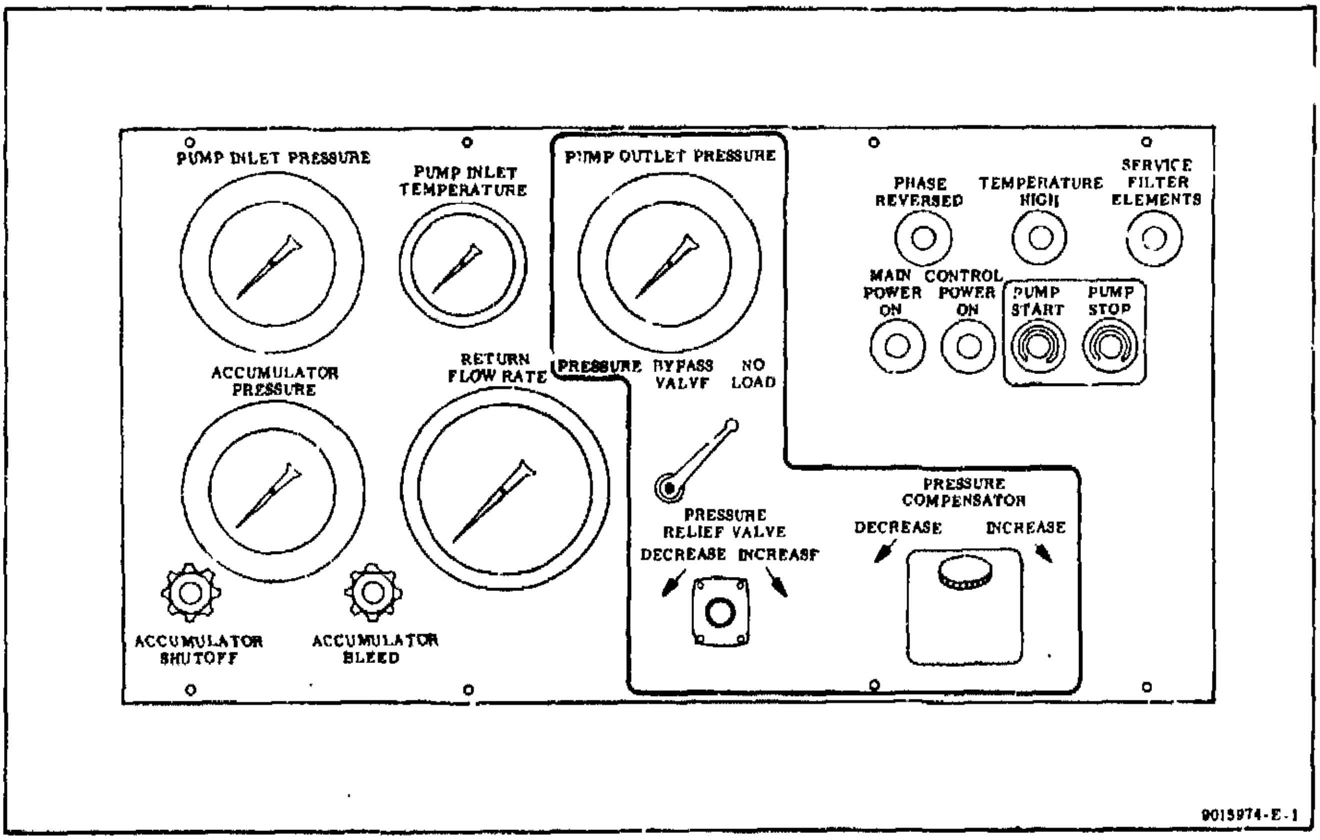


Figure 2-6. Control Panel

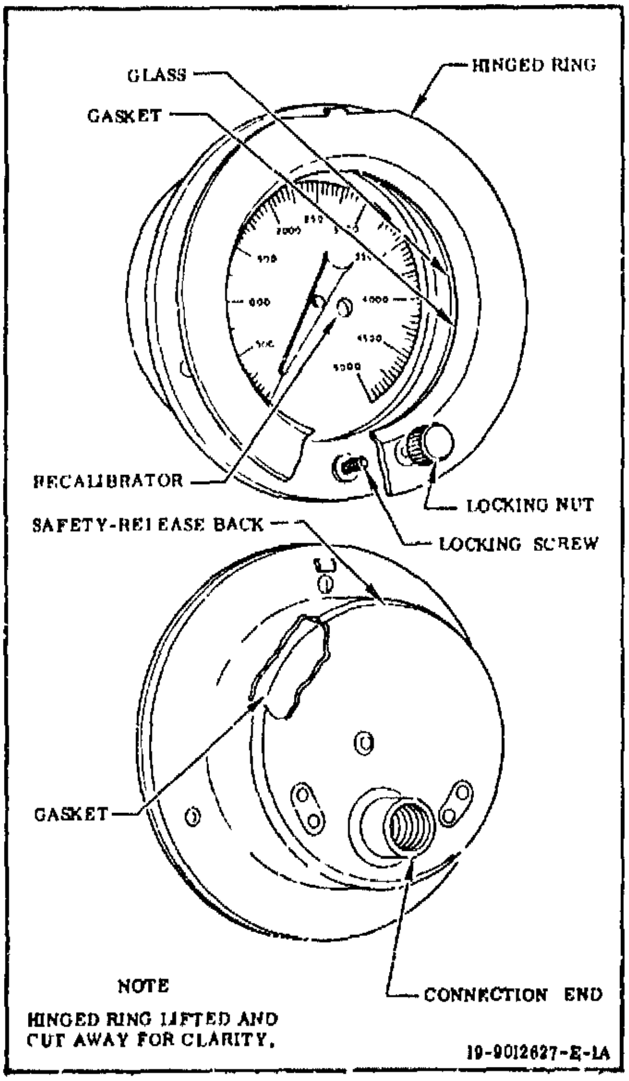


Figure 2-7. Pump Outlet and Accumulator Pressure Gages

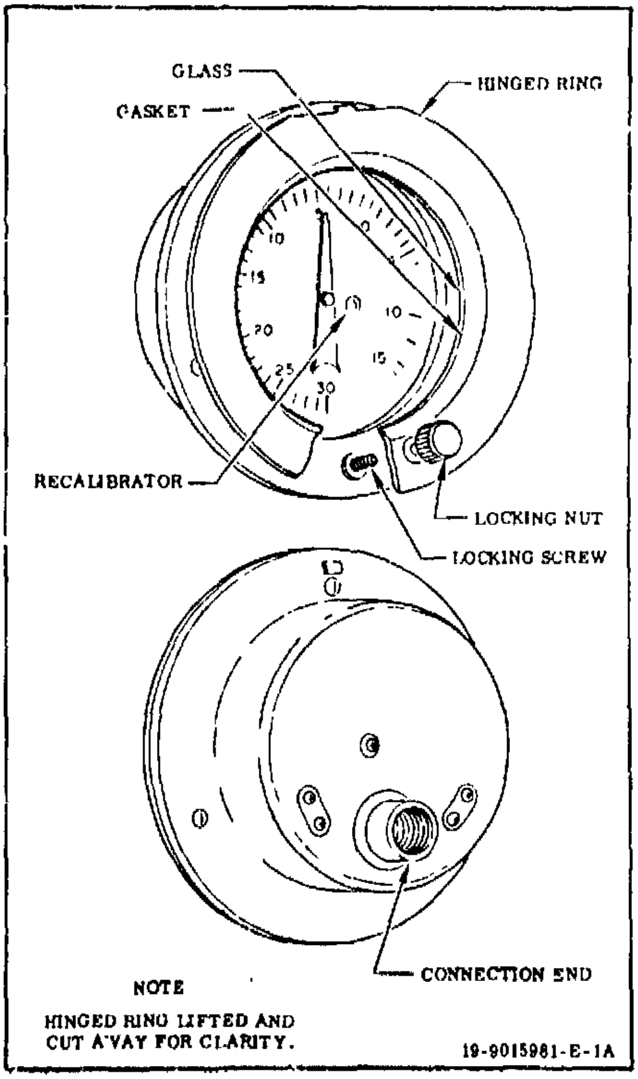


Figure 2-8. Pump Inlet Pressure Gage

2-11. PUMP INLET PRESSURE GAGE. The pump inlet pressure gage (figure 2-8) is a compound pressure gage. The gage has a 4-1/2 inch dial which is protected by shatterproof glass. The glass is held in place by a black enamel steel ring, hinged at the top and held in place at the bottom by a screw. The dial face is white with black numerals and graduation lines. The dial has a range of 30 inches of mercury vacuum to 15 psi. The gage pointer is knife edged and turned to a 90-degree angle. The gage incorporates a drawn steel movement actuated by a stainless-steel bourdon tube. The movement is housed in a stainless-steel case incorporating a front flange for mounting. The flange has three equally spaced countersunk holes drilled to receive #10 screws. The case has a solid front wall directly behind the dial and a safety release disk over the back. The disk automatically opens and relieves pressure should case pressure exceed 1/2 psi. Gage adjustment is performed using the recalibrator-type adjustment screw located on the front of the gage dial.

2-12. PUMP INLET TEMPERATURE GAGE. The pump inlet temperature gage (figure 2-9) is a temperature-indicating device accurate to within ±2° F at 130° F. The gage has a 3-1/2 inch dial which is protected by glass. The glass is held in place with a black enamel steel press-fit ring. The dial face is white with black numerals and graduation lines. The dial range is from 40° to 140° F. The gage pointer is

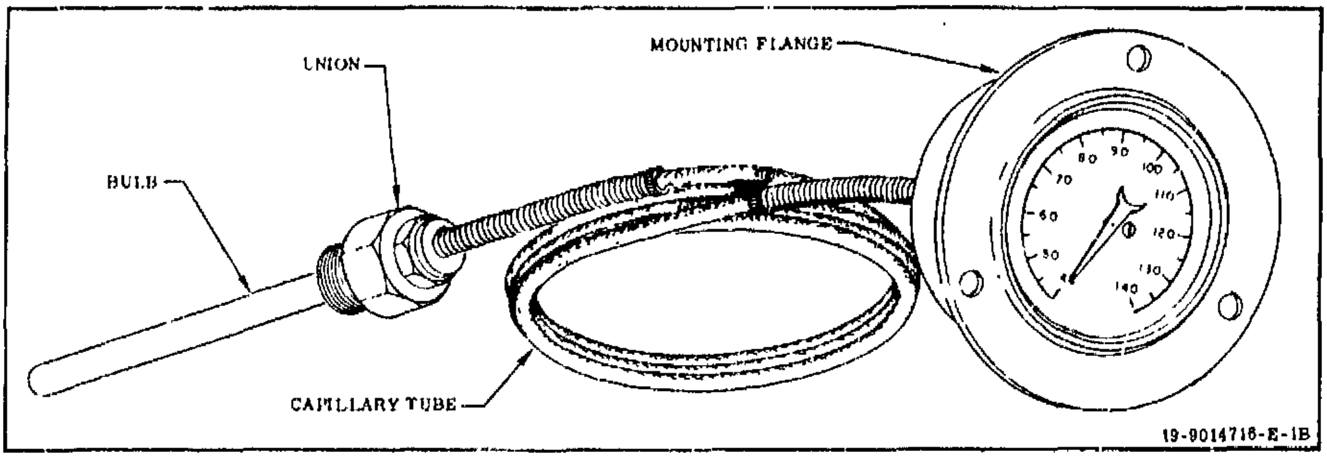


Figure 2-9. Pump Inlet Temperature Gage

knife-edged and turned to a 90-degree angle. The gage movement incorporates stainless-steel shafts fitted in bushings of K-monel. The movement is housed in a black enamel, drawn steel case. The case incorporates a front flange for mounting. The flange has three equally spaced holes drilled to receive #10 screws. The gage incorporates a copper capillary tube and bulb. The bulb is connected to the tube with a union. A double shaft of copper braided wire protects the tube from damage. The braid is reinforced at both ends with brass spiral reinforced ferrules.

2-13. RETURN FLOWRATE GAGE. The return flowrate gage (figure 2-10) is a dual inlet differential gage calibrated from 0-100 inches of water. The gage is connected across a flow tube to monitor the hydraulic return flowrate. The gage includes a low-pressure and high-pressure head with dual inlet ports (one port on each head is plugged). The high-pressure head is connected to the flow tube inlet pressure and the low-pressure head is connected to the outlet pressure.

2-14. BYPASS VALVE. The bypass valve (figure 2-11) is a double seal, ball-type valve that requires only a quarter turn on the lever handle to rotate the ball fully open or closed. The bypass valve is mounted on the control panel. The valve is used during starting or stopping the pumping unit to dump the hydraulic pressure from the remote control port of the high-pressure relief valve. This causes the high-pressure relief valve to relieve at a low pressure and reduces the system pressure to zero.

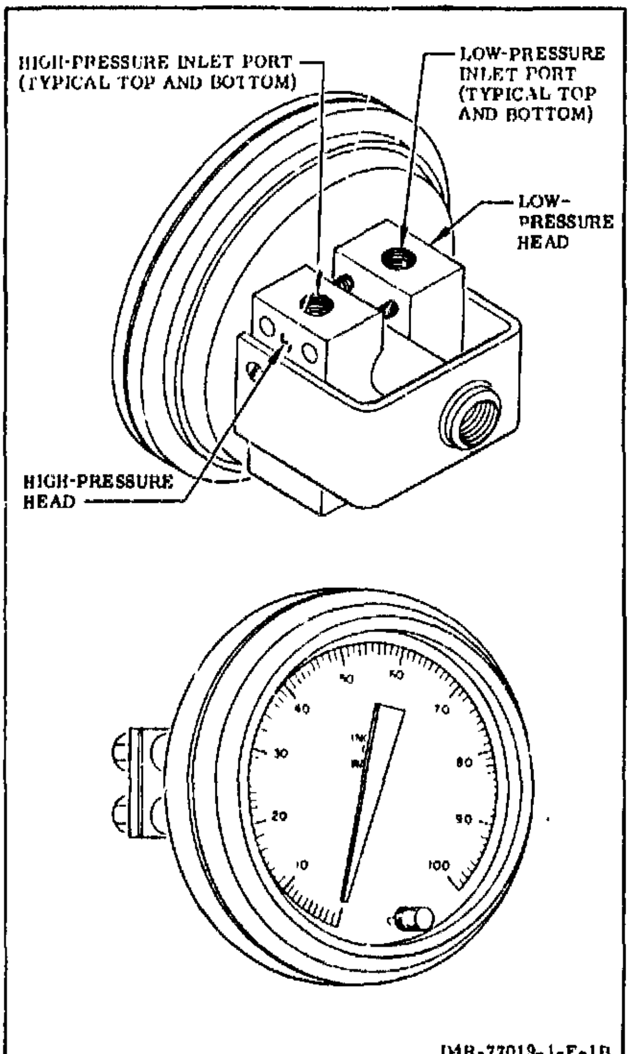


Figure 2-10. Return Flowrate Gage

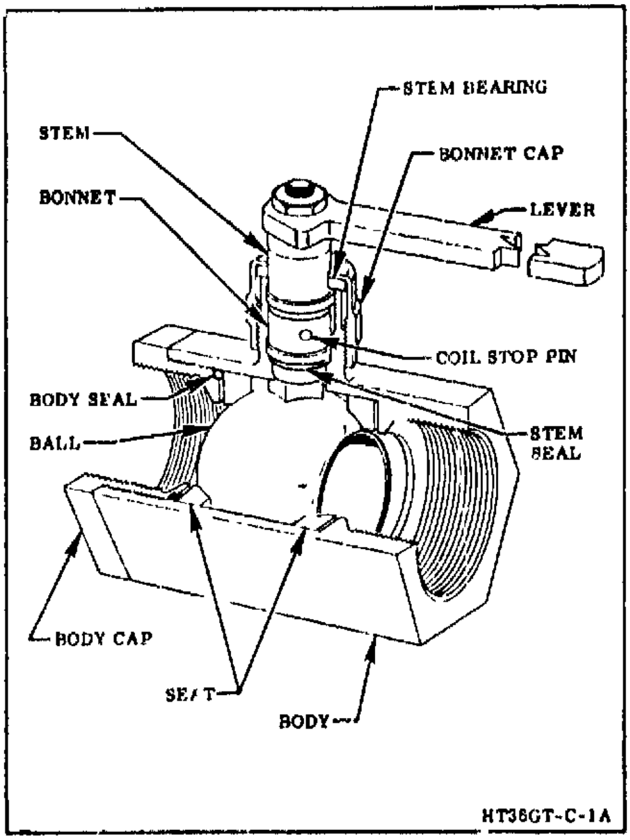


Figure 2-11. Bypass and Shutoff Valves

2-15. PRESSURE RELIEF VALVE. The pressure relief valve (figure 2-12) is a manually-adjusted, relief valve. The valve is used to remotely control and vary the outlet pressure of the high-pressure relief valve. The desired pressure settings are accomplished by rotating the adjusting screw to the decrease or increase positions. A locking nut is provided to lock the adjusting screw to prevent changes in pressure settings. The adjusting screw compresses the spring against the cone forcing the cone into the seat. Compression applied to the cone determines relief pressure of the valve.

2-16. PRESSURE COMPENSATOR. The pressure compensator knob on the control panel is an extension of the hydraulic pump compensator knob. The pressure compensator automatically regulates the volume of fluid delivered by changing length of piston stroke by varying the angle of the cam plate. The stroke change is controlled by system pressure when compensator pressure is reached, fluid volume is automatically reduced to amount of flow required to maintain the compensator pressure.

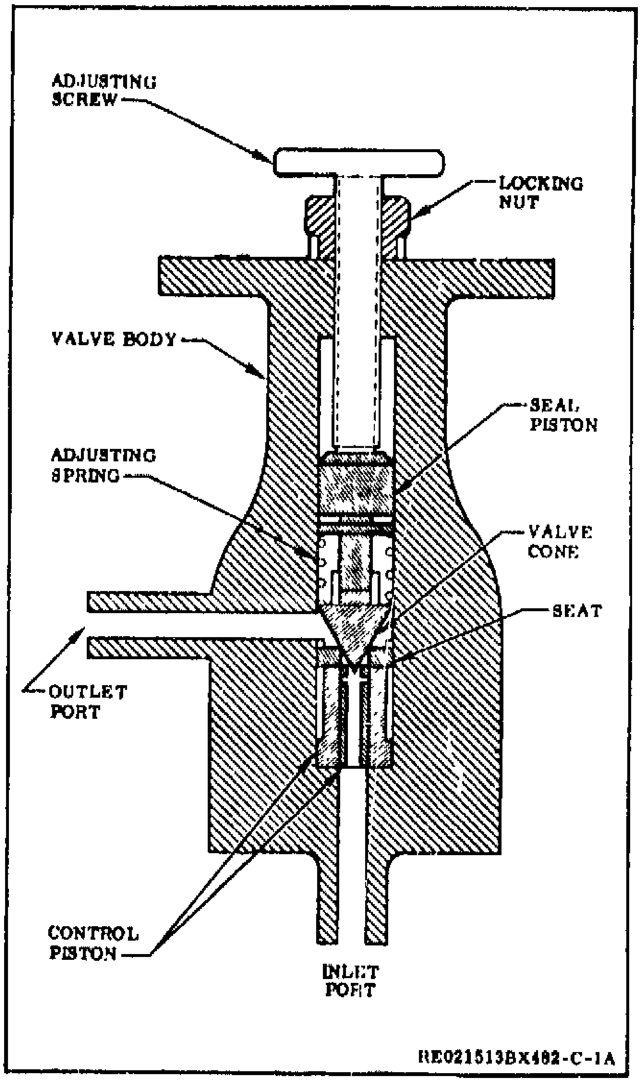


Figure 2-12. Pressure Relief Valve

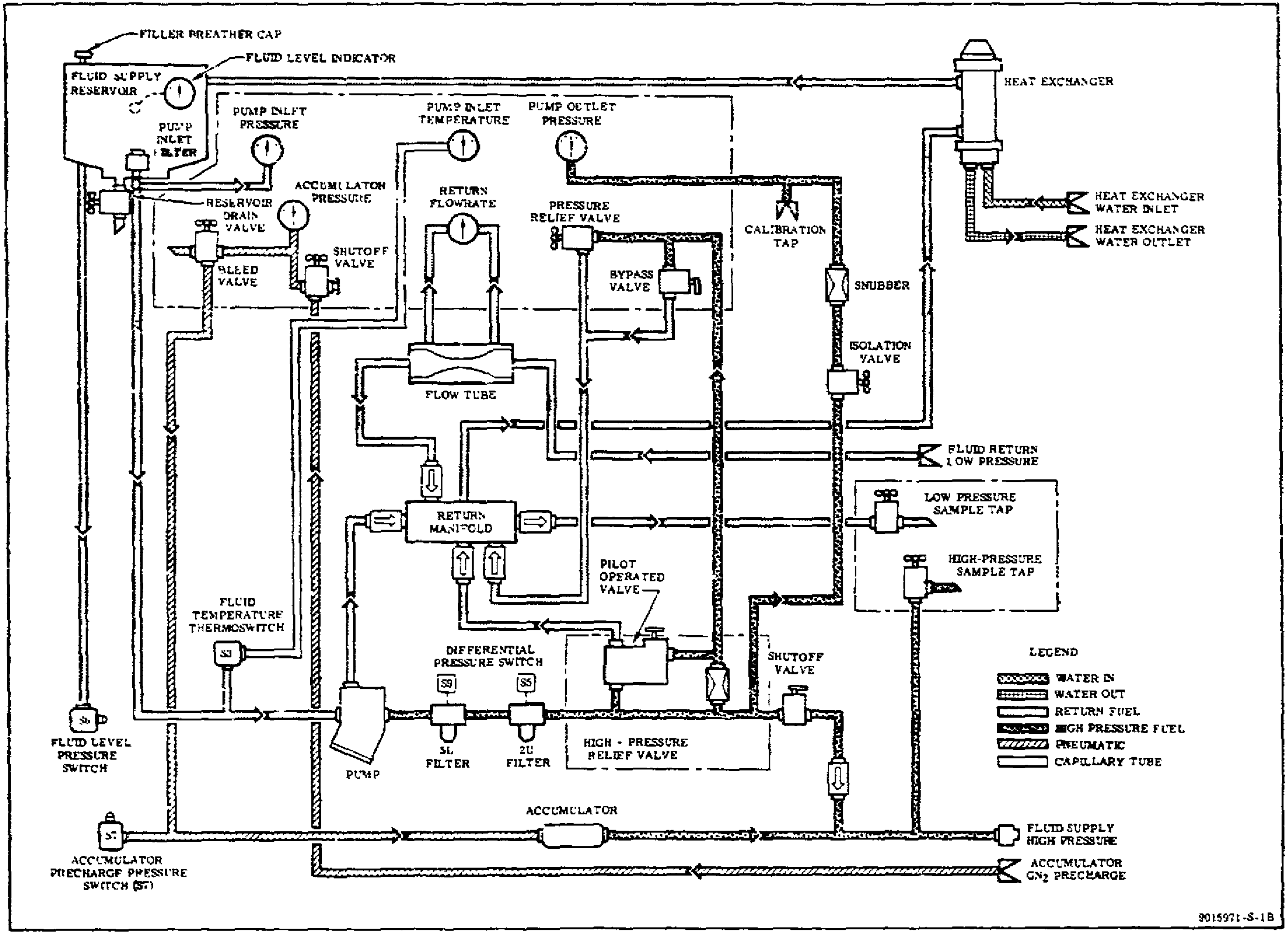


Figure 2-13. Hydraulic Pumping Unit G2025 Hydraulic Schematic

2-17. ACCUMULATOR BLEED AND SHUTOFF VALVES. The accumulator bleed and shutoff valves control and discharge the accumulator precharge pressure. The valves are similar to other three-way valves but function differently. The valve has three ports with the controlling feature of only one port. The passageways of the three ports form a tee in the valve body providing the control feature of one port and free flow through the other two ports. The shutoff valve, with one of the openports plugged, is utilized strictly as a shutoff valve. The bleed valve, with a diffuser installed in the controlled port, is utilized to vent the accumulator.

2-18. PANEL LIGHTS AND SWITCHES. The control switches, pump start andpump stop, are momentary push-type switches. The pump start switch is a momentary-make switch and the stop switch is a momentary-break switch. There are five lights on the panel. The main power and control power lights are green and the phase reversed, temperature high, and service filter elements lights are amber.

2-19. MECHANICAL COMPONENTS.

2-20. The mechanical components are defined as those components mounted on the chassis and in the hydraulic installation. See figure 2-13 for hydraulic schematic.

2-21. HYDRAULIC PUMP. The hydraulic pump (figure 2-14) is an adjustable, pressure-compensated, positive displacement, axial piston type pump. The pump is driven by an explosionproof electrical motor at a speed of 1,170 rpm. Pump delivery at full stroke is 19 gpm at 2,000 psig nominal. Rotational power (supplied by the electrical motor) applied to the pump shaft, rotates the pump cylinder barrel. The pistons, confined in the cylinder barrel, travel in a circular pattern and are spring-loaded against the inclined cam plate. Rotation of the barrel causes axial reciprocation of the pistons. As the cylinder barrel rotates, the pistons following the cam plate away from the port plate draw fluid from the inlet port and the pistons following the cam plate toward the port plate force fluid out the outlet port. Quantity of fluid delivered is directly proportional to the angle of the cam

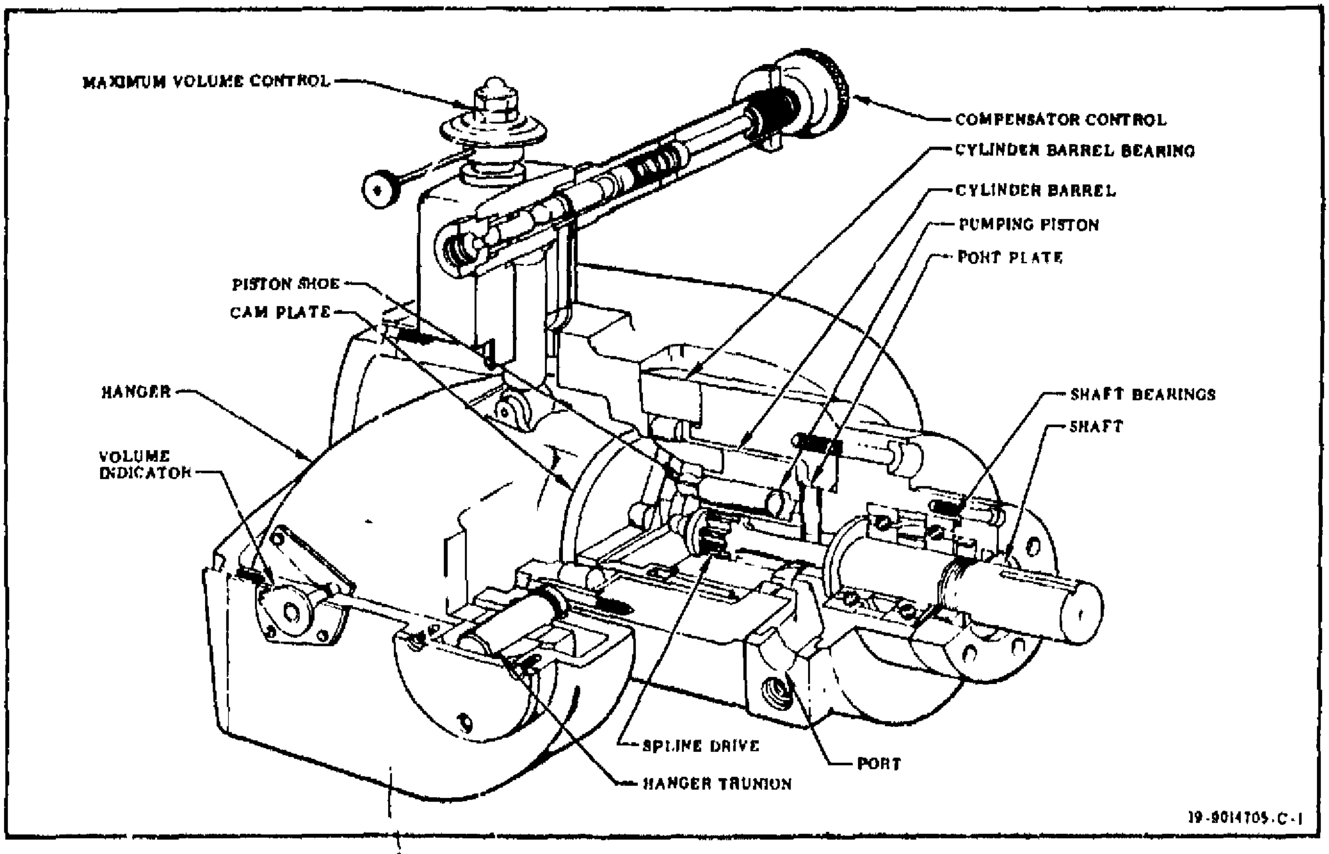


Figure 2-14. Hydraulic Pump

plate. A movable hanger, attached to the cam plate, controls the angle of the cam plate. The hanger is controlled by the pressure compensator. Maximum hanger movement is determined by adjustable minimum and maximum volume control stops. The pressure compensator control has been modified so the control knob extends to the control panel. The pressure compensator automatically regulates the volume of fluid delivered by changing length of piston stroke by varying the angle of the cam plate. Stroke change is controlled by system pressure in such a manner that at pump operation, at pressures less than maximum setting of the compensator control, full fluid volume is delivered. When compensator control pressure is reached, fluid volume is automatically reduced to amount of flow required to maintain pressure.

2-22. HIGH-PRESSURE FILTERS. The high-pressure filters (figure 2-15) are identical in construction but use different filter elements. One element has a two-micron rating and the other a five-micron rating. The elements are corrosion-resistant steel, woven wire cloth. The filter incorporates a differential-pressure indicator which actuates a microswitch when differential pressure between the inlet and outlet ports exceeds 80 ±10 psi. Actuating the microswitch closes the circuit to illuminate the SERVICE FILTER ELEMENTS light on the control panel. Two holes in the filter head are provided to facilitate mounting. Access to the filters is through the high-pressure filter access door.

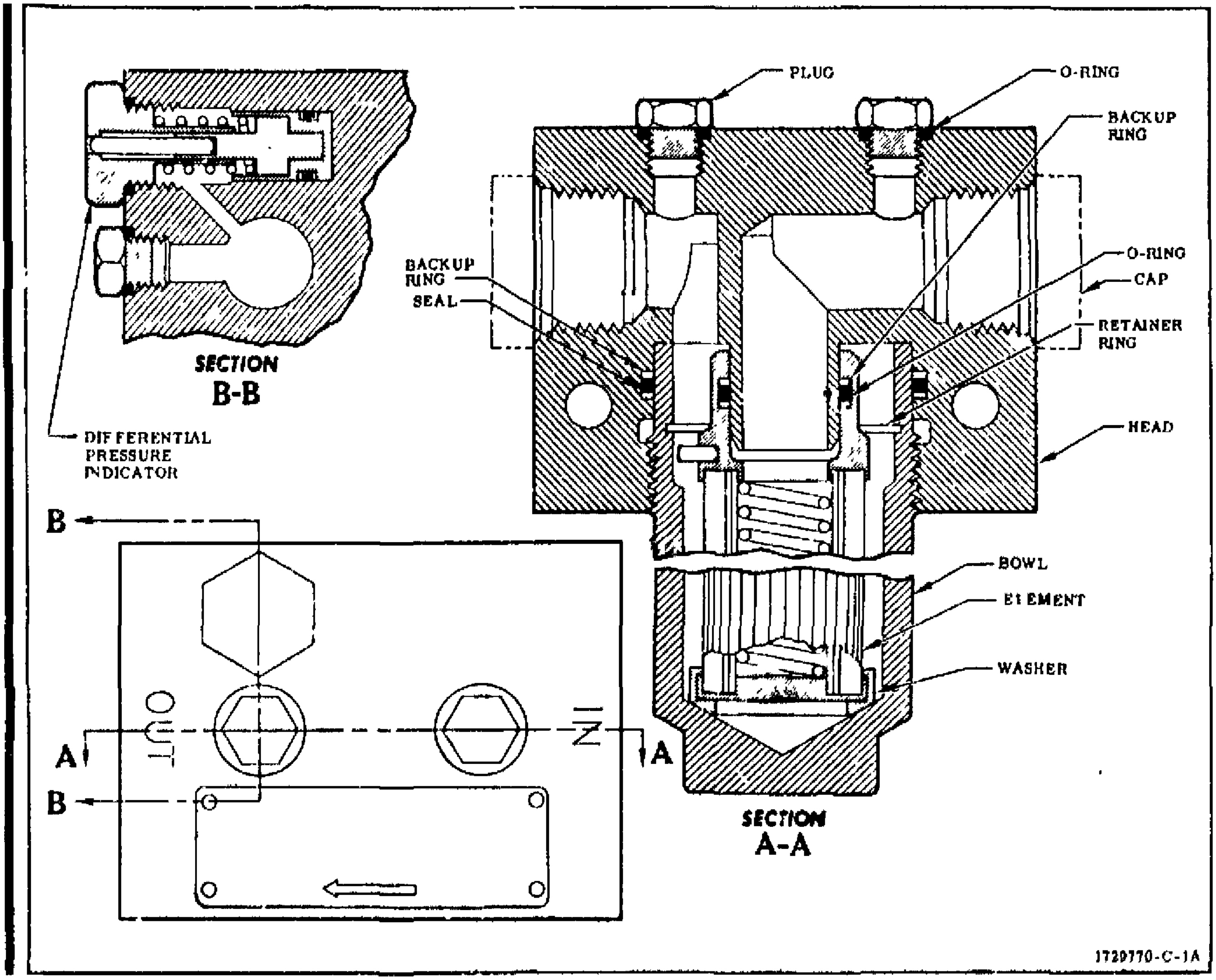


Figure 2-15. High-Pressure Filter

2-23. HIGH-PRESSURE RELIEF VALVE. The high-pressure relief valve (figure 2-16) is a manually adjusted relieving valve that can also be remotely controlled. The valve is used to limit the maximum fluid supply pressure in the event of a compensator malfunction. The valve has a control cap and a body. The control cap contains the adjusting mechanism, external control port, and internal control passageways. The body contains the high-pressure inlet and outlet ports, return port, and the main poppet and seat. The adjusting screw is turned clockwise to increase outlet pressure and counterclockwise to decrease outlet pressure. Access to the valve is through the high-pressure filter access door.

2-24. SHUTOFF VALVE. The shutoff valve is identical to the bypass valve (paragraph 2-14). The shutoff valve is used to close the high-pressure fluid supply outlet and enable an accurate adjustment of the high-pressure relief valve and the pump compensator control. The shutoff valve is mounted in the high-pressure line with access through the fluid sample door (rear of unit).

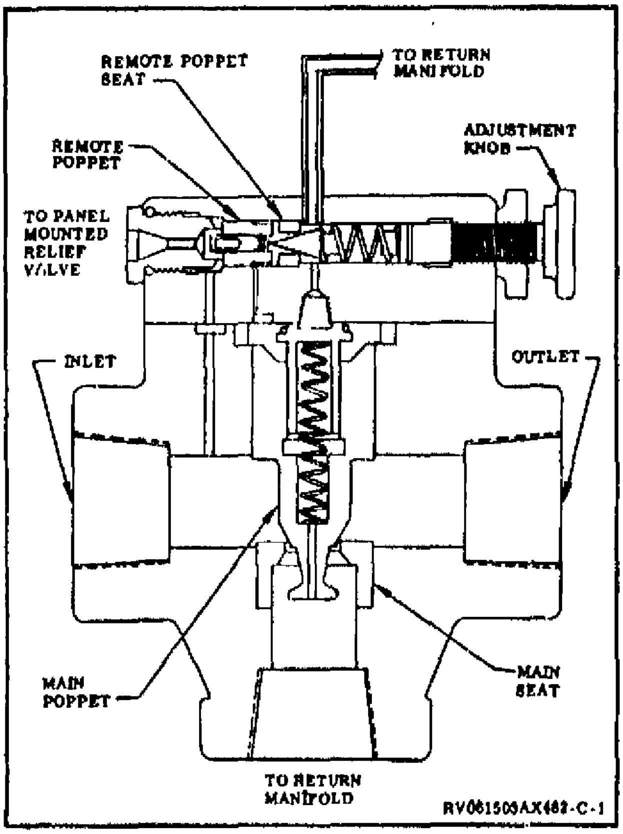


Figure 2-16. High-Pressure Relief Valve

2-25. ISOLATION VALVE AND LOW- AND HIGH-PRESSURE SAMPLE TAP VALVES. The valves (figure 2-17) are needle-type metering valves. The isolation valve is utilized as a shutoff valve for the pump outlet pressure gage. The sample tap valves are used to obtain fluid samples from the hydraulic system during system operation. The sample tap valves are panel-mounted at the rear of the unit.

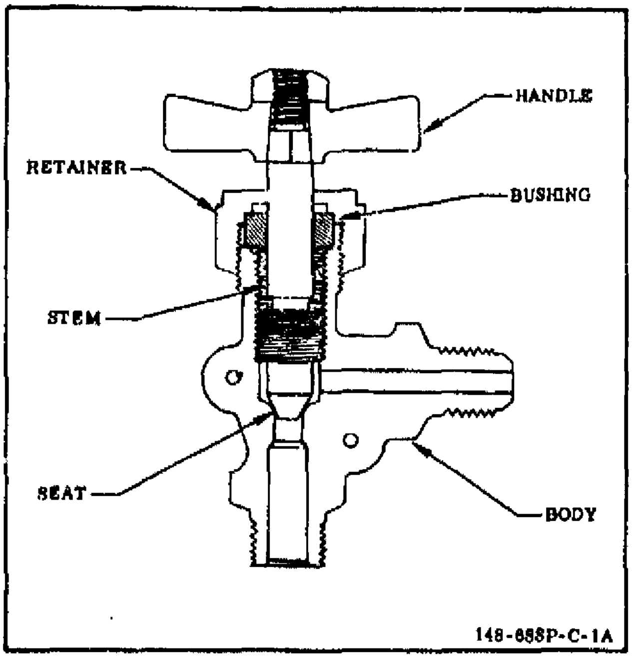


Figure 2-17. Isolation Valve and Low- and High-Pressure Sample Tap Valves

2-26. HIGH-PRESSURE OUTLET GAGE SNUBBER. The snubber (figure 2-18) is a device that protects the pressure gage from surges. A drill-rod inside a drilled passage in the snubber body creates an orifice and, during surges, the rod automatically reduces the orifice size.

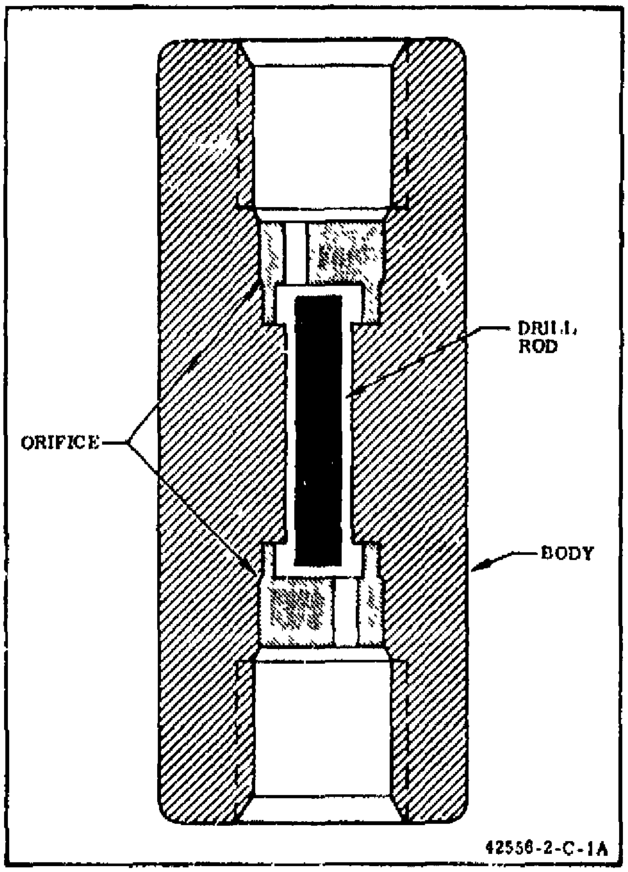


Figure 2-18. High-Pressure Outlet Gage Snubber

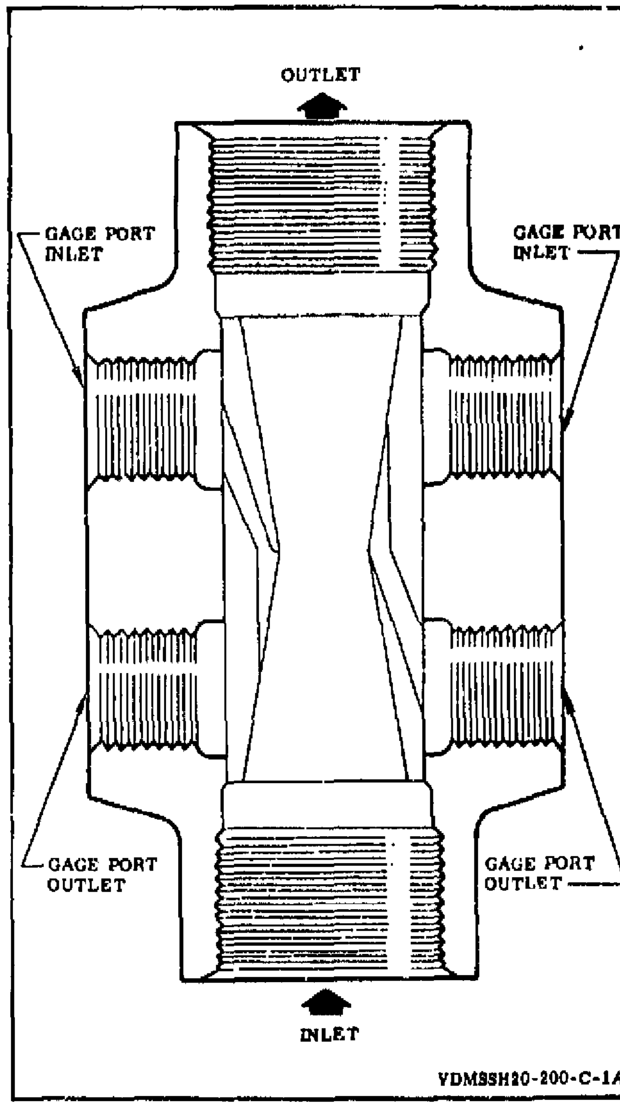


Figure 2-19. Flow Tube

2-27. FLOW TUBE. The flow tube (figure 2-19) is a venturi ported in such a manner that a differential can be measured between the inlet and outlet ports. This differential pressure is directed to the return flowrate gage (paragraph 2-13) for visual monitoring.

2-28. RETURN MANIFOLD. The return manifold serves as a collection point for all return fluid and, in turn, directs the return fluid to the inlet port of the heat exchanger.

2-29. HEAT EXCHANGER. The heat exchanger (figure 2-20) is a fixed-tube bundle fabricated of stainless steel. The heat exchanger is used to cool the hydraulic fluid. The heat exchanger consists of a shell, tubes and baffles, two end castings, and two end bonnets. The shell is placed around the tubing and baffles forming a compartment. The end castings placed on each end of the shell provide the inlet and outlet to the shell compartment. The end bonnets, bolted to the end castings, provide the inlet and outlet to the tubes. The heat exchanger is mounted vertically, at the rear of the unit, with the tube inlet and outlet ports on the bottom.

2-30. ACCUMULATOR. A 10-gallon accumulator is incorporated in the hydraulic system. The accumulator is a bladder accumulator of the same type used in Accumulator Unit G2027. Refer to section IV for a complete description and leading particulars and theory of operation of the accumulator.

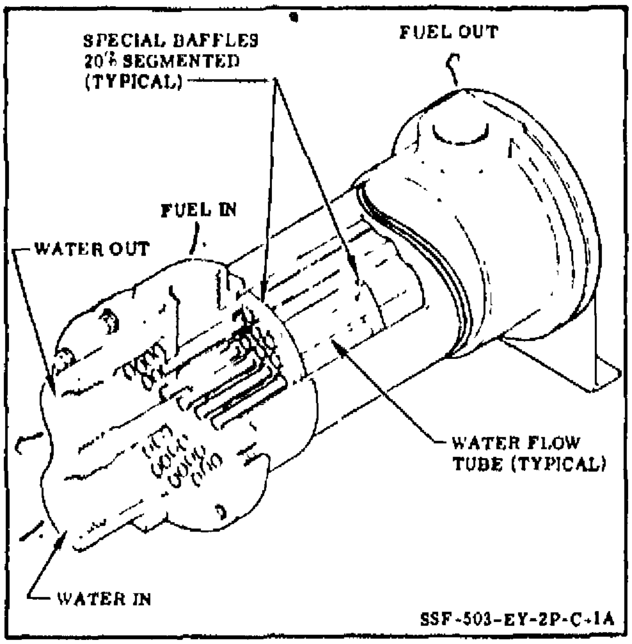


Figure 2-20. Heat Exchanger

2-31. ELECTRICAL COMPONENTS.

2-32. The electrical components are defined as those components mounted on the chassis and in the electrical installation. See figure 2-25, located at end of section, for electrical schematic.

2-33. ELECTRICAL CONTROL BOX. The electrical control (figure 2-21) is fabricated of aluminum alloy and is explosionproof. The control box contains circuit breakers, a stepdown transformer, a starter relay, a phase-reverse relay, five control relays, terminal boards, and necessary wiring. The circuit breakers are controlled from the front of the box by means of a switching yoke. An electrical cable connected to the top of the control box is provided to connect the control box to the facility electrical source. The cable is stored on a bracket inside the rear access doors. A cable pass panel is provided in one of the access doors so the doors can be closed while the cable is connected to the facility source.

2-34. FLUID LEVEL PRESSURE SWITCH. The fluid level pressure switch is an explosionproof, two-position, snap-type, pressure-actuated switch contained in a hermetically sealed container. The switch is mounted in the hydraulic pumping unit at the same height as the inlet to the hydraulic pump. There are three electrical leads, each 18 inches in length, protruding through the receptacle. Weight of fluid

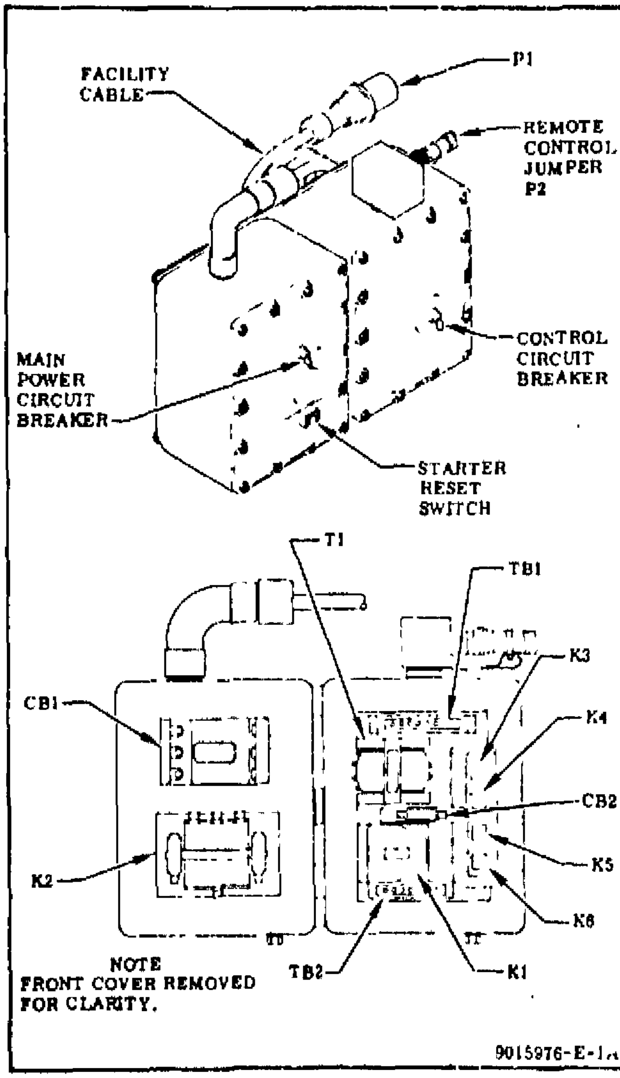


Figure 2-21. Electrical Control Box

contained in the fluid supply tank provides the pressure necessary for switch actuation. The pressure switch is adjusted to deactuate when fluid level decreases to 16 inches above the centerline of the hydraulic pump inlet port. The purpose of the pressure switch is to prevent hydraulic pump operation with an insufficient supply of hydraulic fluid to the pump inlet.

2-35. ACCUMULATOR PRECHARGE PRESSURE SWITCH. The accumulator precharge pressure switch is an explosionproof, single-pole, double-throw, pressure-actuated switch. The switch has an adjustment range of 200-400 psig. For pumping unit operation, the pressure switch is adjusted to deactuate at approximately 350 psig. An accumulator pneumatic precharge exceeding 400 ±25 psig provides the pressure required to keep the pressure switch in the actuated condition. There are three electrical leads, each 18 inches in length, protruding through the receptacle. The purpose of the pressure switch is to prevent pump operation with an insufficient pneumatic precharge in the accumulator.

2-36. PUMP INLET TEMPERATURE THERMOSWITCH. The pump inlet temperature thermoswitch (figure 2-22) is an expanding shell, adjustable temperature monitoring device. The thermoswitch consists of a shell, two electrical contacts, nonexpanding struts, adjusting screw, and two electrical wires. The contact points are mounted to the center of the struts and the struts anchored to each end of the shell. The thermoswitch is adjusted to indicate fluid temperature of 120° ±3° F. As temperature increases above the setting, the shell expands causing the contacts to close. The thermoswitch is mounted in the inlet line to the pump.

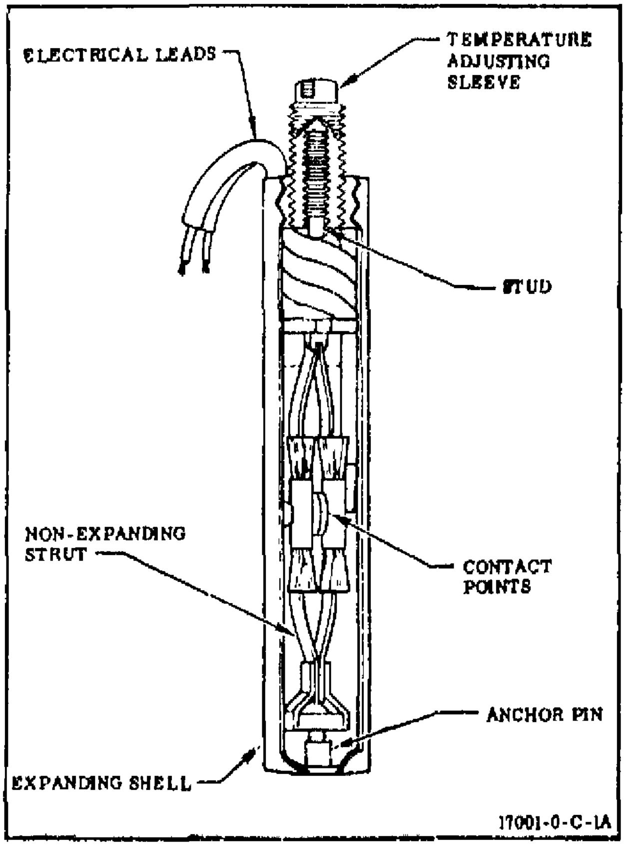


Figure 2-22. Thermoswitch

2-37. HOURMETER. The hourmeter is a hermetically sealed, elapse-time recording (in hours) meter. The hourmeter consists of a 110-vac motor, gears, mechanical five-place decimal counter, and view window. The counter indicates in tenths of an hour up to 10,000 hours. The hourmeter is located to the left of the electrical cable bracket with access through the rear access doors.

2-38. FILTER DIFFERENTIAL PRESSURE MICROSWITCH. The filter differential pressure microswitch plunger is actuated by the filter differential pressure indicator when differential pressure exceeds 80 psi. The microswitches are mounted directly above the filters.

2-39. PUMP MOTOR. The pump motor is an explosionproof, six-pole electric motor operating on 440-vac, 3-phase, 60-cycle power. The motor is rated at 25 hp and rotates at 1,200 rpm. The motor contains a thermal overload device for protection when subjected to excessive loads.

2-40. THEORY OF OPERATION.

2-41. ELECTRICAL SYSTEM.

2-42. The electrical system is divided into two different circuits, a motor control circuit and a local control and monitor circuit. The motor control circuit operates on 440-vac, 3-phase, 60-cycle power and the local control and monitor circuit operates on 110-vac power. Provisions are also included for a 28-vdc remote control circuit.

2-43. MOTOR CONTROL CIRCUIT. The motor control circuit receives power through electrical receptacle J1. The circuit is protected by a 50-ampere circuit breaker. Closing of the circuit breaker energizes the phase control relay and applies 440 vac to the primary windings of the 440-110 vac step-down transformer and to the open contacts of the motor starter relay. In the event the facility 440-vac phasing is incorrect, the phase-reversed light will come on and the local control and monitor circuit is disabled. When the motor starter relay is energized, the pump motor will operate.

2-44. LOCAL CONTROL AND MONITOR CIRCUIT. The local control and monitor circuit receives power from the secondary windings of the step-down transformer. The circuit is protected by a 5-ampere circuit breaker. Closing of the circuit breaker applies 110 vac to the main-power-on light and also applies 110 vac, through the remote control jumper plug P2, to the control power on light and the pump start switch. Momentarily pressing the pump start switch energizes the motor starter relay if phasing is correct, fluid level is within limits, and accumulator precharge pressure is within limits. Energizing the motor starter relay closes contacts to start the motor, energize the hourmeter relay, and lock itself in. Lock-in of the motor starter relay will permit motor operation until either the pump stop switch is momentarily depressed, the pump motor overloads and actuates the thermal temperature device, the accumulator precharge pressure is decreased below allowable limits, or level of hydraulic fluid falls below allowable limits. When the pump inlet fluid temperature exceeds 120° F, the thermoswitch closes, energizing a relay which causes the temperature-high light to illuminate. When the fluid pressure drop across either the 5-micron or the 2-micron filters exceeds 80 psig, the applicable differential pressure switch will actuate closed and the service filter elements light will illuminate.

2-45. HYDRAULIC SYSTEM.

2-46. The hydraulic system is a high-pressure (3,000 psi), high-flow (20 gpm), self-contained, closed system. The hydraulic system utilizes gaseous nitrogen (MIL-P-27401) for the accumulator precharge, water for the heat exchanger cooling agent, and RJ-1 fuel (MIL-F-25558) for the hydraulic fluid.

2-47. ACCUMULATOR OPERATION. The pneumatic precharge is introduced into the accumulator through the GN_2 precharge inlet. The pressure is routed through the shutoff valve to the accumulator pressure gage, then through the bleed valve to the accumulator precharge pressure switch and into the accumulator. The shutoff valve is closed to lock pressure in the accumulator, and the bleed valve is used to depressurize the accumulator. When the precharge pressure exceeds 400 ±25 psi, the pressure switch closes and remains closed until pressure drops below 350 ±15 psi. The accumulator, working in conjunction with the pump, maintains the high-flow requirements necessary during engine operation.

2-48. HEAT EXCHANGER OPERATION. Water for the heat-exchanger enters the pumping unit through the heat exchanger water inlet, circulates through the heat exchanger, and leaves through the heat exchanger water outlet. The water acts as the cooling agent for removing excessive heat from the hydraulic fluid.

2-49. PUMPING OPERATION. Hydraulic fluid for pumping unit operation is stored in the fluid supply reservoir. Fluid, under static pressure, is routed to the inlet of the hydraulic pump, first passing through the reservoir-mounted pump inlet filter, and to the pump inlet pressure gage. Also, fluid is routed to a fluid level pressure switch which closes when level of fluid is 22 inches above the horizontal plane of the pump inlet. Pump suction pressure is monitored by the PUMP INLET PRESSURE gage, and pump inlet temperature is monitored by the PUMP INLET TEMPERATURE gage. The hydraulic pump case is pressurized and the fluid from the pump case drain is directed to the return manifold. The compensator control is adjusted to a desired pump outlet pressure. The pump will deliver maximum flow at pressures less than the setting of the compensator. When pressure reaches compensator setting, flow is automatically reduced to maintain this pressure. Pump discharge pressure is routed through high-pressure filters to the high-pressure relief valve. The high-pressure relief valve outlet pressure (remotely controlled by the pressure relief valve) is routed through the shutoff valve to the accumulator and fluid supply high-pressure outlet. Outlet pressure from the high-pressure relief valve is monitored by the pump outlet pressure gage. The high-pressure relief valve protects the system from excessive pressure if the pump compensator malfunctions. When the relief valve operates, it bypasses fluid to the return manifold. This is accomplished by relieving the pressure through the pressure relief valve or bypass valve, which reduces the back-pressure on the main poppet. With the bypass valve in no load position, pump outlet pressure will be zero. Samples of the pump outlet fluid may be obtained from the high-pressure sample tap valve. Fluid is returned to the pumping unit from the engine through the fluid return low-pressure inlet and is routed through the flow tube to the return manifold. The pressure drop across the flow tube is monitored by the return flowrate gage. Return fluid is directed from the return manifold through the heat exchanger to the fluid supply reservoir. Samples of the return fluid may be obtained from the low-pressure sample tap valve.

2-50. MAINTENANCE.

2-51. Maintenance for the hydraulic pumping unit consists of checkout, removal and installation, cleaning, and servicing. These procedures are performed to make sure the hydraulic pumping unit is in an operable condition. A wiring diagram (figure 2-26), located at end of section, is provided as an aid in the repair or replacement of wiring.

2-52. CHECKOUT.

2-53. Checkout of the hydraulic pumping unit consists of leak-test, relief valve adjustment, thermoswitch and pressure switch test, and flow and fluid level switch test. The tests must be performed at ambient temperature and in the order given. No fittings, connections, or components are to be tightened, loosened, or removed while any portion of the hydraulic pumping unit is pressurized.

2-54. LEAK-TEST. (See figure 2-13.)

a. Open all access doors and set brakes on rear wheels.

b. Move MAIN POWER and CONTROL CIRCUIT BREAKERS to OFF position.

c. Connect a regulated gaseous nitrogen source (MIL-P-27401) to the ACCUMULATOR GN_2 PRECHARGE inlet on the disconnect panel.

d. Check that all valves are in the closed, or decreased position and the BYPASS VALVE in the NO LOAD position.

e. Open ACCUMULATOR SHUTOFF valve and increase GN_2 supply pressure, in 50-psig increments, to 200 psig Check for audible leakage.

f. If audible leakage exists, depressurize, correct leak, and repeat step e.

g. Increase GN_2 supply pressure in 150-psig increments, to 1,800 psig.

h. Leak-test all fittings, joints and connections using leak-test compound (MIL-L-25567). No leakage is allowable.

i. Decrease GN_2 pressure to zero and open ACCUMULATOR BLEED valve until ACCUMULATOR PRESSURE gage indicates zero; then close ACCUMULATOR BLEED valve.

j. Connect GN_2 supply pressure to HEAT EXCHANGER WATER INLET and install a hand valve on the HEAT EXCHANGER WATER OUTLET.

k. Close hand valve and increase GN_2 supply pressure to 50 psig.

l. Leak-test all fittings and end bonnets using leak-test compound (MIL-L-25567). No leakage is allowable.

m. Decrease GN_2 supply pressure to zero and open hand valve. Remove GN_2 supply and hand valve.

n. Thoroughly clean all areas where leak-test compound was used with a clean, dry cloth.

o. Install water hoses 9015979 (stowed above pump) to HEAT EXCHANGER WATER INLET and OUTLET.

p. Connect a water system capable of supplying and draining water at 30-100 psig and at a flowrate of 25 gpm to water hoses.

q. Install return hose 9015977 and pressure hose GR35800CC-16-0840 (Resistoflex) (stowed above pump) to FLUID RETURN LOW PRESSURE inlet and FLUID SUPPLY HIGH PRESSURE outlet respectively.

r. Install a high-pressure filter, system loading valve, and test gage between the pressure and return hoses.

s. Remove high-pressure filter elements, and re-install filter bowl.

t. Fill reservoir with RJ-1 fuel (MIL-F-25558), observing reservoir fluid level gage for correct operation.

u. Check for leakage of reservoir, and fittings and connections to pump and fluid level pressure switch. Leakage of 3 drops in 5 minutes is unacceptable.

v. Turn PRESSURE RELIEF VALVE to full DECREASE and high-pressure relief valve and system loading valve fully counterclockwise.

w. Move BYPASS VALVE to NO LOAD position and open high-pressure shutoff valve.

WARNING

Connecting or disconnecting a high-voltage power cable without turning off electrical power can cause electrical arcing between connectors, resulting in serious injury or death to personnel and damage to equipment.

x. Check that the remote-control jumper plug P2 (figure 2-21) is installed and connect facility cable plug P1 to facility power source of 440-vac, 3-phase, 60-cycle (mating receptacle EPC46642-WT-50-3).

y. Turn on facility power and press MAIN POWER and CONTROL CIRCUIT BREAKERS. The MAIN POWER ON and CONTROL POWER ON lights illuminate. If the PHASE REVERSED light illuminates, reverse the position of any 2 of the 3-phase wires in facility power plug P1.

z. Charge accumulator to 425 ±25 psi as indicated on the ACCUMULATOR PRESSURE gage and close ACCUMULATOR SHUTOFF valve.

aa. While an observer checks direction of motor rotation, press PUMP START switch and immediately press PUMP STOP switch. Rotation of motors must be in same direction as arrow on pump case.

ab. Press PUMP START switch. Check for flow to reservoir and for leakage at fittings and connections of return system. Leakage of 3 drops in 5 minutes is unacceptable.

ac. After step ab is accomplished, turn the following valves clockwise for the number of turns given, after initial spring contact:

(1) PRESSURE RELIEF VALVE; 2 turns.

(2) High-pressure relief valve; 4 turns.

(3) PRESSURE COMPENSATOR valve; 3 turns.

ad. Operate hydraulic pumping unit for 10 minutes; then press PUMP STOP switch.

ae. Apply cooling water pressure and adjust the pump volume control to obtain 1/4 to 1/3 flow as indicated on the pump flow indicator.

af. Turn the high-pressure relief valve, PRESSURE RELIEF VALVE and PRESSURE COMPENSATOR valve clockwise until they bottom out.

ag. Open ACCUMULATOR SHUTOFF valve and charge accumulator to 1800 psi as indicated on the ACCUMULATOR PRESSURE gage. Close ACCUMULATOR SHUTOFF valve.

ah. Open HIGH-PRESSURE SHUTOFF VALVE and system loading valve.

ai. Press PUMP START switch and move BYPASS VALVE to PRESSURE position. Slowly close system loading valve at 500-psi increments to 3,500 psig.

aj. Check all lines, fittings, and connections for leakage. Leakage of 3 drops in 5 minutes is unacceptable.

ak. Do not change setting of system loading valve; proceed immediately with procedures of paragraph 2-55.

2-55. RELIEF VALVE ADJUSTMENT. The relief valve adjustment is performed with the unit in operation.

a. Turn the high-pressure relief valve counterclockwise until PUMP OUTLET PRESSURE gage indicates 3,000 psi. Tighten locknut.

b. Turn the PRESSURE RELIEF VALVE to DECREASE until PUMP OUTLET PRESSURE gage indicates 2,500 psi. Tighten locknut.

c. Turn PRESSURE COMPENSATOR to DECREASE until PUMP OUTLET PRESSURE gage indicates 1,500 psi.

d. Open system loading valve and adjust pump volume control to full output (20 gpm).

e. Close and open HIGH-PRESSURE SHUTOFF VALVE several times. Pump flow should drop to almost zero and the pressure should stabilize at 1,500 psi, as indicated on the PUMP OUTLET PRESSURE gage, each time the shutoff valve is closed.

f. Open HIGH-PRESSURE SHUTOFF VALVE and move BYPASS VALVE to NO LOAD position.

g. Press PUMP STOP switch.

2-56. THERMOSWITCH AND PRESSURE SWITCH TEST. This test is performed after the procedures of paragraph 2-55 are completed.

a. Press PUMP START switch and close HIGH-PRESSURE SHUTOFF VALVE.

b. Adjust PRESSURE COMPENSATOR until PUMP OUTLET PRESSURE gage indicates 2,000 psi.

c. Open HIGH-PRESSURE SHUTOFF VALVE and adjust system loading valve until PUMP OUTLET PRESSURE gage indicates 1,800 psi.

d. Adjust pump volume control for full output.

e. Turn off cooling water and observe that, when PUMP INLET TEMPERATURE gage indicates 120° ±3° F, the TEMPERATURE HIGH light illuminates.

f. Adjust pump volume control to minimum output and turn cooling water on.

g. Adjust system loading valve until PUMP OUTLET PRESSURE gage indicates less than 300 psi.

h. Slowly open ACCUMULATOR BLEED valve and observe that, when ACCUMULATOR PRESSURE gage indicates 350 ±15 psi, pump motor stops.

i. Close ACCUMULATOR BLEED valve and open ACCUMULATOR SHUTOFF valve.

j. Press and hold PUMP START switch while recharging accumulator. When ACCUMULATOR PRESSURE gage indicates 400 ±25 psi, pump motor starts.

k. Repeat steps h, i, and j three times.

l. Charge accumulator to 700 psig and press PUMP STOP switch.

2-57. FLOW AND FLUID LEVEL SWITCH TEST. The fluid temperature must be maintained at 90° ±10° F during the flow test.

a. Disconnect tube at fuel outlet of heat exchanger, and plug tube.

b. Place a clean container (40 gallons) on a scale (500-pound capacity) near unit.

c. Connect a clean drain hose (one inch or larger) to fuel outlet of heat exchanger and place other end in container.

d. Press PUMP START switch and adjust system loading valve until PUMP OUTLET PRESSURE gage indicates 600 psi.

e. Adjust pump volume control to establish the following flowrates (approximately):

(1) 28 pounds per minute.

(2) 56 pounds per minute.

(3) 74 pounds per minute.

(4) 102 pounds per minute.

(5) 130 pounds per minute.

(6) Maximum flow.

f. Perform step e three times; record the weight of each flowrate and the reading of the RETURN FLOWRATE gage each time. Press PUMP STOP switch.

g. Plot on coordinate paper the return flowrate gage readings (inches of water) versus actual weighed fluid (pounds per minute) obtained in step f and draw the best fitting curve through the plotted points.

h. Plot on coordinate paper, gallons per minute versus return flowrate using the curve plotted in step g and place three copies in unit record case.

i. Adjust pump volume control until pump volume indicator reads 1/2 flow.

j. Connect a clear plastic tube to reservoir drain valve and secure tube vertically to side of reservoir with open end of tube above top of reservoir.

k. Place a mark on tube 16 ±2 inches above centerline of pump inlet.

l. Open drain valve. Fluid level in tube should equal level in reservoir.

m. Press PUMP START switch. When fluid level in reservoir reaches the tolerance of step k, pump motor stops.

NOTE

Pressure switch 675GHE26S is adjusted to stop pump motor at required fluid level.

n. Repeat step m until pump stops within the above tolerance.

o. If pumping unit is to be shipped or stored, drain remainder of fluid but do not drain pump case. Attach tag marked PUMP FILLED to control panel.

p. Connect tube removed in step a and install elements in high-pressure filters.

q. Remove test equipment and secure hydraulic pumping unit.

2-58. REMOVAL AND INSTALLATION.

2-59. Component removal procedures are limited to those necessary to prevent injury to personnel, damage to equipment, or special instructions. Where removal procedures are obvious, they have been omitted. The order and methods to be used are left to the discretion of the technician unless specific instructions are included. (See figure 2-23 for index and part numbers.) Lamps of control panel may be replaced with lamp GE10S6 (General Electric Co).

CAUTION

Pressures must be vented and fluids drained prior to disturbing connections in fluid or pneumatic systems.

2-60. Detailed component installation procedures are included when required; otherwise, only information to assist the technician in determining specific lubricants and torque values is given.

2-61. REMOVING ACCUMULATOR (1). Disconnect fluid end of accumulator by backing off nut 50N-4BR at connection; then remove packing.

CAUTION

Make sure accumulator has been depressurized using accumulator bleed valve on control panel to vent gaseous nitrogen precharge.

- Provide a suitable means of support when removing accumulator.

2-62. INSTALLING ACCUMULATOR (1).

CAUTION

Provide a suitable means of support when installing accumulator.

a. Use sealing compound RB0140-005 (Rocketdyne) on male threads of fittings of both the pneumatic and fuel installations of the accumulator except that a new connector 59R-4-300SS must be used in the replacement tank fitting, with a minimum of three wraps of thread sealant tape RB0140-002 (Rocketdyne)

b. Lubricate packings used in the fuel system with FS1281 grease (Dow Corning Corp); lubricate packings used in the pneumatic system with FS1281 grease (Dow Corning Corp).

c. Apply three wraps, minimum, of thread sealant tape RB0140-002 (Rocketdyne) to threads of a new connector 59R-4-300SS and install in replacement tank fitting.

d. Torque the following, as indicated:

(1) Nut 50N-4BR; 3,600 inch-pounds, maximum.

(2) Connector 59R-4-300SS; as required (pipe thread).

(3) Coupling nut; 6?0-750 inch-pounds.

(4) Reducer; 135-185 inch-pounds.

(5) Tube; 270-345 inch-pounds.

(6) Adapter; 110-130 inch-pounds.

(7) Nut; 25-30 inch-pounds.

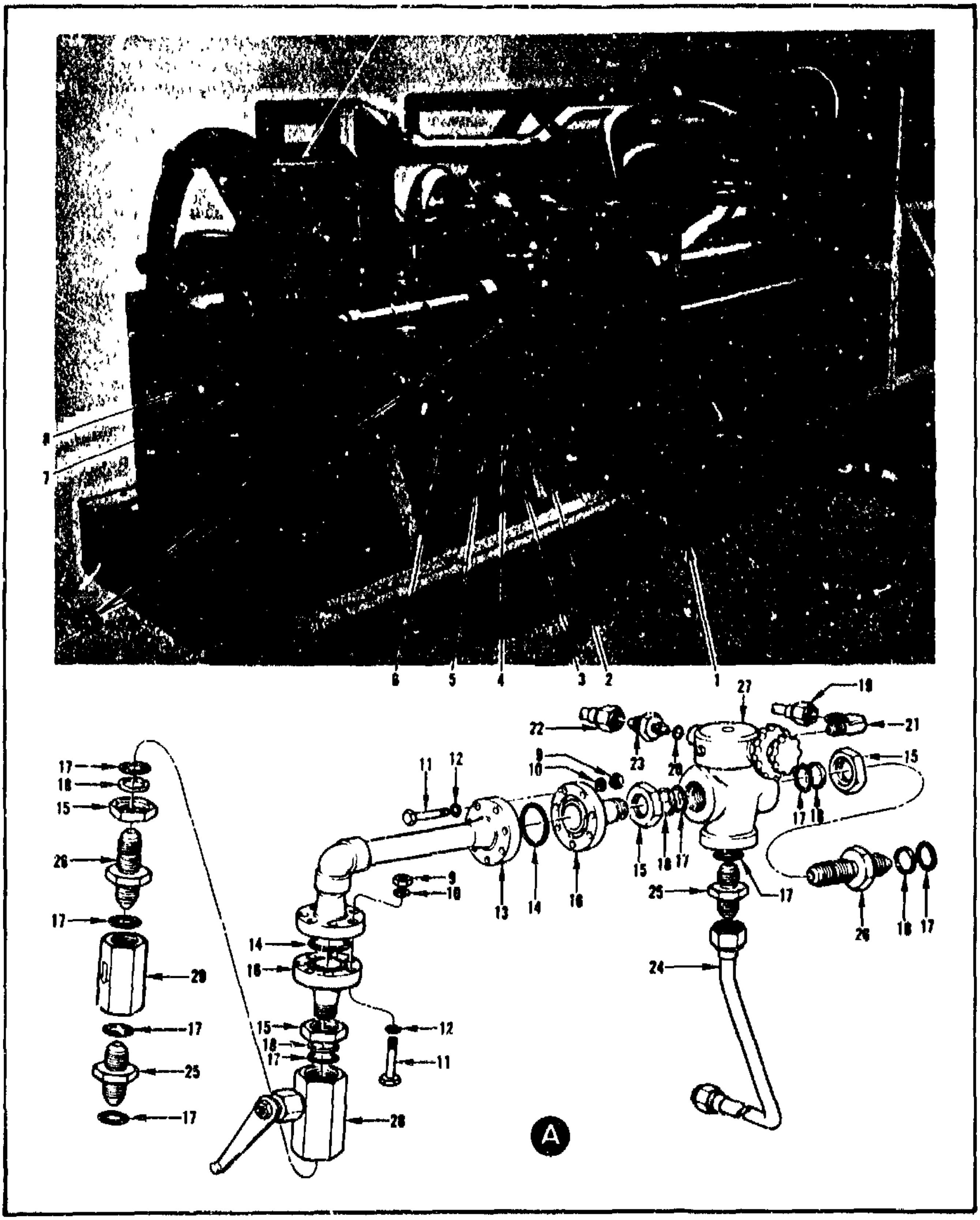


Figure 2-23. Disassembly of Hydraulic Pumping Unit G2025 (Sheet 1 of 2)

Index No.	Part No.	Description
1	A813-200-2-1	Accumulator (F-1)
	59R-4-300SS	Connector (F-3)
	50N-4BR	Nut (F-3)
	MS29514	Packing (F-3)
	NAS679C4W	Nut (F-3)
	LD153-0010-0010	Washer (F-3)
	9020440	Strap (F-3)
	9020469	Tube (M-3)
	9015900	Adapter (F-3)
	MS28775-012	Packing (F-3)
	AN818-10C	Coupling Nut (F-3)
	AN919-6C	Reducer (F-3)
	MS28778-4	Packing (F-3)
2	869A-6BT	Check Valve (F-3)
	9020473	Tube (M-3)
	AN815-6C	Union (F-3)
	MS28778-6	Packing (F-3)
3	869A-12BT	Check Valve (F-3)
	AN837-12C	Elbow (F-3)
	RD114-1003-1012	Nut (F-3)
	MS28777-12	Ring (F-3)
	MS28778-12	Packing (F-3)
	R3800CC-12-0220	Hose (F-3)
4	869A-16BT	Check Valve (F-3)
	9020467	Tube (M-3)
	AN815-16C	Union (F-3)
	MS28778-16	Packing (F-3)
5	869A-6DT	Check Valve (F-3)
	9020465	Tube (M-3)
	AN815-6C	Union (F-3)
	MS28778-6	Packing (F-3)
6	869A-24TT	Check Valve (F-3)
	9020464	Tube (M-3)
	MS28778-24	Packing (F-3)
7	1486-SSP	Sample Tap Valve (F-3)
	9020466	Tube (M-3)
	9020524	Tube (M-3)
8	1486-SSP	Sample Tap Valve (F-3)
	9020524	Tube (M-3)
	9020465	Tube (M-3)
9	NAS679C5	Nut (F-3)
10	LD153-5001-0005	Washer (F-3)
11	NAS1005-20A	Bolt (F-3)
12	RD153-5001-0005	Washer (F-3)
13	9014798	Pipe (F-2)
14	AS117-1-80	Ring Seal (F-3)
15	RD114-1003-1016	Nut (F-3)
16	890073	Flange Adapter (F-3)
17	MS28778-16	Packing (F-3)
18	MS28777-16	Ring (F-3)
19	9021308	Tube (M-3)
20	MS28778-4	Packing (F-3)
21	MS20822-6C	Elbow (F-3)
22	9021309	Tube (M-3)
23	AN919-6C	Reducer (F-3)
24	9020467	Tube (M-3)
25	AN815-16C	Union (F-3)
26	AN832-16C	Union (F-3)
27	RV061503AX482	Pilot-Operated Valve (F-1)
28	HT36GT-1	Shutoff Valve (F-1)
29	HP239T-16BB	Check Valve (F-1)

Figure 2-23. Disassembly of Hydraulic Pumping Unit G2025 (Sheet 2 of 2)

2-63. INSTALLING CHECK VALVES (2, 5).

a. Lubricate packing with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

NOTE

Check valve must be installed with flow away from manifold.

b. Torque the following, as indicated:

(1) Union; 100-150 inch-pounds.

(2) Check valve; 100-150 inch-pounds.

(3) Tube; 130-180 inch-pounds (check valve end); 270-345 inch-pounds (opposite end).

2-64. INSTALLING CHECK VALVE (3).

a. Lubricate packings with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

NOTE

Check valve must be installed with flow toward manifold.

b. Torque the following, as indicated:

(1) Check valve; 420-600 inch-pounds.

(2) Elbow; 420-600 inch-pounds.

(3) Nut; 450-650 inch-pounds.

(4) Hose; 650-800 inch-pounds.

2-65. INSTALLING CHECK VALVE (4).

a. Lubricate packings with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

NOTE

Check valve must be installed with flow toward manifold.

b. Torque the following, as indicated:

(1) Check valve; 600-840 inch-pounds.

(2) Union; 600-840 inch-pounds.

(3) Tube; 900 to 1,100 inch-pounds.

2-66. INSTALLING CHECK VALVE (6).

a. Lubricate packings with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

NOTE

Check valve must be installed with flow toward manifold.

b. Torque the following, as indicated:

(1) Check valve; 840 to 1,080 inch-pounds.

(2) Tube; 1,550 to 1,850 inch-pounds.

2-67. INSTALLING HIGH-PRESSURE SAMPLE TAP VALVE (7).

a. Lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

b. Torque coupling nuts of tubings to 270-345 inch-pounds.

2-68. INSTALLING LOW-PRESSURE SAMPLE TAP VALVE (8).

a. Lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

b. Torque coupling nuts of tubings at tap valve to 270-345 inch-pounds.

c. Torque coupling nut of tubing at check valve to 130-180 inch-pounds.

2-69. REMOVING PILOT-OPERATED VALVE (27).

a. Remove pipe (13) and tubes (19, 22, 24).

b. Loosen nut (15) and rotate pilot-operated valve from union (26).

c. Remove remaining parts as required.

2-70. INSTALLING PILOT-OPERATED VALVE (27).

a. Lubricate packings with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

b. If union (26) was removed from filter, install with packing (17) and ring (18). Torque union to 600-800 inch-pounds.

c. Install nut (15), ring (18), and packing (17) on union (26).

d. Install pilot-operated valve by rotating it onto union (26).

e. Install nut (15), ring (18), and packing (17) on flange adapter (16) and install flange adapter in valve until pipe (13) alines with both flange adapters. Torque nuts (15) to 650-900 inch-pounds.

f. Install ring seals (14) and pipe (13) and secure. Torque nuts (9) not to exceed 275 inch-pounds.

g. Torque the following, as indicated:

(1) Elbow (21); 225-275 inch-pounds.

(2) Tube (19); 270-345 inch-pounds.

(3) Reducer (23); 225-275 inch-pounds.

(4) Tube (22); 135-185 inch-pounds.

(5) Union (25); 600-840 inch-pounds.

(6) Tube (24); 1,200-1,400 inch-pounds.

2-71. INSTALLING SHUTOFF VALVE (28).

a. Lubricate packings with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

NOTE

During assembly, nuts (15) shall not be torqued until alinement with pipe (13) is obtained.

b. Torque the following, as indicated:

(1) Union (26); 600-840 inch-pounds.

(2) Nut (15); 650-900 inch-pounds.

(3) Nut (9); 275 inch-pounds, maximum.

2-72. INSTALLING CHECK VALVE (29).

a. Lubricate packings with FS1281 grease (Dow Corning Corp); lubricate male threads of fittings with sealing compound RB0140-005 (Rocketdyne).

b. Install check valve with flow arrow pointing downward and torque the following, as indicated:

(1) Union (25); 600-840 inch-pounds.

(2) Check valve (29); 600-840 inch-pounds.

c. Complete installation as outlined for shutoff valve in paragraph 2-71.

2-73. CLEANING.

2-74. Clean the hydraulic pumping unit for hydraulic service; clean the accumulator bleed valve, shutoff valve, and tubing for pneumatic service. (Refer to section I for cleaning, handling, and packaging parts.)

2-75. SERVICING

2-76. Servicing of the hydraulic pumping unit consists of lubricating the chassis, pump motor bearings, and pump-to-motor shaft coupling annually with gear grease (MIL-G-23827). The pump inlet filter element must be replaced whenever the pump inlet pressure gage indicates a vacuum of 6 inches of mercury or greater. Access to the filter is gained by removing a cover plate from the top of the reservoir. The filter is removed by pressing the handle down and rotating it one-quarter turn. The high-pressure filter elements must be ultrasonically cleaned, or replaced, as required, every 80 hours of operation or when the service filter elements light comes on, whichever occurs first.

2-77. INSPECTION.

2-78. The inspections establish what is to be inspected, the conditions to be sought and corrected, and the frequency of inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted since they are directly affected by local operations. Visual inspections are conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. These inspections consist of two periodics; the 1st periodic to be accomplished at 30 calendar days, and the 2nd periodic at 180 calendar days. See figure 2-24 for inspection requirements for accumulator unit.

Inspection Requirements	Visual	Periodic	
		1st	2nd
1. Calibration-check.			X
2. Pumping unit exterior and interior for dirt, placard illegibility and tire inflation.	X		X
3. Gages for broken glass, cracked frames, and loose or missing faceplate screws.	X	X	
4. Valves for cracked or broken control knobs and loose or missing retaining screws and locknuts.	X		X
5. Flexible lines for kinks, twists, and deterioration.	X		X
6. Tubing for scratches, dents, cracked sleeves, and loose coupling nuts.			X
7. Filters for contamination.		X	
8. Indicator lights for broken covers and broken or missing bulbs.	X	X	
9. Switches and circuit breakers for looseness and improper operation.	X	X	
10. Power cable for damaged or corroded receptacle and/or plug, and cut, torn, chafed, or deteriorated outer cover.	X		X

Figure 2-24. Inspection Requirements for Hydraulic Pumping Unit G2025

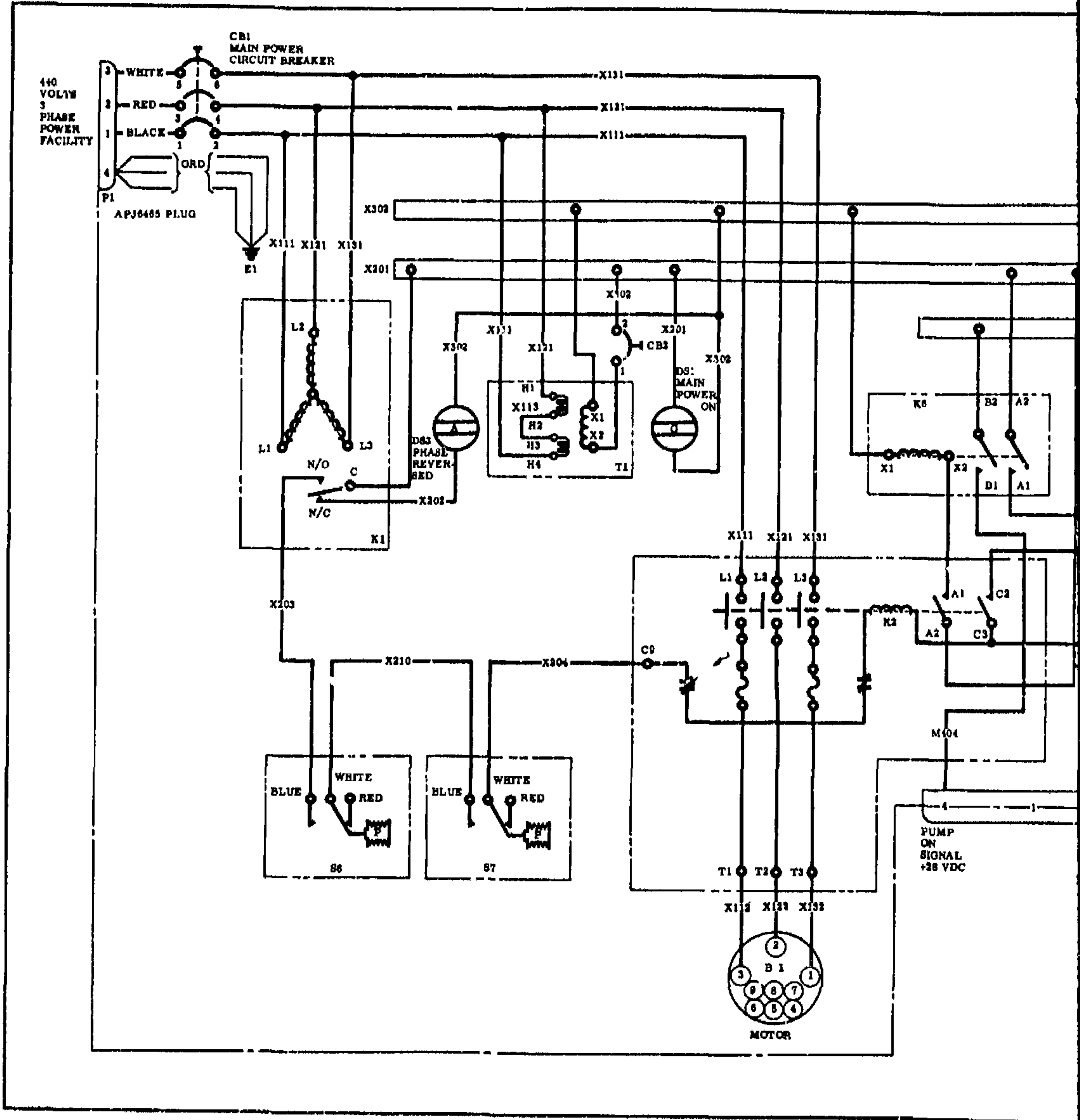
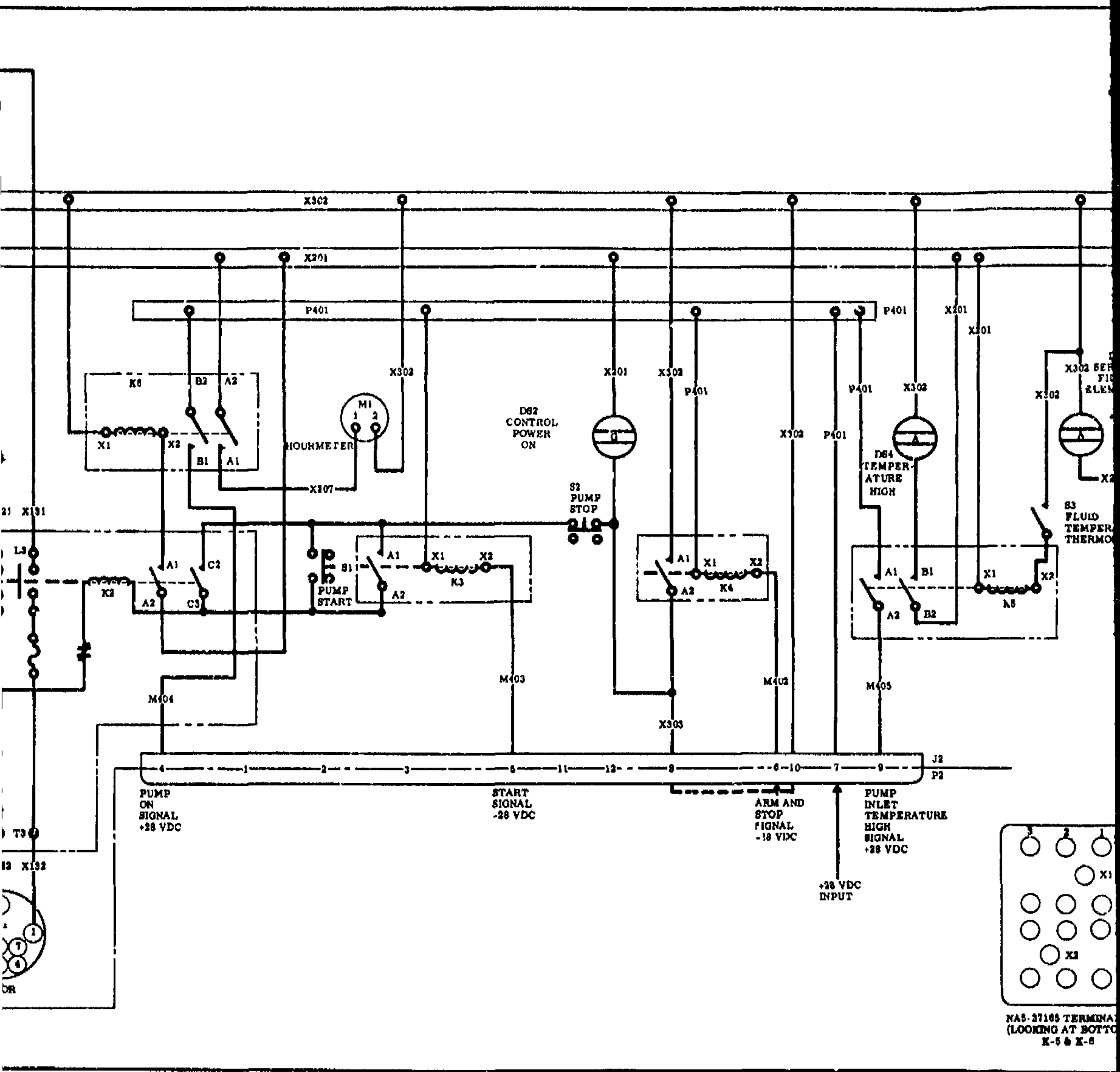
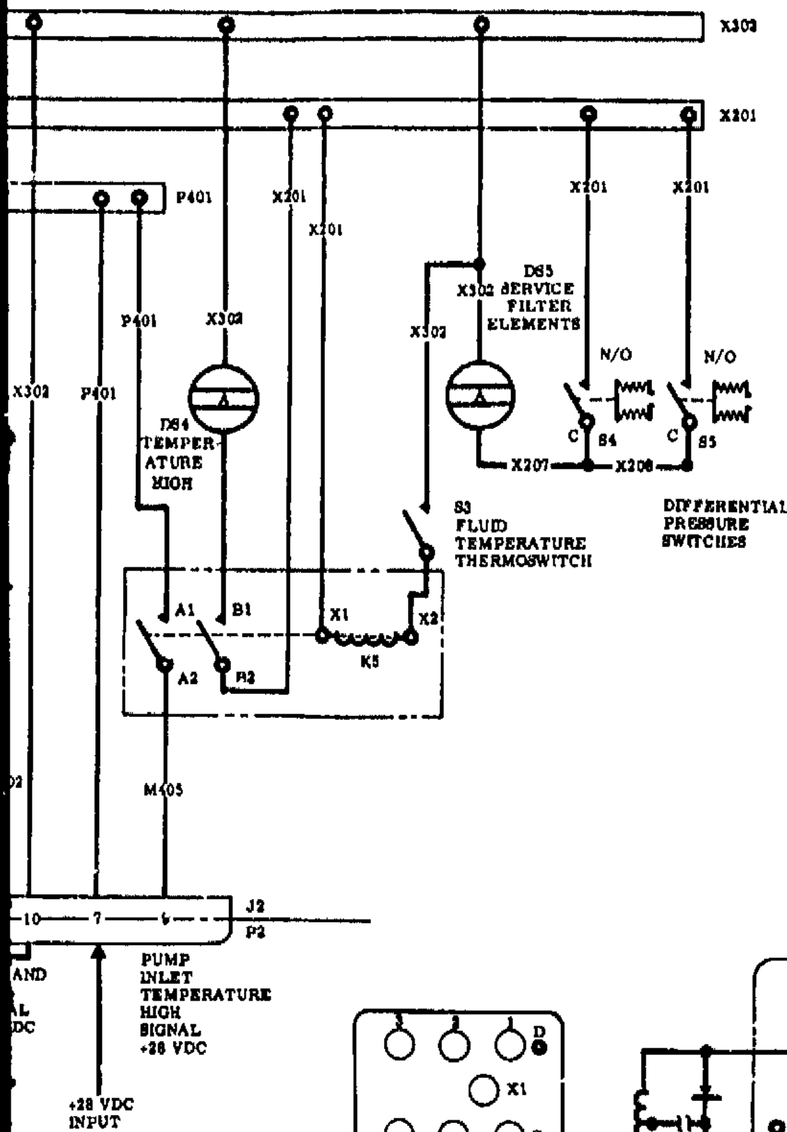


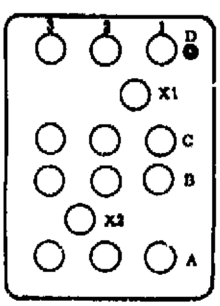
Figure 2-25. Hydraulic Pumping Unit G2025 Electrical Schematic


X302
X201
P401
K6
B2
A2
X1
X2
B1
A1
M1
HOURMETER
X307
DS2
CONTROL
POWER
ON
S2
PUMP
STOP
S1
PUMP
START
K3
K4
DS4
TEMPER-
ATURE
HIGH
S3
FLUID
K5
M404
M403
M402
M405
X303
J2
P2
PUMP
ON
SIGNAL
+28 VDC
START
SIGNAL
-28 VDC
ARM AND
STOP
SIGNAL
PUMP
INLET
TEMPERATURE
HIGH
SIGNAL
+28 VDC
+28 VDC
INPUT
X131
X132
L3
T3
NAS-27165 TERMINAL
K-5 & K-6

lc

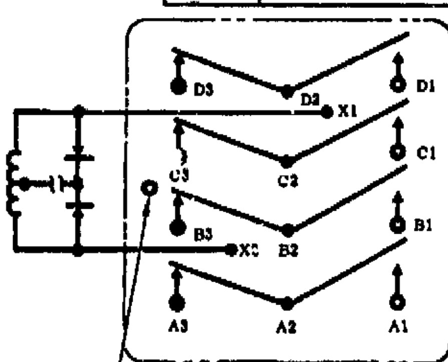
ITEM NO.	DESCRIPTION	PART NUMBER	MFR	SPEC
B1	MOTOR	X200234A	U. S. MOTORS	COML
CB1	CIRCUIT BREAKER	ET-2635 (50 AMP)	I. T. E.	COML
CB2	CIRCUIT BREAKER	QC1005 (5 AMP)	WESTINGHOUSE	COML
DS1	LIGHT	EOP3227J3 BLANK	CROUSE-HINDS	COML
DS2	LIGHT	EOP3227J3 BLANK	CROUSE-HINDS	COML
DS3	LIGHT	EOP313-J6-J6-J6	CROUSE-HINDS	COML
DS4	LIGHT	EOP313-J6-J6-J6	CROUSE-HINDS	COML
DS5	LIGHT	EOP313-J6-J6-J6	CROUSE-HINDS	COML
K1	RELAY, 440 V	8506-J01-440V	SQUARE "D"	COML
K2	RELAY 110 V	HA-232-UAC	ARROW H & H	COML
K3	RELAY, 28 VDC	MS25271-D1		COML
K4	RELAY, 28VDC	MS25271-D1		
K5	RELAY, 110 VAC	NA5-27165		
K6	RELAY 110 VAC	NA5-27165		
M1	HOURMETER	K23209	A. H. HAYDON	COML
S1	SWITCH	EOP3227J3 (BLANK REF)	CROUSE-HINDS	COML
S2	SWITCH	EOP3227J3 (BLANK REF)	CROUSE-HINDS	COML
S3	TEMP SWITCH	17001-0	FENWAL	COML
S4	MICRO SWITCH	EX-Q	HONEYWELL	COML
S5	MICRO SWITCH	EX-Q	HONEYWELL	COML
S6	LEVEL SWITCH	675OHE266	CUSTOM COMP	COML
S7	PRESSURE SWITCH	606G4-18	CUSTOM COMP	COML
T1	TRANSFORMER	CLASS 9070 TYPE E0-4	SQUARE D	
P1	PLUG	APJ6465	CROUSE-HINDS	COML
P2	PLUG	RPX117-911507N	CROUSE-HINDS	
J2	RECEPTACLE	RPE217-940P07N	CROUSE HINDS	COML



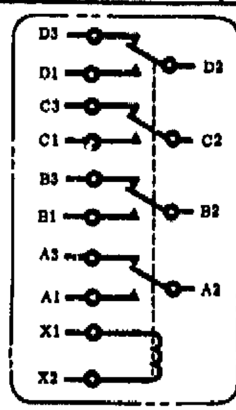


NA5-27165 TERMINALS (LOOKING AT BOTTOM) K-5 & K-6

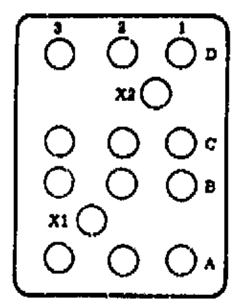
ORIENTATION MARK



NA5-27165 CIRCUIT DIAGRAM

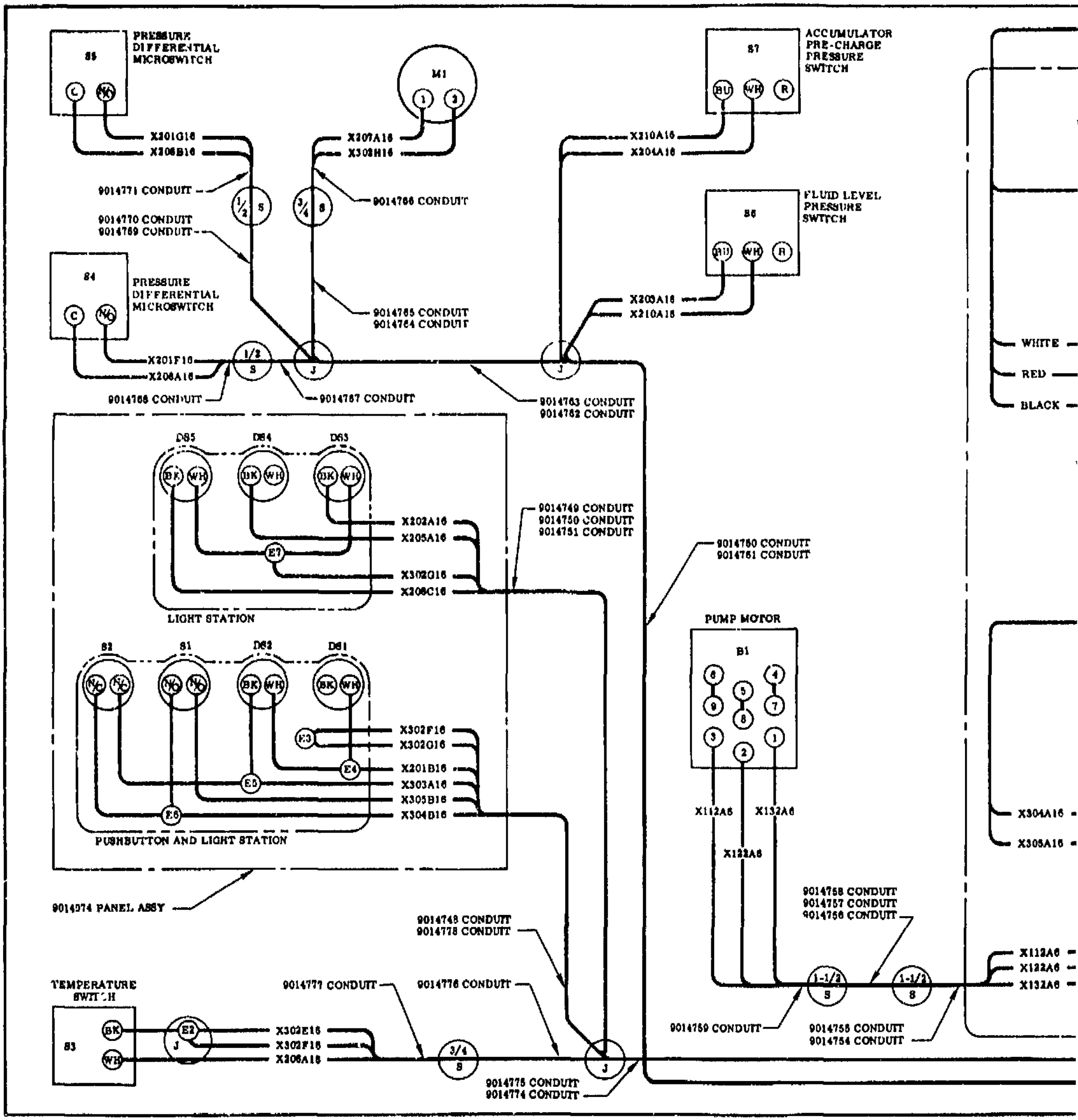


MS25271-D1 CIRCUIT DIAGRAM

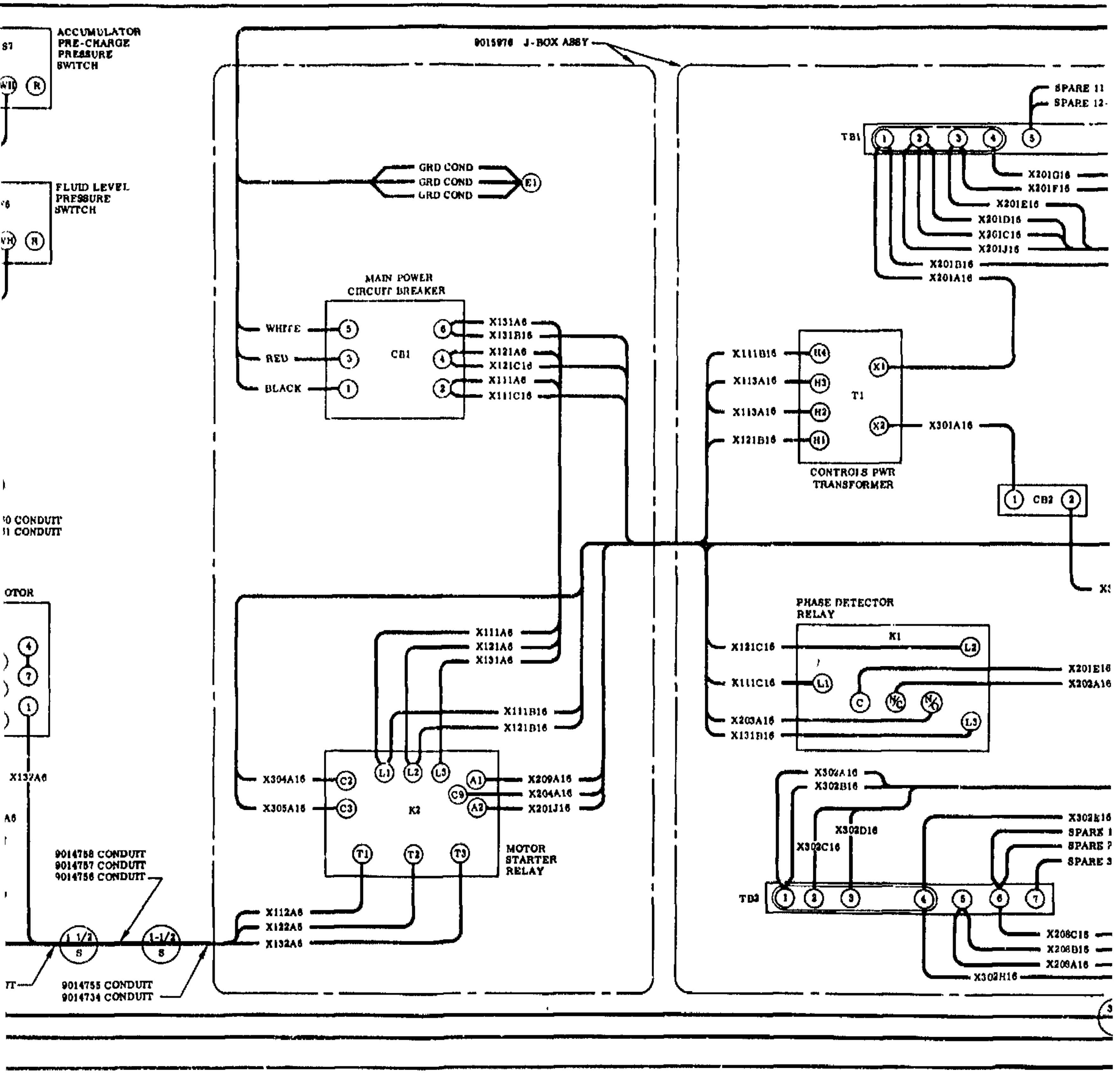


MS25271-D1 TERMINALS (LOOKING AT BOTTOM) K-3 & K-4

9015991-S-1C



PRESSURE DIFFERENTIAL MICROSWITCH
M1
ACCUMULATOR PRE-CHARGE PRESSURE SWITCH
S7
X201G16
X206B16
X207A16
X302H16
X210A16
X204A16
9014771 CONDUIT
9014766 CONDUIT
9014770 CONDUIT
9014769 CONDUIT
FLUID LEVEL PRESSURE SWITCH
S6
S4
PRESSURE DIFFERENTIAL MICROSWITCH
9014765 CONDUIT
9014764 CONDUIT
X203A16
X210A16
X201F16
X206A16
9014768 CONDUIT
9014767 CONDUIT
9014763 CONDUIT
9014762 CONDUIT
WHITE
RED
BLACK
DS5
DS4
DS3
X202A16
X205A16
X302G16
X206C16
9014749 CONDUIT
9014750 CONDUIT
9014751 CONDUIT
9014760 CONDUIT
9014761 CONDUIT
LIGHT STATION
PUMP MOTOR
B1
S2
S1
DS2
DS1
X302F16
X302G16
X201B16
X303A16
X305B16
X304B16
PUSHBUTTON AND LIGHT STATION
X112A6
X132A6
X122A6
X304A16
X305A16
9014774 PANEL ASSY
9014758 CONDUIT
9014757 CONDUIT
9014756 CONDUIT
9014748 CONDUIT
9014778 CONDUIT
TEMPERATURE SWITCH
9014777 CONDUIT
9014776 CONDUIT
X112A6
X122A6
X132A6
S3
X302E16
X302F16
X206A16
9014759 CONDUIT
9014755 CONDUIT
9014754 CONDUIT
9014775 CONDUIT
9014774 CONDUIT



All data on pag

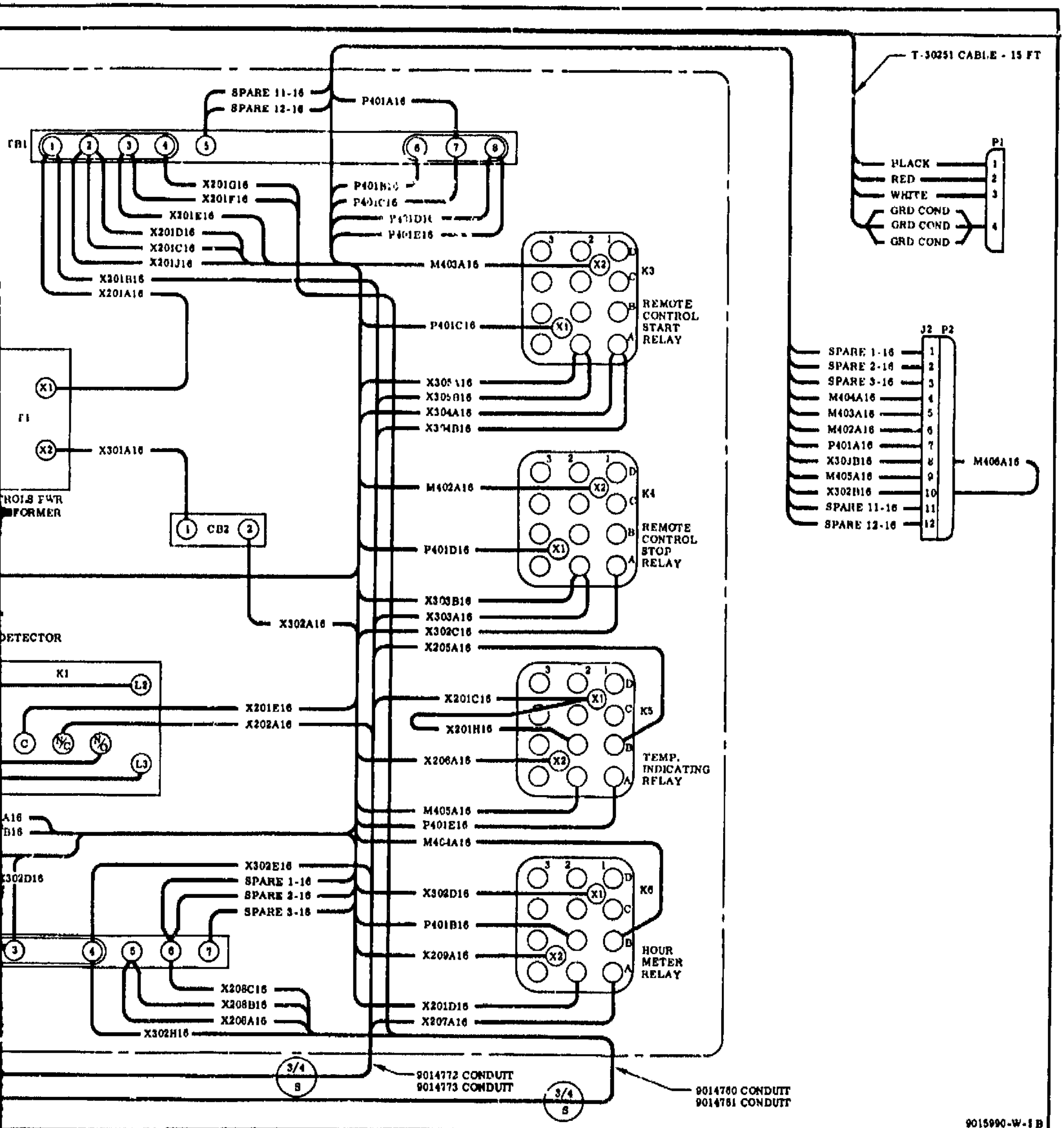


Figure 2-26. Hydraulic Pumping Unit G2025 Wiring Diagram

All data on pages 2-27 through 2-40 deleted.

SECTION III

HYDRAULIC PUMPING UNIT G2026

3-1. **SCOPE.** This section contains description and leading particulars, theory of operation, maintenance, and inspection for Hydraulic Pumping Unit G2026. The hydraulic pumping unit, used in conjunction with the accumulator unit (section IV) provides the high-pressure hydraulic fluid required for performing engine prefiring function-tests and the momentary high-flow demand of hydraulic fluid required during the engine start sequence.

3-2. DESCRIPTION AND LEADING PARTICULARS.

3-3. The hydraulic pumping unit (figure 3-1) is a stationary, skid-mounted, electrical-powered unit containing a variable-delivery hydraulic pump, a water separator, a filter, an electrical junction box, a gage panel, and an explosionproof electrical system. The pumping unit may be started or stopped either locally or remotely. Several pumping units may be combined to meet flow requirements ranging from 33 gpm for a single unit to 165 gpm for 5 units when manifolded in parallel. An external source of low-pressure fluid must be supplied to the inlets of the pumping units. The pressurizing of the inlet fluid is required to prevent pump cavitation under high-flow demand. The pumping unit may be lifted with a sling or a forklift truck. See figure 3-2 for leading particulars for pumping unit.

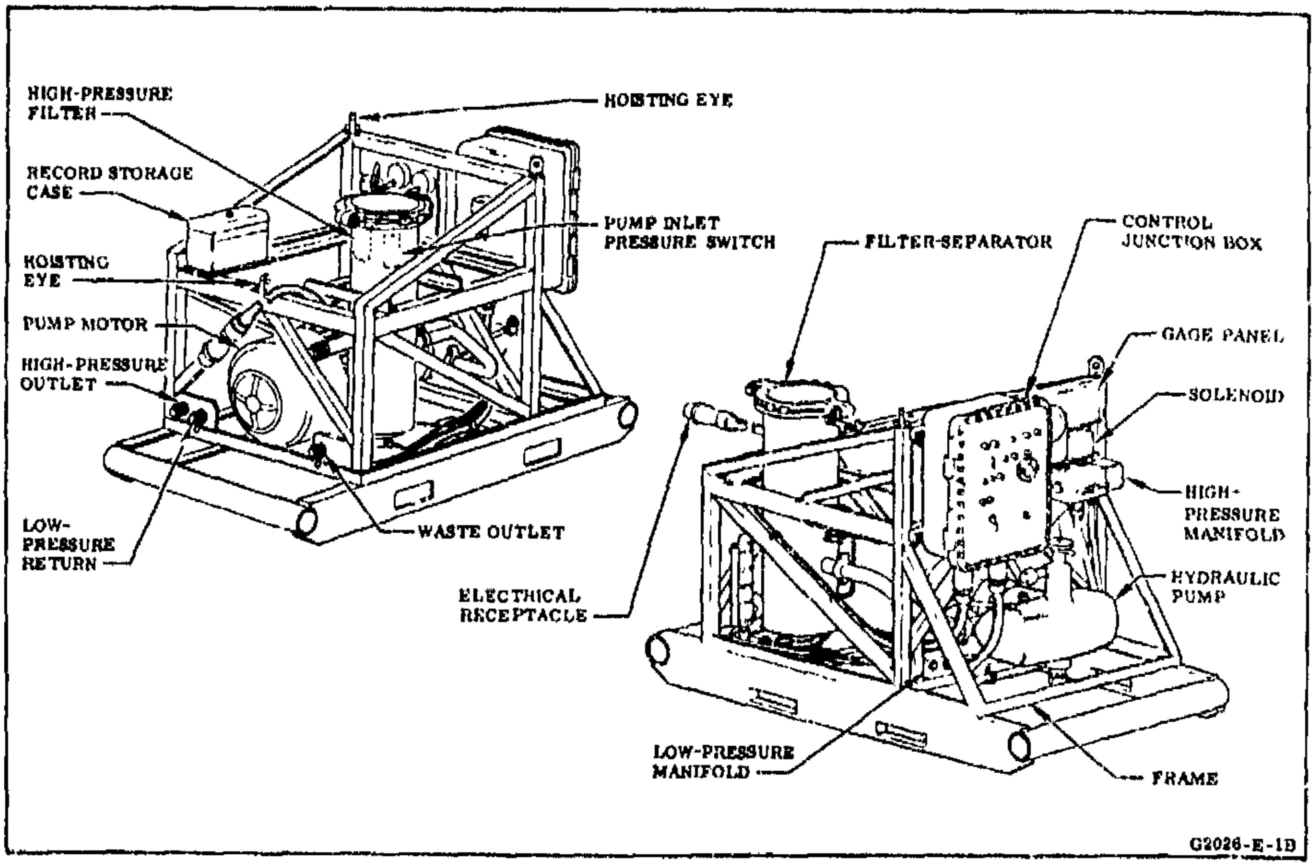


Figure 3-1. Hydraulic Pumping Unit G2026

Length	89 inches
Width	48 inches
Height	54 inches
Gross Weight	3,460 pounds
Electrical Requirements	440-vac, 60-cps, 3-phase, 75-ampere power
Fluid Requirements	RP-1 fuel (MIL-R-25576) and RJ-1 fuel (MIL-F-25558), as required.
Pump Operating Speed	1,170 rpm
Flowrate at Full Stroke	33 gpm at 3,000 psig
Pump Inlet Pressure	5 psig, minimum
Pump Case Pressure	110 psig, maximum

Figure 3-2. Leading Particulars for Hydraulic Pumping Unit G2026

3-4. HYDRAULIC PUMP. The hydraulic pump (figure 3-3) is an adjustable, pressure-compensated, positive-displacement, axial piston pump. The pump has a variable volume, pressure, and piston stroke. The pump is driven by an explosionproof electric motor at a speed of 1,170 rpm. The pump fluid output is rated at 33 gpm at 2,200 psig and 24 gpm at 3,000 psig. Rotational power (supplied by the electric motor), applied to the pump shaft, rotates the pump cylinder barrel. The pistons confined in the cylinder barrel travel in a circular pattern and are spring-loaded against the inclined cam plate. Rotation of the barrel causes axial reciprocation of the pistons. As the cylinder barrel rotates, the pistons following the cam plate away from the port plate draw fluid from the inlet port, and those following the cam plate toward the port plate force fluid out the outlet port. Quantity of fluid delivered is directly proportional to the angle of the cam plate. The cam plate is attached to a movable hanger that controls the angle of the cam plate. Movement of the hanger is controlled by the pressure-compensator control. Maximum movement of the hanger is controlled by adjustable minimum

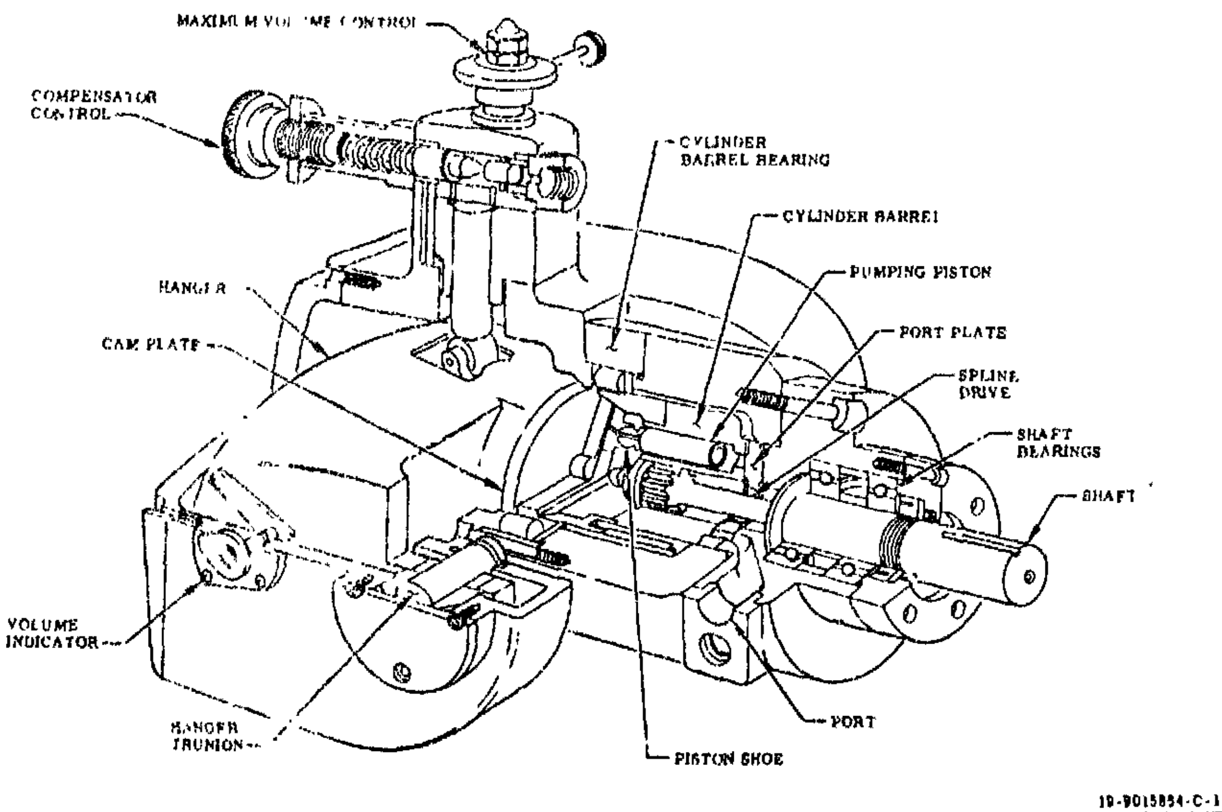


Figure 3-3. Hydraulic Pump

and maximum volume control stops. The pressure-compensator control automatically regulates the volume of fluid delivered by changing the length of the piston stroke and by varying the angle of the cam plate. Stroke change is controlled by system pressure in such a manner that when the pump operates at a pressure less than maximum setting of the compensator control, full fluid volume is delivered. When compensator control pressure is reached, fluid volume is automatically reduced to the amount of flow required to maintain this pressure. The pressure at which these changes take place is adjusted by the knurled knob on the compensator control.

3-5. FILTER-SEPARATOR. The filter-separator (figure 3-4) is a stainless-steel unit installed in the pumping unit suction line. It incorporates four filtering elements of fiber glass, a liquid-level gage, air-bleed valve, and an automatic sump drain. The filter-separator elements provide filtration to 10 microns, nominal. Water removal is 99 percent for 1 percent-by-volume water content in RP-1 fuel.

3-6. HIGH-PRESSURE FILTER. The high-pressure filter is installed in the high-pressure fluid line. The filter has a 5-micron, nominal, pleated stainless-steel, mesh-type element. A differential pressure device indicates when the filter element should be replaced.

3-7. ELECTRICAL JUNCTION BOX. The electrical junction box (figure 3-5) is located on the front of the pumping unit. It is explosion-proof, and contains circuit breakers, switches, hourmeter, and indicator lights for controlling and monitoring pumping unit operation. See figure 3-12, located at end of section, for electrical schematic.

3-8. GAGE PANEL. The gage panel (figure 3-6) is located on the front of the pumping unit and contains a combination filter-separator inlet pressure and pump inlet pressure gage. Either indication is obtainable with the use of a selector valve, and a pump outlet pressure gage.

3-9. HIGH-PRESSURE MANIFOLD. The high-pressure manifold (figure 3-7) is located on the front of the pumping unit under the gage panel. The manifold contains an adjustable high-pressure relief valve, RP-1 shutoff valve, RP-1 bleed valve, gage shutoff valve, and a high-pressure check valve. The manifold controls the high-pressure RP-1 output.

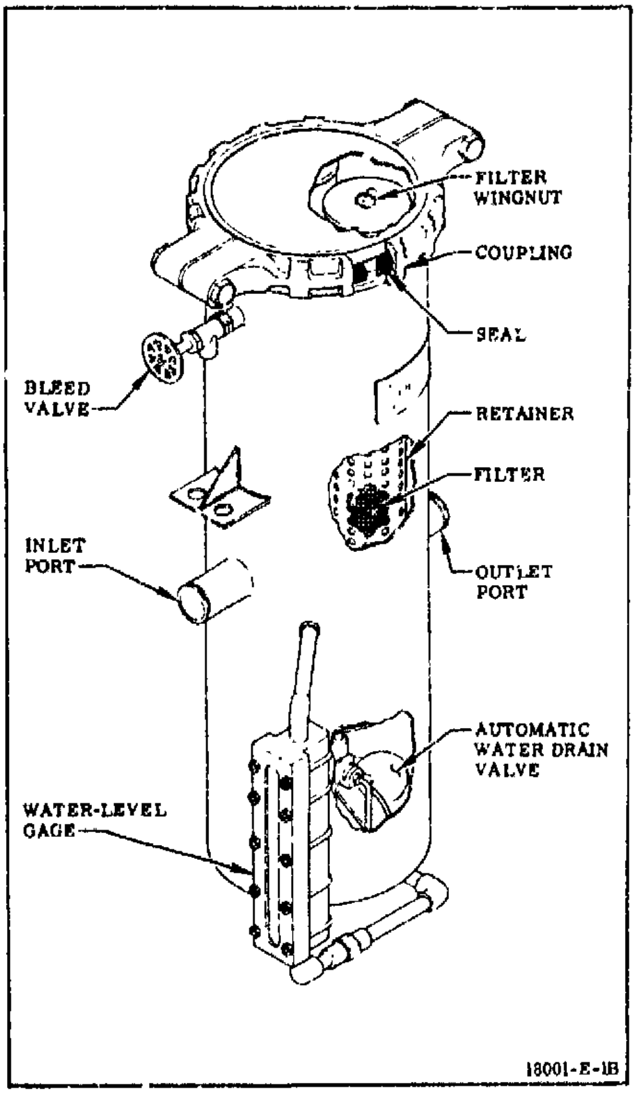


Figure 3-4. Filter-Separator

3-10. LOW-PRESSURE MANIFOLD. The low-pressure manifold (figure 3-8) is located on the front of the pumping unit in the lower left-hand corner. The manifold contains two check valves, a shutoff valve, and a relief valve. The manifold provides a means for automatic or manual drain of the filter separator.

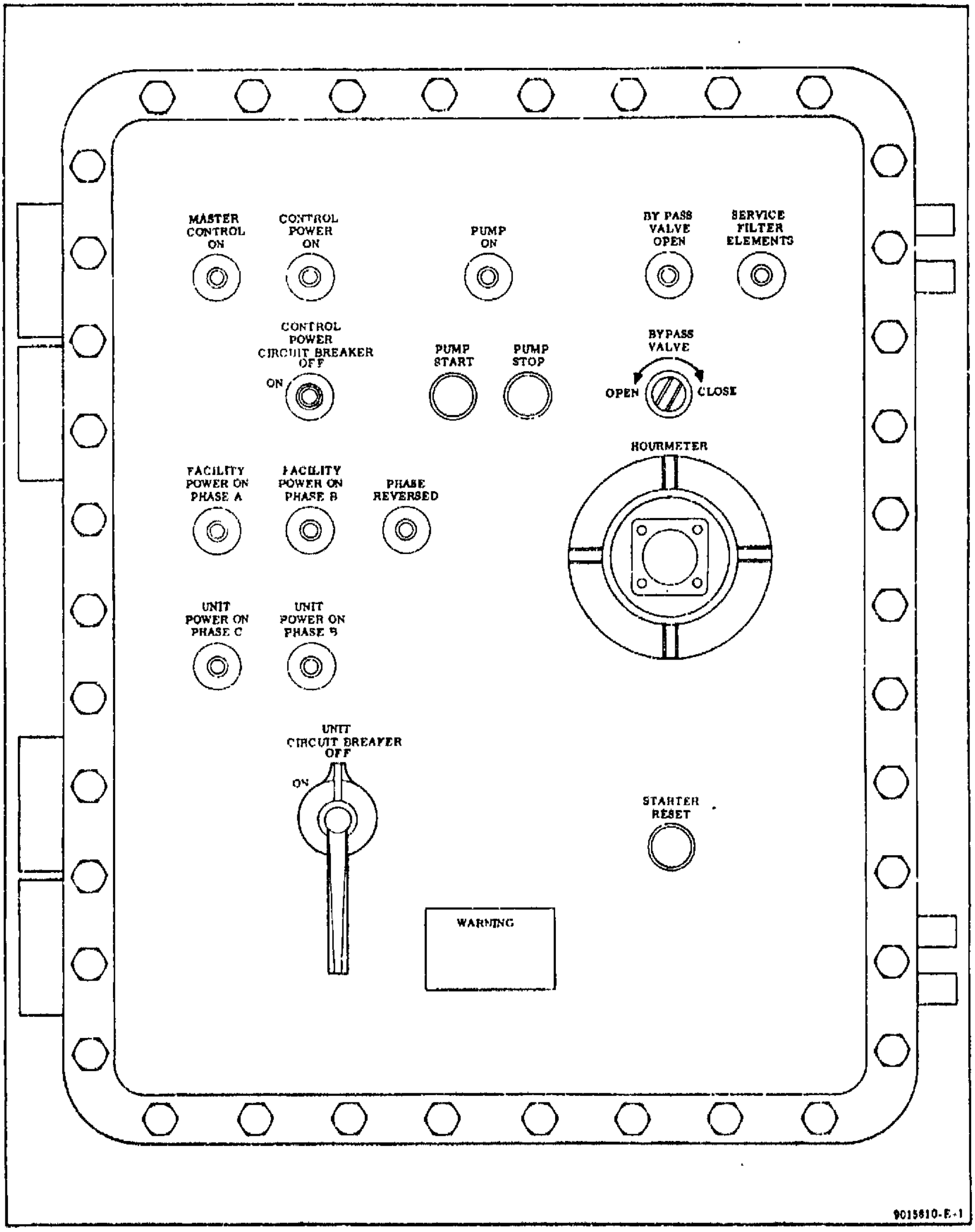


Figure 3-5. Electrical Junction Box

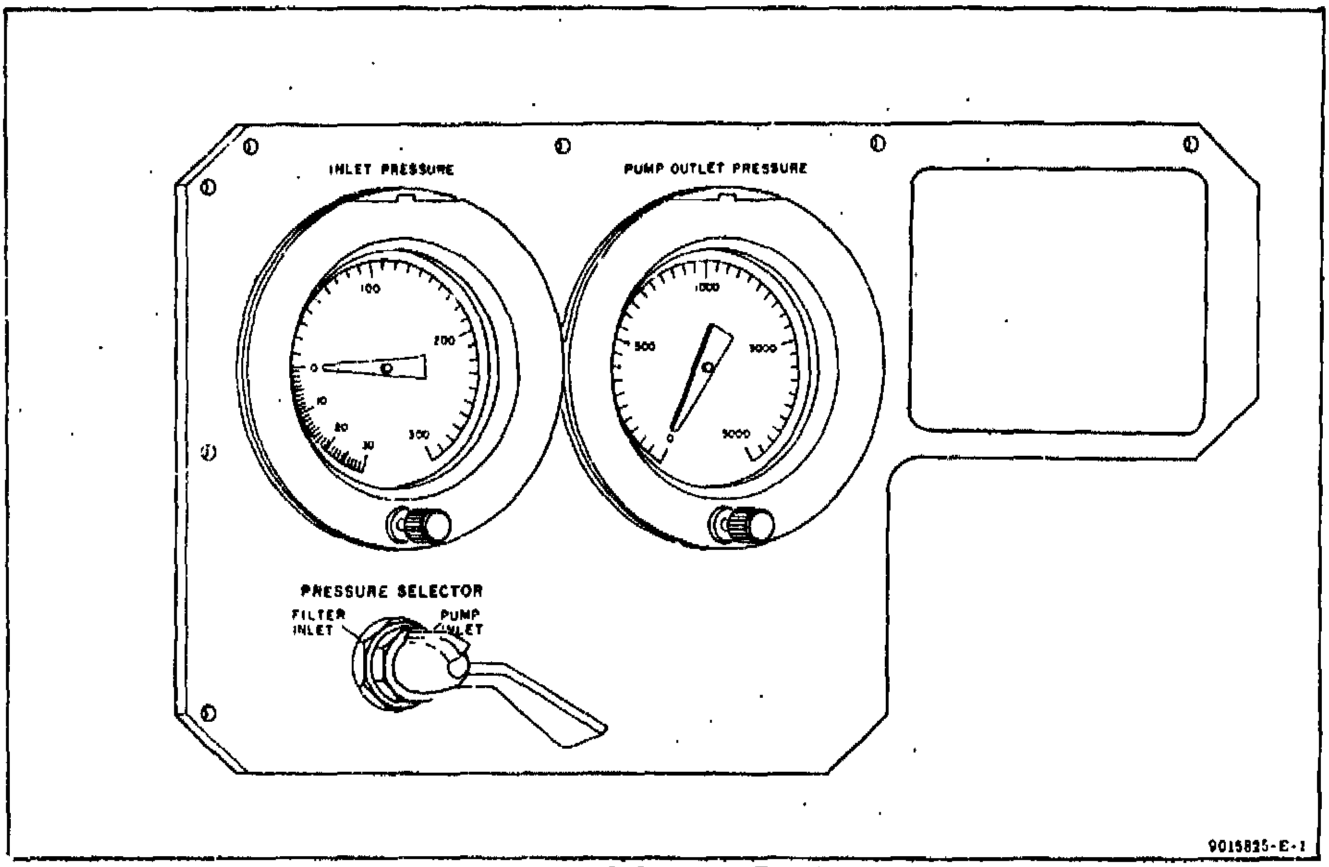


Figure 3-6. Gage Panel

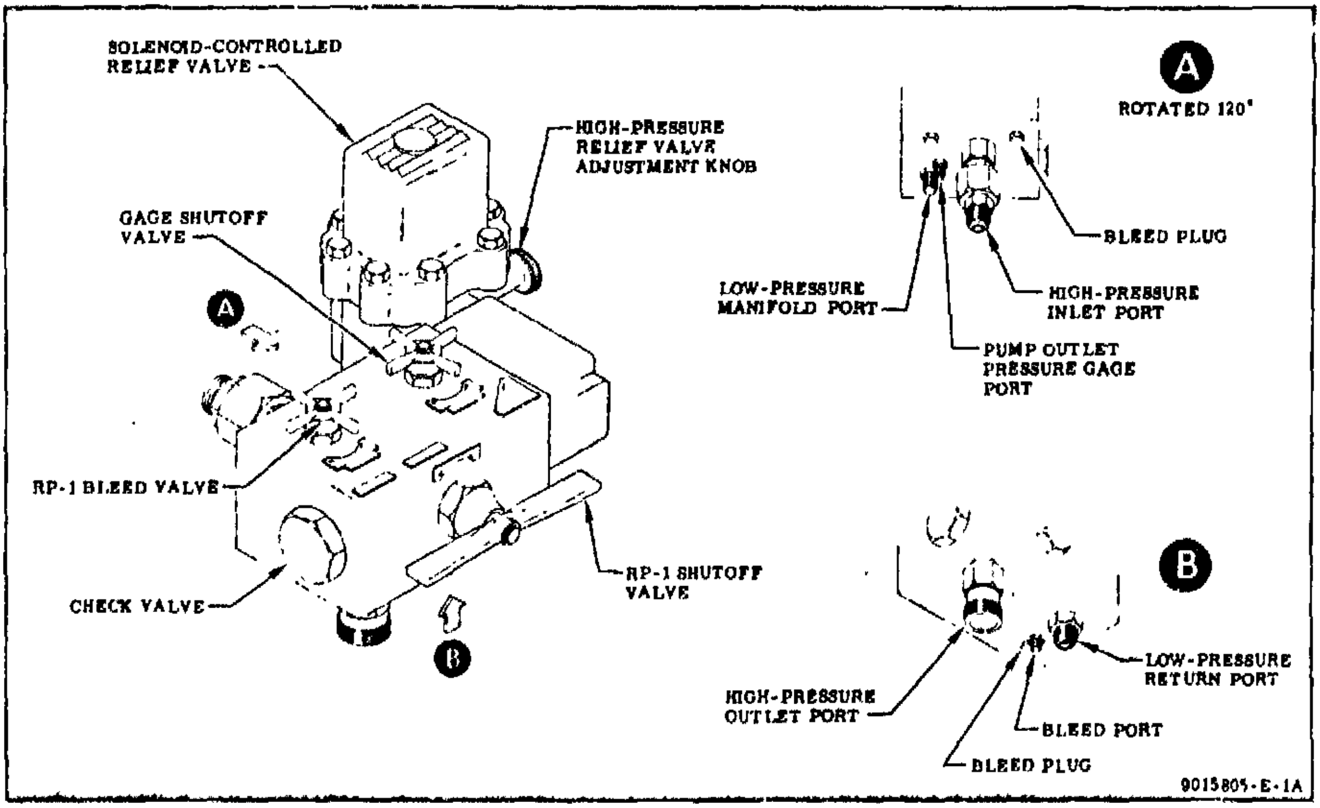


Figure 3-7. High-Pressure Manifold

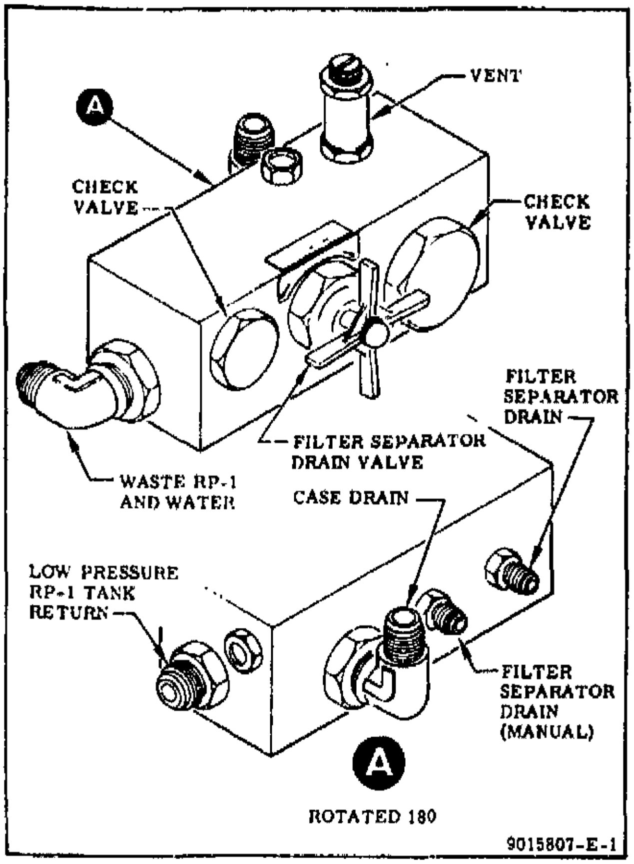


Figure 3-8. Low-Pressure Manifold

3-11. THEORY OF OPERATION

3-12. ELECTRICAL SYSTEM.

3-13. The pumping unit electrical system is divided into three different circuits. The motor circuit is a 440-vac, 60-cycle, 3-phase system; the local control and monitor circuit is a 110-vac system; and the remote-control circuit is a 28-vdc system.

3-14. MOTOR CONTROL CIRCUIT. When facility 440-vac power is turned on, the motor control circuit receives power through electrical plug P1 and the facility-power-on light on the pumping unit comes on. The circuit is protected by a 125-amp circuit breaker. Closing the circuit breaker energizes the unit power on lights and the phase control relay and applies 440-vac to the primary windings of the 440-110 vac step-down transformer and to the open contracts of the motor starter relay. When the motor starter relay is energized by the control circuit, the pump motor will operate.

3-15. LOCAL CONTROL AND MONITOR CIRCUIT. The local control and monitor circuit receives power from the secondary windings of the 440-110 vac step-down transformer. The circuit is protected by a 5-amp circuit breaker. Closing the circuit breaker applies 110-vac to the control-power-on light and to the open contacts of the bypass valve switch, phase control switch, differential pressure switch, master control relay, hourmeter, inlet pressure switch, and motor starter relay. If the facility 440-vac phasing is incorrect, the phase-reversed light will illuminate and start circuit will not be completed. If phasing is correct, 110-vac is routed to the open contacts of the pump start switch and motor starter relay. For local control only, the remote-control stop circuit is bypassed by a jumper plug installed on electrical receptacle J2. The pump motor is started by momentarily pressing the pump start switch. Lock-in of the motor starter relay will permit motor operation until either the pump stop switch is momentarily pressed, the pump motor overloads and actuates the thermal temperature device, or the fluid supply pressure drops below 5 psi at the pump inlet, which causes the inlet pressure switch to actuate and open the starter holding circuit. When the fluid pressure-drop across the filter exceeds a specified amount, the differential pressure switch will actuate closed and the service filter elements light will illuminate.

3-16. REMOTE-CONTROL CIRCUIT. The remote-control circuit receives power from a facility source through electrical receptacle J2. The circuit provides for remote start and stop control of the pump motor and also monitors when the pump is on.

3-17. HYDRAULIC SYSTEM.

3-18. Hydraulic fluid, pressurized to approximately 30 psig from an external source, enters the low-pressure inlet and flows through the filter-separator to the pump inlet. Filter-separator inlet and pump inlet pressures are monitored on the inlet pressure gage by a selector valve. From the pump outlet, the fluid passes through the high-pressure filter and into the high-pressure manifold assembly, where it is routed through the gage shutoff valve to the pump outlet pressure gage, and through the RP-1 shutoff valve and high-pressure check valve to the high-pressure outlet. Fluid which is bypassed in the system is directed to the low-pressure return system. See figure 3-9 for hydraulic schematic.

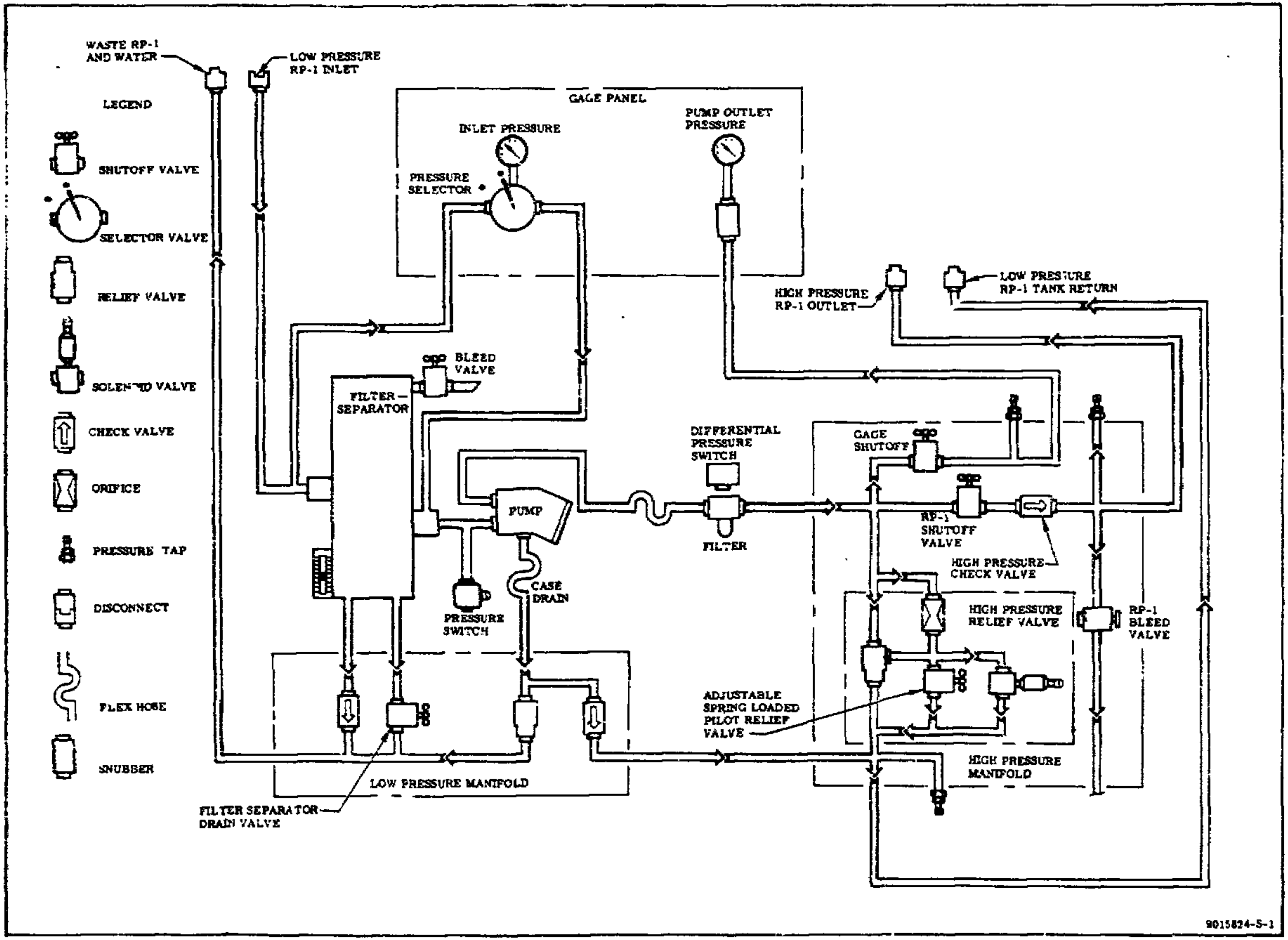


Figure 3-9. Hydraulic Pumping Unit G2026 Hydraulic Schematic

3-19. MAINTENANCE.

3-20. Maintenance for the hydraulic pumping unit consists of checkout, removal and installation, cleaning, and servicing. These procedures are performed to make sure that the hydraulic pumping unit is in an operable condition. A wiring diagram (figure 3-13), located at end of section, is provided as an aid in the repair or replacement of wiring.

3-21. CHECKOUT

3-22. PREPARATION FOR CHECKOUT. Prepare the hydraulic pumping unit for checkout as follows:

a. Position hydraulic pumping unit adjacent to a hydraulic system, capable of supplying 60 gallons of RP-1 fuel (MIL-R-25576) and delivering 30 gpm of test fluid at 20 psig.

b. Connect hose 9015912 to HIGH PRESSURE RP-1 OUTLET and the other end of hose to a system loading valve (output returning to hydraulic system reservoir and diffuser).

c. Connect hose 9015914 to LOW PRESSURE RP-1 RETURN and the other end of hose to hydraulic system reservoir return connection.

d. Connect hose 9015913 to inlet port on filter-separator and other end of hose to hydraulic system supply connection.

e. Connect hose 9015915 to WASTE OUTLET and place other end of hose in a fuel container.

f. Remove filter elements from high-pressure filter and replace housing.

g. Remove cap from tee on top of pump case and fill case with RP-1 fuel (MIL-R-25576). Reinstall cap and attach a tag marked PUMP CASE FILLED to tee.

h. Connect a shutoff valve to the lower tee on front of filter-separator and connect a 0-15 psig test gage, with an accuracy of 1/2 of one percent full scale, to shutoff valve. Close shutoff valve.

3-23. LOW-PRESSURE LEAK-TEST AND PUMP CASE RELIEF VALVE TEST.

a. Connect a low-pressure gaseous nitrogen source, capable of regulating and monitoring 0-100 psig, to the upper tee on front of filter-separator.

b. Increase gaseous nitrogen pressure to 50 psig.

c. Using leak-test compound (MIL-L-25567), leak-test all fittings, seals, and connections of filter-separator, inlet pressure gage, filter-separator drain valve, low-pressure manifold, and pump inlet, case, and case drain. No leakage is allowable.

d. Remove leak-test compound with a clean, dry cloth.

e. Increase gaseous nitrogen pressure to 60 ±8 psig. Flow of fluid, or an audible hiss, must be evident at open end of hose connected to WASTE OUTLET.

NOTE

Due to close tolerances in the pump, it may be necessary to rotate pump several revolutions to allow pressure buildup at relief valve.

f. Decrease gaseous nitrogen source to zero and disconnect it from filter-separator. Reinstall cap on tee.

3-24. ELECTRICAL TEST.

a. Check that jumper plug P2 is installed on receptacle J2, located on aft side of electrical junction box.

b. Check that all switches and circuit breakers are in off position.

c. Connect cable 9015866 to facility power source of 440-vac, 60-cycle, 3-phase, at 70 amperes (mating receptacle EPC 41642).

WARNING

Make sure that facility power is turned off before connecting or disconnecting cable, since arcing between connectors will result in injury to personnel and damage to equipment.

d. Turn facility power on. FACILITY POWER ON PHASE A and FACILITY POWER ON PHASE B lights come on.

e. Move UNIT CIRCUIT BREAKER to ON. UNIT POWER ON PHASE B and UNIT POWER ON PHASE C lights come on.

f. If results of step e are not obtained and the PHASE REVERSED light is on, move UNIT CIRCUIT BREAKER and facility power to off position, and reverse any 2 of the 3-phase wires in the power plug. Do not change position of neutral or ground wire. Repeat steps d and e.

g. Move CONTROL POWER CIRCUIT BREAKER to ON. CONTROL POWER ON light comes on.

h. While an observer checks direction of motor rotation, press the PUMP START switch and immediately press PUMP STOP switch. Rotation of motor must be in same direction as the arrow on pump case.

i. If rotation of motor is incorrect, reverse any 2 of the 3-phase wires at the motor connection box. Do not change position of neutral or ground wire. Repeat step h.

j. Actuate differential pressure microswitch above high-pressure filter. SERVICE FILTER ELEMENTS light comes on.

k. Move CONTROL POWER CIRCUIT BREAKER, UNIT CIRCUIT BREAKER, and facility power switch to off position.

3-25. HIGH-PRESSURE LEAK-TEST AND HIGH-PRESSURE RELIEF VALVE AND COMPENSATOR ADJUSTMENT.

a. Move facility power switch, UNIT CIRCUIT BREAKER, and CONTROL POWER CIRCUIT BREAKER to on position.

b. Adjust system loading valve to fully open and adjust HIGH PRESSURE RELIEF VALVE counterclockwise to minimum setting. Adjust pump PRESSURE COMPENSATOR counterclockwise to minimum setting.

c. Adjust pump volume control until VOLUME INDICATOR indicates 1/2 volume.

d. Open RP-1 SHUTOFF VALVE and GAGE SHUTOFF VALVE and close RP-1 BLEED VALVE.

e. Apply hydraulic system supply to inlet port on filter-separator.

f. Open filter-separator bleed valve until fluid appears; then close valve.

g. Turn BYPASS VALVE switch to OPEN. BYPASS VALVE OPEN light comes on.

h. Press PUMP START switch. PUMP ON light comes on. Move BYPASS VALVE switch to CLOSE. BYPASS VALVE OPEN light goes off.

i. With pump operating, adjust HIGH PRESSURE RELIEF VALVE clockwise 2 complete turns and pump PRESSURE COMPENSATOR one complete turn, after initial spring contact.

j. After one minute of operation, check for fluid flow, at reservoir, from HIGH PRESSURE RP-1 OUTLET.

k. Operate pumping unit for 5 minutes; then proceed with step 1.

l. Adjust pump volume control until VOLUME INDICATOR indicates 1/3 volume.

m. Adjust HIGH PRESSURE RELIEF VALVE and pump PRESSURE COMPENSATOR until adjusting screws bottom (maximum setting).

n. Adjust system loading valve until PUMP OUTLET PRESSURE gage indicates 500 psi.

o. Check all fittings, seals, and connections of entire system for fluid leaks. No leakage is allowable.

p. Repeat step o with system loading valve adjusted at 1,000, 2,000, and 3,000 psig.

q. Adjust system loading valve until PUMP OUTLET PRESSURE gage indicates 3,500 psi.

r. Adjust HIGH PRESSURE RELIEF VALVE until PUMP OUTLET PRESSURE gage indicates 3,300 psi.

s. Adjust pump PRESSURE COMPENSATOR until PUMP OUTLET PRESSURE gage indicates 3,000 psi.

t. Adjust system loading valve to fully open (minimum pressure setting).

u. Repeat step c and press PUMP STOP switch. PUMP on light goes off.

v. Move CONTROL POWER CIRCUIT BREAKER, UNIT CIRCUIT BREAKER, and facility switch to off position.

3-26. REMOVAL AND INSTALLATION.

3-27. Disassemble the hydraulic pumping unit, as required, to accomplish necessary repair or replacement. (See figure 3-10 for index and part numbers.)

3-28. CLEANING.

3-29. Clean hydraulic pumping unit for hydraulic service. Refer to section I for cleaning, handling, and packaging parts.

3-30. SERVICING.

3-31 Periodic servicing is required as follows:

a. The high-pressure filter elements must be ultrasonically cleaned every 80 hours of operation, or whenever the SERVICE FILTER ELEMENTS light comes on.

b. Pump motor shaft coupling. Remove coupling cover and repack chain with gear grease (MIL-G-23827), every 360 days.

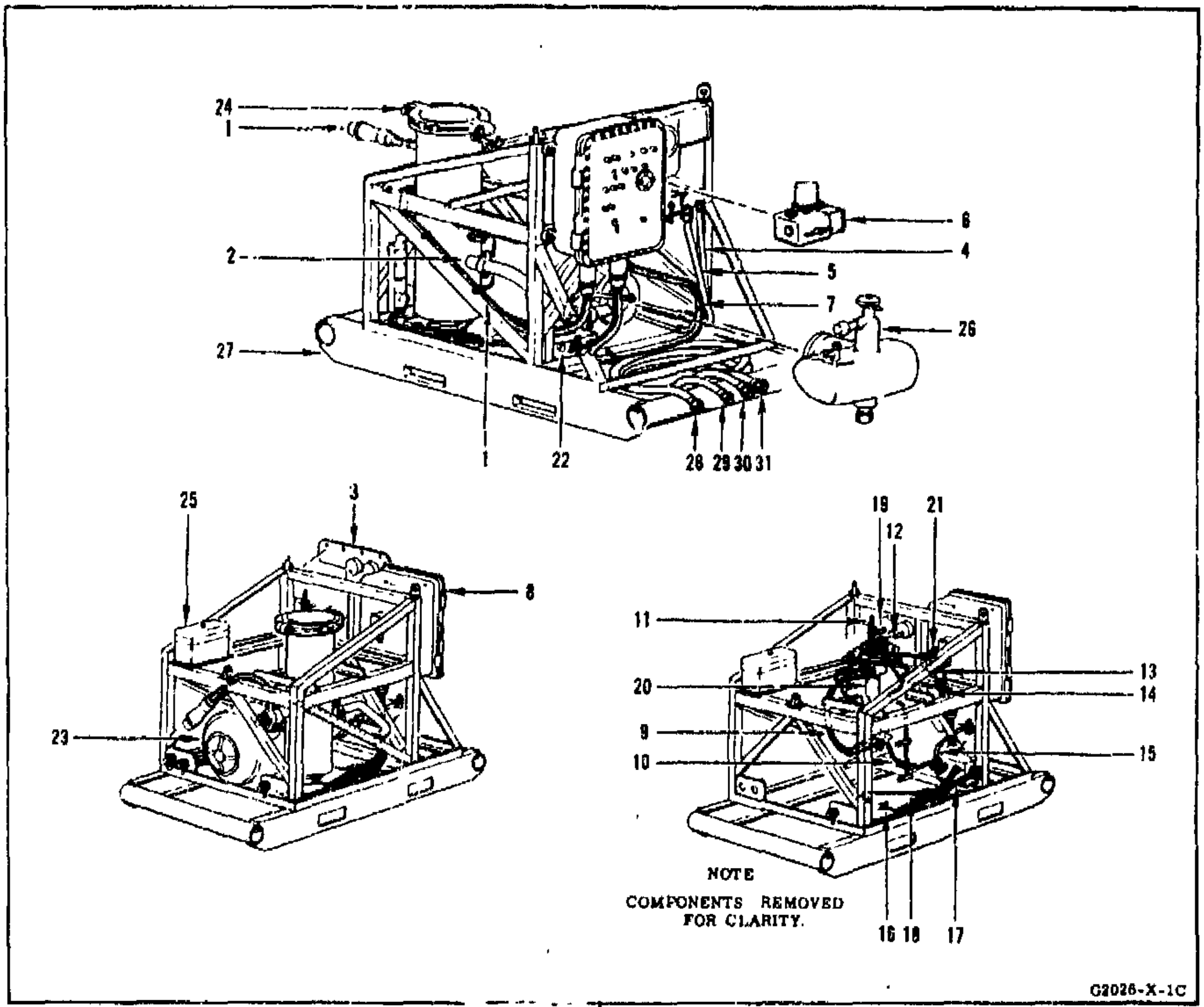
c. Pump motor bearings. Remove grease ejector pipe plugs from motor end bells. Inject new grease (MIL-G-23827) under pressure until all old grease is forced out of bearing through grease drain. Run motor for approximately 5 minutes to remove excess grease. Replace grease ejectors.

d. Filter-separator must be drained whenever water appears in the sight gage.

e. Replace filter-separator filter elements whenever pressure differential of 10-12 psi between FILTER INLET and PUMP INLET occurs at a flowrate of 33 gpm.

3-32. <u>INSPECTION.</u>

3-33. The inspections establish what is to be inspected, conditions to be sought and corrected, and the frequency of inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted since they are directly affected by local operations. Visual inspections are conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. These inspections consist of two periodics; the 1st periodic to be accomplished at 30 calendar days, and the 2nd periodic at 180 calendar days. See figure 3-11 for inspection requirements.



Index No.	Part No.	Description	Index No.	Part No.	Description
1	9015866	Cable (F-3)	13	9015849	Tube (M-3)
2	9015853	Pipe (F-3)	14	9020493	Tube (M-3)
3	9015825	Panel (F-1)	15	R3800CC12-0250	Hose (F-3)
4	9015843	Tube (F-3)	16	9015847	Tube (M-3)
5	9015842-11	Tube (F-3)	17	9015845	Tube (F-3)
6	9015805-11	Manifold (F-1)	18	9015846	Tube (M-3)
7	9015867	Cable (F-3)	19	EX-Q	Miscroswitch (F-3)
8	9015809	Junction Box (F-1)	20	4717B-5CL-ST	Filter (F-1)
9	R35800CC16-0460	Hose (F-3)	21	610GE315S	Pressure Switch (F-3)
10	9015844	Tube (F-3)	22	9015807-11	Manifold (F-1)
11	9015851	Tube (M-3)	23	XA207014	Motor (F-2)
12	9020493	Tube (M-3)			

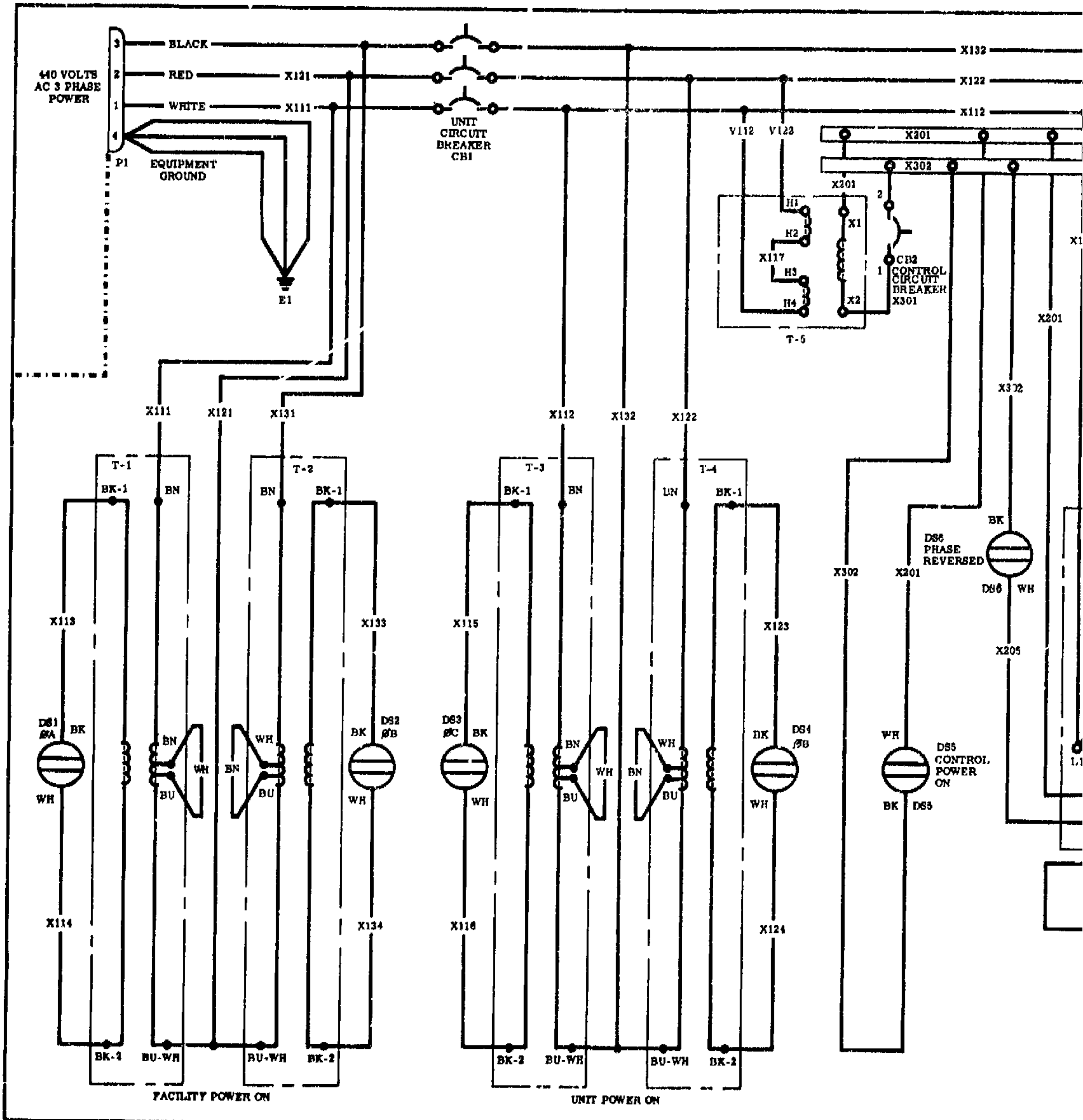
Figure 3-10. Disassembly of Hydraulic Pumping Unit G2026 (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
24	19-9015817	Filter (F-1)	25	9020496	Record Box (F-3)
	18063	Final Barrier (F-3)	26	19-9015864	Pump (F-2)
	1029	Element (F-3)	27	9015803	Skid (X-1)
	18061	End Cap (F-3)	28	9015912	Hose (F-1)
	STYLE #77-12	Coupling (F-3)	29	9015913	Hose (F-1)
	GRADE "T"	Gasket (F-3)	30	9015914	Hose (F-1)
	AN6290-4	O-Ring (F-3)	31	9015915	Hose (F-1)

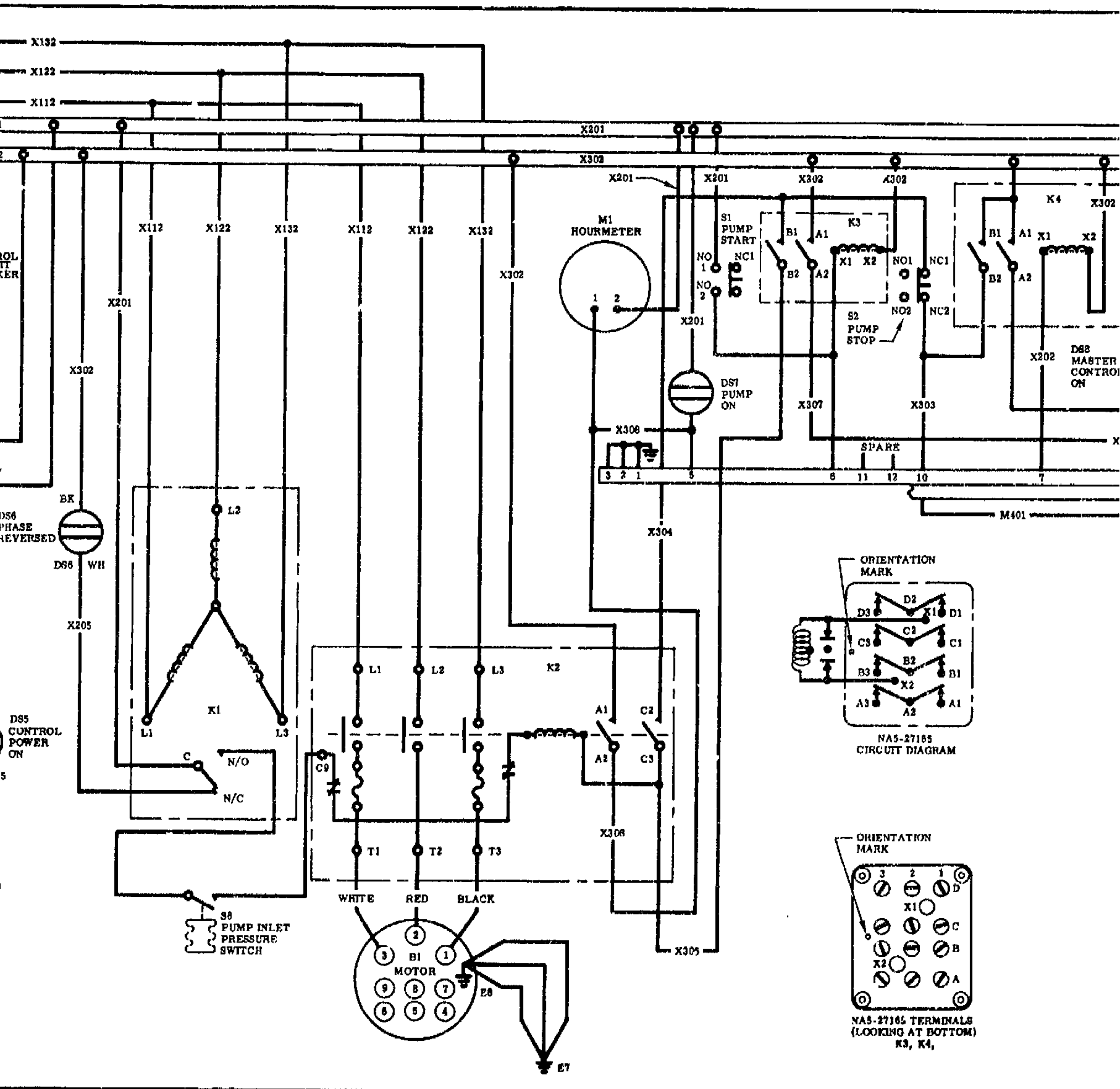
Figure 3-10. Disassembly of Hydraulic Pumping Unit G2026 (Sheet 2 of 2)

Inspection Requirements	Visual	Periodic		Inspection Requirements	Visual	Periodic	
		1st	2nd			1st	2nd
1. Gage calibration-check.			X	7. Filters for contamination.		X	
2. Pumping unit exterior and interior for dirt, and placard illegibility.			X	8. Indicator lights for broken covers and broken or missing bulbs.	X	X	
3. Gages for broken glass, cracked frames, and loose or missing face-plate screws.	X	X		9. Switches and circuit breakers for looseness and improper operation.		X	
4. Valves for cracked or broken control knobs and loose or missing retaining screws and locknuts.	X		X	10. Power cable for damaged or corroded receptacle and/or plug, and cut, torn, chafed, or deteriorated outer cover.			X
5. Flexible lines for kinks, twists, and deterioration.			X				
6. Tubing for scratches, dents, cracked sleeves, and loose coupling nuts.			X				

Figure 3-11. Inspection Requirements for Hydraulic Pumping Unit G2026

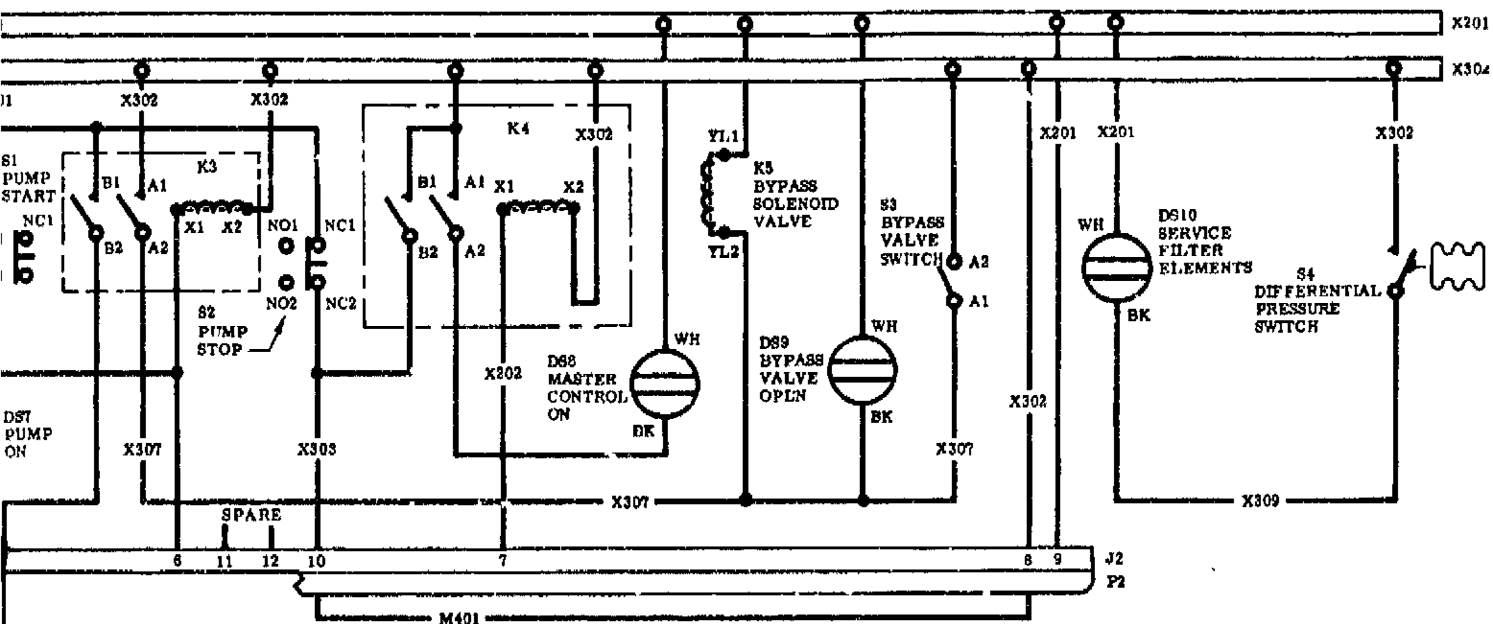


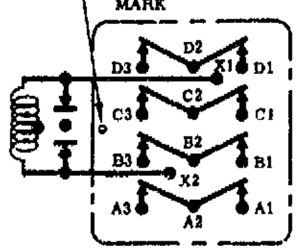
440 VOLTS AC 3 PHASE POWER
BLACK
RED
WHITE
P1
EQUIPMENT GROUND
E1
UNIT CIRCUIT BREAKER CB1
X111
X121
X131
X112
X122
X132
V112
V122
X201
X302
X117
H1
H2
H3
H4
X1
X2
T-5
CB2 CONTROL CIRCUIT BREAKER
X301
X205
T-1
T-2
T-3
T-4
BK-1
BK-2
BN
BU
WH
BU-WH
BK
X113
X114
X133
X134
X115
X116
X123
X124
DS1 ØA
DS2 ØB
DS3 ØC
DS4 ØB
DS5 CONTROL POWER ON
DS6 PHASE REVERSED
FACILITY POWER ON
UNIT POWER ON



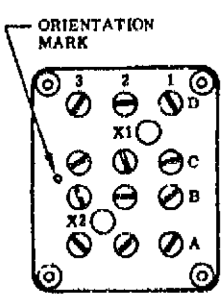
X132
X122
X112
X201
X302
X112
X122
X132
X201
X302
M1
HOURMETER
S1
PUMP
START
NO 1
NC1
NO 2
K3
B1
A1
B2
A2
X1
X2
NO1
NC1
NO2
NC2
S2
PUMP
STOP
K4
DS8
MASTER
CONTROL
ON
X202
X307
X303
DS7
PUMP
ON
X306
SPARE
M401
X304
BK
DS6
PHASE
REVERSED
WH
X205
L1
L2
L3
K1
DS5
CONTROL
POWER
ON
C
N/O
N/C
K2
A1
C2
A2
C3
C9
T1
T2
T3
WHITE
RED
BLACK
S8
PUMP INLET
PRESSURE
SWITCH
B1
MOTOR
E8
E7
X305
ORIENTATION
MARK
D2
D3
D1
C2
C3
C1
B2
B3
B1
A3
A2
A1
NA5-27165
CIRCUIT DIAGRAM
NA5-27165 TERMINALS
(LOOKING AT BOTTOM)
K3, K4,

Figure 3-12. I





NA5-27165
CIRCUIT DIAGRAM

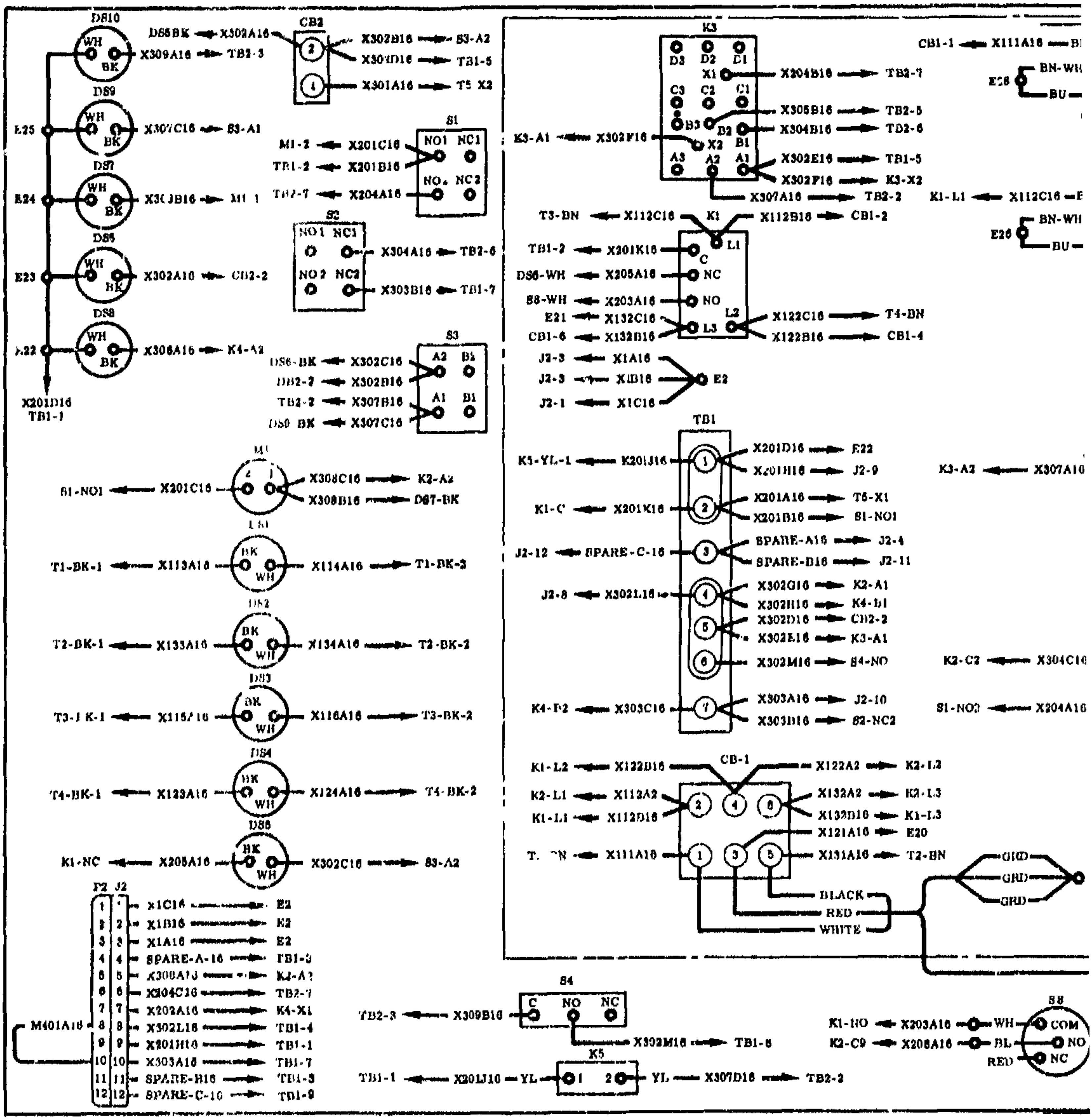


NA5-27165 TERMINALS
(LOOKING AT BOTTOM)
K3, K4,

ITEM NO.	PART NO.	NOMENCLATURE
B1	X-207014	MOTOR
CB1	ET4743	C'BRKR
CB2	AM17-3-63	C'BRKR
DS1	XLG-LESS LAMP	LIGHT
DS2	XLG-LESS LAMP	
DS3	XLG-LESS LAMP	
DS4	XLG-LESS LAMP	
DS5	XLG-LESS LAMP	
DS6	XLA-LESS LAMP	
DS7	XLG-LESS LAMP	
DS8	XLG-LESS LAMP	
DS9	XLG-LESS LAMP	
DS10	XLA-LESS LAMP	LIGHT
K1	8506-J0-1-440V	RELAY
K2	RA332-UAC	
K3	NA5-27165	
K4	NA5-27165	RELAY
K5	QBJ7-175	SOLENOID
M1	K-23209	HOUR METER
S1	XPBB2	SWITCH
S2	XPBB2	
S3	XSSB-15	
S4	AC-4633-205PE	
S8	6100E3158	SWITCH
T1	CLASS 9070 TYPE ED-4	TRANS.
T2	XLT	
T3	XLT	
T4	XLT	
T5	XLT	TRANS.
P1	APJ10467	PLUG
P2	RPX117-911P07N	PLUG
	RPE417-0018	HANDLE
J2	RPX317-913S07N	RECP

9015823-6-1C

Figure 3-12. Hydraulic Pumping Unit G2026 Electrical Schematic


DS10
WH
BK
DS6BK X302A16
X309A16 TB2-3
CB2
X302B16 S3-A2
X302D16 TB1-5
X301A16 T5 X2
DS9
E25
X307C16 S3-A1
S1
NO1 NC1
NO2 NC2
M1-2 X201C16
TB1-2 X201B16
TB2-7 X204A16
DS7
E24
X301B16 M1 1
S2
X304A16 TB2-6
X303B16 TB1-7
DS6
E23
X302A16 CB2-2
DS8
E22
X306A16 K4-A2
S3
A2 B2
A1 B1
DS6-BK X302C16
DB2-2 X302B16
TB2-2 X307B16
DS0 BK X307C16
X201D16
TB1-1
M1
S1-NO1 X201C16
X308C16 K2-A2
X308B16 DS7-BK
DS1
T1-BK-1 X113A16
X114A16 T1-BK-2
DS2
T2-BK-1 X133A16
X134A16 T2-BK-2
DS3
X116A16 T3-BK-2
DS4
T4-BK-1 X123A16
X124A16 T4-BK-2
DS5
K1-NC X205A16
X302C16 S3-A2
P2 J2
X1C16 E2
X1B16 E2
X1A16 E2
SPARE-A-16 TB1-3
X304C16 TB2-7
X202A16 K4-X1
X302L16 TB1-4
X201H16 TB1-1
X303A16 TB1-7
SPARE-B16 TB1-3
SPARE-C-16 TB1-9
M401A16
K3
D3 D2 D1
X1
C3 C2 C1
B3 B2 B1
X2
A3 A2 A1
X204B16 TB2-7
X305B16 TB2-5
X304B16 TB2-6
K3-A1 X302F16
X302E16 TB1-5
X302F16 K3-X2
X307A16 TB2-2
K1
T3-BN X112C16
X112B16 CB1-2
TB1-2 X201K16
DS6-WH X205A16
S8-WH X203A16
E21 X132C16
CB1-6 X132B16
X122C16 T4-BN
X122B16 CB1-4
J2-3 X1A16
J2-1 X1C16
E2
TB1
X201D16 E22
K5-YL-1 X201J16
J2-9
X201A16 T5-X1
K1-C X201K16
X201B16 S1-NO1
SPARE-A16 J2-4
J2-12 SPARE-C-16
SPARE-B16 J2-11
X302G16 K2-A1
J2-8 X302L16
X302H16 K4-B1
X302D16 CB2-2
X302E16 K3-A1
X302M16 S4-NO
X303A16 J2-10
K4-B2 X303C16
X303B16 S2-NC2
CB-1
K1-L2 X122B16
X122A2 K2-L2
K2-L1 X112A2
K1-L1 X112B16
X132A2 K2-L3
X132B16 K1-L3
X121A16 E20
X111A16
X131A16 T2-BN
BLACK
RED
WHITE
GRD
S4
C NO NC
TB2-3 X309B16
X302M16 TB1-6
K5
TB1-1 X201J16 YL
YL X307D16 TB2-2
CB1-1 X111A16
E26
BN-WH
BU
K1-L1 X112C16
K3-A2 X307A16
K2-C2 X304C16
S1-NO2 X204A16
S8
K1-NO X203A16 WH COM
K2-C9 X206A16 BL NO
RED NC

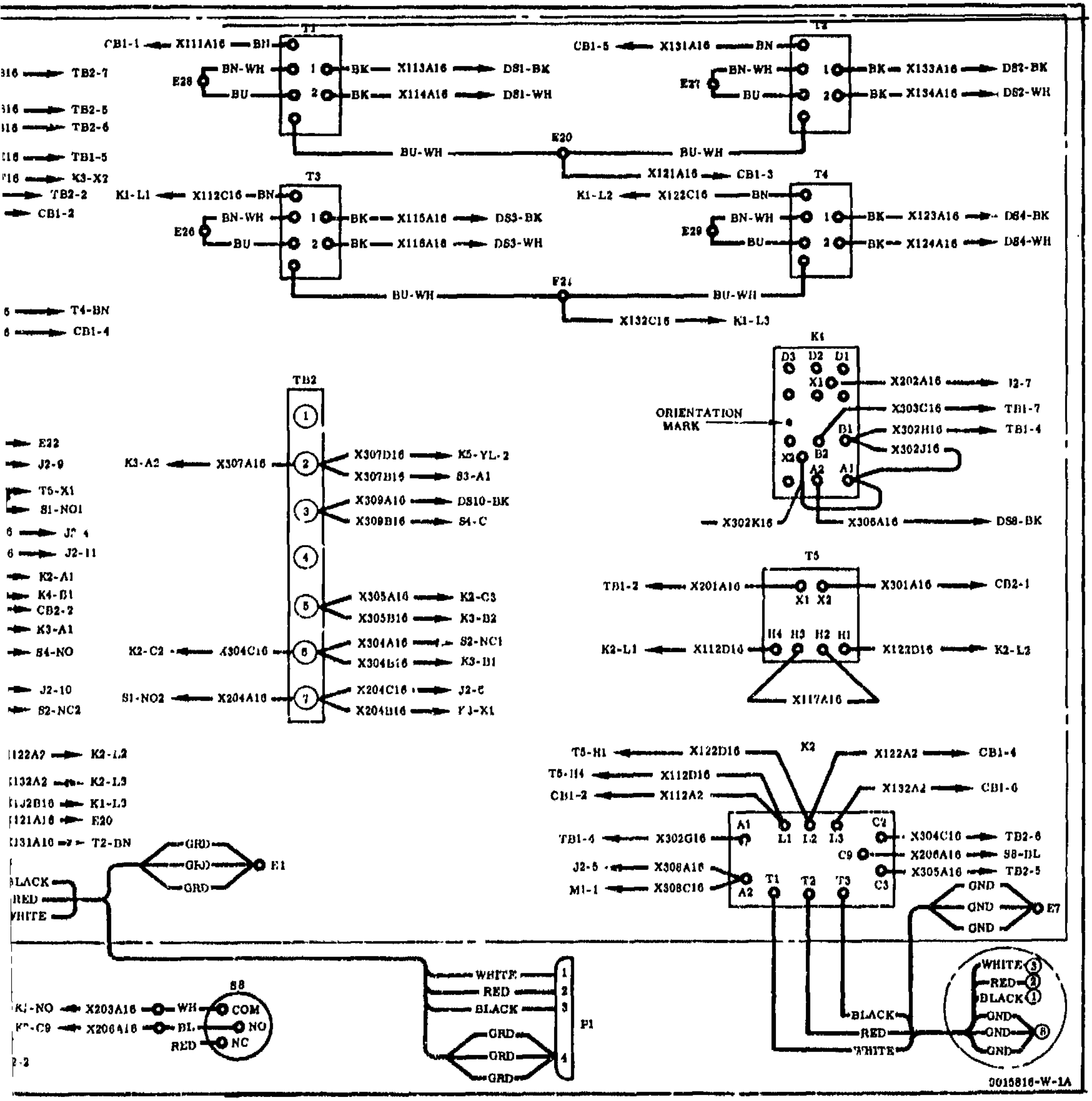


Figure 3-13. Hydraulic Pumping Unit G2026 Wiring Diagram

All data on pages 3-15 through 3-20 deleted.

SECTION IV

ACCUMULATOR UNIT G2027

4-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance, and inspection for Accumulator Unit G2027. The accumulator unit is used in conjunction with Hydraulic Pumping Unit G2026.

4-2. DESCRIPTION AND LEADING PARTICULARS.

4-3. The accumulator unit (figure 4-1) consists of four steel accumulator tanks, a control panel, a manifold, an RP-1 drain and sample valve, an outlet connection, and related plumbing. The four accumulator tanks are manifolded into a single outlet connection, and the drain and sample valve is attached to the manifold at the lowest point of the unit. The unit may be moved with a forklift truck using guides incorporated in the base of the unit. Eyes welded to the frames are provided for lifting or tiedown purposes. See figure 4-2 for leading particulars for the accumulator unit.

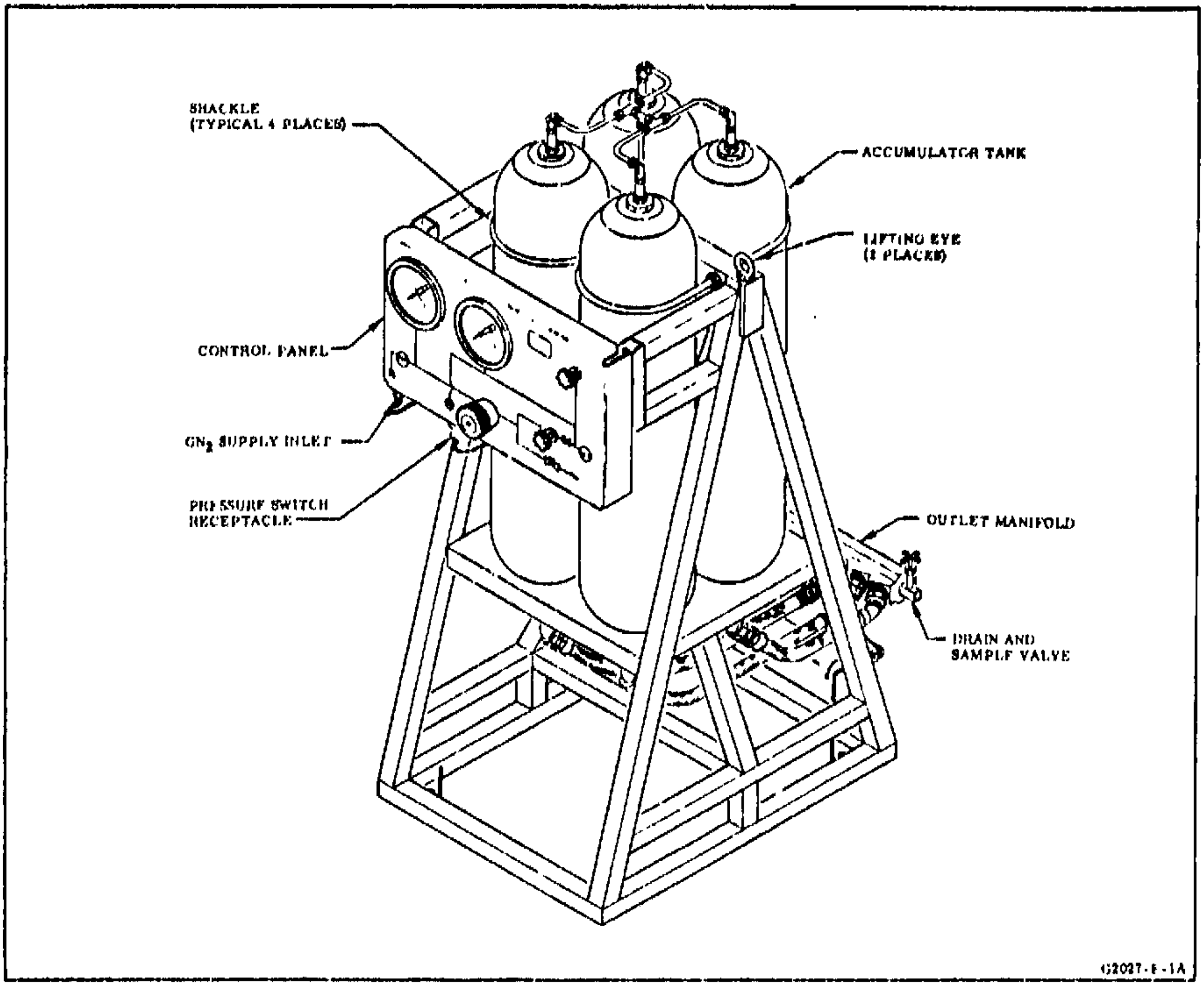


Figure 4-1. Accumulator Unit

Length	25 inches
Width	33 inches
Height	60 inches
Gross Weight	800 pounds
Total Tank Capacity	40 gallons
Total Tank Air Volume	2,080 cubic inches
Tank Operating Temperature	-40° to +180° F
GN_2 Capacity	4.82 cubic feet at 1,000 psig
Fluid Pressure	1,500 psig nominal
Maximum Design Pressure	3,000 psig

Figure 4-2. Leading Particulars for Accumulator Unit

4-4. ACCUMULATOR TANKS.

4-5. Each accumulator tank (figure 4-3) consists of a homogeneous, seamless, high-strength shell, cylindrical in shape and spherical on both ends. This shell has an opening on one end to accommodate a gas valve and an opening on the other end to install the bladder and plug and poppet valve assembly. The fully enclosed cigar-shaped bladder, made of synthetic rubber, is molded to a gas valve assembly. It is installed in the accumulator by means of a lock or jamnut on the upper end of the shell. The bottom end of the shell is sealed by a plug and poppet valve assembly which contains the fluid port. The plug and poppet assembly is designed to provide safety by making it impossible to disassemble the accumulator with a gas precharge in the bladder.

4-6. CONTROL PANEL.

4-7. The control panel (figure 4-4) contains a filter, GN_2 supply inlet, precharge shutoff valve, vent valve, a 0 to 5,000 psig supply pressure gage, 0 to 3,000 psi GN_2 precharge pressure gage, a relief valve, a pressure regulator, and a pressure switch and receptacle for remote monitoring of low precharge pressure.

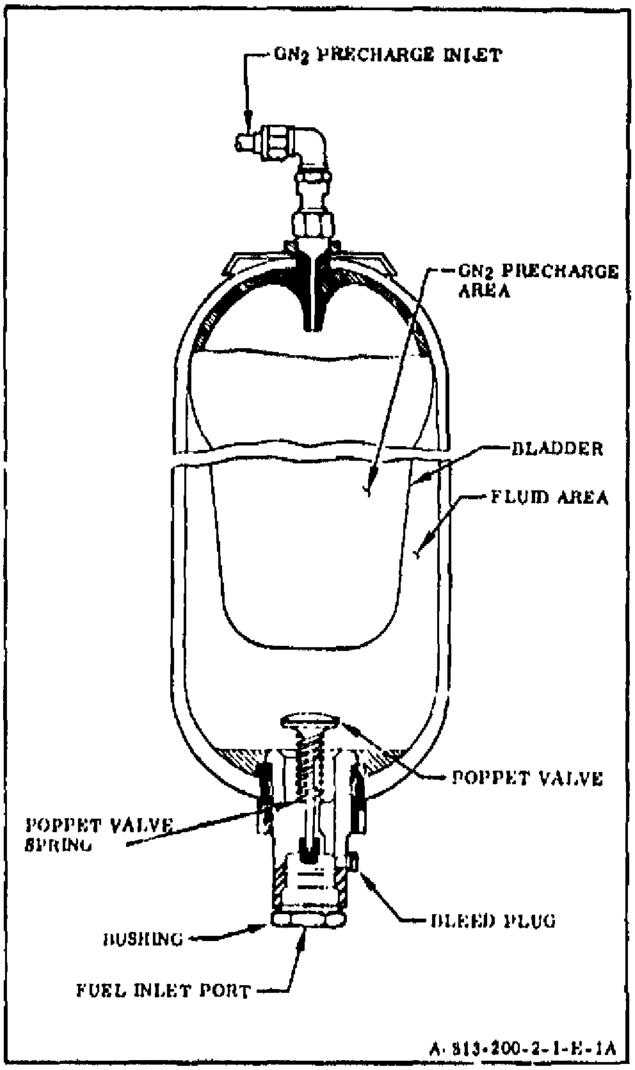


Figure 4-3. Accumulator Tank

4-8. OUTLET MANIFOLD.

4-9. The outlet manifold (figure 4-5) directs the flow of hydraulic fluid from the hydraulic pumping unit to the individual accumulator tanks. One end of the manifold body serves as both an inlet and an outlet port. A manually-operated needle valve is mounted at the other end of the manifold to serve as a drain and sample valve. When the accumulator is not in use, a plug-type cover is provided for the outlet port of the manifold. The manifold itself may be secured in a stowed position by means of a buckle-strap.

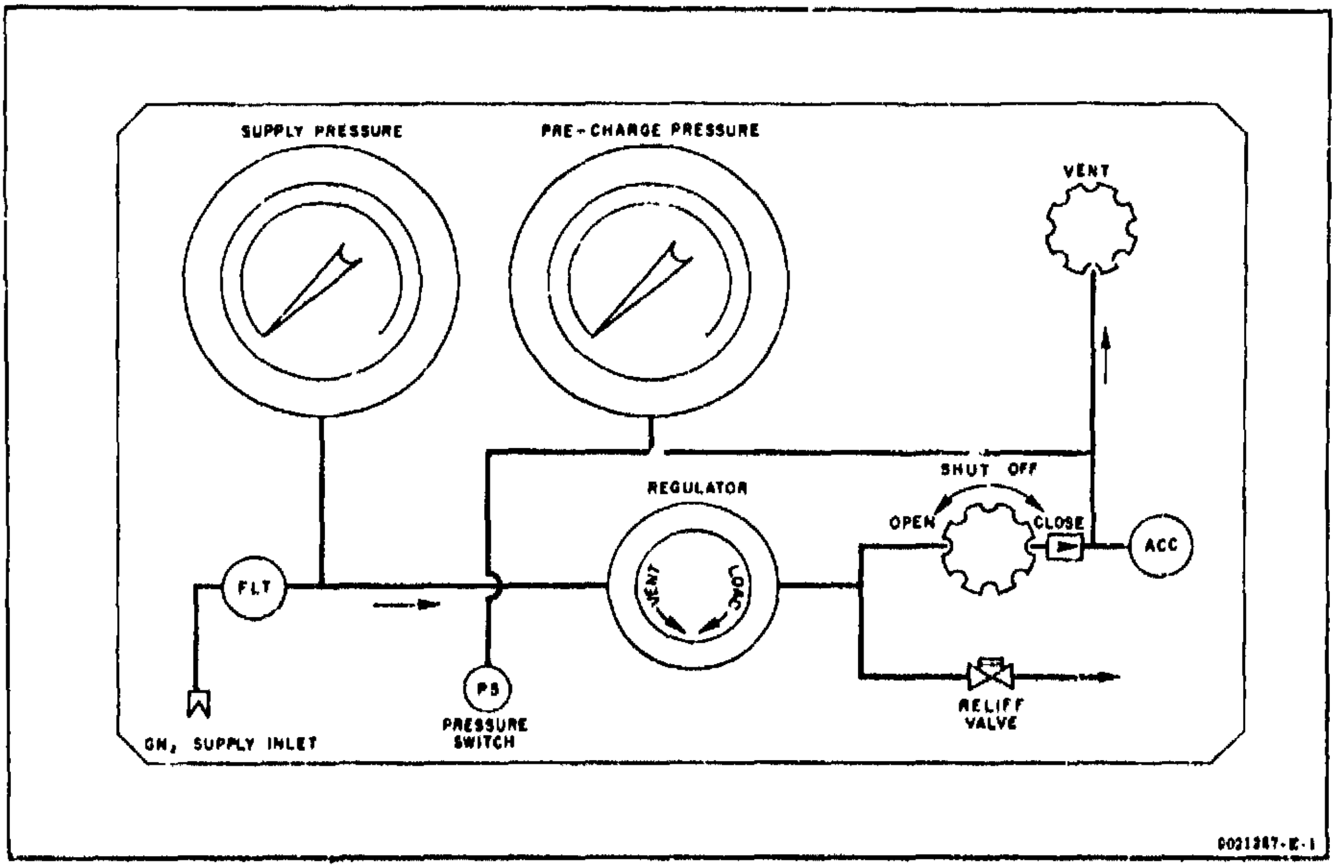


Figure 4-4. Accumulator Unit Control Panel

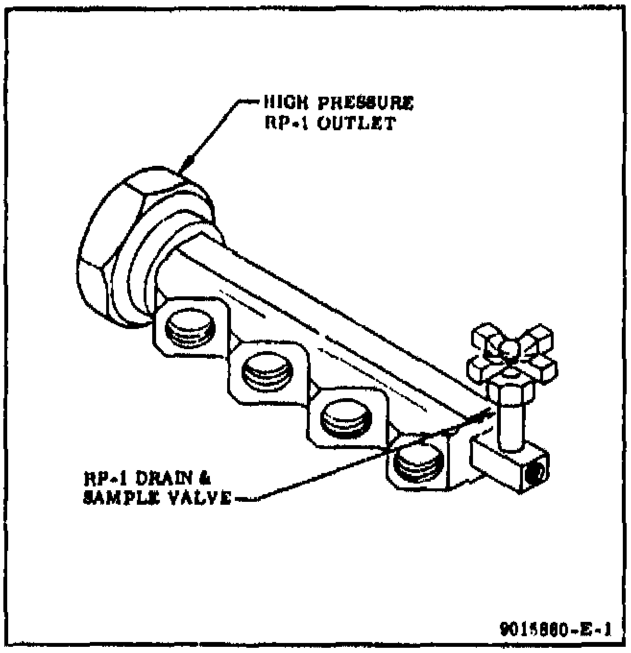


Figure 4-5. Accumulator Unit Outlet Manifold

4-10. THEORY OF OPERATION.

4-11. The accumulator unit is used to smooth out hydraulic pump pulsations and to provide the necessary amount of hydraulic fluid required during cycling of the engine valves during engine checkout or hot-fire tests. (See figure 4-6 for the accumulator unit schematic.) Gaseous nitrogen applied to the GN_2 supply inlet located on the accumulator unit control panel flows through a filter to the supply pressure gage and to the upstream side of the regulator. Opening of the shutoff valve and adjustment of the regulator applies pressure through a check valve to the precharge pressure 0 to 3,000 psi gage and to the bladder pressurizing port of all four accumulators. The check valve, located downstream of the shutoff valve, prevents hydraulic fluid from entering the pneumatic system in the event of bladder damage. Hydraulic fluid from the hydraulic pumping unit enters the accumulator fluid port from the manifold. The fluid which enters the accumulator displaces an equal volume of nitrogen in the bladder. As more fluid is pumped into the accumulator, the nitrogen in the bladder is further compressed so the nitrogen pressure is always equal to the fluid pressure and the bladder floats in equilibrium. Since the fluid is virtually incompressible, the nitrogen maintains pressure in the accumulator when high flow conditions are required by the engine hydraulic system, and absorbs pulsations caused by the hydraulic pumping unit. The pressure switch is set to actuate when precharge pressure increases to 250-300 psig, and this signal may be monitored remotely by connecting the switch electrically to a monitoring device, or to control starter circuits of the hydraulic pump unit. The purpose of the pressure switch is to protect the accumulator bladder by preventing pump operation with an insufficient pneumatic precharge in the accumulator. The relief valve will relieve system pressure and prevent damage to the regulator if the precharge system pressure exceeds 3,350 psig.

4-12. MAINTENANCE.

4-13. Maintenance requirements and procedures outlined in the following paragraphs consist of checkout, removal and installation of components, cleaning, and servicing. These procedures are performed to make sure the accumulator unit is in operable condition.

4-14. CHECKOUT.

4-15. PREPARATION FOR CHECKOUT.

a. Unbuckle buckle-strap securing outlet manifold in stored position.

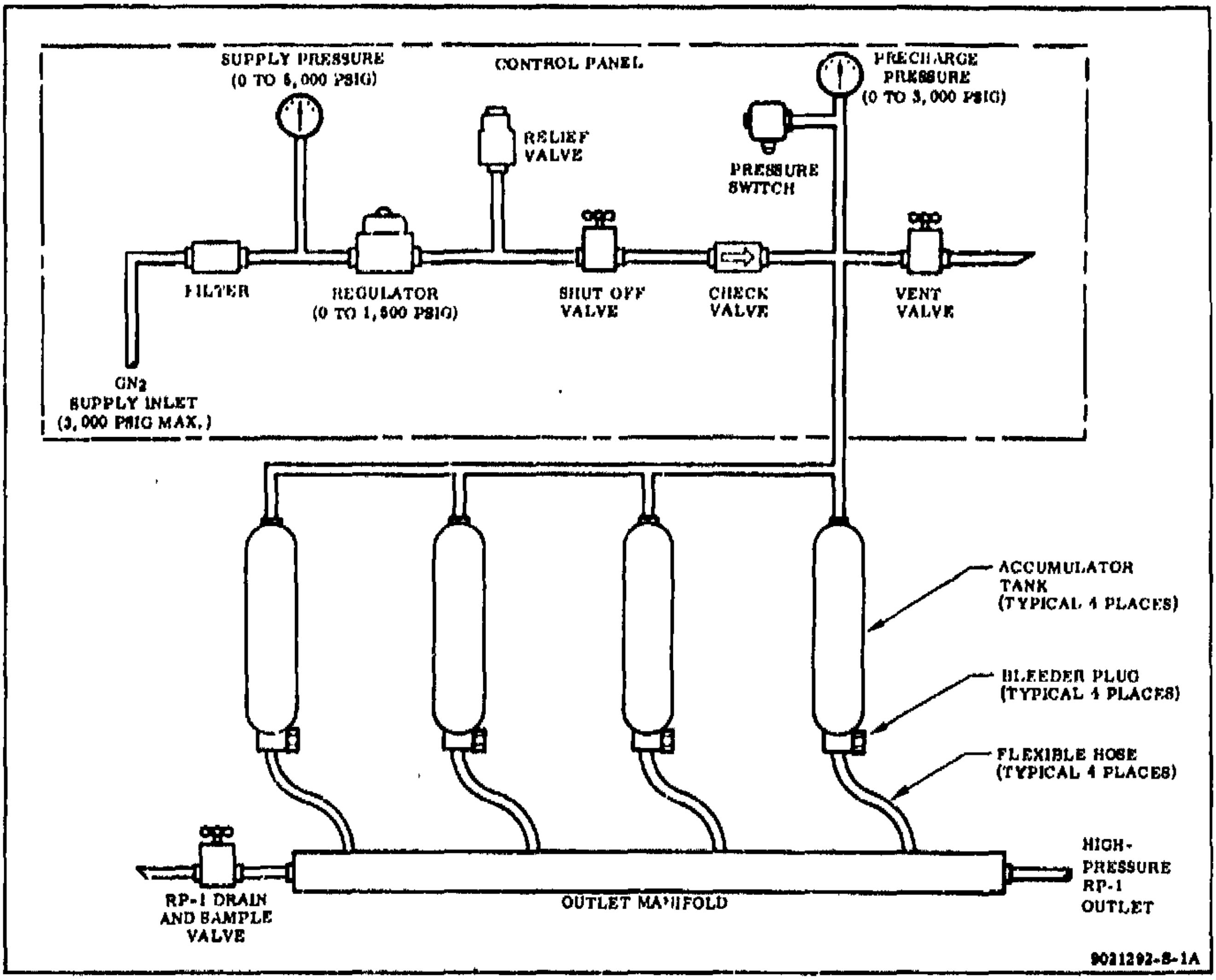


Figure 4-6. Accumulator Unit Schematic

b. Connect a hydraulic pumping unit capable of providing 10 gpm of RJ-1 fuel (MIL-F-25558) at a pressure range of 500 to 3,000 psig to outlet port (union nut 50N-8-BR) of outlet manifold. Check that connection is sufficiently supported.

c. Connect a facility supply capable of providing 5 cubic feet of gaseous nitrogen (MIL-P-27401) at 1,500 psig to GN_2 SUPPLY INLET on accumulator unit control panel.

d. Connect ground cable from base of unit frame to facility ground.

e. Connect a facility monitoring cable to PRESSURE SWITCH connection on bottom of unit control panel.

4-16. LEAK-TEST.

a. Make sure VENT and SHUT OFF valves located on unit control panel are closed.

b. Turn on facility gaseous nitrogen (MIL-P-27401) supply and pressurize unit in 400-psig increments to 1,500 ±100 psig. SUPPLY PRESSURE gage on unit control panel will indicate facility pressure. At each pressure increment, leak-test all accumulator fittings and connections from GN_2 SUPPLY INLET to SHUT OFF valve. No leakage is allowable.

c. Turn off facility gaseous nitrogen supply and vent gaseous nitrogen supply pressure to zero.

d. Open SHUT OFF valve on unit control panel.

e. Turn on facility gaseous nitrogen (MIL-P-27401) supply.

f. Observing PRE-CHARGE PRESSURE gage, pressurize unit to 1,500 ±100 psig in 300-psig increments by adjusting REGULATOR toward LOAD position. Check that PRESSURE SWITCH actuates between 250-300 psig. Check REGULATOR for smoothness of operation through its pressure range. At each pressure increment, leak-test all accumulator fittings and connections. No leakage is allowable.

g. Close SHUT OFF valve on unit control panel.

h. Observe PRE-CHARGE PRESSURE gage for decay in pressure. A decay in pressure would indicate bladder leakage within accumulator tanks or in plumbing downstream of SHUT OFF valve. No pressure decay is allowable.

i. Observe PRE-CHARGE PRESSURE gage and pressure switch monitor and slowly open VENT valve. Check that pressure switch actuates at 250 psig or less. Close VENT valve.

j. Open SHUT OFF valve and again adjust REGULATOR toward LOAD until PRE-CHARGE PRESSURE gage indicates 1,500 ±100 psig.

k. Start hydraulic pumping unit and pressurize fluid system of accumulator unit to 500 psig. Hold pressure for 3 minutes; then bleed off hydraulic pressure. Observe system pressure on PRE-CHARGE PRESSURE gage.

CAUTION

Damage to accumulator unit will result if fluid system is pressurized prior to GN_2 precharge.

NOTE

With fluid system pressurized, PRE-CHARGE PRESSURE gage will indicate fluid system pressure if fluid pressure is greater than pre-charge pressure. With no fluid pressure applied, gage will indicate GN_2 pre-charge pressure.

l. Repeat step k four times. At conclusion of hydraulic cycling, pressurize fluid system to 3,000 psig.

m. Leak-test all fluid system and gaseous nitrogen connections and fittings for fluid leakage. No leakage is allowable.

n. Stop hydraulic pumping unit and depressurize fluid system.

o. Turn off facility gaseous nitrogen supply.

p. Open SHUT OFF and VENT valves on unit control panel and adjust REGULATOR toward VENT until PRE-CHARGE PRESSURE and SUPPLY PRESSURE gages on unit control panel indicate zero.

q. Close SHUT OFF and VENT valves.

r. Disconnect gaseous nitrogen supply from GN_2 SUPPLY INLET on unit. Install protective closure.

s. Disconnect electrical cable from PRESSURE SWITCH connector. Install protective closure.

t. Disconnect pumping unit from outlet manifold. Install protective cover.

u. Place outlet manifold in stored position and secure with buckle-strap.

