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MSFC-MAN-100

TECHNICAL MANUAL

SATURN V LAUNCH VEHICLE GROUND SUPPORT EQUIPMENT FACT BOOKLET

(THE BOEING CO.)

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ii Blank	Original
* iii	25 Aug 1967
iv	Original
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viii	Original
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3-11	Original
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3-38	Original
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3-42 thru 3-49	Original
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3-52 thru 3-53	Original
* 3-54	25 Aug 1967
3-55 thru 3-77	Original
* 3-78	25 Aug 1967
3-79 thru 3-80	Original
* 3-81	25 Aug 1967
3-82 thru 3-83	Original
* 3-84	25 Aug 1967
3-85 thru 3-89	Original
* 3-90	25 Aug 1967
3-91 thru 3-92	Original
* 3-93	25 Aug 1967
3-94 thru 3-96	Original
* 3-97	25 Aug 1967
3-98 thru 3-117	Original
* 3-118	25 Aug 1967
3-119 thru 3-129	Original
* 3-130	25 Aug 1967
3-131	Original
* 3-132	25 Aug 1967
3-133 thru 3-134	Original
* 3-135	25 Aug 1967
3-136 thru 3-137	Original
* 3-138 thru 3-139	25 Aug 1967
3-140 thru 3-141	Original
* 3-142 thru 3-144	25 Aug 1967
3-145	Original
* 3-146 thru 3-147	25 Aug 1967
3-148	Original
* 3-149	25 Aug 1967
3-150 Blank	Original
4-1 thru 4-21	Original
* 4-22	25 Aug 1967
4-23 thru 4-35	Original
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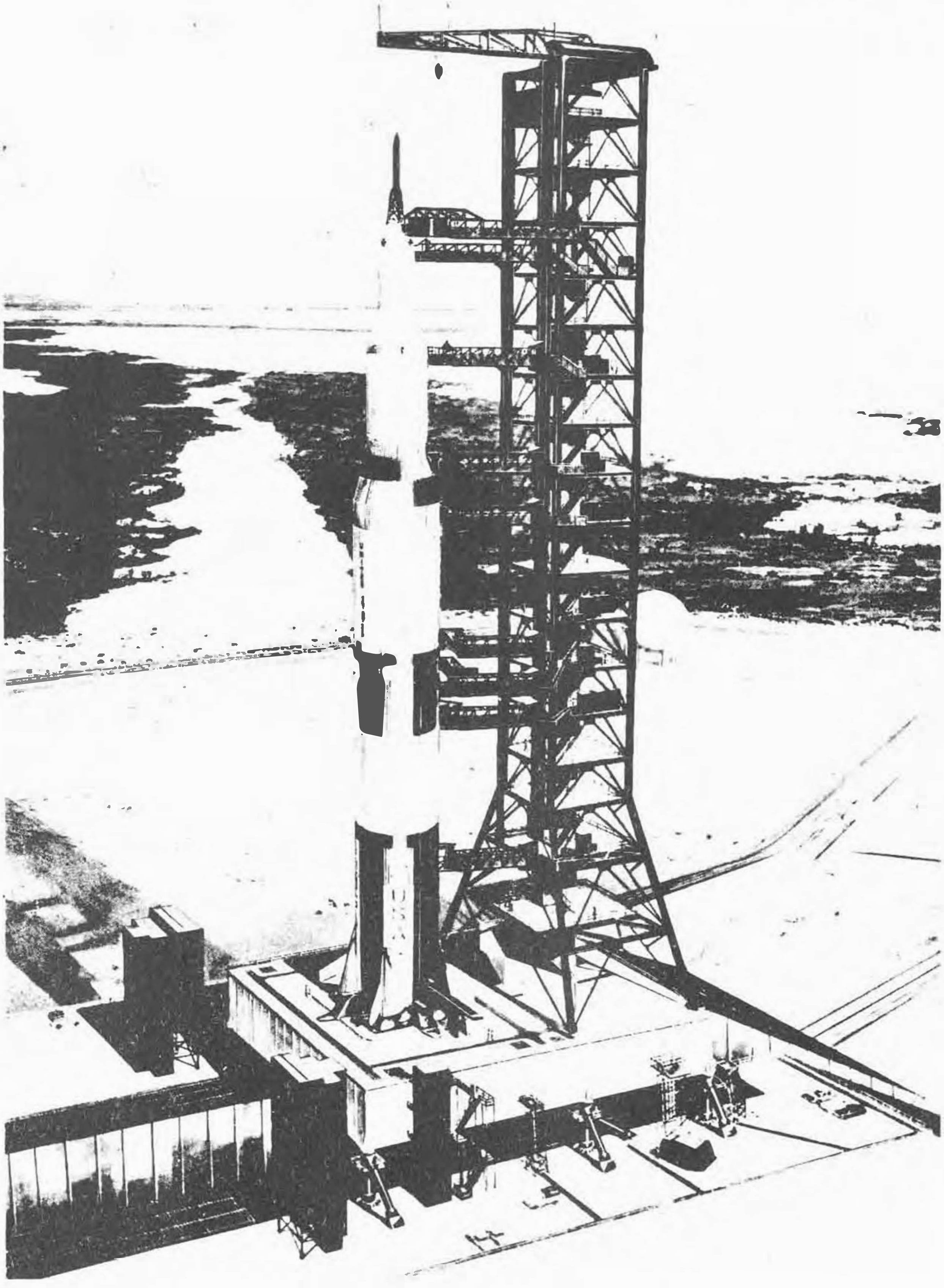