4-17. REMOVAL AND INSTALLATION.

4-18. Disassemble the accumulator unit, as required, to remove and install components. (See figure 4-7 for index and part numbers.) The following steps are only those special instructions necessary for installing specific accumulator components.

a. Lubricate accumulator unit tubing, fittings, and assemblies for pneumatic service or hydraulic fluid service, as applicable.

b. Torque nuts (7, 25) to 50-60 inch-pounds.

c. Torque bolt (10) to 56-66 inch-pounds.

d. Torque nuts (28, 32, 35) to 11-17 inch-pounds.

e. Torque nut (22) to 2-7 inch-pounds above locking torque.

f. Remove valve protector cap and valve core from accumulator charging stem before installing adapter (19).

4-19. CLEANING.

4-20. Clean the fluid side of the accumulator unit for hydraulic service. The accumulator unit parts may be cleaned by the oil scrub and solvent method; the solvent flushing method; the ultrasonic cleaning method; and the method for cleaning natural rubber, synthetic rubber, Teflon, and other metallic soft goods in mild alkaline cleaning solutions. Clean the gaseous nitrogen pre-charge side of the accumulator for pneumatic service. (Refer to section I for cleaning, handling, and packaging parts.)

CAUTION

Do not use the solvent vapor degreasing method for cleaning the accumulator unit.

4-21. SERVICING.

4-22. The servicing instructions as they pertain to the accumulator unit consist of calibration checks only.

4-23. CALIBRATION. Check the calibration of the two accumulator unit control panel gages and perform the minor calibration adjustments, as required, to meet the specified instrument tolerances. The gages have a laboratory-tested accuracy of 0.5 percent over the entire scale reading with a field tolerance of 0.7 percent. The gages should be checked for calibration every 6 months using a test gage with an accuracy of 0.1 percent of full scale. If the gages are not within the tolerance specified, remove the gages from the panel and assign for laboratory calibration. Calibration of the pressure switch must be performed, as required, whenever an out-of-tolerance condition exists as determined during checkout procedure (paragraph 4-14).

4-24. INSPECTION.

4-25. The inspections establish what is to be inspected, the conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted since they are directly affected by local operations. Visual inspections are conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. These inspections consist of two periodics: the 1st periodic to be accomplished at 30 calendar days, and the 2nd periodic at 180 calendar days. See figure 4-8 for inspection requirements for accumulator unit.

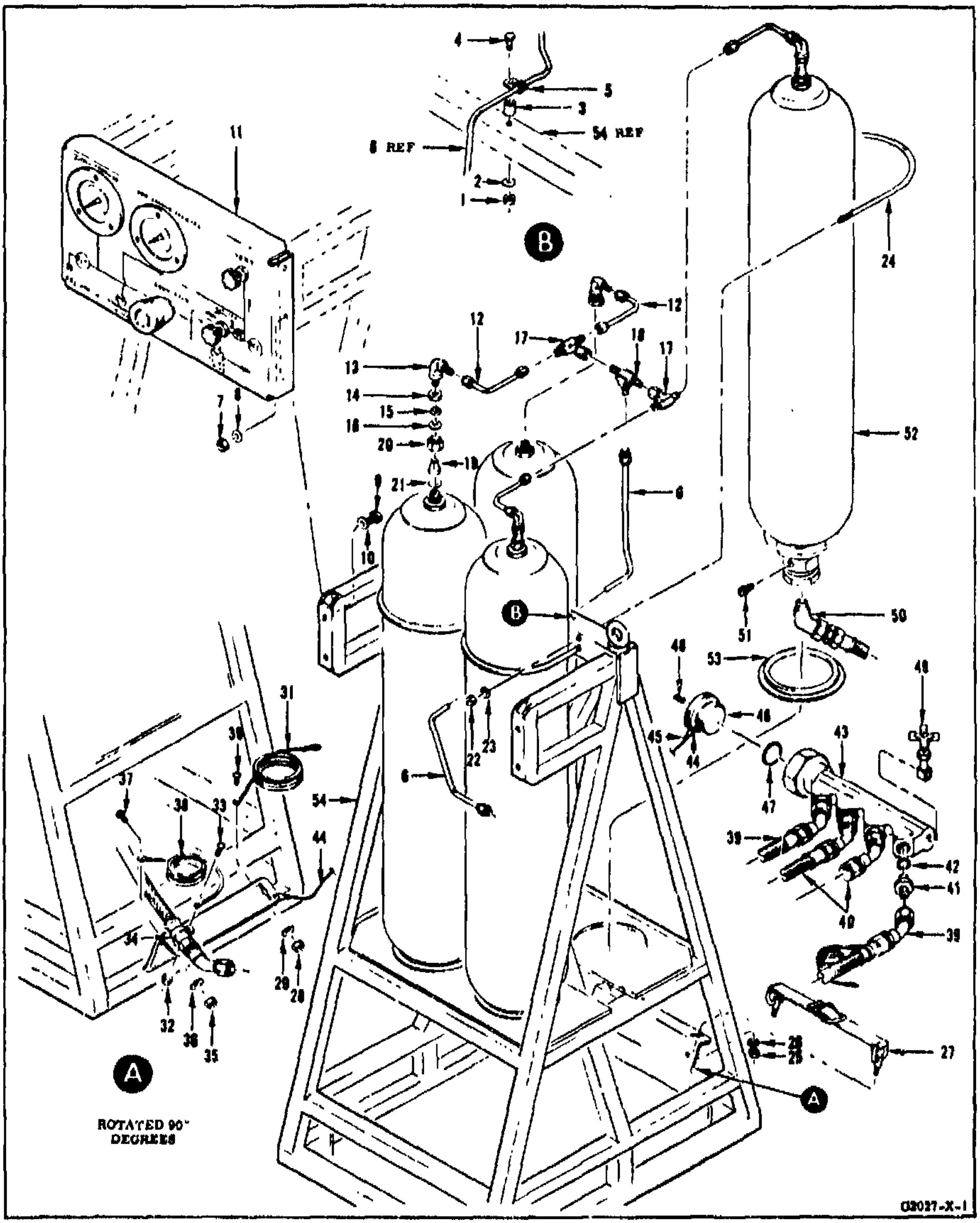


Figure 4-7. Disassembly of Accumulator Unit (Sheet 1 of 2)

Index No.	Part No.	Description
1	NAS679A3W	Nut (F-3)
2	LD153-0011-0011	Washer (F-3)
3	NAS43DD3-20	Spacer (F-3)
4	NAS1003-36A	Bolt (F-3)
5	MS21919-4	Clamp (F-3)
6	9021304	Tube (M-3)
7	NAS679C4W	Nut (F-3)
8	LD153-0011-0014	Washer (F-3)
9	RD153-5001-0004	Washer (F-3)
10	NAS1004-3A	Bolt (F-3)
11	9021287	Control Panel (F-1)
12	9015926	Tube (M-3)
13	AN833-4C	Elbow (F-3)
14	AN6289C4	Nut (F-3)
15	MS28777-4	Ring (F-3)
16	MS28778-4	Packing (F-3)
17	4S6BX-SS	Tee (F-3)
18	AN824-4C	Tee (F-3)
19	9015900	Adapter (F-3)
20	AN818-10C	Nut (F-3)
21	MS28775-012	Packing (F-3)
22	NAS679C4W	Nut (F-3)
23	LD153-0011-0014	Washer (F-3)
24	9015881	Shackle (F-3)
25	NAS679C4W	Nut (F-3)
26	LD153-0011-0014	Washer (F-3)
27	9015897	Buckle-Strap (F-3)
28	NAS679C3W	Nut (F-3)
29	AN961-10	Washer (F-3)
30	AN520C10R8	Screw (F-3)
31	MS25083-2BB24	Jumper (F-3)
32	NAS679C3W	Nut (F-3)
33	AN520C10R8	Screw (F-3)
34	AN735-22	Clamp (F-3)
35	NAS679C3W	Nut (F-3)
36	AN961-10	Washer (F-3)
37	AN520C10R8	Screw (F-3)
38	MS25083-2BB18	Jumper (F-3)
39	R35805CC16-0184	Hose (F-3)
40	R35805CC16-0302	Hose (F-3)
41	AN815-16C	Union (F-3)
42	MS28778-16	Packing (F-3)
43	9015880-11	Outlet Manifold (F-3)
44	RD191-2001-2112	Cable (F-3)
45	28-1-C	Sleeve (F-3)
46	9015896	Cover (F-3)
47	MS28775-227	Packing (F-3)
48	5498	Stopper (F-3)
49	Type 1924 Mfg. 1/4	Needle Valve (F-1)
50	MS20823-16C	Elbow (F-3)
51	A768-218	Bleeder Valve (F-3)
52	A813-200-2-1	Accumulator Tank (F-1)
53	967X20.12LG	Rubber Extrusion (F-3)
54	9015878	Frame (X-1)

Figure 4-7. Disassembly of Accumulator Unit (Sheet 2 of 2)

Inspection Requirements	Visual	Periodic 1st	Periodic 2nd
1. Gage calibration-check.			X
2. All protective caps and covers improperly installed prior to or after use.	X		
3. Unit exterior for any possible damage.	X		X
4. Unit exterior for cleanness and nameplate security and for flaking paint, loose components, loose foundation bolts, and illegibility placard.			X
5. Fittings and electrical connector for cleanness and security, and for cracks, nicks, wear, or damaged threads, and all unit wiring for frays and burned spots.	X	X	
6. Tubing for scratches, dents, cracked sleeves, loose coupling nuts, and improper color coding; pressure and flow-indicating tape for lack of security and for illegibility.			X
7. Gages for cracked or broken glass, cracked frames, and loose or missing faceplate screws.	X	X	
8. GN_2 system and fluid system for leakage when pressurized.		X	
9. SUPPLY PRESSURE and PRE-CHARGE gages for expired calibration dates.	X		

Figure 4-8. Inspection Requirements for Accumulator Unit

All data on pages 4-9 through 4-14 deleted.

SECTION V

ENGINE CHECKOUT CONSOLE G3142

WARNING

ENGINE CHECKOUT CONSOLE G3142 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

5-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance instructions, and inspection requirements for Engine Checkout Console G3142. The console is capable of performing pneumatic, hydraulic, electrical, and leak- and function-tests on the F-1 engine to determine the engine's operational condition and is instrumented to measure pressure, flow, and electrical functions and to record temperatures.

5-2. DESCRIPTION AND LEADING PARTICULARS.

5-3. ENGINE CHECKOUT CONSOLE.

5-4. The engine checkout console (figure 5-1) is an electrical-pneumatic-hydraulic unit designed to perform a complete single-engine checkout of the F-1 engine. The console consists of two metal cabinets, referred to as Console No. 1 and Console No. 2, with four bays each. The cabinets are mounted side-by-side on the engine checkout platform with Console No. 1 on the left-hand side and Console No. 2 on the right. The console incorporates electrical, pneumatic, and hydraulic systems which contain controls, indicator lights, electrical meters, pressure gages, flowmeters and indicators, a temperature recorder, and pressure safety devices. All controls, measuring and indicating devices, and panel schematics are mounted on the front panels. Plumbing and electrical connections and access panels are located on the back panels of the console. Controls and measuring devices are arranged and identified on the individual panels for specific engine tests. See figure 5-2 for leading particulars.

5-5. CONSOLE PANELS. The console front and back panels are vertical panels approximately 25 inches wide, and are attached to the console frame with threaded fasteners. The majority of the operating controls and measuring and indicating devices are mounted on the front panels. Included on each of the top front panels are a panel schematic and two lifting bolts and guide handles to facilitate removal and installation. Handles are also included on nine of the lower front panels. The back panels contain all plumbing and electrical connections for facility input, interconnects between consoles, and outlets to the engine. The remaining panels on the back of the console are for access to console components. All panel components are identified on the panel face and are so arranged on the individual panels to perform a specific function. Most of the front control panels have corresponding outlet panels on the back of the console which pertain to the same engine components. See figures 5-3 through 5-6.

5-6. ELECTRICAL SYSTEM. The electrical system is an ac-dc system used to operate console components and supply electrical power to the engine during engine checkout. The ac electrical system supplies power to operate console indicator lights, hydraulic flow indicator and transducers, temperature recorder, and a five-vdc regulated power supply. It also supplies power to the engine turbopump heaters during checkout. The dc electrical system supplies power to operate console indicator lights, relays, pressure switches and engine components. The five-vdc electrical power supply provides electrical power to the engine propellant valve position indicators and transducers. Electrical controls, switches, lights, meters, a temperature recorder, and flow indicators are located on the front panels. The electrical connectors for the facility electrical, interconnects, engine, and instruments are located on the back panels. The electrical system also includes internal wiring within the console, interconnect wiring between Console No. 1 and Console No. 2, and interconnect wiring from the console to the engine and external recording instruments.

5-7. PNEUMATIC SYSTEM. The pneumatic system is a high-pressure system which controls and regulates pressure at the specified values and flowrates required for engine checkout. The pneumatic system is comprised of several individual systems which utilize gaseous nitrogen, helium, LOX-clean air, and missile air as the pressurants. Also included are two additional systems which supply gaseous Freon to the pressurant systems. Freon is used

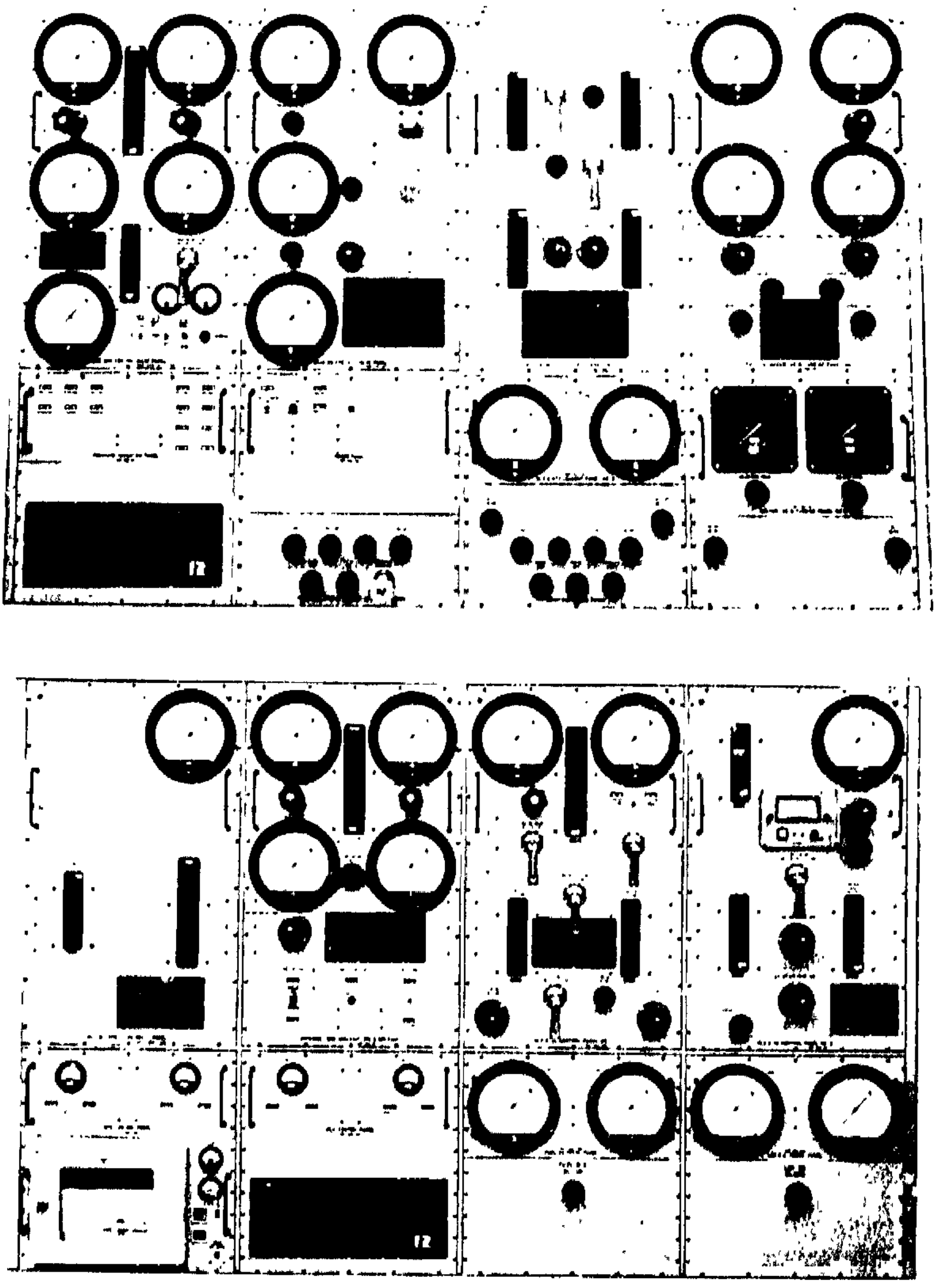


Figure 5-1. Engine Checkout Console

during engine propellant system leak-tests. Components in the pneumatic system include regulators, selector valves, shutoff valves, solenoid valves, check valves, pressure gages, flowmeters, pressure switches, pressure relief valves, filters, and the necessary plumbing. The majority of the pneumatic components which control, regulate, and monitor pneumatic functions are located on the front panels. The inlet, interconnect, and engine plumbing connections are located on the back panels. The remaining components inside the console consist of check valves, relief valves, filters, pressure switches, plumbing, and a gaseous nitrogen purge regulator.

Dimensions and Weight

Console No. 1 (left-hand side):

Length	104.45 inches
Width	11.94 inches
Height	71.64 inches
Weight	2,100 pounds (approximate)

NOTE

Console No. 2 (right-hand side) is identical.

Electrical Power Requirements

Input: 120/208-vac, 3-phase, 4-wire (plus a wire to facility ground), 15-ampere.

28-vdc, regulated, 2-wire, 15-ampere.

Output: 208-vac, turbopump heater.

28-vdc, engine components, and external recording instruments.

5-vdc, engine components, and external recording instruments.

Pneumatic Pressure Requirements

Input: 2,500 to 3,000 psig, gaseous nitrogen (MIL-P-27401) (gaseous nitrogen, LOX-clean air, and missile air systems).

1,000 to 3,000 psig, gaseous helium (Bureau of Mines, Grade A).

50-100 psig, refrigerant, Type 12 (Federal Specification BB-F-1421).

Pneumatic Pressure Requirements (continued)

Output: 0-100 psig, gaseous nitrogen, LOX-clean air, missile air.

0-100 psig, refrigerant, Type 12

0-250 psig, LOX-clean air, missile air.

0-500 psig, gaseous nitrogen.

0 to 1,000 psig, gaseous nitrogen, gaseous helium.

0 to 3,000 psig, gaseous nitrogen, LOX-clean air, missile air.

Hydraulic Pressure Requirements

Input: RJ-1 fuel (MIL-F-25558) with a controlled pressure range of 30-3,000 psig, a delivery volume of 45 gpm at 2,200 psig, and a reservoir volume of 100 gallons minimum.

Output: 1,000 and 3,000 psig, hydraulic fluid.

Figure 5-2. Leading Particulars for Engine Checkout Console

5-8. HYDRAULIC SYSTEM. The hydraulic system is a closed high-pressure fluid system which controls and regulates hydraulic fluid at the specified values and flowrates required for engine checkout. Hydraulic components consist of regulators, selector valves, shutoff valves, solenoid valves, check valves, pressure gages, flowmeters, pressure switches, pressure relief valves, filters, and plumbing. The majority of the hydraulic components which control, regulate, and monitor hydraulic functions are located on the front panels. Hydraulic connections from facility source, interconnects between consoles, and connections to the engine are located on the back panels. Other hydraulic components inside the console are check valves, back pressure regulators, and turbine-type flowmeters.

5-9. THEORY OF OPERATION.

5-10. The engine checkout console is designed to leak- and function-test the F-1 engine to determine the engine's operational condition. A complete single-engine test is accomplished with the console by applying electrical power, pneumatic gas, and hydraulic fluid to the engine under controlled conditions and in a specified

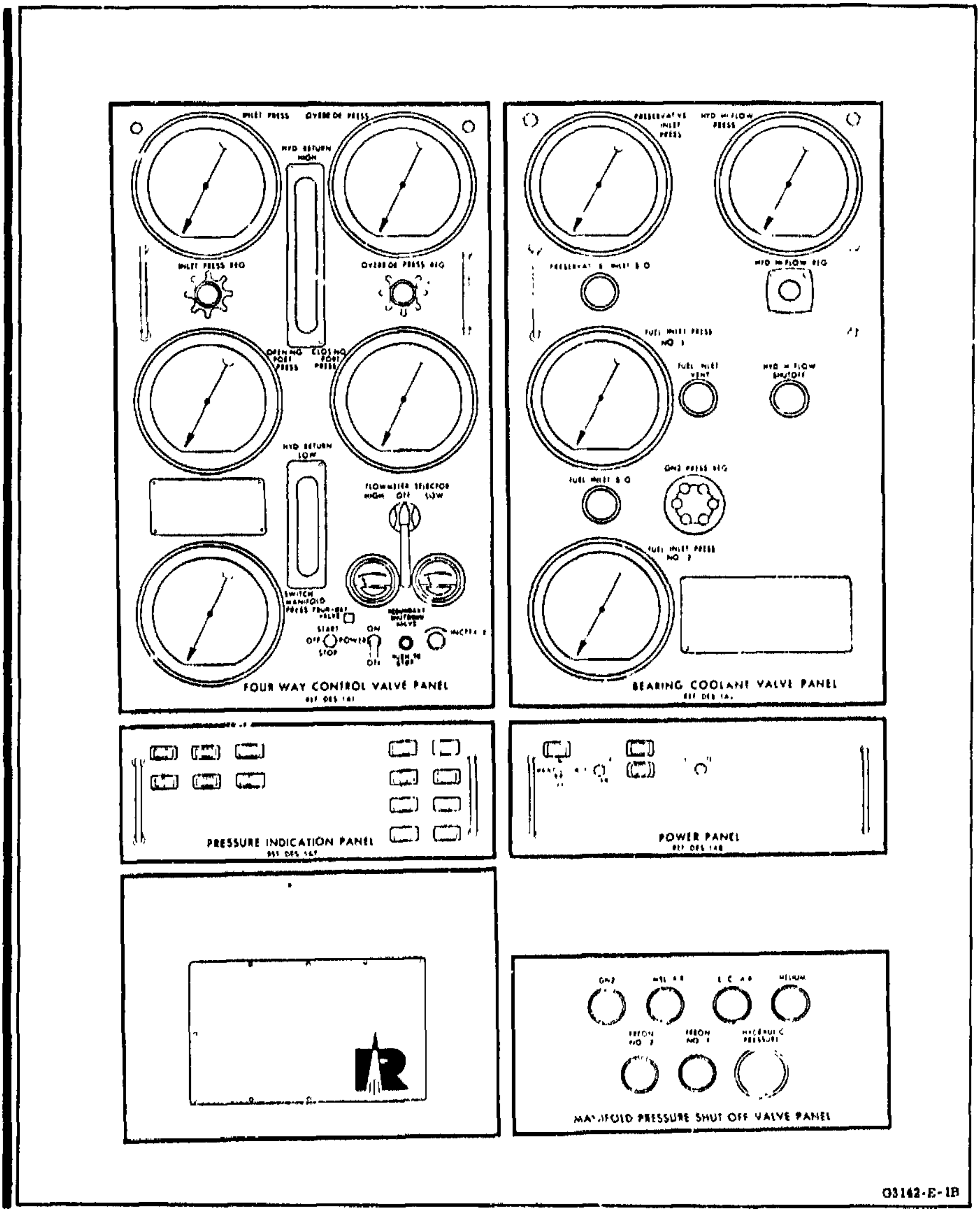


Figure 5-3. Console No. 1 Front Panels (Sheet 1 of 2)

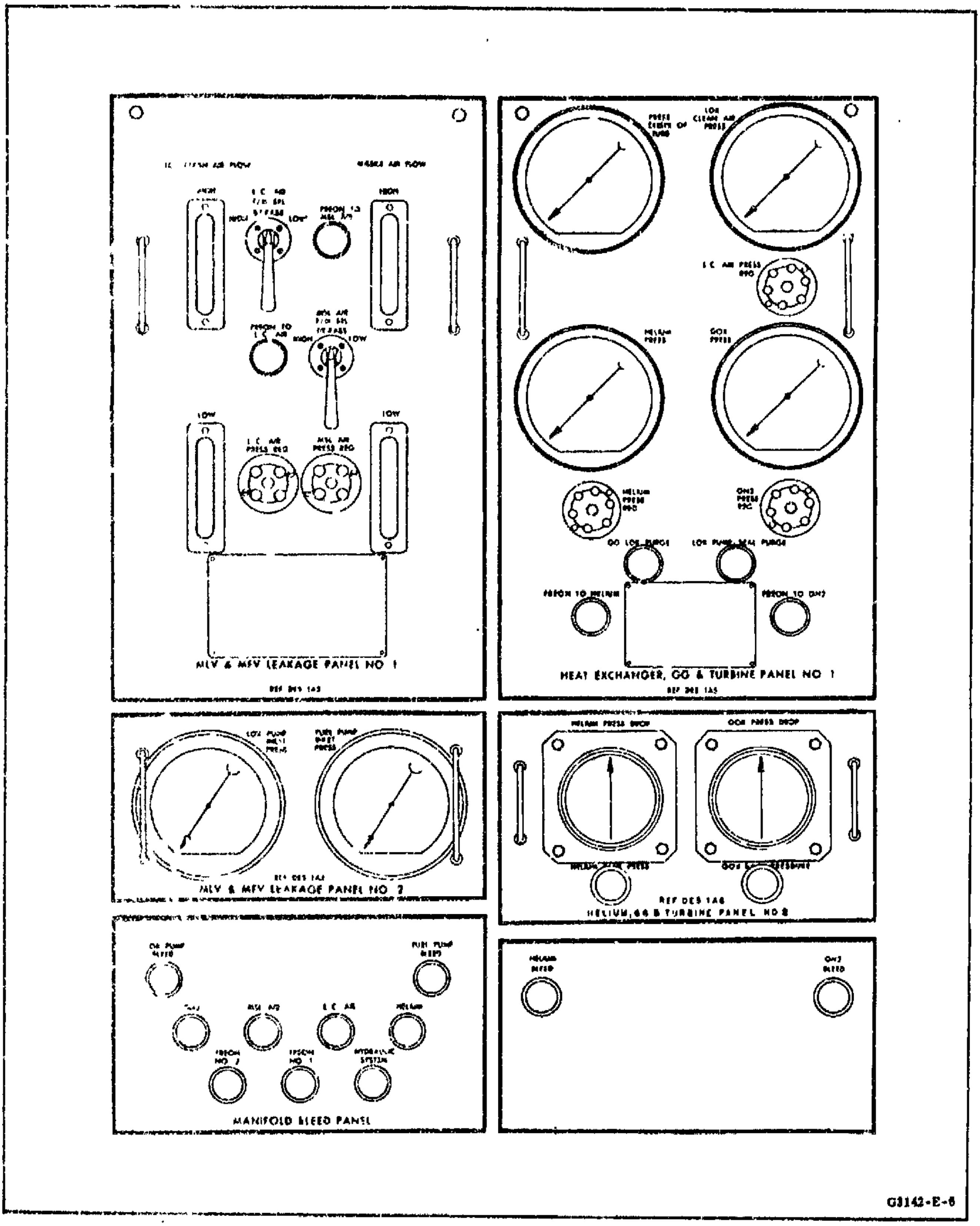


Figure 5-3. Console No. 1 Front Panels (Sheet 2 of 2)

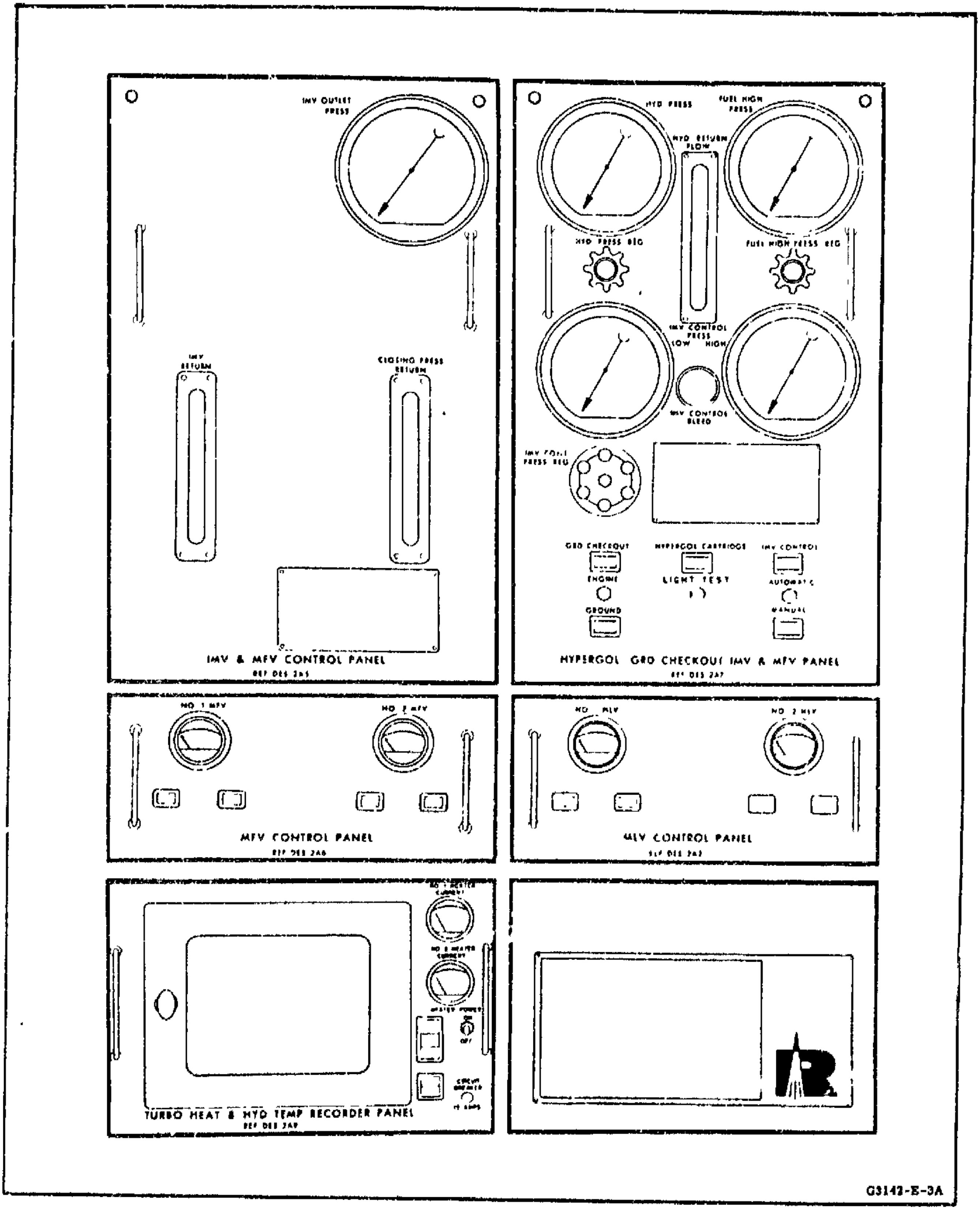
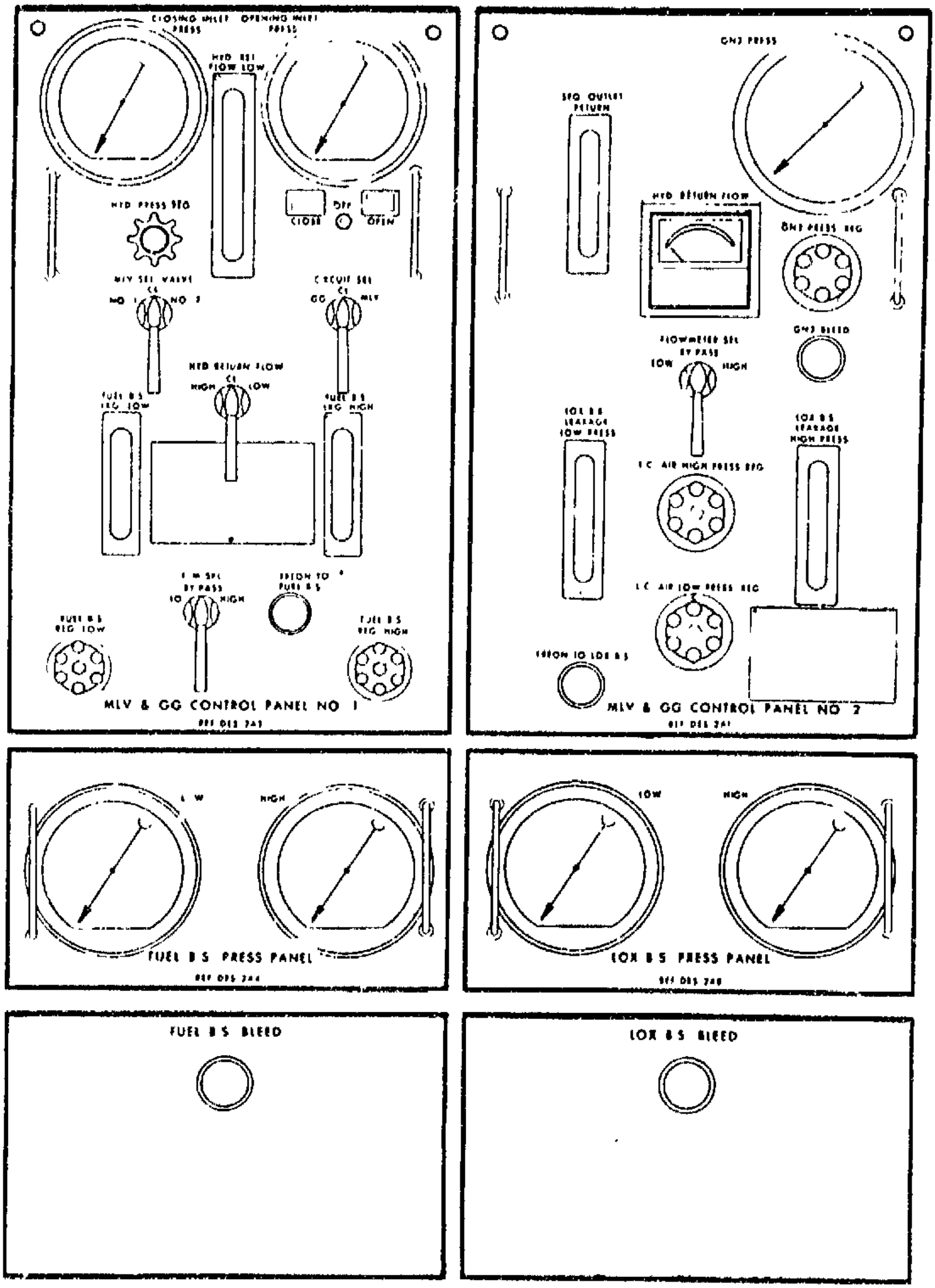
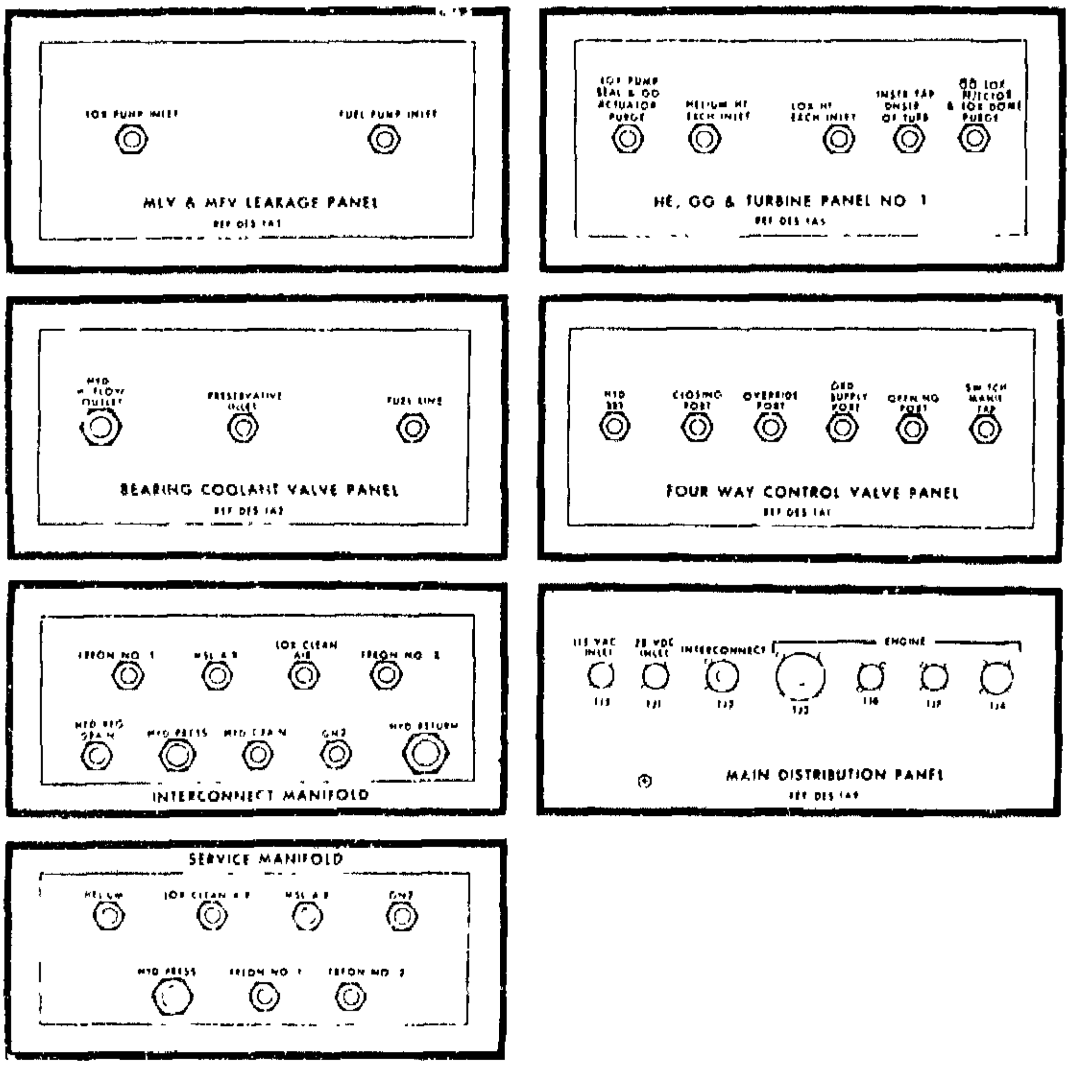


Figure 5-4. Console No. 2 Front Panels (Sheet 1 of 2)



G3142-E-7

Figure 5-4. Console No. 2 Front Panels (Sheet 2 of 2)



G3142-E-2A

Figure 5-5. Console No. 1 Rear Panels

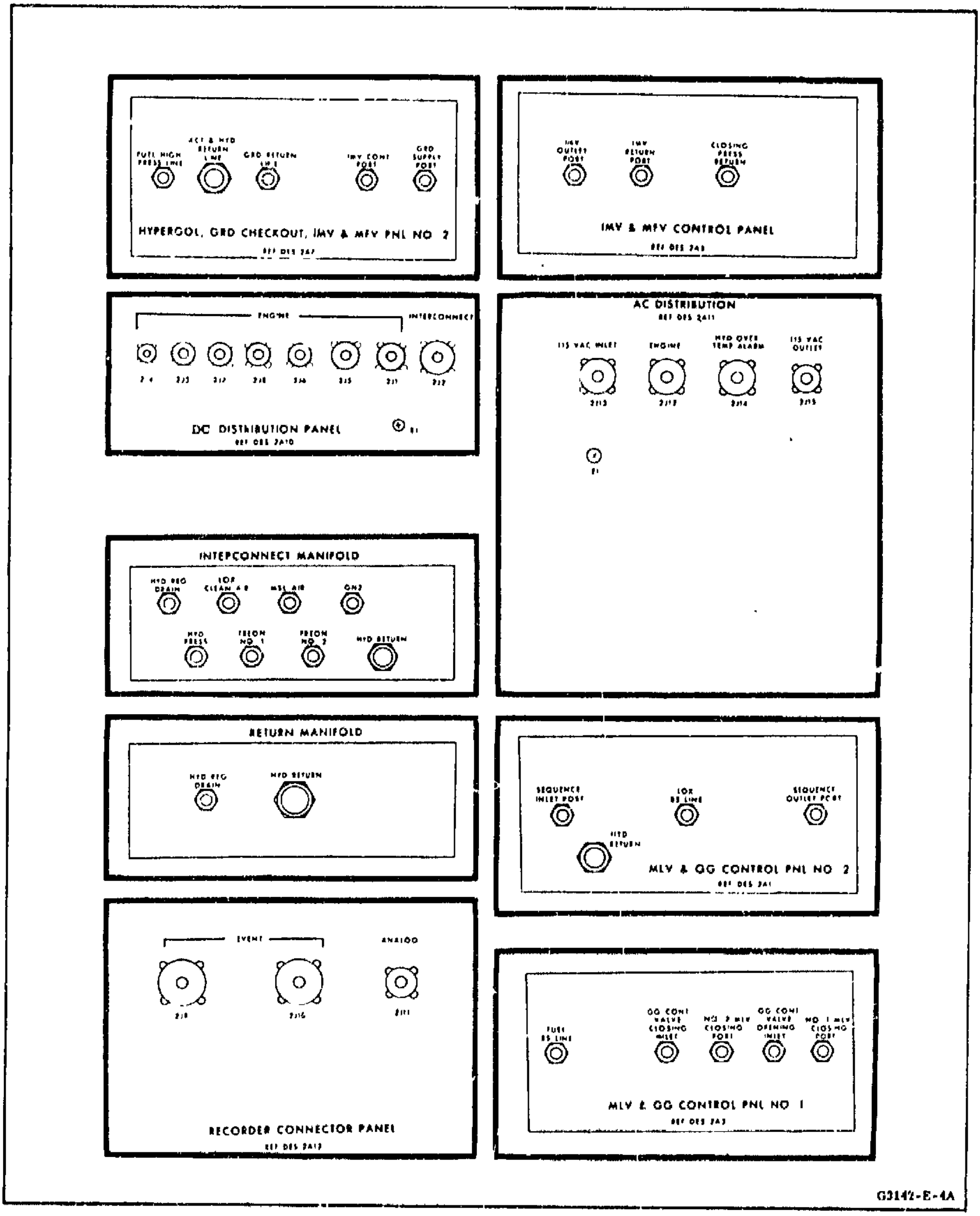


Figure 5-6. Console No. 2 Rear Panels

sequence. Each of the individual console systems is designed to perform a specific engine test. Facility electrical, pneumatic, and hydraulic sources are connected to the console prior to engine checkout. The engine is then connected to the console with electrical cables and pneumatic and hydraulic lines. Engine checkout is conducted in a predetermined manner by operating the console controls to perform engine tests. Operation of the engine is visually monitored on console gages, meters, and lights. Turbopump and hydraulic flow temperatures are recorded on the console temperature recorder during testing. Checkout of the console is performed to verify that it is operating properly prior to attempting an engine checkout. Console checkout is accomplished by applying electrical, pneumatic, and hydraulic power to the console, and then operating controls to check operation and condition of controls, measuring and indicating devices, plumbing, and electrical wiring. Electrical signals that simulate engine operation must also be applied to the console during checkout. Simulating the engine electrical circuits verifies proper operation of that portion of the console directly related to the engine electrical system.

5-11. LOOSE EQUIPMENT.

5-12. Loose equipment supplied with the engine checkout console consists of electrical cable assemblies. Cables are used for electrical connections between console and engine, interconnects between Consoles No. 1 and No. 2, and connections between console and recording instruments. See figure 5-7 for a list of loose equipment.

5-13. MAINTENANCE.

5-14. Maintenance of the engine checkout console consists of checkout, removing, installing, servicing, and shipping and storage. The console electrical schematic (figure 5-21) is included to aid in troubleshooting and is at the end of this section. A suggested simulator circuit appears on the schematic, to simulate the component signals. See figure 5-8 for test equipment and materials used during checkout.

Part Number	Nomenclature	Use
19-9023816	Cable	Engine Control and Checkout Valves
19-9023817	Cable	Engine Hypergol Switch
19-9023818	Cable	Engine Thrust Pressure Switch No. 2
19-9023819	Cable	Engine Instrumentation
19-9023820	Cable	Engine Oxidizer and Fuel Valve Potentiometers
19-9023821	Cable	Engine Oxidizer, Fuel, and Gas Generator Valve Switches
19-9023822 19-9026612[a]	Cable	Engine Turbopump Heater Temperature Transducer
19-9023823	Cable	Engine Pressure Transducer (opening)
19-9023824	Cable	Engine Pressure Transducer (closing)
19-9023826	Cable	Engine Thrust Pressure Switch No. 1
19-9023827	Cable	Engine Turbopump Heaters
19-9023828	Cable	Engine Thrust Pressure Switch No. 3
19-9024129	Cable	Console Interconnect
19-9024130	Cable	Console Interconnect
19-9024131	Cable	Event Recorder
19-9024132	Cable	Event Recorder
19-9024133	Cable	Analog Recorder

(a) Units incorporating MD6 change

Figure 5-7. List of Loose Equipment

Part Number or Specification	Nomenclature	Use
G3134	Engine Simulator, or equivalent	Simulates component signals and function.
Model 630A	Multimeter (Triplett), or equivalent	Measures resistance and voltage.
Type 1432-T	Decade Resistance Box Steps in 0.01, 0.1, 1, 10, 100 ohms (General Radio Co)	Verifies temperature recorder printout.
Model AW, 20 pens, Type-Voltage(24-vdc)	Event Recorder (Esterline Angus), or equivalent	Provides a permanent record of events during checkout.
Model #5-124P4-18 (shunted for 5-volt input)	Oscillograph Recorder (Consolidated Electrodynamics), or equivalent	Provides a linear trace of oxidizer and fuel valves position potentiometers.
--	Filter (5-micron, 3,000-psig, 1/2-inch port), pneumatic service (2 required)	Filters pneumatic inlets to console.
--	Filter (5-micron, 2,200-psig, 1-inch port, 45-gpm), hydraulic service	Filters hydraulic inlets to console.
--	Test gage (0-1,000 psi), hydraulic service	Measures test pressure during flow-test.
--	Shutoff valve, 1-inch port, hydraulic service (3 required)	Controls test pressures.
--	Needle valves (1/2-inch port), hydraulic service (5 required)	Controls and adjusts hydraulic flow.
--	Test gage (0-5 psi) (2 required)	Monitors purge pressure to temperature recorder (2A9) and hydropoise flowrate indicator (2A1).
MIL-L-25567, or equivalent	Leak-Test Compound	Checks plumbing leaks.
MIL-P-27401	Gaseous Nitrogen	Leak- and function-tests console.
Bureau of Mines, Grade A	Gaseous Helium	Leak- and function-tests console.
MIL-F-25558	RJ-1 Fuel	Leak- and function-tests console.
19-9023816	Cable	Electrical interconnect.
19-9023817	Cable	Electrical interconnect.
19-9023818	Cable	Electrical interconnect.
19-9023820	Cable	Electrical interconnect.
19-9023821	Cable	Electrical interconnect.
19-9023826	Cable	Electrical interconnect.
19-9023827	Cable	Electrical interconnect.
19-9023828	Cable	Electrical interconnect.
19-9024129	Cable	Electrical interconnect.
19-9024130	Cable	Electrical interconnect.
19-9024131	Cable	Electrical interconnect.
19-9024132	Cable	Electrical interconnect.
19-9024133	Cable	Electrical interconnect.
19-9026612[a]	Cable	Electrical interface.

(a) Units incorporating MD6 change

Figure 5-8. Test Equipment and Materials

5-15. CHECKOUT.

5-16. Checkout of the engine checkout console is performed in a covered area, under ambient temperature of 65° to 75° F, atmospheric pressure of 28-32 inches of mercury, and relative humidity of 50 percent or less. All test equipment used during checkout must be maintained in the clean condition required for the specific system. When fittings, components, or lines are disconnected, suitable precautions must be taken to prevent entry of foreign material into the system. Personnel in the immediate test area must wear safety equipment and take precautionary measures to protect themselves from injury. The tests must be performed in the order given and the results obtained as specified. During checkout, the reference designation numbers (in parentheses), which appear on the panel face, are used following component nomenclature to identify the panels. On those panels not identified with reference designation numbers, the panel nomenclature (in parentheses) follows the component nomenclature. See figures 5-9 and 5-10 for recommended engine simulator and parts list.

CAUTION

Use extreme care while performing procedures involving pressurization of flowmeters, especially the low-flow flowmeters, since the flowmeter can be damaged by flow surges.

5-17. ELECTRICAL TEST. See figure 5-2 for electrical power requirements and figure 5-11 for test-setup cable diagram.

a. Check that all switches are in off, center, or MANUAL position and pull out CIRCUIT BREAKER 15 AMPS (2A9).

b. Connect cable 19-9024129 to receptacle 1J2 (1A9) and 2J2 (2A10) and connect cable 19-9024130 to receptacle 1J5 (1A9) and 2J15 (2A11).

c. Using multimeter, check for one ohm or less resistance between receptacle 2J13, pin E, (2A11) and the following:

(1) Ground terminal E1 (1A9).

(2) Ground terminal E1 (2A10).

(3) Ground terminal E1 (2A11).

(4) Face (1A1 through 1A9).

(5) Face (2A1 through 2A12).

d. Connect facility AC power to receptacle 2J13 (2A11).

e. Connect facility DC power to receptacle 1J1 (1A9).

f. Turn facility AC and DC power on.

g. Move MAIN POWER switch (1A8) to ON; the following lights come on:

(1) MAIN POWER ON, +DC GROUNDED (dim), -DC GROUNDED (dim) (1A8).

(2) MANUAL and GROUND (2A7).

NOTE

If two or more consoles are connected to a common dc power source, an erroneous condition, indicated by bright illumination of -DC GROUNDED light, occurs when the respective console MAIN POWER switch is on. To correct this erroneous condition, the ground circuit is routed through the contacts of the MAIN POWER switch. See figure 5-21, sheet 1, for wiring information.

h. Press and hold LIGHT TEST switch (1A8); the following lights come on:

(1) +DC GROUNDED and -DC GROUNDED (1A8).

(2) All lights (1A7).

i. Release LIGHT TEST switch (1A8); the following lights go off:

(1) +DC GROUNDED and -DC GROUNDED (dim) (1A8).

(2) All lights (1A7).

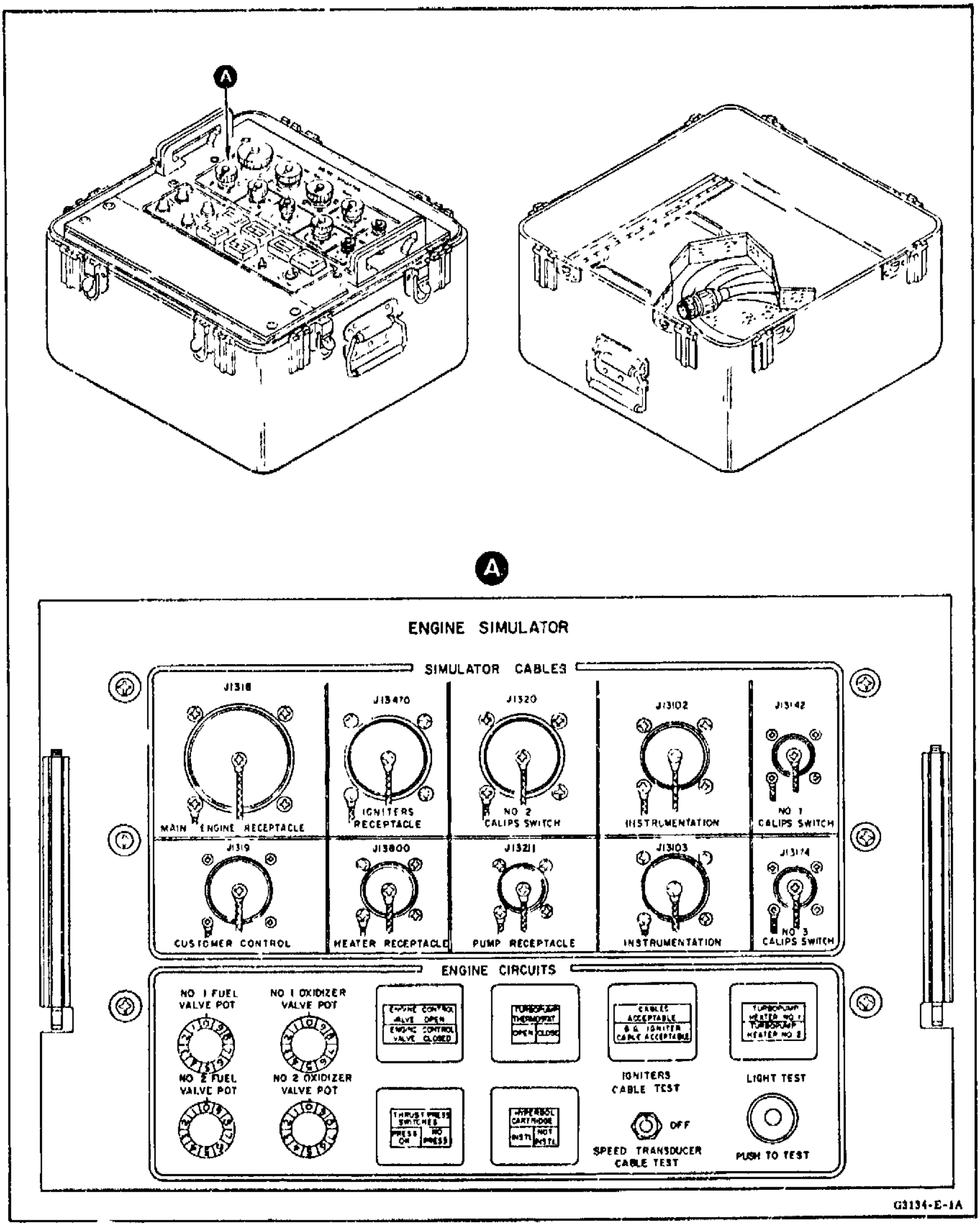


Figure 5-9. Recommended Engine Simulator

Item Number	Part Number	Nomenclature	Number Required	Manufacturer
DS1, DS2	32L-X-304	Lampholder	2	Master Specialties Co
	312-36118	Cover plate	2	
	RD332-0003-0051	Lens	1	
	RD332-0003-0052	Lens	1	
	RD338-0001-0004	Filter	2	
DS3, DS4	32-X-6	Lampholder	2	Master Specialties Co
	312-36118	Cover plate	2	
	RD332-0003-0072	Lens	1	
	RD332-0003-0073	Lens	1	
	RD338-0001-0004	Filter	2	
DS5	125-408-1195-442	Light	1	Dialight Corp
	NE-51	Lamp	1	General Electric Co
S1, S3	RD450-0001-1010	Switch-light	2	
	RD332-0006-0013	Lens	1	
	RD332-0006-0014	Lens	1	
S2	RD450-0001-2010	Switch-light	1	
	RD332-0006-0021	Lens	1	
S4	MS25089-3F	Switch	1	
	A120082	Shield	1	
K1, K2,	MS25271D1	Relay	3	
R1, R2, R3, R4	Model SG1135	Potentiometer	4	Beckman Instrument, Inc
	Model SR158	Dial	4	
R5, R6	RH10-1.1K-1%	Resistor	2	Dale Electronics, Inc
R7	RH-250-200-1%	Resistor	1	Dale Electronics, Inc
J1318	RD414-1010-0070	Connector	1	
J1319	RD414-1010-0074	Connector	1	
J1320	RD414-1010-0058	Connector	1	
J13800	RD414-1010-0026	Connector	1	
J13102	RD414-1010-0044	Connector	1	
J13103	RD414-1010-0043	Connector	1	
J13142	RD414-1010-0010	Connector	1	
J13174	RD414-1010-0012	Connector	1	

Figure 5-10. Recommended Engine Simulator Parts List

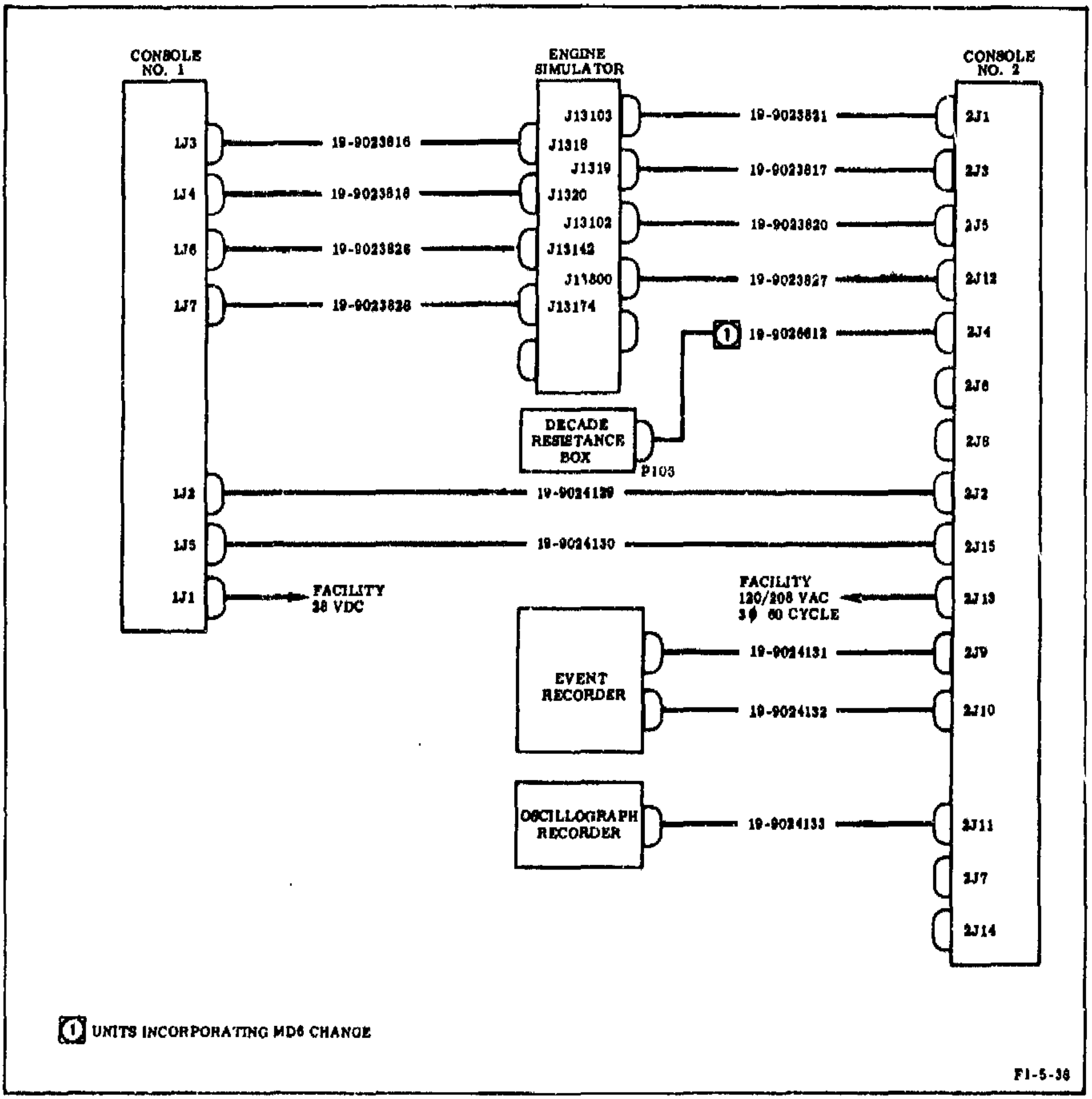


Figure 5-11. Recommended Test-Setup Cable Diagram

j. Press and hold LIGHT TEST switch (2A7); the following lights come on:

(1) HEATER OVER TEMPERATURE and HEATER TEMP NORMAL (2A9).

(2) ENGINE, AUTO, and INSTALLED (2A7).

(3) CLOSED and OPEN (2A3).

(4) NO. 1 CLOSED, NO. 1 OPEN, NO. 2 CLOSED, and NO. 2 OPEN (2A2).

(5) NO. 1 CLOSED, NO. 1 OPEN, NO. 2 CLOSED, and NO. 2 OPEN (2A6).

k. Release LIGHT TEST switch (2A7); lights in step j go off.

l. Push in CIRCUIT BREAKER 15 AMPS (2A9); the following lights come on:

(1) HYD RETURN HIGH and HYD RETURN LOW flowmeters (1A1).

(2) LOX CLEAN AIR FLOW HIGH and LOW flowmeters (1A3).

(3) MISSILE AIR FLOW HIGH and LOW flowmeters (1A3).

(4) SEQ. OUTLET RETURN flowmeter (2A1).

(5) LOX B.S. LEAKAGE HIGH PRESS and LOX B.S. LEAKAGE LOW PRESS flowmeters (2A1).

(6) CLOSING PRESS. RETURN and IMV RETURN flowmeters (2A5).

(7) HYD. RET. FLOW LOW, FUEL B.S. LKG. LOW, and FUEL B.S. LKG. HIGH flowmeters (2A3).

(8) HYD. RETURN FLOW flowmeter (2A7).

m. Press and hold LIGHT TEST switch (2A7); AC POWER PHASE A, AC POWER PHASE B, and AC POWER PHASE C lights come on. Ignore all other lights.

n. Release LIGHT TEST switch (2A7); lights in step m go off.

o. Pull out CIRCUIT BREAKER 15 AMPS (2A9) and move MAIN POWER switch (1A8) to OFF. All lights on both consoles go off.

NOTE

Electrical emergency shutdown may be initiated by moving MAIN POWER switch (1A8) to the OFF position. Shutdown in effect is indicated when all lights on both consoles go off.

p. Using recommended engine simulator, connect interconnecting cables (figure 5-11) as follows:

(1) 19-9023816 between receptacles 1J3 (1A9) and J1318 (simulator).

(2) 19-9023818 between receptacles 1J4 (1A9) and J1320 (simulator).

(3) 19-9023826 between receptacles 1J6 (1A9) and J13142 (simulator).

(4) 19-9023828 between receptacles 1J7 (1A9) and J13174 (simulator).

(5) 19-9023821 between receptacles 2J1 (2A10) and J13103 (simulator).

(6) 19-9023817 between receptacles 2J3 (2A10) and J1319 (simulator).

(7) 19-9023820 between receptacles 2J5 (2A10) and J13102 (simulator).

(8) 19-9023827 between receptacles 2J12 (2A11) and J13800 (simulator).

(9) On units incorporating MD6 change, 19-9026612 to receptacle 2J4.

q. Move MAIN POWER switch (1A8) to ON; the following lights come on:

(1) MAIN POWER ON, +DC GROUND (dim), and -DC GROUNDED (dim) (1A8).

(2) NO. 1 NO THRUST, NO. 2 NO THRUST, and NO. 3 NO THRUST (1A7).

(3) THRUST PRESS SWITCHES and NO PRESS (simulator).

(4) GROUND and MANUAL (2A7).

(5) CLOSED (2A3).

(6) NO. 1 CLOSED and NO. 2 CLOSED (2A2).

(7) NO. 1 CLOSED and NO. 2 CLOSED (2A6).

(8) HYPERGOL CARTRIDGE and NOT INSTL (simulator).

r. Push in CIRCUIT BREAKER 15 AMPS (2A9); all flowmeter lights come on.

s. Move HEATER POWER switch (2A9) to ON; the following events occur:

(1) AC POWER PHASE A, AC POWER PHASE B, AC POWER PHASE C, and HEATER TEMP NORMAL lights come on (2A9).

(2) NO. 1 HEATER CURRENT and NO. 2 HEATER CURRENT meters indicate 1.0 ±0.1 ampere (2A9).

(3) TURBOPUMP THERMOSTAT, CLOSED, TURBOPUMP HEATER #1, and TURBOPUMP HEATER #2 lights come on (simulator).

t. Press TURBOPUMP THERMOSTAT switch-light (simulator); the following events occur:

(1) HEATER TEMP NORMAL light goes off and HEATER OVER TEMPERATURE light comes on (2A9).

(2) NO. 1 HEATER CURRENT and NO. 2 HEATER CURRENT meters indicate zero.

(3) OPEN light comes on and CLOSED, TURBOPUMP HEATER #1, and TURBOPUMP HEATER #2 lights go off (simulator).

u. Press TURBOPUMP THERMOSTAT switch-light (simulator) and move HEATER POWER switch (2A9) to OFF then to ON; the following events occur:

(1) HEATER OVER TEMPERATURE light goes off and HEATER TEMP NORMAL light comes on (2A9).

(2) NO. 1 HEATER CURRENT and NO. 2 HEATER CURRENT meters indicate 1.0 ±0.1 ampere (2A9).

(3) OPEN light goes off and CLOSED, TURBOPUMP HEATER #1, and TURBOPUMP HEATER #2 lights come on (simulator).

v. Move HEATER POWER switch (2A9) to OFF; the following events occur:

(1) AC POWER PHASE A, AC POWER PHASE B, AC POWER PHASE C, and HEATER TEMP NORMAL lights go off (2A9).

(2) NO. 1 HEATER CURRENT and NO. 2 HEATER CURRENT meters indicate zero (2A9).

(3) TURBOPUMP THERMOSTAT, CLOSED, TURBOPUMP HEATER #1, and TURBOPUMP HEATER #2 lights go off (simulator).

w. Press and hold THRUST PRESS SWITCHES switch-light (simulator); the following events occur:

(1) NO. 1 THRUST OK, NO. 2 THRUST OK, and NO. 3 THRUST OK lights come on (1A7).

(2) NO. 1 NO THRUST, NO. 2 NO THRUST, and NO. 3 NO THRUST lights go off (1A7).

(3) NO PRESS light goes off and PRESS OK light comes on (simulator).

x. Release THRUST PRESS SWITCHES switch-light (simulator); the following events occur:

(1) NO. 1 NO THRUST, NO. 2 NO THRUST, and NO. 3 NO THRUST lights come on (1A7).

(2) NO. 1 THRUST OK, NO. 2 THRUST OK, and NO. 3 THRUST OK lights go off (1A7).

(3) NO PRESS light comes on and PRESS OK light goes off (simulator).

y. Move IMV CONTROL switch (2A7) to AUTOMATIC; solenoid valve L2 energizes (audibly).

z. Turn rheostat knob (1A1) fully counter-clockwise and move POWER switch (1A1) to ON. Voltmeter and ammeter indicate zero.

aa. Move four-way valve switch (1A1) to START and hold. Voltmeter and ammeter (1A1) indicate zero.

ab. Turn rheostat knob (1A1) to INCREASE (clockwise) until voltmeter (1A1) indicates 25 ±1 vdc; the following events occur:

(1) Ammeter indicates 0.80 ±0.05 ampere (1A1).

(2) Solenoid valve L1 energizes (audibly).

(3) AUTO light comes on and MANUAL light goes off (2A7).

(4) OPEN light comes on and CLOSED light goes off (2A3).

(5) NO. 1 OPEN and NO. 2 OPEN lights come on; NO. 1 CLOSED and NO. 2 CLOSED lights go off (2A2).

(6) NO. 1 OPEN and NO. 2 OPEN lights come on; NO. 1 CLOSED and NO. 2 CLOSED lights go off (2A6).

(7) ENGINE CONTROL VALVE OPEN light comes on (simulator).

ac. Move four-way valve switch (1A1) to STOP and hold; the following events occur:

(1) Voltmeter indicates 25 ±1 vdc and ammeter indicates 0.55 ±0.05 ampere (1A1).

(2) Solenoid valve L1 deenergizes (audibly).

(3) MANUAL light on and AUTO light off (2A7).

(4) CLOSED light on and OPEN light off (2A3).

(5) NO. 1 CLOSED and NO. 2 CLOSED lights come on; NO. 1 OPEN and NO. 2 OPEN lights go off (2A2).

(6) NO. 1 CLOSED and NO. 2 CLOSED lights come on; NO. 1 OPEN and NO. 2 OPEN lights go off (2A6).

(7) ENGINE CONTROL VALVE CLOSED light comes on and ENGINE CONTROL VALVE OPEN light goes off (simulator).

ad. Move IMV CONTROL switch (2A7) to MANUAL; solenoid valve L2 deenergizes (audibly).

ae. Release four-way valve switch (1A1) to OFF; the following events occur:

(1) Voltmeter indicates 26 ±1 vdc and ammeter indicates zero (1A1).

(2) ENGINE CONTROL VALVE CLOSED light goes off (simulator).

af. Move LIGHT SWITCH and AC LINE switch (inside temperature recorder door) to ON (2A9); panel light comes on.

NOTE

The temperature recorder requires a five-minute warmup period before proceeding with step ag.

ag. Move MOTOR switch (temperature recorder) (2A9) to ON. Chart paper speed moves 30 inches per hour and channels 2 and 3 print ambient temperature. Ignore printout of channels 1, 4, 5, and 6.

ah. Using decade resistance box, connect test leads to receptacle 2J4, pin A, and to pins B and C (one lead to both pins B and C)(2A10). On units incorporating MD6 change, connect test leads to plug P106, pin R, and to pins E and D (one lead to both pins E and D) of cable 19-9026612.

ai. Set resistance values on decade resistance box and verify temperature recorder printout of channel 1 as follows:

(1) 394.82 ohms: 0° ±1° F

(2) 441.91 ohms: 50° ±1° F

(3) 488.60 ohms: 100° ±1° F

(4) 534.92 ohms: 150° ±1° F

(5) 580.85 ohms: 200° ±2° F

(6) 626.40 ohms: 250° ±2° F

(7) 671.56 ohms: 300° ±2° F

aj. Move MOTOR switch (temperature recorder) (2A9) to OFF; chart paper stops.

ak. Move LIGHT SWITCH and AC LINE switch (inside temperature recorder door) to OFF (2A9); panel light goes off.

al. Connect cable 19-9024131 to receptacle 2J9 (2A12) and receptacle 3J1 (recorder console).

am. Connect cable 19-9024132 to receptacle 2J10 (2A12) and receptacle 3J2 (recorder console).

an. Connect cable 19-9024133 to receptacle 2J11 (2A12) and receptacle 3J3 (recorder console).

ao. Turn event recorder on; channels 2, 4, 6, 8, 12, 15, and 16 indicate on condition.

ap. Lift guard and move GRD CHECKOUT switch (2A7) to ENGINE and hold. ENGINE light comes on, GROUND light goes off, and channels 2, 4, 6, 8, 12, 13, and 14 indicate on condition.

aq. Release GRD CHECKOUT switch (2A7) and close guard. GROUND light comes on, ENGINE light goes off, and channels 2, 4, 6, 8, 12, 15, and 16 indicate on condition.

ar. Move IMV CONTROL switch (2A7) to AUTOMATIC; solenoid valve L2 energizes (audibly) (2A7).

as. Move four-way valve switch (1A1) to START and hold; the following events occur:

(1) Voltmeter indicates 25 ±1 vdc and ammeter indicates 0.80 ±0.05 ampere (1A1).

(2) Solenoid valve L1 energizes (audibly) (2A7).

(3) AUTO light comes on and MANUAL light goes off (2A7).

(4) OPEN light comes on and CLOSED light goes off (2A3).

(5) NO. 1 OPEN and NO. 2 OPEN lights come on and NO. 1 CLOSED and NO. 2 CLOSED lights go off (2A2).

(6) NO. 1 OPEN and NO. 2 OPEN lights come on, and NO. 1 CLOSED and NO. 2 CLOSED lights go off (2A6).

(7) ENGINE CONTROL VALVE OPEN light comes on (simulator).

(8) Channels 1, 3, 5, 7, 10, 15, 16, and 17 indicate on condition.

at. Move four-way valve switch (1A1) to STOP and hold; the following events occur:

(1) Voltmeter indicates 25 ±1 vdc and ammeter indicates 0.55 ±0.05 ampere (1A1).

(2) Solenoid valve L1 deenergizes (audibly) (2A7).

(3) MANUAL light comes on and AUTO light goes off (2A7).

(4) CLOSED light comes on and OPEN light goes off (2A3).

(5) NO. 1 CLOSED and NO. 2 CLOSED lights come on, and NO. 1 OPEN and NO. 2 OPEN lights go off (2A2).

(6) NO. 1 CLOSED and NO. 2 CLOSED lights come on, and NO. 1 OPEN and NO. 2 OPEN lights go off (2A6).

(7) ENGINE CONTROL VALVE CLOSED light comes on and ENGINE CONTROL VALVE OPEN light goes off (simulator).

(8) Channels 2, 4, 6, 8, 12, 15, 16, and 18 indicate on condition.

au. Move four-way valve switch (1A1) to OFF; the following events occur:

(1) Voltmeter indicates 26 ±1 vdc and ammeter indicates zero (1A1).

(2) ENGINE CONTROL VALVE CLOSED light goes off (simulator).

(3) Channels 2, 4, 6, 8, 12, 15, and 16 indicate on condition.

av. Press REDUNDANT SHUTDOWN VALVE switch and hold; the following events occur:

(1) Voltmeter indicates 26 ±1 vdc and ammeter indicates 0.30 ±0.10 ampere (1A1).

(2) Channels, 2, 4, 6, 8, 12, 15, 16, and 19 indicate on condition.

aw. Release REDUNDANT SHUTDOWN VALVE switch; the following events occur:

(1) Voltmeter indicates 26 ±1 vdc and ammeter indicates zero ampere (1A1).

(2) Channels 2, 4, 6, 8, 12, 15, and 16 indicate on condition.

ax. Move IMV CONTROL switch (2A7) to MANUAL; solenoid valve L2 deenergizes (audibly) (2A7).

ay. Move control switch (2A3) to CLOSE; solenoid valve (2A3) energizes (audibly) and channels 2, 4, 6, 8, 11, 12, 15, and 16 indicate on condition.

az. Move control switch (2A3) to OFF; solenoid valve (2A3) deenergizes (audibly) and channels 2, 4, 6, 8, 12, 15, and 16 indicate on condition.

ba. Move control switch (2A3) to OPEN; solenoid valve (2A3) energizes (audibly) and channels 2, 4, 6, 8, 9, 12, 15, and 16 indicate on condition.

bb. Repeat step ax; turn event recorder off.

bc. Move POWER switch (1A1) to OFF and turn rheostat knob fully counterclockwise (1A1). Voltmeter and ammeter indicate zero (1A1).

bd. Press HYPERGOL CARTRIDGE switch-light (simulator); the following events occur:

(1) HYPERGOL CARTRIDGE INSTALLED light comes on (2A7).

(2) INSTALLED light comes on and NOT INSTALLED light goes off (simulator).

be. Press HYPERGOL CARTRIDGE switch-light (simulator); the following events occur:

(1) HYPERGOL CARTRIDGE INSTALLED light goes off (2A7).

(2) NOT INSTALLED light comes on and INSTALLED light goes off (simulator).

bf. Turn NO. 1 and NO. 2 FUEL VALVE POT and NO. 1 and NO. 2 OXIDIZER VALVE POT dials (simulator) counterclockwise until stop is reached.

bg. Turn oscillograph recorder on at speed of 4 inches per minute.

bh. Slowly turn NO. 1 FUEL VALVE POT dial (simulator) clockwise until stop is reached. NO. 1 MFV meter (2A6) indicates 45 ±5 microamperes and channel 1 trace deflection proportionally increases.

bi. Slowly turn NO. 1 FUEL VALVE POT dial (simulator) counterclockwise until stop is reached. NO. 1 MFV meter (2A6) indicates 5 ±5 microamperes and channel 1 trace deflection proportionally decreases.

bj. Slowly turn NO. 2 FUEL VALVE POT dial (simulator) clockwise until stop is reached. NO. 2 MFV meter (2A6) indicates 45 ±5 microamperes and channel 2 trace deflection proportionally increases.

bk. Slowly turn NO. 2 FUEL VALVE POT dial (simulator) counterclockwise until stop is reached. NO. 2 MFV meter (2A6) indicates 5 ±5 microamperes and channel 2 trace deflection proportionally decreases.

bl. Slowly turn NO. 1 OXIDIZER VALVE POT dial (simulator) clockwise until stop is reached. NO. 1 MLV meter (2A2) indicates 45 ±5 microamperes and channel 3 trace deflection proportionally increases.

bm. Slowly turn NO. 1 OXIDIZER VALVE POT dial (simulator) counterclockwise until stop is reached. NO. 1 MLV meter (2A2) indicates 5 ±5 microamperes and channel 3 trace deflection proportionally decreases.

bn. Slowly turn NO. 2 OXIDIZER VALVE POT dial (simulator) clockwise until stop is reached. NO. 2 MLV meter (2A2) indicates 45 ±5 microamperes and channel 4 trace deflection proportionally increases.

bo. Slowly turn NO. 2 OXIDIZER VALVE POT dial (simulator) counterclockwise until stop is reached. NO. 2 MLV meter (2A2) indicates 5 ±5 microamperes and channel 4 trace deflection proportionally decreases.

bp. Turn oscillograph off.

bq. Disconnect plug 2WP11 from receptacle 2J11 (2A12).

br. Install jumpers on receptacle 2J6, pins A and B and pins C and D (2A10).

bs. Install jumpers on receptacle 2J8, pins A and B and pins C and D (2A10).

bt. Using multimeter set for 50 vdc, connect test leads to receptacle 2J11 pin J (+) and pin K (-), then pin L (+) and pin M (-) (2A12). Meter indicates 28 ±1 vdc.

bu. Remove multimeter test leads and jumpers from pins of receptacles 2J6 and 2J8 (2A10) and reconnect plug 2WP11 removed in step bq.

bv. Remove F1 fuse (1A1) and install blown fuse in its place; the 5 AMP FUSE BLOWN light comes on.

bw. Replace blown fuse with good fuse; the 5 AMP FUSE BLOWN light goes out.

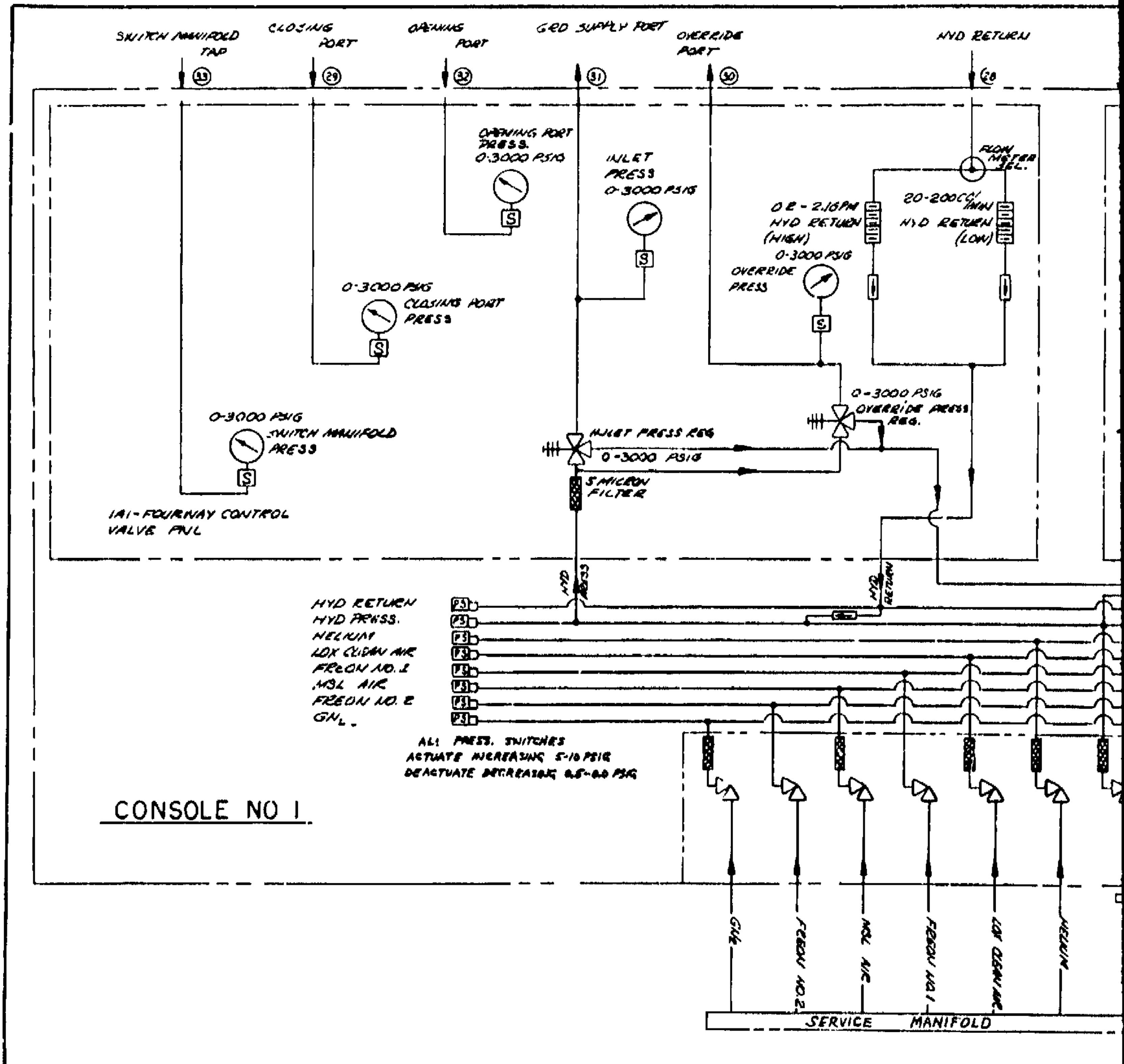
bx. Press HYD RETURN FLOW indicator POWER switch-light; the light comes on (2A1).

by. Leave MAIN POWER switch (1A8) on and CIRCUIT BREAKER 15 AMPS (2A9) pushed in for remaining tests.

5-18. GN_2 SYSTEM LEAK-TEST. (See figure 5-12 for pneumatic/hydraulic schematic.)

a. Connect a 5-micron filter to GN_2 inlet connection on SERVICE MANIFOLD; connect a source of gaseous nitrogen to filter.

b. Make sure gaseous nitrogen interconnect plumbing is installed between consoles No. 1 and No. 2.


SWITCH MANIFOLD TAP
CLOSING PORT
OPENING PORT
GRD SUPPLY PORT
OVERRIDE PORT
HYD RETURN
OPENING PORT PRESS. 0-3000 PSIG
INLET PRESS 0-3000 PSIG
0.2 - 2.1 GPM HYD RETURN (HIGH)
20-200CC/MIN HYD RETURN (LOW)
FLOW METER SEL.
0-3000 PSIG OVERRIDE PRESS
0-3000 PSIG CLOSING PORT PRESS
0-3000 PSIG OVERRIDE PRESS REG.
0-3000 PSIG SWITCH MANIFOLD PRESS
INLET PRESS REG 0-3000 PSIG
5 MICRON FILTER
1A1-FOURWAY CONTROL VALVE PNL
HYD PRESS
HYD RETURN
HYD RETURN
HYD PRESS.
HELIUM
LOX CLEAN AIR
FREON NO. 1
MSL AIR
FREON NO. 2
GN_2
ALL PRESS. SWITCHES ACTUATE INCREASING 5-10 PSIG DEACTUATE DECREASING 0.5-0.0 PSIG
CONSOLE NO I
GN_2
FREON NO.2
MSL AIR
FREON NO.1
LOX CLEAN AIR
HELIUM
SERVICE MANIFOLD

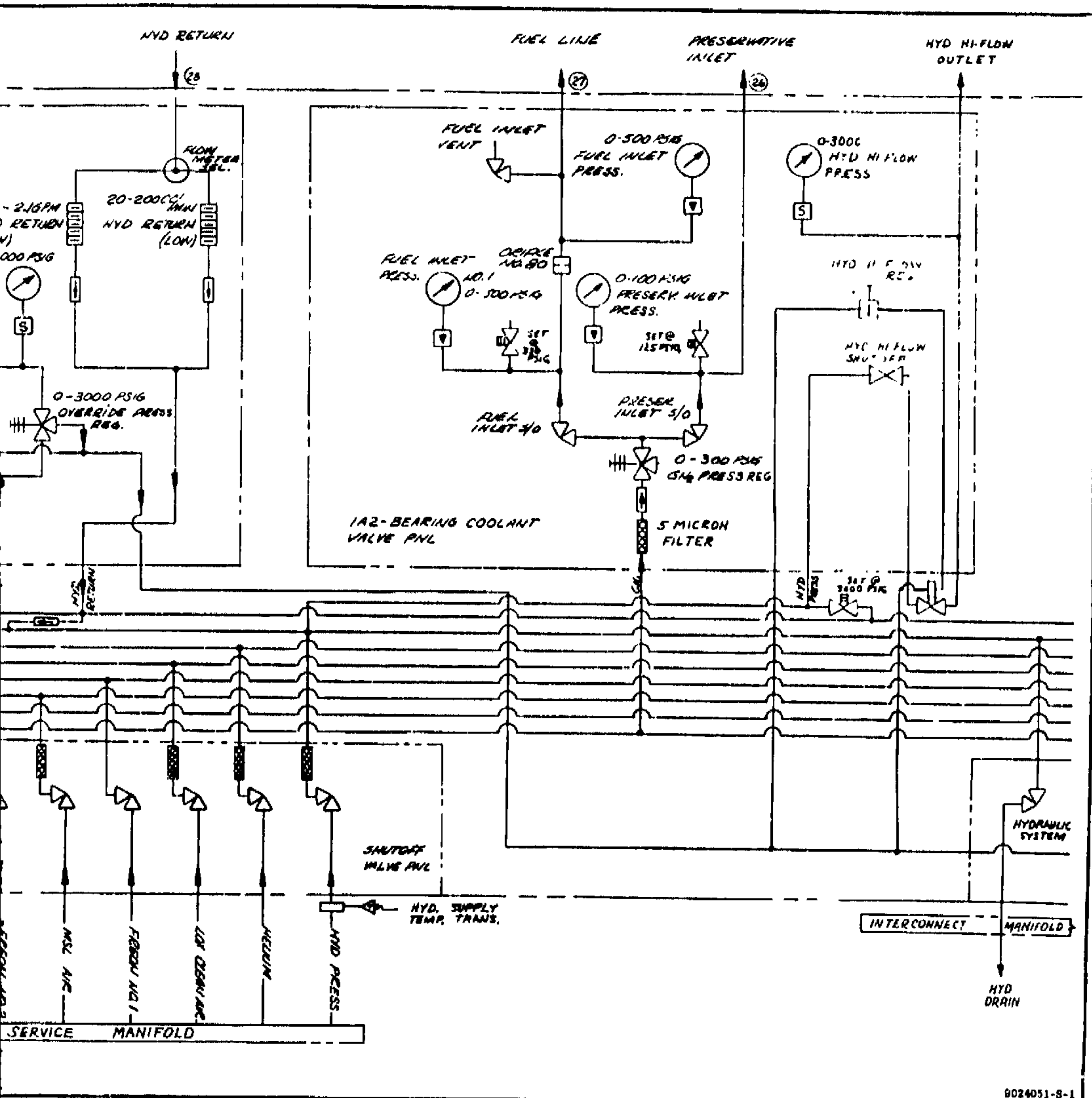


Figure 5-12. Pneumatic/Hydraulic Schematic (Sheet 1 of 4)

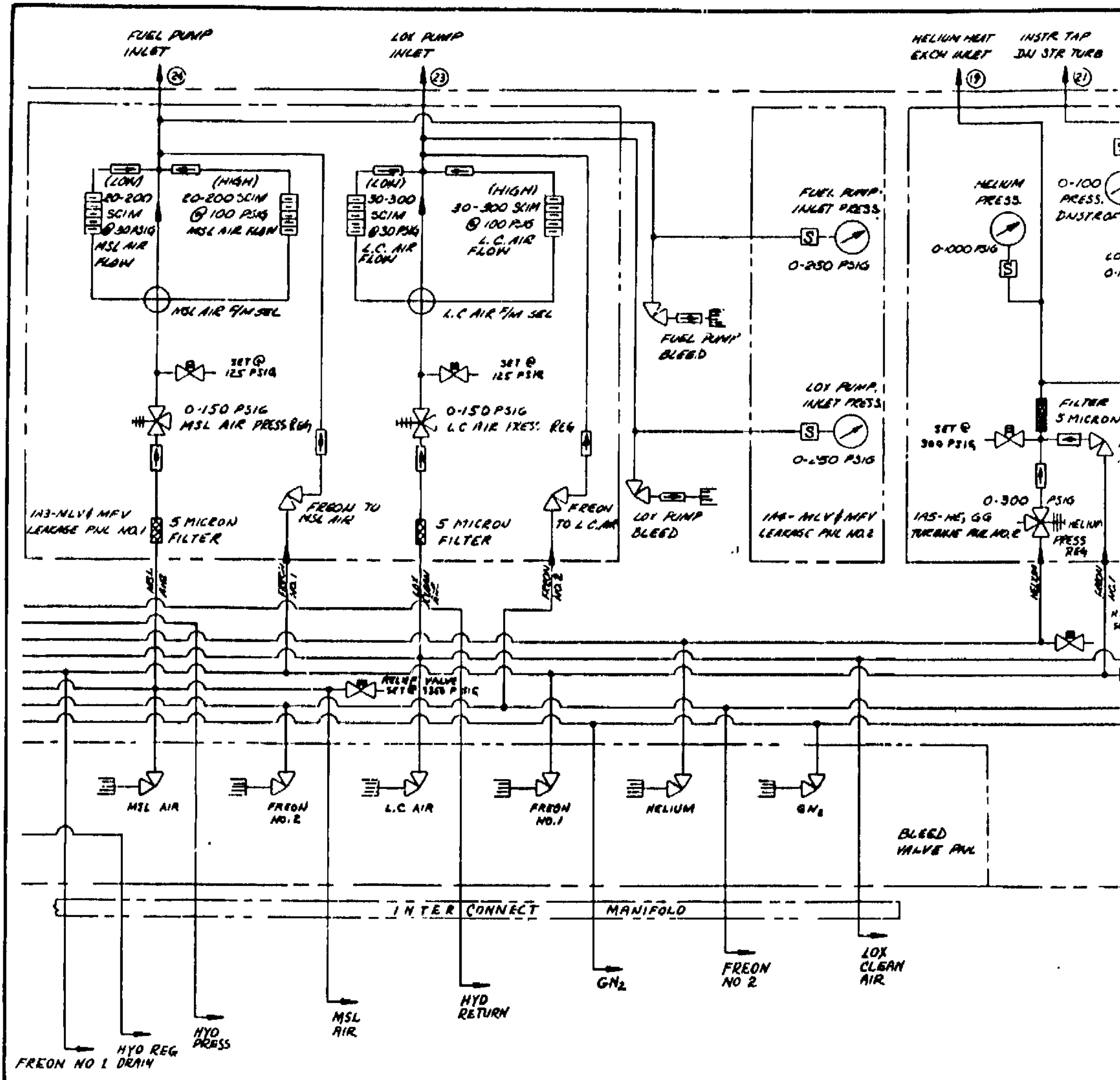
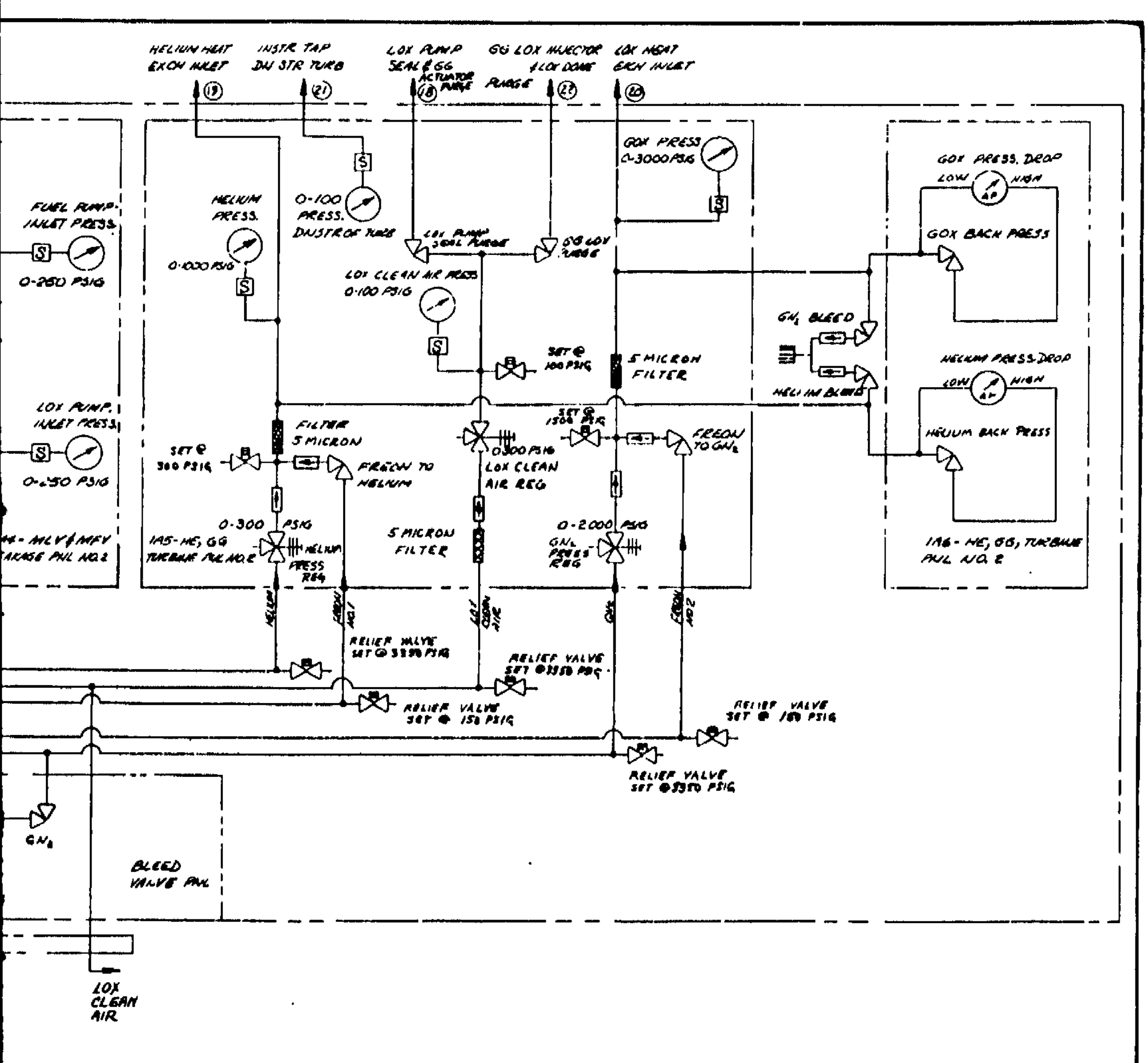
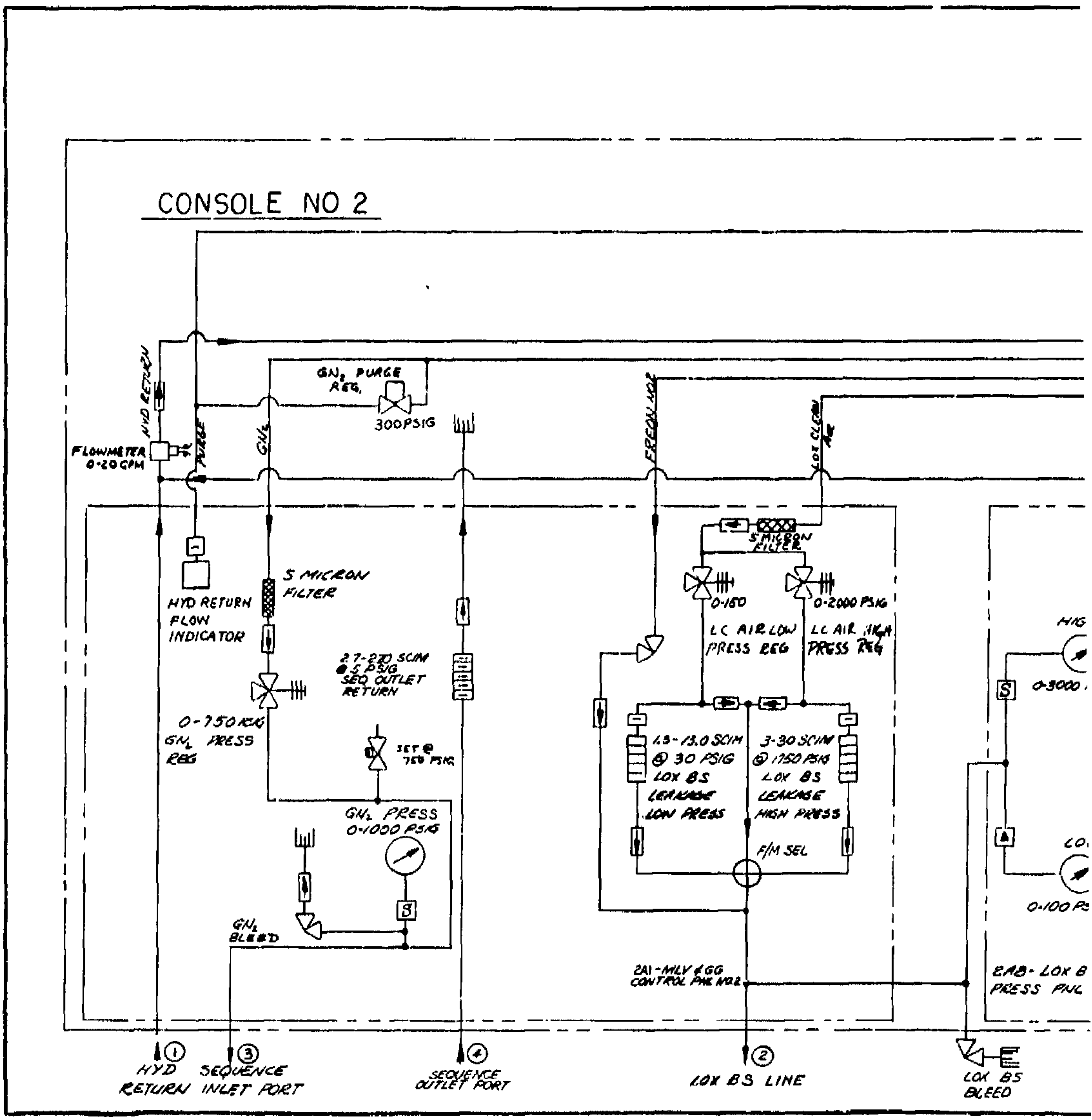


Figure 5-12. Pneumatic/Hydraulic Schematic (Sheet 2 of 4)


HELIUM HEAT EXCH INLET
INSTR TAP DN STR TURB
LOX PUMP SEAL & GG ACTUATOR PURGE
GG LOX INJECTOR & LOX DOME PURGE
LOX HEAT EXCH INLET
GOX PRESS 0-3000 PSIG
GOX PRESS. DROP
LOW
HIGH
GOX BACK PRESS
FUEL PUMP INLET PRESS.
0-250 PSIG
HELIUM PRESS.
0-1000 PSIG
0-100 PRESS. DNSTR OF TURB
LOX PUMP SEAL PURGE
GG LOX PURGE
LOX CLEAN AIR PRESS 0-100 PSIG
SET @ 100 PSIG
5 MICRON FILTER
GN₂ BLEED
HELIUM BLEED
HELIUM PRESS DROP
HELIUM BACK PRESS
LOX PUMP INLET PRESS.
0-250 PSIG
FILTER 5 MICRON
SET @ 300 PSIG
FREON TO HELIUM
0-300 PSIG LOX CLEAN AIR REG
SET @ 1500 PSIG
FREON TO GN₂
0-300 PSIG
1A5-HE, GG TURBINE PNL NO. 2
HELIUM PRESS REG
5 MICRON FILTER
0-2000 PSIG
GN₂ PRESS REG
1A6-HE, GG, TURBINE PNL NO. 2
MLV & MFV LEAKAGE PNL NO. 2
HELIUM
FREON NO 1
LOX CLEAN AIR
GN₂
FREON NO 2
RELIEF VALVE SET @ 3350 PSIG
RELIEF VALVE SET @ 3350 PSIG
RELIEF VALVE SET @ 150 PSIG
RELIEF VALVE SET @ 150 PSIG
RELIEF VALVE SET @ 3350 PSIG
GN₂
BLEED VALVE PNL
LOX CLEAN AIR

9024051-S-2



CONSOLE NO 2
HYD RETURN
FLOWMETER 0-20 GPM
PURGE
GN2
GN2 PURGE REG.
300 PSIG
FREON NO2
LOX CLEAN AIR
HYD RETURN FLOW INDICATOR
5 MICRON FILTER
2.7-270 SCIM @ 5 PSIG SEQ OUTLET RETURN
0-750 PSIG GN2 PRESS REG
SET @ 750 PSIG
GN2 PRESS 0-1000 PSIG
GN2 BLEED
5 MICRON FILTER
0-150
0-2000 PSIG
LC AIR LOW PRESS REG
LC AIR HIGH PRESS REG
1.5-15.0 SCIM @ 30 PSIG LOX BS LEAKAGE LOW PRESS
3-30 SCIM @ 1750 PSIG LOX BS LEAKAGE HIGH PRESS
F/M SEL
2A1-MLV & GG CONTROL PNL NO.2
2A8-LOX B PRESS PNL
0-3000
0-100
1 HYD RETURN
3 SEQUENCE INLET PORT
4 SEQUENCE OUTLET PORT
2 LOX BS LINE
LOX BS BLEED

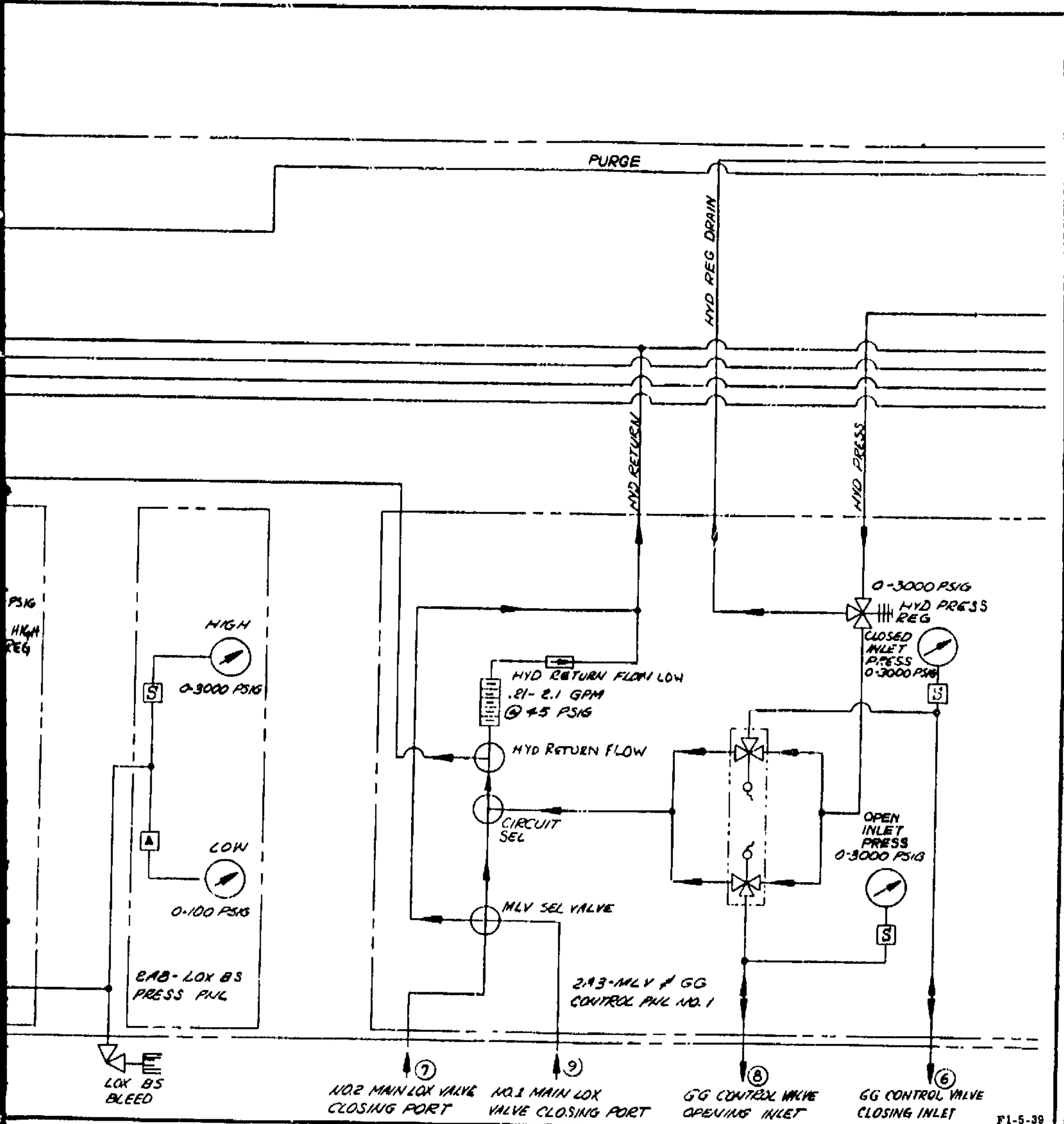


Figure 5-12. Pneumatic/Hydraulic Schematic (Sheet 3 of 4)

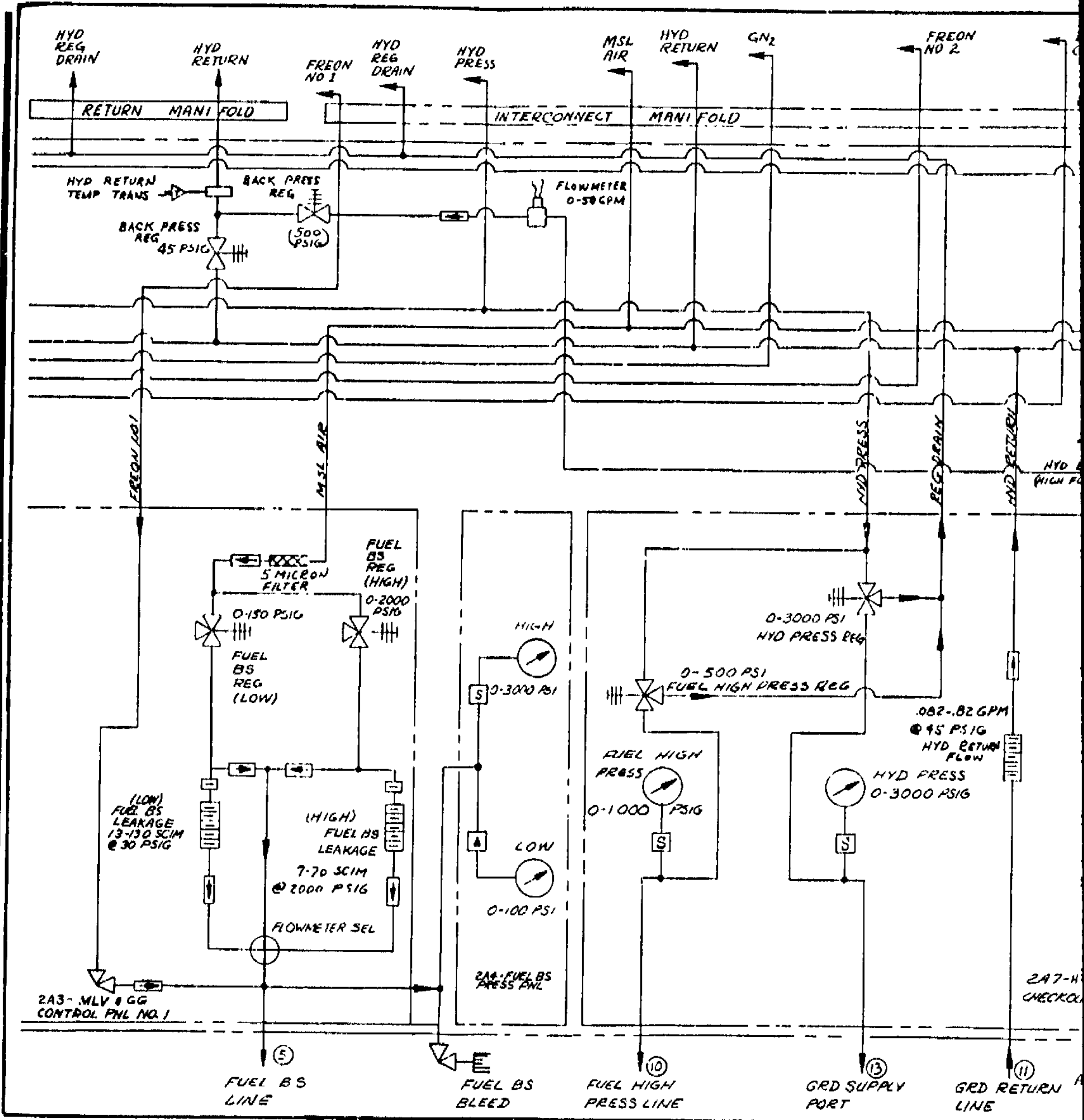
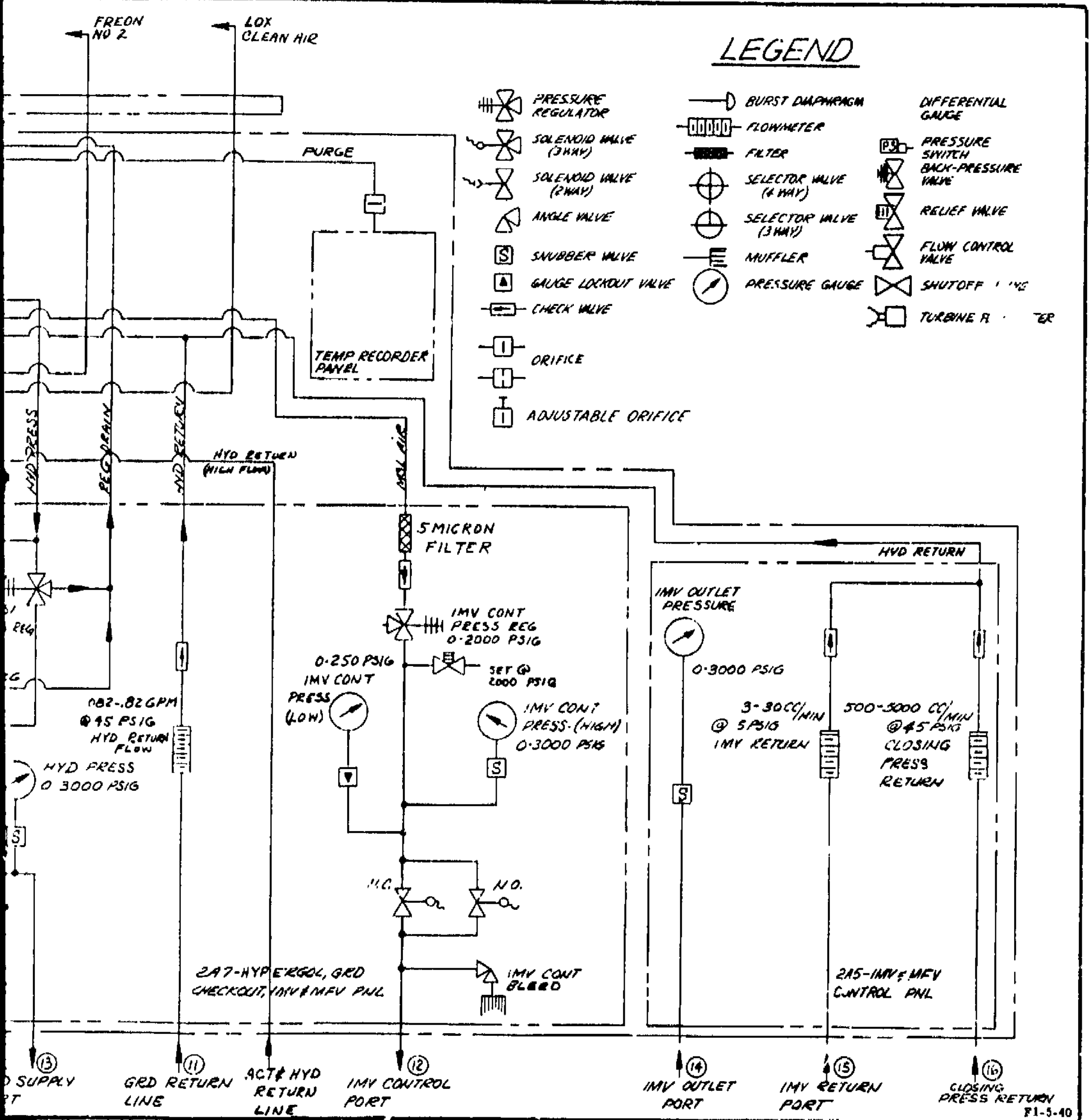


Figure 5-12. Pneumatic/Hydraulic Schematic (Sheet 4 of 4)


FREON NO 2
LOX CLEAN AIR
LEGEND
PRESSURE REGULATOR
SOLENOID VALVE (3 WAY)
SOLENOID VALVE (2 WAY)
ANGLE VALVE
SNUBBER VALVE
GAUGE LOCKOUT VALVE
CHECK VALVE
ORIFICE
ADJUSTABLE ORIFICE
BURST DIAPHRAGM
FLOWMETER
FILTER
SELECTOR VALVE (4 WAY)
SELECTOR VALVE (3 WAY)
MUFFLER
PRESSURE GAUGE
DIFFERENTIAL GAUGE
PRESSURE SWITCH
BACK-PRESSURE VALVE
RELIEF VALVE
FLOW CONTROL VALVE
SHUTOFF
TURBINE
PURGE
TEMP RECORDER PANEL
HYD PRESS
REG DRAIN
HYD RETURN
HYD RETURN (HIGH FLOW)
5 MICRON FILTER
HYD RETURN
IMV CONT PRESS REG 0-2000 PSIG
SET @ 2000 PSIG
0-250 PSIG IMV CONT PRESS (LOW)
IMV CONT PRESS (HIGH) 0-3000 PSIG
IMV OUTLET PRESSURE
0-3000 PSIG
3-30 CC/MIN @ 5 PSIG IMV RETURN
500-5000 CC/MIN @ 45 PSIG CLOSING PRESS RETURN
.082-.82 GPM @ 45 PSIG HYD RETURN FLOW
HYD PRESS 0 3000 PSIG
N.C.
N.O.
IMV CONT BLEED
2A7-HYPERGOL, GRD CHECKOUT, IMV & MFV PNL
2A5-IMV & MFV CONTROL PNL
13 SUPPLY
11 GRD RETURN LINE
ACT & HYD RETURN LINE
12 IMV CONTROL PORT
14 IMV OUTLET PORT
15 IMV RETURN PORT
16 CLOSING PRESS RETURN
F1-5-40

c. Install pressure caps on FUEL LINE and PRESERVATIVE INLET (1A2), LOX HT EXCH INLET (1A5), SEQUENCE INLET PORT (2A1), and SEQUENCE OUTLET PORT (2A1).

d. Install a 0-5 psi pressure gage in HYD RETURN FLOW indicator (2A1) purge line upstream of relief valve.

e. Install a 0-5 psi pressure gage in temperature recorder (2A9) GN_2 purge line upstream of relief valve.

f. Make sure GOX BACK PRESS. valve (1A6) is open and all remaining console valves are closed.

g. Slowly apply 3,000 ±200 psig gaseous nitrogen to console.

h. Open GN_2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL). GN_2 PRESS ON light (1A7) comes on.

i. Check pressure gages in GN_2 purge lines at HYD RETURN FLOW indicator and temperature recorder. Purge pressure must not exceed one psig.

CAUTION

Depressurize GN_2 system immediately if purge system pressure exceeds one psig, since damage to hydraulic flow indicator and temperature recorder will result from excessive purge pressure.

j. Apply leak-test compound to all pressurized lines and connections between GN_2 inlet connection on SERVICE MANIFOLD and panels 1A2, 1A5, 1A6, 2A1, and MANIFOLD BLEED PANEL. No leakage is allowable.

k. Open PRESERVATIVE INLET S/O valve (1A2); slowly open GN_2 PRESS REG until 90 ±10 psi is indicated on PRESERVATIVE INLET PRESS gage (1A2).

l. Apply leak-test compound to all pressurized lines and connections downstream of GN_2 PRESS REG. No leakage is allowable.

m. Close GN_2 PRESS REG (1A2) and open FUEL INLET S/O and FUEL INLET VENT valves to reduce pressure to zero.

n. Close PRESERVATIVE INLET S/O and FUEL INLET VENT valves. Slowly open GN_2 PRESS REG until 300 ±10 psi is indicated on FUEL INLET PRESS NO. 1 and FUEL INLET PRESS NO. 2 gages (1A2).

o. Apply leak-test compound to all pressurized lines and connections downstream of GN_2 PRESS REG. No leakage is allowable.

p. Close GN_2 PRESS REG (1A2) and open FUEL INLET VENT valve to reduce pressure to zero. Close FUEL INLET S/O and FUEL INLET VENT valves.

q. Open GN_2 PRESS REG (1A5) until 1,400 ±50 psi is indicated on GOX PRESS gage.

r. Apply leak-test compound to all pressurized lines and connections downstream of GN_2 PRESS REG. No leakage is allowable.

s. Close GOX BACK PRESS. valve (1A6) and GN_2 PRESS REG (1A5).

t. Open GN_2 BLEED valve; GOX PRESS gage (1A5) indicates zero and GOX PRESS. DROP gage (1A6) indicates 6 psi.

u. Open GOX BACK PRESS. valve (1A6); GOX PRESS. DROP gage indicates 0 ±0.5 psi.

v. Close GN_2 BLEED valve.

w. Remove pressure caps from SEQUENCE INLET PORT (2A1) and SEQUENCE OUTLET PORT (2A1). Interconnect the 2 ports with a pneumatic needle valve installed in line. Close needle valve.

x. Open GN_2 PRESS REG (2A1) until 700 ±20 psi is indicated on GN_2 PRESS gage.

y. Apply leak-test compound to all pressurized lines and connections downstream of GN_2 PRESS REG. No leakage is allowable.

z. Open pneumatic needle valve (2A1) to adjust flow from 2.7 to 27.0 scim, as indicated on SEQ OUTLET RETURN flowmeter (2A1).

NOTE

The flowmeter reading is determined on the tube scale at the highest and widest portion of the float. To obtain correct scim reading (standard cubic inches per minute), use correction curves supplied with each flowmeter.

aa. Apply leak-test compound to all pressurized lines and connections downstream of pneumatic needle valve (2A1). No leakage is allowable.

ab. Close GN_2 PRESS REG (2A1) and open GN_2 BLEED valve to reduce pressure to zero. Close GN_2 BLEED valve and pneumatic needle valve.

ac. Reduce gaseous nitrogen source pressure to zero and open GN_2 bleed valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. GN_2 PRESS ON light (1A7) goes off.

ad. Close GN_2 bleed valve (MANIFOLD BLEED PANEL) and close GN_2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

ae. Remove source of gaseous nitrogen and filter from GN_2 inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

af. Remove pneumatic needle valve and lines from SEQUENCE INLET PORT and SEQUENCE OUTLET PORT (2A1); pressure-cap ports.

5-19. HELIUM SYSTEM LEAK-TEST.

a. Connect a 5-micron filter to HELIUM inlet connection (SERVICE MANIFOLD). Connect a source of helium to filter.

b. Install a pressure cap on HELIUM HT EXCH INLET (1A5).

c. Make sure HELIUM BACK PRESS. valve (1A6) is open and all remaining valves are closed.

d. Slowly apply 3,000 ±200 psig helium to console.

e. Open HELIUM shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL); HELIUM PRESS ON light (1A7) comes on.

f. Apply leak-test compound to all pressurized lines and connections between HELIUM inlet connection on SERVICE MANIFOLD and panels 1A5, 1A6, and MANIFOLD BLEED PANEL. No leakage is allowable.

g. Slowly open HELIUM PRESS REG (1A5) until 250 ±25 psi is indicated on HELIUM PRESS gage.

h. Apply leak-test compound to all pressurized lines downstream of HELIUM PRESS REG. No leakage is allowable.

i. Close HELIUM BACK PRESS. valve (1A6) and HELIUM PRESS REG (1A5).

j. Open HELIUM BLEED valve (HELIUM/GN_2 BLEED); HELIUM PRESS. DROP gage (1A6) indicates 6 psi.

k. Open HELIUM BACK PRESS. valve (1A6); HELIUM PRESS. DROP gage indicates 0 ±0.5 psi.

l. Close HELIUM BLEED valve (HELIUM/GN_2 BLEED).

m. Reduce helium source pressure to zero and open HELIUM bleed valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero; HELIUM PRESS ON light (1A7) goes off.

n. Close HELIUM bleed valve (MANIFOLD BLEED PANEL) and close HELIUM shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

o. Remove source of helium and filter from HELIUM inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-20. LOX-CLEAN AIR SYSTEM LEAK-TEST.

a. Connect a 5-micron filter to LOX CLEAN AIR inlet connection on SERVICE MANIFOLD and connect a source of LOX-clean air to filter.

b. Make sure LOX-clean interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on LOX PUMP INLET (1A3), LOX PUMP SEAL & GG ACTUATOR PURGE, and GG LOX INJECTOR & LOX DOME PURGE (1A5), and LOX BS LINE (2A1).

d. Connect GG LOX INJECTOR & LOX DOME PURGE outlet with INSTR TAP DNSTR OF TURB outlet (1A5).

e. Slowly apply 3,000 ±200 psig LOX-clean air to console.

f. Open L. C. AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL); LOX CLEAN AIR ON light (1A7) comes on.

g. Apply leak-test compound to all pressurized lines and connections between L. C. AIR inlet connection on SERVICE MANIFOLD and panels 1A3, 1A5, 2A1, and MANIFOLD BLEED PANEL. No leakage is allowable.

h. Move L. C. AIR F/M SEL handle (1A3) to LOW position. Open L. C. AIR PRESS REG until 30 (+3, -0) psi is indicated on LOX PUMP INLET PRESS gage (1A4).

i. Apply leak-test compound to all pressurized lines and connections downstream of L. C. AIR PRESS REG. No leakage is allowable.

j. Move L. C. AIR F/M SEL handle (1A3) to HIGH position. Open L. C. AIR PRESS REG until 100 (+10, -0) psi is indicated on LOX PUMP INLET PRESS gage (1A4).

k. Apply leak-test compound to all pressurized lines and connections downstream of L. C. AIR PRESS REG. No leakage is allowable.

l. Move L. C. AIR F/M SEL handle (1A3) to BY-PASS position and close L. C. AIR PRESS REG.

m. Slowly open LOX PUMP BLEED valve (MANIFOLD BLEED PANEL) to reduce pressure to zero; close LOX PUMP BLEED valve.

n. Open GG LOX PURGE and LOX PUMP SEAL PURGE valves (1A5). Open L. C. AIR PRESS REG until 80 ±10 psi is indicated on LOX CLEAN AIR PRESS and PRESS DNSTR OF TURB gages.

o. Apply leak-test compound to all pressurized lines and connections downstream of L. C. AIR PRESS REG. No leakage is allowable.

p. Close L. C. AIR PRESS REG (1A5) to reduce pressure to zero and close GG LOX PURGE and LOX PUMP SEAL PURGE valves.

q. Move FLOWMETER SEL handle (2A1) to LOW position. Open L. C. AIR LOW PRESS REG until 30 (+3, -0) is indicated on LOW pressure gage (2A8).

r. Apply leak-test compound to all pressurized lines and connections downstream of L. C. AIR LOW PRESS REG. No leakage is allowable.

s. Move FLOWMETER SEL handle (2A1) to BY-PASS position. Close L. C. AIR LOW PRESS REG.

t. Move FLOWMETER SEL handle (2A1) to HIGH position. Open L. C. AIR HIGH PRESS REG until 120 +10 psi is indicated on HIGH pressure gage (2A8); LOW pressure gage (2A8) lockout valve actuates at 100 ±5 psig.

u. Open L. C. AIR HIGH PRESS REG until 1,750 (+20, -0) psi is indicated on HIGH pressure gage (2A8).

v. Apply leak-test compound to all pressurized lines and connections downstream of L. C. AIR PRESS REG. No leakage is allowable.

w. Move FLOWMETER SEL handle (2A1) to BY-PASS position. Close L. C. AIR HIGH PRESS REG.

x. Slowly open valve on LOX B.S. BLEED panel. Move FLOWMETER SEL handle (2A1) to HIGH position and then LOW position as required, to reduce pressure to zero.

y. Move FLOWMETER SEL handle (2A1) to BY-PASS position and close valve on LOX B.S. BLEED panel.

z. Reduce LOX-clean air source pressure to zero. Open L. C. AIR valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero; LOX CLEAN AIR ON light (1A7) goes off.

aa. Close L. C. AIR valve (MANIFOLD BLEED PANEL) and close L. C. AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

ab. Remove source of LOX-clean air and filter from LOX CLEAN AIR inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-21. MISSILE AIR SYSTEM LEAK-TEST.

a. Connect a 5-micron filter to MSL AIR inlet connection on SERVICE MANIFOLD and connect a source of missile air to filter.

b. Make sure missile air interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on FUEL PUMP INLET (1A3), FUEL BS LINE (2A3), and IMV CONT PORT (2A7).

d. Slowly apply 3,000 ±200 psig missile air to console.

e. Open MSL AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL); MISSILE AIR ON light (1A7) comes on.

f. Apply leak-test compound to all pressurized lines and connections between MSL AIR inlet connection (SERVICE MANIFOLD), MANIFOLD BLEED PANEL, and panels 1A3, 2A3, and 2A7. No leakage is allowable.

g. Move MSL AIR F/M SEL handle (1A3) to LOW position. Open MSL AIR PRESS REG until 30 (+3, -0) psi is indicated on FUEL PUMP INLET PRESS gage (1A4).

h. Apply leak-test compound to all pressurized lines and connections downstream of MSL AIR PRESS REG. No leakage is allowable.

i. Move MSL AIR F/M SEL handle (1A3) to HIGH position. Open MSL AIR PRESS REG until 100 (+10, -0) psi is indicated on FUEL PUMP INLET PRESS gage (1A4).

j. Apply leak-test compound to all pressurized lines and connections downstream of MSL AIR PRESS REG. No leakage is allowable.

k. Move MSL AIR F/M SEL handle (1A3) to BY-PASS position and close MSL AIR PRESS REG.

l. Slowly open FUEL PUMP BLEED valve (MANIFOLD BLEED PANEL) to reduce pressure to zero; close FUEL PUMP BLEED valve.

m. Move F/M SEL handle (2A3) to LOW position. Open FUEL BS REG LOW until 30 (+3, -0) psi is indicated on LOW pressure gage (2A4).

n. Apply leak-test compound to all pressurized lines and connections downstream of FUEL BS REG LOW. No leakage is allowable.

o. Move F/M SEL handle (2A3) to BY-PASS position and close FUEL BS REG LOW.

p. Move F/M SEL handle (2A3) to HIGH position. Open FUEL BS REG HIGH until 120 ±10 psi is indicated on HIGH pressure gage (2A4); LOW pressure gage (2A4) lockout valve actuates at 100 ±5 psig.

q. Open FUEL BS REG HIGH until 2,000 (+20, -0) psi is indicated on HIGH pressure gage (2A4).

r. Apply leak-test compound to all pressurized lines and connections downstream of FUEL BS REG HIGH. No leakage is allowable.

s. Move F/M SEL handle (2A3) to BY-PASS position and close FUEL BS REG HIGH.

t. Slowly open valve (FUEL B. S. BLEED). Move F/M SEL handle (2A3) to HIGH position and then LOW position as required, to reduce pressure to zero.

u. Move F/M SEL handle (2A3) to BY-PASS position and close valve (FUEL B.S. BLEED).

v. Slowly open IMV CONT PRESS REG (2A7) until 280 ±10 psi is indicated on IMV CONT PRESS HIGH gage; IMV CONT PRESS LOW gage (2A7) lockout valve actuates at 260 (+0, -10) psig.

w. Open IMV CONT PRESS REG until 1,750 (+150, -0) is indicated on IMV CONT PRESS HIGH gage (2A7).

x. Apply leak-test compound to all pressurized lines and connections downstream of IMV CONT PRESS REG. No leakage is allowable.

y. Close IMV CONT PRESS REG. Open IMV CONTROL BLEED valve to reduce pressure to zero; close IMV CONTROL BLEED valve (2A7).

z. Reduce missile air source pressure to zero. Open MSL AIR valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. MISSILE AIR ON light (1A7) goes off.

aa. Close MSL AIR valve (MANIFOLD BLEED PANEL) and close MSL AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF PANEL).

ab. Remove source of missile air and filter from MSL AIR inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-22. FREON SYSTEM LEAK-TEST.

a. Connect 5-micron filters to both FREON NO. 1 and FREON NO. 2 inlet connections (SERVICE MANIFOLD). Connect a common source of gaseous nitrogen to filters.

b. Make sure FREON NO. 1 and NO. 2 interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on FUEL PUMP INLET and LOX PUMP INLET (1A3), HELIUM HT EXCH INLET and LOX HT EXCH INLET (1A5), LOX BS LINE (2A1), and FUEL BS LINE (2A3).

d. Slowly apply 110 ±10 psig gaseous nitrogen to console.

e. Open FREON NO. 1 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL). NO. 1 FREON PRESS ON light (1A7) comes on.

f. Open FREON NO. 2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL). NO. 2 FREON PRESS ON light (1A7) comes on.

g. Apply leak-test compound to all pressurized lines and connections between freon inlet connections on SERVICE MANIFOLD and panels 1A3, 1A5, 2A1, and 2A3. No leakage is allowable.

h. Move MSL AIR F/M SEL handle (1A3) to HIGH position. Open FREON TO MSL AIR valve; FUEL PUMP INLET PRESS gage (1A4) indicates 110 ±10 psi.

i. Apply leak-test compound to all pressurized lines and connections downstream of FREON TO MSL AIR valve (1A3). No leakage is allowable.

j. Close FREON TO MSL AIR valve (1A3). Open FUEL PUMP BLEED valve (MANIFOLD BLEED PANEL) to reduce pressure to zero.

k. Move MSL AIR F/M SEL handle (1A3) to the BY-PASS position and close FUEL PUMP BLEED valve (MANIFOLD BLEED PANEL).

l. Move L. C. AIR F/M SEL handle (1A3) to HIGH position. Open FREON TO L. C. AIR valve; LOX PUMP INLET PRESS gage (1A4) indicates 110 ±10 psi.

m. Apply leak-test compound to all pressurized lines and connections downstream of FREON TO L. C. AIR valve (1A3). No leakage is allowable.

n. Close FREON TO L. C. AIR valve (1A3). Open LOX PUMP BLEED valve (MANIFOLD BLEED PANEL) to reduce pressure to zero.

o. Move L. C. AIR F/M SEL handle (1A3) to BY-PASS position and close LOX PUMP BLEED valve (MANIFOLD BLEED PANEL).

p. Open FREON TO HELIUM valve (1A5); HELIUM PRESS gage (1A3) indicates 110 ±10 psi.

q. Apply leak-test compound to all pressurized lines and connections downstream of FREON TO HELIUM valve (1A5). No leakage is allowable.

r. Close FREON TO HELIUM valve (1A5). Open HELIUM BLEED valve to reduce pressure to zero; close HELIUM BLEED valve.

s. Open FREON TO GN_2 valve (1A5); GOX PRESS gage (1A3) indicates 110 ±10 psi.

t. Apply leak-test compound to all pressurized lines and connections downstream of FREON TO GN_2 valve (1A5). No leakage is allowable.

u. Close FREON TO GN_2 valve (1A5). Open GN_2 BLEED valve to reduce pressure to zero. Close GN_2 BLEED valve.

v. Move FLOWMETER SEL handle (2A1) to HIGH position. Open FREON TO LOX B. S. valve. HIGH pressure gage (2A8) indicates 110 ±10 psi; LOW pressure gage (2A8) indicates 105 ±5 psi.

w. Apply leak-test compound to all pressurized lines and connections downstream of FREON TO LOX B. S. valve (2A1). No leakage is allowable. Open valve on LOX B. S. BLEED panel to reduce pressure to zero.

x. Move FLOWMETER SEL handle (2A1) to BY-PASS position and close valve on LOX B. S. BLEED panel.

y. Move F/M SEL handle (2A3) to HIGH position. Open FREON TO FUEL B. S. valve. HIGH pressure gage (2A4) indicates 110 ±10 psi; LOW pressure gage (2A4) indicates 105 ±5 psi.

z. Apply leak-test compound to all pressurized lines and connections downstream of FREON TO FUEL B. S. valve (2A3). No leakage is allowable.

aa. Close FREON TO FUEL B. S. valve (2A3) and open valve on FUEL B. S. BLEED panel to reduce pressure to zero.

ab. Move F/M SEL handle (2A3) to BY-PASS position and close valve on FUEL B. S. BLEED panel.

ac. Reduce gaseous nitrogen source pressure to zero. Open FREON NO. 1 valve and FREON NO. 2 valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero; NO. 1 FREON PRESS ON light and NO. 2 FREON PRESS ON light go off.

ad. Close the following valves:

(1) FREON NO. 1 and FREON NO. 2 shut-off valves (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

(2) FREON NO. 1 and FREON NO. 2 valves (MANIFOLD BLEED PANEL).

ae. Remove source of gaseous nitrogen and filters from FREON NO. 1 and FREON NO. 2 inlet connections (SERVICE MANIFOLD); pressure-cap inlets.

5-23. HYDRAULIC SYSTEM LEAK-TEST. The temperature of the test fluid must not be less than 35° or more than 125° F any time during testing. See figure 5-2 for the hydraulic requirements and figure 5-12 for the pneumatic/hydraulic schematic.

a. Connect a 5-micron filter to HYD PRESS connection (SERVICE MANIFOLD) and connect a facility hydraulic supply to the filter.

b. Make sure hydraulic interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Connect a line from HYD DRAIN connection (INTERCONNECT MANIFOLD, console No. 1) to supply reservoir.

d. Connect a line from HYD REG DRAIN (RETURN MANIFOLD) to supply reservoir.

e. Connect a line from HYD RETURN (RETURN MANIFOLD) to supply reservoir.

f. Install pressure cap on HYD HI. FLOW OUTLET (1A2).

g. Install pressure caps on FUEL HIGH PRESS LINE and GRD SUPPLY PORT (2A7).

h. Connect a line from OVERRIDE PORT to OPENING PORT; connect a line from GRD SUPPLY PORT to both CLOSING PORT and SWITCH MANIF TAP (1A1).

i. Check that hydraulic high-flow regulator, located at the rear and below panel (1A1), is fully open (adjustment fully clockwise).

j. Close all regulators, shutoff valves, and bleed valves, and position selector valves to BY-PASS, OFF, or CL.

k. Check that MAIN POWER switch is ON (1A8) and CIRCUIT BREAKER 15 AMPS (2A9) is pushed in.

l. Move LIGHT SWITCH and AC LINE switch (2A9), located inside temperature recorder door, to on; panel light comes on.

m. Move MOTOR switch of temperature recorder to ON (2A9). Channel 2 indicates hydraulic fluid inlet temperature and channel 3 indicates hydraulic fluid return temperature. Ignore printout of channels 1, 4, 5, and 6.

n. Slowly increase facility hydraulic supply pressure in 500-psig increments, to 2,600 ±200 psig. Check for leakage from SERVICE MANIFOLD to MANIFOLD PRESSURE SHUT-OFF VALVE PANEL. No leakage is allowable.

o. Slowly open HYDRAULIC PRESSURE valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL); HYD PRESS ON light comes on and GROUND light goes off (1A7).

p. Lift guard on GRD CHECKOUT switch (2A7); move switch to ENGINE position and hold. GROUND light goes off and ENGINE light remains off (2A7).

q. Release GRD CHECKOUT switch (2A7) and close switch guard. GROUND light comes on.

r. Check for leakage from SERVICE MANIFOLD to INLET PRESS REG and OVERRIDE PRESS REG (1A1), HYD HI FLOW SHUT-OFF (1A2), HYDRAULIC SYSTEM (MANIFOLD BLEED PANEL), HYD PRESS REG (2A3), and HYD PRESS REG and FUEL HIGH PRESS REG (2A7). No leakage is allowable.

s. Slowly open INLET PRESS REG in 500-psig increments, holding each increment for one minute, until INLET PRESS, CLOSING PORT PRESS, and SWITCH MANIFOLD PRESS gages indicate 2,200 ±100 psi (1A1). Check for leakage downstream of regulator. No leakage is allowable.

t. Close INLET PRESS REG; INLET PRESS, CLOSING PORT PRESS, and SWITCH MANIFOLD PRESS gages decrease to zero (1A1).

u. Slowly open OVERRIDE PRESS REG in 500-psig increments, holding each increment for one minute, until OVERRIDE PRESS and OPENING PORT PRESS gages indicate 2,200 ±100 psi (1A1). Check for leakage downstream of regulator. No leakage is allowable.

v. Close OVERRIDE PRESS REG; OVERRIDE PRESS and OPENING PORT PRESS gages decrease to zero (1A1).

w. Slowly open HYD HI-FLOW SHUTOFF valve. Slowly open HYD HI-FLOW REG in 500-psig increments, holding each increment for one minute, until HYD HI-FLOW PRESS gage indicates 2,200 ±100 psi (1A2). Check for leakage downstream of shutoff valve. No leakage is allowable.

x. Close HYD HI-FLOW SHUTOFF valve; close HYD HI-FLOW REG; HYD HI-FLOW PRESS gage decreases to zero.

CAUTION

HYD HI-FLOW SHUTOFF valve must be completely closed before closing HYD HI-FLOW REG because damage to or failure of valve 19-9023747 can result.

y. Slowly open FUEL HIGH PRESS REG until FUEL HIGH PRESS gage indicates 500 ±50 psi (2A7). Check for leakage downstream of regulator. No leakage is allowable.

z. Close FUEL HIGH PRESS REG; FUEL HIGH PRESS gage decreases to zero (2A7).

aa. Slowly open HYD PRESS REG in 500-psig increments, holding each increment for one minute, until HYD PRESS gage indicates 2,200 ±100 psi (2A7). Check for leakage downstream of regulator. No leakage is allowable.

ab. Close HYD PRESS REG; HYD PRESS gage decreases to zero (2A7).

ac. Install a tee in GG CONT VALVE CLOSING INLET and connect a line, with a needle valve, between tee and GG CONT VALVE OPENING INLET (2A3).

ad. Install a tee in NO. 1 MLV CLOSING PORT and connect a line between tee and NO. 2 MLV CLOSING PORT (2A3).

ae. Connect a line between tees of steps ac and ad and open needle valve.

af. Move control switch to OPEN.

ag. Slowly open HYD PRESS REG in 500-psig increments, holding each increment for one minute, until OPENING INLET PRESS and CLOSING INLET PRESS gages indicate 2,200 ±100 psi (2A3). Check for leakage downstream of regulator and up to CIRCUIT SEL and MLV SEL VALVE selector valves. No leakage is allowable.

ah. Move control switch to CLOSE.

ai. Close HYD PRESS REG; OPENING INLET PRESS AND CLOSING INLET PRESS gages decrease to zero (2A3).

aj. Close needle valve and move CIRCUIT SEL selector valve to GG position (2A3).

ak. Move HYD RETURN FLOW selector valve to LOW and slowly open HYD PRESS REG until CLOSING INLET PRESS gage indicates 2,200 ±100 psi (2A3).

al. Slowly open needle valve and adjust flow until HYD RET FLOW flowmeter indicates 2.1 gpm (2A3). HYD RETURN PRESS light comes on (1A7) and OPENING INLET PRESS gage indicates 45 ±5 psi (2A3). Check for leakage downstream of selector valve and up to return check valve (2A3). No leakage is allowable.

am. Close needle valve and move HYD RETURN FLOW selector valve to HIGH (2A3).

an. Turn HYD RETURN FLOW selector switch (FLOW RATE INDICATOR) to LOW (2A1).

ao. Slowly open needle valve and adjust flow until HYD RETURN FLOW meter indicates 2 gpm (2A1). Check for leakage from HYD

RETURN FLOW selector valve (2A3) to hydraulic return check valve (2A1) and from hydraulic return check valve to HYD RETURN port (2A1). No leakage is allowable.

ap. Close HYD PRESS REG; CLOSING INLET PRESS and OPENING INLET PRESS gages decrease to zero (2A3).

aq. Move control switch to OFF.

ar. Move CIRCUIT SEL selector valve to CL and HYD RETURN FLOW selector valve to CL (2A3).

as. Connect a line between GRD SUPPLY PORT (2A7) and IMV OUTLET PORT (2A5).

at. Slowly oepn HYD PRESS REG until HYD PRESS gage (2A7) and IMV OUTLET PRESS gage (2A5) indicate 2,200 ±100 psi. Check for leakage from IMV OUTLET PORT TO IMV OUTLET PRESS gage (2A5). No leakage is allowable.

au. Close HYD PRESS REG; HYD PRESS gage (2A7) and IMV OUTLET PRESS gage (2A5) decrease to zero.

av. Install needle valve to CLOSING PRESS RETURN (2A5).

aw. Disconnect line from IMV OUTLET PORT and connect it to needle valve of step av (2A5). Close needle valve.

ax. Slowly open HYD PRESS REG until HYD PRESS gage indicates 2,200 ±100 psi (2A7).

ay. Slowly open needle valve and adjust flow until CLOSING PRESS RETURN flowmeter indicates 5,000 cc/min (2A5). Check for leakage from CLOSING PRESS RETURN port up to return check valve (2A5). No leakage is allowable.

az. Close HYD PRESS REG (2A7) and then close needle valve; HYD PRESS gage decreases to zero.

ba. Disconnect needle valve and line from CLOSING PRESS RETURN and connect them to IMV RETURN PORT (2A5).

bb. Repeat step ax and slowly open needle valve and adjust flow until IMV RETURN flowmeter indicates 30 cc/min (2A5). Check for leakage from IMV RETURN PORT up to return check valve (2A5).

bc. Close HYD PRESS REG (2A7) and then close needle valve; HYD PRESS gage decreases to zero.

bd. Disconnect needle valve and line from IMV RETURN PORT (2A5) and connect them to GRD RETURN LINE (2A7).

be. Repeat step ax, slowly open needle valve, and adjust flow until HYD RETURN FLOW flowmeter indicates 0.82 gpm (2A7). Check for leakage from GRD RETURN LINE port to return check valve (2A7). No leakage is allowable.

bf. Close HYD PRESS REG and then close needle valve; HYD PRESS gage decreases to zero (2A7).

bg. Disconnect needle valve and line from GRD RETURN LINE and connect them to ACT & HYD RETURN LINE (2A7).

bh. Turn HYD RETURN FLOW selector switch (FLOW RATE INDICATOR) to HIGH (2A1).

bi. Repeat step ax and slowly open needle valve until HYD RETURN FLOW meter indicates 2 gpm (2A1). Check for leakage from ACT & HYD RETURN LINE port to return check valve (2A7). No leakage is allowable.

bj. Close HYD PRESS REG (2A7) and then close needle valve; HYD PRESS gage decreases to zero (2A7).

bk. Disconnect needle valve and line from ACT & HYD RETURN LINE and GRD SUPPLY PORT (2A7).

bl. Install needle valve to HYD RETURN (1A1) and connect lines between GRD SUPPLY PORT and needle valve (1A1). Close needle valve.

bm. Slowly open INLET PRESS REG until INLET PRESS gage indicates 2,200 ±100 psi (1A1).

bn. Move FLOWMETER SELECTOR valves to LOW. Slowly open needle valve and adjust flow until HYD RETURN LOW flowmeter indicates 200 cc/min (1A1). Check for leakage of hydraulic return system. No leakage is allowable.

bo. Close needle valve and move FLOWMETER SELECTOR valve to HIGH (1A1).

bp. Slowly open needle valve and adjust flow until HYD RETURN HIGH flowmeter indicates 2.1 gpm (1A1). Check for leakage from HYD RET to return check valve (1A1). No leakage is allowable.

bq. Close needle valve and close INLET PRESS REG; INLET PRESS gage decreases to zero (1A1).

br. Close HYDRAULIC PRESSURE valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL) and open HYDRAULIC SYSTEM valve (MANIFOLD BLEED PANEL); HYD PRESS ON light goes off (1A7). Close HYDRAULIC SYSTEM valve.

bs. Decrease facility hydraulic supply pressure to zero.

bt. Disconnect all test equipment and install caps on all open ports.

5-24. GN_2 SYSTEM FUNCTION-TEST.

a. Connect a 5-micron filter to GN_2 inlet connection (SERVICE MANIFOLD). Connect a source of gaseous nitrogen to filter.

b. Make sure gaseous nitrogen interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on FUEL LINE and PRESERVATIVE INLET (1A2), SEQUENCE INLET PORT and SEQUENCE OUTLET PORT (2A1), and LOX HT EXCH INLET (1A5).

d. Make sure GOX BACK PRESS. valve (1A6) is open and all remaining gaseous nitrogen valves and regulators are closed.

e. Open GN_2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

f. Slowly apply gaseous nitrogen to console until GN_2 PRESS ON light (1A7) comes on. Light comes on at 5-10 psig.

g. Slowly increase gaseous nitrogen pressure until GN_2 relief valve actuates. Relief valve actuates at 3,350 (+0, -150) psig.

h. Reduce gaseous nitrogen pressure to zero. GN_2 relief valve reseats. Adjust gaseous nitrogen pressure to 2,700 ±200 psig.

NOTE

> After pressure buildup within the temperature recorder (2A9) and flowrate indicator (2A1), the purge relief valves, mounted on the rear of the units, relieve intermittently while the GN_2 system is pressurized.

i. Install a shutoff valve on PRESERVATIVE INLET (1A2); close shutoff valve.

j. Open PRESERVATIVE INLET S/O valve and FUEL INLET S/O valve (1A2).

k. Slowly open GN_2 PRESS REG (1A2) until preservative inlet relief valve actuates. Relief valve actuates at 125 ±6 psi, as indicated on FUEL INLET PRESS NO. 1 gage. PRESERVATIVE INLET PRESS gage (1A2) lockout valve actuates at 100 ±10 psig.

l. Close PRESERVATIVE INLET S/O valve (1A2). Open shutoff valve installed on PRESERVATIVE INLET until PRESERVATIVE INLET PRESS gage indicates zero; close shutoff valve.

m. Open GN_2 PRESS REG. (1A2) until fuel inlet relief valve actuates. Relief valve actuates at 330 ±22 psi, as indicated on FUEL INLET PRESS NO. 1 gage.

NOTE

> The pressure reading on FUEL INLET PRESS NO. 2 gage must rise more slowly than the reading on FUEL INLET PRESS NO. 1 gage.

n. Close GN_2 PRESS REG and open FUEL INLET VENT valve to reduce pressure to zero (1A2).

o. Close FUEL INLET VENT valve and FUEL INLET S/O valve. Remove shutoff valve from PRESERVATIVE INLET; pressure-cap PRESERVATIVE INLET connection (1A2).

p. Slowly open GN_2 PRESS REG. (1A5) until LOX heat exchanger inlet relief valve actuates. Relief valve actuates at 1,500 ±75 psi, as indicated on GOX PRESS gage.

q. Close GN_2 PRESS REG. (1A5) and slowly open GN_2 BLEED valve until GOX PRESS gage (1A5) indicates zero; close GN_2 BLEED valve.

r. Open GN_2 PRESS REG. until 1,000 ±50 psi is indicated on GOX PRESS gage (1A5).

s. Close GOX BACK PRESS. valve (1A6) and GN_2 PRESS REG. (1A5). Slowly open GN_2 BLEED valve until GOX PRESS DROP gage (1A8) indicates 3 ±0.5 psi. Close GN_2 BLEED valve.

t. Record differential pressure reading on GOX PRESS DROP gage (1A6). Leave pressure locked-up in system for 10 minutes; record differential pressure reading again on GOX PRESS DROP gage. Difference between readings must be less than 0.25 psig.

u. Slowly open GOX BACK PRESS. valve (1A6) and open GN_2 BLEED valve to reduce pressure to zero; close GN_2 BLEED valve.

v. Slowly open GN_2 PRESS REG (2A1) until sequence inlet port relief valve actuates. Relief valve actuates at 750 ±27 psig.

w. Close GN_2 PRESS REG (2A1) and open GN_2 BLEED valve (2A1) to reduce pressure to zero; close GN_2 BLEED valve.

x. Reduce gaseous nitrogen source pressure to zero and open GN_2 valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. GN_2 PRESS ON light (1A7) goes off.

y. Close GN_2 valve (MANIFOLD BLEED PANEL) and close GN_2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

z. Remove source of gaseous nitrogen and filter from GN_2 inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-25. HELIUM SYSTEM FUNCTION-TEST.

a. Connect a 5-micron filter to HELIUM inlet connection (SERVICE MANIFOLD). Connect a source of helium to filter.

b. Install a bleed valve on HELIUM HT EXCH INLET (1A5) and close bleed valve.

c. Make sure HELIUM BACK PRESS valve (1A6) is open and all remaining helium valves and regulators are closed.

d. Open HELIUM shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

e. Slowly apply helium supply pressure to console until HELIUM PRESS ON light (1A7) comes on; light comes on at 5-10 psig.

f. Slowly increase helium supply pressure until helium relief valve actuates; relief valve actuates at 3,350 (+0, -150) psig.

g. Reduce helium supply pressure to zero; helium relief valve reseats. Adjust helium supply pressure to 2,700 ±200 psig.

h. Slowly open HELIUM PRESS REG (1A5) until helium heat exchanger inlet relief valve actuates. Relief valve actuates at 300 ±15 psi, as indicated on HELIUM PRESS gage.

i. Close HELIUM PRESS REG (1A5) and open bleed valve at HELIUM HT EXCH INLET until HELIUM PRESS gage indicates zero; close bleed valve.

j. Open HELIUM PRESS REG until 250 ±10 psi is indicated on HELIUM PRESS gage (1A5).

k. Close HELIUM BACK PRESS valve (1A6) and HELIUM PRESS REG (1A5). Slowly open HELIUM BLEED valve until HELIUM PRESS DROP gage (1A6) indicates 3 ±0.5 psi; close HELIUM BLEED valve.

l. Record differential pressure reading on HELIUM PRESS DROP gage (1A6). Leave pressure locked-up in system for 10 minutes; record differential pressure reading again on HELIUM PRESS DROP gage. Difference between readings must be less than 0.25 psig.

m. Slowly open HELIUM BACK PRESS valve (1A6) and open HELIUM BLEED valve to reduce pressure to zero.

n. Reduce helium supply pressure to zero and open HELIUM valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. HELIUM PRESS ON light (1A7) goes off.

o. Close HELIUM valve (MANIFOLD BLEED PANEL) and HELIUM shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

p. Remove source of helium and filter from HELIUM inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-26. LOX-CLEAN AIR SYSTEM FUNCTION-TEST.

a. Connect a 5-micron-filter to LOX CLEAN AIR inlet connection (SERVICE MANIFOLD). Connect a source of LOX-clean air to filter.

b. Make sure LOX-clean interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on LOX PUMP INLET (1A3), LOX PUMP SEAL & GG ACTUATOR PURGE and GG LOX INJECTOR & LOX DOME PURGE (1A5), and LOX BS LINE (2A1).

d. Open L. C. AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

e. Slowly apply LOX-clean air to console until LOX CLEAN AIR ON light (1A7) comes on; light comes on at 5-10 psig.

f. Slowly increase LOX-clean air pressure until LOX-clean air relief valve actuates; relief valve actuates at 3,350 (+0, -150) psig.

g. Reduce LOX-clean air pressure to zero; LOX-clean air relief valve reseats. Adjust LOX-clean air pressure to 2,700 ±200 psig.

h. Remove pressure cap from LOX PUMP INLET connection (1A3) and install pneumatic needle valve. Close needle valve.

i. Make sure L. C. AIR F/M SEL handle (1A3) is in BY-PASS position.

j. Slowly open L. C. AIR PRESS REG (1A3) until LOX pump inlet relief valve actuates. Relief valve actuates at 125 ±6 psi, as indicated on LOX PUMP INLET PRESS gage (1A4).

k. Close L. C. AIR PRESS REG (1A3) to reduce pressure to zero; relief valve reseats. Open L. C. AIR PRESS REG to 30 (+3, -0) psi, as indicated on LOX PUMP INLET PRESS gage (1A4).

l. Move L. C. AIR F/M SEL handle (1A3) to LOW position. Slowly open pneumatic needle valve (1A3) to adjust flow, in four equal increments, from 30 to 300 scim, as indicated on LOX CLEAN AIR FLOW-LOW flowmeter (1A3). Float must rise smoothly and stabilize at each increment.

m. Close pneumatic needle valve (1A3); move L. C. AIR F/M SEL handle to HIGH position.

n. Open L. C. AIR PRESS REG (1A3) until 100 ±5 psi is indicated on LOX PUMP INLET PRESS gage (1A4).

o. Open pneumatic needle valve (1A3) to adjust flow, in four equal increments, from 30 to 300 scim, as indicated on LOX CLEAN AIR FLOW-HIGH flowmeter (1A3). Float must rise smoothly and stabilize at each increment.

p. Close L. C. AIR PRESS REG (1A3), move L. C. AIR F/M SEL handle to BY-PASS position, then open pneumatic needle valve to reduce pressure to zero.

q. Remove pneumatic needle valve from LOX PUMP INLET; pressure-cap connection.

r. Slowly open L. C. AIR PRESS REG (1A5) until LOX-clean air pressure relief valve actuates. Relief valve actuates at 105 ±5 psi, as indicated on LOX CLEAN AIR PRESS gage (1A5).

s. Close L. C. AIR PRESS REG (1A5) to reduce pressure to zero.

t. Remove pressure cap from LOX BS LINE (2A1) and install pneumatic needle valve. Close needle valve.

u. Move FLOWMETER SEL handle (2A1) to LOW position; open L. C. AIR LOW PRESS REG (2A1) until 30 ±2 psi is indicated on LOW pressure gage (2A8).

v. Open pneumatic needle valve to adjust flow, in four equal increments, from 1.3 to 13.0 scim, as indicated on LOX B. S. LEAKAGE LOW PRESS flowmeter (2A1). Float must rise smoothly and stabilize at each increment.

w. Close L. C. AIR LOW PRESS REG (2A1); close pneumatic needle valve.

x. Move FLOWMETER SEL handle (2A1) to BY-PASS position.

y. Open L. C. AIR HIGH PRESS REG (2A1) until 115 ±10 psi is indicated on HIGH pressure gage (2A8), LOW pressure gage (2A8) lockout valve actuates at 105 ±5 psig.

z. Move FLOWMETER SEL handle (2A1) to HIGH position. Open L. C. AIR HIGH PRESS REG until 1,750 ±50 psi is indicated on HIGH pressure gage (2A8).

aa. Open pneumatic needle valve to adjust flow, in four equal increments, from 3 to 30 scim, as indicated on LOX B. S. LEAKAGE HIGH PRESS flowmeter (2A1). Float must rise smoothly and stabilize at each increment.

ab. Close L. C. AIR HIGH PRESS REG (2A1), open pneumatic needle valve to reduce pressure to zero, and move FLOWMETER SEL handle to BY-PASS position.

ac. Remove pneumatic needle valve from LOX B. S. LINE (2A1); pressure-cap connection.

ad. Reduce LOX-clean air source pressure to zero. Open L. C. AIR valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. LOX CLEAN AIR ON light (1A7) goes off.

ae. Close L. C. AIR valve (MANIFOLD BLEED PANEL) and close L. C. AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

af. Remove source of LOX-clean air and filter from LOX CLEAN AIR inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-27. MISSILE AIR SYSTEM FUNCTION-TEST.

a. Connect a 5-micron filter to MSL AIR inlet connection (SERVICE MANIFOLD). Connect a source of missile air to filter.

b. Make sure missile air interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on FUEL PUMP INLET (1A3), FUEL BS LINE (2A3), and IMV CONT PORT (2A7).

d. Open MSL AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

e. Slowly apply missile air to console until MISSILE AIR ON light (1A7) comes on; light comes on at 5-10 psig.

f. Slowly increase missile air pressure until missile air relief valve actuates. Relief valve actuates at 3,350 (+0, -150) psig.

g. Reduce missile air pressure to zero; missile air relief valve reseats. Adjust missile air pressure to 2,700 ±200 psig.

h. Remove pressure cap from FUEL PUMP INLET (1A3) and install pneumatic needle valve. Close needle valve.

i. Make sure MSL AIR/F/M SEL handle (1A3) is in BY-PASS position.

j. Slowly open MSL AIR PRESS REG (1A3) until fuel pump inlet relief valve actuates. Relief valve actuates at 125 ±6 psi, as indicated on FUEL PUMP INLET PRESS gage (1A4).

k. Close MSL AIR PRESS REG (1A3) to reduce pressure to zero; relief valve reseats. Open MSL AIR PRESS REG to 30 ±2 psi, as indicated on FUEL PUMP INLET PRESS gage (1A4).

l. Move MSL AIR F/M SEL handle (1A3) to LOW position. Open pneumatic needle valve to adjust flow, in four equal increments, from 20 to 200 scim, as indicated on MISSILE AIR FLOW-LOW flowmeter (1A3). Float must rise smoothly and stabilize at each increment.

m. Close pneumatic needle valve; move MSL AIR F/M SEL handle (1A3) to HIGH position.

n. Open MSL AIR PRESS REG (1A3) until 100 ±5 psi is indicated on FUEL PUMP INLET PRESS gage (1A4).

o. Open pneumatic needle valve to adjust flow, in four equal increments, from 20 to 200 scim, as indicated on MISSILE AIR FLOW-HIGH flowmeter (1A3). Float must rise smoothly and stabilize at each increment.

p. Close MSL AIR PRESS REG (1A3), move MSL AIR F/M SEL handle (1A3) to the BY-PASS position, then open pneumatic needle valve to reduce pressure to zero.

q. Remove pneumatic needle valve from FUEL PUMP INLET; pressure-cap connection.

r. Remove pressure cap from FUEL BS LINE (2A3) and install pneumatic needle valve; close needle valve.

s. Move F/M SEL handle (2A3) to LOW position. Open FUEL BS REG LOW (2A3) until 30 ±2 psi is indicated on LOW pressure gage (2A4).

t. Open pneumatic needle valve to adjust flow, in four equal increments, from 1.3 to 13.0 scim, as indicated on FUEL B.S. LKG LOW flowmeter (2A3). Float must rise smoothly and stabilize at each increment.

u. Close FUEL BS REG LOW (2A3); close pneumatic needle valve.

v. Move F/M SEL handle (2A3) to BY-PASS position.

w. Open FUEL BS REG HIGH (2A3) until 115 ±10 psi is indicated on HIGH pressure gage (2A4); LOW pressure gage (2A4) lockout valve actuates at 105 ±5 psig.

x. Move F/M SEL handle to HIGH position. Open FUEL BS REG HIGH (2A3) until 2,000 ±50 psi is indicated on HIGH pressure gage (2A4).

y. Open pneumatic needle valve to adjust flow, in four equal increments, from 7 to 70 scim, as indicated on FUEL B. S. LKG HIGH flowmeter (2A3). Float must rise smoothly and stabilize at each increment.

z. Close FUEL BS REG HIGH, open pneumatic needle valve to reduce pressure to zero, and move F/M SEL handle (2A3) to BY-PASS position.

aa. Remove pneumatic needle valve from FUEL BS LINE (2A3); pressure-cap connection.

ab. Move POWER switch (1A1) to ON and turn rheostat knob to INCREASE until voltmeter indicates 26 ±1 volts; ammeter indicates zero.

ac. Slowly open IMV CONT. PRESS. REG. (2A7) until 280 ±10 is indicated on IMV CONT PRESS-HIGH gage (2A7); IMV CONT PRESS-LOW gage (2A7) lockout valve actuates at 260 (+0, -10) psig.

ad. Slowly open IMV CONT. PRESS. REG. (2A7) until IMV control relief valve actuates. Relief valve actuates at 2,000 +100 psi, as indicated on IMV CONT PRESS-HIGH gage.

ae. Close IMV CONT. PRESS. REG. (2A7) until relief valve reseats. Open IMV CONT. PRESS. REG. until 1,750 ±100 psi is indicated on IMV CONT PRESS-HIGH gage.

af. Move IMV CONTROL switch (2A7) to AUTOMATIC position; solenoid valve L2 energizes and closes (audibly).

ag. Open IMV CONTROL BLEED valve (2A7). After pressure downstream of closed solenoid valves L1 and L2 bleeds off, close IMV CONTROL BLEED valve.

ah. Move control switch (1A1) to START position and hold. Solenoid valve L1 energizes and opens (audibly); AUTO light comes on and MANUAL light goes off. Ignore all other lights.

ai. Move control switch (1A1) to STOP position; release switch. Solenoid valve L1 de-energizes and closes (audibly); MANUAL light comes on and AUTO light goes off.

aj. Open IMV CONTROL BLEED valve (2A7). After pressure downstream of closed solenoid valves L1 and L2 bleeds off, close IMV CONTROL BLEED valve.

ak. Close IMV CONT PRESS. REG. (2A7).

al. Move IMV CONTROL switch (2A7) to MANUAL position. Solenoid valve L2 deenergizes and opens (audibly).

am. Move POWER switch (1A1) to OFF position and turn rheostat knob fully counterclockwise.

an. Reduce missile air pressure to zero. Open MSL AIR valve (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. MISSILE AIR ON light (1A7) goes off.

ao. Close MSL AIR valve (MANIFOLD BLEED PANEL) and close MSL AIR shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

ap. Remove source of missile air and filter from MSL AIR inlet connection (SERVICE MANIFOLD); pressure-cap inlet.

5-28. FREON SYSTEM FUNCTION-TEST.

a. Connect a 5-micron filter to both FREON NO. 1 and FREON NO 2 inlet connections (SERVICE MANIFOLD). Connect a common source of gaseous nitrogen to filter.

b. Make sure FREON NO. 1 and NO. 2 interconnect plumbing is installed between consoles No. 1 and No. 2.

c. Install pressure caps on FUEL PUMP INLET and LOX PUMP INLET (1A3), HELIUM HT EXCH INLET and LOX HT EXCH INLET (1A5), LOX BS LINE (2A1), and FUEL BS LINE (2A3).

d. Open FREON NO. 1 and FREON NO. 2 shutoff valves (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

e. Slowly apply gaseous nitrogen to the console until NO. 1 FREON PRESS. ON light and NO. 2 FREON PRESS. ON light come on; lights come on at 5-10 psig.

f. Close FREON NO. 2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

g. Slowly increase gaseous nitrogen pressure until NO. 1 gaseous freon relief valve actuates; relief valve actuates at 150 ±5 psig.

h. Reduce gaseous nitrogen pressure until NO. 1 gaseous freon relief valve reseats; increase gaseous nitrogen pressure to 100 ±10 psig.

i. Open FREON NO. 2 shutoff valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL). Slowly increase gaseous nitrogen pressure until NO. 2 gaseous freon relief valve actuates; relief valve actuates at 150 ±5 psig.

j. Reduce gaseous nitrogen pressure until No. 2 gaseous freon relief valve reseats; increase gaseous nitrogen pressure to 100 ±10 psig.

k. Move MSL AIR F/M SEL and L.C. AIR F/M SEL handles (1A3) to HIGH position.

l. Open FREON TO MSL AIR valve (1A3); FUEL PUMP INLET PRESS gage (1A4) indicates 100 ±10 psi.

m. Close FREON TO MSL AIR valve (1A3), open FUEL PUMP BLEED valve (MANIFOLD BLEED PANEL) to reduce pressure to zero, then close FUEL PUMP BLEED valve.

n. Open FREON TO L.C. AIR valve (1A3). LOX PUMP INLET PRESS gage (1A4) indicates 100 ±10 psi.

o. Close FREON TO L.C. AIR valve (1A3), open LOX PUMP BLEED valve (MANIFOLD BLEED PANEL) to reduce pressure to zero, then close LOX PUMP BLEED valve.

oA. Move MSL AIR F/M SEL and L.C. AIR F/M SEL handles (1A3) to BYPASS position.

p. Make sure GOX BACK PRESSURE and HELIUM BACK PRESS valve (1A6) are open.

q. Open FREON TO HELIUM valve (1A5); HELIUM PRESS gage (1A5) indicates 100 ±10 psi.

r. Close FREON TO HELIUM valve (1A5), open HELIUM BLEED valve to reduce pressure to zero, then close HELIUM BLEED valve.

s. Open FREON TO GN_2 valve (1A5); GOX PRESS gage (1A5) indicates 100 ±10 psi.

t. Close FREON TO GN_2 valve (1A5), open GN_2 BLEED valve to reduce pressure to zero, then close GN_2 BLEED valve.

u. Open FREON TO LOX B. S. valve (2A1); HIGH pressure gage (2A8) indicates 100 ±10 psi.

v. Close FREON TO LOX B. S. valve (2A1), open LOX B. S. BLEED valve to reduce pressure to zero, then close LOX B. S. BLEED valve.

w. Open FREON TO FUEL B. S. valve (2A3); HIGH pressure gage (2A4) indicates 100 ±10 psi.

x. Close FREON TO FUEL B. S. valve (2A3), open FUEL B. S. BLEED valve to reduce pressure to zero, then close FUEL B. S. BLEED valve.

y. Reduce gaseous nitrogen source pressure to zero. Open FREON NO. 1 and FREON NO.2 valves (MANIFOLD BLEED PANEL) until system pressure is reduced to zero. NO. 1 FREON PRESS. ON light and NO. 2 FREON PRESS. ON light go off (1A7).

z. Close FREON NO. 1 and FREON NO. 2 valves (MANIFOLD BLEED PANEL) and close FREON NO. 1 and FREON NO. 2 shutoff valves (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

aa. Remove source of gaseous nitrogen and filters from FREON NO. 1 and FREON NO. 2 inlet connections (SERVICE MANIFOLD); pressure-cap inlets.

5-29. HYDRAULIC SYSTEM FUNCTION-TEST. The temperature of the test fluid must not be less than 35° F or more than 125° F any time during testing. See figure 5-2 for hydraulic requirements and figure 5-12 for a pneumatic/hydraulic schematic.

a. Connect a 5-micron filter to HYD PRESS (SERVICE MANIFOLD). Connect a facility hydraulic supply to filter.

b. Make sure hydraulic interconnect plumbing for HYD PRESS, HYD RETURN, and HYD REG DRAIN is installed between console No. 1 and No. 2.

c. Connect separate lines between HYD RETURN and HYD REG DRAIN (RETURN MANIFOLD) and supply reservoir.

d. Connect a line between HYD DRAIN (INTERCONNECT MANIFOLD, console No. 1) and supply reservoir.

e. Check that hydraulic high flow regulator, located at rear and below panel (1A1), is fully open (adjustment fully clockwise).

f. Install a shutoff valve and a 0-1,000 psig test gage on HYD HI. FLOW OUTLET (1A2). Gage must be downstream of shutoff valve.

g. Install a shutoff valve on HYD RETURN port (2A1).

h. Install a shutoff valve on ACT & HYD RETURN LINE (2A7) and interconnect shutoff valve to gage of step f, and to shutoff valve of step g. Close all 3 valves.

i. Install needle valves on HYD RET (1A1), GG CONT VALVE CLOSING INLET (2A3), GRD RETURN LINE (2A7), IMV RETURN PORT, and CLOSING PRESS RETURN (2A5).

j. Install shutoff valves on GRD SUPPLY PORT and OVERRIDE PORT (1A1). Interconnect shutoff valves and needle valve at HYD RET (1A1). Close shutoff valves.

k. Interconnect GG CONT VALVE OPENING INLET to needle valve on GG CONT VALVE CLOSING INLET (2A3).

l. Interconnect GRD SUPPLY PORT to needle valve on GRD RETURN LINE (2A7).

m. Interconnect FUEL HIGH PRESS LINE (2A7) to both needle valves on IMV RETURN PORT and CLOSING PRESS RETURN (2A5). Close all needle valves.

n. Close all regulators, shutoff valves, and bleed valves, and position selector valves to BY-PASS, OFF, or CL.

o. Check that MAIN POWER switch is ON (1A8) and CIRCUIT BREAKER 15 AMPS (2A9) is pushed in.

p. Move LIGHT SWITCH and AC LINE switch (2A9), located inside temperature recorder door, to on; panel light comes on.

q. Move MOTOR switch of temperature recorder to ON (2A9). Channel 2 indicates hydraulic inlet fluid temperature and channel 3 indicates hydraulic return fluid temperature. Monitor temperature on both channels throughout test.

r. Open HYDRAULIC PRESSURE valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL) and slowly increase facility hydraulic supply pressure to 50 (+5, -0) psig. HYD PRESS ON light comes on (1A7).

s. Slowly increase facility hydraulic supply pressure until hydraulic pressure relief valve starts to relieve. Relief valve relieves at 3,000 (+0, -75) psig; flow in hydraulic return system is indicated by HYD RETURN PRESS light coming on (1A7).

t. Decrease facility hydraulic supply pressure until relief valve reseats; increase facility hydraulic supply pressure to 2,600 ±200 psig.

u. Close HYDRAULIC PRESSURE valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL) and open HYDRAULIC SYSTEM valve (MANIFOLD BLEED PANEL); HYD PRESS ON and HYD RETURN PRESS lights go off (1A7).

v. Close HYDRAULIC SYSTEM valve and slowly open HYDRAULIC PRESSURE valve; HYD PRESS ON light comes on (1A7).

w. Open shutoff valve at GRD SUPPLY PORT and slowly open INLET PRESS REG until INLET PRESS gage indicates 2,200 ±100 psi (1A1).

x. Move FLOWMETER SELECTOR valve to LOW, slowly open needle valve at HYD RET, and adjust flow, in four equal increments, from 20 to 200 cc/min as indicated on HYD RETURN LOW flowmeter (1A1). HYD RETURN PRESS light comes on (1A7). Float must rise smoothly and stabilize at each increment.

y. Close INLET PRESS REG, shutoff valve at GRD SUPPLY PORT, and needle valve at HYD RET; move FLOWMETER SELECTOR valve to HIGH. INLET PRESS gage decreases to zero (1A1).

z. Open shutoff valve at OVERRIDE PORT and slowly open OVERRIDE PRESS REG until OVERRIDE PRESS gage indicates 2,200 ±100 psi (1A1).

aa. Slowly open needle valve at HYD RET and adjust flow, in four equal increments, from 0.2 to 2.1 gpm, as indicated on HYD RETURN HIGH flowmeter (1A1). Float must rise smoothly and stabilize at each increment.

ab. Close OVERRIDE PRESS REG, shutoff valve at OVERRIDE PORT, and needle valve at HYD RET; move FLOWMETER SELECTOR valve to OFF. OVERRIDE PRESS gage decreases to zero (1A1).

ac. Open FUEL HIGH PRESS REG until FUEL HIGH PRESS gage indicates 500 ±50 psi (2A7).

ad. Slowly open needle valve at IMV RETURN PORT and adjust flow, in four equal increments, from 3 to 30 cc/min, as indicated on IMV RETURN flowmeter (2A5). Float must rise smoothly and stabilize at each increment.

ae. Close needle valve at IMV RETURN PORT, slowly open needle valve at CLOSING PRESS RETURN, and adjust flow, in four equal increments, from 500 to 5,000 cc/min, as indicated on CLOSING PRESS RETURN flowmeter (2A5). Float must rise smoothly and stabilize at each increment.

af. Close FUEL HIGH PRESS REG (2A7) and open needle valve at IMV RETURN PORT; FUEL HIGH PRESS gage decreases to zero (2A7). Close both needle valves.

ag. Open HYD PRESS REG until HYD PRESS gage indicates 2,200 ±100 psi (2A7).

ah. Slowly open needle valve at GRD RETURN LINE and adjust flow, in four equal increments, from 0.080 to 0.80 gpm, as indicated on HYD RETURN FLOW flowmeter (2A7). Float must rise smoothly and stabilize at each increment.

ai. Close HYD PRESS REG; HYD PRESS gage decreases to zero (2A7). Close needle valve.

aj. Move control switch to CLOSE.

ak. Open HYD PRESS REG until CLOSING INLET PRESS gage indicates 2,200 ±100 psi (2A3). Move CIRCUIT SEL selector valve to GG and HYD RETURN FLOW selector valve to LOW (2A3).

al. Slowly open needle valve at GG CONT VALVE CLOSING INLET and adjust flow, in four equal increments, from 0.21 to 2.1 gpm, as indicated on HYD RET FLOW flowmeter (2A3). Float must rise smoothly and stabilize at each increment.

am. Close needle valve and move control switch to OPEN. OPEN light comes on, CLOSED light goes off, OPENING INLET PRESS gage indicates 2,200 ±100 psi, and CLOSING INLET PRESS gage decreases to 45 ±5 psi (2A3).

an. Repeat step al; close HYD PRESS REG and move CIRCUIT SEL selector valve to CL. CLOSING INLET PRESS and OPENING INLET PRESS gages decrease to zero (2A3).

ao. Move control switch to OFF. Close needle valve.

ap. Turn HYD RETURN FLOW selector switch (FLOW RATE INDICATOR) to HIGH (2A1).

aq. Open shutoff valve at ACT & HYD RETURN LINE (2A7) and open HYD HI-FLOW SHUTOFF valve (1A2).

ar. Open HYD HI-FLOW REG until HYD HI-FLOW PRESS gage indicates 2,200 ±100 psi (1A2).

as. Slowly open shutoff valve at HYD HI-FLOW OUTLET (1A2) and adjust flow from 0 to 45 gpm, as indicated on HYD RETURN FLOW meter (2A1). The 0-1,000 psi test gage downstream of shutoff valve indicates 500 ±100 psi.

at. Close shutoff valve at HYD HI-FLOW OUTLET (1A2) and close shutoff valve at ACT & HYD RETURN LINE (2A7).

au. Turn HYD RETURN FLOW selector switch (FLOW RATE INDICATOR) to LOW (2A1).

av. Slowly open shutoff valve at HYD RETURN port and check that HYD RETURN FLOW selector valve (2A3) is in CL position.

aw. Slowly open shutoff valve at HYD HI-FLOW OUTLET and adjust flow from 0 to 18 gpm, as indicated on HYD RETURN FLOW meter (2A1). The 0-1,000 psi test gage must not exceed 800 psig.

ax. Close HYD HI-FLOW SHUTOFF valve and HYD HI-FLOW REG (1A2).

CAUTION

HYD HI-FLOW SHUTOFF valve must be completely closed before closing HYD HI-FLOW REG because damage to or failure of valve 19-9023747 can result.

ay. Open shutoff valve at ACT & HYD RETURN LINE (2A7). The 0-1,000 psi test gage and HYD HI-FLOW PRESS gage decrease to zero (1A2).

az. Close shutoff valves at ACT & HYD RETURN LINE (2A7), HYD RETURN port (2A1), and HYD HI-FLOW OUTLET (1A2).

ba. Close HYDRAULIC PRESSURE valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL) and open HYDRAULIC SYSTEM valve (MANIFOLD BLEED PANEL). HYD PRESS ON and HYD RETURN PRESS lights go off (1A7).

bb. Move MOTOR, AC LINE, and LIGHT SWITCH switches (2A9), located inside temperature recorder, to OFF; panel light goes off.

bc. Decrease facility hydraulic supply pressure to zero and disconnect supply and filter from HYD PRESS port (SERVICE MANIFOLD).

bd. Connect a 5-micron filter and facility gaseous nitrogen supply to HYD PRESS port (SERVICE MANIFOLD).

be. Close HYDRAULIC SYSTEM valve (MANIFOLD BLEED PANEL) and increase facility gaseous nitrogen supply pressure to 700 ±50 psig.

bf. Open HYDRAULIC PRESSURE valve (MANIFOLD PRESSURE SHUT-OFF VALVE PANEL).

bg. Open INLET PRESS REG and OVERRIDE PRESS REG until INLET PRESS and OVERRIDE PRESS gages indicate 55 ±5 psi (1A1); open shutoff valves at GRD SUPPLY PORT and OVERRIDE PORT (1A1).

bh. Move FLOWMETER SELECTOR valve to LOW and slowly open needle valve at HYD RET port (1A1). Continue purge until no liquid is visible in HYD RETURN LOW flowmeter (1A1).

bi. Close needle valve at HYD RET port and move FLOWMETER SELECTOR valve to HIGH. Open needle valve and continue purge.

bj. Open FUEL HIGH PRESS REG until FUEL HIGH PRESS gage indicates 55 ±5 psi (2A7). Slowly open needle valves at IMV RETURN PORT and CLOSING PRESS RETURN (2A5).

bk. Open HYD PRESS REG until HYD PRESS gage indicates 55 ±5 psi. Slowly open needle valve at GRD RETURN LINE (2A7).

bl. Open shutoff valves at ACT & HYD RETURN LINE (2A7) and HYD RETURN port (2A1).

bm. Open HYD HI-FLOW SHUTOFF valve and open HYD HI-FLOW REG until HYD HI-FLOW PRESS gage indicates 55 ±5 psi (1A2).

bn. Slowly open shutoff valve at HYD HI-FLOW OUTLET (1A2) and continue purge for 3 ±0.5 minutes; close shutoff valve at ACT & HYD RETURN LINE (2A7).

bo. Move CIRCUIT SEL selector valve to GG, HYD RETURN FLOW selector valve to HIGH, and control swith to OPEN. OPEN light comes on (2A3). Allow purge to continue for 3 ±0.5 minutes; close shutoff valve.

bp. Open HYD PRESS REG until OPENING INLET PRESS gage indicates 55 ±5 psi. Slowly open needle valve at GG CONT VALVE CLOSING PORT (2A3). Continue purge for 3 ±0.5 minutes and close needle valve. Move MLV SEL VALVE selector valve to CL, CIRCUIT SEL selector valve to GG, and HYD RETURN FLOW selector valve to LOW (2A3).

bq. Move HYD RETURN FLOW selector valve to LOW and control switch to CLOSE; CLOSED light comes on (2A3).

br. Open HYD PRESS REG until CLOSING INLET PRESS gage indicates 55 ±5 psi; slowly open needle valve at GG CONT VALVE CLOSING PORT (2A3). Continue purge for 3 ±0.5 minutes.

bs. Decrease facility gaseous nitrogen supply pressure to zero and open HYDRAULIC SYSTEM valve (MANIFOLD BLEED PANEL).

bt. Open all test shutoff and needle valves; all hydraulic gages decrease to zero.

bu. Remove test equipment, install pressure caps on all openings, and close all regulators and shutoff and bleed valves.

bv. Pull out CIRCUIT BREAKER 15 AMPS (2A9); all flowmeter lights go off.

bw. Move MAIN POWER switch (1A8) to OFF; remaining lights on both consoles go off.

5-30. REMOVING.

5-31. Disassemble the engine checkout console, as required, to accomplish necessary repair or replacement. See figure 5-13 for index and part numbers. When removing panels 1A1, 1A2, 1A3, 1A5, 2A1, 2A3, 2A5, and 2A7, attach lift fixture T-8102313, or equivalent, to panel lift bolts.

CAUTION

Handles must not be used to lift the panels listed above, since the weight of the panels could cause the handles to break, resulting in damage to the equipment.

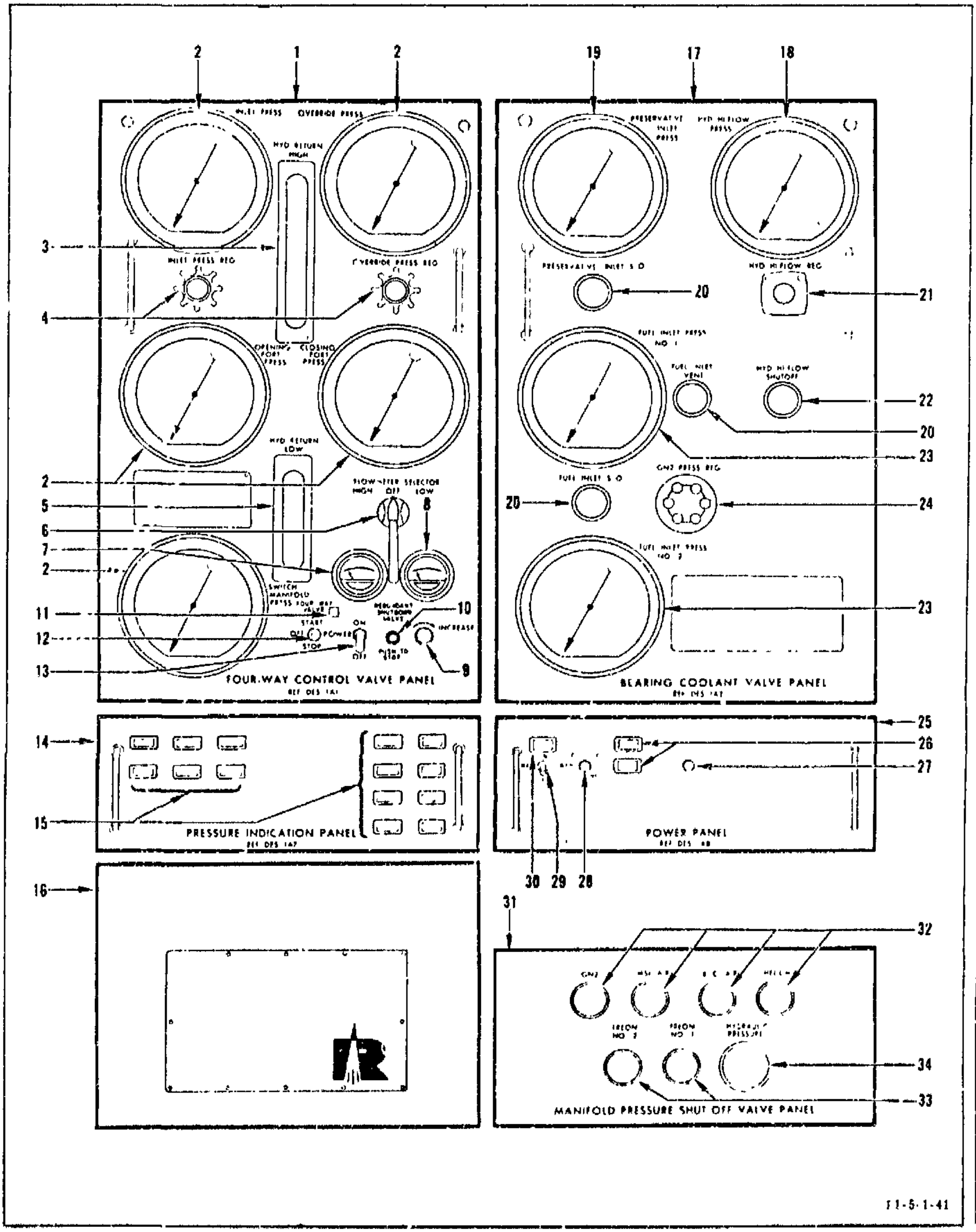


Figure 5-13. Disassembly of Engine Checkout Console (Sheet 1 of 20)

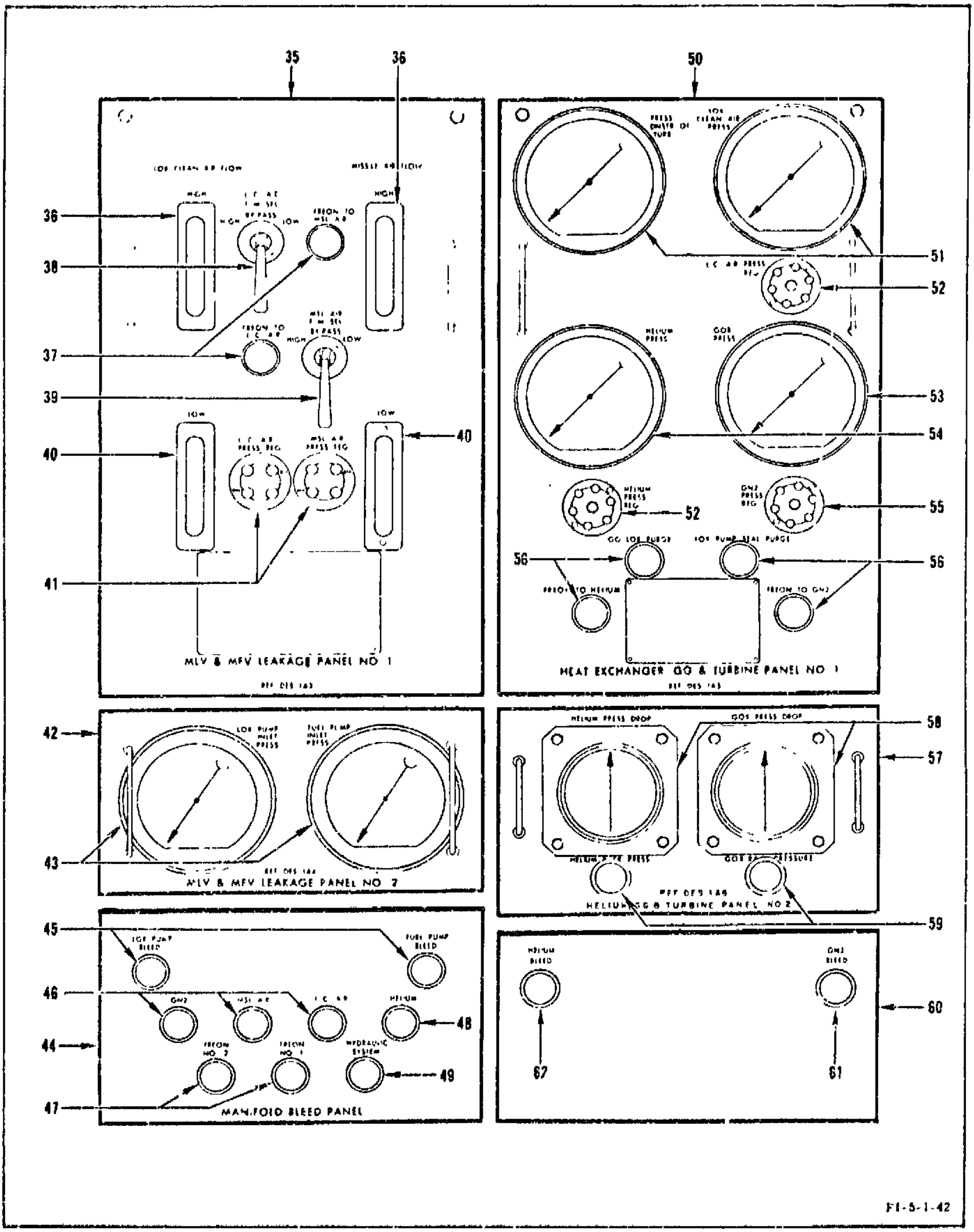


Figure 5-13. Disassembly of Engine Checkout Console (Sheet 2 of 20)

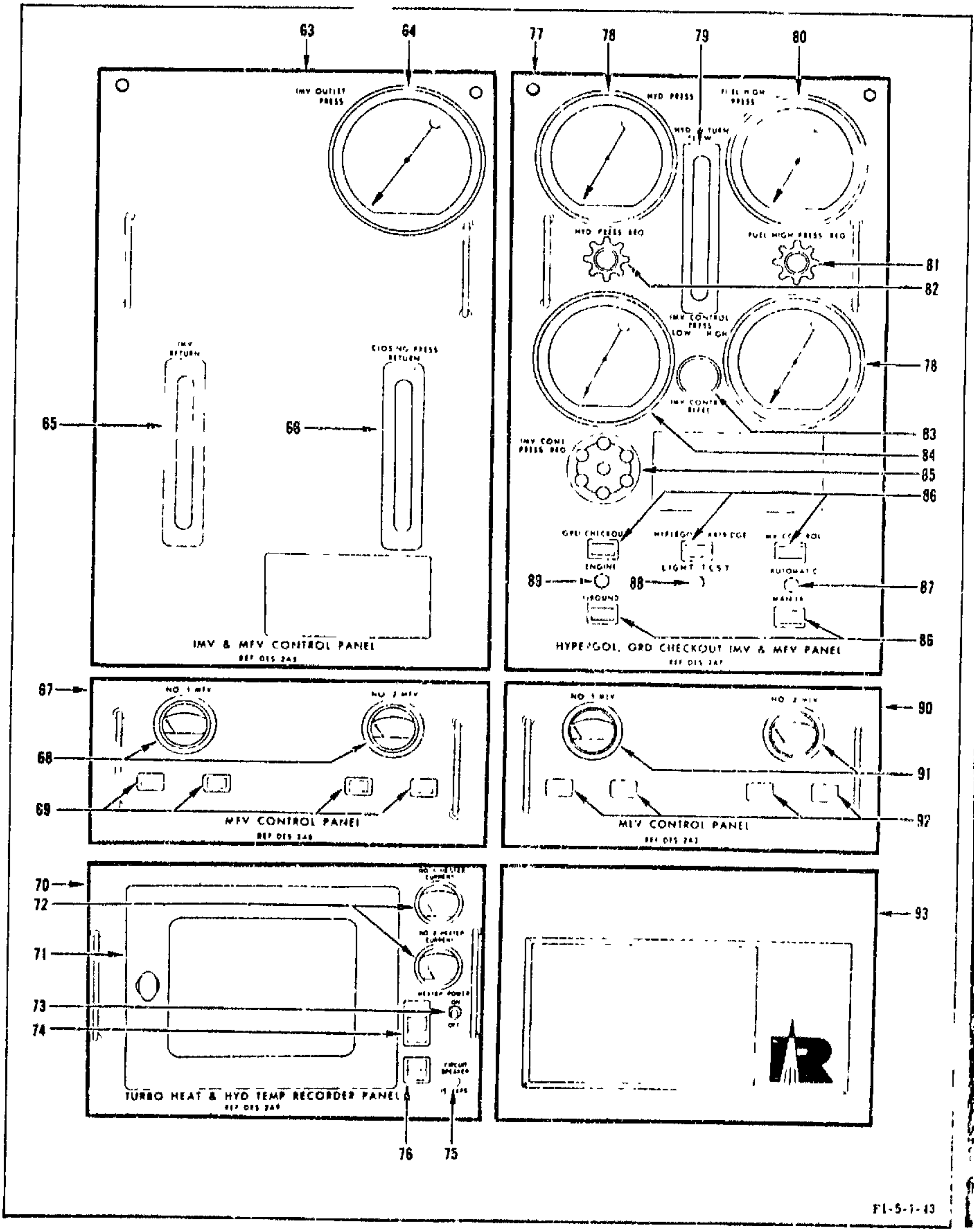


Figure 5-13. Disassembly of Engine Checkout Console (Sheet 3 of 20)

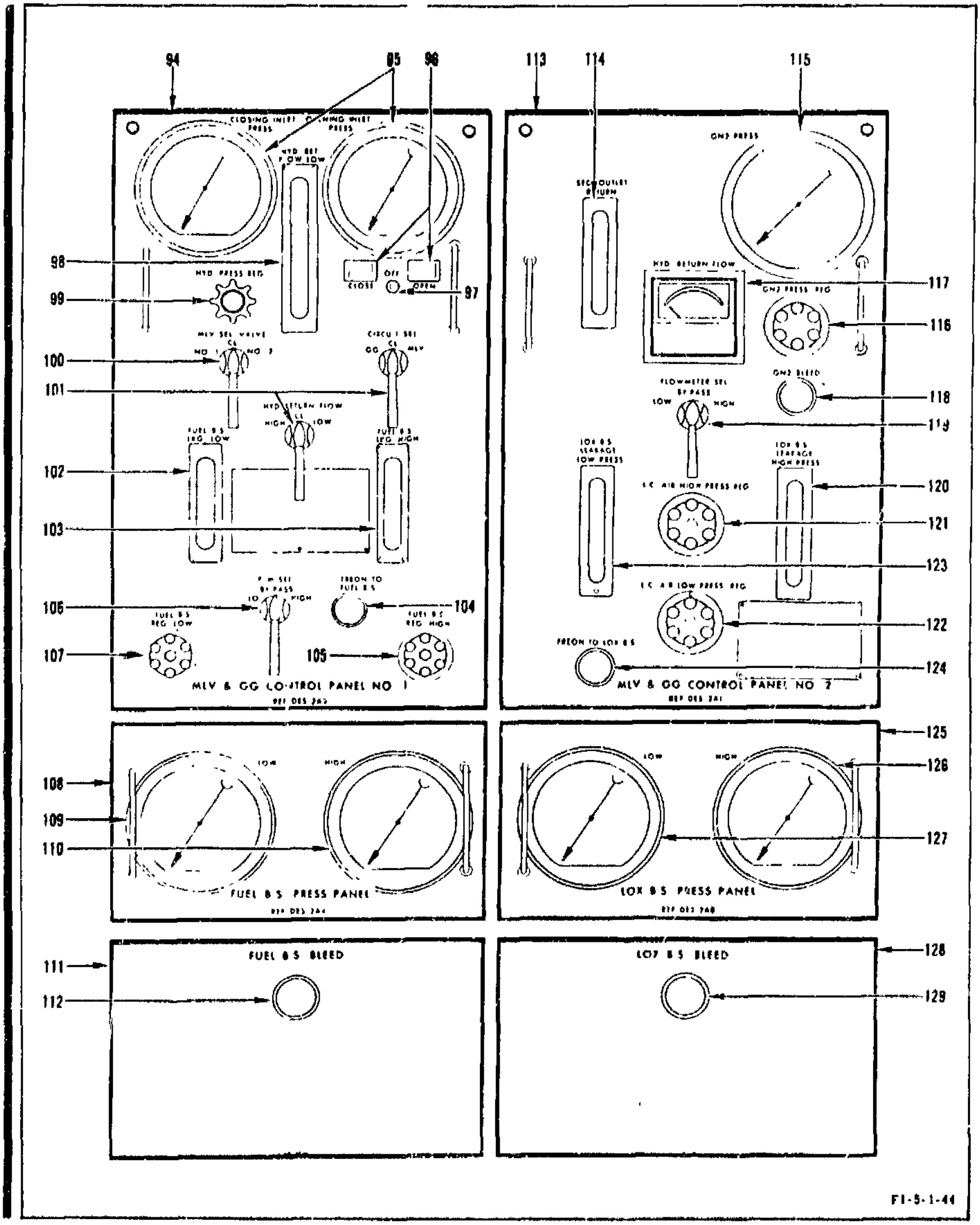


Figure 5-13. Disassembly of Engine Checkout Console (Sheet 4 of 20)

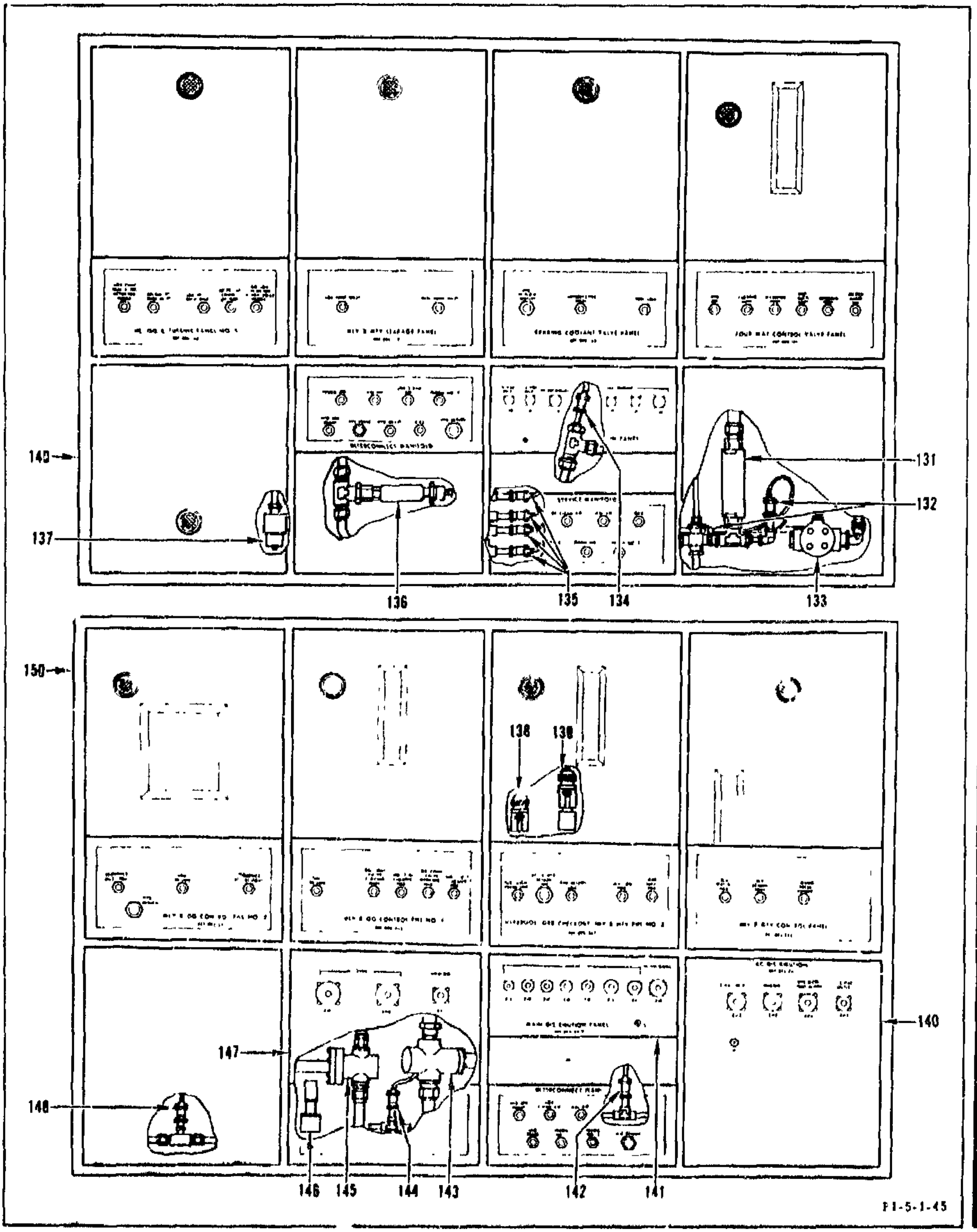


Figure 5-13. Disassembly of Engine Checkout Console (Sheet 5 of 20)

Index No.	Part No.	Description
1	9023453-11	Panel (1A1) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023596	Plate (F-3)
	AN535-4-4	Screw (F-3)
	9023651-21	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
	9023542-3	Chassis (X-3)
	AN507C1032R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
	PT07P-14-5S	Connector (F-3)
	PT07P-14-5P	Connector (F-3)
	PT07P-8-2S	Connector (F-3)
	PT07P-8-2S	Connector (F-3)
2	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	10-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
	AN939C4	Elbow (F-3)
3	9023782	Flowmeter (F-1)
	9023839-1	Bracket (X-3)
	9023839-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	38031N-4C-8	Screw (F-3)
	MS15795-810	Washer (F-3)
	RD273-0015-0800	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	RD284-3003-3002	Check valve (F-2)
	RD273-0015-0800	Elbow (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
	9023838	Bezel (F-3)
	AN515C8R10	Screw (F-3)
3 (cont)	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
4	19-9023778-2	Regulator (F-1)
	LD153-0010-0033	Washer (F-3)
	RD273-0003-0800	Tee (F-3)
	RD273-0004-0600	Tee (F-3)
	RD273-0004-0800	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	RD273-0015-0800	Elbow (F-3)
	RD273-0006-0600	Union (F-3)
	MS28778-8	Packing (F-3)
	MS28778-6	Packing (F-3)
	MS28777-8	Ring (F-3)
	MS28777-6	Ring (F-3)
	AN6289C8	Nut (F-3)
	AN6289C6	Nut (F-3)
5	9023770-21	Flowmeter (F-1)
	9023652-1	Bracket (X-3)
	9023652-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	38031N-4C-8	Screw (F-3)
	MS15795-810	Washer (F-3)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD284-3008-3002	Check valve (F-3)
	AN894C8-6	Bushing (F-3)
	RD273-0016-0800	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS28778-6	Packing (F-3)
	MS28777-8	Ring (F-3)
	MS28777-6	Ring (F-3)
	AN6289C8	Nut (F-3)
	AN6289C6	Nut (F-3)
	9023653	Bezel (F-3)
	AN515C8R10	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
6	19-9023745-1	Valve (F-2)
	NAS1190C08T10N	Screw (F-3)
	MS15795-807	Washer (F-3)
	RD273-0006-0800	Union (F-3)
	RD273-0019-1200	Reducer (F-3)
	MS28778-8	Packing (F-3)
7	MR36W050DCVVR	Voltmeter (F-3)
8	MR36W002DCAAR	Ammeter (F-3)
9	7041	Rheostat (F-3)
	MS25165	Knob (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 6 of 20)

Index No.	Part No.	Description
10	MS25089-3C	Switch (F-3)
11	1126-1	Fuse lite (F-3)
	GLD5AMP	Fuse (F-3)
12	MS25307-272	Switch (F-3)
	31882	Terminal (F-3)
13	MS25307-232	Switch (F-3)
	31882	Terminal (F-3)
14	9023457-11	Panel (1A7) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	MS35234-64	Screw (F-3)
	MS35335-60	Washer (F-3)
	9023788	Chassis (X-3)
	AN515C10R6	Screw (F-3)
	LD153-0010-0007	Washer (F-3)
	NAS679C3W	Nut (F-3)
	PT07P-18-30P	Connector (F-3)
	MS35489-13	Grommet (F-3)
15	RD415-3001-0001	Lampholder (F-3)
	RD450-2001-0001	Control (F-3)
	MS25237-327	Lamp (F-3)
	RD338-0001-0004	Filter (DS7, DS8, DS9) (F-3)
	RD338-0001-0002	Filter (DS12, DS13, DS14) (F-3)
	RD338-0001-0003	Filter (DS1 thru DS6, DS10, DS11) (F-3)
	RD332-0003-0322	Lens (DS1) (F-3)
	RD332-0003-0329	Lens (DS11) (F-3)
	RD332-0003-0316	Lens (DS6) (F-3)
	RD332-0003-0317	Lens (DS10)(F-3)
	RD332-0003-0321	Lens (DS2) (F-3)
	RD332-0003-0318	Lens (DS5) (F-3)
	RD332-0003-0320	Lens (DS3) (F-3)
	RD332-0003-0319	Lens (DS4) (F-3)
	RD332-0003-0280	Lens (DS7) (F-3)
	RD332-0003-0282	Lens (DS8) (F-3)
	RD332-0003-0284	Lens (DS9) (F-3)
	RD332-0003-0281	Lens (DS12) (F-3)
	RD332-0003-0283	Lens (DS13)(F-3)
	RD332-0003-0285	Lens (DS14)(F-3)
16	9024038-3	Panel (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	9023619	Plate (F-3)
	AN535-2-4	Screw (F-3)
17	9023454	Panel (1A2)(F-1)
	AN520C10R14	Screw (F-3)
17 (cont)	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023664	Plate (F-3)
	AN535-4-4	Screw (F-3)
	9023651-31	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
18	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	19-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
19	19-9021928-4	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0007-0404	Nipple (F-3)
	19-9023777-1	Gage saver (F-2)
	NAS1004-24A	Bolt (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9023999	Bracket (M-3)
	AN520C416R12	Screw (F-3)
	RD273-0002-0800	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	AN6289C8	Nut (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	RD284-5017-0125	Relief valve (F-3)
20	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0004-0800	Tee (F-3)
	RD273-0006-0800	Union (F-3)
	AN6289C8	Nut (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
21	19-9023746	Valve (F-1)
	NAS1[illegible]1-4-20	Screw (F-3)
	LD1[illegible]0010-0009	Washer (F-3)
	NAS6[illegible]C4W	Nut (F-3)
	RD273[illegible]0020-0404	Elbow (F-3)

Figure 5-13. Disassembly of Engine Checkout C[illegible] (Sheet 7 of 20)

Index No.	Part No.	Description
22	19-9023774-4	Valve (F-1)
	LD153-0010-0032	Washer (F-3)
	RD273-0015-1600	Elbow (F-3)
	AN6289C16	Nut (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
23	19-9021928-6	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0007-0404	Nipple (F-3)
	19-9023777-3	Gage saver (F-2)
	MS15795-810	Washer (F-3)
	NAS1004-24A	Bolt (F-3)
	NAS679C4W	Nut (F-3)
	9023999	Bracket (M-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0002-0800	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	AN6289C8	Nut (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	9023577	Orifice (F-3)
	RD284-5017-0330	Relief valve (F-3)
24	19-9023772-4	Regulator (F-1)
	RD273-0015-0800	Elbow (F-3)
	AN894C8-6	Bushing (F-3)
	AN6289C6	Nut (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
25	9023458-11	Panel (1A8)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	9023794	Chassis (X-3)
	AN515C8-8	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	MS35489-13	Grommet (F-3)
	9024148	Plate (M-3)
	AN520C10-7	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS3100R22-23P	Connector (F-3)
	AN515C4-7	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
25 (cont)	480073-1	Terminal block (F-3)
	42637-3	Taper pin (F-3)
	42575-3	Taper pin (F-3)
	AN515C8-12	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	480065-3	Bracket (M-3)
	AN515C6-10	Screw (F-3)
	AN515C6-6	Screw (F-3)
	MS15795-806	Washer (F-3)
26	RD415-3001-0001	Lampholder (F-3)
	RD450-2001-0001	Control (F-3)
	RD228-0001-0001	Filter (F-3)
	MS25237-327	Lamp (F-3)
	RD332-0003-0323	Lens (DS3)(F-3)
	RD332-0003-0324	Lens (DS2)(F-3)
27	MS24331-2	Switch (F-3)
28	HKR	Fuse Holder (F-3)
	AGC-15AMP	Fuse (F-3)
29	MS25307-232	Switch (F-3)
30	101-N-W	Lampholder (F-3)
	RD332-0003-0358	Lens (DS1)(F-3)
31	9023810	Panel (X-3)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
32	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	19-9023773-4	Filter (F-2)
	RD273-0006-0800	Union (F-3)
	MS28778-8	Packing (F-3)
	RD273-0019-1900	Reducer (F-3)
	MS28778-12	Packing (F-3)
	AN919-19C	Reducer (F-3)
	AN832-8C	Union (F-3)
	MS28777-8	Ring (F-3)
	AN939C8	Elbow (F-3)
	AN6289C8	Nut (F-3)
33	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0015-0800	Elbow (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
34	19-9023774-4	Valve (F-1)
	LD153-0010-0032	Washer (F-3)
	RD273-0006-1600	Union (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
	RD273-0015-1600	Elbow (F-3)
	AN6289C16	Nut (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 8 of 20)

Index No.	Part No.	Description
35	9023455	Panel (1A3)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023703	Plate (F-3)
	AN535-4-4	Screw (F-3)
	9023651	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
36	9023770	Flowmeter (F-1)
	9023771-11	Flowmeter (F-1)
	9023652-1	Bracket (X-3)
	9023652-2	Bracket (X-3)
	38031N-4C-8	Screw (F-3)
	MS15795-810	Washer (F-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD284-3007-3002	Check valve (F-3)
	AN919-12C	Reducer (F-3)
	MS28778-8	Packing (F-3)
	9023653	Bezel (F-3)
	AN515C8R10	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
37	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD284-3004-4003	Check valve (F-3)
	RD273-0002-0800	Tee (F-3)
	RD273-0004-0800	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
	RD273-0006-0800	Union (F-3)
38	19-9023745-4	Valve (F-2)
	LL22A04P8	Screw (F-3)
	MS15795 807	Washer (F-3)
	RD273-0006-0800	Union (F-3)
	RD273-0016-0800	Tee (F-3)
38 (cont)	RD273-0015-0600	Elbow (F-3)
	AN893-12C	Bushing (F-3)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD273-0003-0600	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	RD284-5015-0125	Relief valve (F-3)
39	19-9023745-4	Valve (F-2)
	LL22A04P8	Screw (F-3)
	MS15795-807	Washer (F-3)
	AN893-12C	Bushing (F-3)
	RD273-0002-0600	Tee (F-3)
	RD273-0019-1200	Reducer (F-3)
	RD273-0004-0800	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	RD284-5015-0125	Relief valve (F-3)
40	9023770-11	Flowmeter (F-1)
	9023771	Flowmeter (F-1)
	9023652-1	Bracket (X-3)
	9023652-2	Bracket (X-3)
	30831N-4C-8	Screw (F-3)
	MS15795-810	Washer (F-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	RD284-3007-3002	Check valve (F-3)
	RD273-0019-1200	Reducer (F-3)
	MS28778-8	Packing (F-3)
41	19-9023772-2	Regulator (F-1)
	RD273-0006-0600	Union (F-3)
	MS28778-6	Packing (F-3)
	RD284-3001-2003	Check valve (F-3)
42	9023459	Panel (1A4)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 9 of 20)

Index No.	Part No.	Description
42 (cont)	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
43	19-9021928-5	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	AN939C4	Elbow (F-3)
	AN815-4C	Union (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	AN6289C4	Nut (F-3)
	19-9023775	Snubber (F-3)
	RD273-0003-0400	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
44	9023811	Panel (X-3)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
45	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0019-1000	Reducer (F-3)
	RD284-3004-4003	Check valve (F-3)
	RD273-2008-0001	Adapter (F-3)
	19-9015761	Silencer (F-3)
	MS28778-8	Packing (F-3)
46	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0006-0800	Union (F-3)
	RD273-2008-0001	Adapter (F-3)
	19-9015761	Silencer (F-3)
	MS28778-8	Packing (F-3)
47	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0002-0800	Tee (F-3)
	AN6289C8	Nut (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	RD284-5017-0150	Relief valve (F-3)
	19-9015761	Silencer (F-3)
	RD273-2008-0001	Adapter (F-3)
48	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0015-0800	Elbow (F-3)
	MS28777-8	Ring (F-3)
	MS28778-8	Packing (F-3)
	AN6289C8	Nut (F-3)
	RD273-2008-0001	Adapter (F-3)
	19-9015761	Silencer (F-3)
49	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0006-0800	Union (F-3)
	MS28778-8	Packing (F-3)
50	9023456	Panel (1A5) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023750	Plate (X-3)
	AN535-4-4	Drive screw (F-3)
	9023651	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
51	19-9021928-4	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	19-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
52	19-9023772-3	Regulator (F-1)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD273-0019-1200	Reducer (F-3)
	AN6289C6	Nut (F-3)
	MS28777-6	Ring (F-3)
	MS28778-6	Packing (F-3)
	RD284-3004-4003	Check valve (F-3)
	RD273-0016-0800	Tee (F-3)
	AN894C8-6	Bushing (F-3)
	AN6289C8	Nut (F-3)
	MS28777-8	Ring (F-3)
	MS28778-8	Packing (F-3)
53	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	19-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
54	19-9021928-7	Gage (F-2)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 10 of 20)

Index No.	Part No.	Description
54	AN507C428R14	Screw (F-3)
(cont)	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	19-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
55	19-9023772-5	Regulator (F-1)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	AN894C8-6	Bushing (F-3)
	RD284-3004-4003	Valve (F-3)
	RD273-0004-0800	Tee (F-3)
	AN6289C8	Nut (F-3)
	MS28777-8	Ring (F-3)
	MS28778-8	Packing (F-3)
	MS28778-6	Packing (F-3)
56	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	RD273-0015-0800	Elbow (F-3)
	AN6289C8	Nut (F-3)
	MS28777-8	Ring (F-3)
	MS28778-8	Packing (F-3)
	RD273-0006-0800	Union (F-3)
	MS28778-8	Packing (F-3)
57	9023460	Panel (1A6) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
58	19-9023748	Pressure indicator (F-2)
	AN4-5A	Bolt (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679A4	Nut (F-3)
	AN814-8C	Plug (F-3)
	MS28778-8	Packing (F-3)
	RD273-0019-1000	Reducer (F-3)
	MS28778-8	Packing (F-3)
	RD273-0015-0400	Elbow (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	RD273-0002-0400	Tee (F-3)
	AN6289C4	Nut (F-3)
	RD273-0019-1000	Reducer (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
59	19-9023774-2	Valve (F-1)
	LD153-0010-0029	Washer (F-3)
	AN893-3C	Bushing (F-3)
	MS28778-8	Packing (F-3)
	RD273-0003-0400	Tee (F-3)
	MS28778-4	Packing (F-3)
	AN6289C4	Nut (F-3)
	MS28777-4	Ring (F-3)
60	9023614	Panel (X-3)
	AN520C10P14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
61	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	AN893-3C	Bushing (F-3)
	MS28778-7	Packing (F-3)
	RD284-3004-0003	Check valve (F-3)
	RD273-0003-0400	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	AN6289C4	Nut (F-3)
	MS28777-4	Ring (F-3)
	MS28778-4	Packing (F-3)
	19-9015761	Silencer (F-3)
	AN912-5C	Bushing (F-3)
	AN816-4-4C	Nipple (F-3)
62	19-9023774-2	Valve (F-1)
	MS15795-826	Washer (F-3)
	AN893-3C	Bushing (F-3)
	MS28778-8	Packing (F-3)
	RD284-3001-0003	Check valve (F-3)
	MS28778-4	Packing (F-3)
	RD273-0019-1000	Reducer (F-3)
63	9023461	Panel (2A5) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023837	Plate (F-3)
	AN535-4-4	Screw (F-3)
	9023653	Bezel (F-3)
	AN515C8R10	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	9023838	Bezel (F-3)
	AN515C8R10	Screw (F-3)
	MS15795-807	Washer (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 11 of 20)

Index No.	Part No.	Description
63 (cont)	NAS679C08W	Nut (F-3)
	9023651	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
64	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	RD273-0006-0400	Union (F-3)
	19-9023775	Snubber (F-3)
	MS28778-4	Packing (F-3)
65	9023771-51	Flowmeter (F-1)
	38031N-4C-8	Screw (F-3)
	MS15795-810	Washer (F-3)
	9023652-1	Bracket (X-3)
	9023652-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0019-1200	Reducer (F-3)
	RD284-3007-3002	Check valve (F-3)
	MS28778-6	Packing (F-3)
	MS28778-8	Packing (F-3)
66	9023782-11	Flowmeter (F-1)
	38031N-4C-8	Screw (F-3)
	MS15795-810	Washer (F-3)
	9023839-1	Bracket (X-3)
	9023839-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0015-0800	Elbow (F-1)
	MS28777-8	Ring (F-3)
	MS28778-8	Packing (F-3)
	AN6289C8	Nut (F-3)
	RD284-3008-3002	Check valve (F-3)
	RD273-0004-0800	Tee (F-3)
67	9023465	Panel (2A6)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	9023967	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
	PT07P-10-6P	Connector (F-3)
	PT07P-14-5P	Connector (F-3)
67 (cont)	PT07P-8-2S	Connector (F-3)
	PT07P-8-4S	Connector (F-3)
	PT07P-8-3S	Connector (F-3)
	PT07P-8-3P	Connector (F-3)
	9023613	Bracket (M-3)
	AN515C6R7	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
68	MR36W050DCUAR	Ammeter (F-3)
69	RD415-3001-0001	Lampholder (F-3)
	RD450-2001-0001	Control (F-3)
	MS25237-327	Lamp (F-3)
	RD338-0001-0004	Filter (F-3)
	RD332-0003-0312	Lens (DS1)(F-3)
	RD332-0003-0313	Lens (DS2)(F-3)
	RD332-0003-0314	Lens (DS3)(F-3)
	RD332-0003-0315	Lens (DS4)(F-3)
70	9024016	Panel (2A9)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	9024018	Bracket (X-3)
	AN520C10R12	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS25271-D1	Relay (F-3)
	NAS679C06W	Nut (F-3)
	MS15795-805	Washer (F-3)
	MS25267-D1	Relay (F-3)
	NAS679C06W	Nut (F-3)
	MS15795-805	Washer (F-3)
	MS25273-D1	Relay (F-3)
	NAS679C06W	Nut (F-3)
	MS15795-805	Washer (F-3)
	MS3100R10SL-3P	Connector (F-3)
	PT00P-8-4S	Connector (F-3)
	MS3100R18-1S	Connector (F-3)
	MS3102R18-11P	Connector (F-3)
	PT00P-12-3S	Connector (F-3)
	AN515C4R6	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
71	27140-1JP	Recorder (F-2)
	9023681	Spacer (F-3)
	9023682	Spacer (F-3)
	AN520C10R10	Screw (F-3)
	LD153-0010-0007	Washer (F-3)
	AN507C1024R12	Screw (F-3)
72	MR26W015ACAAR	Ammeter (F-3)
73	MS25307-232	Switch (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 12 of 20)

Index No.	Part No.	Description	Index No.	Part No.	Description
74	RD415-3012-0002	Lampholder (F-3)	79 (cont)	RD273-0015-0800	Elbow (F-3)
	RD450-2002-0001	Control (F-3)		MS28778-8	Packing (F-3)
	MS25273-327	Lamp (F-3)		MS28777-8	Ring (F-3)
	RD338-0001-0003	Filter (F-3)		AN6289C8	Nut (F-3)
	RD332-0003-0021	Lens (DS3) (F-3)		RD284-3006-3002	Check valve (F-3)
	RD332-0003-0022	Lens (DS4) (F-3)			
	RD332-0003-0023	Lens (DS5) (F-3)	80	19-9021928-7	Gage (F-2)
75	MS21984-15	Circuit breaker (F-3)		AN507C428R14	Screw (F-3)
				LD153-0010-0009	Washer (F-3)
	AN515C6R7	Screw (F-3)		NAS679C4W	Nut (F-3)
	MS15795-805	Washer (F-3)		AN816-4-4C	Nipple (F-3)
76	RD415-3011-0001	Lampholder (F-3)		19-9023775	Snubber (F-3)
	RD450-2001-0001	Control (F-3)		RD273-0006-0400	Union (F-3)
	MS25273-327	Lamp (F-3)		MS28778-4	Packing (F-3)
	RD338-0001-0002	Filter (DS2) (F-3)	81	19-9023778-1	Regulator (F-2)
	RD338-0001-0004	Filter (DS1) (F-3)		LD153-0010-0033	Washer (F-3)
	RD332-0003-0218	Lens (DS2) (F-3)		RD273-0004-0600	Tee (F-3)
	RD332-0003-0255	Lens (DS1) (F-3)		MS28778-6	Packing (F-3)
77	9023462-11	Panel (2A7) (F-3)		MS28777-6	Ring (F-3)
	AN520C10R14	Screw (F-3)		AN6289C6	Nut (F-3)
	LD153-0010-0008	Washer (F-3)		RD273-0003-0800	Tee (F-3)
	1965-2	Handle (F-3)		RD273-0004-0800	Tee (F-3)
	1988-2	Ferrule (F-3)		RD273-0019-1000	Reducer (F-3)
	NAS1190C3T10N	Screw (F-3)		MS28778-8	Packing (F-3)
	MS15795-808	Washer (F-3)		MS28777-8	Ring (F-3)
	RD111-9001-0024	Bolt (F-3)		AN6289C8	Nut (F-3)
	NAS679C6	Nut (F-3)	82	19-9023778-2	Regulator (F-2)
	MS15795-814	Washer (F-3)		LD153-0010-0033	Washer (F-3)
	9023860	Plate (F-3)		RD273-0003-0800	Tee (F-3)
	AN535-4-4	Screw (F-3)		RD273-0019-1000	Reducer (F-3)
	9023838	Bezel (F-3)		MS28778-8	Packing (F-3)
	AN515C8R10	Screw (F-3)		MS28777-8	Ring (F-3)
	MS15795-807	Washer (F-3)		AN6289C8	Nut (F-3)
	NAS679C08W	Nut (F-3)		RD273-0006-0600	Union (F-3)
	9023651-41	Chassis (X-3)		MS28778-6	Packing (F-3)
	AN520C10R10	Screw (F-3)		RD273-0015-0800	Elbow (F-3)
	MS15795-808	Washer (F-3)	83	19-9023774-2	Valve (F-1)
	NAS679C3W	Nut (F-3)		MS15795-828	Washer (F-3)
78	19-9021928-8	Gage (F-2)		RD273-0019-1000	Reducer (F-3)
	AN507C428R14	Screw (F-3)		MS28778-8	Packing (F-3)
	LD153-0010-0009	Washer (F-3)		RD273-2008-0001	Adapter (F-3)
	NAS679C4W	Nut (F-3)		AN832-8C	Union (F-3)
	AN816-4-4C	Nipple (F-3)		AN939-8C	Elbow (F-3)
	19-9023775	Snubber (F-3)		MS28778-8	Packing (F-3)
	RD273-0006-0400	Union (F-3)		MS28777-8	Ring (F-3)
	MS28778-4	Packing (F-3)		AN6289C8	Nut (F-3)
79	9023782-21	Flowmeter (F-1)		19-9015761	Silencer (F-3)
	9023839-1	Bracket (X-3)	84	19-9021928-5	Gage (F-2)
	9023839-2	Bracket (X-3)		AN507C428R14	Screw (F-3)
	AN520C416R12	Screw (F-3)		LD153-0010-0009	Washer (F-3)
	MS15795-810	Washer (F-3)		NAS679C4W	Nut (F-3)
	NAS679C4W	Nut (F-3)		RD273-0007-0404	Nipple (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 13 of 20)

Index No.	Part No.	Description
84 (cont)	19-9023777-2	Gage saver (F-2)
	NAS1004-26A	Bolt (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9023909	Bracket (M-3)
	AN520C416R10	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0002-0800	Tee (F-3)
	RD273-0003-0800	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
85	19-9023772-5	Regulator (F-1)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD273-0019-1200	Reducer (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
86	RD415-3001-0001	Lampholder (F-3)
	RD450-2001-0001	Control (F-3)
	MS25237-327	Lamp (F-3)
	RD332-0003-0309	Lens (DS3)(F-3)
	RD332-0003-0310	Lens (DS2)(F-3)
	RD332-0003-0311	Lens (DS1)(F-3)
	RD332-0003-0327	Lens (DS5)(F-3)
	RD332-0003-0328	Lens (DS4)(F-3)
	RD338-0001-0003	Filter (DS2 thru DS5) (F-3)
	RD338-0001-0004	Filter (DS1)(F-3)
87	MS25307-232	Switch (F-3)
88	MS25089-3C	Switch (F-3)
89	MS25307-262	Switch (F-3)
	MS25224-3	Guard (F-3)
90	9023466	Panel (2A2)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	9023989	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
	M-5.1-0.375	Module (F-2)
	MS25082-2	Nut (F-3)
	MS35333-72	Washer (F-3)
	9023576	Bracket (M-3)
90 (cont)	AN515C8R8	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	9023613	Bracket (M-3)
	AN515C8R7	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	PT07P-12-10P	Connector (F-3)
	PT07P-8-2S	Connector (F-3)
	PT07P-8-4S	Connector (F-3)
	PT07P-8-3S	Connector (F-3)
	PT07P-8-3SW	Connector (F-3)
	PT07P-12-3P	Connector (F-3)
91	MR36W050DCUAR	Ammeter (F-3)
92	RD415-2001-0001	Lampholder (F-3)
	RD450-2001-0001	Control (F-3)
	MS25237-327	Lamp (F-3)
	RD338-0001-0004	Filter (F-3)
	RD332-0003-0312	Lens (F-3)
	RD332-0003-0313	Lens (F-3)
	RD332-0003-0314	Lens (F-3)
	RD332-0003-0315	Lens (F-3)
93	9024038-3	Panel (X-3)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	9023472	Plate (F-3)
	AN535-2-4	Screw (F-3)
94	9023463-11	Panel (2A3)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023838	Bezel (F-3)
	AN515C8R10	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	9023901	Plate (F-3)
	AN535-4-4	Drive screw (F-3)
	9023651	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	NAS679C3W	Washer (F-3)
	9023886	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 14 of 20)

Index No.	Part No.	Description
95	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	19-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
96	RD415-3001-0001	Lampholder (F-3)
	RD450-2001-0001	Control (F-3)
	MS25237-327	Lamp (F-3)
	RD338-0001-0004	Filter (F-3)
	RD332-0003-0326	Lens (DS1) (F-3)
	RD332-0003-0325	Lens (DS2) (F-3)
97	MS25307-212	Switch (F-3)
98	9023782	Flowmeter (F-1)
	9023839-1	Bracket (X-3)
	9023839-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0015-0800	Elbow (F-3)
	RD273-0004-0800	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
	RD284-3008-3002	Check valve (F-3)
99	19-9023778	Regulator (F-2)
	LD153-0010-0033	Washer (F-3)
	RD273-0015-0800	Elbow (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
100	19-9023745-3	Valve (F-2)
	RD273-0006-0800	Union (F-3)
	MS28778-8	Packing (F-3)
101	19-9023745-1	Valve (F-2)
	RD273-0006-0800	Union (F-3)
	MS28778-8	Packing (F-3)
102	9023771-41	Flowmeter (F-1)
	9023652-1	Bracket (X-3)
	9023652-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN832-6C	Union (F-3)
	AN929C6	Elbow (F-3)
102 (cont)	AN894C8-6	Bushing (F-3)
	RD273-0016-0600	Tee (F-3)
	RD284-3006-3002	Check valve (F-3)
	RD273-1028-0014	Restrictor (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	MS28778-8	Packing (F-3)
103	9023770-51	Flowmeter (F-1)
	9023652-1	Bracket (X-3)
	9023652-2	Bracket (X-3)
	AN520C416R12	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	AN894C8-6	Bushing (F-3)
	RD273-0016-0600	Tee (F-3)
	RD284-3001-4003	Check valve (F-3)
	RD273-1028-0014	Restrictor (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	MS28778-7	Packing (F-3)
	AN938C6	Tee (F-3)
	RD273-0006-0600	Union (F-3)
	RD273-3001-2003	Check valve (F-3)
	MS28778-6	Packing (F-3)
104	19-9023774-2	Valve (F-1)
	RD273-0015-0800	Elbow (F-3)
	AN832-8C	Union (F-3)
	AN939C8	Elbow (F-3)
	RD284-3001-4003	Check valve (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
105	19-9023772-5	Regulator (F-1)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
106	19-9023745-4	Valve (F-2)
	NAS1190C08T10N	Screw (F-3)
	MS15795-807	Washer (F-3)
	RD273-0006-0800	Union (F-3)
	AN832-8C	Union (F-3)
	AN939C8	Elbow (F-3)
	RD273-0016-0800	Tee (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 15 of 20)

Index No.	Part No.	Description
106 (cont)	RD273-0019-1200	Reducer (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
107	19-9023772-2	Regulator (F-1)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
108	9023467	Panel (2A4)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	9023999	Bracket (M-3)
	AN520C10R10	Screw (F-3)
	NAS679C3W	Nut (F-3)
	MS15795-808	Washer (F-3)
109	19-9021928-4	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0020-0404	Elbow (F-3)
	19-9023777-1	Gage saver (F-2)
	AN4-20A	Bolt (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
	RD273-0004-0400	Tee (F-3)
	AN893-3C	Bushing (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	AN6289C4	Nut (F-3)
	MS28778-8	Packing (F-3)
	RD273-0019-1000	Reducer (F-3)
110	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0006-0400	Union (F-3)
	AN815-4C	Union (F-3)
	MS28778-4	Packing (F-3)
	19-9023775	Snubber (F-3)
111	9024058-3	Panel (X-3)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
112	19-9023774-2	Valve (F-1)
	RD284-3004-4003	Check valve (F-3)
	RD273-2008-0001	Adapter (F-3)
	19-9015761	Silencer (F-3)

Index No.	Part No.	Description
112 (cont)	MS15795-828	Washer (F-3)
	RD273-0002-0800	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
113	9023464	Panel (2A1)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	RD111-9001-0024	Bolt (F-3)
	NAS679C6	Nut (F-3)
	MS15795-814	Washer (F-3)
	9023653	Bezel (F-3)
	AN515C8R10	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	9023947	Plate (F-3)
	AN535-4-4	Drive screw (F-3)
	9023651-11	Chassis (X-3)
	AN520C10R10	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
114	9023771-21	Flowmeter (F-1)
	9023652-1	Bracket (X-1)
	9023652-2	Bracket (X-1)
	AN520C416R14	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0015-0600	Elbow (F-3)
	RD273-0019-1200	Reducer (F-3)
	RD284-3007-3002	Check valve (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	MS28778-8	Packing (F-3)
115	19-9021928-7	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN816-4-4C	Nipple (F-3)
	19-9023775	Snubber (F-3)
	RD273-0006-0400	Union (F-3)
	MS28778-4	Packing (F-3)
116	19-9023772-4	Regulator (F-1)
	AN832-6C	Union (F-3)
	AN938C8	Tee (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 16 of 20)

Index No.	Part No.	Description
116 (cont)	RD273-0019-0600	Reducer (F-3)
	RD273-0019-1200	Reducer (F-3)
	AN939C6	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
117	P34-S-4100-2	Readout (F-2)
	RD284-5012-0005	Valve (F-3)
	MS28778-4	Packing (F-3)
	AN832-4C	Union (F-3)
	AN939C4	Elbow (F-3)
	9023577-3	Orifice (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	AN6289C4	Nut (F-3)
118	19-9023774-2	Valve (F-1)
	MS15795-828	Washer (F-3)
	AN832-8C	Union (F-3)
	AN939C8	Elbow (F-3)
	RD273-0006-0800	Union (F-3)
	RD284-3001-4003	Check valve (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
119	19-9023745-4	Valve (F-2)
	LLRRA04P8	Screw (F-3)
	MS15795-807	Washer (F-3)
	RD273-0004-0800	Tee (F-3)
	RD273-0010-0600	Tee (F-3)
	RD273-0006-0800	Union (F-3)
	RD273-0019-1200	Reducer (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
120	9023770-31	Flowmeter (F-1)
	9023652-1	Bracket (F-3)
	9023652-2	Bracket (F-3)
	AN520C416R14	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD273-0019-1200	Reducer (F-3)
	RD284-3003-4003	Check valve (F-3)
	RD273-1028-0014	Restrictor (F-3)
	RD273-0002-0600	Tee (F-3)
	RD284-3001-2003	Check valve (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
120 (cont)	AN6289C6	Nut (F-3)
	MS28778-8	Packing (F-3)
121	19-9023772-5	Regulator (F-1)
	RD273-0015-0600	Elbow (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
122	19-9023772-2	Regulator (F-1)
	RD273-0015-0600	Elbow (F-3)
	AN832-3C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD273-0002-0600	Tee (F-3)
	RD273-0019-1200	Reducer (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
123	9023771-41	Flowmeter (F-1)
	AN832-6C	Union (F-3)
	AN939C6	Elbow (F-3)
	RD273-0019-1200	Reducer (F-3)
	RD284-3007-3002	Check valve (F-3)
	RD284-3001-2003	Check valve (F-3)
	RD273-1028-0014	Restrictor (F-3)
	RD273-0002-0600	Tee (F-3)
	MS28778-6	Packing (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	MS28778-8	Packing (F-3)
124	19-9023774-2	Valve (F-1)
	RD284-3004-4003	Check valve (F-3)
	AN832-8C	Union (F-3)
	AN939C8	Elbow (F-3)
	RD273-2008-0001	Adapter (F-3)
	19-9015761	Silencer (F-3)
	AN937C8	Cross (F-3)
	RD273-0006-0800	Union (F-3)
	RD284-5018-0750	Relief valve (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
125	9023468	Panel (2A8)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	1965-2	Handle (F-3)
	1988-2	Ferrule (F-3)
	NAS1190C3T10N	Screw (F-3)
	MS15795-808	Washer (F-3)
	9023999	Bracket (M-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 17 of 20)

Index No.	Part No.	Description
125 (cont)	AN520C10R10	Screw (F-3)
	NAS679C3W	Nut (F-3)
	MS15795-808	Washer (F-3)
126	19-9021928-8	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	RD273-0006-0400	Union (F-3)
	AN816-4-4C	Union (F-3)
	19-9023775	Snubber (F-3)
	MS28778-4	Packing (F-3)
127	19-9021928-4	Gage (F-2)
	AN507C428R14	Screw (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	19-9023777-1	Gage saver (F-2)
	AN4-20A	Bolt (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
	RD273-0004-0400	Tee (F-3)
	AN893-3C	Bushing (F-3)
	RD273-0019-1000	Reducer (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	AN6289C4	Nut (F-3)
	MS28778-8	Packing (F-3)
128	9024058-5	Panel (X-3)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
129	19-9023774-2	Valve (F-1)
	RD284-3004-4003	Check valve (F-3)
	RD273-2008-0001	Adapter (F-3)
	19-9015761	Silencer (F-3)
	MS15795-828	Washer (F-3)
	RD273-0002-0800	Tee (F-3)
	RD273-0019-1000	Reducer (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
130	9023807-21	Panel (1A9) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	RD265-6002-0004	Cap (F-3)
	RD265-6002-0005	Cap (F-3)
	RD265-6002-4010	Cap (F-3)
	RD265-6002-4012	Cap (F-3)
	MS3102R28-12SW	Connector (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
130 (cont)	MS3102R14S-5S	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
	MS3102R14S-2S	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
	MS3102R36-10S	Connector (F-3)
	AN515C8R14	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	MS3100R28-12S	Connector (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	MS3100R16-11P	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
	MS3102R16-10P	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
131	19-9023773-1	Filter (F-2)
132	19-9023544	Pressure switch (F-2)
133	19-9023747	Valve (F-2)
	AN932-S8	Plug (F-3)
	AN912-13C	Bushing (F-3)
	RD273-0020-0404	Elbow (F-3)
	AN914-6C	Elbow (F-3)
	RD273-0007-1612	Nipple (F-3)
	9023552	Bracket (F-3)
	AN4-7A	Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679A4W	Nut (F-3)
	NAS3104C24-16	U-Bolt (F-3)
134	19-9023749	Transducer (F-2)
135	19-9023544	Pressure switch (F-2)
	RD273-0003-0800	Tee (F-3)
	AN893-3C	Bushing (F-3)
	LD153-0010-0024	Washer (F-3)
	MS28778-4	Packing (F-3)
	MS28778-6	Packing (F-3)
	AN924-6C	Nut (F-3)
136	19-9023546	Relief valve (F-2)
	RD273-0019-2300	Reducer (F-3)
	AN893-19C	Bushing (F-3)
	AN894C16-10	Bushing (F-3)
	RD273-0016-1600	Tee (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 18 of 20)

Index No.	Part No.	Description
136 (cont)	MS28778-10	Packing (F-3)
	MS28778-12	Packing (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
	AN6289C16	Nut (F-3)
137	RD284-5001-0001	Relief valve (F-2)
	LD153-0010-0024	Washer (F-3)
	AN924-8C	Nut (F-3)
	LD153-0010-0023	Washer (F-3)
138	19-9023780	Valve (F-2)
	NAS1004-38A	Bolt (F-3)
	MS15795-810	Washer (F-3)
	NAS43HT4-40	Spacer (F-3)
	RD273-0016-0800	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
139	19-9023781	Valve (F-2)
	NAS1004-38A	Bolt (F-3)
	MS15795-810	Washer (F-3)
	NAS43HT4-40	Spacer (F-3)
	RD284-5018-2000	Relief valve (F-3)
	AN832-8C	Union (F-3)
	AN938C8	Tee (F-3)
	RD273-0006-0800	Union (F-3)
	RD273-0015-0800	Elbow (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN6289C8	Nut (F-3)
140	9024021	Panel (2A11)(F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	RD265-6002-0005	Cap (F-3)
	RD265-6002-0006	Cap (F-3)
	RD265-6002-0007	Cap (F-3)
	480031-1	Terminal board (F-3)
	480031-2	Terminal board (F-3)
	AN515C8R16	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	MS3102R16-10S	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
	MS3100R18-1S	Connector (F-3)
	MS3100R18-11P	Connector (F-3)
	MS3100R20-29S	Connector (F-3)
	AN515C4R10	Screw (F-3)
140 (cont)	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
141	9024034-31	Panel (2A10) (F-1)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	RD265-6002-0002	Cap (F-3)
	RD265-6002-0005	Cap (F-3)
	RD265-6002-0007	Cap (F-3)
	RD265-6002-0008	Cap (F-3)
	RD265-6002-4010	Cap (F-3)
	480065-3	Terminal block (F-3)
	582068-9	Terminal block (F-3)
	AN515C6R26	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	480031-1	Terminal block (F-3)
	480031-2	Terminal block (F-3)
	480031-3	Terminal block (F-3)
	AN515C8R16	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	MS3102R28-12P	Connector (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	MS3102R22-14P	Connector (F-3)
	MS3102R22-14S	Connector (F-3)
	MS3102R20-16S	Connector (F-3)
	MS3102R20-33S	Connector (F-3)
	MS3100R10SL-3P	Connector (F-3)
	MS3100R16S-1S	Connector (F-3)
	MS3100R16S-1SW	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-803	Washer (F-3)
	NAS679C04W	Nut (F-3)
142	19-9023743-2	Transducer (F-2)
	RD273-0015-2000	Elbow (F-3)
	NAS424-20	Coupling (F-3)
	RD273-0019-2800	Reducer (F-3)
	MS28778-20	Packing (F-3)
	MS28777-20	Ring (F-3)
	AN6289C20	Nut (F-3)
143	19-9023779-1	Regulator (F-2)
	RD273-0006-2000	Union (F-3)
	NAS424-20	Coupling (F-3)
	RD273-0015-2000	Elbow (F-3)

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 19 of 20)

Index No.	Part No.	Description	Index No.	Part No.	Description
143	MS28778-20	Packing (F-3)	147	9024012	Panel (2A12) (F-1)
(cont)	MS28777-20	Ring (F-3)		AN520C10R14	Screw (F-3)
	AN6289C20	Nut (F-3)		LD153-0010-0008	Washer (F-3)
144	19-9023749	Transducer (F-2)		RD265-6002-4010	Cap (F-3)
	AN937C20	Cross (F-3)		RD265-6002-0007	Cap (F-3)
	RD273-0014-2000	Union (F-3)		TBF-20-11PS	Connector (F-3)
	AN924-20C	Nut (F-3)		AN515C4R8	Screw (F-3)
	LD153-0010-0032	Washer (F-3)		MS15795-803	Washer (F-3)
	RD273-0015-2000	Elbow (F-3)		NAS679C04W	Nut (F-3)
	AN893-24C	Bushing (F-3)		TBF-28-16PSW	Connector (F-3)
	RD273-0015-1600	Elbow (F-3)		MS15795-805	Washer (F-3)
	AN893-6C	Bushing (F-3)		AN515C6R10	Screw (F-3)
	MS28778-4	Packing (F-3)		NAS679C06W	Nut (F-3)
	MS28778-16	Packing (F-3)		10-169228-16S	Connector (F-3)
	MS28777-16	Ring (F-3)		AN515C6R10	Screw (F-3)
	AN6289C16	Nut (F-3)		MS15795-805	Washer (F-3)
	MS28778-20	Packing (F-3)		NAS679C06W	Nut (F-3)
	MS28777-20	Ring (F-3)	148	19-9023743-1	Transducer (F-2)
	AN6289C20	Nut (F-3)		RD273-0018-1612	Bushing (F-3)
145	19-9023779-2	Regulator (F-2)		RD284-3008-6002	Check valve (F-3)
	RD273-0019-2300	Reducer (F-3)		RD273-0019-2300	Reducer (F-3)
	AN894C16-12	Bushing (F-3)		RD273-0006-1600	Union (F-3)
	RD273-0016-1300	Tee (F-3)		MS28778-16	Packing (F-3)
	MS28778-12	Packing (F-3)	149	9023451-41	Console No. 1 (F-1)
	MS28778-16	Packing (F-3)		9023470-1	Frame (X-1)
	MS28777-16	Ring (F-3)	150	9023452-51	Console No. 2 (F-1)
	AN6289C16	Nut (F-3)		9023470-2	Frame (X-1)
146	19-9023555	Regulator (F-2)			
	AN924-4C	Nut (F-3)			
	LD153-0010-0016	Washer (F-3)			

Figure 5-13. Disassembly of Engine Checkout Console (Sheet 20 of 20)

5-32. INSTALLING.

5-33. All parts of the engine checkout console must meet the cleanness requirements outlined in section I prior to installing. See figure 5-13A for typical installation of components, and figure 5-13 for index and part numbers. The following steps include the special instructions. All tubing is locally manufactured from CRES 321 tubing, Type I (MIL-T-8808) with tube end in accordance with MS33584, sleeve MS20819-, and nut AN818-. Use damaged tube for mockup and wall thickness. The lubricant used for dynamic O-rings is FS1281 grease (Dow Corning Corp); for O-rings, seals, straight threads, and sliding surfaces, use lubricant grease RB0140-012 (Rocketdyne). For tapered threads, use thread sealant tape RB0140-002 (Rocketdyne). Refer to section I for lubricant application.

a. Torque threaded fasteners as follows:

NOTE

When tightening fasteners from the head side, torque must be within 10 percent of the high side of the specified torque range.

Part Number	Size/ Thread	Torque (in-lb)
AN4-	1/4-28	61-75
AN505-8-	8-32	5-6
AN507C1032	10-32	8-10
AN507C428-	1/4-28	20-26
AN515C6-	6-32	1 1/2-2
AN515C8-	8-32	5-6
AN515C10-	10-24	7-8
AN520-10-	10-32	8-10
AN520C6-	6-32	1 1/2-2
AN520C10-	10-32	8-10
AN520C416	1/4-28	20-26
AN520UB416-	1/4-28	20-26
NAS1004-	1/4-28	61-75
NAS1190C08-	8-32	14-18
NAS1190C3-	10-32	24-30
NAS1351-4-	1/4-28	36-47
RD111-9001-	3/8-24	290-390
LL22A04P8-	10-24	9-10
38031N-4C-	1/4-20	24-26

b. Torque nut AN924 or union AN815 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	55-80
3/8	100-150
1/2	180-230
3/4	420-600
1	600-840
1-1/4	720-960

c. Torque plug AN814 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	40-65
3/8	80-120
1/2	150-200
3/4	300-500
1	450-600
1-1/4	600-720

d. Torque nut AN6289 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	75-100
3/8	150-200
1/2	200-250
3/4	450-650
1	650-900
1-1/4	800-1,000

e. Torque jamnuts and fittings without gaskets as follows:

Tube	Torque (in-lb)	
OD (Inches)	Aluminum	Steel
1/4	90-105	110-130
3/8	125-145	225-275
1/2	240-280	400-450
3/4	540-660	800-960
1	840-960	1,000-1,200
1-1/4	960-1,200	--

f. Torque B-nuts AN818 for tubing as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	135-185
3/8	270-345
1/2	450-525
3/4	900-1,100
1	1,200-1,400
1-1/4	1,500-1,800

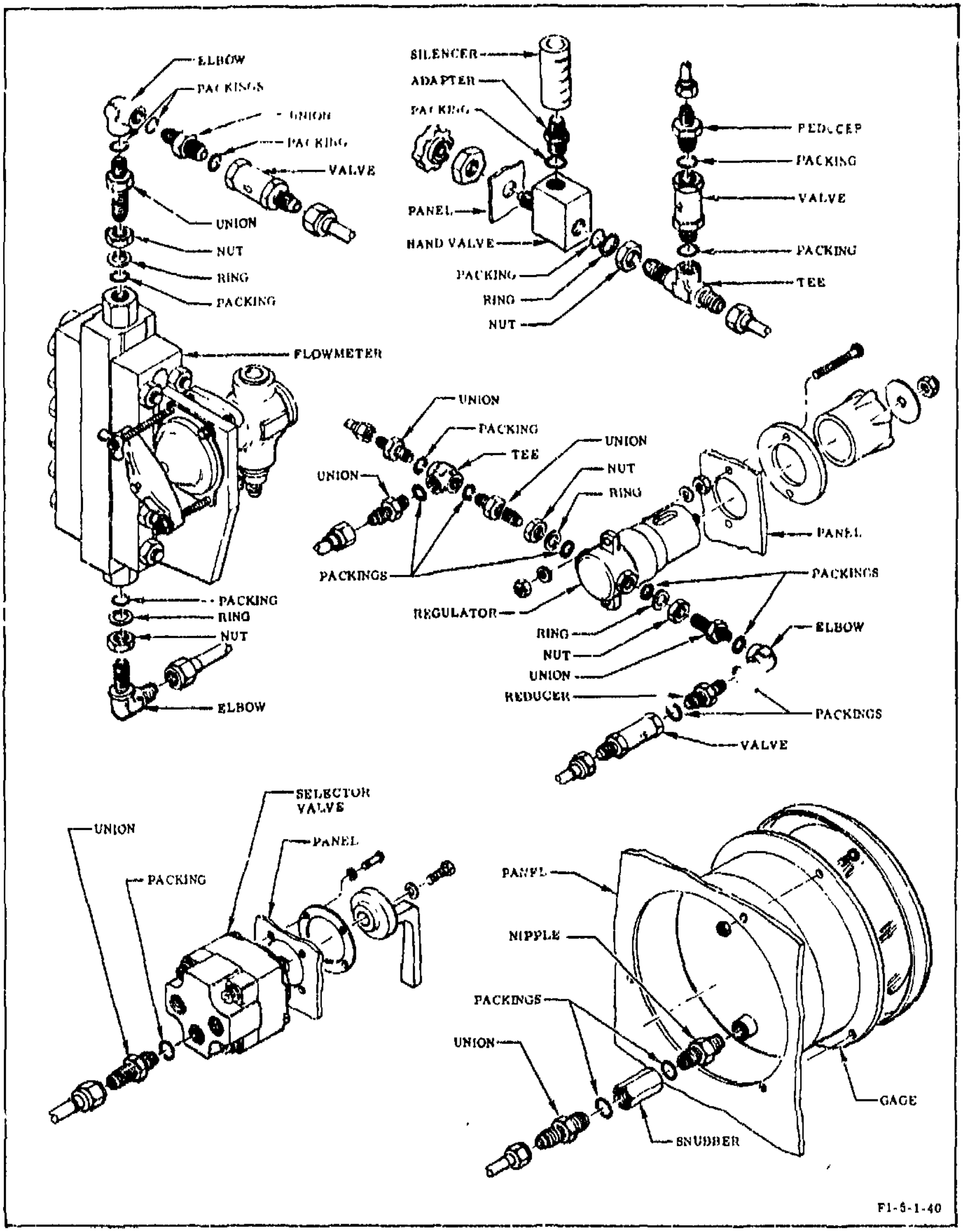


Figure 5-13A. Component Installation (Typical)

5-34. SERVICING.

5-35. Servicing of the engine checkout console consists of a 6-month periodic calibration-check of pressure gages, flowmeters, and electrical measuring instruments. Lubricate pressure regulators 19-9023772-3, -4, and -5 stem and handwheel mating surfaces at 30-day intervals. Refer to paragraph 5-46 for servicing of pressure regulator. Lubricate handvalves 19-9023774-2 and -4 stem threads and seal at 18-month intervals. Refer to paragraph 5-52A for servicing of hand valve. In addition, a function-test of relief valves as outlined in paragraphs 5-24 through 5-29 is required annually. Calibration requirements are listed in figure 5-14.

Part Number	Nomenclature	Range/Accuracy (± Full Scale)	Type of Service	Test Standard Accuracy (± Full Scale)
19-9021928-4	PRESERVATIVE INLET PRESS gage	0-100 psig (0.1%)	Fuel	Using Facility
19-9021928-4	PRESS. DNSTR OF TURB gage	0-100 psig (0.1%)	Fuel	
19-9021928-4	LOX CLEAN AIR PRESS gage	0-100 psig (0.1%)	Pneumatic	
19-9021928-4	LOX B.S. PRESS. LOW gage	0-100 psig (0.1%)	Pneumatic	
19-9021928-4	FUEL B.S. PRESS LOW gage	0-100 psig (0.1%)	Fuel	
19-9021928-5	FUEL PUMP INLET PRESS gage	0-250 psig (0.1%)	Fuel	
19-9021928-5	LOX PUMP INLET PRESS gage	0-250 psig (0.1%)	Pneumatic	
19-9021928-5	IMV CONT PRESS. gage	0-250 psig (0.1%)	Fuel	
19-9021928-6	FUEL INLET PRESS NO. 1 gage	0-500 psig (0.1%)	Fuel	
19-9021928-6	FUEL INLET PRESS NO. 2 gage	0-500 psig (0.1%)	Fuel	
19-9021928-7	HELIUM PRESS. gage	0-1,000 psig (0.1%)	Pneumatic	

Figure 5-14. Calibration-Check Requirements (Sheet 1 of 3)

Part Number	Nomenclature	Range/Accuracy (± Full Scale)	Type of Service	Test Standard Accuracy (± Full Scale)
19-9021928-7	GN2 PRESS gage	0-1,000 psig (0.1%)	Pneumatic	
19-9021928-7	FUEL HIGH PRESS. gage	0-1,000 psig (0.1%)	Fuel	
19-9021928-8	INLET PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	OVERRIDE PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	OPENING PORT PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	CLOSING PORT PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	SWITCH MANIFOLD PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	HYD HI-FLOW PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	GOX PRESS. gage	0-3,000 psig (0.1%)	Pneumatic	
19-9021928-8	LOX B.S. PRESS. HIGH gage	0-3,000 psig (0.1%)	Pneumatic	
19-9021928-8	CLOSING INLET PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	OPENING INLET PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	FUEL B.S. PRESS. HIGH gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	HYD PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	IMV CONT PRESS. HIGH gage	0-3,000 psig (0.1%)	Fuel	
19-9021928-8	IMV OUTLET PRESS. gage	0-3,000 psig (0.1%)	Fuel	
19-9023748	HELIUM PRESS. DROP gage	0-6 psid (0.1%)	Pneumatic	
19-9023748	GOX PRESS. DROP gage	0-6 psid (0.1%)	Pneumatic	
9023770	LOX CLEAN AIR FLOW HIGH flowmeter	30-300 scim at 100 psig (3%)	Pneumatic	
9023770-11	MISSILE AIR FLOW LOW flowmeter	20-200 scim at 30 psig (3%)	Fuel	

Figure 5-14. Calibration-Check Requirements (Sheet 2 of 3)

Part Number	Nomenclature	Range/Accuracy (± Full Scale)	Type of Service	Test Standard Accuracy (± Full Scale)
9023770-21	HYD RETURN LOW flowmeter	20-200 cc/min at 45 psig (3%)	Fuel	
9023770-31	LOX B.S. LEAKAGE HIGH PRESS. flowmeter	3-30 scim at 1,750 psig (3%)	Pneumatic	
9023770-51	FUEL B.S. LKG HIGH flowmeter	7-70 scim at 2,000 psig (3%)	Fuel	
9023771	LOX CLEAN AIR FLOW LOW Flowmeter	30-300 scim at 30 psig (3%)	Pneumatic	
9023771-11	MISSILE AIR FLOW HIGH flowmeter	20-200 scim at 100 psig (3%)	Fuel	
9023771-21	SEQ OUTLET RETURN flowmeter	2.7 to 27.00 scim at 5 psig (3%)	Fuel	
9023771-31	LOX B.S. LEAKAGE LOW PRESS. flowmeter	1.5 to 13.0 scim at 30 psig (3%)	Pneumatic	
9023771-41	FUEL B.S. LKG LOW flowmeter	1.3 to 13.0 scim at 30 psig (3%)	Fuel	
9023771-51	IMV RETURN flowmeter	3-30 cc/min at 45 psig (3%)	Fuel	
9023782	HYD RET FLOW flowmeter	0.2 to 2.1 gpm at 45 psig (3%)	Fuel	
9023782	HYD RETURN HIGH flowmeter	0.2 to 2.1 gpm at 45 psig (3%)	Fuel	
9023782-11	CLOSING PRESS RETURN flowmeter	500-5,000 cc/min at 45 psig (3%)	Fuel	
9023782-21	HYD RETURN FLOW flowmeter	0.082 to 0.82 gpm at 45 psig (3%)	Fuel	
MR36W050DCVVR	Voltmeter	0.50 vdc (0.5%)	None	
MR36W002DCAAR	Ammeter	0-1 ampere (0.5%)	None	
MR36W050DCUAR	Ammeter	0-50 microampere (0.2%)	None	0.5%
MR26W015ACCAAR	Ammeter	0-15 ac ampere (0.2%)	None	
P34-S-4100-2	Readout	0-20 gpm 0-60 gpm (0.01%)	None	0.25%
27140-1JP	Recorder	0-300° F (0.25%)	None	0.05%

Figure 5-14. Calibration-Check Requirements (Sheet 3 of 3)

5-36. SHIPPING AND STORAGE.

5-37. Prepare the engine checkout console for shipping or storage in accordance with MIL-P-116, Method II.

5-38. COMPONENT REPAIR.

5-39. FLOWMETER 19-9023742.

5-40. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the flowmeters.

5-41. DISASSEMBLING. Disassemble the flowmeter, as required, to accomplish necessary repair and/or replacement. See figure 5-15 for parts and index numbers.

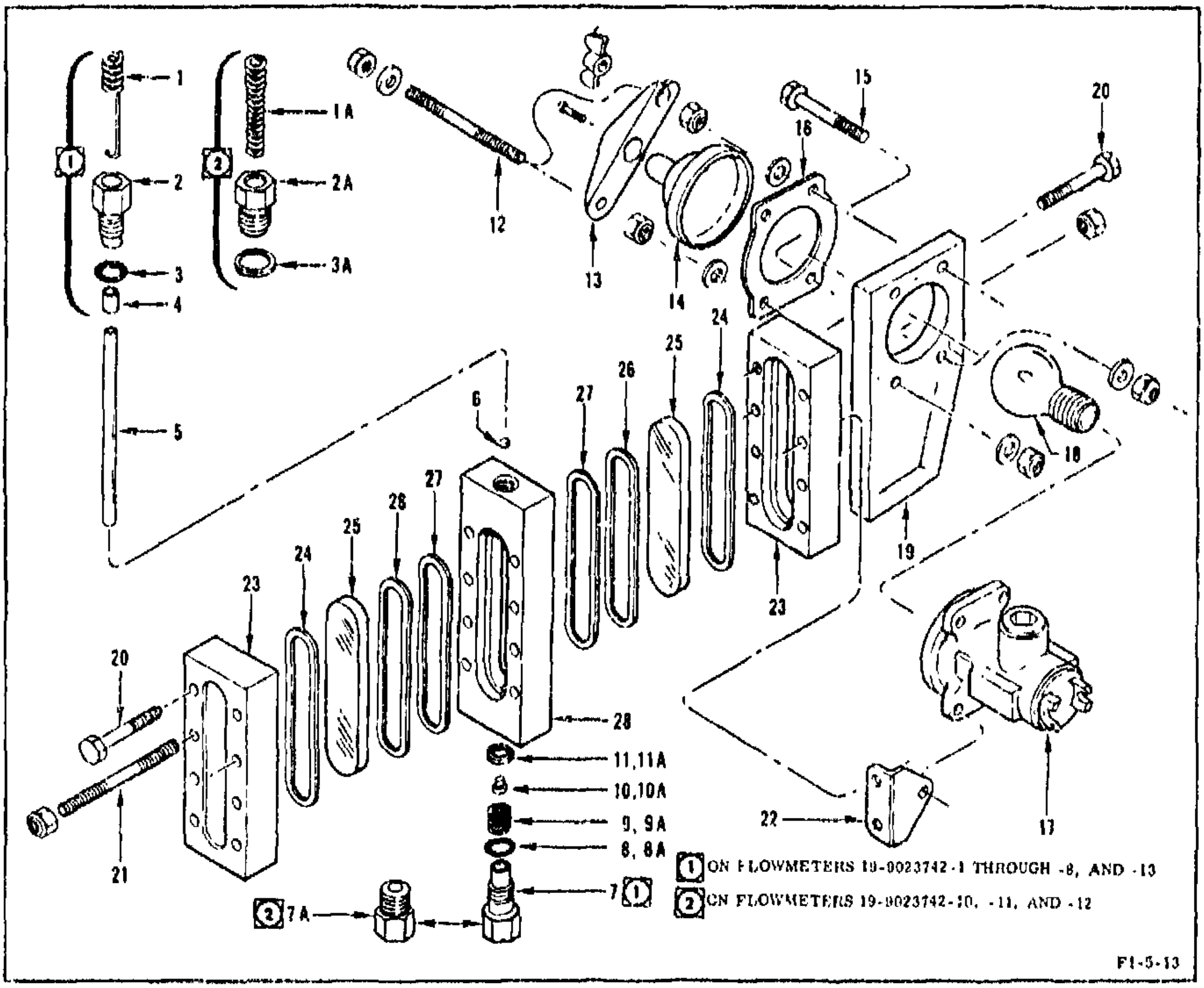


Figure 5-15. Flowmeter--Exploded View (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	A-59-36	Spring (F-3)	10A	A-41-179	Seat (F-3)
1A	A-59-114	Spring (F-3)	11	A-74-33	Gasket (F-3)
2	A-37-218	Outlet Fitting (F-3)	11A	A-74-62	Gasket (F-3)
2A	B-37-626	Outlet Fitting (F-3)	12		Stud Bolt (D-2)
3	A-45-1-13	O-Ring (F-3)			Nut (D-2)
3A	A-45-1-13	O-Ring (F-3)			Wingnut (D-2)
4	A-49-184	Insert (F-3)			Washer (D-2)
5	R-1-15-1 (with	Metering Tube	13		Retainer (D-2)
	A-58-735)[a]	(calibrated) (F-3)	14		Cap (D-2)
	R-1-15-1[b]	Metering Tube (F-3)			Screw (D-2)
	R-2-15-A[c]	Metering Tube (F-3)	15		Bolt (D-2)
	R-2-15-AA[d]	Metering Tube (F-3)			Nut (D-2)
	R-2-15C[e]	Metering Tube (F-3)			Washer (D-2)
	85-387-1[f]	Metering Tube (F-3)	16		Gasket (D-2)
	A-85-387[g]	Metering Tube (F-3)	17		Light Socket (D-2)
6	A-58-174-1[h]	Float (F-3)	18		Globe (115-vac
	A-58-174-2[i]	Float (F-3)			25-watt) (F-3)
	A-58-174-3[j]	Float (F-3)	19		Lens (D-2)
	A-58-174[k]	Float (F-3)	20		Bolt (D-2)
	8-RV-8[l]	Float (F-3)	21		Stud Bolt (D-2)
	8-RV-14[m]	Float (F-3)			Nut (D-2)
	8-RV-31[n]	Float (F-3)			Washer (D-2)
7	A-36-238	Inlet Fitting (F-3)	22		Bracket (D-2)
7A	B-36-508	Inlet Fitting (F-3)	23		Cover (D-2)
8	A-43-1-13	O-Ring (F-3)	24		Cushion (D-2)
8A	A-43-1-13	O-Ring (F-3)	25		Gage Glass (D-2)
9	A-59-6	Spring (F-3)	26		Retainer (D-2)
9A	A-59-9	Spring (F-3)	27		Gasket (D-2)
10	49-2-35	Seat (F-3)	28		Liquid Chamber (D-2)

(a) On flowmeter 19-9023742-2
(b) On flowmeter 19-9023742-4
(c) On flowmeters 19-9023742-1, -7, -8, and -13
(d) On flowmeters 19-9023742-3 and -5
(e) On flowmeter 19-9023742-6
(f) On flowmeters 19-9023742-10 and -11
(g) On flowmeter 19-9023742-12
(h) On flowmeter 19-9023742-5
(i) On flowmeters 19-9023742-1, -6, -8, and -13
(j) On flowmeters 19-9023742-3 and -4
(k) On flowmeter 19-9023742-7
(l) On flowmeter 19-9023742-12
(m) On flowmeter 19-9023742-11
(n) On flowmeter 19-9023742-10

Figure 5-15. Flowmeter--Exploded View (Sheet 2 of 2)

5-42. CLEANING. Clean flowmeters 19-9023742-1 through -5, -7, and -8 for pneumatic service and flowmeters 19-9023742-6 and -10 through -12 for fuel service as outlined in section I. Perform antistatic treatment on tubes and floats of flowmeters 19-9023742-2 through -5, and -7 after cleaning.

a. Place float on lint-free paper and pour a drop of ANSTAC-2M solution (Chemical Development Corp) on paper.

b. Roll float through solution until thoroughly coated; roll float over dry portion of paper until ball appears dry.

c. Using a small piece of lint-free cloth dampened with ANSTAC-2M solution (Chemical Development Corp), wet inside of tube. Wipe tube until it appears dry.

5-43. INSPECTING AND REPAIRING. Inspecting the flowmeter determines whether the individual parts have been damaged by mishandling or wear. See figure 5-16 and inspect parts for cleanness, damage, and wear. Repair of flowmeters is limited to replacement of parts listed (only parts listed with part number) in figure 5-15.

5-44. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 5-42. See figure 5-15 for index and part numbers.

NOTE

The lubricant used in this procedure must be FS1281 grease (Dow Corning Corp) unless otherwise specified.

a. Install (one side at a time) gasket (27), retainer (26), gage glass (25), cushion (24), and cover (23) onto liquid chamber (28); secure loosely with bolts (20).

b. Install bracket (22) on side of cover (23) and secure loosely with stud bolts (21).

c. Install remaining stud bolts (21) through cover and liquid chamber and firmly tighten all stud bolts (21) and bolts (20).

d. On flowmeters 19-9023742-10, -11, and -12, cross-torque stud bolts (21) and bolts (20), starting with center bolts to 60-65 foot-pounds.

NOTE

Final torque values should be reached by making three or more sequential passes, in order to impose as little strain on the gage glass (25) as possible.

e. Install globe (18) into light socket (17), install light socket (17) on one side of lens (19) and gasket (16) on other side of lens, and secure with bolts (15) and stud bolts (12)

f. Install screw through retainer (13) into cap (14) and install as an assembly over stud bolts (12). Secure with nut and wingnut.

g. Install light fixture on bracket (22) and secure with lower stud bolt (12).

Part Name and Index Number	Inspecting	Repairing
Spring (1, 1A)	Distortion	Replace.
Outlet fitting (2, 2A)	Damaged threads	Chase threads; replace if damage exceeds 50 percent of one thread.
Metering tube (5)	Cracks and legibility	Replace.
Float (6)	Cracks, flat spots, and freedom of movement within tube	Replace or perform cleaning and antistatic treatment (paragraph 5-42).
Inlet fitting (7, 7A)	Damaged threads	Chase threads; replace if damage exceeds 50 percent of one thread.
Spring (9, 9A)	Distortion	Replace.
Seat (10, 10A)	Worn sealing surface	Replace.

Figure 5-16. Inspecting and Repairing Flowmeter

h. Lubricate O-ring (8, 8A) and install on inlet fitting (7, 7A). Install spring (9, 9A), seat (10, 10A), and gasket (11, 11A) into inlet fitting (7, 7A).

i. Lubricate threads of inlet fitting (7, 7A) (inlet fitting has a small pressure-balance hole) and screw fitting into liquid chamber (28). Tighten fitting firmly but do not use excessive force.

j. Using lint-free gloves, insert metering tube (5) into top of liquid chamber and, using a wooden dowel of approximate size of tube, push tube onto seat (10, 10A).

k. Tilt flowmeter and, using lint-free gloves, insert float (6) into metering tube (5), allowing float to gently roll down tube.

l. Install insert (4), on flowmeters 19-9023742-1 through -8, and -13, into top of tube (5). Lubricate O-ring (3, 3A) and install onto outlet fitting (2, 2A).

m. Lubricate threads of outlet fitting (2, 2A) and screw fitting into liquid chamber (28). Tighten fitting firmly but do not use excessive force.

n. Install spring (1, 1A) into outlet fitting (2, 2A). Spring (1) is hooked onto insert (4). Install closures on inlet and outlet fittings.

5-45. TESTING. The test procedures require a source of gaseous nitrogen (MIL-P-27401), RJ-1 fuel (MIL-F-25558) capable of maintaining required flowrates, leak-test compound (MIL-L-25567, or equivalent), three shutoff valves, and a needle valve (3,000 psig rating), as applicable, for pneumatic service and for hydraulic service. The flowmeter must be firmly secured in a vertical position during testing.

a. Connect flowmeter to test setup as shown in figure 5-17 and close all valves.

NOTE

For pneumatic testing the needle valve is vented to atmosphere; for hydraulic testing it is vented to return.

b. Apply supply pressure (rated operating pressure, figure 5-14), as applicable, to inlet of test setup.

c. Open bypass valve and slowly open needle valve just enough to obtain flow.

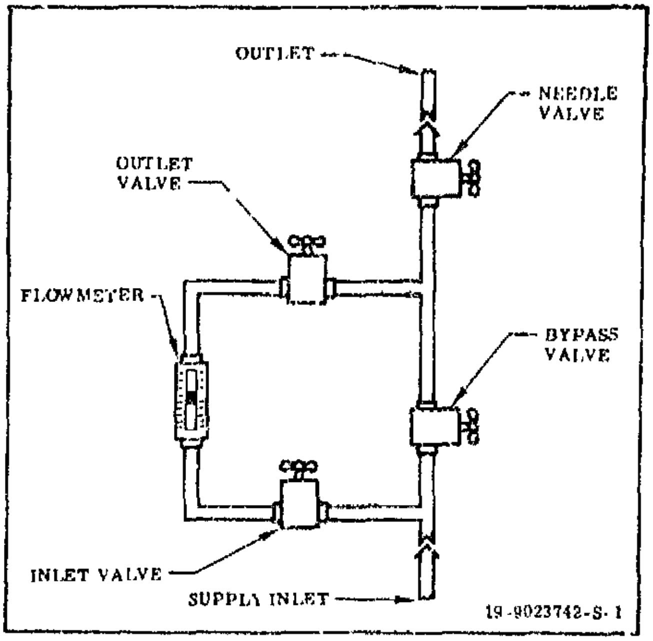


Figure 5-17. Flowmeter Test Setup

d. Slowly open inlet and outlet shutoff valves and allow lines and flowmeter to fill. Slowly close bypass valve.

e. Close needle valve and apply leak-test compound (MIL-L-25567), or observe for fluid leaks, at inlet and outlet fittings and mating surfaces of liquid chamber and covers. No leakage is allowable.

f. Slowly open needle valve and regulate flow to allow float to raise to top of graduated scale of tube and to descend to bottom of tube. Float must rise and descend smoothly.

g. Repeat step f, maintaining stable flow at four equal increments of scale. Float must stabilize at each increment.

h. If float operation is erratic or sticking, check for leakage in test setup or perform cleaning procedure outlined in paragraph 5-42.

5-46. PRESSURE REGULATOR 19-9023772.

5-47. The following procedures contain disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the pressure regulator.

5-48. DISASSEMBLING. Disassemble the regulator, as required, to accomplish necessary repair and/or replacement. See figure 5-18 for parts and index numbers.

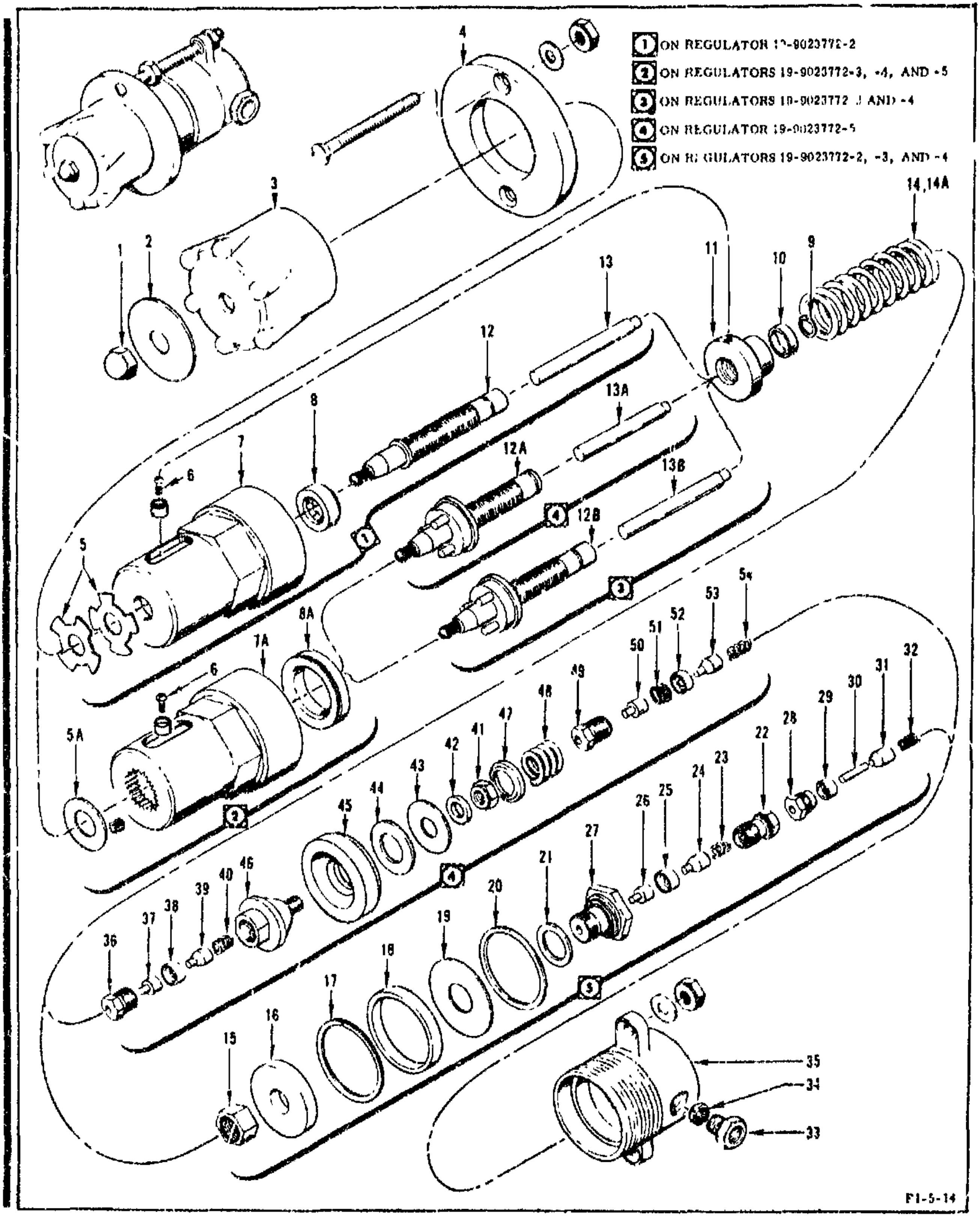


Figure 5-18. Pressure Regulator--Exploded View (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1		Capnut (D-2)	16		Plate (D-2)
2		Nameplate (D-2)	17		Lockring (D-2)
3		Handwheel (D-2)	18		Clamp Ring (D-2)
4		Mounting Plate (D-2)	19	090-02204	Diaphragm (F-3)
		Bolt (D-2)	20	021-02204	Gasket (outer) (F-3)
		Nut (D-2)	21	021-00704	Gasket (inner) (F-3)
		Washer (D-2)	22	22461-1	Retainer (F-3)
5		Washer (D-2)	23	015-10201	Spring (F-3)
5A		Washer (D-2)	24	101-01557	Valve (F-3)
6		Screw (D-2)	25	23460-2	Seat (F-3)
		Guide Button (D-2)	26	261114	Pin (F-3)
7		Spring Barrel (D-2)	27		Diaphragm Bolt (D-2)
7A		Spring Barrel (D-2)	28	101-01574	Retainer (F-3)
		Planet Gear (D-2)	29	23460-2	Seat (F-3)
8	085-01001	Thrust Bearing (F-3)	30	101-01573	Pin (F-3)
8A	101-01565	Thrust Bearing (F-3)	31	101-01557	Valve (F-3)
	101-01566	Bearing Race (F-3) (upper)	32	015-10201	Spring (F-3)
			33	101-01549	Fitting (F-3)
	101-01567	Bearing Race (F-3) (lower)	34	104-01028	Filter (F-3)
			35		Body (D-2)
9		Snapring (D-2)	36	22478	Retainer (F-3)
10		Collar (D-2)	37	261114	Pin (F-3)
11		Adjusting Nut (D-2)	38	23460-2	Seat (F-3)
12	101-01507	Stem Unit (F-3)	39	101-01557	Valve (F-3)
13		Stem Rod (F-3)	40	015-10201	Spring (F-3)
		Screw (F-3)	41		Diaphragm Nut (D-2)
		Spring (F-3)	42		Plate (D-2)
		Pin (F-3)	43	090-01201	Diaphragm (F-3)
12A	101-01564	Stem Unit (F-3)	44	021-01201	Gasket (F-3)
13A		Stem Rod (F-3)	45		Clamp Ring (D-2)
		Screw (F-3)	46		Diaphragm Bolt (D-2)
		Spring (F-3)	47		Guide (D-2)
		Pin (F-3)	48	015-60402	Spring (F-3)
12B	101-01629	Stem Unit (F-3)	49	101-01574	Retainer (F-3)
13B		Stem Rod (F-3)	50	261114	Pin (F-3)
		Screw (F-3)	51	290179	Shims (F-3)
		Spring (F-3)		299245	Shims (F-3)
		Pin (F-3)	52	23460-2	Seat (F-3)
14	10913-1	Loader Spring (F-3)	53	101-01557	Valve (F-3)
14A	015-92402-2	Loader Spring (F-3)	54	015-10201	Spring (F-3)
15		Diaphragm Nut (D-2)			

Figure 5-18. Pressure Regulator--Exploded View (Sheet 2 of 2)

5-49. CLEANING. Clean pressure regulator as outlined in section I. For inspecting and handling parts, refer to section I.

5-50. INSPECTING AND REPAIRING. Inspecting the pressure regulator determines whether the individual parts have been damaged by mishandling or wear. See figure 5-19 and inspect parts for cleanness, damage, and wear. Repair of the pressure regulator is limited to the replacement of parts listed (only parts listed with part numbers) in figure 5-18.

Part Name and Index Number	Inspecting	Repairing
Thrust Bearing (8, 8A)	Wear and pitting	Replace.
Stem Unit (12, 12A, 12B)	Damaged threads and wear	Chase threads; replace if damage exceeds 50 percent of one thread.
Loader Spring (14, 14A)	Distortion	Replace.
Spring (23, 32, 40, 54)	Distortion	Replace.
Valve (24, 31, 39, 53)	Wear, nicks or scratches in seating surface	Replace.
Seat (25, 29, 38, 52)	Wear, nicks, or scratches in sealing surface	Replace.
Pin (26, 30, 37, 50)	Wear	Replace.
Filter (34)	Damage and cleanness	Replace.

Figure 5-19. Inspecting and Repairing Pressure Regulator

5-51. ASSEMBLING. All parts of the pressure regulator must meet the cleaning requirements of section I. Lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne), unless otherwise specified. Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace diaphragm and gaskets with new items. See figure 5-18 for index and part numbers.

a. Clamp body (35) securely in a vise with soft jaws. Lubricate (Method A) threads of fitting (33). Install filter (34) and fitting (33) into body (35) IN ports. Torque fitting (34) to 125-140 foot-pounds.

NOTE

Steps b through e apply to regulators 19-9023772-2, -3, and -4.

b. Lubricate (Method A) threads of retainer (28). Install spring (32), valve (31), pin (30), seat (29), and retainer (28) into body (35). Make sure valve is seated, and torque retainer (28) to 15-17 foot-pounds.

c. Lubricate (Method A) threads of retainer (22). Install pin (26), seat (25), valve (24), spring (23), and retainer (22) into diaphragm bolt (27). Torque retainer (22) to 15-17 foot-pounds.

d. Install gaskets (21), diaphragm (19), plate (16), and diaphragm nut (15) onto diaphragm bolt (27). Torque diaphragm nut (15) to 13 foot-pounds.

CAUTION

Do not overtorque nut (15) or buckling and damage to diaphragm can result.

e. Lubricate (Method A) threads of diaphragm bolt (27) and install bolt into body (35); place gasket (20), clamp ring (18), and lockring (17) into body (35).

NOTE

Steps f through l apply to regulator 19-9023772-5.

f. Lubricate (Method A) threads of retainer (49). Install spring (54), valve (53), seat (52), shims (51), pin (50), and retainer (49) into body (35). Make sure valve is seated, and torque retainer (49) to 15-17 foot-pounds.

g. Measure projection of pin (50) above retainer (49). Dimension must be 0.008 to 0.010 inch. If out of tolerance, replace shims as necessary.

h. Install clamp ring (45) into body (35) and measure and record distance from top of clamp ring (45) to top of pin (50).

i. Remove clamp ring, install diaphragm (43) into clamp ring recess, and place clamp ring and diaphragm into body (35). Measure and record distance from top of clamp ring to top of pin (50). If difference between steps h and i is less than 0.005 inch, one gasket (44) is required.

j. Remove clamp ring and diaphragm from body and install clamp ring (45), gasket (44) (as required), diaphragm (43), plate (42) and diaphragm nut (41) onto diaphragm bolt (4). Torque diaphragm nut (41) to 5 foot-pounds.

CAUTION

Do not overtorque nut (41) or buckling and damage to diaphragm can result.

k. Lubricate (Method A) threads of retainer (36). Install spring (40), valve (39), seat (38), pin (37), and retainer (36) into diaphragm bolt (46). Torque retainer (36) to 15-17 foot-pounds.

l. Lubricate (Method A) threads of diaphragm bolt (46). Install guide (47), spring (48) and diaphragm bolt (46) into body (35).

m. Lubricate (Method A) threads of stem unit (12, 12A, 12B). Screw adjusting nut (11) on stem unit (12, 12A, 12B), and slip stop collar (10) on stem unit, securing it in place with snap-ring (9).

n. Lubricate (Method Z) thrust bearing (8, 8A). Lubricate (Method Z) mating surfaces of planet gears with Molykote G paste (Dow Corning Corp). Install thrust bearing (8, 8A) on stem unit and insert stem unit with planet gears into spring barrel (7, 7A).

o. Lubricate (Method A) threads of screw (6). Install guide button and screw (6) into adjusting nut (11).

p. Lubricate (Method A) external threads of body (35). Install spring (14, 14A) over stem unit and screw spring barrel (7, 7A) with spring (14, 14A) onto body (35) making sure that thrust bearing (8, 8A) is properly seated in spring barrel. Torque spring barrel (7, 7A) to 150 foot-pounds.

q. Install mounting plate (4) onto spring barrel (7, 7A) and body (35).

r. Lubricate (Method Z) mating surface of handwheel (3) and stem unit (12, 12A, 12B) with Molykote G paste (Dow Corning Corp). Install washer (5), handwheel (3), nameplate (2) and capnut (1) onto stem unit (12). Torque capnut to 50-75 inch-pounds. Torque capnut finger-tight on stem unit (12A, 12B).

5-52. TESTING. The test procedures require a source of gaseous nitrogen (MIL-P-27401), leak-test compound (MIL-L-25567, or equivalent), test gages with ranges of 0-150, 0-300, 0-750, and 0-2,000 psi, and a needle valve. The regulator must be firmly secured during testing.

a. Connect gaseous nitrogen (MIL-P-27401) source to IN port of regulator. Tee a test gage, with range applicable to regulator being tested, and needle valve at OUT port. Close needle valve.

b. Turn handwheel fully counterclockwise and increase gaseous nitrogen to a pressure not to exceed rated inlet pressure and above rated outlet pressure of regulator under test.

c. Turn handwheel clockwise to 20 percent of maximum rated outlet pressure of regulator.

d. Remove capnut and handwheel. Adjust relief adjustment screw in end of stem unit, clockwise until venting occurs, then counterclockwise until venting just stops.

e. Install handwheel and capnut; turn handwheel clockwise to maximum outlet pressure of regulator. Test gage must indicate a smooth increase in pressure throughout range.

f. Record maximum outlet pressure indicated on test gage, and after 5 ±1 minutes record pressure again. The difference of pressure must be within ±2 percent of initial pressure.

g. Slowly open needle valve until outlet pressure drops 20-40 percent; then close valve. Outlet pressure must stabilize within ±3 percent of initial pressure.

h. Remove capnut and handwheel; apply leak-test compound to inlet and outlet fittings, and guide button slot into spring barrel. No leakage is allowable.

i. Adjust relief adjustment screw clockwise until steady venting is obtained. Adjust counterclockwise until venting just stops; continue counterclockwise one additional turn.

iA. Check relief adjustment at 3 different pressure settings. Venting must occur within 1/4 to 2 turns counterclockwise.

j. Install handwheel nameplate, and capnut, torque capnut to 50-75 inch-pounds, and turn handwheel fully counterclockwise. Relief system must bleed outlet pressure to zero.

k. Open needle valve and apply leak-test compound to outlet of needle valve. No leakage is allowable.

l. Decrease gaseous nitrogen to zero and remove regulator from test setup.

5-52A. HAND VALVE 19-9023774.

5-52B. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the hand valves.

5-52C. DISASSEMBLING. Disassemble the hand valve, as required, to accomplish necessary repair and/or replacement. Fully open valve prior to start of disassembly. All functional parts of the valve are contained in the bonnet and can be replaced without removing valve from the line. (See figure 5-19A for parts and index numbers.)

5-52D. CLEANING. Clean hand valve as outlined in section I. For inspecting and handling part, refer to section I.

5-52E. INSPECTING AND REPAIRING. Inspecting the hand valve determines whether the individual parts have been damaged by mishandling or wear. See figure 5-19B and inspect parts for cleanness, damage, and wear. Repair of hand valve is limited to the replacement of parts listed (only parts listed with part numbers) in figure 5-19A.

5-52F. ASSEMBLING. All parts must meet cleaning requirements as outlined in paragraph 5-52D. The lubricant used in assembling and at specified periods is Fluorolube grease GR362 (Hooker Chemical Corp) unless otherwise specified. Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I.

NOTE

Steps a through i apply to valve 19-9023774-2.

a. Lubricate (Method J) O-ring (5) and install on bonnet (4).

b. Lubricate (Method J) O-rings (6, 8) and stem seal (7), and install in bonnet (4).

c. Install spring (10) and retainer (9) (small hole first) on stem (11).

d. Lubricate (Method A) threads of stem (11) and screw stem into bonnet (4) until it bottoms; then install seat and metal insert (12) in bonnet.

e. Lubricate (Method A) threads of bonnet (4) and screw into body (13) fingertight.

f. Turn stem (11) to fully closed (clockwise) position; then open 3 turns.

g. Hold valve body in place and torque bonnet (4) to 350-400 inch-pounds; then install nut (2) on bonnet and torque to 180-220 inch-pounds.

h. Lubricate (Method Z) wiper of cap and wiper (3) with lubricating oil MIL-L-7870 and install wiper and cap on stem and bonnet.

i. Install handle (1) and secure with setscrew. Close valve.

NOTE

Steps j through x apply to valve 19-9023774-4.

j. Lubricate (Method Z) (thin, even coat) stem (33) and install in bonnet (31).

k. Lubricate (Method J) O-rings (34) and install one on upper seat (35) and the other on lower seat (37).

l. Install upper seat (35), port ring (36), and lower seat (37) (large taper of lower seat inserted first) in bonnet (31). Make sure that port ring flow holes are in line with flow holes in bonnet.

m. Lubricate (Method J) O-rings (32) and install on bonnet (31).

n. Install spring (29) and washer (28) (beveled edge inserted last) in bonnet (31).

o. Lubricate (Method J) O-ring (27) and stem seal (26) and install in bonnet (31); then push O-ring and stem seal both below threads in bonnet.

p. Lubricate (Method A) threads of retainer (25) and screw into bonnet (31). Torque retainer to 32-38 inch-pounds.

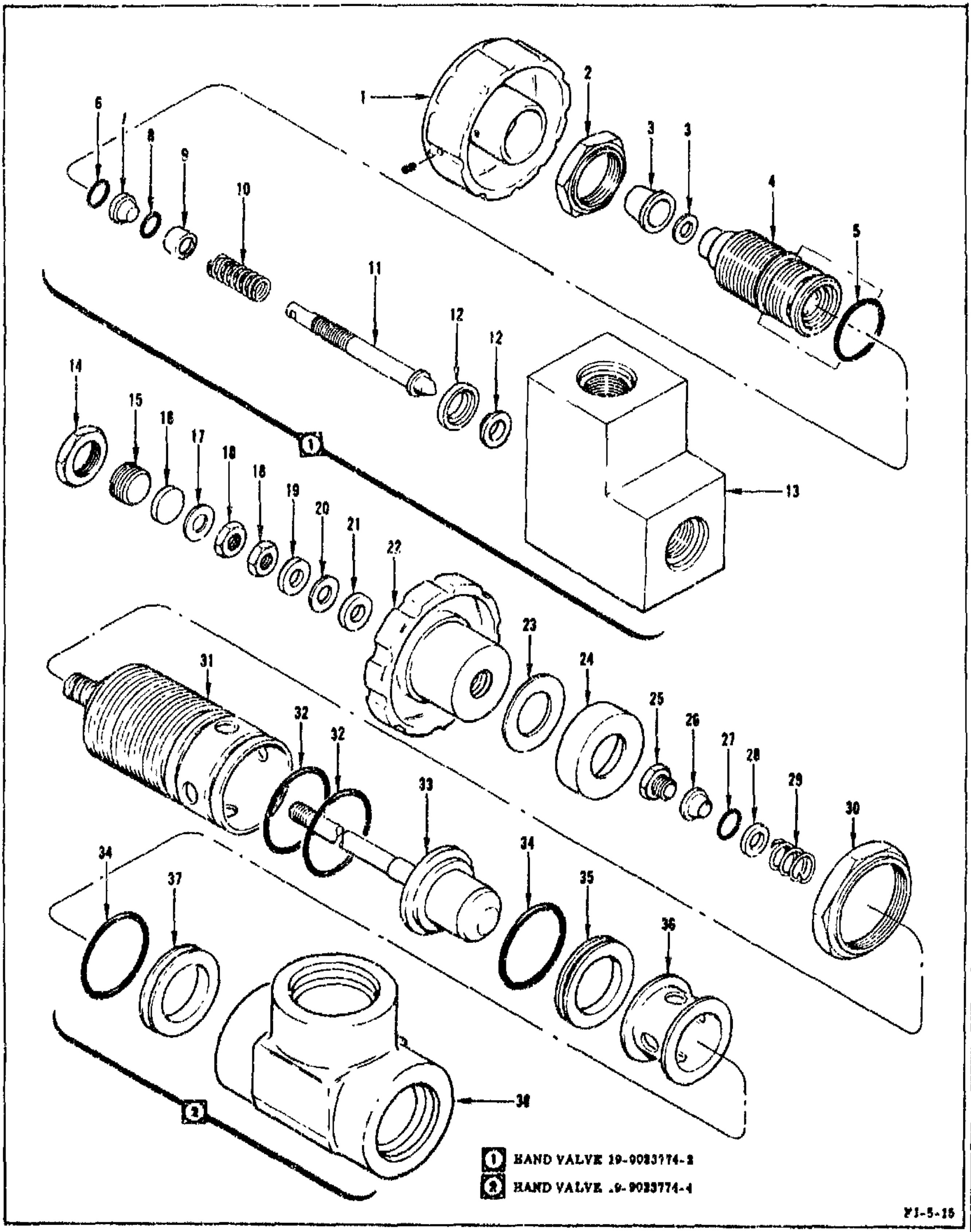


Figure 5-19A. Hand Valve--Exploded View (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1		Handle (D-2)	19		Spacer (D-2)
		Setscrew (D-2)	20		Bearing (D-2)
2		Locknut (D-2)	21		Spacer (D-2)
3		Cap and Wiper (D-2)	22		Handle (D-2)
4		Bonnet (D-2)	23		Wiper (D-2)
5	5212-51[a]	O-Ring (F-3)	24		Cap (D-2)
6	5011-56[a]	O-Ring (F-3)	25		Retainer (D-2)
7		Stem Seal (D-2)	26		Stem Seal (D-2)
8	5011-51[a]	O-Ring (F-3)	27	5008-51[b]	O-Ring (F-3)
9		Retainer (D-2)	28		Washer (D-2)
10		Spring (D-2)	29		Spring (D-2)
11		Stem (D-2)	30		Locknut (D-2)
12	A4CD-41[a]	Seat and Metal Insert (F-3)	31		Bonnet (D-2)
			32	5026-56[b]	O-Ring (F-3)
13		Body (D-2)	33		Stem (D-2)
14		Locknut (D-2)	34	5022-51[b]	O-Ring (F-3)
15		Adjustment Screw (D-2)	35	82-2-11[b]	Upper Seat (F-3)
16		Bearing (D-2)	36		Port Ring (D-2)
17		Spacer (D-2)	37	82-1-11[b]	Lower Seat (F-3)
18		Nut (D-2)	38		Body (D-2)

(a) Component of Kit 4007-4-1
(b) Component of Kit 4019-3-1

Figure 5-19A. Hand Valve--Exploded View (Sheet 2 of 2)

Part Name and Index Number	Inspecting	Repairing
Cap and Wiper (3)	Deterioration and wear.	Replace.
Bonnet (4, 31)	Damaged threads.	Chase threads; replace if damage exceeds 50% of one thread.
Stem Seal (7)	Worn sealing surface.	Replace.
Spring (10, 29)	Distortion.	Replace.
Stem (11, 33)	Damaged threads.	Chase threads; replace if damage exceeds 50% of one thread.
Seat and Metal Insert (12)	Worn sealing surface.	Replace.
Bearings (16, 20)	Wear and pitting.	Replace.
Seat (35, 37)	Worn sealing surface.	Replace.

Figure 5-19B. Inspecting and Repairing Hand Valve

q. Lubricate (Method A) threads of bonnet (31) and screw into body (38). Hold valve body in place and torque bonnet to 140-160 inch-pounds.

r. Install locknut (30) on bonnet (31) and torque to 275-325 inch-pounds.

s. Lubricate (Method Z) wiper (23) with lubricating oil MIL-L-7870, insert in cap (24), and install cap and wiper on handle (22).

t. Install handle (22) on bonnet (31).

u. Install spacer (21), bearing (20), and spacer (19) in handle (22).

v. Install nuts (18) on stem (33). End of stem must be 1/32 to 1/16 inch below top of top nut. Torque nuts against each other to 28-32 inch-pounds.

w. Turn handle fully counterclockwise and install spacer (17), bearing (16), and adjustment screw (15) in handle (22). Torque adjustment screw to 275-325 inch-pounds, then loosen and retorque to 90-110 inch-pounds.

x. Install locknut (14) on adjustment screw (15) and torque nut to 90-110 inch-pounds while holding adjustment screw in place. Close valve.

5-52G. TESTING. The test procedure requires a source of gaseous nitrogen (MIL-P-27401) and leak-test compound (MIL-L-25567), or equivalent. The hand valve must be firmly secured during testing.

a. Connect gaseous nitrogen (MIL-P-27401) source to inlet port of hand valve and close valve.

b. Increase gaseous nitrogen to hand valve operating pressure (stamped on valve) and apply leak-test compound to outlet port and around bonnet and stem. No leakage is allowable.

c. Decrease gaseous nitrogen pressure to zero, and install pressure plug in outlet port.

d. Slowly open hand valve and repeat step b.

e. Decrease gaseous nitrogen pressure to zero, remove valve from test setup, and cap open ports.

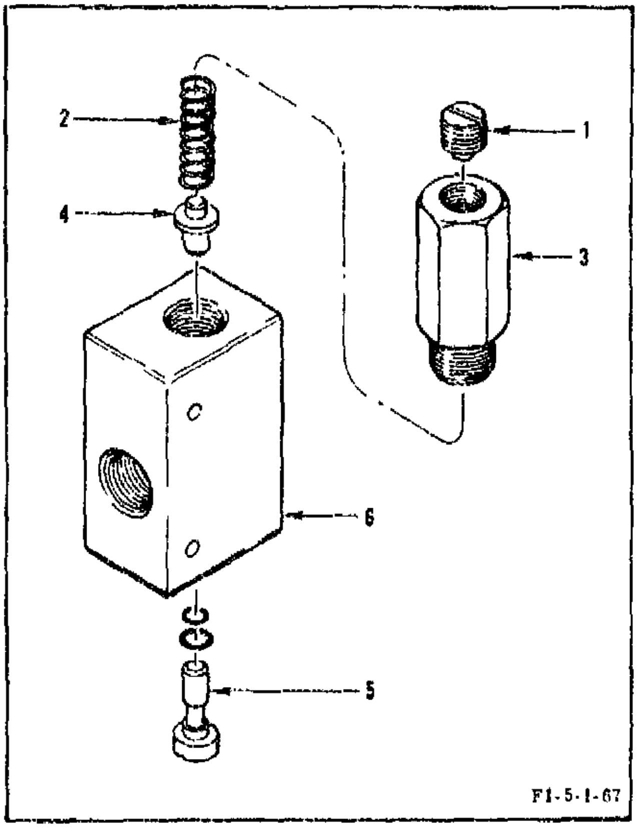
5-52H. GAGE SAVER 19-9023777.

5-52J. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the gage savers.

5-52K. DISASSEMBLING. Disassemble gage saver, as required, to accomplish necessary repair and/or replacement. Turn adjusting screw (1) counterclockwise to relieve tension on spring (2). Do not remove housing (3) with tension on spring (2). (See figure 5-19C for index and part numbers.)

5-52L. CLEANING. Clean all metal parts as outlined in section I.

5-52M. INSPECTING AND REPAIRING. Inspecting the gage saver determines whether the individual parts have been damaged by mishandling or wear. Inspect parts for cleanness, damage, and wear. Repair of gage saver is limited to replacement of parts contained in kit and chasing damaged threads that do not exceed 50 percent of one thread. Gage saver must be replaced if parts not contained in kit are damaged or worn.



Index No.	Part No.	Description
1		Adjusting Screw
2		Spring
3		Housing
4		Guide
5		Poppet
	G180-011	O-ring
	G180-008	O-ring
6		Body

Figure 5-19C. Gage Saver--Exploded View

5-52N. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 5-52L. Lubricant used for straight threads and O-rings during assembly is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. See figure 5-19C for index and part numbers.

a. Lubricate (Method J) O-rings and install on poppet (5). Install poppet into inlet port of body (6).

b. Install large end of guide (4) into body (6).

c. Lubricate (Method A) threads of housing (3) and install into body (6). Torque housing to 10-20 foot-pounds.

d. Lubricate (Method A) threads of adjusting screw (1) and install spring (2) and adjusting screw (1) into housing (3). Turn adjusting screw (1) until all threads are engaged.

e. Install closures on inlet and outlet ports.

f. Test and adjust gage saver as outlined in paragraph 5-52P.

5-52P. TESTING. Testing consists of testing set and reseat pressures of gage savers. Perform testing after repair and any time misuse or damage is suspected. Pressure must be gradually increased to check set pressures, and decreased to check reseat pressure. The gage saver must be adjusted with no pressure applied; then repressurized to recheck adjustment. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Install gage saver in a test setup with a 3,000 psi gage at inlet, a suitable gage at outlet to read pressures specified in step c, and a vent valve downstream of outlet gage.

b. Firmly secure gage saver, remove closures, and connect a source of gaseous nitrogen (MIL-P-27401) with a crontrolled pressure of 3,000 ±50 psig to inlet port.

c. Close vent valve and slowly increase pressure to 3,000 ±50 psig. Observe outlet gage and record set pressures as follows: 19-9023777-1, 100-110 psig; -2, 250-275 psig; -3, 500-550 psig; and -4, 1,000-1,100 psig.

d. Decrease pressure to zero and turn adjusting screw (1), clockwise to increase and counterclockwise to decrease, to obtain settings in step c.

e. Repeat step c five times. The gage saver must repeat within the tolerance of step c or gage saver must be replaced.

f. Open vent valve and slowly increase pressure to 3,000 ±50 psig.

g. Apply leak-test compound (MIL-L-25567) to vent valve outlet port. No internal leakage of gage saver is allowable.

h. Close vent valve and apply leak-test compound (MIL-L-25567) to adjusting screw (1) and housing (3) and body (6) mating surface. No external leakage is allowable.

i. Decrease pressure to zero and remove leak-test compound from gage saver.

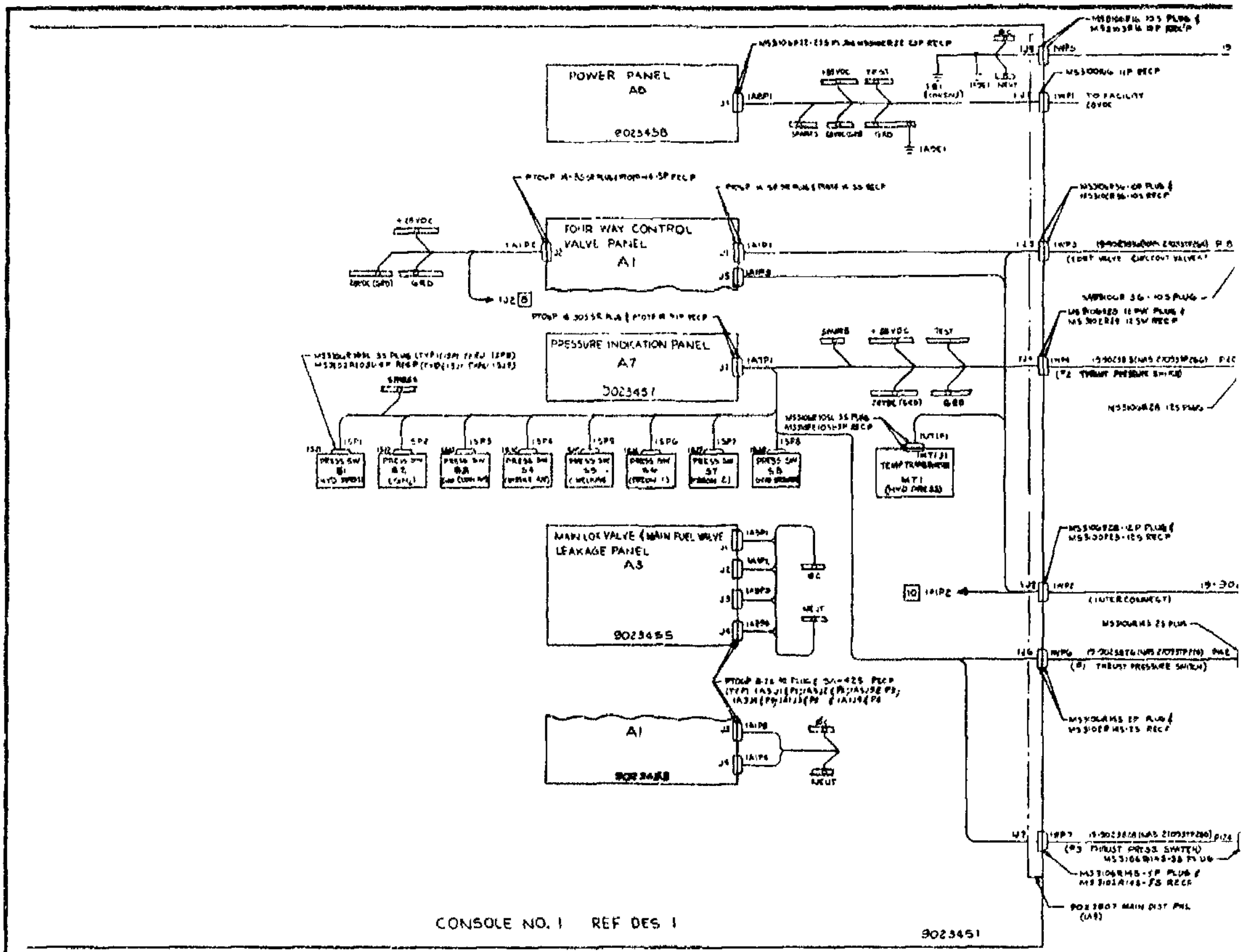
j. Remove gage saver from test setup and install closures in inlet and outlet ports.

5-53. INSPECTION.

5-54. Figure 5-20 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspections requirements cannot be predicted because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions, and that hardware configuration is in accordance with appropriate records. A visual inspection is made before operating of the unit. Periodic inspections are made at specified periods. See figure 5-20 for inspection and periodic intervals.

Inspection	Periodic (Months) 3	6	12	24
1. Obvious signs of damage to all structural members.			X	
2. Foreign matter and illegibility of placarding on exterior and interior surfaces.			X	
3. Broken glass, cracked frames, and loose or missing faceplate screws on gages.			X	
4. Cracked or broken control knobs and loose or missing retaining screws and locknuts on hand valves and regulators.			X	
5. Scratches, dents, cracked sleeves and loose coupling nuts on tubing.			X	
6. Calibration-check.	(See paragraph 5-35.)			
7. Broken covers and broken or missing bulbs on indicator lights.			X	
8. Looseness and improper operation of switches and circuit breakers.			X	
9. Damaged or corroded receptacles and/or plugs on electrical cables, and cut, torn, chafed, or deteriorated outer cover.			X	
10. Lubrication of regulators and hand valves.	(See paragraph 5-35.)			
11. Function-test of relief valves.	(See paragraph 5-35.)			

Figure 5-20. Inspection Requirements



5 UNITS NOT INCORPORATING MD8 CHANGE

6 UNITS INCORPORATING MD8 CHANGE

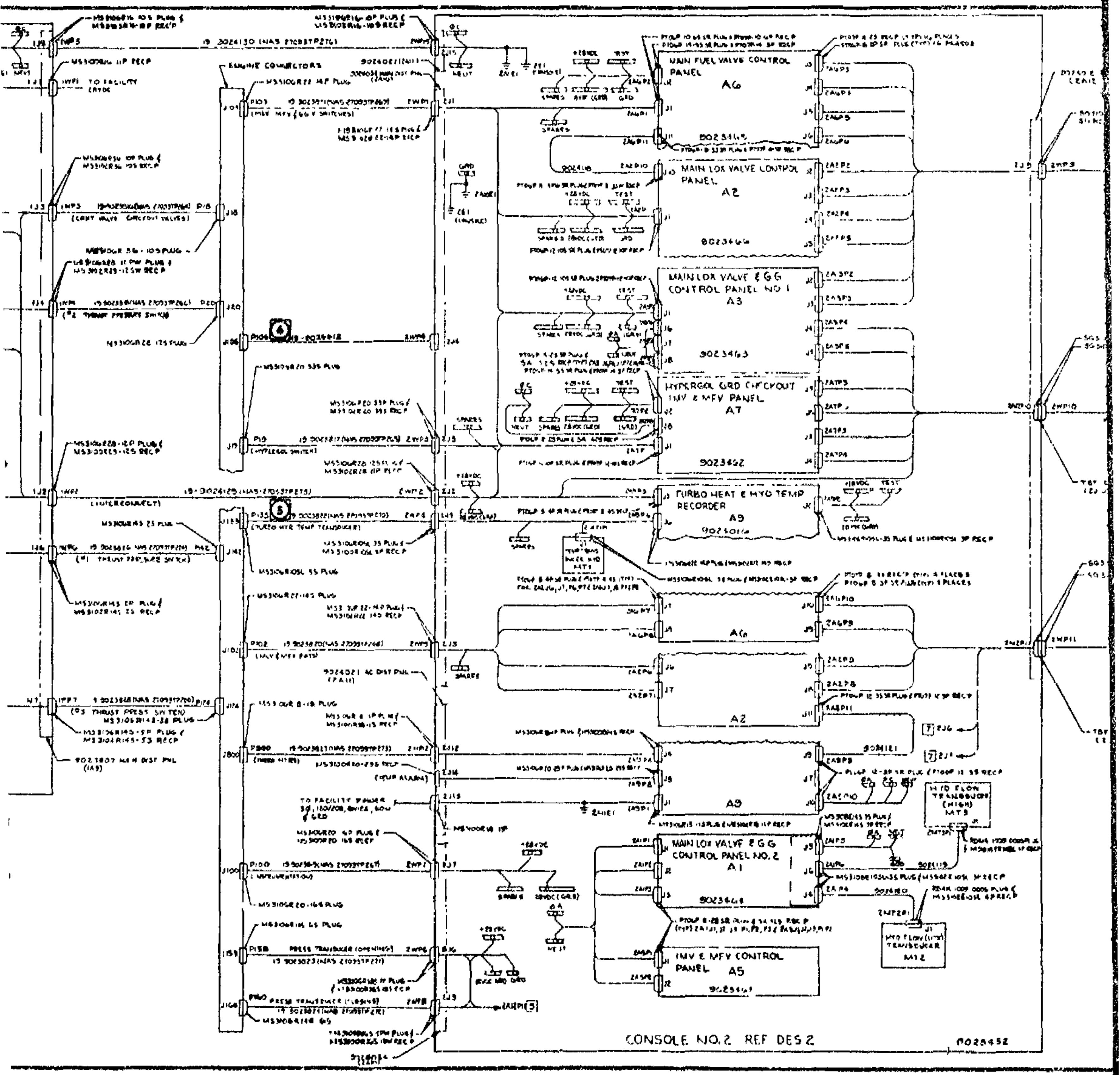


Figure 5-21 Engin

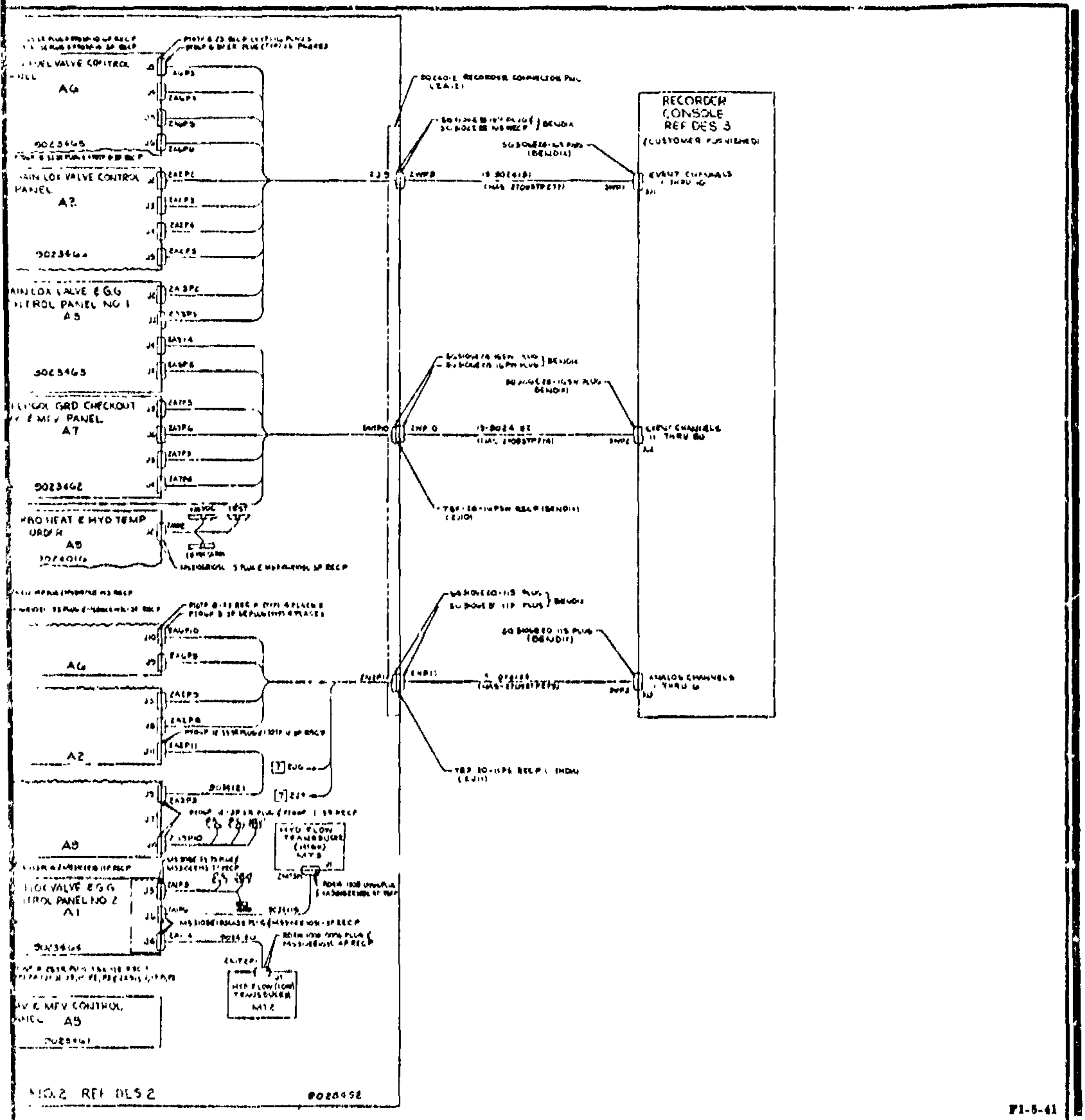


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 1 of 7)

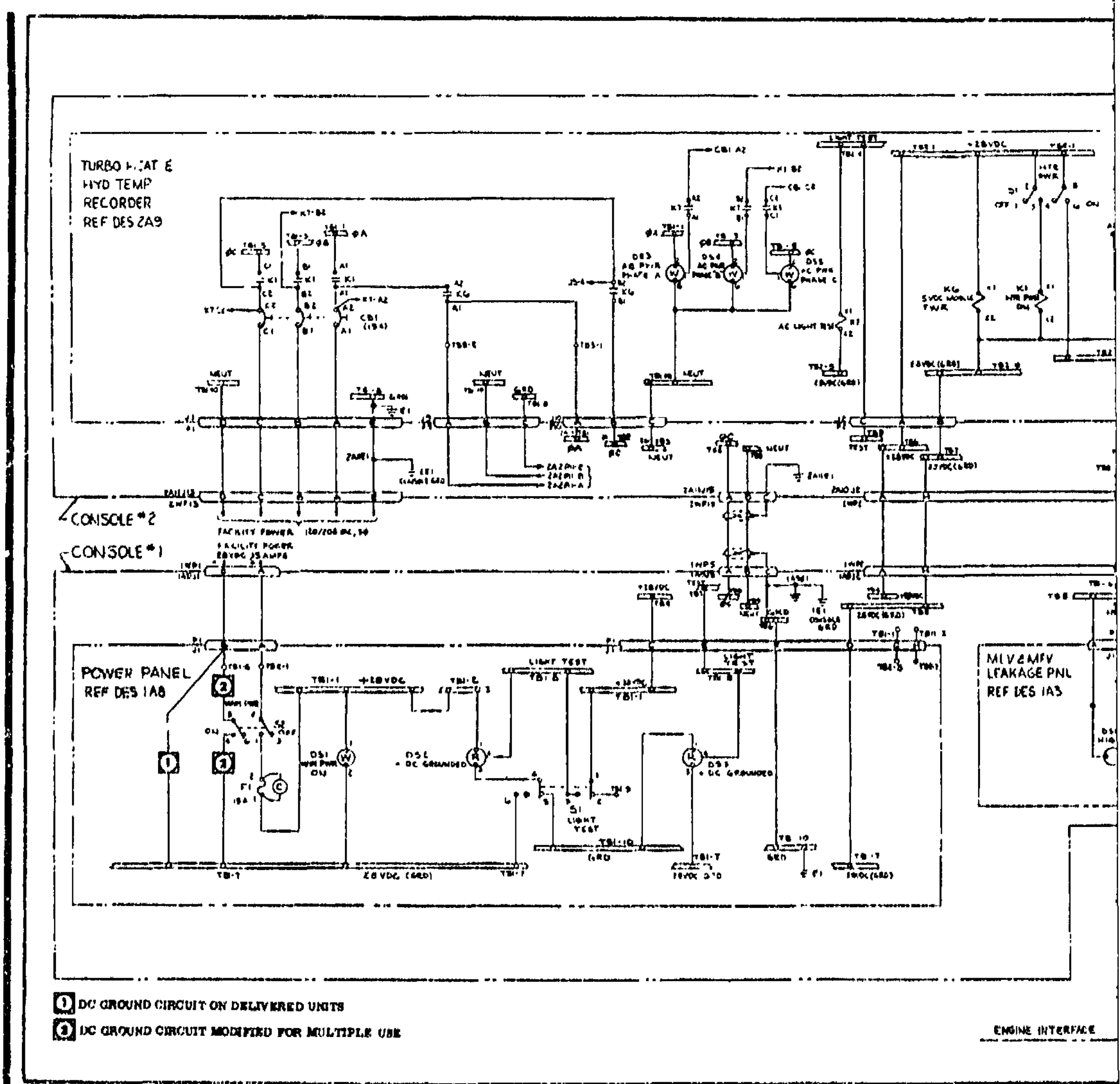
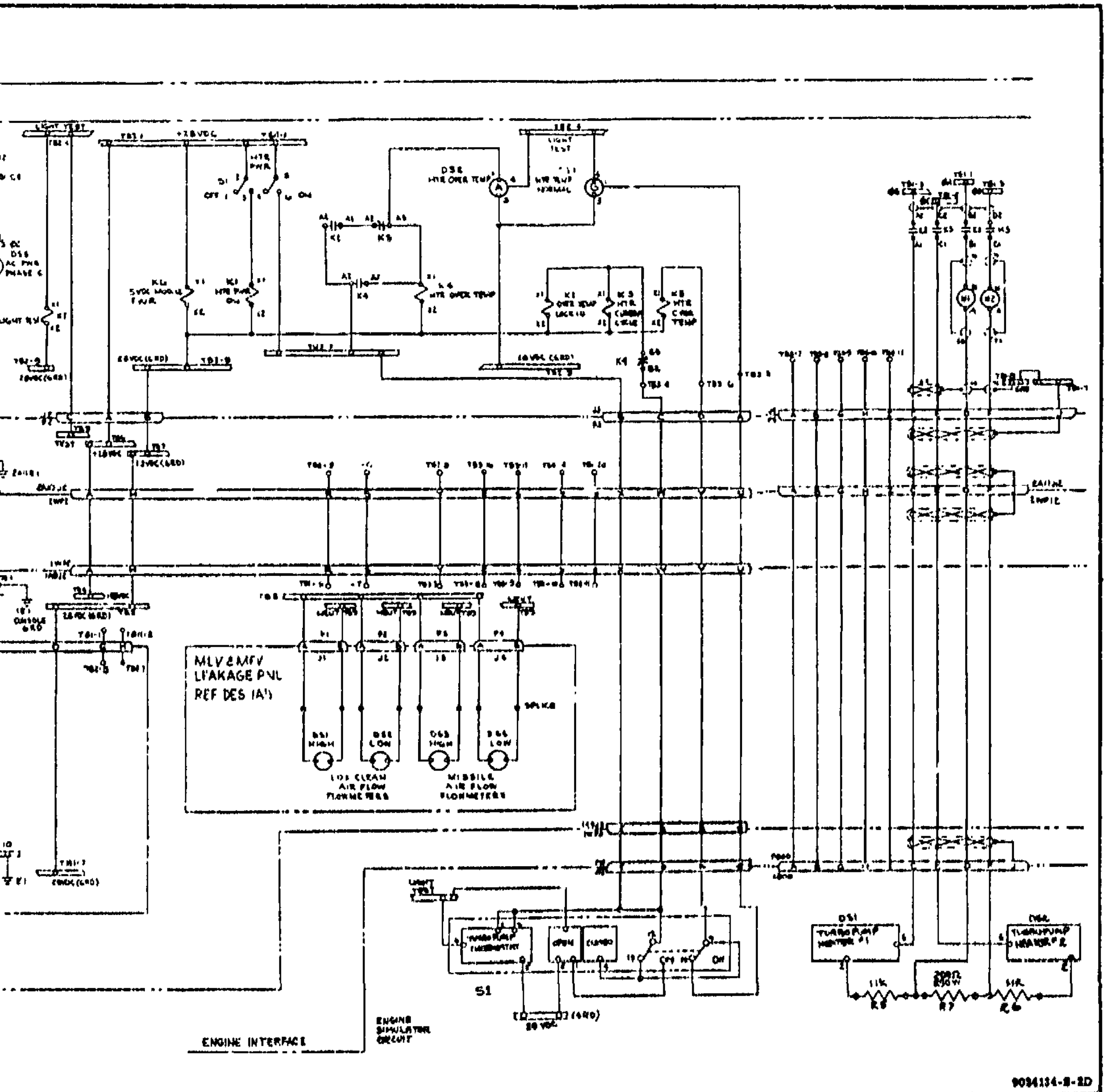
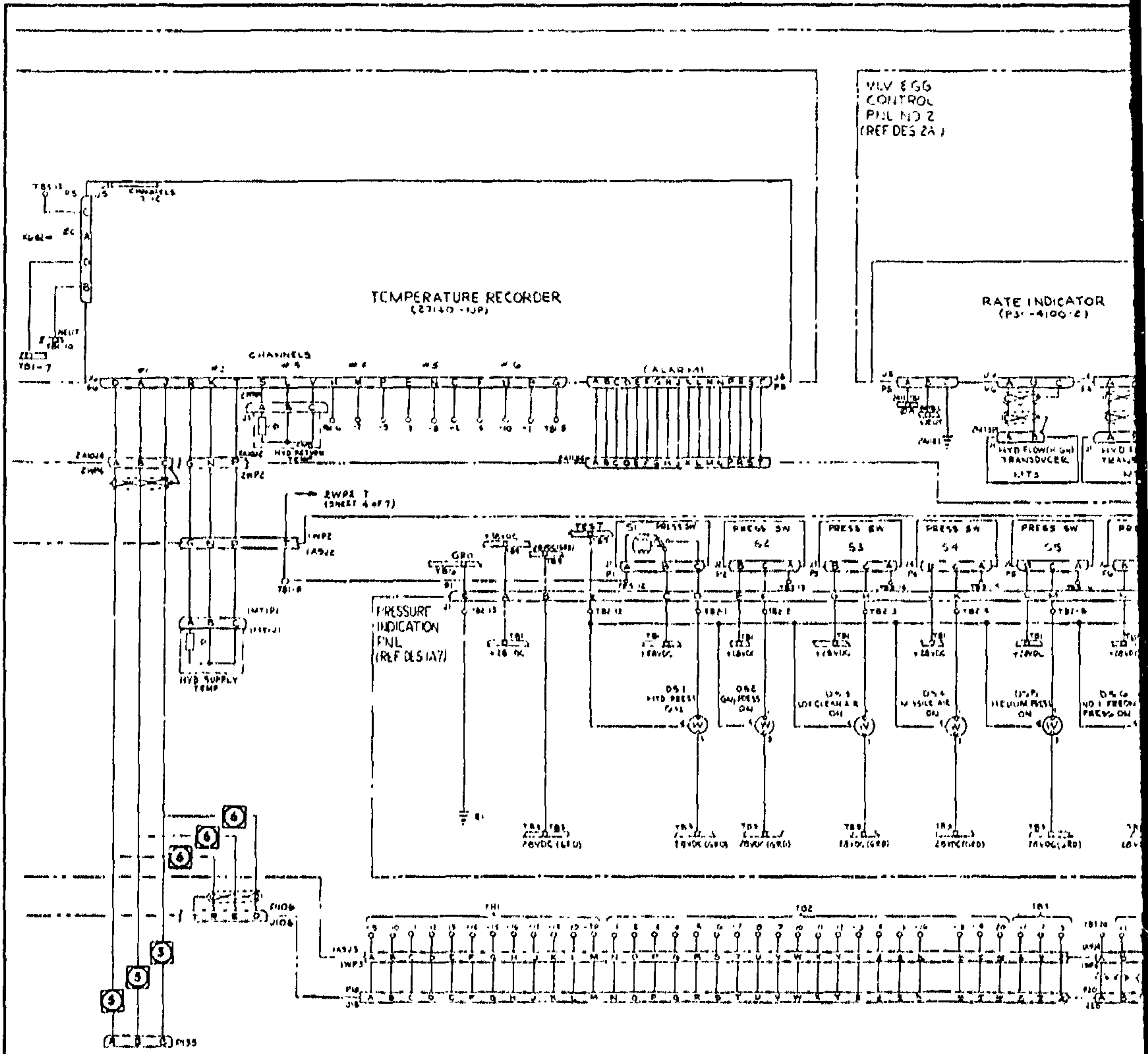


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 2 of 7)



LIGHT TEST
+28VDC
HTR PWR
HTR OVER TEMP
MLV & MFV
LEAKAGE PNL
REF DES (A1)
DS1
HIGH
DS2
LOW
DS3
HIGH
DS4
LOW
LOX CLEAN
AIR FLOW
FLOWMETERS
MISSILE
AIR FLOW
FLOWMETERS
S1
28 VDC
ENGINE INTERFACE
ENGINE
SIMULATOR
CIRCUIT
R5
R7
R6



[5] UNITS NOT INCORPORATING MD8 CHANGE

[6] UNITS INCORPORATING MD8 CHANGE

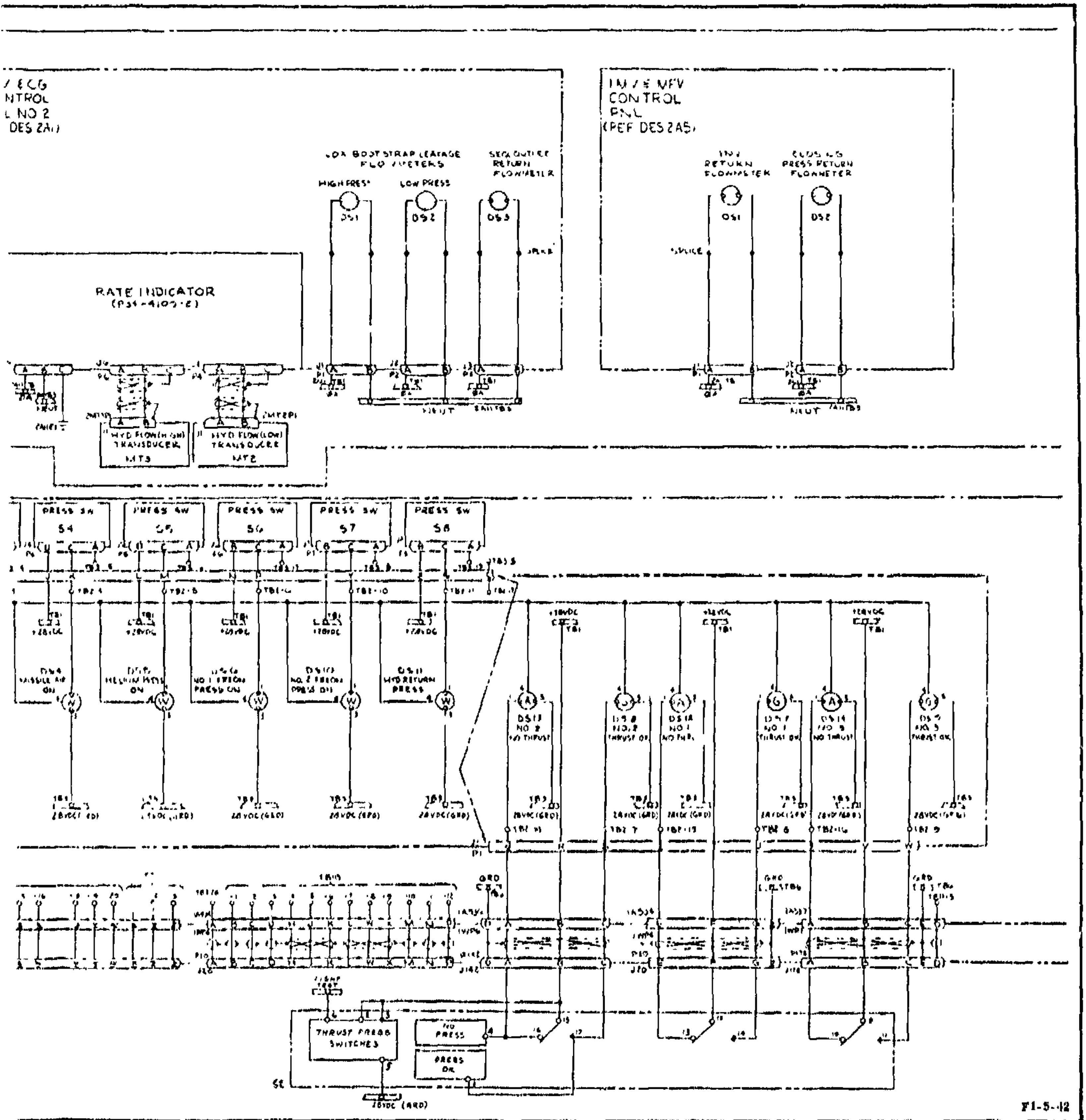


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 3 of 7)

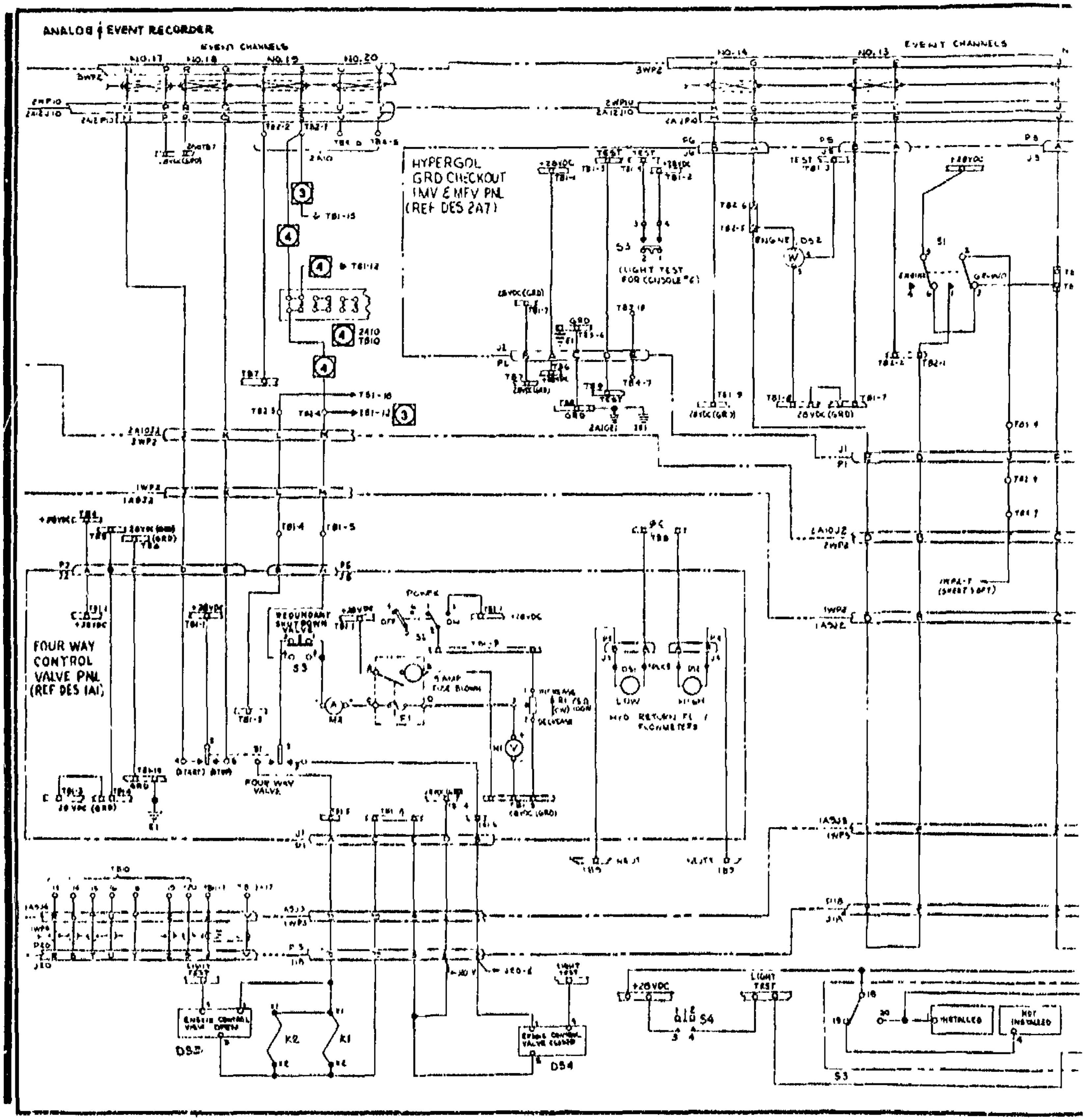
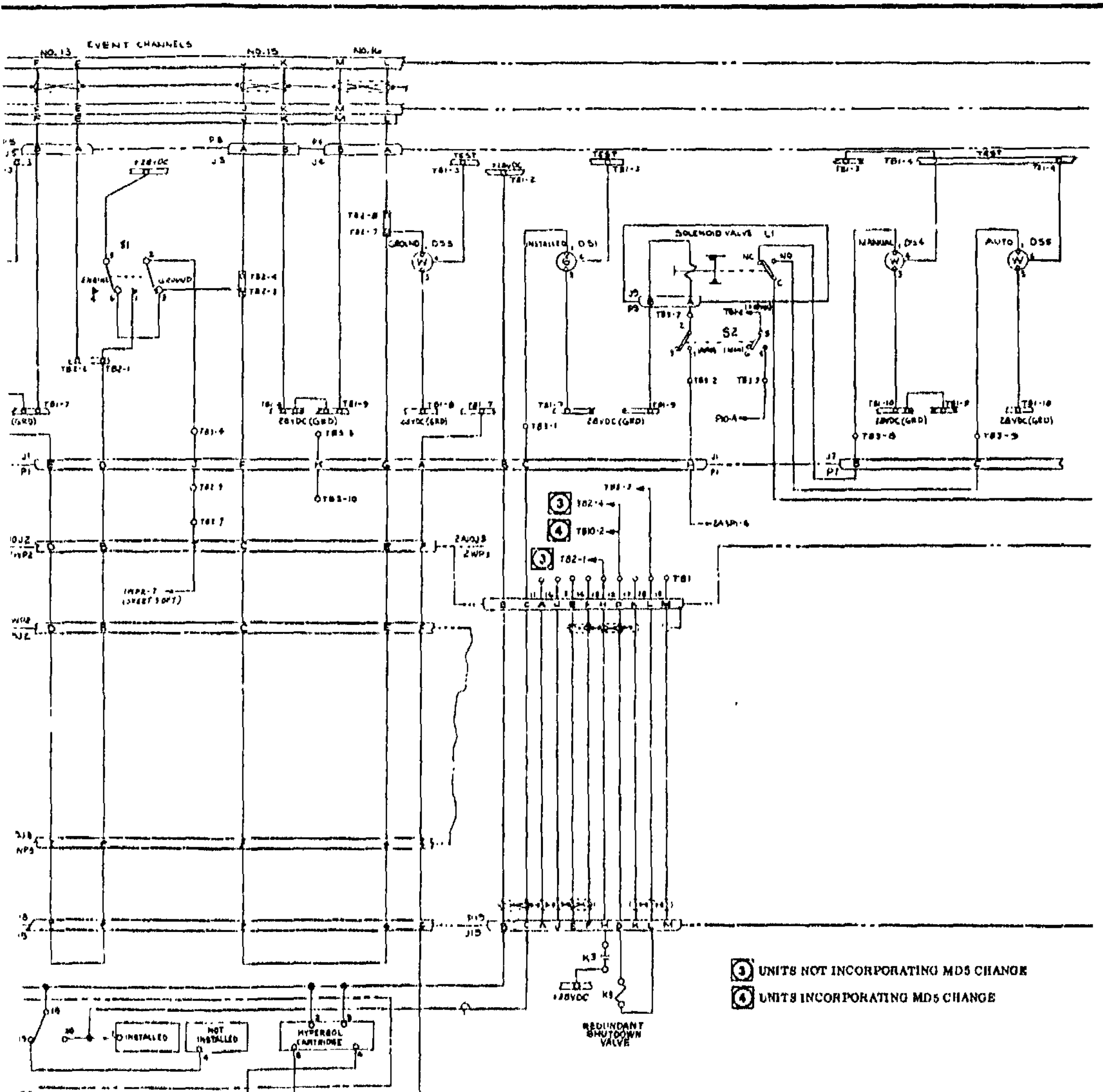
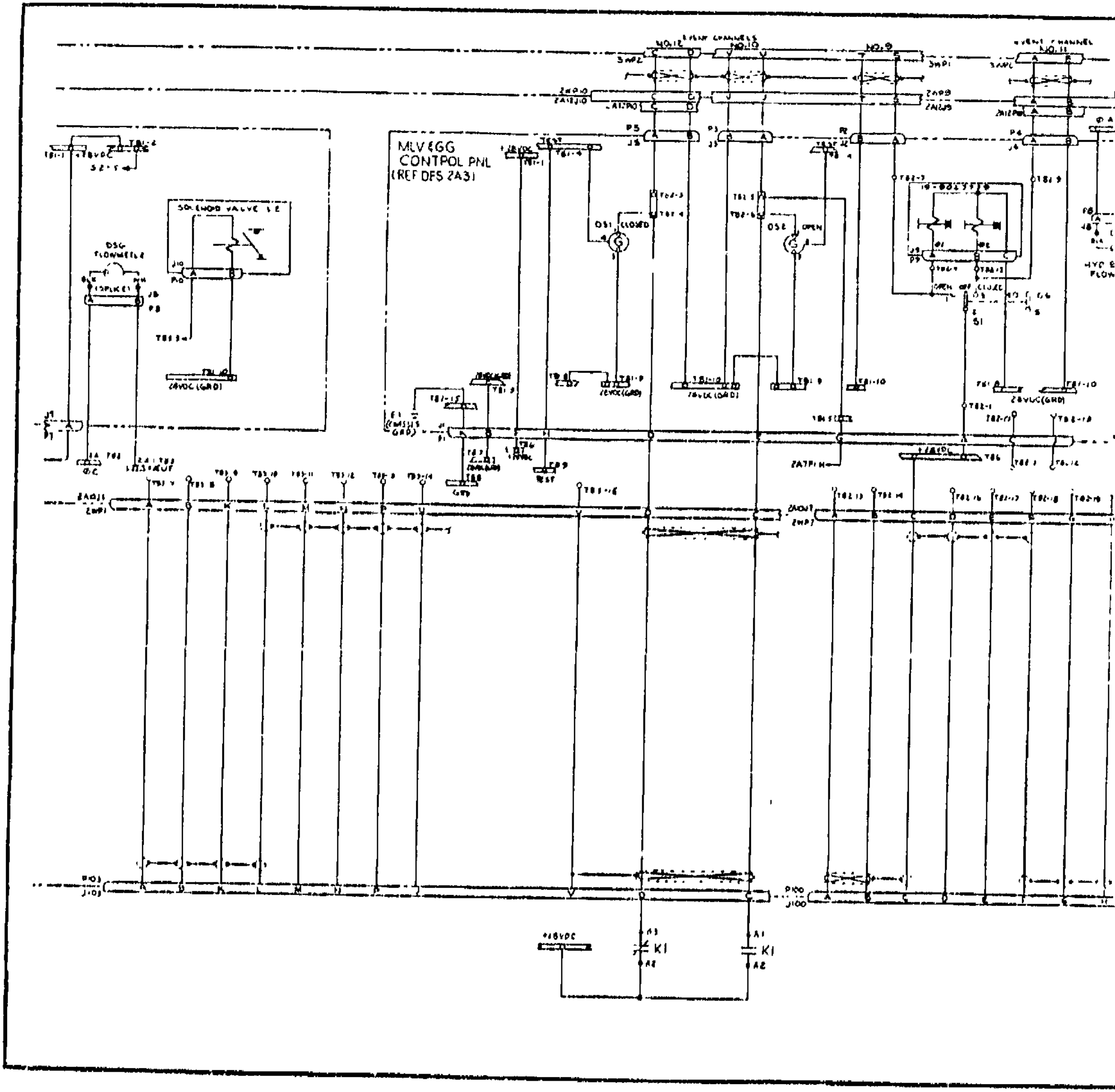


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 4 of 7)


EVENT CHANNELS
NO. 13
NO. 15
NO. 16
TEST
S1
ENGINE
GROUND
SOLENOID VALVE L1
NC
NO
S2
INSTALLED
MANUAL
AUTO
28 VDC (GRD)
REDUNDANT SHUTDOWN VALVE
INSTALLED
NOT INSTALLED
HYPERGOL CARTRIDGE
S3
3 UNITS NOT INCORPORATING MD5 CHANGE
4 UNITS INCORPORATING MD5 CHANGE

F1-5-13


EVENT CHANNELS
NO.12
NO.10
NO.9
EVENT CHANNEL
NO.11
MLV 4GG
CONTPOL PNL
(REF DFS 2A3)
SOLENOID VALVE
DS1
CLOSED
DS2
OPEN
S1
28VDC(GRD)
TEST
K1
K1

Fig

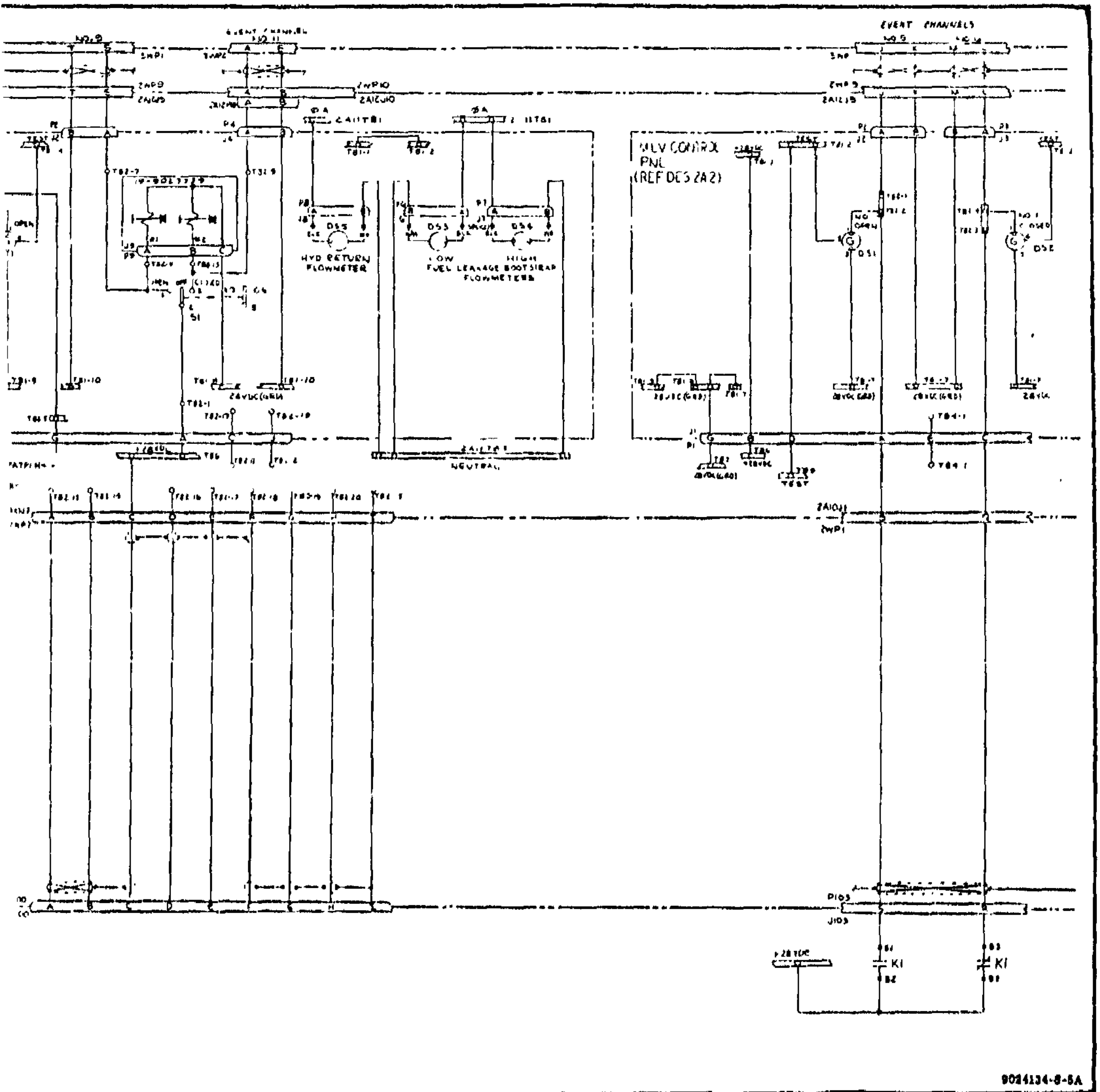


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 5 of 7)

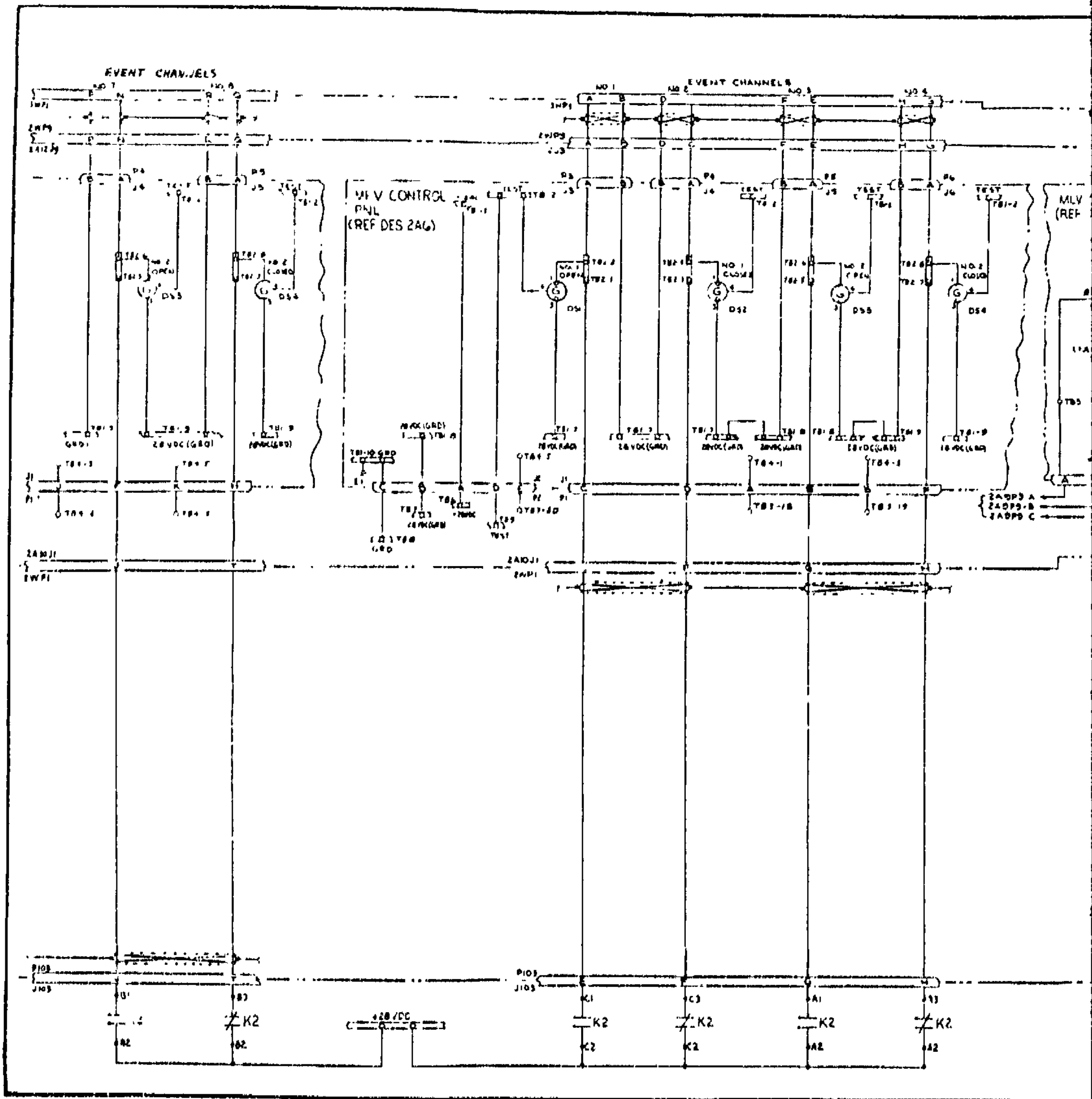
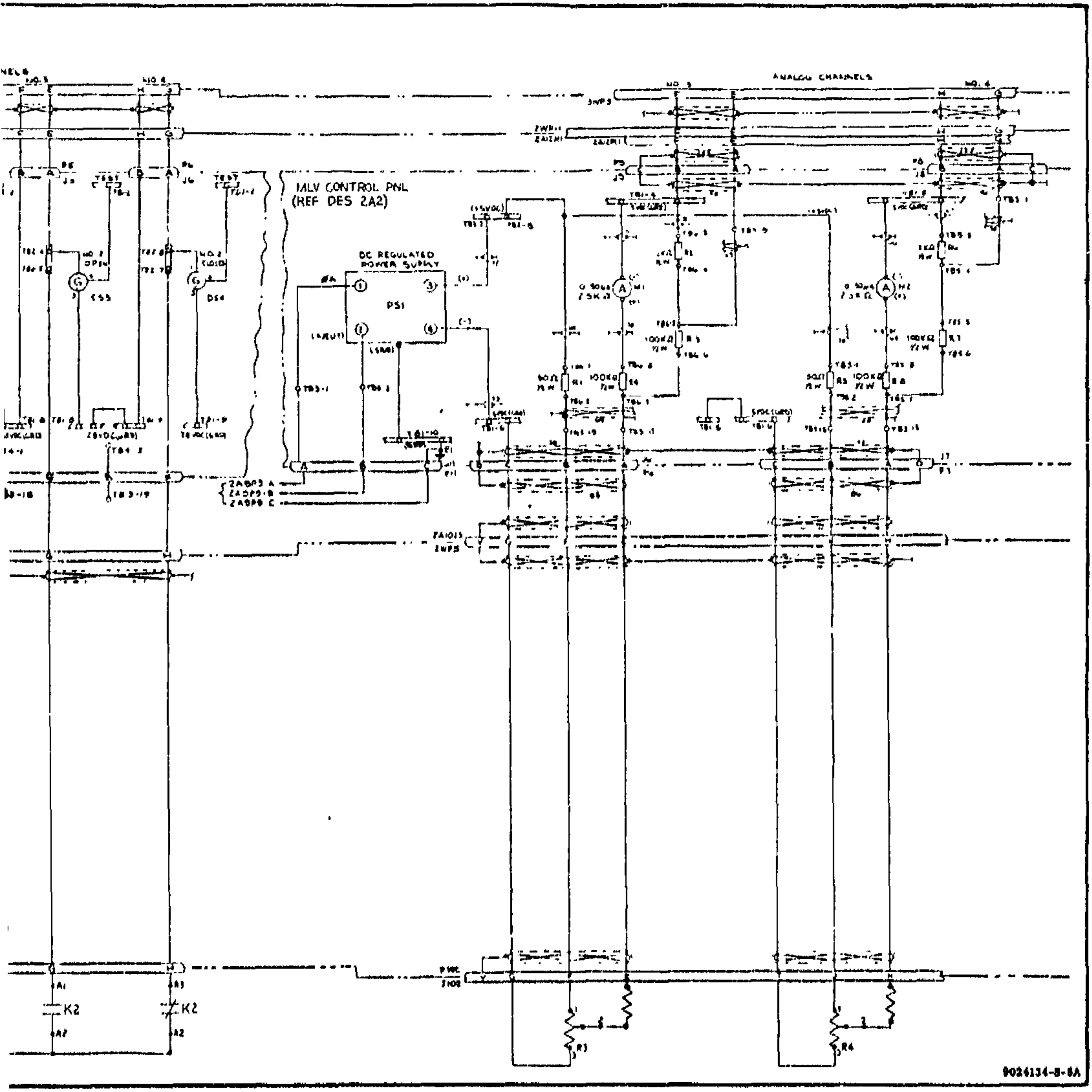
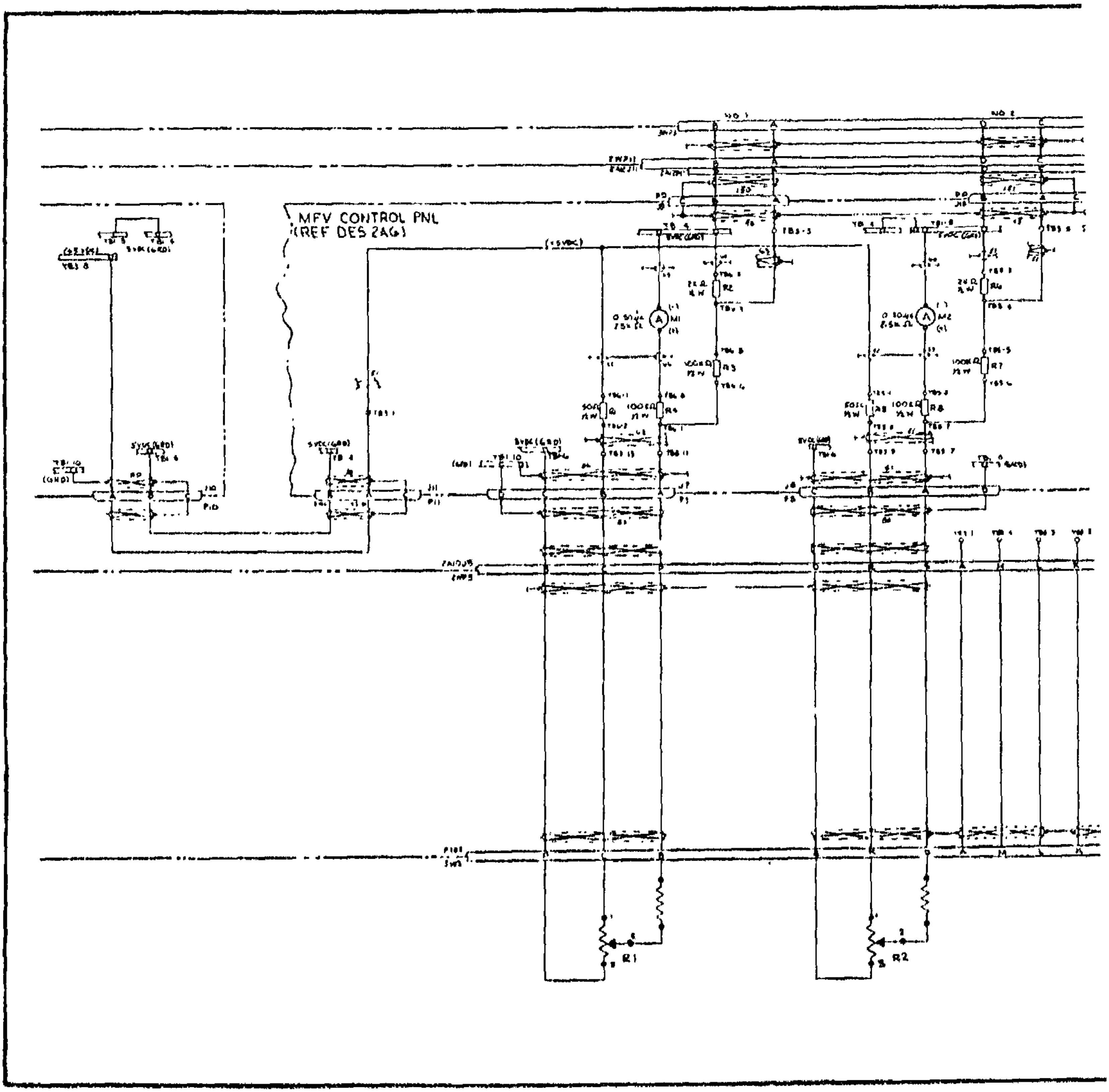


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 6 of 7)



ANALOG CHANNELS
MLV CONTROL PNL
(REF DES 2A2)
DC REGULATED
POWER SUPPLY
PS1
K2
K2
R3
R4

9024134-5-8A



Pages 5-77 th

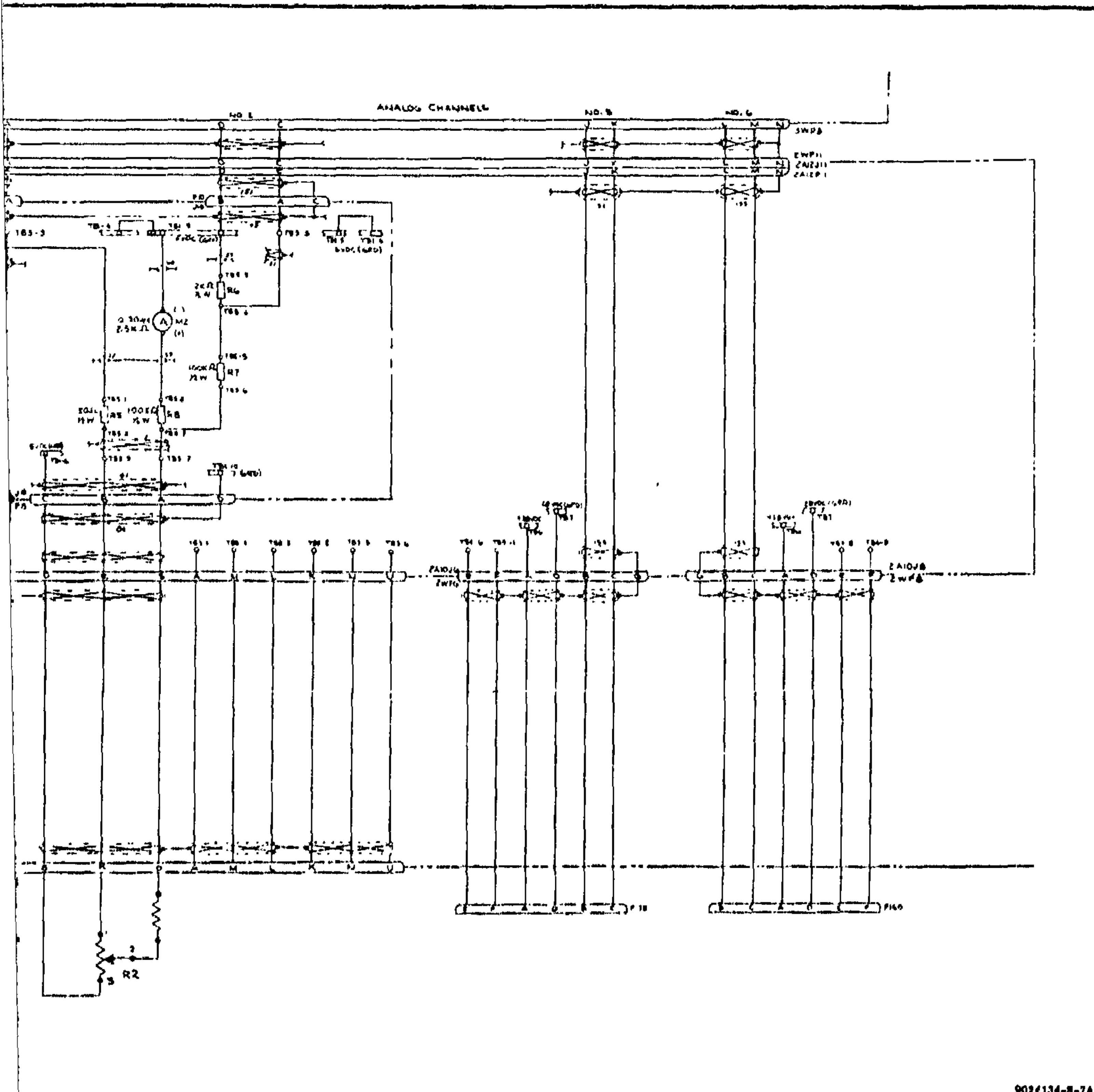


Figure 5-21. Engine Checkout Console Electrical Schematic (Sheet 7 of 7)

Pages 5-77 through 5-98 deleted.

SECTION VI

PNEUMATIC FLOW MONITORS G3130 AND G3131

WARNING

PNEUMATIC FLOW MONITORS G3130 AND G3131 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

6-1. SCOPE. This section contains description, operation, maintenance, and inspection for Pneumatic Flow Monitor G3130 (fuel) and Pneumatic Flow Monitor G3131 (oxidizer). The flow monitors measure leakage of engine systems and/or components.

6-2. DESCRIPTION.

6-3. The pneumatic flow monitor (figure 6-1) is a portable flowmeter in a suitcase-type container. The flow monitor has inlet and outlet ports, a low-flow flowmeter, a high-flow

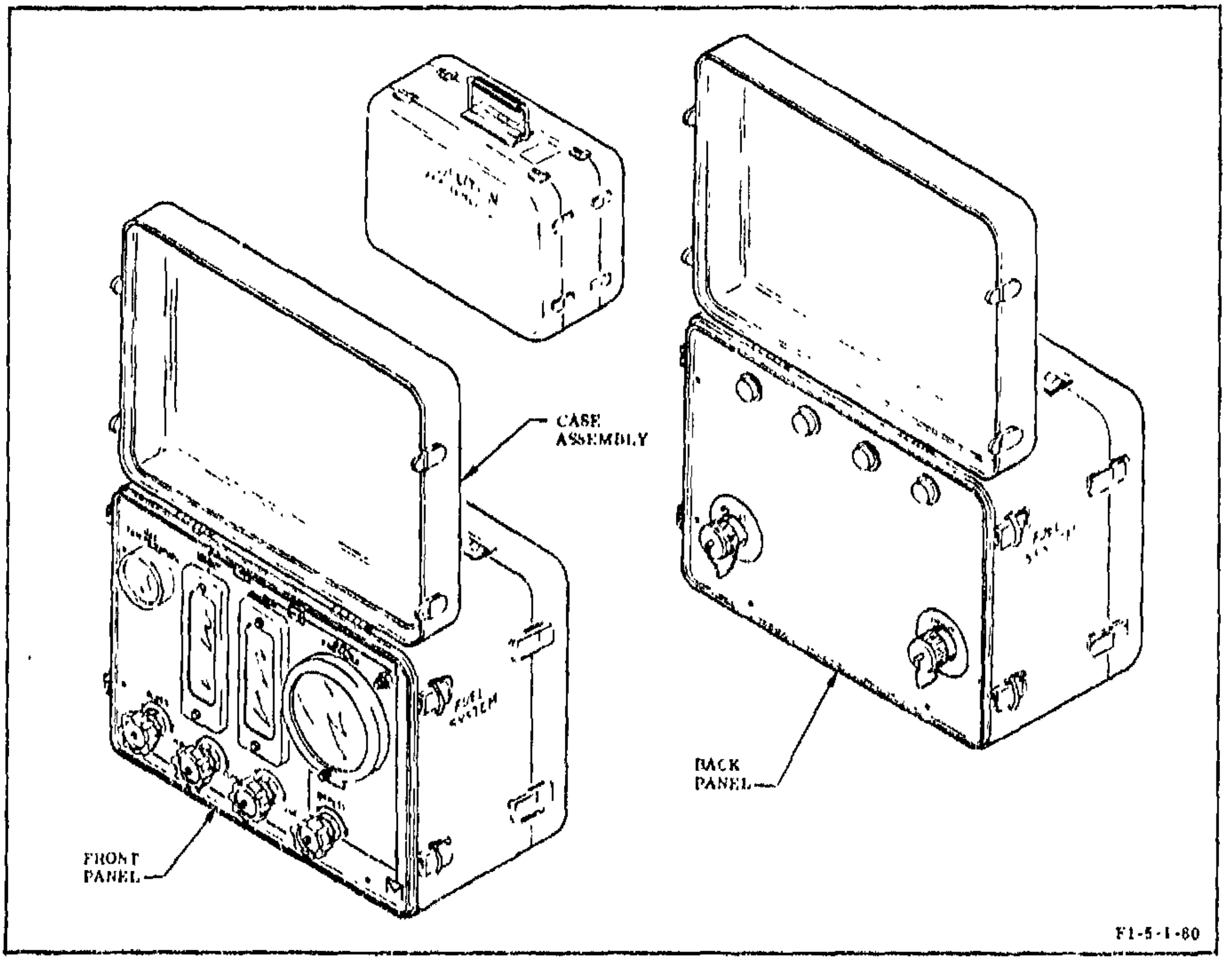


Figure 6-1. Pneumatic Flow Monitor

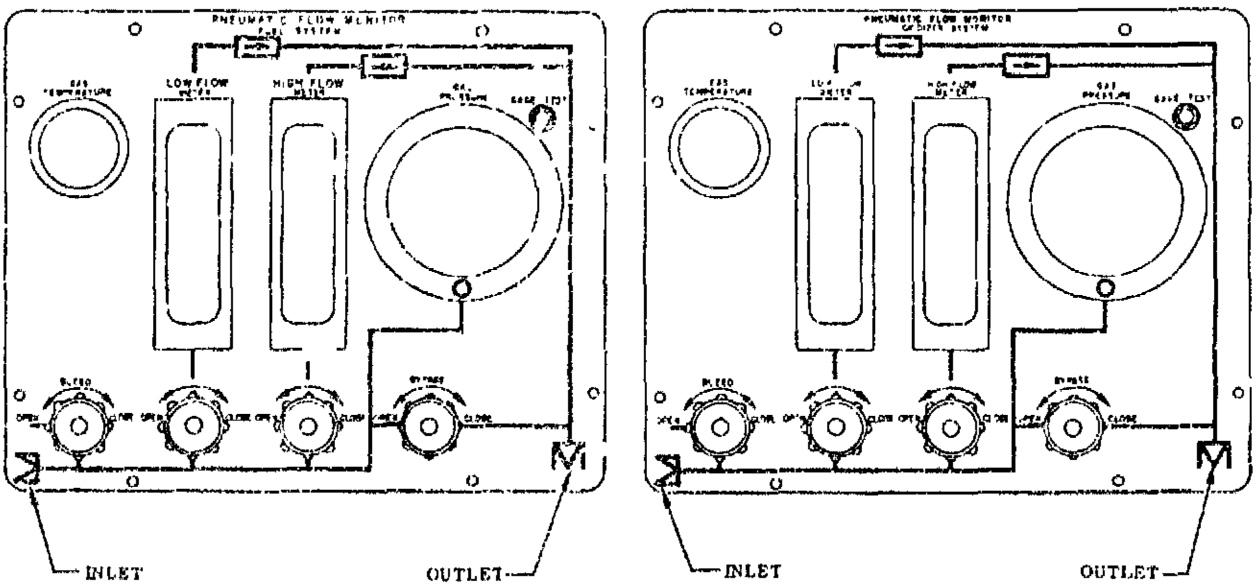
flowmeter, a gas temperature gage, a pressure gage, a relief valve, two check valves, four hand valves, and front and back panels. All components are mounted on the front panel and the panel is mounted in the container. See figure 6-2 for flow monitor front panel and figure 6-3 for leading particulars.

6-4. OPERATION.

6-5. The pneumatic flow monitor is connected between a pneumatic source and a system or component. Pneumatic pressure applied to flow monitor inlet passes through the normally open ports of the BLEED valve, LOW FLOW METER and HIGH FLOW METER shutoff valves, and BYPASS valve, to the relief valve and GAS PRESSURE gage. The relief valve will relieve at 100 ±5 psig and reseat at 80 psig. Opening the BYPASS valve allows system pressure to stabilize before admitting pressure to flowmeter tubes. After pressure stabilizes, as indicated on GAS PRESSURE gage, the LOW FLOW METER or HIGH FLOW METER shutoff valve (as applicable) is opened and bypass valve closed. Temperature of test gas is indicated on GAS TEMPERATURE gage and leakage in system or component under test is indicated on applicable flowmeter. Conversion charts are provided with the units so the user can convert flowmeter and temperature indications to scim leakage rates. The units are depressurized by closing the flowmeter shutoff valves and opening BYPASS and BLEED valves.

6-6. MAINTENANCE.

6-7. Maintenance of the pneumatic flow monitor consists of checkout, removing, installing, servicing, and shipping and storing. The surface area and/or lettering is repainted, as required when paint becomes chipped, scratched, or worn off and when lettering becomes illegible. (Refer to section I for painting information.) The flow monitor is cleaned, when applicable, as outlined in section I.



F1-5-1-81

Figure 6-2. Pneumatic Flow Monitor Front Panels

Length	19-1/8 inches
Width	12-5/8 inches
Height	15-5/8 inches
Weight	50 pounds, approx.
Low Flowmeter	0.92 to 37.9 scim at 30 psig
High Flowmeter	27.9 to 744 scim at 30 psig
Temperature Gage	-75° to +225° F
Pressure Gage	0-100 psi

Figure 6-3. Leading Particulars for Pneumatic Flow Monitor

6-8. CHECKOUT.

6-9. Checkout consists of leak and function testing. The only preparation for use of the flow monitors is to open the lids of the suitcase container and secure them in the open position. See figure 6-4 for pneumatic flow monitor schematic.

6-10. LEAK TESTING. The back panel must be removed to perform this test.

a. Connect nipple assembly to flow monitor INLET (405-00290 for fuel system, 405-00286 for oxidizer system) and connect a 0-200 psig source of gaseous nitrogen (MIL-P-27401) to nipple assembly.

b. Connect a 0-200 psig test gage to flow monitor OUTLET. (Use socket assembly 405-00298 for fuel system, 405-00294 for oxidizer system.)

c. Close all valves on panel.

d. Open BYPASS valve.

e. Increase source pressure to 90 psig and slowly open LOW FLOWMETER and HIGH FLOWMETER shutoff valves.

f. Leak-test all connections and components with leak-test compound (MIL-L-25567). No leakage is allowable.

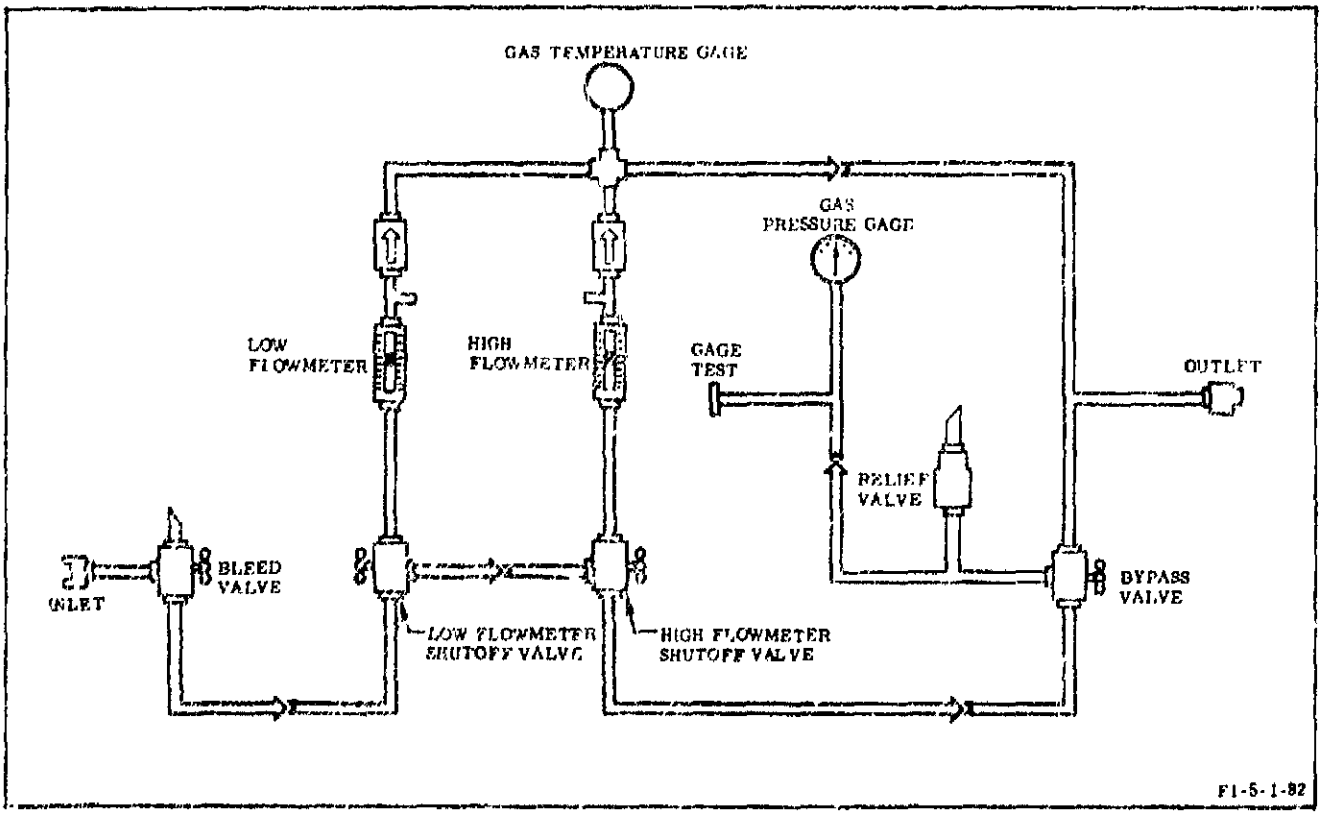


Figure 6-4. Pneumatic Flow Monitor Schematic

g. Decrease source pressure to zero.

h. Open BLEED valve. Pressure vents to zero as shown on test gage and panel GAS PRESSURE gage.

i. Remove test gage from flow monitor OUTLET.

j. Remove source pressure from flow monitor INLET and connect it to flow monitor OUTLET.

k. Close BLEED and BYPASS valves.

l. Increase source pressure to 90 psig as shown on panel GAS PRESSURE gage.

m. Leak-test open INLET fitting with leak-test compound (MIL-L-25567). No leakage is allowable.

n. Decrease source pressure to zero.

o. Slowly open BYPASS valve.

p. Open BLEED valve. Pressure vents to zero as shown on GAS PRESSURE gage.

q. Close all panel valves and remove all leak-test compound.

r. Remove all external equipment and reinstall back panel in container.

6-11. FUNCTION TESTING. This test or applicable portions of the test are performed as specified in inspection requirements.

a. Connect socket assembly to flow monitor OUTLET (405-00298 for fuel system, 405-00294 for oxidizer system) and connect a needle valve to socket assembly.

b. Connect calibration standard capable of measuring 0 to 1,000 scim and 55° to 95° F temperature, with accuracy of 0.5 percent of indicated flow and ±1° F between 55° to 95° F, to needle valve.

c. Connect nipple assembly to flow monitor INLET (405-00290 for fuel system, 405-00286 for oxidizer system) and connect a 0-200 psig source of gaseous nitrogen (MIL-P-27401) to nipple assembly.

d. Close panel valves and needle valve.

e. Remove pressure cap from gage test port on front of panel and connect a 0-150 psig calibrated test gage with accuracy of ±1/10 percent of full scale.

f. Slowly increase source pressure and check pressure gage for accuracy at 3 settings. Gage accuracy must be ±1/4 percent of full scale.

g. Decrease source pressure to zero and open BLEED valve. Pressure vents to zero as shown on panel and test gages.

h. Slowly increase source pressure until relief valve relieves. Relief valve must relieve at 105 ±5 psig.

i. Decrease source pressure. Relief valve must reseat at 80 (+0, -8 psig).

j. Decrease pressure to zero and open BYPASS valve.

k. Slowly increase source pressure to 30 psig as shown on GAS PRESSURE gage; maintain this pressure.

l. Slowly open the LOW FLOW METER shutoff valve.

m. Close BYPASS valve.

n. Slowly open needle valve (connected to OUTLET) and regulate flow to allow top float to rise to top of graduated scale of tube.

o. Take LOW FLOW METER tube reading for top float, beginning at the highest scale reading on tube and working down. Record each major reading on tube and calibration standard.

p. Repeat step o for bottom float.

q. Compare reading of GAS TEMPERATURE gage with reading of calibration standard. GAS TEMPERATURE gage must indicate within ±7° F of standard.

r. Close needle valve.

s. Slowly open HIGH FLOW METER shutoff valve, and close LOW FLOW METER shutoff valve.

t. Repeat steps n through q for HIGH FLOW METER.

u. Close needle valve, and decrease source pressure to zero.

v. Close HIGH FLOW METER shutoff valve, and open BYPASS valve.

w. Open BLEED valve. Pressure vents to zero as shown on GAS PRESSURE gage. Install closures on open ports.

x. With data obtained in steps o and t compare reading with each individual flow meter curve. The recorded readings must be within ±4 percent of full scale of any one float. Establish new curves if necessary.

NOTE

The flowmeter unit is provided with a set of curves with temperature correction information. These curves are labeled LOW FLOW METER TOP FLOAT, LOW FLOW METER BOTTOM FLOAT, HIGH FLOW METER TOP FLOAT, and HIGH FLOW METER BOTTOM FLOAT.

6-12. REMOVING.

6-13. Disassemble the pneumatic flow monitor, as required, to accomplish necessary repair or replacement. See figure 6-5 for index and part numbers.

6-14. INSTALLING.

6-15. All parts of the pneumatic flow monitor must meet the cleaning requirements outlined in section I before installing. See figure 6-5 for index and part numbers. The following steps include the special instructions. All tubing is locally manufactured from CRES 321, Type I (MIL-T-8808) with tube end flared in accordance with MS33584, with sleeve MS20819- and nut AN818-. (A damaged tube should be used for mockup and wall thickness.) The lubricant used during installation is lubricant grease RB0140-012 (Rocketdyne), except as specified. Refer to section I for lubricant application.

a. Torque nuts of threaded fasteners as follows:

NOTE

When tightening fasteners from the head side, torque must be within 10 percent of the high side of the specified torque range.

Part Number	Size/ Thread	Torque (in-lb)
AN3	10-32	24-30
AN507	10-32	8-10
AN526	10-32	8-10

b. Torque nut AN924 or union AN815 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	55-80
3/8	100-150

c. Torque nut AN6289 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	75-100
3/8	150-200

d. Torque jamnuts and fittings without gaskets as follows:

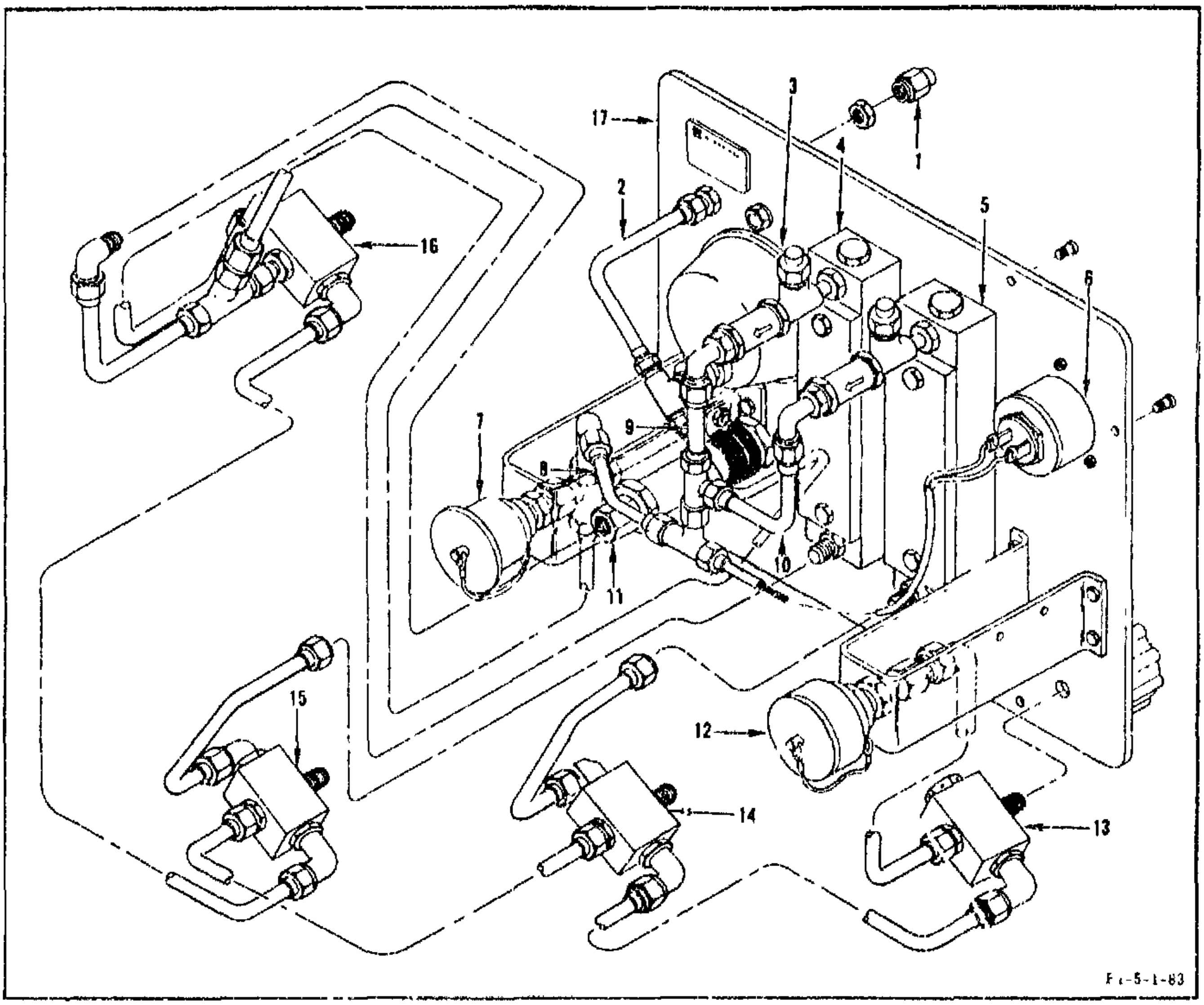
Tube OD (Inches)	Torque (in-lb) Aluminum	Torque (in-lb) Steel
1/4	90-105	110-130
3/8	125-145	225-275

e. Torque B-nuts AN818 for tubing as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	135-185
3/8	270-345

6-16. SERVICING.

6-17. Servicing of pneumatic flow monitor consists of a 12-month periodic function-test of flowmeter, pressure gage, temperature gage, and relief valve. Lubricate (Method 2) handvalves stem threads annually, with Fluorolube grease GR-362 (Hooker Chemical Corp), by applying 2 streaks 180 degrees apart.



Index No.	Part No. (Fuel)	Part No. (Oxidizer)	Description
1	AN929-4C	AN929-4C	Cap (F-3)
2	9016820	9016810	Tube (M-3)
	AN832-4C	AN832-4C	Union (F-3)
	AN924-4C	AN924-4C	Nut (F-3)
3	45-1377SSX2MZ0L	45-1377SSX2MZ0L	Gage (F-2)
	4S50X-SS	4S50X-SS	Tee (F-3)
	MS28778-4	MS28778-4	Packing (F-3)
	AN507-1032R20	AN507-1032R20	Screw (F-3)
	LD153-0010-0007	LD153-0010-0007	Washer (F-3)
	NAS679A3W	NAS679A3W	Nut (F-3)
4	P33-F1-1110-2AR	P33-F1-1110-2AR	Flowmeter (F-2)
5	P33-F1-1110-2R	P33-F1-1110-2R	Flowmeter (F-2)
	AN784C6	AN784C6	Tee (F-3)
	AN6289C6	AN6289C6	Nut (F-3)
	MS28777-6	MS28777-6	Ring (F-3)

Figure 6-5. Disassembly of Pneumatic Flow Monitor (Sheet 1 of 2)

Index No.	Part No. (Fuel)	Part No. (Oxidizer)	Description
5 (cont)	MS28778-6	MS28778-6	Packing (F-3)
	RD284-3008-2002	RD284-3008-2002	Check valve (F-2)
	AN929-6C	AN929-6C	Cap (F-3)
	6C50X-SS	6C50X-SS	Elbow (F-3)
	AN815-6C	AN815-6C	Union (F-3)
6	19-9017278	19-9017278	Pyrometer (F-2)
	19-9017277	19-9017277	Thermocouple (F-2)
7	405-00292	405-00288	Nipple (F-3)
	AN924-6C	AN924-6C	Nut (F-3)
	6S6X-SS	6S6X-SS	Tee (F-3)
	6C6X-SS	6C6X-SS	Elbow (F-3)
8	9020133	9020126	Tube (M-3)
	6S6X-SS	6S6X-SS	Tee (F-3)
9	9016816	9016806	Tube (M-3)
	AN824-6C	AN824-6C	Tee (F-3)
10	9016817	9016807	Tube (M-3)
11	RD284-5015-0100	RD284-5015-0100	Relief valve (F-2)
	9015302	9015302	Diffuser (F-2)
	MS28778-6	MS28778-6	Packing (F-3)
	MS21919-G17	MS21919-G17	Clamp (F-3)
	AN3-4A	AN3-4A	Bolt (F-3)
	LD153-0010-0007	LD153-0010-0007	Washer (F-3)
	NAS679A3W	NAS679A3W	Nut (F-3)
	6C6X-SS	6C6X-SS	Elbow (F-3)
12	405-00300	405-00296	Socket (F-3)
	AN924-6C	AN924-6C	Nut (F-3)
13	RD284-6002-0002	RD284-6002-0002	Hand valve (F-2)
	9015302	9015302	Diffuser (F-2)
	MS28778-6	MS28778-6	Packing (F-3)
	LD153-0010-0026	LD153-0010-0026	Washer (F-3)
	6C50X-SS	6C50X-SS	Elbow (F-3)
	9016812	9016802	Tube (M-3)
	9020147	9020127	Tube (M-3)
	RD273-3004-0001	RD273-3004-0001	Reducer (F-3)
	AN818-6C	AN818-6C	Nut (F-3)
14	RD284-6002-0002	RD284-6002-0002	Hand valve (F-2)
	9016812	9016802	Tube (M-3)
	9016813	9016803	Tube (M-3)
	6C50X-SS	6C50X-SS	Elbow (M-3)
15	RD284-6002-0002	RD284-6002-0002	Hand valve (F-2)
	9020135	9020128	Tube (M-3)
	9016813	9016803	Tube (M-3)
	6C50X-SS	6C50X-SS	Elbow (F-3)
16	RD284-6002-0002	RD284-6002-0002	Hand valve (F-2)
	9020146	9020129	Tube (M-3)
	9020145	9020130	Tube (M-3)
	9020134	9020131	Tube (M-3)
	6R6X-SS	6R6X-SS	Tee (F-3)
	6C50X-SS	6C50X-SS	Elbow (F-3)
17	9020138	9020139	Panel (F-1)
	AN526-1032-R10	AN526-1032-R10	Screw (F-3)

Figure 6-5. Disassembly of Pneumatic Flow Monitor (Sheet 2 of 2)

Inspection	Periodic (Months)			
	3	6	12	24
Visual inspections				
1. Obvious signs of damage to all structural members.				
2. Illegible stencils, decals, or nameplates.				
3. Contamination that could result in adverse effects to equipment or engine.				
4. Completeness of units and records.				
Periodic inspections				
1. Case for dents, gouges, and cracks; handles and latches for looseness and difficult operation.				X
2. Instrument panel for loose screws, broken fasteners, and placard illegibility.				X
3. Flowmeter tubes for cracks, moisture condensation, and marking illegibility. Ball floats for lack of free movement.			X	
4. Temperature gage for looseness, damage, and incorrect indication of ambient air temperature.			X	
5. Function Testing (paragraph 6-11).			X	
6. Lubrication of hand valves (paragraph 6-16).			X	

Figure 6-6. Inspection Requirements

6-18. SHIPPING AND STORING.

6-19. Prepare the pneumatic flow monitor for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS).

6-20. INSPECTION.

6-21. Figure 6-6 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, since they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damaged conditions, and that hardware configuration is in accordance with appropriate records. A visual inspection is made before operation of the unit. Periodic inspections are made at specified periods. See figure 6-6 for inspection requirements and periodic intervals.

SECTION VII

ENGINE VERTICAL INSTALLER G4049 AND 75M51505

WARNING

ENGINE VERTICAL INSTALLER G4049 AND 75M51505 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

7-1. SCOPE. This section contains description, operation, maintenance, and inspection for the Engine Vertical Installer G4049 and 75M51505. The installer is used to position the F-1 engine during installation in and removal from a test stand or a vertical stage. Engine Vertical Installer G4049 is also used to position the thrust chamber nozzle extension during installation on and removal from a vertical engine.

7-2. DESCRIPTION.

7-3. ENGINE VERTICAL INSTALLER G4049.

7-4. Engine Vertical Installer G4049 (figure 7-1) is an electrohydraulic-operated, self-propelled, lifting and positioning unit for the F-1 engine. The vertical installer consists of a dual-pressure hydraulic system, electrical system, control console, a hydraulically-operated azimuth drive, a three-stage lifting cylinder and engine platform, manually-operated tilting cylinders, manually-operated horizontal positioning platform, and three trucks supporting a triangular frame. The electrohydraulic system operates through a single electric motor, two gearcases, and two hydraulic pumps. A pump and gearcase are mounted on each end of the motor and the assembly is mounted on the frame. The azimuth drive is mounted on a bracket attached to the outer casing of the cylinder. Hydraulic pressure is directed to the motor through flexible hoses. The lifting cylinder is housed in a well, resting on a ball and socket joint, of the horizontal positioning platform and held in the vertical position by the two tilt cylinders. The engine platform is bolted to the lifting cylinder. The three trucks consist of two forward drive trucks and one aft swivel truck. The forward trucks have four casters and a frame, a hydraulic motor and gearbox, and a clutch and chain drive. The trucks are pinned to the frame and hydraulic pressure is directed to the motor through flexible hoses. The aft truck has four casters and a frame, and is pinned to the frame. (See figure 7-2 for leading particulars.)

7-5. ENGINE VERTICAL INSTALLER 75M51505.

7-6. The engine vertical installer 75M51505 (figure 7-1) is a modified version of the installer described in paragraph 7-3. The modification consists of replacing the trucks with air bearing pads, replacing the engine platform, and adding a pneumatic system. The air bearing pads have an air stability tank and two micrometer valves. The engine platform design lowers the engine support ring approximately 16 inches. The pneumatic system provides the lift pressure for the air bearing pads. This installer is moved manually. (See figure 7-2 for leading particulars.)

7-7. HYDRAULIC SYSTEM. The hydraulic system contains a reservoir, electric motor driven hydraulic pumps, filters, relief valves, check valve, bypass valve, interlock valve, solenoid valves, control valves, pressure gages, hydraulic motors, temperature gage, and fixed orifices. The reservoir (140-gallon capacity) contains hydraulic fluid to supply the two hydraulic pumps and has a filler cap, fluid level sight gage, a drain valve, and a filter connected to each of the pump suction lines. The filter consists of a base, a wire mesh insert, and a coupler cap. The hydraulic pumps are fixed displacement pumps and are driven by the motor through a chain coupling. A 20-micron inline filter is connected at the outlet of each pump and consists of a housing and removable cartridge. The high- and low-pressure relief valves are adjustable spring-loaded valves which maintain pump output pressure by relieving pressure greater than the valve setting and returning it to the reservoir.

7-8. The pilot operated check valve and bypass valve are installed in a common manifold at the base of the cylinder. The check valve is a spring-loaded-ball, pilot operated, and subplate mounted. The bypass valve is a lever-operated, two-way, spring return valve with a 20 gpm flow capacity. The solenoid valves are two-way and four-way electrically operated valves. The manual control valves are three-way manually operated valves with a spring return to neutral

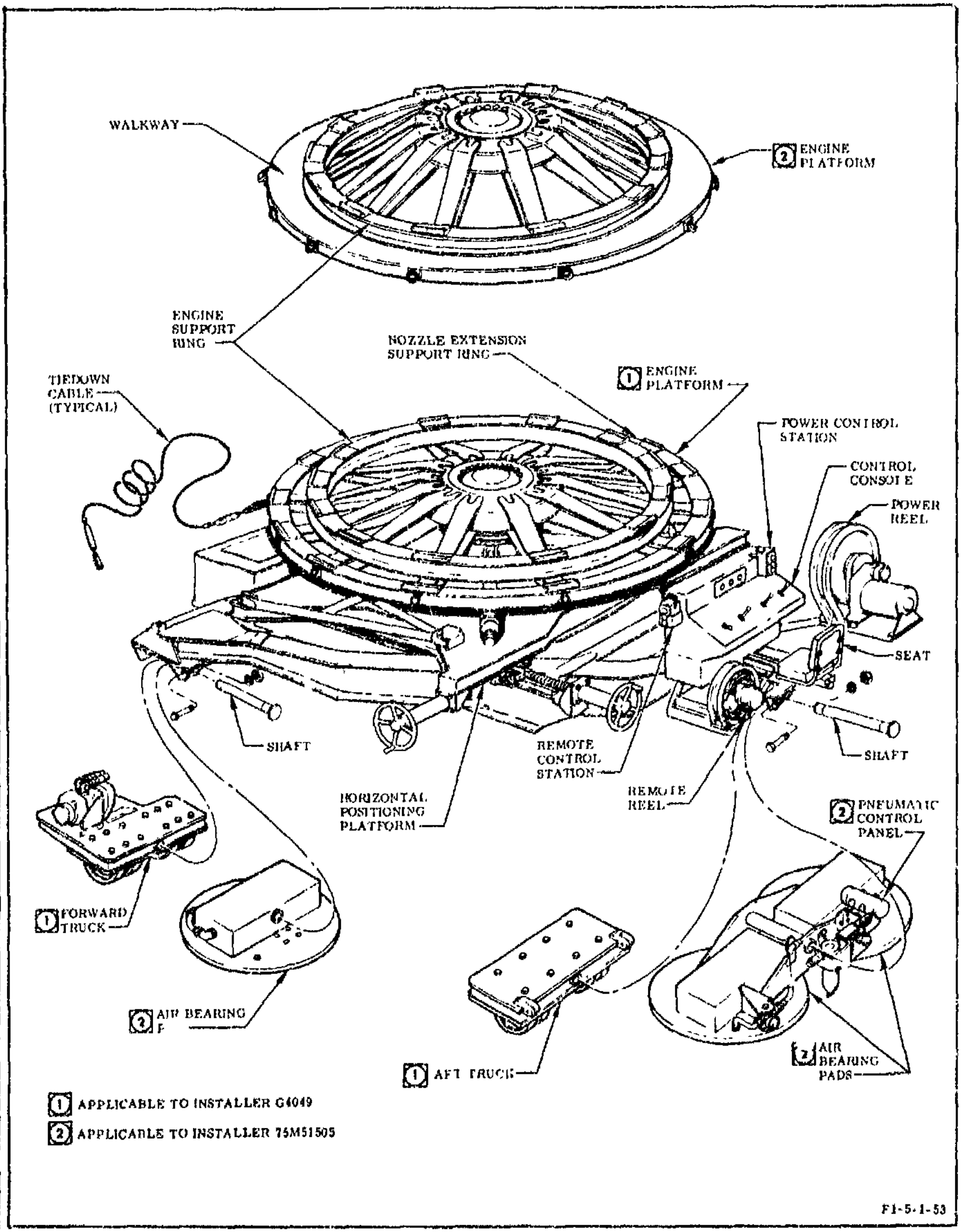


Figure 7-1. Engine Vertical Installer

Length	230 inches
Width	206 inches
Height	70 inches
Gross Weight	27,000 pounds
Maximum Load Capacity	17,500 pounds 20,000 pounds (units *incorporating MD2* change)
Towing Speed[a]	1/2 mph, loaded 1 mph, unloaded
Driving Speed[a]	1/2 mph
Platform Rotation	360 degrees
Platform Rotation Speed	1/3 rpm, maximum 1/175 rpm, minimum
Platform Traverse	8 inches each side of centerline
Platform Tilt	2 degrees each side of vertical
Cylinder Lifting Speed	40 inches a minute, maximum 3 inches a minute, minimum
Fluid	Hydraulic fluid (MIL-H-5606)
Reservoir	140 gallons
Relief Valves	
High-pressure	1,900-2,100 psig
Low-pressure	260-280 psig
Pressure Gages	
High-pressure	0 to 3,000 psi
Low-pressure	0 to 600 psi

Hydraulic Motors	Hydraulic pressure, 0-3,000 psig
Electric Motor	440 vac, 1,800 rpm, 20 hp
Hydraulic Pumps	10 gpm at 3,000 psig 30 gpm at 500 psig
Hydraulic High-Pressure System	0 to 3,000 psig
Hydraulic Low-Pressure System	0 to 500 psig
Manual Control Valves	Cylinder LH and RH drive[a] Azimuth
Electrical Remote Control Valves	Cylinder Azimuth
Filters	20-micron hydraulic
Lifting Cylinder	3 Stage 1st 20-inch stroke 2nd 20.5-inch stroke 3rd 31.5-inch stroke
Temperature Gage	+30° to +220° F range with a +200° F Redline
Air Bearing	10 inches high
Pads[b]	46 inches in diameter
Lifting area[b]	[illegible] square feet
Operating height[b]	1 inch maximum
Pneumatic Pressure[b]	50-125 psig, 30-120 scfm

(a) Applicable to Engine Vertical Installer G4049.
(b) Applicable to Engine Vertical Installer 75M51505.

Figure 7-2. Leading Particulars for Engine Vertical Installer or off position. The pressure gages, a low-pressure 0-600 psig range and a high-pressure 0-3,000 psig range, are bourdon tube type gages. The temperature gage is used to indicate temperature of the hydraulic fluid and is red lined at 200° F. The fixed orifices in the hydraulic lines provide controlled flowrates to the lift cylinder and hydraulic motors. See figure 7-3 for hydraulic schematic.

7-9. ENGINE VERTICAL INSTALLER 75M51505 PNEUMATIC SYSTEM. The pneumatic system contains a filter, shutoff valve, manifold, four regulators and pressure gages, and eight micrometer valves. The filter consists of a bowl, cap, drain valve, and 75-micron monel screen element. The filter, shutoff valve, and manifold are mounted on a control panel below and to the right of the pilot seat. The regulators are piston-spring-operated with a pressure control adjusting knob. The pressure gage, mounted in a port of the regulator, has a 2-inch diameter dial with a 0-160 psig range. A regulator and gage are mounted on a panel on each air bearing pad. The micrometer valves are manually adjusted needle valves and are installed threaded holes on the air bearing pads. See figure 7-4 for pneumatic schematic.

7-10. ELECTRICAL SYSTEM. The electrical system consists of three junction boxes, a motor, a power control station, a remote-control station, and solenoid valves. See figure 7-5 for electrical schematic. The junction boxes (figure 7-6) have a step-down transformer, a phase-reversal relay, a motor-control relay, a phase-reverse light, two circuit breakers, an hourmeter, and a starter reset switch. The electrical system operates from a 440-vac, 60-cycle, 3-phase facility power source. The power control station is mounted on the control console and the remote-control station is stored in a rack mounted on the console. The power control station has the start and stop buttons that control the motor and a power-on light. The remote-control station has a power switch, cylinder up and down switches, and azimuth clockwise and counterclockwise switches. The complete electrical system is explosionproof. A wiring diagram (figure 7-11), located at the end of this section, is provided to aid in repair or replacement of wiring.

7-11. CONTROL CONSOLE. The control console (figure 7-7) consists of a control panel, an instrument panel, a record box, an operator's seat, a remote-control station cable and reel, and an electrical power supply cable and reel. The control panel has the manual control valves to propel the vertical installer, to operate the azimuth control, and to raise or lower the lifting cylinder. The gage panel has the low- and high-pressure hydraulic gages and the temperature gage. The record box is for storage of installer records. The remote-control station cable and reel allow the operator to be away from the control console when rotating, raising, or lowering the cylinder. The electrical power supply cable and reel allow operation of the installer a maximum of 90 feet from the facility electrical source.

7-12. AZIMUTH DRIVE. The azimuth drive (see figure 7-8) is a hydraulic pressure operated unit that rotates the cylinder and engine platform 360 degrees in either direction. The azimuth drive assembly consists of a speed-reducing unit, a double-strand roller chain, two sprockets, a coupling, and a hydraulic motor. The drive sprocket is mounted on a ring at the top of the outer casing of the cylinder and keyed to the first stage of the cylinder. The driver sprocket on the reduction unit and the driven sprocket on the lifting cylinder are linked mechanically through the chain.

7-13. ENGINE PLATFORM AND LIFTING CYLINDER. The engine platform and lifting cylinder (see figure 7-8) are a telescopic, three-stage actuator assembly designed for a 300-psig working pressure and is extended by hydraulic pressure and retracted by gravity. The retracted height of the lifting cylinder is 61.5 inches, and the extended height is 141.5 inches. The 80-inch extension is obtained by a 20-inch stroke by the first stage, a 28.5-inch stroke by the second stage, and 31.5-inch stroke by the third stage. The outer cylinder contains the three stages when in the retracted position, is keyed to the first lifting stage. The first stage is keyed to the second stage and the second stage is keyed to the third stage. Each stage has an oil seal at the bottom and a felt wiper at the top. The engine platform is attached to a ring on the third stage of the cylinder. On installer G4049, the engine platform has an engine support ring

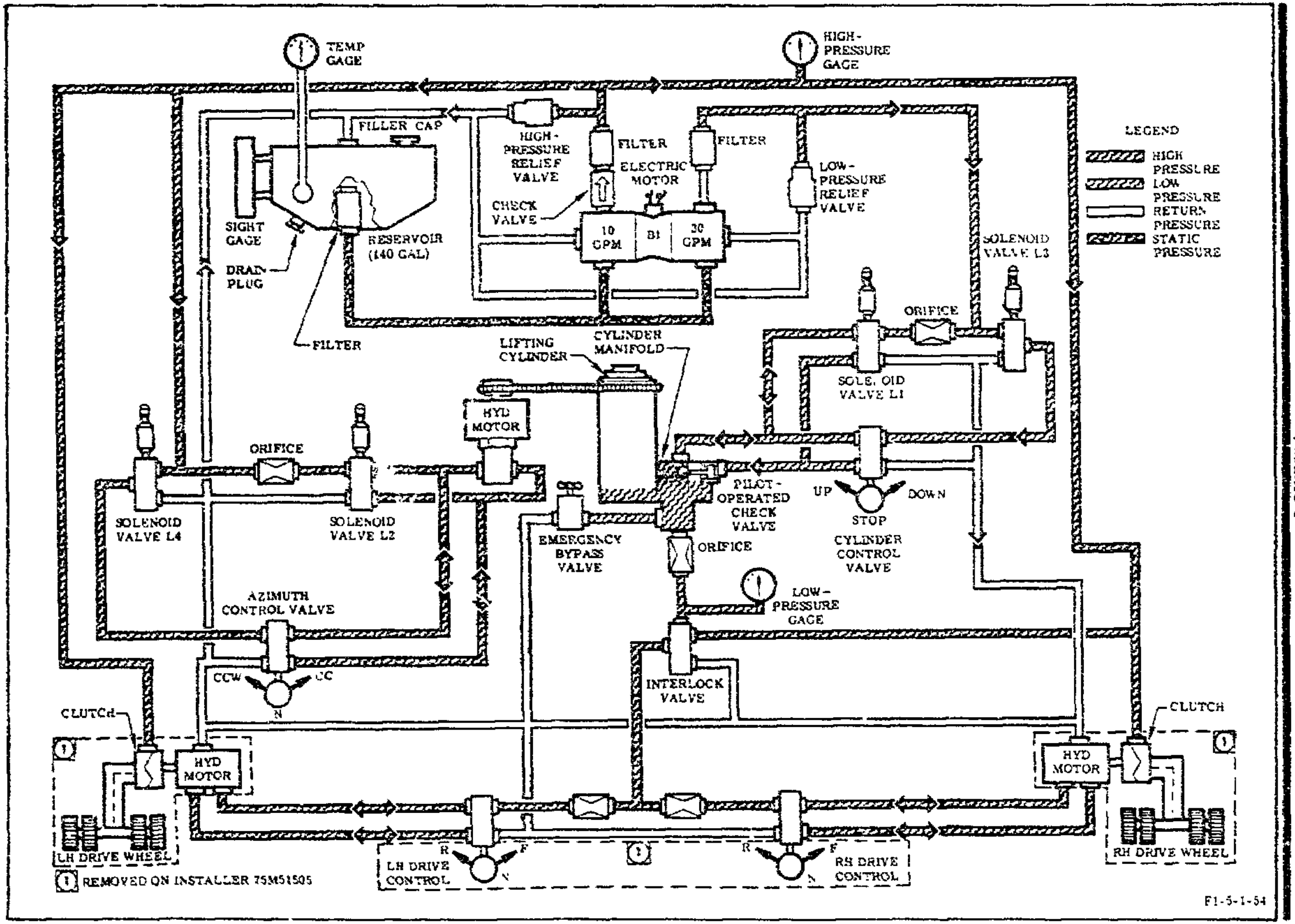


Figure 7-3. Engine Vertical Installer Hydraulic Schematic

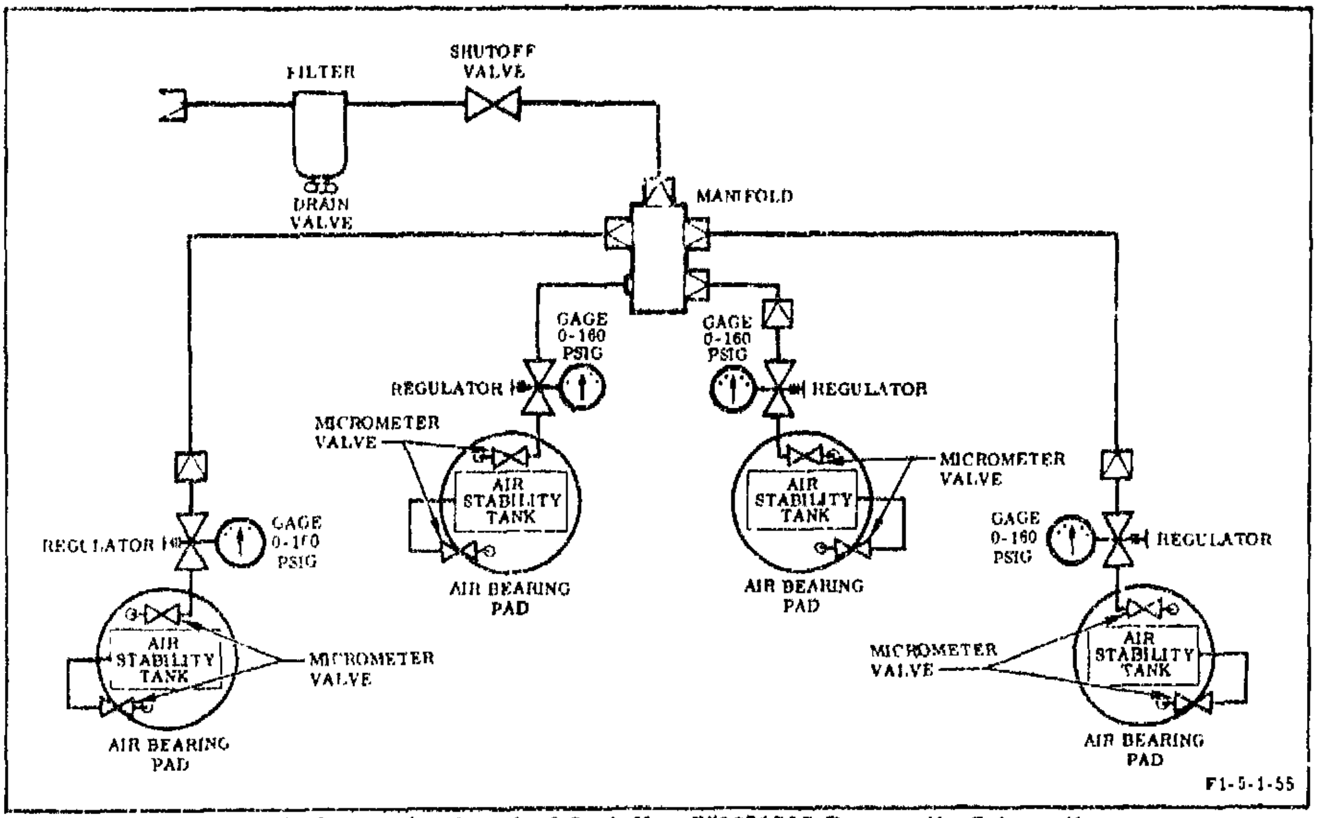


Figure 7-4. Engine Vertical Installer 75M51505 Pneumatic Schematic

and a nozzle extension support ring. On installer 75M51505, the engine platform has an engine support ring and a grated walkway around the perimeter of the ring. The platform and cylinder is mounted in the geometric center of the installer chassis.

7-14. VERTICAL TILT CYLINDERS. The vertical tilt cylinders (see figure 7-8) consist of two adjustable cylinders mounted 90 degrees apart on the platform. The right-hand cylinder is attached to the lifting cylinder with a brace and the left-hand cylinder is attached to the lifting cylinder with a strut. The cylinder consists of a housing, shaft with acme threads, block, bearing, nut, mount, keeper, retainer, and an adjusting cap. Each cylinder is capable of moving the lifting cylinder 2 degrees each side of the vertical centerline. The adjustments are made by turning the adjusting cap. On units incorporating MD2 change, an indicator is installed on the shaft to indicate vertical attitude of the lifting cylinder.

7-15. HORIZONTAL POSITIONING PLATFORM. The horizontal positioning platform (see figure 7-8) consists of a platform, four roller blocks, eight roller tracks, and two traversing units (a lateral unit and a longitudinal unit). The platform is constructed from low carbon steel plate and has a well in the center approximately 25 inches deep with a bottom diameter of 28 inches and a top diameter of 43 inches. The roller blocks consist of blocks, retainers, pins, and eight double-row needle bearings. The roller blocks ride on the tracks, mounted 90 degrees from each other, on the platform and the chassis. The lateral and longitudinal units have a handwheel, a housing assembly, and an acme-thread screw. The longitudinal unit has a chain drive that operates a similar longitudinal unit simultaneously with the single longitudinal handwheel. Each unit is capable of traversing approximately eight inches in either direction. The lateral unit is bolted to the platform and pinned to the roller block. Rotation of the lateral handwheel moves the platform on rollers in the lateral direction. The longitudinal unit is bolted to the chassis and pinned to the roller block. Rotation of the longitudinal handwheel moves the roller blocks to carry the platform in the longitudinal direction. Both units may be operated simultaneously to adjust the platform to the desired position.

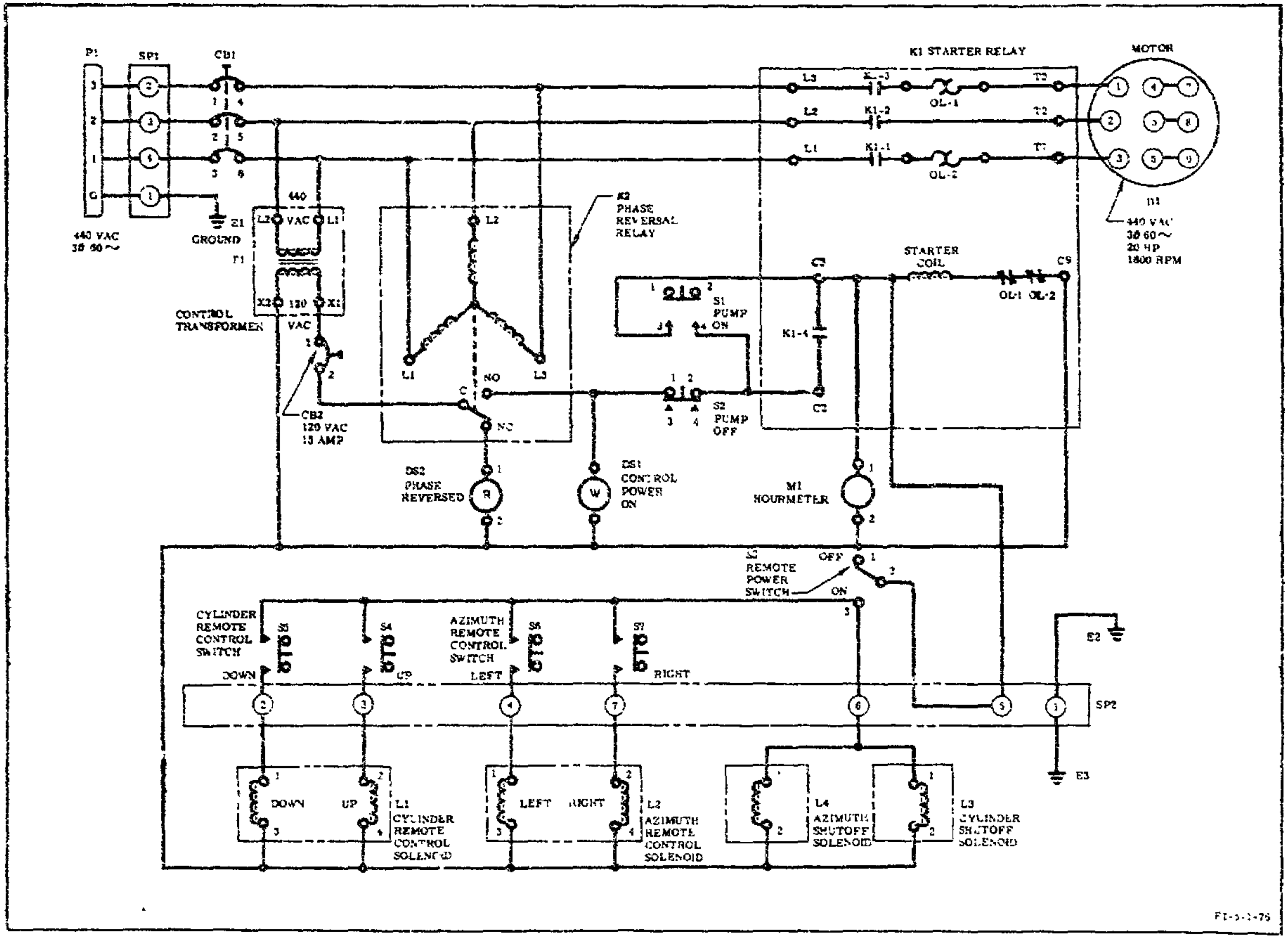


Figure 7-5. Engine Vertical Installer Electrical Schematic

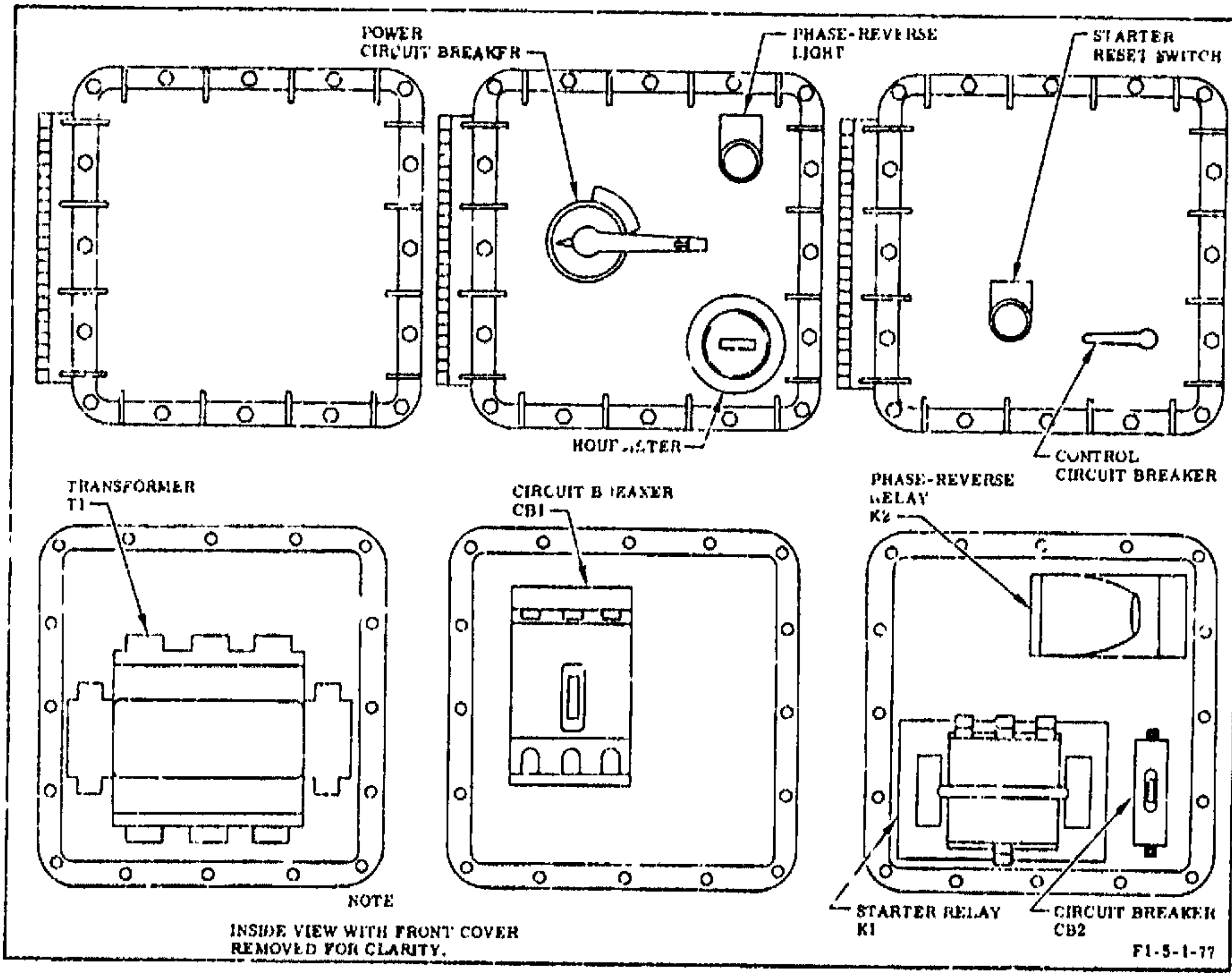


Figure 7-6. Engine Vertical Installer Electrical Junction Boxes

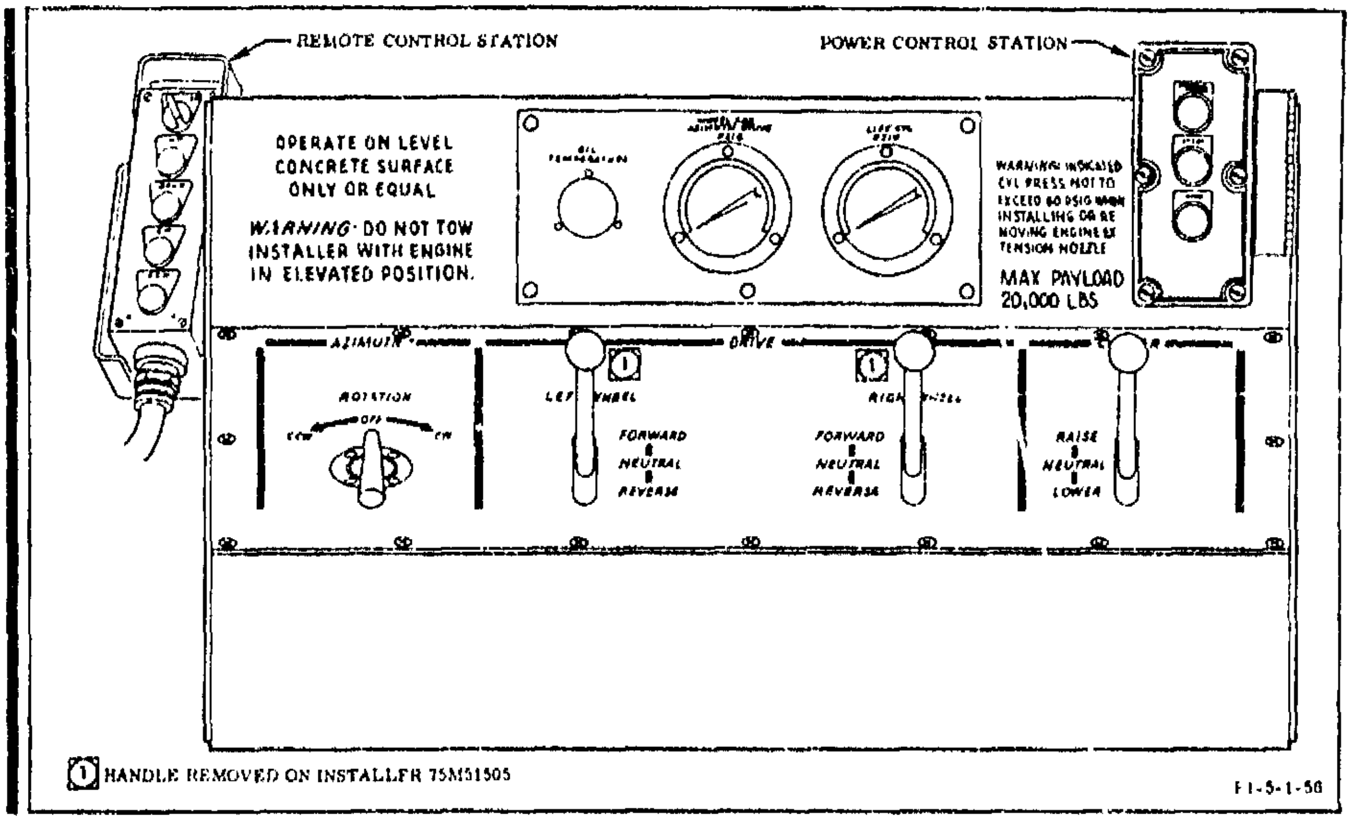


Figure 7-7. Engine Vertical Installer Control Console

7-16. OPERATION.

7-17. Closing of the facility circuit breaker energizes the electrical system. The vertical installer electrical system has two different circuits. The motor circuit is a 440-vac, 60-cycle, 3-phase system and the control circuit is a 120-vac system. The motor and control circuits receive power through electrical receptacle P1 and are protected by a 70-ampere circuit breaker CB1. Closing of the circuit breaker energizes the phase control relay (K2) and applies 440 vac to the primary winding of a step-down transformer and the open contacts of the motor starter relay. If phasing is correct, the phase reversal relay will energize and partially complete the control circuit. The control circuit receives its power through the step-down transformer (T1). The circuit is protected by a 15-ampere circuit breaker (CB2). Closing the circuit breaker applies 120 vac to the CONTROL POWER light, through closed contacts of STOP switch (S2), and to the open contacts of START switch (S1). Pressing the START switch energizes the motor starter relay, closing K1 starter contacts to apply 440 vac to the motor and lockin control power. At the same time, control power starts the hourmeter and provides power to the remote-control station power switch. Moving the remote control box control switch to ON provides power through electrical receptacle SP2 to close the normally open azimuth shutoff (L4) and piston shutoff (L3) solenoid valves; and control power to the cylinder remote-control (S4, S5) and azimuth remote-control (S6, S7) switches. Energizing the cylinder remote-control switches (S4, S5) controls the four-way solenoid (L1), and hydraulic pressure raises the lift cylinder. Energizing the azimuth remote-control switches (S6, S7) controls the four-way solenoid (L2), and hydraulic pressure rotates the platform.

7-18. The electric motor driven pumps supply low-pressure fluid to the lifting cylinder and high-pressure fluid to the remainder of the hydraulic system. The high-pressure system fluid is drawn from the reservoir through a filter into the hydraulic pump where pressure is increased to approximately 2,000 psig at the rate of 10 gpm. High-pressure fluid is then distributed to the system through a 20-micron

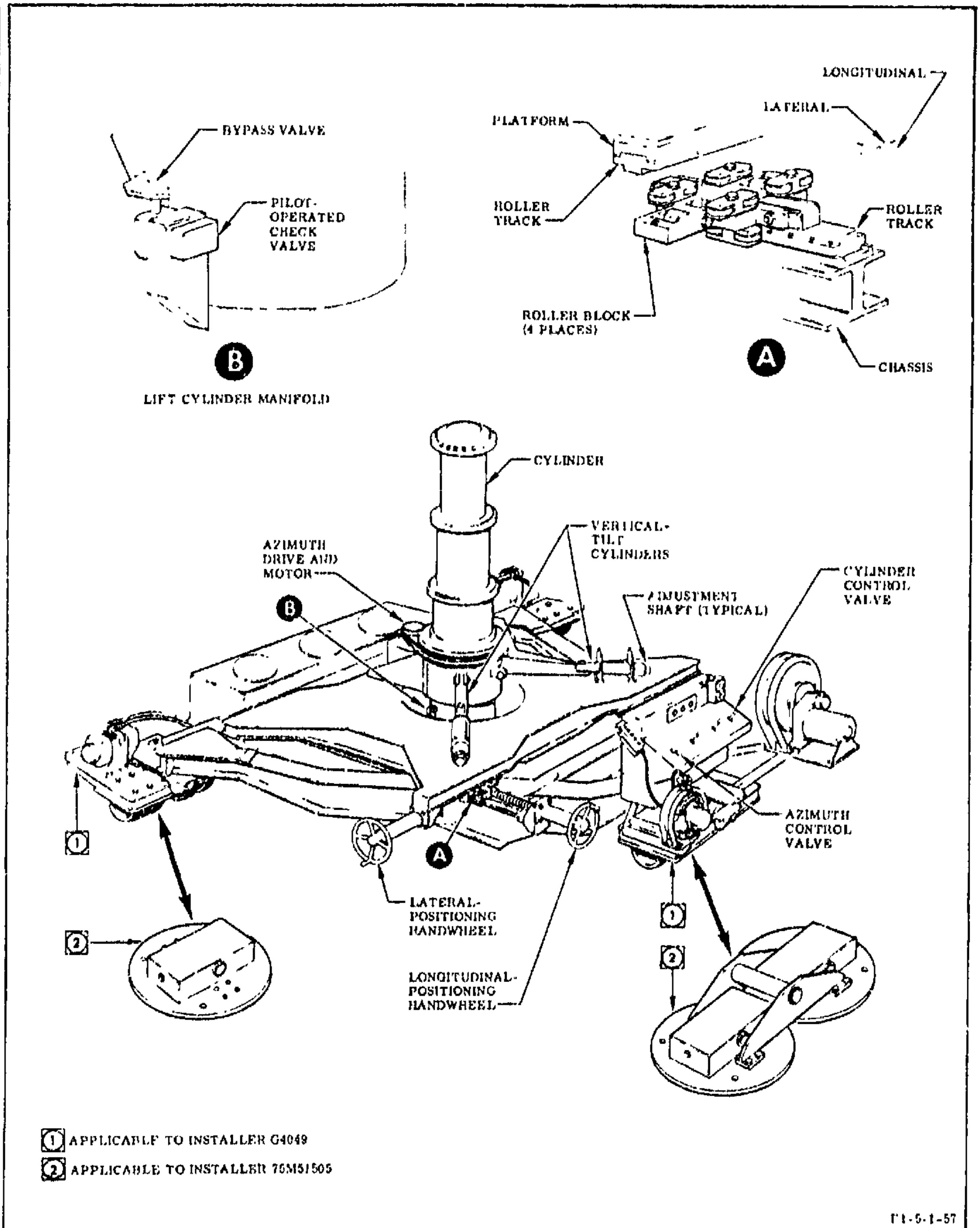


Figure 7-8. Engine Vertical Installer Positioning Mechanisms

filter to the high-pressure relief valve, pressure gage, to the azimuth remote-control solenoid, through the azimuth shutoff solenoid to the azimuth control valve and through the interlock valve to the left-hand and right-hand drive control valves. Operation of the AZIMUTH control valve allows flow to rotate the hydraulic azimuth drive motor. The azimuth indirectly operates chain drives to obtain the desired results. On installer G4049, high pressure is also distributed to the clutch of the drive wheels, and the interlock valve prevents the flow of hydraulic fluid through the drive control valves when the lifting cylinder is in use. Operation of the DRIVE control levers opens the manual control valves allowing fluid flow to rotate the hydraulic wheel drive motors. The low-pressure system fluid is drawn from the reservoir through a filter and into the hydraulic pump where pressure is increased to approximately 270 psig at the rate of 30 gpm. Low-pressure fluid is then distributed to the system through a 20-micron filter to the low-pressure relief valve to the cylinder remote-control solenoid, through the cylinder shutoff solenoid to the cylinder control valve. Operation of the CYLINDER control valve allows flow through the pilot-operated check valve to raise the cylinder, through an orifice to the pressure gage, and to the bypass valve. The pilot-operated check valve prevents loss of pressure from the lifting cylinder if a line breaks or a control valve leaks. The bypass valve is in a return line and is used for emergency release of the hydraulic pressure in the lifting cylinder. On installer 75M51505, a source of dry air is connected to the inlet of the filter. Opening the shutoff valve allows pressure to each regulator. Adjusting the regulator and micrometer valves, allows pressure to enter the air bearing pads causing the installer to become airborne. The pressure gage indicates cylinder internal pressure.

7-19. MAINTENANCE.

7-20. Maintenance of the engine vertical installer consists of checkout, removing, installing, servicing, and shipping and storing. The surface area and/or lettering is repainted, as required, when paint becomes chipped, scratched, or worn off and when lettering becomes illegible. (Refer to section I for painting information.) The installer is cleaned, when applicable, as outlined in section I.

7-21. CHECKOUT.

7-22. Checkout of the engine vertical installer consists of preparation for use, leak and function testing, and proof testing.

7-23. PREPARATION FOR USE.

a. Place installer near a 440-vac, 60-cycle, 3-phase, 60-ampere facility power source. Installer 75M51505 requires a source of dry air at 125 psig (maximum) with a minimum flowrate of 120 cfm.

b. For Installer G4049, the floor area must be approximately 20 feet wide and 60 feet long, within 0.5 degree of level, and capable of withstanding a total weight of 64,200 pounds.

c. For Installer 75M51505, the floor area must be approximately 20 feet wide and 30 feet long, within 0.1 degree of level, smooth without cracks or deformities, and capable of withstanding a total weight of 51,750 pounds.

d. Check that hydraulic reservoir is filled to correct level with hydraulic fluid (MIL-H-5606).

e. Check that power control station and remote-control station switches are off, and control valves are in off, closed, or neutral position.

f. Check that the 2 circuit breaker handles, located on boxes near right-front drive wheels or air bearing pads, are in open position.

g. Connect installer power cable to facility electrical source, using receptacle 4264BC or RA4264BC (Russell and Stoll Co).

h. For Installer 75M51505, connect a source of dry air to inlet of filter on control panel.

i. Turn on facility electrical power.

j. Move the 2 circuit breaker handles (step f) to close position.

k. Check that PHASE REVERSED indicator light on box near right-front drive wheel or air bearing pad is off.

l. Check that CONTROL POWER light located on power control station at upper right-hand corner of control console is on.

m. Press power control station START switch to momentarily start hydraulic pump motor; then press STOP switch. Check that pump rotation is in a clockwise direction when looking into end of high-pressure pump.

n. If electrical power shuts off automatically, isolate problem area and repair as necessary. Press starter reset switch; then repeat steps e through l.

o. Operate horizontal positioning system by turning lateral and longitudinal handwheels full travel in both directions. During operation, make sure the following results are obtained.

(1) System operates smoothly without binding or excessive backlash.

(2) Correct clearance between moving parts of horizontal positioning systems and chassis.

(3) Hydraulic flex hoses have adequate clearance and bend radii are smooth without excessive stress in hose.

p. Operate both vertical tilt cylinders by raising lockpin and turning adjustment nut full travel in both directions. During operation, make sure the following results are obtained:

(1) Both cylinders operate smoothly without binding.

(2) Hydraulic flex hoses between lift cylinder and platform have adequate clearance, and bend radii are smooth without excessive stress in hose.

q. Adjust vertical tilt cylinders as necessary to return lift cylinder to a vertical position. On units incorporating MD2 change, adjust vertical tilt cylinders until indicator pointer is over center of block mounting bolthead.

7-24. LEAK AND FUNCTION TESTING.

a. Press power control station START switch. Hydraulic pump starts and WHEEL AND AZIMUTH DRIVE PSIG gage must indicate 1,900-2,100 psi. Adjust relief valve, if necessary, to obtain specified pressure.

b. Make sure oil temperatu[illegible] does not exceed redline value on OIL TEMPERATURE gage throughout test.

c. Check all hydraulic lines, flex hoses, and fittings between hydraulic pumps and control valves for leakage. Leakage is not allowable.

d. Move CYLINDER manual control to RAISE. Allow engine platform to move up approximately 2 feet. LIFT CYL PSIG gage must indicate 260-280 psi. Adjust relief valve, if necessary, to obtain specified pressure.

e. Check cylinder, cylinder pilot valve lines, and control valve for leakage. Leakage is not allowable.

f. Move CYLINDER manual control to LOWER. Engine platform must move to fully down position.

g. Move AZIMUTH ROTATION manual control to CW until engine platform rotates 30 degrees clockwise. Leak-test azimuth control system. Leakage is not allowable.

h. Move AZIMUTH ROTATION manual control to CCW until engine platform rotates 30 degrees counterclockwise. Leak-test azimuth control system. Leakage is not allowable.

NOTE

Steps i through l apply to Installer G4049.

i. Release wheel brakes and move RIGHT WHEEL manual control to FORWARD until right wheels move forward approximately 3 feet. Check control valve, lines, flex hoses, and motor for leakage during operation. Leakage is not allowable. Right-wheel drive must operate smoothly.

j. Move LEFT WHEEL manual control to FORWARD until left wheels move forward approximately 3 feet. Check control valve, lines, flex hoses, and motor for leakage during operation. Leakage is not allowable. Left-wheel drive must operate smoothly.

k. Move RIGHT WHEEL and LEFT WHEEL manual controls to FORWARD until installer moves forward approximately 5 feet; then move RIGHT WHEEL and LEFT WHEEL manual controls to REVERSE until installer returns to original position. Check control valves, lines, hoses, and motor for leakage. Leakage is not allowable.

l. Press power control station STOP switch. Hydraulic pumps stop.

NOTE

Steps m through r apply to Installer 75M51505.

m. Increase dry air source pressure to 120 ±5 psig, and slowly open air shutoff valve located on control panel.

n. Apply leak-test compound (MIL-L-25567), or equivalent, to all connections between filter inlet and pressure regulators located at each air bearing pad. Leakage is not allowable.

o. Adjust pressure regulator until pressure gage indicates 90 (+0, -5) psi.

p. Apply leak-test compound (MIL-L-25567), or equivalent, to all connections between pressure regulators and micrometer valves. Leakage is not allowable.

q. Slowly open micrometer valves located at each air bearing pad. The installer must become airborne at 90 psig maximum.

r. Close air shutoff valve, permitting installer to rest on air bearing pads. Leave pressure regulators and micrometer valves adjusted.

s. Press power control station START switch. Hydraulic pump starts, and WHEEL AND AZIMUTH DRIVE PSIG gage must indicate 1,000-2,100 psi.

t. Move AZIMUTH ROTATION manual control to CW. Engine platform must rotate 360 degrees clockwise within 2-3 minutes.

u. Move AZIMUTH ROTATION manual control to CCW. Engine platform must rotate 360 degrees counterclockwise within 2-3 minutes.

v. Move CYLINDER manual control to RAISE. Engine platform must move to fully up position within 4 minutes.

w. Move CYLINDER manual control valve to LOWER. Engine platform must move to fully down position within 8 minutes.

x. Move CYLINDER manual control to RAISE. Allow cylinder to move to fully up position.

y. Press power control station STOP switch. Hydraulic pumps stop.

z. Open bypass valve at bottom of lift cylinder. Engine platform must move to fully down position within 10 minutes. Check that LIFT CYL PSIG gage indicates zero. Close bypass valve.

aa. Press power control station START switch. Hydraulic pumps start.

ab. Move remote control station power switch to ON.

ac. Move CYLINDER manual control to RAISE. System must be inoperative.

ad. Move AZIMUTH ROTATION manual control to CW, CCW, and OFF. System must be inoperative.

ae. Press remote-control station azimuth control CW switch; then CCW switch. Engine platform must rotate clockwise; then counterclockwise.

af. Press remote-control station azimuth control CW switch; then CCW switch to rotate engine platform intermittently through 30 degrees both clockwise and counterclockwise.

ag. Press remote-control station lift cylinder UP switch until engine platform raises 2 inches; then press DOWN switch until engine platform moves to fully down position.

ah. Move remote-control station power switch to OFF.

ai. Move AZIMUTH ROTATION manual control to CW, CCW, and OFF. System must be operative.

aj. Move CYLINDER manual control to RAISE; then to LOWER. System must be operative.

NOTE

Steps ak through aq apply to Installer G4049.

ak. Release wheel brakes.

al. Move RIGHT WHEEL and LEFT WHEEL manual controls to FORWARD to move installer forward at full speed for 30 feet; then move controls to NEUTRAL. Forward speed of installer must be approximately 1/2 ft/sec.

am. Move RIGHT WHEEL and LEFT WHEEL manual controls to REVERSE until installer returns to original position; then move both manual controls to NEUTRAL.

an. Move CYLINDER manual control to RAISE until engine platform raises one foot; then move control to NEUTRAL.

ao. Move LEFT WHEEL and RIGHT WHEEL manual control valves to FORWARD; then REVERSE. Wheel drive system must be inoperative.

ap. Move CYLINDER manual control to LOWER until cylinder stops at lowest position. Check that LIFT CYL PSIG gage indicates zero.

aq. Repeat step ao. Wheel drive system must be operative.

ar. Press power control station STOP switch. Hydraulic pumps stop.

as. Move 2 circuit breaker handles, located on boxes near right-front drive wheels on air bearing pads, to open position. CONTROL POWER indicator light at power control station goes off.

at. Turn off facility power, disconnect power cable from facility, and store cable on reel.

au. Secure all equipment.

7-25. PROOF TESTING. The engine vertical installer must be proof tested in accordance with MSFC STD 126, Standard Inspection, Proof-Testing, and Certification of Handling Equipment.

7-26. REMOVING.

7-27. Disassemble the engine vertical installer, as required, to accomplish necessary repair or replacement. See figure 7-9 for index and part numbers.

7-28. INSTALLING.

7-29. All parts of the engine vertical installer must meet the cleanness requirements outlined in section I before installing. See figure 7-9 for index and part numbers. The following steps include the special instructions. All tubing is locally manufactured from CRES 304 seamless tubing (MIL-T-6845) with tube ends flared in accordance with MS33584, with sleeve MS20819- and nut AN818-. (A damaged tube should be used for mockup.) The lubricant used on O-rings, seals, and straight threads of tubing is hydraulic fluid (MIL-H-5606). For tapered threads, use thread sealant tape RB0140-002 (Rocketdyne). Refer to section I for lubricant application.

a. Torque bolts AN101109, that secure cover (1) to platform (5), to 50-70 in-lb.

b. Torque nuts UWN1216, that secure platform (5) to lift cylinder (10), to 80-100 ft-lb.

c. Torque nuts NAS1022C20, that secure strut (6) to lift cylinder (10) and cylinder (9), to 700 to 1,000 in-lb.

d. Torque nuts, that secure brace (8) to lift cylinder (10) and cylinder (9), as follows:

(1) Nut NAS679C4W to 61-75 in-lb.

(2) Nut NAS1022C20 to 700-1,000 in-lb.

e. Torque nuts RD114-8001-0010, that secure cylinder (9) to platform (12), to 550-650 in-lb.

f. Torque nuts NAS679C6, that secure track (13) to platform (12), to 210-280 in-lb.

g. Torque nuts, that secure mechanism (14) to platform (12), as follows:

(1) Nut MS20500-820 to 400-530 in-lb.

(2) Nut MS20364-1216C to 50-75 in-lb.

h. Torque nuts, that secure mechanism (15) to platform (12), as follows:

(1) Nut MS20500-820 to 400-500 in-lb.

(2) Nut NAS679C4W to 47-61 in-lb.

(3) Nut MS20500-428 to 25-30 in-lb.

(4) Nut MS20364-1216C to 50-75 in-lb.

i. Torque nuts NAS679C6, that secure track (24) to chassis (41), to 210-280 in-lb.

j. Torque nuts MS20364-820, that secure cover (25) to chassis (41), to 160-180 in-lb.

k. Torque nuts 79NU-101, that secure motor (26) to truck (36, 37), to 300-350 in-lb.

l. Torque nuts 79NU-101, that secure clutch (29) to truck (36, 37), to 300-350 in-lb.

m. Torque nuts MS20500-1216, that secure casters (30, 31) to truck (36, 37), to 1,000-1,200 in-lb.

n. Torque nuts MS20500-820, that secure reels (32, 33) to chassis (41), to 310-410 in-lb.

o. Torque nuts NAS1022C12, that secure trucks (36, 37, 40) to chassis (41), to 10 in-lb over locking torque.

p. Torque nuts MS20500-918, that secure frame (38) to chassis (41), to 810-1,070 in-lb.

q. Torque nuts NAS679A4W, that secure valve (48, 49) to chassis (41), to 70-90 in-lb. On units incorporating MD4 change, torque nut NAS679A6, that secures valve (49), to 90-110 in-lb.

r. Torque nuts NAS679A6, that secure filter (50) to chassis (41), to 125-160 in-lb.

s. Torque nuts NAS679A4W, that secure filter (51) to chassis (41), to 70-90 in-lb.

t. Torque nuts MS20500-800, that secure valve (52) to chassis (41), to 200-230 in-lb.

u. Torque nuts MS20500-820, that secure motor (53) to chassis (41), to 400-520 in-lb.

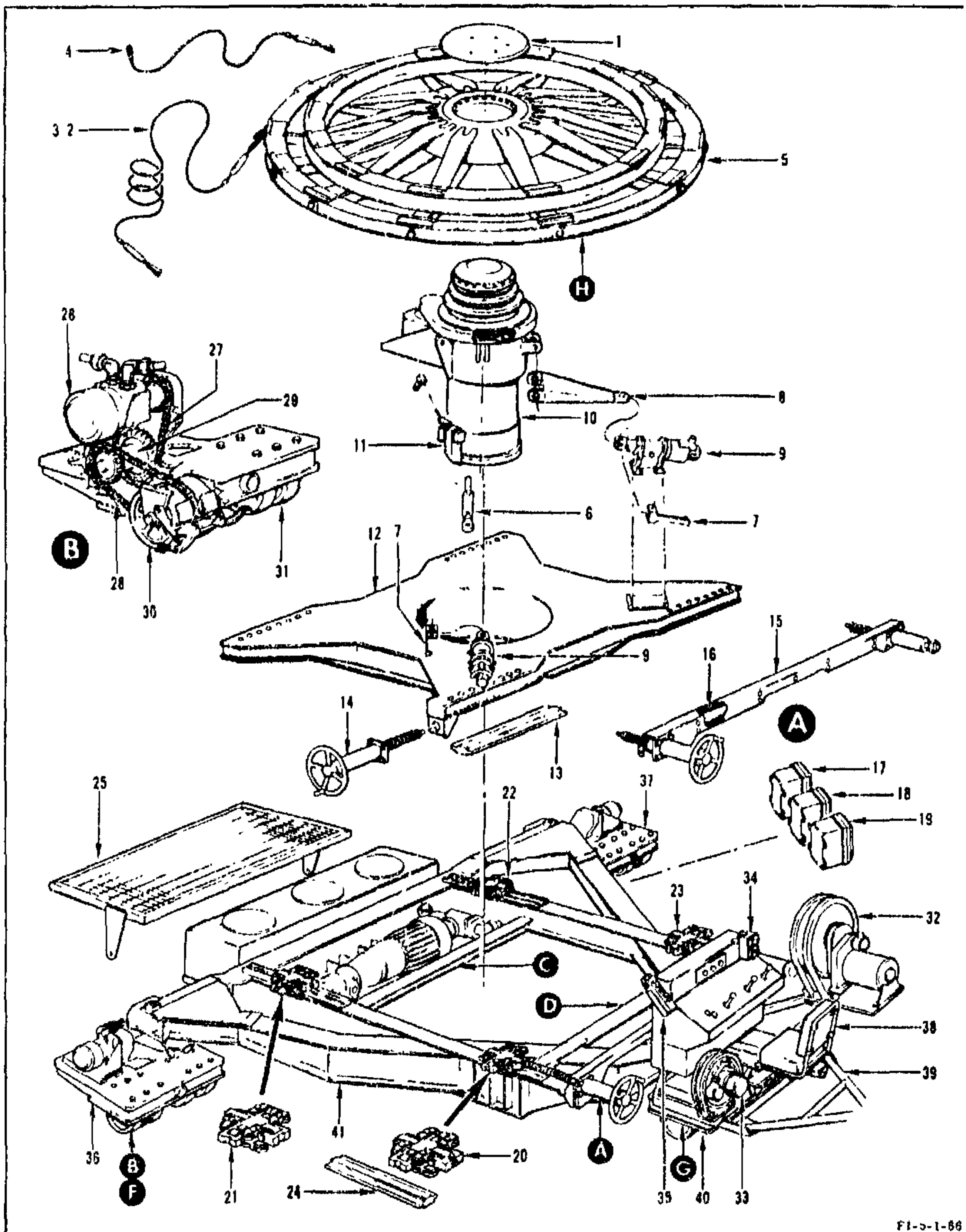


Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 1 of 8)

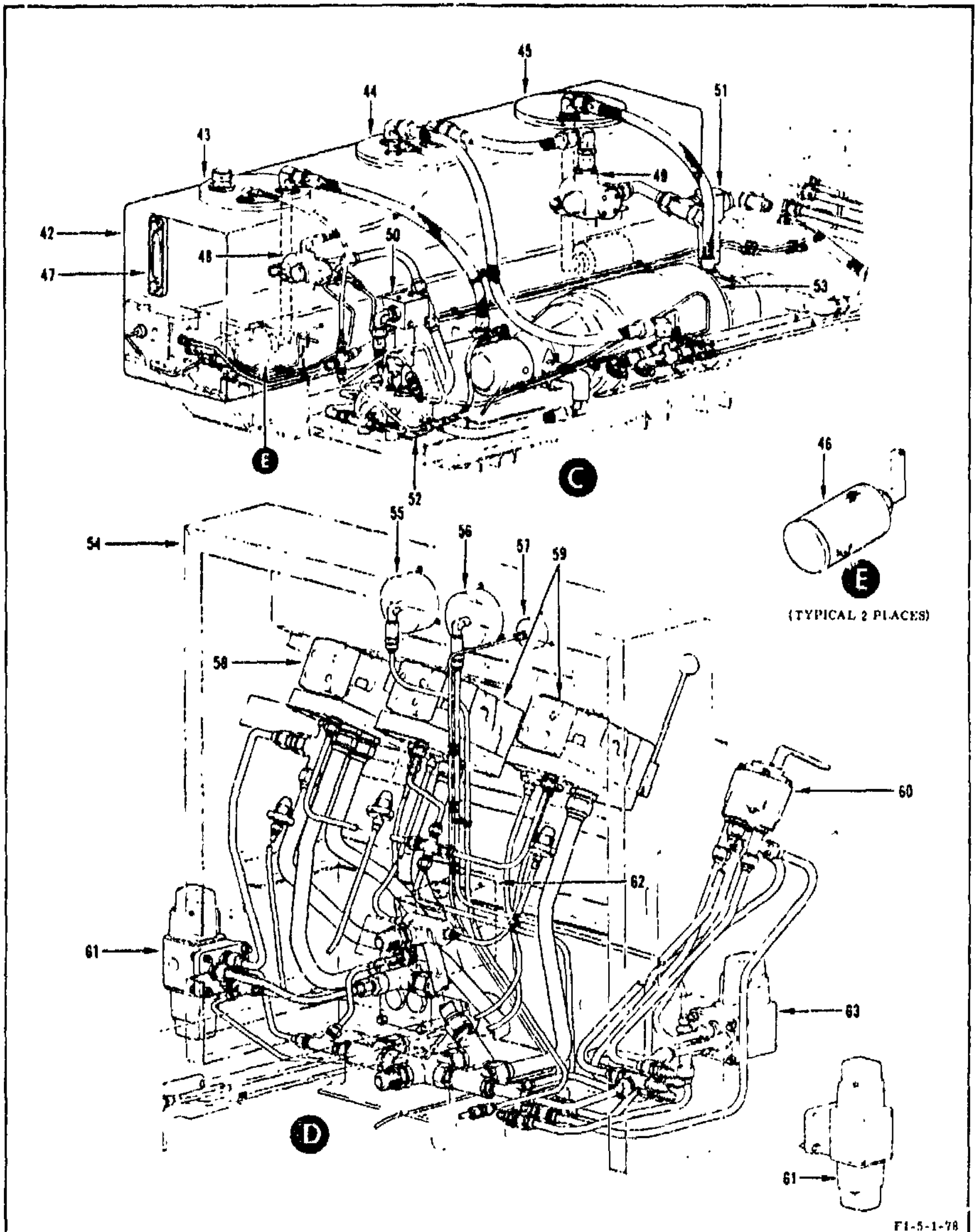
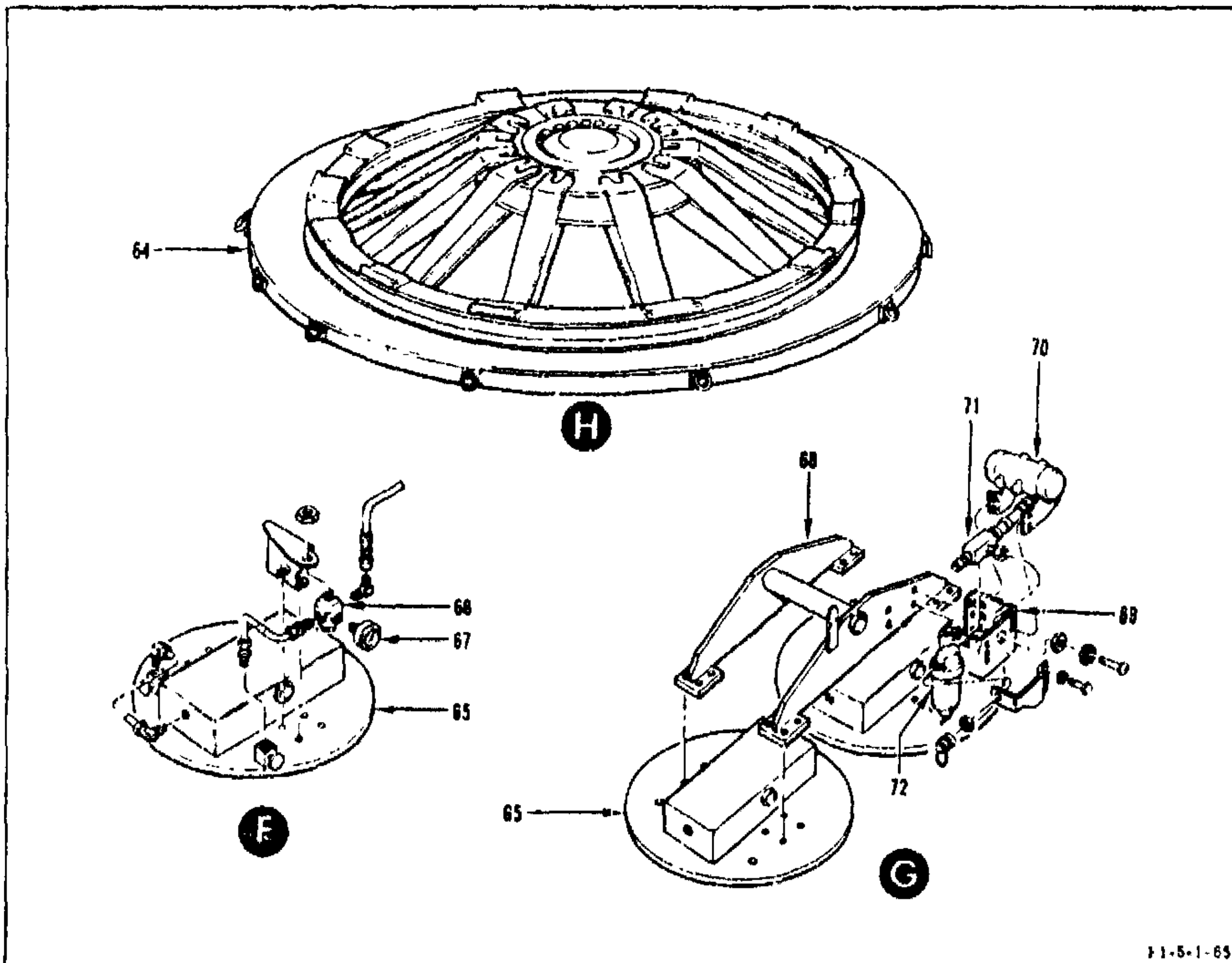


Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 2 of 8)



Index No.	Part No.	Description
1	9019817	Cover (F-3)
	AN101109	Bolt (F-3)
	MS27183-10	Washer (F-3)
2	9019803	Tiedown (F-1)
3	9019806-11	Tiedown (F-1)
4	9021710	Cable (F-3)
5	9019715	Platform (X-3)
	9019715-31 (a)	Platform (X-3)
	20097-12F-81C	Screw (F-3)
	MS20002C12	Washer (F-3)
	MS20002-12	Washer (F-3)
	UWN1216	Nut (F-3)
	9019764	Clip (F-3)
	9019716	Pad (F-3)
5 (cont)	20094-6F-24C	Screw (F-3)
	20094-6F-19C	Screw (F-3)
	MS27183-14	Washer (F-3)
	MS20500-624	Nut (F-3)
	9019750	Panel (F-3)
	AN101113	Bolt (F-3)
	AN101115	Bolt (F-3)
	MS27183-10	Washer (F-3)
	MS20500-428	Nut (F-3)
	9019810	Ring (F-3)
	AN101318	Bolt (F-3)
	MS27183-14	Washer (F-3)
	MS20500-624	Nut (F-3)
	5016	Ring (F-3)

(a) Units incorporating MD2 change

Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 3 of 8)

Index No.	Part No.	Description
6	901975*	Strut (F-1)
	NAS1020-54A	Bolt (F-3)
	NAS1020-40A	Bolt (F-3)
	NAS1020-52A[(a)]	Bolt (F-3)
	NAS1020-64A[(a)]	Bolt (F-3)
	LD153-0010-0030	Washer (F-3)
	RD153-5004-0020	Washer (F-3)
	9019799	Bushing (F-3)
	NAS1022C20	Nut (F-3)
7	9015958[(a)]	Indicator (F-3)
8	9019752	Brace (F-1)
	NAS1004-60A	Bolt (F-3)
	LD153-0010-0009	Washer (F-3)
	RD153-5004-0004	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9019813	Pin (F-3)
	NAS1020-40A[(a)]	Bolt (F-3)
	NAS1020-52A	Bolt (F-3)
	LD153-0010-0030	Washer (F-3)
	RD153-5004-0020	Washer (F-3)
	9019799	Bushing (F-3)
	NAS1022C20	Nut (F-3)
9	9019790	Cylinder (F-2)
	20097-10F-65D	Bolt (F-3)
	MS20002-10	Washer (F-3)
	MS20002C10	Washer (F-3)
	RD114-8001-0010	Nut (F-3)
	9019794	Housing (F-3)
	9019779	Block (F-3)
	AN10-44A	Bolt (F-3)
	LD153-0010-0022	Washer (F-3)
	MS20500-1018	Nut (F-3)
	9019795	Shaft (F-3)
	9019778	Seal (F-3)
	MS15001-1	Fitting (F-3)
	9019798	Cap (F-3)
	MS171756	Pin (F-3)
	9019791	Keeper (F-3)
	MS171588	Pin (F-3)
	9019801	Mount (F-3)
	AN5-5A	Bolt (F-3)
	LD153-0010-0012	Washer (F-3)
	9019797	Retainer (F-3)
	MS171650	Pin (F-3)
	9019796	Nut (F-3)
	T-252W	Bearing (F-3)
10	NA5-28122	Lift Cylinder (F-2)
10 (cont)	NA5-28171[(a)]	Lift Cylinder (F-2)
	9019821	Washer (F-3)
	NAS1228-28L	Bolt (F-3)
	DK063332M	Check Valve (F-2)
	133R3HC2MC[(b)]	Bypass Valve (F-1)
11	9021599	Fitting (F-3)
	9022856	Cable (F-3)
	AN4-6A	Bolt (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
12	9019811	Platform (X-2)
13	9019834	Track (F-3)
	20097-6F-55D	Capscrew (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679C6	Nut (F-3)
14	9019767	Mechanism (F-1)
	AN509-816R39	Bolt (F-3)
	LD153-0010-0017	Washer (F-3)
	MS20500-820	Nut (F-3)
	AN105422	Bolt (F-3)
	RD153-5001-0012	Washer (F-3)
	MS20364-1216C	Nut (F-3)
	9019776	Bracket (F-3)
	NAS1101C3-12	Screw (F-3)
	LD153-0010-0007	Washer (F-3)
	MS20500-1032	Nut (F-3)
	NAS1004-7A	Bolt (F-3)
	RD153-5004-0004	Washer (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9019789	Handwheel (F-3)
	9019818	Nut (F-3)
	9019785	Key (F-3)
	55245	Seal (F-3)
	MS15001-1	Fitting (F-3)
	66225	Cone (F-3)
	66462	Cup (F-3)
	9019783	Housing (X-2)
	B-3952	Shield (F-3)
	802-0144	Clamp (F-3)
	802-0250	Clamp (F-3)
	9019775	Closure (F-3)
	62045	Seal (F-3)
	TW-111	Lockwasher (F-3)

(a) Units incorporating MD2 change
(b) For repair use kit 70003

Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 4 of 8)

Index No.	Part No.	Description
14 (cont)	TN-11	Locknut (F-3)
	9019787	Spacer (D-3)
	9022858	Spacer (D-3)
	9019782	Screw (D-3)
	9019788	Nut (D-3)
15	9019766	Mechanism (F-1)
	AN509-816R42	Bolt (F-3)
	AN509-816R39	Bolt (F-3)
	LD153-0010-0017	Washer (F-3)
	MS20500-820	Nut (F-3)
	9019777-1	Bracket (F-3)
	9019777-2	Bracket (F-3)
	AN4-7A	Bolt (F-3)
	LD153-0010-0009	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9022860-1	Clip (F-3)
	9022860-2	Clip (F-3)
	AN101113	Bolt (F-3)
	AN101115	Bolt (F-3)
	LD153-0010-0009	Washer (F-3)
	MS20500-428	Nut (F-3)
	AN105422	Bolt (F-3)
	RD153-5004-0012	Washer (F-3)
	MS20364-1216C	Nut (F-3)
	9019781	Frame (X-2)
	9019770	Block (F-3)
	9019771	Block (F-3)
	AN6-40A	Bolt (F-3)
	LD153-0010-0015	Washer (F-3)
	NAS679A6	Nut (F-3)
	9019780	Sprocket (F-1)
	9019773	Sleeve (F-3)
	9019774	Spacer (F-3)
	9019772	Spacer (F-3)
	NAS1008-58A	Bolt (F-3)
	LD153-0013-0006	Washer (F-3)
	LD153-0010-0017	Washer (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20500-820	Nut (F-3)
16	No. 50	Roller Chain Link (F-3)
	No. 50	Master Link (F-3)
	No. 50	Half Link (F-3)
17	9021609	Control Panel Box (F-1)
	500970-202	Circuit Breaker (CB2) (F-3)
17 (cont)	RA-232-U	Relay (K1) (F-3)
	500622-6	Relay (K2) (F-3)
	PLG1-SA	Plug (F-3)
	AN6-14A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	RD153-0115-0030	Washer (F-3)
	NAS679A6	Nut (F-3)
18	9021610	Circuit Breaker Box (F-1)
	500970-266	Circuit Breaker (CB1) (F-3)
	501001-6	Phase Reversed Light (DS2) (F-3)
	501001-5	Hourmeter (M1) (F-3)
	AN6-14A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	RD153-0115-0030	Washer (F-3)
	NAS679A6	Nut (F-3)
19	9021701	Transformer Box (F-1)
	501001-19	Transformer (T1) (F-3)
	AN6-14A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	RD153-0115-0030	Washer (F-3)
	NAS679A6	Nut (F-3)
20	9019835	Block (F-3)
21	9019837-1	Block (F-3)
22	9019837-2	Block (F-3)
23	9019836	Block (F-3)
	9019840	Block (F-1)
	9019841	Retainer (F-1)
	NAS1116-96D	Bolt (F-3)
	LD153-0013-0011	Washer (F-3)
	9019843	Spacer (F-3)
	LD153-0010-0027	Washer (F-3)
	9019833	Nut (F-3)
	MS9245-71	Pin (F-3)
24	9019834	Track (F-3)
	20097-6F-57D	Capscrew (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679C6	Nut (F-3)
25	9020244	Cover (F-1)
	NAS1047-6P060	Turnbuckle (F-3)
	9020245	Link (M-3)

Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 5 of 8)

Index No.	Part No.	Description
25	AN8-11A	Bolt (F-3)
(cont)	LD153-0010-0018	Washer (F-3)
	MS20364-820	Nut (F-3)
26	9021611(e)	Motor (F-2)
	9019786	Bolt (F-3)
	MS20002-10	Washer (F-3)
	79NU-101	Nut (F-3)
	9021613	Spacer (F-3)
	AN10-32A	Bolt (F-3)
	MS20002-10	Washer (F-3)
	MS20500-1018	Nut (F-3)
	9022857	Bolt (F-3)
	AN316C12	Nut (F-3)
	MS28759H0160	Hose (F-2)
	A278603 20S-30(c)	Hose (F-2)
	MS28741-20-0240	Hose (F-2)
	MS28759H0440(c)	Hose (F-2)
27	No. 100(e)	Roller Chain (41 pitches) (F-3)
28	No. 100(e)	Roller Chain (53 pitches) (F-3)
29	9019800(e)	Clutch (A-1)
	9019786-3	Bolt (F-3)
	9019786-7	Bolt (F-3)
	LD153-0010-0021	Washer (F-3)
	79NU-101	Nut (F-3)
	9019830	Sprocket (F-3)
	NAS1081-8D10L	Screw (F-3)
	9019816-1	Guard (F-3)
	9019816-2	Guard (F-3)
	AN4-10A	Bolt (F-3)
	LD153-0010-0009	Washer (F-3)
	9019815-1	Guard (F-3)
	9019815-2	Guard (F-3)
30	12763(e)	Caster (F-1)
31	12763-3(e)	Caster (F-1)
	AN12-31A	Bolt (F-3)
	MS20002-12	Washer (F-3)
	MS20500-1216	Nut (F-3)
32	9021607	Reel (F-1)
	AN8-21A	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20500-820	Nut (F-3)
	4268BC	Connector (F-3)
	AN3420-20	Bushing (F-3)

Index No.	Part No.	Description
33	9021608	Reel (F-1)
	AN8-21A	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20500-820	Nut (F-3)
	CGB295K	Connector (F-3)
34	9021620	Power Control Station (F-1)
	AN4-10A	Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679A4W	Nut (F-3)
35	501001-D	Remote Control Station (F-1)
36	9019822-1(e)	Truck (A-1)
37	9019822-2(e)	Truck (A-1)
	MS15001-1	Fitting (F-3)
	9019820-3	Shaft (F-3)
	NAS1012-92	Bolt (F-3)
	LD153-0010-0024	Washer (F-3)
	RD153-5004-0012	Washer (F-3)
	NAS1022C12	Nut (F-3)
	MS15001-3	Fitting (F-3)
38	9021612	Frame (X-3)
	AN101611	Bolt (F-3)
	MS20002-0	Washer (F-3)
	MS20500-918	Nut (F-3)
	635577	Cushion (F-3)
	635579	Back (F-3)
	AN545-10R5	Screw (F-3)
	MS27183-8	Washer (F-3)
	9019761	Support (F-3)
	AN101515	Bolt (F-3)
	MS20002-8	Washer (F-3)
	MS20500-820	Nut (F-3)
39	9019769	Drawbar (F-1)
40	9019819(e)	Truck (A-1)
	9019490	Frame (X-2)
	12758	Caster (F-1)
	AN12-30A	Bolt (F-3)
	LD153-0010-0024	Washer (F-3)
	LD153-0013-0009	Washer (F-3)
	MS20500-1216	Nut (F-3)
	9019820-5	Shaft (F-3)
	MS15001-1	Fitting (F-3)
	NAS1012-92	Bolt (F-3)
	LD153-0010-0024	Washer (F-3)
	RD153-5001-0012	Washer (F-3)
	NAS1022C12	Nut (F-3)

(c) Units incorporating MD3 change
(e) Applicable to installer G4049

Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 6 of 8)

Index No.	Part No.	Description
41	9019809	Chassis (X-1)
	9019809-251[a]	Chassis (X-1)
42	90197[illegible]8	Reservoir (A-1)
	9022835	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
	9019740	Cover (F-1)
	9019754	Cover (F-1)
	9019755	Cover (F-1)
	AN5-13A	Bolt (F-3)
	MS20002-5	Washer (F-3)
	A-100	Breather Cap (F-3)
	9021712	Tube (M-3)
	9021580	Tube (M-3)
	9021581	Tube (M-3)
	9021582	Tube (M-3)
43	9019740	Cover (F-1)
44	9019754	Cover (F-1)
45	9019755	Cover (F-1)
	AN5-13A	Bolt (F-3)
	MS20002-5	Washer (F-3)
46	40M150	Filter (F-1)
47	550-7	Liquid Level Gage (F-3)
48	9021720	Valve (F-2)
	9021709	Cover (F-3)
	NAS3104C18-14	U-Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679A4W	Nut (F-3)
49	9021719	Valve (F-2)
	9021708	Cover (F-2)
	NAS3104C22-16	U-Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679A4W	Nut (F-3)
	9027033[d]	Valve (F-2)
	9027034[d]	Cover (F-3)
	9027035[d]	Clamp (F-3)
	9027036[d]	Bracket (F-3)
	AN4-7A[d]	Bolt (F-3)
	LD153-0010-0013[d]	Washer (F-3)
	NAS679A6[d]	Nut (F-3)
50	4716F-20CK-ST	Filter (F-1)
	AN6-41A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
	476F-20CK	Element (F-3)
	MS28775	O-ring (F-3)
51	4517F-20CK-ST	Filter (F-1)
	NAS104-20-16	U-Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679A4W	Nut (F-3)
	457F-20CK	Element (F-3)
	MS28775	O-ring (F-3)
52	9021718	Valve (F-2)
	MS20008C48	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20002C8	Washer (F-3)
	MS20500-600	Nut (F-3)
53	9021606	Motor (F-2)
	AN8-23A	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20500-820	Nut (F-3)
54	9019756	Console (F-1)
	AN4-6A	Bolt (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679C4W	Nut (F-3)
	9019760	Case (F-1)
	TA50A06	Valve (F-3)
	AN101009	Bolt (F-3)
	LD153-0010-0008	Washer (F-3)
	NAS679A3W	Nut (F-3)
	9019759	Panel (X-3)
	AN520C10R14	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	9019758	Panel (X-3)
	AN520C10R12	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
55	KW-G36-600	Gage (F-3)
	AN914-2C	Elbow (F-3)
	694-1/4SS	Snubber (F-3)
	AN816-4-4C	Nipple (F-3)
56	KW-G35-3000	Gage (F-3)
	AN914-2C	Elbow (F-3)
	694-1/4SS	Snubber (F-3)
	AN816-4-4C	Nipple (F-3)
57	KW-T21-7A	Thermometer (F-3)
	AN520-4R8	Screw (F-3)
	LD153-0010-0002	Washer (F-3)
	NAS679A04W	Nut (F-3)
58	9021722	Valve (F-2)
59	9021721	Valve (F-2)
	AN6-17A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)

(a) Units incorporating MD2 change
(d) Units incorporating MD4 change

Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 7 of 8)

Index No.	Part No.	Description
60	9021714	Valve (F-2)
	LL22A04P8	Screw (F-3)
61	9021705	Valve (F-2)
	AN6-12A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
62	9021706	Valve (F-2)
	AN6-17A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
63	9021707	Valve (F-2)
	AN6-12A	Bolt (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
64	J75M15222 (f)	Platform
	AMS3209	Pads
65	B75M51509 (f)	Air Bearing Pad
	No Number	Micrometer Valve
	J75M51525-1	Bracket
	J75M51525-2	Bracket
	AN8-10	Bolt
	MS35339-48	Lockwasher
66	B75M51511 (f)	Regulator
67	B75M51520 (f)	Gage
	AN912-6C	Bushing
68	J75M51524 (f)	Support Beam
	AN8-7	Bolt
	MS35339-48	Washer
69	J75M51523 (f)	Control Panel
	AN4-16	Bolt
	AN960-416	Washer
	MS20365-428	Nut
	J75M51523-2	Bracket
	J75M51523-3	Bracket
	MS90726-7	Capscrew
	AN960-416	Washer
	MS20365-428	Nut
70	J75M51523-1 (f)	Manifold Weldment
	MS90726-7	Capscrew
	AN960-416	Washer
	MS20365-428	Nut
71	B75M16788 (f)	Valve
	1210-1-12-316	Connector
	J75M51523-8	Tube
	1211-A-12-316	Adapter
72	B75M51508 (f)	Filter
	J75M51523-4	Connector
	SVHN12-1250	Coupling
	MS9100-12	Nut
	MS28778-12	Gasket

(f) Applicable to installer 75M51505

Figure 7-9. Disassembly of Engine Vertical Installer (Sheet 8 of 8)

v. Torque nuts NAS679C4W, that secure console (54) to chassis (41), to 61-75 in-lb.

w. Torque nuts NAS679A6, that secure valves (58, 59) to console (54), to 140-160 in-lb.

x. Torque nuts NAS679A6, that secure valves (61, 62, 63) to console (54), to 125-160 in-lb.

y. Torque nut AN924 or union AN814 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	55-80
3/8	100-150
1/2	180-230
3/4	420-600
1	600-840
1-1/4	720-960

z. Torque plug AN814 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	40-65
3/8	80-120
1/2	150-200
3/4	300-500
1	450-600
1-1/4	600-720

aa. Torque nut AN6289 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	75-100
3/8	150-200
1/2	200-250
3/4	450-650
1	650-900
1-1/4	800-1,000

ab. Torque jamnuts and fittings without gaskets as follows:

Tube OD (Inches)	Torque (in-lb) Aluminum	Steel
1/4	90-105	110-130
3/8	125-145	225-275
1/2	240-280	400-450
3/4	540-660	800-960
1	840-960	1,000-1,200
1-1/4	960-1,200	--

ac. Torque B-nuts AN818 for tubing as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	135-165
3/8	270-345
1/2	450-525
3/4	900-1,100
1	1,200-1,400
1-1/4	1,500-1,800

7-30. SERVICING.

7-31. Servicing of engine vertical installer consists of lubricating, checking gage, calibration, filling hydraulic reservoir, filling azimuth drive gearcase, cleaning hydraulic filters, and on installer 75M51505, draining pneumatic filter.

a. Lubricate (Method X) installer in accordance with decal, located on right-hand side of chassis, using gear grease (MIL-G-23827) and hydraulic fluid (MIL-H-5606).

b. Pack (Method Y) bearings of roller blocks with gear grease (MIL-G-23827) when 200-300 hours operating time is indicated on hourmeter. Replace bearings if they become dry or are galled.

c. Perform gage calibration-check at 12-month intervals. Gage accuracy for pressure gages must be within 2 percent of full scale range, and for gas temperature gage ±1 scale division.

d. Fill reservoir with hydraulic fluid (MIL-H-5606) before use.

e. Fill azimuth drive gearcase with American Gear Manufacturer's Association (AGMA) No. 8A compound to oil level indicated in window on case before use.

f. Clean hydraulic filters at 30-hour intervals of operating time, indicated on hourmeter, as follows:

WARNING

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

(1) Remove element and place element in a clean container filled with trichloroethylene (MIL-T-27602).

(2) Slosh filter element in trichloroethylene to remove any foreign matter lodged in element.

(3) Blow filter element dry with low-pressure gaseous nitrogen (MIL-P-27401). Blow filter element dry from the center outward, to prevent foreign particles from lodging in the center of the element.

(4) Clean interior of filter body, using clean cloth and trichloroethylene (MIL-T-27602).

g. On installer 75M51505, drain pneumatic filter before use.

WARNING

Facility power to the G4049 must be turned off before removing covers from electrical boxes for inspection, or injury to personnel or damage to equipment can result.

h. Remove covers from boxes (figure 7-9, index 17, 18, 19) and inspect interior of box and electrical components for corrosion and moisture at 12-month intervals; if installer has been subjected to rain or moisture, the inspection must be made before use. If corrosion or moisture exists, do the following:

(1) Remove corrosion, and dry parts as outlined in section I. Severely corroded parts must be replaced.

(2) Spray interior of box and electrical components with Krylon No. 1301 clear spray (Borden Chemical), or equivalent.

(3) Reinstall covers on boxes and tighten bolts until cover fits snugly against box housing. Torque bolts to 25 ±1 ft-lb.

7-32. INSPECTION.

7-33. Figure 7-10 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, since they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damaged conditions, and that hardware configuration is in accordance with appropriate records. A visual inspection is made before operation of the unit. Periodic inspections are made at specified periods. See figure 7-10 for inspection requirements and periodic intervals.

Inspection	Periodic (Months) 3	6	12	24
Visual Inspection				
1. Completeness of unit and records.				
2. Obvious signs of damage or corrosion to all structural members.				
3 Illegible stencils, decals, or nameplates.				
4. Power on and phase-reversal lights for broken or missing bulbs and covers.				
Periodic Inspection				
1. Circuit breakers for broken handles, and incorrect operation.			X	
2. Hourmeter for broken glass and incorrect operation.			X	
3. Pilot seat for security.			X	
4. Power control and remote-control cables and reels for security.			X	
5. Cuts in electrical cables and condition of insulation.			X	
6. Contaminated or incorrect lubrication (paragraph 7-30).		X		
7. Gages for broken glass, cracked frames, and loose or missing mounting screws.			X	
8. Valves for cracked or broken control knobs and incorrect operation.				X
9. Flexible lines for kinks, twists, and deterioration.				X
10. Tubing for scratches, dents, and loose coupling nuts.				X
11. Truck tire for deterioration and flat spots.				X
12. Gage calibration-check (paragraph 7-30.)			X	
13. Interior of electrical boxes for corrosion and moisture (paragraph 7-30).			X	

Figure 7-10. Inspection Requirements

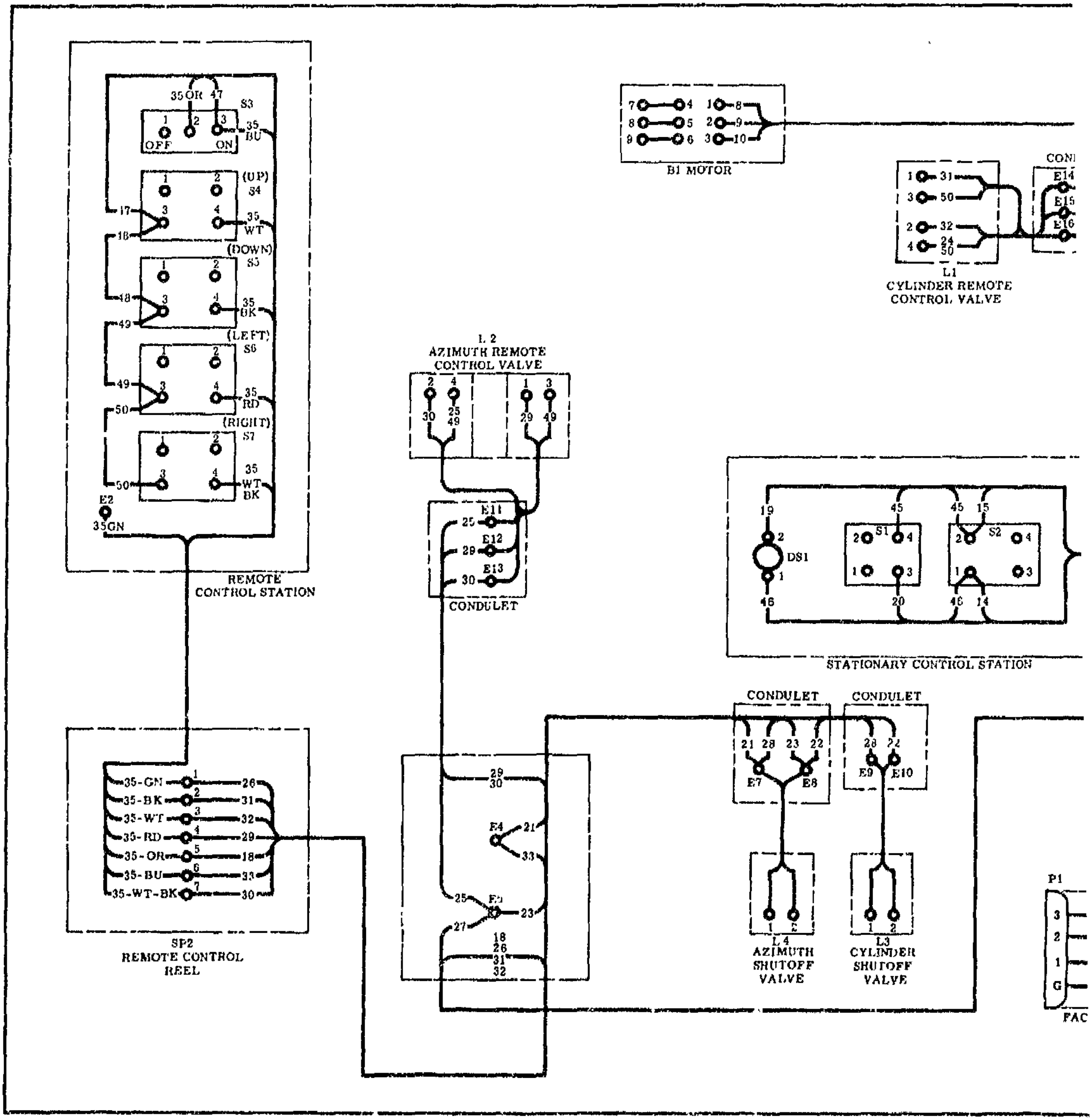
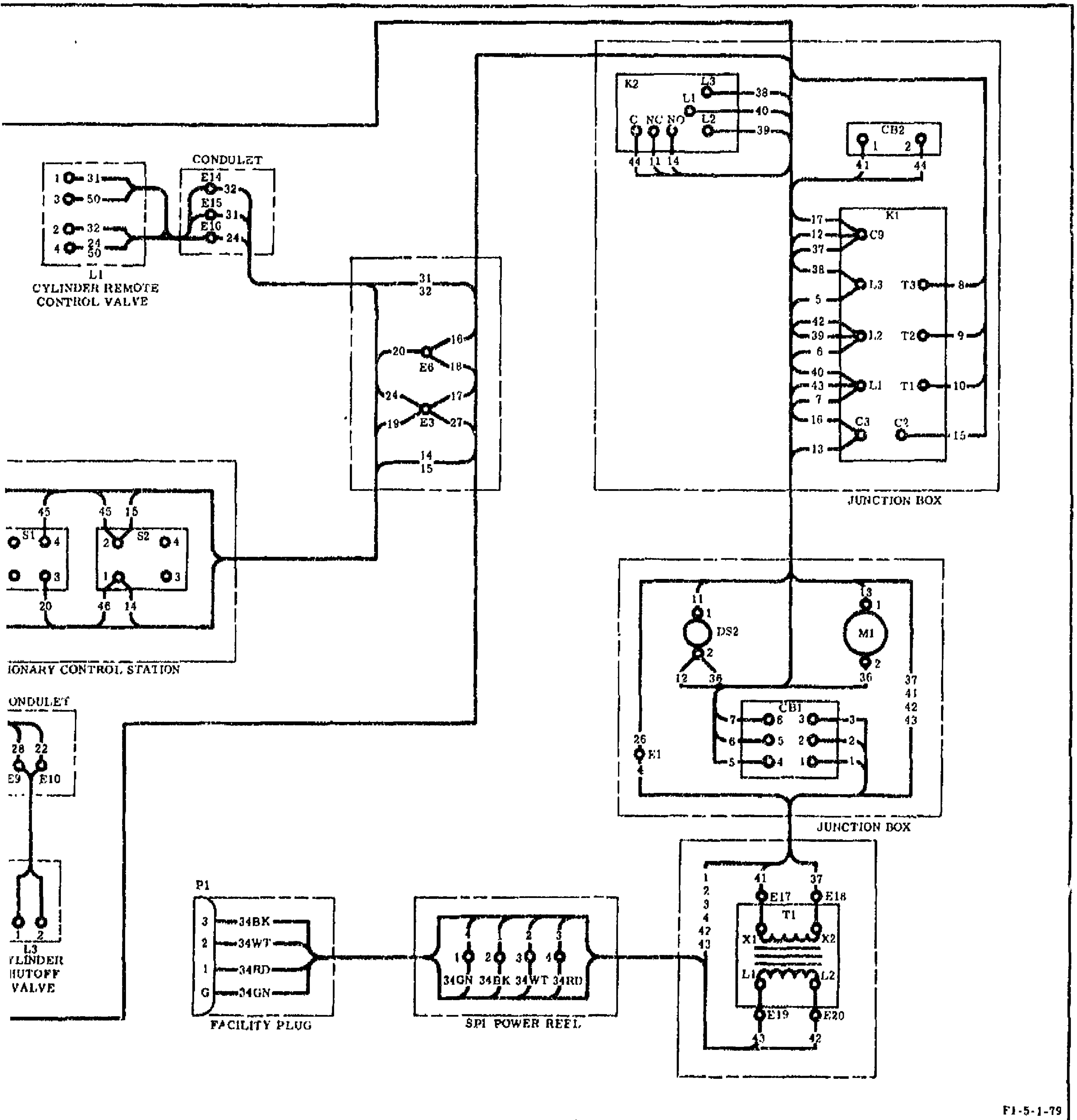


Figure 7-11. Engine Vertical Installer Wiring Diagram


CONDULET
L1
CYLINDER REMOTE
CONTROL VALVE
JUNCTION BOX
IONARY CONTROL STATION
ONDULET
JUNCTION BOX
P1
L3
YLINDER
HUTOFF
VALVE
FACILITY PLUG
SP1 POWER REEL
FI-5-1-79

SECTION VIII

ENGINE ROTATING SLING G4050

WARNING

ENGINE ROTATING SLING G4050 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

8-1. SCOPE. This section contains inspection, description, operation, and maintenance for Engine Rotating Sling G4050. The engine rotating sling provides a means for lifting the engine in either the horizontal or vertical position and rotating the engine around the Y-axis.

8-2. INSPECTION.

8-3. Figure 8-1 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions, and that hardware configuratión is in accordance with appropriate records. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. (See figure 8-1 for inspection and periodic intervals.)

Inspection	Periodic (Months)			
	3	6	12	24
1. Operation check of reverse and forward limit switches (paragraph 8-11)		X		
2. Obvious signs of damage to all structural members				X
3. Incorrect torque values (paragraph 8-13)				X
4. Illegible stencils, decals, or nameplates			X	
5. Damaged or worn teeth in sprockets				X
6. Damage to chain				X
7. Broken caster pedals and binding or dragging caster wheels				X
8. Improper fit of lockpins, causing unsafe operation of sling		X		
9. Cuts in electrical cables and condition of insulation				X
10. Incorrect gap clearance between carriage guides and beam (paragraph 8-13)			X	
11. Contaminated or improper lubrication (paragraph 8-14)		X		
12. Proof test expiration (paragraph 8-10)			X	

Figure 8-1. Inspection Requirements

8-4. DESCRIPTION.

8-5. The engine rotating sling (figure 8-2) is an arc-shaped beam incorporating engine attach fittings and roller track. Mounted on the beam is an electrically powered carriage, which has a starter box, a power gear, electrical power and control reels, a pushbutton control station, idler wheel and sprocket, and drive wheels and sprockets. A roller chain with 198 links has a retainer fitting on one end and an adjustable fitting on the other end. The aft engine attaching arms have a half-moon cutout on the end and a clevis and lockpins. The forward engine attach strut has a clevis fitting on one end and a ball joint and collar with lockpin on the other. An adapter with a lockpin attaches to the strut as a short extension. On units incorporating MD3 change, 600 pounds of weights are added to the forward end and a pneumatic tire added to the aft end of the beam. Casters attached to the sling in a tricycle arrangement provide limited mobility. The forward caster swivels and provides the attach point for a tow bar. See figure 8-3 for leading particulars.

8-6. OPERATION.

8-7. The engine rotating sling is capable of rotating the engine to a vertical or a horizontal position. The sling is suspended from an overhead crane or hoist of 25-ton capacity, or greater, by the hoist attachment fitting located on the carriage. The upper portion or carriage, when suspended, remains stationary, and the beam assembly rotates through the carriage to the position desired. An electrical receptacle is connected to a facility 440-vac, 3-phase, 60-cycle power source. Operation of the sling is controlled from the control station. There are three sprockets that engage the chain: two idler sprockets and a center sprocket. The sprockets engage the roller chain links that are attached to the periphery of the arc-shaped beam. The center sprocket is attached to the power gear and supplies the power that drives the unit. Two sets of wheels rotate under the top portion of the beam, bearing the weight during operation. The reels are self-contained and spring loaded, allowing the electrical cables to be pulled out to various lengths and rewound automatically. The sling has six load conditions, indicated by a one-inch-wide black strip on the underside of the beam with corresponding numbers on each side of the beam. An Operating Instructions plate, attached to the control cable and located just above the control station, lists the six strip positions and briefly describes load conditions for each position. An arrow on the carriage drive bracket should be alined with the numbered strip positions on the beam for load conditions. On units that incorporate MD3 change, the sling has seven load-condition strips; the weights counterbalance the aft end of the sling, and the bumper prevents the beam end from contacting the engine. On units incorporating MD4 change, the sling has eight load-condition strips.

8-8. MAINTENANCE.

8-9. Maintenance requirements and procedures outlined in the following paragraphs consist of proof testing, function testing, disassembling, assembling, and servicing. Repaint surface area and/or lettering, as required, when paint becomes chipped, scratched, or worn off and when lettering becomes illegible. (Refer to section I for painting information.) Clean sling, as applicable, as outlined in section I. (See figure 8-4 for electrical schematic.)

8-10. PROOF TESTING. Proof-test the engine rotating sling at 12-month intervals and to the weight configuration shown in figure 8-5. The proof load required for proof testing must be a minimum of 150 percent of the working load of the sling. The proof-test interval may be extended if the sling is unused between proof-test intervals. Verification of "no use" is substantiated by application of Alucast No. 67 seals after each proof testing.

WARNING

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

a. Provide engine dummy weight frame assembly 88-9017417, engine dummy weight assembly 88-9014883, and assorted weights specified in figure 8-5.

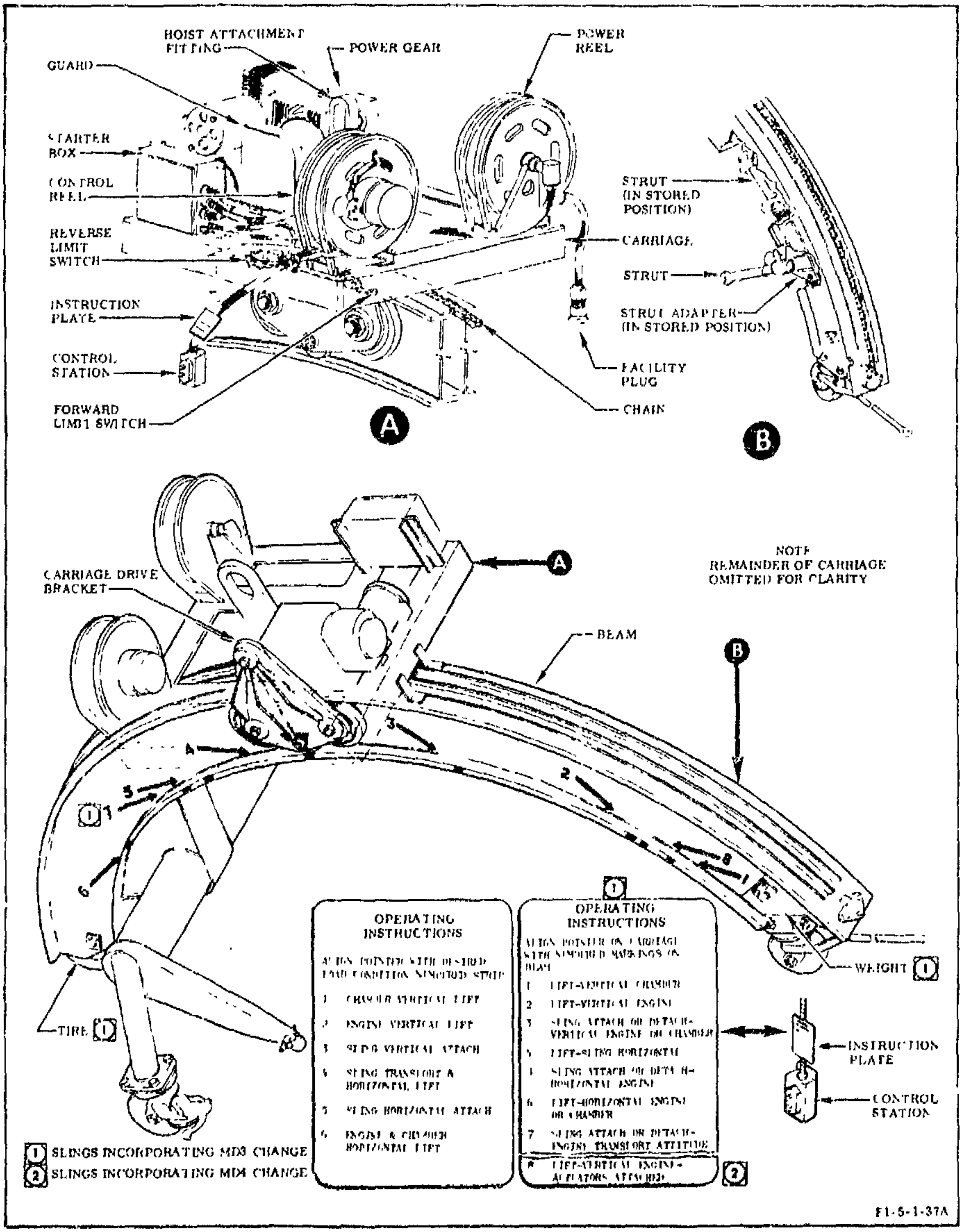


Figure 8-2. Engine Rotating Sling

Length	180 inches	Maximum load capacity	21,500 pounds
Width	90 inches	Proof load	43,000 pounds
Height	108 inches	Maximum towing speed	2-1/2 mph
Weight	4,000 pounds (approximately)		
Electrical power requirements	440-vac, 3-phase 60-cycles		

Figure 8-3. Leading Particulars for Engine Rotating Sling

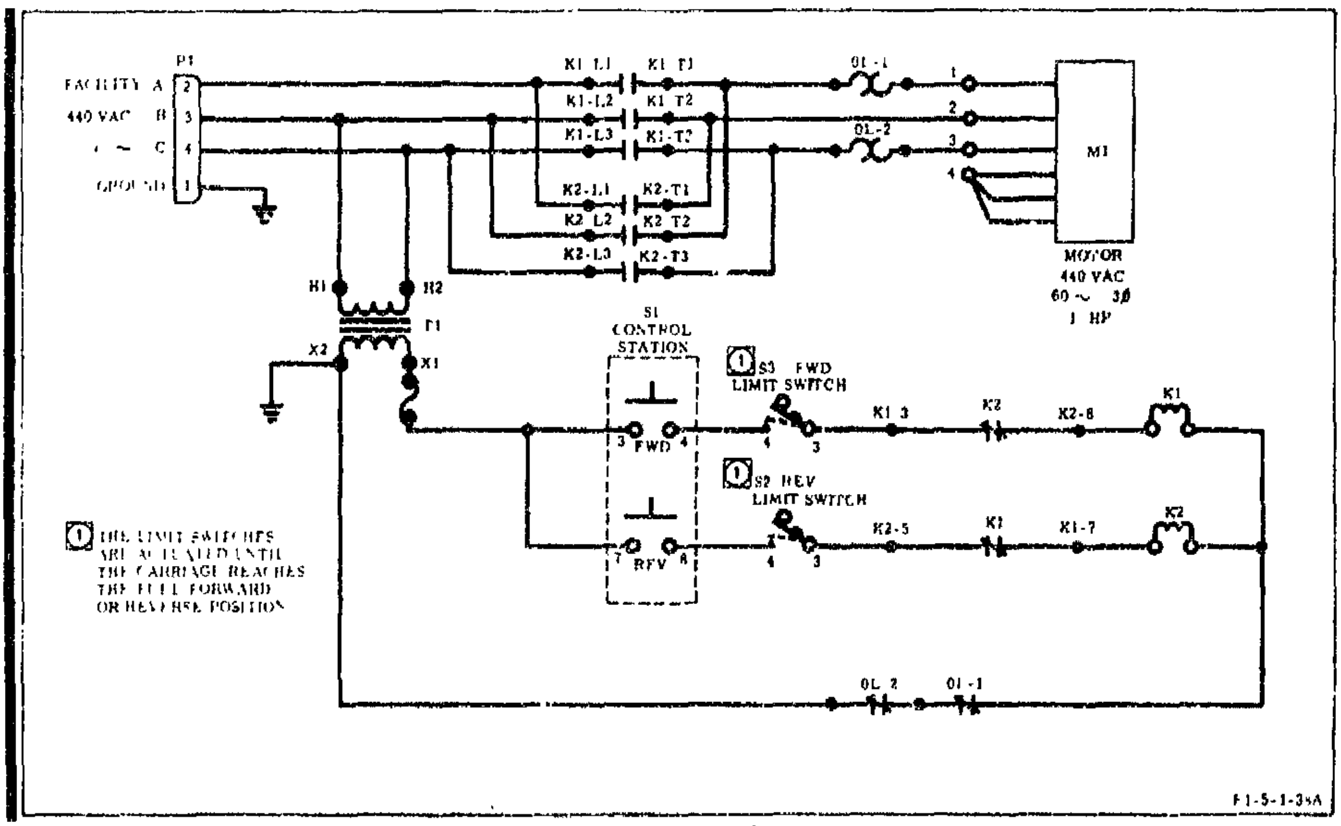


Figure 8-4. Engine Rotating Sling Electrical Schematic

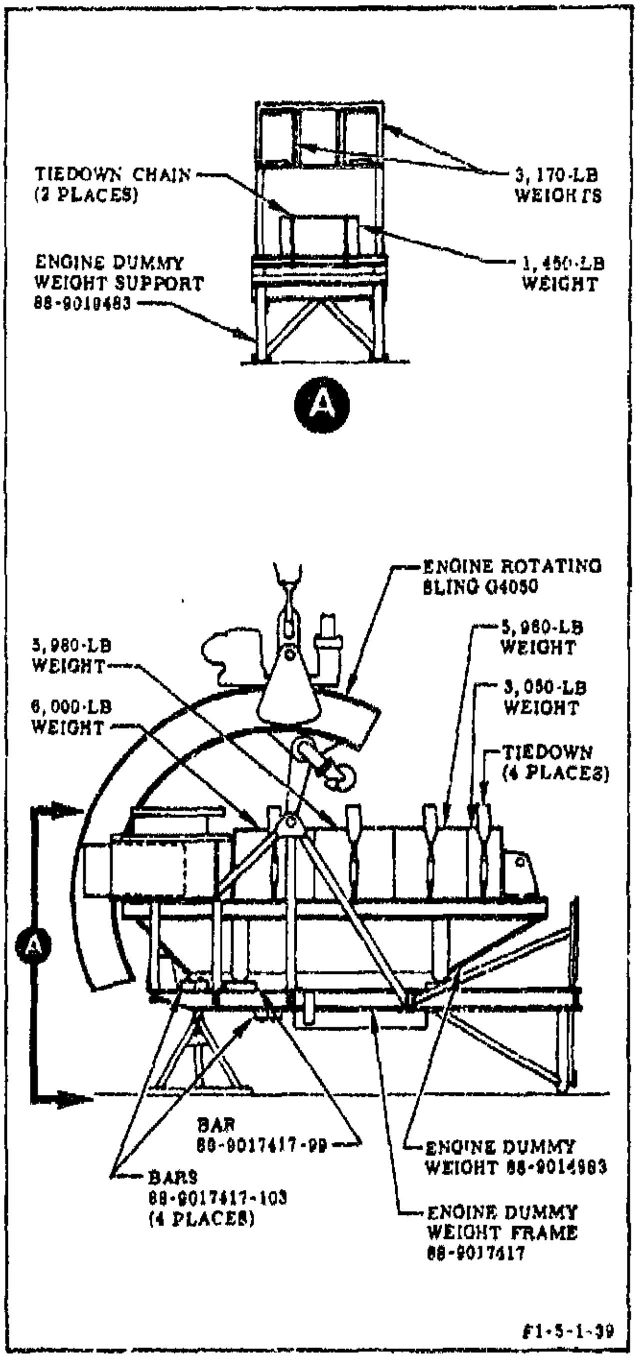


Figure 8-5. Recommended Proof-Test Setup for Engine Rotating Sling

b. Provide a facility electrical power source of 440-vac, 60-cycles, 3-phase at 15 amperes, with connector RPX317-912S04A and handle RPE417-002K069D (Crouse-Hinds) within 50 feet of engine rotating sling.

c. Position engine rotating sling beneath a facility hoist capable of lifting a minimum of 25 tons, and remove tow bar.

d. Check oil level of power gear and service as required. (Refer to paragraph 8-14.)

e. Connect engine rotating sling electrical cable to facility electrical power source; turn facility electrical power source on.

f. Press control station FORWARD button and position carriage to load condition number 6 strip position.

NOTE

If the carriage moves toward load condition number 1 strip position, the facility power source is out of phase with the sling motor and requires reversing any 2 of the 3-phase wires in the power plug. Do not change position of neutral or ground wire.

g. Connect facility hoist hook to engine rotating sling lifting lug.

h. Press control station REVERSE button and position carriage to load condition number 4 strip position.

NOTE

The facility hoist hook must be raised and the hoist centered over the carriage as step h is performed.

i. Hoist engine rotating sling to clear floor; press control station FORWARD button and position beam to load condition number 5 strip position.

NOTE

The load condition number strip positions are used for initial positioning of the engine rotating sling beam. Minor adjustments of the beam to either side of a strip position may be required to level the load.

j. Position engine rotating sling over test load, attach sling clevises to the 2 top attach points; then attach strut and adapter 9017823 to forward attach point.

k. Press control station FORWARD button and position carriage to load condition number 6 strip position.

l. Hoist engine rotating sling and test load high enough to clear floor when sling is rotated; hold for 3 minutes.

m. Press control station REVERSE button until beam reaches load condition number 1 strip position, and hold for 3 minutes.

n. Press control station FORWARD button until beam reaches load condition number 6 strip position; then lower sling and test load to floor. The drive motor may need physical assistance when returning to the number 6 strip position.

o. Press control station REVERSE button and position carriage to load condition number 5 strip position; then remove sling from test load.

p. Press control station REVERSE button and position carriage to load condition number 4 strip position; then lower sling to floor.

q. Press control station FORWARD button and position carriage to load condition number 6 strip position.

NOTE

The facility hoist hook must be lowered and the hoist repositioned as step q is performed.

r. Disconnect facility hoist hook from sling lifting lug.

s. Press control station REVERSE button and position carriage to load condition number 4 strip position.

t. Inspect engine rotating sling for any distortion, weld cracks, or yielding.

u. Secure engine rotating sling and test equipment.

v. Remove existing proof-load plate RD171-1032-0001 and using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate including new inspection date. Install new plate where old plate was removed.

8-11. FUNCTION TESTING.

a. Position engine rotating sling beneath a facility hoist capable of lifting a minimum of 5 tons, and remove tow bar.

b. Check oil level of power gear and service as required. (Refer to paragraph 8-14.)

c. Connect engine rotating sling electrical cable to facility electrical power source, 440-vac, 60 cycles, 3-phase, at 15 amperes, with connector RPX317-912S04A and handle RPE417-002K069D (Crouse-Hinds). Turn facility electrical power source on.

d. Press control station FORWARD button and position carriage to load condition number 6 strip position.

NOTE

If the carriage moves toward load condition number 1 strip position, the facility power source is out of phase with the sling motor and requires reversing any 2 of the 3-phase wires in the power plug. Do not change position of neutral or ground wire.

e. Connect facility hoist hook to engine rotating sling lifting lug.

f. Press control station REVERSE button and position carriage to load condition number 4 strip position.

NOTE

The facility hoist hook must be raised and the hoist centered over the carriage as step f is performed.

g. Hoist sling high enough to clear floor when sling is rotated.

h. Press control station FORWARD and REVERSE buttons, as applicable, rotating beam throughout its extremity in both directions 3 times.

WARNING

Control station reverse and forward pushbutton switches must be off when performing step i, since movement of beam can result in injury to personnel.

i. While beam is at each extreme direction and switch actuator arm roller is in notch, manually actuate switch arm several times and verify audible click of switch. Do not press control station pushbutton switches when manually actuating switch.

j. If forward and reverse limit switches fail to give an audible click or do not disable control station in both extreme directions, adjust switch actuator arm to deactuate switch when roller drops into notch, or replace switch.

k. Press control station FORWARD or REVERSE button to position beam to load condition number 4 strip position.

l. Using facility hoist, lower engine rotating sling to floor.

m. Press control station FORWARD button and position carriage to load condition number 6 strip position.

NOTE

The facility hoist hook must be lowered and the hoist repositioned as step m is performed.

n. Disconnect facility hoist hook from engine rotating sling lifting lug.

o. Press control station REVERSE button and position carriage to load condition number 4 strip position.

p. Disconnect and reel in electrical cable.

q. Attach tow bar to front caster with ball lockpin.

r. Attach tractor to tow bar.

s. Tow sling 50 feet and execute turn and backing operations.

t. Disconnect tractor from tow bar, and secure equipment.

8-12. DISASSEMBLING. (See figure 8-6 for index and part numbers.) Disassemble the engine rotating sling as required to accomplish necessary repair or replacement. (See figure 8-7 for electrical wiring diagram.)

8-13. ASSEMBLING. (See figure 8-6 for index and part numbers.) The following steps include the special instructions required during assembly.

a. Install washer (7) between case and carriage frame.

b. Torque nut (5) to 400-500 in-lb and nut (23) to 210-280 in-lb.

c. Torque nut (27) to 115-155 ft-lb and nut (36) to 25-30 in-lb.

d. Torque nut (44) to 100 in-lb above inherent nut torque with engine rotating sling empty and suspended.

e. Torque nuts (48,88) to 400-500 in-lb.

f. Install guides (61) into carriage drive bracket to obtain 0.03 to 0.04 inch gap between end of guide and flange of beam (106) and torque nut (60) to 1,000-1,100 in-lb.

g. Torque nut (62) to 1,100-1,200 in-lb.

h. Torque nuts (93,99) to 400-500 in-lb.

i. Torque nut of bolt (107) to 400-500 in-lb.

j. Torque nuts of wheel (109) to 80-100 in-lb.

k. Install new bearing, seal, and rings, in wheel (109) anytime it is assembled.

l. Torque nuts of weights (110) to 50 in-lb above inherent nut torque.

8-14. SERVICING. Servicing consists of lubricating the engine rotating sling at 6-month intervals and packing caster bearings at 12-month intervals. (See decals attached to the sling for location of lubrication points.)

a. Lubricate (Method X) sprockets and drive wheels with gear grease (MIL-G-23827) and a grease gun.

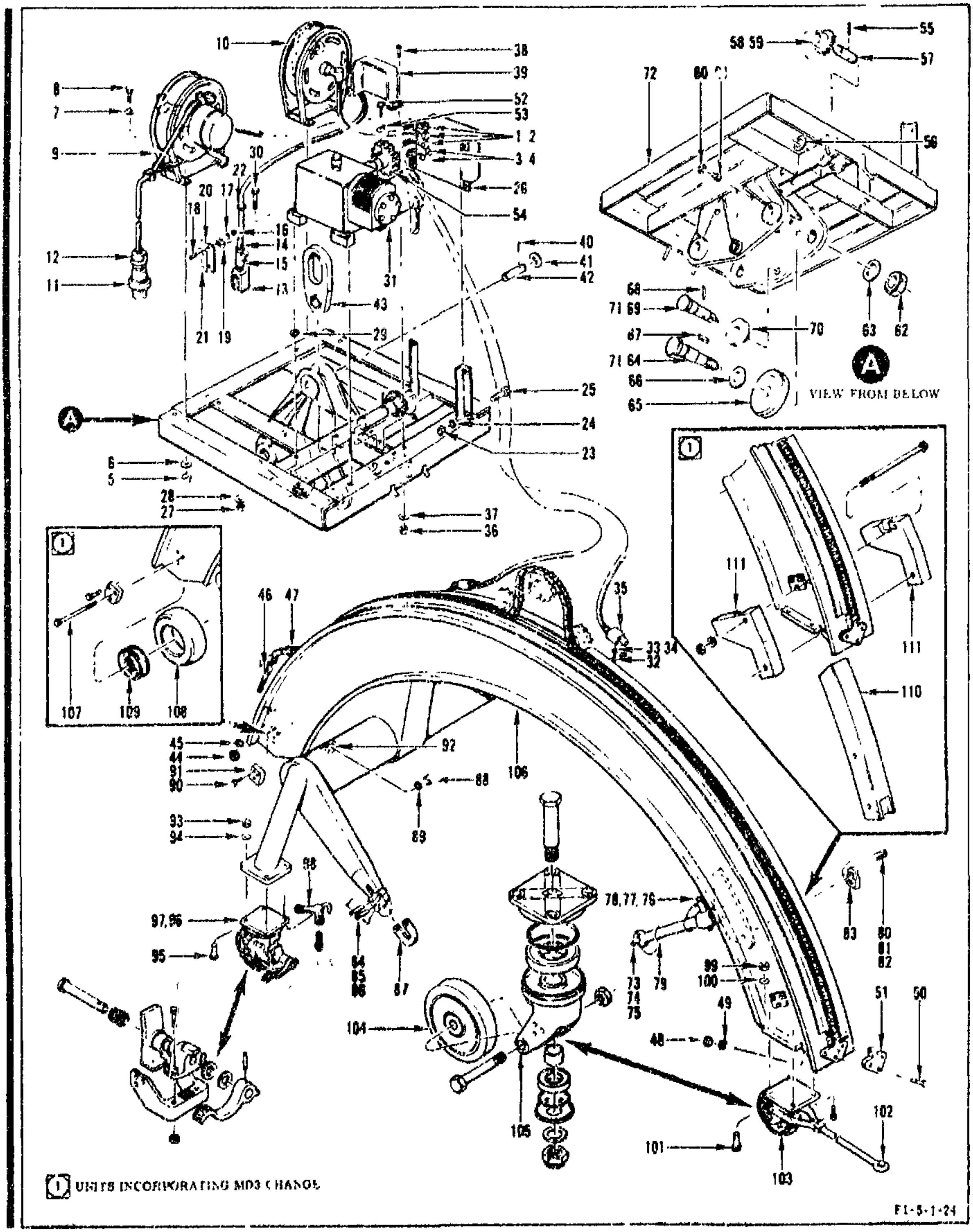


Figure 8-6. Disassembly of Engine Rotating Sling (Sheet 1 of 3)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	WW-C-566 (one inch)	Cable (F-3)	46	9017804	Fitting (F-3)
2	5334	Connector (F-3)	47	100	Roller chain (F-3)
3	WW-C-566 (1/2 inch)	Cable (F-3)	48	MS20364-820	Nut (F-3)
4	5332	Connector (F-3)	49	LD153-0010-0017	Washer (F-3)
5	MS20364-620	Nut (F-3)	50	AN8-30A	Bolt (F-3)
6	LD153-0010-0018	Washer (F-3)	51	9017816	Fitting (F-3)
7	MS35335-79	Washer (F-3)	52	NAS1081-6D6L	Setscrew (F-3)
8	AN8-16A	Bolt (F-3)	53	9017811	Key (F-3)
9	9021601	Power reel (F-1)	54	9015568	Drive sprocket (F-3)
10	9021602	Control reel (F-1)	55	MS171666	Pin (F-3)
11	RPX117-989P04A	Plug (F-3)	56	9017822	Washer (F-3)
12	1109	Stop (F-3)	57	9017809	Axle (F-3)
13	EFS1190-SA	Control station (F-2)	58	9015562	Idler sprocket (F-3)
14	EYS16-SA	Seal (F-3)	59	MS15001-1	Fitting (F-3)
15	CGB194-K-SA	Cable grip (F-3)	60	MS9201-11	Nut (F-3)
16	NAS679C3W	Nut (F-3)	61	9017808	Carriage guide (F-3)
17	LD153-0010-0007	Washer (F-3)	62	NAS509-32	Nut (F-3)
18	AN520C10R7	Screw (F-3)	63	9017822	Washer (F-3)
19	MS21919WDG10	Clamp (F-3)	64	9017807	Axle (F-3)
20	9017814	Holder (F-3)	65	80301	Drive wheel (F-3)
	9014124[a]	Holder (F-3)	66	LD153-0010-0034	Washer (F-3)
	9014124-3[b]	Holder (F-3)	67	NAS558P1010-21	Key (F-3)
21	9017813	Instruction plate (F-3)	68	MS171693	Pin (F-3)
	9014123[a]	Instruction plate (F-3)	69	9017806	Axle (F-3)
	9014123-3[b]	Instruction plate (F-3)	70	9017805	Idle wheel (F-3)
22	1109	Stop (F-3)	71	MS15001-1	Fitting (F-3)
23	NAS679A6	Nut (F-3)	72	9017802	Carriage (F-1)
24	LD153-0011-0017	Washer (F-3)	73	BLC-16-GT-22	Pin (F-3)
25	AN6-7A	Bolt (F-3)	74	RD1912002-1320	Wire rope (F-3)
26	9021603	Starter box (F-2)	75	28-2-G	Sleeve (F-3)
27	MS20364-1216	Nut (F-3)	76	BLC-20-GT-38	Pin (F-3)
28	LD153-0010-0023	Washer (F-3)	77	RD191-2002-1320	Wire rope (F-3)
29	MS35335-32	Washer (F-3)	78	28-2-G	Sleeve (F-3)
30	AN12-36A	Bolt (F-3)	79	9017810-11	Strut (F-3)
31	9021604	Power gear (F-2)	80	BLC-16-GT-21	Pin (F-3)
32	MS35233-84	Screw (F-3)	81	RD191-2002-1316	Wire rope (F-3)
33	MS35333-40	Washer (F-3)	82	28-2-G	Sleeve (F-3)
34	MS25335-75	Washer (F-3)	83	9017823	Strut adapter (F-3)
35	1LS3	Limit switch (F-3)	84	BLC-10-GT-16	Pin (F-3)
36	NAS679C4W	Nut (F-3)	85	RD191-2002-1318	Wire rope (F-3)
37	LD153-0010-0009	Washer (F-3)	86	28-2-6	Sleeve (F-3)
38	AN520C416R14	Screw (F-3)	87	9017817	Clevis (F-3)
39	9017819	Guard (F-3)	88	MS20364-820	Nut (F-3)
40	MS171667	Pin (F-3)	89	LD153-0010-0017	Washer (F-3)
41	LD153-0010-0035	Washer (F-3)	90	AN8-21A	Bolt (F-3)
42	9017815	Pin (F-3)	91	9017818	Stop (F-3)
43	9017803	Fitting (F-3)	92	5015	Ring (F-3)
44	52E-126	Nut (F-3)			
45	LD153-0010-0023	Washer (F-3)			

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

Figure 8-6. Disassembly of Engine Rotating Sling (Sheet 2 of 3)

Index No.	Part No.	Description
93	MS20364-820	Nut (F-3)
94	LD153-0010-0017	Washer (F-3)
95	AN8-20A	Bolt (F-3)
96	SH10-1-3-XL10	Left-hand caster (F-1)
97	SH10-1-[illegible]-XL10	Right-hand caster (F-1)
98	11761	Swivel lock (F-3)
99	MS20364-820	Nut (F-3)
100	LD153-0010-0017	Washer (F-3)
101	AN8-20A	Bolt (F-3)
102	82024-49	Tow bar (F-3)
103	12701	Caster (F-1)
	AS60-6-8	Screw (F-3)
	AS60-6-12	Screw (F-3)
	AN960-616L	Washer (F-3)
	52241	Block (F-2)
	AS364-624	Nut (F-3)
	52240	Bracket (F-2)
104	ASLHD10-T-08CM	Wheel (F-2)
105	23113	Caster rig (F-2)
	10158SL-3	Baseplate (F-2)
	10112SL-ME	Horn (F-2)
	51341-53	Kingpin (F-2)
	MS24665-357	Pin (F-3)
	AS320-16	Nut (F-3)
	11522-56	Axle (F-2)
	AS364-1614	Nut (F-3)
	11012-10	Retainer (F-2)
	11132	Washer (F-2)
	A-2297	Bearing (F-2)
	D-2016	Bearing (F-2)
	T-126W	Bearing (F-2)
	6230-05	O-ring (F-2)
	6230-34	O-ring (F-2)
106	9022871	Beam (X-2)
	9022871-51[a]	Beam (X-2)
	RD171-1032-0001	Plate (F-3)
107	9014125[a]	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	NAS1022-C8	Nut (F-3)
108	5:00 x 5[a] Type III (tube-type blackwall tire), 6-ply rating, nose wheel per civil C62, 1,260-lb static load	Tire (F-3)
	5:00 x 5	Tube (F-3)
109	9014127[a]	Wheel (F-2)
	MS51923-213	Pin (F-3)
	AN960-2116L	Washer (F-3)
	9014122	Spacer (F-3)
	9014120	Shim (F-3)
	9014121	Adapter (F-3)
	AN4-31A	Bolt (F-3)
	AN960-416	Washer (F-3)
	AN365-428	Nut (F-3)
	08231	Bearing (F-3)
	154-6	Seal (F-3)
	153-8	Ring (F-3)
	155-2	Ring (F-3)
110	9014117[a]	Weight (M-3)
111	9014118-1[a]	Weight (M-3)
	9014118-2[a]	Weight (M-3)
	9014119	Bolt (F-3)
	LD153-0010-0024	Washer (F-3)
	NAS1022-C12	Nut (F-3)

(a) Units incorporating MD3 change

Figure 8-6. Disassembly of Engine Rotating Sling (Sheet 3 of 3)

b. Lubricate chain with gear grease (MIL-G-23827) and a brush.

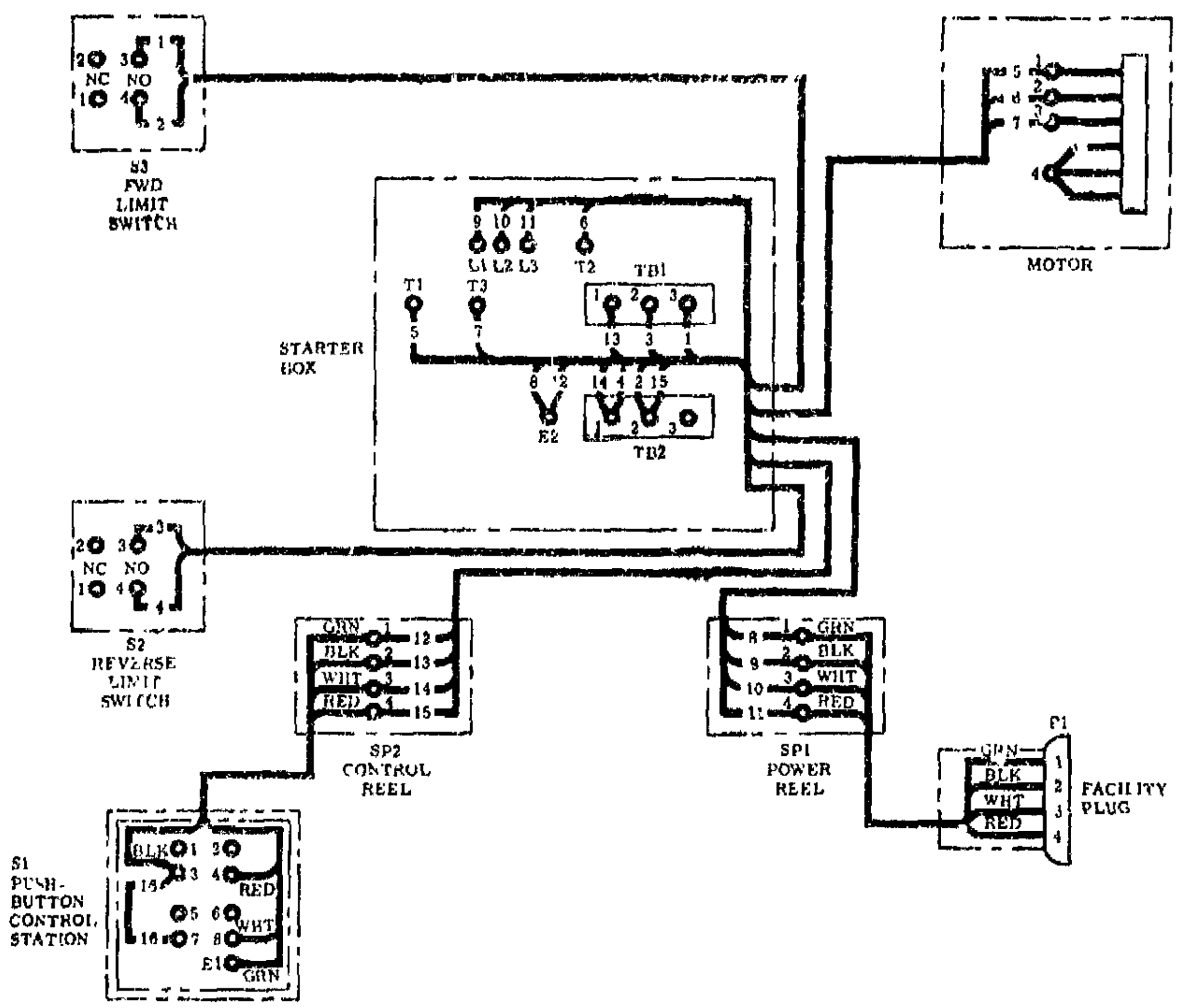
c. Lubricate machined surface of beam where guides (61, figure 8-6) contact, with gear grease (MIL-G-23827) and a brush.

d. Pack (Method Y) caster rig (105) bearings with gear grease (MIL-G-23827).

e. Fill power gear with American Gear Manufacturers Association (AGMA) No. 8A compound to oil level indicated in window on inboard side of case.

8-15. <u>SHIPPING AND STORAGE</u>.

8-16. Position carriage to load condition number 4 strip position, and prepare engine rotating sling for shipping or storage in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 1, 00,00, ZZ, and Z.



WIRE LIST						
WIRE			FROM		TO	
NUMBER	AWG	TYPE	ITEM AND TERM	END FITTING	ITEM AND TERM	END FITTING
1	20	MIL-W-5086, II	S3-3	MS25036-49	TB1-3	
2	20		S3-4	MS25036-49	TB2-2	
3	20		S2-3	MS25036-49	TB1-2	
4	20		S2-4	MS25036-49	TB2-1	
5	12		M1-1	MS25036-11	T1	
6	12		M1-2	MS25036-11	T2	
7	12		M1-3	MS25036-11	T3	
8	20		SP1-1		E2	MS25036-50
9	20		SP1-2		L1	
10	20		SP1-3		L2	
11	20		SP1-4		L3	
12	20		SP2-1		E2	MS25036-50

WIRE LIST						
WIRE			FROM		TO	
NUMBER	AWG	TYPE	ITEM AND TERM	END FITTING	ITEM AND TERM	END FITTING
13	20		SP2-2		TB1-1	
14	20		SP2-3		TB2-1	
15	20		SP2-4		TB2-2	
16	30		S1-3	MS25036-2	S1-7	MS25036-2
SP1-GRN	12		SP1-1		P1-1	
SP1-BLK	12		SP1-2		P1-2	
SP1-WHT	12		SP1-3		P1-3	
SP1-RED	12		SP1-4		P1-4	
SP2-GRN	16		SP2-1		S1-E1	MS25036-7
SP2-BLK	16		SP2-2		S1-[illegible]	MS25036-7
SP2-WHT	16		SP2-3		S1-8	MS25036-7
SP2-RED	16	MIL-W 5086, U	SP2-4		S1-4	MS25036-7

F1-5-1-25B

Figure 8-7. Engine Rotating Sling Wiring Diagram

SECTION IX

FLIGHT COMBUSTION MONITOR 703227

9-1. SCOPE. This section contains description and leading particulars, theory of operation, and maintenance instructions for the flight combustion monitor. The flight combustion monitor is used to initiate engine cutoff when combustion instability exceeds a predetermined, damaging amplitude for a given time duration.

9-2. DESCRIPTION AND LEADING PARTICULARS.

9-3. The flight combustion monitor (figure 9-1) consists of three accelerometers, a normalizing network unit, and a control unit. The accelerometer consists of internally supported, non-case-sensitive, piezoelectric elements mounted in the center of a triangular mounting plate. The accelerometer is connected to the normalizing network unit by a coaxial cable. The normalizing network unit consists of three individual normalizing networks housed in a cylindrical casing. The output coaxial cables from each network terminate at a common connector to enable connection to the control unit. The control unit is a transistorized, three-channel, electronic unit housed in a sealed aluminum alloy casting. Two electrical receptacles are provided. One receptacle is used for accelerometer input signals and the other receptacle is used for power and calibration inputs and for the output signals. The circuitry for each channel is mounted on an individual circuit board which is sealed in a plastic potting compound. The circuit boards are separated from each other by spacers. After the unit is assembled, the case is filled with elastic foam potting material. See figure 9-2 for leading particulars.

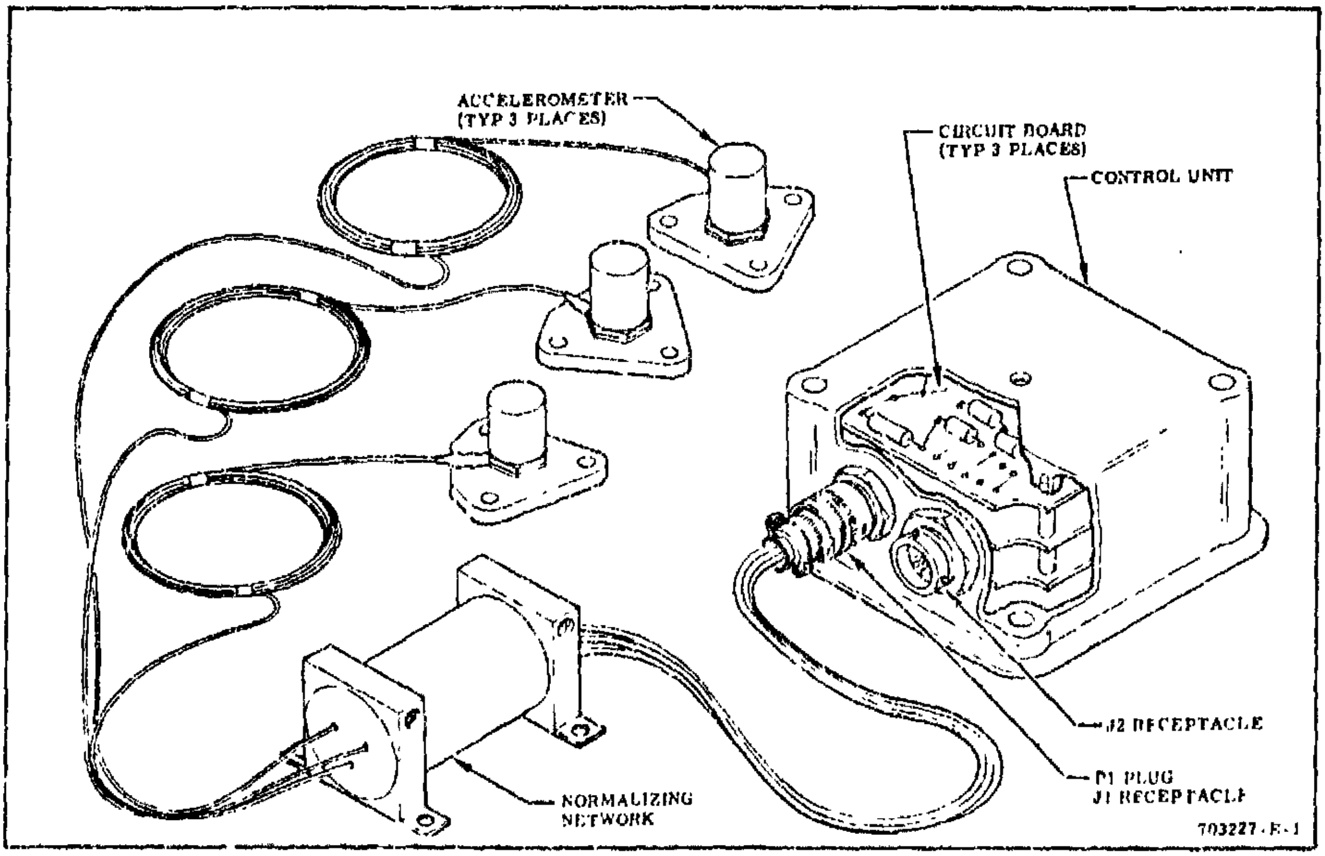


Figure 9-1. Flight Combustion Monitor

Accelerometer and Mounting Plate

Length	2.38 inches
Width	[illegible].125 inches
Height	1.5 inches

Normalizing Network

Length	4 inches
Width	2.5 inches
Height	2.5 inches

Operating Requirements

Sensitivity	5.00 ±0.10 millivolts rms per g rms at 1,200 cps and 77° ±18° F.
Total Capacitance	Larger than 2,500 picofarads (pf)
Calibration Capacitance	±2.5 percent of total capacitance

Control Unit

Length	5.75 inches
Width	5.75 inches
Height	3 inches
Weight	4.5 pounds

Operating Requirements

Electrical Input	28 ±4 vdc at 0.5 ampere
Vibration-Cutoff Level	100 g rms 141 g peak
Vibration Frequency	600 to 3,000 cps range
Time Delay	20-50 milliseconds (depending on input signal amplitude)
Storage Time	260 milliseconds

Figure 9-2. Leading Particulars for Flight Combustion Monitor

9-4. THEORY OF OPERATION.

9-5. The flight combustion monitor is designed to guard against excessive vibrations caused by high-frequency combustion instability. Combustion instability is detected by a piezoelectric accelerometer which produces a voltage proportional to the vibration level. When the vibration level reaches a predetermined value, within a specified frequency band, the control unit channel is triggered and begins to time the duration of the vibration. If the vibration remains above the trigger level for the specified time period, a cutoff signal is initiated and the affected engine is shut down. The cutoff signal may be initiated by any one or all three channels since a channel, with its own accelerometer, is independent of the other two channels. The normalizing network standardizes each accelerometer sensitivity to the same value and provides an operational checkout of the flight combustion monitor prior to use. The accelerometer signal (5.00 MV/G) is received by a high input resistance circuit which increases the signal power gain and provides a low impedance monitor output. This signal is fed to the band-pass filter network where only frequencies between 600 to 3,000 cps are allowed to pass through. The signal is applied to the primary of a step-up transformer with a 10.6 to 1 ratio. The output signal of the secondary is routed through a full wave rectifier where the ac signal is converted to a pulsating dc signal. This dc signal operates the peak voltage sensor which responds to the input signal when the amplitude reaches the specified value (referred to as the trigger level). The peak voltage sensor produces, from peaks of the waveform, a series of trapezoidal pulses to operate the timer. The timer integrates these pulses and provides an output voltage, increasing with time (time delay), which is sensed by the voltage sensitive output switch. When the output voltage reaches the trigger level, the voltage sensitive output switch operates and provides the engine cutoff signal. If the accelerometer input signal drops below the trigger level before the voltage sensitive output switch operates, the signal generated by the timer dissipates with time.

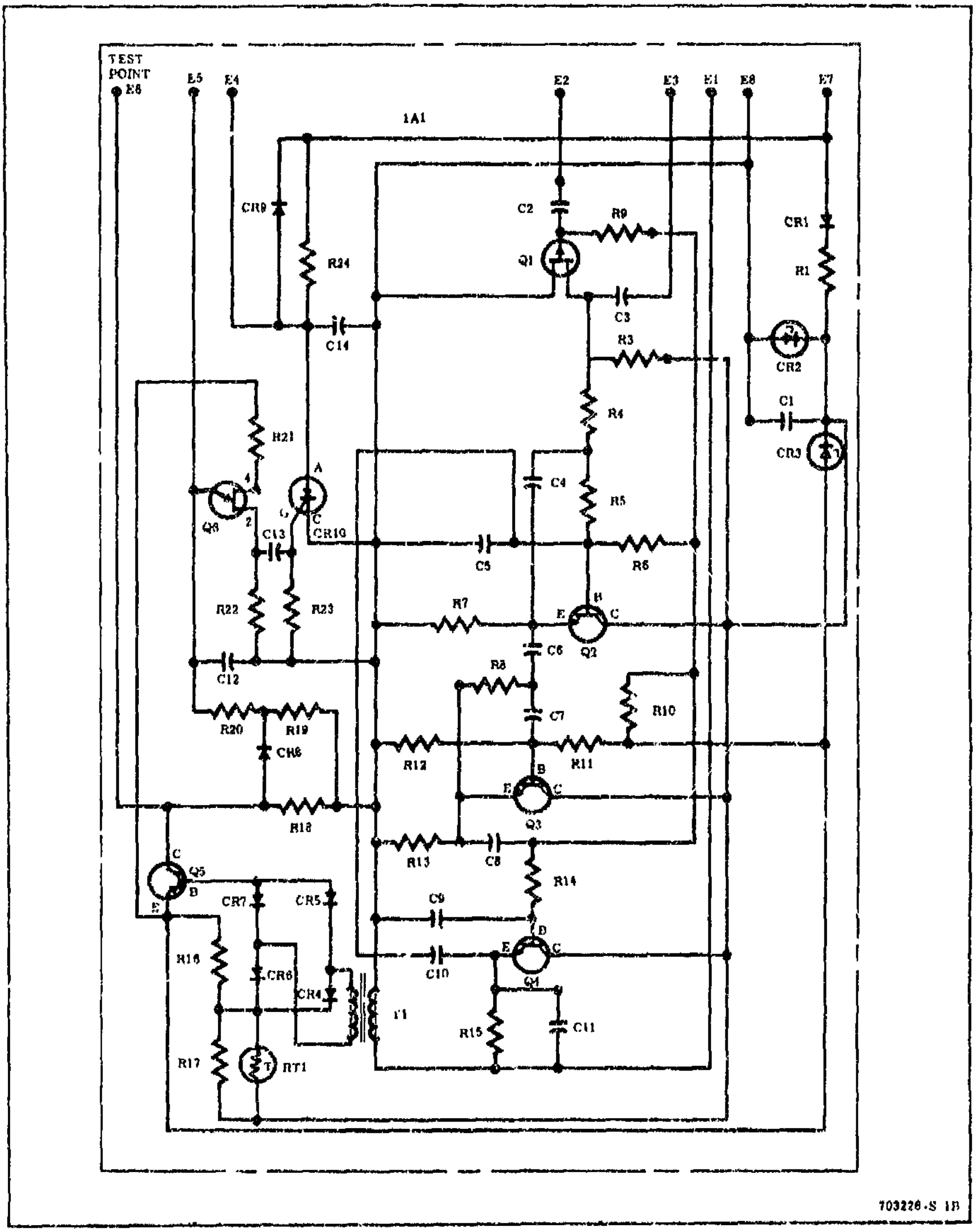


Figure 9-3. Control Unit Circuit Board Schematic (Typical)

9-6. MAINTENANCE.

9-7. Maintenance of the flight combustion monitor consists of checkout of control unit and checkout of accelerometer. Since all units of the flight combustion monitor are potted and sealed, the unit must be replaced if it fails to meet the requirements of the tests performed in paragraphs 9-10 through 9-23. The checkouts are performed at ambient temperature of 77° ±18° F, atmospheric pressure of 28-32 inches of mercury, and relative humidity of 80 percent or less. See figures 9-3 and 9-4 for electrical schematics.

9-8. CHECKOUT OF CONTROL UNIT.

9-9. Checkout of the control unit shall be performed in the order given and the results recorded for each channel. Since the channel circuit boards are identical, except for pin designation of receptacles J1 and J2, only one set of procedures employing circuit board terminal numbers is presented. See figure 9-5 for suggested test setup. A wiring diagram (figure 9-8), located at the end of the section, is provided to aid in troubleshooting.

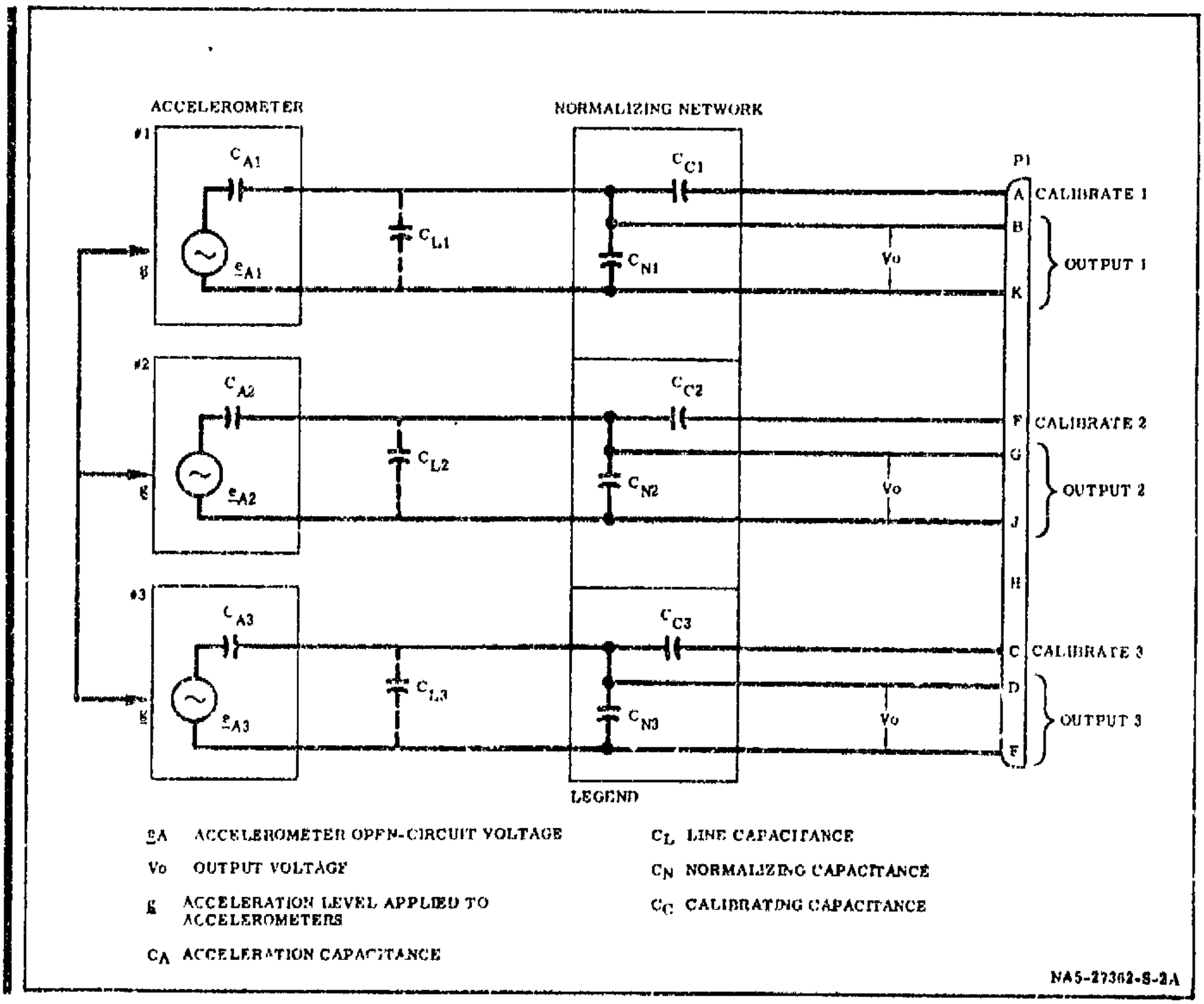


Figure 9-4. Accelerometer and Normalizing Network Schematic

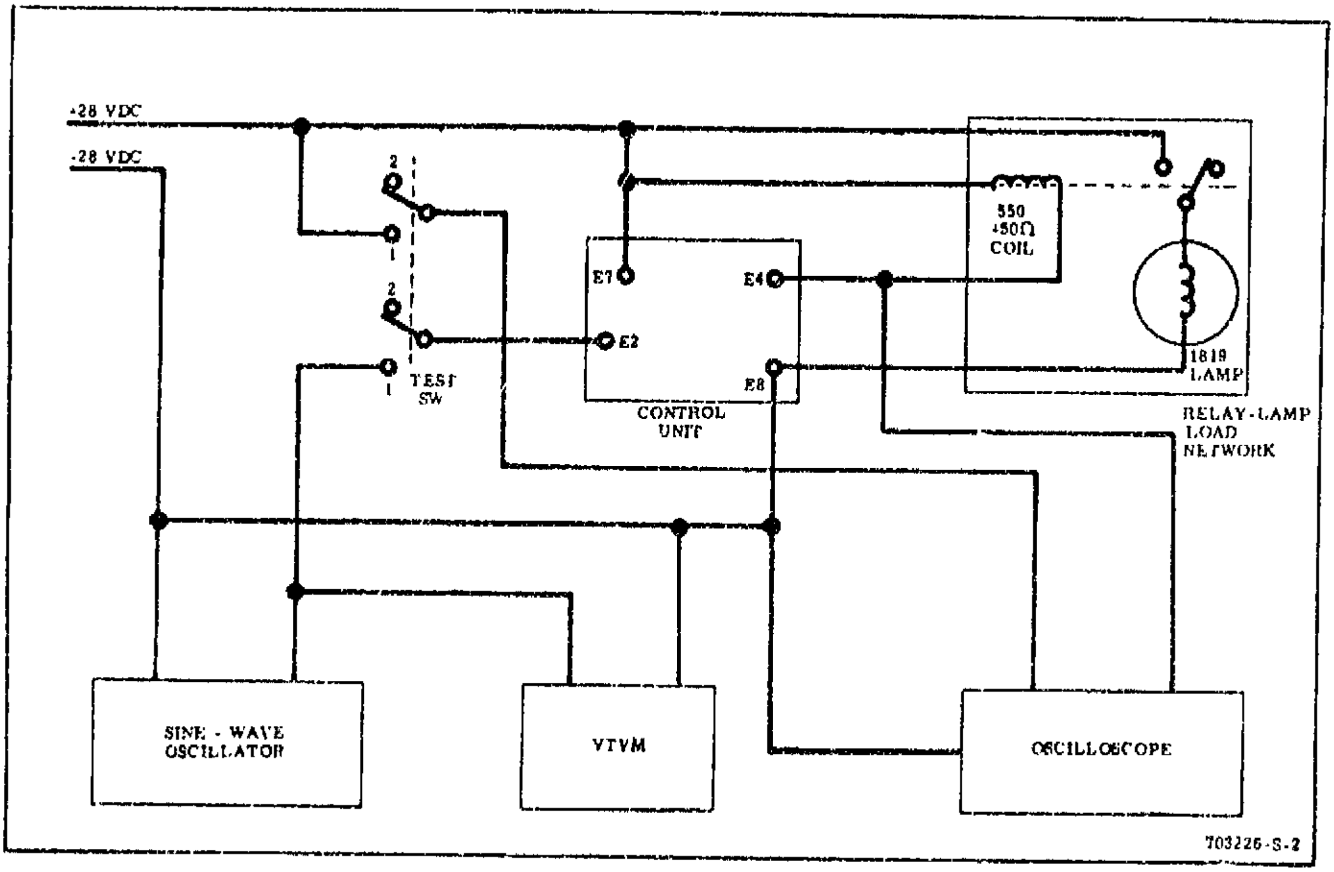


Figure 9-5. Suggested Test Setup for Circuit Board Checkout

9-10. INSULATION RESISTANCE-TEST. This test requires a 500-volt dc megohmmeter, with an effective series output resistance of one megohm minimum.

a. Install a jumper wire to all pins in receptacles J1 and J2 which are connected to circuit board 1A1.

CAUTION

Make sure jumper wire is not touching pin M of receptacle J2 (case ground) when test is performed, since arcing or a short-circuit can cause damage to equipment.

b. Connect megohmmeter between the jumper and case: then apply test voltage for 5-60 seconds. Resistance must be greater than 100 megohms.

9-11. NOISE-LEVEL TEST.

NOTE

Terminals E2 and E8, of the two circuit boards not under test, must be short circuited during this test and the following tests performed in paragraphs 9-12 through 9-16.

a. Apply 28 vdc to terminals +E7 and -E8.

b. Temporarily short-circuit signal input terminals E2 and E8.

c. Using a vacuum tube voltmeter capable of measuring from 0.1 to 1.0 vac rms with an accuracy of ±1 percent; and from 0.001 to 0.1 and 1.0 to 20 vac rms with an accuracy of ±10 percent, measure the voltage between terminals E1 and E8. Reading must be less than 0.005 vac rms.

d. Remove jumper from terminals E2 and E8 and disconnect test equipment.

9-12. TRIGGER LEVEL AMPLITUDE-TEST.

a. Connect a 550 ±50 ohm load-bank, with an indicator, to terminals E4 and E7.

b. Connect an audio oscillator, with output continuously variable from 0.1 to 20 vac rms and a frequency range of 60 to 30,000 cps with 0.5 percent maximum distortion, between terminals E2 and E8. Set frequency at 1,200 cps.

c. Apply 28 vdc to terminals E7 and E8.

d. Slowly increase oscillator output voltage until the load-bank indicator comes on.

e. Using vacuum tube voltmeter, measure and record oscillator output voltage. Reading must be 0.500 ±0.30 vac rms.

9-13. FILTER GAIN AMPLITUDE-TEST.

a. Connect an audio oscillator between terminals E2 and E8 and set frequency at 1,200 cps.

b. Connect a vacuum tube voltmeter across oscillator output.

c. Apply 28 vdc to terminals E7 and E8.

d. Increase oscillator output voltage to 0.300 ±0.003 vac rms.

e. Using vacuum tube voltmeter, measure voltage between terminals E1 and E8. Reading must be between 0.225 and 0.285 vac rms.

9-14. FREQUENCY-RESPONSE TEST.

a. Connect an audio oscillator between terminals E2 and E8.

b. Connect a capacitor (3,300 picofarads ±10 percent) between the oscillator high side terminal and terminal E2.

c. Connect a 550 ±50 ohm load-bank, with an indicator, between terminals E4 and E7.

d. Apply 28 vdc to terminals E7 and E8.

e. Set oscillator frequency at 1,200 cps; then increase oscillator output voltage until load-bank indicator comes on.

f. Using vacuum tube voltmeter, record oscillator output voltage. The reading must be 0.500 ±0.040 vac rms.

g. Repeat steps e and f using the values listed in figure 9-6. The load-bank indicator must come on at all frequencies except 60 cps, 200 cps, 12.5 kc, and 30 kc.

NOTE

The load-bank indicator should not come on below the voltages specified in figure 9-6 for 60 cps, 200 cps, 12.5 kc, and 30 kc settings. If the indicator does come on, the control unit must be replaced.

h. Set oscillator frequency at 30 kc and the output voltage to 5 ±0.2 vac rms. Measure voltage between terminals E1 and E8. The reading must be less than 0.055 vac rms.

i. Set oscillator frequency at 60 cps and the output voltage to 1 ±0.1 vac rms. Measure voltage between terminals E1 and E8. The reading must be less than 0.015 vac rms.

j. Remove all test equipment.

Frequency	Volts AC
60 cps	Greater than 20 volts
200 cps	Greater than 3 volts
400 cps	Greater than 1,200 cps reading
600 cps	Value of 1,200 cps reading ±0.05 volt rms
800 cps	Value of 1,200 cps reading ±0.05 volt rms
1,200 cps	0.500 ±0.040 volt rms
2 kc	Value of 1,200 cps reading ±0.05 volt rms
3 kc	Value of 1,200 cps reading ±0.05 volt rms
6 kc	Greater than 1,200 cps reading
12.5 kc	Greater than 15 volts
30 kc	Greater than 20 volts

NOTE

The Control Unit must be reset after each frequency test.

Figure 9-6. Circuit Board Frequency-Response Values

9-15. STAGE ONE MAXIMUM-OUTPUT TEST.

a. Apply 28 vdc to terminals E7 and E8.

b. Connect an audio oscillator between terminals E2 and E8 and set frequency at 1,200 cps.

c. Connect an oscilloscope between terminals E3 and E8.

d. Increase oscillator output voltage until clipping of sine-wave is observed on oscilloscope. Voltage across terminals E3 and E8, just prior to clipping, must be greater than 2.5 vac rms.

9-16. TIME-DELAY TEST.

a. Connect a double pole, double-throw, snap-action test switch between +28 vdc and the oscilloscope external trigger input; and between oscillator high side and terminal E2. Both circuits must be closed when switch is placed in on position.

b. Connect a 550 ±50 ohm load-bank, with an indicator, between terminals E4 and E7.

c. Connect oscillator low side to terminal E8 and set frequency at 1,200 cps.

d. Connect vacuum tube voltmeter across oscillator output terminals.

e. Connect oscilloscope vertical input to terminals E4 and E8.

f. Apply 28 vdc to terminals E7 and E8.

g. Move test switch to on and increase oscillator output voltage until load-bank indicator just comes on.

h. Record voltage of vacuum tube voltmeter (trigger level voltage).

i. Increase oscillator output voltage to 1.07 times the value obtained in step h.

j. Set oscilloscope to generate one horizontal sweep when test switch is snapped to on position.

k. Move test switch to off and reset control unit.

l. Move test switch to on and measure time delay between the start of the oscilloscope trace and negative step of trace (turn-on of SCR CR10). Time delay must be 50 ±15 milliseconds.

m. Increase oscillator output voltage to 2.00 times the value obtained in step h.

n. Move test switch to off and reset control unit.

o. Repeat step 1. Time delay must be 17.5 ±2.5 milliseconds.

p. Move test switch to off and disconnect test equipment.

9-17. CHECKOUT OF ACCELEROMETER.

9-18. Checkout of the accelerometer must be performed in the order given and the results recorded for each accelerometer. See figure 9-7 for suggested test setup.

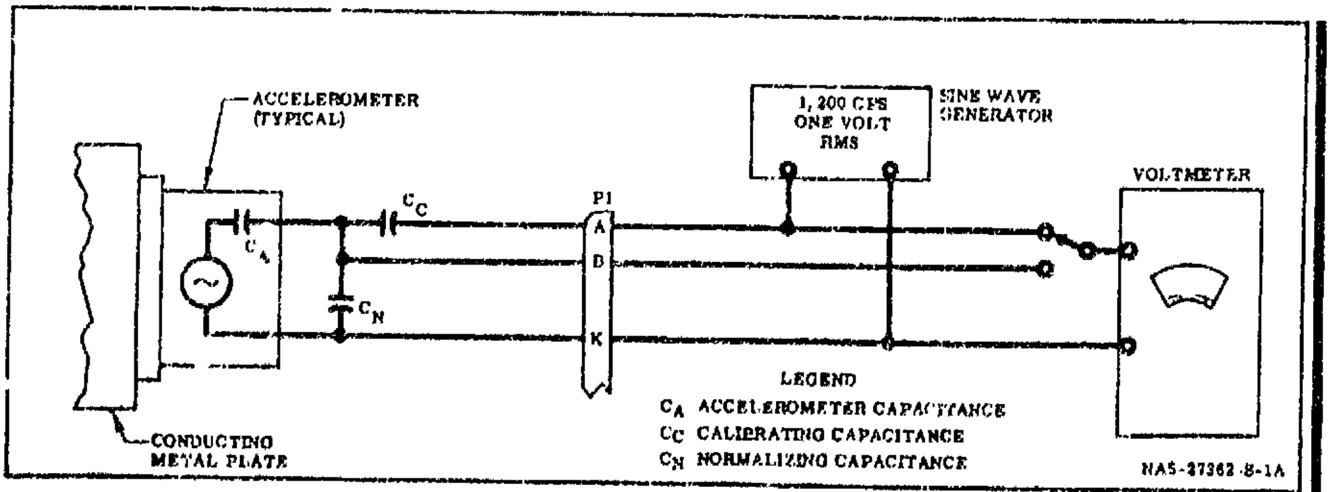


Figure 9-7. Suggested Test Setup for Accelerometer and Normalizing Network (Typical)

9-19. INTERNAL RESISTANCE-TEST. This test requires a 50-volt dc megohmmeter.

a. Connect megohmmeter between pins B and K of plug P1; then apply test voltage for 5-60 seconds. Resistance must be greater than 100 megohms.

b. Perform step a with megohmmeter connected to pins G and J, and D and E with the same results.

9-20. INSULATION RESISTANCE-TEST. This test requires a 500-volt dc megohmmeter, with an effective series output resistance of one megohm minimum.

a. Mount accelerometer to a conducting metal plate which simulates an actual installation on the engine.

b. Connect megohmmeter between conducting metal plate and each pin of plug P1.

c. Apply test voltage for 5-60 seconds. Resistance must be greater than 50 megohms.

9-21. OUTPUT AND CALIBRATION CAPACITANCE-TEST. This test requires a one-kc capacitance bridge.

a. Connect bridge between the following pins of plug P1 and measure output capacitance. Capacitance must be greater than 2,500 picofarads and within the following tolerance:

(1) B and K within ±2 percent of manufacturer's value.

(2) G and J within ±2 percent of manufacturer's value.

(3) D and E within ±2 percent of manufacturer's value.

b. Connect bridge between the following pins of plug P1 and measure calibration capacitance. The capacitance must be as follows:

(1) A and B: same as B and K ±3.5 percent.

(2) F and G: same as G and J ±3.5 percent.

(3) C and D: same as D and E ±3.5 percent.

9-22. NORMALIZING-NETWORK TEST. This test is performed on each accelerometer. See figure 9-4 for corresponding pins of plug P1 for each accelerometer.

a. Connect accelerometer for test setup as illustrated in figure 9-7.

b. Set sine-wave generator frequency at 1,200 ±100 cps and output amplitude to 1 ±0.01 vac rms.

c. Measure output voltage on voltmeter. Reading must be 0.50 ±0.015 vac rms.

9-23. ACCELEROMETER-SENSITIVITY AND FREQUENCY-RESPONSE TEST. This test requires a vibrating machine capable of applying and measuring (+3 percent accuracy) 100 ±10 g rms to the accelerometer under test; and an electrical load equivalent to a 10 ±1 megohm resistor shunted by a 25 ±5 picofarads capacitance.

a. Mount the accelerometer onto vibrating machine and place normalizing network unit on workbench.

b. Connect electrical load across output of accelerommeter under test.

c. Apply a 100 ±10 g rms level and increase vibration frequency to 1,200 ±100 cps.

d. Measure output voltage of accelerometer. Sensitivity must be 5.00 ±0.25 millivolts per g.

e. Reduce g-level to 10 ±5 g rms and with vibration frequency at 1,200 ±100 cps; measure and record sensitivity.

f. Vibrate accelerometer at 5 additional frequencies between 600 and 3,000 cps.

NOTE

The frequencies used in step f must be spaced to obtain approximately equal increments of length on a logarithmic scale.

g. Measure and record sensitivities at each frequency. Sensitivity must be within (+7.5, -6.0) percent of results of step e.

h. Remove accelerometer and secure test equipment.

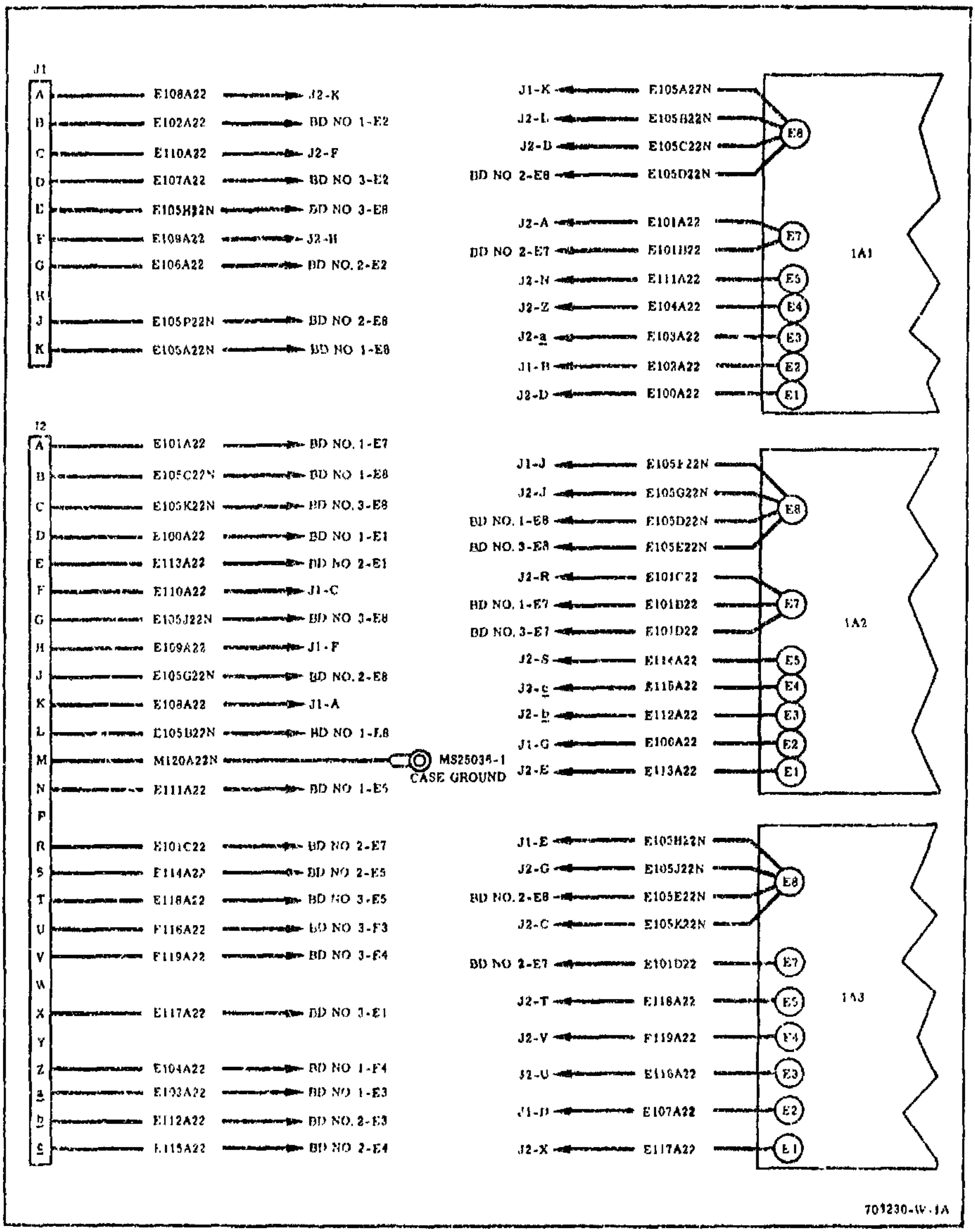


Figure 9-8. Control Unit Wiring Diagram

Pages 9-11 through 9-14 deleted.

SECTION X

COMPONENTS TEST CONSOLE G3141 AND COMPONENTS ADAPTER SET G3143

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. SCOPE. This section contains description and leading particulars, theory of operation, maintenance instructions, and inspection requirements for Components Test Console G3141 and Components Adapter Set G3143. The test console is used to leak- and function-test the F-1 rocket engine components. The adapter set provides the necessary accessories required for component test setups and the special test equipment, used in conjunction with the test console, required in the test cell.

10-2. DESCRIPTION AND LEADING PARTICULARS.

10-3. COMPONENTS TEST CONSOLE.

10-4. The components test console (figure 10-1) consists of two two-bay control cabinets and a workbench cabinet. The cabinets are constructed of steel and designed to receive standard 19-inch panels. The console is a semi-permanent installation with provisions for leveling and for lifting with a forklift. The console incorporates electrical, pneumatic, and hydraulic systems which include a monitor system for each one. The systems are arranged in the console in logical order with the same or similar systems contained in the same bay. The left-hand cabinet (as viewed facing the workbench cabinet) houses the major portion of the electrical system and the monitor system. The right-hand cabinet houses the hydraulic system and the pneumatic system. The workbench cabinet houses the crossover plumbing and wiring and utility panel shutoff valves, and provides a workbench for testing. Doors at the rear of each control cabinet permit easy access to components, plumbing, and electrical harness. The electrical, pneumatic, and hydraulic system inlet and outlet connections to the test cell are through the test cell panel. All external facility connections for electrical, pneumatic, and hydraulic systems are located at the rear of the right-hand cabinet. See figure 10-2 for leading particulars.

10-5. CONSOLE PANELS. The console panels are constructed from aluminum alloy and incorporate two handles on the face of each panel. Hand valves, regulators, gages, switches, and indicators are mounted to the front panels, and some panels incorporate a chassis for additional component mounting. The electrical control panel is mounted on slides for access to the patch-panel. The components which are controlled electrically, pneumatically, or hydraulically are mounted to the structure of the cabinets. All panels are secured to the front of the cabinets and are arranged in a logical order to provide ease of operation and accuracy of readings. Markings, silk-screened on the face of each panel, show nomenclature, direction of operation, positions, indications, sections of panels, and a schematic portion of the pneumatic or hydraulic system affected. See figure 10-3 for location and list of panels.

10-6. ELECTRICAL SYSTEM. The electrical system is an ac/dc system consisting of a power distribution panel, dc power supply panel, electrical control panel, ac outlet bus, electrical utility panel, and wiring. The power distribution panel contains a ten-amp and 30-amp circuit breaker, an ac control relay, and four receptacles. The ten-amp circuit breaker provides protection for the utility panel ac circuit and the 30-amp circuit breaker provides protection for the ac input circuit to the distribution panel. The relay controls distribution of ac power to the utility panel, hydraulic control panel, and ac outlet bus. The dc power supply panel consists of a variable 0-40 vdc power supply, voltmeter, ammeter, power switch and light, and voltage and current adjustment controls. For a complete description of the dc power supply, refer to Operation and Service Manual, Model TVR040-15 (Perkin Electronics). The electrical control panel contains a dc power supply, patchboard, milliameter, voltmeter, voltage adjust variable resistor, relay, switches, and switch-lights. The dc power supply is a self-regulated,

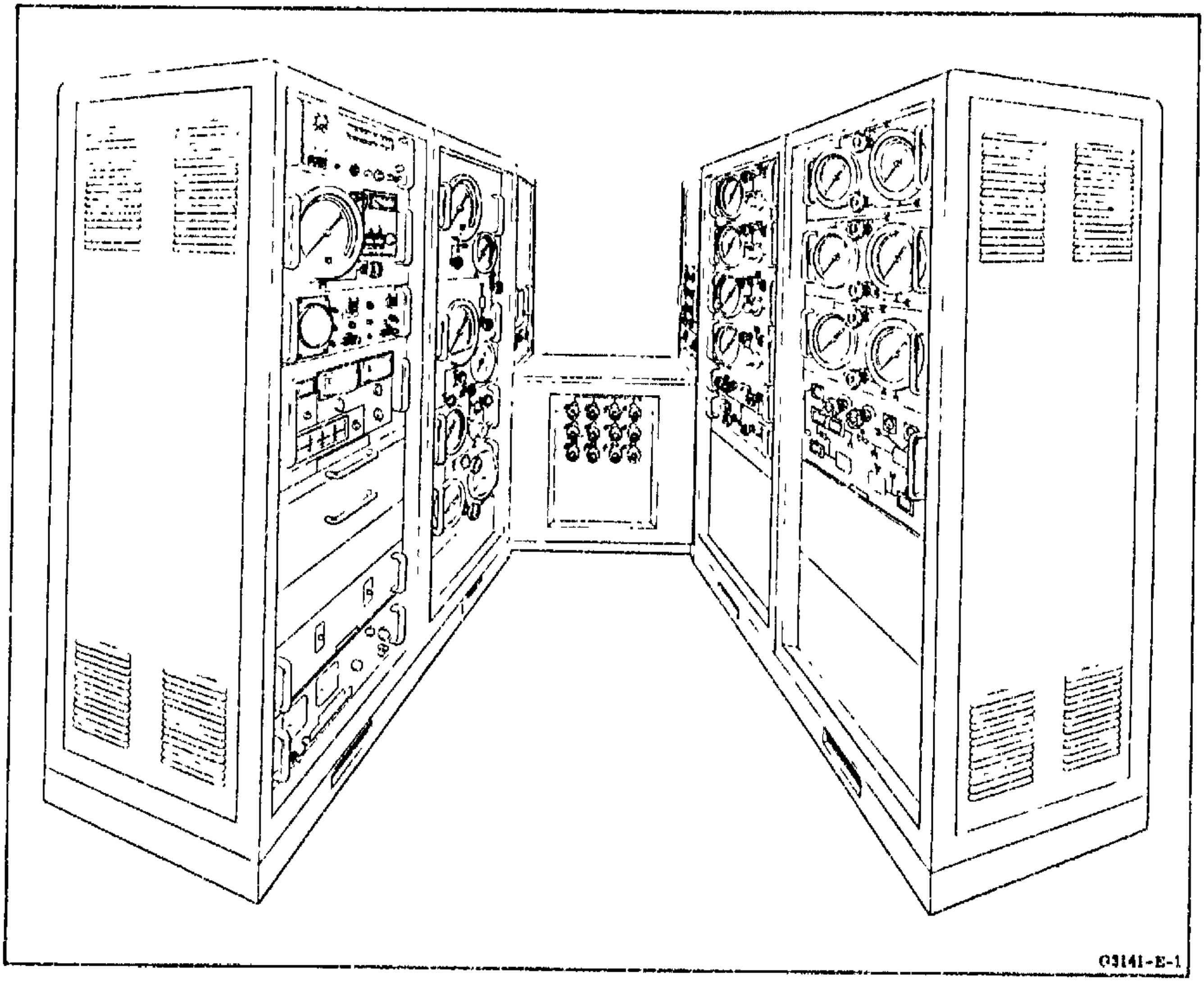


Figure 10-1. Components Test Console

Dimensions and Weight			Workbench cabinet:	Length	36 inches
Left-hand control cabinet:	Length	64.80 inches		Width	17.38 inches
	Width	30.00 inches		Height	36 inches
	Height	77.38 inches		Weight	461 pounds
	Weight	1,859 pounds	**Electrical Power Requirements**		
Right-hand control cabinet:	Length	64.80 inches	Input:	120 vac, single-phase, 60-cycle, 3-wire, 30-ampere. Facility power receptacle catalog #CPS532 (Crouse-Hinds)	
	Width	30.00 inches			
	Height	77.38 inches			
	Weight	1,881 pounds			

Figure 10-2. Leading Particulars for Components Test Console (Sheet 1 of 2)

Electrical Power Requirements (continued)			
Output:	120 vac, single-phase, 60-cycle, 10-ampere 0-40 vdc, 10-ampere 28 vdc, 0.25-ampere	Output:	0-160 psig 0-1,500 psig (Cryogenic Supply Unit G3146 tank pressure) 0-5,000 psig 0-1,000 psig (fuel-compatible) 0-5,000 psig (fuel-compatible)
Monitor:	0-150 vac 0-150 vdc 0-1,000 milliamperes dc Pneumatic flow of 0.3 to 4.8 cfm at 200 psig, and hydraulic flow of 0.15 to 15 gpm +30° to +100° F and -190° to -260° F temperature Voltage, frequency, period, and time (digital voltmeter) Voltage, frequency, period, time, and phase shift (oscilloscope)	Monitor:	0-100 psig (fuel-compatible) 0-300 psig (fuel-compatible) 0-1,000 psig (fuel-compatible) 0-1,000 psig 0-6,000 psig 0-15 psid 0-60 psid (fuel-compatible)
Pneumatic Pressure Requirements		**Hydraulic Pressure Requirements**	
Input:	Gaseous nitrogen (MIL-P-27401) 5,000 ±200 psig at a minimum flowrate of 0-40 scfm for 5 minutes. Gaseous helium (Bureau of Mines, Grade A) 3,500 ±200 psig at a minimum flowrate of 0-60 scfm for 5 minutes.	Input:	Hydraulic fluid (MIL-H-5606) 0-5,000 psig static pressure for 5 minutes and 2,100 psig at 0.25 gpm for 5 minutes.
		Output:	0-5,000 psig A, B, and C
		Monitor:	0-1,000 psig 0-2,000 psig 0-5,000 psig 0-60 psid

Figure 10-2. Leading Particulars for Components Test Console (Sheet 2 of 2)

Panel Nomenclature	Location	Panel Nomenclature	Location
Left-Hand Control Cabinet (reading from left to right)		**Right-Hand Control Cabinet (reading from right to left)**	
DIGITAL VOLTMETER panel	Bay One	HYD HIGH PRESS. MONITOR panel	Bay One
PRESSURE/TEMPERATURE MONITOR panel	Bay One	HYD MED PRESS. MONITOR panel	Bay One
OSCILLOSCOPE panel	Bay One	HYD DIFF PRESS. MONITOR panel	Bay One
ELECTRICAL CONTROL panel	Bay One	HYDRAULIC CONTROL panel	Bay One
POWER DISTRIBUTION panel	Bay One	MED PRESS. FUEL COMPATIBLE panel	Bay Two
DC POWER SUPPLY panel	Bay One	HIGH PRESS. FUEL COMPATIBLE panel	Bay Two
PRESS/Δ P MONITOR FUEL COMPATIBLE panel	Bay Two	LOW PRESSURE panel	Bay Two
FLOW/Δ P MONITOR panel	Bay Two	HIGH PRESSURE panel	Bay Two
LN_2 TANK PRESSURE panel	Bay Two	SYSTEM SUPPLY panel	Bay Two
LOW PRESS. MON. FUEL COMPATIBLE panel	Bay Two	PNEU SOURCE CONTROL panel	Bay Two
ELECTRICAL UTILITY panel	Bay Three	Pneumatic/Hydraulic UTILITY OUTLETS panel	Bay Three
Workbench Cabinet		**Right-Hand Control Cabinet (rear)**	
UTILITY NO. 1 panel	Top	HYDRAULIC supply panel	Bay One
UTILITY NO. 2 panel	Center	Electrical/PNEU. SOURCE panel	Bay Two
UTILITY NO. 3 panel	Bottom		

Figure 10-3. List of Console Panels

precision, 28-volt supply housed in a hermetically sealed case. The patch-board consists of a receptacle frame, patch-panel, and patch-cords. The receptacle frame contains a locking mechanism and a receptacle (identified as J6) with 15 rows of 20-each spring contacts. The patch-panel has a handle at each end and 15 rows (A to R) of 20-each (1 through 20) holes that correspond with the spring contacts. The patch-cords consist of 20AWG wire, insulated with polyvinyl chloride, with a ball-detent-type plug on each end. Some patch-cords have up to four plugs. The milliameter and voltmeter are multi-range, precision instruments with a curved scale and a view window. A range select switch is provided for the selection of the different ranges and include an off position. A zero-adjust screw is located on the face of the meters. The switch-lights are a combination switch and light that perform and indicate a specific function. The ac outlet bus is constructed of steel ducting with internal wiring to four double ac outlets equally spaced on the duct. The electrical utility panel contains a convenient outlet and test jack panel with two ac outlets and ten banana plugs, control and instrumentation connectors, and a grounding stud on the front panel. Six electrical connectors, a purge inlet adapter, and a purge outlet plate are located on the chassis. The panel serves as the interconnect point between the electrical control panel and the component being tested in either the test cell or on the workbench cabinet.

10-7. PNEUMATIC SYSTEM. The pneumatic system is a high-pressure gaseous nitrogen or helium system that regulates and controls the test gas, supplied from a facility source, to engine components. The pneumatic system contains a pneumatic source, pneumatic source control, system supply, high-pressure, low-pressure, high-pressure fuel-compatible, medium-pressure fuel-compatible, liquid nitrogen tank pressure, and utility outlet panels. Also included in the system are filters and pressure switches. The panels contain pressure gages, shutoff valves, vent valves, relief valves, and regulators. The vent systems of high- and medium-pressure fuel-compatible panels are connected to a common external vent system.

10-8. HYDRAULIC SYSTEM. The hydraulic system is a high-pressure, high-flow fluid system that regulates and controls the test fluid, supplied from a facility source, to engine components. The hydraulic system contains a hydraulic supply panel, a hydraulic control panel, a dome-loaded regulator, a temperature transducer, solenoid valves, and related plumbing. The hydraulic supply panel provides the facility hydraulic source supply and return connect points and the pneumatic external vent connect point. The hydraulic control panel contains pressure gages, shutoff valves, and switch-lights. The switch-lights are a switch and light combination that perform and indicate a specific function. The dome-loaded regulator is a diaphragm-poppet-type regulator, remotely controlled by pneumatic pressure. The temperature transducer contains a pure platinum, resistant element wound on a ceramic bobbin and housed in a stainless-steel case. The transducer is an emersion-type with a mounting flange and electrical connector. The solenoid valves are two-way and three-way valves, solenoid-operated.

10-9. MONITOR SYSTEM. The monitor system contains the necessary sensing devices, indicators, and instruments to visually observe performance of engine components. The system monitors electrical signals and pneumatic and hydraulic flows, temperature, and pressure. The electrical monitors are the oscilloscope, digital voltmeter, and temperature indicator panels. For a complete description of the oscilloscope, refer to Operating and Service Manual, Model 122AR (Hewlett Packard Co). For a complete description of the digital voltmeter, refer to Operating and Service Manual, Model DY2401B (Hewlett Packard Co). The pneumatic monitors are the flow/differential-pressure monitor, pressure/differential-pressure monitor fuel-compatible, pressure/temperature monitor, and low-pressure monitor fuel-compatible panels. The hydraulic monitors are the hydraulic high-pressure monitor, hydraulic medium-pressure monitor, and hydraulic differential-pressure monitor panels. Also included in the monitor system are flowmeters, temperature transducers, and related plumbing and wiring. The panels contain pressure gages, differential pressure gages, hand valves, and relief valves. The flowmeters are turbine-type, in-line, mounted units, constructed of stainless steel with standard MS ports and an electro-magnetic pickup. The temperature transducer is identical to the one in the hydraulic system.

10-10. COMPONENTS ADAPTER SET.

10-11. The components adapter set consists of accessories and special test equipment (figure 10-4) stored in a steel cabinet. The adapter set includes hand valves, accumulators, filters, orifices, transducers, calibrator, camera, cylinder, container, tubes, hoses, cables, test leads, and standard fittings.

Part No.	Description
AN6289C12	Nut (F-3)
AN6289C4	Nut (F-3)
AN6289C6	Nut (F-3)
AN6289C8	Nut (F-3)
AN814-12C	Plug (F-3)
AN814-16C	Plug (F-3)
AN814-2C	Plug (F-3)
AN814-4C	Plug (F-3)
AN814-6C	Plug (F-3)
AN814-8C	Plug (F-3)
AN815-12C	Union (F-3)
AN815-4C	Union (F-3)
AN815-6C	Union (F-3)
AN815-8C	Union (F-3)
AN816-16C	Nut (F-3)
AN816-4C	Nipple (F-3)
AN824-12C	Tee (F-3)
AN824-4C	Tee (F-3)
AN824-6C	Tee (F-3)
AN824-8C	Tee (F-3)
AN832-12C	Union (F-3)
AN832-4C	Union (F-3)
AN832-6C	Union (F-3)
AN832-8C	Union (F-3)
AN893-12C	Bushing (F-3)
AN893-16C	Bushing (F-3)
AN893-19C	Bushing (F-3)
AN893-2C	Bushing (F-3)
AN893-4C	Bushing (F-3)
AN894C10-8	Bushing (F-3)
AN894C16-8	Bushing (F-3)
AN894C20-8	Bushing (F-3)
AN894C8-4	Bushing (F-3)
AN919-1C	Reducer (F-3)
AN919-10C	Reducer (F-3)
AN919-12C	Reducer (F-3)
AN919-16C	Reducer (F-3)
AN919-18C	Reducer (F-3)
AN919-19C	Reducer (F-3)
AN919-21C	Reducer (F-3)
AN919-23C	Reducer (F-3)
AN919-6C	Reducer (F-3)
AN924-6C	Nut (F-3)
AN929-12C	Cap (F-3)
AN929-2C	Cap (F-3)
AN929-4C	Cap (F-3)
AN929-6C	Cap (F-3)
AN929-8C	Cap (F-3)

Part No.	Description
AN937C12	Cross (F-3)
AN937C4	Cross (F-3)
AN937C6	Cross (F-3)
AN937C8	Cross (F-3)
AN938C12	Tee (F-3)
AN938C4	Tee (F-3)
AN938C6	Tee (F-3)
AN938C8	Tee (F-3)
AP2057-5.03	Orifice (F-3)
AP2057-5.83	Orifice (F-3)
AP2057-4.10[a]	Orifice (F-3)
AP2057-4.70[a]	Orifice (F-3)
HP10351A	Carrying Case (F-1)
MS28777-12	Ring (F-3)
MS28777-4	Ring (F-3)
MS28777-6	Ring (F-3)
MS28777-8	Ring (F-3)
MS28778-12	Packing (F-3)
MS28778-4	Packing (F-3)
MS28778-6	Packing (F-3)
MS28778-8	Packing (F-3)
NAS1006-4A	Bolt (F-3)
RD153-5002-0010	Washer (F-3)
RD171-6017-0001	Plate (F-3)
RD273-1009-0140	Restrictor (F-3)
RD273-1009-0020	Restrictor (F-3)
RD273-1009-0046	Restrictor (F-3)
RD273-1010-0080	Restrictor (F-3)
RD273-3004-0012	Reducer (F-3)
VD261-0123-0004	Seal (F-3)
VD261-0123-0006	Seal (F-3)
VD261-0123-0008	Seal (F-3)
VD261-0123-0012	Seal (F-3)
VD261-0123-0016	Seal (F-3)
BB52748 or 1231001	Cable (F-3)
BB52747 or 1231002	Cable (F-3)
BB52745-1 or 1231003	Cable (F-3)
BB52745-2 or 1231004	Cable (F-3)
BB52744 or 1231005	Cable (F-3)
BB52752 or 1231006	Cable (F-3)
BB52746-1 or 1231007	Cable (F-3)
BB52751 or 1231008	Cable (F-3)
BB52750-1 or 1231009	Cable (F-3)
BB52746-2 or 1231011	Cable (F-3)
BB52750-2 or 1231012	Cable (F-3)
1052	Calibrator (F-1)
12C6X-SS	Elbow (F-3)
19-9014946-13	Hose (F-3)
19-9014946-14	Hose (F-3)

(a) Units incorporating MD1 change

Figure 10-4. List of Equipment in Components Adapter Set (Sheet 1 of 2)

Part No.	Description	Part No.	Description
19-9014946-15	Hose (F-3)	19-9026587-3	Valve (F-1)
19-9014946-16	Hose (F-3)	19-9026587-4	Valve (F-1)
19-9018996-2	Cabinet (X-2)	19-9026587-5	Valve (F-1)
19-9021905-1	Filter (F-1)	19-9026587-6	Valve (F-1)
19-9021905-2	Filter (F-1)	19-9026587-7	Valve (F-1)
19-9021929-4	Gage (F-3)	19-9026587-8	Valve (F-1)
19-9021933	Valve (F-2)	196B	Camera Oscilloscope (F-2)
19-9021936	Valve (F-1)	2680-LOX	Temperature Transducer (F-3)
19-9021937-14	Valve (F-1)	19-9021935[a]	Temperature Transducer (F-3)
19-9021937-15	Valve (F-1)	28-464-51	Nalgene Graduated Cylinder (F-3)
19-9021937-16	Valve (F-1)	4C6X-SS	Elbow (F-3)
19-9021937-17	Valve (F-1)	4R6X-SS	Tee (F-3)
19-9021937-18	Valve (F-1)	6C6X-SS	Elbow (F-3)
19-9021937-19	Valve (F-1)	648	Crocodile Clip Test Lead (F-3)
19-9021937-20	Valve (F-1)	675	Crocodile Clip Test Lead (F-3)
19-9021937-21	Valve (F-1)	699	Universal Test Lead (F-3)
19-9022606-1	Valve (F-1)	9013531	Container (F-3)
19-9022606-2	Valve (F-1)	9022320	Adapter (F-3)
19-9026501	Valve (F-1)	9022321	Hose (F-3)
19-9026518	Press. Transducer (F-3)	9024714	Accumulator (F-1)
19-9026519	Meter (F-1)	9022322	Bladder (F-3)
19-9026520	Filter (F-1)	9024714-3	Bag (F-3)
19-9026522-1	Hose (F-3)	9026576	Plate (F-3)
19-9026522-2	Hose (F-3)	9026577	Tube (M-3)
19-9026522-3	Hose (F-3)	9026578	Tube (M-3)
19-9026522-4	Hose (F-3)	9026579	Handle (F-3)
19-9026522-5	Hose (F-3)	9026581	Tube (M-3)
19-9026522-6	Hose (F-3)	9026582	Tube (M-3)
19-9026525-1	Hose (F-3)	9026583	Plate (F-3)
19-9026525-2	Hose (F-3)	9259T-1PP	Valve (F-1)
19-9026585	Accumulator (F-1)		
19-9026587-1	Valve (F-1)		
19-9026587-2	Valve (F-1)		

(a) Units incorporating MD1 change

Figure 10-4. List of Equipment in Components Adapter Set (Sheet 2 of 2)

10-12. THEORY OF OPERATION.

10-13. COMPONENTS TEST CONSOLE.

10-14. The components test console has the capability of performing proof-, leak-, function-, electrical, and calibration-tests and is instrumented to measure voltage, frequency, temperature, flow, and differential pressure. The console is arranged in a U-shape outside the test cell. The workbench cabinet is placed against the test cell wall, and the two control cabinets are attached at 105-degree angles to the ends of the workbench cabinet.

10-15. The electrical system utilizes 120-vac, single-phase, 60-cycle power to operate the dc power supplies, oscilloscope, digital voltmeter, electronic flowmeter, and solenoid valves and switch-lights. The 0-40 vdc power supply provides the variable voltages required during component testing. The 28-vdc power supply provides power to operate the temperature indicator, test switch-lights, test cell and console pressure-on warning lights (controlled by the pressure switches), and those components requiring precision 28 volts.

10-16. The pneumatic system utilizes 5,000 psig gaseous nitrogen or gaseous helium as the pressurant for component testing, for the cryogenic supply unit tank, and for the operation of components within the console. Each pressurant has a separate inlet to the source control panel where both are monitored and controlled and either system is selected as required. Outlet pressure from the source control panel is supplied, through a two-micron filter, to the system supply, high-pressure, and low-pressure panels. Pressure is supplied from the system supply panel, through two check valves to the high- and medium-pressure fuel-compatible panels. Pressure from either panel is supplied to the hydraulic dome-loaded regulator. The helium inlet is also supplied, through another two-micron filter, to the system supply panel and then to the liquid nitrogen tank pressure panel. The panels regulate, monitor, and supply pressure at specific values to components being tested. Regulated pressure in each system is read directly on a pressure gage and sensed by a pressure switch. The pressure switch in each system (wired in parallel) operates warning lights to indicate that the test cell and console are pressurized.

10-17. The hydraulic system uses hydraulic fluid (MIL-H-5606) pressurized to 5,000 psig as the test fluid. Solenoid valves, energized and deenergized by switch-lights on the hydraulic control panel, control the hydraulic supply and return and the hydraulic high-pressure outlet. A dome-loaded regulator maintains a constant delivery pressure and responds instantaneously to a change in the outlet pressure. If the dome pressure is lost or a diaphragm fails, the regulator returns to the closed position. The hydraulic supply temperature is sensed by a temperature transducer. The regulated pressure is sensed by a pressure switch that turns on the test cell and console pressure-on warning lights.

10-18. The monitor system provides the necessary data to evaluate the performance of components being tested. Pressure gages and differential pressure gages permit direct reading of pressure indications. The flowmeter produces an output signal, at a frequency proportional to the flowrate, that is received by the electronic flowmeter which conditions the signal for readout on the digital voltmeter. A serialized, calibrated flow curve for each flowmeter (stored in console drawer), is used to convert the cps reading to gpm. Output signals from the temperature transducers are read directly on the temperature indicator.

10-19. COMPONENTS ADAPTER SET.

10-20. The adapter set provides the standard and special equipment that adapts components to be tested to the respective pneumatic and electrical connections of the test cell or console. The special test equipment in the adapter set utilizes pneumatic and electrical power from the console to function. This special test equipment is used to perform those component tests that cannot be performed by the console alone.

10-21. MAINTENANCE.

10-22. Maintenance of the components test console and components adapter set consists of checkout, removing, installing, servicing, and shipping and storage. The console electrical schematic (figure 10-17) is included to aid in troubleshooting and is at the end of this section. See figure 10-5 for test equipment and materials used during checkout.

Part Number or Specification	Nomenclature	Use
G3143	Components adapter set	Adapts components to different test setups.
Model 630A	Multimeter (Triplett), or equivalent (2 required)	Measures voltage at test points and performs continuity tests.
RP300A	Patch-panel (Vector Electronic Co, Inc)	Provides multiple program setups.
K3. 06, K3.09, K3. 15, K4.09, K5.09	Patch-cords (Vector Electronic Co, Inc)	Patches different circuits across patch-panel.
3088-12, 3088-17	Resistor and diode patch cord (Goldak Co, Inc)	Adds resistance to and block voltages in circuits for specific tests.

NOTE

Patch-cords K3.06 (black), K3.09 (yellow), and K3.15 (blue) are dual-plug jumpers and 6, 9, and 15 inches long, respectively. Patch-cords K4.09 and K5.09 (9 inches long) are 3- and 4-plug jumpers, respectively.

- The patch-panels and patch-cords are stored in the console storage drawer.

Figure 10-5. Test Equipment and Materials (Sheet 1 of 2)

Part Number or Specification	Nomenclature	Use
BB52749 or 1231010	Power Cable	Connects component test console to facility electrical power.
MIL-L-25567	Leak-test compound	Leak-tests pneumatic system.
MIL-P-27401	Gaseous nitrogen	Pressurizes for leak- and function-test of pneumatic system.
MIL-H-5606	Hydraulic fluid	Leak- and function-tests hydraulic system.
ANSTAC-2M	Antistatic solution (Chemical Development Corp)	Antistatic alloy treats meter tube and float.

Figure 10-5. Test Equipment and Materials (Sheet 2 of 2)

10-23. CHECKOUT OF COMPONENTS TEST CONSOLE.

NOTE

The following checkout procedures pertain to a self-check of the components test console and do not include the procedures to be accomplished when the test console is connected to other items of GSE:

10-24. Checkout of the components test console is performed at ambient temperature of 65° to 75° F, atmospheric pressure of 28-32 inches of mercury, and relative humidity of 50 percent or less. All external hoses used must have teflon as the inner liner and be maintained in the clean condition specified for the type of service intended. When fittings, components, or lines are disconnected, suitable precautions must be taken to prevent entry of foreign material into the system. The tests must be performed in the order given and the results obtained as specified. All personnel in the immediate test area must wear safety equipment and take precautionary measures to protect themselves from injury.

10-25. ELECTRICAL GROUND-, POWER-, AND VOLTAGE-TEST. See figure 10-2 for electrical power and facility power receptacle requirements. See figure 10-6 for typical patch-panel and patch-cords. Refer to Operation and Service Manual, Model 122AR, (Hewlett Packard Co) and Operation and Service Manual, Model DY2401B, (Hewlett Packard Co) for operation and calibration instructions for the oscilloscope and digital voltmeter.

a. Make sure all electrical connectors are installed, and resistor plugs 3088-9 are installed on receptacles RTD5 and RTD6 of PRESSURE TEMPERATURE MONITOR panel and on test cell panel receptacle J703.

b. On POWER DISTRIBUTION panel, pull out circuit breakers CB1 and CB2.

c. On DC POWER SUPPLY panel, turn CURRENT LIMIT switch to 10A, VOLTAGE ADJUST switch fully counterclockwise, VOLTAGE VERNIER switch to midpoint (vertical), and AC INPUT switch to OFF.

d. On ELECTRICAL CONTROL panel, turn MILLIAMPERES RANGE SELECT switch to OFF, VOLTS RANGE SELECT switch to OFF, and VOLTAGE ADJUST switch to DECREASE.

e. On OSCILLOSCOPE panel, turn INTENSITY & POWER switch to OFF.

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

g. On DIGITAL VOLTMETER panel, turn power ON switch to off (down position), RANGE selector switch to 100V, FUNCTION selector switch to FREQ, SAMPLE PERIOD selector switch to .1 SEC, SAMPLING RATE control to STOP, and ATTEN control fully clockwise. At rear of panel, move count switch to DISPLAY DURING COUNT, 100KC STD switch to INT, and AC LINE VOLTAGE switch to 115 position.

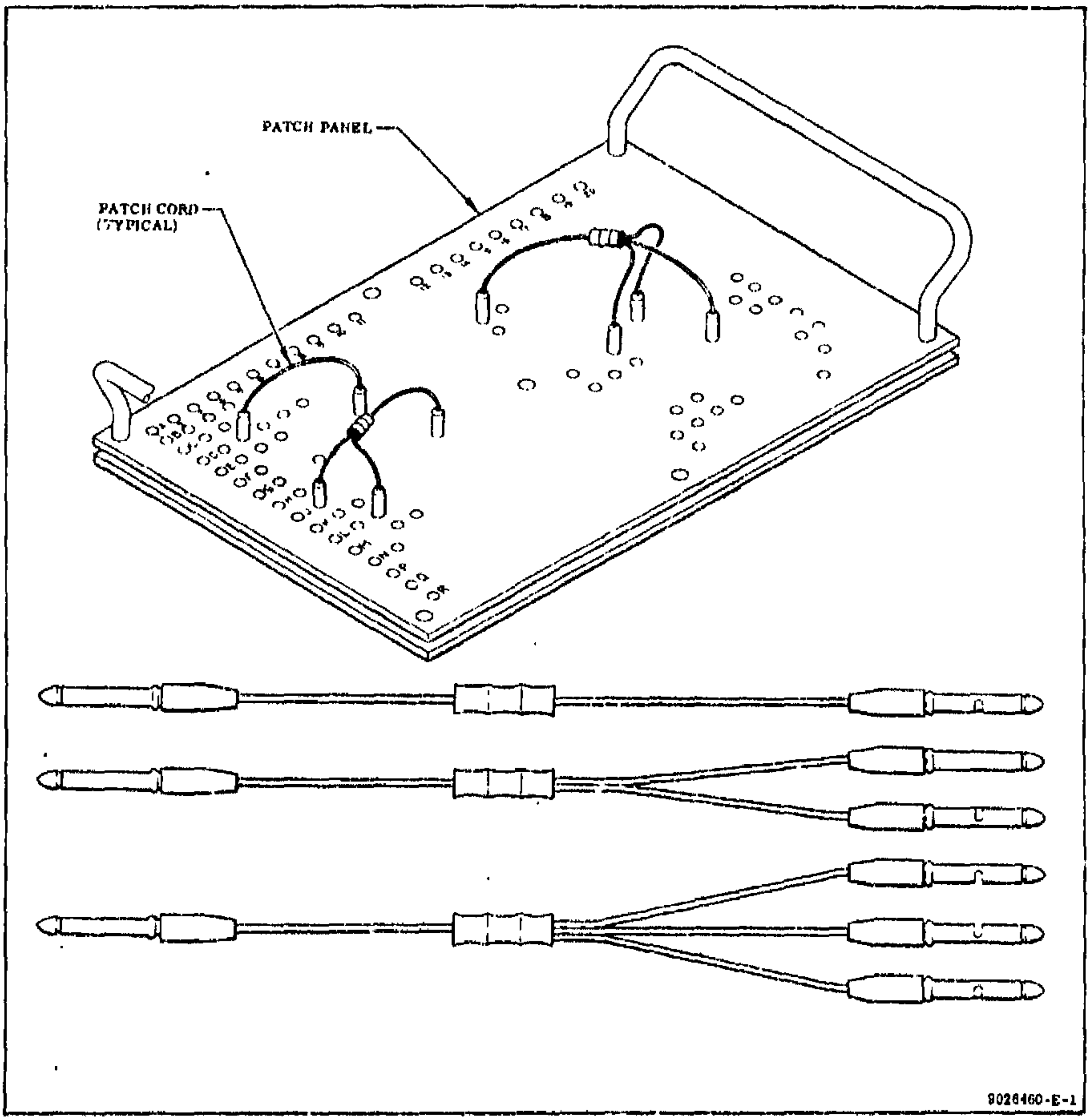


Figure 10-6. Patch-Panel and Patch-Cords (Typical)

h. Using multimeter, check for one ohm or less between the following points:

(1) From electrical/PNEU SOURCE panel E6 ground stud (located under right-hand handle) to a mounting screw and then a pneumatic fitting on same panel.

(2) From ELECTRICAL CONTROL panel handle to POWER DISTRIBUTION panel handle.

(3) From any front panel pneumatic fitting to test cell panel.

(4) From E6 ground stud to HYDRAULIC CONTROL panel handle.

(5) From E6 ground stud to test cell panel GROUND JACK J706.

(6) From E6 ground stud to ELECTRICAL UTILITY panel GROUND JACK J32.

i. Remove ELECTRICAL CONTROL panel mounting screws and pull out panel until patchboard is accessible.

j. Using patch-cords, patch a patch-panel according to TEST SETUP NO. 1 of figure 10-7. Install patch-panel into receptacle frame and lock in place with locking mechanism.

k. Push ELECTRICAL CONTROL panel back into console but do not install mounting screws.

l. Connect power cable BD52749 or 1231010 (stored on floor of monitor bay of left-hand cabinet) between electrical/pneumatic inlet panel receptacle J8 and facility receptacle.

WARNING

Facility power must be turned off and shell of facility receptacle must be grounded (earth ground) before connecting or disconnecting cable, or injury to personnel or damage to equipment can result.

m. Turn facility power on; on POWER DISTRIBUTION panel push in circuit breaker CB2, 10AMP. No visible results.

n. On POWER DISTRIBUTION panel, push in circuit breaker CB1, 30AMP; on ELECTRICAL CONTROL panel, press POWER switch-light if necessary. POWER light comes ON.

o. On DC POWER SUPPLY panel, move AC INPUT switch to ON; AC INPUT light comes on. On OSCILLOSCOPE panel, turn INTENSITY & POWER control to midposition; red light comes on. On DIGITAL VOLTMETER panel, move power switch to ON; KC-000000-000001 appears in display window (press RESET switch if necessary).

p. On ELECTRICAL CONTROL panel, turn VOLTAGE ADJUST switch to INCREASE until voltmeter on DC POWER SUPPLY panel indicates 32-33 volts; on DC POWER SUPPLY panel, turn VOLTAGE ADJUST switch until voltmeter indicates 40-41 volts.

q. On DC POWER SUPPLY panel, turn VOLTAGE ADJUST switch fully counterclockwise; on ELECTRICAL CONTROL panel, turn VOLTAGE ADJUST switch to DECREASE until voltmeter on DC POWER SUPPLY panel indicates 20 ±0.5 volts.

NOTE

On ELECTRICAL CONTROL panel, the TEST SELECT 1 through 8 switch-lights should be in off position.

r. On HYDRAULIC CONTROL panel, position switch-lights as follows:

(1) HYDRAULIC SYSTEM BYPASS to OPEN.

(2) HYDRAULIC SYSTEM SUPPLY to CLOSE.

(3) LOW FLOW BYPASS to CLOSE.

(4) TEST CELL SUPPLY "A" to VENT.

(5) TEST CELL SUPPLY "B" to VENT.

(6) FLOW MONITOR SHUTOFF to CLOSE.

s. On ELECTRICAL CONTROL panel, press and hold LAMP TEST switch; on ELECTRICAL CONTROL panel, make sure all 3 sections of TEST SELECT 1 through 8 switch-lights, both sections of switch lights listed in step r above, and both SYSTEM PRESSURIZED lights are on. Release LAMP TEST switch. All lights except those listed in step r go off.

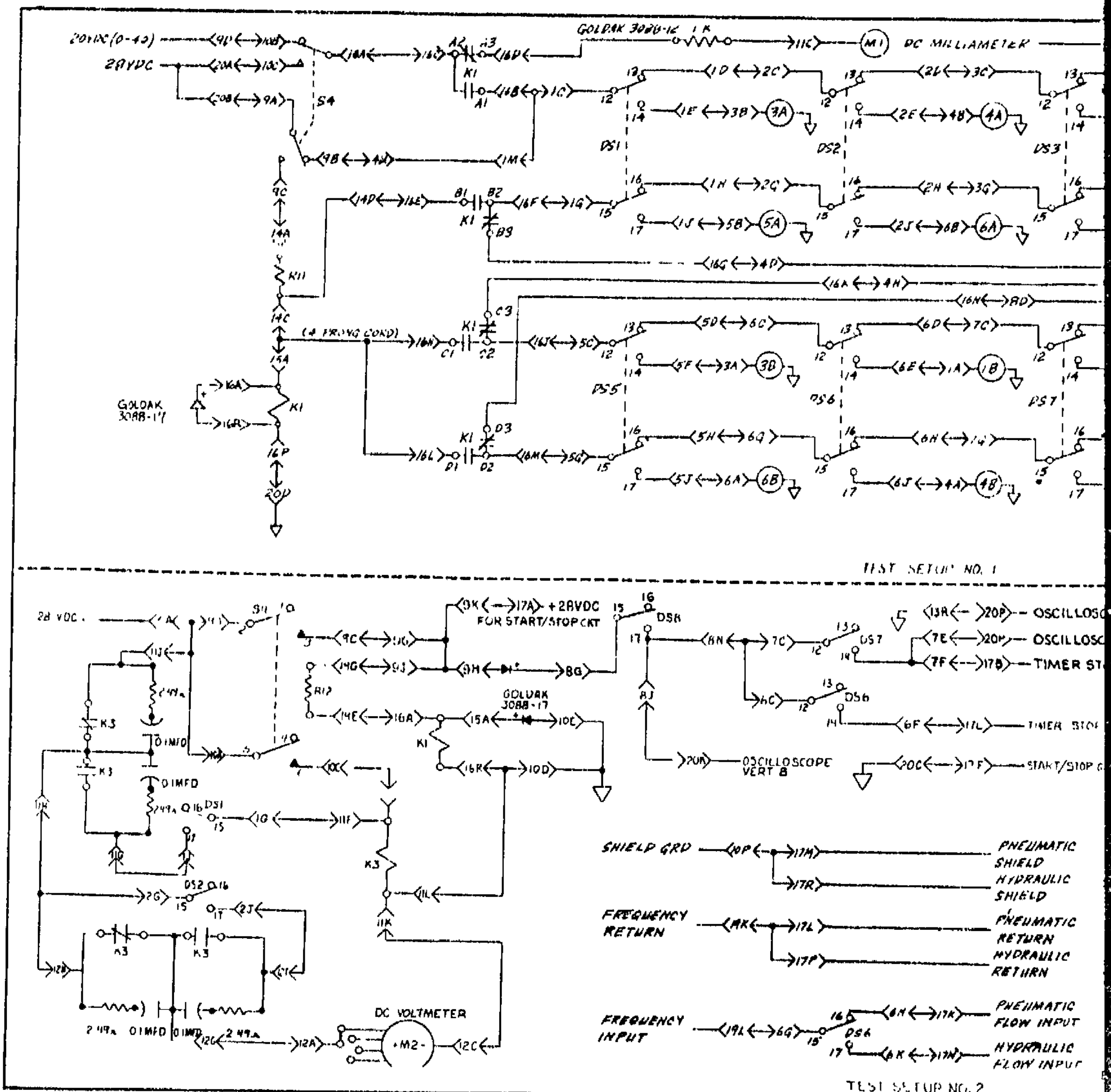
t. On ELECTRICAL CONTROL panel, turn VOLTS RANGE SELECT switch to the following positions:

(1) D (0-30), VOLTS meter indicates 28 ±0.5 volts.

NOTE

An external voltage adjust screw on the power supply (PS1) may be used if adjustment is necessary to obtain results in substep 1.

(2) C (0-75), VOLTS meter indicates 27-29 volts.



28VDC (0-40)
28VDC
S4
GOLDAK 3088-16
1K
DC MILLIAMETER
K1
DS1
DS2
DS3
K11
(4 PRONG CORD)
GOLDAK
3088-17
DS5
DS6
DS7
TEST SETUP NO. 1
28 VDC
+28VDC
FOR START/STOP CKT
DS8
OSCILLOSCOPE
TIMER
GOLDAK
3088-17
OSCILLOSCOPE
VERT B
START/STOP
R17
K3
.01MFD
DC VOLTMETER
M2
SHIELD GRD
PNEUMATIC
SHIELD
HYDRAULIC
SHIELD
FREQUENCY
RETURN
PNEUMATIC
RETURN
HYDRAULIC
RETURN
FREQUENCY
INPUT
PNEUMATIC
FLOW INPUT
HYDRAULIC
FLOW INPUT
TEST SETUP NO. 2

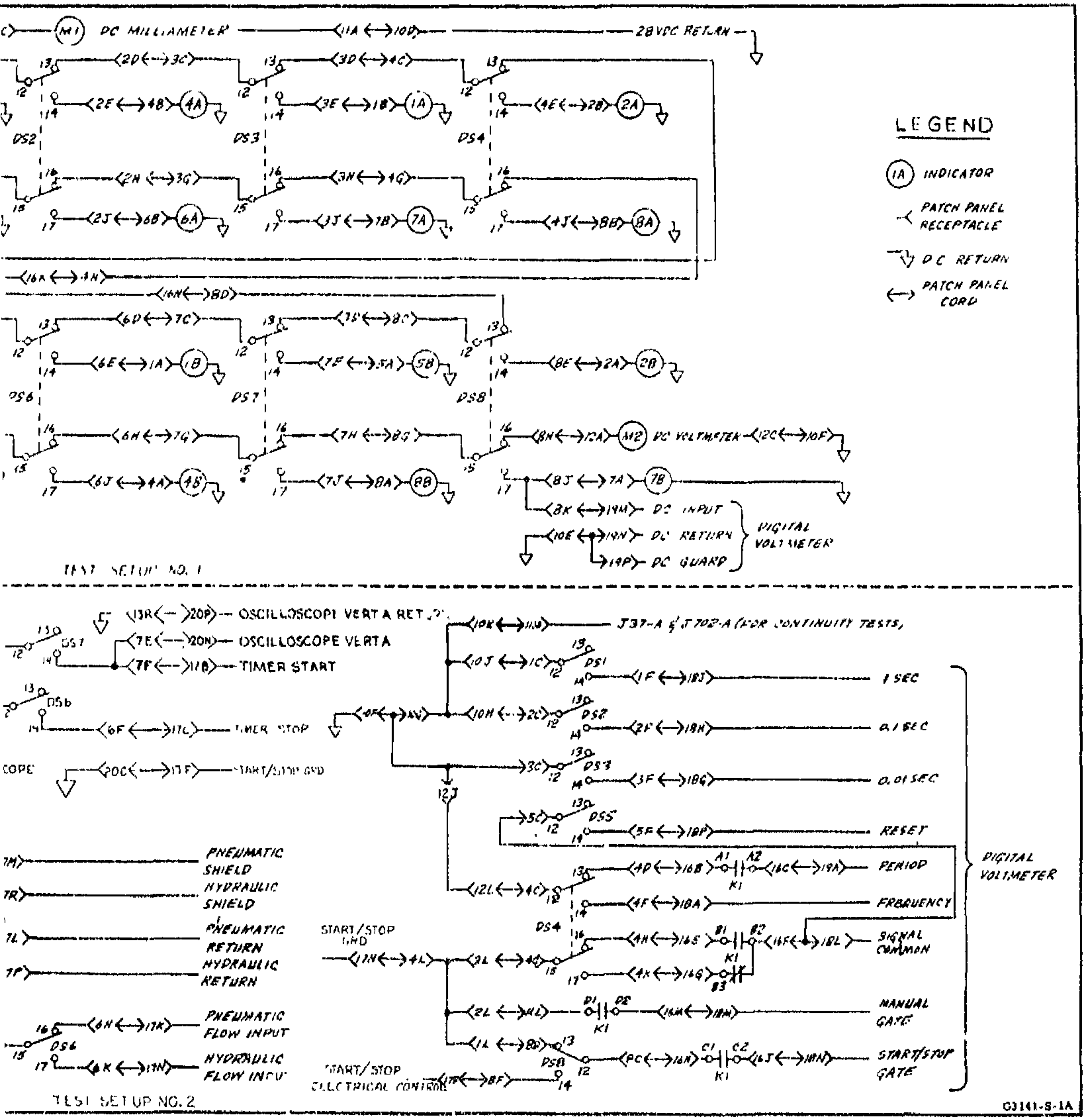


Figure 10-7. Patch-Panel Test Setup (Sheet 1 of 3)

Patch-Cord[a]	From J6-	To J6-
TEST SETUP NO. 1[b]		
K3.	1A	6E
K3.	1B	3E
K4.09	1C	1M
		16B
K3.	1D	2C
K3.	1E	3B
K3.	1G	16F
K3.	1H	2G
K3.	1J	5B
K3.	2A	8E
K3.	2B	4E
K3.	2D	3C
K3.	2E	4B
K3.	2H	3G
K3.	2J	6B
K3.	3A	5E
K3.	3D	4C
K3.	3H	4G
K3.	3J	7B
K3.	4A	6J
K3.	4D	16G
K3.	4H	16K
K3.	4J	8E
K3.	4M	9B
K3.	5A	7E
K3.	5C	16J
K3.	5D	6C
K3.	5G	16M
K3.	5H	6G
K3.	5J	6A
K3.	6D	7C
K3.	6H	7G
K3.	7A	8J
K3.	7D	8C
K3.	7H	8G
K3.	7J	8A
K3.	8D	16N
K3.	8H	12A
K3.	8K	19M
K3.	9A	20B
K3.	9C	14A
K3.	9D	10B
K3.	10A	16C
K3.	10C	20A
K3.	10D	11A
K4.09	10E	19N
		19P
K3.	10F	12C
3088-12	11C	16D
K5.09	14C	15A
		16H
		16L
K3.	14D	16E
3088-17[c]	16A(+)	16R
K3.	16P	20D
TEST SETUP NO. 2		
K3.	1C	10J
K3.	1F	18J
K3.	1G	11F
K3.	1J	11G
K3.	1L	8D
K3.	2C	10H
K3.	2F	18H
K4.09	2G	11H
		12H
K3.	2J	12F
K3.	2L	16L
K5.09	3C	10F
		10G
		12J
K3.	3F	18G
K3.	3L	4G
K3.	4C	12L
K3.	4D	16B
K3.	4F	18A
K3.	4H	16E
K3.	4K	16G
K3.	4L	17H
K4.09	5C	16F
		18L
K3.	5F	18P
K4.09	6C	7C
		8K
K3.	6F	17C
D3.	6G	19L
K3.	6H	17K
K3.	6K	17N
K3.	7E	20N
K3.	7F	17B
K3.	8C	16H
K3.	8F	17D
3088-17[c]	8G(+)	9H
K3.	8J	20K

(a) Use any cord length required on all patch-cords numbered K3.
(b) If a patch-panel is to remain patched for testing, indicate test setup No. 1 or No. 2 on panel.
(c) Diode patch-cord must be connected with red lead on same side as (+).

Figure 10-7. Patch-Panel Test Setup (Sheet 2 of 3)

Patch-Cord[a]	From J6-	To J6-
K5.09	9A	10A
		11J
		20A
K3.	9C	9G
K3.	9J	14G
K3.	9K	17A
K3.	10C	11E
K4.09	10D	11L
		16R
3088-17[c]	10E	15A(+)
K3.	10K	11M
K4.09	10P	17M
		17R
K3.	11K	12C
K3.	12A	12G
K3.	13R	20P
K3.	14E	16A
K3.	16C	19A
K3.	16J	18N
K3.	16M	18M
K3.	17F	20C
K4.09	17L	17P
		19K

(a) Use any cord length required on all patch-cords numbered K3.
(c) Diode patch-cord must be connected with red lead on same side as (+).

Figure 10-7. Patch-Panel Test Setup (Sheet 3 of 3)

(3) B (0-150), VOLTS meter indicates 27-29 volts.

(4) A (0-150 AC), VOLTS meter indicates 26-29 volts.

u. On ELECTRICAL CONTROL panel, turn MILLIAMPERES RANGE SELECT switch to the following positions:

(1) A (0-500) X2, MILLIAMPERES meter indicates 5-15 milliamperes.

(2) B (0-500), MILLIAMPERES meter indicates 15-30 milliamperes.

(3) C (0-250), MILLIAMPERES meter indicates 15-25 milliamperes.

(4) D (0-50), MILLIAMPERES meter indicates 15-25 milliamperes.

v. Turn both RANGE SELECT switches to OFF. MILLIAMPERES meter and VOLTS meter indicate between zero and first-scale increment.

w. On ELECTRICAL CONTROL panel, press and hold TEST OPERATE switch and press each TEST SELECT switch-light in sequence shown in figure 10-8.

NOTE

Each switch-light must be pressed a second time to turn the light off before proceeding to the next switch-light. The digital voltmeter must indicate KC-000000-000001 for all switch-lights for both light positions.

Switch-Light Number	Lights On
1	1, 3A, and 5A
2	2, 4A, and 6A
3	3, 1A, and 7A
4	4, 2A, and 8A
5	5, 3B, and 6B
6	6, 1B, and 4B
7	7, 5B, and 8B
8	8, 2B, and 7B

Figure 10-8. Test Select Switch-Lights

x. On DIGITAL VOLTMETER panel, turn FUNCTION selector switch to VOLTS and momentarily press RESET switch. Digital voltmeter indicates VOLTS 0027.35-0028.65.

y. On ELECTRICAL CONTROL panel, press switch-light 8, lights 8, 2B, and 7B on. Digital voltmeter indicates VOLTS 0027.35-0028.65.

z. Release TEST OPERATE switch, pull out ELECTRICAL CONTROL panel, and remove and store patch-panel in storage drawer.

aa. Using patch-cord K3.06, jumper between J6-10F and J6-11M on a patch-panel. Install patch-panel into receptacle frame and lock in place with locking mechanism.

ab. Using patch-cord K3.15, jumper between points on patch-panel and make sure 28 ±2 vdc exists at test points, as indicated in figure 10-9.

Patch-Panel Points From J6-20A To	Voltage-Test Points +28 vdc	-28 vdc	Patch-Panel Points From J6-20A To	Voltage-Test Points +28 vdc	-28 vdc
J6-1P	J25-A	J37-A	J6-10L	J48	J37-A
J6-1P	J701-A	J702-A	J6-10M	J49	J37-A
J6-1P	J704-A	J702-A	J6-10N	J50	J37-A
J6-1R	J25-B	J37-A	J6-11N	J37-B	J37-A
J6-1R	J701-B	J702-A	J6-11N	J702-B	J702-A
J6-1R	J704-B	J702-A	J6-12M	J37-V	J37-A
J6-2P	J25-D	J37-A	J6-12M	J702-V	J702-A
J6-2P	J701-D	J702-A	J6-12M	J705-A	J702-A
J6-2P	J704-D	J702-A	J6-12N	J37-W	J37-A
J6-2R	J25-E	J37-A	J6-12N	J702-W	J702-A
J6-2R	J701-E	J702-A	J6-12N	J705-B	J702-A
J6-2R	J704-E	J702-A	J6-12P	J37-X	J37-A
J6-3P	J25-G	J37-A	J6-12P	J702-X	J702-A
J6-3P	J701-G	J702-A	J6-12P	J705-C	J702-A
J6-3P	J704-G	J702-A	J6-12R	J37-U	J37-A
J6-3R	J25-H	J37-A	J6-12R	J702-U	J702-A
J6-3R	J701-H	J702-A	J6-12R	J705-D	J702-A
J6-3R	J704-H	J702-A	J6-13B	J37-E	J37-A
J6-4P	J25-K	J37-A	J6-13B	J702-E	J702-A
J6-4P	J701-K	J702-A	J6-13C	J37-F	J37-A
J6-4P	J704-K	J702-A	J6-13C	J702-F	J702-A
J6-4R	J25-L	J37-A	J6-13D	J37-G	J37-A
J6-4R	J701-L	J702-A	J6-13D	J702-G	J702-A
J6-4R	J704-L	J702-A	J6-13E	J37-H	J37-A
J6-5P	J25-N	J37-A	J6-13E	J702-H	J702-A
J6-5P	J701-N	J702-A	J6-13F	J37-J	J37-A
J6-5P	J704-N	J702-A	J6-13F	J702-J	J702-A
J6-5R	J25-P	J37-A	J6-13G	J37-K	J37-A
J6-5R	J701-P	J702-A	J6-13G	J702-K	J702-A
J6-5R	J704-P	J702-A	J6-13H	J37-L	J37-A
J6-6P	J25-S	J37-A	J6-13H	J702-L	J702-A
J6-6P	J701-S	J702-A	J6-13J	J37-M	J37-A
J6-6P	J704-S	J703-A	J6-13J	J702-M	J702-A
J6-6R	J25-T	J37-A	J6-13K	J37-N	J37-A
J6-6R	J701-T	J702-A	J6-13K	J702-N	J702-A
J6-6R	J704-T	J702-A	J6-13L	J37-P	J37-A
J6-7N	J25-k	J37-A	J6-13L	J702-P	J702-A
J6-7N	J701-k	J702-A	J6-13M	J37-R	J37-A
J6-7P	J25-m	J37-A	J6-13M	J702-R	J702-A
J6-7P	J701-m	J702-A	J6-13N	J37-S	J37-A
J6-7R	J25-n	J37-A	J6-13N	J702-S	J702-A
J6-7R	J701-n	J702-A	J6-13P	J37-T	J37-A
J6-8N	J25-q	J37-A	J6-13P	J702-T	J702-A
J6-8N	J701-q	J702-A	J6-14H	J51	J37-A
J6-8P	J25-r	J37-A	J6-14J	J52	J37-A
J6-8P	J701-r	J702-A	J6-14K	J25-V	J37-A
J6-8R	J25-s	J37-A	J6-14K	J701-V	J702-A
J6-8R	J701-s	J702-A	J6-14L	J25-W	J37-A
J6-9L	J43	J37-A	J6-14L	J701-W	J702-A
J6-9M	J44	J37-A	J6-14M	J25-X	J37-A
J6-9N	J45	J37-A	J6-14M	J701-X	J702-A
J6-9P	J46	J37-A	J6-14N	J25-Y	J37-A
J6-9R	J47	J37-A			

Figure 10-9. DC-Voltage Check Points (Sheet 1 of 2)

Patch-Panel Points From J6-20A To	Voltage-Test Points +28 vdc	-28 vdc
J6-14N	J701-Y	J702-A
J6-14P	J25-Z	J37-A
J6-14P	J701-Z	J702-A
J6-14R	J25-a	J37-A
J6-14R	J701-a	J702-A
J6-15B	J25-i	J37-A
J6-15B	J701-i	J702-A
J6-15C	J25-h	J37-A
J6-15C	J701-h	J702-A
J6-15D	J25-f	J37-A
J6-15D	J701-f	J702-A
J6-15E	J25-e	J37-A
J6-15E	J701-e	J702-A
J6-15F	J25-u	J37-A
J6-15F	J701-u	J702-A
J6-15G	J25-v	J37-A
J6-15G	J701-v	J702-A
J6-15H	J25-w	J37-A
J6-15H	J701-w	J702-A
J6-15J	J25-x	J37-A
J6-15J	J701-x	J702-A
J6-15K	J25-y	J37-A
J6-15K	J701-y	J702-A
J6-15L	J25-z	J37-A
J6-15L	J701-z	J702-A
J6-15M	J25-AA	J37-A
J6-15M	J701-AA	J702-A
J6-15N	J25-BB	J37-A
J6-15N	J701-BB	J702-A

Figure 10-9. DC-Voltage Check Points (Sheet 2 of 2)

ac. Remove and store patch-panel in storage drawer. Push ELECTRICAL CONTROL panel back into console.

ad. On ELECTRICAL UTILITY panel, use multimeter to determine the following voltages at receptacles J17 and J36 (located behind CONVENIENCE OUTLETS AND TEST JACKS door):

(1) From neutral (long rectangle) to phase (short rectangle): 120 ±10 percent vac.

(2) From phase (short rectangle) to ground (half-circle): 120 ±10 percent vac.

(3) From neutral (long rectangle) to ground (half-circle): one vac (maximum).

ae. On POWER DISTRIBUTION panel, pull out circuit breaker CB2 and repeat step ad: voltmeter indicates zero. Push in circuit breaker CB2.

af. On ELECTRICAL CONTROL panel, press POWER CONTROL switch-light and leave remaining switches and controls at respective positions. Proceed with timer start/stop-test outlined in paragraph 10-26.

10-26. TIMER START/STOP-TEST. The electrical power-, ground-, and voltage-test outlined in paragraph 10-25 must be accomplished prior to this test.

a. Using patch-cords, patch a patch-panel according to TEST SETUP NO. 2 of figure 10-7. Install patch-panel into receptacle frame and lock in place with locking mechanism. On ELECTRICAL CONTROL panel, press POWER CONTROL switch-light. POWER light ON and voltmeter indicates 28 ±0.5 volts.

b. On DIGITAL VOLTMETER panel, turn FUNCTION selector switch to EXT SEL, SAMPLE PERIOD selector switch to EXT SEL, and ATTEN control to CHECK. Press RESET switch; digital voltmeter indicates KC-000000-000001.

c. On ELECTRICAL CONTROL panel, press TEST SELECT 6, 7, and 8 switch-lights. Lights 6, 7, and 8 come on.

d. On OSCILLOSCOPE panel, position switches and controls as follows:

(1) "A" and "B" VERT. SENSITIVITY to 10 VOLTS/CM (CAL) DC.

(2) SWEEP TIME to 200 MILLISEC/CM (CAL).

(3) TRIGGER LEVEL and SYNC to INT + (AUTO).

(4) CHANNEL "A" POLARITY to POS. UP.

(5) VERTICAL PRESENTATION to CHOP.

(6) VERTICAL "A" POSITION to 3 grid lines up.

(7) VERTICAL "B" POSITION to 6 grid lines up.

(8) HORIZONTAL POSITION to first grid line at left.

NOTE

During the remainder of the test, all switches used are located on the ELECTRICAL CONTROL panel unless otherwise specified.

e. Press and hold TEST OPERATE switch and press TEST SELECT 5 switch-light. Light 5 comes on, digital voltmeter indicates MILLISEC 000000-000001, and oscilloscope indicates 25-30 volts positive on channels "A" and "B". Press TEST SELECT 5 switch-light; light 5 goes off.

f. Press TEST SELECT 6 switch-light; light 6 goes off and digital voltmeter starts timing.

g. Press TEST SELECT 7 switch-light when digital voltmeter indicates between MILLISEC 040000 and 050000. Light 7 goes off; digital voltmeter does not stop timing.

h. Press TEST SELECT 6 switch-light when digital voltmeter indicates between MILLISEC 090000 and 100000. Light 6 comes on; digital voltmeter stops timing.

i. Release TEST OPERATE switch and press TEST SELECT 6 and 8 switch-lights. Lights 6 and 8 go off and oscilloscope channels A and B indicate zero.

j. Press TEST SELECT 5 switch-light. Light 5 comes on and digital voltmeter indicates KC-000000-000001. Press TEST SELECT 5 switch-light; light 5 goes off.

k. Press TEST SELECT 4 switch-light. Light 4 comes on.

l. Press TEST SELECT 3 and then 5 switch-lights. Lights 3 and 5 come on and digital voltmeter indicates KC-00010.0.

m. Press TEST SELECT 3 and 5 switch-lights; lights 3 and 5 go off.

n. Repeat step j and press TEST SELECT 2 then 5 switch-lights. Lights 2 and 5 come on and digital voltmeter indicates KC-0010.00.

o. Press TEST SELECT 2 and 5 switch-lights; lights 2 and 5 go off.

p. Repeat step j and press TEST SELECT 1 then 5 switch-lights. Lights 1 and 5 come on and digital voltmeter indicates KC-010.000.

q. Press TEST SELECT 1, 4, and 5 switch-lights; lights 1, 4, and 5 go off.

r. Repeat step j.

s. On OSCILLOSCOPE panel, turn INTENSITY & POWER switch to OFF. Scope display and red light go off.

t. On ELECTRICAL CONTROL panel, press and hold TEST OPERATE switch. Voltmeter indicates zero.

u. On ELECTRICAL CONTROL panel, press TEST SELECT 1 and 2 switch-lights. Voltmeter indicates 28 ±0.5 volts and lights 1 and 2 come on.

v. Release TEST OPERATE switch and press TEST SELECT 1 and 2 switch-lights Lights 1 and 2 go off.

10-27. TEMPERATURE-INDICATOR-TEST. This test requires removal of the temperature transducers (accessible through rear doors of cabinets); therefore, the test should be performed before leak-testing, or leak-tests of affected systems must be performed again.

a. Disconnect plug P15 from transducer, remove transducer from boss, plug boss, and reconnect plug P15. (Transducer is located behind FLOW/ΔP MONITOR panel.)

CAUTION

Make sure resistor plugs 3088-9 are installed on receptacles RTD5 and RTD6 of PRESSURE/TEMPERATURE MONITOR panel and on test cell panel receptacle J703 before performing step b, or damage to equipment can result.

b. Turn TEMPERATURE CHANNEL SELECT switch to position 2 and allow meter to stabilize to ambient temperature.

c. Observe temperature meter; increase temperature to transducer by gripping it between fingers. Temperature meter indicates an increase in temperature.

d. Turn CHANNEL SELECT switch to OFF.

e. Using a new packing MS28778-8, reinstall transducer. Torque transducer to 150-200 inch-pounds and reconnect plug P15.

f. Disconnect plug P18 from transducer, remove transducer from boss and plug boss, and reconnect plug P18. (Transducer is located behind pneumatic and hydraulic UTILITY OUTLETS panel.)

g. Turn TEMPERATURE CHANNEL SELECT switch to position 3 and allow meter to stabilize to ambient temperature.

h. Repeat steps c through e, but reconnect plug P18.

i. Disconnect plug P63 from transducer, remove transducer from boss and plug boss, and reconnect plug P63. (Transducer is located behind and below HYDRAULIC CONTROL panel.)

j. Turn TEMPERATURE CHANNEL SELECT switch to position 4 and allow meter to stabilize to ambient temperature.

k. Repeat steps c through e, but reconnect plug P63.

l. Turn TEMPERATURE CHANNEL SELECT switch, in turn, to position 1, 5, and 6 and then to OFF. Meter must not peg upscale at any of the 3 positions.

10-28. PNEUMATIC SOURCE CONTROL, SYSTEM SUPPLY, HIGH-PRESSURE, AND PRESSURE/TEMPERATURE MONITOR SYSTEMS LEAK-TEST. See figure 10-2 for pneumatic requirements and figure 10-10 for pneumatic schematic.

a. Turn all SHUTOFF and VENT valves to CLOSE and all PRESSURE REGULATORS to full DECREASE.

b. Open gage isolation valves (accessible through rear doors) on the following panels:

(1) HIGH PRESSURE.

(2) LOW PRESSURE.

(3) HIGH PRESS. FUEL COMPATIBLE.

(4) MED PRESS. FUEL COMPATIBLE.

(5) LN_2 TANK PRESSURE.

NOTE

The isolation valves are closed only when a calibration check of the pressure gage is performed.

c. Make sure test cell and console inlet and outlet connections and all gage test connections are pressure-capped and torqued.

d. Make sure vent ports to atmosphere of all vent valves and relief valves are unrestricted.

e. Connect an external vent line to EXTERNAL VENT on HYDRAULIC supply panel and make sure vent is unrestricted.

f. Connect a regulated facility gaseous nitrogen supply to 5,000 PSIG FACILITY NITROGEN and 5,000 PSIG FACILITY HELIUM on electrical PNEU SOURCE panel.

g. Connect a test hose (oxidizer-compatible) between test cell panel PNEU HIGH PRESS. OUTLET and PNEU HI PRESS. MON INLET.

h. Increase facility gaseous nitrogen supply pressure until PNEU SOURCE CONTROL panel SOURCE PRESS gages indicate 5,000 ±50 psi.

WARNING

Do not tighten or loosen any connections while system is pressurized, or serious injury to personnel and damage to equipment can result.

i. On PNEU SOURCE CONTROL panel, slowly turn NITROGEN and HELIUM SOURCE SHUTOFF valves to OPEN. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates source pressure.

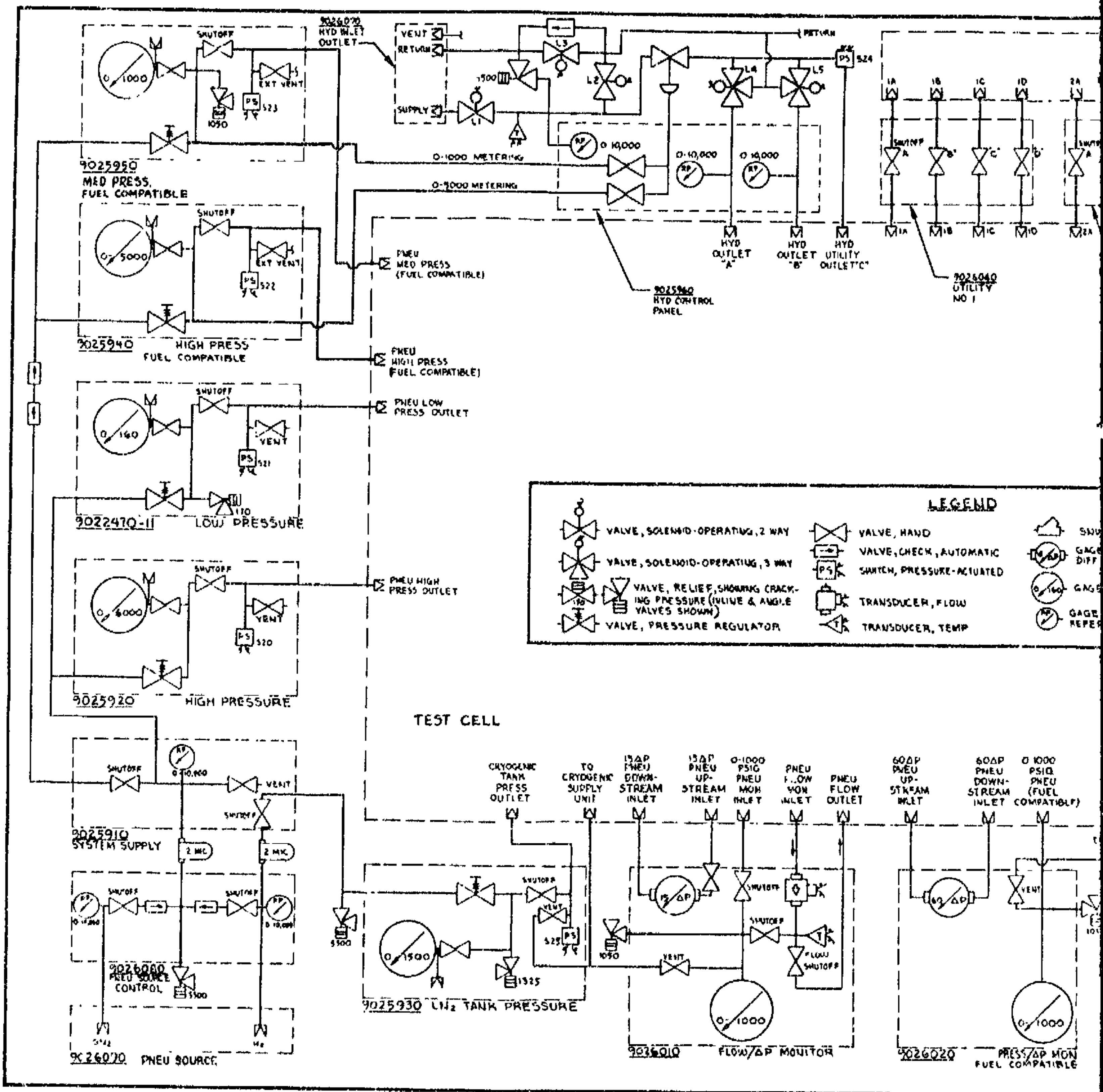
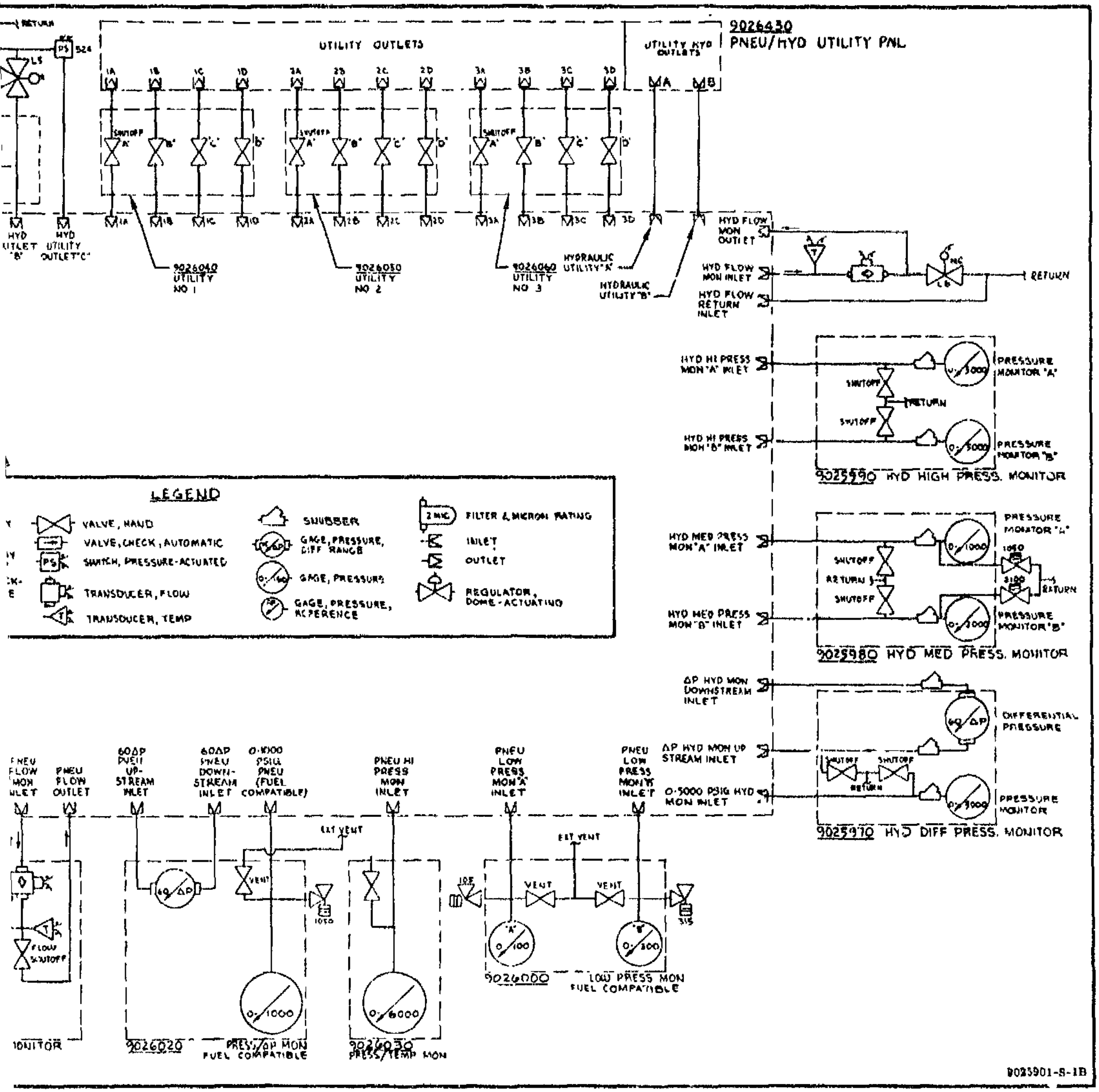


Figure 10-10. Components Test Console Pneumatic/Hydraulic Schematic



9026430
PNEU/HYD UTILITY PNL
UTILITY OUTLETS
UTILITY HYD OUTLETS
9026040 UTILITY NO 1
9026050 UTILITY NO 2
9026060 UTILITY NO 3
HYDRAULIC UTILITY "A"
HYDRAULIC UTILITY "B"
HYD FLOW MON OUTLET
HYD FLOW MON INLET
HYD FLOW RETURN INLET
RETURN
HYD HI PRESS MON "A" INLET
HYD HI PRESS MON "B" INLET
PRESSURE MONITOR "A"
PRESSURE MONITOR "B"
9025990 HYD HIGH PRESS. MONITOR
HYD MED PRESS MON "A" INLET
HYD MED PRESS MON "B" INLET
9025980 HYD MED PRESS. MONITOR
ΔP HYD MON DOWNSTREAM INLET
ΔP HYD MON UP STREAM INLET
0-5000 PSIG HYD MON INLET
DIFFERENTIAL PRESSURE
PRESSURE MONITOR
9025970 HYD DIFF PRESS. MONITOR
LEGEND
VALVE, HAND
VALVE, CHECK, AUTOMATIC
SWITCH, PRESSURE-ACTUATED
TRANSDUCER, FLOW
TRANSDUCER, TEMP
SNUBBER
GAGE, PRESSURE, DIFF RANGE
GAGE, PRESSURE
GAGE, PRESSURE, REFERENCE
FILTER & MICRON RATING
INLET
OUTLET
REGULATOR, DOME-ACTUATING
PNEU FLOW MON INLET
PNEU FLOW OUTLET
60ΔP PNEU UP-STREAM INLET
60ΔP PNEU DOWN-STREAM INLET
0-1000 PSIG PNEU (FUEL COMPATIBLE)
PNEU HI PRESS MON INLET
PNEU LOW PRESS MON "A" INLET
PNEU LOW PRESS MON "B" INLET
EXT VENT
9026020 PRESS/ΔP MON FUEL COMPATIBLE
9026030 PRESS/TEMP MON
9026000 LOW PRESS MON FUEL COMPATIBLE
MONITOR
9025901-S-1B

j. On HIGH PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage and PRESSURE/TEMPERATURE MONITOR panel PRESSURE gage indicate 5,000 (+0, -100) psi. SYSTEM PRESSURIZED lights come on.

k. On SYSTEM SUPPLY panel, slowly turn LN_2 PRESS PANEL shutoff valve to OPEN.

l. Apply leak-test compound to all connections on and between PNEU SOURCE CONTROL, SYSTEM SUPPLY, HIGH PRESSURE, PRESSURE/TEMPERATURE MONITOR, and test cell panels, and up to LOW PRESSURE and LN_2 TANK PRESSURE panels PRESSURE REGULATOR. No leakage is allowable.

m. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE. HIGH PRESSURE and PRESSURE/TEMPERATURE MONITOR panel gages decrease to zero and SYSTEM PRESSURIZED lights go off.

n. On HIGH PRESSURE panel, turn SHUTOFF valve to CLOSE, disconnect test hose installed in step g, and pressure-plug or -cap open ports.

10-29. LOW-PRESSURE, LN_2 TANK PRESSURE, AND FLOW/Δ P MONITOR SYSTEMS LEAK-TEST.

a. Connect test hose (oxidizer-compatible) between test cell panel 0-1000 PSIG PNEU MON INLET and cryogenic tank press outlet.

b. Connect test hose (oxidizer-compatible) to test cell panel PNEU HIGH PRESS. OUTLET and 15 Δ P PNEU UPSTRM INLET and 15 Δ P PNEU DNSTRM INLET.

c. On LOW PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 150 ±2 psi. SYSTEM PRESSURIZED lights come on.

d. Apply leak-test compound to all connections on and between LOW PRESSURE and test cell panels. No leakage is allowable.

e. On LOW PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage decreases to zero and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

f. On LN_2 TANK PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 1,200 ±12 psi. SYSTEM PRESSURIZED lights come on.

g. Apply leak-test compound to all connections on and between LN_2 TANK PRESSURE and test cell panels. No leakage is allowable.

h. On LN_2 TANK PRESSURE panel, turn PRESSURE REGULATOR to DECREASE until REG SUPPLY PRESS gage decreases to 900 ±25 psi.

i. On FLOW/Δ P MONITOR panel, turn FLOW MONITOR TEST CELL OUTLET, FLOW MONITOR TEST CELL INLET, and PRESSURE DIFFERENTIAL SHUTOFF valves to OPEN, slowly turn TEST CELL INLET SHUTOFF valve to OPEN. TEST CELL MONITOR PRESSURE gage indicates 900 ±25 psi.

j. On HIGH PRESSURE panel, turn SHUTOFF valve to OPEN and then turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 5,000 (+0, -100) psi.

k. Apply leak-test compound to all connections on and between FLOW/Δ P MONITOR and test cell panels. No leakage is allowable.

l. On LN_2 TANK PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE. The REG SUPPLY PRESS and TEST CELL MONITOR PRESSURE gages decrease to zero. Turn SHUTOFF valves to close.

m. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage decrease to zero and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

n. Disconnect hoses installed in steps a and b and pressure-plug or -cap open ports.

10-30. HIGH-PRESSURE FUEL-COMPATIBLE AND MEDIUM-PRESSURE FUEL-COMPATIBLE SYSTEMS LEAK-TEST.

a. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to OPEN.

b. On HIGH PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 5,000 (+0, -100) psi. SYSTEM PRESSURIZED lights come on.

c. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 900 ±25 psi.

d. Apply leak-test compound to all pneumatic connections on and between SYSTEM SUPPLY, HIGH PRESS and MED PRESS FUEL COMPATIBLE, HYDRAULIC CONTROL, and test cell panels. No leakage is allowable.

e. On HIGH PRESSURE FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage decreases to zero. Turn SHUTOFF valve to CLOSE.

CAUTION

Pneumatic pressure remains trapped between regulator and check valve unless steps f and g are accomplished.

f. On SYSTEM SUPPLY panel, turn to FUEL COMPATIBLE SYST shutoff valve to CLOSE.

g. On MED PRESS FUEL COMPATIBLE panel, turn VENT valve to OPEN. REG SUPPLY PRESS gage decreases to zero and SYSTEM PRESSURIZED lights go off.

h. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE and SHUTOFF and VENT valves to CLOSE.

10-31. PRESSURE/Δ P MONITOR FUEL-COMPATIBLE AND LOW-PRESSURE MONITOR FUEL-COMPATIBLE SYSTEMS LEAK-TEST.

a. Connect test hose (fuel-compatible) between test cell panel PNEU HIGH PRESS. (FUEL COMPATIBLE) outlet and 60 Δ P PNEU UPSTRM INLET and 60 Δ P PNEU DNSTRM INLET.

b. Connect test hose (fuel-compatible) between test cell panel PNEU MED PRESS. (FUEL COMPATIBLE) outlet and 0-1000 PSIG PNEU (FUEL COMPATIBLE) inlet.

c. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to OPEN.

d. On HIGH PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 5,000 (+0, -100) psi. SYSTEM PRESSURIZED lights come on.

e. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 900 ±25 psi. TEST CELL MONITOR PRESSURE gage indicates 900 ±25 psi.

f. Apply leak-test compound to all connections on and between PRESS/Δ P MONITOR FUEL COMPATIBLE and test cell panels. No leakage is allowable.

g. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage and TEST CELL MONITOR PRESSURE gage decrease to zero.

h. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE REG SUPPLY PRESS gage decreases to zero and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

i. Disconnect test hose connected to 0-1000 PSIG PNEU (FUEL COMPATIBLE) and connect it to PNEU LOW PRESS. MON "A" INLET.

j. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 90 ±10 psi. PRESSURE MONITOR "A" gage indicates 90 ±10 psi and SYSTEM PRESSURIZED lights come on.

k. Apply leak-test compound to connections on and between LOW PRESS MONITOR FUEL COMPATIBLE (MONITOR "A" portion) and test cell panels. No leakage is allowable.

l. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage decreases to zero, SYSTEM PRESSURIZED lights go off, and PRESSURE MONITOR "A" gage decreases to zero.

m. Disconnect test hose connected to PNEU LOW PRESS. MON "A" INLET and connect it to PNEU LOW PRESS. MON "B" INLET.

n. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 270 ±30 psi. PRESSURE MONITOR "B" gage indicates 270 ±30 psi and SYSTEM PRESSURIZED lights come on.

o. Apply leak-test compound to connections on and between LOW PRESS MONITOR FUEL COMPATIBLE (MONITOR "B" portion) and test cell panels. No leakage is allowable.

p. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to CLOSE.

q. On MED PRESS FUEL COMPATIBLE panel, turn VENT valve to OPEN. REG SUPPLY PRESS and PRESSURE MONITOR "B" gages decrease to zero and SYSTEM PRESSURIZED lights go off.

r. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE and VENT and SHUTOFF valves to CLOSE.

s. Remove test hose and pressure-plug or -cap open ports.

10-32. PNEUMATIC UTILITY OUTLETS SYSTEM LEAK-TEST.

a. On UTILITY OUTLETS panel, make sure all ports are pressure-capped and torqued.

b. Connect test hose (oxidizer-compatible) between test cell panel PNEU HIGH PRESS. OUTLET and UTILITY 1A inlet.

c. On UTILITY NO. 1 panel, turn all shutoff valves to OPEN.

d. On HIGH PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 5,000 (+0, -100) psi. SYSTEM PRESSURIZED lights come on.

e. Apply leak-test compound to connections on and between UTILITY NO. 1 and test cell panels. No leakage is allowable.

f. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage decreases to zero and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

g. Repeat steps b through f for test cell UTILITY 1B, 1C, and 1D inlets and each test cell inlet on UTILITY NO. 2 and UTILITY NO. 3 panels.

h. Close all valves opened in steps c and g.

i. Disconnect test hoses and pressure-cap or -plug open ports.

10-33. HYDRAULIC SYSTEM LEAK-TEST. See figure 10-2 for hydraulic requirements and figure 10-10 for hydraulic schematic.

a. On HYDRAULIC CONTROL panel, check that switch-lights are indicating and shutoff valves are positioned as follows:

(1) HYDRAULIC SYSTEM BYPASS light indicates OPEN.

(2) HYDRAULIC SYSTEM SUPPLY light indicates CLOSE.

(3) LOW FLOW BYPASS light indicates CLOSE.

(4) TEST CELL SUPPLY "A" light indicates VENT.

(5) TEST CELL SUPPLY "B" light indicates VENT.

(6) FLOW MONITOR SHUTOFF light indicates CLOSE.

(7) HIGH PRESS SHUTOFF valve to CLOSE.

(8) MED PRESS SHUTOFF valve to CLOSE.

b. Make sure a regulated facility hydraulic source pressure line is connected to HYDRAULIC SUPPLY port on hydraulic supply panel.

c. Make sure facility hydraulic source return line is connected through valve to HYDRAULIC RETURN port on hydraulic supply panel. Open needle valve.

d. Connect test hose between test cell panel HYDRAULIC OUTLET "A" in a manifold arrangement) to the following points:

(1) HYDRAULIC UTILITY "A" and HYDRAULIC UTILITY "B".

(2) HYD HI PRESS. MON "A" INLET and HYD HI PRESS. MON "B" INLET.

(3) 0-5,000 PSIG HYD MON INLET.

(4) HYD FLOW MON INLET.

(5) Δ P HYD MON UPSTRM and DNSTRM INLETS.

e. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to OPEN.

f. On HYDRAULIC CONTROL panel, press switch-lights as follows:

(1) HYDRAULIC SYSTEM BYPASS (light indicates CLOSE).

(2) HYDRAULIC SYSTEM SUPPLY (light indicates OPEN).

(3) TEST CELL SUPPLY "A" (light indicates SUPPLY).

(4) LOW FLOW BYPASS (light indicates OPEN).

g. Slowly increase hydraulic source pressure to 5,000 ±50 psig. SUPPLY PRESSURE gage indicates source pressure.

h. Check all lines and connections on and between hydraulic supply panel and HYDRAULIC CONTROL panel for leaks. No leakage is allowable.

i. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 4,200 ±200 psi.

j. On HYDRAULIC CONTROL panel, slowly turn HIGH PRESS SHUTOFF valve to OPEN. PRESS "A" gage indicates 4,200 ±200 psi and SYSTEM PRESSURIZED lights come on. On HYD HIGH PRESS MONITOR panel, PRESSURE MONITOR "A" and PRESSURE MONITOR "B" gages, and on HYD. DIFF. PRESS. MONITOR panel, PRESSURE MONITOR gage, indicate 4,200 ±200 psi.

k. Leak-test cell panel and all lines and connections on and between points connected in step d. No leakage is allowable.

l. On HIGH PRESS FUEL COMPATIBLE panel, slowly turn PRESSURE REGULATOR to DECREASE.

m. On HYDRAULIC CONTROL panel, press switch-lights as follows:

(1) HYDRAULIC SYSTEM SUPPLY (light indicates CLOSE).

(2) HYDRAULIC SYSTEM BYPASS (light indicates OPEN).

(3) TEST CELL SUPPLY "A" (light indicates VENT and PRESS "A" gage decreases to zero).

n. Connect test hose between test cell panel HYDRAULIC OUTLET "B" and HYD MED PRESS. MON "B" INLET.

o. On HYDRAULIC CONTROL panel, press switch-lights as follows:

(1) HYDRAULIC SYSTEM SUPPLY (light indicates OPEN).

(2) HYDRAULIC SYSTEM BYPASS (light indicates CLOSE).

(3) TEST CELL SUPPLY "B" (light indicates SUPPLY).

p. On HIGH PRESS FUEL COMPATIBLE panel, slowly turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 2,000 (+0, -200) psi.

q. Check all lines and connections on and between HYD MED PRESS MONITOR (MONITOR "B" portion) and test cell panels for leaks. No leakage is allowable.

r. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to DECREASE, and on HYDRAULIC CONTROL panel, press switch-lights as follows:

(1) HYDRAULIC SYSTEM SUPPLY (light indicates CLOSE).

(2) HYDRAULIC SYSTEM BYPASS (light indicates OPEN).

(3) TEST CELL SUPPLY "B" (light indicates VENT and PRESS "B" gage decreases to zero).

s. On test cell panel, disconnect test hose at HYD MED PRESS. MON "B" INLET and connect it to HYD MED PRESS. MON "A" INLET. Pressure-cap HYD MED PRESS. MON "B" INLET.

t. Repeat step o and, on HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to DECREASE until REG SUPPLY PRESS gage indicates 1,000 (+0, -100) psi.

u. Leak-test test cell panel and all lines and connections on and between HYD MED PRESS MONITOR (monitor "A"). No leakage is allowable.

NOTE

Prior to decreasing pressure to perform step v, check that other units are not using hydraulic supply pressure.

v. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE and decrease hydraulic source pressure to 300 ±100 psig.

CAUTION

Pneumatic pressure remains trapped between regulator and check valve.

w. On HYDRAULIC CONTROL panel, turn HIGH PRESS SHUTOFF valve to CLOSE.

x. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 60 ±10 psi.

y. On HYDRAULIC CONTROL panel, slowly turn MED PRESS SHUTOFF valve to OPEN.

z. Close needle valve in facility return line; on HYD MED PRESS MONITOR panel, slowly turn PRESSURE MONITOR "A" shutoff valve to OPEN

aa. Leak-test all lines and connections of entire hydraulic return system. No leakage is allowable.

ab. On HYD MED PRESS MONITOR panel, turn PRESSURE MONITOR "A" shutoff valve to CLOSE and open needle valve in facility return line.

ac. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to CLOSE and decrease hydraulic source pressure to zero.

ad. On HYDRAULIC CONTROL panel, press switch-lights as follows:

(1) HYDRAULIC SYSTEM SUPPLY (light indicates CLOSE).

(2) HYDRAULIC SYSTEM BYPASS (light indicates OPEN).

(3) TEST CELL SUPPLY "A" (light indicates VENT).

(4) TEST CELL SUPPLY "B" (light indicates VENT).

(5) LOW FLOW BYPASS (light indicates CLOSE).

ae. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF and VENT valves to OPEN until pressure decays; turn SHUTOFF and VENT valves to CLOSE and PRESSURE REGULATOR to full DECREASE.

af. On HYDRAULIC CONTROL panel, turn MED PRESS SHUTOFF valve to CLOSE and disconnect all test hoses connected in the test cell. Cap all test cell inlets and outlets.

10-34. PNEUMATIC SYSTEM FUNCTION-TEST. See figure 10-2 for pneumatic requirements and figure 10-10 for pneumatic schematic.

a. Make sure all valves and regulators are closed and facility gaseous nitrogen supply pressure is adjusted to 5,000 ±50 psig.

b. On PNEU SOURCE CONTROL panel, slowly turn NITROGEN and HELIUM SOURCE SHUTOFF valves to OPEN. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to OPEN. SYSTEM SUPPLY panel SYS SUPPLY PRESS gage indicates supply pressure.

c. On DIGITAL VOLTMETER panel, turn SAMPLING RATE control fully clockwise and ATTEN control to midposition.

d. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to full INCREASE. REG SUPPLY PRESS gage changes smoothly.

e. Turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage changes smoothly.

f. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full INCREASE. REG SUPPLY PRESS gage changes smoothly.

g. Turn PRESSURE REGULATOR to INCREASE to full DECREASE. REG SUPPLY PRESS gage changes smoothly.

h. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until SYSTEM PRESSURIZED lights come on. Pressure switch actuates at 50 ±25 psig.

i. Turn PRESSURE REGULATOR to INCREASE until relief valve starts to relieve. Relief valve starts to relieve at 1,050 ±50 psig and REG SUPPLY PRESS gage changes smoothly.

j. Turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage changes smoothly and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

k. On LOW PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until SYSTEM PRESSURIZED lights come on. Pressure switch actuates at 50 ±25 psig.

l. Turn PRESSURE REGULATOR to INCREASE until relief valve starts to relieve. Relief valve starts to relieve at 170 ±9 psig and REG SUPPLY PRESS gage changes smoothly.

m. Turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage changes smoothly and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

n. On SYSTEM SUPPLY panel, turn LN_2 PRESS PANEL shutoff valve to OPEN.

o. On LN_2 TANK PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until SYSTEM PRESSURIZED lights come on. Pressure switch actuates at 50 ±25 psig.

p. Turn PRESSURE REGULATOR to INCREASE until relief valve starts to relieve. Relief valve relieves at 1,325 ±66 psig and REG SUPPLY PRESS gage changes smoothly.

q. Turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage changes smoothly and SYSTEM PRESSURIZED lights go off. Turn SHUTOFF valve to CLOSE.

r. Connect oxidizer-clean test hose, between test cell panel 0-1000 PSIG PNEU MON INLET and PNEU HIGH PRESS OUTLET.

s. On FLOW/Δ P MONITOR panel, turn SHUTOFF valve to OPEN.

t. On HIGH PRESSURE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until SYSTEM PRESSURIZED lights come on and FLOW/Δ P MONITOR panel relief valve starts to relieve. Pressure switch actuates at 50 ±25 psig and relief valve relieves at 1,050 ±50 psig.

u. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE. SYSTEM PRESSURIZED lights go off and TEST CELL MONITOR PRESSURE gage decreases to zero.

v. On test cell panel, disconnect test hose at 0-1000 PSIG PNEU MON INLET, connect it to PNEU FLOW MON INLET, then remove pressure cap from PNEU FLOW OUTLET. Cap 0-1000 PSIG PNEU MON INLET.

w. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 200 ±20 psi. SYSTEM PRESSURIZED lights come on.

x. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light; light 5 comes on. Press same switch-light; light 5 goes off.

y. Press TEST SELECT 1 and 4 switch-lights, lights 1 and 4 come on. If ATTEN control on digital voltmeter requires readjustment, refer to digital voltmeter Operating and Service Manual, Model DY2401B (Hewlett Packard Co).

z. On FLOW/Δ P MONITOR panel, slowly turn FLOW MONITOR TEST CELL OUTLET SHUTOFF valve to OPEN then to CLOSE. Digital voltmeter indicates from 0-1,000 cps and back to zero.

aa. On HIGH PRESSURE panel, turn PRESSURE REGULATOR to full DECREASE and SHUTOFF valve to CLOSE.

ab. Disconnect test hose installed in step v and pressure-cap open ports.

ac. Connect test hose (fuel-compatible) between test cell panel PNEU HIGH PRESS. (FUEL COMPATIBLE) outlet and 0-1000 PSIG PNEU (FUEL COMPATIBLE) inlet.

ad. On HIGH PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until SYSTEM PRESSURIZED lights come on and PRESS/Δ P MONITOR FUEL COMPATIBLE panel relief valve starts to relieve. Pressure switch actuates at 50 ±25 psig and relief valve relieves at 1,050 ±50 psig.

ae. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE and SHUTOFF valve to CLOSE. SYSTEM PRESSURIZED lights go off and TEST CELL MONITOR PRESSURE gage decreases to zero.

af. Disconnect test hose installed in step ac and pressure-cap open ports.

ag. Connect test hose (fuel-compatible) between test cell panel PNEU MED PRESS. (FUEL COMPATIBLE) outlet and PNEU LOW PRESS. MON "A" INLET.

ah. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until LOW PRESS MONITOR FUEL COMPATIBLE panel (monitor A) relief valve starts to relieve. Relief valve relieves at 105 ±6 psig.

ai. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to DECREASE and SHUTOFF valve to CLOSE.

aj. Disconnect test hose from PNEU LOW PRESS. MON "A" INLET and connect it to PNEU LOW PRESS. MON "B" INLET. Pressure-cap PNEU LOW PRESS. MON "A" INLET.

ak. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF valve to OPEN and PRESSURE REGULATOR to INCREASE until LOW PRESS MONITOR FUEL COMPATIBLE panel (monitor "B") relief valve starts to relieve. Relief valve relieves at 315 ±16 psig.

al. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to CLOSE.

am. On MED PRESS FUEL COMPATIBLE panel, turn VENT valve to OPEN until REG SUPPLY PRESS gage indicates zero; turn VENT and SHUTOFF valves to CLOSE and PRESSURE REGULATOR to full DECREASE.

an. Disconnect test hose installed in step aj and pressure-cap open ports.

ao. On PNEU SOURCE CONTROL panel, turn HELIUM SOURCE SHUTOFF valve to CLOSE.

ap. Slowly increase facility gaseous nitrogen pressure at 5,000 PSIG FACILITY HELIUM inlet until relief valve behind LN_2 TANK PRESSURE panel starts to relieve. Relief valve relieves at 5,500 ±300 psig.

aq. Decrease facility gaseous nitrogen pressure at 5,000 PSIG FACILITY HELIUM inlet to zero.

ar. On SYSTEM SUPPLY panel, turn LN_2 PRESS PANEL shutoff valve to CLOSE.

as. Slowly increase facility gaseous nitrogen pressure at 5,000 PSIG FACILITY NITROGEN inlet until relief valve behind PNEU SOURCE CONTROL panel starts to relieve. Relief valve relieves at 5,500 ±300 psig.

at. Decrease gaseous nitrogen pressure at 5,000 PSIG FACILITY NITROGEN inlet to 5,000 ±50 psig.

10-35. HYDRAULIC SYSTEM FUNCTION-TEST. See figure 10-2 for hydraulic requirements and figure 10-10 for hydraulic schematic.

a. Make sure facility hydraulic source pressure and return lines are connected to SUPPLY and RETURN ports on hydraulic supply panel and a needle valve is installed in return line.

b. Connect a 1/2-inch test hose between test cell panel HYD UTILITY OUTLET "C" and HYD MED PRESS. MON "A" INLET.

c. Open needle valve in hydraulic return line and slowly increase facility hydraulic source pressure to 300 ±100 psig.

d. On SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to OPEN.

e. On HYDRAULIC CONTROL panel, turn MED PRESS SHUTOFF valve to OPEN and press switch-lights as follows:

(1) HYDRAULIC SYSTEM BYPASS (light indicates CLOSE).

(2) LOW FLOW BYPASS (light indicates OPEN).

(3) HYDRAULIC SYSTEM SUPPLY (light indicates OPEN and SUPPLY PRESSURE gage indicates source pressure).

f. On MED PRESS FUEL COMPATIBLE panel, slowly turn PRESSURE REGULATOR to INCREASE until SYSTEM PRESSURIZED lights come on. Pressure switch actuates at 50 ±25 psig.

g. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE and increase facility hydraulic source pressure to 5,000 ±50 psig.

h. On HYDRAULIC CONTROL panel, turn MED PRESS SHUTOFF valve to CLOSE and HIGH PRESS SHUTOFF valve to OPEN.

i. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until relief valve behind HYD MED PRESS MONITOR panel (monitor A) starts to relieve. Relief valve relieves at 1,050 ±50 psig.

j. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to full DECREASE. REG SUPPLY PRESS gage decreases to zero.

k. On HYD MED PRESS MONITOR panel, turn hydraulic return shutoff valve (monitor A) to OPEN. PRESSURE MONITOR "A" gage decreases to zero and SYSTEM PRESSURIZED lights go off. Close shutoff valve.

l. On test cell panel, disconnect test hose from HYD MED PRESS. MON "A" INLET and connect it to HYD MED PRESS. MON "B" INLET. Cap inlet.

m. On HIGH PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until relief valve behind HYD MED PRESS MONITOR panel (monitor B) starts to relieve. Relief valve relieves at 2,100 ±100 psig. SYSTEM PRESSURIZED lights come on.

n. Repeat step j and, on HYD MED PRESS MONITOR panel, turn hydraulic return shutoff valve (monitor B) to OPEN. PRESSURE MONITOR "B" gage decreases to zero and SYSTEM PRESSURIZED lights go off. Close shutoff valve.

o. Disconnect test hose from test cell panel HYD MED PRESS. MON "B" INLET and connect it to HYD FLOW MON INLET. Cap inlet.

p. On HYDRAULIC CONTROL panel, turn HIGH PRESS SHUTOFF valve to CLOSE and MED PRESS SHUTOFF valve to OPEN; press FLOW MONITOR SHUTOFF switch-light. OPEN light comes on and CLOSE light goes off.

q. On ELECTRICAL CONTROL panel, press TEST SELECT 5 switch-light; light 5 comes on. Press same switch-light; light 5 goes off.

r. Press TEST SELECT 1, 4, and 6 switch-lights; lights 1, 4, and 6 come on. If ATTEN control on digital voltmeter requires readjustment, refer to digital voltmeter Operating and Service Manual, Model DY2401B (Hewlett Packard Co).

s. Decrease facility hydraulic source pressure to 300 ±100 psig and close needle valve in return line.

t. On MED PRESS FUEL COMPATIBLE panel, turn PRESSURE REGULATOR to INCREASE until REG SUPPLY PRESS gage indicates 100 ±10 psi. SYSTEM PRESSURIZED lights come on.

u. Slowly open and close needle valve in return line until digital voltmeter indicates from 0-500 cps and back to zero.

v. On HYDRAULIC CONTROL panel, press LOW FLOW BYPASS switch-light. CLOSE light comes on and OPEN light goes off.

w. Repeat step u and press LOW FLOW BYPASS switch-light. OPEN light comes on and CLOSE light goes off.

x. On ELECTRICAL CONTROL panel, press TEST SELECT 1, 4, and 6 switch-lights; lights 1, 4, and 6 go off.

y. ON SYSTEM SUPPLY panel, turn TO FUEL COMPATIBLE SYST shutoff valve to CLOSE.

z. On MED PRESS FUEL COMPATIBLE panel, turn SHUTOFF and VENT valves to open until REG SUPPLY PRESS gage decreases to zero. Turn SHUTOFF and VENT valves to CLOSE and PRESSURE REGULATOR to full DECREASE.

aa. On HYDRAULIC CONTROL panel, press FLOW MONITOR SHUTOFF switch-light. CLOSE light comes on and OPEN light goes off.

ab. Increase facility hydraulic supply pressure at HYDRAULIC SUPPLY until relief valve behind HYDRAULIC CONTROL panel starts to relieve. Relief valve relieves at 5,500 ±250 psig.

ac. Decrease facility hydraulic and gaseous nitrogen supply pressures to zero.

ad. On SYSTEM SUPPLY panel, slowly turn VENT valve to OPEN until SYST SUPPLY PRESS gage indicates zero.

ae. On PNEU SOURCE CONTROL panel, turn NITROGEN SOURCE SHUTOFF valve to CLOSE.

af. On HYDRAULIC CONTROL panel, press HYDRAULIC SYSTEM BYPASS and HYDRAULIC SYSTEM SUPPLY switch-lights. Lights indicate OPEN and CLOSE respectively.

ag. On DIGITAL VOLTMETER panel, turn power ON switch to off (down position) and on ELECTRICAL CONTROL panel, press POWER switch-light. All lights go off.

ah. On POWER DISTRIBUTION panel, pull out circuit breakers CB1 and CB2 and turn electrical DC power supply switch off.

ai. Disconnect test equipment and cap or protect all connections.

aj. Pull out ELECTRICAL CONTROL panel; remove patch-panel and store in storage drawer.

ak. Push in ELECTRICAL CONTROL panel and secure with screws.

10-36. CHECKOUT OF COMPONENTS ADAPTER SET.

10-37. PROOF-TEST OF HOSES. The hydraulic and pneumatic hoses supplied in the components adapter set must be proof-tested at six-month intervals and any time misuse or damage is suspected. Proof pressure is applied for two minutes, five successive times, without evidence of permanent deformation. Proof-test hydraulic flexible hoses with hydraulic fluid (MIL-H-5606). Proof-test pneumatic-fuel, pneumatic-oxidizer, and cryogenic flexible hoses with gaseous nitrogen (MIL-P-27401). Figure 10-11 lists the hoses and proof-test requirements.

10-37A. LEAK TEST OF HOSES. Leak-test hydraulic flexible hoses with hydraulic fluid (MIL-H-5606). Leak-test pneumatic-fuel, pneumatic-oxidizer, and cryogenic flexible hoses (figure 10-11) with gaseous nitrogen (MIL-P-27401), helium (MIL-P-27407), or helium (Bureau of Mines, Grade A).

a. Apply 1,000 ±20 psig to flexible hose for 15 minutes. Allowable leakage rates are as follows:

(1) Hydraulic test media: zero leakage

(2) Gaseous nitrogen test media: 50 cc per 12 inches of hose

(3) Helium test media: 140 cc per 12 inches of hose

b. Remove pressure from flexible hoses.

10-38. RELIEF VALVE FUNCTION-TEST. The relief valves supplied in the components adapter set must be function-tested at 12-month intervals and any time misuse or damage is suspected. Perform procedures outlined in paragraph 10-83.

10-39. CALIBRATOR FUNCTION-TEST. The calibrator function-test is performed at six-month intervals, when the piston operates erratically, and any time misuse or damage is suspected. Perform applicable portion of procedures outlined in paragraph 10-104.

a through v. (Deleted)

Part Number	Operating Pressure (psig)	Proof Pressure (psig)	Type of Service
19-9014946-13	5,000	10,000 ±200	Hydraulic
19-9014946-14	5,000	10,000 ±200	Hydraulic
19-9014946-15	5,000	10,000 ±200	Hydraulic
19-9014946-16	3,000	6,000 ±120	Hydraulic
19-9026522-1	5,000	10,000 (+200, -0)	Pneumatic-Fuel
19-9026522-2	5,000	10,000 (+200, -0)	Pneumatic-Fuel
19-9026522-3	5,000	10,000 (+200, -0)	Pneumatic-Fuel
19-9026522-4	5,000	10,000 (+200, -0)	Pneumatic-Oxidizer
19-9026522-5	5,000	10,000 (+200, -0)	Pneumatic-Oxidizer
19-9026522-6	5,000	10,000 (+200, -0)	Pneumatic-Oxidizer
19-9026525-1	2,000	4,000 (+80, -0)	Cryogenic
19-9026525-2	2,000	4,000 (+80, -0)	Cryogenic

Figure 10-11. Proof-Test Requirements for Hoses

10-40. REMOVING.

10-41. No disassembly of components adapter set is necessary. Disassemble the components test console, as required, to accomplish necessary repair or replacement. See figure 10-13 for index and part numbers.

10-42. INSTALLING.

10-43. All parts of the components test console must meet the cleanness requirements outlined in section I prior to installing. See figure 10-13 for index and part numbers. The following steps include the special instructions. The lubricant used for dynamic O-rings is FS1281 grease (Dow Corning Corp); for O-rings, seals, st: tight threads, and sliding surfaces, use lubricant grease RB0140-012 (Rocketdyne). For tapered threads, use thread sealant tape RB0140-002 (Rocketdyne). Refer to section I for lubricant application.

a. Torque threaded fasteners as follows:

NOTE

When tightening fasteners from the head side, torque must be within 10 percent of the high side of the specified torque range.

Part Number	Size/ Thread	Torque (in-lb)
AN507C1032-	10-32	8-10
AN515C6-	6-32	1.5-2
AN515C8-	8-32	5-6
AN520C10-	10-32	8-10
AN520C416	1/4-28	20-26
AN520UB416-	1/4-28	20-26

Figure 10-12 deleted.

b. Torque plug AN814 as follows:

Tube OD (Inches	Torque (in-lb)
1/4	40-65
3/8	80-120
1/2	150-200
3/4	300-500
1	450-600
1-1/4	600-720

c. Torque union nut 450N- of tubing as follows:

Tube OD (Inches)	Torque (ft-lb)
1/4	10-12
3/8	22-28
1/2	36-40
3/4	40-45
1	100-116

d. Install spacer 9026464 between terminal board 9026465 and chassis of electrical control panel.

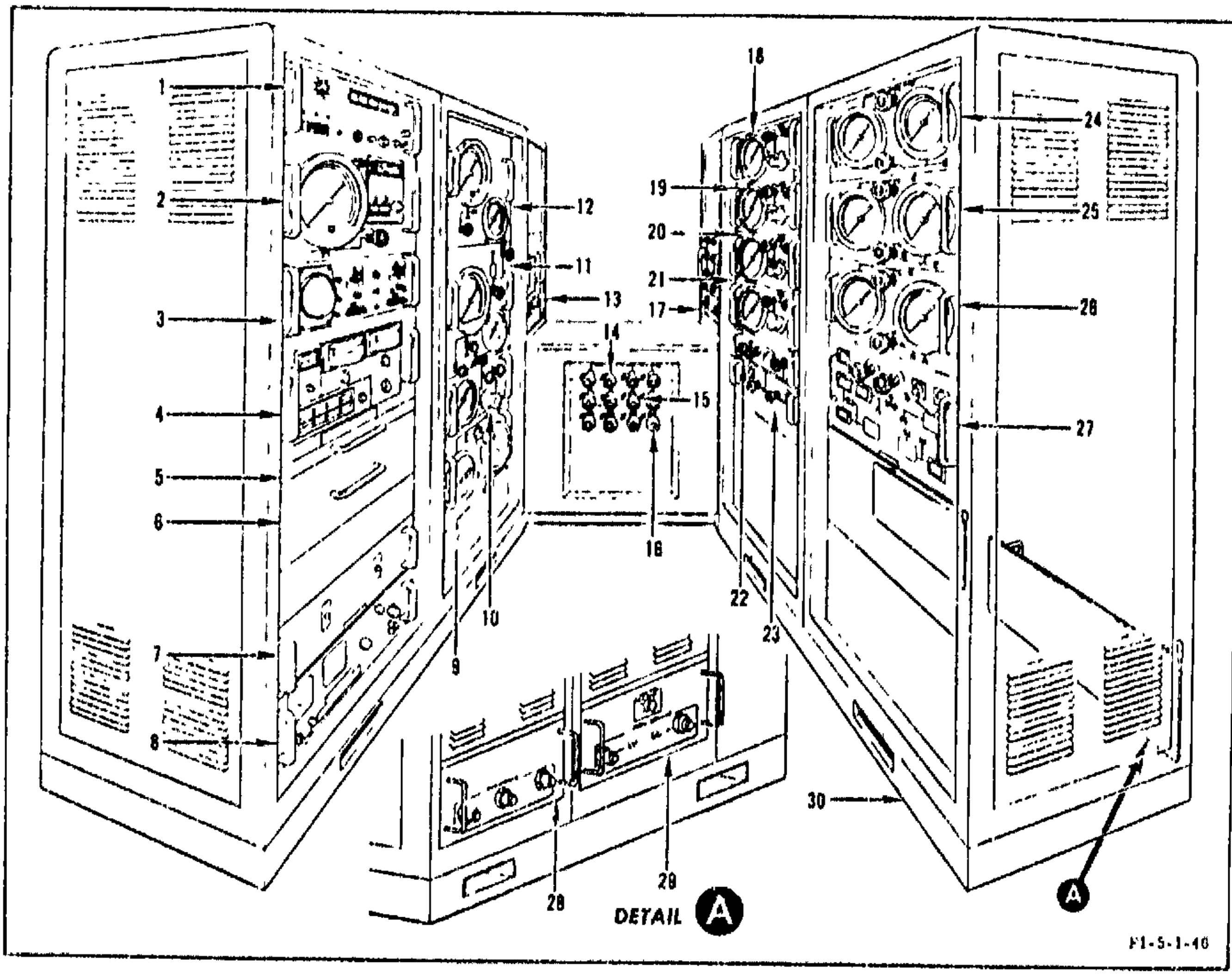


Figure 10-13. Disassembly of Components Test Console (Sheet 1 of 25)

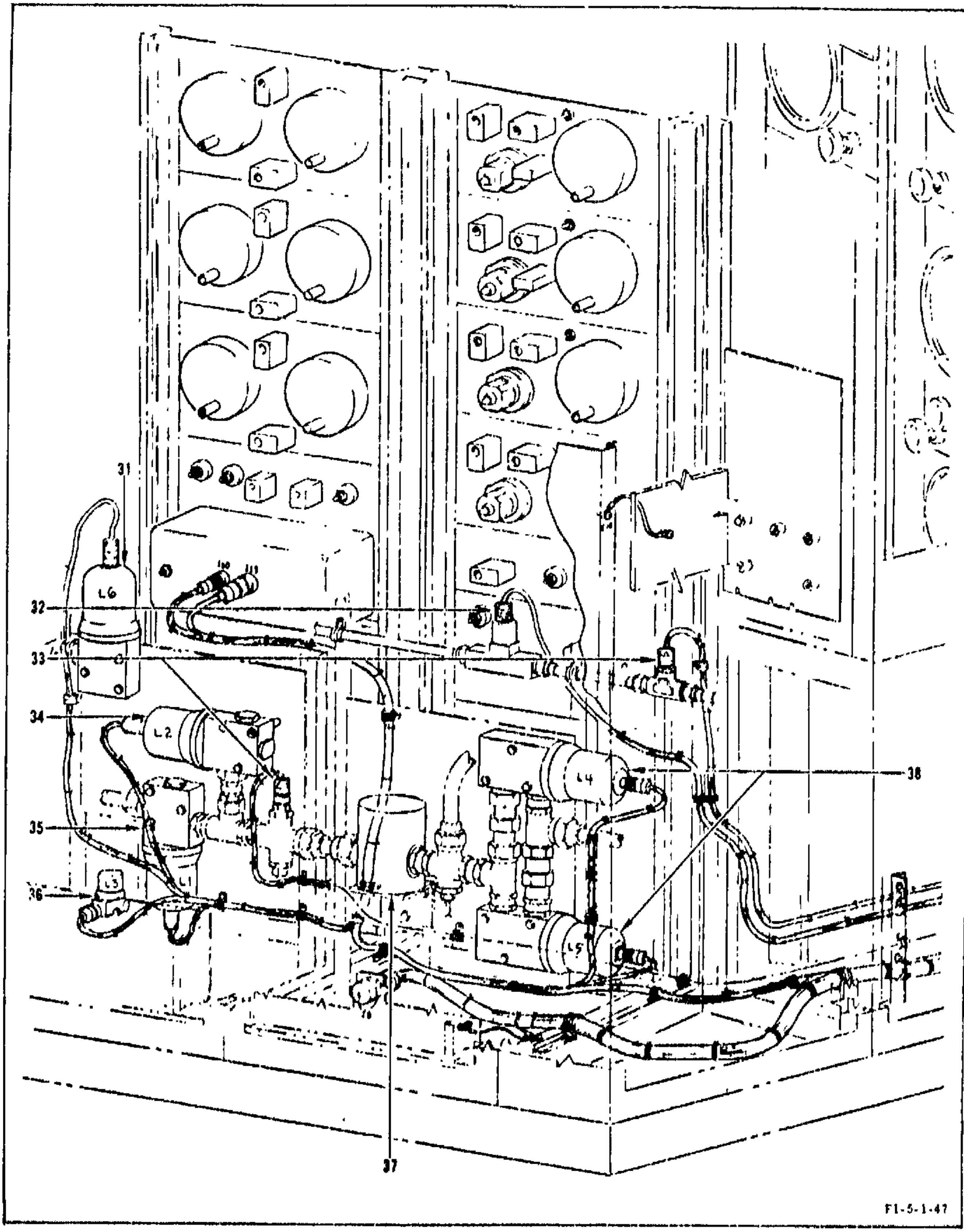


Figure 10-13. Disassembly of Components Test Console (Sheet 2 of 25)

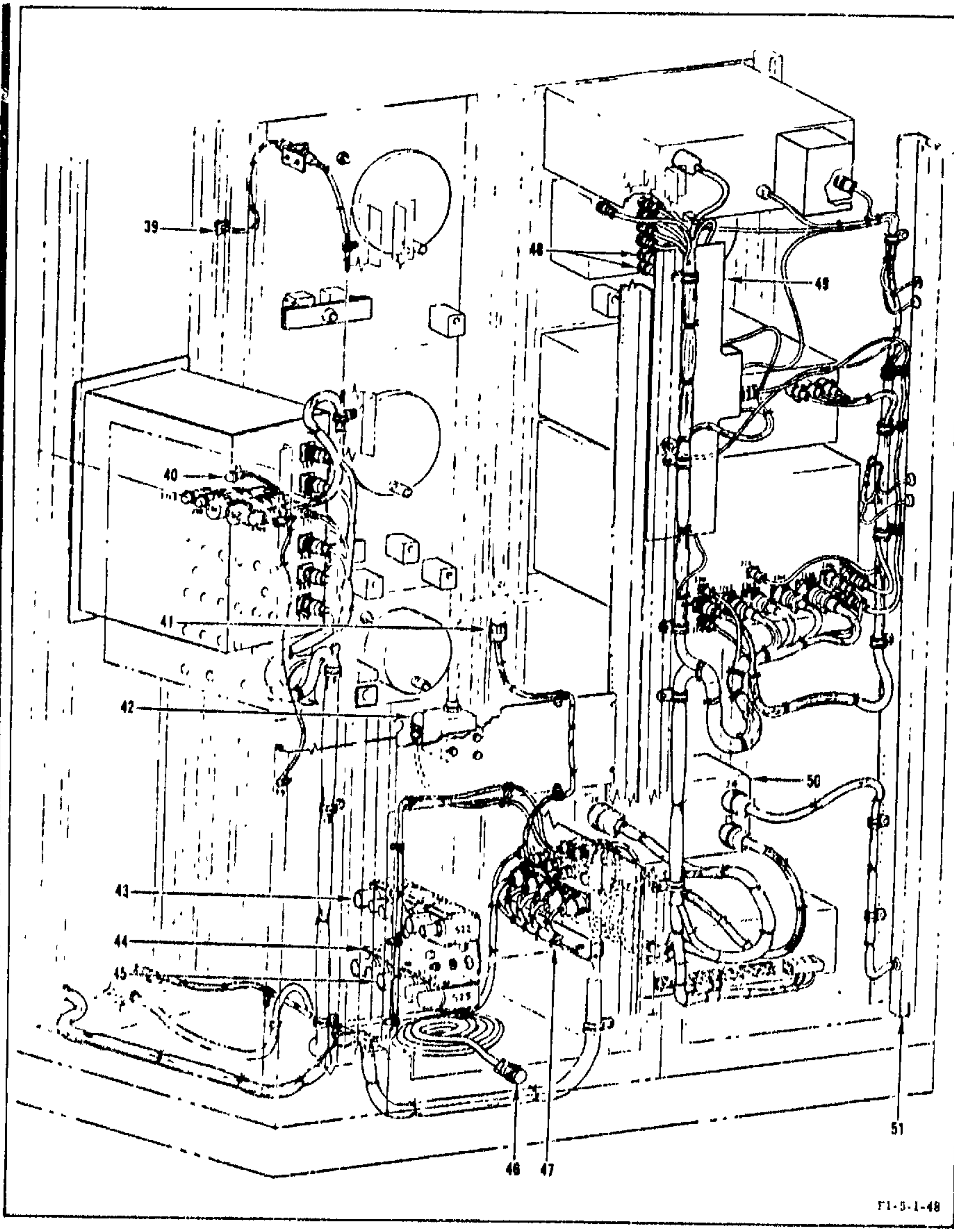


Figure 10-13. Disassembly of Components Test Console (Sheet 3 of 26)

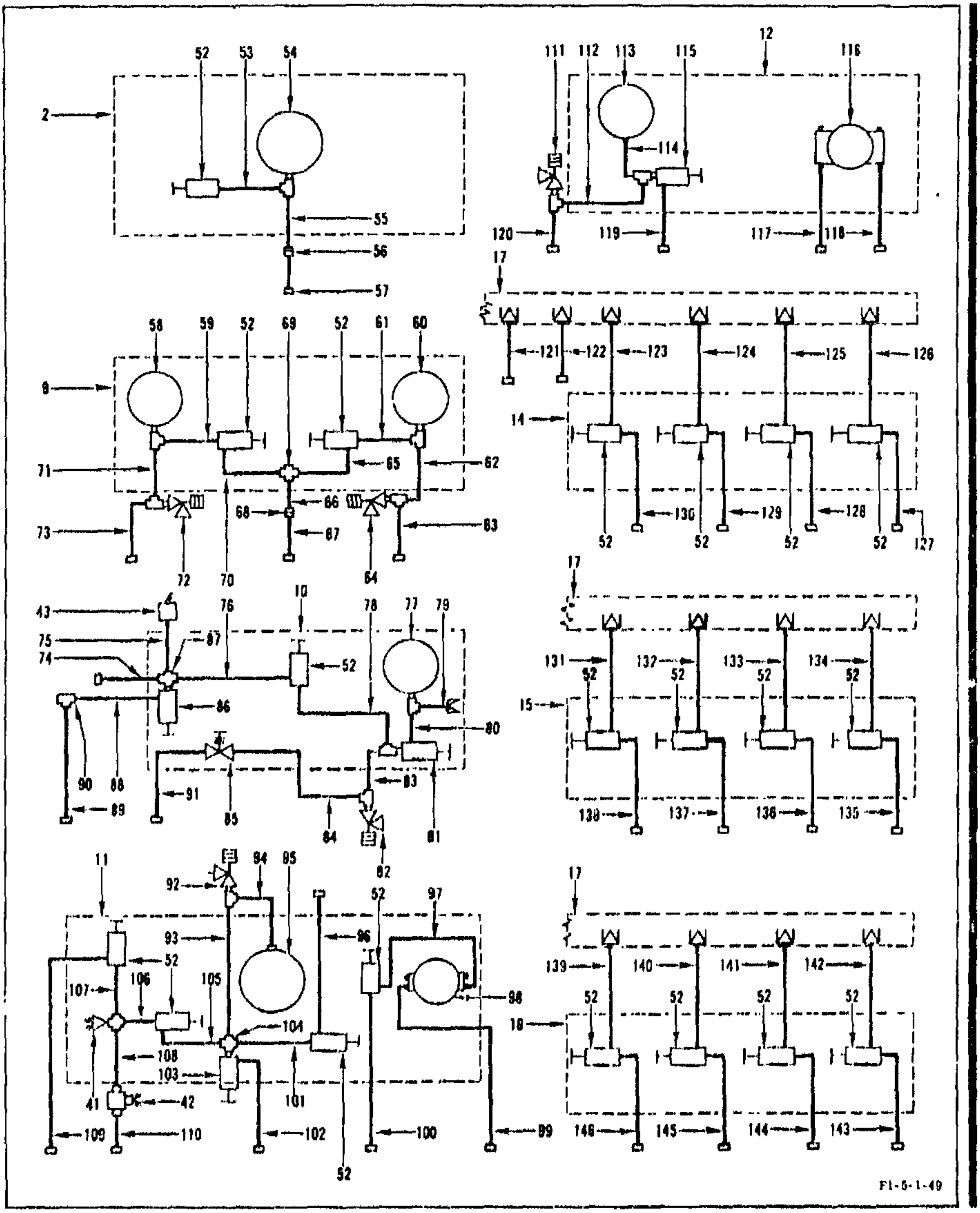


Figure 10-13. Disassembly of Components Test Console (Sheet 4 of 25)

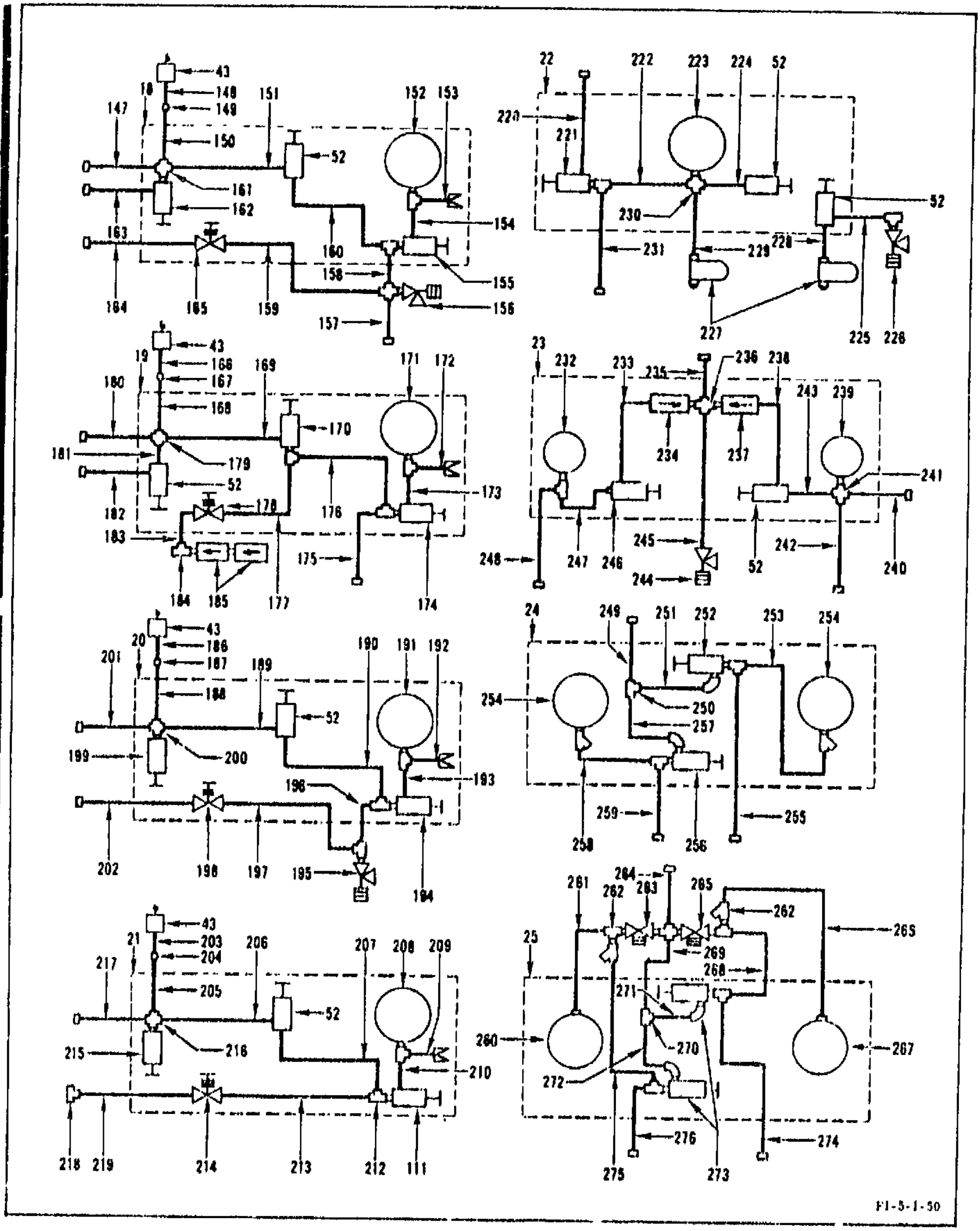


Figure 10-13. Disassembly of Components Test Console (Sheet 5 of 25)

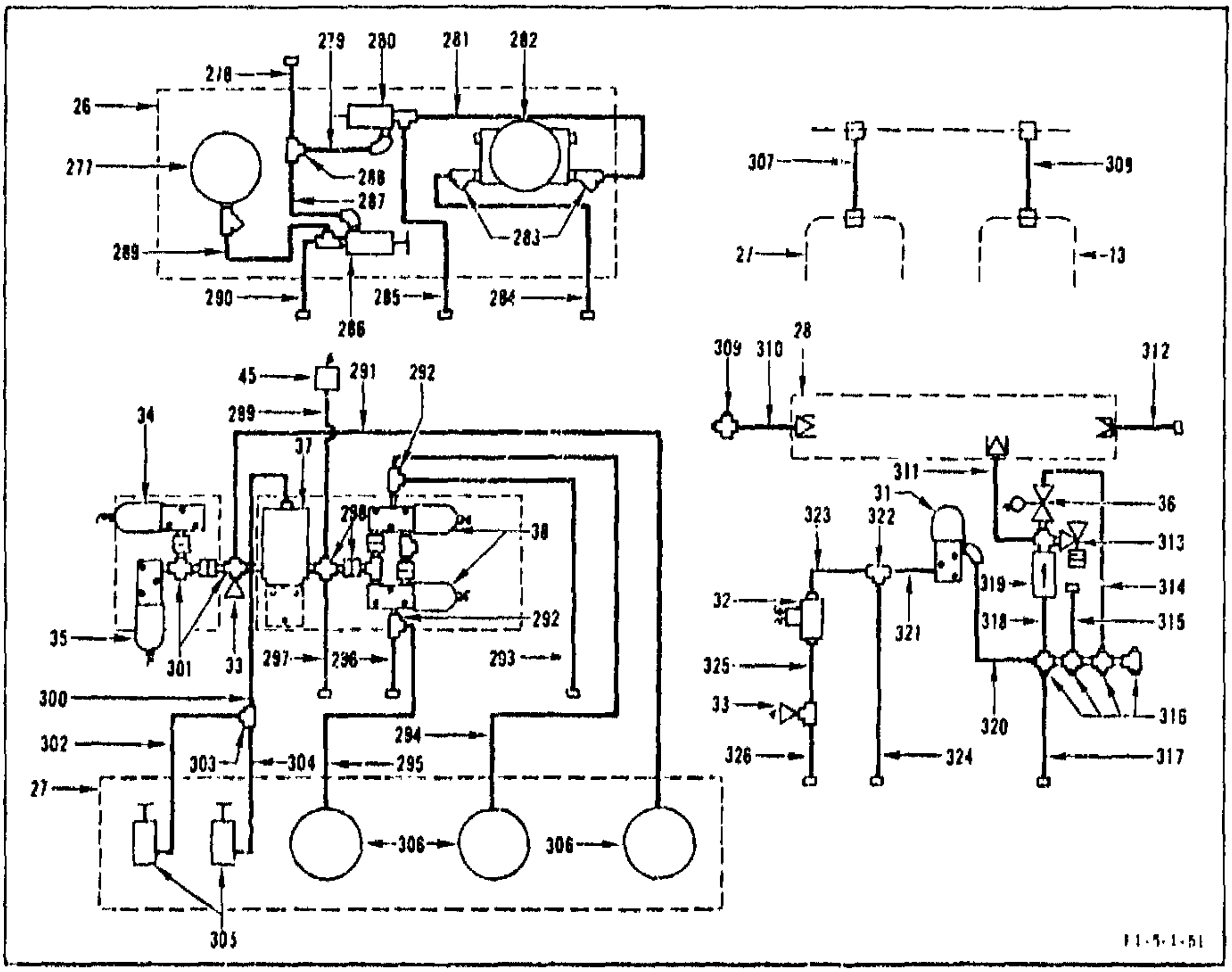


Figure 10-13. Disassembly of Components Test Console (Sheet 6 of 25)

Index No.	Part No.	Description
1	2401B-M30M40M31	Voltmeter panel (F-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
2	9026030	Pressure temperature monitor panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	4104-5	Temperature indicator (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
	1035-13	Handle (F-3)
	AN507C1032R10	Screw (F-3)
3	122AR,06,07	Oscilloscope panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
4	9026460-11	Electrical control panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	21-X-X-7-G	Switch-light (F-3)
	211-36492	Cover plate (F-3)
	19-9017500-121	Lens (F-3)
	JAWL1W	Milliammeter (F-3)
	AN515C6R7	Screw (F-3)
	MS15795-805	Washer (F-3)
	JAWV0D1	Voltmeter (F-3)
	AN515C6R7	Screw (F-3)
	MS15795-805	Washer (F-3)
	1035-13	Handle (F-?)
	AN507C1032R10	Screw (F-3)
	211-CB-12A	Switch (F-3)
	MS25166-1	Knob (F-3)
	AN507C632R6	Screw (F-3)
	CU3521	Variable resistor (F-3)
	MS25166-1	Knob (F-3)
	2PB42	Switch (F-3)
	22-X-T-7-G	Switch-light (F-3)
	242-36492	Cover plate (F-3)
	19-9017500-105	Lens (F-3)
	19-9017500-107	Lens (F-3)
	19-9017500-109	Lens (F-3)
	19-9017500-111	Lens (F-3)
4 (cont)	19-9017500-113	Lens (F-3)
	19-9017500-115	Lens (F-3)
	19-9017500-117	Lens (F-3)
	19-9017500-119	Lens (F-3)
	1102A	Terminal board (F-3)
	AN515C4R10	Screw (F-3)
	NAS43DD-0-16	Spacer (F-3)
	LD153-0011-0006	Washer (F-3)
	NAS673A06W	Nut (F-3)
	RP300A	Patch-panel (F-3)
	PPB300	Receptacle frame (F-3)
	K3.06	Patch-cord (F-3)
	K3.09	Patch-cord (F-3)
	K3.15	Patch-cord (F-3)
	K4.09	Patch-cord (F-3)
	K5.09	Patch-cord (F-3)
	3088-12	Resistor patch-cord (F-3)
	3088-13	Resistor patch-cord (F-3)
	3088-14	Resistor patch-cord (F-3)
	3088-15	Resistor patch-cord (F-3)
	3088-16	Resistor patch-cord (F-3)
	3088-17	Diode patch-panel (F-3)
	3088-18	Connector patch-cord (F-3)
	3088-19	Connector patch-cord (F-3)
	AN520C10R8	Screw (F-3)
	LD153-0010-0008	Washer (F-3)
	NAS679C3W	Nut (F-3)
	9026465	Terminal board (F-3)
	AN515C6R7	Screw (F-3)
	LD153-0011-0008	Washer (F-3)
	NAS679A06W	Nut (F-3)
	9026464	Spacer (F-3)
	M-28.0-1.5	Power supply (F-1)
	MS15795-810	Washer (F-3)
	MS35338-82	Locknut (F-3)
	AN335-4	Nut (F-3)
	MS25271-D1	Relay (F-3)
	MS15795	Washer (F-3)
	NAS679C06W	Nut (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 7 of 25)

Index No.	Part No.	Description	Index No.	Part No.	Description
4 (cont)	MDA942-4	Bridge rectifier (F-3)	10 (cont)	MS35337-81	Lockwasher (F-3)
				1035-13	Handle (F-3)
	HG2B-1013	Relay (F-3)		AN507C1032R10	Screw (F-3)
	MIL-R-93	Resistor (F-3)		RD265-1001-0004	Cap (F-3)
	MIL-C-19978-2	Capacitor (F-3)		MS24393C4	Union (F-3)
5	WS-1/8-19-20-F	Writing shelf (F-3)		AN924-4C	Nut (F-3)
6	DA-8-3/4-20	Storage drawer (F-3)		MS15795-816	Washer (F-3)
7	9026450	Power distribution panel (X-3)	11	9026010	Flow/Δ P monitor panel (F-1)
	AN520C10R8	Screw (F-3)		AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)		MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)		MS35337-81	Lockwasher (F-3)
	1034-13	Handle (F-3)		1035-13	Handle (F-3)
	AN507C1032R10	Screw (F-3)		AN507C1032R10	Screw (F-3)
	9022621	Box (F-3)	12	9026020	Pressure/Δ P monitor panel (F-1)
	MP-703H	Circuit breaker (F-3)		AN520C10R8	Screw (F-3)
	MP-750H	Circuit breaker (F-3)		MS15795-808	Washer (F-3)
				MS35337-81	Lockwasher (F-3)
	RD417-4001-1010	Terminal board (F-3)		1035-13	Handle (F-3)
				AN507C1032R10	Screw (F-3)
	NAS1060-4-2	Bus (F-3)	13	9026130	Electrical utility panel (F-1)
	NAS1063C10-1	Strip (F-3)			
	MS25227-3	Strip (F-3)		AN520C10R8	Screw (F-3)
	AN515C4R6	Screw (F-3)		MS15795-808	Washer (F-3)
	NAS679C04W	Nut (F-3)		MS35337-81	Lockwasher (F-3)
	398-10	Terminal cover (F-3)		1035-13	Handle (F-3)
				AN507C1032R10	Screw (F-3)
	NAS1060-4-3	Bus (F-3)		9026136	Plate (F-3)
	6042H51	Relay (F-3)		AN515C8R10	Screw (F-3)
	AN520C10R10	Screw (F-3)		MS15795-807	Washer (F-3)
	LD153-0011-0012	Washer (F-3)		AN520UB10-14	Screw (F-3)
	NAS679C3W	Nut (F-3)		MS35335-74	Washer (F-3)
	MS3102R24-2S	Connector (F-3)		AN961-10	Washer (F-3)
	MS3102R24-7S	Connector (F-3)		MS20341-10B	Nut (F-3)
	MS3102R24-22S	Connector (F-3)		9017714	Terminal (F-3)
	MS3102R28-12S	Connector (F-3)		AN520C10R14	Screw (F-3)
8	TVR040-15	Power supply (F-2)		LD153-0010-0007	Washer (F-3)
	AN520C10R8	Screw (F-3)		NAS43DD3-24	Spacer (F-3)
	MS15795-808	Washer (F-3)		NAS679C3W	Nut (F-3)
	MS35337-81	Lockwasher (F-3)		AN807-16C	Adapter (F-3)
9	9026000	Low-pressure monitor panel (F-1)		AN924-16C	Nut (F-3)
				LD153-0010-0031	Washer (F-3)
	AN520C10R8	Screw (F-3)		AN515C8R12	Screw (F-3)
	MS15795-808	Washer (F-3)		MS15795-807	Washer (F-3)
	MS35337-81	Lockwasher (F-3)		PT02E22-55S	Connector (F-3)
	1035-13	Handle (F-3)		AN515C4R7	Screw (F-3)
	AN507C1032R10	Screw (F-3)		MS15795-804	Washer (F-3)
10	9025930	LN_2 tank pressure panel (F-1)		NAS679C04W	Nut (F-3)
				PT02E24-61P	Connector (F-3)
	AN520C10R8	Screw (F-3)		AN515C6R8	Screw (F-3)
	MS15795-808	Washer (F-3)		MS15795-805	Washer (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 8 of 25)

Index No.	Part No.	Description
13 (cont)	NAS679C06W	Nut (F-3)
	PT02E16-23S	Connector (F-3)
	AN515C4R7	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
	PT02E22-21S	Connector (F-3)
	AN515C4R7	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
	PT02E22-21P	Connector (F-3)
	AN515C4R7	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
	MS3102R20-7P	Connector (F-3)
	AN515C4R8	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
	9026139	Box (F-3)
	AN507C1032R12	Screw (F-3)
	MS25036-8	Terminal (F-3)
	320306	Terminal (F-3)
	33156	Terminal (F-3)
	PT03E22-55S	Connector (F-3)
	AN515C4R10	Screw (F-3)
	MS15795	Washer (F-3)
	NAS679C04W	Nut (F-3)
	10-101960-22-5	Cap (F-3)
	PT02E22-21S	Connector (F-3)
	AN515C4R10	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
	10-101960-22-5	Cap (F-3)
	257	Binding post (F-3)
	5272	Receptacle (F-3)
	AN515C8R8	Screw (F-3)
	MS15795-807	Washer (F-3)
	NAS679C08W	Nut (F-3)
14	9026040	Utility No. 1 panel (X-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
15	9026050	Utility No. 2 panel (X-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
16	9026060	Utility No. 3 panel (X-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
17	9026430	Utility outlet panel (X-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	1035-13	Handle (F-3)
	AN507C1032R10	Screw (F-3)
18	9025950	Medium-pressure fuel compatible panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	RD265-1001-0004	Cap (F-3)
	MS24393C4	Union (F-3)
	AN924-4C	Nut (F-3)
	MS15795-816	Washer (F-3)
19	9025940	High-pressure fuel compatible panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	RD265-1001-0004	Cap (F-3)
	MS24393C4	Union (F-3)
	AN924-4C	Nut (F-3)
	MS15795-816	Washer (F-3)
20	9022470-11	Low-pressure panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	RD265-1001-0004	Cap (F-3)
	MS24393C4	Union (F-3)
	AN924-4C	Nut (F-3)
	MS15795-816	Washer (F-3)
21	9025920	High-pressure panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	RD265-1001-0004	Cap (F-3)
	MS24393C4	Union (F-3)
	AN924-4C	Nut (F-3)
	MS15795-816	Washer (F-3)
22	9025910	System supply panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 9 of 25)

Index No.	Part No.	Description
23	9026080	Pneumatic source control panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
24	9025990	Hydraulic high-pressure monitor panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
25	9025980	Hydraulic medium-pressure monitor panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
26	9025970	Hydraulic differential-pressure monitor panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
27	9025960	Hydraulic control panel (F-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
	21-X-W-1-G	Switch (F-3)
	211-36492	Cover plate (F-3)
	19-9017500-123	Legend (F-3)
	221-36492	Cover plate (F-3)
	19-9017500-125	Legend (F-3)
	19-904807	Terminal board (F-3)
	9026464	Spacer (F-3)
	AN515C6R12	Screw (F-3)
	LD153-0011-0008	Washer (F-3)
	NAS679C06W	Nut (F-3)
	JAN-IN645M	Diode (F-3)
	RW67V761	Resistor (F-3)
	9025965	Support (F-3)
	AN507C1032R10	Screw (F-3)
	LD153-0010-0007	Washer (F-3)
	NAS679C3W	Nut (F-3)
	9026136	Plate (F-3)
	AN515C8R8	Screw (F-3)
	LD153-0011-0010	Washer (F-3)
	AN520C10R8	Screw (F-3)
	LD153-0011-0011	Washer (F-3)
	9025966	Plate (F-3)
27 (cont)	AN520C10R10	Screw F-3)
	LD153-0011-0011	Washer (F-3)
	AN807-16C	Adapter (F-3)
	LD153-0010-0031	Washer (F-3)
	AN924-16C	Nut (F-3)
	MS3102R24-28S	Connector (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	AN520UB10R14	Screw (F-3)
	MS35335-74	Washer (F-3)
	MS20341-10B	Nut (F-3)
	MS25036-8	Terminal (F-3)
	AN961-10	Washer (F-3)
	MS3102R20-7P	Connector (F-3)
	AN515C4R10	Screw (F-3)
	MS15795-804	Washer (F-3)
	NAS679C04W	Nut (F-3)
	9025963	Cover (F-3)
	AN507C1032R20	Screw (F-3)
28	9026070	Hydraulic panel (X-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
29	9206090	Pneumatic source electrical panel (X-1)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS35337-81	Lockwasher (F-3)
30	D1749	Console (F-2)
31	19-9026504	Solenoid valve (F-2)
	AN893-17C	Bushing (F-3)
	4597-8-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	MS28778-16	Packing (F-3)
	AN832-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	MS28777-8	Ring (F-3)
	AN939C8	Elbow (F-3)
	NAS1004-60A	Bolt (F-3)
	NAS42DD8-96	Spacer (F-3)
	RD153-5004-0004	Washer (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
32	19-9026509	Flowmeter (F-2)
	486T-8-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 10 of 25)

Index No.	Part No.	Description
33	19-9026515	Transducer (F-2)
	AN938C8	Tee (F-3)
	459T-8-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
34	19-9026502	Solenoid valve (F-2)
35	19-9026504	Solenoid valve (F-2)
	59T-4-30055-LOX	Threaded piece (F-3)
36	19-9026505	Solenoid valve (F-2)
	MS28778-6	Packing (F-3)
	459T-6-300	Threaded piece (F-3)
	AN832-6C	Union (F-3)
	MS28777-6	Ring (F-3)
	AN6289C6	Nut (F-3)
	AN893-14C	Bushing (F-3)
	MS28778-16	Packing (F-3)
37	19-9026507	Dome regulator (F-2)
	9026121	Bracket (F-3)
	NAS1004-6A	Bolt (F-3)
	RD153-5004-0004	Washer (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
38	19-9026503	Solenoid valve (F-2)
	AN938C16	Tee (F-3)
	AN832-16C	Union (F-3)
	AN6289C16	Nut (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
	59T-4-300SS	Threaded piece (F-3)
	59R-4-300SS	Tailpiece (F-3)
	59N-4-300SS	Nut (F-3)
	MS28775-214	Packing (F-3)
39	851310-843	Lamp (F-3)
40	101-3830-973	Lamp (F-3)
41	19-9021035	Transducer (F-2)
	AN937C8	Cross (F-3)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	459T-8-300	Threaded piece (F-3)
41 (cont)	MS28778-4	Packing (F-3)
	MS28778-8	Packing (F-3)
42	19-9026508	Flowmeter (F-2)
	486T-8-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
43	19-9021939	Pressure switch (S20, S21, S22, S23, S25) (F-2)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
44	9026110	Bracket (X-3)
	AN520C416R10	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
45	19-9026513	Pressure switch (S24) (F-2)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
46	BB52749	Cable (F-3)
47	RD417-4001-0020	Terminal board (F-3)
48	3088-9	Resistor plug (RTD5, RTD6) (F-3)
49	Z1303	Electronics flowmeter (F-2)
	AN520C10R24	Screw (F-3)
	MS15795-808	Washer (F-3)
	MS43DD3-64	Spacer (F-3)
50	9025925	Box (X-3)
	AN520C10R14	Screw (F-3)
	MS15795-808	Washer (F-3)
51	9022640	Outlet (X-3)
	AN520C416B8	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
52	19-9022606-1	Valve (F-1)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
53	9022513	Tube (F-3)
	MS28778-2	Packing (F-3)
54	19-9021928-3	Gage (F-1)
	AN507C428R14	Screw (F-3)
	NAS679C4W	Nut (F-3)
	459R-4-300	Tailpiece (F-3)
	459N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	440-4-300	Tee (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 11 of 25)

Index No.	Part No.	Description
54 (cont)	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
55	9026034	Tube (F-3)
	MS28778-2	Packing (F-3)
56	489T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
57	9026032	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
58	19-9021929-7	Gage (F-1)
	AN520C416R16	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	459R-4-300	Tailpiece (F-3)
	459N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	440-4-300	Tee (F-3)
	MS28778-2	Packing (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
59	9026455	Tube (F-3)
	MS28778-2	Packing (F-3)
60	19-9021929-6	Gage (F-1)
	AN520C416R16	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	459-4-300	Tailpiece (F-3)
	459N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	440-4-300	Tee (F-3)
	MS28778-2	Packing (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
61	9026006	Tube (F-3)
	MS28778-2	Packing (F-3)
62	9026003	Tube (F-3)
	MS28778-2	Packing (F-3)
63	9026005	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
64	19-9021937-7	Relief valve (F-1)
	AN893-16C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28778-12	Packing (F-3)
	AN832-8C	Union (F-3)
	AN893-3C	Bushing (F-3)
	AN6289C8	Nut (F-3)
	MS28777-8	Nut (F-3)
	AN938C8	Tee (F-3)
	MS28778-8	Packing (F-3)
65	9026007	Tube (F-3)
	MS28778-2	Packing (F-3)
66	9026009	Tube (F-3)
	MS28778-2	Packing (F-3)
67	9026048	Tube (F-3)
	MS28778-2	Packing (F-3)
68	489T-4-300	Threaded piece (F-3)
69	443-4-300	Cross (F-3)
70	9026454	Tube (F-3)
	MS28778-2	Packing (F-3)
71	9026456	Tube (F-3)
	MS28778-2	Packing (F-3)
72	19-9021937-12	Relief valve (F-1)
	AN893-16C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28778-12	Packing (F-3)
	AN6289C8	Nut (F-3)
	MS28777-8	Ring (F-3)
	AN938C8	Tee (F-3)
	AN832-8C	Union (F-3)
	AN893-3C	Bushing (F-3)
	MS28778-8	Packing (F-3)
73	9026466	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
74	9025935	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 12 of 25)

Index No.	Part No.	Description
75	9025933	Tube (F-3)
	MS28778-2	Packing (F-3)
76	9022459	Tube (F-3)
	MS28778-2	Packing (F-3)
77	19-9021929-4	Gage (F-1)
	AN520C416R16	Screw (F-3)
	MS15795-810	Washer (F-3)
	NAS679C4W	Nut (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	440-4-300	Tee (F-3)
78	9026041	Tube (F-3)
	MS28778-2	Packing (F-3)
79	9022465	Tube (F-3)
	MS28778-2	Packing (F-3)
80	9025922	Tube (F-3)
	MS28778-2	Packing (F-3)
81	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	459T-4-300	Threaded piece (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	440-4-300	Tee (F-3)
82	19-9021937-2	Relief valve (F-1)
	AN893-3C	Bushing (F-3)
	MS28778-8	Packing (F-3)
	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	AN938C4	Tee (F-3)
	459T-4-300	Threaded piece (F-3)
83	9025932	Tube (F-3)
	MS28778-2	Packing (F-3)
84	9025936	Tube (F-3)
	MS28778-2	Packing (F-3)
85	19-9021932-2	Regulator (F-2)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
86	19-9022606-1	Valve (F-1)
	AN894C8-4	Bushing (F-3)
86 (cont)	459T-8-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	MS28778-4	Packing (F-3)
87	443-4-300	Cross (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
88	9026532	Tube (F-3)
	MS28778-5	Packing (F-3)
89	9026529	Tube (F-3)
	MS28778-5	Packing (F-3)
90	AN938C8	Tee (F-3)
	459T-8-300	Threaded piece (F-3)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3
	MS28778-4	Packing (F-3)
91	9026095	Tube (F-3)
	MS28778-2	Packing (F-3)
92	19-9021937-6	Relief valve (F-1)
	AN32-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	AN938C8	Tee (F-3)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	MS28778-4	Packing (F-3)
93	9026484	Tube (F-3)
	MS28778-2	Packing (F-3)
94	9026015	Tube (F-3)
	MS28778-2	Packing (F-3)
95	19-9021928-1	Gage (F-1)
	AN507C428R14	Screw (F-3)
	NAS679C4W	Nut (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
96	9025928	Tube (F-3)
	MS28778-2	Packing (F-3)
97	9026478	Tube (F-3)
	MS28778-2	Packing (F-3)
98	19-9021934-6	Gage (F-1)
	LD153-0010-0009	Washer (F-3)
	459T-4-300	Threaded piece (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 13 of 25)

Index No.	Part No.	Description
98	AN814-4C	Plug (F-3)
(cont)	MS28778-4	Packing (F-3)
99	9026473	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
100	9026477	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
101	9026479	Tube (F-3)
	MS28778-4	Packing (F-3)
102	9026476	Tube (F-3)
	487T-4-300	Packing (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
103	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	MS28778-2	Packing (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	459T-4-300	Threaded piece (F-3)
104	443-4-300	Cross (F-3)
105	9026483	Tube (F-3)
	MS28778-2	Packing (F-3)
106	9026019	Tube (F-3)
	MS28778-2	Packing (F-3)
107	9026017	Tube (F-3)
	MS28778-5	Packing (F-3)
108	9026016	Tube (F-3)
	MS28778-5	Packing (F-3)
109	9026018	Tube (F-3)
	MS28778-5	Packing (F-3)
	487T-8-300	Threaded piece (F-3)
	489N-8-300	Nut (F-3)
	AN814-8C	Plug (F-3)
	MS28778-8	Packing (F-3)
110	9026012	Tube (F-3)
	MS28778-5	Packing (F-3)
	487T-8-300	Threaded piece (F-3)
110	489N-8-300	Nut (F-3)
(cont)	AN814-8C	Plug (F-3)
	MS28778-8	Packing (F-3)
111	19-9021927-6	Relief valve (F-1)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	AN832-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	AN938C8	Tee (F-3)
	MS28778-8	Packing (F-3)
	MS26777-8	Ring (F-3)
112	9026028	Tube (F-3)
	MS28778-2	Packing (F-3)
113	19-9021928-1	Gage (F-2)
	AN507C428R14	Screw (F-3)
	NAS679C4W	Nut (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
114	9022485	Tube (F-3)
	MS28778-2	Packing (F-3)
115	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
	AN938C4	Tee (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
116	19-9021934-5	Gage (F-2)
	LD153-0010-0009	Washer (F-3)
	459T-4-300	Threaded piece (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
117	9026023	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
118	9026025	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 14 of 25)

Index No.	Part No.	Description
119	9026537	Tube (F-3)
	MS28778-2	Packing (F-3)
120	9026027	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
121	9026072	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
122	9026073	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
123	9026487	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
124	9026486	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
125	9026038	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
126	9026044	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
127	9026489	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
128	9026047	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
129	9026049	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
130	9026045	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
131	9026014	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
132	9026066	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
133	9026076	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F 3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 15 of 25)

Index No.	Part No.	Description
134	9026057	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
135	9026053	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
136	9026054	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
137	9026055	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
138	9026056	Tube (F-3)
	MS28778-2	Packing (F-3)
	487-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
139	9026035	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
140	9026492	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
141	9025904	Tube (F-3)
	MS28778-2	Packing (F-3)
141 (cont)	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
142	9025979	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
143	9026064	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
144	9026062	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
145	9026496	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
146	9026497	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
147	9025954	Tube (F-3)
	MS28778-2	Packing (F-3)
	487T-4-300	Threaded piece (F-3)
	489N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)
148	9026039	Tube (F-3)
	MS28778-2	Packing (F-3)
149	489T-4-300	Threaded piece (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 16 of 25)

Index No.	Part No.	Description
150	9025953	Tube (F-3)
	MS28778-2	Packing (F-3)
151	9022459	Tube (F-3)
	MS28778-2	Packing (F-3)
152	19-9021929-8	Gage (F-1)
	AN520C416R14	Screw (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	440-4-300	Tee (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
153	9022456	Tube (F-3)
	MS28778-2	Packing (F-3)
154	9022577	Tube (F-3)
	MS28778-2	Packing (F-3)
155	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	440-4-300	Tee (F-3)
156	19-9021937-6	Relief valve (F-1)
	AN832-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	AN937C8	Cross (F-3)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	MS28778-4	Packing (F-3)
157	9026068	Tube (F-3)
	MS28778-2	Packing (F-3)
158	9025976	Tube (F-3)
	MS28778-2	Packing (F-3)
159	9025956	Tube (F-3)
	MS28778-2	Packing (F-3)
160	9026043	Tube (F-3)
	MS28778-2	Packing (F-3)
161	443-4-300	Cross (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
161 (cont)	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	459T-4-300	Threaded piece (F-3)
162	19-9022606-1	Valve (F-1)
163	9025955	Tube (F-3)
	MS28778-2	Packing (F-3)
164	9025949	Tube (F-3)
	MS28778-2	Packing (F-3)
165	19-9021932-2	Regulator (F-2)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
166	9026037	Tube (F-3)
	MS28778-2	Packing (F-3)
167	489T-4-300	Threaded piece (F-3)
168	9025946	Tube (F-3)
	MS28778-2	Packing (F-3)
169	9022468	Tube (F-3)
	MS28778-5	Packing (F-3)
170	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	AN832-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	AN938C8	Tee (F-3)
	459T-8-300	Threaded piece (F-3)
	459T-4-300	Threaded piece (F-3)
	AN893-3C	Bushing (F-3)
	MS28778-8	Packing (F-3)
	MS28778-4	Packing (F-3)
	MS28777-8	Ring (F-3)
171	19-9021929-10	Gage (F-2)
	AN520C416R14	Screw (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	440-4-300	Tee (F-3)
172	9022465	Tube (F-3)
	MS28778-2	Packing (F-3)
173	9022473	Tube (F-3)
	MS28778-2	Packing (F-3)
174	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 17 of 25)

Index No.	Part No.	Description
174 (cont)	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	440-4-300	Tee (F-3)
175	9026069	Tube (F-3)
	MS28778-2	Packing (F-3)
176	9025942	Tube (F-3)
	MS28778-2	Packing (F-3)
177	9022462	Tube (F-3)
	MS28778-5	Packing (F-3)
178	19-9021932-5	Regulator (F-2)
	459T-6-300	Threaded piece (F-3)
	459T-8-300	Threaded piece (F-3)
	MS28778-6	Packing (F-3)
	MS28778-8	Packing (F-3)
179	AN937C8	Cross (F-3)
	AN893-3C	Bushing (F-3)
	459T-8-300	Threaded piece (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	MS28778-4	Packing (F-3)
180	9026097	Tube (F-3)
	MS28778-5	Packing (F-3)
	487T-8-300	Threaded piece (F-3)
	489N-8-300	Nut (F-3)
	AN814-8C	Plug (F-3)
	MS28778-8	Packing (F-3)
181	9026527	Tube (F-3)
	MS28778-2	Packing (F-3)
182	9025945	Tube (F-3)
	MS28778-2	Packing (F-3)
183	9026099	Tube (F-3)
	MS28778-4	Packing (F-3)
184	AN938C6	Tee (F-3)
	459T-6-300	Threaded piece (F-3)
	AN893-2C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-6	Packing (F-3)
	MS28778-4	Packing (F-3)
185	19-9026514	Check valve (F-3)
	AN815-8C	Union (F-3)
	AN893-12C	Bushing (F-3)
	459T-6-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	MS28778-6	Packing (F-3)
	AN815-6C	Union (F-3)
186	9026036	Tube (F-3)
	MS28778-2	Packing (F-3)
187	489T-4-300	Threaded piece (F-3)
188	9025947	Tube (F-3)
	MS28778-2	Packing (F-3)
189	9022459	Tube (F-3)
	MS28778-2	Packing (F-3)
190	9026042	Tube (F-3)
	MS28778-2	Packing (F-3)
191	19-9021929-1	Gage (F-1)
	AN520C416R16	Screw (F-3)
	NAS679C4W	Nut (F-3)
	MS15795-810	Washer (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	440-4-300	Tee (F-3)
192	9026046	Tube (F-3)
	MS28778-2	Packing (F-3)
193	9022464	Tube (F-3)
	MS28778-2	Packing (F-3)
194	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	440-4-300	Tee (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
195	19-9021937-1	Relief valve (F-1)
	AN893-16C	Bushing (F-3)
	AN832-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 18 of 25)

Index No.	Part No.	Description	Index No.	Part No.	Description
195	MS28778-12	Packing (F-3)	209	9022465	Tube(F-3)
(cont)	MS28778-8	Packing (F-3)		MS28778-2	Packing (F-3)
	MS28777-8	Ring (F-3)	210	9022455	Tube (F-3)
	MS28778-4	Packing (F-3)		MS28778-2	Packing (F-3)
196	9025938	Tube (F-3)	211	19-9022606-1	Valve (F-1)
	MS28778-2	Packing (F-3)		MS15795-820	Washer (F-3)
197	9025957	Tube (F-3)		459R-4-300	Tailpiece (F-3)
	MS28778-2	Packing (F-3)		450N-4-300	Nut (F-3)
198	19-9021932-1	Regulator (F-2)		AN6289C4	Nut (F-3)
	459T-4-300	Threaded piece (F-3)		459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)		MS28778-4	Packing (F-3)
199	19-9022606-1	Valve (F-1)		MS28777-4	Ring (F-3)
	MS15795-820	Washer (F-3)		MS28778-2	Packing (F-3)
200	443-4-300	Cross (F-3)	212	440-4-300	Tee (F-3)
	459R-4-300	Tailpiece (F-3)	213	9022453	Tube (F-3)
	450N-4-300	Nut (F-3)		MS28778-2	Packing (F-3)
	AN6289C4	Nut (F-3)	214	19-9021932-3	Regulator (F-2)
	MS28778-4	Packing (F-3)		459T-4-300	Threaded piece (F-3)
	MS28777-4	Ring (F-3)			
	MS28778-2	Packing (F-3)		MS28778-4	Packing (F-3)
201	9025939	Tube (F-3)	215	19-9022606-1	Valve (F-1)
	MS28778-2	Packing (F-3)		MS15795-820	Washer (F-3)
	487T-4-300	Threaded piece (F-3)	216	443-4-300	Cross (F-3)
				459R-4-300	Tailpiece (F-3)
	489N-4-300	Nut (F-3)		450N-4-300	Nut (F-3)
	AN814-4C	Plug (F-3)		AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)		MS28778-4	Packing (F-3)
202	9025937	Tube (F-3)		MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)		MS28778-2	Packing (F-3)
203	9026051	Tube (F-3)	217	9025926	Tube (F-3)
	MS28778-2	Packing (F-3)		MS28778-2	Packing (F-3)
204	489T-4-300	Threaded piece (F-3)	218	440-4-300	Tee (F-3)
			219	9022353	Tube (F-3)
205	9025927	Tube (F-3)		MS28778-2	Packing (F-3)
	MS28778-2	Packing (F-3)	220	9025918	Tube (F-3)
206	9022459	Tube (F-3)		MS28778-4	Packing (F-3)
	MS28778-2	Packing (F-3)	221	19-9022606-1	Valve (F-1)
207	9022458	Tube (F-3)		MS15795-820	Washer (F-3)
	MS28778-2	Packing (F-3)		AN894C6-4	Bushing (F-3)
208	19-9021929-5	Gage (F-1)		MS28778-4	Packing (F-3)
	AN520C416R16	Screw (F-3)		AN832-6C	Union (F-3)
	MS15795-810	Washer (F-3)		AN6289C6	Nut (F-3)
	NAS679C4W	Nut (F-3)		MS28777-6	Ring (F-3)
	459R-4-300	Tailpiece (F-3)		459T-6-300	Threaded piece (F-3)
	450N-4-300	Nut (F-3)			
	AN6289C4	Nut (F-3)		459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)			
	MS28777-4	Ring (F-3)		MS28778-6	Packing (F-3)
	MS28778-2	Packing (F-3)		AN938C6	Tee (F-3)
	440-4-300	Tee (F-3)		AN893-2C	Bushing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 19 of 25)

Index No.	Part No.	Description
222	9025917	Tube (F-3)
	MS28778-4	Packing (F-3)
223	19-9017879-2	Gage (F-2)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
224	9026093	Tube (F-3)
	MS28778-2	Packing (F-3)
225	9026088	Tube (F-3)
	MS28778-2	Packing (F-3)
226	19-9021937-5	Relief valve (F-1)
	440-4-300	Tee (F-3)
	459R-4-300	Tailpiece (F-3)
	450N-4-300	Nut (F-3)
	AN6289C4	Nut (F-3)
	AN893-4C	Bushing (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	MS28778-2	Packing (F-3)
	MS28778-12	Packing (F-3)
227	19-9017923-2	Filter (F-3)
	AN894C6-4	Bushing (F-3)
	MS28778-4	Packing (F-3)
	MS28778-6	Packing (F-3)
	459T-6-300	Threaded piece (F-3)
	459T-4-300	Threaded piece (F-3)
228	9026092	Tube (F-3)
	MS28778-2	Packing (F-3)
229	9025916	Tube (F-3)
	MS28778-4	Packing (F-3)
230	AN937C6	Cross (F-3)
	459T-6-300	Threaded piece (F-3)
	MS28778-6	Packing (F-3)
	AN893-2C	Bushing (F-3)
	MS28778-4	Packing (F-3)
	459T-4-300	Threaded piece (F-3)
231	9026094	Tube (F-3)
	MS28778-2	Packing (F-3)
232	19-9017879-2	Gage (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	AN832-4C	Union (F-3)
	AN6289C4	Nut (F-3)
232 (cont)	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	AN893-2C	Bushing (F-3)
	MS28778-6	Packing (F-3)
	459T-6-300	Threaded piece (F-3)
	AN938C6	Tee (F-3)
233	9025914	Tube (F-3)
	MS28778-4	Packing (F-3)
234	19-9026514	Check valve (F-3)
235	9025915	Tube (F-3)
	MS28778-4	Packing (F-3)
236	AN937C8	Cross (F-3)
	AN815-8C	Union (F-3)
	AN894C8-4	Bushing (F-3)
	AN893-12C	Bushing (F-3)
	MS28778-8	Packing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	459T-6-300	Threaded piece (F-3)
	MS28778-6	Packing (F-3)
237	19-9017897-1	Check valve (F-3)
238	9026087	Tube (F-3)
	MS28778-2	Packing (F-3)
239	19-9017879-2	Gage (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	459R-4-300	Tailpiece (F-3)
	AN6289C4	Nut (F-3)
	MS28778-4	Packing (F-3)
	MS28777-4	Ring (F-3)
	450N-4-300	Nut (F-3)
	MS28778-2	Packing (F-3)
240	9026089	Tube (F-3)
	MS28778-2	Packing (F-3)
241	443-4-300	Cross (F-3)
242	9022422	Tube (F-3)
	MS28778-2	Packing (F-3)
243	9022432	Tube (F-3)
	MS28778-2	Packing (F-3)
244	19-9021937-5	Relief valve (F-3)
	AN893-13C	Bushing (F-3)
	MS28778-12	Packing (F-3)
	459T-6-300	Threaded piece (F-3)
	MS28778-6	Packing (F-3)
245	9026086	Tube (F-3)
	MS28778-4	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 20 of 25)

Index No.	Part No.	Description	Index No.	Part No.	Description
246	19-9022606-1	Valve (F-1)	256	19-9026501	Valve (F-2)
	MS15795-820	Washer (F-3)		AN893-16C	Bushing (F-3)
	AN894C6-4	Bushing (F-3)		AN832-8C	Union (F-3)
	MS28778-4	Packing (F-3)		AN6289C8	Nut (F-3)
	459T-6-300	Threaded piece (F-3)		AN939C8	Elbow (F-3)
	MS28778-6	Packing (F-3)		AN938C8	Tee (F-3)
247	9025913	Tube (F-3)		459T-8-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)		AN893-3C	Bushing (F-3)
248	9025912	Tube (F-3)		459T-8-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)		MS28778-4	Packing (F-3)
249	9025878	Tube (F-3)		MS28778-8	Packing (F-3)
	MS28775-018	Packing (F-3)		MS28777-8	Ring (F-3)
250	AN938C12	Tee (F-3)		MS28778-12	Packing (F-3)
	459T-12-300	Threaded piece (F-3)	257	9025876	Tube (F-3)
	MS28778-12	Packing (F-3)		MS28778-5	Packing (F-3)
	AN893-16C	Bushing (F-3)	258	9025995	Tube (F-3)
	459T-8-300	Threaded piece (F-3)		MS28778-2	Packing (F-3)
	MS28778-8	Packing (F-3)	259	9025998	Tube (F-3)
251	9025877	Tube (F-3)		MS28778-5	Packing (F-3)
	MS28775-018	Packing (F-3)		487T-8-300	Threaded piece (F-3)
252	19-9026501	Valve (F-2)		489N-8-300	Nut (F-3)
	AN832-12C	Union (F-3)		AN814-8C	Plug (F-3)
	MS28778-12	Packing (F-3)		MS28778-8	Packing (F-3)
	MS28777-12	Ring (F-3)	260	19-9026516-1	Gage (F-2)
	AN6289C12	Nut (F-3)		AN520C416R16	Screw (F-3)
	AN938C12	Tee (F-3)		MS15795-810	Washer (F-3)
	AN939C12	Elbow (F-3)		NAS679C4W	Nut (F-3)
	459T-12-300	Threaded piece (F-3)		459T-4-300	Threaded piece (F-3)
	AN893-4C	Bushing (F-3)		MS28778-4	Packing (F-3)
	459T-4-300	Threaded piece (F-3)	261	9026534	Tube (F-3)
	MS28778-4	Packing (F-3)		MS28778-2	Packing (F-3)
253	9025994	Tube (F-3)	262	19-9026510	Snubber (F-3)
	MS28778-2	Packing (F-3)		459T-4-300	Threaded piece (F-3)
254	19-9026516-3	Gage (F-2)		MS28778-4	Packing (F-3)
	AN520C416R16	Screw (F-3)		AN938C4	Tee (F-3)
	MS15795-810	Washer (F-3)	263	19-9026512-1	Relief valve (F-2)
	NAS679C4W	Nut (F-3)		MS28778-4	Packing (F-3)
	459T-4-300	Threaded piece (F-3)		AN832-4C	Union (F-3)
	MS28778-4	Packing (F-3)		AN6289C4	Nut (F-3)
	19-9026510	Snubber (F-3)		MS28777-4	Ring (F-3)
255	9025993	Tube (F-3)		AN893-3C	Bushing (F-3)
	MS28775-018	Packing (F-3)		AN937C8	Cross (F-3)
	487T-12-300	Threaded piece (F-3)		MS28778-8	Packing (F-3)
	489N-12-300	Nut (F-3)		459T-8-300	Threaded piece (F-3)
	AN814-12C	Plug (F-3)		AN894C8-4	Bushing (F-3)
	MS28778-12	Packing (F-3)	264	9025986	Tube (F-3)
				MS28778-5	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 21 of 25)

Index No.	Part No.	Description	Index No.	Part No.	Description
265	19-9026512-2	Relief valve (F-2)	277	19-9026516-3	Gage (F-2)
266	9026533	Tube (F-3)		AN520C416R16	Screw (F-3)
	MS28778-2	Packing (F-3)		MS15795-810	Washer (F-3)
267	19-9026516-2	Gage (F-3)		NAS679C4W	Nut (F-3)
	AN520C416R16	Screw (F-3)		19-9026510	Snubber (F-3)
	MS15795-810	Washer (F-3)		459T-4-300	Threaded piece (F-3)
	NAS679C4W	Nut (F-3)		MS28778-4	Packing (F-3)
	459T-4-300	Threaded piece (F-3)	278	9025978	Tube (F-3)
	MS28778-2	Packing (F-3)		MS28775-018	Packing (F-3)
268	9026452	Tube (F-3)	279	9026059	Tube (F-3)
	MS28778-2	Packing (F-3)		MS28775-018	Packing (F-3)
269	9025983	Tube (F-3)	280	19-9026501	Valve (F-2)
	MS28778-5	Packing (F-3)		459T-12-300	Threaded piece (F-3)
270	440-8-300	Tee (F-3)		AN832-12C	Union (F-3)
271	9025987	Tube (F-3)		MS28778-12	Packing (F-3)
	MS28778-5	Packing (F-3)		AN6289C12	Nut (F-3)
272	9025985	Tube (F-3)		AN939C12	Elbow (F-3)
	MS28778-5	Packing (F-3)		MS28777-12	Ring (F-3)
273	19-9026501	Valve (F-2)		AN938C12	Tee (F-3)
	AN893-16C	Bushing (F-3)		AN893-4C	Bushing (F-3)
	AN832-8C	Union (F-3)		MS28778-4	Packing (F-3)
	AN6289C8	Nut (F-3)		459T-4-300	Threaded piece (F-3)
	AN939C8	Elbow (F-3)	281	9025974	Tube (F-3)
	AN938C8	Tee (F-3)		MS28778-2	Packing (F-3)
	459T-8-300	Threaded piece (F-3)	282	19-9026517	Indicator (F-2)
	AN893-3C	Bushing (F-3)		LD153-0010-0009	Washer (F-3)
	459T-4-300	Threaded piece (F-3)		AN814-4C	Plug (F-3)
	MS28778-4	Packing (F-3)		MS28778-4	Packing (F-3)
	MS28778-8	Packing (F-3)	283	19-9026510	Snubber (F-3)
	MS28777-8	Ring (F-3)		459T-4-300	Threaded piece (F-3)
	MS28778-12	Packing (F-3)		MS28778-4	Packing (F-3)
274	9025999	Tube (F-3)		AN814-4C	Plug (F-3)
	MS28778-5	Packing (F-3)		MS28778-4	Packing (F-3)
	487T-8-300	Threaded piece (F-3)	284	9025973	Tube (F-3)
	489N-8-300	Nut (F-3)		MS28778-2	Packing (F-3)
	AN814-8C	Plug (F-3)		487T-4-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)		489N-4-300	Nut (F-3)
275	9025948	Tube (F-3)		AN814-4C	Plug (F-3)
	MS28778-2	Packing (F-3)		MS28778-4	Packing (F-3)
276	9025982	Tube (F-3)	285	9025975	Tube (F-3)
	MS28778-5	Packing (F-3)		MS28775-018	Packing (F-3)
	487T-8-300	Threaded piece (F-3)		487T-12-300	Threaded piece (F-3)
	489N-8-300	Nut (F-3)		489N-12-300	Nut (F-3)
	AN814-8C	Plug (F-3)		AN814-12C	Plug (F-3)
	MS28778-8	Packing (F-3)		MS28778-12	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 22 of 25)

Index No.	Part No.	Description
286	19-9026501	Valve (F-2)
	AN893-16C	Bushing (F-3)
	AN832-8C	Union (F-3)
	AN6289C8	Nut (F-3)
	MS28778-8	Packing (F-3)
	MS28777-8	Ring (F-3)
	AN939C8	Elbow (F-3)
	AN938C8	Tee (F-3)
	459T-8-300	Threaded piece (F-3)
	AN893-3C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
	MS28778-12	Packing (F-3)
287	9026061	Tube (F-3)
	MS28778-5	Packing (F-3)
288	AN938C12	Tee (F-3)
	459T-12-300	Threaded piece (F-3)
	MS28778-12	Packing (F-3)
	AN893-16C	Bushing (F-3)
	MS28778-8	Packing (F-3)
	459T-8-300	Threaded piece (F-3)
289	9025996	Tube (F-3)
	MS28778-2	Packing (F-3)
290	9025879	Tube (F-3)
	MS28778-5	Packing (F-3)
	487T-8-300	Threaded piece (F-3)
	489N-8-300	Nut (F-3)
	AN814-8C	Plug (F-3)
	MS28778-8	Packing (F-3)
291	9025968	Tube (F-3)
	MS28778-2	Packing (F-3)
292	AN938C16	Tee (F-3)
	59T-4-300SS-LOX	Threaded piece (F-3)
	MS28778-16	Packing (F-3)
	AN893-5C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
293	9026439	Tube (F-3)
	MS28775-214	Packing (F-3)
	87T-4-300SS	Threaded piece (F-3)
	89N-4-300SS	Nut (F-3)
	AN814-16C	Plug (F-3)
	MS28778-16	Packing (F-3)
294	9025964	Tube (F-3)
	MS28778-2	Packing (F-3)
295	9026058	Tube (F-3)
	MS28778-2	Packing (F-3)
296	9026436	Tube (F-3)
	MS28775-214	Packing (F-3)
	87T-4-300SS	Threaded piece (F-3)
	89N-4-300SS	Nut (F-3)
	AN814-16C	Plug (F-3)
	MS28778-16	Packing (F-3)
297	9026435	Tube (F-3)
	MS28775-214	Packing (F-3)
	87T-4-300SS	Threaded piece (F-3)
	89N-4-300SS	Nut (F-3)
	AN814-16C	Plug (F-3)
	MS28778-16	Packing (F-3)
298	AN937C16	Cross (F-3)
	50N-4-300SS	Nut (F-3)
	59T-4-300SS	Threaded piece (F-3)
	59R-4-300SS	Tailpiece (F-3)
	AN832-16C	Union (F-3)
	AN6289C16	Nut (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
	MS28775-214	Packing (F-3)
	AN893-5C	Bushing (F-3)
	MS28778-4	Packing (F-3)
	459T-4-300	Threaded piece (F-3)
299	9026437	Tube (F-3)
	MS28778-2	Packing (F-3)
300	9026442	Tube (F-3)
	MS28778-2	Packing (F-3)
301	AN937C16	Cross (F-3)
	AN832-16C	Union (F-3)
	AN6289C16	Nut (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
	59R-4-300SS	Tailpiece (F-3)
	50N-4-300SS	Nut (F-3)
	59T-4-300SS	Threaded piece (F-3)
	MS28775-214	Packing (F-3)
	AN893-5C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	AN893-17C	Bushing (F-3)
	19-9026515	Transducer (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 23 of 25)

Index No.	Part No.	Description
301	MS28778-8	Packing (F-3)
(cont)	MS28778-4	Packing (F-3)
302	9026447	Tube (F-3)
	MS28778-2	Packing (F-3)
303	440-4-300	Tee (F-3)
304	9026446	Tube (F-3)
	MS28778-2	Packing (F-3)
305	19-9022606-1	Valve (F-1)
	MS15795-820	Washer (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
306	19-9017879-5	Gage (F-3)
	AN515C6R10	Screw (F-3)
	MS15795-805	Washer (F-3)
	NAS679C06W	Nut (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
307	9026082-5	Tube (F-3)
	AN737TW44-48	Clamp (F-3)
	AN807-16C	Adapter (F-3)
	AN924-16C	Nut (F-3)
308	9026082	Tube (F-3)
	AN737TW44-48	Clamp (F-3)
	AN807-16C	Adapter (F-3)
	AN924-16C	Nut (F-3)
309	AN937C12	Cross (F-3)
	MS28778-12	Packing (F-3)
	459T-12-300	Threaded piece (F-3)
	AN893-4C	Bushing (F-3)
	459T-4-300	Threaded piece (F-3)
	MS28778-4	Packing (F-3)
310	9025903	Tube (F-3)
	MS28775-018	Packing (F-3)
	AN832-12C	Union (F-3)
	AN924-12C	Nut (F-3)
	AN929-12C	Cap (F-3)
311	9025891	Tube (F-3)
	MS28775-214	Packing (F-3)
312	9025897	Tube (F-3)
	MS28775-214	Packing (F-3)
	AN832-16C	Union (F-3)
	AN924-16C	Nut (F-3)
	AN929-16C	Cap (F-3)
313	19-9026521	Relief valve (F-2)
	AN894C16-12	Bushing (F-3)
	MS28778-12	Packing (F-3)
	AN832-16C	Union (F-3)
	MS28778-16	Packing (F-3)

Index No.	Part No.	Description
313	MS28777-16	Ring (F-3)
(cont)	AN6289C16	Nut (F-3)
	AN937C16	Cross (F-3)
	59T-4-300SS-LOX	Threaded piece (F-3)
314	9025896	Tube (F-3)
	MS28778-4	Packing (F-3)
315	9026448	Tube (F-3)
	MS28775-214	Packing (F-3)
316	AN937C16	Cross (F-3)
	AN938C16	Tee (F-3)
	AN832-16C	Union (F-3)
	AN6289C16	Nut (F-3)
	MS28778-16	Packing (F-3)
	MS28777-16	Ring (F-3)
	59T-4-300SS-LOX	Threaded piece (F-3)
	AN893-22C	Bushing (F-3)
	459T-12-300	Threaded piece (F-3)
	MS28778-12	Packing (F-3)
	AN893-17C	Bushing (F-3)
	459T-8-300	Threaded piece (F-3)
	MS28778-8	Packing (F-3)
	AN893-14C	Bushing (F-3)
	459T-6-300	Threaded piece (F-3)
	MS28778-6	Packing (F-3)
317	9026427	Tube (F-3)
	MS28775-018	Packing (F-3)
	487T-12-300	Threaded piece (F-3)
	489N-12-300	Nut (F-3)
	AN814-12C	Plug (F-3)
	MS28778-12	Packing (F-3)
318	9026052	Tube (F-3)
	MS28775-214	Packing (F-3)
319	19-9026511	Check valve (F-3)
320	9025906	Tube (F-3)
	MS28778-5	Packing (F-3)
321	9025886	Tube (F-3)
	MS28778-5	Packing (F-3)
322	440-8-300	Tee (F-3)
323	9025907	Tube (F-3)
	MS28778-5	Packing (F-3)
324	9025887	Tube (F-3)
	MS28778-5	Packing (F-3)
	487T-8-300	Threaded piece (F-3)
	489N-8-300	Nut (F-3)
	AN814-8C	Plug (F-3)
	MS28778-8	Packing (F-3)

Figure 10-13. Disassembly of Components Test Console (Sheet 24 of 25)

Index No.	Part No.	Description	Index No.	Part No.	Description
325	9025908	Tube (F-3)	326	489N-8-300	Nut (F-3)
	MS28778-5	Packing (F-3)		AN814-8C	Plug (F-3)
326	9025909	Tube (F-3)		MS28778-8	Packing (F-3)
	MS28778-5	Packing (F-3)			
	487T-8-300	Threaded piece (F-3)			

Figure 10-13. Disassembly of Components Test Console (Sheet 25 of 25)

10-44. SERVICING.

10-45. Servicing of the components test console and adapter set is as follows:

a. Calibrate all pressure, fluid, and electrical measuring instruments at 6-month intervals and anytime misuse or damage is suspected. See figure 10-14 for calibration-check requirements.

b. Perform hydraulic fluid sampling and maintain fluid cleanness of components test console as follows:

(1) Sample console hydraulic fluid every 30 days or within 30 days before using console. When testing a component, waive the sample test until test is complete.

(2) Sample console hydraulic fluid whenever known or suspected contaminants are introduced into console hydraulic system.

(3) Sample hydraulic fluid supply each time facility hydraulic supply system is violated.

(4) Check delta-P of facility downstream 10-micron absolute delta-P gages before each component test with system flowing. If above 80 psid, remove and clean or replace filters and perform a fluid sample test.

(5) Maintain hydraulic fluid cleanness to service contractors cleanness level.

c. Lubricate hand valve stem threads (paragraphs 10-54, 10-61, 10-68, and 10-75) annually.

d. Function-test relief valves (paragraph 10-83) annually.

10-46. SHIPPING AND STORAGE.

10-47. Prepare the components test console and components adapter set for shipping or storage in accordance with MIL-P-116, Method II.

10-48. <u>COMPONENT REPAIR.</u>

10-48A. REGULATORS 19-9021932-1, 19-9021932-2, 19-9021932-3, AND 19-9021932-5.

10-48B. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the regulators.

10-48C. DISASSEMBLING REGULATORS 19-9021932-1, 19-9021932-2, AND 19-9021932-3. (See figure 10-14A.)

a. Turn handle (3) to vent position, to relieve trapped pressure; then pry off button plug (1). Hold handle (3) and remove nut (2); then lift handle from shaft of actuator assembly (28).

b. Remove two screws (4) and plate (5). If plate (7) is to be removed, loosen screw (6) with a 3/32-inch hex wrench and slide plate (7) from regulator element (21).

WARNING

Pressure limit valve screw (8) must be backed off or removed, to relieve any pressure trapped in the regulator.

c. On regulators 19-9021932-1 and -2, disassemble pressure limit valve from body and pin assembly (86) as follows:

(1) Remove screw (8) with a 5/32-inch hex wrench; then remove spring (9), washer (10), and poppet (11).

Part Number	Nomenclature	Range/Accuracy (± Full Scale)	Type of Service	Test Standard Accuracy (± Full Scale)
19-9021929-1	REG SUPPLY PRESS gage	0-160 psig (0.25%)	Pneumatic	0.1%
19-9021928-1	TEST CELL MONITOR PRESSURE gage	0-1,000 psig (0.1%)	Pneumatic	Dead-weight tester
19-9021929-5	REG SUPPLY PRESS. gage	0-6,000 psig (0.25%)	Pneumatic	0.1%
19-9021928-3	MONITOR gage	0-6,000 psig (0.1%)	Pneumatic	Dead-weight tester
19-9021934-6	PRESSURE DIFFER-ENTIAL gage	0-15 psid (0.5%)	Pneumatic	0.2%
19-9021929-4[a]	REG SUPPLY PRESS. gage	0-1,500 psig (0.25%)	Cryogenic	0.1%
19-9021929-6	PRESSURE MONITOR "A" gage	0-100 psig (0.25%)	Pneumatic-Hydraulic	0.1%
19-9021929-7	PRESSURE MONITOR "B" gage	0-300 psig (0.25%)	Pneumatic-Hydraulic	0.1%
19-9021929-8	REG SUPPLY PRESS. gage	0-1,000 psig (0.25%)	Pneumatic-Hydraulic	0.1%
19-9021928-1	TEST CELL MONITOR PRESSURE gage	0-1,000 psig (0.1%)	Pneumatic-Hydraulic	Dead-weight tester
19-9021929-10	REG SUPPLY PRESS. gage	0-5,000 psig (0.25%)	Pneumatic-Hydraulic	0.1%
19-9021934-5	PRESSURE DIFFER-ENTIAL gage	0-60 psid (0.5%)	Pneumatic-Hydraulic	0.2%
19-9026516-1	PRESSURE MONITOR "A" gage	0-1,000 psig (0.25%)	Hydraulic	0.1%
19-9026516-2	PRESSURE MONITOR "B" gage	0-2,000 psig (0.25%)	Hydraulic	0.1%
19-9026516-3	PRESSURE MONITOR "A" and "B" and PRES-SURE MONITOR gages	0-5,000 psig (0.25%)	Hydraulic	0.1%
19-9026517	DIFFERENTIAL PRES-SURE gage	0-60 psid (0.5%)	Hydraulic	0.2%
JAWV0D1	Voltmeter	0-150 vdc (0.5%)	None	0.1%
JAWL1W	Milliammeter	0-500 milli-amperes dc (0.5%)	None	0.2%

(a) Also included in Components Adapter Set G3143.

Figure 10-14. Calibration-Check Requirements (Sheet 1 of 2)

Part Number	Nomenclature	Range/Accuracy (± Full Scale)	Type of Service	Test Standard Accuracy (± Full Scale)
19-9026508	Turbine-Type Flow-meter	3-70 scfm of gaseous nitrogen at 200 psig ±0.06 scfm at minimum flow ±0.35 scfm at maximum flow	Pneumatic (Gaseous Nitrogen, Helium)	Using Facility
19-9026509	Turbine-Type Flow-meter	0.15 to 15 gpm ±0.003 gpm at minimum flow ±0.75 gpm at maximum flow	Hydraulic	Using Facility
1052[b]	Calibrator (Refer to paragraph 10-104 for calibrator function-test.)		Pneumatic	
None	Stop Watch (item of calibrator)	0-30 minutes (0.4 seconds for 30 minutes)		0.02%
19-9026519[b]	Rotameter	2-200 cc/m (2%)	Hydraulic	0.1%
4104-5	Refer to Temperature Indicator Operation Manual (Winsco).			
2401B-M30M40M31	Refer to Digital Voltmeter Operating and Service Manual (Hewlett Packard Co).			
122AR, 06, 07	Refer to Oscilloscope Operating and Service Manual (Hewlett Packard Co).			

(b) Items of Components Adapter Set G3143.

Figure 10-14. Calibration-Check Requirements (Sheet 2 of 2)

(2) Remove screw (12) with screwdriver T11245, or equivalent; then remove guide (13), retainer (14), O-ring (15), gland (16), and O-ring (17).

d. On regulator 19-9021932-3, remove plug (17A) and O-ring (17B) from body and pin assembly (86).

NOTE

Screws (18) securing nameplate (19) to body and pin assembly (86) are drive screws. Screws must not be removed unless absolutely necessary, since removing them will cause wear on mount holes in body and pin assembly.

e. If necessary, pry out 4 screws (18) and remove nameplate (19) from body and pin assembly (86).

f. Remove control head (20) from regulator element (21) as follows:

(1) Remove retaining ring (22) and washer shims (23) from shaft of actuator assembly (28). Record quantity of washer shims removed.

(2) Unscrew and remove housing (24) from regulator element (21) and determine, during removal, if slug (25) provides a locking drag.

(3) If slug (25) is damaged or slug does not provide a locking drag when housing is unscrewed, remove slug with O-ring pick TK4171, or equivalent.

NOTE

If screw assembly (26) is removed from housing (24), the adjustment between screw assembly and actuator assembly (28) must be made during reassembly.

(4) If required, remove screw assembly (26) from housing (24) with wrench TK4160 and determine, during removal, if slugs (27) provide a locking drag.

(5) If 4 slugs (27) are damaged or do not provide a locking drag when screw assembly is removed, remove slugs with O-ring pick TK4171, or equivalent.

(6) Remove actuator assembly (28) and spring (29) as an assembly; then remove washer (30).

NOTE

Substeps 7 through 9 may be performed after disassembly of control element (31).

(7) Remove control element (31) from regulator element (21).

(8) Remove O-ring (32) and backup washer (33) from pin and body assembly (67) of control element (31).

(9) Remove bushing (34) from regulator element (21) or from pin and body assembly (67) of control element (31), as applicable; then remove O-rings (17) from bushing.

g. Remove dome metering valve from pin and body assembly (67) of control element (31) as follows:

NOTE

Dome metering valve parts must be kept separate from inlet metering valve parts, since parts are similar and could be inadvertently interchanged.

(1) Remove dome pin (35); then remove dome retainer (36) with wrench TK2335, or equivalent, and determine, during removal, if slugs (37) provide a locking drag.

(2) If 2 slugs (37) are damaged or do not provide a locking drag when dome retainer is removed, remove slugs with O-ring pick TK4171, or equivalent.

(3) Remove O-rings (39, 41) from dome retainer (36).

(4) On regulator 19-9021932-2, remove backup washers (38, 40) from dome retainer (36).

(5) On regulator 19-9021932-3, remove backup washer (40) from dome retainer (36).

(6) Carefully remove poppet and support assembly (42) and attached parts from pin and body assembly (67); then remove O-ring (39) from seat assembly (44) or from bore of pin and body assembly (67), as applicable.

CAUTION

Poppet and support assembly (42) are matched parts and fit together tightly. Take care not to bend poppet when parts are separated.

(7) Carefully separate poppet and support assembly (42) and remove shims (43), seat assembly (44), and stop (45). Record quantity and thickness of shims removed.

(8) Remove spring (46) and washer (47) from pin and body assembly (67).

h. On regulators 19-9021932-2 and 19-9021932-3, remove inlet metering valve from pin and body assembly (67) of control element (31) as follows:

NOTE

Inlet metering valve parts must be kept separate from dome metering valve parts, since parts are similar and could be inadvertently interchanged.

(1) Remove inlet pin (48); then remove inlet retainer (49) with wrench TK2335, or equivalent, and determine, during removal, if slugs (37) provide a locking drag.

(2) If 2 slugs (37) are damaged or do not provide a locking drag when inlet retainer is removed, remove slugs with O-ring pick TK4171, or equivalent.

(3) Remove O-rings (39, 41) from inlet retainer (49).

(4) On regulator 19-9021932-2, remove backup washers (38, 40) from inlet retainer (49).

(5) On regulator 19-9021932-3, remove backup washer (40) from inlet retainer (49).

(6) Carefully remove inlet support (50), seat assembly (44), stop (45), and inlet poppet (51) as an assembly; then remove O-ring (39) from seat assembly (44) or from bore of pin and body assembly (67), as applicable.

(7) Carefully remove inlet support (50), seat assembly (44), and stop (45) from inlet poppet (51).

(8) Remove inlet spring (52) and washer (47) from pin and body assembly (67).

i. On regulator 19-9021932-1, remove inlet metering valve from pin and body assembly (67) of control element (31) as follows:

NOTE

Inlet metering valve parts must be kept separate from dome metering valve parts, since parts are similar and could be inadvertently interchanged.

(1) Remove inlet retainer (49) with wrench TK2335, or equivalent.

(2) Record quantity of inlet washers (53) and quantity and thickness of shims (55) used in this assembly; then remove inlet washers (53), inlet button (54), shims (55), and inlet spring (56).

(3) Remove inlet plunger (57) and O-ring (58).

(4) Remove inlet retainer (59) and inlet poppet (51) with attaching parts as an assembly; then carefully separate inlet retainer (59), seat assembly (44), and stop (45) from inlet poppet (51). Remove O-rings (39) from inlet retainer (59).

(5) Remove inlet spring (52) and washer (47) from pin and body assembly (67).

j. Remove bleed orifice from pin and body assembly (67) of control element (31) as follows:

(1) Remove setscrew (60) with a 5/32-inch hex wrench and remove orifice washer (61).

(2) Carefully remove orifice spring (62), spring guide (63), and pin and housing assembly (64).

k. Remove retainer (65) and gasket seal (66) from pin and body assembly (67) of control element (31) with screwdriver T11236, or equivalent.

l. Disassemble vent valve from regulator element (21) by removing vent fitting (68), washer (69), spring (70), and retainer (71) from body and pin assembly (86).

m. Disassemble regulator assembly from regulator element (21) as follows:

(1) Carefully pull nut (72) and poppet adapter (76), with attached parts, as an assembly from body and pin assembly (86). Remove O-ring (74) from groove in bore of body and pin assembly (86).

(2) Remove nut (72); then remove piston (73), and O-ring (75) from poppet adapter (76).

(3) Remove screw (77) from body and pin assembly (86) with a 3/8-inch hex wrench and determine, during removal, if slugs (78) provide a locking drag.

(4) If 2 slugs (78) are damaged or do not provide a locking drag when screw (77) is removed, remove slugs with O-ring pick TK4171, or equivalent.

(5) Carefully remove retainer (79), seat (80), and poppet (83) from body and pin assembly (86).

(6) Remove O-ring (81) from groove in bore of body and pin assembly (86).

(7) Remove O-ring (82) from poppet (83).

(8) Remove O-ring (84) and backup washer (85) from body and pin assembly (86).

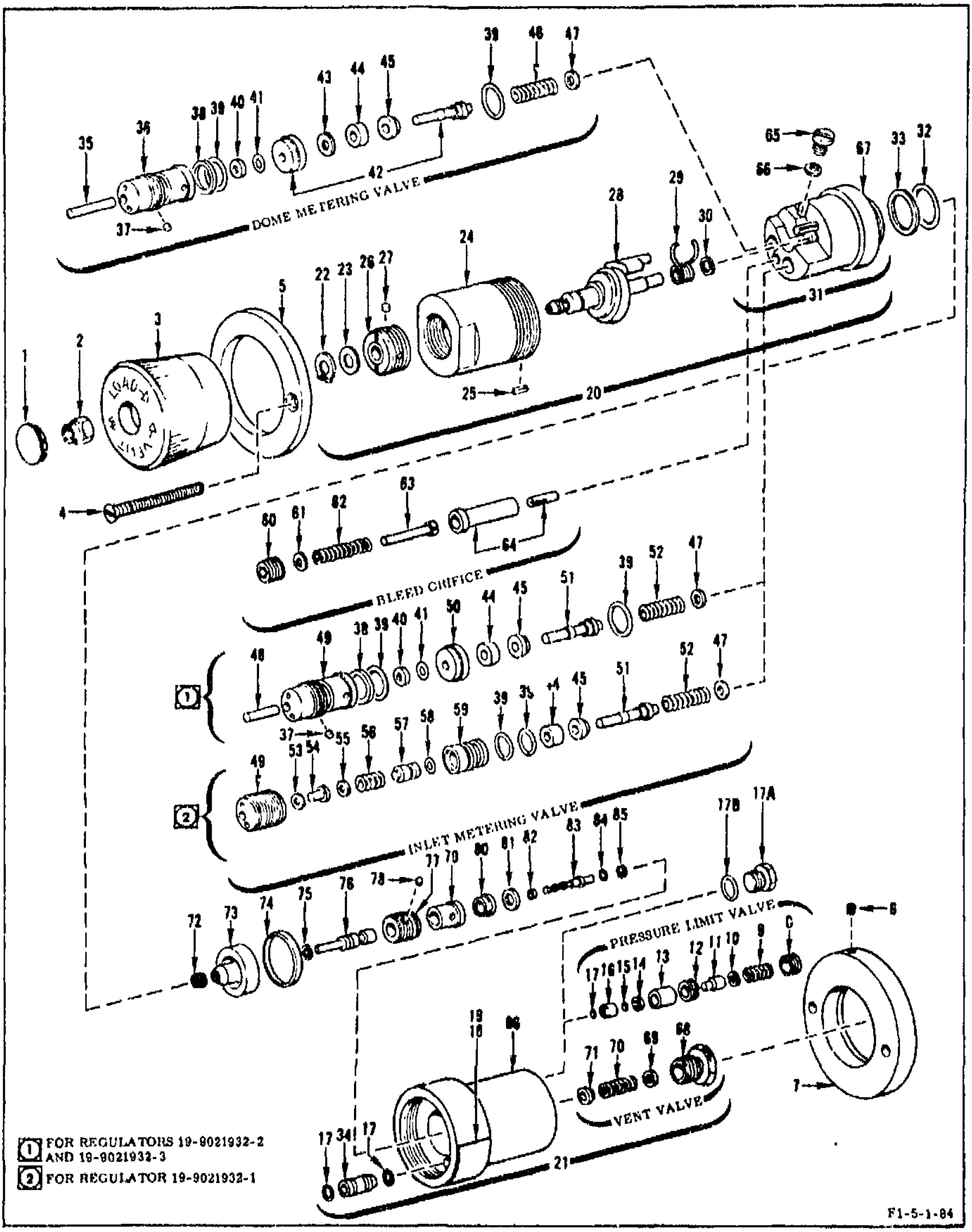


Figure 10-14A. Regulators 19-9021932-1, -2, and -3--Exploded View (Sheet 1 of 3)

NOTE

Allowable alternate O-ring part numbers are listed in figure 10-14C.

Index No.	Part No.	Description
1	127461	Button plug (F-3)
2	79NTE-064	Nut (F-3)
3	223301	Handle (F-3)
4	AN505C416-28	Screw (F-3)
5	157232 or 127382	Plate (F-3)
6	M72CR1032-6E	Screw (F-3)
7	156192	Plate (F-3)
8[a][b]	157011	Screw (F-3)
9[a][b]	156991	Spring (F-3)
10[a][b]	120002-136	Washer (F-3)
11[a][b]	156942-3[a] 156942-2[b]	Poppet (F-3)
12[a][b]	157001	Screw (F-3)
13[a][b]	156981	Guide (F-3)
14[a][b]	156972[a] 156962-2[b]	Retainer (F-3)
15[a][b]	J200AC8[a] J200AC5[b]	O-ring (F-3)
16[a][b]	156952-3[a] 156952-2[b]	Gland (F-3)
17[a][b]	J200AC5	O-ring (F-3)
17A[c]	AN814-4CL	Plug (F-3)
17B[c]	J201AC4	O-ring (F-3)
18	AN535-00-2	Screw (F-3)
19	168392[a] 168412[b] 168502[c]	Nameplate (F-3)
20	225363-02[a] 223263-04[b] 223263-01[c]	Control head (F-3)
21	223674-51	Regulator element (F-3)
22	3100-50	Retaining ring (F-3)
23	121902-10	Washer shim (F-3)
24	156133-1	Housing (F-3)
25	111112-GR1	Slug (F-3)
26	223271	Screw assembly (F-3)
27	111112-DA1	Slug (F-3)
28	223422	Actuator assembly (F-3)
29	127392	Spring (F-3)
30	120002-24	Washer (F-3)
31	225354-02[a] 223294-04[b] 223294-01[c]	Control element (F-3)
32	J200AC24	O-ring (F-3)
33	108241-58	Backup washer (F-3)
34	217981	Bushing (F-3)
35	127441-6	Dome pin (F-3)
36	156152-1-2	Dome retainer (F-3)
37	111112-BB1	Slug (F-3)
38[b]	MS28774-011	Backup washer (F-3)
39	J200AC11	O-ring (F-3)
40[b][c]	108241-78	Backup washer (F-3)
41	J200AC4	O-ring (F-3)
42	223611	Poppet and support assembly (matched assembly) (F-3)
43	130331-1X	Shim (F-3)
44	212401	Seat assembly (F-3)
45	156141[a] 156141-1[b][c]	Stop (F-3)
46	153401	Spring (F-3)
47	120002-153	Washer (F-3)
48[b][c]	127441-7	Inlet pin (F-3)
49	160112-1[a] 156152-1-1[b][c]	Inlet retainer (F-3)
50[b][c]	156912	Inlet support (F-3)
51	127252	Inlet poppet (F-3)
52	153391	Inlet spring (F-3)
53[a]	121902-26	Inlet washer (F-3)
54[a]	160131-1	Inlet button (F-3)
55[a]	131331-2-X	Shim (F-3)
56[a]	153201	Inlet spring (F-3)
57[a]	160121-1	Inlet plunger (F-3)
58[a]	J200AC6	O-ring (F-3)
59[a]	160142-1	Inlet retainer (F-3)
60	127281	Setscrew (F-3)
61	120002-25	Orifice washer (F-3)
62	127361	Orifice spring (F-3)
63	127341	Spring guide (F-3)
64	213901	Pin and housing assembly (F-3)
65	157102	Retainer (F-3)
66	156161	Gasket seal (F-3)
67	223282-1	Pin and body assembly (F-3)
68	218982	Vent fitting (F-3)

(a) Used on regulator 19-9021932-1.
(b) Used on regulator 19-9021932-2.
(c) Used on regulator 19-9021932-3.

Figure 10-14A. Regulators 19-9021932-1, -2, and -3--Exploded View (Sheet 2 of 3)

Index No.	Part No.	Description	Index No.	Part No.	Description
69	120002-155	Washer (F-3)	79	155522(e)	Retainer (F-3)
70	155501	Spring (F-3)	80	155512(e)	Seat (F-3)
71	145621-1	Retainer (F-3)	81	J200AC12	O-ring (F-3)
72	H42L08	Nut (F-3)	82	J200AC2	O-ring (F-3)
73	160532	Piston (F-3)	83	162713-1	Poppet (F-3)
74	J200AC26	O-ring (F-3)	84	J200AC7	O-ring (F-3)
75	J200AC8	O-ring (F-3)	85	121822-42-2	Backup washer (F-3)
76	155672(d)	Poppet adapter (F-3)	86	223712-2	Body and pin assembly (F-3)
77	155541	Screw (F-3)			
78	111112-BC3	Slug (F-3)			

(d) Optional part 231552-2.
(e) Optional parts, seat 176472-2 and support 176482-1.

Figure 10-14A. Regulators 19-9021932-1, -2, and -3--Exploded View (Sheet 3 of 3)

10-48D. DISASSEMBLING REGULATOR 19-9021932-5. (See figure 10-14B.)

a. Turn handle (3) to vent position, to relieve trapped pressure; then pry off button plug (1). Hold handle (3) and remove nut (2); then lift handle from shaft of actuator assembly (23).

b. Remove 2 screws (4) and plate (5).

WARNING

Pressure limit valve setscrew (6) must be backed off or removed to relieve any pressure trapped in valve.

c. Disassemble pressure limit valve from pin and adapter assembly (16) as follows:

(1) Remove setscrew (6) with 5/32-inch hex wrench; then remove washer (7), spring (8), and poppet (9).

(2) Remove retainer (10) with screwdriver T11245, or equivalent, and determine during removal if slugs (11) provide a locking drag; then remove support (12) and omniseal (13).

(3) If 2 slugs (11) are damaged or slugs do not provide a locking drag when retainer is removed, remove slugs with O-ring pick TK4171, or equivalent.

d. Disassemble housing and actuator assembly (14) by disassembling and removing control head (15) from pin and adapter assembly (16) as follows:

(1) Remove retaining ring (17) and washer shims (18) from shaft of actuator assembly (23). Record quantity of washer shims removed.

(2) Unscrew and remove housing (19) from pin and adapter assembly (16) and determine, during removal, if slug (20) provides a locking drag.

(3) If slug (20) is damaged or slug does not provide a locking drag when housing is unscrewed, remove slug with O-ring pick TK4171, or equivalent.

NOTE

If screw assembly (21) is removed from housing (19), the adjustment between screw assembly and actuator assembly (23) must be accomplished during reassembly.

(4) If required, remove screw assembly (21) from housing (19) with wrench TK4160 and determine, during removal, if slugs (22) provide a locking drag.

(5) If 4 slugs (22) are damaged or do not provide a locking drag when screw assembly is removed, remove slugs with O-ring pick TK4171, or equivalent.

(6) Remove actuator assembly (23) and spring (24) as an assembly; then remove washer (25).

NOTE

Substeps 7 through 9 may be performed after disassembly of control element (26).

(7) Remove control element (26) from pin and adapter assembly (16).

(8) Remove O-ring (27) and backup washer (28) from pin and body assembly (58) of control element (26).

(9) Remove bushing (29) from pin and adapter assembly (16) or from pin and body assembly (58) of control element (26), as applicable, then remove O-rings (30) from bushing.

e. Remove dome metering valve from pin and body assembly (58) of control element (26) as follows:

NOTE

Dome metering valve parts must be kept separate from inlet metering valve parts, since parts are similar and could be inadvertently interchanged.

(1) Remove dome pin (31); then remove dome retainer (32) with wrench TK2335, or equivalent, and determine, during removal, if slugs (33) provide a locking drag.

(2) If 2 slugs (33) are damaged or do not provide a locking drag when dome retainer is removed, remove slugs with O-ring pick TK4171, or equivalent.

(3) Remove O-rings (34, 35) and backup washer (36).

(4) Carefully remove poppet and support assembly (37) and attached parts; then remove O-ring (34) from seat assembly (39) or from bore of pin and body assembly (58), as applicable.

CAUTION

Poppet and support assembly (37) are matched parts and fit together tightly. Take care not to bend poppet when parts are separated.

(5) Carefully separate poppet and support assembly (37) and remove shims (38), seat assembly (39), and stop (40). Record quantity and thickness of shims removed.

(6) Remove spring (41) and washer (42) from pin and body assembly (58).

f. Remove inlet metering valve from pin and body assembly (58) of control element (26) as follows:

NOTE

Inlet metering valve parts must be kept separate from dome metering valve parts, since parts are similar and could be inadvertently interchanged.

(1) Remove inlet pin (43); then remove inlet retainer (44) with wrench TK2335, or equivalent, and determine, during removal, if slugs (33) provide a locking drag.

(2) If 2 slugs (33) are damaged or do not provide a locking drag when inlet retainer is removed, remove slugs with O-ring pick TK4171, or equivalent.

(3) Remove O-rings (34, 35) and backup ring (36) from inlet retainer (44).

(4) Carefully remove inlet support (45), seat assembly (39), stop (40), and inlet poppet (46) as an assembly; then remove O-ring (34) from seat assembly (39) or from bore of pin and body assembly (58), as applicable.

(5) Carefully remove inlet support (45), seat assembly (39), and stop (40) from inlet poppet (46).

(6) Remove inlet spring (47) and washer (42) from pin and body assembly (58).

g. Remove bleed orifice from pin and body assembly (58) of control element (26) as follows:

(1) Remove setscrew (48) with a 5/32-inch hex wrench and remove orifice washer (49).

(2) Carefully remove orifice spring (50), spring guide (51), and pin and housing assembly (52).

h. Remove panic vent valve from pin and body assembly (58) of control element (26) as follows:

(1) Remove clip spring (53).

(2) Remove retainer (54) and gasket seal (55) with screwdriver T11236, or equivalent.

(3) Remove panic poppet (56) and panic spring (57).

NOTE

Nameplate (59) is glued to pin and adapter assembly (16) with adhesive (60) and must not be removed.

i. Remove 8 screws (61) and separate pin and adapter assembly (16) from body (84); then remove O-rings (34, 62) and backup washer (63) from pin and adapter assembly (16).

j. Remove bushing (64) from pin and adapter assembly (16) or body (84), as applicable; then remove O-rings (65) from bushing.

k. Remove regulator parts from body (84) as follows:

(1) Remove piston (66), O-ring (67), retainer (68), seat (69), and O-ring (70).

(2) Remove lockwire (71) and tag (72) from retainer and screen assembly (73); then remove retainer and screen assembly, spring (74), and spring bushing (75).

l. Carefully remove seat retainer (76), O-rings (77, 78), and poppet (79) as an assembly; then remove screen (80), poppet seat (81), support seat (82), and O-ring (83).

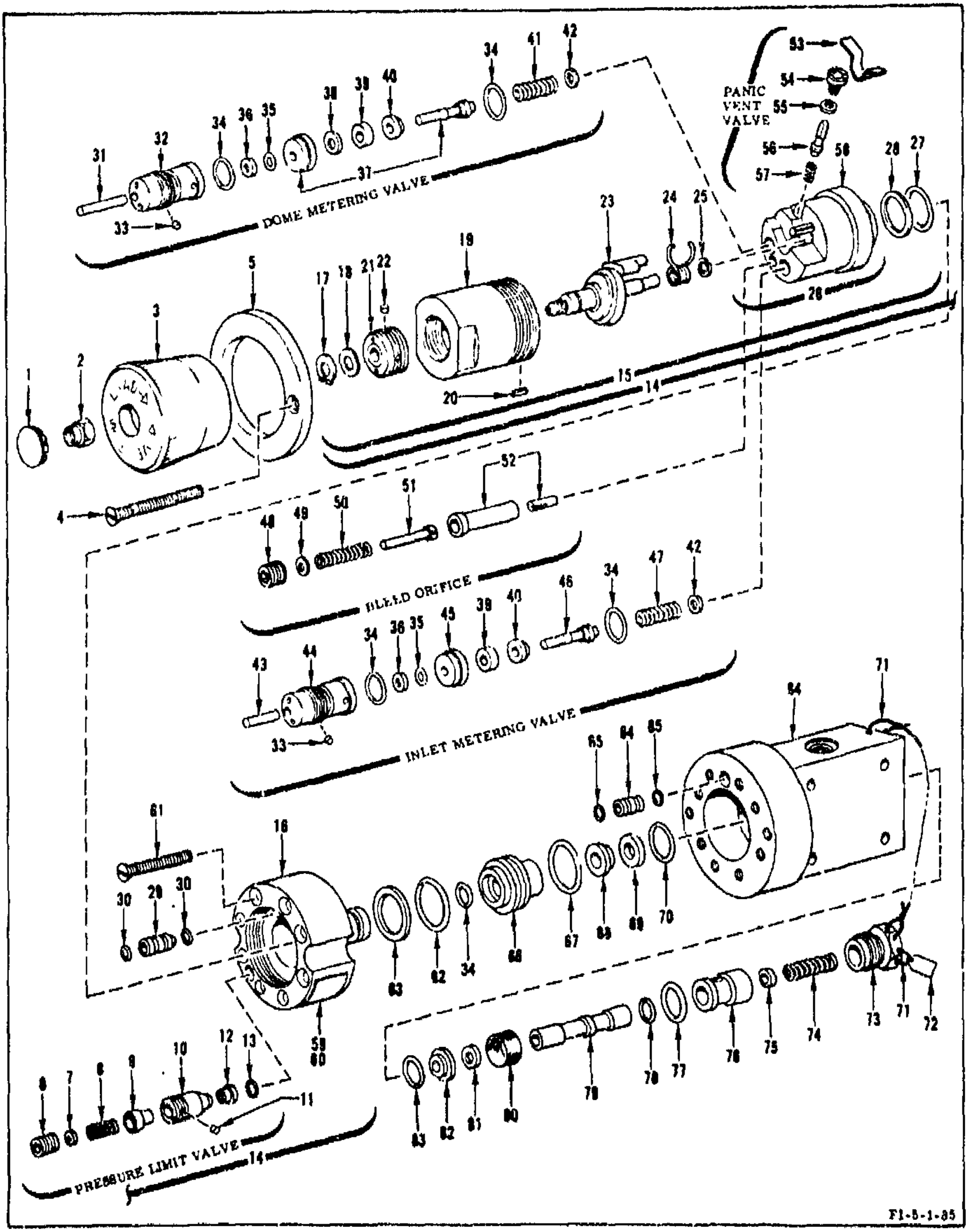


Figure 10-14B. Regulator 19-9021932-5--Exploded View (Sheet 1 of 2)

NOTE

Allowable alternate O-ring part numbers are listed in figure 10-14C.

Index No.	Part No.	Description
1	127461	Button plug (F-3)
2	79NTE064	Nut (F-3)
3	223301	Handle (F-3)
4	AN505C416-40	Screw (F-3)
5	173072	Plate (F-3)
6	127281	Setscrew (F-3)
7	120002-25	Washer (F-3)
8	162291	Spring (F-3)
9	180054	Poppet (F-3)
10	180052-1	Retainer (F-3)
11	111112-EB1	Slug (F-3)
12	180053	Support (F-3)
13	R10105-004-AIN	Omniseal (F-3)
14	230554-1	Housing and actuator assembly (F-3)
15	223263-P1	Control head (F-3)
16	230562-2	Pin and adapter assembly (F-3)
17	3100-50	Retaining ring (F-3)
18	121902-10	Washer shim (F-3)
19	156133-1	Housing (F-3)
20	111112-GR1	Slug (F-3)
21	223271	Screw assembly (F-3)
22	111112-DA1	Slug (F-3)
23	223422	Actuator assembly (F-3)
24	127392	Spring (F-3)
25	120002-24	Washer (F-3)
26	223294-P1	Control element (F-3)
27	J200AC24	O-ring (F-3)
28	108241-58	Backup washer (F-3)
29	217981	Bushing (F-3)
30	J200AC5	O-ring (F-3)
31	127441-6	Dome pin (F-3)
32	156152-1-2	Dome retainer (F-3)
33	111112-BB1	Slug (F-3)
34	J200AC11	O-ring (F-3)
35	J200AC4	O-ring (F-3)
36	108241-78	Backup washer (F-3)
37	223611	Poppet and support assembly (matched assembly)(F-3)
38	130331-1X	Shim (F-3)
39	212401	Seat assembly (F-3)
40	156141-1	Stop (F-3)
41	153401	Spring (F-3)
42	120002-153	Washer (F-3)
43	127441-7	Inlet pin (F-3)
44	156152-1-1	Inlet retainer (F-3)
45	156912	Inlet support (F-3)
46	127252	Inlet poppet (F-3)
47	153391	Inlet spring (F-3)
48	127281	Setscrew (F-3)
49	120002-25	Orifice washer (F-3)
50	127361	Orifice spring (F-3)
51	127341	Spring guide (F-3)
52	213901	Pin and housing assembly (F-3)
53	171492	Clip spring (F-3)
54	172013	Retainer (F-3)
55	121822-54-4	Gasket seal (F-3)
56	172033	Panic poppet (F-3)
57	156651	Panic spring (F-3)
58	223282-1	Pin and body assembly (F-3)
59	J215A262	Nameplate (F-3)
60	----	Adhesive (epoxy glue) (F-3)
61	J507A524-34	Screw (F-3)
62	J200AC131	O-ring (F-3)
63	108241-26	Backup washer (F-3)
64	173841-2	Bushing (F-3)
65	J200AC8	O-ring (F-3)
66	177323	Piston (F-3)
67	J200AC31	O-ring (F-3)
68	177342	Retainer (F-3)
69	177332	Seat (F-3)
70	J200AC16	O-ring (F-3)
71	MS20995G-20	Lockwire (F-3)
72	142621	Tag (F-3)
73	231802	Retainer and screen assembly (F-3)
74	107381	Spring (F-3)
75	144711-1	Spring bushing (F-3)
76	140352-2	Seat retainer (F-3)
77	J200AC18	O-ring (F-3)
78	J200AC12	O-ring (F-3)
79	140202-1	Poppet (F-3)
80	140361	Screen (F-3)
81	129861-1	Poppet seat (F-3)
82	140382-1	Support seat (F-3)
83	J200AC15	O-ring (F-3)
84	173084-1	Body (F-3)

Figure 10-14B. Regulator 19-9021932-5--Exploded View (Sheet 2 of 2)

10-48E. CLEANING. Clean regulator as outlined in section I.

10-48F. INSPECTING AND REPAIRING. Inspecting regulators determines if individual parts are clean and if parts have been damaged by mishandling or wear. Repair of regulators consists of cleaning parts, replacing O-rings and backup washers and replacing other parts, if parts are damaged or worn.

Vendor Part No.	Alternate Part No.
J200AC2	None
J200AC4	MS28775-004
J200AC5	MS28775-005
J200AC6	MS28775-006
J200AC7	MS28775-007
J200AC8	MS28775-008
J200AC11	MS28775-011
J200AC12	MS28775-012
J200AC15	MS28775-015
J200AC16	MS28775-016
J200AC18	MS28775-018
J200AC24	MS28775-024
J200AC26	MS28775-026
J200AC31	None
J200AC131	MS28775-131
J201AC4	MS28778-4

Figure 10-14C. Allowable Alternate O-Ring Part Numbers

10-48G. ASSEMBLING REGULATORS 19-9021932-1, 19-9021932-2, AND 19-9021932-3. (See figure 10-14A.) All parts must meet cleaning requirements outlined in paragraph 10-48E. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants are specified in section I.

a. Assemble regulator assembly into regulator element (21) as follows:

(1) Lubricate (Method J) O-ring (84); then install backup washer (85) and O-ring in bottom of bore in body and pin assembly (86).

(2) Lubricate (Method J) O-ring (81) and install in groove of bore in body and pin assembly (86).

(3) Install seat (80) on poppet (83); then lubricate (Method J) O-ring (82) and install O-ring on poppet.

(4) Carefully insert poppet (83) and attached parts into bore of body and pin assembly (86). Take care not to jam seat against poppet seating surface.

(5) Install retainer (79) against seat (80).

(6) If slugs (78) were removed, press 2 slugs in screw (77).

(7) Lubricate (Method A) threads of screw (77); then install screw in body and pin assembly (86) with a 3/8-inch hex wrench. Torque screw to 50 in-lb; then back off screw about one-eighth turn and retorque to 40 in-lb.

(8) Lubricate (Method J) O-ring (75) and install O-ring on poppet adapter (76).

(9) Carefully install piston (73) on poppet adapter (76). Lubricate (Method A) threads of poppet adapter and install nut (72). Hold poppet adapter and tighten nut until piston bottoms on poppet adapter.

(10) Lubricate (Method J) O-ring (74) and insert O-ring into groove in bore of body and pin assembly (86).

(11) Carefully insert poppet adapter (76), piston (73), and attached parts into bore of body and pin assembly (86) so that poppet adapter bore slides over O-ring (82) and piston slides inside O-ring (74).

b. Install vent valve into regulator element (21) as follows:

(1) Install retainer (71) in body and pin assembly (86) over end of poppet (83).

(2) Lubricate (Method A) threads of vent fitting (68).

(3) Insert washer (69) and spring (70) into vent fitting (68) and install as an assembly in body and pin assembly (86). Torque vent fitting to 50 in-lb.

c. Lubricate (Method A) threads of retainer (65); then install gasket seal (66) and retainer in pin and body assembly (67). Tighten retainer securely with screwdriver T11236, or equivalent.

d. Install bleed orifice in pin and body assembly (67) of control element (31) as follows:

(1) Lubricate (Method W) pin of pin and housing assembly (64).

(2) Install pin and housing assembly (64) in bleed orifice cavity with pin groove inserted in hole in housing.

(3) Lubricate (Method W) large end of spring guide (63) and install spring guide and orifice spring (62) in bleed orifice cavity.

(4) Lubricate (Method A) threads of setscrew (60), insert orifice washer (61) in cavity of setscrew, and install setscrew over orifice spring (62). Make sure that orifice spring is in cavity of setscrew; then tighten setscrew securely with a 5/32-inch hex wrench.

e. On regulator 19-9021932-1, install inlet metering valve in pin and body assembly (67) of control element (31) as follows:

(1) Install washer (47) and inlet spring (52) in inlet metering valve cavity.

(2) Lubricate (Method J) O-ring (39) and install O-ring in top shelf of inlet metering valve cavity.

(3) Lubricate (Method J) O-ring (39) and install O-ring on inlet retainer (59).

(4) Install stop (45), seat assembly (44) (Teflon on seat assembly toward cavity), and inlet retainer (59) on inlet poppet (51) and insert as an assembly into inlet metering valve cavity.

(5) Lubricate (Method W) end of inlet poppet (51) protruding in inlet retainer (59).

(6) Lubricate (Method J) O-ring (58) and install on inlet plunger (57); then install inlet plunger in inlet retainer (59).

(7) Install inlet spring (56).

(8) Lubricate (Method W) part of inlet button (54) that will insert into inlet retainer (49).

(9) Install shims (55) (use same quantity and thickness as removed or as required to obtain proper adjustment), inlet button (54), inlet washers (53) (install same quantity as was removed or as required to obtain proper adjustment), and inlet retainer (49). Tighten inlet retainer (49) with wrench TK2353 until retainer is secure and parts bottom.

f. On regulators 19-9021932-2 and 19-9021932-3, install inlet metering valve in pin and body assembly (67) of control element (31) as follows:

(1) Install washer (47) and inlet spring (52) in inlet metering valve cavity.

(2) Lubricate (Method J) O-ring (39) and install O-ring in top shelf of inlet metering valve cavity.

(3) Install stop (45), seat assembly (44) (Teflon on seat assembly toward cavity), and inlet support (50) on inlet poppet (51).

(4) On regulator 19-9021932-2, install backup washers (38, 40) on inlet retainer (49).

(5) On regulator 19-9021932-3, install backup washer (40) on inlet retainer (49).

(6) Lubricate (Method J) O-rings (39, 41) and install O-rings on inlet retainer (49).

(7) If 2 slugs (37) were removed, press slugs into inlet retainer (49).

(8) Lubricate (Method W) end of inlet poppet (51) that will protrude into inlet retainer (49).

(9) Install inlet retainer (49) and attached parts onto inlet poppet (51) and attached parts; then insert the assembly into inlet metering valve cavity. Tighten inlet retainer fingertight.

(10) Lubricate (Method W) inlet pin (48) and insert inlet pin into inlet retainer (49).

(11) Tighten inlet retainer (49) with wrench TK2353 until retainer is secure and parts bottom.

g. Install dome metering valve in pin and body assembly (67) of control element (31) as follows:

(1) Install washer (47) and spring (46) in dome metering valve cavity.

(2) Lubricate (Method J) O-ring (39) and install O-ring in top shelf of dome metering valve cavity.

CAUTION

Poppet and support assembly (42) are matched parts and fit together tightly. Take care not to bend poppet when parts are separated.

(3) Separate poppet and support assembly (42); then reassemble with stop (45), seat assembly (44) (Teflon on seat assembly toward cavity), and shims (43) (install same quantity of shims and shim thickness as was removed or as required to obtain proper adjustment).

(4) On regulator 19-9021932-2, install backup washers (38, 40) on dome retainer (36).

(5) On regulator 19-9021932-3, install backup washer (40) on dome retainer (36).

(6) Lubricate (Method J) O-rings (39, 41) and install O-rings on dome retainer (36).

(7) If 2 slugs (37) were removed, press slugs into dome retainer (36).

(8) Lubricate (Method W) end of poppet and support assembly (42) that will protrude into dome retainer (36).

(9) Install dome retainer (36) and attached parts onto poppet and support assembly (42) and attached parts; then insert as an assembly into dome metering valve cavity. Tighten dome retainer fingertight.

(10) Lubricate (Method W) dome pin (35) and insert dome pin into dome retainer (36).

(11) Tighten dome retainer (36) with wrench TK2353 until retainer is secure and parts bottom.

h. Install control head (20) in regulator element (21) as follows:

(1) Lubricate (Method J) O-ring (32) and install O-ring and backup washer (33) on pin and body assembly (67) of control element (31).

(2) Lubricate (Method J) O-rings (17) and install O-rings on bushing (34).

(3) Insert bushing (34) in cavity of pin and body assembly (67) of control element (31) or regulator element (21), as applicable, with screen end of bushing on regulator element end.

(4) Install pin and body assembly (67) of control element (31) with attaching parts in regulator element (21).

(5) If spring (29) was removed, install spring and washer (30) on actuator assembly (28); then install actuator assembly and attached parts onto pin and body assembly (67) of control element (31) with spring arms positioned over pin.

(6) Lubricate shaft of actuator assembly (28) where shaft will protrude through screw assembly (26).

(7) If slug (25) was removed, press slug into housing (24).

(8) Install housing (24) over pin and body assembly (67) and into regulator element (21). Screw housing into regulator element until housing bottoms.

(9) If screw assembly (26) was removed and slugs (27) were removed, press 4 slugs in screw assembly; then install screw assembly in housing (24) with wrench TK4160. Adjust screw assembly to permit actuator assembly (28) to move in or out approximately 0.005 inch.

(10) Install washer shims (23) as required to take up gap between retaining ring (22) and housing (24) when retaining ring is installed; then install retaining ring.

i. If nameplate (19) was removed, install nameplate with 4 screws (18).

j. On regulators 19-9021932-1 and 19-9021932-2, install pressure limit valve in body and pin assembly (86) as follows:

(1) Lubricate (Method J) O-rings (15, 17) and install O-rings in gland (16).

(2) Insert gland (16) with O-rings (15, 17) in limit valve cavity with chamfer on gland toward cavity.

(3) Install retainer (14) (with countersink toward poppet), guide (13), and screw (12). Securely tighten screw (12) with screwdriver T11245, or equivalent.

(4) Insert poppet (11) in guide (13); then install washer (10), spring (9), and screw (8). Tighten screw with a 5/32-inch hex wrench until top of screw is flush with pin and housing assembly (86).

NOTE

Pressure limit valve adjustment will be made during regulator testing.

k. On regulator 19-9021932-3, lubricate (Method J) O-ring (17B) and (Method A) threads of plug (17A); then install plug and O-ring in body and pin assembly (86). Torque plug to 40-65 in-lb.

l. Install plate (7) and secure plate with screw (6). Tighten screw with a 3/32-inch hex wrench.

m. Complete regulator assembly after regulator testing as follows:

(1) Install plate (5) and secure plate with 2 screws (4).

(2) Install handle (3). Hold handle and install nut (2). Tighten nut sufficiently to secure handle in position.

(3) Press in button plug (1).

n. Safetywire plug (17A) and vent fitting (68) with lockwire MS20995C-20. If a tag was removed from the regulator, reinstall same tag as was removed.

10-48H. ASSEMBLING REGULATOR 19-9021932-5. (See figure 10-14B.) All parts must meet cleaning requirements outlined in paragraph 10-48E. The lubricant used in this procedure is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants are specified in section I.

a. Install regulator parts into body (84) as follows:

(1) Lubricate (Method J) O-ring (83), then install O-ring, support seat (82), poppet seat (81), and screen (80).

(2) Lubricate (Method J) O-rings (77, 78). Install O-ring (78) in seat retainer (76) and O-ring (77) in body (84).

(3) Install seat retainer (76) and poppet (79).

(4) Install spring bushing (75), spring (74), and retainer and screen assembly (73). Tighten retainer and screen assembly until it bottoms securely.

(5) Safetywire retainer and screen assembly (73) to body (84) with lockwire (71). Safetywire tag (72) to retainer and screen assembly (73) with lockwire (71).

(6) Lubricate (Method J) O-ring (70) and install O-ring in piston (66).

(7) Lubricate (Method J) O-ring (67) and install O-ring on piston (66).

(8) Insert retainer (68) and seat (69) in piston (66) and install piston in body (84).

b. Lubricate (Method J) O-rings (65) and install O-rings on bushing (64); then install bushing in body (84).

c. Lubricate (Method J) O-rings (34, 62); then install O-rings and backup washer (63) on pin and adapter assembly (16).

d. Install pin and adapter assembly (16) on body (84) and secure with 8 screws (61). Tighten screws until secure.

e. If new nameplate is required, install nameplate (59) with adhesive (60).

NOTE

Steps j through m may be performed at this time to permit using body (84) as a holding device for assembling parts of control element (26).

f. Install panic vent valve in pin and body assembly (58) of control element (26) as follows:

(1) Install panic spring (57) and panic poppet (56).

(2) Lubricate threads of retainer (54) and install gasket seal (55) and retainer over panic poppet (56). Tighten retainer securely with screwdriver T11236, or equivalent.

(3) Install clip spring (53) and position spring tab in slot.

g. Install bleed orifice in pin and body assembly (58) of control element (26) as follows:

(1) Lubricate (Method W) pin of pin and housing assembly (52).

(2) Install pin and housing assembly (52) in bleed orifice cavity with pin groove inserted in hole in housing.

(3) Lubricate (Method W) large end of spring guide (51) and install spring guide and orifice spring (50) in bleed orifice cavity.

(4) Lubricate (Method A) threads of setscrew (48), insert orifice washer (49) in cavity of setscrew, and install setscrew over orifice spring (50). Make sure that orifice spring is in cavity of setscrew; then tighten setscrew securely with a 5/32-inch hex wrench.

h. Install inlet metering valve in pin and body assembly (58) of control element (26) as follows:

(1) Install washer (42) and inlet spring (47) in inlet metering valve cavity.

(2) Lubricate (Method J) O-ring (34) and install O-ring in top shelf of inlet metering valve cavity.

(3) Install stop (40), seat assembly (39) (Teflon on seat assembly toward cavity), and inlet support (45) on inlet poppet (46).

(4) Lubricate (Method J) O-rings (34, 35) and install O-rings and backup washer (36) in inlet retainer (44).

(5) If 2 slugs (33) were removed, press slugs into inlet retainer (44).

(6) Lubricate (Method W) end of inlet poppet (46) that will protrude into inlet retainer (44).

(7) Install inlet retainer (44) and attached parts onto inlet poppet (46) and attached parts; then insert as an assembly into inlet metering valve cavity. Tighten inlet retainer fingertight.

(8) Lubricate (Method W) inlet pin (43) and insert inlet pin into inlet retainer (44).

(9) Tighten inlet retainer (44) with wrench TK2353 until retainer is secure and parts bottom.

i. Install dome metering valve in pin and body assembly (58) of control element (26) as follows:

(1) Install washer (42) and spring (41) in dome metering valve cavity.

(2) Lubricate (Method J) O-ring (34) and install O-ring in top shelf of dome metering valve cavity.

CAUTION

Poppet and support assembly (37) are matched parts and fit together tightly. Take care not to bend poppet when parts are separated.

(3) Separate poppet and support assembly (37); then reassemble with stop (40), seat assembly (39) (Teflon on seat assembly toward cavity), and shims (38) (install same quantity of shims and shim thickness as was removed or as required to obtain proper adjustment).

(4) Lubricate (Method J) O-rings (34, 35) and install O-rings and backup washer (36) on dome retainer (32).

(5) If 2 slugs (33) were removed, press slugs into dome retainer (32).

(6) Lubricate (Method W) end of poppet and support assembly (37) that will protrude into dome retainer (32).

(7) Install dome retainer (32) and attached parts onto poppet and support assembly (37) and attached parts; then insert as an assembly into dome metering valve cavity. Tighten dome retainer fingertight.

(8) Lubricate (Method W) dome pin (31) and insert dome pin into dome retainer (32).

(9) Tighten dome retainer (32) with wrench TK2353 until retainer is secure and parts bottom.

j. Lubricate (Method J) O-rings (30) and install O-rings on bushing (29).

k. Insert bushing (29) in cavity of pin and body assembly (58) of control element (26) or pin and adapter assembly (16), as applicable, with screen end of bushing on pin and adapter assembly end.

l. Lubricate (Method J) O-ring (27) and install O-ring and backup washer (28) on pin and body assembly (58) of control element (26).

m. Install control element (26) in pin and adapter assembly (16).

n. Assemble control head (15) as follows:

(1) Install spring (24) and washer (25) on actuator assembly (23); then install actuator assembly and attached parts onto pin and body assembly (58) of control element (26) with spring arms positioned over pin.

(2) Lubricate shaft of actuator assembly (23) where shaft will protrude through screw assembly (21).

(3) If slug (20) was removed from housing (19), press slug into housing.

(4) Install housing (19). Screw housing into pin and adapter assembly (16) until housing bottoms.

(5) If screw assembly (21) was removed and slugs (22) were removed, press 4 slugs in screw assembly; then install screw assembly in housing (19) with wrench TK4160. Adjust screw assembly to permit actuator assembly (23) to move in or out approximately 0.005 inch.

(6) Install washer shims (18) as required to take up gap between retaining ring (17) and housing (19) when retaining ring is installed; then install retaining ring.

o. Install pressure limit valve in pin and adapter assembly (16) as follows:

(1) Install omniseal (13) and support (12).

(2) If 2 slugs (11) were removed, press slugs into retainer (10).

(3) Install retainer (10) with screwdriver T11245, or equivalent. Tighten retainer until it bottoms.

(4) Insert poppet (9) in retainer (10); then install spring (8), washer (7), and setscrew (6). Tighten setscrew with a 5/32-inch hex wrench until top of setscrew is flush with pin and adapter assembly (16).

NOTE

Pressure limit valve adjustment will be done during regulator testing.

p. Complete regulator assembly after regulator testing as follows:

(1) Install plate (5) and secure plate with 2 screws (4).

(2) Install handle (3). Hold handle and install nut (2). Tighten nut sufficiently to secure handle in position.

(3) Press in button plug (1).

10-48J. TESTING. The test procedure requires a source of regulated gaseous nitrogen (MIL-P-27401), leak-test compound (MIL-L-25567), or equivalent, and a hand valve, gages, hoses, a relief valve, and a solenoid valve as specified in test setup. The regulator must be firmly secured during testing. See figure 10-14D for test setup.

a. Install regulator in test setup. On regulators 19-9021932-3 and 19-9021932-5, install a relief valve, adjusted to relieve at 10 percent above maximum regulator outlet pressure listed, in test setup outlet line when supply pressure to test setup could exceed 5,000 psig.

b. Close bypass valve.

c. Position regulator handle on regulator to full vent position and allow it to return to neutral.

d. Verify that solenoid valve is deenergized (closed).

e. On regulators 19-9021932-1, 19-9021932-2, and 19-9021932-5, adjust pressure limit valve to relieve within pressure listed as follows:

Regulator 19-9021932-1
190 (+50, -0) psig

Regulator 19-9021932-2
1,500 ±100 psig

Regulator 19-9021932-5
4,500 ±100 psig

(1) Pressurize regulator inlet as indicated on pressure gage 1 to upper limit of relief pressure listed.

(2) Slowly turn regulator handle to load position and verify a pressure buildup on pressure gage 2; then allow handle to return to neutral and verify that pressure locks up.

(3) If regulator operation is satisfactory in substep 2, continue to load regulator in one-quarter increments of pressure listed until maximum regulated pressure is achieved. Audibly verify that bleed orifice vents during pressure buildup. At each pressure level, use leak-test compound and verify no external leakage.

(4) If pressure limit valve venting occurs before maximum regulated pressure is within limits of pressure listed, use a 5/32-inch hex wrench and rotate pressure limit valve adjusting screw in small increments clockwise until venting occurs and pressure regulator outlet pressure increases within limits listed.

(5) If pressure limit valve does not vent and maximum regulated outlet pressure is within limits listed, use a 5/32-inch hex wrench and rotate pressure limit valve adjusting screw in small increments counterclockwise until venting occurs with pressure regulator outlet pressure still within limits listed.

(6) Turn regulator handle to vent position and vent pressure gage 2 to zero. On regulator 19-9021932-5, turn regulator handle to extreme vent position and verify that panic vent valve dumps pressure faster than normal venting through dome metering valve.

(7) Repeat substeps 2 through 6 until pressure limit valve is adjusted and regulator operation repeatability is verified.

(8) Depressurize regulator inlet to below 600 psi as indicated on pressure gage 1.

f. Energize (open) solenoid valve.

g. Pressurize regulator inlet as indicated on pressure gage 1 to 600 ±10 psi, 1,500 ±50 psi, 3,000 ±100 psi, 4,000 ±100 psi, and 4,900 ±100 psi. At each pressure level check for regulator internal leakage at solenoid valve outlet and using leak-test compound (MIL-L-25567), or equivalent, check regulator for external leakage. Leakage is not allowable.

h. Deenergize (close) solenoid valve.

NOTE

In the following step, if regulator adjustment sensitivity is not as desired, perform step j.

i. Adjust regulator outlet pressure, as indicated on pressure gage 2, to pressures listed. At each pressure level use leak-test compound (MIL-L-25567) and check regulator for external leakage. Leakage is not allowable.

Regulator 19-9021932-1	Regulator 19-9021932-2
50 ±2	50 ±2
90 ±4	500 ±10
130 ±4	950 ±50
160 ±4	1,350 ±50

Regulator 19-9021932-3	Regulator 19-9021932-5
50 ±2	50 ±2
1,650 ±50	1,400 ±50
4,000 ±100	2,000 ±100
4,800 ±100	4,200 ±100

j. If regulator adjustment sensitivity must be changed, reduce outlet pressure to zero, remove handle, and adjust screw assembly (26, figure 10-14A or 21, figure 10-14B) with wrench TK4160, or equivalent, (clockwise to increase sensitivity and counterclockwise to decrease sensitivity) while manipulating actuator assembly (28, figure 10-14A or 23, figure 10-14B); then repeat step i and check adjustment sensitivity. Repeat adjustment until desired sensitivity is obtained. If sensitivity cannot be obtained, disassemble dome metering valve (paragraphs 10-48C or 10-48D, as required) and change quantity and/or thickness of shims (43, figure 10-14A or 38, figure 10-14B), as required to obtain desired sensitivity. Adding shims or increasing shim thickness slows down rate of pressure rise and removing shims or decreasing shim thickness increases rate of pressure rise.

k. On regulators 19-9021932-1, 19-9021932-2, and 19-9021932-5, adjust regulator outlet pressure as indicated on pressure gage 2 to pressures listed and verify that pressure limit valve vents within limits. Readjust setting, if required, as outlined in step e.

Regulator 19-9021932-1
190 (+50, -0) psig

Regulator 19-9021932-2
1,500 ±100 psig

Regulator 19-9021932-5
4,500 ±100 psig

l. Turn regulator handle to vent position and depressurize pressure gage 2 to zero.

m. Adjust regulator outlet pressure, as indicated on pressure gage 2, to pressures listed, and at each pressure level perform the following:

Regulator 19-9021932-1	Regulator 19-9021932-2
50 ±2	50 ±2
90 ±4	500 ±10
130 ±4	950 ±50
160 ±4	1,350 ±50

Regulator 19-9021932-3	Regulator 19-9021932-5
50 ±2	50 ±2
1,650 ±50	1,400 ±50
4,000 ±100	2,000 ±100
4,800 ±100	4,200 ±100

(1) Cycle solenoid valve 5 times and verify that pressure gage 2 indication returns to within ±2 percent of lockup pressure after each cycle when pressure stabilizes.

(2) After the 5th cycle, verify that indication on pressure gage 2 remains constant within ±2 percent of lockup pressure for 5 minutes.

(3) Slowly open bypass valve and verify that regulator vent valve vents at a maximum of 120 percent of actual lockup pressure; then close bypass valve and verify that vent valve reseats at a maximum of 88 percent of initial lockup pressure.

n. Turn regulator handle to vent position and depressurize pressure gage 2 to zero.

o. Depressurize regulator inlet to zero as indicated on pressure gage 2.

p. Complete regulator assembly as outlined in paragraph 10-48G or 10-48H, as applicable.

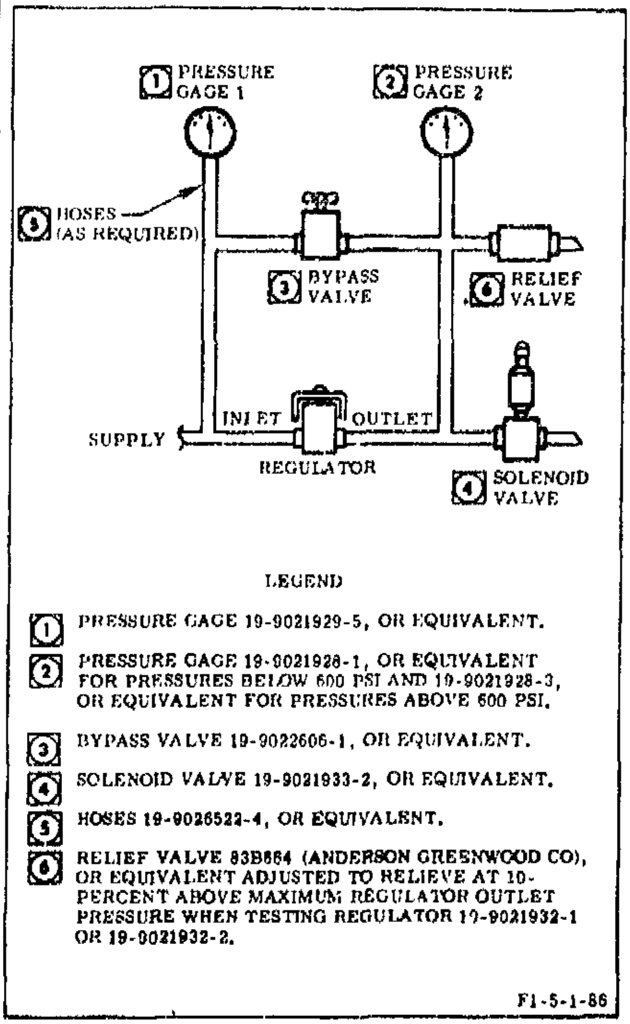


Figure 10-14D. Regulator Test Setup

10-49. HAND VALVE 19-9022606.

10-50. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the hand valves.

10-51. DISASSEMBLING. Disassemble the hand valve, as required, to accomplish necessary repair and/or replacement. Sleeve (16) contains left-hand threads. See figure 10-15 for index and part numbers.

10-52. CLEANING. Clean hand valve as outlined in section I.

10-53. INSPECTING AND REPAIRING. Inspecting the hand valve determines whether the individual parts have been damaged by mishandling or wear. Inspects the parts for cleanness, damage, and wear. Repair of hand valve is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of hand valve.

10-54. ASSEMBLING. All parts must meet cleaning requirements as outlined in paragraph 10-52. Lubricant used during assembly is FS1281 grease (Dow Corning Corp) unless otherwise specified. Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods.

a. Lubricate (Method J) and install packing (12) onto retainer (11). Lubricate (Method A) threads of retainer and install into body (13). Torque retainer to 25-35 ft-lb. On hand valve 19-9022606-2, torque retainer to 35-45 ft-lb.

b. Lubricate (Method A) threads of retainer (11) and install locknut (10) onto retainer.

NOTE

Steps c through h apply to hand valve 19-9022606-1.

c. Install seat packing (9) and screw (8) into stem (7). Torque screw (8) to 11-13 in-lb.

d. Apply (Method A) 3 streaks of Fluorolube grease GR-362 (Hooker Chemical Corp) flush with thread peaks, 1/8- to 1/4-inch wide, 120 degrees apart, to threads of stem (7). For periodic lubrication of valve, apply 2 streaks.

e. Fully screw stem (7) into retainer (11), remove, and repeat step d.

f. Repeat step e until an even film of grease covers all stem threads. Do not allow grease to contact seat packing (9) or screw (8).

g. Lubricate (Method J) backup ring (4), stem packing (5), and install spacers (6) stem packing (5), and backup ring (4) onto stem (7).

h. Lubricate (Method A) threads of sleeve (3) and screw sleeve into retainer (11). Torque sleeve (3) to 10-20 ft-lb.

NOTE

Steps i through o apply to hand valve 19-9022606-2.

i. Install seat packing (9) and screw (8) into stem (17). Torque screw (8) to 11-13 in-lb.

j. Apply (Method A) 3 streaks of Fluorolube grease GR-362 (Hooker Chemical Corp) flush with thread peaks, 1/8- to 1/4-inch wide, 120 degrees apart, to thread of stem (17). For periodic lubrication, apply 2 streaks.

k. Fully screw stem (17) into sleeve (16), remove, and repeat step j.

l. Repeat step k until an even film of grease covers all stem threads. Do not allow grease to contact seat packing (9) or screw (8).

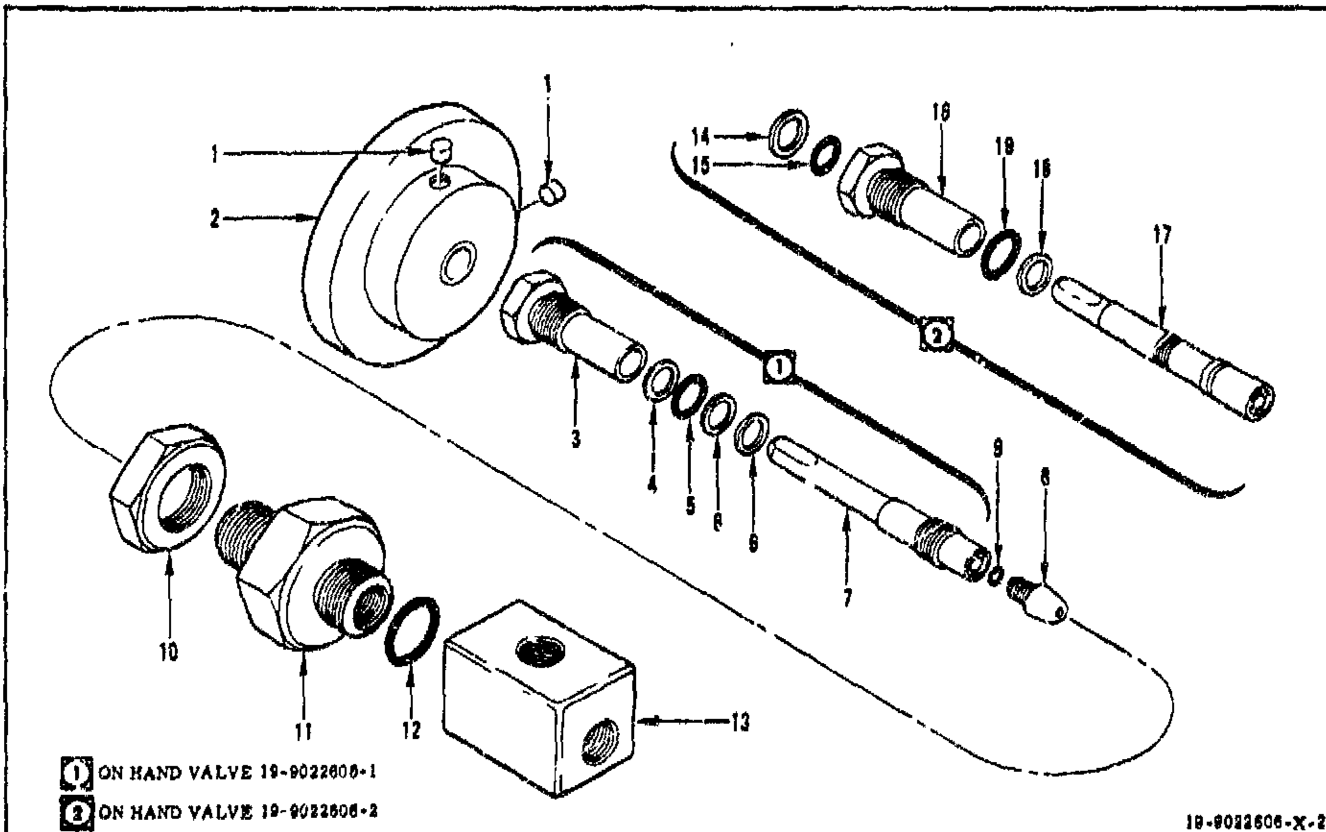
m. Lubricate (Method J) sleeve packing (19) and install onto sleeve (16). Lubricate (Method J) stem packing (18) and install onto stem (17).

n. Screw stem (17) into sleeve (16) and install sleeve into retainer (11). Torque sleeve (16) to 15-25 ft-lb.

o. Lubricate (Method J) stem packing (15) and backup ring (14) and install onto stem (17).

p. Install control knob (2) and secure with setscrews (1).

q. Install closures in open ports.



Index No.	Part No.	Description	Index No.	Part No.	Description
1		Setscrew	11		Retainer
2		Control Knob	12	MS28778-6	Retainer Packing
3		Sleeve		MS28778-8	Retainer Packing
4	MS28774-10 (a)	Backup Ring	13		Body
5	MS28775-010	Stem Packing	14	MS28774-10 (a)	Backup Ring
6		Spacer	15	MS28775-010	Stem Packing
7		Stem	16		Sleeve
8		Screw	17		Stem
9		Seat Packing	18	MS28775-010 (a)	Stem Packing
10		Locknut	19	MS28778-6	Sleeve Packing

(a) Alternate for vendor part number

Figure 10-15. Hand Valve 19-9022606--Exploded View

10-55. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a source of gaseous nitrogen (MIL-P-27401) with a controlled pressure of 0-5,000 psig and leak-test compound (MIL-L-25567 or equivalent). The hand valve must be firmly secured during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Remove closures, connect gaseous nitrogen (MIL-P-27401) source to inlet port of hand valve, and close valve.

b. Increase gaseous nitrogen to 3,000 psig and apply leak-test compound to outlet port and around retainer, sleeve, and stem. No leakage is allowable.

c. Decrease gaseous nitrogen pressure to zero and install pressure plug into outlet port.

d. Slowly open hand valve and repeat step b.

e. Decrease gaseous nitrogen pressure to zero, remove valve from test setup, and install closures in open ports.

10-56. HAND VALVE 19-9026501.

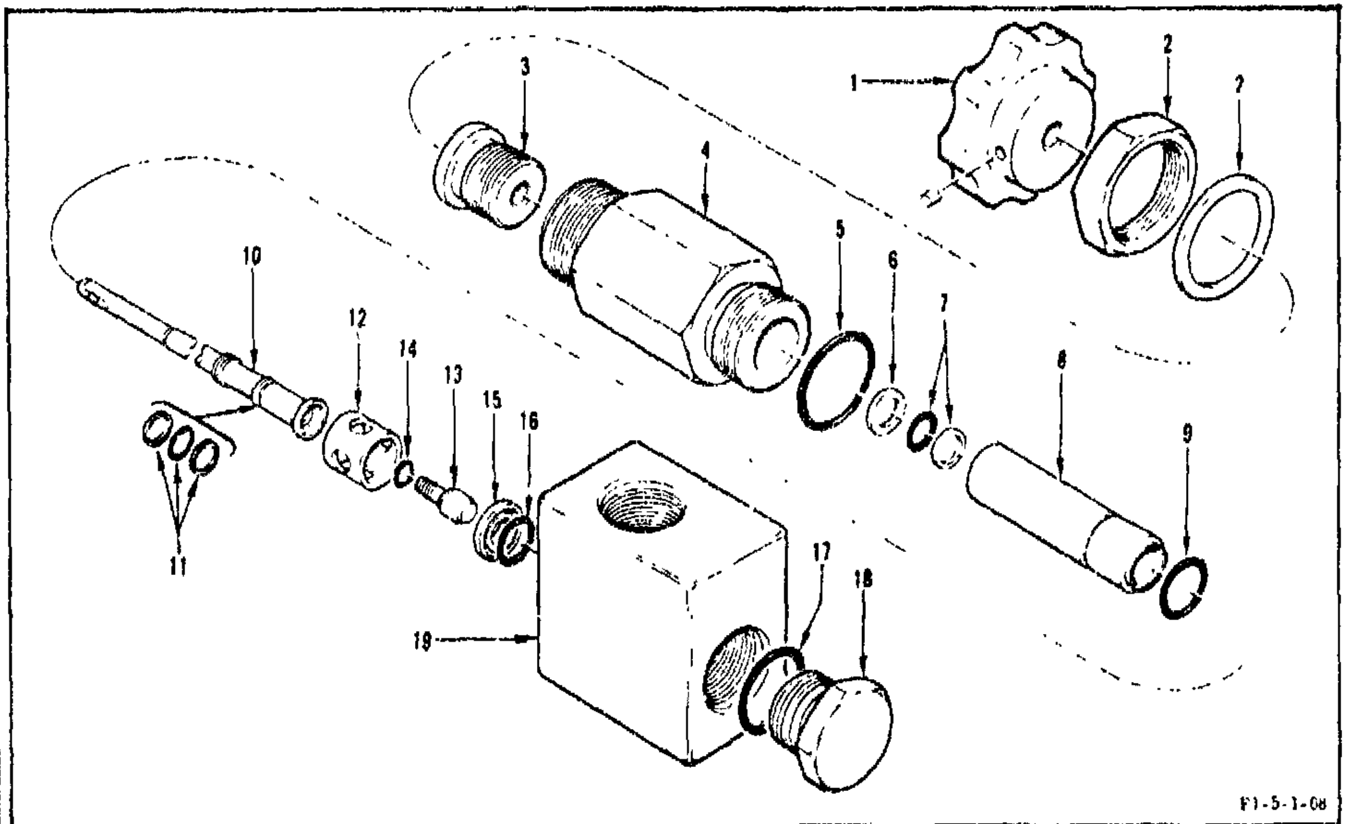
10-57. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the hand valves.

10-58. DISASSEMBLING. Disassemble the hand valve, as required, to accomplish necessary repair and/or replacement. Retainer (3) has left-hand threads. See figure 10-15A for index and part numbers.

10-59. CLEANING. Clean hand valve as outlined in section I.

10-60. INSPECTING AND REPAIRING. Inspecting the hand valve determines whether the individual parts have been damaged by mishandling or wear. Inspect the parts for cleanness, damage, and wear. Repair of hand valve is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of hand valve.

10-61. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-59. Lubricant used during assembly is



Index No.	Part No.	Description
1		Knob
		Set screw
2		Nut
		Washer
3		Retainer
4		Body
5	MS28778-16	Packing
6		Washer
7	MS28775-010	Packing
	AS140-01-10	Ring
8		Sleeve
9	MS29513-18	Packing
10		Stem
11	MS29513-12	Packing
	AS140-01-012	Ring
12		Sleeve
13		Screw
14		Seat
15		Seat
16	MS29513-15	Packing
17	MS28778-12	Packing
18	AN814-12C	Plug
19		Body

Figure 10-15A. Hand Valve 19-9026501--Exploded View grease FS1281 (Dow Corning Corp) unless otherwise specified. Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods. See figure 10-15A for index and part numbers.

a. Lubricate (Method J) and install packing (16) in groove of seat (15) and install seat into body (19).

b. Install seat (14) and screw (13) into stem (10). Torque screw (13) to 37-43 in-lb.

c. Lubricate (Method J) backup rings and packing (11) and install on stem (10).

d. Apply (Method A) 3 streaks of Fluorolube grease GR-362 (Hooker Chemical Corp) flush with thread peaks, 1/8- to 1/4-inch wide, 120 degrees apart, to thread of stem (10). (For periodic lubrication, apply 2 streaks.)

e. Fully screw stem (10) into sleeve (8), remove, and repeat step d.

f. Repeat step e until an even film of grease covers all stem threads. Do not allow grease to contact seat (14) or screw (13).

g. Install sleeve (12) into body (19) onto seat (15).

h. Lubricate (Method J) packing (5) and install on body (4).

i. Lubricate (Method A) threads of body (4) and install into body (19). Torque body (4) to 100-120 ft-lb.

j. Lubricate (Method J) packing (9), install onto sleeve (8), and install stem (10) and sleeve (8) into body (4). Make sure sleeve (8) is seated on sleeve (12).

k. Lubricate (Method J) packing and backup ring (7) and install over stem (10) into groove of sleeve (8).

l. Install washer (6) and retainer (3) into body (4). Torque retainer (3) to 25-35 ft-lb.

m. Install washer and nut (2) onto body (4). Tighten fingertight.

n. Install knob (1) on stem (10) and secure with setscrew.

o. Lubricate (Method J) packing (17), install onto plug (18), and install plugs into ports of body (19). Torque plug (18) to 300-500 in-lb.

10-62. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a source of hydraulic fluid with a controlled pressure of 0-5,000 psig. The hand valve must be firmly secured during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Remove plugs from inlet and outlet ports, and connect fuel source to inlet port of valve.

b. Close valve and increase pressure to 3,000 psig. Check for internal leakage at outlet port. No leakage is allowable.

c. Decrease pressure to zero, install plug in outlet port, and open valve.

d. Increase pressure to 3,000 psig and check for external leakage. No leakage is allowable.

e. Decrease pressure to zero, remove valve from test setup, and install plugs in open ports.

10-63. HAND VALVE 19-9021936.

10-64. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the hand valves.

10-65. DISASSEMBLING. Disassemble the hand valve, as required, to accomplish necessary repair and/or replacement. Bushing (3) and bonnet (5) have left-hand threads. See figure 10-15B for index and part numbers.

10-66. CLEANING. Clean hand valve as outlined in section I.

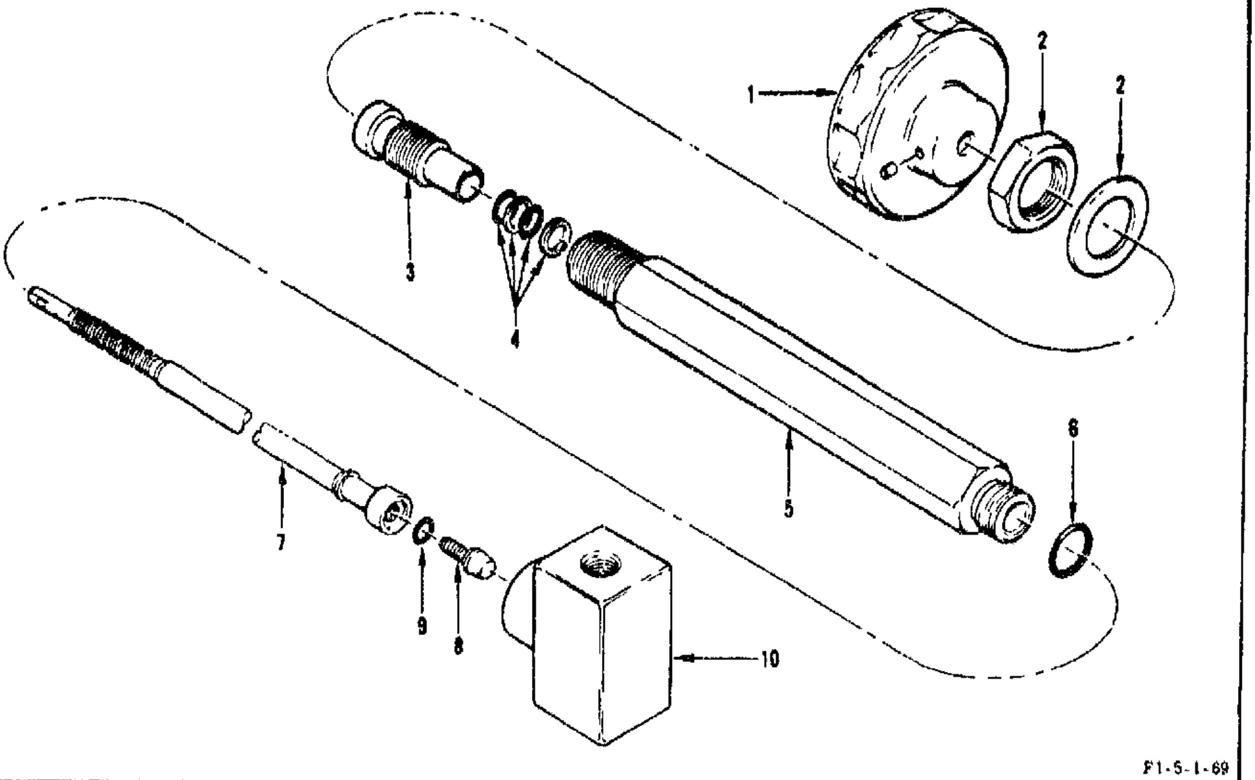
10-67. INSPECTING AND REPAIRING. Inspecting the hand valve determines whether the individual parts have been damaged by mishandling or wear. Inspect the parts for cleanness, damage, and wear. Repair of hand valve is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of hand valve.

10-68. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-66. Lubricant used during assembly is lubricant grease RB0140-012 (Rocketdyne) unless otherwise specified. Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods. See figure 10-15B for index and part numbers.

a. Install seat (9) and screw (8) into stem (7). Torque screw (8) to 27-33 in-lb.

b. Apply (Method A) 3 streaks of Fluorolube grease GR-362 (Hooker Chemical Corp) flush with thread peaks, 1/8- to 1/4-inch wide, 120 degrees apart, to threads of stem (7). (For periodic lubrication, apply 2 streaks.)

c. Fully screw stem (7) into bonnet (5), remove, and repeat step b.



Index No.	Part No.	Description	Index No.	Part No.	Description
1		Knob	5		Bonnet
		Set screw	6	VD-261-0123-0010	Packing
2		Nut	7		Stem
		Washer	8		Screw
3		Bushing	9	AS113-65-110	Seat
4	555122-1	Packing	10		Body
	555122-2	Packing			
	555122-3	Packing			
	555124	Ring			

Figure 10-15B. Hand Valve 19-J021936--Exploded View

d. Repeat step c until an even film of grease covers all stem threads. Do not allow grease to contact seat packing (9) or screw (8).

e. Lubricate (Method J) and install packing (6) onto bonnet (5). Lubricate (Method A) threads of bonnet and install into body (10). Torque bonnet to 45-55 ft-lb.

f. Lubricate (Method J) packings and ring (4) and install ring first, then packings, over stem (7) until they bottom in bonnet (5).

g. Lubricate (Method A) threads of bushing (3) and install into bonnet (5).

h. Install washer and nut (2) onto bonnet (5). Tighten fingertight.

i. Install knob (1) on stem (7) and secure with setscrew.

j. Install closures in open ports

10-69. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a source of gaseous nitrogen (MIL-P-27401) with a controlled pressure of 0-5,000 psig and leak-test compound (MIL-L-25567 or equivalent). The hand valve must be firmly secured during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Remove closures, connect gaseous nitrogen (MIL-P-27401) source to inlet port of hand valve, and close valve.

b. Increase gaseous nitrogen to 3,000 psig and apply leak-test compound to outlet port and around bonnet, bushing, and stem. No leakage is allowable.

c. Decrease gaseous nitrogen pressure to zero and install pressure plug into outlet port.

d. Slowly open hand valve and repeat step b.

e. Decrease gaseous nitrogen pressure to zero, remove valve from test setup, and install closures in open ports.

10-70. HAND VALVE 9259T-1PP.

10-71. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the hand valves.

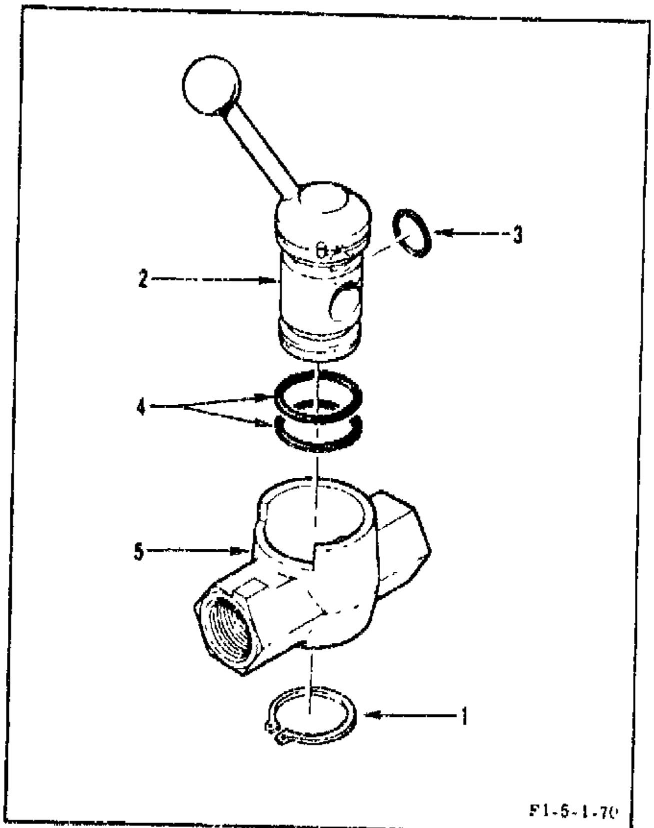
10-72. DISASSEMBLING. Disassemble the hand valve, as required, to accomplish necessary repair and/or replacement. See figure 10-15C for index and part numbers.

10-73. CLEANING. Clean hand valve as outlined in section I.

10-74. INSPECTING AND REPAIRING. Inspecting the hand valve determines whether the individual parts have been damaged by mishandling or wear. Inspect the parts for cleanness, damage, and wear. Repair of hand valve is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of hand valve.

10-75. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-73. Lubricant used during assembly is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods. See figure 10-15C for index and part numbers.

a. Lubricate (Method L) O-rings (3, 4) and install on plug (2).



Index No.	Part No.	Description
1		Lockring
2		Plug
3	5004-49	O-ring
4	5007-59	O-ring
5		Body

Figure 10-15C. Hand Valve 9259T-1PP--Exploded View

b. Install plug (2) into body (5) and secure with lockring (1).

c. Install closures in open ports.

10-76. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a regulated source of gaseous nitrogen (MIL-P-27401) with a controlled pressure of 0-150 psig and leak-test compound (MIL-L-25567 or equivalent). The hand valve must be firmly secured during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Remove closures, connect gaseous nitrogen (MIL-P-27401) source to inlet port of hand valve, and close valve.

b. Increase gaseous nitrogen to 150 psig (maximum) and apply leak-test compound to outlet port and around top and bottom of plug. No leakage is allowable.

c. Decrease gaseous nitrogen pressure to zero and install pressure plug into outlet port.

d. Slowly open hand valve and repeat step b.

e. Decrease gaseous nitrogen pressure to zero, remove valve from test setup, and install closures in open ports.

10-77. RELIEF VALVE 19-9021937 AND 19-9026587.

10-78. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the relief valves.

10-79. DISASSEMBLING. Disassemble relief valve, as required, to accomplish necessary repair and or replacement. Turn adjusting screw (2) counterclockwise to relieve tension on spring (7). Do not remove bonnet (5) with tension on spring (7). Remove blowdown ring (14), by reaching in outlet port of body (18) and unscrewing blowdown ring off of bushing (15). (See figure 10-15D for index and part numbers.)

10-80. CLEANING. Clean all metal parts as outlined in section I.

10-81. INSPECTING AND REPAIRING. Inspecting the valve determines whether the individual parts have been damaged by mishandling or wear. Inspect parts for cleanness, damage, and wear. Repair of relief valve is limited to replacement of parts contained in kit and chasing damaged threads that do not exceed 50 percent of one thread. Replacement of relief valve is required if parts not contained in kit are damaged or worn.

10-82. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-80. Lubricant used during assembly is sealant and antiseize compound RB0140-005 (Rocketdyne) for flat seals and lubricant grease RB0140-012 (Rocketdyne) for straight threads. Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. (See figure 10-15D for index and part numbers.)

CAUTION

Care must be taken when installing bushing in body, to prevent damage to bushing threads.

a. Lubricate (Method J) seal (16) and (Method A) threads of bushing (15), and install seal and bushing in body (18). Torque bushing to 22-26 ft-lb.

b. Thread blowdown ring (14) on bushing (15) to obtain 75 percent thread engagement.

c. Install disk (10), ball (9), spring follower (8), spring (7), and spring follower (6) in body (18). Make sure that spring follower (8) mates with ball (9) and spring follower (6) mates with adjusting screw (2).

d. Lubricate (Method J) seal (17) and (Method A) threads of body (18), and install seal (17) and bonnet (5) on body. Tighten bonnet to firmly seat seal.

e. Lubricate (Method A) threads of adjusting screw (2), and install locknut (3) on adjusting screw until nut bottoms on screw head.

f. Screw adjusting screw (2) in bonnet (5) one full turn after contact with spring follower (6).

g. Lubricate (Method J) seal (4) and (Method A) threads of bonnet (5), and install cap (1) on bonnet fingertight.

h. Lubricate (Method J) seal (12), and install washer (13), seal (12), and lockscrew (11) into body (18).

i. Install protective closures on inlet and outlet ports.

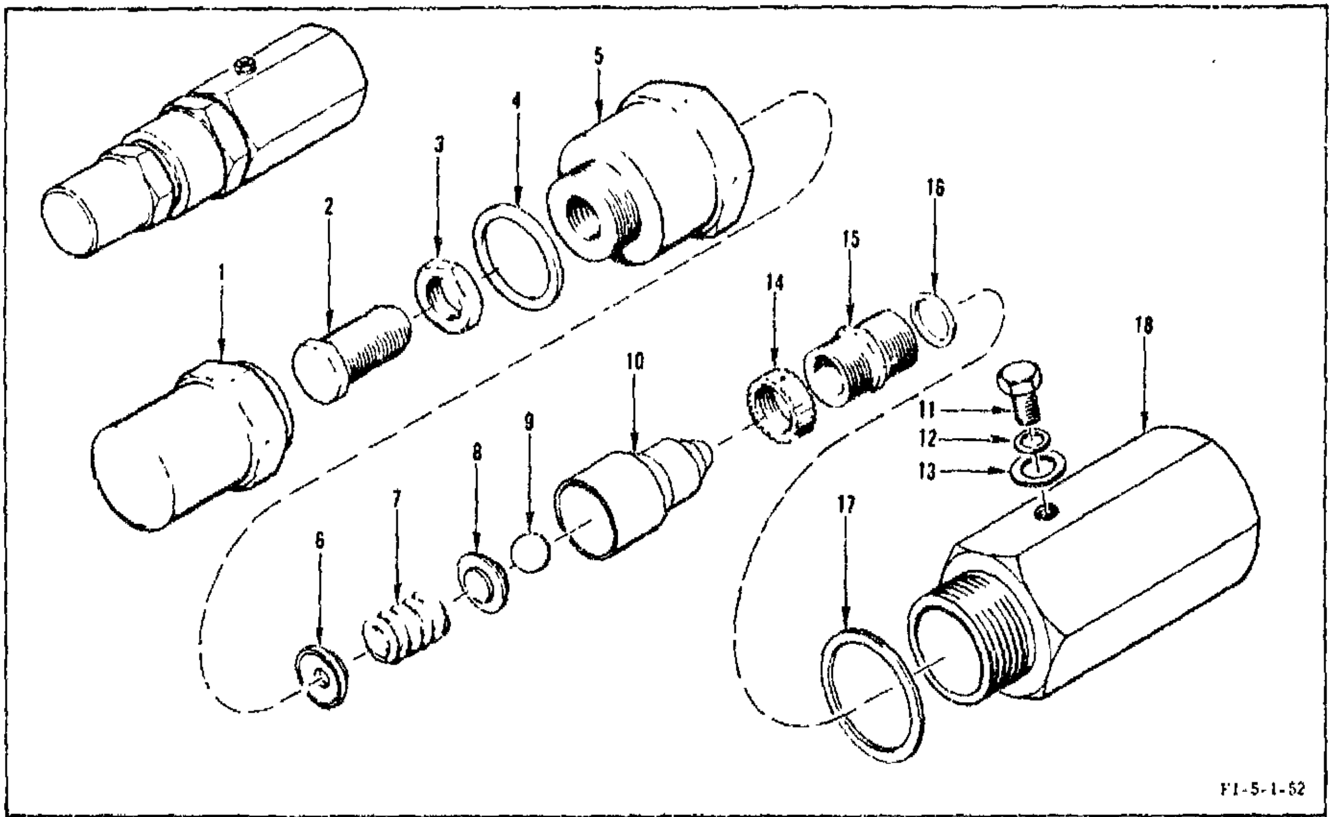
10-83. TESTING. Testing consists of testing start-to-leak, set, and reseat pressures of relief valves. Perform testing after repair and any time misuse or damage is suspected. Pressure must be gradually increased to check start-to-leak and set pressures, and decreased to check reseat pressure. Adjustment of the relief valve must be accomplished with no pressure applied and then repressurized to recheck adjustment. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Firmly secure relief valve, remove closures, and connect a source of gaseous nitrogen (MIL-P-27401) with a controlled pressure of 0-5,800 psig to inlet port.

b. Slowly increase pressure and record start-to-leak and set pressures. Decrease pressure and adjust adjusting screw (2), as necessary, to obtain settings specified in figure 10-15E.

c. Turn adjusting screw clockwise to increase set pressure and counterclockwise to decrease set pressure. After adjustment, hold adjusting screw (2) in place while the locknut (3) is being tightened. Tighten cap (1) to firmly seat seal.

d. Increase pressure to set pressure; then slowly decrease pressure, and record reseat pressure. Adjust blowdown ring (14), as necessary, to obtain settings specified in figure 10-15B. Repeat steps b and c.



Index No.	Kit No.	Description	Index No.	Kit No.	Description
1		Cap	10	(a)	Disk
2		Adjusting screw	11		Lockscrew
3		Locknut	12	(a)	Seal
4	(a)	Seal	13		Washer
5		Bonnet	14		Blowdown ring
6		Spring follower	15	(a)	Bushing
7		Spring	16	(a)	Seal
8		Spring follower	17	(a)	Seal
9		Ball	18		Body

(a) On valve 19-9021937-1 use kit RDDD-RK-1100S.
On valve 19-9021937-2 use kit RDCA-RK-1100C.
On valve 19-9021937-5 use kit RDEA-RK-1100S.
On valve 19-9021937-6 use kit RDEB-RK-1100S.
On valve 19-9021937-7 use kit RDEG-RK-1100S.
On valve 19-9021937-12 use kit RDEH-RK-1100S.
On valve 19-9021937-14 use kit RDJA-RK-1100S.
On valve 19-9021937-15 use kit RDJB-RK-1100S.
On valve 19-9021937-16 use kit RDJC-RK-1100S.
On valve 19-9021937-17 use kit RDJD-RK-1100S.
On valve 19-9021937-18 use kit RDJE-RK-1100S.
On valve 19-9021937-19 use kit RDJO-RK-1100S.
On valve 19-9021937-20 use kit RDJP-RK-1100S.
On valve 19-9021937-21 use kit RDJR-RK-1100S.
On valve 19-9026587-1 use kit RDJF-RK-1100S.
On valve 19-9026587-2 use kit RDJG-RK-1100S.
On valve 19-9026587-3 use kit RDJH-RK-1100S.
On valve 19-9026587-4 use kit RDJJ-RK-1100S.
On valve 19-9026587-5 use kit RDJK-RK-1100S.
On valve 19-9026587-6 use kit RDJL-RK-1100S.
On valve 19-9026587-7 use kit RDJM-RK-1100S.
On valve 19-9026587-8 use kit RDJN-RK-1100S.

Figure 10-15D. Relief Valve--Exploded View

Part Number	Start-to-Leak Pressure (psig) (Minimum)	Set Pressure (psig)	Reseat Pressure (psig) (Minimum)
19-9021937-1	162	170 ±6	153
19-9021937-2	1,258	1,325 ±40	1,190
19-9021937-5	5,225	5,500 ±165	4,950
19-9021937-6	1,000	1,050 ±30	950
19-9021937-7	100	105 ±5	95
19-9021937-12	300	315 ±10	285
19-9021937-14	1,900	1,995 (+60, -0)	1,795
19-9021937-15	1,490	1,575 (+47, -0)	1,410
19-9021937-16	3,580	3,780 (+113, -0)	3,400
19-9021937-17	4,360	4,620 (+139, -0)	4,160
19-9021937-18	3,620	3,828 (+115, -0)	3,450
19-9021937-19	1,150	1,210 (+36, -0)	1,090
19-9021937-20	522	550 (+17, -0)	495
19-9021937-21	100	100 (+3, -0)	95
19-9026587-1	2,320	2,440 (+75, -0)	2,195
19-9026587-2	2,875	3,024 (+95, -0)	2,720
19-9026587-3	3,040	3,202 (+100, -0)	2,880
19-9026587-4	2,895	3,050 (+95, -0)	2,745
19-9026587-5	4,360	4,620 (+140, -0)	4,160
19-9026587-6	4,190	4,410 (+135, -0)	3,970
19-9026587-7	3,820	4,022 (+125, -0)	3,620
19-9026587-8	1,490	1,575 (+48, -0)	1,410

Figure 10-15E. Relief Valve Test Requirements

e. Turn blowdown ring (14) clockwise to increase reseat pressure and counterclockwise to decrease reseat pressure. Adjustment is accomplished, through outlet port, by loosening lockscrew (11) and using a screwdriver in the serrations of the blowdown ring. Tighten lockscrew (11) after adjustment.

f. If screw (11) does not seat on seal (12), turn blowdown ring to permit end of screw to enter a serration of the ring.

g. Secure equipment, and install closures on inlet and outlet ports of relief valve.

10-84. FILTER 19-9026520, 19-9021905-1 AND 19-9021905-2.

10-85. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the filters.

10-86. DISASSEMBLING. Disassemble the filter, as required, to accomplish necessary repair and/or replacement. See figure 10-15F for index and part numbers.

10-87. CLEANING. Clean filter and element as outlined in section I.

10-88. INSPECTING AND REPAIRING. Inspecting the filter determines whether the individual parts have been damaged by mishandling or wear. Inspect the parts for cleanness, damage, and wear. Repair of filter is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of filter.

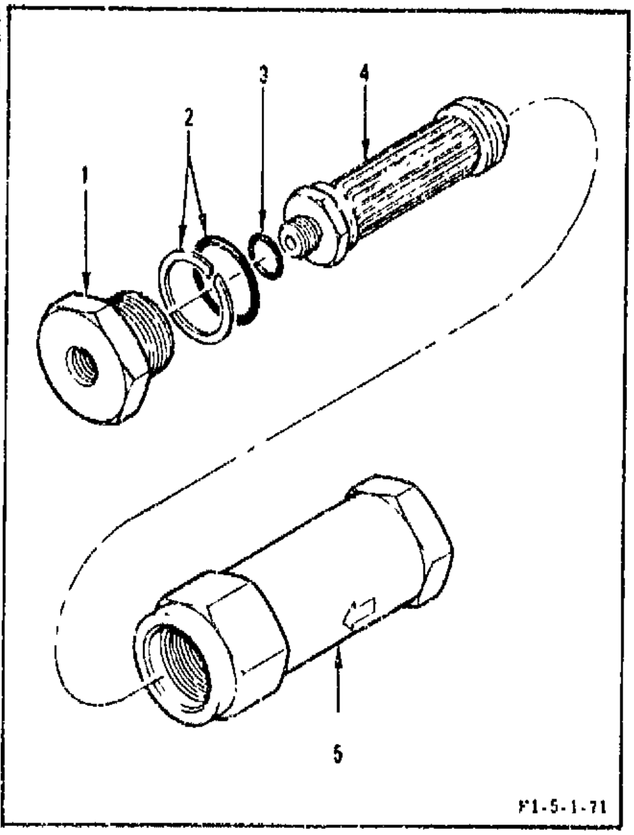
10-89. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-87. Lubricant used during assembly is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods. See figure 10-15F for index and part numbers.

a. Lubricate (Method J) O-ring and ring (2) and install onto plug (1).

b. Lubricate (Method J) O-ring (3) and install onto element (4), lubricate (Method A) threads of element (4), and install element into plug (1). Torque element to 6-8 ft-lb.

c. Lubricate (Method A) threads of plug (1) and install plug and element into case (5). Torque plug to 13-15 ft-lb.

d. Install closures in open ports.



Index No.	Part No.	Description
1		Plug
2	4213-20[a]	O-ring
	8213[a]	Ring
	4114-20[b]	O-ring
	8114[b]	Ring
	4118-20[c]	O-ring
	8118[c]	Ring
3	4112-20[a]	O-ring
	4011-20[b]	O-ring
	4111-20[c]	O-ring
4		Element
5		Case

(a) On filter 19-9026520
(b) On filter 19-9021905-1
(c) On filter 19-9021905-2

Figure 10-15F. Filter--Exploded View

10-90. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a regulated source of gaseous nitrogen (MIL-P-27401) with a controlled pressure of 0-3,000 psig and leak-test compound (MIL-L-25567 or equivalent). The filter must be firmly secured during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Remove closures, connect gaseous nitrogen (MIL-P-27401) source to inlet of filter, and install pressure plug in outlet port.

b. Increase pressure to 3,000 psig and apply leak-test compound at mating surface of plug and case. No leakage is allowable.

c. Decrease pressure to zero, remove filter from test setup, and install closures in open ports.

10-91. ROTAMETER 19-9026519.

10-92. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the rotameter.

10-93. DISASSEMBLING. Disassemble rotameter, as required, to accomplish necessary repair and/or replacement. The gland bolts (8) must be completely removed to free the metering tube. The metering tube and float must be handled with care to prevent breaking tube and damaging or losing the float. See figure 10-15G for index and part numbers.

10-94. CLEANING. Clean rotameter metal and nonmetal parts as outlined in section I. Perform antistatic treatment on tubes and floats after cleaning as follows:

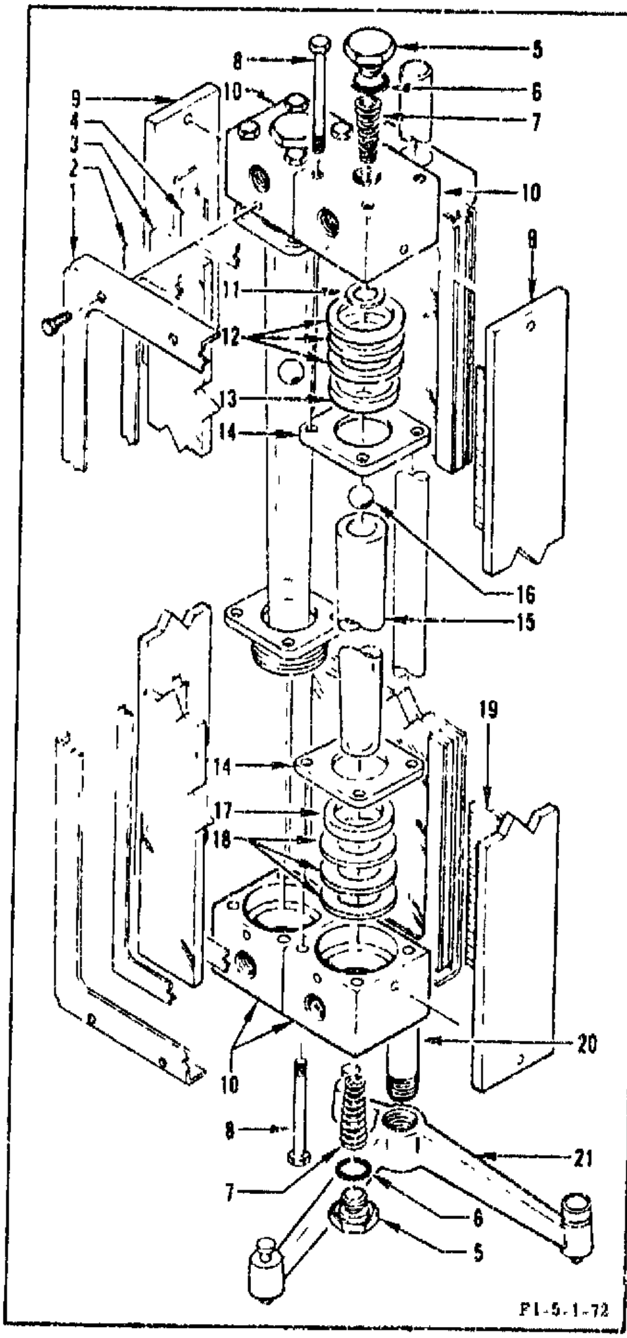
a. Place float on lint-free paper and pour a drop of ANSTAC-2M solution (Chemical Development Corp) on paper.

b. Roll float through solution until thoroughly coated; roll float over dry portion of paper until ball appears dry.

c. Using a small piece of lint-free cloth dampened with ANSTAC-2M solution (Chemical Development Corp), wet inside and outside of tube. Wipe tube until it appears dry.

10-95. INSPECTING AND REPAIRING. Inspecting the rotameter determines whether the individual parts have been damaged by mishandling or wear. See figure 10-15G and inspect parts for cleanness, damage, and wear. Repair of rotameter is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of rotameter.

10-96. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-94. Lubricant used during assembly is



Index No.	Part No.	Description
1		Frame
		Screw
2		Gasket
3		Window glass
4		Gasket
5		Plug
6	015	O-ring
7		Spring
8		Gland bolt
9		Sideplate
		Screw
10		Fitting
11		Tube gasket
12	R-2-15-A	Packing set
	R-2-15-C	Packing set
13		Gland ring
14		Gland follower
15	R-2-15-A	Metering tube
	R-2-15-C	Metering tube
16		Float
17		Gland ring
18	R-2-15-A	Packing set
	R-2-15-C	Packing set
19		Scale
20		Rod
21		Base
		Level
		Thumbscrew

Figure 10-15G. Rotameter--Exploded View

lubricant grease RB0110-012 (Rocketdyne). Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods. See figure 10-15G for index and part numbers.

a. Install rod (20) into base (21) and tighten handtight. Install thumbscrews into base.

b. Install scale (19) onto sideplate (9).

c. Position metering tube (15) in horizontal position and install gland follower (14) on each end of tube.

d. On small end of metering tube (15) install gland ring (17) and packing (18), and on large end of tube install gland ring (13), packing (12) Place tube gasket (11) on end of tube.

e. Install fitting (10) over tube gasket (11), packing (12), and gland ring (13). Install bolts (8) into gland follower (14). Cross-torque bolts (8) until tube end is firmly seated on tube gasket.

f. Install fitting (10) over packing (18) and gland ring (17) and install gland bolts (8) into gland follower (14). Tighten bolts (8) fingertight.

g. Aline sideplates (9) with dowel-pins of fittings (10) and install sideplate screws.

h. Cross-torque bolts (8) of fitting (10) until gland ring (17) and packing (18) are firmly seated.

i. Verify that the zero line of metering tube (15) and scale (19) are in exact alinement.

j. Install float (16) into metering tube (15); then lubricate (Method J) O-ring (6) and install spring (7) and plug (5) into fittings (10).

k. Install gasket (4), window glass (3), gasket (2), and frame (1). Secure with screws.

l. Position rotameter in a vertical position and install on rod (20).

10-97. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a source of hydraulic fluid capable of maintaining 2-200 cc/m flowrates, three shutoff valves, and a needle valve for hydraulic service. The flowmeter must be firmly secured in a vertical position during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Connect rotameter to test setup with a shutoff valve at both inlet and outlet ports, a shutoff valve as a bypass valve, and a needle valve downstream of the outlet valve and bypass valve.

b. Connect hydraulic source to inlet of inlet shutoff and bypass valves and connect needle valve to hydraulic return. Close all valves.

c. Level rotameter with thumbscrews of base and increase pressure to 150 psig.

d. Open bypass valve and slowly open needle valve just enough to obtain flow.

e. Slowly open inlet and outlet shutoff valves and allow lines and rotameter to fill.

f. Slowly close bypass valve and needle valve. Observe for fluid leaks at inlet and outlet fittings and ends of tube. No leakage is allowable.

g. Slowly open needle valve and regulate flow to allow float to rise to top of graduated scale of tube; then descend to bottom of tube. Float must rise and descend smoothly.

h. Repeat step g, maintaining stable flow at four equal increments of scale. Float must stabilize at each increment.

i. If float operation is erratic or sticking, check for leakage in test setup or clean as outlined in paragraph 10-94.

j. Decrease pressure to zero, remove rotameter from test setup, and install closures on inlet and outlet ports.

10-98. CALIBRATOR MODEL 1052.

10-99. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the calibrator.

10-100. DISASSEMBLING. Disassemble the calibrator, as required, to accomplish necessary repair and/or replacement. The precision bore glass tube is released when the jackscrew (1) is removed. See figure 10-15H for index and part numbers.

10-101. CLEANING. Clean parts, as applicable, as outlined in section I. Antistatic treat tube by using a piece of lint-free cloth dampened with ANSTAC-2M solution (Chemical Development Corp), wet inside and outside of tube. Wipe tube until it appears dry.

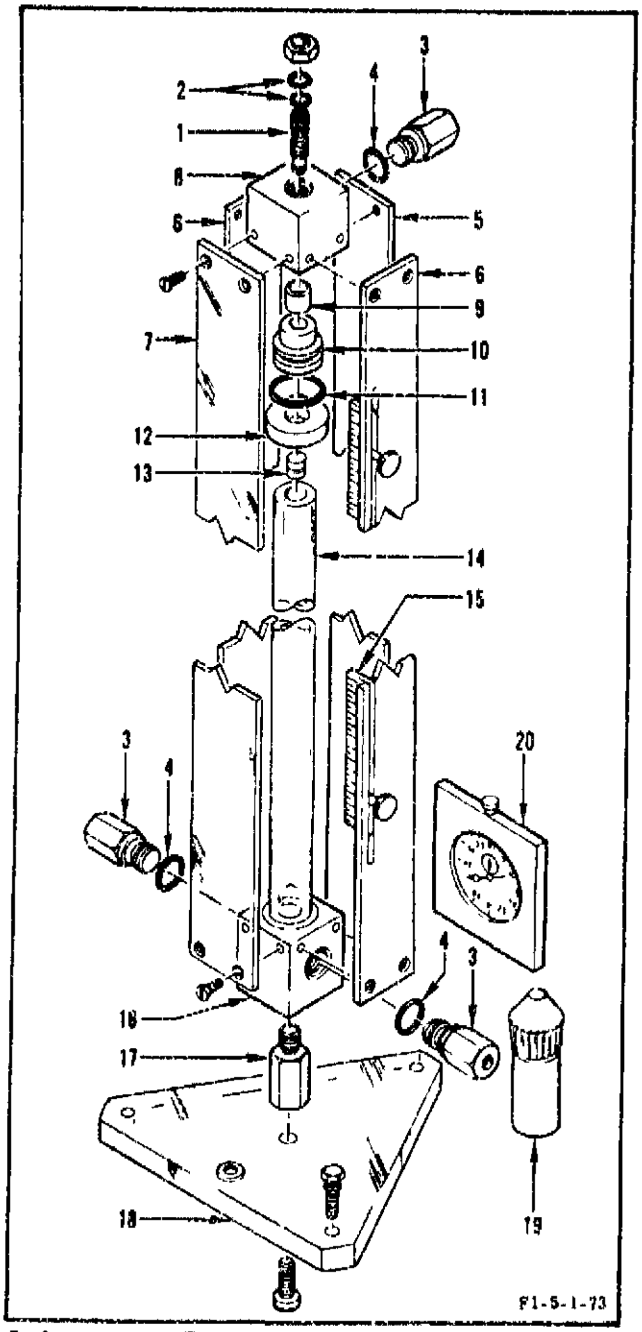
10-102. INSPECTING AND REPAIRING. Inspecting the calibrator determines whether the individual parts have been damaged by mishandling or wear. Inspect the parts for cleanness, damage, and wear. Repair of calibrator is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of calibrator.

10-103. ASSEMBLING. All parts must meet cleaning requirements as outlined in paragraph 10-101. Lubricant used during assembly is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. Replace all soft goods. See figure 10-15H for index and part numbers.

a. Install thumbscrews in base (18) and install standoff (17) on base (18).

b. Lubricate (Method A) threads of standoff (17) and install fitting (16) on standoff (17).

c. Install scale (15) on sideplate (6) with thumbscrews, and install sideplates (6) on fittings (8, 16).



Index No.	Part No.	Description
1		Jackscrew
		Nut
2	P-100009-905	Packing
	P-100009-010	Packing
3		Adapter
4	P-10009-908	O-ring
5		Backplate
		Screw
6		Sideplate
		Screw
7		Window glass
		Screw
8		Fitting
9		Adapter
10		Plug
11	P-100009-211	O-ring
12		Ring plug
	100574	Packing
13		Piston
14		Tube
15		Scale
		Thumbscrew
16		Fitting
	100574	Packing
17		Standoff
		Screw
18		Base
		Level
		Thumbscrew
19	P-1000027	Mercury
20		Stop watch

Figure 10-15H. Calibrator--Exploded View

d. Lubricate (Method J) O-ring (11) and install adapter (9), plug (10), and O-ring (11) into fitting (8).

e. Install tube (14) on packing of fitting (16) and install piston (13) in tube (14).

f. Install ring plug (12) on top of tube (14) and position ring plug and tube under plug (10).

g. Lubricate (Method J) packing (2), install packing on jackscrew (1) and install jackscrew into fitting (8). Tighten jackscrew until tube (14) makes light contact with packing.

h. Center tube (14) at top and bottom seals and tighten jackscrew until a compression seal is obtained. Secure jackscrew with nut.

i. Install backplate (5) and window glass (7) on fittings (8, 16).

j. Lubricate (Method J) O-rings (4), install on adapter (3), and install adapters in fittings (8, 16). Install closures in open ports.

10-104. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a regulated source of gaseous nitrogen (MIL-P-27401) with a controlled flow of 0-100 cc/m. The safety and general maintenance requirements outlined in section I apply to this procedure. The observed volumes of gas must be corrected to standard conditions of pressure and temperature. The weight and friction of the piston and mercury contribute to a back pressure that should be indicated with a water manometer connected at the inlet of the calibrator. This pressure must be added to the corrected barometer reading to obtain the total pressure at which the gas is collected. The temperature of the flowing gas should be noted and these values of pressure and temperature used in the gas law equation to obtain the volume at standard conditions.

$$V_s = V_i \times \frac{P_i}{P_s} \times \frac{T_s}{T_i}$$

Where:

V_s = volume at standard conditions

V_i = volume indicated

P_i = total pressure (back pressure + barometric pressure) in absolute units

P_s = standard pressure in absolute units

T_i = gas temperature indicated in absolute units

T_s = standard temperature in absolute units.

NOTE

Steps a through g tests piston function.

a. Remove closures, attach hand valve 9259T-1PP (paragraph 10-70) to calibrator outlet, and open hand valve.

b. Check that vent at top rear of calibrator is open.

CAUTION

If vent is not open, excessive pressure can build up in tube, causing damage to calibrator.

c. Level calibrator with base thumbscrews and circular level.

d. Check that mercury seal forms a continuous ring in piston groove. Establish mercury seal, if necessary, as outlined in steps m through p.

e. Flow 20-100 cubic centimeters per minute of gaseous nitrogen (MIL-P-27401) into calibrator inlet.

NOTE

Sudden surges of pressure must be avoided when pressure is applied, to avoid blowing out the mercury seal.

f. Adjust hand valve at outlet to allow piston to rise to top of graduated scale of tube. Piston must rise smoothly.

NOTE

If piston rises to the extreme top of tube, the mercury seal can be blown out of the piston groove.

g. Open hand valve at outlet to allow piston to descend to bottom of tube. Piston must descend smoothly.

h. If piston operation is erratic or mercury fails to seal, perform steps i through u.

i. Remove window glass (7) and backplate (5).

j. Loosen jackscrew (1) (counterclockwise) until tube (14) unseats from compression seal.

CAUTION

Precision bore glass tube is released when jackscrew is loosened. Damage to tube can result if tube is allowed to fall.

k. Place calibrator in horizontal position and remove tube (14) with piston (13); remove piston.

l. Clean tube and piston and perform anti-static treatment as outlined in paragraph 10-101.

m. Remove screw from piston, secure tube in vertical position, and insert piston into tube just far enough for groove to be within bore.

n. Pour several drops of mercury (19) (supplied with calibrator) into screw hole in piston.

o. Insert screw into piston and tighten screw until piston groove completely fills with a continuous ring of mercury. If mercury ring is too full, it will appear to overflow from groove, and readjustment of screw may be necessary.

p. Place clean, lint-free cloth on bottom of tube, release piston, and observe rate of fall several times by inverting tube from end to end.

q. Place calibrator in horizontal position and insert tube into frame, placing end of tube (14) on bottom packing first.

r. Tighten jackscrew (1) until tube (14) makes light contact with seal.

s. Center tube at top and bottom seals and tighten jackscrew until a compression seal is obtained.

t. Install backplate (5) and window glass (7).

u. Repeat steps a through g.

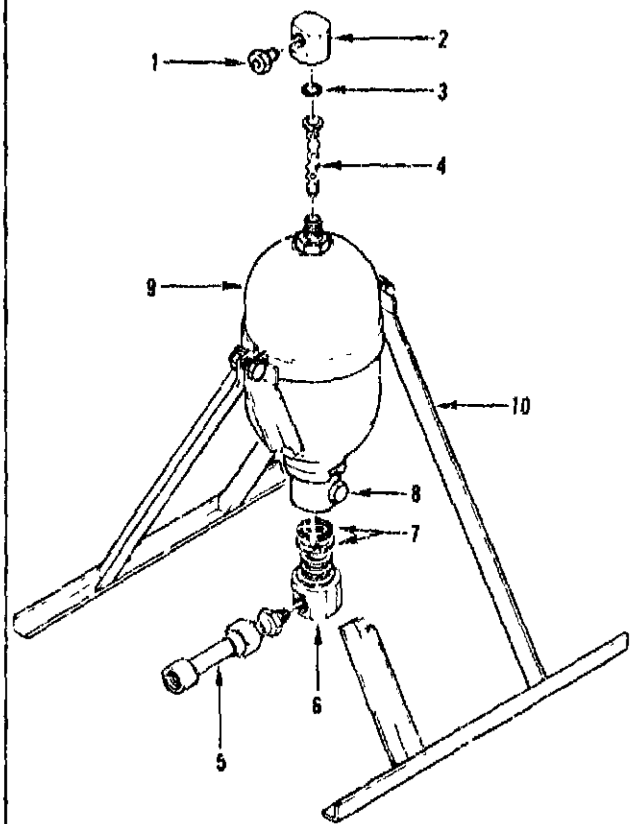
v. Decrease pressure to zero, remove calibrator from test setup, and install closures on open ports.

10-105. ACCUMULATOR 19-9026585.

10-106. The following procedures contain the disassembling, cleaning, inspecting and repairing, assembling, and testing information required to maintain the accumulator.

10-107. DISASSEMBLING. Disassemble accumulator, as required, to accomplish necessary repair and/or replacement. Do not disassemble burst disc (1, 5). (See figure 10-15J for index and part numbers.)

10-108. CLEANING. Clean parts, as applicable, as outlined in section I.



F1-5-1-74

Index No.	Part No.	Description
1	A65507-204	Burst disc
2		Adapter
3	S1400-11-A	O-ring
4		Tube
5	A65507-206	Burst disc
6		Adapter
7	S1402-3-A	O-ring
	MS28774-220	Ring
8		Plug
9		Shell
10		Stand

Figure 10-15J. Accumulator--Exploded View

10-109. INSPECTING AND REPAIRING. Inspecting the accumulator determines whether the individual parts have been damaged by mishandling or wear. Inspect parts for cleanness, damage, and wear. Repair of accumulator is limited to replacement of parts listed with a part number and chasing damaged threads that do not exceed 50 percent of one thread. Damaged or worn parts not listed requires replacement of accumulator.

10-110. ASSEMBLING. All parts must meet cleaning requirements outlined in paragraph 10-108. Lubricant used during assembly is lubricant grease RB0140-012 (Rocketdyne). Procedures (methods) for applying lubricants specified in assembly procedures are outlined in section I. (See figure 10-15J for index and part numbers.)

a. Place shell (9) between bands of stand (10) and secure with bolts.

b. Lubricate (Method J) O-ring and ring (7) and install on adapter (6). Install adapter (6) into shell (9).

c. Lubricate (Method A) threads of burst disc (5) and install into adapter (6).

d. Install tube (4) into shell (9).

e. Lubricate (Method J) O-ring (3) and install into adapter (2). Install adapter (2) onto shell (9).

f. Lubricate (Method A) threads of burst disc (1) and install into adapter (2).

10-111. TESTING. Testing is performed after repair and any time misuse or damage is suspected. The test procedures require a source of hydraulic fluid with a controlled pressure of 0-3,000 psig, a source of gaseous nitrogen (MIL-P-27401) with a controlled pressure of 0-3,000 psig, and leak-test compound (MIL-L-25567 or equivalent). The accumulator must be firmly secured during testing. The safety and general maintenance requirements outlined in section I apply to this procedure.

a. Remove closures, and connect gaseous nitrogen source to adapter (2) inlet port and hydraulic source to adapter (6) inlet port.

b. Increase gaseous nitrogen pressure in 300 psig increments to 1,500 +100 psig.

c. Audibly check for leakage at each increment, then apply leak-test compound (MIL-L-25567) to adapter (2). No leakage is allowable.

d. Lock source pressure in accumulator and record pressure. Observe for pressure decay for 3 minutes. No pressure decay is allowable.

CAUTION

Damage to accumulator will result if fluid system is pressurized before the pneumatic system is pressurized.

e. Maintain pressure of step b and increase hydraulic pressure in 500 psig increments to 3,000 psig.

f. Check for fluid leakage at adapter (6) and burst disc (5). No leakage is allowable.

g. Decrease hydraulic pressure to zero first; then decrease gaseous nitrogen pressure to zero.

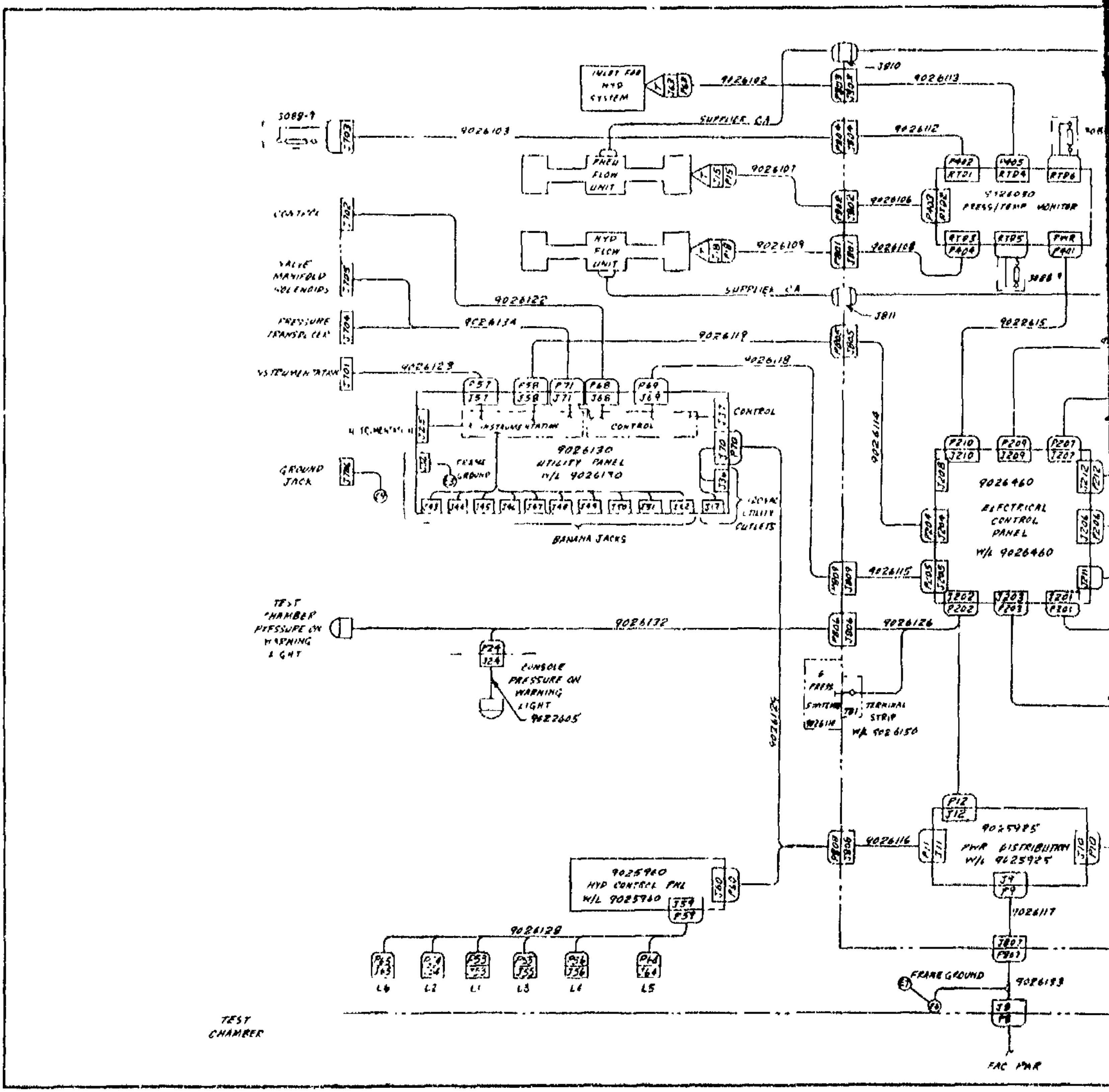
h. Remove accumulator from test setup and install closures in open ports.

10-112. INSPECTION.

10-113. Figure 10-16 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspections requirements cannot be predicted because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions, and that hardware configuration is in accordance with appropriate records. A visual inspection is made before operating the unit. Periodic inspections are made at specified periods. See figure 10-16 for inspection and periodic intervals.

Inspection	Periodic (Months)			
	3	6	12	24
1. Obvious signs of damage to all structural members.			X	
2. Foreign matter and illegibility of placarding on exterior and interior surfaces.			X	
3. Broken glass, cracked frames, and loose or missing faceplate screws on gages.			X	
4. Cracked or broken control knobs and loose or missing retaining screws and locknuts on hand valves and regulators.			X	
5. Scratches, dents, cracked sleeves, and loose coupling nuts on tubing.			X	
6. Contamination of filters.			X	
7. Broken covers and broken or missing bulbs on indicator lights.			X	
8. Looseness and improper operation of switches and circuit breakers.			X	
9. Damaged or corroded receptacles and/or plugs on electrical cables and cut, torn, chafed, or deteriorated outer cover.			X	
10. Calibration-check (paragraph 10-45).		X		
11. Lubrication of hand valves (paragraph 10-45).			X	
12. Function-test of relief valves (paragraph 10-45).			X	

Figure 10-16. Inspection Requirements



INLET FOR HYD SYSTEM
9026102
9026113
3810
3089-9
9026103
SUPPLIED CA
9026112
PNEU FLOW UNIT
9026107
9026106
PRESS/TEMP MONITOR
CONTROL
HYD FLOW UNIT
9026109
9026108
VALVE MANIFOLD SOLENOIDS
SUPPLIED CA
3811
PRESSURE TRANSDUCER
9026122
9026134
9026119
9026615
9026123
9026118
INSTRUMENTATION
CONTROL
9026130 UTILITY PANEL W/L 9026170
9026114
FRAME GROUND
GROUND JACK
9026460
ELECTRICAL CONTROL PANEL W/L 9026460
BANANA JACKS
LOCAL UTILITY OUTLETS
9026115
TEST CHAMBER PRESSURE ON WARNING LIGHT
9026172
9026126
CONSOLE PRESSURE ON WARNING LIGHT 9022605
TERMINAL STRIP W/L 9026150
9026127
9025975 PWR DISTRIBUTION W/L 9025925
9026116
9025960 HYD CONTROL PNL W/L 9025960
9026117
9026128
L6 L2 L1 L3 L4 L5
FRAME GROUND
9026133
TEST CHAMBER
FAC PWR

Fig

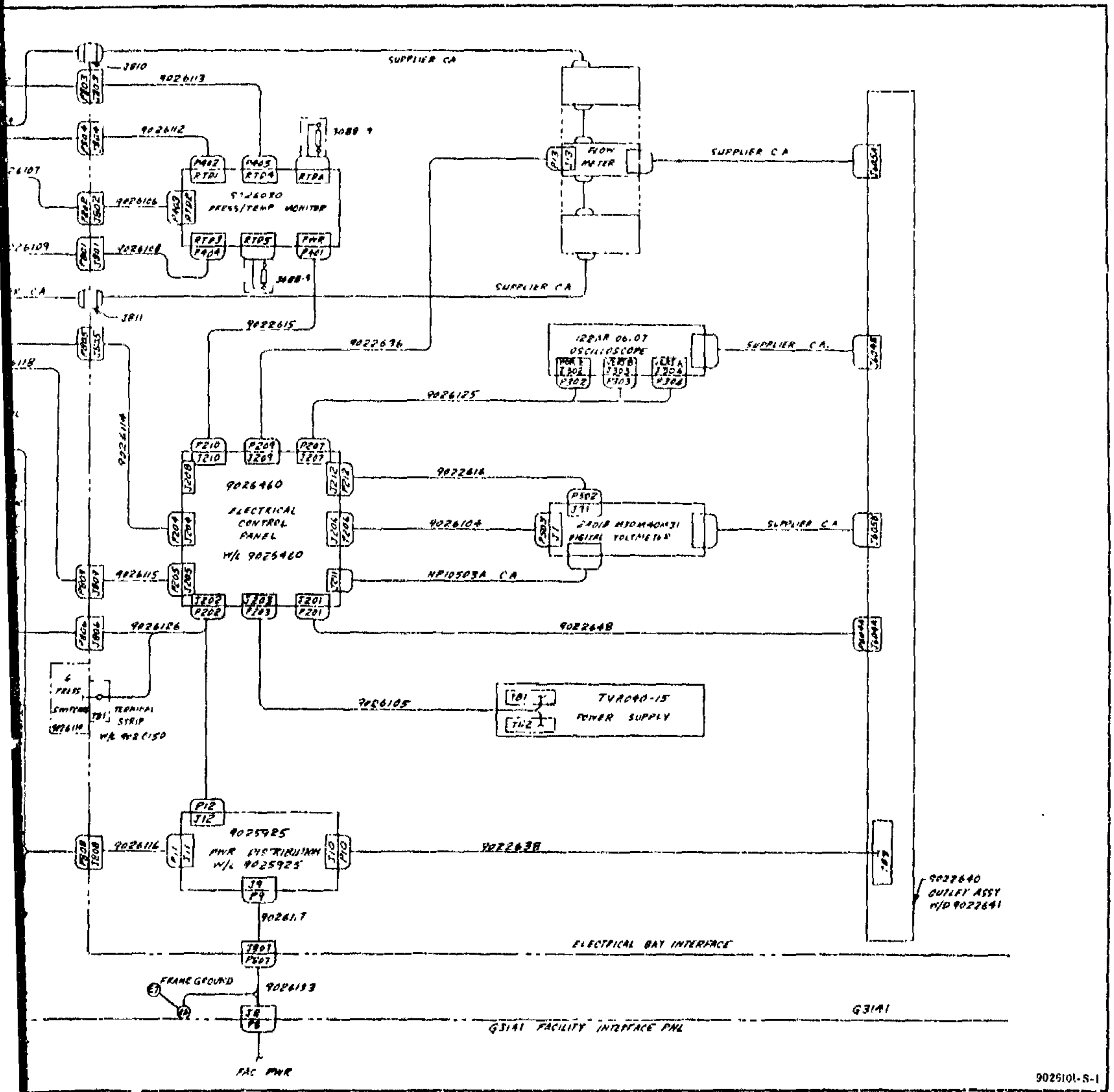


Figure 10-17. Components Test Console Electrical Schematic (Sheet 1 of 13)

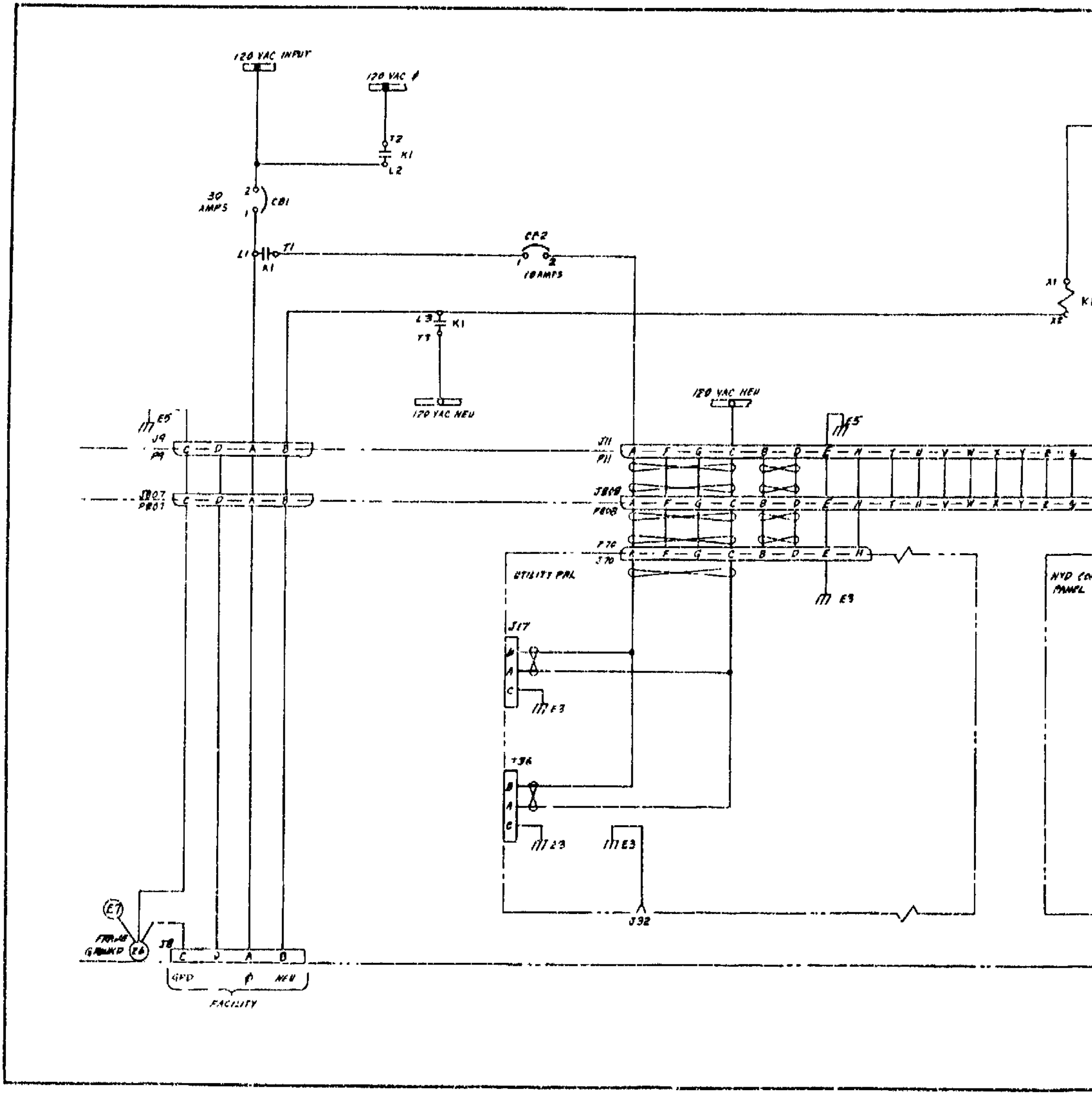
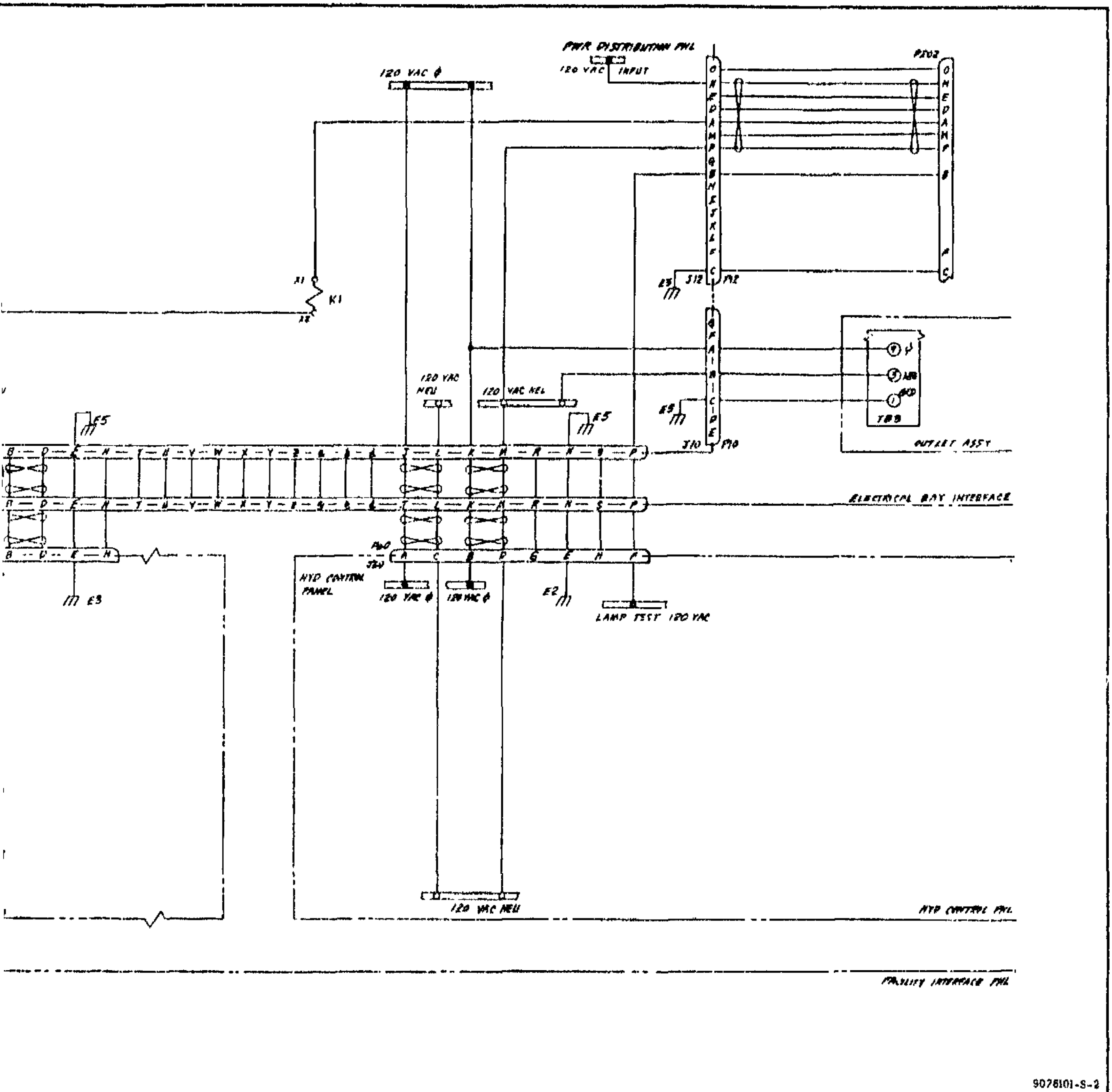
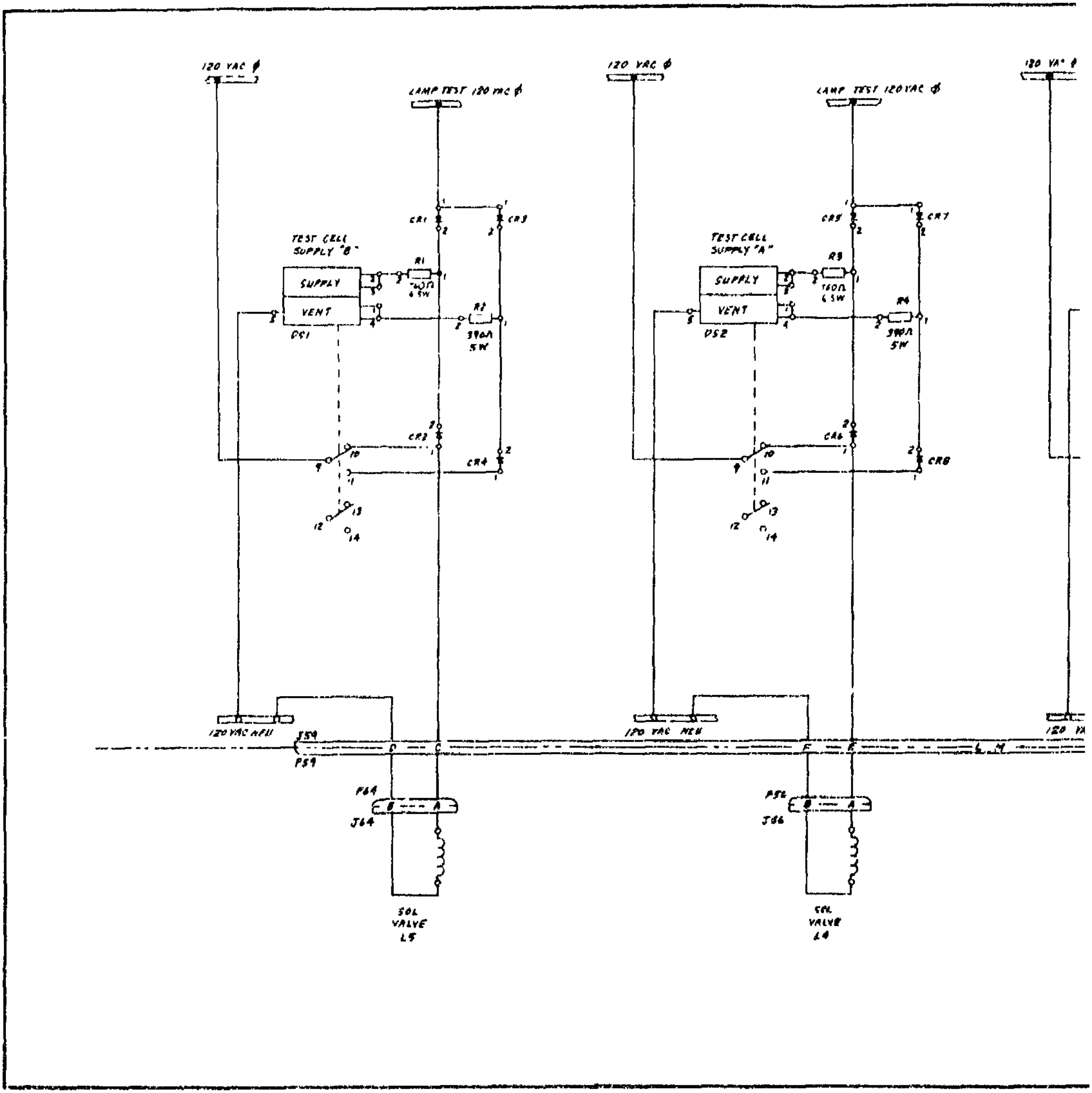


Figure 10-17. Components Test Console Electrical Schematic (Sheet 2 of 13)


PWR DISTRIBUTION PNL
120 VAC INPUT
P202
120 VAC ϕ
K1
120 VAC NEU
120 VAC NEL
E5
J12
P12
J10
P10
TB9
OUTLET ASSY
ELECTRICAL BAY INTERFACE
HYD CONTROL PANEL
120 VAC ϕ
LAMP TEST 120 VAC
E2
E3
120 VAC NEU
HYD CONTROL PNL
FACILITY INTERFACE PNL
9078101-S-2

13)



120 VAC ϕ
LAMP TEST 120 VAC ϕ
TEST CELL SUPPLY "B"
SUPPLY
VENT
DS1
R1
R2
390Ω 5W
CR1
CR2
CR3
CR4
120 VAC NEU
J59
P59
P64
J64
SOL VALVE L5
120 VAC ϕ
LAMP TEST 120 VAC ϕ
TEST CELL SUPPLY "A"
SUPPLY
VENT
DS2
R3
160Ω 6.5W
R4
390Ω 5W
CR5
CR6
CR7
CR8
120 VAC NEU
P56
J56
SOL VALVE L4

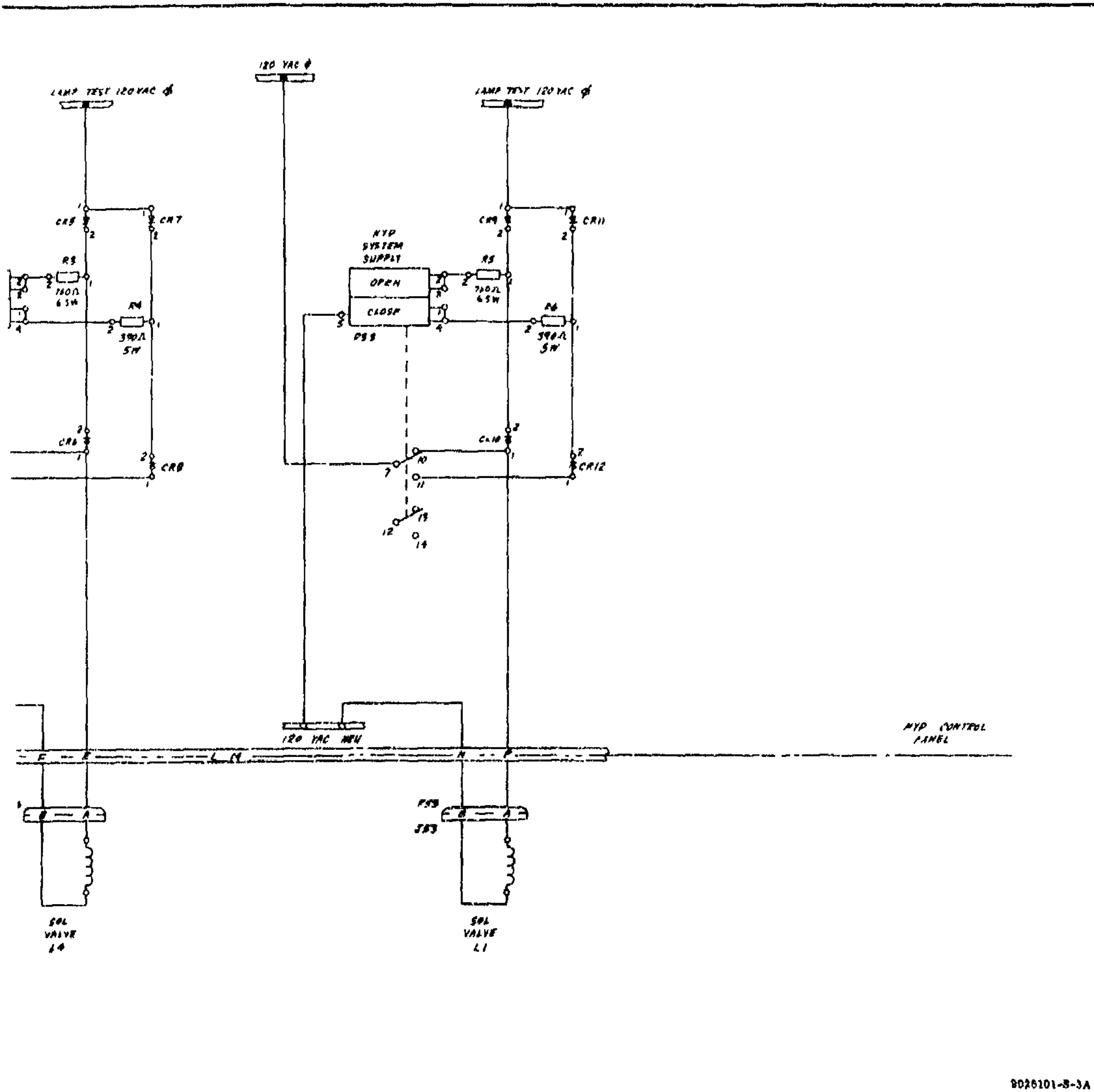


Figure 10-17. Components Test Console Electrical Schematic (Sheet 5 of 13)

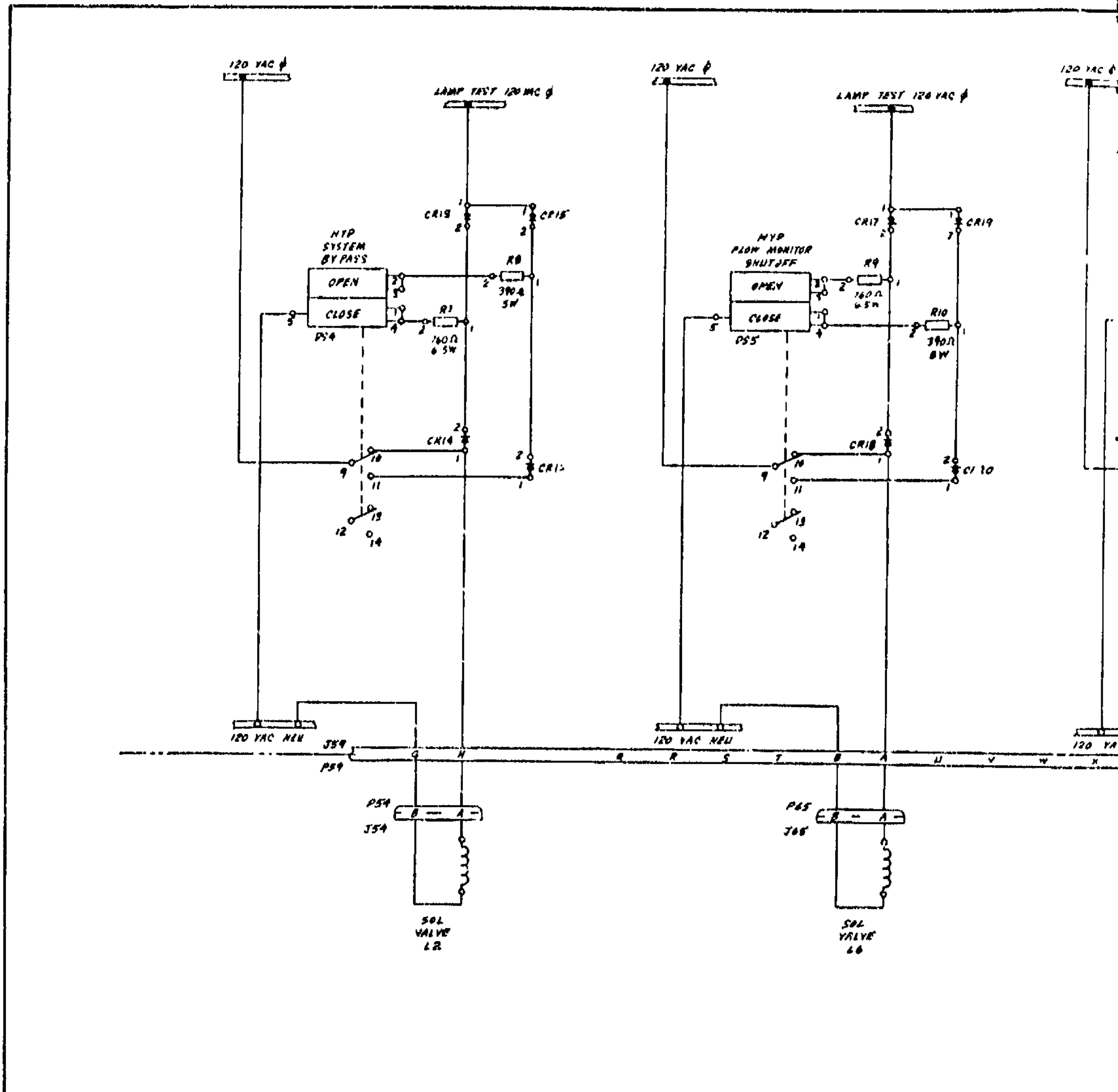
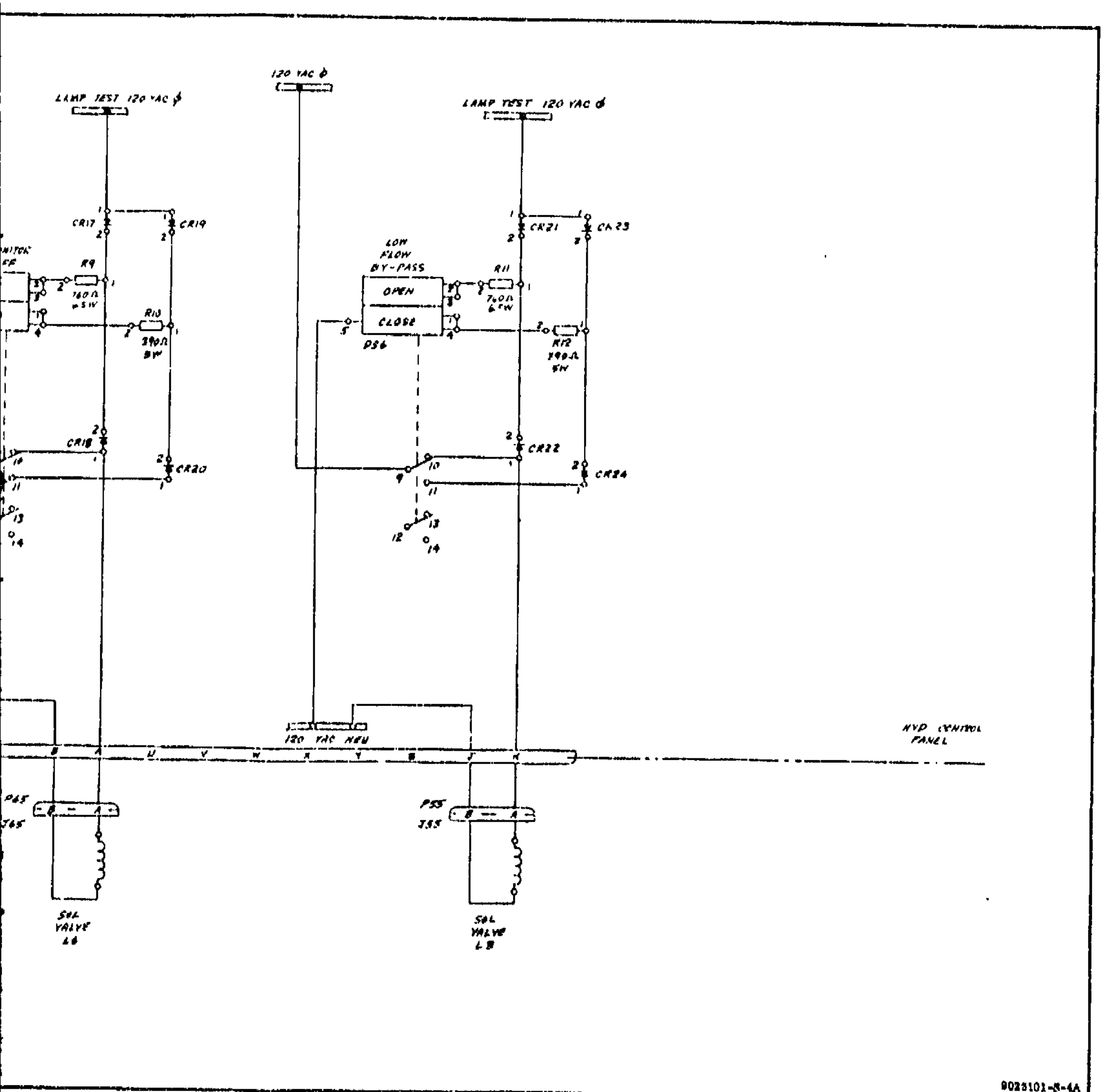
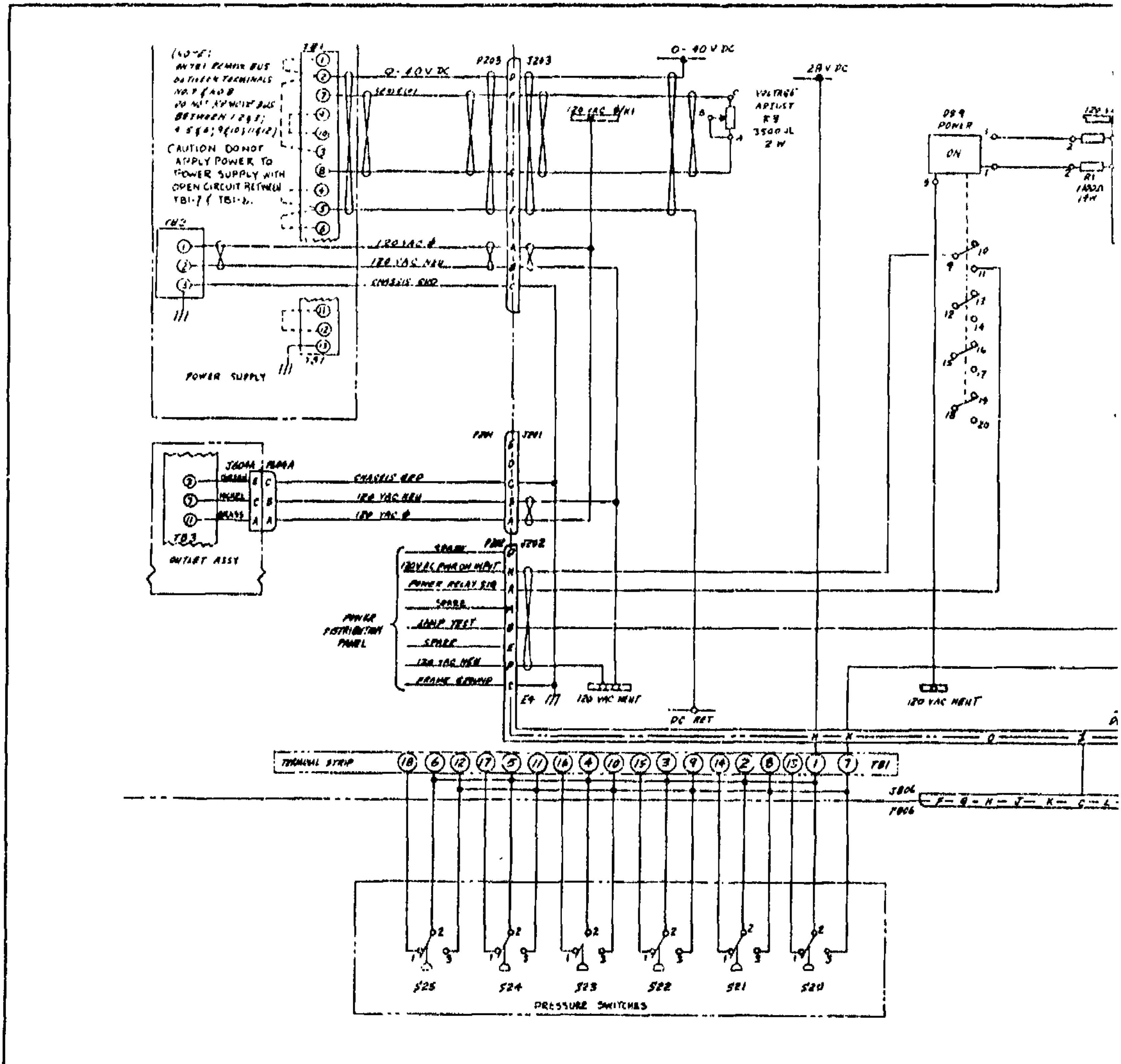


Figure 10-17. Components Test Console Electrical Schematic (Sheet 4 of 13)


LAMP TEST 120 VAC ϕ
120 VAC ϕ
LAMP TEST 120 VAC ϕ
CR17
CR19
R9
R10
CR18
CR20
LOW
FLOW
BY-PASS
OPEN
CLOSE
DS6
R11
R12
CR21
CR23
CR22
CR24
120 VAC NEU
HYD CONTROL
PANEL
P65
J65
P55
J55
SOL
VALVE
L6
SOL
VALVE
L8
9028101-8-4A


0-40 V DC
28 V DC
CAUTION DO NOT APPLY POWER TO POWER SUPPLY WITH OPEN CIRCUIT BETWEEN TB1-7 & TB1-6.
POWER SUPPLY
P203
J203
VOLTAGE ADJUST
R9
3500 Ω
2 W
120 VAC NEUT
120 VAC Ø
CHASSIS GND
ON
TB2
TB3
OUTLET ASSY
J201
J202
SPARE
POWER RELAY SIG
LAMP TEST
FRAME GROUND
POWER DISTRIBUTION PANEL
DC RET
TERMINAL STRIP
TB1
S25
S24
S23
S22
S21
S20
PRESSURE SWITCHES

Fig

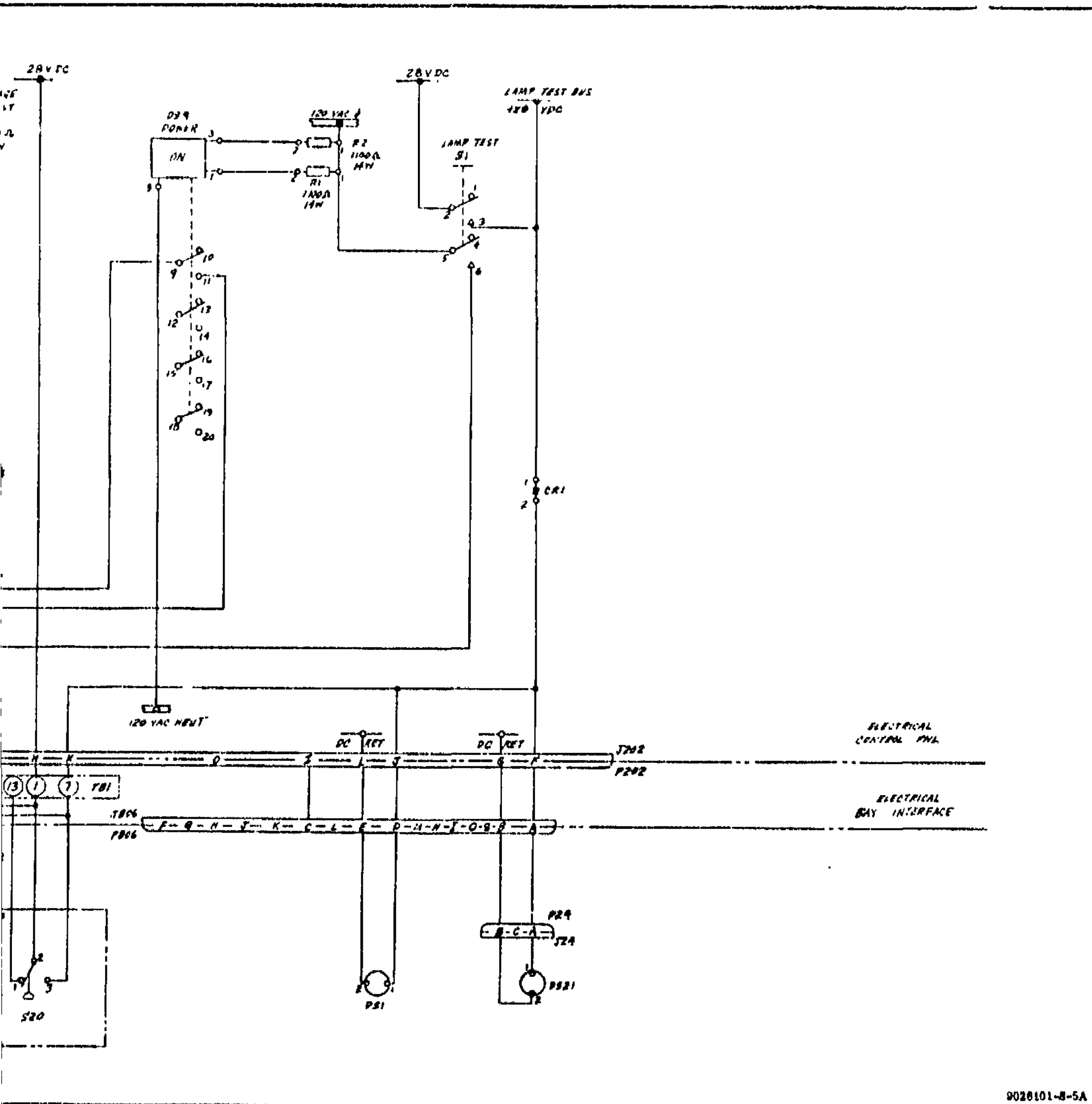


Figure 10-17. Components Test Console Electrical Schematic (Sheet 5 of 13)

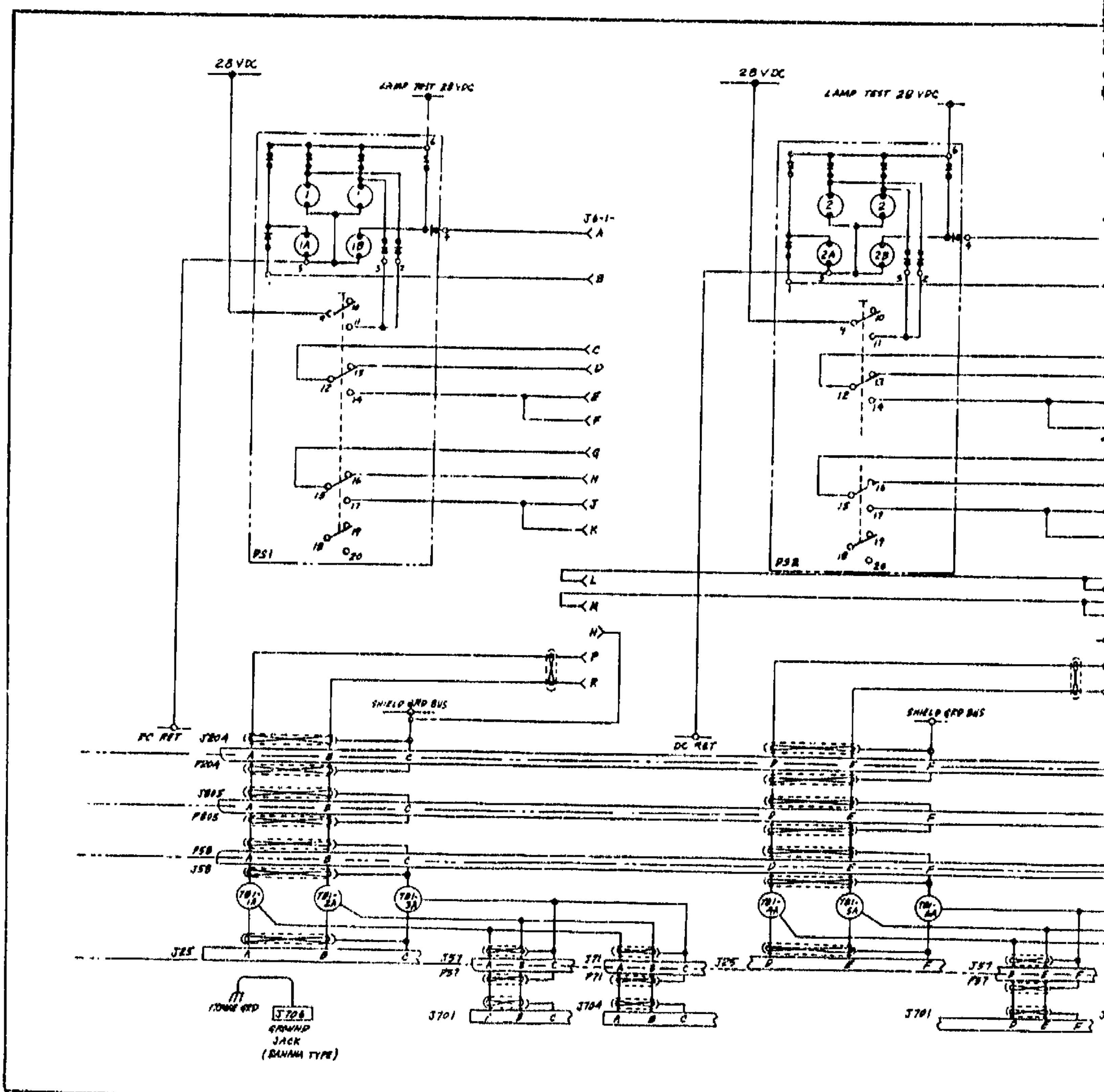
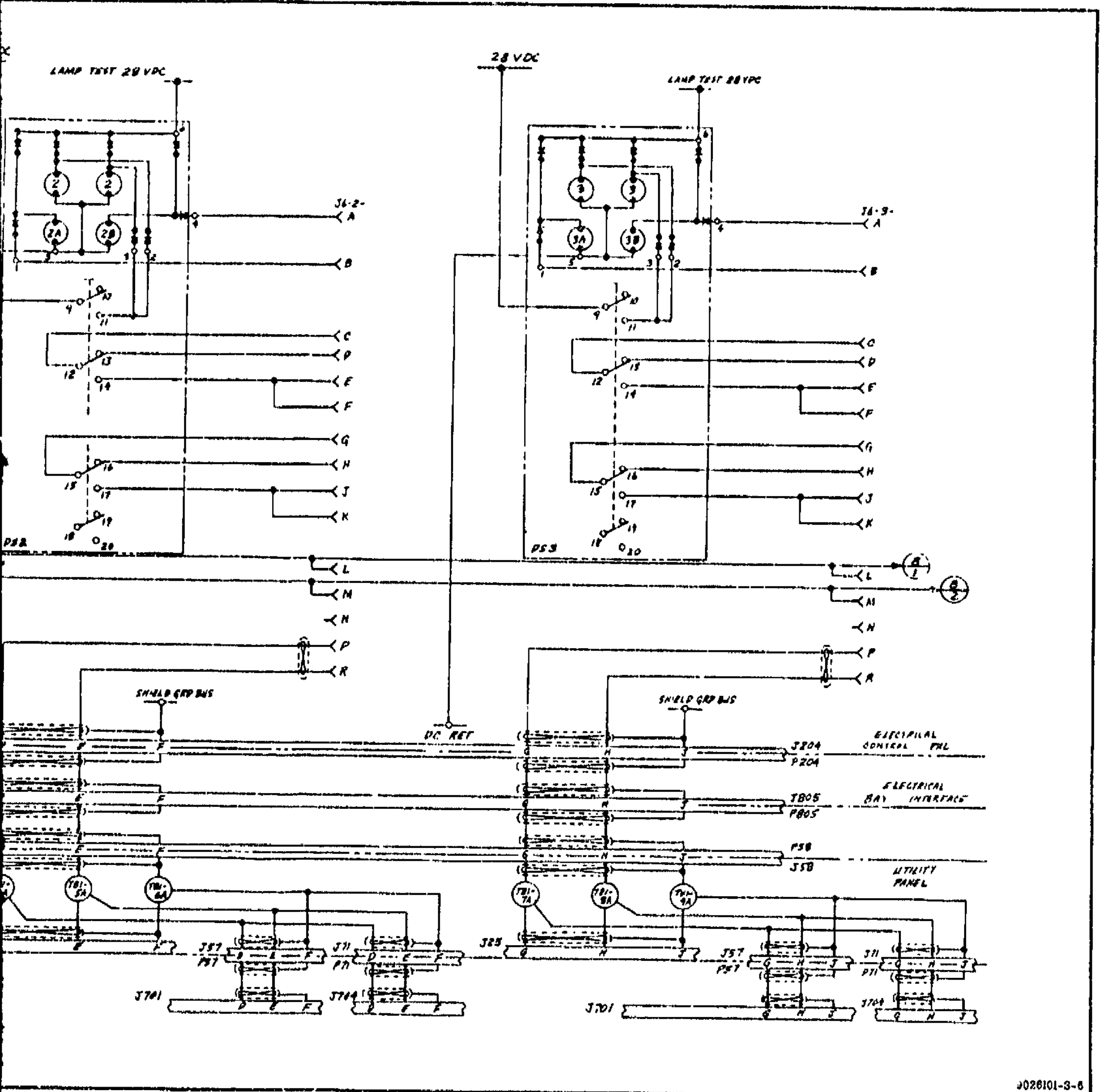
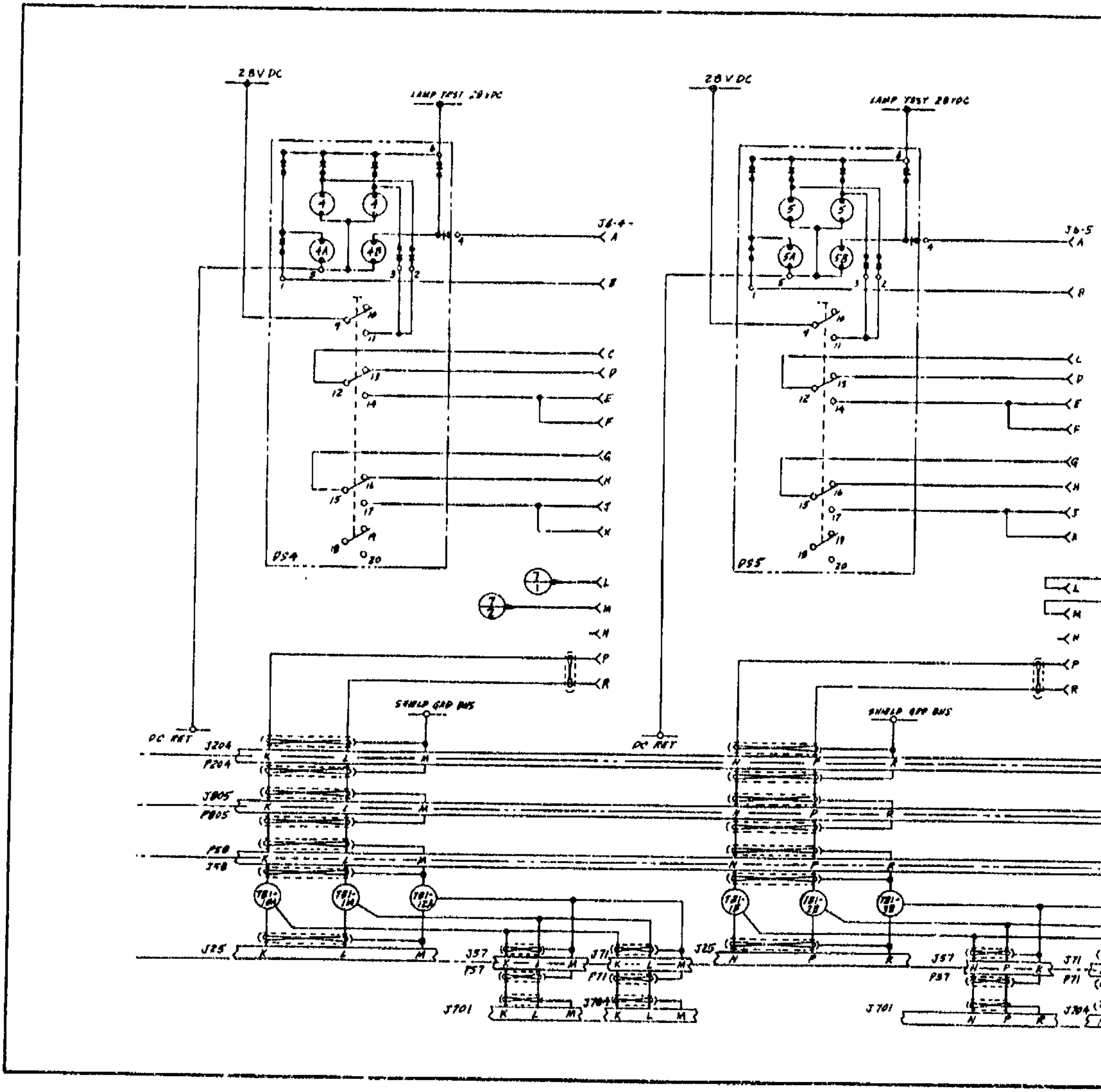


Figure 10-17. Components Test Console Electrical Schematic (Sheet 6 of 13)


LAMP TEST 28 VDC
28 VDC
LAMP TEST 28 VDC
J6-2-
J6-3-
PS2
PS3
SHIELD GRD BUS
SHIELD GRD BUS
DC RET
J204
P204
ELECTRICAL CONTROL PNL
TB05
PB05
ELECTRICAL BAY INTERFACE
P58
J58
UTILITY PANEL
J25
J57
P57
J11
P11
J701
J704
J026101-3-6

3)



28 V DC
LAMP TEST 28 VDC
J6-4
J6-5
DS4
DS5
SHIELD GRD BUS
DC RET
J204
P204
J805
P805
P58
J58
J25
J57
P57
J71
P71
J701
J704

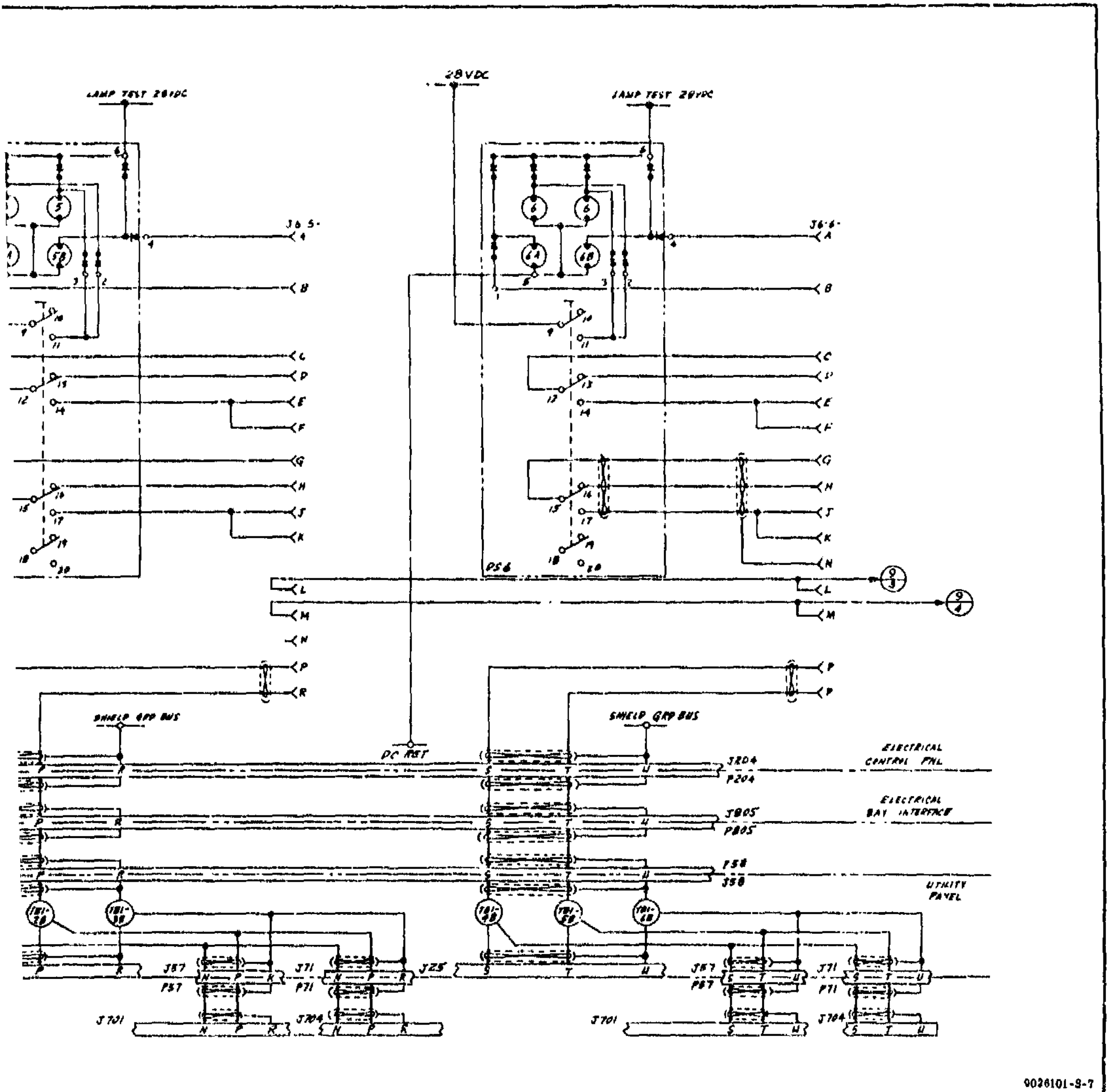


Figure 10-17. Components Test Console Electrical Schematic (Sheet 7 of 13)

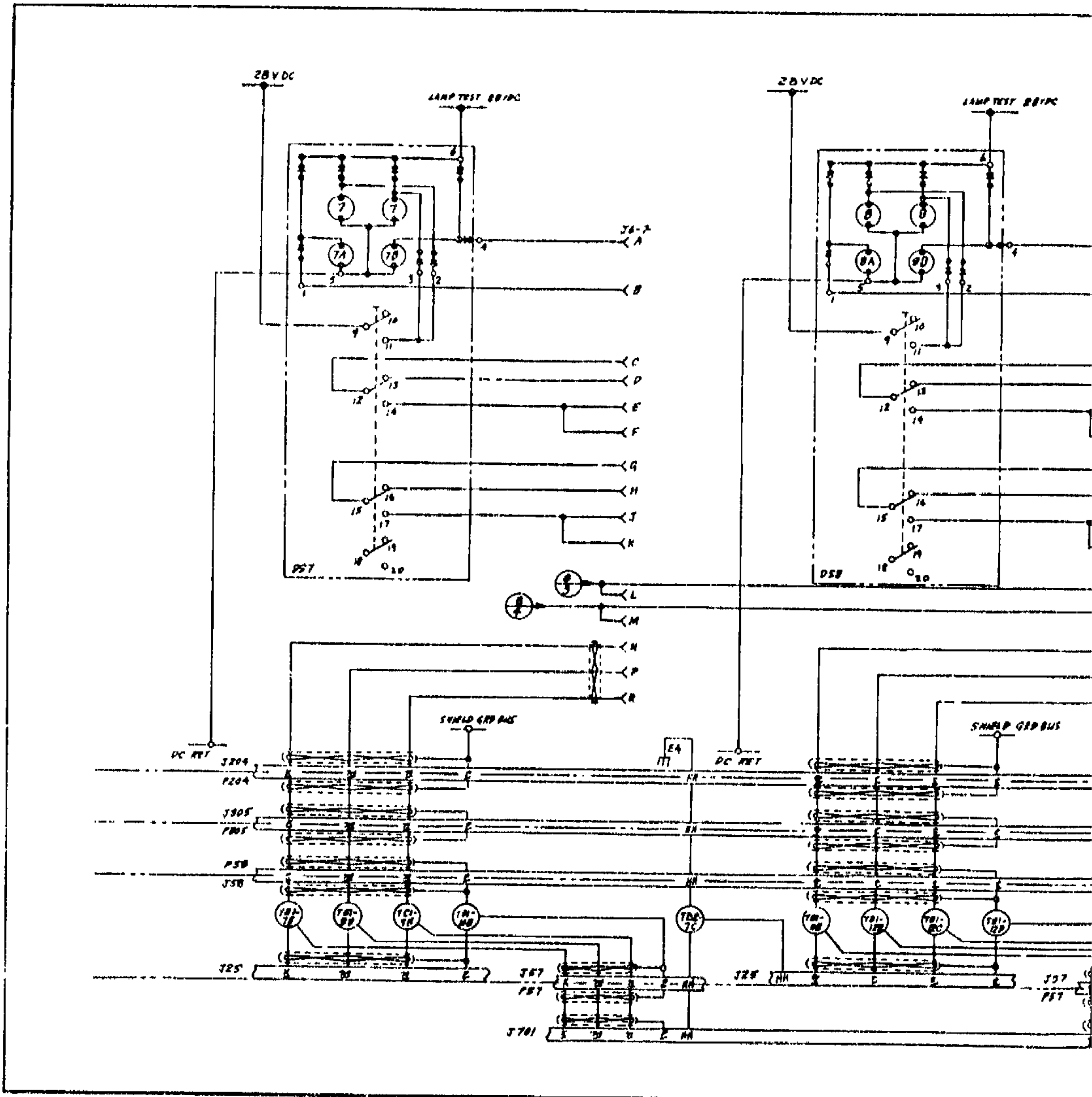
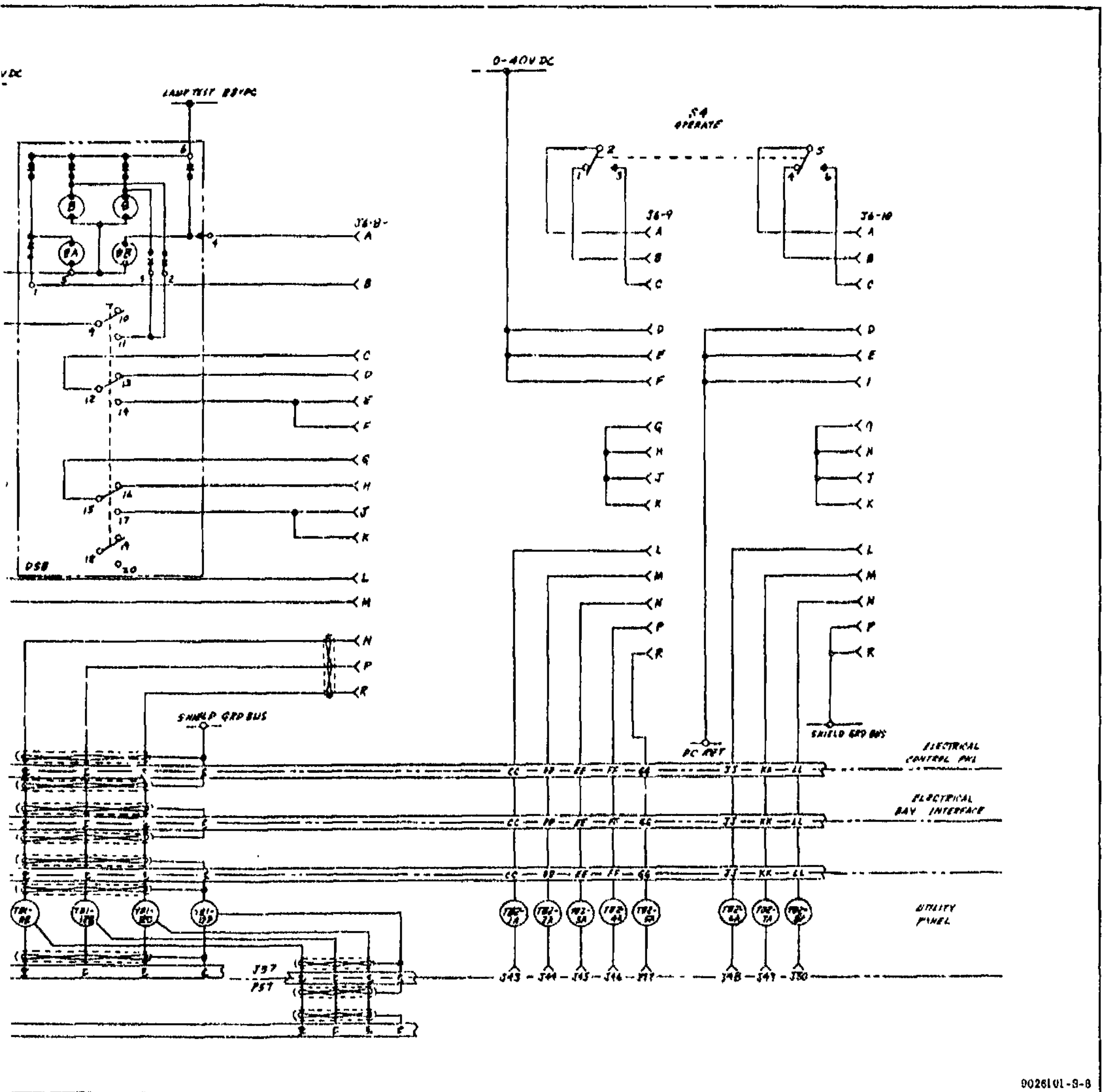
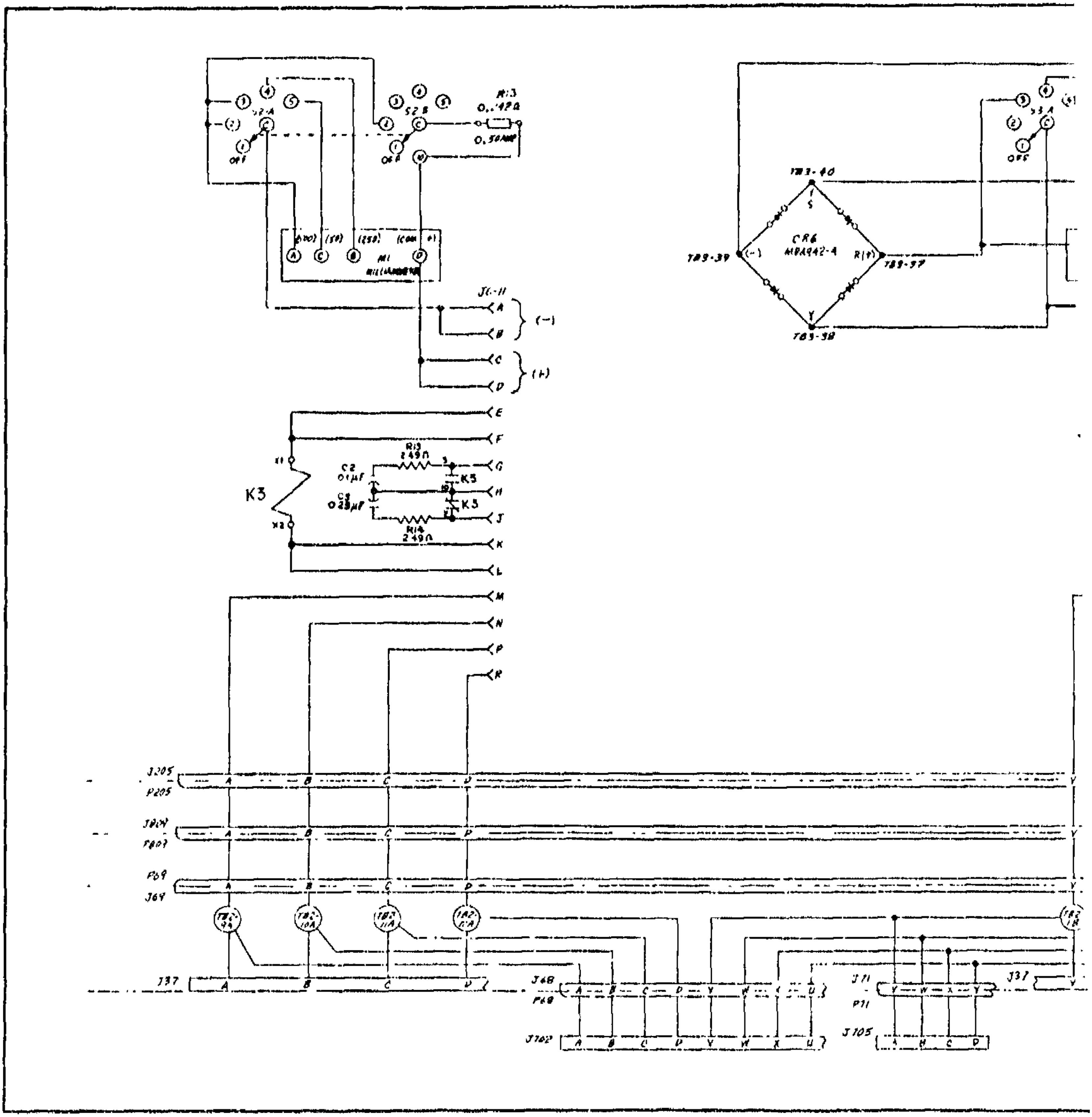


Figure 10-17. Components Test Console Electrical Schematic (Sheet 8 of 13)



0-40V DC
LAMP TEST 28VDC
S4
OPERATE
J6-8
J6-9
J6-10
DS8
SHIELD GRD BUS
DC RET
ELECTRICAL CONTROL PNL
ELECTRICAL BAY INTERFACE
UTILITY PANEL
J57
P57

9026101-S-8



S2-A
S2 B
OFF
R13
0.5 AMP
M1
MILLIAMMETER
J6-11
(−)
(+)
K3
C2
.01μF
C3
0.25μF
R13
249Ω
R14
249Ω
K5
CR6
MDA942-A
TB3-40
TB3-39
TB3-37
TB3-38
S3 A
OFF
J205
P205
J204
P204
P69
J69
J37
J68
P68
J102
J71
P71
J105

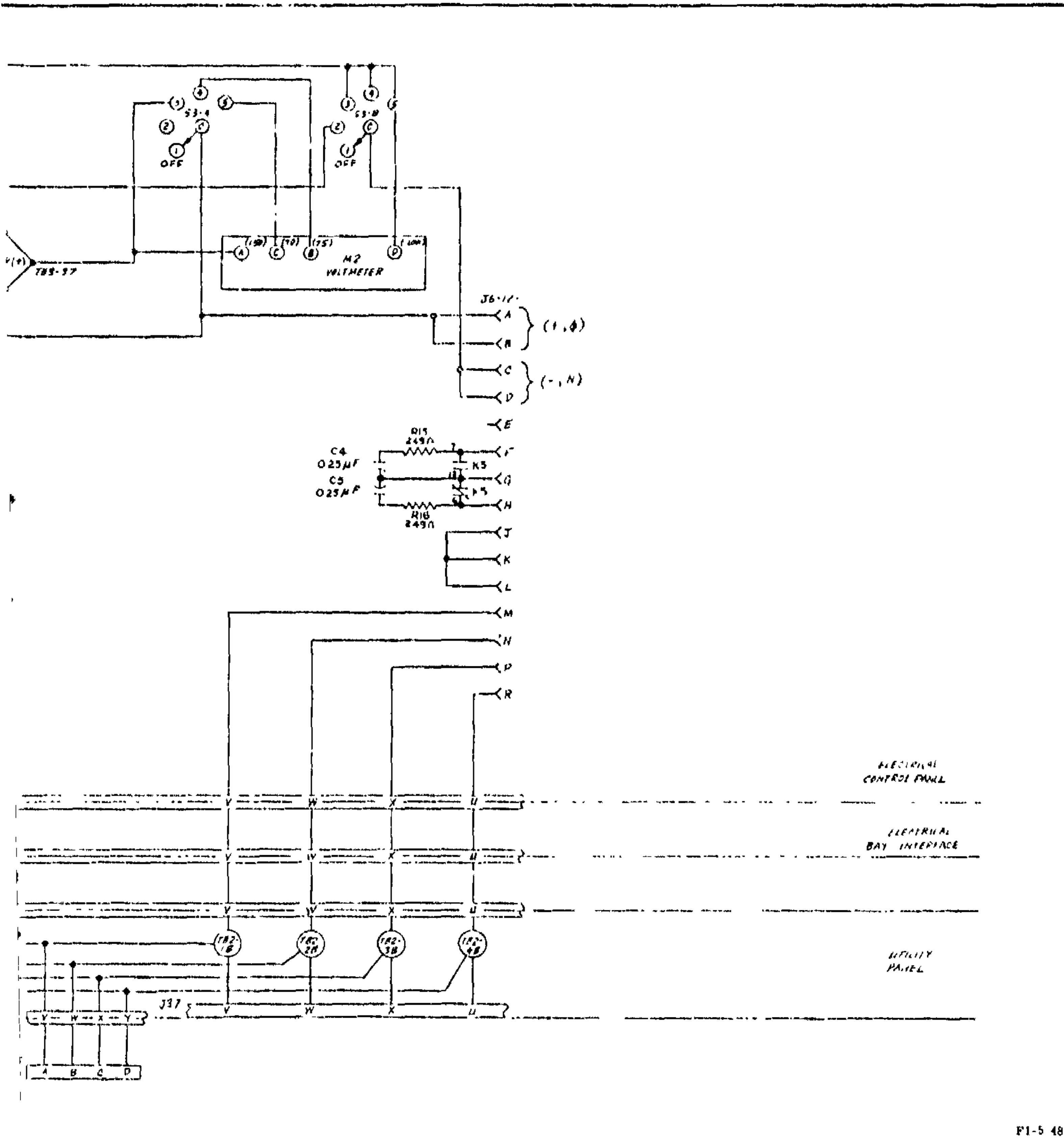


Figure 10-17. Components Test Console Electrical Schematic (Sheet 9 of 13)

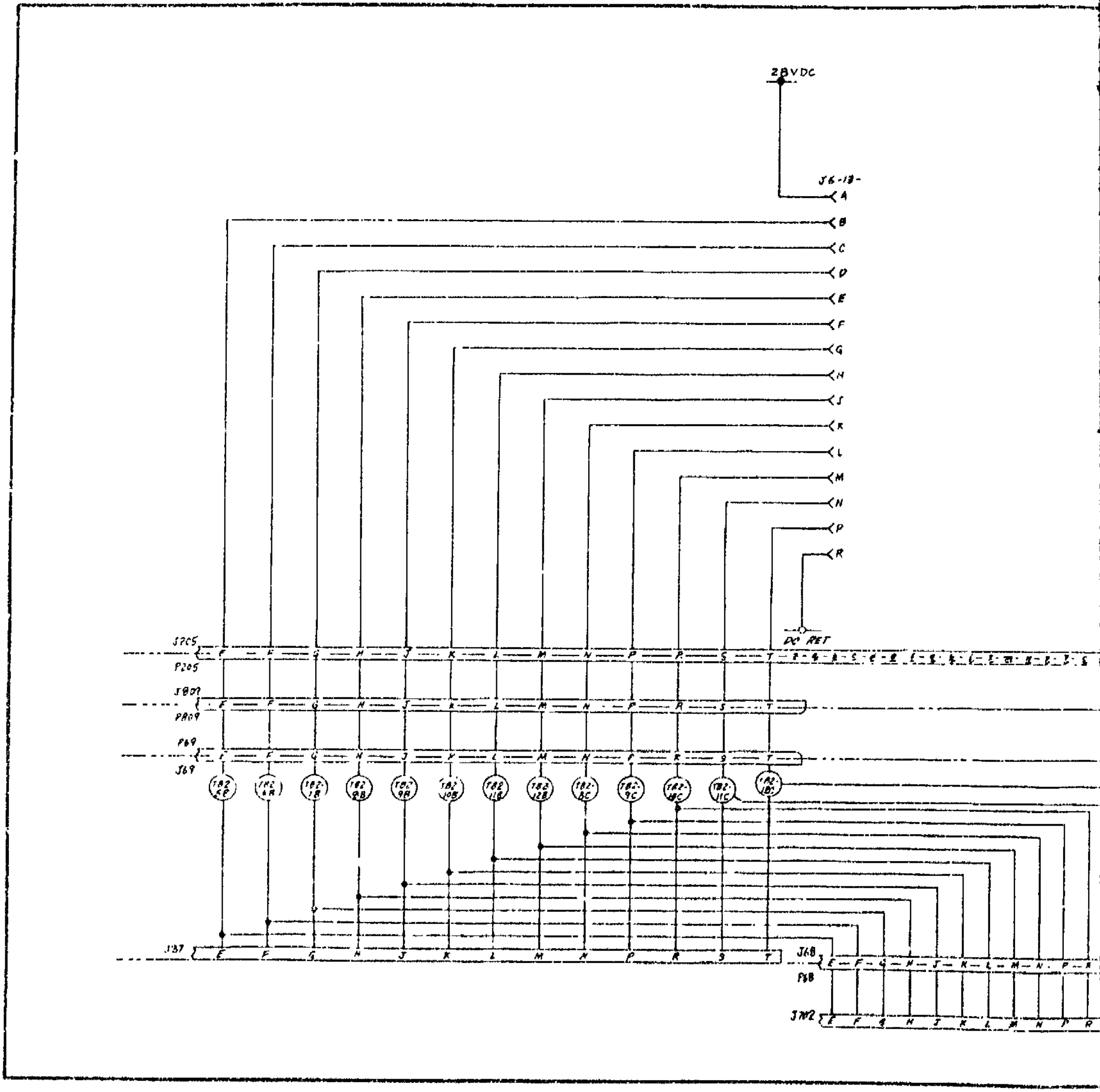
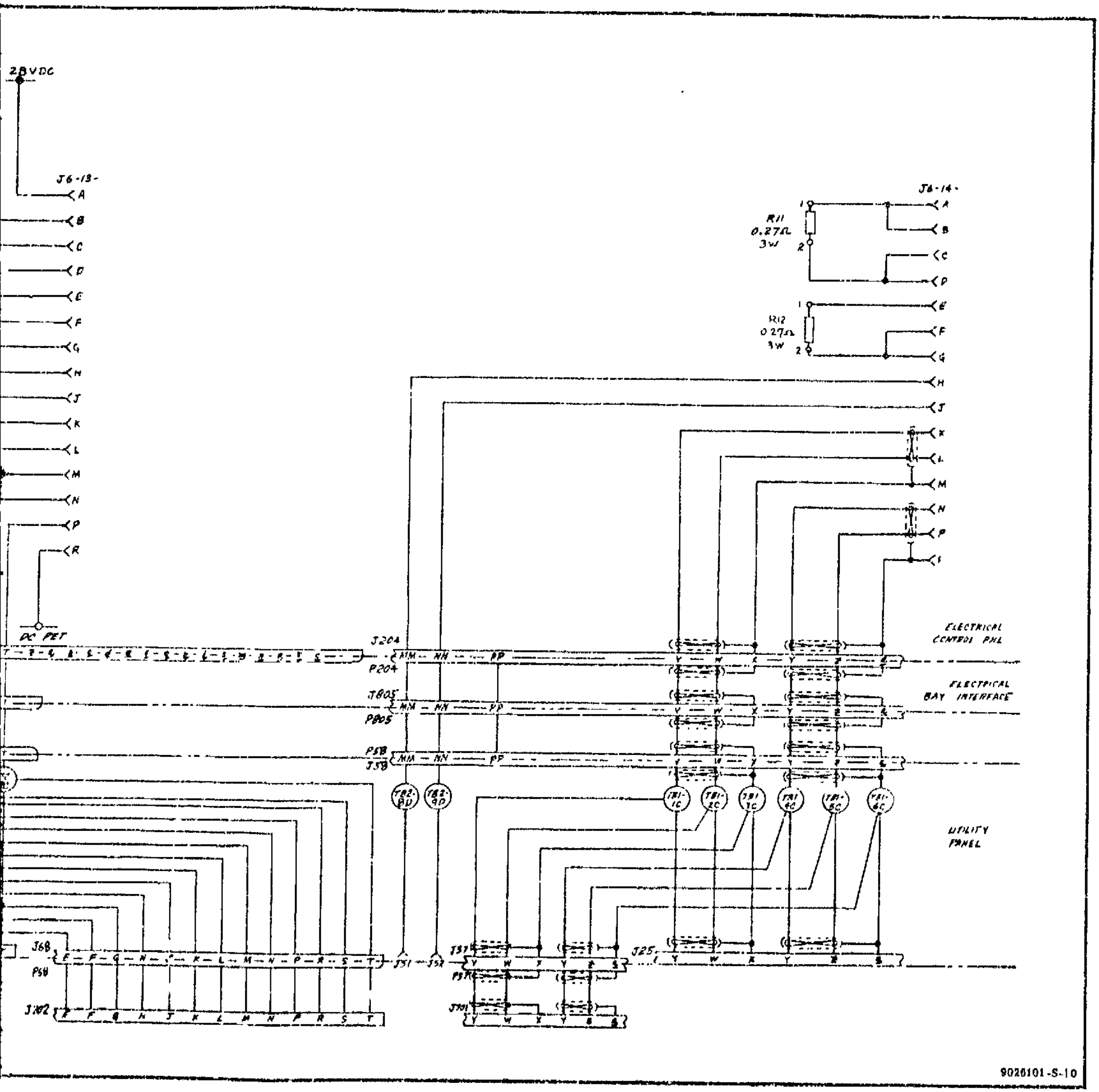
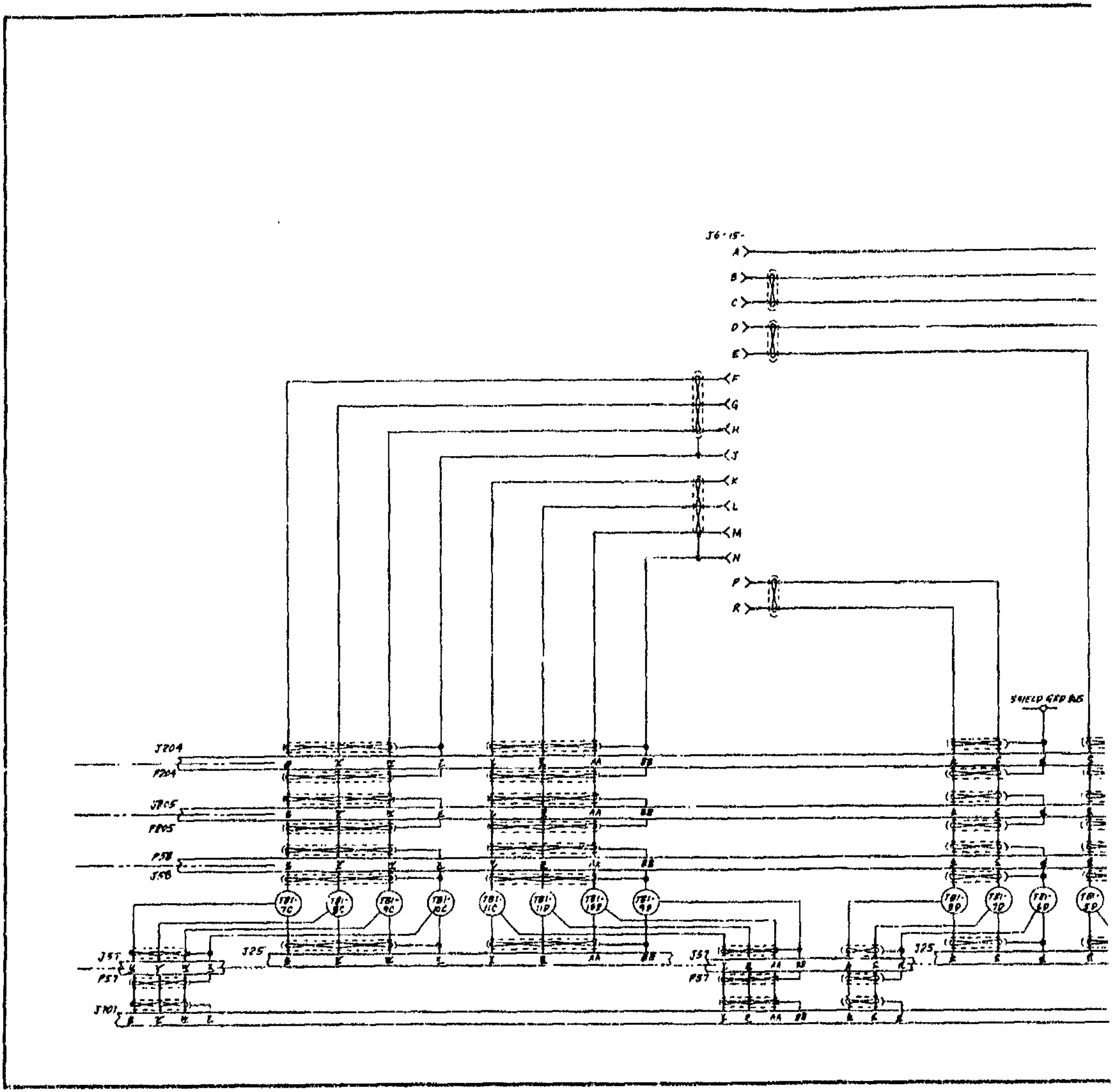


Figure 10-17. Components Test Console Electrical Schematic (Sheet 10 of 13)


28VDC
J6-13-
DC RET
J6-14-
R11
0.27Ω
3W
R12
0.27Ω
3W
J204
P204
J805
P805
P58
J58
J68
P68
J102
J51
J52
J37
P37
J101
J25
ELECTRICAL
CONTROL PNL
ELECTRICAL
BAY INTERFACE
UTILITY
PANEL
9020101-S-10

13)



J6-15-
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
SHIELD GRD BUS
J204
P204
J205
P205
P58
J58
J57
P57
J701
J25

Figu

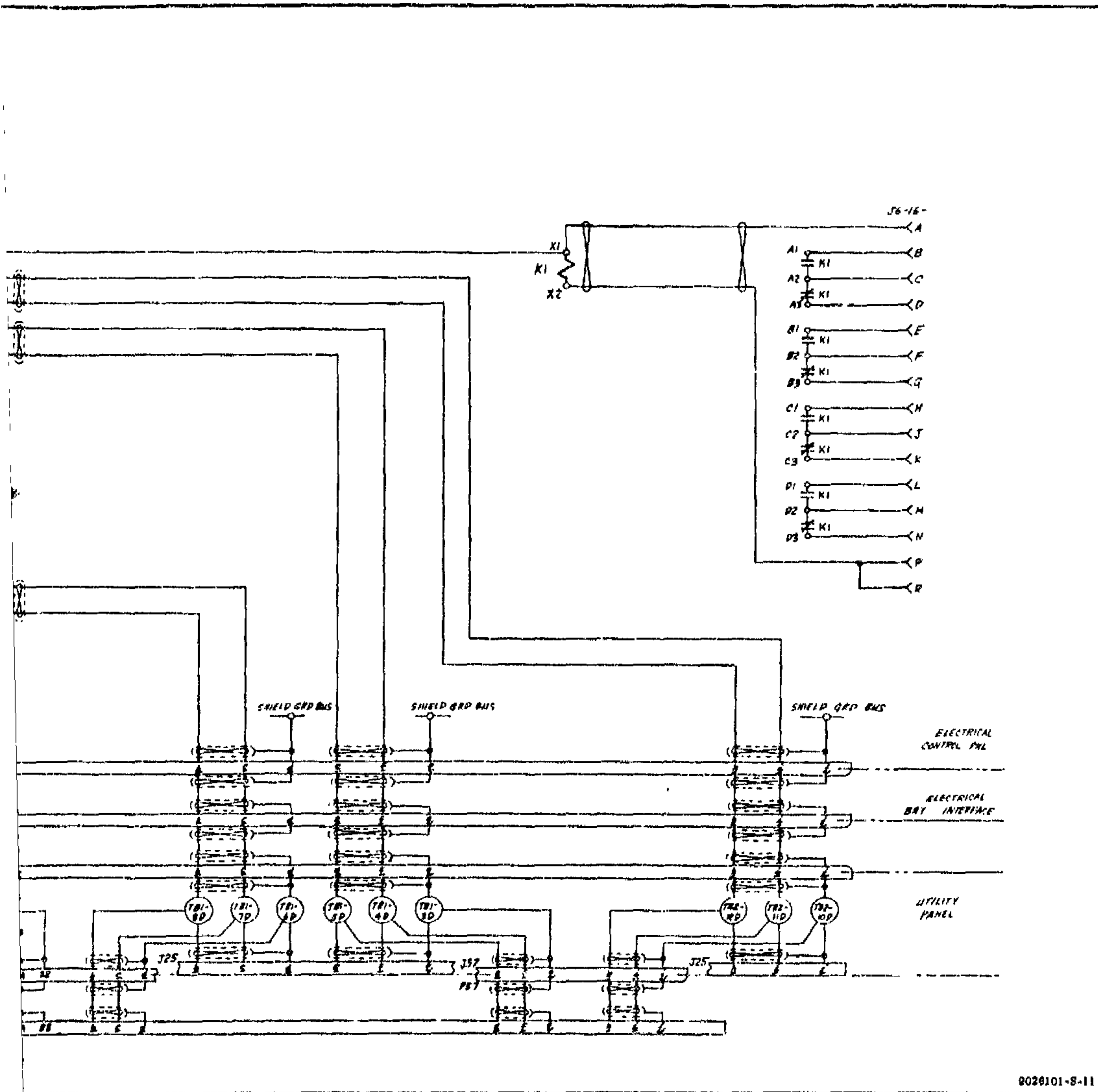


Figure 10-17. Components Test Console Electrical Schematic (Sheet 11 of 13)

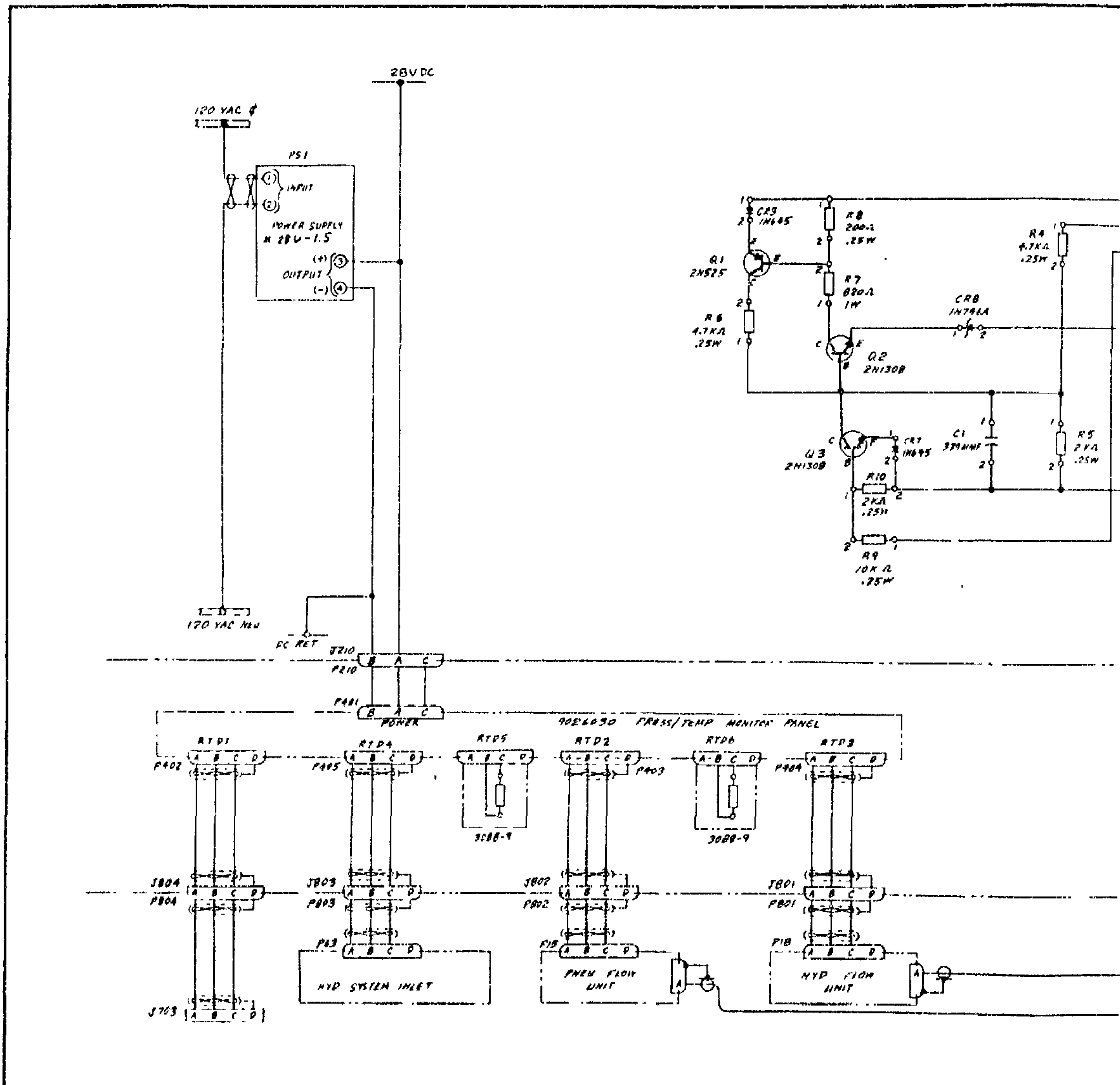
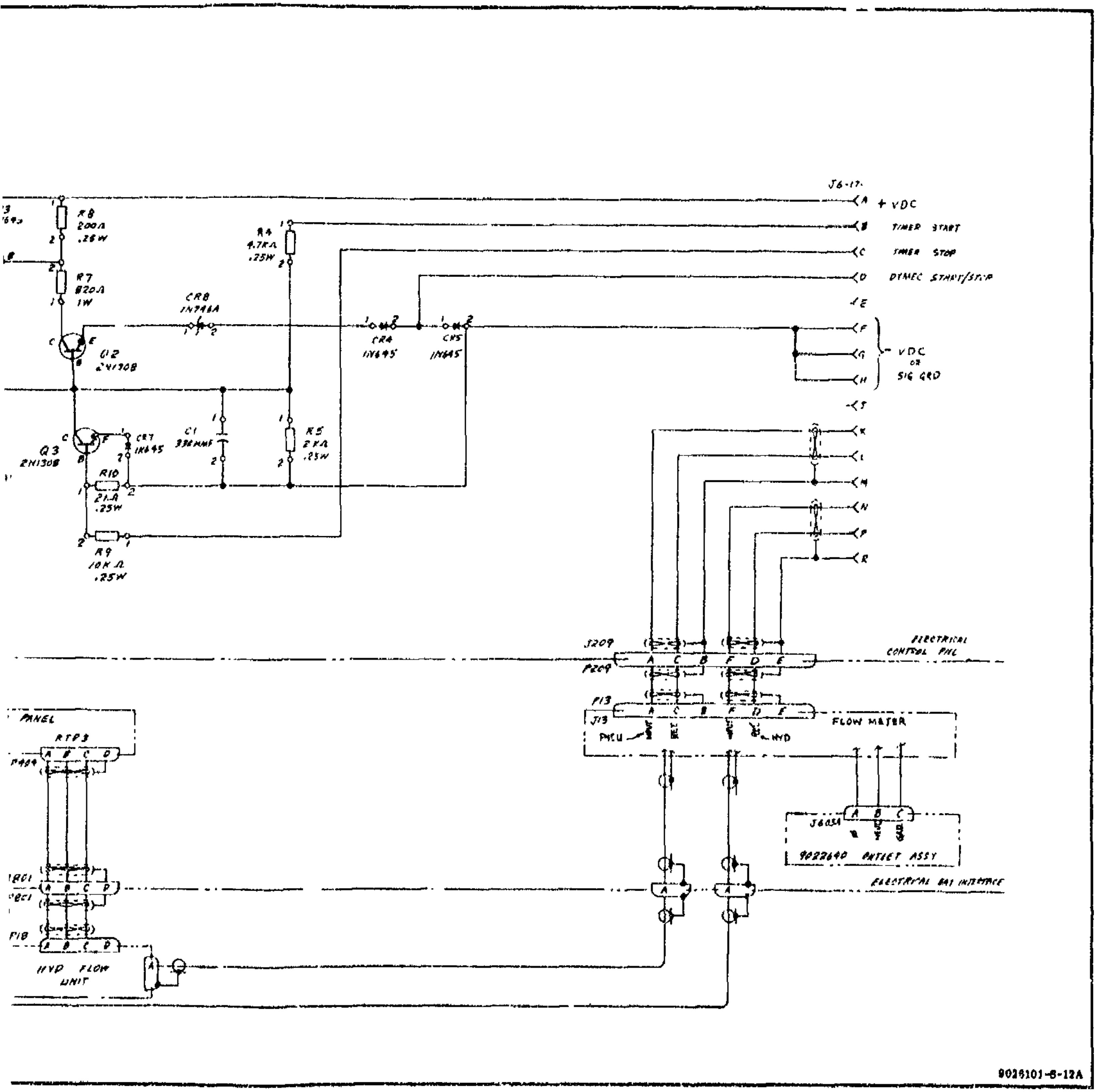
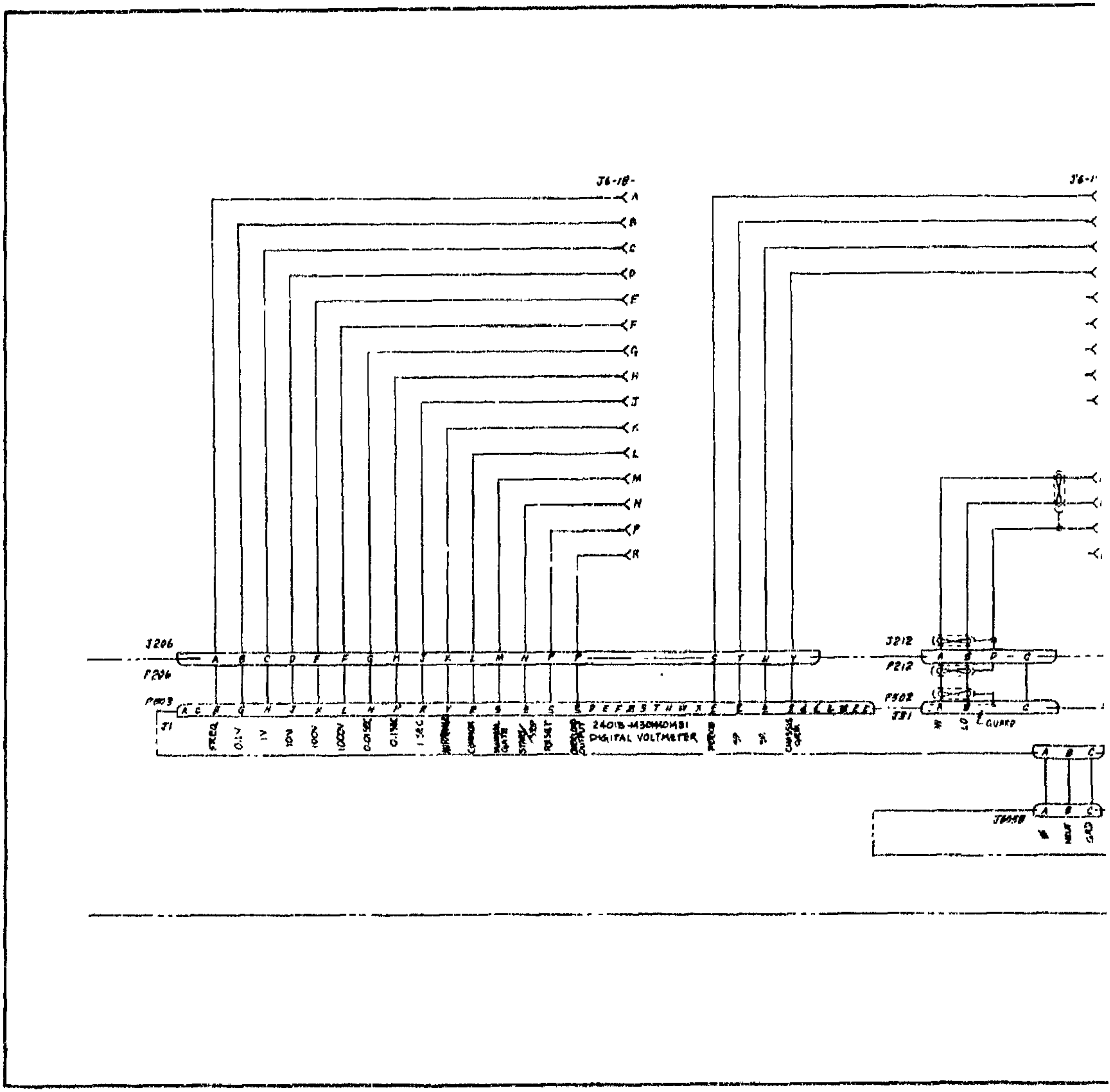


Figure 10-17. Components Test Console Electrical Schematic (Sheet 12 of 13)


J6-17-
+VDC
TIMER START
TIMER STOP
DYMEC START/STOP
VDC OR SIG GRD
R8 200Ω .25W
R7 820Ω 1W
CR8 1N746A
R4 4.7KΩ .25W
CR4 1N645
CR5 1N645
Q2 2N1308
Q3 2N1308
CR7 1N645
C1 330MMF
R5 2KΩ .25W
R10 21Ω .25W
R9 10KΩ .25W
J209
P209
ELECTRICAL CONTROL PNL
P13
J13
FLOW METER
PNEU
HYD
J603A
9022690 OUTLET ASSY
ELECTRICAL BAY INTERFACE
PANEL
P404
P18
HYD FLOW UNIT
9026101-6-12A

3)



Fig

Pages 10-5

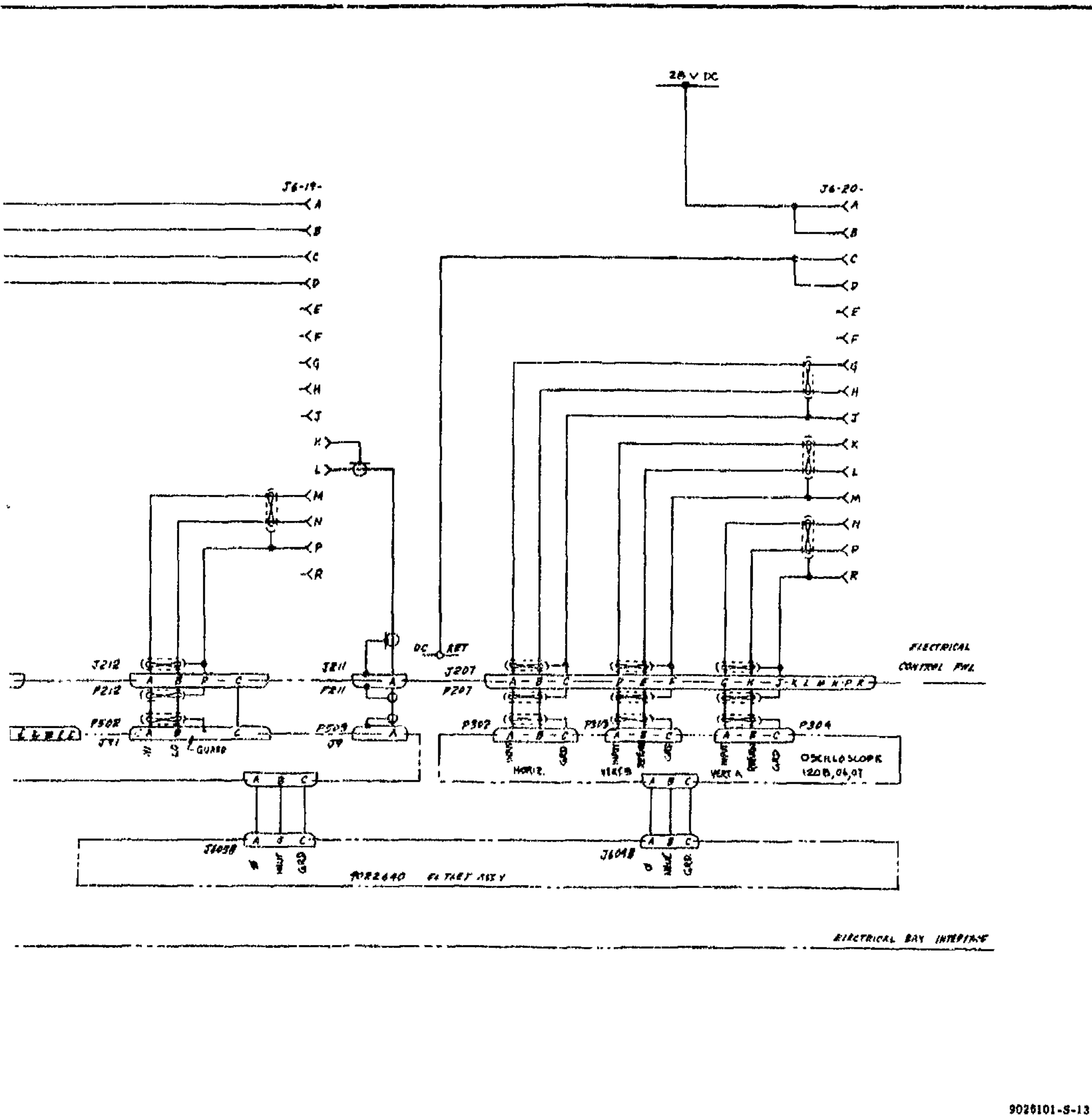


Figure 10-17. Components Test Console Electrical Schematic (Sheet 13 of 13)

Pages 10-57 through 10-76 deleted.

SECTION XI

CRYOGENIC SUPPLY UNIT G3146

WARNING

CRYOGENIC SUPPLY UNIT G3146 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

11-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance, and inspection for the Cryogenic Supply Unit G3146. The supply unit is used, in conjunction with the Components Test Console G3141, to perform cryogenic tests on specific components of the F-1 rocket engine.

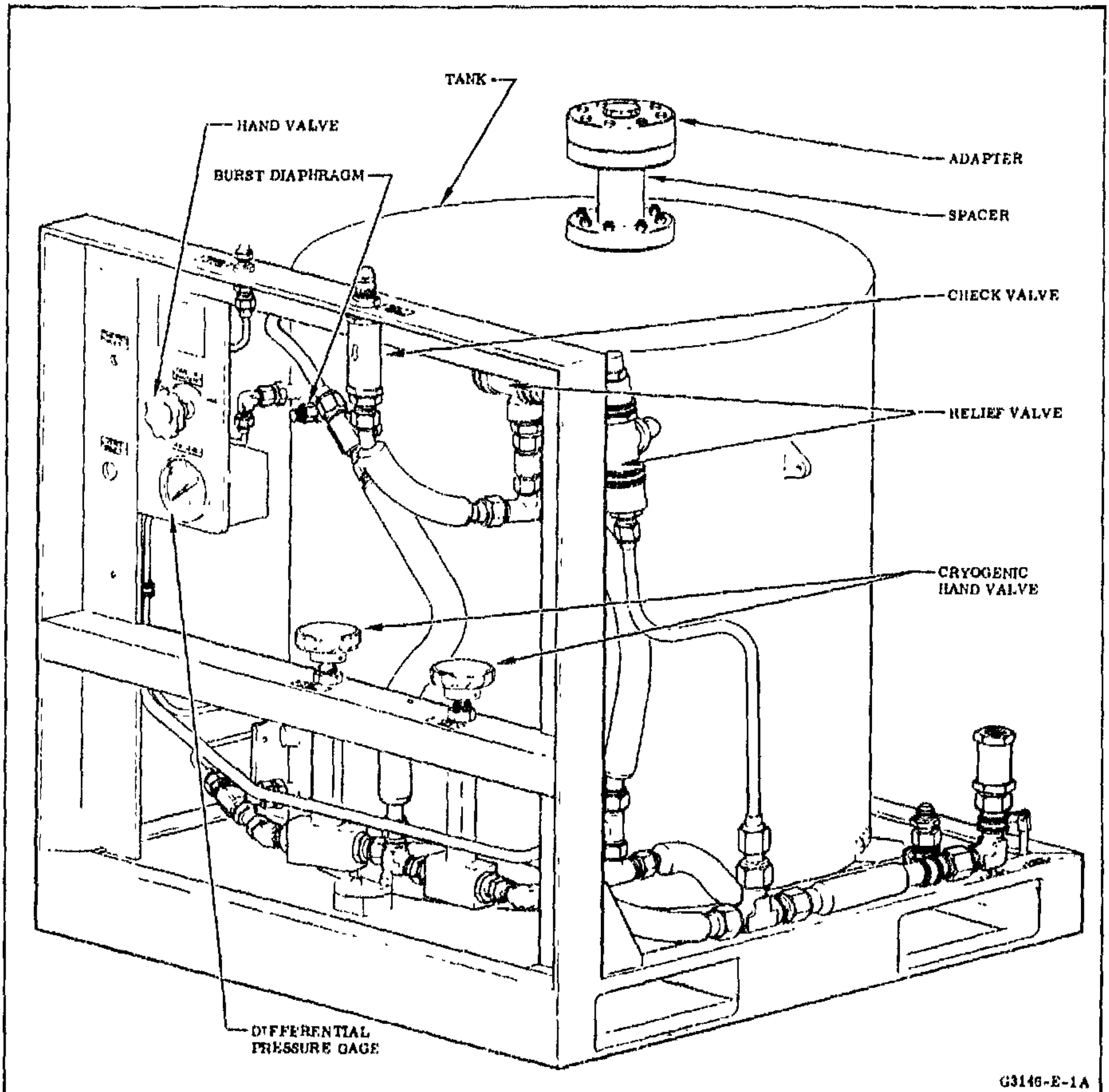


Figure 11-1. Cryogenic Supply Unit

11-2. DESCRIPTION AND LEADING PARTICULARS.

11-3. The cryogenic supply unit (figure 11-1) consists of a frame, a liquid nitrogen tank, shutoff valves, relief valves, check valves, a differential pressure gage, and related plumbing. The unit is a semi-permanent installation with provisions for lifting with a forklift. The tank is mounted on the horizontal portion of the frame and the operating controls are mounted on the vertical portion of the frame. See figure 11-2 for leading particulars.

Length	36 inches
Width	36 inches
Height	40-1/2 inches
Weight	1,500 pounds (approximate)
Tank Liquid Capacity	40 gallons
Maximum Operating Pressure	1,200 psig at -321° F
Design Pressure	1,500 psig

Figure 11-2. Leading Particulars for Cryogenic Supply Unit

11-4. FRAME.

11-5. The frame is constructed of steel plate welded to form a horizontal and vertical support for mounting the tank and operating components. The components mounted to the vertical support include two cryogenic hand valves, two relief valves, two check valves, a gage shutoff valve, and a differential pressure gage. Plates, with nomenclature engraved on the face, are attached to the frame identifying the inlet, outlet, or component use.

11-6. LIQUID NITROGEN TANK.

11-7. The liquid nitrogen tank is a cylindrical unit consisting of an inner and outer shell, seven bosses, a standpipe, three mounting lugs, and two lifting lugs. The inner and outer shells form a compartment for containing the insulating material (polyurethane foam, type I) required to prevent excessive boil-off. The bosses provide attach points for the inlet and outlet to the tank and for installation of a burst diaphragm. The standpipe extends to within an inch of the bottom of the tank and incorporates a flange for mounting a spacer and adapter for the tank liquid outlet. The mounting lugs are positioned 120 degrees from each other and the lifting lugs are 180 degrees from each other.

11-8. THEORY OF OPERATION.

11-9. The cryogenic supply unit is designed to provide 40 gallons of liquid nitrogen to test components at extremely low temperatures. The tank requires pneumatic pressure (0 to 1,200 psig) from Components Test Console G3141, to force the liquid nitrogen up the standpipe and out the outlet. The LN_2 level gage (pressure differential) is connected to the top and bottom of the tank to indicate liquid level. The gage senses pressure in the tank at both the top and bottom, and senses the liquid nitrogen head pressure at the bottom, which results in the indication on the gage. The liquid nitrogen supply is controlled by a shutoff valve, and a vent valve is incorporated to allow filling of the tank. Check valves installed in the supply and return lines prevent reverse flow of the liquid. A burst diaphragm is installed in a boss of the tank to prevent overpressurization, and relief valves installed in the supply and vent lines relieve excessive pressure.

11-10. MAINTENANCE.

11-11. Maintenance of the cryogenic supply unit consists of checkout, removal and installation, cleaning, servicing, and shipping and storage. The only test equipment and tools required during maintenance are a cryogenic hand valve, a calibrated test gage, and cryogenic test lines. (See figure 11-3 for schematic.)

11-12. CHECKOUT.

11-13. Checkout of the cryogenic supply unit consists of a leak-test and a function-test. All tests must be performed at a temperature of 65° to 75° F, at a barometric pressure of 29-32 inches of mercury, and at a humidity not greater than 50 percent.

NOTE

The following checkout procedures apply only to a self-check of the cryogenic supply unit. The procedures do not apply to supply unit when it is connected to Components Test Console G3141 or other GSE used in conjunction with the supply unit.

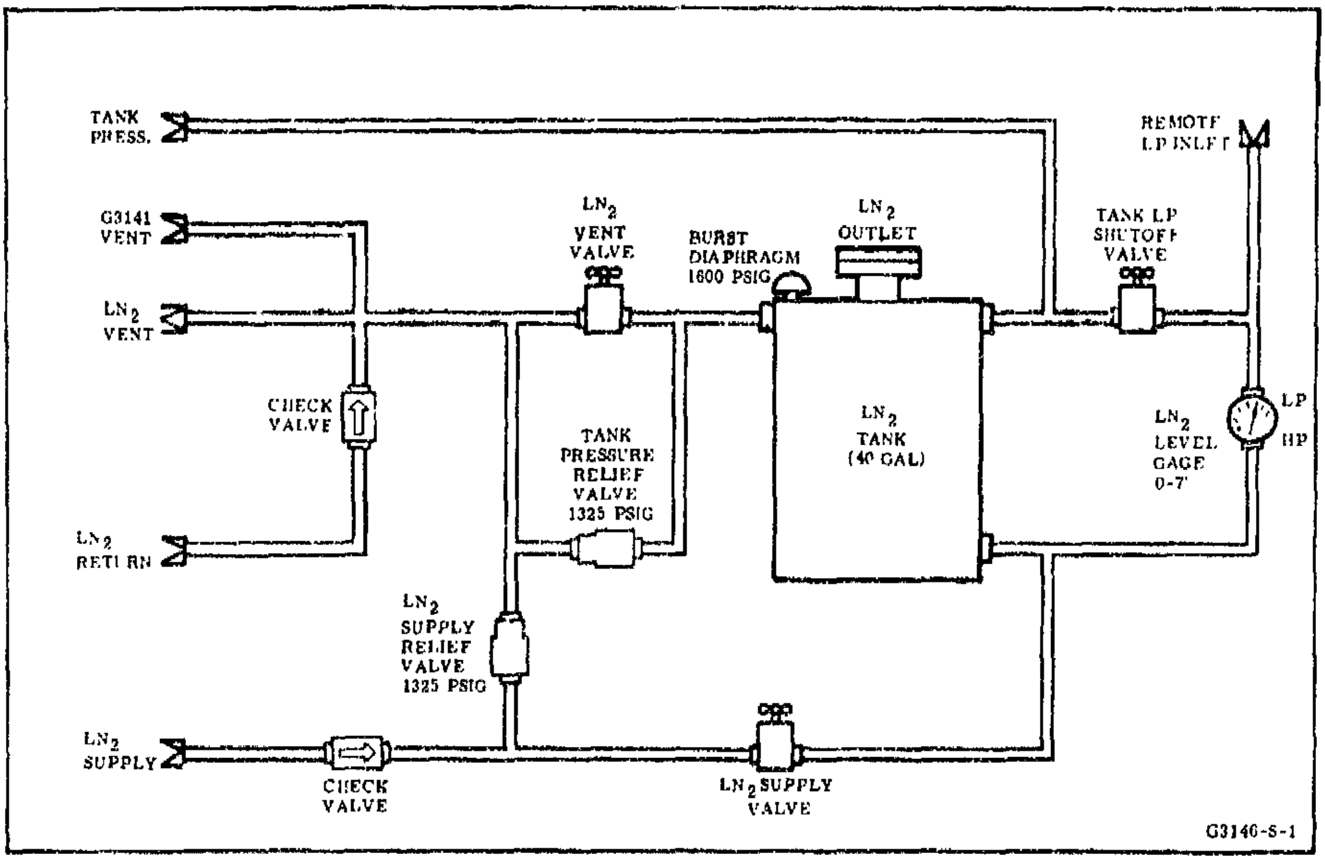


Figure 11-3. Cryogenic Supply Unit Schematic

11-14. LEAK-TEST.

a. Connect a regulated facility supply of gaseous nitrogen (MIL-P-27401) capable of delivering 1,800 (+20, -0) psig to LN_2 SUPPLY.

CAUTION

Make sure all external hoses, lines, fittings, and components used in testing unit are cleaned for liquid nitrogen service. (Refer to paragraph 11-18.)

b. Connect a pneumatic test line and a cryogenic hand valve between LN_2 outlet, located at top of liquid nitrogen tank, and LN_2 RETURN. Close cryogenic hand valve.

c. Make sure all unused ports are plugged or capped.

d. Open LN_2 SUPPLY and TANK LP SHUTOFF valves.

e. Slowly increase facility supply pressure to 1,200 (+0, -100) psig.

f. Using leak-test compound (MIL-L-25567), leak-test all pressurized supply unit fittings and connections. Fuzz leakage is allowable.

g. Reduce facility gaseous nitrogen supply pressure to zero and open cryogenic hand valve of step b.

h. Slowly increase facility supply pressure to 100 ±10 psig and repeat step f.

i. Decrease facility supply to zero and disconnect supply from LN_2 SUPPLY and cap port.

j. Disconnect pneumatic test line and close all supply unit valves.

11-15. FUNCTION-TEST.

a Connect a test line and a cryogenic hand valve between LN_2 outlet, located at top of liquid nitrogen tank, and LN_2 RETURN. Close cryogenic hand valve.

b. Connect a test line from LN_2 VENT to an external vent capable of accepting liquid nitrogen drain-off.

c. Make sure all supply unit valves are closed and all unused ports are capped or plugged.

d. Connect a regulated facility supply of gaseous nitrogen (MIL-P-27401) capable of delivering 1,500 ±100 psig to LN_2 SUPPLY.

e. Slowly increase facility supply pressure to LN_2 SUPPLY until LN_2 supply line relief valve starts to relieve. LN_2 supply line relief valve shall start to relieve audibly at 1,325 ±50 psig.

f. Reduce facility gaseous nitrogen supply pressure to zero. Relief valve must reseat at 1,190 psig.

g. Open LN_2 SUPPLY and LN_2 VENT valves and allow trapped pressure to vent.

h. Disconnect facility gaseous nitrogen supply from LN_2 SUPPLY and close all supply unit valves.

i. Connect a facility supply of liquid nitrogen (MIL-P-27401) capable of delivering 40 gallons at 1,500 ±100 psig to LN_2 SUPPLY.

j. Connect facility gaseous nitrogen supply to TANK PRESS INLET.

k. Open LN_2 VENT and TANK LP SHUTOFF valves.

l. Open LN_2 SUPPLY valve and fill liquid nitrogen tank until LN_2 LEVEL gage indicates 15 inches; then close LN_2 SUPPLY and LN_2 VENT valves.

m. Slowly increase facility pressure at TANK PRESS INLET to 1,200 ±100 psig.

n. Check all pressurized fittings and connections for excessive leakage.

WARNING

Do not tighten or loosen connections while system is pressurized or at cryogenic temperature, since serious injury to personnel and damage to equipment can result.

o. Increase facility supply pressure at TANK PRESS INLET until LN_2 tank relief valve starts to relieve. LN_2 tank relief valve must start to relieve audibly at 1,325 ±50 psig.

p. Reduce facility gaseous nitrogen supply pressure to zero. Relief valve must reseat at 1,190 psig.

q. Open cryogenic hand valve installed between LN_2 OUTLET and LN_2 RETURN.

r. Increase facility gaseous nitrogen supply pressure to 60 ±10 psig and maintain until level of liquid nitrogen in tank is too low to rise up standpipe and out vent.

s. Reduce facility gaseous nitrogen supply pressure to zero.

t. Disconnect facility liquid nitrogen supply; then open LN_2 VENT and LN_2 SUPPLY valves.

NOTE

Allow liquid nitrogen remaining in tank to evaporate and tank and plumbing to warm to room temperature before proceeding with steps u through w.

u. Disconnect facility gaseous nitrogen and liquid nitrogen supplies.

v. Close all supply unit valves and cap or plug all open ports.

w. Remove test line and cryogenic hand valve between LN_2 outlet and LN_2 RETURN. Cap or plug open ports.

11-16. REMOVING.

11-17. Disassemble the cryogenic supply unit, as required, to accomplish necessary repair or replacement. (See figure 11-4 for index and part numbers.) Make sure supply unit is drained and tank and plumbing are at room temperature before tightening or loosening connections. Refer to section X for repair of hand valves and relief valves.

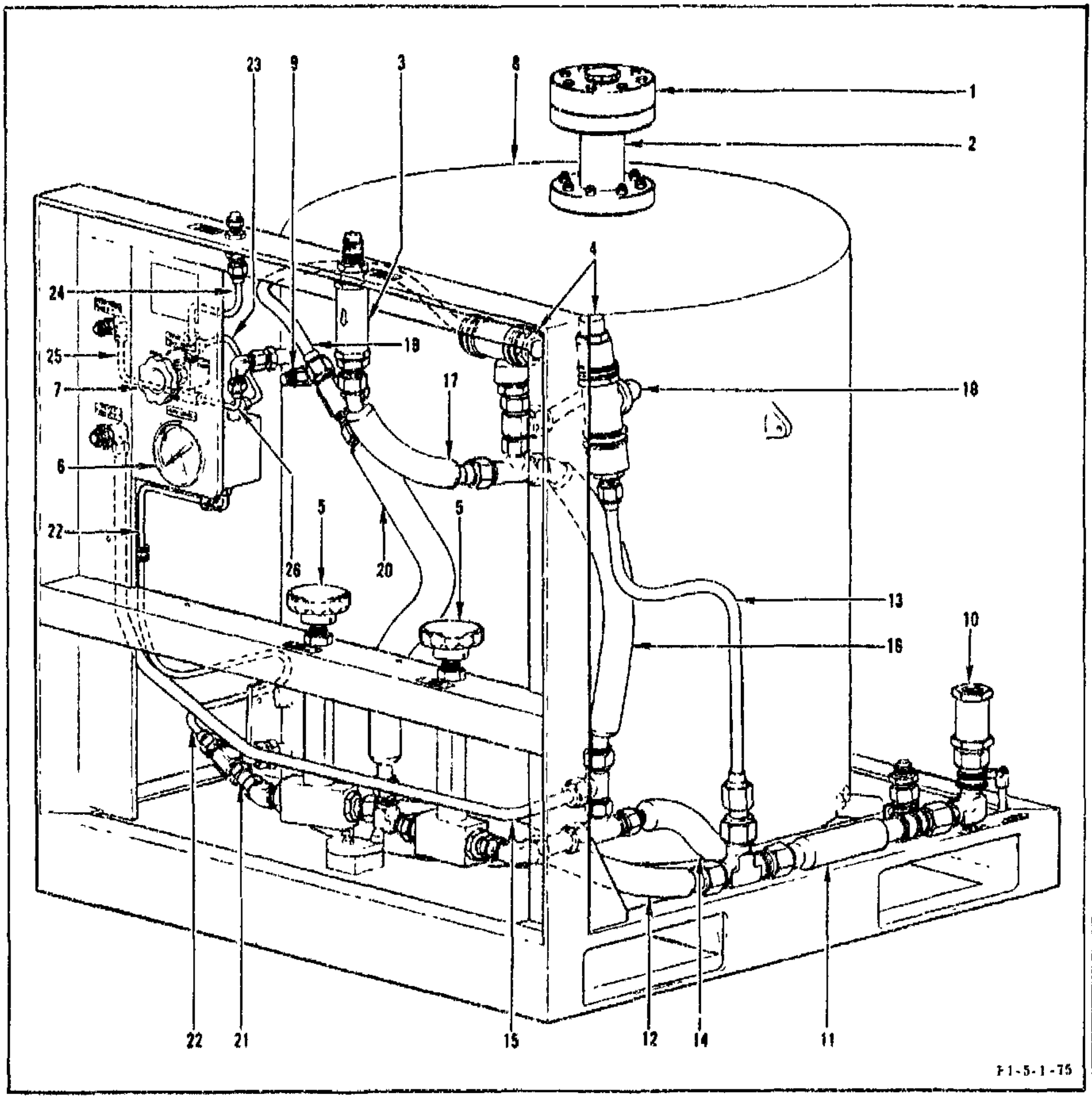


Figure 11-4. Disassembly of Cryogenic Supply Unit (Sheet 1 of 3)

Index No.	Part No.	Description
1	9022712	Adapter (F-3)
	RD111-1010-6628	Bolt (F-3)
	RD153-5004-0006	Washer (F-3)
	RD261-3010-0044	Seal (F-3)
	AN814-16C	Plug (F-3)
	VD261-0123-0016	Seal (F-3)
2	9022704	Spacer (F-3)
	MS15795-818	Washer (F-3)
3	RD284-3005-9001	Check Valve (F-3)
	AN832-12C	Union (F-3)
	AN924-12C	Nut (F-3)
	VD261-0123-0012	Seal (F-3)
	AN815-12C	Union (F-3)
4	19-9021937-2[a]	Relief Valve (F-1)
	AN815-8C	Union (F-3)
	VD261-0123-0008	Seal (F-3)
	AN815-12C	Union (F-3)
	VD261-0123-0012	Seal (F-3)
	MS21919G35	Clamp (F-3)
	MS15795-808	Washer (F-3)
	AN520C10R12	Screw (F-3)
	NAS679C3W	Nut (F-3)
	MS21919DG28	Clamp (F-3)
	NAS43DD3-32	Spacer (F-3)
	19-9014935-5	Tee (F-3)
	19-9014936-5	Tee (F-3)
	19-9014934-5	Elbow (F-3)
5	19-9021936[a]	Cryogenic Hand Valve (F-1)
	VD261-0123-0012	Seal (F-3)
	AN815-12C	Union (F-3)
	19-9014934-5	Elbow (F-3)
	19-9014936-5	Tee (F-3)
	19-9014937-9	Reducer (F-3)
	AN818-12C	Nut (F-3)
	AN6289C12	Nut (F-3)
	VD261-0106-0012	Seal (F-3)
	AN837-12C	Elbow (F-3)
6	19-9021934-4	Differential Pressure Gage (F-2)
	AN815-4C	Union (F-3)
	19-9014934-1	Elbow (F-3)
	AN814-4C	Plug (F-3)
	VD261-0123-0004	Seal (F-3)
7	19-9022606-1[a]	Hand Valve (F-1)
	AN815-4C	Union (F-3)
	VD261-0123-0004	Seal (F-3)
	19-9014934-1	Elbow (F-3)
	19-9014935-1	Tee (F-3)
	19-9014936-1	Tee (F-3)
8	NA5-28143T1	Tank (F-2)
	RD111-1010-7023	Bolt (F-3)
	RD153-5004-0010	Washer (F-3)

Index No.	Part No.	Description
8 (cont)	AN814-16C	Plug (F-3)
	VD261-0123-0016	Seal (F-3)
	AN814-32C	Plug (F-3)
	VD261-0123-0032	Seal (F-3)
9	19-9021941-37	Burst Diaphragm (F-3)
	VD261-0123-0006	Seal (F-3)
	AN893-14C	Bushing (F-3)
	VD261-0123-0010	Seal (F-3)
10	RD284-3003-9001	Check Valve (F-3)
	19-9014934-5	Elbow (F-3)
11	9026159	Tube (F-3)
	AN824-12C	Tee (F-3)
	19-9014937-9	Reducer (F-3)
	AN818-12C	Nut (F-3)
12	9026163	Tube (F-3)
13	9026158	Tube (F-3)
14	9026157	Tube (F-3)
	19-9014934-5	Elbow (F-3)
15	9026173	Tube (F-3)
	AN832-8C	Union (F-3)
	AN924-8C	Nut (F-3)
16	9026156	Tube (F-3)
	MS21919DG12	Clamp (F-3)
	AN520C10R10	Screw (F-3)
	MS9101-02	Bracket (F-3)
	MS21919DG16	Clamp (F-3)
	MS15795-808	Washer (F-3)
17	9026154	Tube (F-3)
18	9026155	Tube (F-3)
19	9026152	Tube (F-3)
20	9026156	Tube (F-3)
	AN919-23C	Reducer (F-3
	VD261-0123-0016	Seal (F-3)
	19-9014935-5	Tee (F-3)
	19-9014937-9	Reducer (F-3)
	AN818-12C	Nut (F-3)
21	9026164	Tube (F-3)
	AN919-23C	Reducer (F-3)
	VD261-0123-0016	Seal (F-3)
	19-9014935-5	Tee (F-3)
	19-9014937-4	Reducer (F-3)
	AN818-12C	Nut (F-3)
22	9026165	Tube (F-3)
	MS21919DG4	Clamp (F-3)
	AN520C10R18	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
	NAS43DD3-32	Spacer (F-3)
	AN520C10R8	Screw (F-3)
	MS21919DG8	Clamp (F-3)
23	9026166	Tube (F-3)

(a) Refer to section X for repair.

Figure 11-4. Disassembly of Cryogenic Supply Unit (Sheet 2 of 3)

Index No.	Part No.	Description
24	9026169	Tube (F-3)
	AN832-4C	Union (F-3)
	AN924-4C	Nut (F-3)
	AN929-4C	Cap (F-3)
25	9026168	Tube (F-3)
	AN832-4C	Union (F-3)
	AN924-4C	Nut (F-3)
26	9026167	Tube (F-3)
	AN919-10C	Reducer (F-3)
	VD261-0123-0008	Seal (F-3)
	19-9014934-1	Elbow (F-3)

Figure 11-4. Disassembly of Cryogenic Supply Unit (Sheet 3 of 3)

11-18. INSTALLING.

11-19. All parts of the cryogenic supply unit must meet the cleanness requirements outlined in section I before installing. See figure 11-4 for index and part numbers. The following steps include the special instructions. All tubing is locally manufactured from CRES 304 seamless tubing, (MIL-T-6845) with tube end flared in accordance with MS33584, with sleeve MS20819- and nut AN818-. (A damaged tube should be used for mockup.) New tube must be of the same material and wall thickness as replaced tube. Cover length of tubing with 4 layers of No. PT1 tape (Virginia Chemicals & Smelting Co), except leave one inch minimum clearance at B-nuts. Paint tape using color light gray (Federal Specification TT-P-95) and apply identification tape on exterior surface of tape. The lubricant used for assembling is lubricant grease RB0140-012 (Rocketdyne). Refer to section I for lubricant application.

a. Torque bolts of tank (8) to 65-90 ft-lb.

b. Torque clamp screw nuts to 8-10 in-lb.

c. Torque bolts of adapter (1) to 210-280 in-lb.

d. Torque nut AN924 or union AN815 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	55-80
1/2	180-230
3/4	420-600

e. Torque plug AN814 as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	40-65
3/4	300-500
1	450-600

f. Torque nut AN6289 as follows:

Tube OD (Inches)	Torque (in-lb)
3/4	450-650

g. Torque B-nuts AN818 for tubing as follows:

Tube OD (Inches)	Torque (in-lb)
1/4	135-185
1/2	450-525
3/4	900-1,100

h. Torque fittings used with seals as follows:

Seal Part No.	Fitting Torque (ft-lb)
VD261-0106-0012	115-125
VD261-0123-0004	12-15
VD261-0123-0006	17-23
VD261-0123-0008	30-40
VD261-0123-0012	65-85
VD261-0123-0016	65-85
VD261-0123-0032	95-125

i. Install tube (22) horizontally, within (+0.5, -0.0) inch, a minimum of 24 inches from the boss on tank (8). Centerline of tube must not be below the horizontal plane of the centerline of the boss.

11-20. SERVICING.

11-21. Servicing of the cryogenic supply unit consists of a periodic calibration-check of differential pressure gage 19-9021934-4, lubrication of hand valves, and function test of relief valves. Calibration requirements for the differential pressure gage are as follows:

Range and Accuracy	0-7 feet of LN_2 head; 0.5 percent of full-scale differential pressure
Calibration Tolerance	±0.7 percent
Calibration Frequency	6 months
Test Gage Accuracy	0-7 feet of LN_2 head; 0.25 percent of full-scale differential pressure

11-22. SHIPPING AND STORAGE.

11-23. Prepare the cryogenic supply unit for shipping or storage in accordance with MIL-P-116, Method III.

11-24. INSPECTION.

11-25. Figure 11-5 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspections requirements cannot be accurately predicted, since they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damaged conditions, and that hardware configuration is in accordance with appropriate records. A visual inspection is made before operation of the unit. Periodic inspections are made at specified periods. See figure 11-5 for inspection requirements and periodic intervals.

Inspection	Periodic (Months)			
	3	6	12	24
1. Security of all tubing and components.			X	
2. Unit exterior for any possible damage.				X
3. Unit exterior for cleanness and for flaking paint, loose foundation bolts, and placard illegibility.				X
4. Tubing for scratches, dents, cracked sleeves, loose coupling nuts, and improper color coding; pressure- and flow-indicating tape for lack of security and for illegibility.			X	
5. Function-test of relief valves (paragraph 11-15).			X	
6. Lubrication of hand valves. (Refer to section X.)			X	
7. LN_2 LEVEL gage calibration check.		X		

Figure 11-5. Inspection Requirements

SECTION XII

PNEUMATIC FLOW TESTERS G3104 AND G3104MD1

WARNING

PNEUMATIC FLOW TESTERS G3104 AND G3104MD1 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

12-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance, and inspection for Pneumatic Flow Testers G3104 and G3104MD1. The pneumatic flow tester is used for measuring flowrates of dry gaseous nitrogen or helium from components during engine leak- and function-tests. Flowrates of 0.26 to 4,100 scim (standard cubic inches per minute) of gaseous nitrogen or 0.29 to 10,000 scim of gaseous helium at standard atmospheric pressure and temperature can be measured.

12-2. DESCRIPTION AND LEADING PARTICULARS.

12-3. The pneumatic flow tester (figure 12-1) is a portable-type flowmeter suitable for shop or field use. It is a suitcase-type unit with aluminum sections and a rubberized hair liner to protect the instrument from damage. The pneumatic flow tester has an instrument panel, a compartment for graphs and instructions, and storage space for accessories. See figure 12-2 for leading particulars.

12-4. INSTRUMENT PANEL. The instrument panel has five flowmeters, a pyrometer and thermocouple, pneumatic inlets and outlets, and a level at the top of the panel. Flowmeters No. 1 through No. 3 have a sapphire ball float, No. 4 a glass ball float, and No. 5 a steel ball float.

12-5. ACCESSORIES. The accessories stored in the pneumatic flow tester consist of hoses, adapters, leveling legs, a handle, and an accumulator.

12-6. THEORY OF OPERATION.

12-7. The pneumatic flow tester is connected downstream of the system or component under test. The pneumatic flow enters the panel SOURCE inlet, flows from the panel METER outlet, passes through the meter hose into the flowmeter, and vents to atmosphere. Temperature of the pneumatic flow is indicated on the pyrometer. Leakage in system or component under test is indicated on the applicable flowmeter. Readings recorded on individual flowmeters must be converted to standard cubic inches per minute (scim) using individual meter flow curves and a temperature correction chart.

12-8. MEASURING FLOW. The expected flowrate of the system or component to be tested should be determined and a meter with sufficient capacity used. When possible, a meter that will indicate in upper 2/3 of scale, to increase accuracy of result, must be used. When flowrate is unknown, the largest capacity flowmeter must be used first; then the smallest capacity flowmeter on which a reading can be obtained, to increase accuracy of results. Measure flow as follows:

a. Verify that accuracy of flowtester has been checked within the previous 6 months.

b. Verify that the particular flow curve (nitrogen or helium) for applicable flowmeter(s) is identified with the serial number, or equivalent, of the pneumatic flow tester being used.

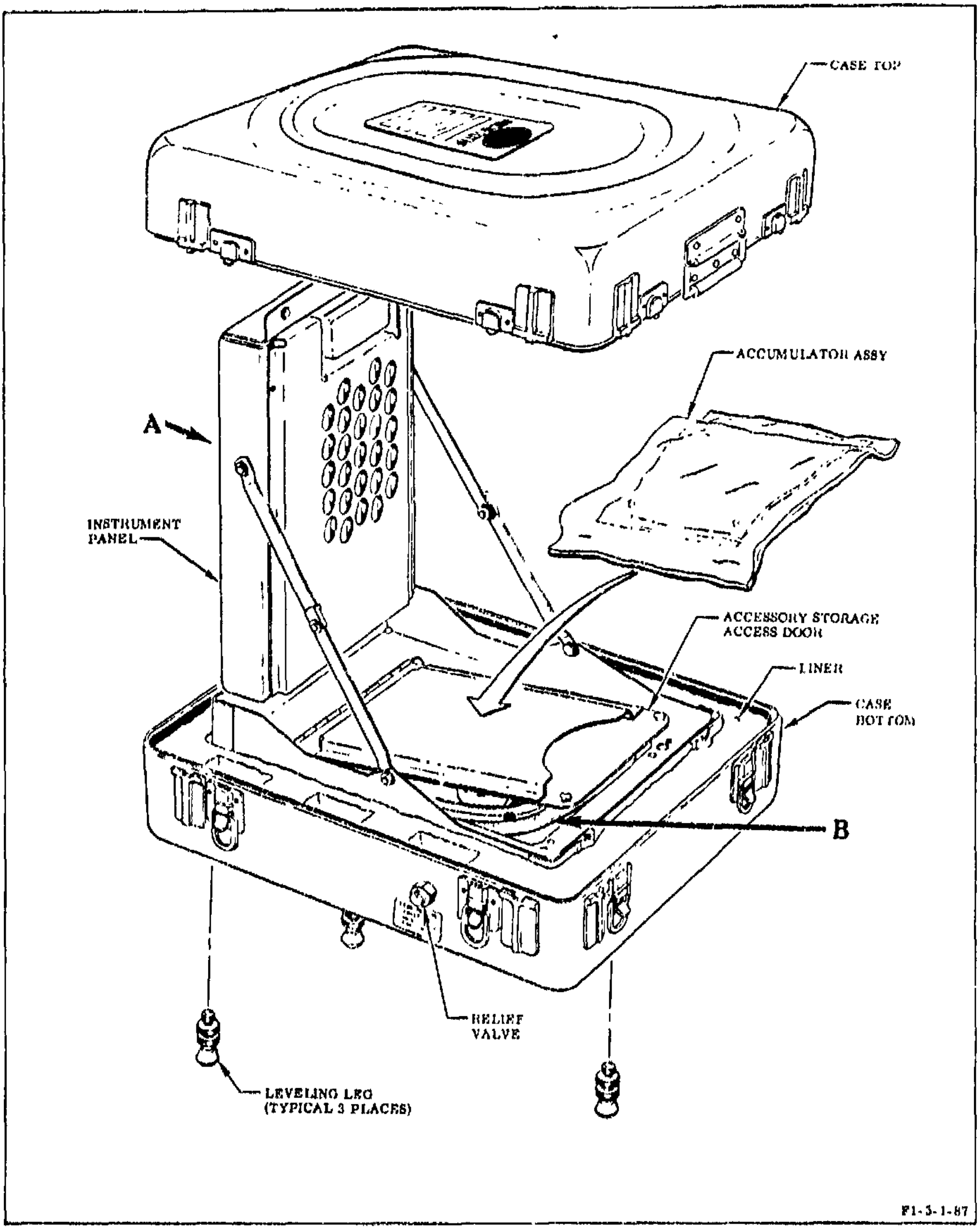
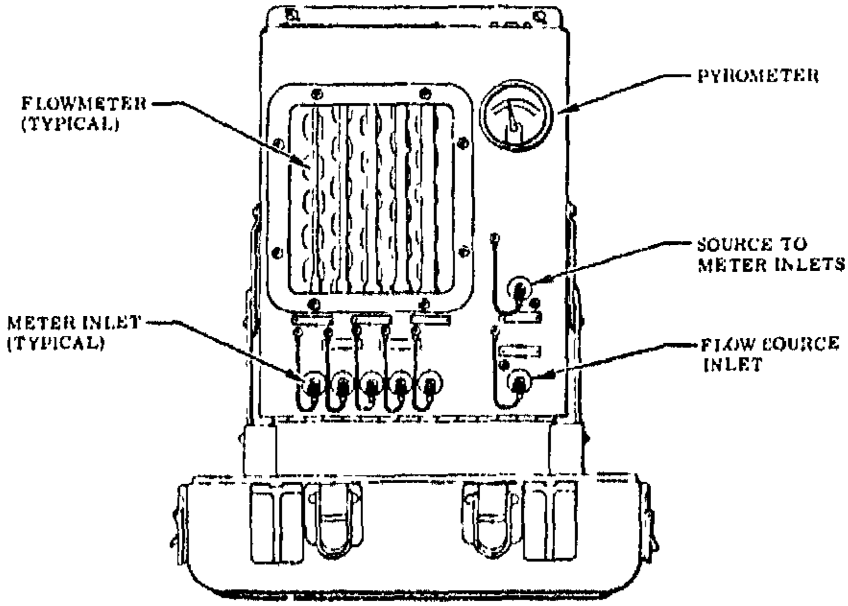
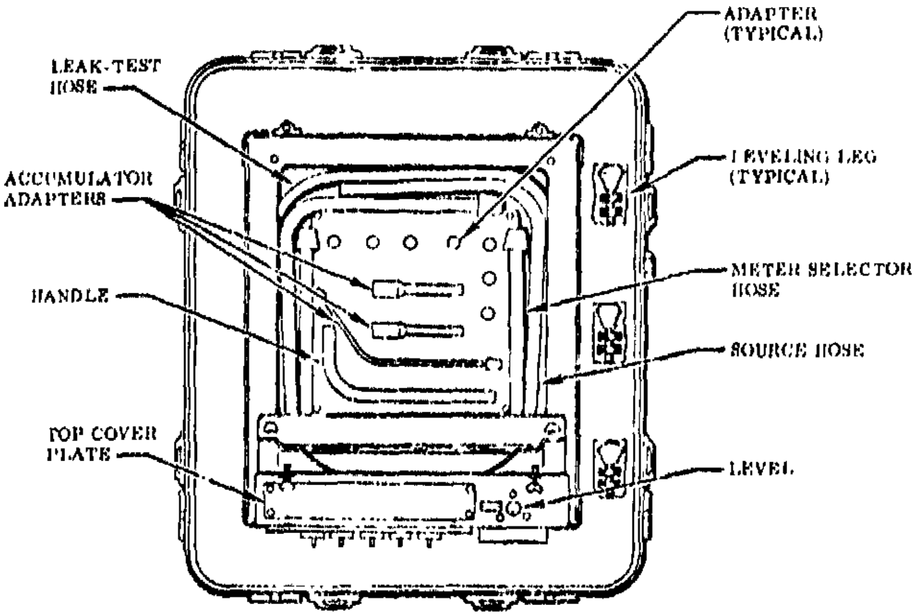


Figure 12-1. Pneumatic Flow Tester (Sheet 1 of 2)



DETAIL A



DETAIL B

F1-5-1-88

Figure 12-1. Pneumatic Flow Tester (Sheet 2 of 2)

Case

Material	Weatherproof aluminum sections
Internal Protection	Shock-reducing rubberized hair
Pressure Compensation	Vacuum relief valve for relieving low pressure inside case caused by altitude changes
Leveling Adjustment	Fittings on bottom of case for attachment of 3 adjustable leveling legs
Dimensions (closed)	22.42 x 19.25 x 8.75 inches (approximately)
Weight	40 pounds

Instrument Panel

Meter No. 1	Capacity 0.26 to 2.60 scfm gaseous nitrogen 0.29 to 2.9 scfm helium
Meter No. 2	Capacity 1.1 to 11.3 scfm gaseous nitrogen 1.5 to 15.5 scfm helium
Meter No. 3	Capacity 5.8 to 58.5 scfm gaseous nitrogen 11.8 to 118 scfm helium
Meter No. 4	Capacity 55.5 to 555.0 scfm gaseous nitrogen 100 to 1,340 scfm helium
Meter No. 5	Capacity 410 to 4,100 scfm gaseous nitrogen 1,000 to 10,000 scfm helium
Pyrometer	Indicated Range -75° to +225° F Usable Range +40° to +125° F

(a) Flowtesters incorporating MD1 change.

Accessories

Adapter, 908128	0.06-inch ID x 0.12-inch OD tip
Adapter, 908130	0.19-inch ID x 0.56-inch OD tip
Adapter, 908131	0.19-inch ID x 0.38-inch OD tip
Adapter, 908132	Close-corner for a 0.12-inch diameter hole 0.09 inch from side
Adapter, 908133	0.16-inch ID x 0.22-inch OD tip
Adapter, 908138	Close-corner for a 0.25-inch diameter hole 0.19 inch from side
Adapter, 908139	Close-corner for a 0.38-inch diameter hole 0.42 inch from side
Adapter, 908141	0.38-inch ID x 0.90-inch OD tip
Meter Hose, 907041	3/8-inch ID x 1/2-inch OD x 20 inches
Handle, 907042	Connects source hose to adapters
Source Hose, 907043	3/8-inch ID x 1/2 inch OD x 96 inches
Adapter, 9022319[a] (Naflex seal vent)	1/8-inch diameter x 0.060-inch diameter tip
Adapters, 9022320 (Accumulator)[a]	0.375-inch OD x 0.437-inch OD x 3 ±0.06 inches (2 required)
Hose, 9022321[a]	3/8-inch ID x 1/2 inch OD x 96 ±1 inches
Accumulator Assembly, 9024714[a]	
Adapter Y-Fitting, 69196[a]	3/8-inch OD

Figure 12-2. Leading Particulars for Pneumatic Flow Tester

c. Connect suitable hoses, adapters, and handle to perform flow test. Connect meter hose to flowmeter capable of measuring expected flow.

NOTE

On testers incorporating MD1 change, the accumulator may be used to dampen flow surges. Flowtesters may be used in parallel to measure flowrates beyond the capacity of a single flowtester. (See figure 12-3 for multiple connection.)

d. Press and aline adapter onto part of system or component being tested. Make sure source hose is not kinked and adapter is alined with port.

NOTE

Gas will not flow freely into source hose if adapter is not alined with port.

- Flowmeter reading will fluctuate if source hose is kinked or disturbed.

e. Observe and record gas temperature when temperature has stabilized.

f. Observe and record flowmeter reading. Read indication at widest part of float.

NOTE

Scales on each flowmeter bear no relation to each other. For example, a reading of 8 on METER NO. 1 scale has no relation to a reading of 8 on METER NO. 2 scale.

g. Using flow curve (scale reading versus actual flow), step b, for applicable flowmeter, determine flow in scim. If temperature is different from that recorded on flow curve, apply flow reading obtained from flow curve to temperature correction chart (figure 12-4). Multiply actual flow reading by correction factor to obtain scim. Result obtained will be within the following tolerance for the flowmeter:

METER NO. 1	10% of full scale
METER NO. 2	5% of full scale
METER NO. 3	5% of full scale
METER NO. 4	3% of full scale
METER NO. 5	3% of full scale

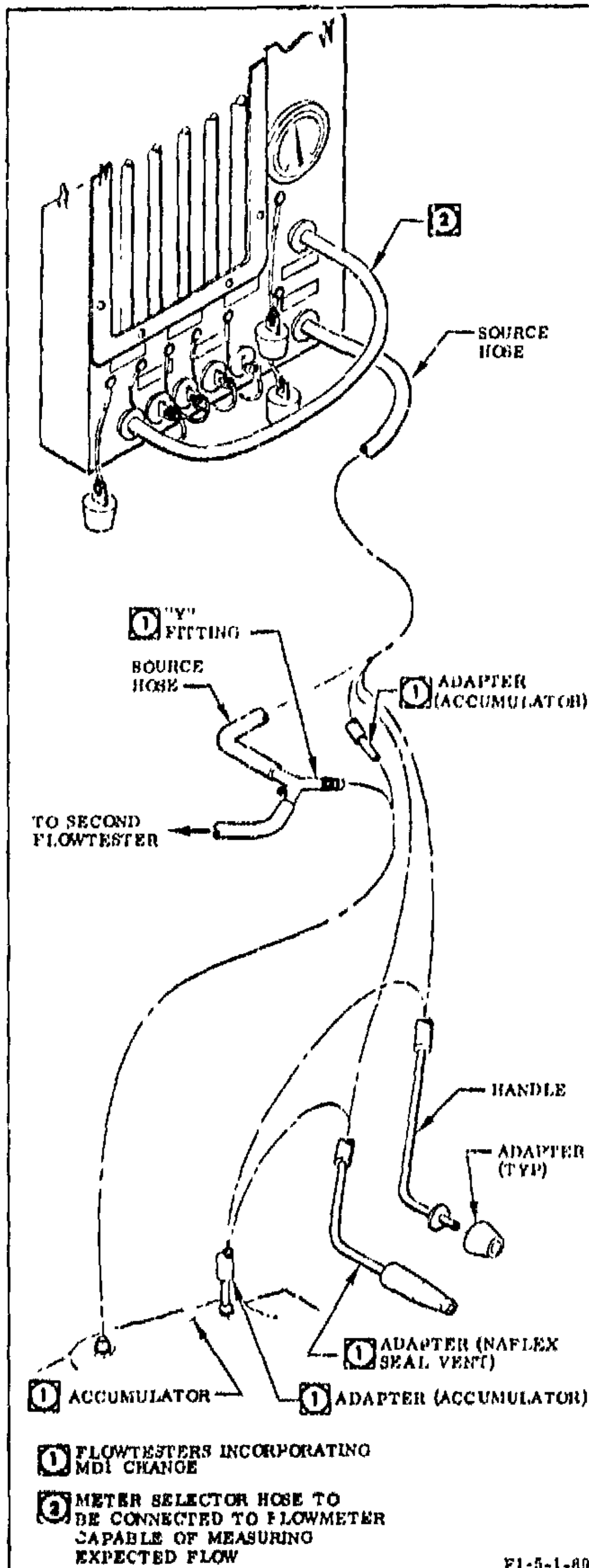


Figure 12-3. Accumulator and Multiple Flowtester Setup

Flowmeter Temperature (° F)	Correction Factor (Standard Temperature 70° F)
40	1.030
45	1.024
50	1.019
55	1.014
60	1.010
65	1.005
70	1.000
75	0.995
80	0.991
85	0.986
90	0.982
95	0.977
100	0.973
105	0.968
110	0.964
115	0.960
120	0.956
125	0.952

Figure 12-4. Temperature Correction Chart

12-9. MAINTENANCE.

12-10. Maintenance for the pneumatic flow tester consists of testing, removal and installation, cleaning, servicing, and shipping and storage. (See figure 12-5 for maintenance requirements.)

12-11. TEST EQUIPMENT AND MATERIALS.

12-12. The test equipment and material requirements for performing testing procedures are listed in figure 12-6.

12-13. TESTING.

12-14. PREPARING FLOWTESTER FOR USE. (See figure 12-1.)

WARNING

Pneumatic flow tester must be operated by authorized personnel trained in the use of the equipment.

a. Open relief valve on side of case. Unlatch and remove top of case.

b. Remove 3 leveling legs from case and attach to bottom of case.

c. Erect instrument panel and lock in place with braces.

d. Position flowtester to permit connection of source hose to component or system being tested with instrument panel facing into the wind or draft.

e. Adjust leveling legs on bottom of case until bubble level on instrument panel indicates flowtester is in level position.

12-15. VERIFYING PYROMETER ACCURACY.

WARNING

Pneumatic flow tester must be operated by authorized personnel trained in the use of the equipment.

a. Prepare flowtester for use as outlined in paragraph 12-14.

b. Remove instrument panel back cover to gain access to thermocouple.

c. Place hotplate and container of distilled water near flowtester.

d. Immerse thermocouple tip and mercury thermometer into water and record 3 temperatures between 55° and 95° F as indicated on pyrometer and thermometer. The pyrometer must indicate within 8° F of thermometer.

e. Reinstall thermocouple in inlet manifold.

f. If testing is complete, secure flowtester as outlined in paragraph 12-21.

12-16. LEAK-TESTING ACCUMULATOR (See figure 12-7.)

WARNING

Pneumatic flow tester must be operated by authorized personnel trained in the use of the equipment.

a. Prepare flowtester for use as outlined in paragraph 12-14.

Requirements	Receiving	Before Use	Storage	Special	Remarks
INSPECTING					
Flowtester for completeness	x	x			
Case for dents, gouges, and cracks	x	x			
Handles for security	x	x			
Latches for security and freedom of operation	x	x			
Rubberized hair shock pads for dirt, deterioration, and damage	x	x			
Case relief valve for security	x	x			
Brace assemblies for security and correct operation	x	x			
Leveling legs for deterioration, torn rubber caps, stripped threads, and ease of adjustment	x	x			
Instrument panel for broken fasteners	x	x			
Placards for legibility	x	x			
Screws for security	x	x			
Bubble level for security and cracked lens and bubble.	x	x			
Flowmeter tubes for cracks, moisture condensation, and legibility	x	x			
Plastic coupling sleeves for security	x	x			
Ball floats for freedom of movement		x			Tilt flowtester to determine freedom of float movement.
Exhaust manifold grommets for cracks and deterioration	x	x			
Exhaust manifold screen for dirt	x	x			
Port plugs for deterioration and dirt	x	x			
Cables for security and damage	x	x			

Figure 12-5. Maintenance Requirements (Sheet 1 of 3)

Requirements	Receiving	Before Use	Storage	Special	Remarks
Pyrometer for security, damage, and legibility	x	x			
Adapters for dirt, deterioration, correct type and quantity, and correct fit on handle	x	x			
Hoses for contamination, cracks, deterioration, obstructions, and correct fit in inlets and outlets on instrument panel and on handle.	x	x			
<u>TESTING</u>					
Verifying pyrometer accuracy				x	Every 6 months or when malfunction is suspected.
Leak-testing accumulator				x	Every 6 months or when malfunction is suspected.
Leak-testing flowtester				x	Every 6 months, when malfunction is suspected, when accuracy of meters must be verified, and after cleaning tubes.
Testing flowmeter pressure-drop				x	Every 6 months, when malfunction is suspected, when accuracy of meters must be verified, and after cleaning meters.
Verifying flowmeter accuracy.				x	Every 6 months and when malfunction is suspected.
Developing flow curve				x	Before initial use. Any time flowmeter fails to come within specified tolerance during accuracy verification checks.
<u>CLEANING</u>					
Flowtester carrying case and instrument panel exterior				x	When contaminated.
Flowmeter tubes				x	When flowmeter operates erratically, fails leak test, or fails pressure-drop test.
Flowtester accessories				x	When contaminated.
Exhaust manifold screen				x	When contaminated.

Figure 12-5. Maintenance Requirements (Sheet 2 of 3)

Requirements	Receiving	Before Use	Storage	Special	Remarks
SERVICING					
Antistatic treatment of flowmeter tubes and floats				x	Every 6 months, when malfunction is suspected, and after cleaning tubes.
PAINTING					
Instrument panel				x	When surface is damaged. Paint with grey semi-gloss enamel (TT-E-529), color 26622 (Federal Standard 595).
Case exterior				x	When surface is damaged. Paint with green camouflage enamel (MIL-E-5556), color 34300 (Federal Standard 595).

Figure 12-5. Maintenance Requirements (Sheet 3 of 3)

Identification	Name	Use
ANSTAC-2M (Chemical Development Corp)	Antistatic solution	Antistatic treatment of flowmeter tubes and floats.
MIL-L-25567	Leak-test compound	Detecting leakage.
MIL-P-27401	Gaseous nitrogen	Performing checkout.
MIL-T-27602	Trichloroethylene	Cleaning flowmeters.
No number	Flow calibration standard (accuracy 1.0% of indicated reading)	Comparing readings with flowmeters.
No number	Hose adapter (consisting of 3/8-inch tubing, nut and sleeve)	Connecting pneumatic test source of flowmeter SOURCE inlet hose.
No number	Hose (thin-walled tygon or plastic), 1/4-, 3/8-, 1/2-, and 5/8-inch ID	Cleaning and testing flowmeters.
No number	Hot plate	Performing pyrometer accuracy test.
No number	Mercury thermometer, range of 40° to 100° F (accuracy ±1° F)	Measuring accuracy of pyrometer and thermocouple.
No number	Needle valve, minimum 3/8 inch	Adjusting flowrates.
No number	Pressure regulator, 10 psig	Controlling inlet pressure.
No number	Pressure gage, 25 psig	Indicating inlet pressure.
No number	Water manometer [(a)]	Measuring inches of water.
T-0043P5-2	Piezometer (3/8-inch)	Providing upstream connection for manometer.
TT-M-261	Methyl-ethyl-ketone	Cleaning inlet manifold.

(a) Water manometer must be a minimum of 30 inches or of sufficient capacity to measure back pressure from flow calibration standard.

Figure 12-6. Test Equipment and Materials

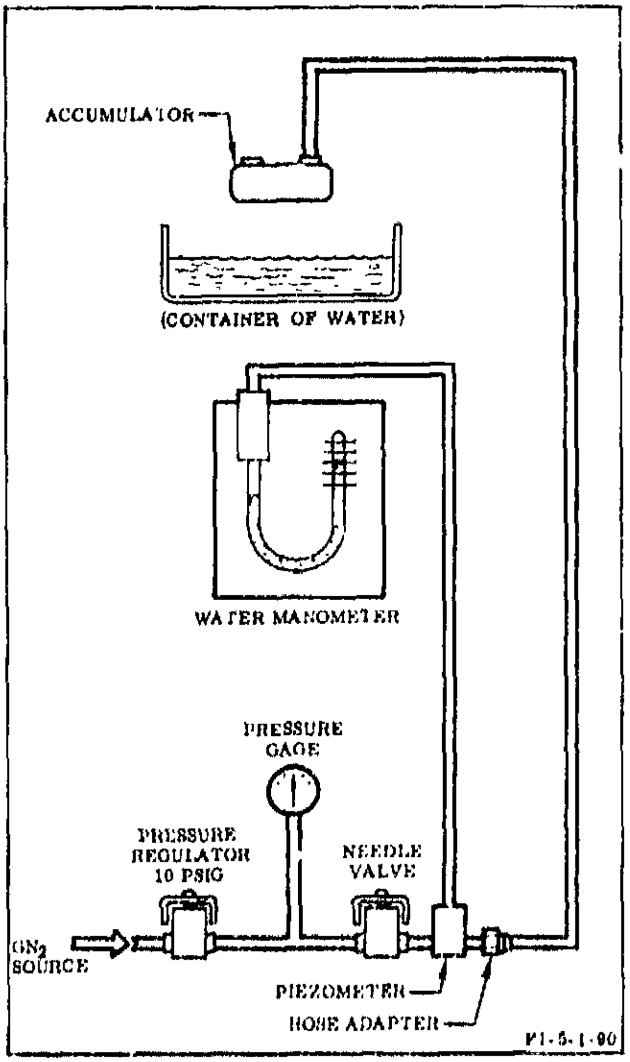


Figure 12-7. Suggested Test Setup for Leak-Testing Accumulator

b. Pressurize accumulator to 10 ±1 inches of water.

c. Immerse pressurized accumulator (and adapters) in water and check for leakage along seams on all 4 edges and at connectors on accumulator. Leakage is not allowable. (It is not necessary to submerge entire accumulator at one time.)

d. Check for surface leakage (both sides). (Surfaces may be checked by carefully running water over one area at a time.) Leakage is not allowable.

e. Depressurize accumulator.

f. If testing is complete, secure flowtester as outlined in paragraph 12-21.

12-17. LEAK-TESTING FLOWTESTER. (See figure 12-8.)

WARNING

Pneumatic flow tester must be operated by authorized personnel trained in the use of the equipment.

NOTE

Manometer and calibration standard must not be connected at this time.

a. Prepare flowtester for use as outlined in paragraph 12-14.

b. Remove instrument panel back cover to gain access to lower part of flowmeter tubes and flowmeter inlet manifold block.

c. Remove instrument panel top cover to gain access to flowmeter outlets.

d. Install plugs or short lengths of plastic hoses of applicable sizes to outlets of each flowmeter tube and plug other end of plastic hoses.

e. Connect meter hose between METER port and METER NO. 1 port.

f. Connect a regulated source of gaseous nitrogen (MIL-P-27401) to source hose; then press source hose into SOURCE port.

g. Increase source pressure to 10 psig, open needle valve, and adjust pressure regulator until pressure gage indicates 0.5 to 1.0 psi.

NOTE

It may be necessary to hold the plug, installed at the tube outlet or end of plastic hose, while pressurizing and during leak-test to prevent it from blowing out.

h. Apply leak-test compound to flowmeter tube and inlet manifold block and at pyrometer connections. Leakage is not allowable.

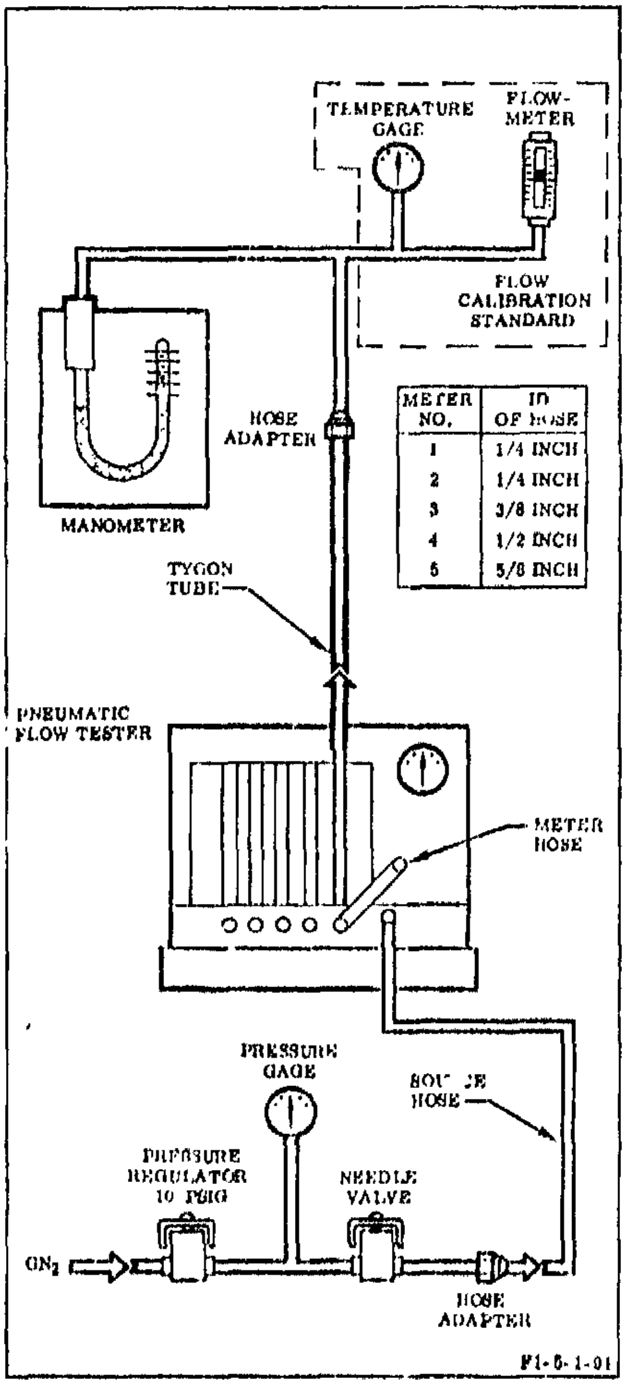


Figure 12-8. Suggested Test Setup for Leak and Accuracy Testing Flowmeters

i. Close needle valve.

j. Remove meter hose from METER NO. 1 port and install it in METER NO. 2 port. Cap METER NO. 1 port.

k. Repeat procedure to leak-test flowmeters 2 through 5.

l. Close needle valve, carefully remove plugs or plastic hoses from outlet of each flowmeter, wipe leak-test compound from flowmeter tube and manifold block, and install instrument panel top cover and back cover. Torque screws to 12-14 in-lb.

m. If testing is complete, secure flowtester as outlined in paragraph 12-21.

12-18. TESTING FLOWMETER PRESSURE-DROP. (See figure 12-9.)

WARNING

Pneumatic flow tester must be operated by authorized personnel trained in the use of the equipment.

a. Prepare flowtester for use as outlined in paragraph 12-14.

b. Make sure flowmeter tube outlets are open to atmosphere.

c. Connect meter hose between METER port and METER NO. 1 port.

d. Slowly open needle valve until METER NO. 1 scale reading is maximum.

e. Observe manometer for pressure drop. Pressure drop must not exceed 0.5 inch of water for METER NO. 1.

f. Close needle valve.

g. Repeat procedures for flowmeters 2 through 5. Pressure drop must not exceed 0.5 inch of water for METER NO. 2, 0.7 inch for METER NO. 3, 1.0 inch for METER NO. 4, and 14.0 inches for METER NO. 5.

h. If pressure drop exceeds values specified, a restriction is evident in either the meter, inlet manifold block, or hoses and must be corrected before proceeding.

i. Close needle valve and remove manometer.

j. If testing is complete, secure flowtester as outlined in paragraph 12-21.

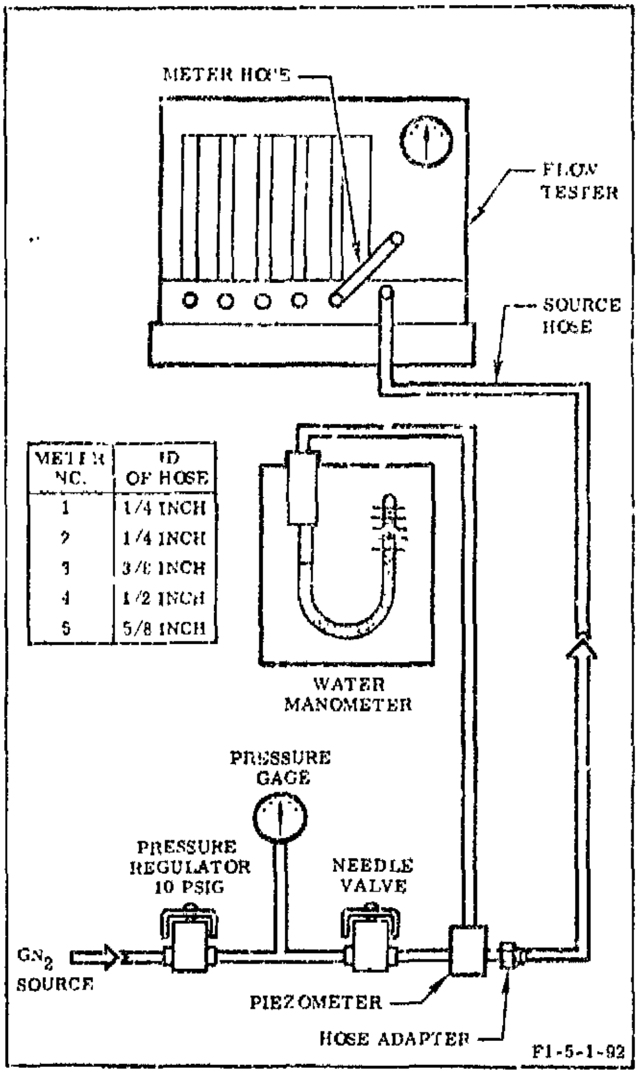


Figure 12-9. Suggested Test Setup for Testing Flowmeter Pressure Drop

12-19. VERIFYING FLOWMETER ACCURACY. (See figure 12-8.)

a. Prepare flowtester for use as outlined in paragraph 12-14.

b. In test setup, needle valve and all test equipment between needle valve and source hose must have a minimum inside diameter of 3/8 inch. All test equipment between flowtester and flow calibration standard must be same size as flowmeter tube being tested.

c. Establish a flowrate equivalent to approximately each 10-percent increment of full scale on METER NO. 1. Record the following data for each flow:

(1) Gas temperature indicated on pyrometer and meter scale reading after temperature stabilizes (pneumatic flow tester).

(2) Absolute pressure at meter outlet (barometric pressure plus water manometer pressure).

(3) Actual flow in scim at 14.7 psia and 70° F (flow calibration standard).

d. Determine indicated flow (in scim) using flow curve (scale reading versus actual flow) for each flowrate through each meter.

e. Multiply each result obtained in step d by temperature correction factor obtained from figure 12-4.

f. Correct result obtained in step e for flowmeter condition of average barometric pressure indicated on calibration curve being verified.

g. Indicated flows obtained in step f must be within 3 percent of full scale of respective flows obtained in step c, substep 3.

NOTE

The degree of accuracy specified in step g must be obtained to ensure the degree of accuracy specified in paragraph 12-8.

h. If results in step g are not obtained, clean flowmeter tube as outlined in paragraph 12-34 and antistatic treat flowmeter tube and float as outlined in paragraph 12-36 and repeat steps b through g. If results in step g are still not within tolerance, develop a new flow curve as outlined in paragraph 12-20.

i. Reduce pressure to zero.

j. Remove meter hose from METER NO. 1 and repeat steps c through i for METER NO. 2 through METER NO. 5, connecting meter hose to applicable meter.

k. If testing is complete, secure flowtester as outlined in paragraph 12-21.

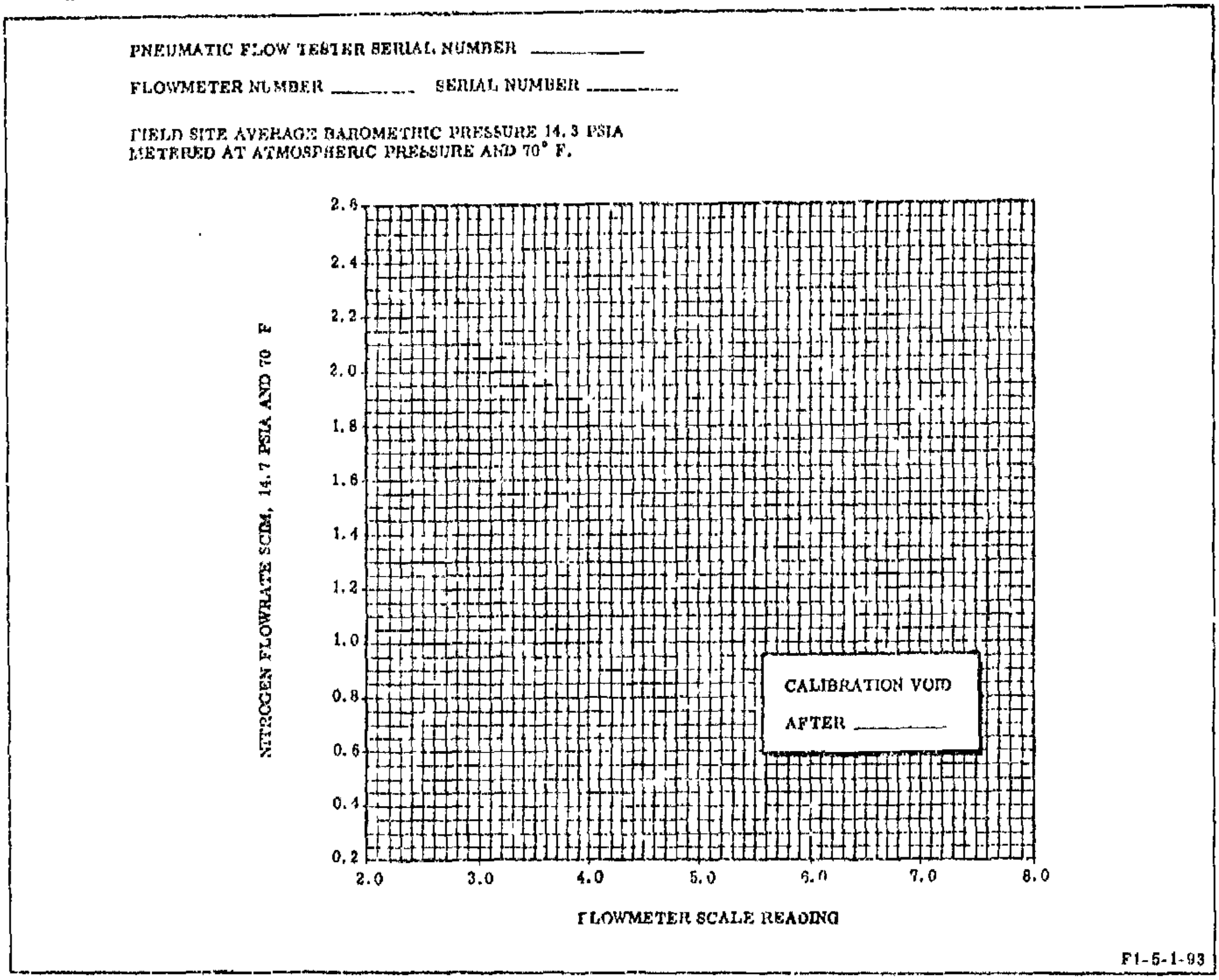


Figure 12-10. Typical Flow Plot

12-20. DEVELOPING FLOW CURVE. (See figures 12-8 and 12-10.)

WARNING

Pneumatic flow testers must be operated by authorized personnel trained in the use of the equipment.

a. Prepare flowtester for use as outlined in paragraph 12-14.

b. In the test setup, needle valve and all test equipment between needle valve and source hose must have a minimum inside diameter of 3/8 inch. All test equipment between flowtester and flow calibration standard must be the same size as flowmeter tube being tested.

c. Establish a flowrate equivalent to approximately each 10-percent increment of full scale on METER NO. 1. Record the following data for each flow:

(1) Gas temperature indicated on pyrometer and meter scale reading after temperature stabilizes (pneumatic flow tester).

(2) Absolute pressure at flowmeter outlet (barometric pressure plus water manometer pressure).

(3) Actual flow in scim at 14.7 psia and 70° F (flow calibration standard).

d. Determine actual flow from step c, substep 3, corrected for a flow condition at 70° F and the average barometric pressure at the particular site, using standard laboratory calibration procedures.

e. Plot curve of scale reading and results of step d.

f. Remove meter hose from METER NO. 1, and repeat steps a through e for METER NO. 2 through METER NO. 5, connecting meter hose to applicable meter.

g. Reduce pressure to zero.

h. Install back cover and top cover plate on instrument panel. Torque screws to 12-14 in-lb.

i. If testing is complete, secure flowtester as outlined in paragraph 12-21.

12-21. SECURING FLOWTESTER. (See figure 12-1.)

WARNING

Pneumatic flow testers must be operated by authorized personnel trained in the use of the equipment.

a. Disconnect and secure all test equipment.

b. Place handle, adapters, and hoses in correct space in flowtester storage compartment and close compartment door.

c. Place accumulator on top of storage compartment door.

d. Unlock instrument panel braces, lower instrument panel to storage position, and secure in place.

e. Remove leveling legs from exterior of case and store in liner.

f. Install cover on case and secure locks.

g. Close relief valve on side of case.

12-22. REMOVAL AND INSTALLATION.

12-23. Disassemble the pneumatic flow tester, as required, for repairs or replacement. (See figure 12-11 for index and part numbers.)

12-24. REMOVING FLOWMETER TUBE. The only special procedure required for removing the flowmeter tube is to cut and remove plastic coupling sleeve from base of tube.

CAUTION

Flowmeter tubes must be handled with care since tubes break easily.

12-25. INSTALLING FLOWMETER TUBE. When installing flowmeter 1, 2, or 3, perform antistatic treatment outlined in paragraph 12-36.

WARNING

The following procedure specifies methyl-ethyl-ketone, 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.

a. Clean adhesive from inlet manifold block using methyl-ethyl-ketone (Federal Specification TT-M-261).

b. Apply thin coat of general purpose adhesive (MIL-A-5092, Type II) approximately 3/4 inch wide around exterior of flowmeter tube and inlet manifold block nipple, approximately 1/2 inch from end of tube and nipple.

c. Insert bottom end of flowmeter tube into plastic coupling sleeve.

d. Insert flowmeter tube through rubber grommet in exhaust manifold, with tube scale facing forward and highest scale graduation at the top.

e. Install flowmeter tube and plastic coupling sleeve on inlet manifold block nipple.

12-26. REMOVING PYROMETER.

a. Remove back cover from instrument panel.

b. Disconnect thermocouple wires from pyrometer.

CAUTION

Care must be used to prevent damage when handling thermocouple.

c. Remove thermocouple from inlet manifold.

d. Remove pyrometer through front of instrument panel.

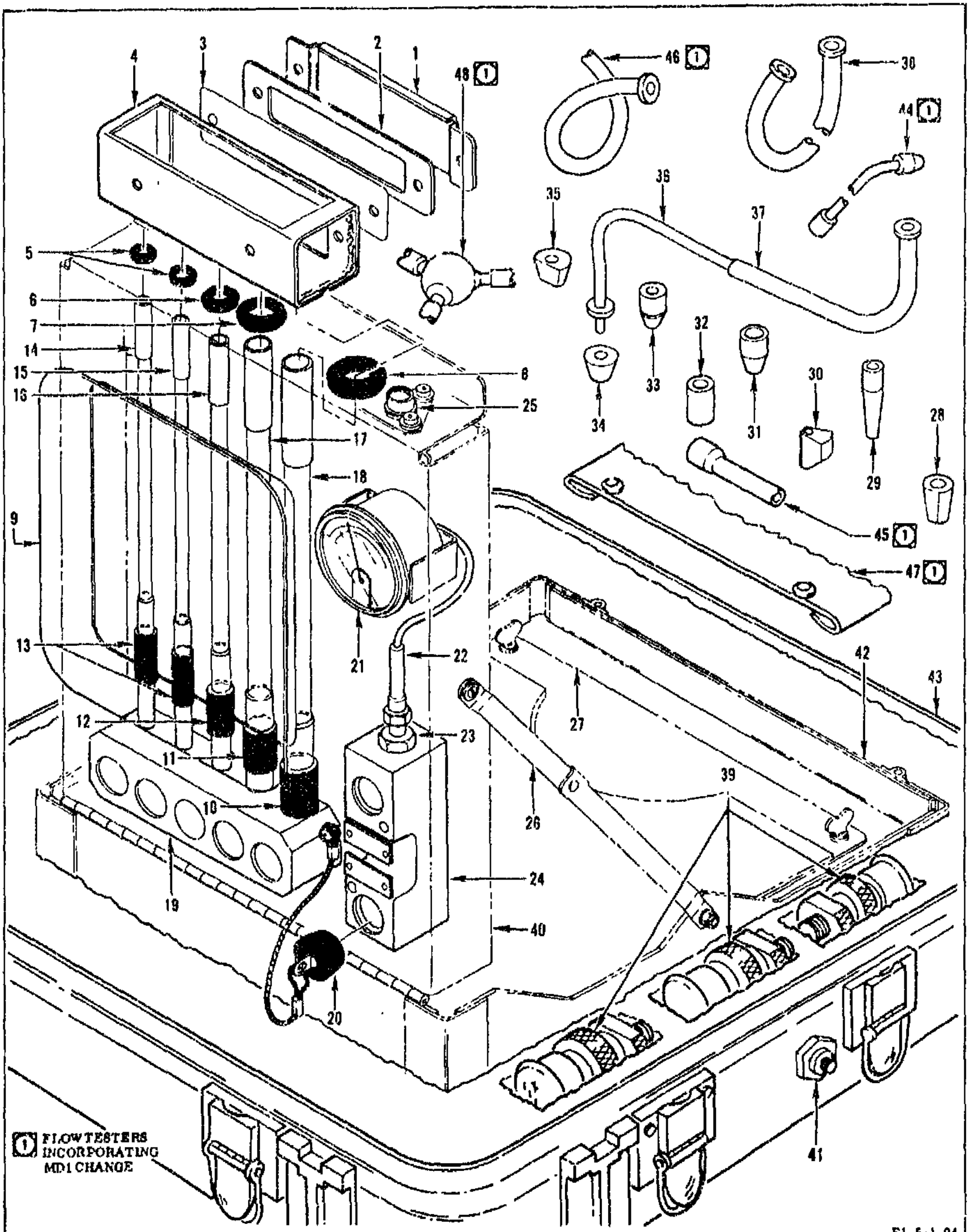


Figure 12-11. Disassembly of Pneumatic Flow Tester (Sheet 1 of 2)

Index No.	Part No.	Description
1	900736	Shield (F-3)
2	900735	Plate (F-3)
3	900734	Screen (F-3)
	LD153-0011-0011	Washer (F-3)
	AN520-10R8	Screw (F-3)
4	9019866	Meter Box (F-1)
	AN520-10R10	Screw (F-3)
	LD153-0011-0011	Washer (F-3)
5	MS35489-6	Grommet (F-3)
6	MS35489-11	Grommet (F-3)
7	MS35489-16	Grommet (F-3)
8	MS35489-19	Grommet (F-3)
9	900727	Window (F-3)
	AN520-10R8	Screw (F-3)
	LD153-0011-0011	Washer (F-3)
	NAS679A3W	Nut (F-3)
10	900737	Sleeve (F-3)
11	900738	Sleeve (F-3)
12	900739	Sleeve (F-3)
13	900740	Sleeve (F-3)
14	NA5-26727T1	Flowmeter (F-3)
15	NA5-26727T2	Flowmeter (F-3)
16	NA5-26727T3	Flowmeter (F-3)
17	NA5-26727T4	Flowmeter (F-3)
18	NA5-26727T6	Flowmeter (F-3)
19	9022814	Block (F-3)
	AN520-10R30	Screw (F-3)
	LD153-0011-0011	Washer (F-3)
	NAS679A3W	Nut (F-3)
20	900730	Plug (F-3)
	NAS679C3W	Nut (F-3)
	LD153-0010-0007	Washer (F-3)
	SIZE No. 5	Stopper (F-3)
	903309	Spacer (F-3)
	AN42B-C12A	Eyebolt (F-3)
	RD191-2001-2109	Cable (F-3)
	28-1-C	Sleeve (F-3)
	RD132-4001-0003	Bushing (F-3)
21	19-9017278	Pyrometer (F-1)
	LD153-0011-0001	Washer (F-3)
	NAS679A04W	Nut (F-3)
22	19-9017277	Thermocouple (F-3)
23	AN919-14	Reducer (F-3)
	MS28778-10	Packing (F-3)
24	9019862	Block (F-3)
	AN520-10R36	Screw (F-3)
	LD153-0011-0011	Washer (F-3)
	NAS679A3W	Nut (F-3)
25	2100	Level (F-3)
	901096	Plate (F-3)
	MS28777-10	Ring (F-3)
	AN503-8-10	Screw (F-3)
	LD153-0011-0008	Washer (F-3)
	22ND8-82	Spline Nut (F-3)
26	903307	RH Brace (F-1)
	903308	LH Brace (F-1)
	903306	Pin (F-3)
	LD153-0011-0011	Washer (F-3)
	AN507-632-R10	Screw (F-3)
	LD153-0011-0008	Washer (F-3)
	NAS679A06W	Nut (F-3)
27	901053	Door (F-1)
	MS20253-2-1075	Pin (F-3)
	2600-4SW	Wing Head Stud (F-3)
	2600-LW	Washer (F-3)
	212-12A	Receptacle (F-3)
28	908141	Adapter (F-3)
29	908133	Adapter (F-3)
30	908139	Adapter (F-3)
31	908138	Adapter (F-3)
32	908132	Adapter (F-3)
33	908131	Adapter (F-3)
34	908130	Adapter (F-3)
35	908129	Adapter (F-3)
36	907042	Handle (F-1)
37	907043	Hose (F-3)
38	907041	Hose (F-3)
39	903302	Leg (F-3)
40	9019864	Stand (F-1)
	2600-4SW	Wing Head Stud (F-3)
	2600-LW	Washer (F-3)
	26R1-1	Receptacle (F-3)
	903301[b]	Back Cover (F-3)
	9019867[b]	Cover (F-3
	AN520-10-10	Screw (F-3)
	LD153-0010-0010	Washer (F-3)
41	120H-A14	Relief Valve (F-1)
42	900746	Base (F-3)
	9019868	Plate (F-3)
	9019868-11[a]	Plate (F-3)
43	120H-5C	Case (F-1)
44	9022319[a]	Adapter (F-3) (Naflex seal vent)
45	9022320[a]	Adapter (F-3) (Accumulator)
46	9022321[a]	Hose (F-3) (Accumulator)
47	9024714[a]	Accumulator (F-1)
	9024714-3[a]	Bag (F-3)
	9022322[a]	Accumulator (F-3)
48	69196[a]	Y-Connector (F-3)

(a) Flowtesters incorporating MD1 change.
(b) Item not illustrated.

Figure 12-11. Disassembly of Pneumatic Flow Tester (Sheet 2 of 2)

12-27. INSTALLING PYROMETER.

a. Insert pyrometer through front of instrument panel and secure with washers and nuts.

b. Install thermocouple in inlet manifold.

c. Connect thermocouple to pyrometer by installing blue wire to (+) positive terminal.

d. Install red wire to (-) negative terminal.

e. Perform leak-test (paragraph 12-17).

12-28. REMOVING LEVEL. Remove safetywire, 3 attaching screws, base plate, ring, and level through rear of instrument panel.

12-29. INSTALLING LEVEL.

a. Install ring on level and insert level through mounting hole in top of instrument panel.

b. Place base plate against bottom of level and install and tighten 3 mounting screws to secure bubble level to instrument panel.

c. Install adjustable legs into bottom of case and position stand of flowtester in vertical position.

d. Adjust legs, as required, until front and one side of stand are vertical as indicated with a reference level.

e. Adjust level to center bubble by tightening the 3 attaching screws; then safetywire screws with Inconel lockwire MS20995N32.

12-30. CLEANING.

12-31. CLEANING FLOWTESTER EXTERIOR AND ACCESSORIES.

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.

a. Use a lint-free cloth dampened with trichloroethylene RB0210-003 (Rocketdyne) to handwipe flowtester exterior surfaces.

b. Remove any contamination from hoses, handle, and adapters by washing in a detergent solution of 6-8 ounces of Oakite No. 61 (Oakite Products Co), or equivalent, per gallon of water at a temperature of 120° to 180° F.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

c. Rinse hoses, handle, and adapters with clean water, and dry them thoroughly with low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401).

d. Clean exhaust manifold screen in trichloroethylene RB0210-003 (Rocketdyne). Blow screen dry with low-pressure gaseous nitrogen (MIL-P-27401).

12-32. CLEANING FLOWMETER TUBES. (See figure 12-12.)

a. With instrument panel locked in upright position, remove instrument panel rear cover to provide access to outlet end of flowmeter.

b. Remove cover above exhaust manifold.

c. Install piece of tygon tubing, or any thin-walled plastic tubing, approximately 6 inches long, over outlet end of flowmeter tubes as follows:

(1) METER NO. 1 and METER NO. 2, 1/4-inch ID tubing.

(2) METER NO. 3, 3/8-inch ID tubing.

(3) METER NO. 4, 1/2-inch ID tubing.

(4) METER NO. 5, 5/8-inch ID tubing.

WARNING

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

d. Fill a clean, bent-tip oil can with trichloroehtylene RB0210-003 (Rocketdyne). Oil can tip must be small enough to fit the inlet manifold nipple..

NOTE

One flowmeter is cleaned at a time, with the flowmeter in place in the flowtester.

e. Place flowtester on workbench in an inverted position.

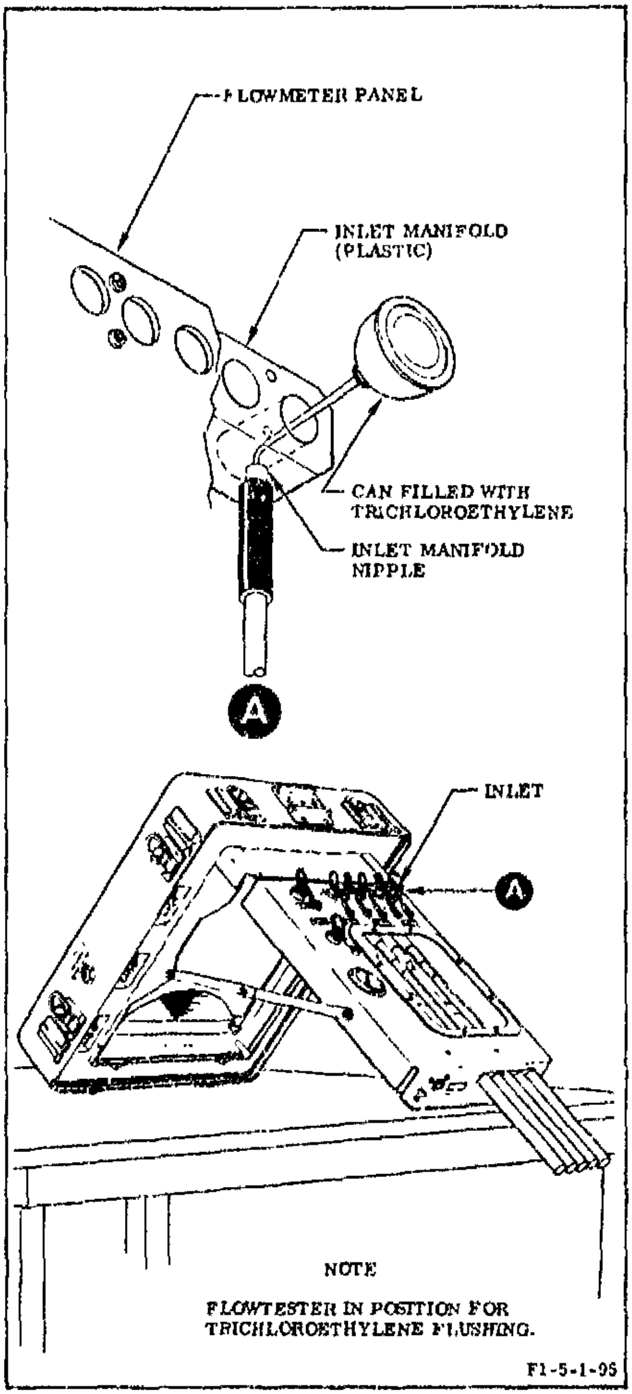


Figure 12-12. Cleaning Flowmeter Tubes

CAUTION

Trichloroethylene can damage plastic manifold. Any trichloroethylene contacting manifold must be wiped off immediately with a clean, lint-free cloth.

f. Hold plastic tubing (installed in step c) closed and fill flowmeter tube with trichloroethylene from the oiler.

g. Open plastic tube and allow trichloroethylene to drain.

h. Repeat steps f and g a minimum of 3 times.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

CAUTION

Purge pressure in excess of 1.5 psig can damage flowmeter.

i. Purge inlet manifold block until dry with low-pressure (less than 1.5 psig) gaseous nitrogen (MIL-P-27401).

j. Insert source hose plug into inlet manifold block and purge flowmeter for approximately 3 minutes or until dry.

12-33. SERVICING.

12-34. ANTISTATIC TREATMENT OF FLOWMETER TUBES AND FLOATS. The following procedure applies to flowmeter tubes No. 1, 2, and 3 only.

a. Clean applicable flowmeter tubes as outlined in paragraph 12-32.

b. Set pneumatic flow tester on bench in upright position.

c. Remove tygon tubing installed during cleaning procedure, from flowmeter outlet.

d. Remove float stop from flowmeter tube, using hook fabricated from 0.032-inch stainless-steel wire. (See figure 12-13.)

e. Reinstall tygon tubing over flowmeter outlet.

f. Place a piece of lint-free paper in palm of one hand to form a pocket for ball float.

CAUTION

Ball floats must be handled with care, since they are breakable.

g. Tilt flowmeter slowly until ball float rolls out.

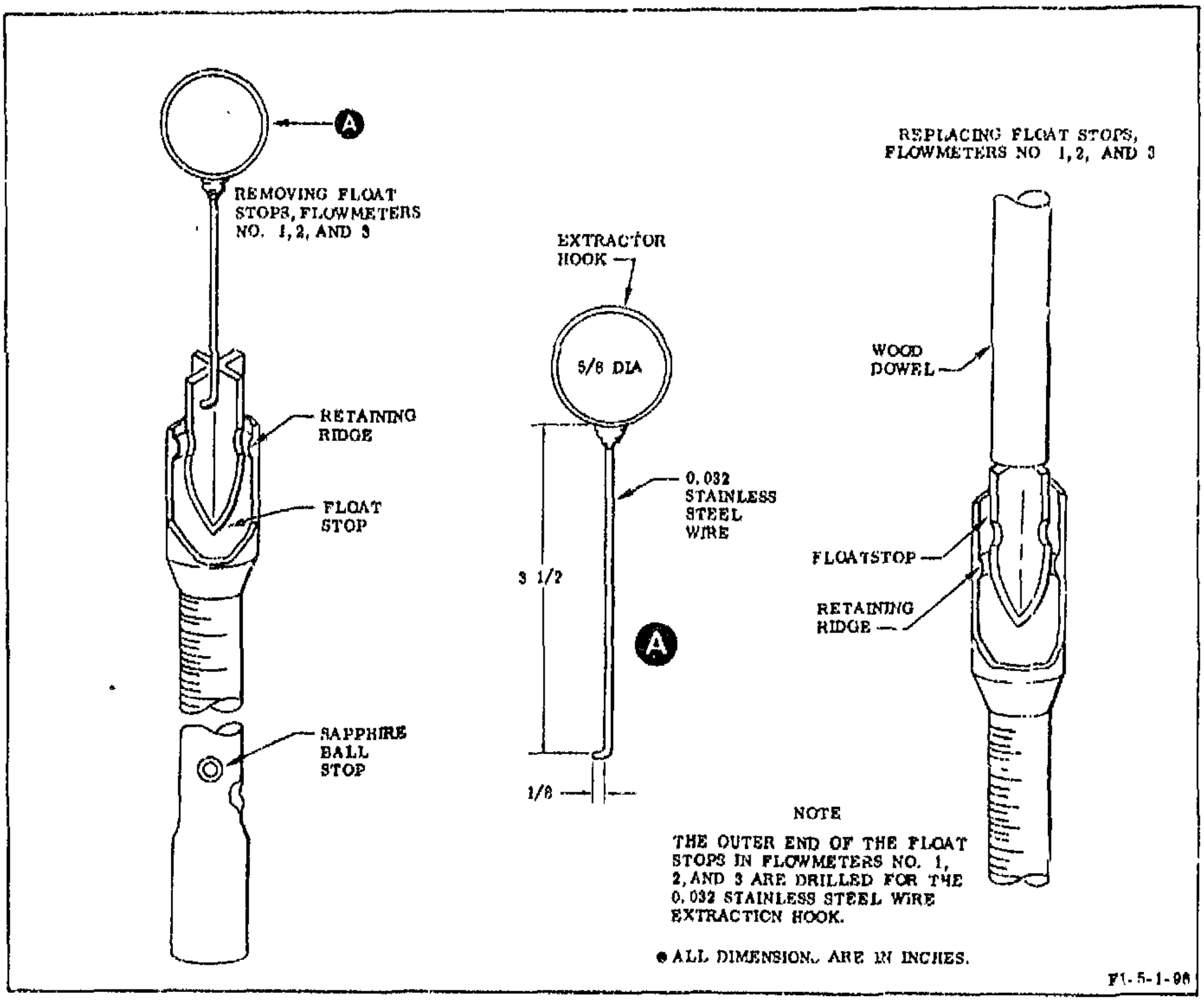


Figure 12-13. Replacing Flowmeter Float Stop

h. Set paper and ball float on bench and place flowtester in horizontal position.

i. Place a drop of ANSTAC-2M solution (Chemical Development Corp) on paper and roll ball float through solution until it is thoroughly coated.

j. Roll ball float over dry portion of paper until ball appears dry.

k. Using a small piece of lint-free cloth dampened with ANSTAC-2M solution (Chemical Development Corp), wet inside of tube. Wipe tube until it appears dry.

l. Place ball float into tygon tubing; tilt tubing and flowtester so that ball float gently rolls into flowmeter.

m. Set flowtester in upright position.

WARNING

Glass tube must be wrapped with a cloth before float stop is forced into the tube, since serious injury can result if the glass tube breaks.

n. Install float stop in flowmeter tube by forcing stop into place with small dowel. (See figure 12-13.)

o. Connect a regulated source of gaseous nitrogen (MIL-P-27401) through a needle valve to source hose; then press source hose into SOURCE port.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

CAUTION

Purge pressure in excess of 1.5 psig can damage flowmeter.

p. Purge flowmeter for approximately 3 minutes with low-pressure (less than 1.5 psig) gaseous nitrogen (MIL-P-27401).

q. Carefully vary flow of gas through flowmeter to allow float to travel from bottom to top of scale. The float must move freely in the tube.

r. If evidence of stickiness is noted, repeat cleaning procedure, increase duration or purge, and use less ANSTAC-2M solution (Chemical Development Corp).

s. Upon completion of cleaning and antistatic treatment of flowmeters, replace cover above meter box and rear cover. Torque screws to 12-14 in-lb.

12-35. SHIPPING AND STORAGE.

12-36. Prepare the pneumatic flow tester for shipping and storage in accordance with MIL-P-116, Method II.

SECTION XIII

HIGH-VOLTAGE IGNITER TESTER G3153 AND INERT IGNITER 9026622

WARNING

HIGH VOLTAGE IGNITER TESTER G3153 AND INERT IGNITER 9026622 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

13-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance. and inspection for the High-Voltage Igniter Tester G3153 and inert igniter 9026622. The igniter tester is used to perform current- and resistance-tests on the high-voltage igniters of the F-1 rocket engine. The inert igniter may be used to simulate the high-voltage igniter links.

13-2. DESCRIPTION AND LEADING PARTICULARS.

13-3. The high-voltage igniter tester (figure 13-1) is a portable, suitcase-type unit consisting of an instrument panel, chassis, and case. The panel contains handles, meters, fuses, switches, light, potentiometers, calibration-check receptacle, and power and test cables. The chassis contains a power module, regulator, heat sink and diodes, relays, and battery. The chassis and panel are mounted in the case. The case contains two relief valves to compensate for altitude changes and desiccant to absorb moisture within the case. The inert igniter (figure 13-1A) contains a gasket, thread protector, a shorting cap, igniter case, and streamer. The inert igniter is identical to a high-voltage igniter with the squib circuit and pyrotechnic charge removed. See figure 13-2 for leading particulars.

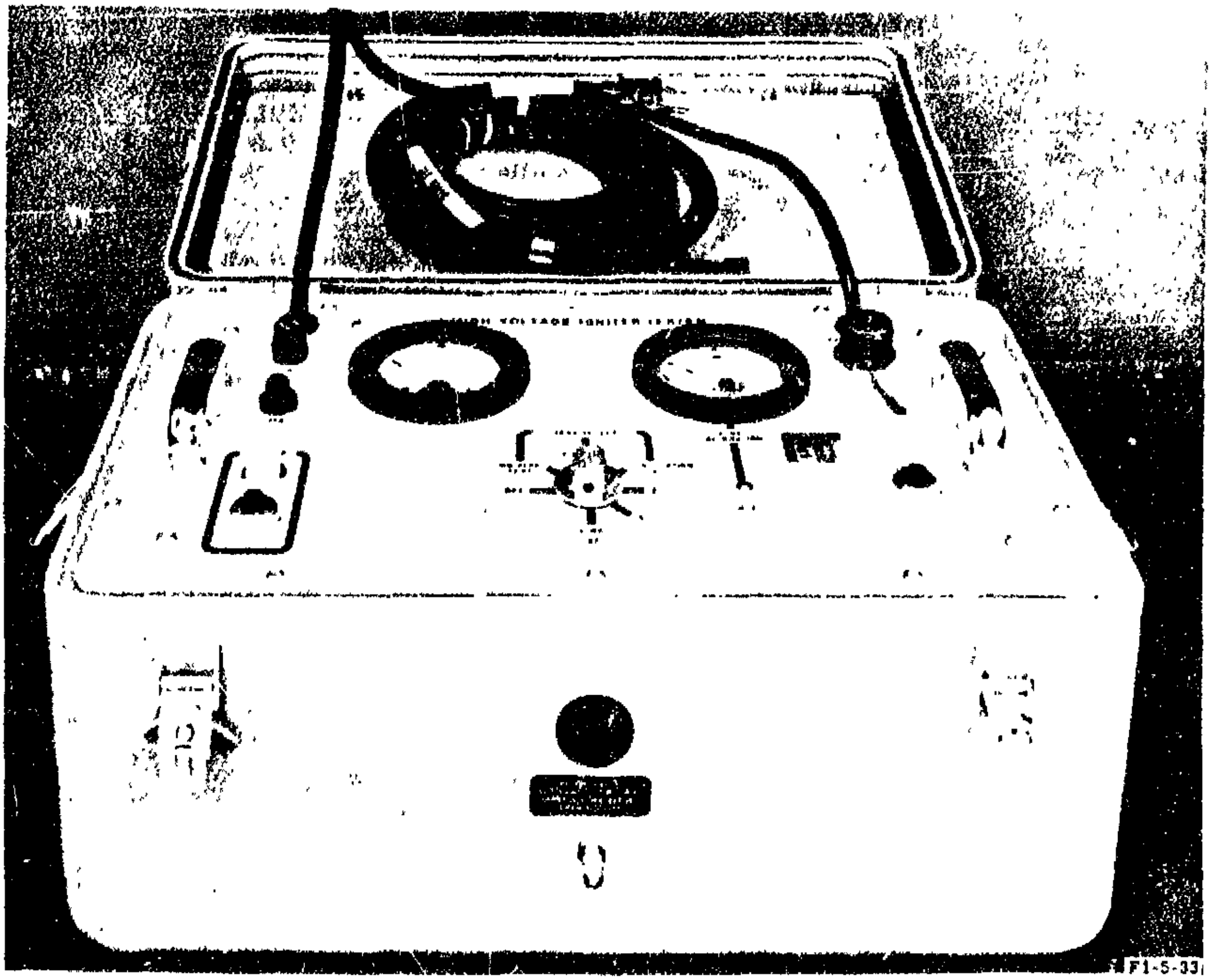


Figure 13-1. High-Voltage Igniter Tester

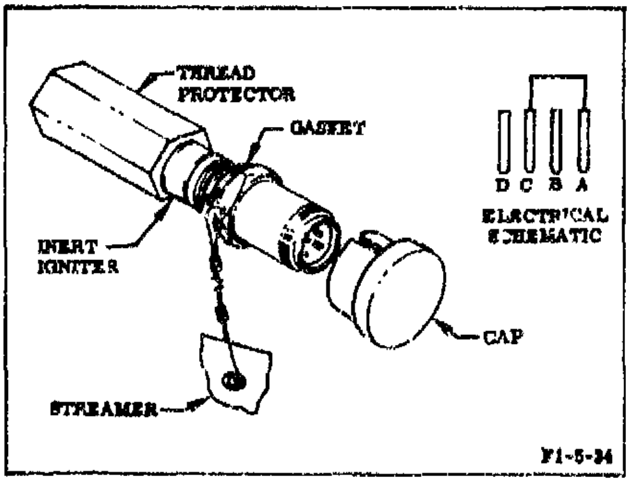


Figure 13-1A. Inert Igniter

Length	18 inches
Width	11 inches
Height	10-3/4 inches
Weight	30 pounds (approximately
Operating Requirements	
Input:	120 vac, single-phase, 60-cycle, 0.5-ampere
Output:	250 vac (10 milliampere maximum) 500 vac (5 milliampere maximum) 975-1,040 vdc (10 milliampere maximum) 1.0 to 2.0 vdc (350 milliampere maximum)
Timing Range	0-20 seconds (squib circuit limited to 15 seconds maximum)
Safety Feature	Two-hand operation for controlling power and test circuits

Figure 13-2. Leading Particulars for High-Voltage Igniter Tester

13-4. THEORY OF OPERATION.

13-5. With the high-voltage igniter tester connected to an external power source and to the high-voltage igniter to be tested, desired test functions are selected by positioning the TEST SELECT switch. The selected test circuit is energized by pressing the POWER andTEST switches. When the POWER switch is pressed, the POWER light comes on to indicate power being applied to the selected test circuit. Test results are indicated on FIRE/NO FIRE and INSULATION/LINK TEST meters. Tester accuracy can be checked by connecting the tester output cable to the CALIBRATION CHECK receptacle, and adjusted by adjusting the potentiometers within the tester. With TEST SELECT switch placed at NO FIRE TEST, 250 vac (current limited to 10 milliamperes) is applied to the igniter squib circuit. Placing the TEST SELECT switch at FIRE TEST applies 500 vac, with a limited current of 10 milliamperes to the igniter squib circuit. This voltage application is time-limited to 15 seconds through operation of a delay timer. Positioning TEST SELECT switch to INSULATION 1, 2, or 3 connects the 975-vdc (current limited to 5 milliamperes) output of the power module, to the igniter squib and link circuits. With TEST SELECT switch in the LINK position, voltage from the tester battery is applied to the link circuit. The current of this voltage is limited to 350 milliamperes. The inert igniters are installed in the gas generator and nozzle extension and connected to the engine control circuitry.

13-6. MAINTENANCE.

13-7. Maintenance of the high-voltage igniter tester consists of checkout, removal and installation, cleaning, servicing, and shipping and storage. Maintenance of the inert igniter consists of checkout, removal and installation, and shipping and storage. The tester electrical schematic (figure 13-6), located at the end of this section, is provided to aid in troubleshooting. See figure 13-3 for test equipment used during checkout.

Part Number	Nomenclature	Use
--	AC Power Supply (variable between 100-125-vac, 60-cycle, single-phase, 5-ampere sine-wave output)	Provides power for testing.
Model No. 535, or equivalent (input impedance greater than one megohm)	Oscilloscope (Tektronix Inc)	Measures sine wave and voltage peaks.
Model P6007, or equivalent	100 X Multiplier (Tektronix Inc)	Used with oscilloscope.
Model 412A, or equivalent	Vacuum Tube Voltmeter (Hewlett Packard Co)	Measures resistance.
Model 803, or equivalent	Differential Voltmeter (John Fluke Co)	Measures differential voltage of regulator output. (Use a 3-pin to 2-pin line adapter at ac outlet for isolating purposes.)

Figure 13-3. Test Equipment

13-8. CHECKOUT OF IGNITER TESTER.

13-9. Checkout of the high-voltage igniter tester is performed at ambient temperature of 59° to 95° F, atmospheric pressure of 28-32 inches of mercury, and relative humidity of 75 percent or less. The tests must be performed in the order given and the results obtained as specified. The following procedures are performed anytime a component is replaced or when results specified in paragraph 13-13 or on calibration-check procedure instruction plate are not obtained.

13-10. INITIAL ADJUSTMENT. This test must be accomplished prior to any subsequent test.

a. Turn TEST SELECT switch to NO FIRE TEST, connect VTVM leads between plug P2 pins B and D, and adjust potentiometer R10 fully clockwise. VTVM indicates 55 K ±3 K ohms.

b. Turn TEST SELECT switch to FIRE TEST and adjust potentiometer R9 fully clockwise. VTVM indicates 105 K ±5 ohms.

c. Turn TEST SELECT switch to INSULATION TEST 2 and connect VTVM leads between plug P2 pin C and positive (+) terminal of battery.

d. Press POWER switch. VTVM indicates 4 ±0.2 ohms.

e. Turn TEST SELECT switch of OFF and connect VTVM leads between terminals E1 and E12. VTVM indicates 0.5 megohms ±50 K ohms.

f. Connect VTVM leads between terminals E12 and E13. VTVM indicates 200 K ±10K ohms.

13-11. RESISTANCE-TEST.

a. Connect VTVM leads between plug P2 pins B and D. VTVM indicates a minimum of 100 megohms.

b. Turn TEST SELECT switch to NO FIRE TEST. VTVM indicates 53 K ±3 K ohms.

c. Turn TEST SELECT switch to FIRE TEST. VTVM indicates 105 K ±5 K ohms.

d. Turn TEST SELECT switch to INSULATION TEST 1 and connect VTVM leads between plug P2 pin D and shell. VTVM indicates a minimum of 100 megohms.

e. Turn TEST SELECT switch to INSULATION TEST 2 and connect VTVM leads between plug P2 pin C and shell. VTVM indicates a minimum of 100 megohms.

f. Turn TEST SELECT switch to INSULATION TEST 3 and connect VTVM leads between plug P2 pins A and B. VTVM indicates a minimum of 100 megohms.

g. Turn TEST SELECT switch to LINK, connect VTVM leads between plug P2 pin A and negative (-) terminal of battery, and press TEST switch. VTVM indicates a maximum of one ohm.

h. Turn TEST SELECT switch to OFF and remove VTVM leads.

13-12. ELECTRICAL POWER FUNCTION-TEST.

a. Make sure TEST SELECT switch is OFF.

b. Connect differential voltmeter to variable AC power supply and adjust power supply to 115 volt. Remove differential voltmeter and connect power cable to power supply.

c. Turn TEST SELECT switch to NO FIRE TEST and connect differential voltmeter between terminals E1 (ground) and E4.

NOTE

The POWER and TEST switches are momentary pushbutton switches. POWER switch must be pressed and held, and the TEST switch must be pressed and held, to obtain correct results for the following steps.

d. Press POWER and TEST switches. POWER light comes on and differential voltmeter indicates 250 ±18 volts rms.

e. Release POWER and TEST switches. POWER light goes off and differential voltmeter indicates zero.

f. Disconnect differential voltmeter and connect plug P2 to CALIBRATION CHECK receptacle.

g. Press POWER and TEST switches. POWER light comes on. Adjust potentiometer R1C until FIRE/NO FIRE TEST meter indicates 7.0 milliamperes.

h. Release POWER and TEST switches. POWER light goes off and FIRE/NO FIRE TEST meter indicates zero.

i. Turn TEST SELECT switch to FIRE TEST.

j. Press POWER and TEST switches. POWER light comes on. Adjust potentiometer R9 until FIRE/NO FIRE TEST meter indicates 7.0 milliamperes.

NOTE

The POWER and TEST switches may have to be released and re-pressed if step j is not accomplished within 15 seconds, since the delay timer is adjusted to open in 15 seconds and terminate the test.

k. Release POWER and TEST switches. POWER light goes off and FIRE/NO FIRE TEST meter indicates zero.

l. Disconnect plug P2 and connect differential voltmeter between plug P2 pins B and D.

m. Press POWER and TEST switches. POWER light comes on and differential voltmeter indicates a minimum of 455 volts rms.

n. Release POWER and TEST switches. POWER light goes off and differential voltmeter indicates zero.

o. Connect differential voltmeter between terminals E1 and E2.

p. Press POWER and TEST switches. POWER light comes on and differential voltmeter indicates 250 ±18 volts rms.

q. Release POWER and TEST switches. POWER light goes off and differential voltmeter indicates zero.

r. Connect differential voltmeter to variable power supply and adjust power supply to 105 volts.

s. Repeat steps o through q.

t. Connect differential voltmeter between terminals E1 and E4 and repeat steps p and q.

u. Connect differential voltmeter to variable power supply and adjust power supply to 125 volts.

v. Repeat steps o through q; then repeat step t.

w. Connect differential voltmeter to variable power supply and adjust power supply to 115 volts. Reconnect power cable plug to power supply.

x. Turn TEST SELECT switch to NO FIRE TEST.

y. Connect oscilloscope (calibrated to read 200 volts per centimeter with the 100 X multiplier) to plug P2 pins B and D (pin B is ground).

z. Press POWER and TEST switches. POWER light comes on and oscilloscope displays a 60-cps sine wave with 707 ±50 volts peak to peak.

aa. Release POWER and TEST switches. POWER light goes off and oscilloscope display goes off.

ab. Connect oscilloscope between terminals E1 and E2 (E1 is ground and repeat steps z and aa.

ac. Disconnect oscilloscope and turn TEST SELECT switch OFF.

13-13. CALIBRATION CHECK-TEST.

a. Connect VTVM positive lead to plug P2 pin D and negative lead to plug P2 shell. Set VTVM to 1,000 vdc range.

b. Turn TEST SELECT switch to INSULATION TEST 1.

c. Press POWER and TEST switches. POWER light comes on. Adjust power module (high-voltage dc power supply) until VTVM indicates 1,000 vdc.

d. Release POWER and TEST switches. POWER light goes off and VTVM indicates zero vdc. Remove VTVM.

e. Connect plug P2 to CALIBRATION CHECK receptacle.

f. Press POWER and TEST switches. POWER light comes on and INSULATION LINK TEST meter indicates 100 megohms (black area).

NOTE

If meter indicates outside of 100-megohm scale (black area), readjustment of the power module is necessary to bring meter with 100-megohm range. If readjustment is required for one of the three insulation test positions, the other two positions must be rechecked.

g. Release POWER and TEST switches. POWER light goes off and INSULATION/LINK TEST meter indicates infinity.

h. Turn TEST SELECT switch to INSULATION TEST 2 and repeat steps f and g.

i. Turn TEST SELECT switch to INSULATION TEST 3 and repeat steps f and g.

j. Turn TEST SELECT switch to LINK.

k. Press POWER and TEST switches. POWER light comes on. Adjust potentiometer R7 until INSULATION/LINK TEST meter indicates 50.

l. Repeat step g; turn TEST SELECT switch to OFF.

m. Disconnect plug P2 and power cable and store cables in lid. Close lid and secure latches.

13-13A. CHECKOUT OF INERT IGNITER.

13-13B. RESISTANCE-TEST. This test must be performed to verify integrity of the link circuit and insulation resistance of squib pins or when damage is suspected. This test is performed using High-Voltage Igniter Tester G3153 and megohmmeter, Model 1620C (Freed Transformer Co), or equivalent.

a. Perform calibration check procedure, as outlined on tester instruction plate of high-voltage igniter tester.

b. Remove shorting cap and connect inert igniter to tester test cable.

c. Turn TEST SELECT switch to NO FIRE TEST position.

d. Press POWER and TEST switches. POWER light comes on and FIRE/NO FIRE TEST meter indicates (less than one milliampere) zero.

e. Turn TEST SELECT switch to FIRE TEST position.

f. Press POWER and TEST switches. POWER light comes on and FIRE/NO FIRE TEST meter indicates (less than one milliampere) zero.

g. Turn TEST SELECT switch to INSULATION TEST 1 position.

h. Press POWER and TEST switches. POWER light comes on, and INSULATION/LINK TEST meter indicates 100 megohms or greater (black area).

i. Repeat steps g and h for INSULATION TEST 2 and 3 positions. Results are the same as in step h.

j. Move TEST SELECT switch to LINK position.

k. Press POWER and TEST switches. POWER light comes on, and INSULATION/LINK TEST meter indicator moves to green area.

l. Move TEST SELECT switch to OFF position, disconnect test cable from inert igniter, and secure test equipment.

m. Using a megohmmeter, apply 500 vdc for 5-60 seconds between pin B and case and pins A to D. Resistance of each application must exceed 200 megohms.

n. Remove test equipment, and install shorting cap on igniter.

13-14. REMOVAL AND INSTALLATION.

13-15. Disassemble the high-voltage igniter tester to accomplish necessary repairs or replacement. No disassembly of inert igniter is required. Replacement parts consist of gasket 651912-3, thread protector RK395-10055-003, and cap RD265-6009-0001. See figure 13-4 for index and part numbers. The following steps include the special instructions required during assembly:

a. Apply silicone grease, supplied with power module (15), to base before mounting, to aid in heat transfer and corrosion prevention.

b. Capacitor supplied with regulator (20) is replaced only when regulator is replaced, since they are matching units.

13-16. CLEANING.

13-17. No special cleaning is required. Use a clean, lint-free cloth to wipe dust from case and front panel.

13-18. SERVICING.

13-19. Servicing of the igniter tester consists of a six-month periodic calibration check of meters. Accuracy of meters must be within two percent of full scale, using a test standard with an accuracy of one percent of full scale. Replace battery every six months.

13-20. SHIPPING AND STORAGE.

13-21. Prepare high-voltage igniter tester or inert igniter for shipping or storage in accordance with Rocketdyne Rapid Automated Packaging System (RAPS).

13-22. INSPECTION.

13-23. The inspection establishes what is to be inspected, conditions to be sought and corrected, and the frequency of the inspection. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, since they are directly affected by local operation. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. These inspections consist of two periodics: the first periodic to be accomplished at 30 calendar days; the second, at 180 calendar days. See figure 13-5 for inspection requirements.

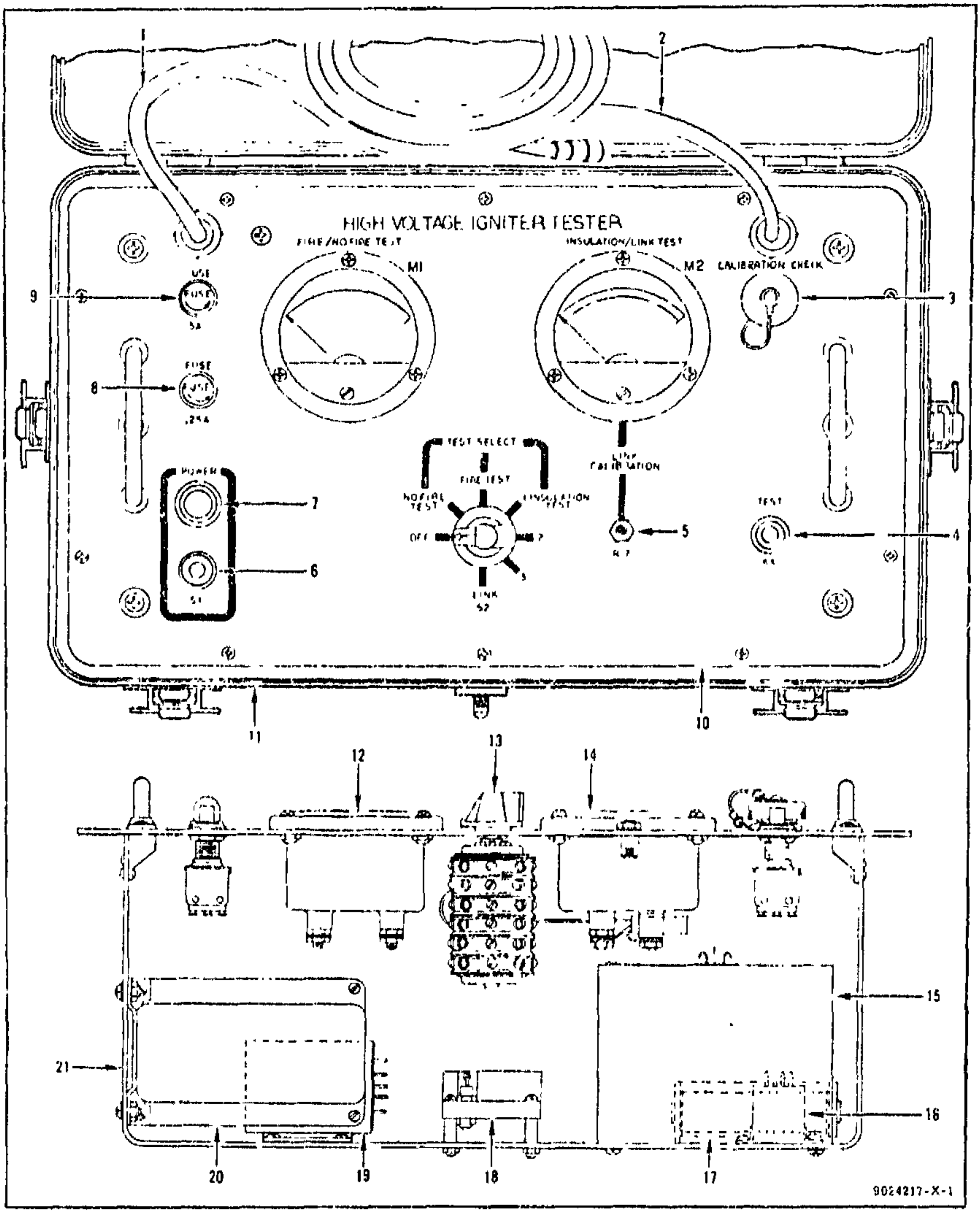


Figure 13-4. Disassembly of High-Voltage Igniter Tester (Sheet 1 of 2)

Index No.	Part No.	Description
1	17408-S	Cable (F-3)
	RCG105	Cord Grip (F-3)
	8003	Nut (F-3)
	W277	Washer (F-3)
	AS10-20	Washer (F-3)
	MS29512-10	Packing (F-3)
2	9026761	Cable (F-3)
	RCG104	Cord Grip (F-3)
	800	Nut (F-3)
	W277	Washer (F-3)
	AS10-20	Washer (F-3)
	MS29512-10	Packing (F-3)
3	H55K-14S-2PG-44	Receptacle (F-3)
	RD265-6007-2004	Cap (F-3)
	600-001-7/8	Bolt Seal (F-3)
4	2D8	Switch (F-3)
	6C1	Face Nut (F-3)
	6A46	Pushbutton (F-3)
5	3367S-1-103	Potentiometer (F-3)
	MS29513-009	Packing (F-3)
6	2D8	Switch (F-3)
	6C1	Face Nut (F-3)
	6A46	Pushbutton (F-3)
7	125-408-1195-443	Light (F-3)
	NE-51	Lamp (F-3)
8	HMR	Fuse Holder (F-3)
	313.250	Fuse (F-3)
9	HMR	Fuse Holder (F-3)
	313.500	Fuse (F-3)
10	9024218	Panel (F-3)
	NAS388-10-10P	Screw (F-3)
	NAS391B10P	Washer (F-3)
	1008-12	Handle (F-3)
	600-001-10	Bolt Seal (F-3)
	AN507C1032R10	Screw (F-3)
11	D21021	Case (F-1)
	9024223	Instruction Plate (F-3)
	9024217-11	Panel (F-1)
	ZP5031-24	Gasket (F-3)
	AN520C10R12	Screw (F-3)
	MS15795-808	Washer (F-3)
	600-001-10	Bolt Seal (F-3)
	ZSP6-037-4	Relief Valve (F-3)
	ZSP6-608	Humidity Indicator (F-3)
12	MR36W010ACMAR	Meter (F-3)
	PW0203	Gasket (F-3)
	MS35337-78	Washer (F-3)
13	MS25002-6	Switch (F-3)
	MS25165-1	Knob (F-3)
	N-9060-1/4	Shaft Seal (F-3)
14	19-9024200	Meter (F-3)
	PW0203	Gasket (F-3)
	MP-9000	Protector (F-3)
	NAS1397P6N	Clamp (F-3)
	MS15795-806	Washer (F-3)
15	HA05D-990A	Power Module (F-3)
	AN520C10R6	Screw (F-3)
	MS15795-808	Washer (F-3)
16	19-9024149	Relay (F-3)
	AN515C6R6	Screw (F-3)
	MS15795-806	Washer (F-3)
	NAS679C06W	Nut (F-3)
17	RM-42RT-2	Battery (F-3)
	2870-2	Holder (F-3)
18	9024221	Heat Sink (F-3)
	1N3015B	Diode (F-3)
	AN515C6R20	Screw (F-3)
	MS15795-806	Washer (F-3)
	NAS679C06W	Nut (F-3)
	NAS43DD1-32	Spacer (F-3)
19	19-9024248	Relay (F-3)
	AN515C6R6	Screw (F-3)
	MS15795-806	Washer (F-3)
	NAS679C06W	Nut (F-3)
20	19-9024250	Regulator (F-3)
	AN520C10R8	Screw (F-3)
	MS15795-808	Washer (F-3)
	NAS679C3W	Nut (F-3)
21	9024219	Chassis (X-1)
	3020L-1-503	Potentiometer (R9) (F-3)
	3020L-1-253	Potentiometer (R10) (F-3)
	AN515C2R8	Screw (F-3)
	MS15795-802	Washer (F-3)
	MS35338-39	Washer (F-3)
	AN340C2	Nut (F-3)
	RS10 25K 1%	Resistor (R1, R2) (F-3)
	M22684/4-0221	Resistor (R13) (F-3)
	MVX-1-100 MEG ±5%	Resistor (R3, R4, R5) (F-3)
	RB58CE4R020F	Resistor (R11) (F-3)
	RS10 12K 1%	Resistor (R14, R15) (F-3)
	M22684/4-0159	Resistor (R12) (F-3)
	M22684/4-0207	Resistor (R8) (F-3)
	M22684/4-0227	Resistor (R6) (F-3)

Figure 13-4. Disassembly of High-Voltage Igniter Tester (Sheet 2 of 2)

Inspection Requirements	Visual	Periodic 1st	Periodic 2nd
HIGH VOLTAGE IGNITER TESTER			
1. Dents, gouges, and cracks in case; security of handles; security and free operation of latches; deterioration and damage to cover seal; security of relief valves.			X
2. Indicator shows pink in 40 percent range of humidity indicator plug. Replace desiccant as outlined in R-3896-11.	X	X	
3. Deterioration and general serviceability of power input and output electrical cables and connectors.	X	X	
4. Damage to instrument panel controls and indicators, illegible placards, and security of screws.			X
5. Calibration-check in accordance with instruction plate.	X		
6. Expired date on unit calibration decal (refer to paragraph 13-18 for calibration requirements); and battery replacement.	X		X

Inspection Requirements	Visual	Periodic 1st	Periodic 2nd
INERT IGNITER			
1. Foreign particles, dust, dirt, moisture, or lubricant on contact pins.	X		
2. Bent contact pins. Contact pins not bent more than 20 degrees from connector axis may be repaired. (Refer to R-3896-3, Volume I, for repair and dimensional limits for electrical connectors.)	X		
3. Damaged threads, corroded contacts, or damaged inserts. (Refer to R-3896-3, Volume I, for thread repair.)	X		

Figure 13-5. Inspection Requirements for High-Voltage Igniter Tester and Inert Igniter

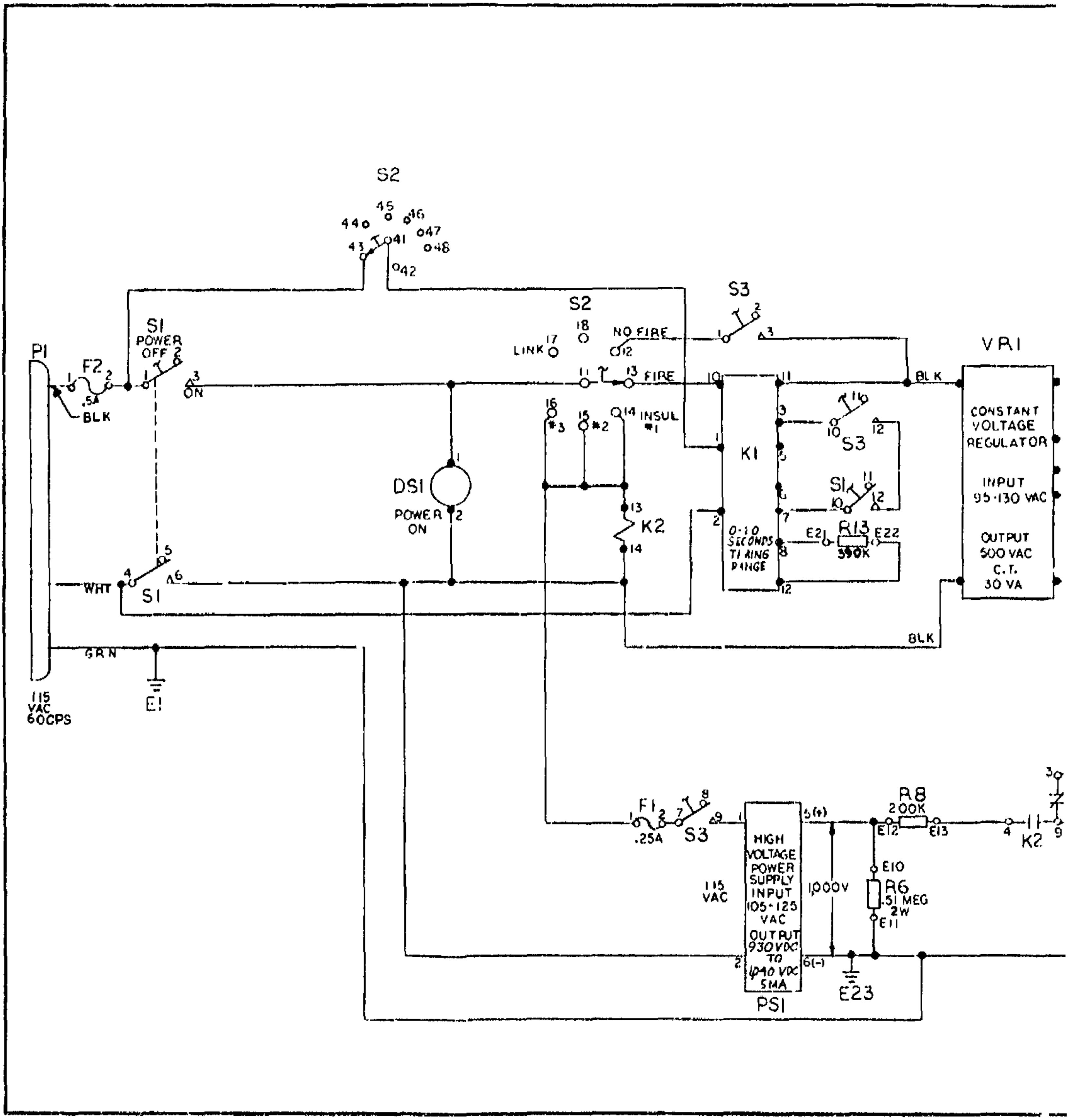
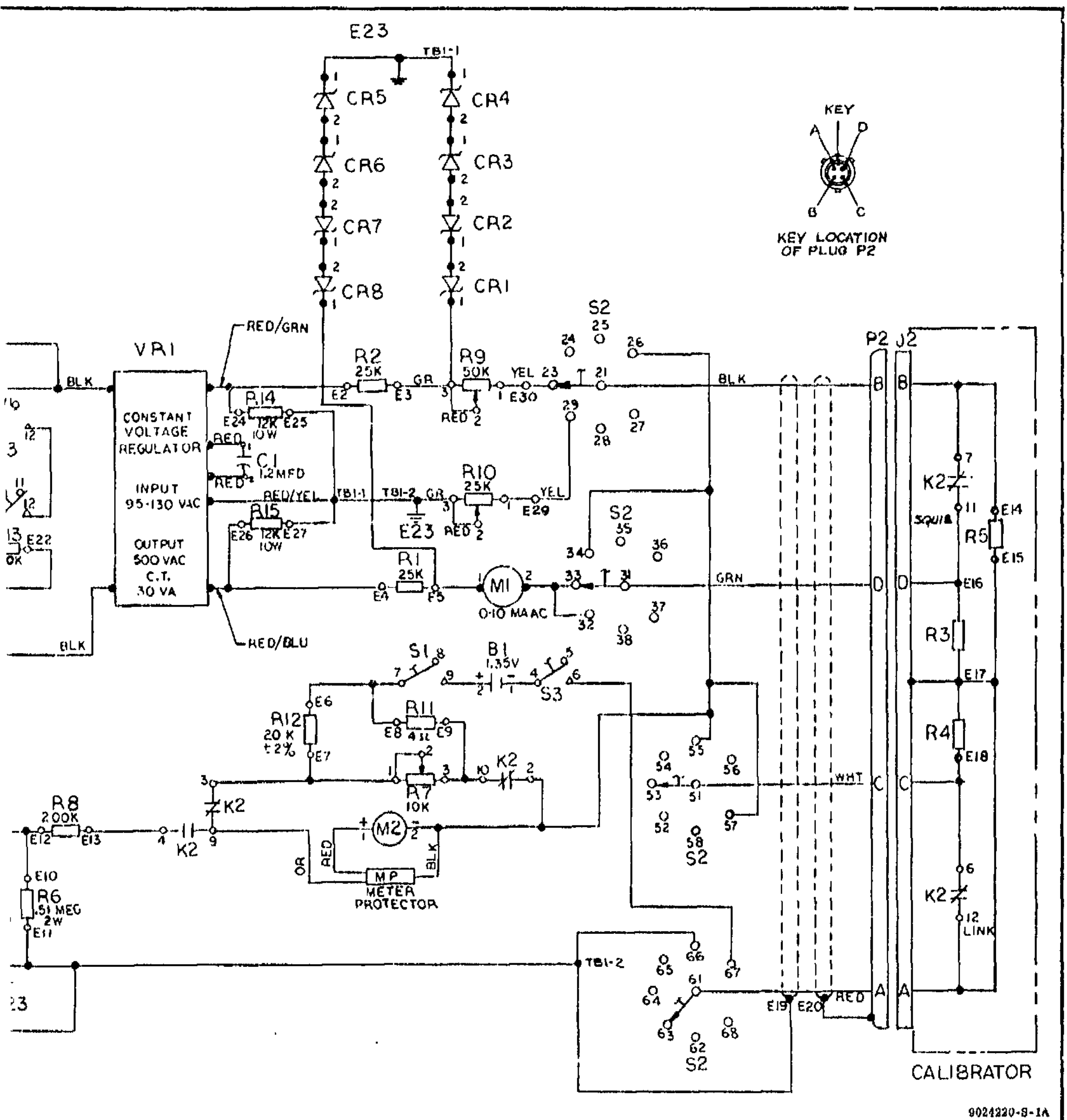


Figure 13-6. High-Voltage Igniter Tester Electrical Schematic


E23
TB1-1
CR5
CR6
CR7
CR8
CR4
CR3
CR2
CR1
KEY
A
B
C
D
KEY LOCATION OF PLUG P2
S2
VR1
CONSTANT VOLTAGE REGULATOR
INPUT 95-130 VAC
OUTPUT 500 VAC C.T. 30 VA
RED/GRN
RED/BLU
BLK
R2 25K
R9 50K
R14 12K 10W
R15 12K 10W
C1 1.2 MFD
R10 25K
R1 25K
M1 0-10 MA AC
GRN
S1
B1 1.35V
S3
R11 4Ω
R12 20 K ±2%
R7 10K
K2
R8 200K
M2
MP METER PROTECTOR
R6 .51 MEG 2W
WHT
RED
P2
J2
K2
SQUIB
R5
R3
R4
LINK
CALIBRATOR
9024220-8-1A

SECTION XIV

IMPACT RECORDER UNIT G4090 AND 99-9014031

14-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance instructions, and inspection requirements for the Impact Recorder Unit G4090 and 99-9014031. The impact recorder unit is used to sense and record impact forces of the F-1 rocket engine during truck transport. It senses and records impact forces along the vertical, lateral, and longitudinal axes, within a range of ±5 g's.

14-2. DESCRIPTION AND LEADING PARTICULARS.

14-3. The impact recorder unit (figure 14-1) consists of two accelerometers, a case, a base plate, a lower plate, and an electrical harness and cable. Each accelerometer contains three styluses, an event marker, a chart and three spools, an inverter, a chart drive motor and clutch, a power switch, a fuse, and an electrical

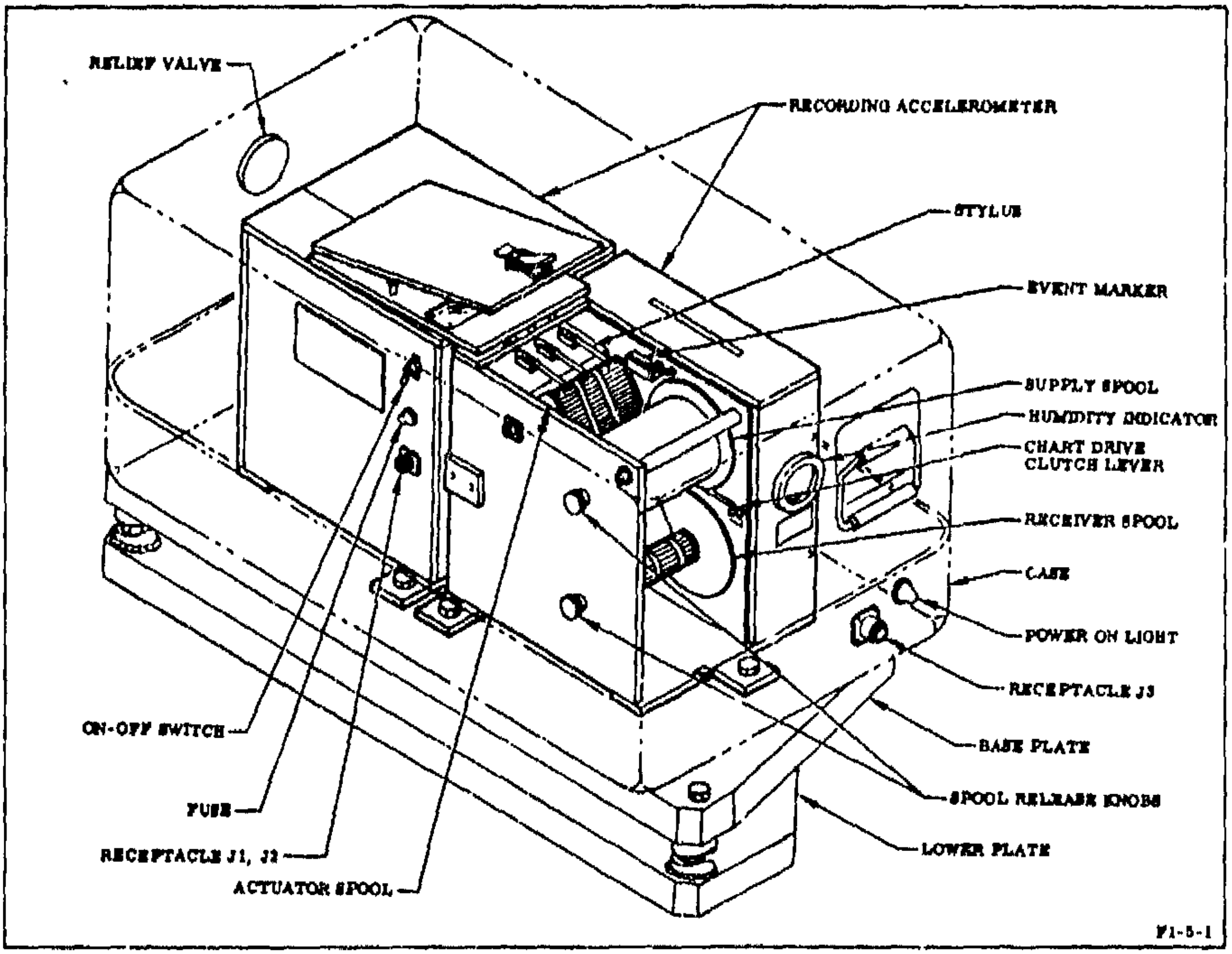


Figure 14-1. Impact Recorder Unit

receptacle. One end of each stylus has a tip to make an impression on the chart and the other end is mounted to a mechanical accelerometer. The event marker has a pin to make an impression on the chart and a solenoid to move the pin. The chart is a pressure-sensitive recording chart 400 feet long, with holes along one side. The spools are the supply spool, the actuating spool, and the receiving spool. The inverter is a vibrating reed-type unit that converts 12 volts DC to 115 volts AC, 60 cycle power. The chart drive motor is a 115 volt AC 60 cycle synchronous motor. The clutch is operated by a lever located inside the chart compartment. The power switch controls the DC power to the accelerometer. The fuse protects the internal electrical circuit of the accelerometer. The receptacle is used to electrically connect the accelerometer to the harness, and the cable connects the impact recorder unit to the truck tractor. The case has four handles, two latches, a removable lid, a humidity indicator, a desiccant holder, a relief valve, a power on light, and a receptacle and is constructed from aluminum alloy. The lid contains a seal to provide environmental protection. The base plate is constructed from aluminum alloy and has inserts for mounting the accelerometers and the case. The plate has three pads welded to the bottom side to maintain a horizontal position when mounted on the I-beam of the air transport engine handler. The lower plate is constructed from aluminum alloy, is triangular in shape, and has three pads (same as the base plate) and three tubes that aline the mounting bolts. See figure 14-2 for leading particulars.

<u>Dimensions and Weight</u>

Length	2?.50 inches
Width	17.42 inches
Height	21.12 inches
Weight	110 pounds

<u>Electrical Power Requirements</u>

12 VDC Battery (Lead Acid)

<u>Operating Requirements</u>

Range	±5g in each axis
Sensing Axes	Longitudinal, lateral, and vertical
Chart Length	400 feet
Chart Speed	1 inch per minute
Temperature Range	-10° to 150° F

Figure 14-2. Leading Particulars for Impact Recorder Unit

14-4. THEORY OF OPERATION.

14-5. The impact recorder unit is designed to provide a permanent, continuous record of acceleration in three mutually perpendicular axes, with a full scale range of ±5 g's in the vertical, lateral, and longitudinal axes. The accelerations are sensed by means of a mechanical accelerometer using pivoted mass elements (pendulum-type). Pneumatic damping is provided by a precision double-acting piston, with variable bypass orifices, and a cylinder. The recording is accomplished by means of an individual stylus for each axis making an impression on the pressure-sensitive chart in either the positive or negative direction. The event marker makes an impression on the right side of the chart; and when electrically energized by the truck tractor operator when abnormal conditions result, the event marker moves to the right, indicating the event.

14-6. MAINTENANCE.

14-7. Maintenance of the impact recorder unit consists of checkout, removal and installation, cleaning, and shipping and storage. See figure 14-3 for test equipment.

14-8. CHECKOUT.

14-9. Checkout of the impact recorder unit consists of removing and installing the chart, a function-test, and a calibration-verification-test. See figure 14-4 for electrical schematic.

14-10. REMOVING RECORDER CHART. See figure 14-5.

a. Remove cover from case and open accelerometer access door.

b. Move power switch to OFF position and pull chart drive clutch lever to OFF position.

c. Pull out on receiver spool release knob and remove receiver spool.

d. Cut or tear chart after last acceleration record and unroll chart from receiver spool.

Part Number	Nomenclature	Use
TVR0-40-15, or equivalent	DC Power Supply (variable between 0-40 vdc) (Perkins)	Provides power for testing.
M8-4151 M8-4152 M8-4153	Text Fixture	Mounts accelerometer on vibration machine.
MODEL C10, or equivalent	Vibration Test Equipment (MB Mfg Co.)	Vibrates accelerometer in the three axes.
CEC4-202-0001 ±10g (±3% accuracy) or equivalent	Calibrated Reference Accelerometer (Consolidated Electrodynamics)	Provides reference during calibration verification.
Model No. 535 or equivalent	Oscilloscope (Tektronic Inc)	Measures acceleration.

Figure 14-3. Test Equipment

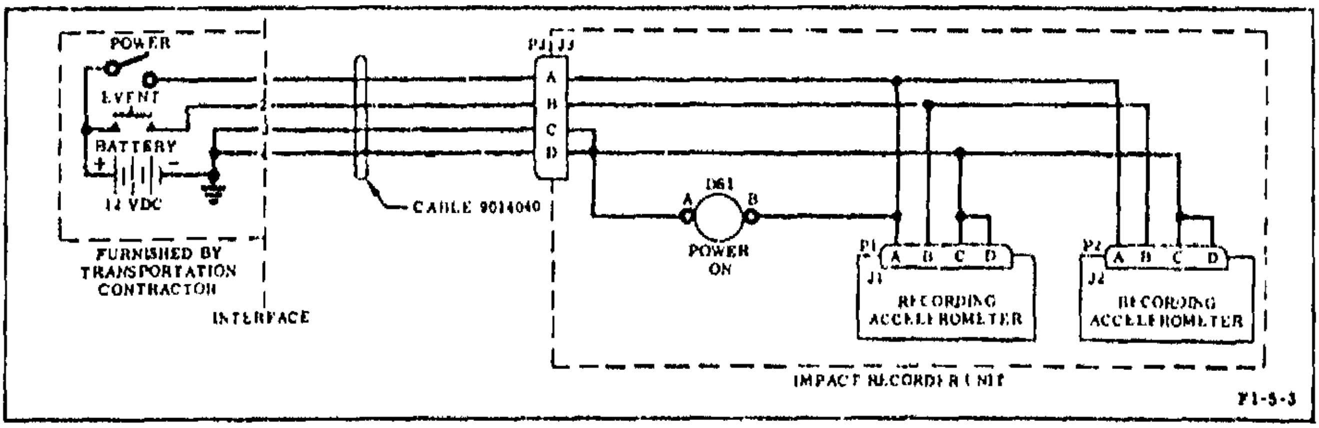


Figure 14-4. Electrical Schematic

e. Pull out on receiver spool release knob and install receiver spool. Release the release knob to lock spool in place.

NOTE

The receiver spool must be reinstalled into the same accelerometer or adjustment of the receiver spool slip clutch may be necessary.

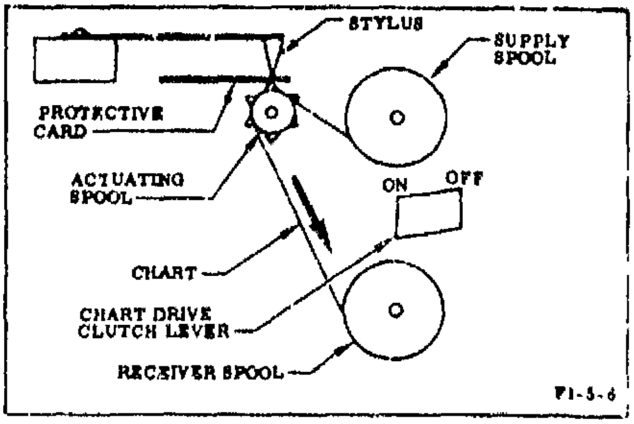


Figure 14-5. Removing and Installing Chart

f. Install protective card between styluses and actuating spool.

CAUTION

Do not move stylus more than 1/8 inch, or damage to stylus and accelerometer may result.

g. Close accelerometer access door and install cover on case.

14-11. INSTALLING RECORDER CHART. See figure 14-5.

a. Remove cover from case and open accelerometer access door.

b. Move power switch to OFF position and pull chart drive clutch lever to OFF position.

c. Remove protective card from between styluses and actuating spool and store protective card in compartment under receiver spool.

d. Pull out on supply spool release knob and place supply roll core (with holes of chart to the left) onto bosses of the spool ends. Release the release knob to lock supply roll in place.

e. Cut corners of chart end to form a point; and feed end of chart under stylus and hold-down clip and over actuating spool with holes in chart matching sprocket of actuating spool.

f. Pull chart to front of accelerometer and insert point end into slot of receiver spool.

g. Turn receiver spool by hand, so that recording side of chart is on outside of roll, approximately five turns.

CAUTION

Use extreme care when threading chart to prevent damage to styluses.

h. Push chart drive clutch lever to ON position and turn actuating spool until drive gear engages.

i. Close accelerometer access door and install cover on case.

14-12. FUNCTION-TEST. See figure 14-4.

a. Remove cover from case and open accelerometer access door.

b. Install chart as outlined in paragraph 14-11 and push chart drive clutch lever to ON position.

c. Turn power switches of both accelerometers to OFF position.

d. Remove power cable from case and connect plug P3 to receptacle J3.

e. Connect a 12 (+3, -0) vdc power supply positive (+) lead to wire 1 and negative (-) lead to wires 3 and 4 of power cable. POWER ON light comes on.

f. Move power switch on accelerometer to ON position. Chart moves one-inch per minute, and styluses and event marker make legible traces on chart.

g. If stylus trace is too heavy or not legible, adjust stylus pressure by turning screw through hole at base of stylus approximately 20 degrees at a time until satisfactory trace is obtained.

NOTE

The stylus trace must be as light as possible while still giving legible records, for maximum accuracy.

h. Allow chart to operate for approximately 5 minutes; and while still in operation, momentarily connect 12 (+3, -0) vdc power supply positive (+) lead to wire 2 of power cable (negative (-) lead connected in step e). Event marker momentarily moves to right of its normal trace.

i. Repeat step h two times.

j. Move power switch on accelerometer to OFF position. Chart stops.

k. Disconnect power supply from power cable. POWER ON light goes off.

l. Disconnect power cable from case, install dust caps, and store power cable inside of case.

m. Close accelerometer access door and install cover on case.

14-13. CALIBRATION-VERIFICATION-TEST. See figure 14-6.

a. Remove cover from case and remove accelerometer from case.

b. Connect accelerometer in test setup as shown in figure 14-6, starting with vertical axis.

c. Apply 12 (+3, -0) vdc to receptacle pins A (positive) and C (negative) and move power switch to ON position. Chart moves one-inch per minute.

d. Determine frequency response and dynamic linearity by vibrating the accelerometer at the following acceleration and frequency levels:

Input Accelerations (plus and minus -g's)	Frequency (cps)
(1) 1, 2, 3, 4, and 5	12 ±2
(2) 1, 2, 3, and 4	10 ±2
(3) 1	5 ±1

CAUTION

Mounting the accelerometer in various attitudes during testing will cause the stylus to displace by one g in some axes and is considered the static zero base line for these axes. In these axes the input acceleration must not exceed plus or minus 4 g's or damage to accelerometer can result.

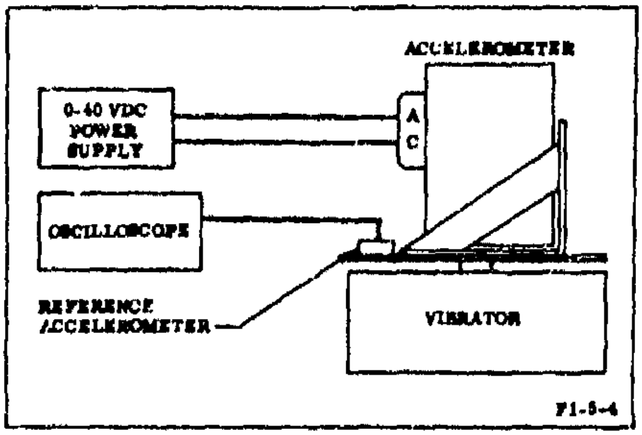


Figure 14-6. Calibration-Verification-Test Setup

e. Accelerometer must indicate the input accelerations, within 10 percent of full scale, about static zero base line.

f. Repeat steps b through e for lateral and longitudinal axes.

g. If accelerometer fails to meet requirement of steps d and e, it must be returned to Rocketdyne for calibration.

n. Move power switch to OFF position and secure equipment.

i. Install accelerometer into case and install cover on case.

14-14. REMOVAL AND INSTALLATION.

14-15. Disassemble the impact recorder unit, as required, to accomplish necessary repair or replacement. See figure 14-7 for wiring diagram. See figure 14-8 for index and part numbers.

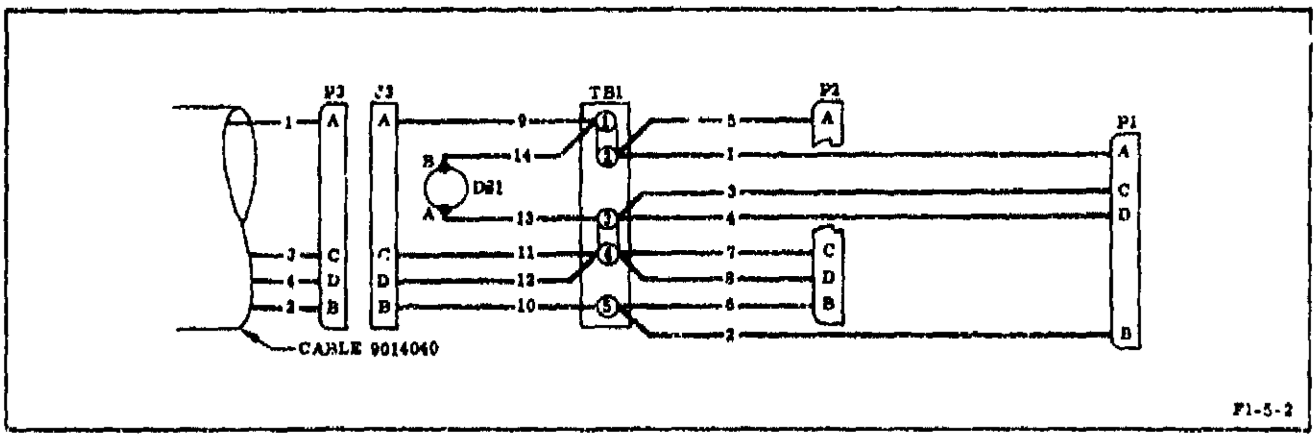
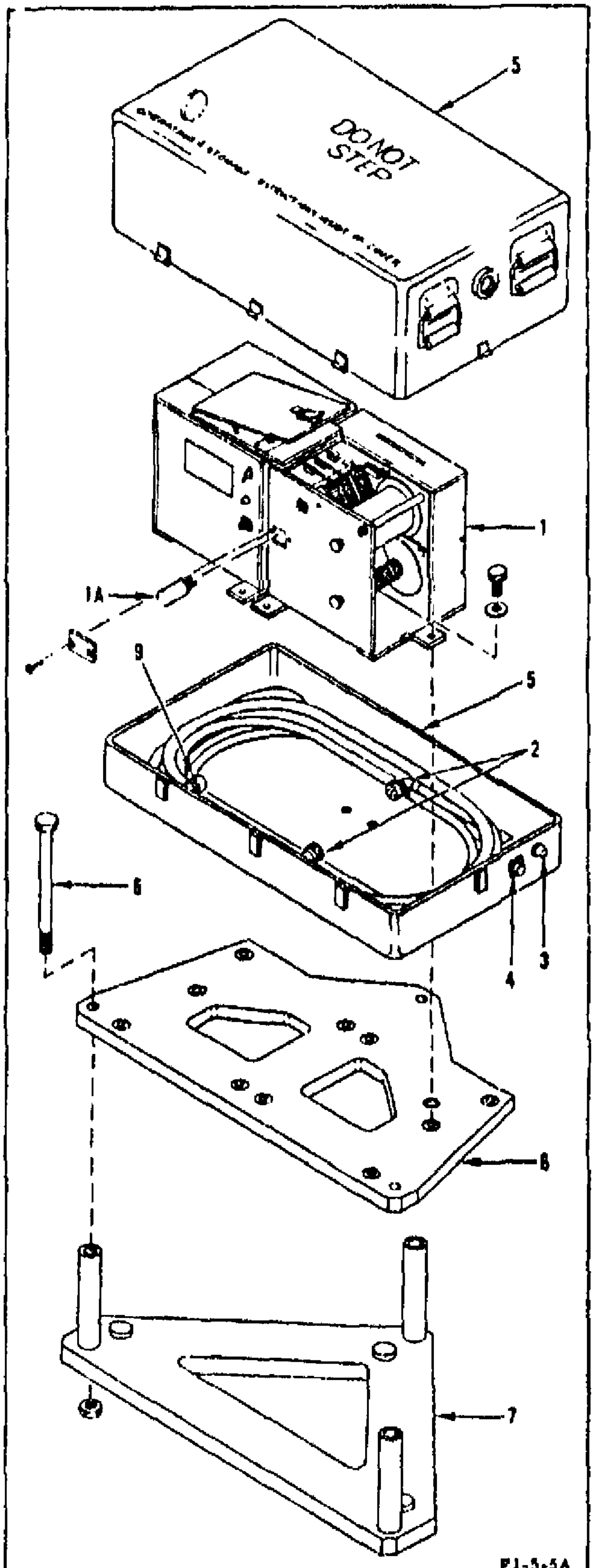


Figure 14-7. Wiring Diagram



Index No.	Part No.	Description
1	19-9014038	Accelerometer (D-2)
	RM-400	Chart (F-3)
	AN4-6A	Bolt (F-3)
	RD153-0113-0048	Washer (F-3)
	MS29513-114	Packing (F-3)
1A	1283C	Vibrator (F-3)
2	9014041	Harness (D-2)
	9014041-11	Harness (D-2)
	MS3108R14S-28	Connector (F-3)
3	72-0410-1235-303	Lampholder (F-3)
	1891	Lamp (F-3)
4	RD414-1010-0010	Connector (F-3)
	RD261-2004-0004	Gasket (F-3)
	MS51957-17	Screw (F-3)
	LD153-0010-0002	Washer (F-3)
	NAS679C04W	Nut (F-3)
5	19-9014033	Case (D-2)
	AN4-4A	Bolt (F-3)
	RD153-0113-0048	Washer (F-3)
	MS29513-114	Packing (F-3)
	9014037	Plate (F-3)
	9014044	Plate (F-3)
	LD153-0010-0008	Washer (F-3)
	NAS679C3W	Nut (F-3)
	ZSP6-608	Humidity Indicator (F-3)
	ZSP6-037-1	Relief Valve (D-3)
	ZSP5-504	Seal (F-3)
6	9014034	Base Plate (D-2)
7	9014035	Lower Plate (D-3)
8	19-9014036	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20500-820	Nut (F-3)
9	9014040	Cable (F-3)

Figure 14-8. Disassembly of Impact Recorder Unit

14-16. CLEANING.

14-17. No special cleaning is required. Use a clean, lint-free cloth to wipe dust from case, or wipe with a clean lint-free cloth dampened with drycleaning solvent (Federal Specification P-D-680).

WARNING

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

14-18. SHIPPING AND STORAGE.

14-19. Prepare impact recorder unit for shipping or storage in accordance with Rocketdyne Rapid Automated Packaging System (RAPS).

NOTE

The impact recorder unit is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping instructions.

14-20. INSPECTION.

14-21. The inspections establish what is to be inspected, conditions to be sought and corrected, and the frequency of the inspection. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted since they will be directly affected by local operation. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. These inspections will consist of two periodics: the first periodic to be accomplished at 30 calendar days and the second periodic at 180 calendar days. See figure 14-9 for inspection requirements.

Inspection Requirements	Visual	Periodic	
		1st	2nd
1. Case for dents, gouges, and cracks; handles for security; latches for security and free operation; cover seal for deterioration and damage; relief valve for security.			X
2. Humidity indicator plug. Replace desiccant as outlined in R-3896-11 if indicator shows pink color in 40 percent relative humidity range.	X		
3. Power cables and connectors for deterioration and general serviceability.		X	
4. Controls and indicators for damage; placards for legibility.	X		
5. Perform Calibration Verification-Test Procedure in accordance with paragraph 14-13.	X		

Figure 14-9. Inspection Requirements for Impact Recorder Unit

SECTION XV

COMPONENTS WELDING SETS 9026560, 9026561, AND 9026570

WARNING

COMPONENTS WELDING SETS 9026560, 9026561, AND 9026570 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

15-1. SCOPE. This section contains description and leading particulars, theory of operation, maintenance instructions, and inspection requirements for Components Welding Sets 9026560, 9026561, and 9026570. The components welding sets are used to spotweld and percussion-stud weld the F-1 engine thermal insulation insulators and studs.

15-2. DESCRIPTION AND LEADING PARTICULARS.

15-3. COMPONENTS WELDING SET 9026560. The components welding set (figure 15-1) consists of a solid-state transistorized power supply, a welding gun, and a ground probe and cable. The power supply has a power switch and light, a unit ready light, a range switch, a heat control switch, a watt-second meter, a weld setup switch, two welding jacks (+, -), an initiation receptacle, an accessory receptacle, a power cable, and electrical and electronic components. The welding gun contains an electrode, a firing switch, a 4-foot-long welding cable, a 4-foot-long initiation cable, a 4-foot-long ground cable and probe, a light-weight metal case, and a tip force adjustment screw.

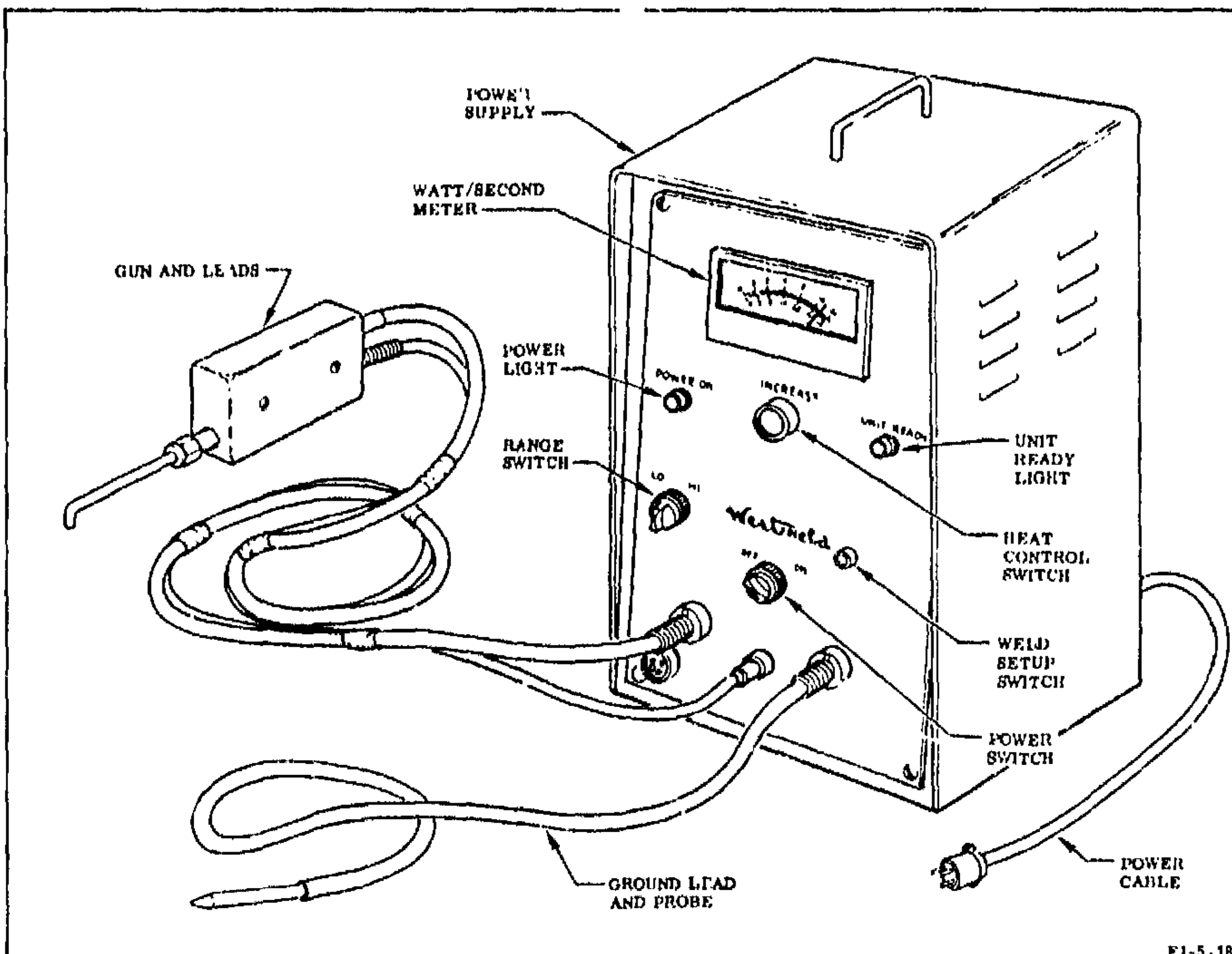


Figure 15-1. Components Welding Set 9026560

15-4. COMPONENTS WELDING SET 9026561. The components welding set (figure 15-2) consists of a power and control unit, a single-probe gun, a dual-probe gun, a ground probe and cable, a ground plate and cable, a switch cable, and a welding cable. The power and control unit contains a power cable, a power circuit breaker, a heat and mode selector panel, pneumatic and water systems, welding gun attach points, control switches, a tap switch and electrical and electronic components. The components are contained in a steel cabinet which is mounted on four casters. The single- and dual-probe guns (featuring manually operated sideward action) have a welding cable, a gun control cable, firing switches, electrodes, and tip force adjustment screws. The ground probe, made from copper, is permanently attached to an insulated electrical cable. The copper ground plate is bolted to an insulated electrical cable. The welding cable is insulated and contains an electrical terminal on each end.

15-5. COMPONENTS WELDING SET 9026570. The components welding set (figure 15-3) consists of a power and control unit, a gap welding gun, a contact welding gun, a 25-foot gun harness extension, a 25-foot ground cable, collets, and stops. The power and control unit contains a power cable, line and control fuses, a control panel, and electrical and electronic components. The components are housed in a cabinet, which is mounted on two wheels and two support legs. The cabinet is equipped with a handle to move the equipment easily. Two panels, located at the rear of the cabinet, permit access to fuses, welding contactor, and capacitor links. The upper section of the cabinet contains the control relays and rectifiers. The welding guns consist of a housing, a pistol grip and trigger, rear

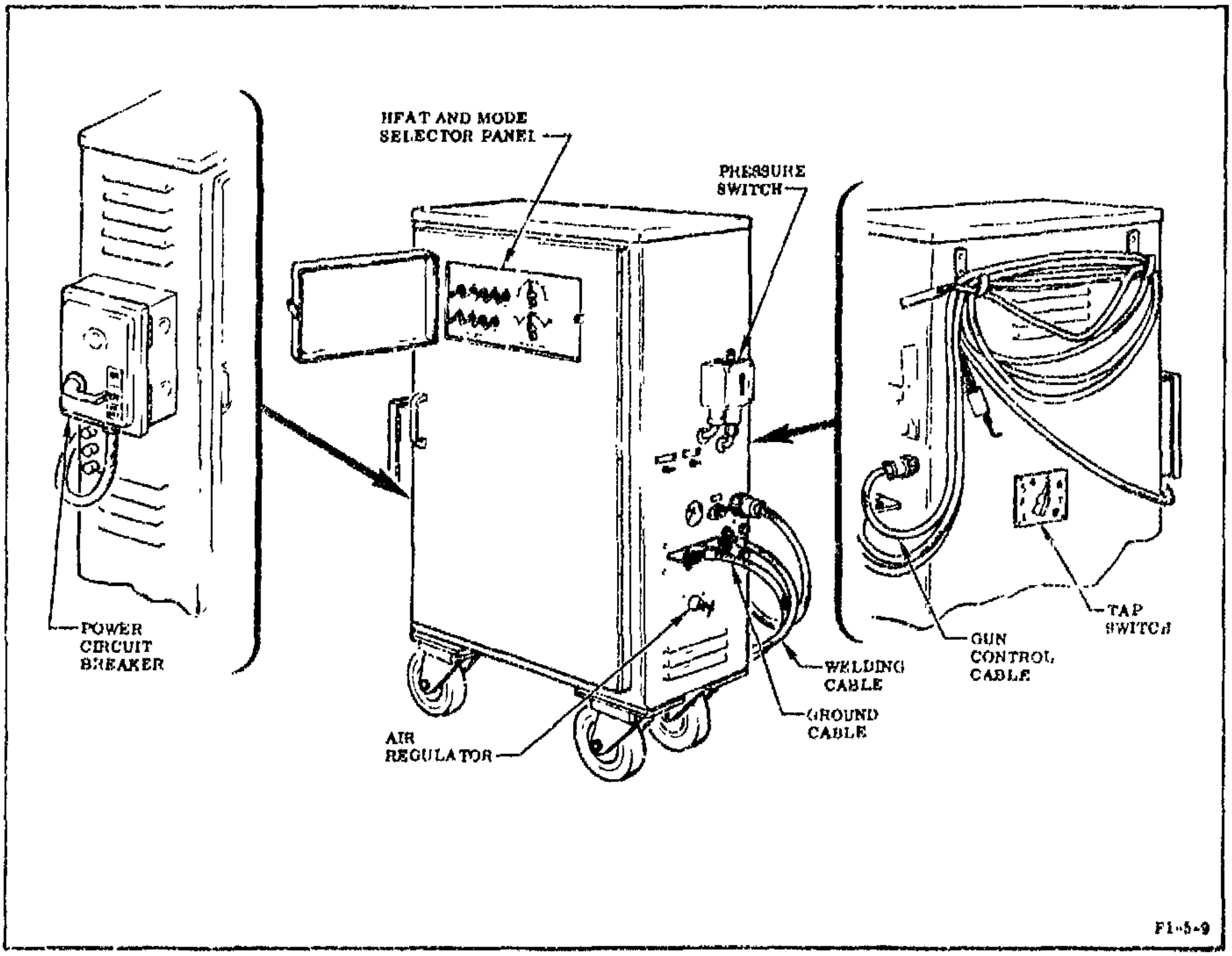


Figure 15-2. Components Welding Set 9026561 (Sheet 1 of 2)

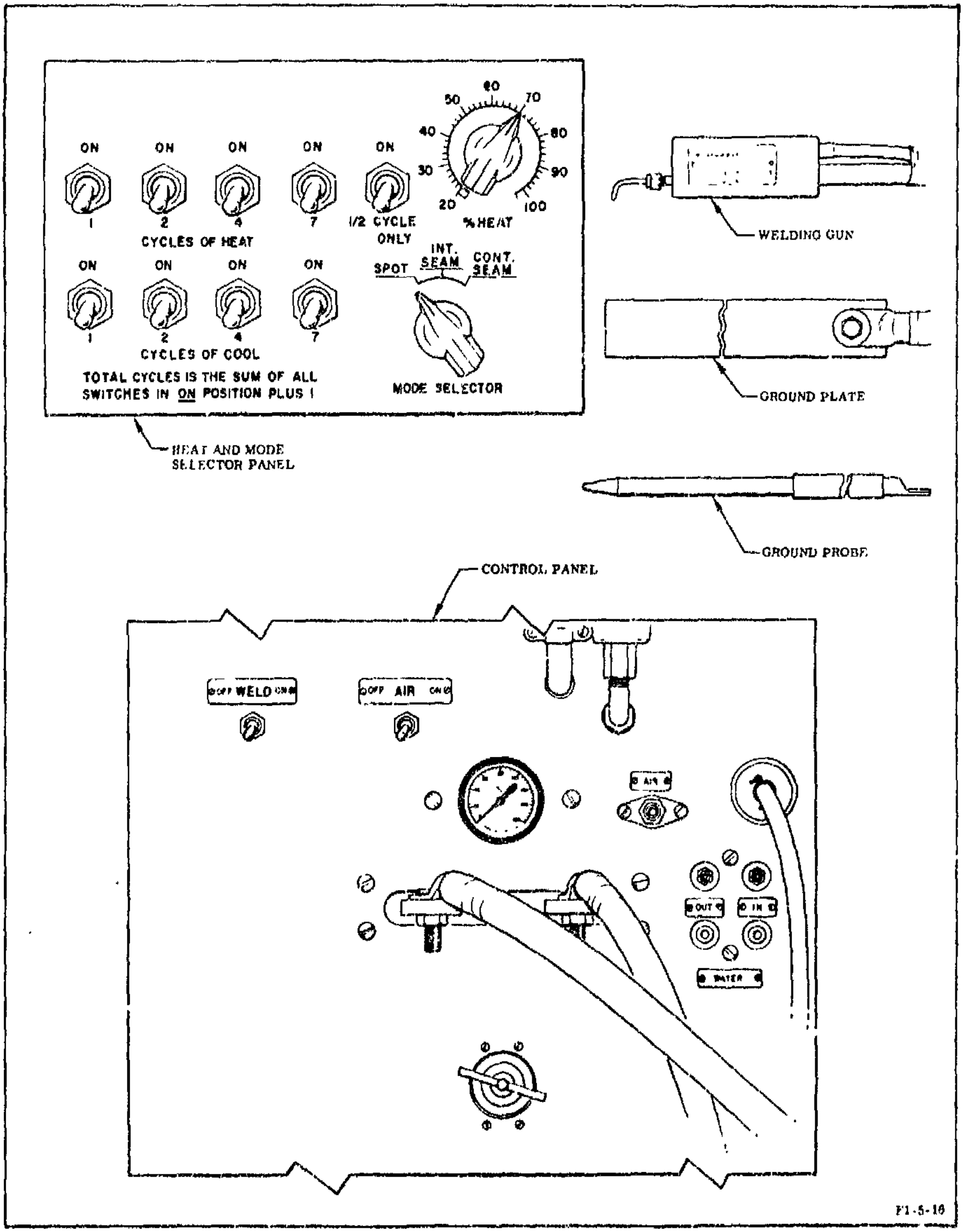


Figure 15-2. Components Welding Set 9026561 (Sheet 2 of 2)

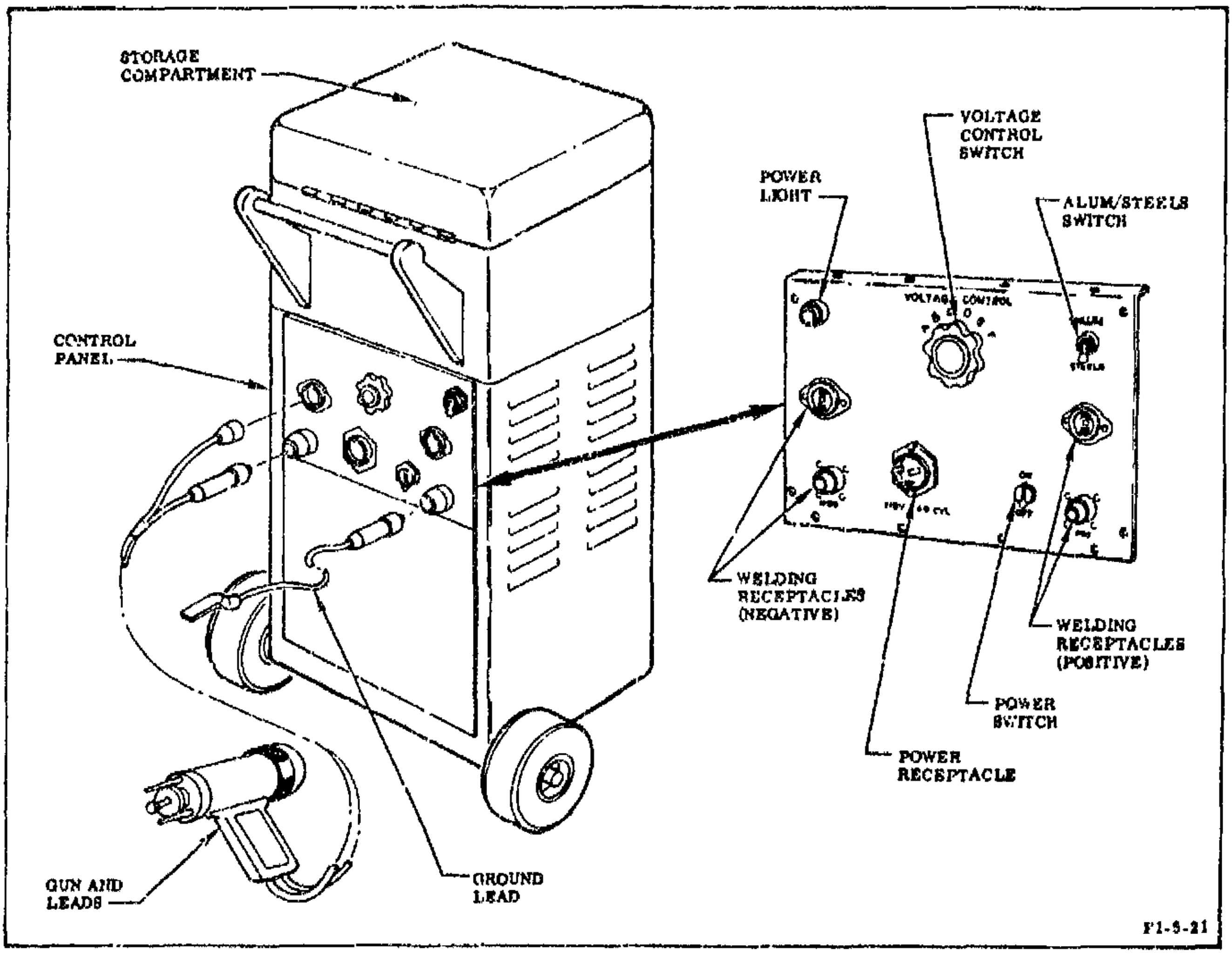


Figure 15-3. Components Welding Set 9026570

cap, front cap, leg, collet, and a welding and control cable. The major internal parts consist of a shaft, a stop, a stop retainer cap, and a spring. The S6-G gun has, in addition, an armature and coil. The guns have a decal attached that identifies the gun part number. The gun harness, ground cable, guns, stops, collets, allen-wrench and T-wrench are stored in the compartment located in the top of the cabinet. The compartment has a hinged door and lock (with two keys). (See figure 15-4 for leading particulars.)

15-6. THEORY OF OPERATION.

15-7. COMPONENTS WELDING SET 9026560. The components welding set (100 watt-seconds) is designed for resistance-spotwelding doublers that are less than 0.004 inch in thickness to insulation sheets. The power supply is placed on a bench or stand next to work area. The welding gun initiation cable is connected to the INIT receptacle, and the welding cable is connected to the + (positive) receptacle. The ground cable is connected to the - (negative) receptacle and clamped to the piece of work. The power supply is connected to a 120-vac polarized power source, and the range switch positioned to LO or HI, as applicable. The power switch is placed to the ON position and heat control switch turned to INCREASE until the desired setting is indicated on the watt-seconds meter. Pressure is applied between the probe tip and the material to be welded. The applied pressure overcomes a spring tension and actuates a firing switch, which allows the welding energy to travel between the probe tip and the material, forming the weld.

9026560

Height	15 inches
Width	11 inches
Depth	16 inches
Weight	70 pounds

Electrical Power Requirements

110-120 vac, polarized, 60 cps, single-phase

Range

0.02 to 20 watt-seconds

0.1 to 100 watt-seconds

9026561

Height	48 inches
Width	36 inches
Depth	24 inches
Weight	700 pounds (approximately)

Electrical Power Requirements

440 vac, 60 cps, three-phase, 10 kva

Connector 20415 (mating receptacle 20403 or 22427) (Harvey Hubble Inc)

Range

1-15 cycles of heat

20-100 percent heat (phase shift)

1 to 8 tap selections (open circuit, secondary voltage 3-12 volts)

Maximum short-circuit secondary current and transformer in series, 834 amperes

9026570

Height	36 inches
Width	15 inches
Depth	17 inches
Weight	200 pounds (approximately)

Electrical Power Requirements

110-120 vac, 60 cps, single-phase, 15 amperes

Range

12 heat settings (combination of voltage control switch and capacitor links)

Insul-Pins 1/2 to 5-1/2 inches long, 1/4 inch diameter

Studs 1/2 to 4-3/4 inches long, 1/4 inch diameter

Figure 15-4. Leading Particulars for Components Welding Sets

15-8. COMPONENTS WELDING SET 9026561. The components welding set (10 kva) is designed for resistance-spotwelding doublers that are 0.004 to 0.032 inch in thickness to insulation sheets. Cables provided with the set permit welding to be performed up to 33 feet from the power and control unit. The power and control unit is connected to a 440-vac power source and the tap switch set to the desired setting. The welding and ground cables are connected to the secondary lugs protruding from the power and control unit, and the gun control cable is connected to a receptacle. The power circuit breaker is moved to the ON position, and the heat and mode selector panel is set up as specified. Pressure is applied between the probe tip and the material to be welded. The applied pressure overcomes a spring tension and actuates a firing switch, which allows the welding energy to travel between the probe tip and the material, forming the weld. The power and control unit has the capability for using air-operated, water-cooled, or push-type guns, but these guns are not furnished as a part of the set. If using an air-operated or water-cooled gun, the air or water supply is connected to applicable quick-disconnects. The regulator is adjusted to the desired pressure setting indicated on the air pressure gage. The AIR switch and WELD switch are moved to the ON positions. If a push-type gun is used, the WELD switch is moved to the ON position and the AIR switch to the OFF position.

15-9. COMPONENTS WELDING SET 9026570. The components welding set (0.5 kva, three capacitors at 20,000 microfarads each) is a portable, percussion stud-welding unit. Cables provided with the set permit a 50-foot diameter working area without moving the equipment. The gun harness is connected to receptacles, as specified, on the control panel. The unit is connected to a 120-vac power source, and the ground cable is connected to a receptacle on the control panel and clamped to the workpiece. The voltage control switch, capacitor links, stop, collet, and gap are setup, as specified, for the type of welding to be performed. The S6-G gun must have the specified gap setting, the stud inserted into the collet and making contact with the stop, and the gun cocked to firing position. The VP-G gun must have the stud inserted into the collet and making contact with the stop in order to fire. The gun legs are pressed firmly against the base material and the trigger squeezed.

15-10. MAINTENANCE.

15-11. Maintenance of the components welding sets consist of checkout, removal and installation, cleaning, shipping, and storage. A certified operator is required to operate components welding sets. Force gage 7-003-02 (Unitek), or equivalent, and tensile testing machine TH-5 (Pacific Scientific Co), or equivalent, are required to perform checkout of components welding sets. (See figures 15-5, 15-6, and 15-7 for electrical schematics.) The following definitions are provided for clarity:

(1) Spot welds -- welds of structural importance.

(2) Indirect method of spot welding -- gun probe and ground probe applied to same side of material.

(3) Direct method of spot welding -- gun probe and ground probe applied to opposite sides of material.

15-12. CHECKOUT.

15-13. CHECKOUT OF COMPONENTS WELDING SET 902?560. The components welding set is certified periodically or when electromechanical modification is performed. The welding set is considered certified upon completion of the following procedures:

a. Connect initiation cable to INIT receptacle.

b. Connect gun welding cable to + (positive) receptacle and ground cable to - (negative) receptacle.

c. Prepare 3 test specimens each, from 0.001, 0.002, 0.003, and 0.004 inch thick material 1 inch wide and 3 inches long using same type and gauge of material as workpiece.

d. Clean surfaces of materials to be welded using a lint-free cloth dampened with isopropyl alcohol (Federal Specification TT-I-735) or methyl-ethyl-ketone (Federal Specification TT-M-261). Dry clean surfaces with a clean, lint-free cloth.

WARNING

Isopropyl alcohol and methyl-ethyl-ketone are flammable and must not be used near heat, sparks, or open flame. Inhalation of the vapors or prolonged contact with the liquids can cause serious injury or death.

e. Using force gage 7-003-02 (Unitek), or equivalent, adjust electrode tip pressure to 8 pounds.

f. Connect power cable to a power source. (See figure 15-4.)

g. Move power switch to ON and turn range selector switch to LO. POWER ON and UNIT READY lights come on.

WARNING

Personnel must not use welding equipment in wet areas or if any of the welder electrical equipment or the operator is wet. Electrical shock can cause serious injury or death.

h. If UNIT READY light fails to come on, turn on weld setup switch.

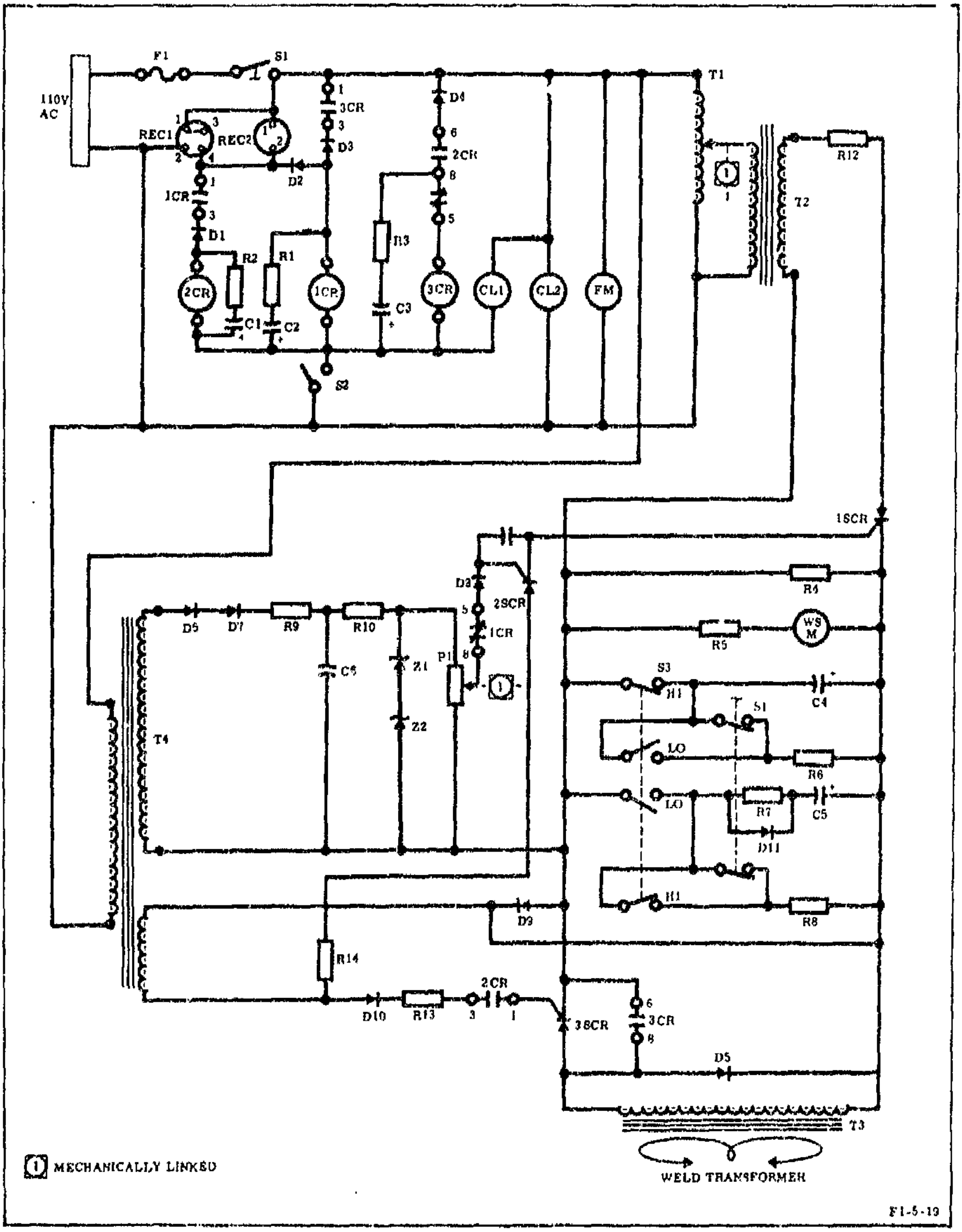


Figure 15-5. Components Welding Set 9026560 Electrical Schematic

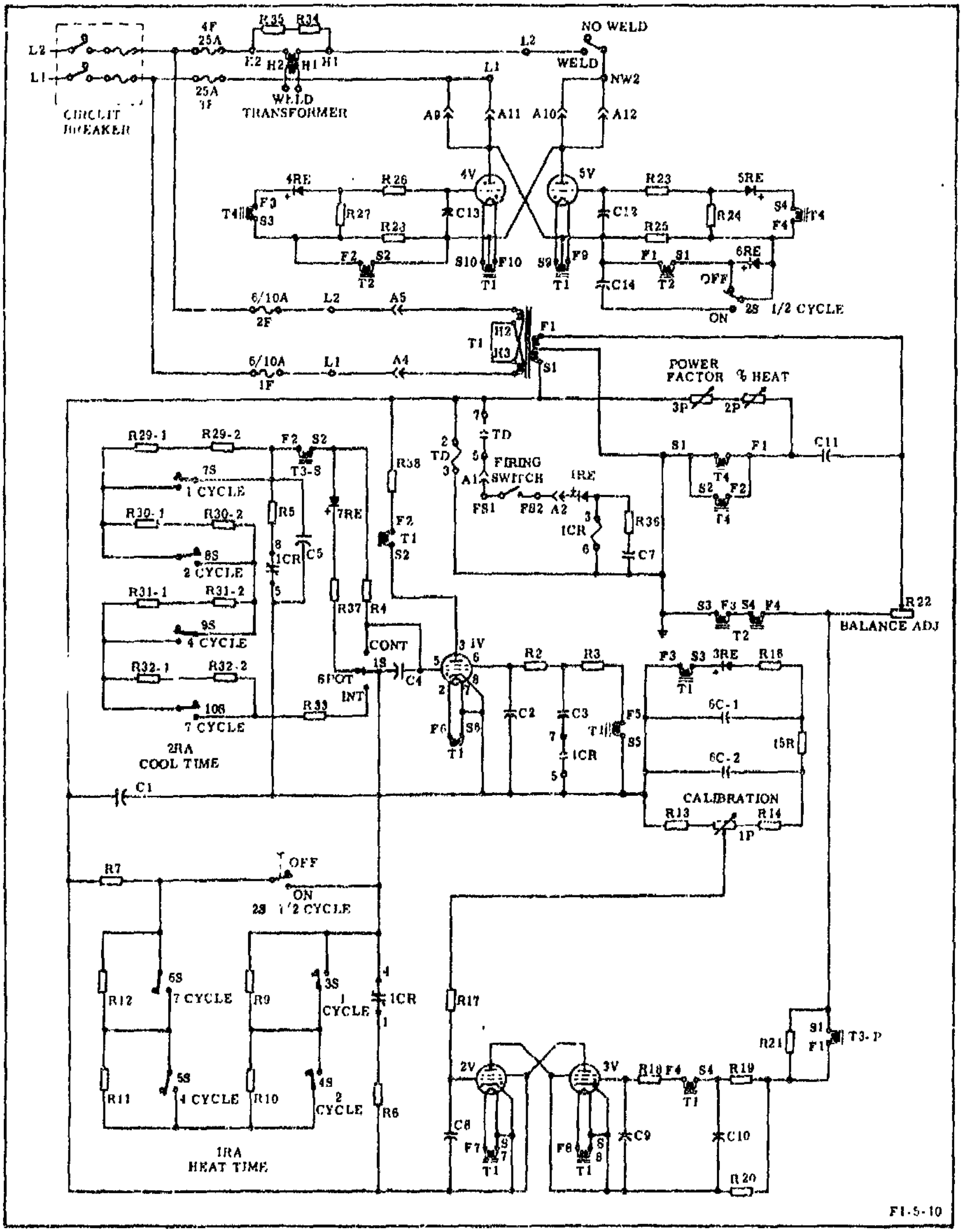


Figure 15-6. Components Welding Set 9026561 Electrical Schematic

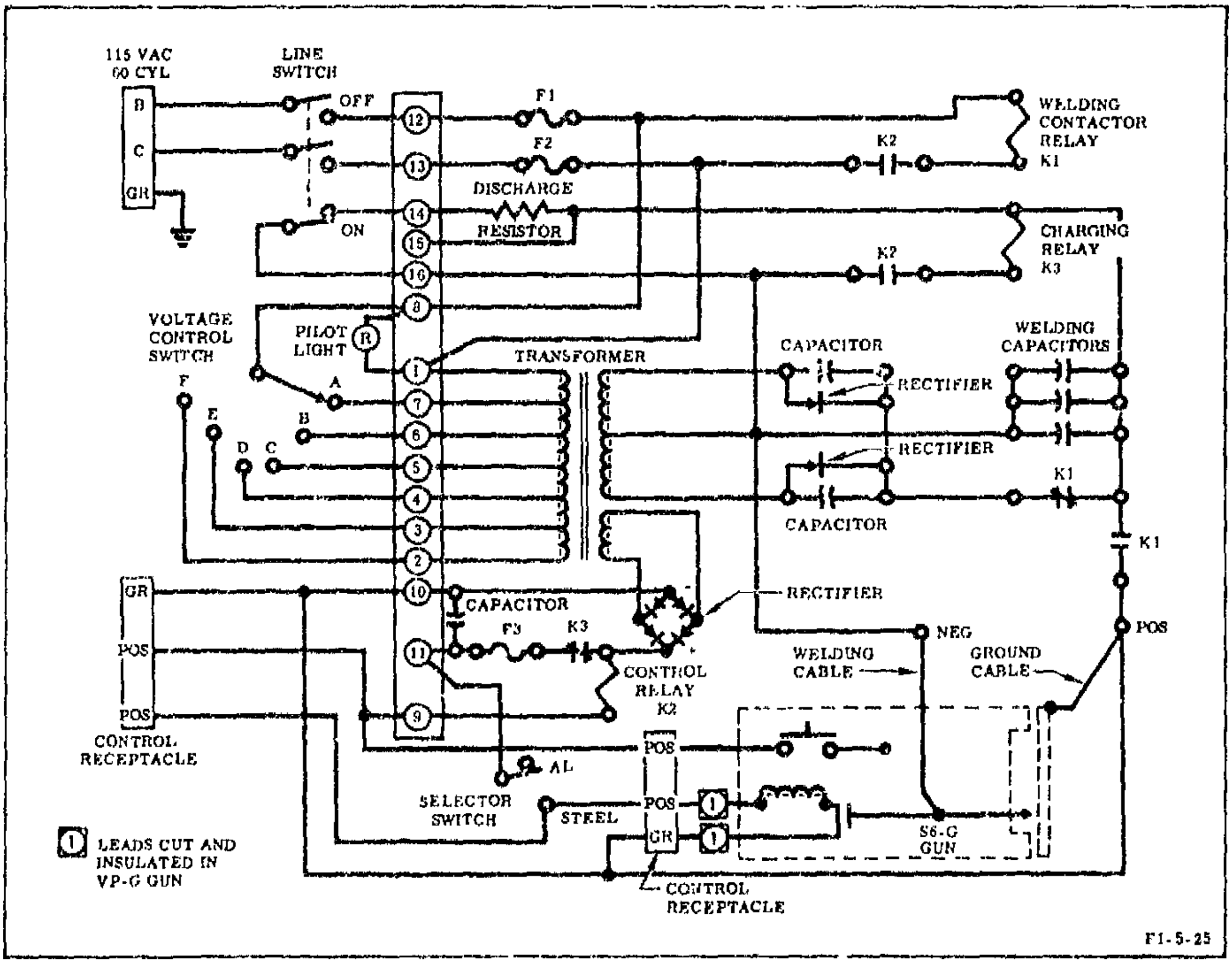


Figure 15-7. Components Welding Set 9026570 Electrical Schematic

i. Turn heat control switch until watt-seconds meter indicates midrange. Settings are approximate. Final settings are those used to obtain acceptable test specimens.

j. Prior to welding test specimens or performing repair welding, make sure that welding cables are no more than 6 inches apart and that cables are not coiled.

k. Using 0.001-inch test specimens, press ground probe on under side of weld spot, and apply pressure on tip until gun fires. Make single weld only.

l. Perform peel test on test specimen. The weld nugget must peel out from either piece of material of test specimen.

m. Turn heat control switch until watt-seconds meter indicates maximum reading.

n. Using 0.002-inch test specimens, repeat steps k and l.

o. Turn range switch to HI position and heat control switch until watt-seconds meter indicates midrange.

p. Using 0.003-inch test specimens, repeat steps k and l.

q. Repeat step m and using 0.004-inch test specimens, repeat steps k and l.

r. Turn heat control switch fully counterclockwise, and move power switch to OFF.

s. Disconnect power cable, gun welding cable, ground cable, and initiation cable, and secure equipment.

15-14. CHECKOUT OF COMPONENTS WELDING SET 9026561. The components welding set is certified periodically or when electromechanical modification is performed. The welding set is considered certified upon completion of the following procedures:

a. Connect switch cable to receptacle, gun welding cable to right-hand bus bar, and ground cable to left-hand bus bar located at rear of power and control unit.

b. Make sure circuit breaker is in OFF position, connect power cable to power source (figure 15-4), and move circuit breaker to ON.

c. Move MODE SELECTOR switch to CONT. SEAM, % HEAT switch to 100, and CYCLES OF HEAT switches 1, 2, 4, and 7 to ON (15 cycles total).

d. Turn tap switch to position 1, actuate welding gun, and using a multimeter, measure voltage across bus bars (right-hand positive, left-hand negative) at rear of unit. Voltage must be 3 ±1 vac.

e. Turn tap switch to positions 2 through 8; actuate gun and measure voltage at each position. Respective voltages for each tap must be 4.2 ±1, 5.4 ±1, 7.2 ±1, 8.4 ±1, 9.6 ±1, and 12 ±1 vac.

f. Move circuit breaker to OFF.

g. Prepare test specimens using dimensions of figure 15-8 and material combinations of Conditions No. 1, 4, 9, 12, 14, and 18 of figure 15-9.

h. Move WELD switch to ON, AIR switch to OFF, and circuit breaker to ON.

i. On heat and mode selector panel, move 1/2 CYCLE ONLY switch to off (down) position and MODE SELECTOR switch to SPOT.

j. Position CYCLES OF HEAT and % HEAT switches and tap switch as specified in figure 15-9.

k. Spotweld test specimens as indicated for the following material combination: (See figure 15-8.)

(1) Texturized material to texturized material. Make one parallel row of spot welds (6 spot welds per inch) across overlap of pieces of test specimen. Locate each spot weld in low portion of material texture.

(2) Flat material to texturized material. Make one parallel row of spot welds (6 spot welds per inch) across overlap of pieces of test specimen. Locate each spot weld where texturization is nearest flat material.

(3) Flat material to flat material. Make one parallel row of spot welds (6 spot welds per inch) across overlap of pieces of test specimen.

l. Perform peel test on test specimens. Test specimens are acceptable if they meet or exceed peel test requirements of figure 15-9.

m. If pull test method is used, make 2 parallel rows of spot welds and perform pull test. (See figures 15-8 and 15-9.) Tensile testing machine TH-5 (Pacific Scientific Co), or equivalent, may be used for pull testing.

n. Turn power circuit breaker to OFF and WELD switch to OFF.

o. Disconnect power cable, and store power cable, gun cable, and ground cable on hooks of power control unit.

15-15. CHECKOUT OF COMPONENTS WELDING SET 9026570. The components welding set is certified periodically or when electromechanical modification is performed. The welding set is considered certified upon completion of the following procedures: (See figure 15-3.)

a. Connect gun harness to NEG receptacles and ground cable to POS receptacle on control panel when welding aluminum or steel studs.

b. Install collet, stop, and stud as shown and specified in figure 15-10.

NOTE

The code letter is stamped on the top of the stop.

c. If S6-G gun is used, set gap (figure 15-11) as follows:

(1) Cock gun by pushing inward on washer.

(2) Remove rear cap and turn adjusting nut (clockwise to increase gap and counterclockwise to decrease gap) to dimension specified in figure 15-12. Dimensions are approximate; final dimensions are those used to obtain acceptacle test specimens.

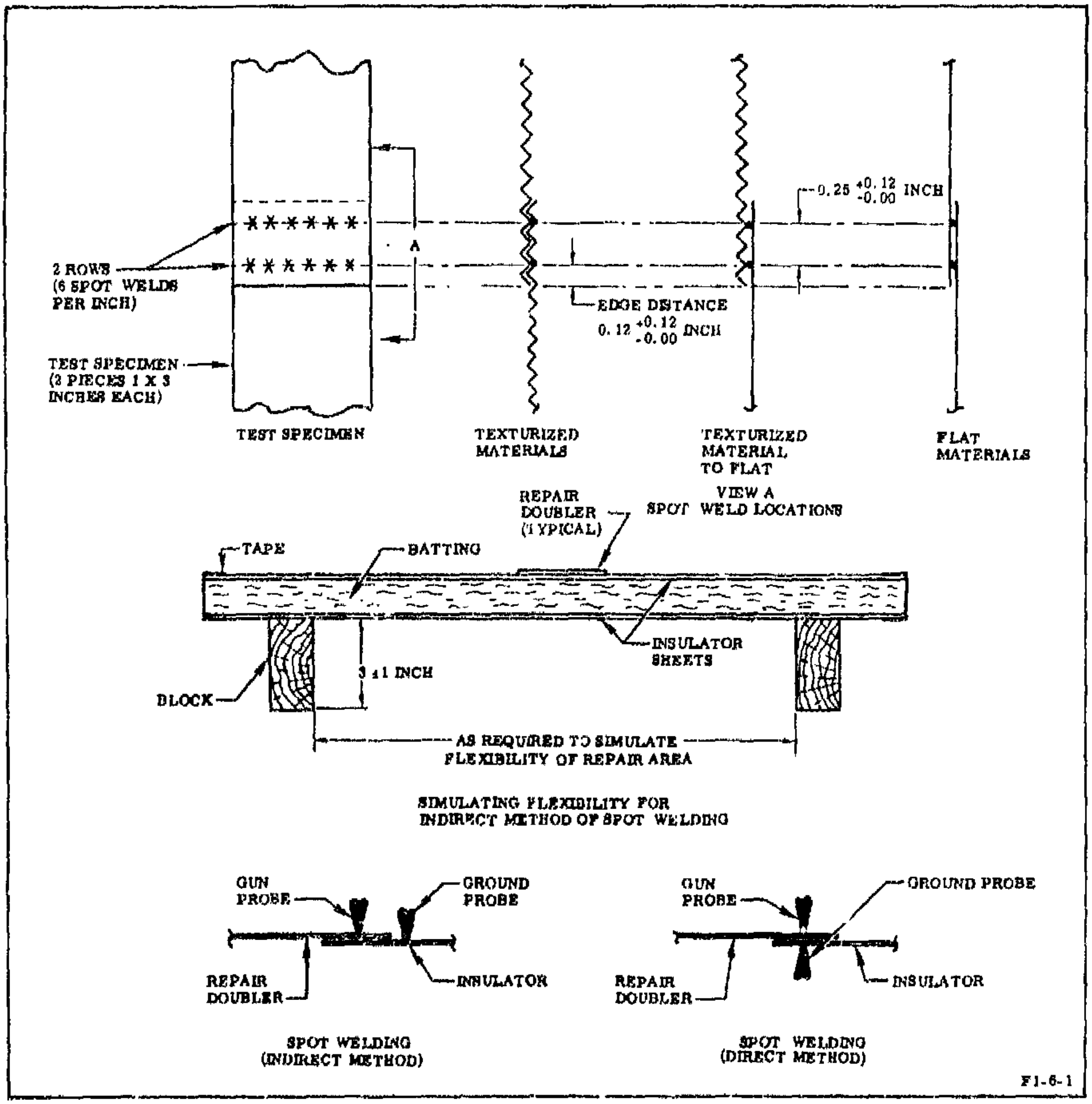
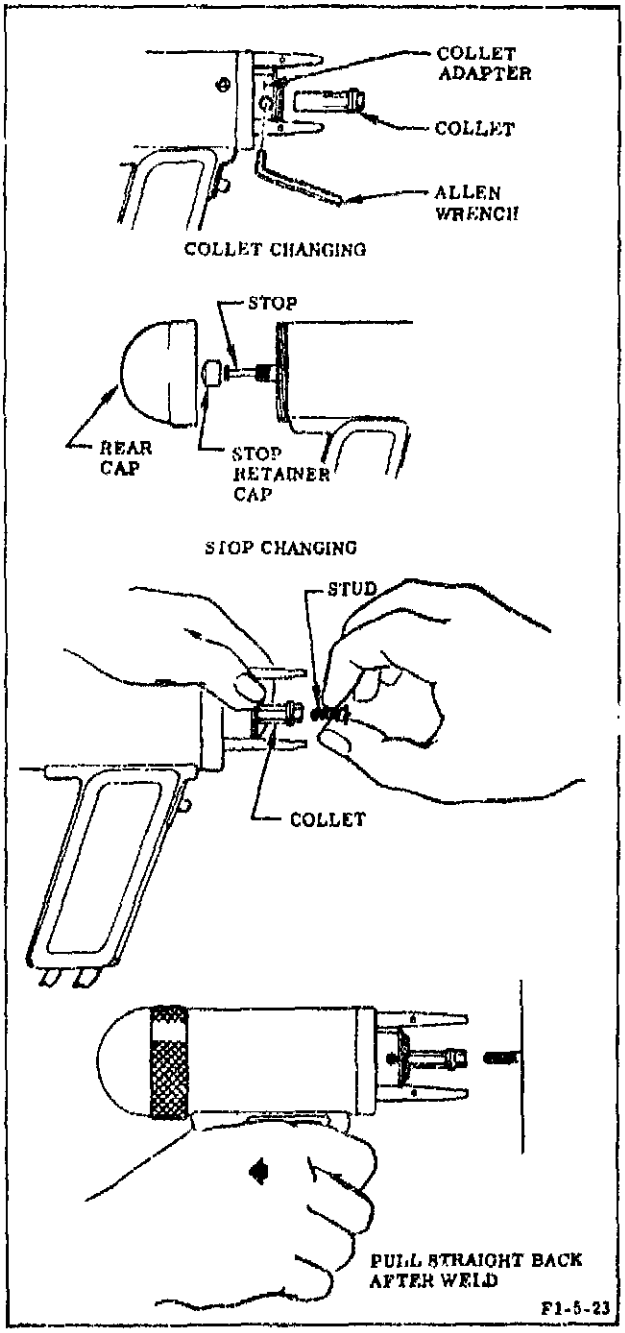


Figure 15-8. Preparing and Spot-Welding Test Specimen

Condition No.	Welding Method	Repair Doubler Thickness (Inch)	Base Material Thickness (Inch)	Cycle	Heat (%)	Tap No.	Electrode Diameter (Inch)	Gun Tip Pressure[a] (Pounds)	Peel Test Reqd[b]	Pull Test (Pounds Minimum)
1	Indirect	0.004[c]	0.004[c]	2	96	6	1/8	6-1/4	yes	160
2	Indirect	0.006[c]	0.004[c]	1	96	8	1/8	8-1/4	yes	160
3	Indirect	0.006[c]	0.006[c]	2	94	8	1/8	9-1/4	yes	265
4	Indirect	0.006[c]	0.006[c], 0.004[c]	2	80	8	1/8	9-1/4	yes	265
5	Indirect	0.006[c]	0.006[c], 0.006[c]	2	94	8	1/8	9-1/4	yes	265
6	Indirect	0.006[c]	0.006[c], 0.006[c], 0.006[c]	2	94	8	1/8	9-1/4	yes	265
7	Indirect	0.010[d]	0.004[c]	3	96	8	1/8	6	yes	160
8	Indirect	0.010[d]	0.006[c]	2	96	8	1/8	9-1/4	yes	265
9	Indirect	0.010[d]	0.006[c], 0.006[c]	2	96	8	1/8	9-1/4	yes	265
10	Indirect	0.010[d]	0.006[c], 0.006[c], 0.006[c]	2	96	8	1/8	9-1/4	yes	265
11	Indirect	0.020[d]	0.006[c]	4	100	8	1/4	9-1/4	yes	265
12	Indirect	0.020[d]	0.006[c], 0.006[c]	5	80	8	1/4	9-1/4	yes	265
13	Indirect	0.020[d]	0.006[c], 0.006[c], 0.006[c]	5	100	8	1/4	9-1/4	yes	265
14	Direct	0.020[d]	0.006[c], 0.006[c], 0.006[c], 0.006[c]	5	90	8	1/4	9-1/4	yes	none
15	Direct	0.020[d]	0.020[d], 0.006[c], 0.006[c], 0.006[c]	5	100	8	1/4	9-1/4	yes	none
16	Direct	0.025[d]	0.025[d], 0.006[c], 0.025[d], 0.006[c]	15	100	8	1/4	9-1/2	yes	none
17	Direct	0.032[d]	0.032[d]	15	100	8	1/4	9-1/4	yes	none
18	Direct	0.032[d]	0.032[d], 0.006[c], 0.006[c], 0.006[c]	10	90	8	1/4	9-1/4	yes	none

(a) Pressure may be set using force gage 7-003-02 (Unitek).
(b) Nuggets must peel through thinner material or either material if materials are same thickness.
(c) Texturized nickel-base alloy AMS5540
(d) Flat nickel-base alloy AMS5540

Figure 15-9. Basic Settings for Spot Welding



Stop Code Letter	Model VP-G Gun Stud Length	Model S6-G Gun Stud Length
A	--	1/2 to 3/4
B	--	3/4 to 1
C	--	1 to 1-1/4
E	1/2 to 3/4 (#1/4)	1-1/2 to 1-3/4
F	3/4 to 1	1-3/4 to 2
G	1 to 1-1/4	2 to 2-1/4

Figure 15-10. Installing Collet, Stop, and Stud in S6-G and VP-G Guns

Collet Part No.	Stud Size
36-245-E-#10	#10
36-245-E-3/16	3/16
36-245-E-1/4	#1/4 (0.246)
36-245-E-0.250	1/4 (0.250)

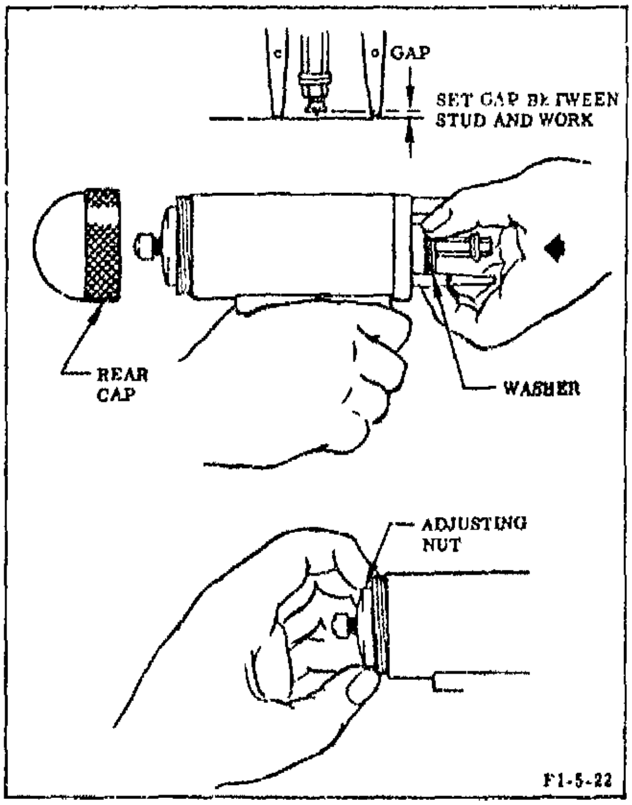
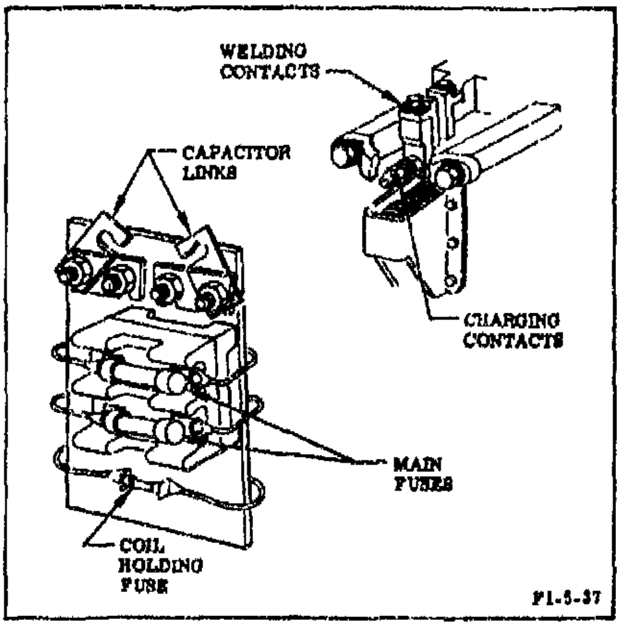


Figure 15-11. Adjusting Gap of S6-G Gun



Stud Size	Gap	Voltage Control Tap	Voltage Control No. Capacitors	Maximum Gun Lead Length (feet)	Base Material and Thickness
SETTINGS FOR S6-G WELDING GUN					
STEEL STUD MATERIAL					
#6 straight	3/16	B	1	25	1/4 HRS
#6 straight	3/16	C	1	50	1/4 HRS
#8 straight	1/4	B	3	25	1/4 HRS
#8 straight	3/16	B	3	50	1/4 HRS
#10 straight	3/16	C	3	25	1/4 HRS
#10 straight	3/16	D	3	50	1/4 HRS
STAINLESS STEEL STUD MATERIAL					
#6 straight	3/16	B	1	25	14-gage SST
#6 straight	3/16	C	1	50	14-gage SST
#8 straight	1/4	B	3	25	14-gage SST
#8 straight	3/16	B	3	50	14-gage SST
#10 straight	3/16	C	3	25	14-gage SST
#10 straight	3/16	D	3	50	14-gage SST
ALUMINUM (1, 100-H18) STUD MATERIAL					
Insul Pin					
106 flanged	3/32	E	1	50	3003-H14 aluminum (0.064 thick)
106 flanged	3/32	E	1	25	3003-H14 aluminum (0.064 thick)
#6 flanged	1/8	E	3	50	3003-H14 aluminum (0.064 thick)
#6 flanged	1/8	D	3	25	3003-H14 aluminum (0.064 thick)
#8 flanged	1/8	E	3	50	3003-H14 aluminum (0.064 thick)
#8 flanged	1/8	E	3	25	3003-H14 aluminum (0.064 thick)

Figure 15-12. Voltage Control and Gun Settings (Sheet 1 of 3)

Stud Size	Gap	Voltage Control		Maximum Gun Lead Length (feet)	Base Material and Thickness
		Tap	No. Capacitors		
ALUMINUM (1,100-H18) STUD MATERIAL (cont)					
#8 straight	1/16	E	1	50	3003-H14 aluminum (0.064 thick)
#8 straight	3/32	E	1	25	3003-H14 aluminum (0.064 thick)
#10 flanged	5/32	C	3	50	3003-H14 aluminum (0.064 thick)
#10 flanged	5/32	B	3	25	3003-H14 aluminum (0.064 thick)
#10 straight	5/32	C	3	50	3003-H14 aluminum (0.064 thick)
#10 straight	1/4	C	3	25	3003-H14 aluminum (0.064 thick)
#1/4 straight	5/32	E	3	25	3003-H14 aluminum (0.064 thick)
INCONEL 600 STUD MATERIAL					
1/4 threaded	1/8	F	3	25	Hastelloy C (0.125 thick)
<u>SETTINGS FOR VP-G WELDING GUN</u>					
STEEL STUD MATERIAL					
#6 flanged		D	1	25	1/4 HRS
#6 flanged		E	1	50	1/4 HRS
#8 flanged		A	3	25	1/4 HRS
#8 flanged		B	3	50	1/4 HRS
#10 flanged		C	3	25	1/4 HRS
#10 flanged		D	3	50	1/4 HRS
#1/4 flanged		E	3	25	1/4 HRS
#1/4 flanged		E	3	50	1/4 HRS
STAINLESS STEEL STUD MATERIAL					
#6 flanged		C	1	25	14-gage SST
#6 flanged		D	1	50	14-gage SST
#8 flanged		A	3	25	14-gage SST
#8 flanged		B	3	50	14-gage SST
#10 flanged		C	3	25	14-gage SST
#10 flanged		D	3	50	14-gage SST
#1/4 flanged		E	3	25	14-gage SST
#1/4 flanged		E	3	50	14-gage SST
1010 STEEL STUD MATERIAL (GALVANIZED BASE MATERIAL)					
.106 flanged		A	3	25	22-gage galv steel
.106 flanged		B	3	50	22-gage galv steel
#6 flanged		B	3	25	22-gage galv steel
#6 flanged		C	3	50	22-gage galv steel
#8 flanged		B	3	25	22-gage galv steel
#8 flanged		C	3	50	22-gage galv steel
#10 flanged		E	3	25	22-gage galv steel
#10 flanged		F	3	50	22-gage galv steel
#1/4 straight		E	3	25	22-gage galv steel

Figure 15-12. Voltage Control and Gun Settings (Sheet 2 of 3)

Stud Size	Gap	Voltage Control Tap	Voltage Control No. Capacitors	Maximum Gun Lead Length (feet)	Base Material and Thickness
321 CRES STUD MATERIAL					
#10 threaded		B	3	25	347 Cres (0.125 thick)
INCONEL 600 STUD MATERIAL					
1/4 straight		F	3	25	Inconel X (0.064 thick)

Figure 15-12. Voltage Control and Gun Settings (Sheet 3 of 3)

(3) Place legs of gun on test specimen holding gun perpendicular to test specimen, and measure dimension of gap between test specimen and flange of stud.

NOTE

Measurement is taken from the flange, not from the tip of the stud.

d. Connect power cable to power source (figure 15-4) and move power switch to ON.

NOTE

The power switch, which is a combination line and capacitor discharge switch, must be turned to OFF for at least 2 minutes for capacitors to discharge.

e. Move ALUM/STEELS switch to ALUM or STEELS position as applicable.

f. Set up gun and power control unit as specified in figure 15-12.

g. Using each gun, weld studs to 3 test specimens.

h. Inspect and correct unsatisfactory weld results as follows:

(1) Examine base of trial weld for too little or excessive heat. Adjust voltage control switch to higher or lower setting to compensate.

(2) Check to see if capacitor link is properly set.

(3) Check gap setting (S6-G gun only). If aluminum stud is overwelded, reduce gap slightly. If aluminum stud fails to adhere, increase gap slightly.

NOTE

The power switch must be in the OFF position when a voltage setting is changed, in order for the capacitors to correctly charge.

i. Move power switch to OFF, allow capacitors (2 minutes) to discharge, and secure equipment.

15-16. REMOVAL AND INSTALLATION.

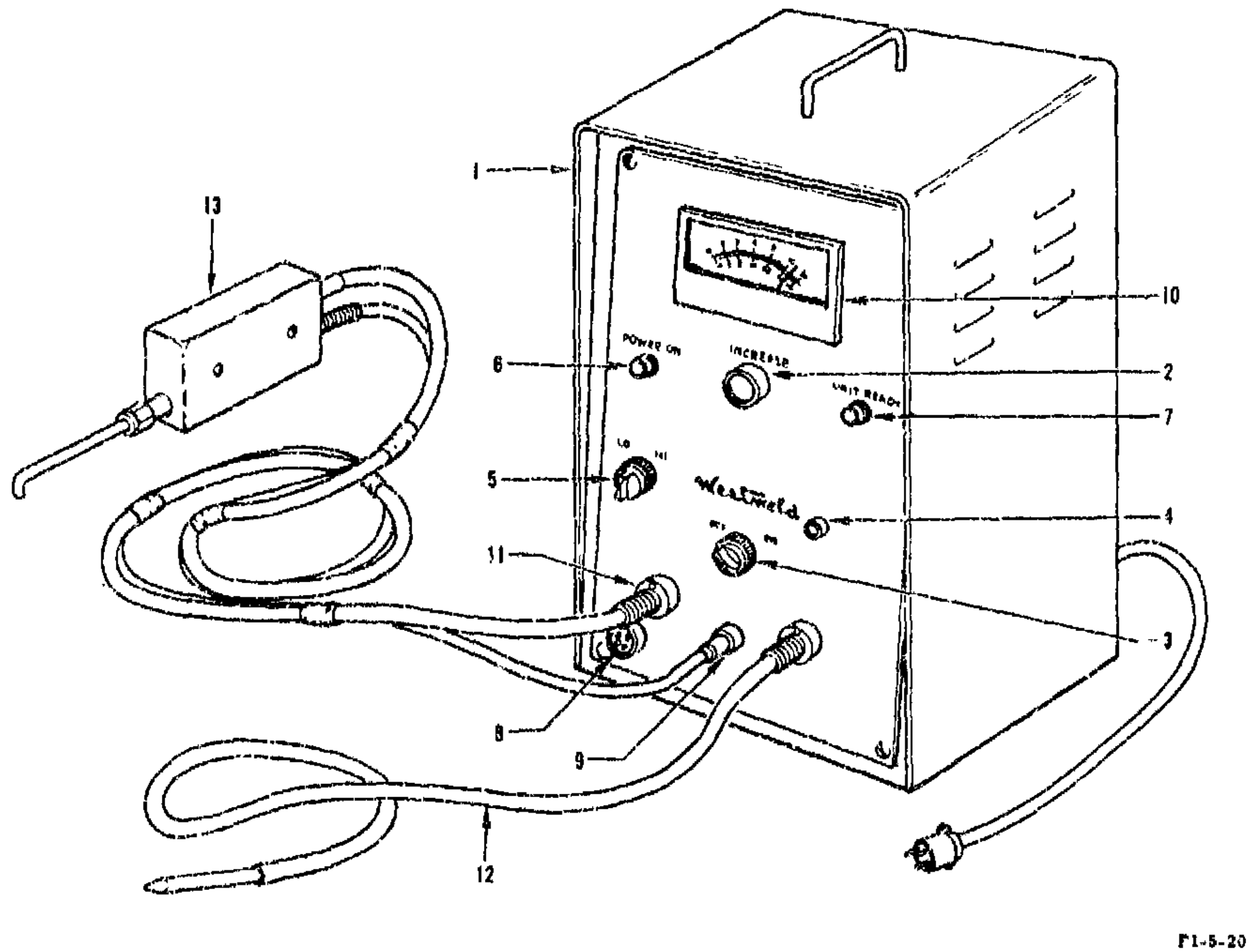
15-17. Disassemble the components welding sets, as required, to accomplish necessary repair or replacement. (See figures 15-13, 15-14, and 15-15 for index and part numbers.)

15-18. CLEANING.

15-19. No special cleaning is required. Use a clean, lint-free cloth to wipe dust from power and control unit.

15-20. SERVICING.

15-21. No servicing is required for Components Welding Set 9026560. Servicing of Components Welding Set 9026561 consists of filling air lubricator with No. 10 light oil. Servicing of Components Welding Set 9026570 consists of checking the operation and condition of the welding and charging contacts annually. Replace, if necessary.



Index No.	RDI No.	Part No.	Description
1		Model WD-100-DR	Power supply
	C1, C3	11-01	Capacitor
	C2	11-02	Capacitor
	C4, C5	11-16	Capacitor
	C6	11-19	Capacitor
	R1, R2, R3	10-17	Resistor
	R4	10-69	Resistor
	R5	10-02	Resistor
	R6, R7, R8	10-76	Resistor
	R9	10-52	Resistor
	R10	10-55	Resistor
	R12	10-78	Resistor
	R13	10-14	Resistor
	R14	10-15	Resistor
1 (cont)	D1 through D4	12-08	Diode
	D5	12-06	Diode
	D6 through D9	12-09	Diode
	D10	12-08	Diode
	D11	12-05	Diode
	Z1, Z2	13-01	Zener diode
	1SCR	14-04	Silicon controlled rectifier
	2SCR	14-07	Silicon controlled rectifier
	3SCR	14-06	Silicon controlled rectifier

Figure 15-13. Disassembly of Components Welding Set 9026560 (Sheet 1 of 2)

Index No.	RDI No.	Part No.	Description
1 (cont)	T1	16-20	Variable transformer
	T2	16-11	Charging transformer
	T3	16-14	Pulse transformer
	T4	16-04	Reference voltage transformer
2	P1	17-02	Potentiometer
3	S1	19-01	Switch (F-3)
		19-04	Contact block (F-3)
4	S2	19-08	Switch (F-3)
5	S3	19-01	Switch (F-3)
		19-04	Contact block (F-3)
		19-02	Contact block (F-3)
6	CL1	21-02	Control light (green) (F-3)
7	CL2	21-01	Control light (red) (F-3)
7 (cont)		22-01	Lamps (F-3)
	F	23-01	Fuse holder (F-3)
8	REC 1	18-01	Initiation receptacle (4-pin) (F-3)
9	REC 2	18-03	Initiation receptacle (2-pin) (F-3)
10	WS	24-09	Watt-seconds meter (F-3)
	1CR, 2CR, 3CR	15-01	Relay (F-3)
11		18-17	Weld cable receptacles (F-3)
12		RR100-48	Ground cable and probe (F-3)
13		WG-150	Welding gun (F-3)

Figure 15-13. Disassembly of Components Welding Set 9026560 (Sheet 2 of 2)

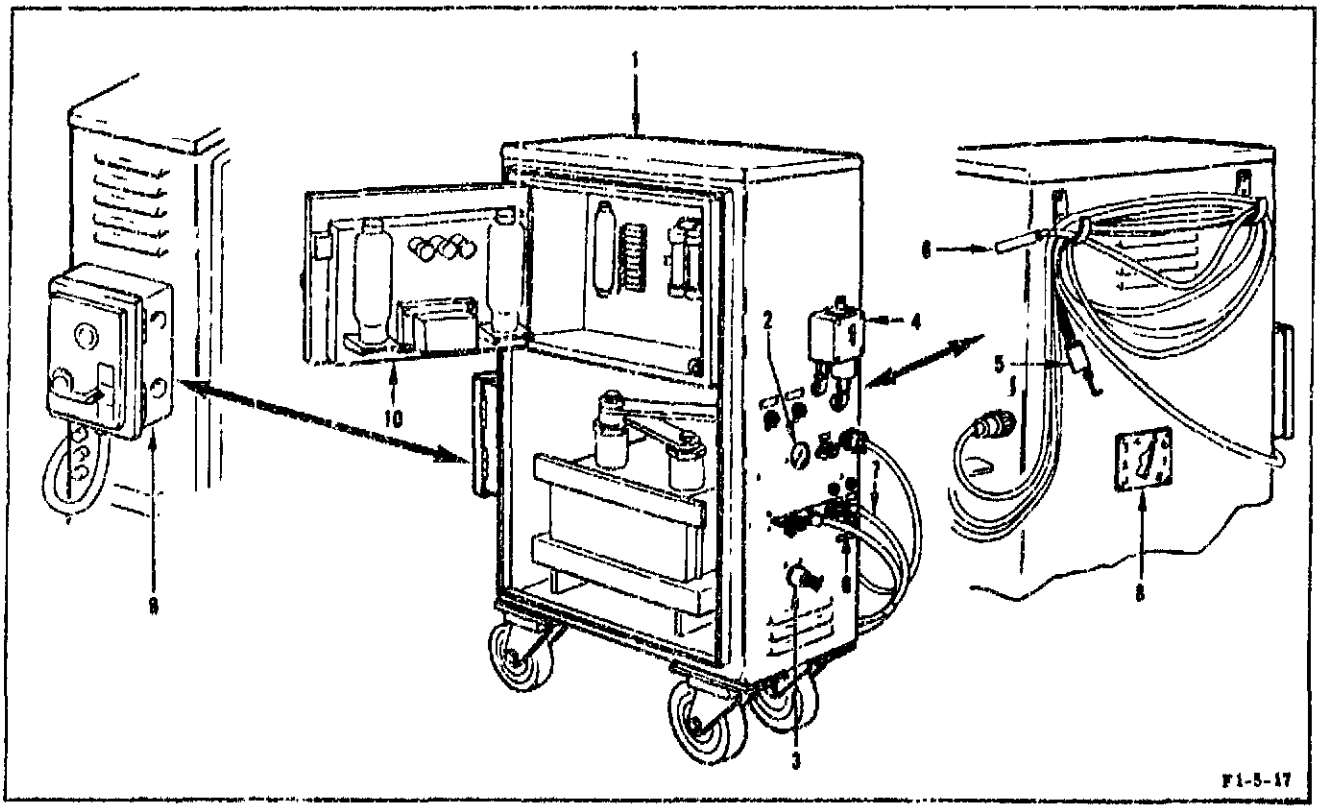


Figure 15-14. Disassembly of Components Welding Set 9026561 (Sheet 1 of 3)

Index No.	RDI No.	Part No.	Description
1		5705-SA-440-10	Power and control unit
		917-4	Caster
		S206HL16C-4	Thermostat
		6100	Transformer
	R34, R35	201-0156	Resistor (250 ohm, 75w)
	F1, F2	6/10 ampere	Fuse
	F3, F4	25 ampere	Fuse
		20415	Plug
		92-C	Receptacle
2		2156	Gauge
		4BTX	Connector (air)
3		R-2025	Regulator
		LN-1025	Air lubricator
		1613A2001	Air valve
		F1025	Filter
4		9012	Pressure switch
5		5961-HDC	Gun and leads
		7718	Gun and leads
		5991	Offset holder (30 degrees)
6		GP100HDC	Cable and ground plate
		7526-HDC	Ground probe
7		8129	Welding cable
		92M	Plug
		MS3106R20-4P[a]	Plug
8		P-108	Tap switch
9		EH3-B030	Circuit breaker
10		S1H-S5H	Timer panel
	T1	204-0866	Transformer
	T2	204-0615	Transformer
	T3	204-0100	Transformer
	T4	204-0615	Transformer
	1V, 2V, 3V	210-0004	Tube 2050
	4V and 5V	210-0181	Tube NL-760L
	R2, R18, R25	201-0096	Resistor (100,000 ohm, 1w)
	R3	201-0085	Resistor (36,000 ohm, 1w)
10 (cont)	R4, R14, R15	201-0072	Resistor (10,000 ohm, 1w)
	R5, R6, R38	201-0025	Resistor (100 ohm, 1w)
	R7	201-0756	Resistor (5,000 ohm, 1w)
	R9	201-0288	Resistor (5,000 ohm, 1%, 1w)
	R10	201-0289	Resistor (10,000 ohm, 1%, 1w)
	R11	201-0290	Resistor (20,000 ohm, 1%, 1w)
	R12	201-0291	Resistor (35,000 ohm, 1%, 1w)
	R13	201-0083	Resistor (30,000 ohm, 1w)
	R16	201-0056	Resistor (2,000 ohm, 1w)
	R17	201-0127	Resistor (2,000,000 ohm, 1w)
	R19, R24, R27, R28	201-0076	Resistor (15,000 ohm, 1w)
	R20	201-0344	Resistor (1.000 ohm, 1w)
	R21	201-0345	Resistor (300 ohm, 1w)
	R22	201-0212	Resistor (3,000 ohm, 25w)
	R23, R26	201-0089	Resistor (51,000 ohm, 1w)
	R29	201-0562	Resistor (100,000 ohm, 1w)
	R30-1	201-0288	Resistor (5,000 ohm, 1%, 1w)

(a) Alternate Part. (See figure 15-14A for electrical schematic.)

Figure 15-14. Disassembly of Components Welding Set 9026561 (Sheet 2 of 3)

Index No.	RDI No.	Part No.	Description
10 (cont)	R30-2	201-0565	Resistor (180,000 ohm, 1%, 1w)
	R31-1	201-0560	Resistor (25,000 ohm, 1%, 1w)
	R31-2	201-0563	Resistor (330,000 ohm, 1%, 1w)
	R32-1	201-0316	Resistor (40,000 ohm, 1%, 1w)
	R32-2	201-0564	Resistor (620,000 ohm, 1%, 1w)
	R33	201-0561	Resistor (90,000 ohm, 1%, 1w)
	R34, R35	201-0156	Resistor (250 ohm, 75w)
	R36	201-0187	Resistor (100 ohm, 10w)
	R37	201-0017	Resistor (47 ohm, 1w)
	C1	202-0056	Capacitor (2 µf, 600v)
	C2, C9	202-0004	Capacitor (0.001 µf, 500v)
	C3, C5	202-0060	Capacitor (2 x 0.1 µf, 600v)
	C4, C8	202-0009	Capacitor (0.004 µf, 500v)
	C6	202-0053	Capacitor (2 x 1 µf, 600v)

Index No.	RDI No.	Part No.	Description
10 (cont)	C7	202-0052	Capacitor (1. µf, 600v)
	C10	202-0032	Capacitor (0.5 µf, 600v)
	C11	202-0143	Capacitor (0.8 µf, 400v)
	C12, C13	202-0141	Capacitor (0.003 µf, 600v)
	C14	202-0012	Capacitor (0.5 µf, 400v)
	1P	216-0069	Potentiometer (10,000 ohm, 1w)
	2P and 3P	216-0003	Potentiometer (5,000 ohm, 25w)
	1CR	222-0046	Relay (115 vdc)
	TD	221-0030	Relay (115v, 120 sec)
	1RE, 7RE	226-0012	Rectifier (750 ma, silicone)
	3RE, 4RE, 5RE	225-0024	Rectifier (50 ma)
	6RE	225-0024	Rectifier (50 ma)
	1S	215-0223	Switch
	2S	215-0003	Switch
	3SW and 6SW	215-0001	Switch
	7SW and 10SW	215-0001	Switch
	11SW	215-0293	Switch (20 amp, 600v)

Figure 15-14. Disassembly of Components Welding Set 9026561 (Sheet 3 of 3)

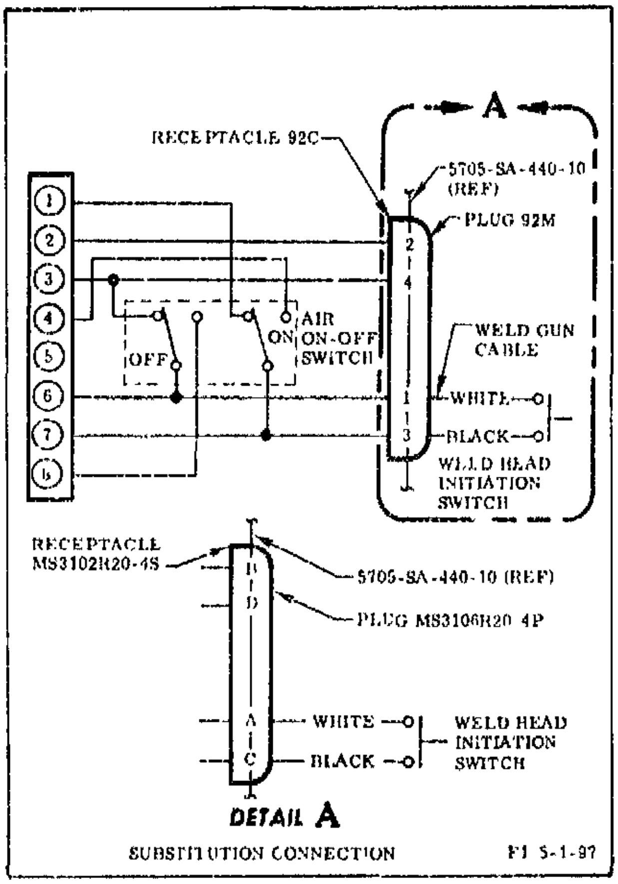
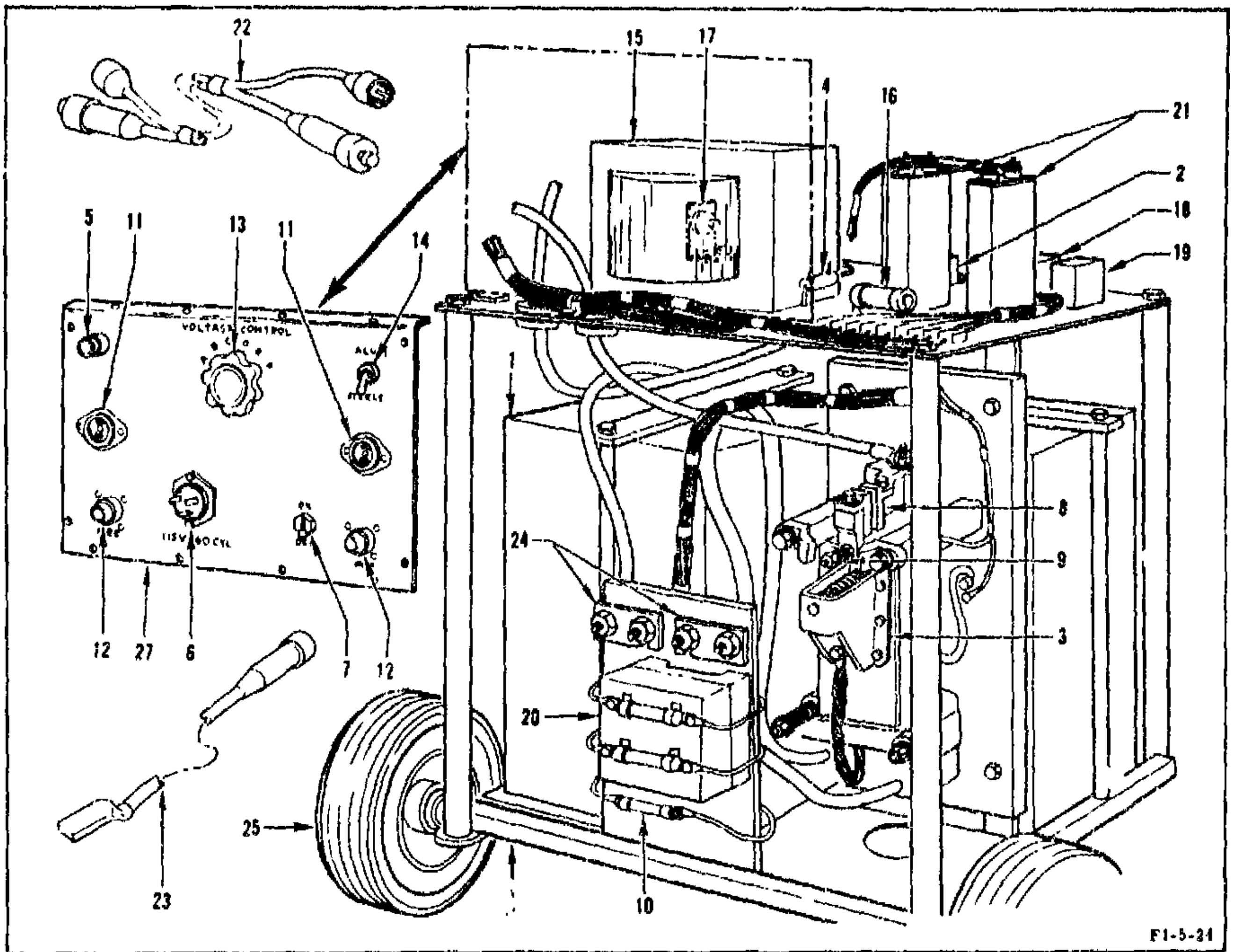


Figure 15-14A. Components Welding Set 9026561 Alternate Part Electrical Schematic



Index No.	Part No.	Description
1	S6-103-E	Capacitor
2	S6-105-E	Rectifier
3	S6-107-E	Contactor
4	S6-109-E	Resistor
5	S6-112-E	Pilot light
	S6-204-E	Bulb
6	S6-116-E	Receptacle
7	S6-117-E	Switch
8	S6-187-E	Contact
9	S6-188-E	Contact
10	S6-212-E	Fuse block
	S6-213-E	Fuse (2 amp)
11	S6-250-E	Receptacle
12	S6-251-E	Receptacle
13	S6-252-E	Switch
14	S6-253-E	Switch
15	S6-255-E	Transformer
16	S6-256-E	Capacitor
17	S6-257-E	Rectifier
18	S6-258-E	Relay
19	S6-259-E	Relay
20	S6-286-E	Fuse block
	S6-287-E	Fuse (15 amp)
21	S6-288-E	Capacitor
22	S6-275-E	Extension leads
23	S6-276-E	Ground lead
24	S6-285-E	Capacitor links
25	S6-142-E	Wheel
26	S6-170-E	Axle
27	S6-249-E	Control panel
	S6-246-E[a]	Allen wrench, 5/64-inch
	S6-287-E[a]	T-wrench
	S6-G[a]	Gun and leads
	VP-G[a]	Gun and leads

(a) Not illustrated

Figure 15-15. Disassembly of Components Welding Set 9026570

15-22. SHIPPING AND STORAGE.

15-23. Prepare components welding sets for shipping or storage in accordance with Rocketdyne Rapid Automated Packaging System (RAPS).

15-24. INSPECTION.

15-25. The inspection establishes what is to be inspected, conditions to be sought and corrected, and the frequency of the inspection. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, since they are directly affected by local operation. Visual inspection is conducted prior to operation of the unit. Periodic inspections are conducted at specified periods. These inspections consist of two periodics: the first periodic to be accomplished at 30 calendar days; the second, at 180 calendar days. See figure 15-16 for inspection requirements.

Inspection Requirements	Visual	Periodic	
		1st	2nd
1. For deterioration and general serviceability of power, ground, welding, and gun control cables.			X
2. For burns and for proper radius of electrode tip. (Use Number 400 or 600 carborundum paper.)	X		
3. To perform recertification procedures (paragraphs 15-13, 15-14, and 15-15).			X

Figure 15-16. Inspection Requirements for Components Welding Sets

SECTION XVI

HANDLING AND SHIPPING EQUIPMENT

WARNING

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

G4044, Air Transport Engine Handler
G4051, Roadable Vertical Engine Dolly
G4052, Engine Handler Sling
G4058, Engine Handling Dolly
G4060, Vertical Installer Sling
G4068, Component Handling Fixture Set
G4069, Engine Handler
G4080, Nozzle Extension Handling Fixture
G4081, Nozzle Extension Handling Adapter
G4088 and 99-9026814, Turbopump Shaft Preload Fixture
G4089 and 99-9026815, Thrust Chamber Throat Security Closure

16-1. SCOPE. This section contains description of, and operation, maintenance, and inspection requirements for, equipment used during engine and nozzle extension handling and shipping, and equipment used to support engine components during removal and installation.

16-2. INSPECTION OF HANDLING AND SHIPPING EQUIPMENT.

16-3. Figure 16-1 lists items to be inspected, conditions to be sought and corrected, and the frequency of the inspections. Inspection requirements are classified as visual and periodic. Their scope should be increased or decreased to suit varying conditions. All inspection requirements cannot be accurately predicted, because they are directly affected by local operations. Visual inspection is defined as an inspection to determine if there are undesirable, discrepant, or damage conditions and that hardware configuration is in accordance with appropriate records. Visual inspection is made before operation or use of the equipment. Periodic inspections are made at specified periods. (See figure 16-1 for inspection and periodic intervals.)

Inspection	Frequency (Months) 3	6	12	24
VISUAL INSPECTIONS FOR ALL UNITS				
1. Obvious signs of damage to all structural members.				
2. Illegible stencils, decals, or nameplates.				
3. Contamination that could result in adverse effects to equipment or engine.				
4. Completeness of units and records.				
5. Damage to threaded fasteners, inserts, and fittings.				
6. Broken or missing lockpin attaching cables and worn or bent lockpins.				

Inspection	Frequency (Months) 3	6	12	24
AIR TRANSPORT ENGINE HANDLER G4044				
1. Worn or damaged locking mechanism of lockpins.			X	
2. Broken caster pedals and binding caster wheels.			X	
3. Bent or misalined struts.				X
4. Machined surfaces for corrosion and voids in corrosion preventative (paragraph 16-16).		X		
5. Proper lubrication (paragraph 16-16).		X		
6. Proof-test expiration (paragraph 16-13).				X

Figure 16-1. Periodic Inspection Requirements (Sheet 1 of 4)

Inspection	Frequency (Months) 3	6	12	24
ENGINE COVER G4047				
1. Tears or holes in cover (paragraph 16-28).			X	
2. Damaged zippers and straps.			X	
THRUST CHAMBER PROTECTIVE COVER G4048				
1. Cracks or broken straps of outer shell.			X	
2. Loose or torn sections of inner padding.			X	
ROADABLE VERTICAL ENGINE DOLLY G4051				
1. Misalinement of wheel and steering assemblies.			X	
2. Broken strands, frays, and kinks in cables.			X	
3. Proper lubrication (paragraph 16-50).		X		
4. Proof-test expiration (paragraph 16-47).				X
ENGINE HANDLER SLING G4052				
1. Bent or misalined bars.			X	
2. Broken strands, frays, and kinks in cables.			X	
3. Proof-test expiration (paragraph 16-60).			X	

Inspection	Frequency (Months) 3	6	12	24
ENGINE VERTICAL SLING G4054				
1. Bent or misalined spreader bar or sling legs.			X	
2. Worn or damaged locking mechanism of lockpins.			X	
3. Broken strands, frays, and kinks in cables.			X	
4. Proof-test expiration (paragraph 16-70).			X	
TURBOPUMP DOLLY G4056				
1. Damage to frame and vertical pump supports.			X	
2. Broken caster pedals and binding caster wheels.			X	
3. Proof-test expiration (paragraph 16-82).				X
TURBOPUMP SLING G4057				
1. Worn or damaged locking mechanism of lockpins.			X	
2. Proof-test expiration (paragraph 16-94).			X	
ENGINE HANDLING DOLLY G4058				
1. Damage to chassis and protective padding.				X

Figure 16-1. Periodic Inspection Requirements (Sheet 2 of 4)

Inspection	Frequency (Months) 3	6	12	24
ENGINE HANDLING DOLLY G4058 (cont)				
2. Broken strands, frays, and kinks in cables.			X	
3. Worn or damaged locking mechanism of lockpins.			X	
4. Broken caster pedals and binding caster wheels.			X	
5. Cracked mounting plate and swivel body, and clearance between heads of mounting bolts and swivel body (paragraph 16-109).		X		
6. Proof-test expiration (paragraph 16-107).				X
GIMBAL BEARING LOCK G4059				
1. Damage to threads.			X	
VERTICAL INSTALLER SLING G4060				
1. Broken strands, frays, and kinks in cables.			X	
2. Proof-test expiration (paragraph 16-130).			X	
ENGINE SHIPPING BUTTRESS G4067				
1. Misalinement of frame, and missing hardware.			X	
2. Galled threads in adjustment screw.			X	

Inspection	Frequency (Months) 3	6	12	24
COMPONENT HANDLING FIXTURE SET G4068				
1. Broken strands, frays, and kinks in cables.			X	
2. Damaged or improper gap of fitting nut (paragraph 16-153).			X	
3. Damaged or cracked welded areas.			X	
4. Worn or damaged locking mechanism of lockpins.			X	
5. Proof-test expiration (paragraph 16-151).			X	
ENGINE HANDLER G4069				
1. Broken caster pedals and binding caster wheels.			X	
2. Bent or misalined struts and supports.				X
3. Worn or damaged locking mechanism of lockpin.			X	
4. Proper lubrication (paragraph 16-166).			X	
5. Proof-test expiration (paragraph 16-163).				X
NOZZLE EXTENSION HANDLING FIXTURE G4080				
1. Bent or misalined struts and support.				X
2. Broken strands, frays, and kinks in forward lift cable.		X		

Figure 16-1. Periodic Inspection Requirements (Sheet 3 of 4)

Inspection	Frequency (Months) 3	6	12	24
NOZZLE EXTENSION HANDLING FIXTURE G4080 (cont)				
3. Worn or damaged locking mechanism of lockpins.			X	
4. Deteriorated or damaged pads.			X	
5. Galled threads in adjustment screws of nozzle exit pads.			X	
6. Binding of aft hoist extension.			X	
7. Plated surfaces and ball joints for corrosion and voids in corrosion preventative (paragraph 16-179).		X		
8. Proof-test expiration (paragraph 16-176).				X
NOZZLE EXTENSION HANDLING ADAPTER G4081				
1. Misalined forward support (paragraph 16-190).			X	
2. Ball joints for corrosion and voids in corrosion preventative (paragraph 16-191).		X		
3. Galled threads in turnbuckles and base ring stop bolt.			X	
TURBOPUMP SHAFT PRELOAD FIXTURE G4088 AND 99-9026814 (PROTOTYPE)				
1. Damage to closure and foot.		X		
2. Damage to threads, and lubrication of preload screw.			X	
THRUST CHAMBER THROAT SECURITY CLOSURE G4089 AND 99-9026815 (PROTOTYPE)				
1. Damage to threads of shaft.			X	
2. Damage to tube, gage, and hose.			X	
3. Damage to closure and cover.			X	
ENGINE ENVIRONMENTAL COVER SET 99-9014130				
1. Tears or holes in cover (paragraph 16-223).		X		
2. Damaged nylon rope.		X		

Figure 16-1. Periodic Inspection Requirements (Sheet 4 of 4)

16-4. <u>PROOF-TEST INTERVAL EXCEPTIONS FOR HANDLING AND SHIPPING EQUIPMENT.</u>

16-5. Exceptions to the proof-test expiration frequencies listed in figure 16-1 are established to permit extension of the proof-test interval of handling and shipping equipment under specific conditions. Figure 16-2 lists the conditions that allow for extension of the proof test interval.

Status of Equipment	Proof-Test Interval	Loaded	Unloaded	Inspection	Limitations of Extension
1. Normal usage.	As specified		X	Periodic, as specified	
2. Proof test expiration off-site.	Extended	X		Visual	Until unloaded or 2 trips (loaded) from site to site or one trip (loaded) from site to Rocketdyne.
3. Proof test expiration off-site.	Extended		X	Visual	Two trips (loaded) from site to site or one trip (loaded) from site to Rocketdyne.
4. Completion of condition 2 or 3 and before next use.	As specified		X	Periodic, as specified	
5. Not used after acceptance of equipment and/or unused between proof-test intervals (equipment stored under controlled environment).	Extended		X	Visual	Specified interval begins after first use. Verification of "no use" is substantiated by application of Alucast No. 67 seals after final inspection, before acceptance, and after each proof test and inspection.

Figure 16-2. Proof-Test Interval Extension Requirements

16-6. AIR TRANSPORT ENGINE HANDLER G4044.

16-7. DESCRIPTION.

16-8. The air transport engine handler is a rectangular chassis mounted on four dual-wheel casters with individual wheel brakes, a draw bar, steering linkage, and engine mounting structure. The engine mounting structure consists of two front mounts and a rear mount. The front mounts include support blocks, struts, drag braces, turnbuckles, and socket support blocks. The left front mount also includes a sway bar. The turnbuckles and drag braces secure the engine to the handler. The rear mount includes two yokes, a truss, a truss plug, and a spring-loaded compensator. The truss plug is secured in a bracket mounted on the rear of the chassis. The draw bar is detachable and may be stored during engine transport. Tiedown/lift rings are incorporated on the chassis at each of the corners. Two lift rings are located forward of rear stacking adapters on the chassis, and two lift adapters are stored on the forward platform. (See figure 16-3 for leading particulars for the air transport engine handler.)

Length	196 inches
Width	96 inches
Height (truss, stored)	28 inches
Weight	4,500 pounds
Maximum load capacity	20 000 pounds
Proof load	40,080 pounds
Maximum towing speed	2-1/2 mph
Turning radius	160 inches minimum

Figure 16-3. Leading Particulars for Air Transport Engine Handler

16-9. OPERATION.

16-10. The air transport engine handler is used to support the engine when it is transported by air or truck and during maintenance. The engine is supported on the air transport engine handler by three mounts. The two front mounts bear the engine weight in either the engine lowered or engine horizontal positions. The rear mount prevents the thrust chamber exit from moving upward and provides longitudinal shock protection of the engine when the engine is in the engine lowered position, by means of a spring-loaded compensator. The tiedown-lift rings at each corner are used to lift the handler. The two adapters and the two lift rings forward of the stacking adapters are used to lift the handler and engine.

16-11. MAINTENANCE.

16-12. Maintenance of the air transport engine handler consists of proof testing, disassembling, assembling, servicing, and shipping and storing. Repaint surface area and/or lettering, as required, when paint becomes chipped, scratched, or worn off and when lettering becomes illegible. (Refer to section I for painting information.) Clean handler and parts as outlined in section I.)

16-13. PROOF TESTING. Proof-test air transport engine handler at 24-month intervals and to the weight configuration shown in figure 16-4. The proof load required for proof testing must be a minimum of 150 percent of the working load of the handler. The proof-test interval may be extended if one of the conditions of figure 16-2 exists.

WARNING

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

NOTE

Parts indexed in the following procedure are illustrated in figure 16-5.

a. Obtain engine dummy weight frame assembly 88-9017417, engine dummy weight assembly 88-9014883, and assorted weights. (See figure 16-4.)

b. Connect an overhead crane and sling, having a minimum load capacity of 25 tones, to test load and raise test load to clear floor.

c. Remove right-hand block (17) and left-hand block (46) from handler and install blocks on test load with pins. Torque wedge screws to 25-40 ft-lb and jamnuts to 100-140 in-lb.

d. Remove yokes (22) from handler and remove clamps (24) from yokes; install clamps on test load as follows:

(1) Remove block (23) from clamp (24).

(2) Install clamp (24) by inserting pin without cam in hole first and adjusting cam pins to fit remaining holes.

(3) Secure clamp (24) with block (23). Torque bolt to 275-325 in-lb.

e. Connect a facility hoist and sling capable of lifting a minimum of 250 pounds to handler truss. (Attach sling at painted lift points on truss.)

f. Disconnect truss from handler; use facility hoist to lift and aline truss to test load.

g. Install left-hand and right-hand yokes (22) on truss (21), and secure yokes with lockpins.

h. Attach truss and yokes to clamps on test load with bolts. Torque bolts to 275-325 in-lb.

i. Attach clevis (35) to test load with nut (36), torque nut to 40-50 in-lb, then disconnect sling and facility hoist from truss.

j. Move blocks (20) to BLOCK LOCATION ENGINE HORIZONTAL (aft position).

k. Check that struts (18) are properly secured to handler with washers and pins. Place forward end of struts (18) to outside of handler for easy access.

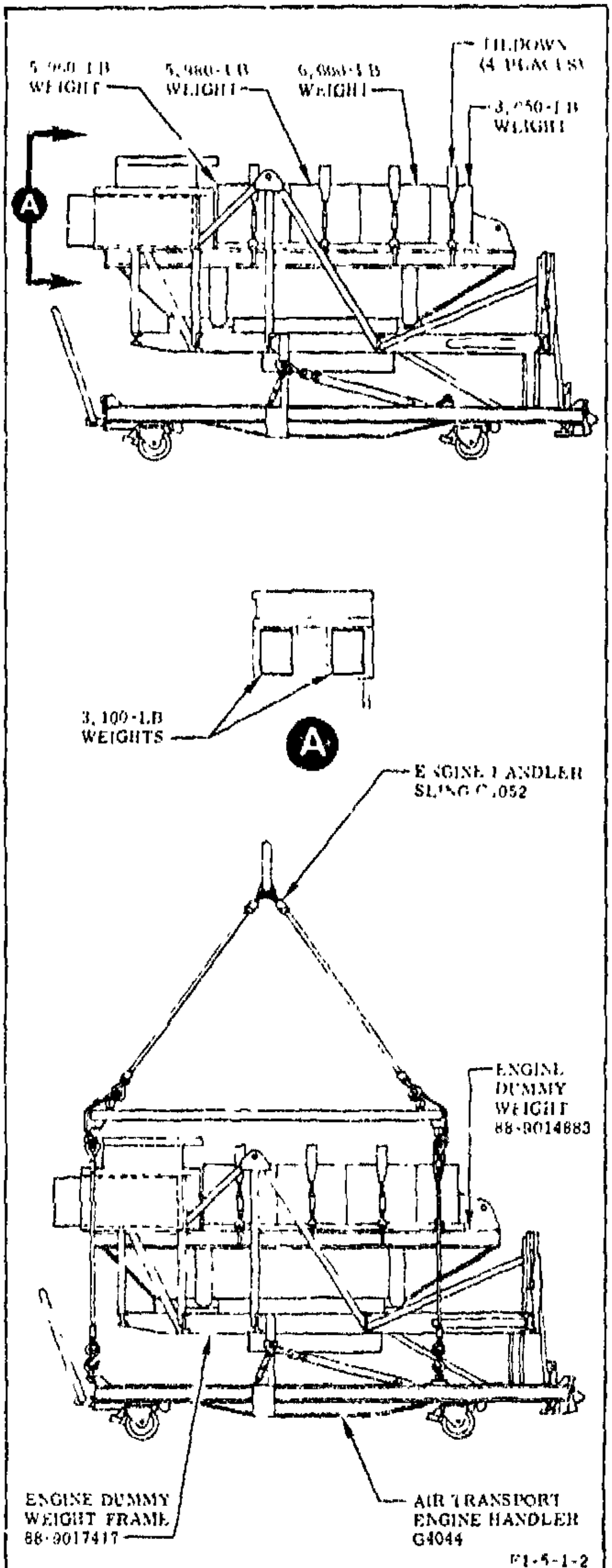


Figure 16-4. Recommended Proof-Test Setup for Air Transport Engine Handler

l. Place left-hand strut (47) into block (20) and attach strut to handler with lockpin.

NOTE

The right-hand strut (19) will be installed when the test load is lowered onto the handler.

m. Make sure that wheels of handler are alined fore and aft and that brakes are unlocked.

n. Remove pin from bracket (37).

o. Using facility hoist, position test load over handler and slowly lower test load until plug (25) is properly inserted into its mating socket in bracket (37).

p. Install pin into bracket (37) through plug (25) to secure truss to handler. Torque pin to 20-40 in-lb.

q. Insert lockpin into plug (25).

r. Place right-hand strut (19) into socket support block (20); hold right-hand strut (19) and left-hand strut (47) in vertical position.

s. Using facility hoist, slowly lower test load until right-hand block (17) and left-hand block (46) are firmly mated with right-hand strut (19) and left-hand strut (47). Maintain tension on sling.

t. Adjust length of struts (18), as required; then attach forward end of struts to right-hand block (17) and left-hand block (46) with lockpins.

u. Using facility hoist, slowly lower test load until entire weight of test load is firmly resting on struts. Do not remove sling.

v. Attach turnbuckles (16) to right-hand block (17), left-hand block (46), and to upper attach point on handler. Torque turnbuckles to 60-70 ft-lb.

w. Torque jamnuts on struts (18) to 75-100 ft-lb.

x. Torque jamnuts on turnbuckles (16) to 340-460 in-lb.

y. Slowly lower facility hoist until tension is relieved on test load sling.

z. After 3 minutes, inspect all parts of air transport engine handler for any distortion, weld cracks, or yielding.

aa. Using facility hoist, lift test load until weight of test load is imposed on hoist. (See figure 16-4.)

CAUTION

Struts (18) must not be loosened or adjusted, since damage to the load compensator spring on truss (21) can result.

ab. Loosen turnbuckles; remove pins from upper attach point on handler.

ac. Using facility hoist, slowly lift test load until right-hand block (17) and left-hand block (46) are disengaged from right-hand strut (19) and left-hand strut (47).

ad. Remove right-hand strut (19). Remove lockpin; then remove left-hand strut (47).

ae. Move blocks (20) to BLOCK LOCATION ENGINE LOWERED (forward position).

af. Using facility hoist, slowly lower test load until right-hand block (17) and left-hand block (46) are firmly mated with blocks (20).

ag. Attach turnbuckles (16) to lower attach point on handler, with pins. Torque turnbuckles to 60-70 ft-lb.

ah. Using facility hoist, slowly lower test load until entire weight of test load rests on handler.

ai. Torque jamnut on turnbuckles (16) to 340-460 in-lb.

aj. Slowly lower facility hoist until tension is relieved on test load sling; remove sling.

ak. After 3 minutes, inspect all parts of air transport engine handler for any distortion, weld cracks, or yielding.

CAUTION

In step al, the eyebolts of the lift rings must have full thread engagement since partial thread engagement can result in damage to equipment.

al. Using facility hoist, lift Engine Handler Sling G4052 and position sling over handler and test load. Remove the 2 rings (10) and replace with adapters (11). Store rings on handler, and connect sling to lift rings on handler. Make sure that eyebolts of lift rings have full thread engagement and are positioned so that lift ring is in line of lift before connecting sling.

am. Using facility hoist, slowly lift loaded handler 6 inches from floor level.

an. After 3 minutes, inspect all parts of air transport engine handler for distortion, weld cracks, or yielding.

ao. Slowly lower facility hoist until handler rests on floor.

ap. Inspect all parts of air transport engine handler for any distortion, weld cracks, or yielding.

aq. Disconnect Engine Handler Sling G4052 from handler and use facility hoist to lower handler sling.

ar. Using facility hoist, lift test load sling and position sling over test load. Connect sling to test load.

as. Using facility hoist, slowly lift test load until weight of test load is imposed on hoist.

CAUTION

Drag braces (18) must not be loosened or adjusted, since damage to the load compensator spring on truss (21) can result.

at. Loosen turnbuckles (16), and remove pins from lower attach point on handler.

CAUTION

The engine must not be raised higher than 15 inches while truss (21) is secured to bracket (37), since damage to the engine and equipment can result.

au. Using facility hoist, slowly raise front end of test weight approximately 15 inches (measured at block (20) and right-hand block (17).

av. Remove lockpin from plug (25), and remove pin from bracket (37).

aw. Using facility crane, slowly lift test load from handler. Position test load at a convenient level so that truss, yokes, and support blocks can be easily removed.

ax. Remove truss, yokes, and support blocks from test load and store on handler.

ay. Inspect all parts of air transport engine handler for distortion, weld cracks, or yielding.

az. Remove existing proof load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate including new inspection date. Install new plate where old plate was removed.

16-14. DISASSEMBLING. (See figure 16-5.) Disassemble air transport engine handler, as required, to accomplish necessary repairs or replacement.

16-15. ASSEMBLING. (See figure 16-5.) The following steps include the special instructions required during assembly:

a. Torque nut of latch (3) to 24-30 in-lb.

b. Torque nuts of platform (8) to 32-80 in-lb.

c. Torque nuts of bracket (9) to 62-80 in-lb.

d. Torque nuts of adapter (12) to 160-210 in-lb.

e. Torque nuts of adapter (13) to 95-110 in-lb.

f. Torque screws of yoke (22) to 72-90 in-lb.

g. Tighten nut of plug (25) fingertight.

h. Torque capscrews of cap (26) to 11-17 in-lb.

i. Apply corrosion preventative RB0210-016 (Rocketdyne) to all surfaces of items (26 through 31) contained within tube (30).

j. Tighten nut (28) to eliminate free movement of rod (31).

k. Torque mounting bolts of tube (30) to 70-90 in-lb.

l. Torque bolts of bell crank (32) and (33) to 25-30 in-lb.

m. Torque nut (36) to 40-50 in-lb.

n. Torque nuts of bracket (37) to 700-900 in-lb.

o. Torque nuts of bracket (38) to 400-530 in-lb.

p. Torque mounting bolts of caster (39) to 700-900 in-lb.

q. Tighten nut of kingpin and nut of axle of caster rig (40) until all play is removed; then loosen 1/4 to 1/2 turn.

r. Torque nuts of bracket (42) to 110-130 in-lb.

s. Torque nuts of brake (43) to 110-130 in-lb.

t. Torque nuts of bracket (44) to 400-530 in-lb.

u. Adjust tie rod (7) to obtain ±0.25 inch caster toe-in. Overall caster toe-in is ±0.50 inch.

16-16. SERVICING. Servicing the air transport engine handler consists of lubricating, applying corrosion preventative, and packing caster bearings, as specified. Refer to section I for lubrication procedures (methods).

a. Lubricate (Method X) air transport engine handler with gear grease (MIL-G-23827) at 6-month intervals. See decal attached to front of handler for location of lubrication points.

b. Apply corrosion preventative RB0210-016 (Rocketdyne) to void areas in preservative of machined areas of right-hand block (17) and left-hand block (46) at 6-month intervals.

c. Pack (Method Y) bearings of caster rig (40) and wheel (41) with gear grease (MIL-G-23827) at 12-month intervals.

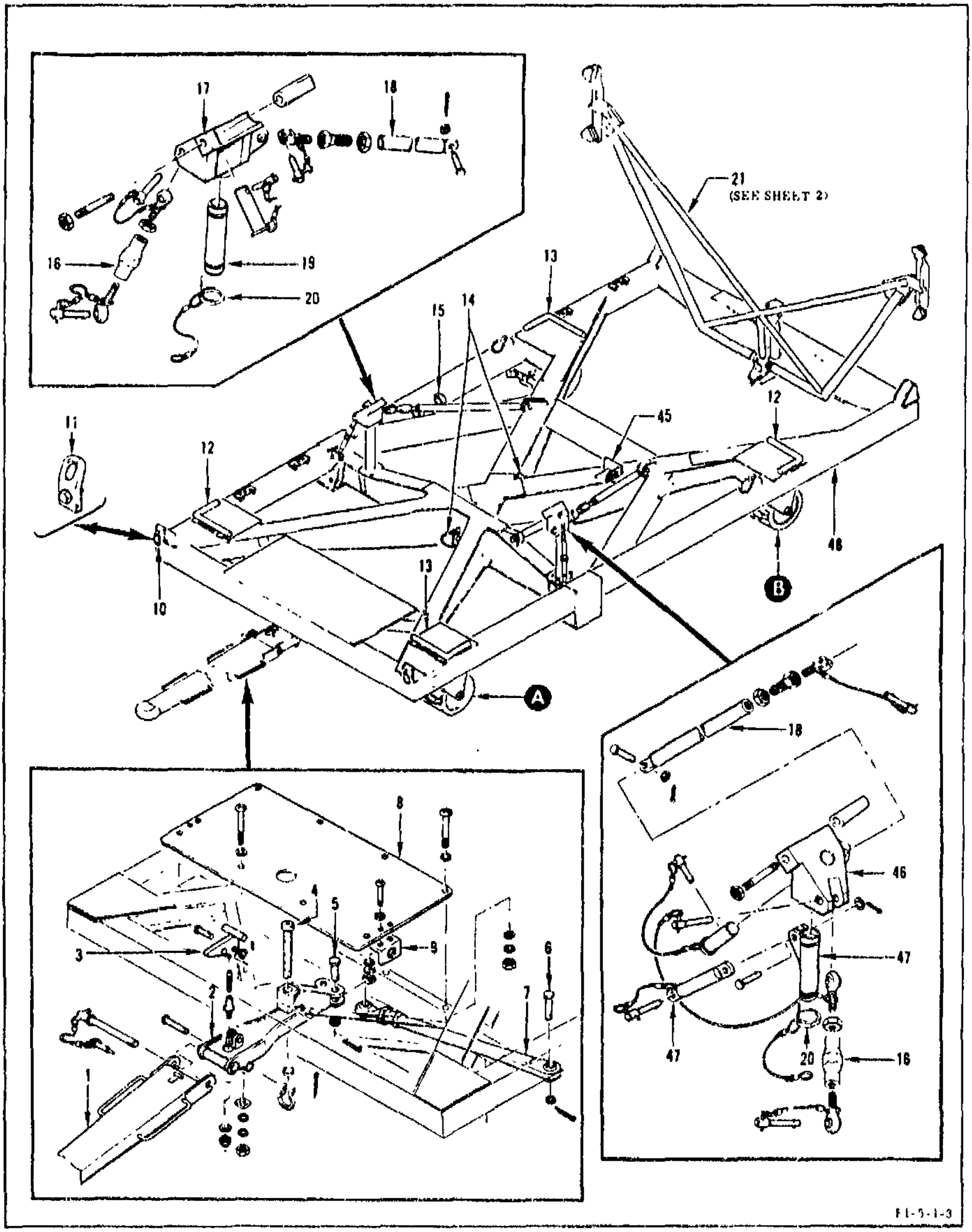


Figure 16-5. Air Transport Engine Handler (Sheet 1 of 5)

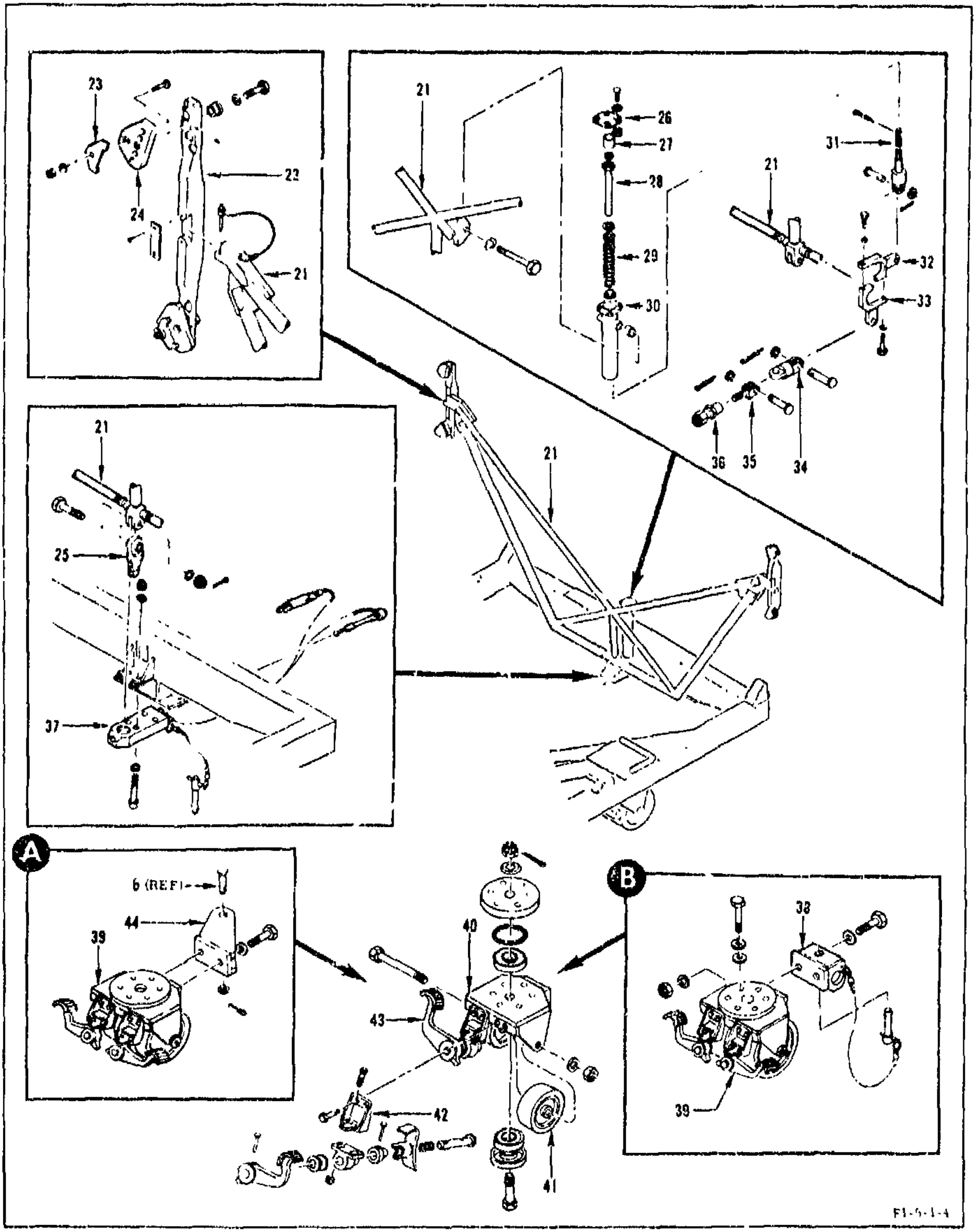


Figure 16-5. Air Transport Engine Handler (Sheet 2 of 5)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	9017356	Drawbar (F-2)	13	9017354-2	Adapter (F-3)
	50249-92	Pin (F-3)		NAS679A6	Nut (F-3)
	28-2-G	Sleeve (F-3)		LD153-0010-0013	Washer (F-3)
	RD191-2002-1318	Cable (M-3)		NAS1100-6-18	Screw (front) (F-3)
2	9017362	Tongue (F-3)		NAS1100-6-32	Screw (rear) (F-3)
3	9017363	Latch (F-3)	14	9017355	Pin (F-3)
	MS24665-283	Pin (F-3)		50603C4R13	Pin (F-3)
	LD153-0010-0014	Washer (F-3)		28-2-G	Sleeve (F-3)
	MD20392-5C45	Pin (F-3)		RD191-2002-1312	Cable (M-3)
	NAS679A3W	Nut (F-3)		28-6-X	Sleeve (F-3)
	LD153-0010-0007	Washer (F-3)		RD191-2002-1314	Cable (M-3)
	AN42B-C44	Bolt (F-3)		RD191-2002-1330	Cable (M-3)
	MS171494	Pin (F-3)	15	50603C4T36	Pin (F-3)
	LE-055D-4SS	Spring (F-3)		28-2-G	Sleeve (F-3)
4	9017360	Pin (F-3)		RD191-2002-1312	Cable (M-3)
	MS15001-0	Fitting (F-3)	16	9017391-11	Turnbuckle (F-1)
	MS24665-380	Pin (F-3)		9017394	Eye (F-2)
	G-213-7/8	Shackle and pin (F-3)		9019500	Nut (F-3)
				9017393	Eye (F-2)
	9017364	Washer (F-3)		9017392-3	Body (F-3)
5	MS20392-11C85	Pin (F-3)		BLS14GT27	Pin (F-3)
	MS24665-443	Pin (F-3)		28-2-G	Sleeve (F-3)
	LD153-0010-0026	Washer (F-3)		RD191-2002-1314	Cable (M-3)
6	MS20392-11C83	Pin (F-3)	17	9017365-2	Right-hand block (F-1)
	MS24665-442	Pin (F-3)			
	LD153-0010-0025	Washer (F-3)		9017366-2	Block (F-2)
7	9017357	Tie rod (F-1)		9017367	Pin (F-3)
	9017358	Tie rod (X-3)		RD114-1004-0007	Nut (F-3)
	ARY-14CRAF	Bearing (F-3)		9017369	Screw (F-3)
	AN316-14	Nut (F-3)		9017368	Wedge (F-3)
	ASBY-14-CRAX	Bearing (D-3)		BLS4GT21	Pin (F-3)
	MS15001-1	Fitting (F-3)		28-2-G	Sleeve (F-3)
8	9017353-3	Platform (M-2)		RD191-2002-1318	Cable (M-3)
	MS51967-7	Nut (F-3)	18	9017396	Strut (F-1)
	MS35337-65	Washer (F-3)		9017397	Strut (F-2)
	LD153-0010-0013	Washer (F-3)		MS24665-443	Pin (F-3)
	NAS1099-6	Washer (F-3)		LD153-0010-0026	Washer (F-3)
	MS35206-315	Screw (F-3)		MS20392-11C83	Pin (F-3)
	MS35206-314	Screw (F-3)		9017398	Clevis (F-3)
	RD153-0113-0094	Washer (F-3)		9017399	Screw (F-3)
9	9027043	Bracket (F-3)		LD114-0005-0017	Nut (F-3)
	RD153-0113-0094	Washer (F-3)		BLS14GT27	Pin (F-3)
	LD153-0010-0013	Washer (F-3)		28-2-G	Sleeve (F-3)
	MS35337-65	Washer (F-3)		RD191-2002-1314	Cable (M-3)
	MS35206-314	Screw (F-3)	19	9017395	Right-hand strut (F-3)
	MS51967-7	Nut (F-3)			
10	5016	Ring (F-3)	20	9017411	Block (F-1)
11	9027040	Adapter (F-1)		MS171532	Pin (F-3)
	9027041	Adapter (F-3)		28-2-G	Sleeve (F-3)
	9027042	Bolt (F-3)		RD191-2002-1314	Cable (M-3)
	MS171667	Pin (F-3)	21	9024731-21	Truss (F-1)
12	9017354-1	Adapter (F-3)		9024732	Truss (F-3)

Figure 16-5. Air Transport Engine Handler (Sheet 3 of 5)

Index No.	Part No.	Description
21 (cont)	BLS4B10SC10	Pin (F-3)
	28-1-C	Sleeve (F-3)
	RD191-2002-1212	Cable (M-3)
22	9024744-11	Left-hand yoke (F-1)
	9024744-12	Right-hand yoke (F-1)
	9024733-1	Left-hand yoke (F-3)
	9024733-2	Right-hand yoke (F-3)
	9024736	Bolt (F-3)
	LD153-0010-0022	Washer (F-3)
	28712N-4F-6	Setscrew (F-3)
	9024735	Bushing (top) (F-3)
	9024734	Cam (bottom) (F-3)
	MS171536	Pin (F-3)
	9024745	Retainer (F-3)
	NAS1189-4T10	Screw (F-3)
23	9024739	Block (F-3)
	MS20500-720	Nut (F-3)
	LD153-0010-0016	Washer (F-3)
	RD111-1010-6730	Bolt (F-3)
24	9024737	Clamp (F-1)
	9024738	Fitting (F-3)
	9024740	Stud (F-3)
	9024742	Bushing (F-3)
	MS171528	Pin (F-3)
	9024741	Stud (F-3)
	9024743	Cam (F-3)
	28712N-4F-6	Setscrew (F-3)
25	9017386-11	Plug (F-2)
	MS24665-373	Pin (F-3)
	AN320-12	Nut (F-3)
	LD153-0010-0024	Washer (F-3)
	NAS1112-36D	Bolt (F-3)
26	9017373	Cap (M-3)
	AN520-10R12	Screw (F-3)
	AN961-10	Washer (F-3)
	NAS679A3W	Nut (F-3)
27	9017376	Tube (M-3)
	MS24665-300	Pin (F-3)
	LD153-0011-0022	Washer (F-3)
28	9025009	Nut (F-3)
29	9017374	Spring (F-3)
	9017377-3	Collar (F-3)
	9017378	Collar (F-3)
30	9017373	Tube (F-3)
	AN101309	Bolt (F-3)
	LD153-0011-0018	Washer (F-3)
	9017361	Spacer (M-3)
31	9025010	Rod (F-3)
	MS24665-300	Pin (F-3)
	LD153-0011-0017	Washer (F-3)
	MS20392-5C19	Pin (F-3)
32	9024746	Bell crank (F-3)
33	9024747	Bell crank (F-2)
	NAS1223-3L	Bolt (F-3)
	AN961-10	Washer (F-3)
34	9017383	Link (F-2)
35	9017415-11	Clevis (F-3)
	MS24665-161	Pin (F-3)
	AN961-416	Washer (F-3)
	MS20392-3C33	Pin (F-3)
36	9017416	Nut (F-3)
37	9017403-11	Bracket (F-1)
	9017404-3	Bracket (F-3)
	RD114-8001-0010	Nut (F-3)
	LD153-0010-0022	Washer (F-3)
	RD111-1016-1046	Bolt (F-3)
	LD153-0013-0008	Washer (F-3)
	BLC6GT24	Pin (F-3)
	28-1-C	Sleeve (F-3)
	RD191-2002-1218	Cable (M-3)
	9017405-3	Pin (F-3)
	9017407	Pin (F-3)
	MS171525	Pin (F-3)
	9017408	Pin (F-3)
	28-1-C	Sleeve (F-3)
	28-3-M	Sleeve (F-3)
	RD191-2002-1230	Cable (M-3)
38	9017410	Bracket (F-3)
	RD114-8001-0008	Nut (F-3)
	LD153-0010-0018	Washer (F-3)
	NAS1008-20A	Bolt (F-3)
	LD153-0013-0008	Washer (F-3)
	BLC12GT31	Pin (F-3)
	28-2-G	Sleeve (F-3)
39	12654	Caster (F-1)
	NAS1230-17	Bolt (F-3)
	NAS1230-7	Bolt (F-3)
	LD153-0010-0021	Washer (F-3)
	LD153-0013-0008	Washer (F-3)
40	23108	Caster rig (F-2)
	34124	Horn (F-2)
	36090-1	Baseplate (F-2)
	MS150465	Ball bearing (F-2)
	LM67048	Cone (F-2)
	LM67010	Cup (F-2)
	AS330-2012	Nut (F-3)
	MS24665-359	Pin (F-3)
	11011-12	Retainer (F-2)
	6230-11	O-ring (F-2)
	5033	Fitting (F-3)
	6230-50	O-ring (F-2)

Figure 16-5. Air Transport Engine Handler (Sheet 4 of 5)

Index No.	Part No.	Description	Index No.	Part No.	Description
40	51443-146	Axle (F-2)		LD153-0010-0018	Washer (F-3)
(cont)	AS364-2012	Nut (F-2)		NAS1003-20A	Bolt (F-3)
41	EHD12-T-10	Wheel (F-2)		LD153-0013-0006	Washer (F-3)
	30074	Wheel (F-2)	45	9015965	Clamp (F-3)
	10034	Retainer (F-2)		AN6-12A	Bolt (F-3)
	10002Y-T30	Spacer (F-2)		NAS679A6	Nut (F-3)
	6227-23	O-ring (F-2)		LD153-0010-0014	Washer (F-3)
	3188	Cone (F-2)		MS35489-114	Grommet (F-3)
42	51600	Bracket (F-3)	46	9017365-1	Left-hand block (F-1)
	AS60-6-10	Screw (F-3)		9017366-1	Block (F-2)
	LD153-0011-0016	Washer (F-3)		9017367	Pin (F-3)
	AS364-624	Nut (F-3)		RD114-1004-0007	Nut (F-3)
43	51765R	Brake (F-1)		9017369	Screw (F-3)
	51765L	Brake (F-1)		9017368	Wedge (F-3)
	AS60-6-16	Screw (F-3)		BLS4GT21	Pin (F-3)
	LD153-0011-0016	Washer (F-3)		28-2-G	Sleeve (F-3)
	AS364-624	Nut (F-3)		RD191-2002-1318	Cable (M-3)
	51764R	Brake (F-1)	47	9017400	Left-hand strut (F-1)
	51764L	Brake (F-1)		9017401	Strut (F-2)
	51042-2	Shoe (F-3)		9017402	Strut (F-3)
	51042-1MA	Housing (F-3)		BLS14GT27	Pin (F-3)
	51763	Pedal (F-3)		28-2-G	Sleeve (F-3)
	3/16X1-1/4LG	Roll pin (F-3)		RD101-2002-1314	Cable (M-3)
	51042-7	Shaft (F-3)		MS24665-441	Pin (F-3)
	51042-4	Cam (F-3)		LD153-0011-0030	Washer (F-3)
	11761-4	Spring (F-3)		MS20392-11C87	Pin (F-3)
	AN960-1216	Washer (F-3)	48	902[illegible]50-231	Chassis (X-2)
	3/16X1-1/8LG	Roll pin (F-3)		TA[illegible]85-14	Holder (F-3)
44	9017359	Bracket (F-3)		RD171-1032-0001	Plate (F-3)
	RD114-8001-0008	Nut (F-3)			

Figure 16-5. Air Transport Engine Handler (Sheet 5 of 5)

16-17. SHIPPING AND STORING.

16-18. The air transport engine handler is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping instructions. Prepare air transport engine handler for shipping or storing in accordance with MIL-P-116, Method III, and as follows: (See figure 16-5.)

a. Disconnect drawbar (1) and store on forward end of handler chassis (48).

b. Disconnect turnbuckles (16) from upper attach points on handler chassis (maintenance position).

c. Move blocks (20) to BLOCK LOCATION ENGINE LOWERED (forward position) on handler chassis.

d. Remove right-hand strut (19).

e. Lower right-hand block (17) onto block (20).

f. Disconnect and remove left-hand strut (47).

g. Lower left-hand block (46) onto block (20).

h. Connect turnbuckles (16) to lower attach points on handler chassis (shipping position). Hand-tighten turnbuckles.

i. Stow right-hand strut (19) and left-hand strut (47).

j. Make sure that yokes (22), blocks (23), and clamps (24) are properly stored on handler chassis.

k. Store truss on handler chassis, making sure that plug (25) and clevis (35) are inserted into grommets on bracket (44).

l. Inspect all hardware of engine handler for completeness and all lockpins for full engagement.

m. Secure Engine Cover G4047 to engine handler. (Refer to paragraph 16-30 for shipping and storing procedures for engine cover.)

n. Position air transport engine handler on truck/trailer with handler resting on its wheels, and unlock wheel brakes.

NOTE

The air transport engine handlers may be stacked one on top of another with the wheels of the top handler resting on stacking adapters (12, 13) on the frame.

16-19. ENGINE COVER G4047.

16-20. DESCRIPTION.

16-21. The engine cover consists of a lightweight frame, a fabric cover, and a container. The frame is constructed of all welded-aluminum tubing and is made in two parts. The top frame has a front and rear padded support, with minor adjustments on the front support and tiedown straps on the rear of the frame. The bottom frame has two padded supports with tiedown straps. The cover is tailored from a waterproof fabric, equipped with straps and zippers, and is made in two parts. Due to differences in manufacturers' installation of zippers on covers, the upper and lower covers must be retained as a set. For future procurement and rework of covers, the upper and lower covers have the same serial number. The container is a bag made of the same material as the cover. The container measures 36 by 72 inches and has a drawstring closure.

16-22. OPERATION.

16-23. The engine cover is used to completely enclose the engine during transportation and storage. The tubular frame is attached to the engine and provides a support for the fabric cover. The cover is positioned around the engine and frame and secured with straps and zippers. The container is used to store the cover when not installed on the engine.

16-24. MAINTENANCE.

16-25. Maintenance of the engine cover consists of disassembling, assembling, repairing, and shipping and storing. Clean engine cover as outlined in section I.

16-26. DISASSEMBLING. Disassemble engine cover as required to accomplish necessary repair or replacement. (See figure 16-6 for index and part numbers.)

16-27. ASSEMBLING. There are no special instructions for assembly. (See figure 16-6 for index and part numbers.)

16-28. REPAIRING. Repair tears and holes (a maximum of 6 inches in length and 6 inches in diameter), using nylon waterproof cloth (MIL-C-20696, Type II, Class III), color 34087 (Federal Standard 595), extending 1-1/2 inches around perimeter of tear or hole, and adhesive EC1099 (Minnesota Mining and Mfg). The cover must be replaced if a seam is damaged.

16-29. SHIPPING AND STORING.

16-30. The engine cover is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping information. Prepare engine cover for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, 00, 00, 0, RK392-600001, and as follows: (See figure 16-6.)

a. Disconnect bottom frame (28) from top frame (27). Store attaching pins.

CAUTION

Straps (8, 9, 21, 22) of the engine cover must not be used to attach the frame to the crate since damage to straps can occur during shipment.

b. Invert top frame and secure on shipping crate with metal straps. Use adequate padding between frame and crate to prevent damage.

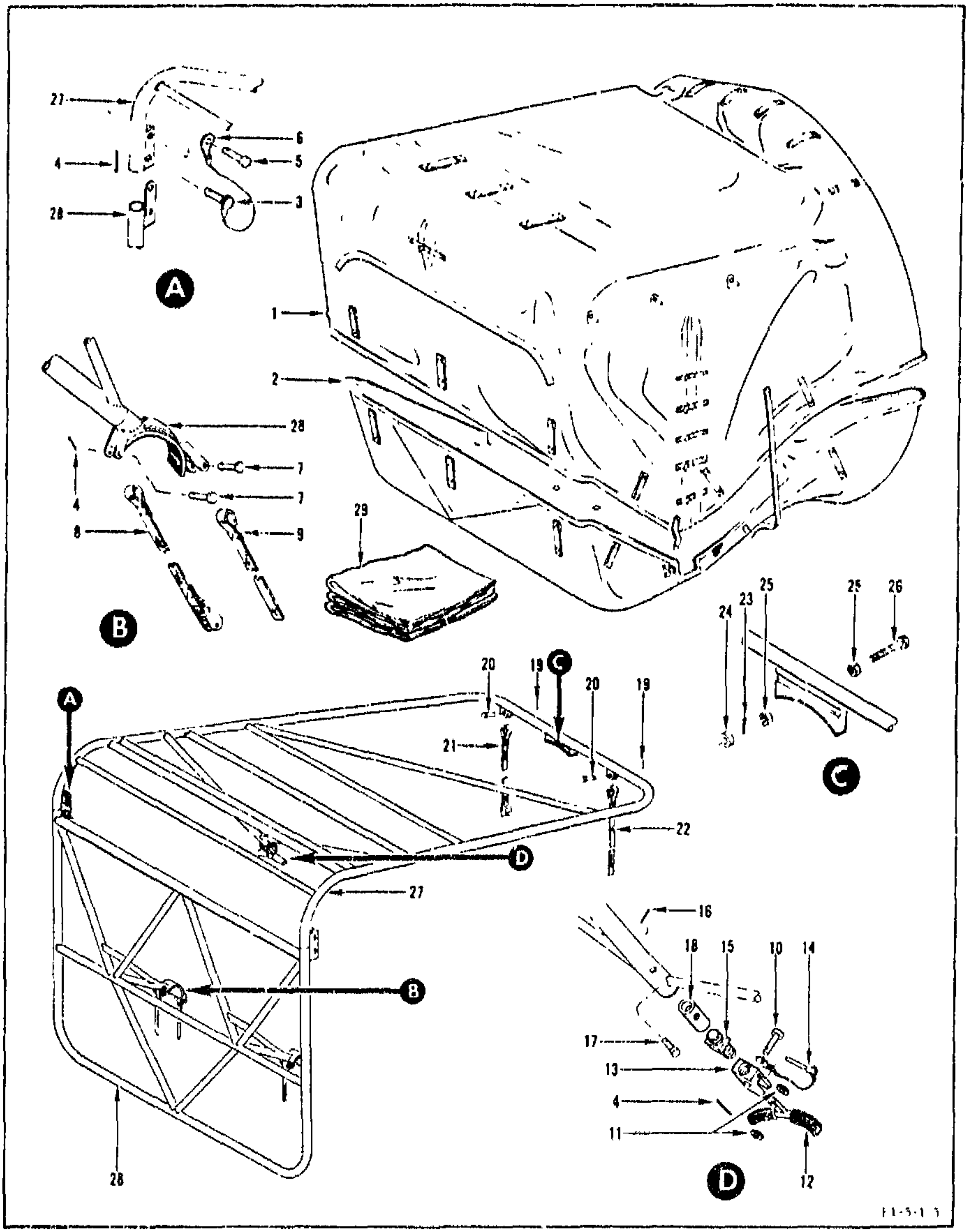


Figure 16-6. Engine Cover (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	19-9020243-11	Top cover (X-2)	15	9020230	Screw (D-3)
	19-9026906-11[a]	Top cover (X-2)	16	MS24665-132	Pin (F-3)
2	19-9020243-21	Bottom cover (X-2)	17	MS20392-3C97	Pin (F-3)
	19-9026906-21[a]	Bottom cover (X-2)	18	9020232	Insert (D 3)
3	NAS1337-S3S12F	Pin (F-3)	19	MS24665-281	Pin (F-3)
	RD191-2002-1206	Cable (F-3)	20	MS20392-4C69	Pin (F-3)
	28-3-M	Sleeve (F-3)	21	NAS1213P15K12	Strap (F-3)
4	MS24665-283	Pin (F-3)	22	NAS1212P15JK70	Strap (F-3)
5	MS20392-6C41	Pin (F-3)	23	MS24665-71	Pin (F-3)
6	RD191-4001-0004	Lug (D-3)		MS24665-285[a]	Pin (F-3)
7	MS20392-4C75	Pin (F-3)	24	9020234	Pad (D-3)
	MS24665-281	Pin (F-3)		9020234-3[a]	Pad (D-3)
8	NAS1213P15K6	Strap (F-3)	25	NAS679A6	Nut (F-3)
9	NAS1212P15JK40	Strap (F-3)	26	NAS566-51	Bolt (F-3)
10	MS20392-7C73	Pin (F-3)		9026904[a]	Bolt (F-3)
	MS24665-283	Pin (F-3)	27	9020229	Top frame (X-2)
11	NAS43HT8-8	Spacer (F-3)	28	9015959	Bottom frame (X-2)
12	9020231	Support (F-2)		9015959-11[a]	Bottom frame (X-2)
13	9020226	Connector (D-3)	29	19-9020243-31[b]	Container (X-2)
14	NAS1333-S6S19D	Pin (F-3)		19-9026906-31[a,b]	Container (X-2)
	RD191-2002-1212	Cable (F-3)			
	28-3-M	Sleeve (F-3)			

(a) Units incorporating MD2 change.
(b) Units stored in Rocketdyne GFP stores.

Figure 16-6. Engine Cover (Sheet 2 of 2)

CAUTION

Padded supports on the bottom frame must be facing up to prevent damage to supports.

c. Invert bottom frame and secure to top frame. Use adequate padding between frames to prevent damage.

d. Store matching or serialized engine covers (1, 2) in a suitable container.

e. Secure container to shipping crate.

16-31. THRUST CHAMBER PROTECTIVE COVER G4048.

16-32. DESCRIPTION.

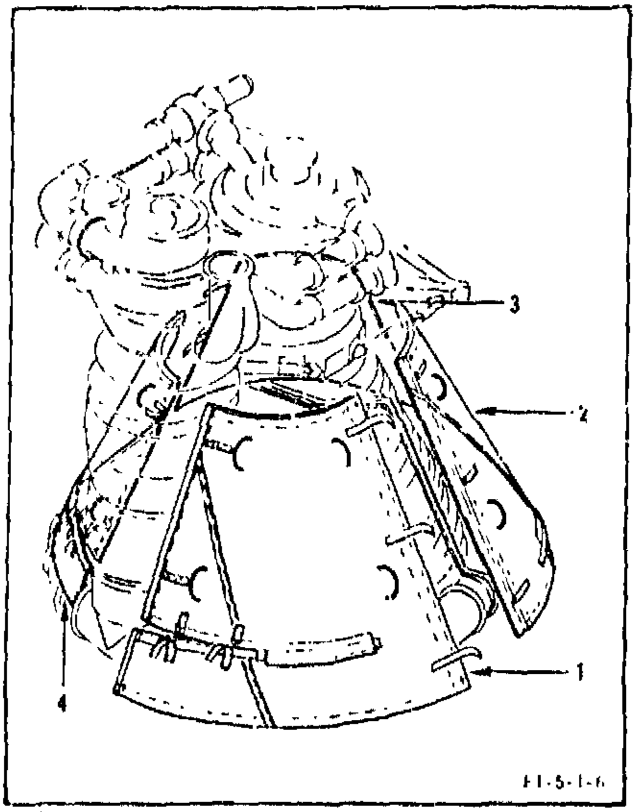
16-33. The thrust chamber protective cover consists of four separate sections, each of which is designed to cover a specific quarter section of the thrust chamber. (See figure 16-7.) Each section is constructed of a hard outer shell and a protective inner padding that rests against the thrust chamber tubes. When installed on the thrust chamber, the cover sections are secured together with straps and buckles.

16-34. OPERATION.

16-35. The thrust chamber protective cover is a molded shell contoured to fit the lower portion of the thrust chamber. The cover protects the exposed fuel tubes from possible damage during maintenance and shipping.

16-36. MAINTENANCE.

16-37. There are no special maintenance instructions for the thrust chamber protective cover. Clean cover as outlined in section I. (See figure 16-7 for index and part numbers.)



Index No.	Part No.	Description
1	9021622	Pad (X-1)
2	9021623	Pad (X-1)
3	9020239	Pad (X-1)
4	9021550	Pad (X-1)

Figure 16-7. Thrust Chamber Protective Cover

16-38. SHIPPING AND STORING.

16-39. The thrust chamber protective cover is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping information. Prepare thrust chamber protective cover for shipping or storing in accordance with MIL-P-116, Method III.

16-40. ROADABLE VERTICAL ENGINE DOLLY G4051.

16-41. DESCRIPTION.

16-42. The roadable vertical engine dolly consists of a flat-bed chassis mounted on six 21-inch cushion-tread wheels. Four wheels with parking brakes are located at the rear of the dolly and two wheels are located at the front. A tow bar and steering linkage is attached to the front of the dolly. Four cable assemblies are also included to tie down the engine to the dolly. (See figure 16-8 for leading particulars.)

Height	28 inches
Width	140 inches
Length	180 inches
Weight	6,100 pounds
Maximum load capacity	20,000 pounds
Proof load	40,000 pounds
Operating surface	Graded gravel road, or better
Maximum towing speed	10 mph
Maximum ramp angle (with engine installed)	5 degrees
Minimum turning radius	212 inches

Figure 16-8. Leading Particulars for Roadable Vertical Engine Dolly

16-43. OPERATION.

16-44. The roadable vertical engine dolly is used to support and transport the engine or nozzle extension in a vertical position for relatively short distances, such as on site, building to building, and test stand. The dolly is not designed for transporting the engine on another vehicle. The dolly accommodates the engine without the nozzle extension installed, or the nozzle extension. The engine is secured to the dolly by two rear cables attached to the turbopump mounts and two forward cables attached to the gimbal struts.

16-45. MAINTENANCE.

16-46. Maintenance of the roadable vertical engine dolly consists of proof testing, disassembling, assembling, servicing, and shipping and storing. Clean the dolly as outlined in section I.

16-47. PROOF TESTING. Proof-test roadable vertical engine dolly at 24-month intervals to weight configuration shown in figure 16-9. The proof load required for proof testing must be a minimum of 150 percent of the working load of the dolly. The proof-test interval may be extended if one of the conditions of figure 16-2 exists.

WARNING

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

a. Obtain dummy weight assembly T-5047380, dummy sling T5047381, and Kirksite weights specified in figure 16-9.

b. Connect an overhead crane and sling, having a minimum load capacity of 25 tons, to test load.

c. Lift test load high enough to position roadable vertical engine dolly underneath.

d. Position test load so that center of gravity is at aft end of dolly. Center test load between stops on dolly. Make sure test load evenly contacts dolly shock pads.

e. Lock brakes on dolly.

f. Relieve all tension on hoist and sling for 3 minutes.

g. Remove test load.

h. Inspect roadable vertical engine dolly for distortion, weld cracks, or yielding.

i. Remove existing proof load plate RD171-1032-0001, and using stencil-cutting setting of a typewriter, transfer all information to new proof load plate including new inspection date.

16-48. DISASSEMBLING. Disassemble roadable vertical engine dolly as required to accomplish necessary repair or replacement. (See figure 16-10 for index and part numbers.)

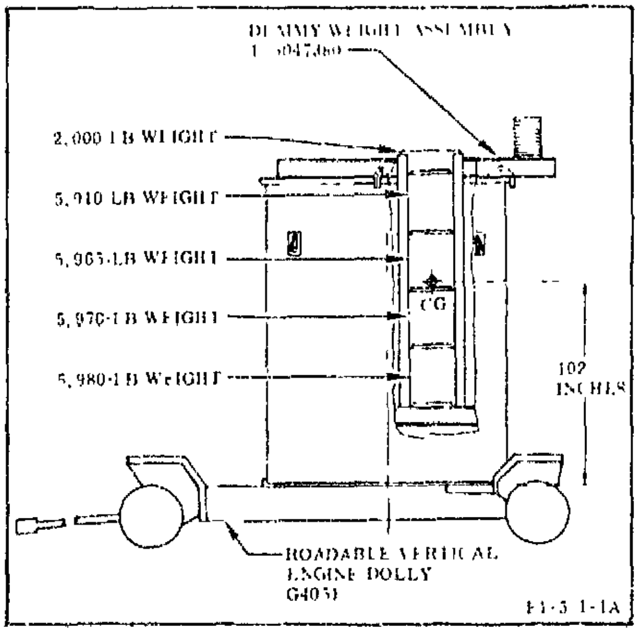


Figure 16-9. Recommended Proof-Test Setup for Roadable Vertical Engine Dolly

16-49. ASSEMBLING. (See figure 16-10.) The following steps include the special instructions required during assembly:

a. Torque rod end attaching screw of tongue (4) to 110-130 in-lb.

b. Torque screws of bracket (5) to 400-500 in-lb.

c. Torque nuts of mount (6) to 400-530 in-lb and screws of mount (6) to 200-250 in-lb.

d. Torque attaching nuts of steering arm (7) to 210-280 in-lb and rod end attaching nuts of steering arm (7) to 110-130 in-lb.

e. Tighten axle nut of wheel (8) until all play is removed; then loosen nut 1/4 to 1/2 turn.

f. Torque nut of brake (10) to 110-130 in-lb.

g. Torque all nuts of fenders (11, 12, 13, 14) to 160-210 in-lb.

h. Place one washer (16) under head of attaching bolt of platform (15).

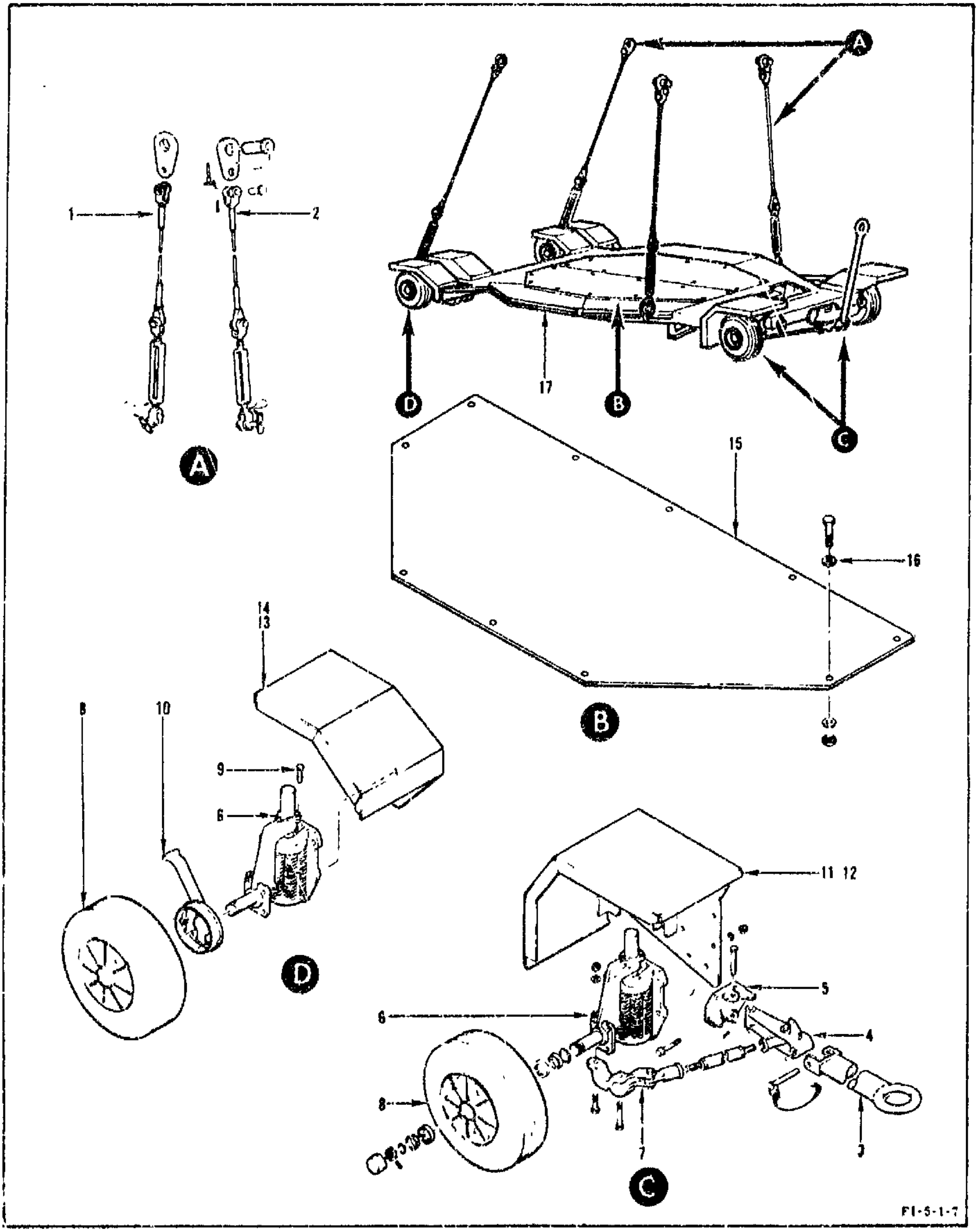


Figure 16-10. Roadable Vertical Engine Dolly (Shee' 1 of 2)

Index No.	Part No.	Description
1	9019806-11	Pump mount tiedown (F-1)
	9019807	Link (F-3)
	19-9019805-4	Cable (F-3)
	NAS1047-12P090	Turnbuckle (F-3)
	NAS1340C2C22	Pin (F-3)
	RD191-2002-1310	Cable (M-3)
	28-2-G	Sleeve (F-3)
2	9019803-11	Gimbal strut tiedown (F-1)
	9019804	Link (F-3)
	19-9019805-3	Cable (F-3)
	9017307	Pin (F-3)
	NAS1334C2C21	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1312	Cable (M-3)
	NAS1047-12P090	Turnbuckle (F-3)
	NAS1340C2C22	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1310	Cable (F-3)
3	82106-49	Towbar (F-1)
	701-350	Towbar (F-3)
	51696	Pin (F-3)
4	51963	Tongue (F-1)
	52213-506	Pin (F-3)
	MS24665-425	Pin (F-3)
	51991-17.3	Tie rod (F-3)
	AN316-10L	Nut (F-3)
	AN316-1018	Nut (F-3)
	FR-10	Rod end (F-3)
	50147-272	Reducer (F-3)
	AS60-6-26	Screw (F-3)
	MS15795-215	Washer (F-3)
	MS20364-624C	Nut (F-3)
5	52331	Bracket (F-1)
	NAS1351-10-24	Screw (F-3)
	LD153-0010-0014	Washer (F-3)
6	82172	Mount (F-1)
	MS20008-28	Bolt (F-3)
	RD114-8001-0008	Nut (F-3)
	MS20002C8	Washer (F-3)
	NAS1351-8-32	Screw (F-3)
7	52005-1	Steering arm (F-1)
	52005-2	Steering arm (F-1)
	AN6-15A	Bolt (F-3)
	AN6-26A	Bolt (F-3)
	AN960-616	Washer (F-3)
	MS20365-624C	Nut (F-3)
	FRL-10	Rod end (F-3)
	50147-147	Reducer (F-3)
	AS60-6-16	Screw (F-3)
	MS15795-215	Washer (F-3)
	MS20364-624C	Nut (F-3)
8	80159	Wheel (F-1)
	50308S	Seal (F-3)
	24780	Timken cone (F-3)
	24720	Timken cup (F-3)
	32119-1	Wheel (F-3)
	15245	Timken cup (F-3)
	15123	Timken cone (F-3)
	51146	Washer (F-3)
	AS320-16	Nut (F-3)
	AN380-4-7	Pin (F-3)
	50012	Hubcap (F-3)
9	51604	Pin (F-3)
10	51671-R	Brake (F-1)
	51671-L	Brake (F-1)
	AS60-6-10	Screw (F-3)
	AS364-624	Nut (F-3)
	AN960-616	Washer (F-3)
11	9021539-1	Fender (X-1)
12	9021539-2	Fender (X-1)
	LD153-0010-0014	Washer (F-3)
	AN6-10A	Bolt (F-3)
	AN6-12A	Bolt (F-3)
	AN6-15A	Bolt (F-3)
	AN6-21A	Bolt (F-3)
	NAS679A6	Nut (F-3)
13	9021548-1	Fender (X-1)
14	9021548-2	Fender (X-1)
	LD153-0010-0014	Washer (F-3)
	NAS1226-2L	Bolt (F-3)
	NAS1226-3L	Bolt (F-3)
	AN6-10A	Bolt (F-3)
	AN6-16A	Bolt (F-3)
	AN6-21A	Bolt (F-3)
	NAS679A6	Nut (F-3)
15	9021541	Platform (X-3)
	AN4-13A	Bolt (F-3)
	AN315-4	Nut (F-3)
	LD153-0010-0009	Washer (F-3)
16	RD153-0113-0048	Washer (F-3)
17	9021547	Frame (X-1)
	5016	Ring (F-3)
	RD171-1032-0001	Plate (F-3)

Figure 16-10. Roadable Vertical Engine Dolly (Sheet 2 of 2)

16-50. SERVICING. Lubricate (Method X) roadable vertical engine dolly every 6 months, and pack (Method Y) wheel bearings annually with gear grease (MIL-G-23827). Refer to section I for lubrication procedures (methods).

16-51. SHIPPING AND STORING.

16-52. Prepare roadable vertical engine dolly for shipping or storing in accordance with MIL-P-116, Method III.

16-53. ENGINE HANDLER SLING G4052.

16-54. DESCRIPTION.

16-55. The engine handler sling consists of four separator bars, eight cables, and a sling. The separator bars have a self-alining, spherical ball bearing on one end and a flange plate on the other end. The bars are connected together, forming a square, with lockpins. The cables have an eye on one end and a hook on the other end. The sling has four cables fastened to a single lift ring. The cables and sling are connected to the separator bars by shackle and lockpins. (See figure 16-11 for leading particulars.)

Height	216 inches
Width	108 inches
Weight	600 pounds (approx)
Maximum load capacity	24,000 pounds
Proof load	48,000 pounds
Maximum load capacity (stored cables)	1,000 pounds (each)
Proof load	2,000 pounds (straight pull)

Figure 16-11. Leading Particulars for Engine Handler Sling

16-56. OPERATION.

16-57. The engine handler sling, adaptable at a single point to an overhead crane, is used to lift either Air Transport Engine Handler G4044, with or without the engine installed, or the thrust chamber nozzle extension. When lifting the engine and handler or handler alone, the long cables with hooks are used. When lifting the nozzle extension, the four cables stored on the bars are used.

16-58. MAINTENANCE.

16-59. There are no special maintenance instructions for the engine handler sling, except for proof testing. (See figure 16-12 for proof testing.) Disassemble sling as required to accomplish necessary repair or replacement. (See figure 16-13 for index and part numbers.) Clean and repair engine handler sling as outlined in section I.

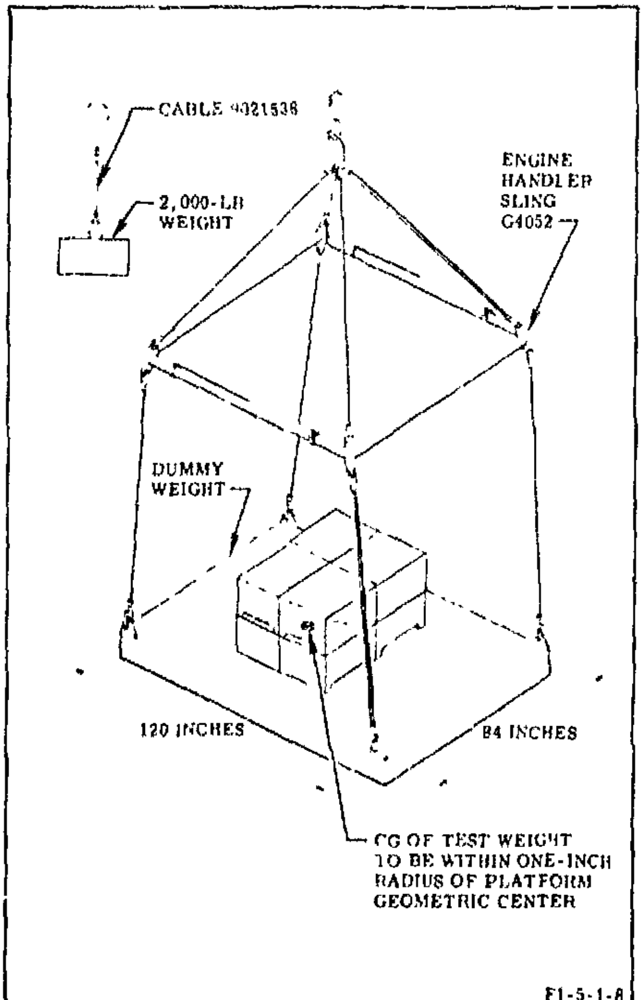
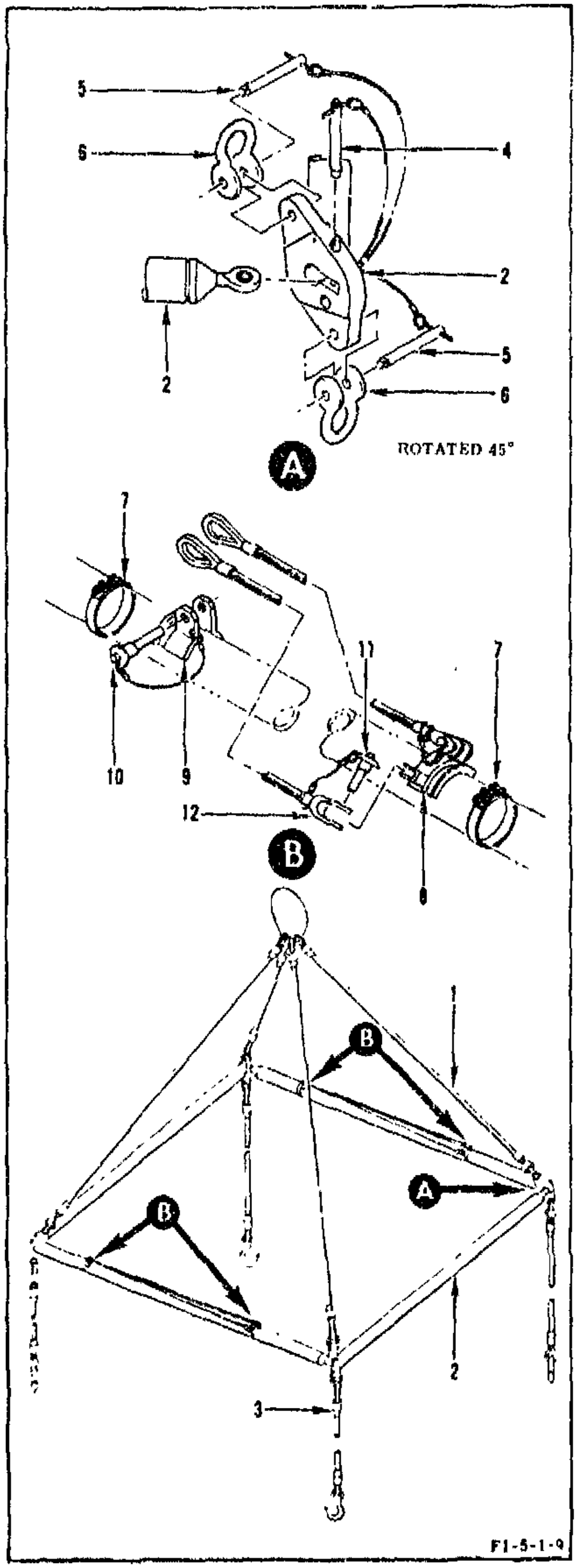


Figure 16-12. Recommended Proof-Test Setup for Engine Handler Sling



Index No.	Part No.	Description
1	19-9019476	Sling (F-3)
2	9019478	Bar (F-1)
	RD171-1032-0001	Plate (F-3)
3	19-9019477	Cable (F-3)
4	BLC12GT38	Pin (F-3)
5	BLC16GT35	Pin (F-3)
	RD191-2002-1312	Cable (F-3)
	28-2-G	Sleeve (F-3)
	RD191-4001-0005	Lug (F-3)
	AN535-4-6	Screw (F-3)
6	NAS1042-14	Shackle (F-3)
7	520C100-375-S	Clamp (F-3)
8	9021536	Retainer (F-3)
9	9021537	Retainer (F-1)
10	NAS1334C3C14D	Pin (F-3)
	RD191-2002-3310	Cable (M-3)
	28-2-G	Sleeve (F-3)
11	MS17984C1215	Pin (F-3)
	RD191-2002-1312	Wire rope (M-3)
	28-2-G	Sleeve (F-3)
12	9021538	Cable (F-1)
	RD171-4006-0002	Tag (F-3)
	RD191-2002-1308	Wire rope (M-3)
	28-2-G	Sleeve (F-3)

Figure 16-13. Engine Handler Sling

16-60. PROOF TESTING. Proof-test engine handler sling and cables 9021538 at 12-month intervals. The proof load required for proof testing must be a minimum of 150 percent of the working load of the sling. The proof-test interval may be extended if the sling is clean, packaged, and stored. If proof-test expires during storage, proof testing is mandatory before use.

WARNING

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

NOTE

Parts indexed in the following procedure are illustrated in figure 16-13.

a. Obtain a solid test load constructed to dimensions that establish center of gravity (cg) limit as shown in figure 16-12.

NOTE

If a solid test load is not available, construct a rigid structure capable of supporting 48,000 pounds (structure weight included).

b. Connect an overhead hoist that has a minimum load capacity of 25 tons to lifting eye of sling (1).

c. Check that all cables (3) are properly attached and that lockpins that secure bars (2) together are properly installed.

d. Position handler sling over test load and hook 4 cables (3) to lifting eyes of test load.

WARNING

Make sure only single test loads, as specified, are used during proof loading, since individual test loads at each cable can result in injury to personnel and damage to equipment.

e. Slowly lift test load until it clears floor, observing sling for any irregularities, and hold test load suspended for 3 minutes.

f. Lower test load to floor, and inspect sling for distortion and cables for broken strands, frays, and kinks.

g. Unhook cables (3) from test load, and secure equipment.

h. Provide a solid test load of 2,000 pounds and an overhead hoist that has a minimum load capacity of 5 tons. (See figure 16-12.)

i. Remove the 4 cables (12) from stored position on sling bars (2) and connect each cable, in turn, to hoist and test load.

j. Slowly lift test load until it clears floor, observing cable for any irregularities, and hold test load suspended for 3 minutes.

k. Lower test load to floor, and inspect cable for broken strands, frays, and kinks.

l. Install cables (12) in stored positions on sling bars, and secure equipment.

m. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

n. Remove existing proof-load tag RD171-4006-0002 and, using stencil-cutting setting of a typewriter, transfer all information to new tag, including new inspection date. Install new tag where old tag was removed.

16-61. SHIPPING AND STORING.

16-62. Prepare engine handler sling for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, 00, LK, and X.

16-63. ENGINE VERTICAL SLING G4054.

16-64. DESCRIPTION.

16-65. The engine vertical sling consists of a triangular-frame spreader bar, three cables, two links, two legs, and a lifting eye. The longest cable of the three is fastened to a plate on the spreader bar, and all three cables are centrally connected to the lifting eye. The two legs may be removed from the spreader bar and are fastened to the bar by means of lockpins. The two links are stored on the frame and when used are attached to the frame and the two short cables with lockpins. (See figure 16-14 for leading particulars.)

Height	9 feet (approx)
Triangular frame	5 by 6 feet (approx)
Weight	200 pounds (approx)
With links 19-9020237 installed	
Maximum load capacity	8,200 pounds
Proof load	16,400 pounds
Without links installed	
Maximum load capacity	20,000 pounds
Proof load	40,000 pounds

Figure 16-14. Leading Particulars for Engine Vertical Sling

16-66. OPERATION.

16-67. The engine vertical sling, supported by a facility hoist, is used to lift the thrust chamber of an engine from a vertical position. When the sling is used to lift the thrust chamber, both sling links and all three cables are used. The two links are fastened at one end to fittings on the spreader bar and at the other end to the two short cables that are attached to the lifting eye. When lifting a complete engine, the large cable attached to the plate is used without the links attached. Five attachment holes in the plate provide options for center of gravity alinement. The lifting eye is provided for lifting the sling.

16-68. MAINTENANCE.

16-69. Maintenance of the engine vertical sling consists of proof testing, disassembling, and assembling.

16-70. PROOF TESTING. Proof-test engine vertical sling at 12-month intervals using weight configuration listed in figure 16-15. The proof load required for proof testing must be a minimum of 150 percent of the working load of the sling. The proof-test interval may be extended if the sling is clean, packaged, and stored. If proof-test expires during storage, proof testing is mandatory before use.

WARNING

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

NOTE

Parts indexed in the following procedure are illustrated in figure 16-16.

a. Provide engine dummy weight frame assembly 88-9017417, engine dummy weight assembly 83-9014883, and assorted weights.

b. Remove sling links (12) and adapter (14) from stored position on frame, and connect sling links to the 2 short cables of sling cable (4) and adapter to lift plate on frame (13).

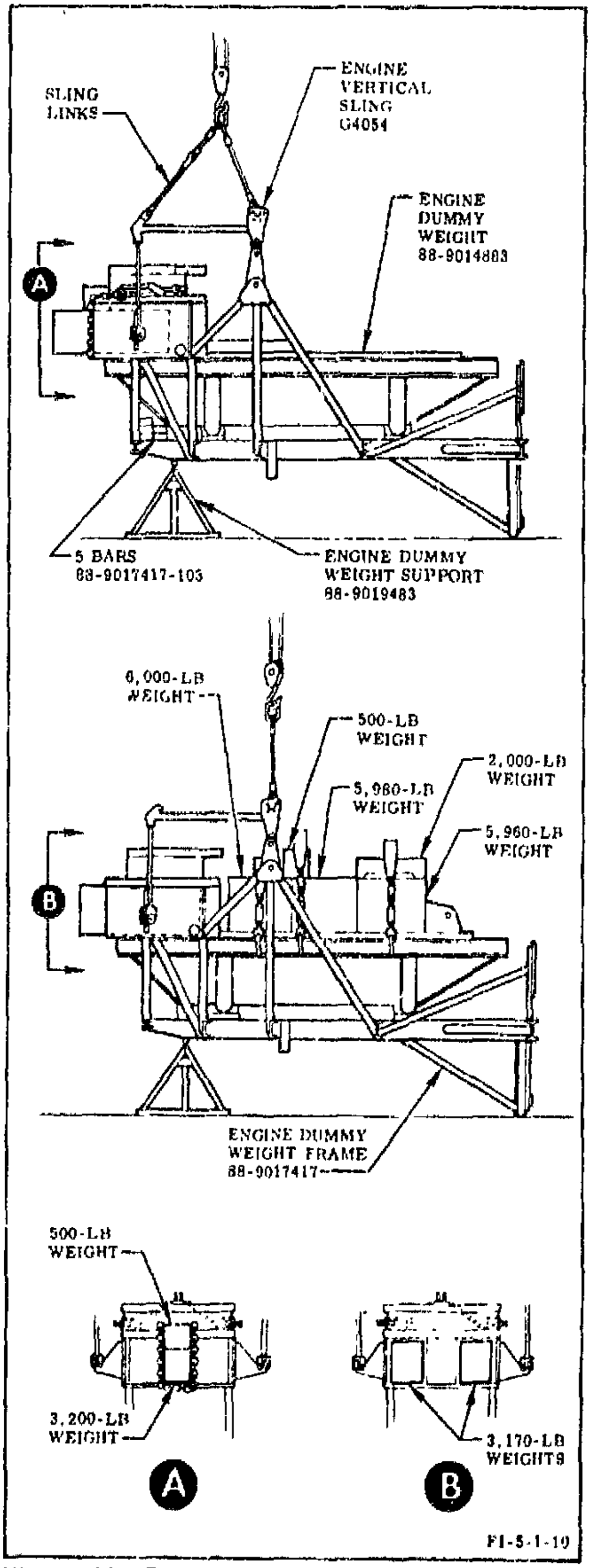


Figure 16-15. Recommended Proof-Test Setup for Engine Vertical Sling

c. Connect an overhead hoist that has a minimum load capacity of 25 tons to sling cable (4) lift eye.

d. Position sling over test load (16,400 pounds), and connect sling to the 3 attach points on test load. (See figure 16-15, test No. 1.)

e. Slowly lift test load until it clears floor, observing sling for any irregularities, and hold test load suspended for 3 minutes.

f. Lower test load to floor. Inspect sling and adapter (14) for distortion and cables for broken strands, frays, and kinks.

g. Remove sling from test load and disconnect sling links (12) and store on frame.

h. Position sling over test load (40,000 pounds), and connect sling to the 3 attach points on test load. (See figure 16-15, test No. 2.)

i. Slowly lift test load until it clears floor, observing sling for any irregularities, and hold test load suspended for 3 minutes.

j. Lower test load to floor. Inspect sling and adapter (14) for distortion and cable for broken strands, frays, and kinks.

k. Disconnect sling, and secure equipment.

l. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

16-71. DISASSEMBLING. Disassemble engine vertical sling as required to accomplish necessary repair or replacement. Clean sling, when necessary, as outlined in section I. (See figure 16-16 for index and part numbers.)

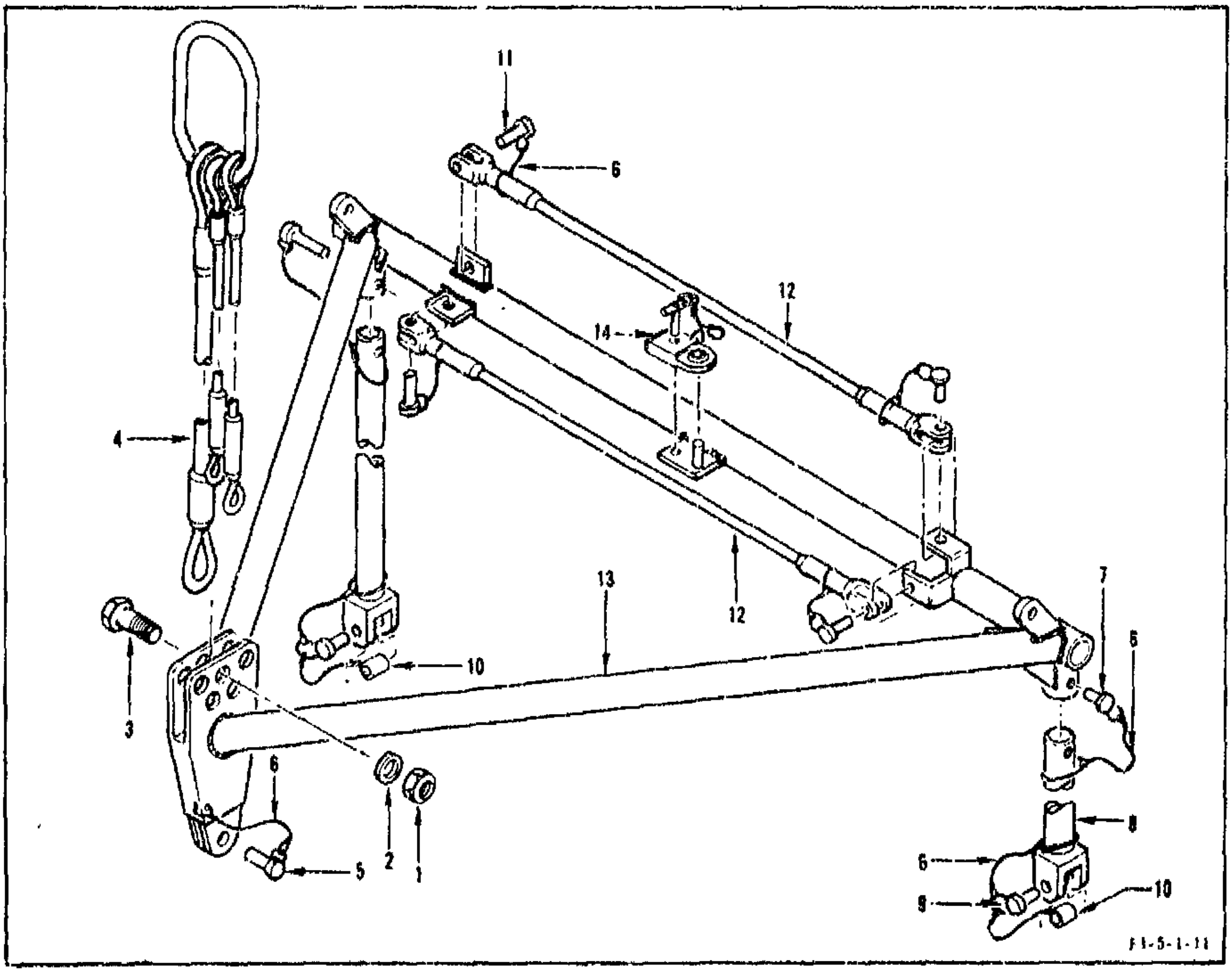


Figure 16-16. Engine Vertical Sling (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	NAS509-20	Nut (F-3)	10	9020246	Bushing (F-1)
2	MS35338-93	Washer (F-3)	11	NAS1343-C3C21F	Pin (F-3)
3	NAS1320-42	Bolt (F-3)	12	19-9020237	Sling link (F-3)
4	19-9020238	Sling cable (F-3)	13	9020235-31	Frame (F-3)
5	NAS1343-C3C22F	Pin (F-3)		RD171-1032-0001	Plate (F-3)
6	RD191-2002-1212	Cable (M-3)	14	9017823	Adapter (F-3)
	28-3-M	Sleeve (F-3)		NAS1343-C2C21	Pin (F-3)
7	NAS1338-C3C22F	Pin (F-3)		RD191-2002-1316	Wire rope (F-3)
8	9020236	Sling leg (F-3)		28-2-G	Sleeve (F-3)
9	NAS1341-C3C21F	Pin (F-3)			

Figure 16-16. Engine Vertical Sling (Sheet 2 of 2)

16-72. ASSEMBLING. (See figure 16-16.) The special instruction during assembly is to torque nut (1) to 100-120 ft-lb.

16-73. SHIPPING AND STORING.

16-74. Prepare engine vertical sling for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, 00, 00, and 0.

16-75. TURBOPUMP DOLLY G4056.

16-76. DESCRIPTION.

16-77. The turbopump dolly consists of a rectangular chassis mounted on four casters, a vertical pump mount on each side of the chassis, and a single strut at the front support. Lifting eyes and forklift guides are also included for lifting the dolly with the turbopump installed. (See figure 16-17 for leading particulars.)

Height	54 inches
Width	56 inches
Length	76 inches
Weight	500 pounds
Maximum load capacity	3,300 pounds
Proof load	5,000 pounds

Figure 16-17. Leading Particulars for Turbopump Dolly

16-78. OPERATION.

16-79. The turbopump dolly is a portable unit designed to hold the turbopump in a vertical position for buildup, maintenance, towing, and storage. The blocks are bolted to the turbopump mounting pads at the rear side of the fuel inlets and then pinned to the saddles. The strut is attached to the forward mounting lug of the turbopump to hold the pump in the vertical position.

16-80. MAINTENANCE.

16-81. Maintenance of the turbopump dolly consists of proof testing, disassembling, and assembling.

16-82. PROOF TESTING. Proof-test turbopump dolly at 24-month intervals using weight listed in figure 16-18. The proof load required for proof testing must be a minimum of 150 percent of the working load of the dolly. The proof-test interval may be extended if one of the conditions of figure 16-2 exists.

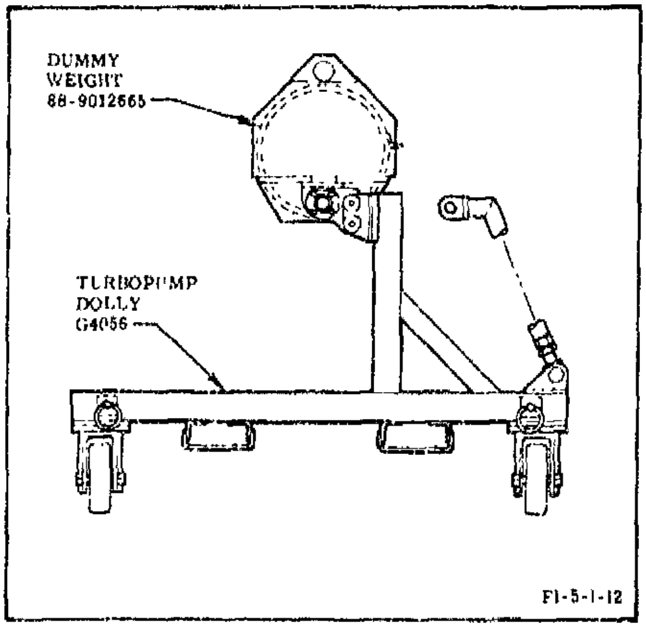


Figure 16-18. Recommended Proof-Test Setup for Turbopump Dolly

WARNING

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

a. Obtain turbopump dummy weight assembly 88-9012665.

b. Position dolly on level floor with all casters contacting floor and swivels locked.

c. Connect an overhead hoist that has a minimum load capacity of 3 tons to eye on test load.

d. Slowly lift test load enough to position dolly under load.

e. Lower test load until holes in test load are seated on blocks (17, figure 16-19).

f. Relieve all tension on hoist for 3 minutes.

g. Remove test load, and inspect dolly for distortion, weld cracks, or yielding.

h. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

16-83. DISASSEMBLING. Disassemble turbopump dolly as required to accomplish necessary repair or replacement. (See figure 16-19 for index and part numbers.)

16-84. ASSEMBLING. (See figure 16-19.) The following steps include the special instructions required during assembly:

a. Torque bolts (10) to 70-90 in-lb.

b. Torque bolts (14) to 24-30 in-lb.

c. Torque bolts (18, 20) to 100-145 in-lb.

d. Torque bolts (22, 23) to 20-30 in-lb above locking torque.

e. Install swivel locks (26) on inboard side of caster (25) with bolts (22).

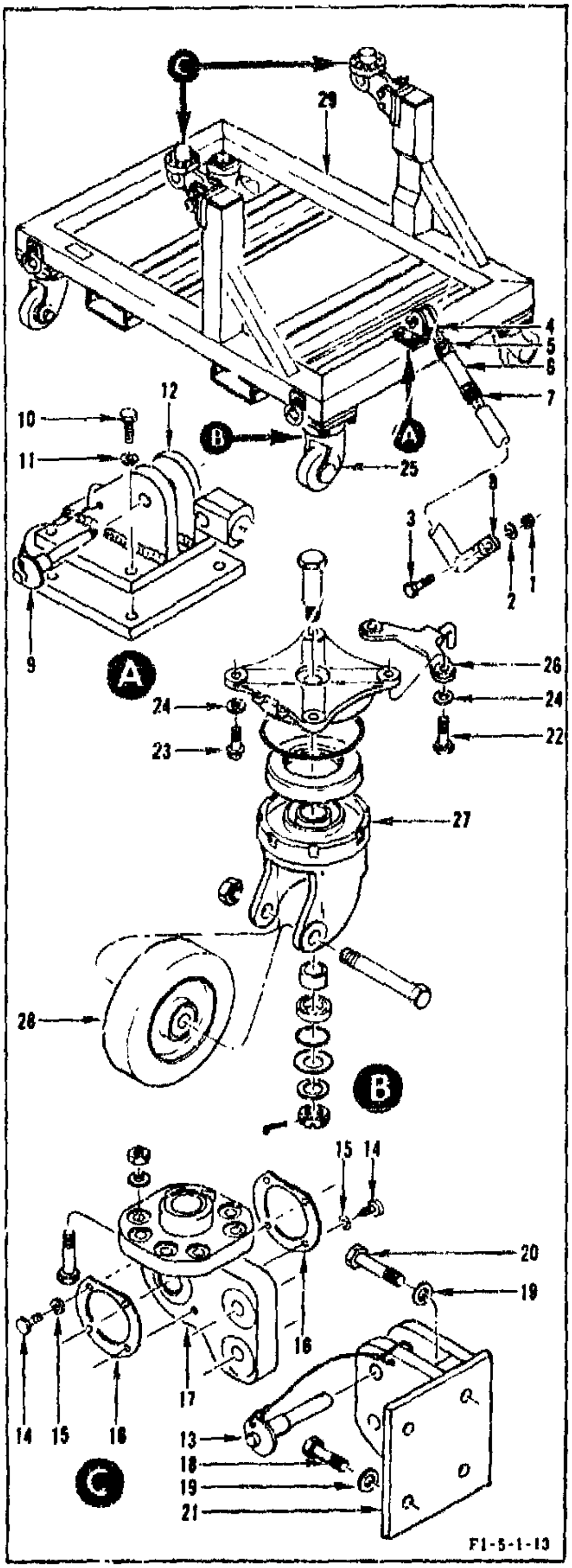
16-85. SHIPPING AND STORING.

16-86. Prepare turbopump dolly for shipping and storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 1, 11, GB, 00, and 0.

16-87. <u>TURBOPUMP SLING G4057</u>.

16-88. DESCRIPTION.

16-89. The turbopump sling consists of a frame, two mounting pads, two arms, two supports, a mounting ring, and a chain hoist. The frame is constructed of square steel tubing welded into a U-shape. A lifting plate is incorporated in the frame. The oval-shaped mounting pads consist of low-carbon steel plate with mounting holes and mounting flanges. On units incorporating MD1 change, additional mounting holes are provided in the pads to correspond to changes of turbopump fuel inlets. The arms are constructed of a stainless-steel tube and a mounting plate. The supports are constructed of seamless steel tubing with a bearing pressed into the tube and a mounting tongue. The ring is constructed of steel plate with a lift ring and mounting holes. The hoist is a self-locking, chain-driven unit with a lift hook. (See figure 16-20 for leading particulars.)



Index No.	Part No.	Description
1	NAS1022C17	Nut (F-3)
2	LD153-0010-0028	Washer (F-3)
3	AN16-37A	Bolt (F-3)
4	9019491	Bolt (F-3)
5	NAS509L24	Nut (F-3)
6	9019492	Nut (F-3)
7	NAS509-24	Nut (F-3)
8	9019493	Strut (F-1)
9	NAS1341C3C36D	Pin (F-3)
	RD191-2002-1320	Wire rope (F-3)
	28-2-G	Sleeve (F-3)
10	NAS1226C6L	Bolt (F-3)
11	LD153-0010-0014	Washer (F-3)
12	9019495	Saddle (F-1)
13	NAS1341C3C34D	Pin (F-3)
	RD191-2002-1320	Wire rope (F-3)
	28-2-G	Sleeve (F-3)
14	NAS1223C1N	Bolt (F-3)
15	LD153-0010-0008	Washer (F-3)
16	9019496	Ring (F-3)
17	9019498	Block (F-1)
	AN9-12A	Bolt (F-3)
	LD153-0010-0020	Washer (F-3)
	NAS509-9	Nut (F-3)
18	NAS1227C6L	Bolt (F-3)
19	LD153-0010-0016	Washer (F-3)
20	NAS1227C26L	Bolt (F-3)
21	9019497-1	Right-hand saddle (F-1)
	9019497-2	Left-hand saddle (F-1)
22	NAS1228C16L	Bolt (F-3)
23	NAS1228C10L	Bolt (F-3)
24	LD153-0010-0018	Washer (F-3)
25	12779	Caster (F-1)
	11829	Caster (F-2)
	11241-66	Reducer (F-2)
26	11761	Swivel lock (F-2)
27	23016	Caster rig (F-2)
	11522-56	Axle (F-2)
	AS364-1614	Nut (F-2)
	51341-53	Kingpin (F-2)
	MS24665-357	Cotter pin (F-3)
	AS320-16	Nut (F-2)
	11132	Washer (F-2)
	10158SL-3	Baseplate (F-2)
	6230-34	O-ring (F-2)
	A-2297	Bearing (F-2)
	B-2016	Bearing (F-2)
	11012-10	Retainer (F-2)
	6230-5	O-ring (F-2)
	T-126W	Bearing (F-2)
28	EHD10-T-10	Wheel (F-2)
29	9019499	Frame (X-1)
	RD171-1032-0001	Plate (F-3)
	5555	Ring (F-3)

Figure 16-19. Turbopump Dolly

Height	98 inches
Width	76 inches
Depth	22 inches
Weight	425 pounds
Maximum load capacity	3,500 pounds
Proof load	7,000 pounds

Figure 16-20. Leading Particulars for Turbopump Sling

16-90. OPERATION.

16-91. The turbopump sling, supported by a facility hoist, is used to lift the turbopump during removal and installation of the pump on the engine and on the turbopump dolly. The mounting pads are bolted to the turbopump fuel inlets, and the ring is bolted to the oxidizer inlet. The hoist chain is hooked to the ring and is used only for rotating the turbopump after it is secured to the sling. The mounting pads are secured to the arms with lockpins. One arm is capable of being locked so the turbopump may be positioned at four different positions.

16-92. MAINTENANCE.

16-93. Maintenance of the turbopump sling consists of proof testing, disassembling, assembling, and servicing.

16-94. PROOF TESTING. Proof-test turbopump sling at 12-month intervals using weights listed in figure 16-21. The proof load required for proof testing must be a minimum of 150 percent of the working load of the sling. The proof-test interval may be extended if condition 5 of figure 16-2 exists.

WARNING

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

NOTE

Parts indexed in the following procedure are illustrated in figure 16-22.

a. Obtain turbopump dummy weight assembly 88-9012665 and a 2,000-pound weight.

b. Connect an overhead hoist that has a minimum load capacity of 4 tons to turbopump sling lift eye.

c. Remove pads (5) from a sling, and install pads on test load.

d. Position sling over test load, and lower sling until pins (4) can be inserted through pads (5).

e. Remove ring (21) and hoist (22) from sling.

f. Slowly lift test load until it clears floor, observing sling for any irregularities, and hold test load suspended for 3 minutes.

g. Lower test load to floor, and inspect sling for distortion, weld cracks, or yielding.

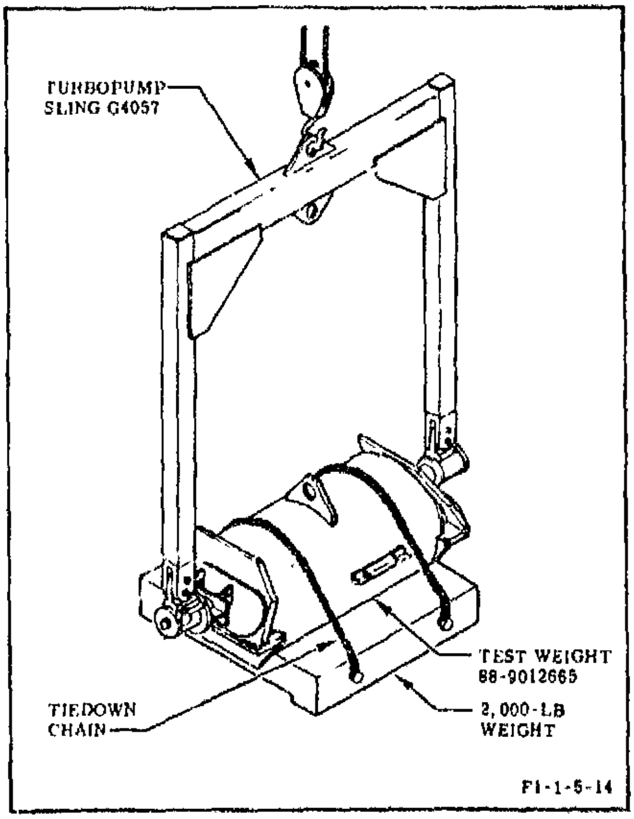


Figure 16-21. Recommended Proof-Test Setup for Turbopump Sling

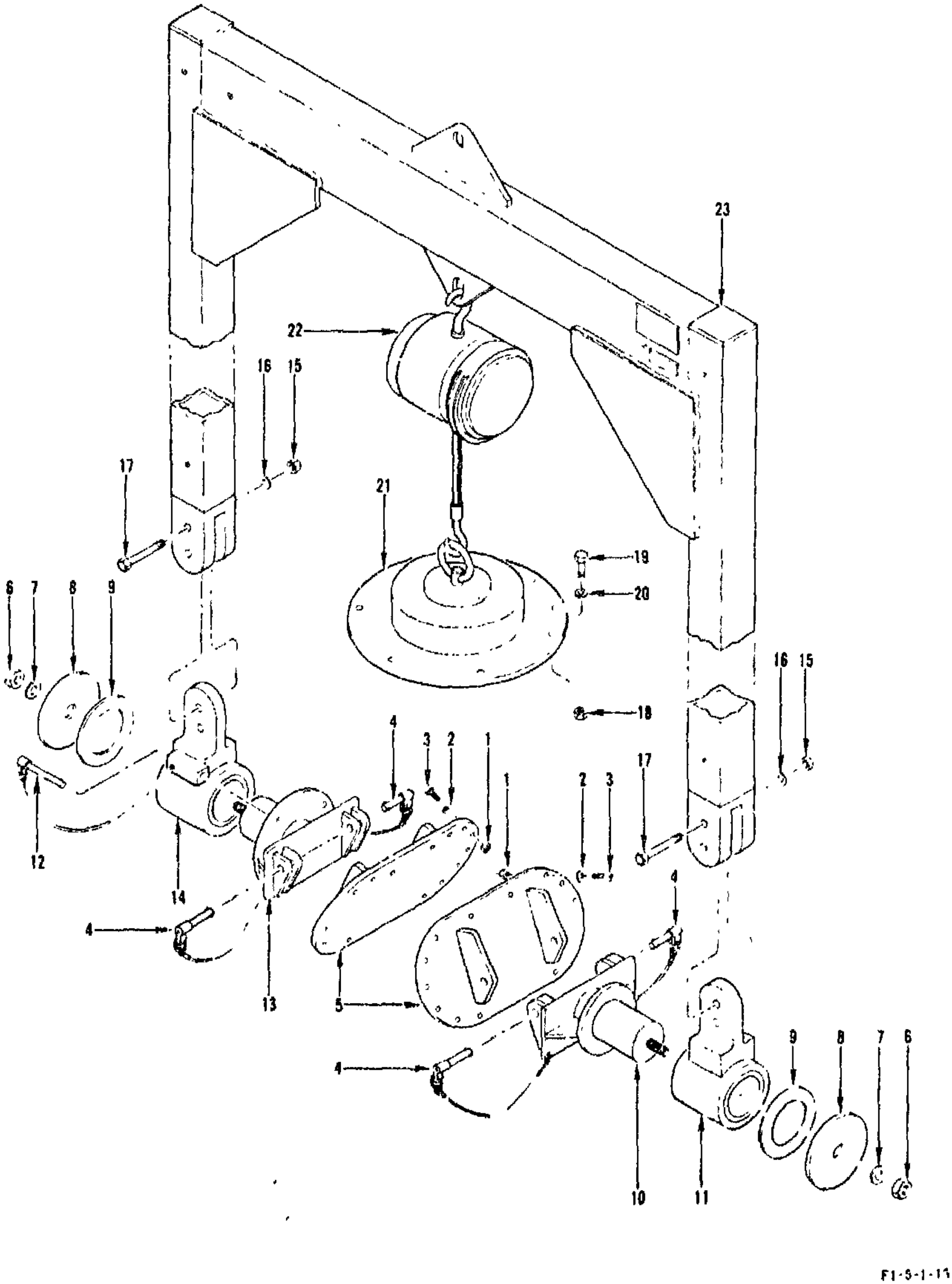


Figure 16-22. Turbopump Sling (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
1	AN315-8R	Nut (F-3)	11	9021529-21	Support (F-3)
	NAS509-7(a)	Nut (F-3)	12	NAS1338A5S48D	Pin (F-3)
2	LD153-0013-0006	Washer (F-3)		RD191-2002-1320	Wire rope (F-3)
	LD153-0013-0005(a)	Washer (F-3)		28-2-G	Sleeve (F-3)
3	RD111-3003-3818	Bolt (F-3)	13	9021532	Arm (F-3)
	RD111-3003-3730(a)	Bolt (F-3)	14	9021529-11	Support (F-3)
4	NAS1341A5S20D	Pin (F-3)	15	AN315-12R	Nut (F-3)
	RD191-2002-1320	Wire rope(F-3)	16	LD153-0010-0024	Washer (F-3)
	28-2-G	Sleeve (F-3)	17	AN12-47A	Bolt (F-3)
5	9021531	Pad (F-3)	18	AN315-7R	Nut (F-3)
	9025199(a)	Pad (F-3)	19	AN7-12A	Bolt (F-3)
6	MS20500-1614	Nut (F-3)	20	LD153-0010-0016	Washer (F-3)
7	LD153-0010-0028	Washer (F-3)	21	9021528	Ring (F-3)
8	9021533	Ring (F-3)	22	4504	Hoist (F-1)
9	9021534	Washer (F-3)	23	9021530	Frame (F-3)
10	9021535	Arm (F-3)		RD171-1032-0001	Plate (F-3)

(a) Units incorporating MD1 change

Figure 16-22. Turbopump Sling (Sheet 2 of 2)

h. Remove sling from test load and overhead hoist, and secure equipment.

i. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

16-95. DISASSEMBLING. (See figure 16-22.) Disassemble turbopump sling as required to accomplish necessary repair or replacement.

16-96. ASSEMBLING. (See figure 16-22.) The following steps include the special instructions required during assembly:

a. Torque nuts (1) to 330-430 in-lb.

b. Torque nuts (6) to 40-50 in-lb above locking torque.

c. Torque nuts (15) to 150-195 ft-lb.

d. Torque nuts (18) to 330-430 in-lb.

16-97. SERVICING. Servicing the turbopump sling consists of applying dry-film lubricant (Method V) RB0140-007 (Rocketdyne) to arms (10, 13, figure 16-22) when film is removed by wear or damage. Refer to section I for lubrication procedures (methods).

16-98. SHIPPING AND STORING.

16-99. Prepare turbopump sling for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, 00, 00, and 0.

16-100. ENGINE HANDLING DOLLY G4058.

16-101. DESCRIPTION.

16-102. The engine handling dolly consists of a flat-bed chassis mounted on four dual casters. A padded flat frame on top of the dolly serves as a support for the engine at its thrust-exit ring. All four sets of casters incorporate wheel brakes on the outboard wheel. The tow bar is detachable and may be stored when desired. Four cables, which secure the engine to the dolly, are stored in a compartment at the rear of the dolly. Engine tiedown and dolly tiedown rings are provided at each corner of the chassis. (See figure 16-23 for leading particulars.)

16-103. OPERATION.

16-104. The engine handling dolly is used to support and move the engine or thrust chamber in a vertical position within assembly buildings, repair shops, or hangars during engine buildup and maintenance. The handler is not designed for transporting the engine or thrust chamber on another vehicle. When there is a considerable distance between points of use, the handler must be transported by another vehicle. The four cables, secured to rings on each corner of the chassis, are attached to the turbopump mounts and gimbal struts to secure the engine to the dolly.

16-105. MAINTENANCE.

16-106. Maintenance of the engine handling dolly consists of proof testing, disassembling, assembling, repairing, and servicing. Repaint surface area and/or lettering, as required, when paint becomes chipped, scratched, or worn off and when lettering becomes illegible. (Refer to section I for painting information.)

Height	20 inches (approx)
Width	125 inches (approx)
Length	159 inches (approx)
Weight	4,000 pounds (approx)
Maximum load capacity	20,000 pounds
Proof load	40,000 pounds
Operating surface	Concrete floor and adjacent concrete apron
Maximum towing speed	2-1/2 mph
Maximum ramp angle (with engine installed)	5 degrees

Figure 16-23. Leading Particulars for Engine Handling Dolly

16-107. PROOF TESTING. Proof-test engine handling dolly at 24-month intervals using weight configuration shown in figure 16-9. Since engine handling dolly loading and tiedown requirements are identical to roadable vertical engine dolly, perform procedures of paragraph 16-47. The proof load required for proof testing must be a minimum of 150 percent of the working load of the dolly. The proof-test interval may be extended if one of the conditions of figure 16-2 exists.

16-108. DISASSEMBLING. Disassemble engine handling dolly as required to accomplish necessary repair or replacement. (See figure 16-24 for index and part numbers.)

16-109. ASSEMBLING. (See figure 16-24.) The following steps include the special instructions required during assembly.

a. Torque nuts of mounting bolts of caster (4, 5) to 85-115 ft-lb.

b. Torque mounting bolts of swivel lock (6) to 110-130 in-lb.

c. Torque nuts of housing bolts of brake (7) to 110-130 in-lb.

d. Torque screws of bracket (8) to 110-130 in-lb.

e. Tighten wheel (10) axle nut and caster rig (9) kingpin nut until all play is removed; then loosen nut 1/4 to 1/2 turn.

f. Torque screw of locator (12) to 25-35 in-lb.

16-110. REPAIRING. The dolly bumper (11, figure 16-24) or pads (13 through 17) may be repaired as follows:

a. Remove all of deteriorated or damaged pad or bumper.

WARNING

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

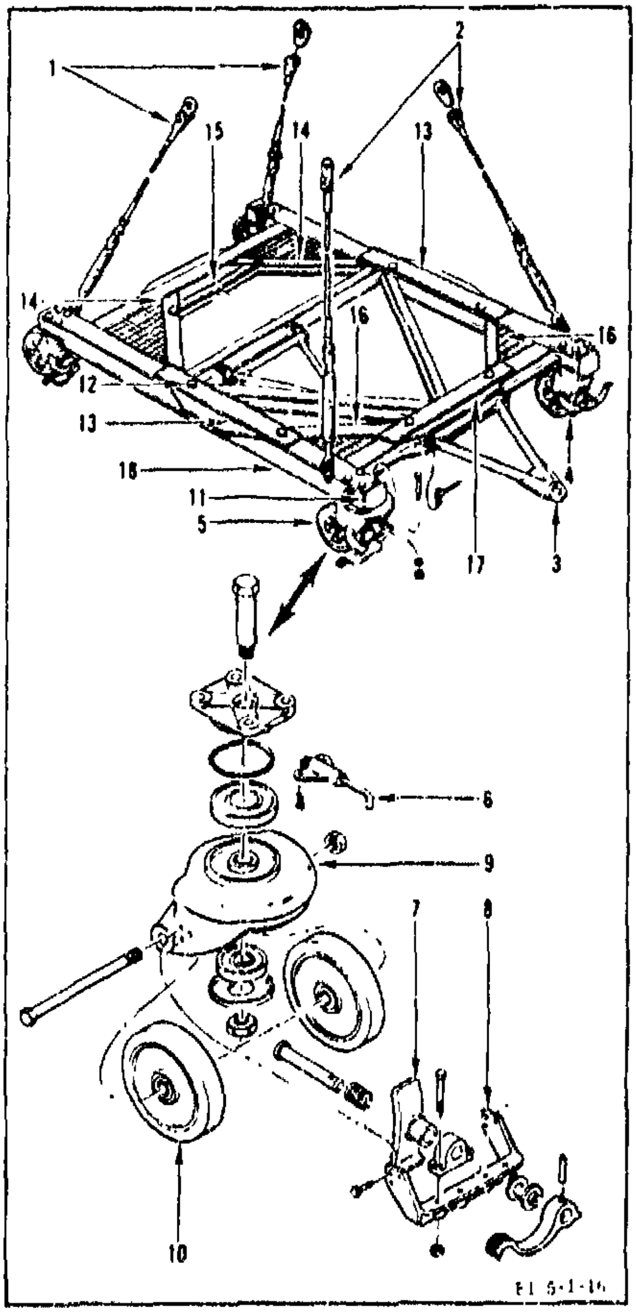
b. Remove all old adhesive from metal surface and any loose adhesive from pad or bumper using toluene (Federal Specification TT-T-548) and a wooden paddle.

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.

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

d. Apply one thin, even coat of adhesive 584 (Coast Pro-Seal) to metal surface and pad or bumper, and allow adhesive to become tacky (approximately 15 minutes). To determine proper stage of tackiness, touch a knuckle or a piece of clean cellophane to adhesive and if adhesive adheres and does not pull away with knuckle or cellophane, the adhesive is ready for bonding.



Index No.	Part No.	Description
1	9019806	Pump mount tiedown (F-1)
	9019807	Link (F-3)
	19-9019805-1	Cable (F-3)
	NAS1047-12P090	Turnbuckle (F-3)
	NAS1340C2C22	Pin (F-3)
	RD191-2002-1310	Cable (F-3)
	28-2-G	Sleeve (F-3)
2	9019803	Gimbal strut tiedown (F-1)
	9019804	Link (F-3)
	19-9019605-2	Cable (F-3)
	9017367	Pin (F-3)
	NAS1334C2C21	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1312	Cable (M-3)
	NAS1047-12P090	Turnbuckle (F-3)
	NAS1340C2C22	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1310	Cable (F-3)
3	9021527	Tow bar (F-2)
	NAS1342-C2C-26D	Pin (F-3)
	RD191-2002-1110	Cable (M-3)
	28-2-G	Sleeve (F-3)
	AN530-6R6	Screw (F-3)
	LD153-0010-0004	Washer (F-3)
4	12782-1	Left-hand caster (F-1)
5	12782-2	Right-hand caster (F-1)
	MS20500-1018	Nut (F-3)
	MS20364-1018	Nut (F-3)
	LD153-0010-0021	Washer (F-3)
	AN10-64A	Bolt (F-3)
	AN10-66A	Bolt (F-3)
6	54066-4	Swivel lock (F-1)
	AS65-5-6	Screw (F-3)
	MS35333-41	Lockwasher (F-3)
7	51664-R	Right-hand brake (F-1)
	51664-L	Left-hand brake (F-1)
	51042-9	Pedal (F-3)
		Roll pin (F-3), 3/16 by 1-1/4 in.
	AN960-1216	Washer (F-3)
	51042-4	Cam (F-3)
		Roll pin (F-3), 3/16 by 1-1/8 in.
	51042-2	Shoe (F-3)
	11761-4	Spring (F-3)
	51042-7	Shaft (F-3)
	51042-1	Housing (F-2)
	AS60-6-16	Screw (F-3)
	AN960-616	Washer (F-3)
	AS364-624	Nut (F-3)
8	51478	Bracket (F-3)
	AS65-4-6	Screw (F-3)
	MS35334-19	Lockwasher (F-3)

Figure 16-24. Engine Handling Dolly (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
9	23059	Caster rig (F-2)		3188	Cone (F-2)
	11522-133	Axle (F-2)		10002Y-T18	Spacer (F-2)
	AS364-1614	Nut (F-2)		6227-23	O-ring (F-2)
	51488-243	Kingpin (F-2)		10034	Retainer (F-2)
	MS24665-359	Cotter pin (F-2)	11	9021526-71	Bumper (F-3)
	A3320-20	Nut (F-2)	12	9021526-67	Locator (F-3)
	36029-SL	Baseplate (F-2)		NAS1351-6-24P	Screw (F-3)
	50038-85	Lip seal (F-2)		LD153-0010-0014	Washer (F-3)
	A-2344	Bearing (F-2)	13	9021526-59	Pad (F-3)
	34062-SL-MB-1	Horn (F-2)	14	9021526-65	Pad (F-3)
	MS15001-1	Fitting (F-3)	15	9021526-63	Pad (F-3)
	LM67048	Cone (F-2)	16	9021526-61	Pad (F-3)
	LM67010	Cup (F-2)	17	9021526-57	Pad (F-3)
	50041-10	Wafer seal (F-3)	18	9021526	Frame (X-1)
10	79026-3	Wheel (F-2)		N05016	Ring (F-3)
	11241-87	Reducer (F-2)		N05015	Ring (F-3)
	30077	Wheel (F-2)		RD171-1032-0001	Plate (F-3)

Figure 16-24. Engine Handling Dolly (Sheet 2 of 2)

e. Aline pad or bumper with metal surface before making contact with adhesive. (A sheet of waxed paper placed between the pad or bumper and the metal surface will aid in positioning the pad or bumper and will not stick to the adhesive.)

f. Roll or firmly press both pad or bumper and metal surface together to remove any air bubbles. Apply approximately 10 psi even pressure by clamps or weights to pad or bumper, and allow adhesive to cure at room temperature for 24 hours.

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

16-111. SERVICING. Servicing of engine handling dolly consists of packing (Method Y) bearings of caster rig (9, figure 16-24) and wheel (10) with gear grease (MIL-G-23827) at 12-month intervals. Refer to section I for lubrication procedures (methods).

16-112. SHIPPING AND STORING.

16-113. Prepare engine handling dolly for shipping or storing in accordance with MIL-P-116, Method III.

16-114. GIMBAL BEARING LOCK G4059.

16-115. DESCRIPTION.

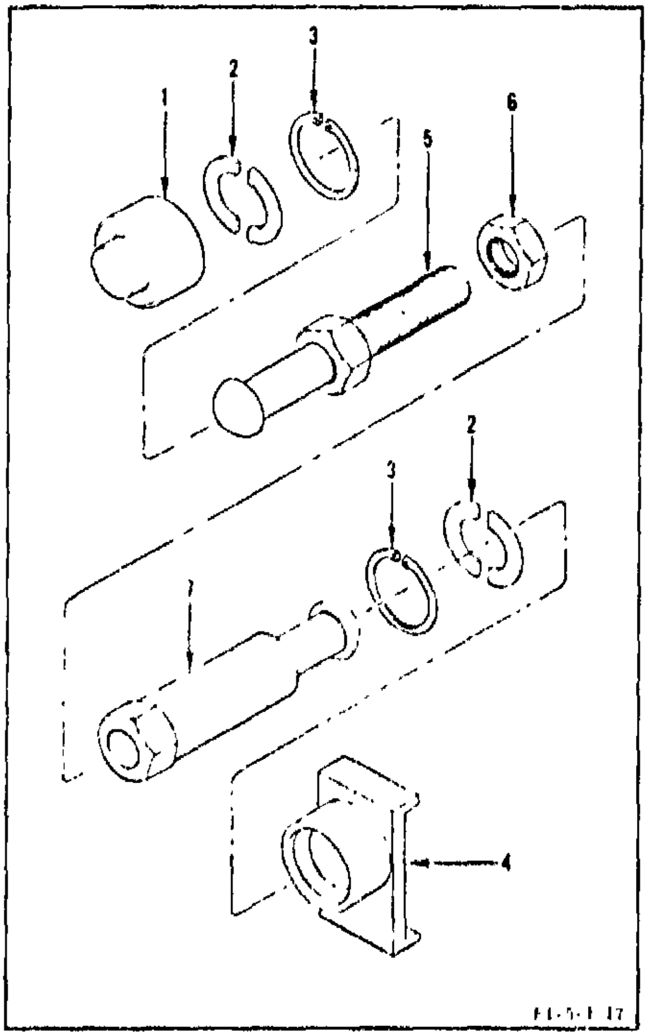
16-116. The gimbal bearing lock, constructed of alloy steel, consists of two sockets and two spherical ends. The spherical ends are keyed to the sockets and screwed one within the other to provide adjustment.

16-117. OPERATION.

16-118. The gimbal bearing lock is used to immobilize the gimbal bearing. The gimbal bearing lock is a simple screwjack mechanism with socket-type interface mounts. Four gimbal bearing locks are positioned around the gimbal bearing. The length of the locks is adjusted as required to center and immobilize the gimbal.

16-119. MAINTENANCE.

16-120. There are no special maintenance instructions for the gimbal bearing lock. Disassemble gimbal bearing lock as required to accomplish necessary repair or replacement. (See figure 16-25 for index and part numbers.) Clean gimbal bearing lock, when applicable, as outlined in section I.



Index No.	Part No.	Description
1	9019952	Socket (F-3)
	9019952-3[a]	Socket (F-3)
2	N-5000-125	Ring (F-3)
3	9019953	Split washer (F-3)
4	9019951	Socket (F-3)
	9019951-3[a]	Socket (F-3)
5	9019954	Spherical end (F-3)
6	AN316C10R	Nut (F-3)
7	9019955	Spherical end (F-3)

(a) Units incorporating MD1 change.

Figure 16-25. Gimbal Bearing Lock

16-121. SHIPPING AND STORING.

16-122. Prepare gimbal bearing lock for shipping and storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 3G, 1, 1, 00, EA, 00, and 0, and as follows:

NOTE

The gimbal bearing locks are a rotatable item and must be returned to Rocketdyne. The responsible Rocketdyne representative must be contacted for the required shipping information.

a. Inspect gimbal bearing lock for completeness.

b. Package 4 gimbal bearing locks in a set for shipping or storing.

16-123. VERTICAL INSTALLER SLING G4060.

16-124. DESCRIPTION.

16-125. The vertical installer sling is a simple cable assembly consisting of three cables. Two of the cables incorporate safety-eye hooks; the third cable incorporates a turnbuckle and a clevis fitting. The three cables are centrally connected to a lifting eye. (See figure 16-26 for leading particulars.)

Length	236 inches
Weight	200 pounds (approx)
Maximum load capacity	36,000 pounds
Proof load	81,000 pounds
Proof load (individual cable)	27,000 pounds

Figure 16-26. Leading Particulars for Vertical Installer Sling

16-126. OPERATION.

16-127. The vertical installer sling, supported by a facility hoist, is used to lift Engine Vertical Installer G4049 without the engine installed. The sling attaches to three points on the installer, and the turnbuckle is adjusted to level the installer.

16-128. MAINTENANCE.

16-129. There are no special maintenance instructions for the vertical installer sling, except for proof testing. Disassemble sling as required to accomplish necessary repair or replacement. (See figure 16-27 for proof-test setup and figure 16-28 for index and part numbers.)

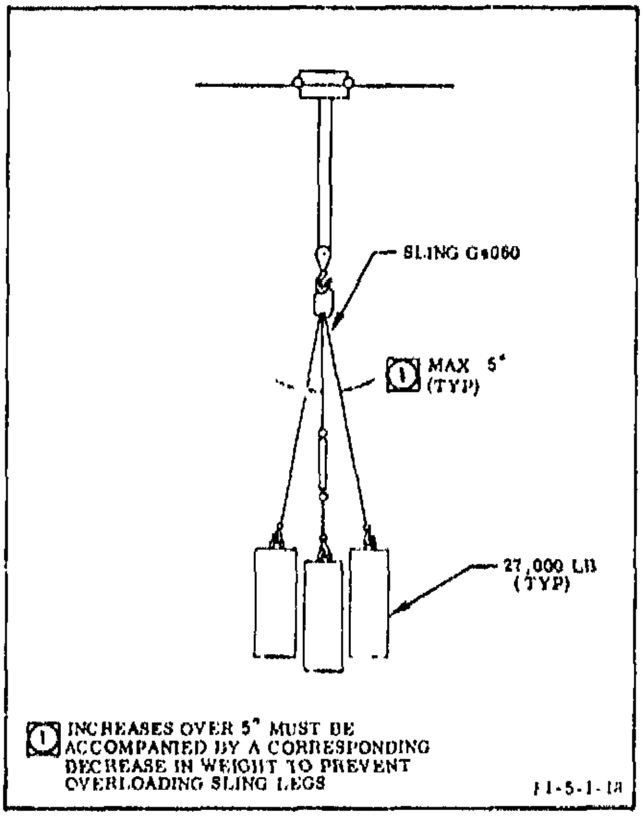
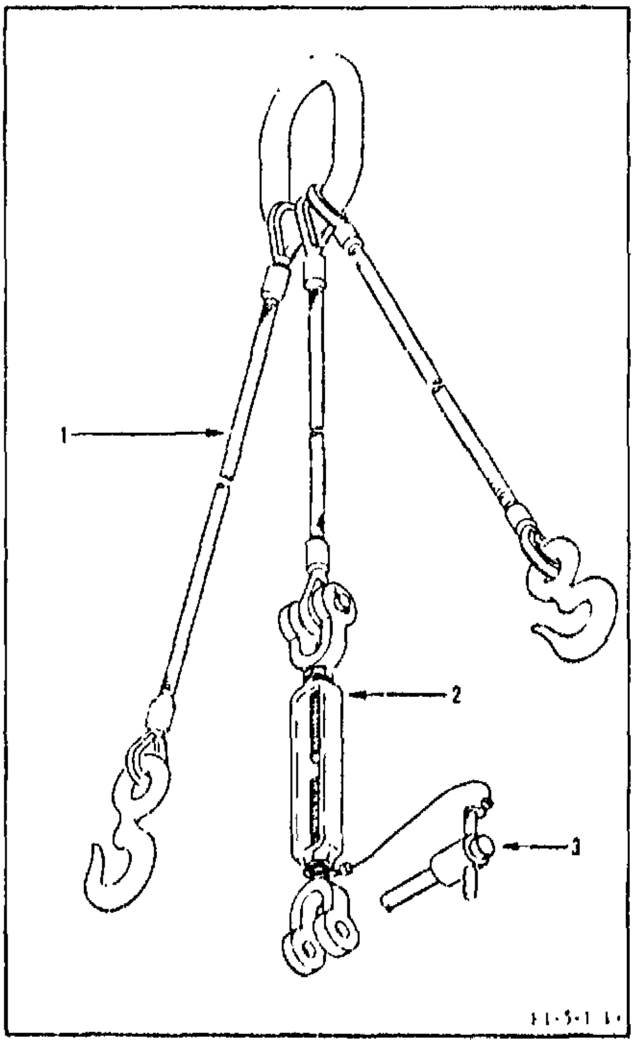


Figure 16-27. Recommended Proof-Test Setup for Vertical Installer Sling



Index No.	Part No.	Description
1	19-9022250	Cable (F-2)
2	NAS1047-20P120	Turnbuckle (F-3)
	57601A-2007	Nut (F-3)
3	BLC-18-GT-38	Pin (F-3)
	RD191-2002-1318	Cable (M-3)
	28-2-G	Sleeve (F-3)

Figure 16-28. Vertical Installer Sling

16-130. PROOF TESTING. Proof-test vertical installer sling at 12-month intervals using weight listed in figure 16-27. The proof load required for proof testing must be a minimum of 150 percent of the working load of the sling. The proof-test interval may be extended if the sling is clean, packaged, and stored. If proof-test expires during storage, proof testing is mandatory before use.

WARNING

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

a. Obtain 3 solid test loads, maintaining maximum angular degrees, as shown in figure 16-27.

NOTE

An alternate method of proof-testing may be accomplished by hydraulic loading, to provide straight-line pull of 27,000 pounds for each leg in unison.

b. Connect an overhead hoist that has a minimum load capacity of 45 tons to sling lifting eye.

c. Position sling over test loads, and connect sling legs to individual test loads.

d. Slowly lift test loads until loads clear floor, observing sling for any irregularities, and hold test loads for 3 minutes.

e. Lower test loads to floor, and inspect sling for any distortion and cables for broken strands, frays, and kinks.

f. Disconnect sling, and secure equipment.

g. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

16-131. SHIPPING AND STORING.

16-132. Prepare vertical installer sling for shipping or storing in accordance with MIL-P-116, Method III.

16-133. ENGINE SHIPPING BUTTRESS G4067.

16-134. DESCRIPTION.

16-135. The engine shipping buttress consists of a tubular frame, left-hand and right-hand base assemblies, an adapter, and an adjustment screw. The frame and bases are matched assemblies and must remain as a set. The frame is made from steel tubing welded into an A-frame, with four attach points. The base assemblies are made from steel I-beams and incorporate attach fittings for the frame attach points. All attaching hardware is secured to the frame and base assemblies. A turnbuckle is attached to each base to provide additional tiedown for Air Transport Engine Handler G4044. On units incorporating MD3 change, new tiedown equipment, including a single base and turnbuckles and two tiedown adapters and shackles, is added. The adapter is made from steel plate formed to cover the gimbal bearing. The adjustment screw is made from a solid steel tube that incorporates wrench flats and threads on one end and lockpin holes at different locations on the body.

16-136. OPERATION.

16-137. The engine shipping buttress is designed to be used only during transportation of the engine in aircraft PG377 to prevent forward movement of the engine and air transport engine handler during landing. On units incorporating MD3 change, the shipping buttress includes tiedown provisions for transporting the engine in aircraft C133. The frame forward attach points and the base assemblies are attached to the shipping pallet; the frame rear attach points are attached to the base assemblies. An adapter stored on the frame is used as the contact plate between the engine and engine shipping buttress.

16-138. MAINTENANCE.

16-139. Maintenance of the engine shipping buttress consists of disassembling and assembling. Repaint surface area and/or lettering, as required, when paint becomes chipped, scratched, or worn and when lettering becomes illegible. (Refer to section I for painting information.) Clean surface area, when applicable, as outlined in section I.

16-140. DISASSEMBLING. Disassemble engine shipping buttress as required to accomplish necessary repair or replacement. (See figure 16-29 for index and part numbers.)

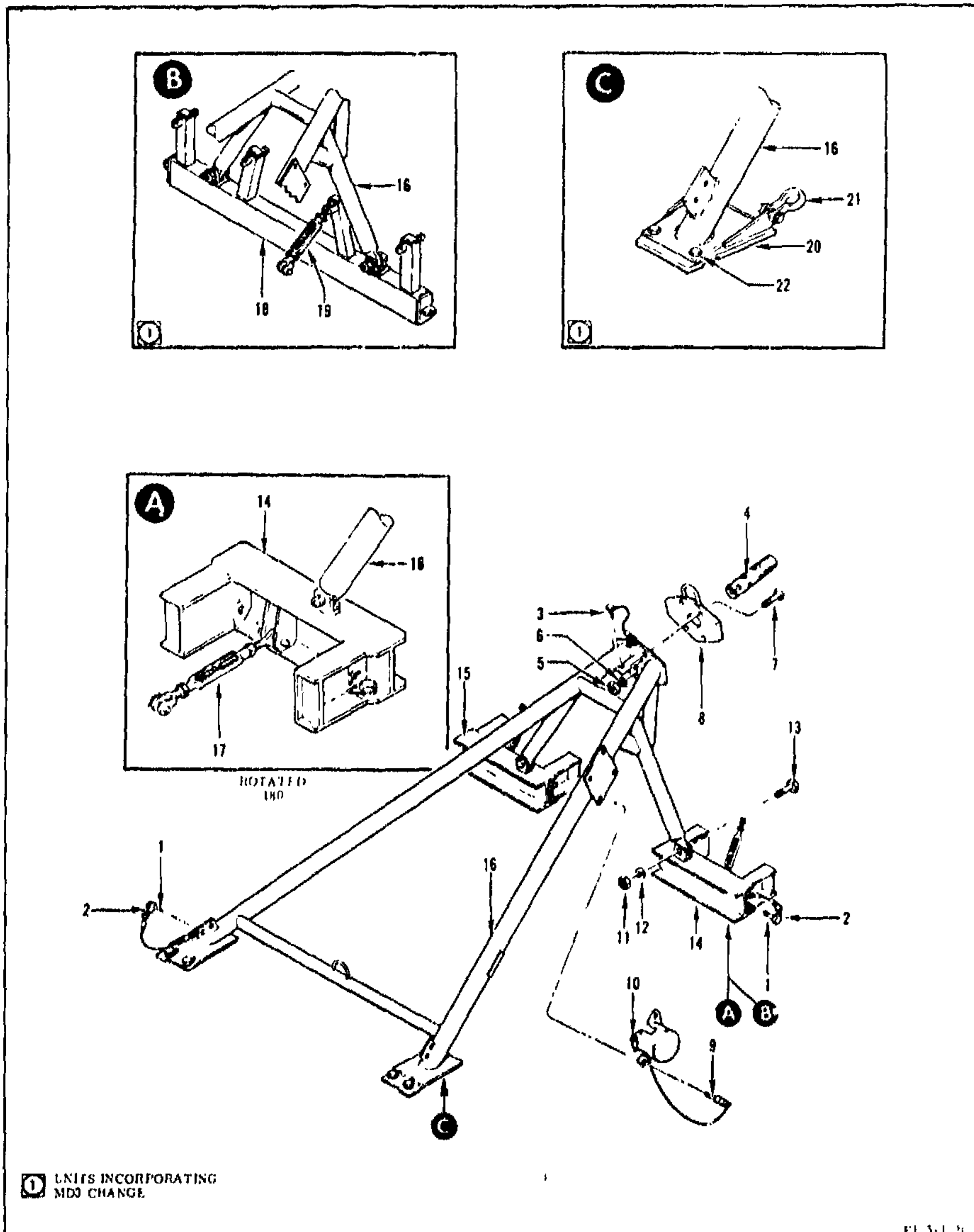


Figure 16-29. Engine Shipping Buttress (Sheet 1 of 2)

Index No.	Part No.	Description
1	9025044	Bolt (F-3)
2	9022863	Tab (F-3)
	RD191-2002-1318	Wire rope (M-3)
	28-2-G	Sleeve (F-3)
	MS35333-50	Washer (F-3)
3	NAS1356DS2S45	Pin (F-3)
	RD191-2002-1308	Cable (M-3)
	28-2-G	Sleeve (F-3)
4	9022866	Screw (F-3)
5	NAS679A6	Nut (F-3)
6	RD153-0113-0076	Washer (F-3)
7	AN6-22A	Bolt (F-3)
8	9022867	Plate (F-3)
9	FDC1390M-14-20	Fastener (F-3)
	RD191-2002-1308	Cable (F-3)
	28-2-G	Sleeve (F-3)
10	9022864	Adapter (F-1)
11	31FKF1210	Nut (F-3)
12	MS27183-23	Washer (F-3)
13	12705-16C-20C	Bolt (F-3)
14	9014224-3	Base (X-1)
15	9014224-5	Base (X-1)
16	9021723	Buttress (X-2)
17	9017391	Turnbuckle (F-1)
	BLS14GT27	Pin (F-3)
	RD191-2002-1314	Cable (M-3)
	28-2-G	Sleeve (F-3)
18	9026653[a]	Base (X-1)
19	NAS1047-12P090[a]	Turnbuckle (F-1)
	BLS-10-GT-22[a]	Pin (F-3)
	RD191-2002-1318[a]	Cable (M-1)
	28-2-G[a]	Sleeve (F-3)
20	9026654-1[a]	Tiedown adapter left-hand (X-1)
	9026654-2[a]	Tiedown adapter right-hand (X-1)
21	NAS1042-14[a]	Shackle (F-1)
22	9026655[a]	Bolt (F-3)
	LD153-0010-0029[a]	Washer (F-3)
	F52NE-182[a]	Nut (F-3)

(a) Units incorporating MD3 change.

Figure 16-29. Engine Shipping Buttress (Sheet 2 of 2)

16-141. ASSEMBLING. (See figure 16-29.) The following steps include the special instructions required during assembly:

a. Torque nut (5) to 210-280 in-lb.

b. Torque nut (11) to 185-240 ft-lb.

16-142. SHIPPING AND STORING.

16-143. Prepare engine shipping buttress for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, Z, 00, ZZ, 00, and 0. On units incorporating MD3 change, the tiedown equipment not in use will accompany the shipping buttress in transit, to provide the capability of transporting the engine either in aircraft PG377 or C133.

16-144. <u>COMPONENT HANDLING FIXTURE SET G4068</u>.

16-145. DESCRIPTION.

16-146. The component handling fixture set consists of 23 separate items: 5 fixtures, 2 slings, 15 adapters, and one support. The fixtures are constructed of steel tubing, incorporating lifting eyes and adapter attaching lockpins. The fixture's design is such that the center of gravity is maintained on the component during handling. The interface sling consists of four cables, a lift ring, and four adapters. The cables are attached to the lift ring, and an adapter is attached to each cable with lockpins. The heat exchanger sling consists of four cables, a spreader bar, a lift ring, and an adapter. Two cables are attached to the lift ring, and the spreader bar and the other two cables are attached to the spreader bar and the adapter. The adapters are constructed of aluminum, incorporating a spud for attachment to the fixtures and stud fittings for attachment to components. The support consists of a circular two-piece support with two clevis locks and four adjustment screws. (See figure 16-30 for leading particulars.)

16-147. OPERATION.

16-148. The component handling fixture set is used to support engine components during removal and installation. The fixture set is designed to handle components with the engine in either the vertical or horizontal position. The

Nomenclature	Weight (Pounds)	Load Capacity (Pounds)
No. 1 C-beam fixture	40	550
No. 2 C-beam fixture	50	290
No. 3 C-beam fixture	63	355
Gimbal support	11	288
Gimbal block injector dome fixture	375	3,810
Lift fixture	13	4,295
Interface panel sling	30	600
Heat exchanger sling	165	1,076
No. 1 fuel line adapter	32	290
No. 2 fuel line adapter	32	254
No. 1 oxidizer line adapter	37	510
No. 2 oxidizer line adapter	37	420
Fuel inlet elbow adapter	26	110
Main fuel valve adapter	21	112

Nomenclature	Weight (Pounds)	Load Capacity (Pounds)
Main oxidizer valve adapter	21	210
Gas generator adapter	25	265
Dome and gimbal block lifting adapter	40	3,760
Injector lifting adapter	32	1,555
No. 1 rigid fuel duct adapter	32	107
No. 2 rigid fuel duct adapter	25	88
No. 1 rigid oxidizer duct adapter	28	125
No. 2 rigid oxidizer duct adapter	27	91
Main fuel valve solid lines adapter	13	112
Turbopump support strut	13	2,200

Figure 16-30. Leading Particulars for Component Handling Fixture Set

fixtures or slings, suspended from an overhead crane, are attached to the adapter after it is installed on a component. Since the adapters are of lightweight construction, they are easily installed by hand on the components. Each fixture is designed to be adaptable to more than one adapter and component combination. Placarding on the fixtures indicates the lifting point to be used when handling specific components.

16-149. MAINTENANCE.

16-150. Maintenance of component handling fixture set consists of proof testing, disassembling, and assembling. Repaint surface area and lettering, as required, when paint becomes chipped, scratched, or worn and when lettering becomes illegible. (Refer to section I for painting information.) Clean component handling fixture set, when applicable, as outlined in section I.

16-151. PROOF TESTING. Proof-test component handling fixture set at 12-month intervals using adapter, fixture, T-tool, and test weight specified in figure 16-31. Either weights that equal the test weight specified in figure 16-31 (where applicable) or dynamometers with a corresponding range may be used. The proof load required for proof testing must be a minimum of 150 percent of the working load of the adapter, fixture, or sling. The proof-test interval may be extended for all items of the fixture set if the set is clean, packaged, and stored and condition 5 of figure 16-2 exists. If proof-test expires during storage of the interface panel sling and heat exchanger sling, proof testing is mandatory for the slings before use.

WARNING

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

a. Obtain adapter, fixture, T-tool, and test weight or dynamometer, as applicable, listed in figure 16-31.

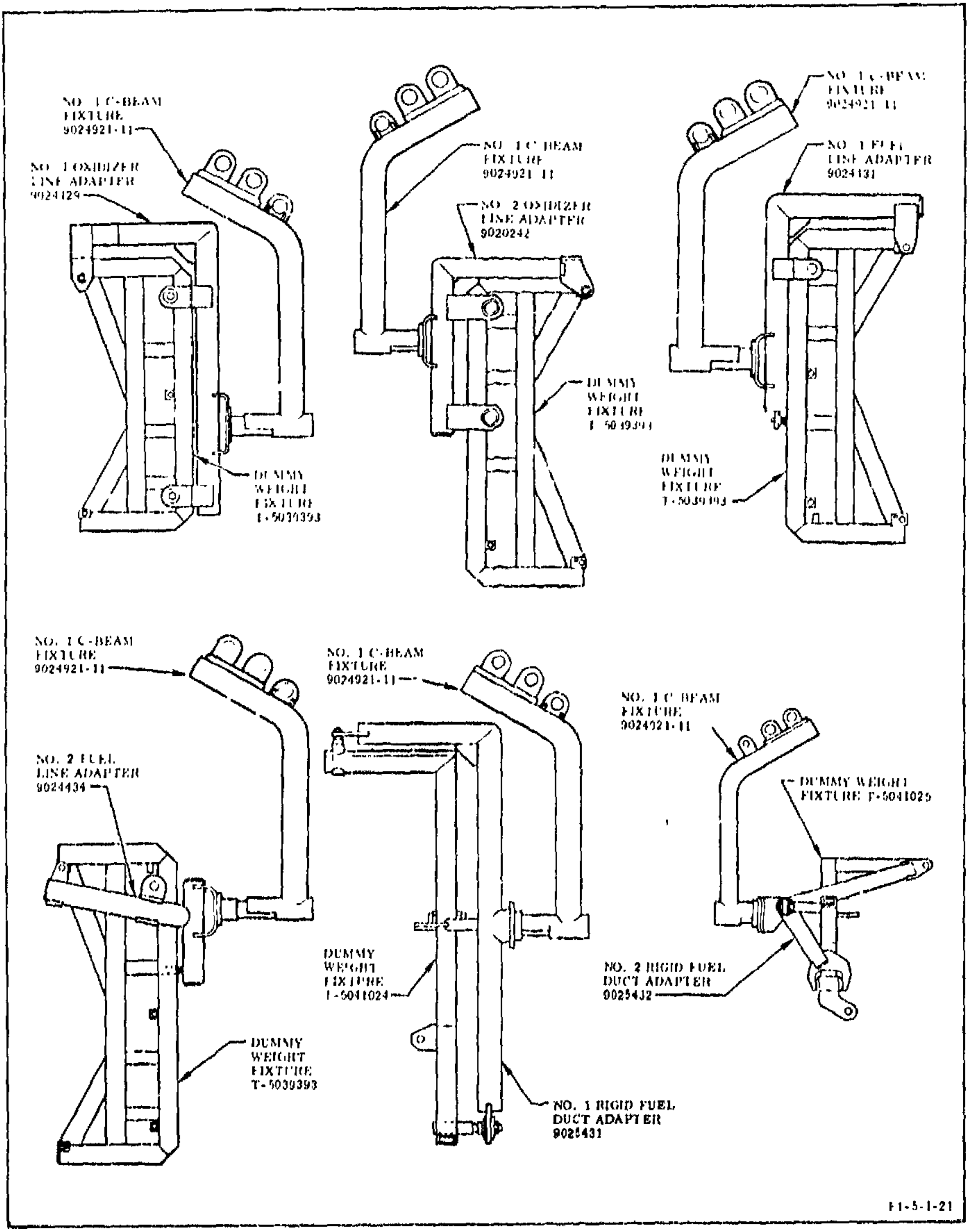


Figure 16-31. Recommended Proof-Test Setup for Component Handling Fixture Set (Sheet 1 of 4)

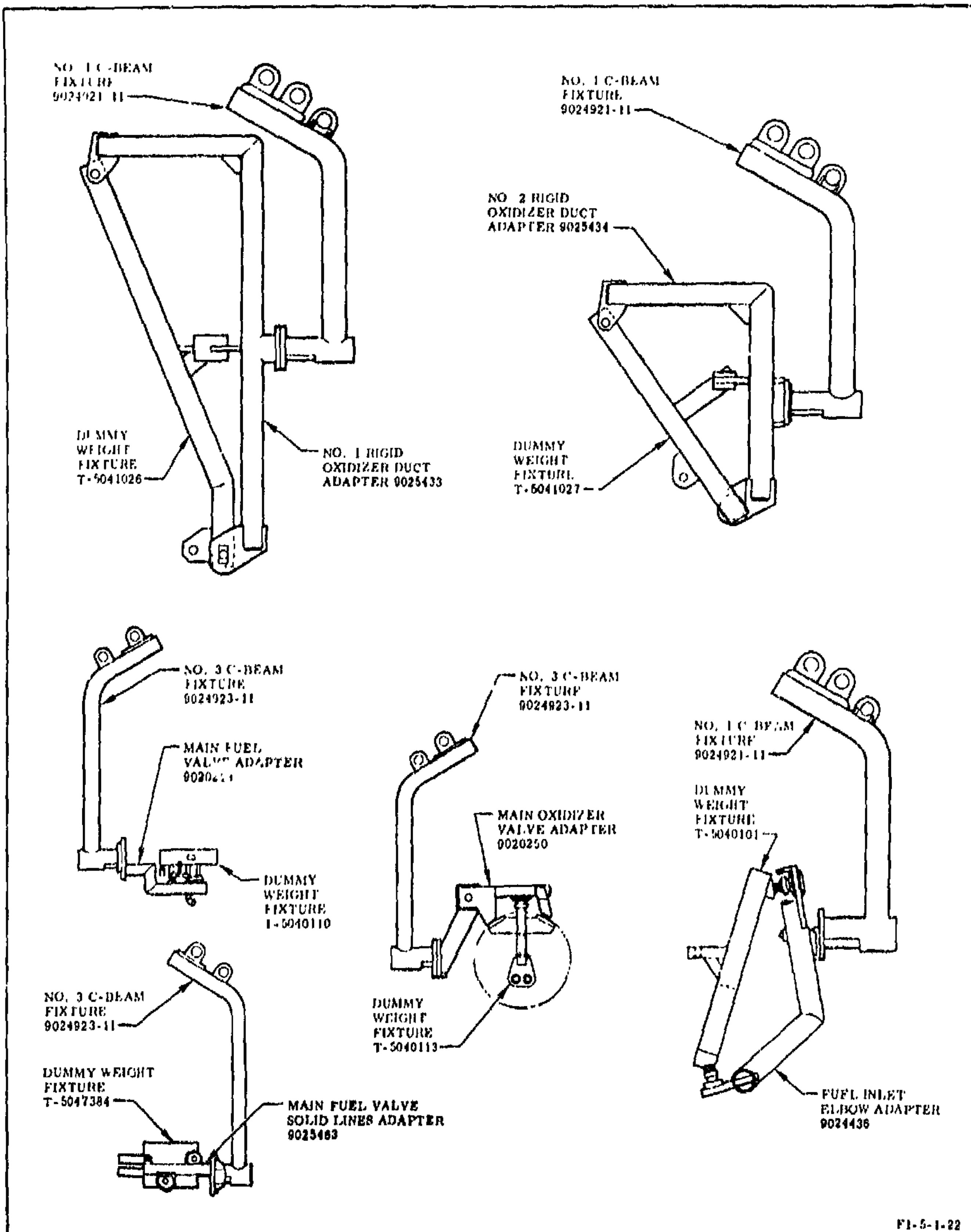


Figure 16-31. Recommended Proof-Test Setup for Component Handling Fixture Set (Sheet 2 of 4)

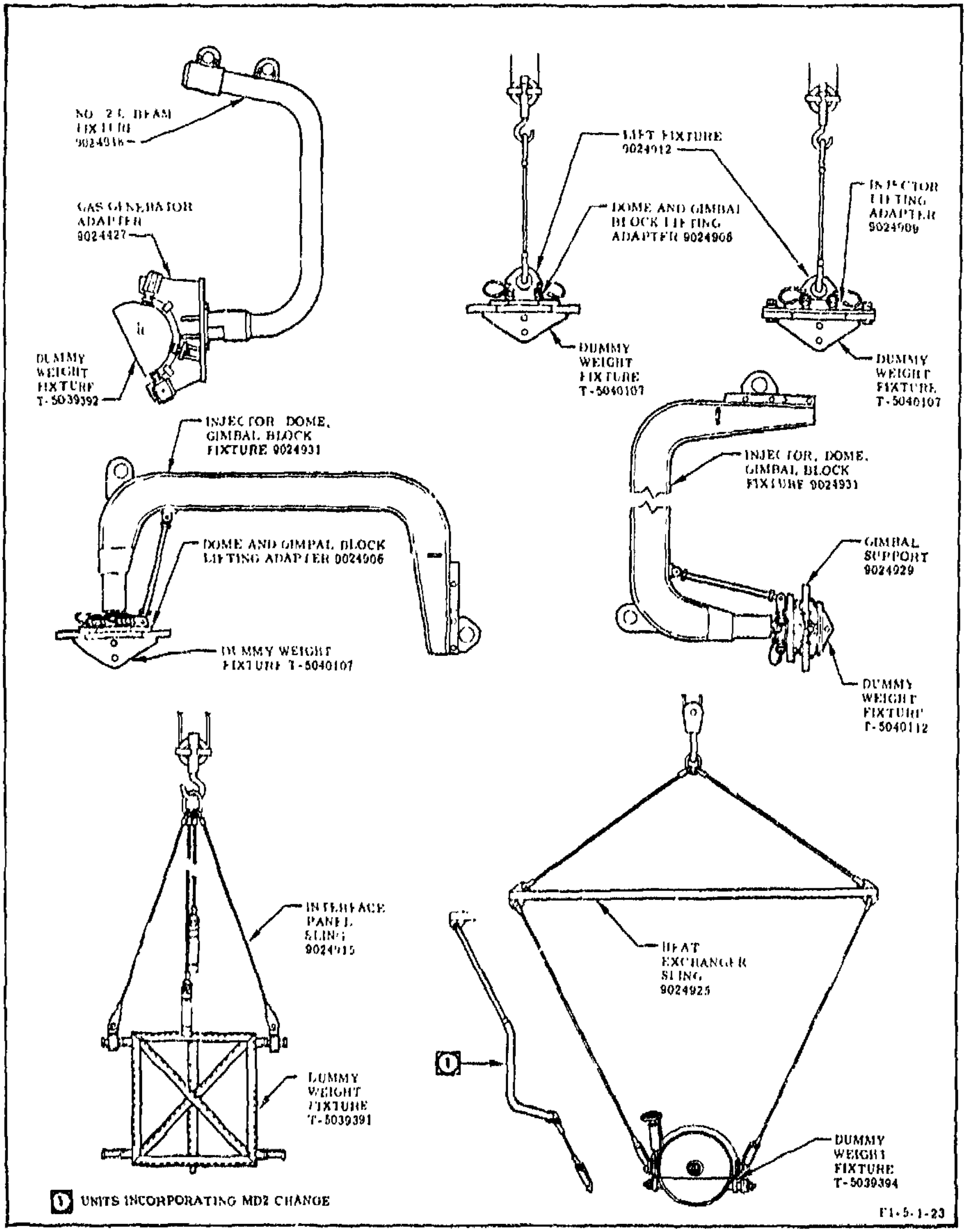


Figure 16-31. Recommended Proof-Test Setup for Component Handling Fixture Set (Sheet 3 of 4)

Adapter/ Support	Fixture/ Sling	T-Tool	T-Tool Weight (Pounds)	Test Load (Pounds ±5% Except as Noted)	Proof Load (Pounds)
--	9024921-11	--	--	--	1,100
9024429	9024921-11	T-5039393	130	890	1,020
9020242	9024921-11	T-5039393	130	710	840
9024431	9024921-11	T-5039393	130	460	590
9024434	9024921-11	T-5039393	130	380	508
9025431	9024921-11	T-5041024	82	135	214
9025432	9024921-11	T-5041025	70	105	176
9025433	9024921-11	T-5041026	47	200	250
9025434	9024921-11	T-5041027	39	145	182
9024436	9024921-11	T-5040101	70	145	216
--	9024923-11	--	--	--	710
9020248	9024923-11	T-5040110	35	190	224
9020250	9024923-11	T-5040113	16	405	420
9025463	9024923-11	T-5047384	221	0	224
--	9024918	--	--	--	580
9024427	9024918	T-5039392	29	500	530
--	9024912	--	--	--	8,590
9024906	9024912	T-5040107	131	7,400 ±1%	7,525
9024906	9024912	T-5040107	131	7,400 ±1%	7,525
9024009	9024912	T-5040107	131	2,980 ±2%	3,110
--	9024931	--	--	--	7,620
9024906	9024931	T-5040107	131	7,400 ±1%	7,525
9024906	9024931	T-5040107	131	7,400 ±1%	7,525
9024929	9024931	T-5040112	114	575	576
--	9024915	T-5039391	226	975	1,200
--	9024925	T-5039394	2,150	0	2,152

Figure 16-31. Recommended Proof-Test Setup for Component Handling Fixture Set (Sheet 4 of 4)

NOTE

The proof-test procedures are not necessarily performed in the order presented. Individual items may be proof tested by performing the applicable steps.

b. Connect specified fixture to overhead hoist, attach specified adapter spud to fixture with lockpin, and attach specified T-tool to adapter (figure 16-31).

c. Install dynamometer between T-tool and floor anchor point, or attach specified test weight to T-tool.

d. Using hoist, lift test weight or apply tension on hoist until dynamometer indicates required weight, and hold for 3 minutes.

e. Lower test load to floor or relieve tension on hoist and inspect adapter and fixture for distortion or yielding.

f. Rotate adapter and T-tool 90 degrees on fixture, and repeat steps c through e.

g. Repeat steps c through f with fixture connected to other spud of adapter 9020250.

h. Perform steps i through r and repeat procedures outlined in steps b through e for each step.

i. Attach adapter 9024906 to T-tool T-5040107 by installing bolts through holes in T-tool and into tapped holes of adapter. Torque bolts to 240-310 ft-lb.

j. Remove bolts installed in step h and reinstall bolts through holes in adapter and into tapped holes of T-tool. Torque bolts to 240-310 ft-lb.

k. Remove adapter 9024906, and install adapter 9024909 in its place. Torque bolts to 240-310 ft-lb.

l. Repeat step i, and attach hoist to fixture 9024931 lower lifting eye. Support upper end of fixture to maintain a horizontal position.

m. Repeat step j, and attach hoist to fixture 9024031 DOME & INJECTOR lifting eye.

n. Remove adapter 9024906 and T-tool T-5040107 from fixture 9024931.

o. Attach T-tool T-5040112 to fixture 9024931, and attach support 9024929 to T-tool. Make sure hoist is attached to fixture DOME & INJECTOR lifting eye.

p. Rotate support 9024929 ninety degrees at a time, and apply load until all 4 adjusting screws have appeared at bottom position.

q. Connect sling 9024915 to hoist, and attach adapters of sling to 4 corners of T-tool T-5039391. Apply load to sling.

r. Disconnect 2 legs of sling at a time, and apply a load to each pair.

s. Connect sling 9024925 to hoist, and install 4 machine screws 20094-4F-12C (Standard Pressed Steel Co), or equivalent, in top of cylinder. Alternately turn each screw until tight.

t. Turn handwheel fully counterclockwise, place adapter around T-tool T-5039394, and turn handwheel clockwise until cylinder spring bottoms out.

u. Repeat steps d and e with adapter in horizontal and vertical positions.

v. Remove 4 machine screws (step s).

w. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

16-152. DISASSEMBLING. Disassemble component handling fixture set as required to accomplish necessary repair or replacement. (See figure 16-32 for index and part numbers.)

16-153. ASSEMBLING. (See figure 16-32.) The following steps include the special instructions required during assembly:

a. Torque nuts of lifting-eye attaching bolts of fixtures (1, 3) to 210-280 in-lb.

b. Torque nuts of lifting-eye attaching bolts of fixture (2) to 520-680 in-lb.

c. Torque nut of arm attaching bolt to 1,000-1,200 in-lb and nuts of turnbuckle attaching bolts to 1,450-1,920 in-lb of fixture (5).

d. Torque nuts of plate attaching bolts of sling (8) to 290-390 in-lb.

e. Torque nuts of spud attaching bolts of adapters (9, 10, 11, 12, 14, 16, 19, 20, 21, 22, 23) to 330-430 in-lb.

f. Adjust nut 52NTE182 on fittings 9025182 and 9025169 to establish a 0.003- to 0.006-inch gap between nut and plate 9024949 or washer 9025170 on adapters (9, 10, 11, 12, 15, 19, 20, 21, 22).

g. Torque nut of stud fitting 33115 of adapters (9, 10, 11, 12, 13, 15, 16, 19, 20, 21, 22, 23) to 100-140 in-lb.

h. Position actuation pin of stud fitting 33115 within 2 degrees of position shown in figure 16-32.

i. Torque nuts of spud attaching bolts of adapter (13) to 120-155 in-lb.

j. Torque nuts of sustainer and pad attaching screws of adapter (14) to 8-10 in-lb.

k. Torque nut of spud attaching bolt to 61-75 in-lb and nut of pad attaching screw to 20-26 in-lb on adapter (15).

l. Torque nuts of bumper attaching bolts of adapters (19, 20, 21, 22) to 2-8 in-lb above locking torque.

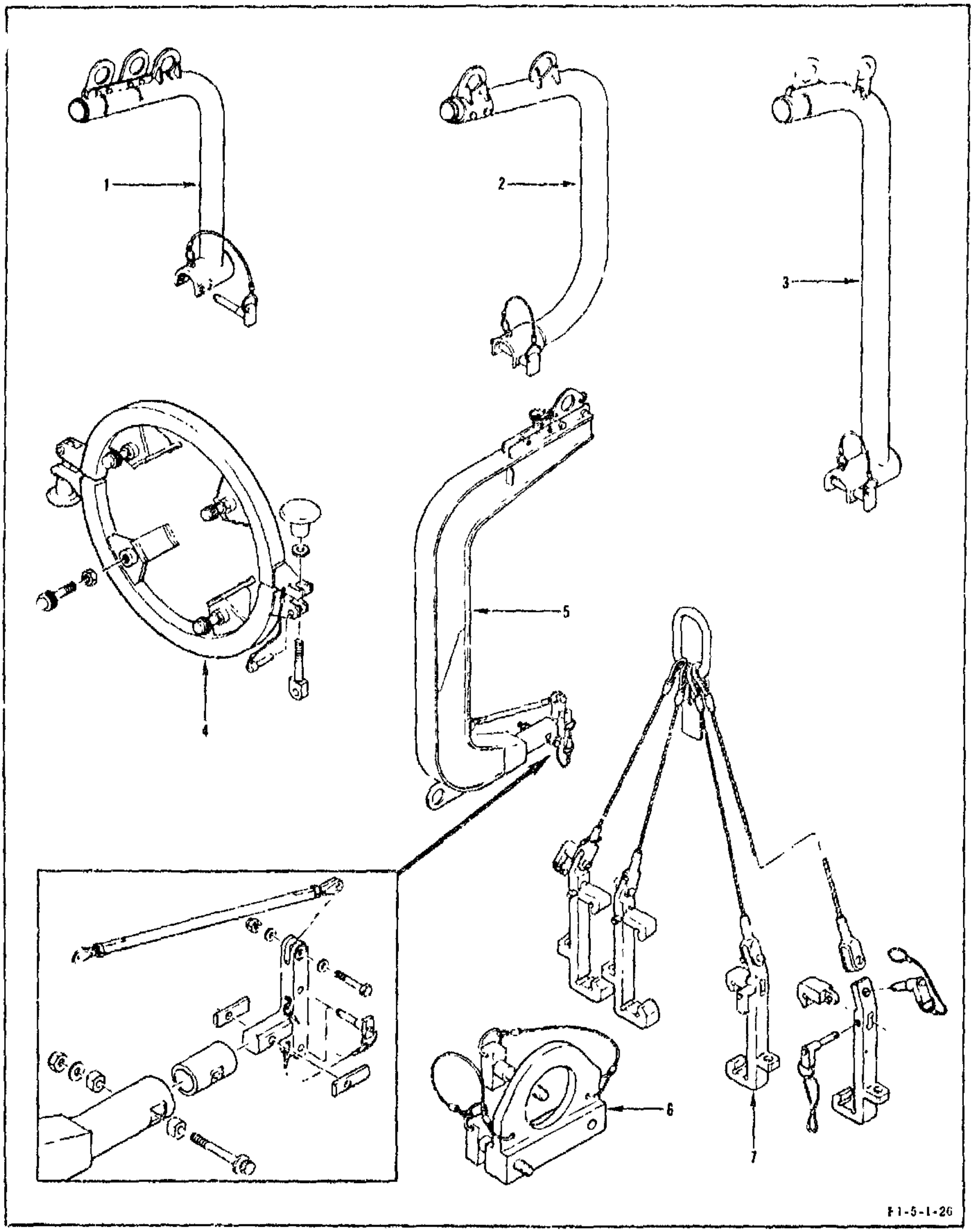


Figure 16-32. Component Handling Fixture Set (Sheet 1 of 7)

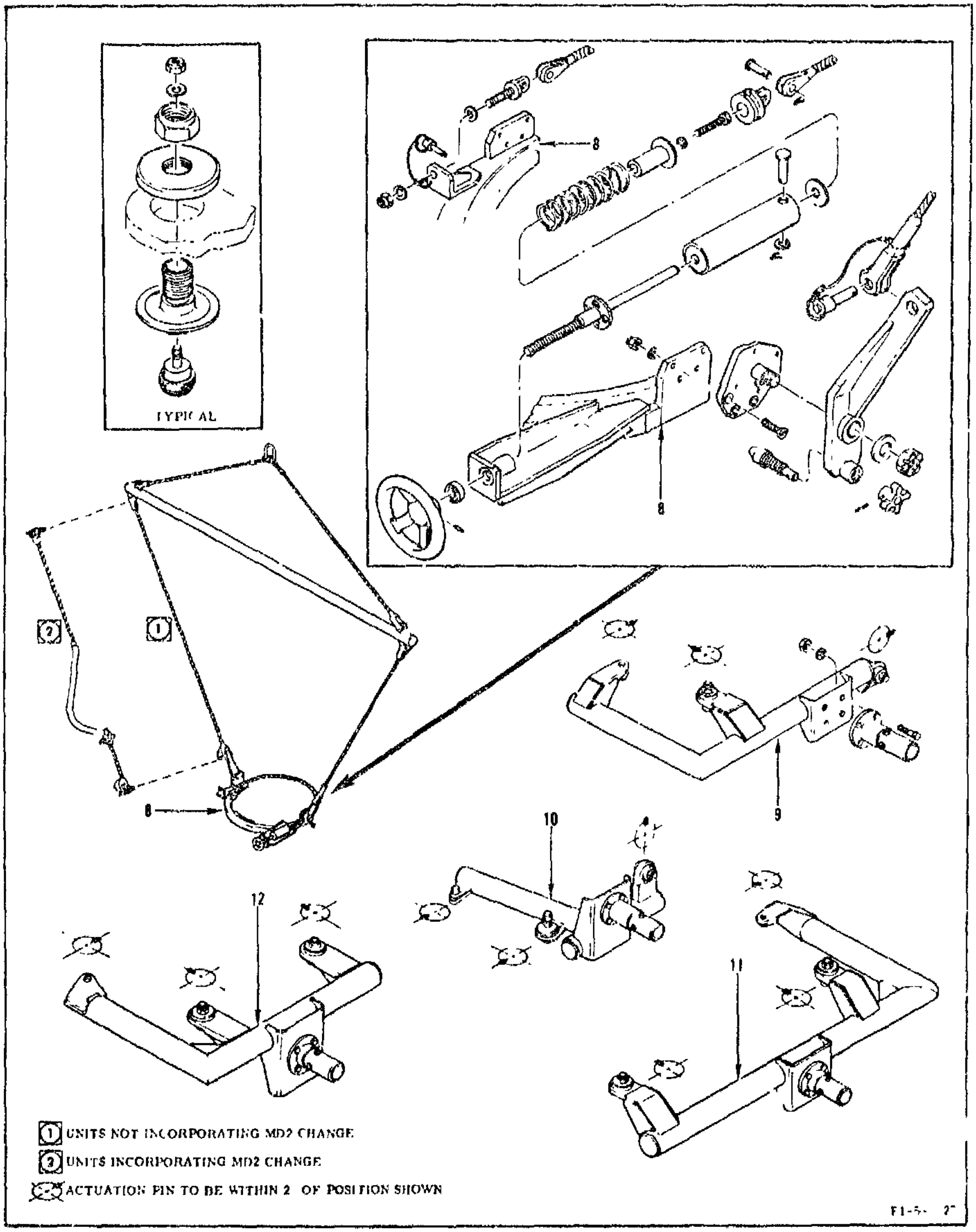


Figure 16-32. Component Handling Fixture Set (Sheet 2 of 7)

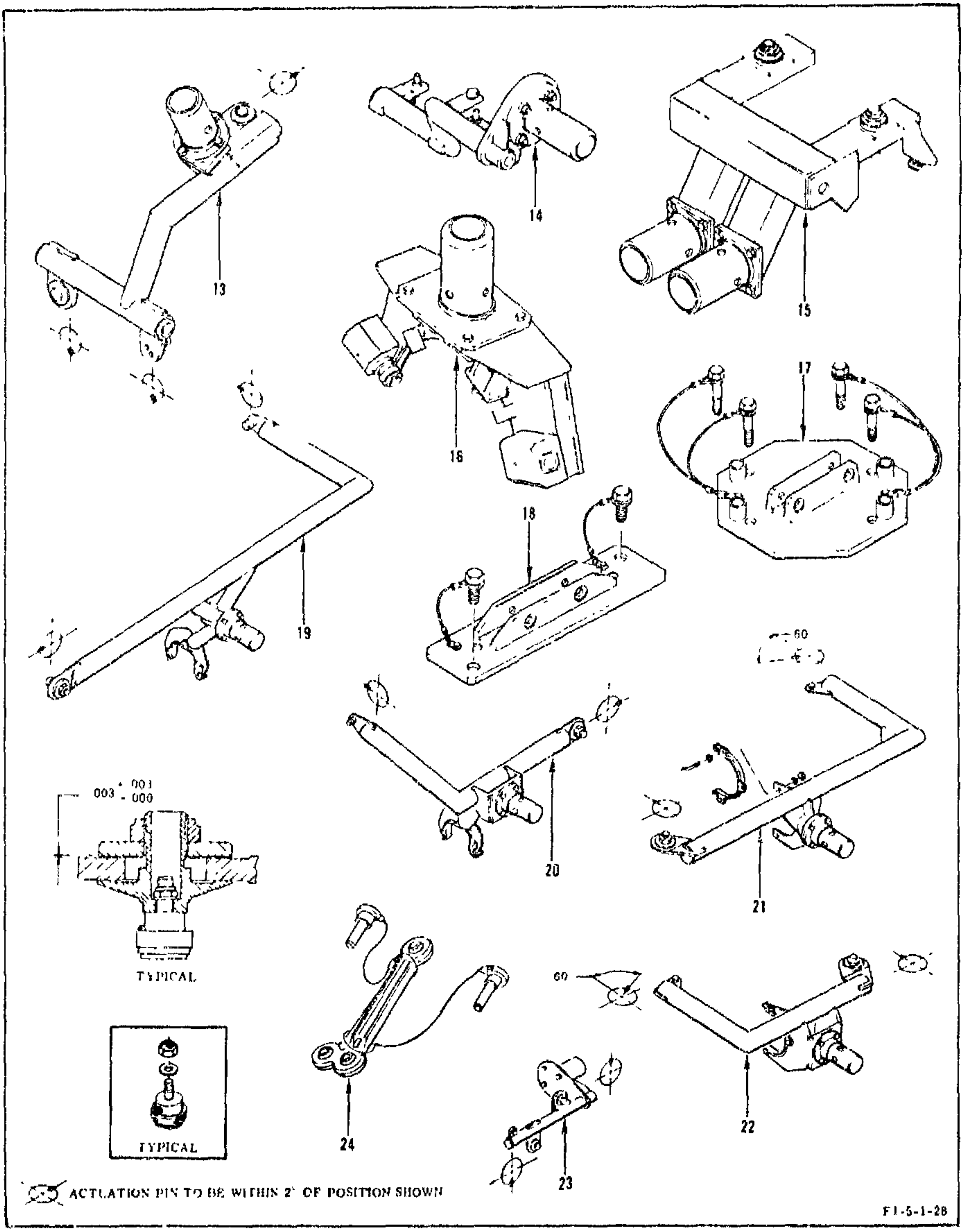


Figure 16-32. Component Handling Fixture Set (Sheet 3 of 7)

Index No.	Part No.	Description
1	9024921[a]	No. 1 C-beam fixture (F-1)
	9024921-11	No. 1 C-beam fixture (F-1)
	9024922	Lift fixture (X-3)
	9025157	Eye (F-3)
	AN104921	Bolt (F-3)
	LD153-0010-0013	Washer (F-3)
	MS20500-624	Nut (F-3)
	NAS1340C2C53F	Pin (F-3)
	RD191-2002-1312	Cable (F-3)
	28-2-G	Sleeve (F-3)
2	9024918	No. 2 C-beam fixture (F-1)
	9024919	Lift fixture (X-3)
	9024920	Eye (X-3)
	AN8-46	Bolt (F-3)
	LD153-0010-0018	Washer (F-3)
	MS20500-820	Nut (F-3)
	NAS1340C2C53F	Pin (F-3)
	RD191-2002-1312	Cable (F-3)
	28-2-G	Sleeve (F-3)
3	9024923[a]	No. 3 C-beam fixture (F-1)
	9024923-11	No. 3 C-beam fixture (F-1)
	9024924	Lift fixture (X-3)
	9025157	Eye (F-3)
	AN104921	Bolt (F-3)
	LD153-0010-0013	Washer (F-3)
	MS20500-624	Nut (F-3)
	NAS1340C2C53F	Pin (F-3)
	RD191-2002-1214	Cable (F-3)
	28-2-G	Sleeve (F-3)
4	9024929	Gimbal support (F-1)
	9024908	Support (F-2)
	TC-4A-CA2	Handle (F-3)
	2W2B-33-40-125	Washer (F-3)
	SWB-2CA2	Bolt (F-3)
	9024910	Screw (F-3)
	AN316-8	Nut (F-3)
	23-S-500-1000	Pin (F-3)
	RD191-2002-1214	Cable (F-3)
	28-1-C	Sleeve (F-3)
5	9024931	Injector, dome, gimbal block fixture (F-1)
	9024914	Frame (X-2)
	9024439	Arm (F-3)
	NAS1341C2C26	Pin (F-3)
	RD191-2002-1208	Cable (F-3)
	28-2-G	Sleeve (F-3)
	5B28-41-4A	Bolt (F-3)
	9024934	Body (F-3)
	9024903	Spacer (F-3)
	9024905	Spacer (F-3)
	LWB22-16-76	Bolt (F-3)
	LD153-0010-0028	Washer (F-3)
	NAS1022-C16	Nut (F-3)
	9024904	Turnbuckle (F-1)
	MS21250-10018	Bolt (F-3)
	MS2002-10	Washer (F-3)
	MS2002C10	Washer (F-3)
	MS20364-1018C	Nut (F-3)
	9024913	Eye (F-3)
	NAS1341C2C24	Pin (F-3)
	RD191-2002-121	Cable (F-3)
	28-2-G	Sleeve (F-3)
6	9024912	Lift fixture (F-1)
	9024907	Eye (F-3)
	NAS1341C2C24	Pin (F-3)
	RD191-2002-1210	Cable (F-3)
	28-2-G	Sleeve (F-3)
7	9024915	Interface panel sling (F-1)
	19-9024933	Cable (F-3)
	9025173	Adapter (F-3)
	9025174	Adapter (F-3)
	NAS1341C5C15D	Pin (F-3)
	RD191-2002-1310	Cable (F-3)
	28-2-G	Sleeve (F-3)
	NAS1336C5C16D	Pin (F-3)
	RD191-2002-1316	Cable (F-3)
	28-2-G	Sleeve (F-3)
8	9024925	Heat exchanger sling (F-1)
	9024925-11[b]	Heat exchanger sling (F-1)
	19-9024927	Cable (F-3)
	9024926	Bar (F-3)
	9026919[b]	Sling leg (F-3)
	19-9026920[b]	Cable (F-3)
	MS20392-11C51[b]	Pin (F-3)
	MS24665-439	Pin (F-3)
	19-9024928	Cable (F-3)
	NAS1342S2S19D	Pin (F-3)
	RD191-2002-1310	Cable (F-3)
	28-2-G	Sleeve (F-3)
	9024442	Lug (F-1)

(a) Contained in units with serial numbers 1001 through 1004.
(b) Units incorporating MD2 change.

Figure 16-32. Component Handling Fixture Set (Sheet 4 of 7)

Index No.	Part No.	Description
8 (cont)	AN320-16	Nut (F-3)
	MS27183-27	Washer (F-3)
	MS24665-292	Cotter pin (F-3)
	9024441-1	Plate (F-3)
	NAS1102-6-47	Screw (F-3)
	LD153-0010-0013	Washer (F-3)
	NAS679A6	Nut (F-3)
	9024441-2	Plate (F-3)
	NAS1102-6-30	Bolt (F-3)
	LD153-0010-0013	Washer (F-3)
	NAS679A6	Nut (F-3)
	9024440	Adapter (X-2)
	9024446	Screw (F-3)
	MS20002-8	Washer (F-3)
	MS20500-820	Nut (F-3)
	NAS1337S6S08D	Pin (F-3)
	RD191-2002-1308	Cable (F-3)
	28-2-G	Sleeve (F-3)
	19-9025180	Cable (F-3)
	MS20392-6C29	Pin (F-3)
	MS20002-7	Washer (F-3)
	MS24665-283	Cotter pin (F-3)
	9025176	Cylinder (F-3)
	9025172	Lug (F-3)
	MS20392-8C85	Pin (F-3)
	MS20002-9	Washer (F-3)
	MS24665-353	Cotter pin (F-3)
	9025198	Hand wheel (F-3)
	9025175	Shaft (F-3)
	23-S-250-0812	Pin (F-3)
	607	Bearing (F-3)
	MS20002-20	Washer (F-3)
	19-9025181	Spring (F-3)
	9025197	Bolt (F-3)
	MS20002-7	Washer (F-3)
	9025177	Sleeve (F-3)
9	9024431	No. 1 fuel line adapter (F-1)
	9025183	Adapter (X-2)
	9025151	Spud (F-3)
	AN7-11A	Bolt (F-3)
	LD153-0010-0016	Washer (F-3)
	NAS679A7	Nut (F-3)
	33115	Stud fitting (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
	9024949	Plate (F-3)
	9025182	Fitting (F-3)
	52NTE182	Nut (F-3)
10	9024434	No. 2 fuel line adapter (F-1)
	9025184	Adapter (X-2)
	9025152	Spud (F-3)
	AN7-11A	Bolt (F-3)
	LD153-0010-0016	Washer (F-3)
	NAS679A7	Nut (F-3)
	33115	Stud fitting (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
	9024949	Plate (F-3)
	9025182	Fitting (F-3)
	52NTE182	Nut (F-3)
11	9024429	No. 1 oxidizer line adapter (F-1)
	9025185	Adapter (X-2)
	9025153	Spud (X-3)
	AN7-11A	Bolt (F-3)
	LD153-0010-0016	Washer (F-3)
	NAS679A7	Nut (F-3)
	33115	Stud fitting (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
	9024949	Plate (X-3)
	9025182	Fitting (F-3)
	52NTE182	Nut (F-3)
12	9020242	No. 2 oxidizer line adapter (F-1)
	9025186	Adapter (X-2)
	9025154	Spud (F-3)
	AN7-11A	Bolt (F-3)
	LD153-0010-0016	Washer (F-3)
	NAS679C7	Nut (F-3)
	33115	Stud fitting (F-3)
	LD153-0010-0014	Washer (F-3)
	NAS679A6	Nut (F-3)
	9024949	Plate (F-3)
	9035182	Fitting (F-3)
	52NTE182	Nut (F-3)
13	9024436	Fuel inlet elbow adapter (F-1)
	9025189	Adapter (X-2)
	9025155	Spud (F-3)
	AN5-43	Bolt (F-3)
	AN5-11	Bolt (F-3)
	LD153-0010-0011	Washer (F-3)
	NAS679C5	Nut (F-3)
	33115	Stud fitting (F-3)
	LD153-0010-0013	Washer (F-3)

Figure 16-32. Component Handling Fixture Set (Sheet 5 of 7)

Index No.	Part No.	Description	Index No.	Part No.	Description
13	NAS679A6	Nut (F-3)		MS171590	Pin (F-3)
(cont)	9025191	Cap (F-3)		33115	Stud fitting (F-3)
	9025192	Housing (F-3)		LD153-0014-0017	Washer (F-3)
14	9020248	Main fuel valve adapter (F-1)		MS20500-624	Nut (F-3)
				MS27133-14	Washer (F-3)
	9025456	Adapter (X-3)		NAS679A6W	Nut (F-3)
	9025457	Spud (F-3)	17	9024906	Dome and gimbal block lifting adapter (F-1)
	AN7-14A	Bolt (F-3)			
	LD153-0010-0018	Washer (F-3)			
	MS20500-720	Nut (F-3)		9025178	Adapter (F-3)
	9025458	Pad (F-3)		9025188	Bolt (F-3)
	AN509C10-13	Screw (F-3)		5B28-41-5A	Bolt assembly (F-3)
	RD153-0113-0028	Washer (F-3)		RD191-2002-1310	Cable (F-3)
	NAS679A3W	Nut (F-3)		28-2-G	Sleeve (F-3)
	9025459	Bolt (F-3)	18	9024909	Injector lifting adapter (F-1)
	KSBY-6C	Bearing (F-3)			
	9025460	Retainer (F-3)		9025179	Adapter (F-3)
	9025461	Sustainer (F-3)		9025187	Bolt (F-3)
	AN509C10-15	Screw (F-3)		5B28-41-5A	Bolt assembly (F-3)
	LD153-0010-0007	Washer (F-3)		RD191-2002-1316	Cable (F-3)
	NAS679A3W	Nut (F-3)		28-2-G	Sleeve (F-3)
	RD191-2002-1312	Cable (F-3)	19	9025431	No. 1 rigid fuel duct adapter (F-1)
	28-2-G	Sleeve (F-3)			
15	9020250	Main oxidizer valve adapter (F-1)		9025435	Adapter (X-2)
				9025154	Spud (F-3)
	9020249	Adapter (X-2)		AN101413	Bolt (F-3)
	9020240	Spud (F-3)		MS20002-7	Washer (F-3)
	NAS1004-7A	Bolt (F-3)		NAS679A7	Nut (F-3)
	RD153-1002-0004	Washer (F-3)		9025182	Fitting (F-3)
	NAS679C4W	Nut (F-3)		52NTE182	Nut (F-3)
	9024911	Pad (F-3)		9024949	Plate (F-3)
	AN509C416R21	Screw (F-3)		33115	Stud fitting (F-3)
	RD153-0113-0048	Washer (F-3)		MS20002-6	Washer (F-3)
	NAS679C4W	Nut (F-3)		NAS679A6	Nut (F-3)
	33115	Stud fitting (F-3)		9025443	Bumper (F-3)
	9025169	Fitting (F-3)		AN101121	Bolt (F-3)
	9025170	Washer (F-3)		RD153-0113-0048	Washer (F-3)
	LD153-0010-0014	Washer (F-3)		MS20002-4	Washer (F-3)
	52NTE182	Nut (F-3)		NAS679A4	Nut (F-3)
	NAS679A6	Nut (F-3)	20	9025432	No. 2 rigid fuel duct adapter (F-1)
16	9024427	Gas generator adapter (F-1)			
				9025436	Adapter (X-2)
	9024426	Adapter (F-1)		9025154	Spud (F-3)
	9024947	Spud (F-3)		AN101413	Bolt (F-3)
	AN7-11A	Bolt (F-3)		MS20002-7	Washer (F-3)
	LD153-0014-0019	Washer (F-3)		NAS679A7	Nut (F-3)
	MS20500-720	Nut (F-3)		9025182	Fitting (F-3)
	9024437	Lug (X-3)		52NTE182	Nut (F-3)
	9024438	Lug (X-3)		9024949	Plate (F-3)

Figure 16-32. Component Handling Fixture Set (Sheet 6 of 7)

Index No.	Part No.	Description
20 (cont)	33115	Stud fitting (F-3)
	MS20002-6	Washer (F-3)
	NAS679A6	Nut (F-3)
	9025443	Bumper (F-3)
	AN101121	Bolt (F-3)
	RD153-0113-0048	Washer (F-3)
	MS20002-4	Washer (F-3)
	NAS679A4	Nut (F-3)
21	9025433	No. 1 rigid oxidizer duct adapter (F-1)
	9025437	Adapter (X-2)
	9025154	Spud (F-3)
	AN101413	Bolt (F-3)
	MS20002-7	Washer (F-3)
	NAS679A7	Nut (F-3)
	9025182	Fitting (F-3)
	52NTE182	Nut (F-3)
	9024949	Plate (F-3)
	33115	Stud fitting (F-3)
	MS20002-6	Washer (F-3)
	NAS679A6	Nut (F-3)
	9025445	Bumper (F-3)
	RD153-0113-0048	Washer (F-3)
	AN101121	Bolt (F-3)
	MS20002-4	Washer (F-3)
	NAS670A4	Nut (F-3)
22	9025434	No. 2 rigid oxidizer duct adapter (F-1)
	9025438	Adapter (X-2)
	9025154	Spud (F-3)
	AN101414	Bolt (F-3)
	MS20002-7	Washer (F-3)
	NAS679A7	Nut (F-3)
	9025182	Fitting (F-3)
	52NTE182	Nut (F-3)
	9024949	Plate (F-3)
	33115	Stud fitting (F-3)
	MS20002-6	Washer (F-3)
	NAS679A6	Nut (F-3)
	9025445	Bumper (F-3)
	AN101121	Bolt (F-3)
	RD153-0113-0048	Washer (F-3)
	MS20002-4	Washer (F-3)
	NAS679A4	Nut (F-3)
23	9025463	Main fuel valve solid lines adapter (F-1)
	9025464	Adapter (X-2)
	9025457	Spud (F-3)
	AN7-13A	Bolt (F-3)
	MS20500-720	Nut (F-3)
	LD153-0010-0016	Washer (F-3)
	9025465	Housing (F-3)
	9025191	Cap (F-3)
	33115	Stud fitting (F-3)
	LD153-0010-0013	Washer (F-3)
	NAS679C6	Nut (F-3)
24	9025193	Turbopump support strut (F-1)
	9025468	Strut (X-2)
	51320-25	Pin (F-3)
	51320-35	Pin (F-3)
	RD191-2002-1324	Cable (F-3)
	28-2-G	Sleeve (F-3)

Figure 16-32. Component Handling Fixture Set (Sheet 7 of 7)

16-154. SHIPPING AND STORING.

16-155. Prepare component handling fixture set for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, EA, LK, and K.

16-156. ENGINE HANDLER G4069.

16-157. DESCRIPTION.

16-158. The engine handler is a rectangular chassis that is mounted on four dual casters with individual wheel brakes and has a detachable tow bar. Crossmembers form a three-point engine mounting structure. The mounting structure consists of engine attachment fittings, struts, supports, and a guy assembly. Lugs welded to crossmembers and chassis are provided for storing the fittings, struts, supports, and guy assembly. (See figure 16-33 for leading particulars.)

Length	192 inches
Width	144 inches
Height	28 inches
Weight	4,000 pounds (approx)
Maximum load capacity	21,600 pounds
Proof load	43,200 pounds
Operating surface	Concrete floor and adjacent concrete aprons
Maximum towing speed	2-1/2 mph
Maximum ramp angle (with engine installed)	2 degrees

Figure 16-33. Leading Particulars for Engine Handler

16-159. OPERATION.

16-160. The engine handler is used to support and move the engine in a horizontal position within assembly buildings, repair shops, or hangars during engine building and maintenance. When there is a considerable distance between points of use, the handler must be transported by another vehicle. The handler accommodates the complete engine, including the nozzle extension and gimbal actuators. The handler is not designed for transporting the engine on another vehicle. The fittings attach to pads on each side of the engine, and the front support clevis attaches to a lug on the bottom of the engine. The struts and supports provide minor adjustments, and the guy assembly prevents upward movement of the thrust chamber exit.

16-161. MAINTENANCE.

16-162. Maintenance of the engine handler consists of proof testing, disassembling, assembling, and servicing. Repaint surface area and lettering, as required, when paint becomes chipped, scratched, or worn and when lettering becomes illegible. (Refer to section I for painting information.) Clean engine handler, as applicable, as outlined in section I.

16-163. PROOF TESTING. Proof-test engine handler at 24-month intervals using weight configuration shown in figure 16-34. The proof load required for proof testing must be a minimum of 150 percent of the working load of the handler. The proof-test interval may be extended if one of the conditions of figure 16-2 exists.

WARNING

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

NOTE

Parts indexed in the following procedure are illustrated in figure 16-35.

a. Obtain engine dummy weight assembly 88-9014883 and assorted weights shown in figure 16-34.

b. Connect an overhead crane and sling that has a minimum load capacity of 25 tons to test load.

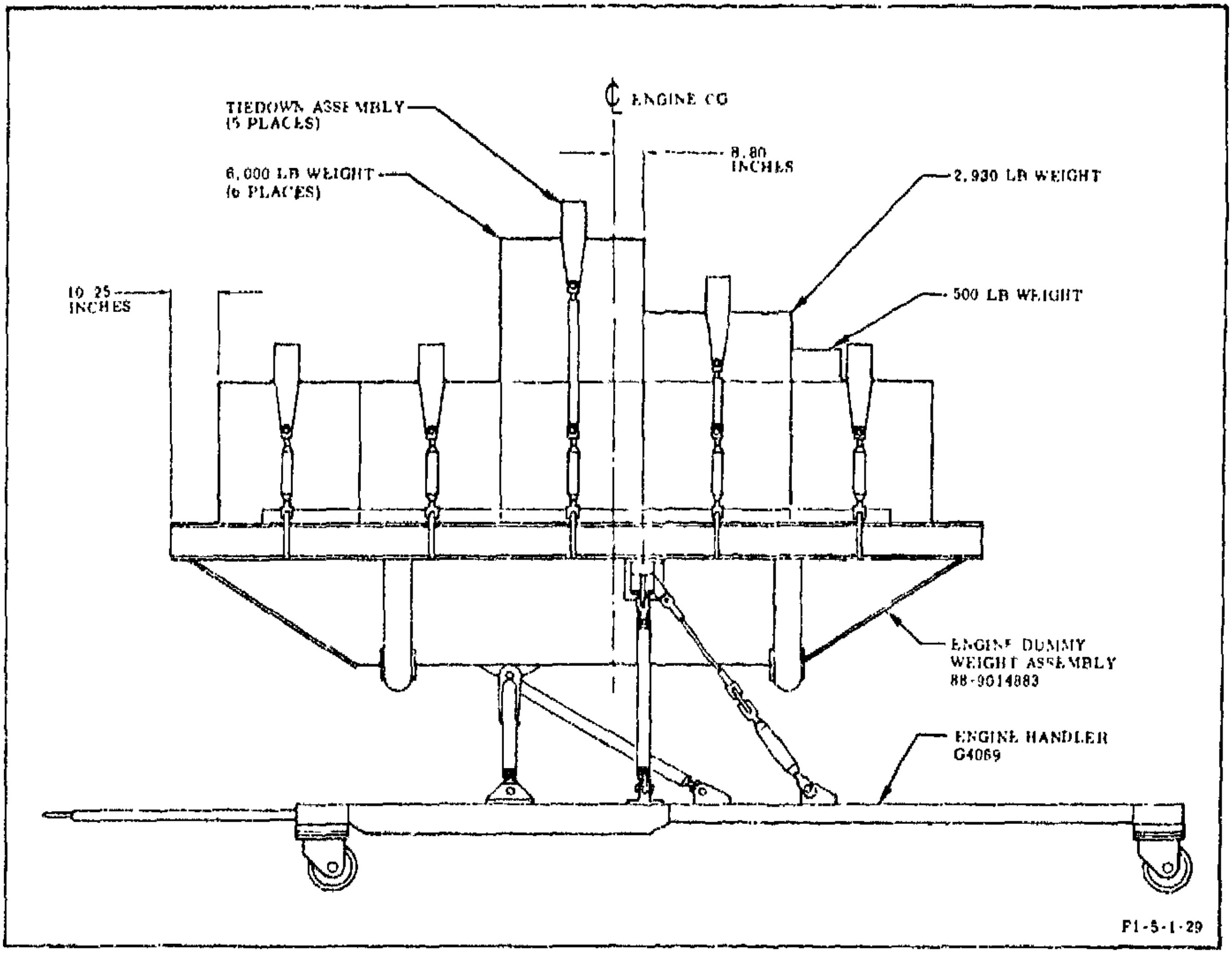


Figure 16-34. Recommended Proof-Test Setup for Engine Handler

c. Lift test load high enough to position engine handler underneath.

d. Make sure that wheels of handler are alined fore and aft and that brakes are unlocked.

e. Remove fittings (1, 2) from engine handler and install fittings, with FORWARD SIDE marking facing toward front of handler and HANDLER SIDE marking facing down, on test load attachment points. Torque bolts to 200-270 ft-lb.

f. Loosen double nuts on clevis (10). Raise and aline clevis to meet lug on front when test load is lowered.

g. Adjust brace (11) to position support (7) perpendicular to handler frame.

h. Adjust screws of supports (4, 6) to obtain 6-5/8 inches between connector face and support face. Tighten locknuts.

i. Lower test load until fittings (1, 2) seat in supports (4, 6) and pin can be inserted securing test load to clevis (10).

NOTE

To improve alinement or roll of test load to handler, adjust engine handler right-hand aft support (6) and left-hand aft support (4) and strut (3) simultaneously.

j. Tighten inner nut on clevis (10) finger-tight and lock in place with outer nut.

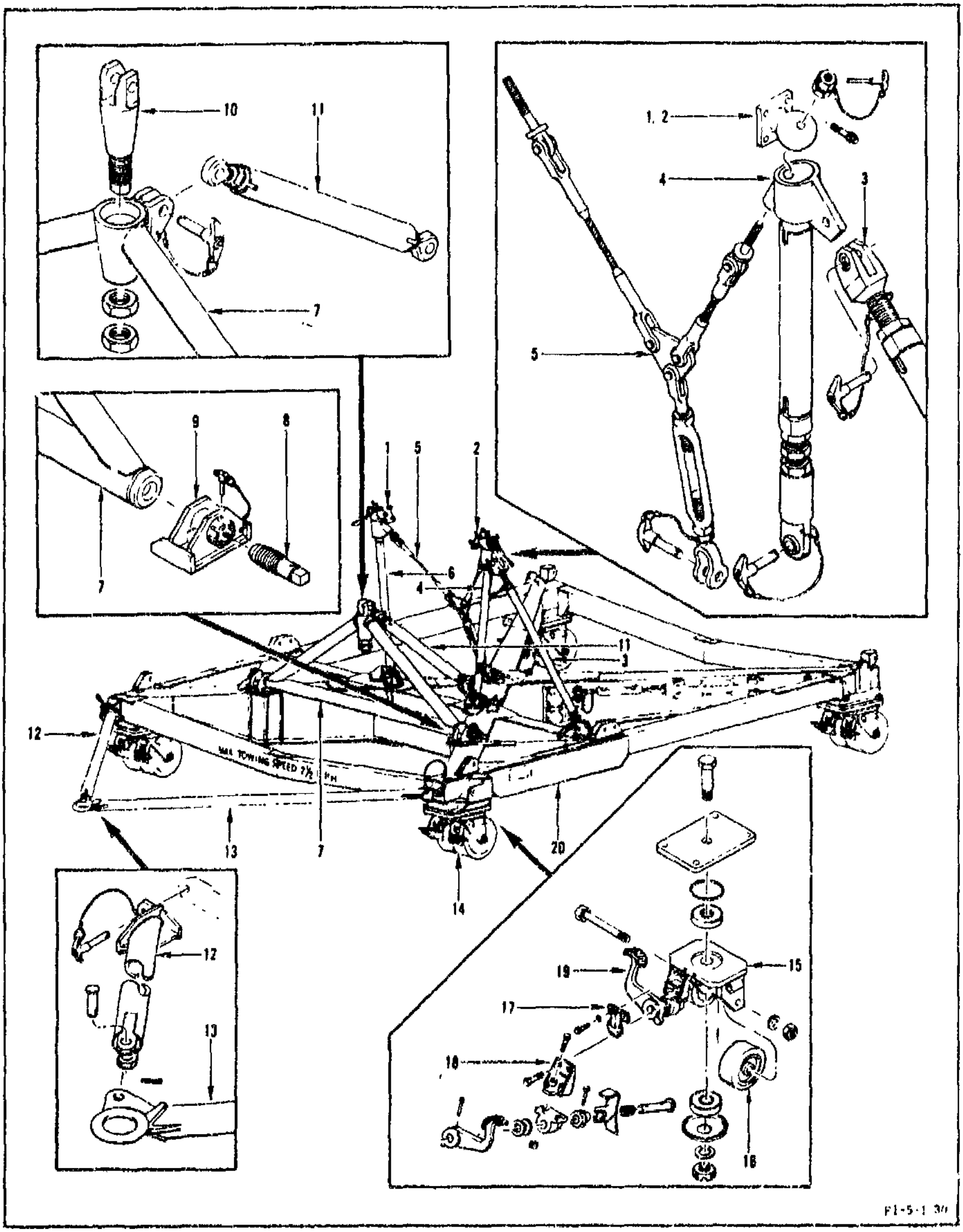


Figure 16-35. Engine Handler (Sheet 1 of 3)

Index No.	Part No.	Description
1	9014636-1	Fitting (F-3)
2	9014636-2	Fitting (F-3)
	MS21250H12012	Bolt (F-3)
3	9014644	Strut (F-1)
	9014892	Strut (F-3)
	9014893	Rod end (F-3)
	NAS509-28	Nut (F-3)
	BLS16TA28S	Pin (F-3)
	RD191-2001-2114	Cable (M-3)
	28-1-C	Sleeve (F-3)
	9014894	Rod end (F-3)
	NAS509L28	Nut (F-3)
	BLS16TA23S	Pin (F-3)
	RD191-2001-2114	Cable (M-3)
	28-1-C	Sleeve (F-3)
4	9014641	Support (F-1)
	9014890	Support (F-3)
	9014895	Connector (F-3)
	9014896	Screw (F-3)
	NAS509-28	Nut (F-3)
	NAS509L28	Nut (F-3)
	BLS16TA23S	Pin (F-3)
	RD191-2001-2112	Cable (M-3)
	28-1-C	Sleeve (F-3)
5	9014630	Guy (F-1)
	9014639	Link (F-3)
	NAS1047-16P120	Turnbuckle (F-3)
	MS20392-11C91	Pin (F-3)
	MS24665-423	Pin (F-3)
	BLS14TA28S	Pin (F-3)
	RD191-2001-2112	Cable (M-3)
	28-1-C	Sleeve (F-3)
	Type 11-6-6-21.25	Sling (F-3)
	9014897	Connector (F-3)
	9014898	Nut (F-3)
	BLS4TA21S	Pin (F-3)
	RD191-2001-2112	Cable (M-3)
	28-1-C	Sleeve (F-3)
6	9014643	Support (F-1)
	9014891	Support (F-3)
	9014895	Connector (F-3)
	9014896	Screw (F-3)
	NAS509-28	Nut (F-3)
	NAS509L28	Nut (F-3)
	BLS16TA23S	Pin (F-3)
	RD191-2001-2112	Cable (M-3)
	28-1-C	Sleeve (F-3)
7	9012667	Support (F-2)
8	9014647	Screw (F-3)
	BLS6TA25S	Pin (F-3)
9	9014645	Bracket (F-3)
	AN12-21A	Bolt (F-3)
	MS20500-1216	Nut (F-3)
	LD153-0011-0027	Washer (F-3)
10	9014646	Clevis (F-3)
	9014650	Nut (F-3)
	50249-35	Pin (F-3)
11	9012669	Brace (F-2)
	HBL-20ES	Rod end (F-3)
	HB-20ES	Rod end (F-3)
	NAS509L20	Nut (F-3)
	NAS509-20	Nut (F-3)
	50249-30	Pin (F-3)
12	9014878	Strut (F-2)
	BLS16GT30F	Pin (F-3)
	RD191-2002-1312	Cable (M-3)
	28-2-G	Sleeve (F-3)
13	9014877	Coupler (F-2)
	MS20392-11C115	Pin (F-3)
	LD153-0001-0030	Washer (F-3)
	MS24665-423	Pin (F-3)
	BLS16GT30F	Pin (F-3)
	RD191-2002-1312	Cable (M-3)
	28-2-G	Sleeve (F-3)
14	12433	Caster (F-1)
	AN12-26A	Bolt (F-3)
	MS20500-1216	Nut (F-3)
	LD153-0011-0027	Washer (F-3)
15	23084	Caster rig (F-2)
	34065MB-3	Horn (F-2)
	36047	Baseplate (F-2)
	MS150465	Ball bearing (F-2)
	LM67048	Cone (F-2)
	LM67010	Cup (F-2)
	AS330-2012	Nut (F-2)
	AN380-4-7	Pin (F-3)
	51443-146	Axle (F-2)
	AS364-2012	Nut (F-2)
	11011-12	Retainer (F-2)
	6230-11	O-ring (F-2)
	5033	Fitting (F-3)
	6230-50	O-ring (F-2)
16	EHD12-T-10	Wheel (F-2)
	30074	Wheel (F-2)
	10034	Retainer (F-2)

Figure 16-35. Engine Handler (Sheet 2 of 3)

Index No.	Part No.	Description	Index No.	Part No.	Description
16	10002Y-T30	Spacer (F-2)		AS364-624	Nut (F-3)
(cont)	6227-23	O-ring (F-2)		51764R	Brake (F-1)
	3188	Cone (F-2)		51764L	Brake (F-1)
17	54043	Swivel lock (F-2)		51042-2	Shoe (F-3)
	AS60-6-8	Screw (F-2)		51042-1MA	Housing (F-3)
	MS35333-42	Lockwasher (F-3)		51763	Pedal (F-3)
18	51600	Bracket (F-3)		3/16X1-1/4LG	Roll pin (F-3)
	AS60-6-10	Screw (F-3)		51042-7	Shaft (F-3)
	LD153-0011-0016	Washer (F-3)		51042-4	Cam (F-3)
	AS364-624	Nut (F-3)		11761-4	Spring (F-3)
19	51765R	Brake (F-1)		AN960-1216	Washer (F-3)
	51765L	Brake (F-1)		3/16X1-1/8LG	Roll pin (F-3)
	AS60-6-16	Screw (F-3)	20	9021724	Frame (X-2)
	LD153-0011-0016	Washer (F-3)		RD171-1032-0001	Plate (F-3)

Figure 16-35. Engine Handler (Sheet 3 of 3)

k. Insert connectors of guy (5) through fittings (1, 2), and tighten nuts until lockpin can be installed.

l. Torque turnbuckle of guy (5) to 1,700-1,800 in-lb.

m. Relieve all tension on hoist and sling (do not disconnect sling) for 3 minutes; then remove test load.

n. Inspect engine handler for any distortion, weld cracks, or yielding.

o. Remove fittings (1, 2) from test load, and store on engine handler.

p. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate, including new inspection date. Install new plate where old plate was removed.

16-164. DISASSEMBLING. (See figure 16-35.) Disassemble engine handler as required to accomplish necessary repairs or replacement.

16-165. ASSEMBLING. (See figure 16-35.) The following steps include the special instructions required during assembly:

a. Torque nuts on bracket (9) to 800-1,000 in-lb.

b. Torque nuts of casters (14) to 800-1,000 in-lb.

c. Tighten nut of kingpin and nut of axle of caster rig (15) until all play is removed; then loosen nut 1/4 to 1/2 turn.

d. Torque screw of swivel lock (17) to 110-130 in-lb.

e. Torque nut of bracket (18) to 110-130 in-lb.

f. Torque nut of brake (19) to 110-130 in-lb.

16-166. SERVICING. Servicing the engine handler consists of lubricating threads and packing caster bearings. (Refer to section I for lubrication procedures (methods).)

a. Lubricate (Method A) threads of guy (5, figure 16-35) and clevis (10) with gear grease (MIL-G-23827) at 12-month intervals.

b. Pack (Method Y) bearings of caster rig (15) and wheel (16) with gear grease (MIL-G-23827) at 12-month intervals.

16-167. SHIPPING AND STORING.

16-168. Prepare engine handler for shipping or storing in accordance with MIL-P-116, Method III, and storage markings stenciled on the handler.

16-169. NOZZLE EXTENSION HANDLING FIXTURE G4080.

16-170. DESCRIPTION.

16-171. The nozzle extension handling fixture is a conical frame structure designed to fit into the exit end of the thrust chamber nozzle extension. Eight shock-mounted support pads are located on the base ring of the fixture to contact the aft end of the nozzle extension. Eight adjustable nozzle exit pads are located near the support pads to bear on the inner surface of the nozzle extension. Eight adjustable struts, hanging from the apex of the fixture, extend to bear on the forward flange of the nozzle extension. A forward lifting cable, attached at the apex end of the fixture, and an aft hoist extension, located on the base ring of the fixture, are used when lifting or rotating the fixture. (See figure 16-36 for leading particulars.)

Height	85 inches
Diameter	150 inches
Weight	1,525 pounds
Maximum load capacity	2,000 pounds
Proof load	4,000 pounds
Forward lift cable	6,880 pounds

Figure 16-36. Leading Particulars for Nozzle Extension Handling Fixture

16-172. OPERATION.

16-173. The nozzle extension handling fixture is a portable unit designed to hold the nozzle extension in a rigid position during rotating, shipping, or storing. The nozzle extension is lowered over the conical-shaped handling fixture until contact is made with shock-mounted support pads on the base ring of the fixture. Nozzle exit pads are adjusted to contact the inner surface of the nozzle extension. Adjustable nozzle flange struts are extended until the pads contact the forward flange of the nozzle extension. Cables secure the flange struts in the extended position.

16-174. MAINTENANCE.

16-175. Maintenance of the nozzle extension handling fixture consists of proof testing, disassembling, assembling, and servicing. Repaint surface area and/or lettering, as required, when paint becomes chipped, scratched, or worn and when lettering becomes illegible. (Refer to section I for painting information.) Clean fixture, when applicable, as outlined in section I.

16-176. PROOF TESTING. The nozzle extension handling fixture is proof tested in conjunction with Nozzle Extension Handling Adapter G4081 (paragraph 16-182). The nozzle extension handling fixture and adapter are proof tested at 24-month intervals. The forward lift cable is proof tested at 12-month intervals. (See figure 16-37.) The proof load required for proof testing must be a minimum of 150 percent of the working load of the fixture, adapter, and sling. The proof-test interval may be extended for the fixture and adapter if one of the conditions of figure 16-2 exists. The proof-test interval may be extended for the forward lift cable if the cable is clean, packaged, and stored. If proof-test expires during storage of the cable, proof testing becomes mandatory before use.

WARNING

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

NOTE

> Parts indexed in the following procedure are illustrated in figure 16-38.

a. Obtain nozzle extension proof-weight assembly 86-9027028.

b. Connect an overhead hoist that has a minimum load capacity of 5 tons to Engine Handler Sling G4052.

c. Remove cables 19-9019477, and install cables 9021538 in their place.

d. Place Nozzle Extension Handling Fixture G4080 on a flat, paved surface.

e. Turn cable-adjusting nut to outer end of screw, and make sure nozzle flange struts on fixture are in retracted position.

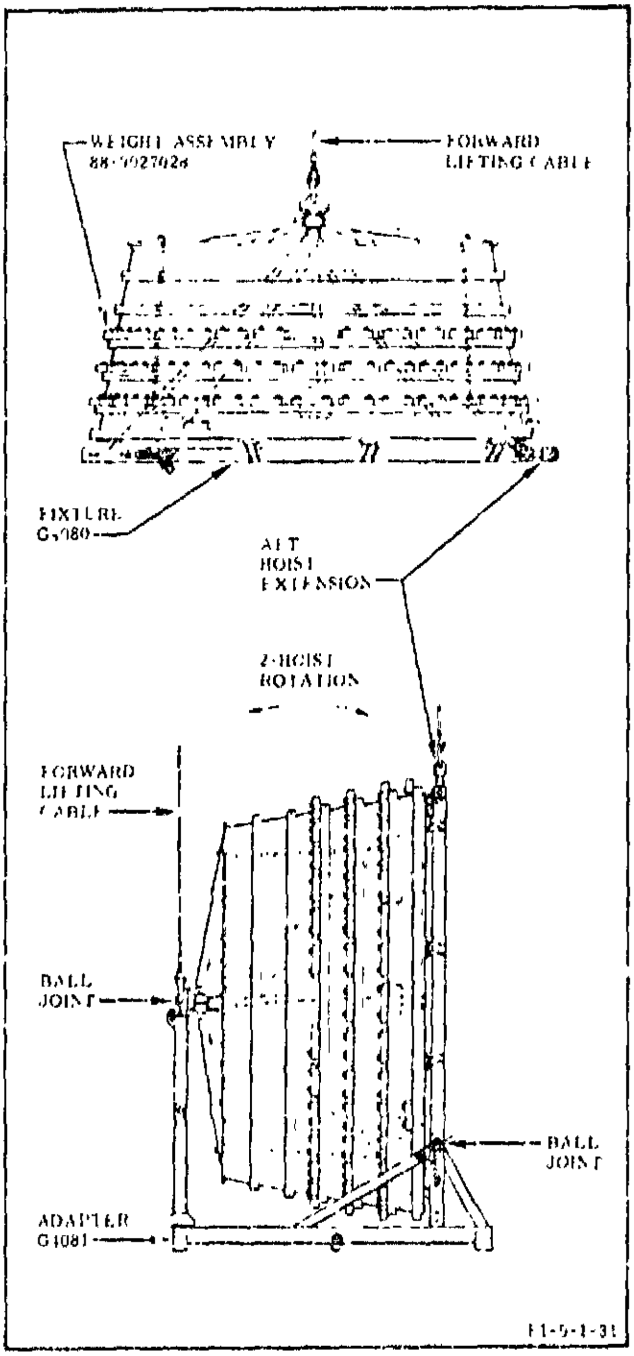


Figure 16-37. Recommended Proof-Test Setup for Nozzle Extension Handling Fixture and Adapter

f. Remove quick-release pin from apex end of each nozzle flange strut, lift strut until pin can be inserted through upper hole under strut, then lower strut against pin.

g. Temporarily secure forward lift cable near pad end of one nozzle flange strut.

NOTE

Securing the cable to the strut makes the cable accessible after the weight assembly is installed on the fixture.

h. Remove quick-release pins from adjustment screws on nozzle exit struts located to the left and right of fixture zero-degree index point. Turn adjustment screw until pads are in neutral position. Install quick-release pins.

i. Using procedure in step h, retract all remaining nozzle exit pads.

j. Connect lower ends of cables to 4 lifting lugs near small end of weight assembly.

k. Slowly lift weight assembly with hoist to a height of approximately 7 feet and suspend it concentrically over fixture.

l. Slowly lower weight assembly until it contacts the 2 neutral nozzle exit pads and all 8 base ring pads.

m. Starting with a 2 nozzle exit pads opposite the 2 neutral pads, turn adjustment screw until adjustable pads lightly contact weight assembly.

n. Torque adjustment screws on 2 nozzle exit pads, located opposite the 2 neutral pads, to 300-450 in-lb. Install quick-release pins.

o. Torque adjustment screw on 3 nozzle exit pads, located between and opposite the 2 neutral pads, to 300-450 in-lb; torque remaining 3 pads to 300-450 in-lb. Install quick-release pins in adjustment screws.

p. Remove quick-release pin from adjustment screw on the 2 neutral nozzle exit pads. Torque screw to 300-450 in-lb. Install quick-release pin.

q. Lift each nozzle flange strut in turn, and remove quick-release pin. Extend strut until flange pad engages weight assembly flange, with alinement pin of pad in appropriate hole in flange. Insert quick-release pin in strut.

NOTE

The appropriate hole can be found by moving the flange strut sideways in each direction until it stops, then determining the hole nearest the center of full travel.

r. Torque each nozzle flange strut cable preload nut to 35-40 in-lb. Torque each jam-nut to 170-230 in-lb.

s. Disconnect cables from weight assembly lifting lugs, and remove Engine Handler Sling G4052.

t. Connect forward lift cable of fixture to hoist. Slowly lift loaded fixture clear of floor and hold for 3 minutes.

u. Lower loaded fixture to floor, and examine fixture for distortion and yielding and cable for frays, broken strands, or kinks.

NOTE

A solid test load of 8,880 pounds may be used in lieu of this test to proof-test the forward lifting cable.

v. Lift loaded fixture approximately 4 feet above floor.

w. Extend aft hoist extension from fixture base ring and secure in place with quick-release pin.

x. Attach a 3/4-inch shackle to aft hoist extension, and secure second hook from a hoist to shackle. Slowly lift aft end of fixture until loaded fixture is in a horizontal position. Hold for 3 minutes, and examine fixture for distortion and yield.

y. With adapter G4081 placed on a flat, paved surface, disengage forward support from stored position and swing support forward until end rests on floor.

z. Back out fixture base ring stop bolt.

aa. Position loaded fixture over adapter until ball joints on fixture aline with ball joints on adapter.

ab. Slowly lower loaded fixture until ball joints are mated. Do not relieve tension on cables.

ac. On adapter, swing forward support to vertical position and aline ball joints on fixture and adapter. Lift load as required.

ad. Slowly lower loaded fixture until all ball joints are properly seated. Secure forward support ball joint with T-bolt. Torque nut to 240-300 in-lb.

ae. Remove lower end of each turnbuckle from brackets on adapter, attach to fixture ball joint bracket, then tighten turnbuckle handtight. Torque turnbuckle rod end nut to 240-300 in-lb.

af. Adjust base ring stop bolt until it contacts fixture. Torque locknut to 360-480 in-lb.

ag. Disconnect hoists from forward lift cable and aft hoist extension, and using Engine Handler Sling G4052 connect cables 19-9019477 to 4 outboard lift rings on adapter.

ah. Slowly lift loaded adapter clear of floor and hold for 3 minutes; then lower adapter to floor and examine adapter and fixture for distortion and yielding.

ai. Disconnect Engine Handler Sling G4052 from adapter. Connect 2 hoists to forward lift cable and aft hoist extension.

aj. Take up slack in forward and aft cables and back out base ring stop bolt.

ak. Loosen and disconnect end of each turnbuckle at fixture ball joint bracket. Store turnbuckles on adapter bracket.

al. Loosen and disconnect T-bolt that secures forward support ball joint.

am. Slowly raise hoist attached to forward lifting cable until forward support can be disengaged and swung forward until end rests on floor.

an. Slowly raise hoists until loaded fixture clears adapter (approximately 4 feet above floor).

ao. Lower aft hoist until loaded fixture is in vertical position.

ap. Remove cable hook and shackle from aft hoist extension. Retract extension and secure with quick-release pin.

aq. Slowly lower forward hoist until loaded fixture rests on floor. Disconnect cable from hoist. Store cable.

ar. Connect overhead hoist to and suspend Engine Handler Sling G4052 above weight assembly.

as. Connect sling cables 9021538 to 4 lifting lugs near small end of weight assembly. Lift sling until slack is removed from cables.

at. On nozzle flange struts, turn cable-adjusting nut to outer end of screw.

au. Remove quick-release pin from each nozzle flange strut, lift strut until flange clears weight assembly flange, then retract strut and install quick-release pin.

av. Lower each flange strut until it contacts quick-release pin at apex of strut.

aw. Remove quick-release pin from each nozzle exit pad adjustment screw. Turn screw until exit pad is in retracted position. Install quick-release pin in adjustment screw.

ax. Slowly raise weight assembly until it clears fixture.

ay. Move weight assembly from above fixture and carefully lower weight onto floor. Disconnect sling cables from weight assembly and secure equipment.

az. Remove existing proof-load plate RD171-1032-0001 and, using stencil-cutting setting of a typewriter, transfer all information to new proof-load plate including new inspection date. Install new plate where old plate was removed.

16-177. DISASSEMBLING. (See figure 16-38.) Disassemble handling fixture as required to accomplish necessary repair or replacement.

16-178. ASSEMBLING. (See figure 16-38.) The following steps include the special instructions required during assembly:

a. Lubricate (Method A) threads and (Method Z) seat of screw (3) with Molykote G paste (Dow Corning Corp).

b. Adjust jamnut on screw (3) to 0.010 -0.003 inch between face of washer and collar on screw. Torque locknut to 600-790 in-lb.

c. Install pad bottom mounting bolt of arm (4) and tighten until 1.080 ±0.020 inches exists between pad and plate of arm. Adjust top bolt to aline surface of pad 10 degrees and 30 minutes from vertical; adjust the 2 remaining bolts to maintain an equal distance ±0.020 inch between pad and plate on arm. Dimension must be measured at centerline of bolt. Torque nuts to 250-330 in-lb.

d. Torque nut at apex of arm (6) to 50-100 in-lb. Torque nut at support and arm (6) to 10-20 in-lb over locking torque.

e. Torque stud of pad (9) to 30-50 in-lb.

f Torque bolt of pad (9) to 150-190 in-lb.

16-179. SERVICING. Servicing the nozzle extension handling fixture consists of applying corrosion preventative RB0210-016 (Rocketdyne) to ball joints and preservative WD-40 (Rocket Chemical Co) on plate surface of arm 9026670 at 6-month intervals. If corrosion exists on arm, clean and apply preservative as outlined in section I.

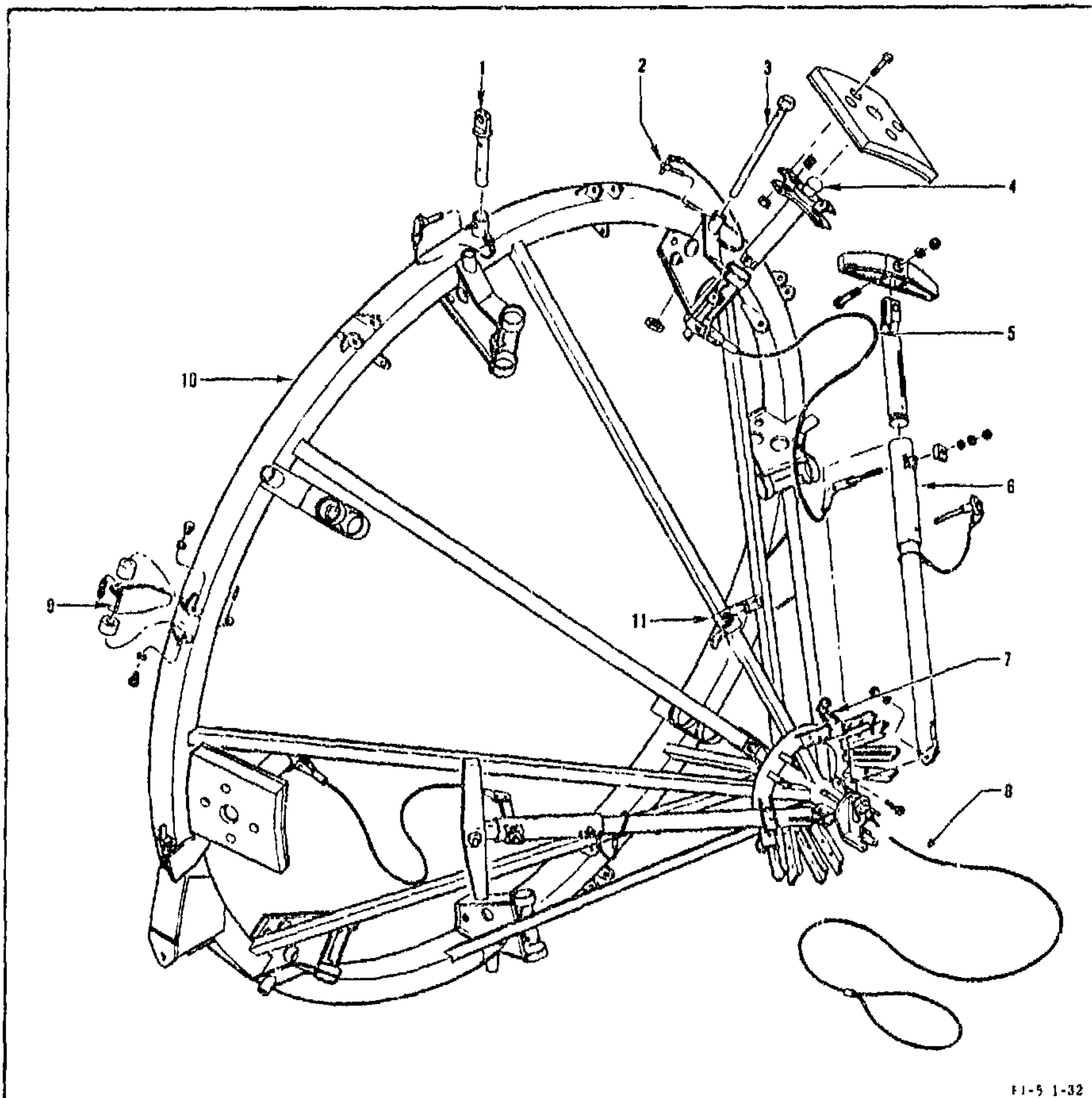
16-180. SHIPPING AND STORING.

16-181. The nozzle extension handling fixture is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping instructions. Prepare handling fixture for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, EA, 00, and 0, and as follows: (See figure 16-38.)

a. Secure arms (6) in stored position with pins (7) and straps (11).

b. Secure cables (5) to fixture frame.

c. Stow forward lift cable at apex of fixture.



Index No.	Part No.	Description
1	9023725	Extension (F-3)
	MS17984-820	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1307	Cable (F-3)
2	NAS1354S2S21	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1308	Cable (F-3)
3	9026673	Screw (F-3)
	9026657	Seat (F-3)

Index No.	Part No.	Description
	AN316-12R	Nut (F-3)
	2W2SP-49-58-62	Washer (F-3)
	9026674	Trunnion(F-3)
	9026675	Nut (F-3)
	NAS607-4-10	Pin (F-3)
	NAS1354S2S21	Pin (F-3)
	28-2-G	Sleeve (F-3)
	RD191-2002-1308	Wire rope(F-3)

Figure 16-38. Nozzle Extension Handling Fixture (Sheet 1 of 2)

Index No.	Part No.	Description	Index No.	Part No.	Description
4	9026670	Arm (F-2)		9026664	Support (F-1)
	9026671	Link (F-3)		AN30-40A	Bolt (F-3)
	MS20392-9C39	Pin (F-3)		MS20364-1018C	Nut (F-3)
	MS24665-353	Pin (F-3)		LD153-0010-0021	Washer (F-3)
	2W2SP-41-32-32	Washer (F-3)		NAS1358S2S39	Pin (F-3)
	9026672	Arm (F-3)		28-2-G	Sleeve (F-3)
	MS20992-11C77	Pin (F-3)		RL191-2002-1316	Cable (F-3)
	MS24665-423	Pin (F-3)	7	NAS1358S2S39	Pin (F-3)
	LD153-0010-0026	Washer (F-3)		28-2-G	Sleeve (F-3)
	9026669-11	Pad (F-2)		RD191-2002-1316	Cable (F-3)
	9016000	Spring (F-3)	8	9026658	Cable (F-3)
	AN9-17A	Bolt (F-3)		NAS1042-14	Shackle (F-3)
	AN316-9R	Nut (F-3)	9	9026667	Pad (F-3)
5	9026668	Cable (F-3)		MS171716	Pin (F-3)
	MS20392-6C27	Pin (F-3)		9015980	Stud (F-3)
	MS24665-231	Pin (F-3)		JA-3424-2	Spool (F-3)
	LD153-0010-0015	Washer (F-3)		20094K-8C-10C	Bolt (F-3)
	9026665	Tiedown (F-3)		LD153-0013-0006	Washer (F-3)
	AN315-8R	Nut (F-3)	10	9026661	Frame (X-2)
	LD153-0010-0018	Washer (F-3)		9027039	Pad (F-3)
	9026666	Lock (F-3)		AN737TW74	Clamp (F-3)
6	9026662	Arm (F-2)	11	NAS1213R10J48	Strap (F-3)
	12705-8F-22C	Bolt (F-3)		AN3-24A	Bolt (F-3)
	NAS679A6	Nut (F-3)		RD153-0110-0018	Washer (F-3)
	LD153-0010-0017	Washer (F-3)		NAS679A3W	Nut (F-3)
	9026663	Arm (F-3)			

Figure 16-38. Nozzle Extension Handling Fixture (Sheet 2 of 2)

16-182. NOZZLE EXTENSION HANDLING ADAPTER G4081.

16-183. DESCRIPTION.

16-184. The nozzle extension handling adapter is a rectangular frame structure designed to support the handling fixture and nozzle extension in a horizontal position during shipping or storage. Ball joints on the aft and forward supports are located to coincide with ball joints on the handling fixture. The forward and aft left-hand supports have stationary ball joint and the right-hand support has a movable ball joint for ease of mating with the handling fixture. Turnbuckles on the aft supports are used to secure the handling fixture to the adapter. Rings are attached to the frame for lifting the loaded adapter and for tiedown during shipping. (See figure 16-39 for leading particulars.)

Length	153 inches
Width	97 inches
Height	41 inches
Weight	1,200 pounds
Maximum load capacity	3,300 pounds
Proof load	5,300 pounds

Figure 16-39. Leading Particulars for Nozzle Extension Handling Adapter

16-185. OPERATION.

16-186. The nozzle extension handling adapter is a portable unit used to support the fixture-mounted nozzle extension in a horizontal position. The forward support may be disengaged from a vertical position and swung forward to facilitate installation of the handling fixture, or swung inward for shipping or storing. The base ring stop bolt, located on the aft frame, maintains the handling fixture in a horizontal plane.

16-187. MAINTENANCE.

16-188. Maintenance of the nozzle extension handling adapter consists of disassembling, assembling, and servicing. The nozzle extension handling adapter is proof tested in conjunction with Nozzle Extension Handling Fixture G4080 (paragraph 16-169). Repaint surface area and/or lettering, as required, when paint becomes chipped, scratched, or worn and when lettering becomes illegible. (Refer to section I for painting information.) Clean adapter, when applicable, as outlined in section I.

16-189. DISASSEMBLING. Disassemble handling adapter as required to accomplish necessary repair or replacement. (See figure 16-40 for index and part numbers.)

16-190. ASSEMBLING. (See figure 16-40.) The following steps include the special instructions required during assembly:

a. Lubricate (Method A) threads of pins that secure support (2) to frame (5) with Molykote G paste (Dow Corning Corp). Remove excess grease after installation.

b. Install and adjust pins that secure support (2) to frame (5) to maintain a dimension of 62.00 ±0.06 inches, measured from centerline of left-hand ball joint to centerline of forward-support ball joint. Torque pins to snug fit; then back one off 1/2 turn. Install bolt through housing and pin, and torque bolt to a loose fit.

c. Torque nuts of housing mounting bolts of support (2) to 180-240 in-lb.

d. Torque nut that secures retainer to aft support to 20-25 in-lb.

e. Torque nut that secures rod end of support (2) to 60-120 in-lb.

f. Store support (2) on frame (5) and tighten bolts through bar (1) and frame (5) to maintain a dimension of 2.50 inches, measured from top of bracket on frame to lower side of bar. Torque swing bolt to 36-84 in-lb.

16-191. SERVICING. Servicing the nozzle extension handling adapter consists of applying corrosion preventative RB0210-016 (Rocketdyne) to ball joints at 6-month intervals.

16-192. SHIPPING AND STORING.

16-193. The nozzle extension handling adapter is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping instructions. Prepare handling adapter for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, EA, 00, and 0, and as follows: (See figure 16-40.)

a. Store support (2) on frame (5). (Refer to paragraph 16-190.)

b. Store turnbuckle on each aft support of frame (5), using brackets provided.

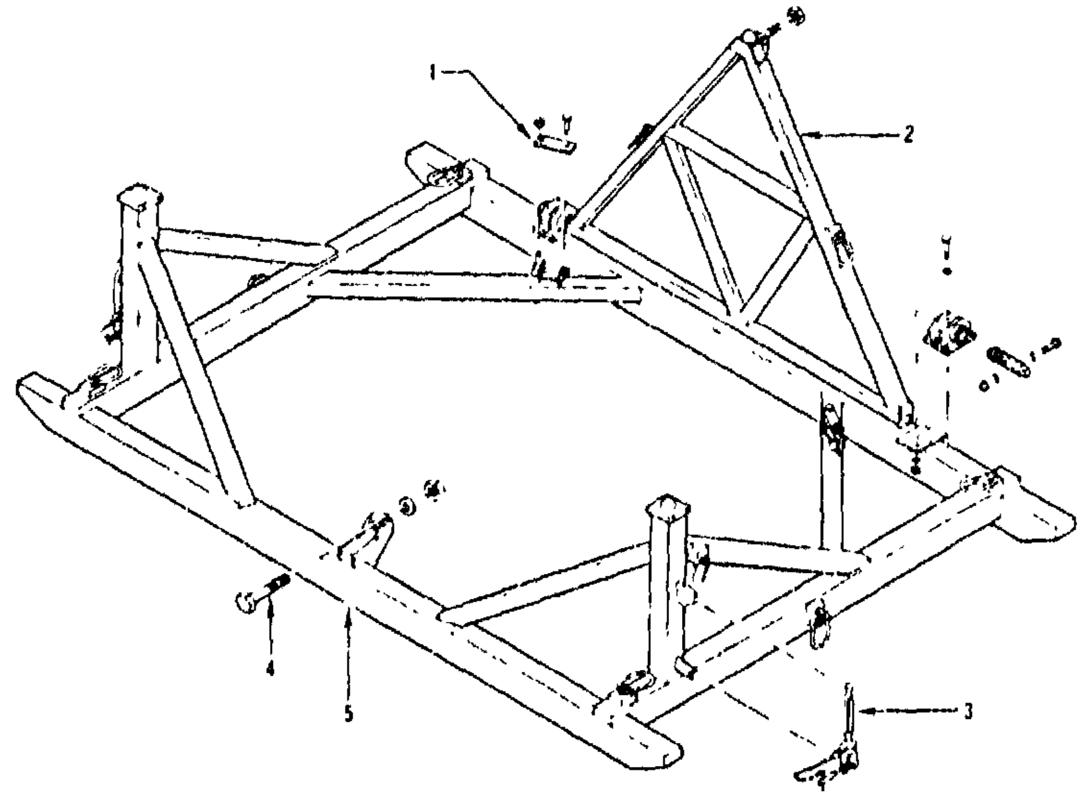
16-194. <u>TURBOPUMP SHAFT PRELOAD FIXTURE G4088 and 99-0026814 (PROTOTYPE).</u>

16-195. DESCRIPTION.

16-196. The turbopump shaft preload fixture consists of a bracket, screw and pawl, closure, and mounting hardware. The bracket is approximately 19 inches long, 8 inches high, and 7 inches wide. The screw is 0.875 inch in diameter and approximately 8 inches long. The screw contains 1-1/2 inches of threads approximately 1-1/2 inches from the end and a notched plate welded to the bottom of a hexed head. The closure consists of a plastic cup and a corrosion-resistant steel foot. The mounting hardware is stored on the bracket in threaded holes.

16-197. OPERATION.

16-198. The turbopump shaft preload fixture is used to apply a preload to the turbopump shaft during truck transport. The closure is installed in place of the existing cup on the oxidizer inlet closure, with the foot positioned on the shaft end. The bracket is attached to the inlet flange over the oxidizer inlet closure, with the screw inserted into the foot of the closure. The screw is torqued to a specified value and locked in place with the pawl.



Index No.	Part No.	Description
1	9014209	Bar (F-3)
	NAS1006-11A	Bolt (F-3)
	F52NE-064	Nut (F-3)
	RD153-5004-0006	Washer (F-3)
	LD153-0010-0014	Washer (F-3)
	SWB-1CA2	Swing bolt (F-3)
	F52NE-066	Nut (F-3)
	RD153-0115-0032	Washer (F-3)
	NAS1006-17A	Bolt (F-3)
2	9014207	Support (X-2)
	9014205	Housing (X-3)
	9014206	Pin (X-3)
	NAS1004-40A	Bolt (F-3)
	F42NE-048	Nut (F-3)
	RD153-5004-0004	Washer (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS1006-14A	Bolt (F-3)

Index No.	Part No.	Description
	F52NE-064	Nut (F-3)
	RD153-5004-0006	Washer (F-3)
	LD153-0010-0014	Washer (F-3)
	9014212	Rod end (F-3)
	F52NE-108	Nut (F-3)
	RD153-0113-0110	Washer (F-3)
	NAS1008-24A	Bolt (F-3)
	F52NE-080	Nut (F-3)
	RD153-5004-0008	Washer (F-3)
	LD153-0010-0018	Washer (F-3)
3	NAS1047-10P060	Turnbuckle (F-3)
	MS20392-7C63	Pin (F-3)
	MS24665-287	Pin (F-3)
	LD153-0010-0017	Washer (F-3)
	MS17985C818	Pin (F-3)
	RD191-2002-1308	Cable (F-3)
	28-2-G	Sleeve (F-3)
	RD191-4001-0008	Lug (F-3)

Figure 16-40. Nozzle Extension Handling Adapter (Sheet 1 of 2)

Index No.	Part No.	Description
4	9014210	Bolt (F-3)
	AN315C18R	Nut (F-3)
	LD153-0010-0029	Washer (F-3)
5	9014208	Frame (X-2)
	5016	Tiedown ring(F-3)
	5015	Tiedown ring(F-3)
	9014204	Support (F-3)
	9014203	Retainer (F-3)
	NAS1003-68A	Bolt (F-3)
	MS20500-1032	Nut (F-3)
	RD153-5004-0003	Washer (F-3)
	LD153-0010-0008	Washer (F-3)

Figure 16-40. Nozzle Extension Handling Adapter (Sheet 2 of 2)

16-199. MAINTENANCE.

16-200. Maintenance of the turbopump shaft preload fixture consists of disassembling and assembling. Clean, inspect, handle, and package closure (1, figure 16-41) and remaining parts as outlined in section I.

16-201. DISASSEMBLING. Disassemble turbopump shaft preload fixture as required to accomplish necessary repair or replacement. (See figure 16-41 for index and part numbers.)

16-202. ASSEMBLING. (See figure 16-41.) The following steps include special instructions required during assembly:

a. Tighten nut of pawl (2) fingertight.

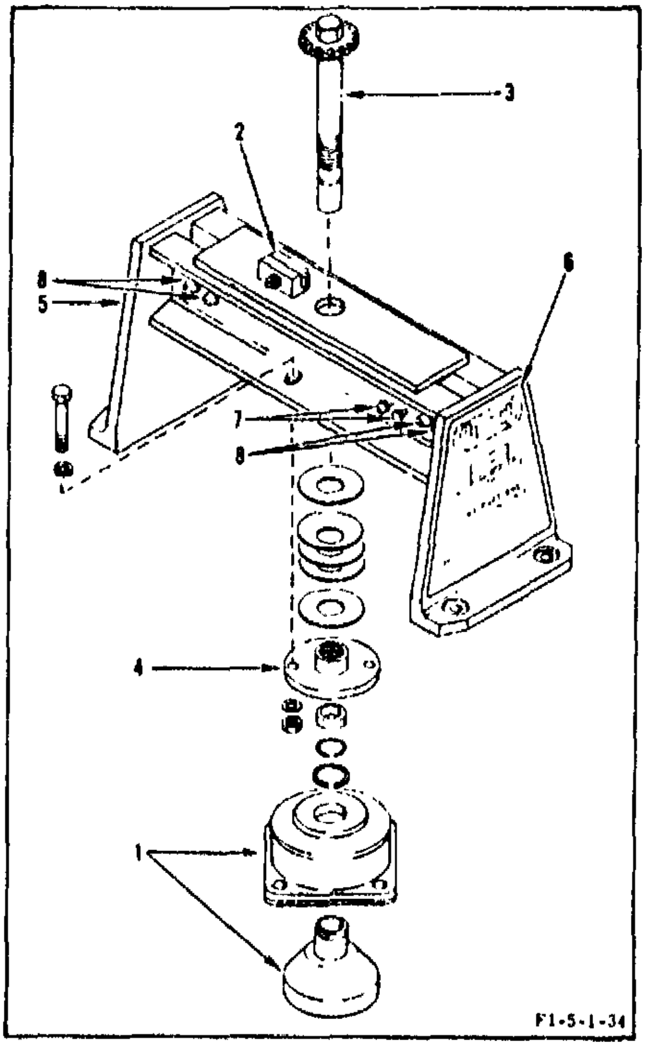
b. Lubricate (Method A) threads of screw (3) with Molykote G paste (Dow Corning Corp).

c. Screw attaching bolts (7, 8) into storage holes of bracket (5) fingertight.

d. Tighten mounting bolts of nut (4) until all slack is removed between adjacent surfaces; then loosen bolts to obtain 0.02 (+0.02, -0.00) inch clearance between bottom washer and nut of mounting bolts.

16-203. SHIPPING AND STORING.

16-204. The turbopump shaft preload fixture is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping instructions. Prepare turbopump shaft preload fixture for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 3Q, 1, Z, 00, ZZ, F1, and 0.



Index No.	Part No.	Description
1	9026818	Closure (F-1)
	9026816	Foot (F-3)
	MS16624-1131	Ring (F-3)
	9026817	Cup (F-1)
	9026901	Grommet (F-3)
2	9026860	Pawl (F-3)
	AN4-14A	Bolt (F-3)
	AN960C416	Washer (F-3)
	NAS679C4W	Nut (F-3)
3	9026820	Screw (F-3)
	9026821	Stop (F-3)
	MS16624-1087	Ring (F-3)
4	9026822	Nut (F-3)
	9026823	Seat (F-3)
	9026903	Washer (F-3)
	AN6-17A	Bolt (F-3)
	AN960C616	Washer (F-3)
	NAS679A6	Nut (F-3)

Figure 16-41. Turbopump Shaft Preload Fixture (Sheet 1 of 2)

Index No.	Part No.	Description
5	9026859	Bracket (F-3)
6	9026880	Plate (F-3)
7	AN4-7A	Bolt (F-3)
8	MS20007H22	Bolt (F-3)
	LD153-0013-0005	Washer (F-3)

Figure 16-41. Turbopump Shaft Preload Fixture (Sheet 2 of 2)

16-205. THRUST CHAMBER THROAT SECURITY CLOSURE G4089 AND 99-9026815 (PROTOTYPE).

16-206. DESCRIPTION.

16-207. The thrust chamber throat security closure consists of a shaft, locking mechanism, cover, closure, and lock. The shaft is constructed from aluminum alloy and has a steel screw pinned to one end. The shaft is 51.88 inches long and 1.5 inches in diameter. The locking mechanism consists of a handle, cable, spring, and shaft and is mounted on supports of the shaft. The pan-shaped cover is made from a plastic material and contains a number of holes. The cover has Camloc fasteners and is 16 inches in diameter. The wheel-shaped closure is made from a plastic material and has a beaded rim to retain a tube and a pressurizing hose. The closure has a handle riveted to the center to slide over the shaft and is 35.5 inches in diameter. The lock is a standard combination lock. The total weight of the security closure is approximately 30 pounds.

16-208. OPERATION.

16-209. The thrust chamber throat security closure is used to seal the thrust chamber throat area, provide protection from moisture, and secure accessible classified documents of the engine. The shaft is screwed into the center hole of the injector, and the locking mechanism is released to lock the shaft in place. Desiccant bags are installed in the compartment of the closure and secured in place with the cover. The closure and cover are slid over the shaft that positions the inflatable tube at the smallest portion of the throat. The lock is installed through holes in the shaft and handle of the closure. The tube is inflated to 5-7 psig, and the pressurizing hose is secured to the shaft.

16-210. MAINTENANCE.

16-211. Maintenance of the thrust chamber throat security closure consists of disassembling and assembling. Clean closure, when applicable, as outlined in section I.

16-212. DISASSEMBLING. Disassemble thrust chamber throat security closure as required to accomplish necessary repair or replacement. (See figure 16-42 for index and part numbers.)

16-213. ASSEMBLING. (See figure 16-42.) The following steps include special instructions required during assembly:

a. Leak-test hose (2) and tube (3) with gaseous nitrogen (MIL-P-27401) or air at 2 (+1, -0) psig unrestrained, before assembling on closure diaphragm. Repeat procedure for a total of 5 cycles. No visible leakage is allowable during a 5-minute period.

b. Tighten nuts of bolt NAS1004-30 and bolt NAS1003-8 of handle (6) until snug.

c. Torque nut of bolt NAS1003-8, attaching cable to handle (5), to 3-5 in-lb above torque required to install nut.

d. Torque nut of bolt NAS1003-12, attaching cable to shaft (8), to 25-30 in-lb.

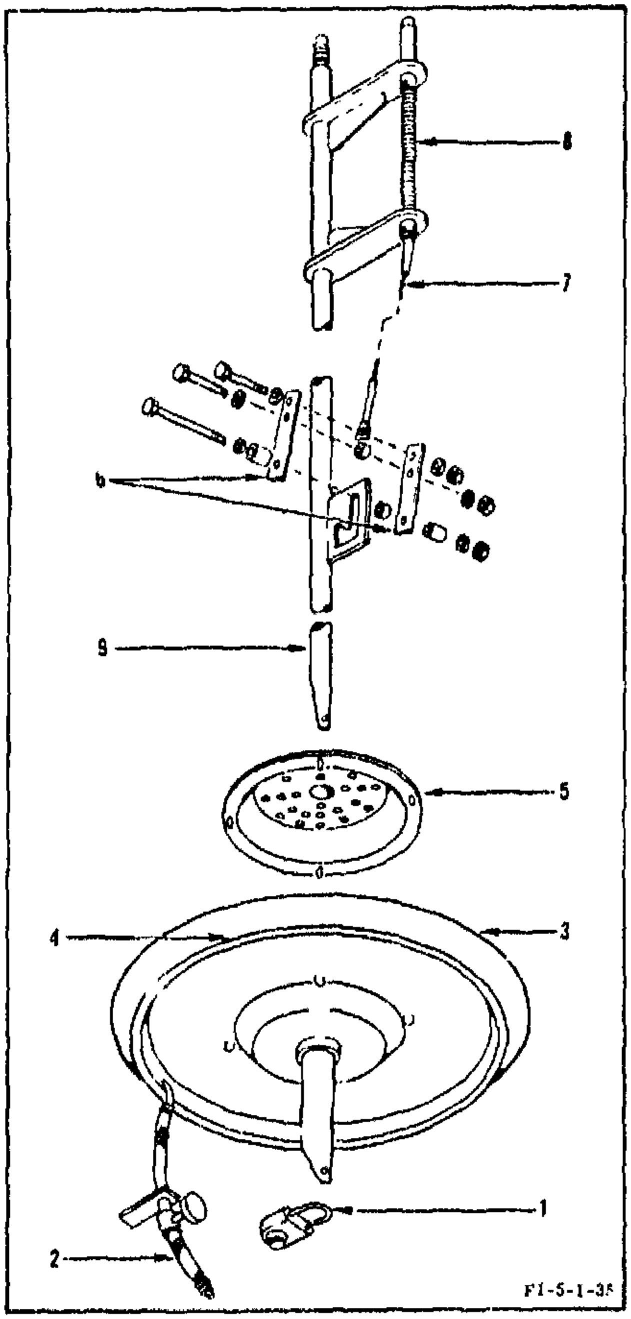
16-214. SHIPPING AND STORING.

16-215. The thrust chamber throat security closure is a rotatable item and must be returned to Rocketdyne. Contact responsible Rocketdyne representative for required shipping instructions. Prepare thrust chamber throat security closure for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, EA, LK, and X.

16-216. ENGINE ENVIRONMENTAL COVER SET 99-9014130.

16-217. DESCRIPTION.

16-218. The engine environmental cover set consists of a rubber-impregnated glass fabric cover with an aluminum coating on the inner side and drawstrings made of nylon rope. The cover has grommets at the top and bottom and two double rows down one side. The cover has



Index No.	Part No.	Description
1	9026900	Lock (F-3)
2	9026884	Hose (F-1)
	6300	Cap (F-3)
	6100 T	Valve core(F-3)
	609-1	Stem (F-3)
	619	Ferrule (F-3)
	3676-1	Hose (F-3)
	P5001 1/2 0-30 1/8 CBM	Gage (F-3)
	8888-7	Tee (F-3)
	3676-16	Hose (F-3)
	8384	Pump connection(F-3)
3	9026883	Tube (F-3)
4	9026882	Closure (F-1)
	9026896	Closure (F-1)
	9025893-3[a]	Seal (F-3)
	9025893-5[a]	Seal (F-3)
	9026891	Handle (F-3)
	MS20470A4	Rivet (F-3)
	8034442[b]	Humidity indicator (F-3)
	9026897	Plate (F-3)
5	9026895	Cover (F-1)
	2600-9W	Stud (F-3)
	2600-LW	Washer (F-3)
6	9026889	Handle (F-3)
	NAS1003-8	Bolt (F-3)
	NAS43DD3-18	Spacer (F-3)
	LD153-0013-0001	Washer (F-3)
	LD153-0010-0008	Washer (F-3)
	NAS679C3W	Nut (F-3)
	NAS1004-30	Bolt (F-3)
	NAS43DD4-48	Spacer (F-3)
	LD153-0013-0002	Washer (F-3)
	LD153-0010-0010	Washer (F-3)
	NAS679C4W	Nut (F-3)
	NAS43DD4-18	Spacer (F-3)
7	9026886	Cable (F-3)
8	9026892	Shaft (F-3)
	NAS1003-12	Bolt (F-3)
	LD153-0013-0001	Washer (F-3)
	LD153-0010-0008	Washer (F-3)
	NAS679C3W	Nut (F-3)
	293	Spring (F-3)
	9026889	Pin (F-3)
	MS171655	Pin (F-3)
9	9026887	Shaft (F-3)
	9026888	Screw (F-3)
	MS171658	Pin (F-3)

(a) Use RX204466-3 or RX204466-5 until exhausted.
(b) Allowable alternate: MS20003-2.

Figure 16-42. Thrust Chamber Throat Security Closure a 36-inch flap between the double rows of grommets. Four flaps are provided for access to the thrust chamber drain ports and two holes for the fuel and oxidizer overboard drain lines. The cover is 15-1/2 feet long, 28 feet at the bottom, and 20 feet at the top and weighs approximately 60 pounds.

16-219. OPERATION.

16-220. The engine environmental cover set is used to protect the thermal insulation, engine, and nozzle extension from impingement of liquid fluids. The cover is placed around the thrust chamber and nozzle extension and fitted by pleating the top around the thrust chamber throat and lacing the flap.

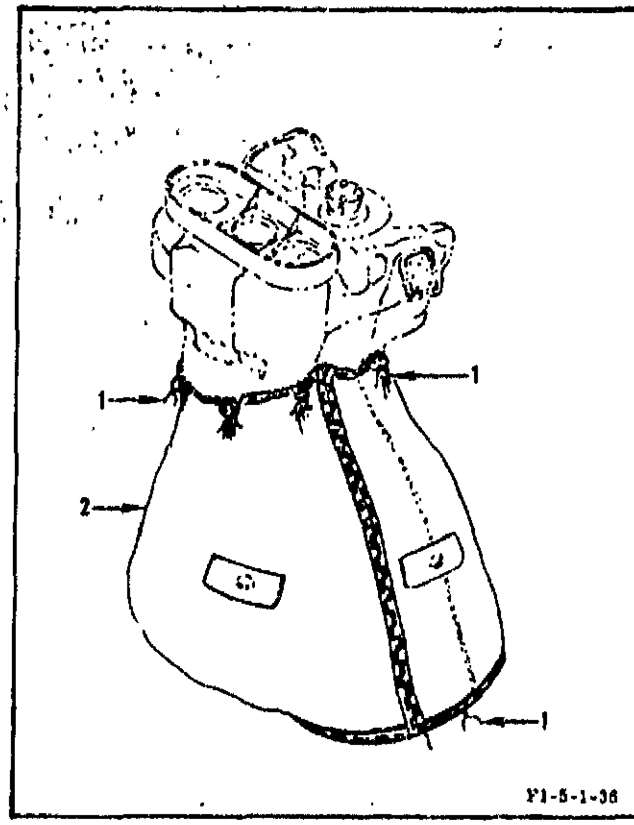
16-221. MAINTENANCE. (See figure 16-43.)

16-222. There are no special maintenance instructions, except for repair of the engine environmental cover. Replace damaged nylon rope and cover when damage is beyond repair.

16-223. REPAIRING. (See figure 16-43.) Tears or holes may be repaired by cleaning the damaged area with fabric cleaner 0200 (Minnesota Mining and Mfg) and applying 2-inch-wide pressure-sensitive tape FGA-32600 (Minnesota Mining and Mfg). Remove any air pockets between tape and material of cover by pressing or rolling. Tape may be installed on either or both sides of cover, if necessary. Tears or holes that cannot be repaired using tape may be patched using glass fabric SRGA-0214 (Minnesota Mining and Mfg), 36 inches wide, and items contained in kit A200. Grommets may be replaced using thermal insulator grommet tool set 9023570 and items contained in kit A200.

16-224. SHIPPING AND STORING.

16-225. Prepare engine environmental cover set for shipping or storing in accordance with Rocketdyne Automated Packaging System (RAPS), codes 10, 1, 0, 00, 00, 00, and 0.



Index No.	Part No.	Description
1	1/4-inch diameter	Nylon rope (100 ft)
2	99-9014131	Cover

Figure 16-43. Engine Environmental Cover Set

MANUAL DATA SUPPLEMENTS

Manual Data Supplements are issued from time to time to communicate important and urgent information concerning the equipment covered in this volume. These supplements bear an identifying number and should be filed in this Appendix.

Manual Data Supplements directly affect the data in this volume and will be incorporated into this volume during a future updating effort.

A Supplement Record is issued periodically to indicate the status of supplements issued for this volume. The status of each supplement is indicated in the "Supplement Status" column. For active supplements, no status is entered. For incorporated supplements, "Incorporated" is entered.

Upon receipt of a Manual Data Supplement make an appropriate reference to the supplement in the margin next to the data supplemented and enter the number, date, and subject matter of the supplement on the Manual Data Supplement Record.

MANUAL DATA SUPPLEMENT RECORD

This Supplement Record indicates the status of supplements issued for Technical Manual R-3896-5, Volume I. Supplements which have been incorporated into the volume shall be removed from the Appendix and destroyed.

Supplement Number	Dated	Description	Supplement Status
R-3896-5 Vol I-1	2 December 1958	Clarifies removal of supplement numbers from the Manual Data Supplement Record issued against the basic R-3896-5.	Incorporated
R-3896-5 Vol I-2	7 February 1969	Adds repair procedures for the neoprene pads and bumpers of Engine Handling Dolly G4058.	Incorporated
R-3896-5 Vol I-3	25 March 1969	Revises proof-test procedures to include T-tools for proof-testing Component Handling Fixture Set G4068.	Incorporated
R-3896-5 Vol I-4	23 April 1969	Deletes requirements to replace vibrator prior to each calibration-verification test of Impact Recorder Unit G4090.	Incorporate
R-3896-5 Vol I-5	15 July 1969	Changes part number of ammeter on Engine Checkout Console G3142.	Incorporated
R-3896-5 Vol I-6	22 September 1969	Adds repair procedures for relief valves of Components Test Console G3141.	Incorporated

Supplement Number	Dated	Description	Supplement Status
R-3896-5 Vol I-7	5 December 1969	Provides proof-test conditions and exceptions for handling and shipping equipment, and establishes the minimum proof load.	Incorporated
R-3896-5 Vol I-8	19 June 1970	Adds periodic inspection and procedure for removal of corrosion and moisture from electrical boxes of Engine Vertical Installer G4049.	Incorporated
R-3896-5 Vol I-9	15 October 1970	Revises checkout procedure for components welding set 9026561.	Incorporated
R-3896-5 Vol I-10	2 April 1971	Adds an allowable alternate humidity indicator for use with the thrust chamber throat security closures.	Incorporated
R-3896-5 Vol I-11	4 May 1971	Changes the hydraulic fluid requirements for Components Test Console G3141 from RJ-1 fuel (MIL-F-25558) to hydraulic fluid (MIL-H-5606).	Incorporated
R-3896-5 Vol I-12	11 October 1971	Adds hydraulic fluid sampling and cleanness levels for Components Test Console G3141.	Incorporated
R-3896-5 Vol I-13	13 June 1972	Changes the pressure limit for low-pressure gases.	Incorporated
R-3896-5 Vol I-14	25 June 1972	Adds an alternate part numbered electrical plug and socket on Components Welding Set 9026561.	Incorporated

This supplement affects the data in Technical Manual R-3896-5, Volume I. 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 the passivating procedure by adding the requirements for a glass fiber applicator.

On page 1-25, paragraph 1-99, add step eA and change steps f and g as follows:

eA. Obtain a cotton-tipped applicator and break off end containing cotton tip. Form a new tip on remaining portion of applicator using a suitable amount of Pyrex brand glass wool filtering fiber (Corning Glass Works). Remove excess fibers.

f. Using applicator, passivate area by swabbing with nitric acid solution at 10-minute intervals for a minimum of 60 minutes. If necessary, provide a barrier to prevent solution from contacting other surface or equipment.

g. Thoroughly rinse passivated area with tap water. Rinse and discard applicator.

This supplement affects the data in Technical Manual R-3896-5, Volume I. 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 1-14, paragraph 1-49, add the following warning before step g:

WARNING

Primer (MIL-P-8585) 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 1-15, paragraph 1-55, add the following warning before step g:

WARNING

Primer (MIL-P-8585) 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 1-24, paragraph 1-97, add the following warning before step d:

WARNING

Primer (MIL-P-8585) 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 16-15, add the following warning after paragraph 16-28:

WARNING

Adhesive EC1099 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 adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

On page 16-33, paragraph 16-110, add the following warning before step d:

WARNING

Adhesive 584 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 adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

MANUAL DATA SUPPLEMENT NO. R-3896-5 VOL I-17
Sheet 1 of 1 16 April 1973

This supplement affects the data in Technical Manual R-3896-5, Volume I. 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.	Figure No.	Paragraph No.	Step
1-9	1-2		
2-16		2-54	1
3-8		3-23	c
5-63		5-45	e
5-67		5-52	
5-68C		5-52G	
5-68D		5-52P	g and h
6-3		6-10	f
6-4		6-10	m
7-13		7-24	n and p
10-8	10-5		
10-42P-16		10-48J	g
10-42P-17		10-48J	i
10-42Q		10-55	
10-42U		10-76	
10-42Y		10-90	
10-42AE		10-111	
12-10	12-6		