TABLE OF CONTENTS

Section		Page
	INTRODUCTION	ix
I	GENERAL	1-1
	Saturn V Mobile Launcher	1-2
II	UMBILICAL EQUIPMENT	2-1
	Saturn V Umbilical Carriers	2-3
	S-IC Stage Umbilical Carriers	2-6
	S-IC Stage Aft Umbilical Carriers	2-10
	S-IC Stage Intertank Umbilical Carrier	2-13
	S-IC Intertank Umbilical Ground Carrier Control Test Set	2-15
	S-IC Stage Forward Umbilical Carrier	2-19
	S-II Stage Umbilical Carriers	2-21
	S-II Stage Intermediate Umbilical Carrier	2-23
	S-II Stage Forward Umbilical Carrier	2-25
	S-II Stage LOX/LH_2 Propellant Couplings	2-28
	S-IVB Stage/I. U. Umbilical Carriers	2-30
	S-IVB Stage Aft Umbilical Carrier	2-32
	S-IVB Stage Forward/I. U. Umbilical Carrier	2-35
III	SERVICING EQUIPMENT	3-1
	S-IC Pneumatic Ground Support Equipment	3-3
	S-IC Pneumatic Console	3-5
	S-IC Pneumatic Checkout Racks	3-9
	S-IC Forward Umbilical Service Console	3-12
	S-IC Pneumatic Portable Testers	3-16
	S-IC Hydraulic Supply and Checkout Unit	3-18
	Hydraulic Power Unit	3-21
	Motor Control Center	3-24
	System Checkout Console	3-26
	S-IC GSE Hydraulic Performance Tester	3-26B
	Console Assembly	3-26D
	Manifold Assembly	3-26F
	S-IC Inert Prefill Unit	3-28
	Hydraulic Pumping Unit	3-31
	System Checkout Console	3-33
	S-IC Flush and Purge Service Truck	3-36
	S-IC RJ-1/Ethylene Glycol Mobile Servicer.	3-39

TABLE OF CONTENTS

Section		Page
III	S-II Pneumatic Ground Support Equipment	3-42
	S-II Pneumatic Consoles (S7-41A, B, C, D)	3-50
	S-II LH_2 Heat Exchanger (A7-71)	3-53
	S-II Pneumatic Console Test Set (C7-70).	3-56
	Portable Vacuum Pump Unit (S7-37)	3-58
	Stationary Vacuum Pump (S7-29)	3-60
	Electrical Container Air Servicing Unit (S7-34)	3-62
	Hydraulic Accumulator Precharge Servicing Unit (S7-38). .	3-64
	Purge and Thermal Control Nitrogen Servicing Unit (S7-40)	3-66
	Pneumatic Checkout Blanking Plate Set (C7-53)	3-68
	Pneumatic Checkout Console Set (C7-603)	3-70
	Electrical Pneumatic Servicing Console (S7-42)	3-73
	S-IVB Pneumatic Ground Support Equipment	3-75
	S-IVB Pneumatic Console "A" (DSV-4B-432 & 432A) . .	3-77
	S-IVB Pneumatic Console "B" (DSV-4B-433 & 433A) . .	3-80
	S-IVB Gas Heat Exchanger (DSV-4B-438)	3-83
	S-IVB Pneumatic Console Test Set (DSV-4B-286&286A) .	3-86
	S-IVB APS Propellant Servicing Unit (GS6500-1&-2)	3-89
	S-IVB APS Pneumatic Console (DSV-4B-436A)	3-93
	S-IVB Hydraulic Pumping Unit (DSV-4B-358)	3-95
	Nitrogen Fill Truck (DSV4-186)	3-97
	APS Pneumatic Console Portable Test Set (DSV-4B-186) . .	3-99
	Vacuum Pumping Unit (DSV4-187)	3-101
	Battleship Pneumatic Console "A" (DSV-4B-327)	3-103
	Battleship Pneumatic Console "B" (DSV-4B-333)	3-105
	Battleship Pneumatic Console "C" (DSV-4B-328)	3-107
	Propellant Transfer and Interconnect Kit (DSV-4B-472&-473)	3-109
	APS Checkout Accessories Kit (DSV-4B-493A)	3-111
	APS Instrumentation and Checkout Kit (DSV-4B-1874&-1875)	3-114
	I. U. Pneumatic Ground Support Equipment	3-116
	I. U. Pneumatic Console	3-118
	I. U. Pneumatic Console (500FS)	3-120
	I. U. Pneumatic Console Test Set	3-125
	I. U. Ground Support Cooling Unit	3-129
	Ground Support Cooling Unit Flow Control Valve Box (RM1801A)	3-132
	I. U. Water Accumulator Servicer	3-134

TABLE OF CONTENTS (Cont)

Section		Page
	S-II/S-IVB Mobile Hydraulic Servicer (DSV-4B-479) . . .	3-137
	Mobile Pneumatic Checkout Console	3-139
	Mobile Pneumatic Test Set	3-141
	Portable Pneumatic Regulators and Hose Kits	3-143
	Hazardous Gas Detection System	3-146
IV	ACCESS EQUIPMENT	4-1
	S-IC Access Equipment	4-12
	S-II Access Equipment	4-18
	LH_2 Tank Servicing Mechanism (A7-35)	4-20
	LH_2 Tank Clean Room (A7-39)	4-22
	LH_2 Tank Servicing Air Conditioner (A7-40)	4-24
	Propellant Tanks Pressurization System (S7-44)	4-26
	Engine Compartment Auxiliary Purge Manifold (A7-57) . .	4-28
	S-IVB Access Equipment	4-33
	I. U. Access Equipment	4-35
V	HANDLING AND AUXILIARY EQUIPMENT	5-1
	S-IC Handling and Auxiliary Equipment	5-19
	S-II Handling and Auxiliary Equipment	5-51
	S-IVB Handling and Auxiliary Equipment	5-80
	I. U. Handling and Auxiliary Equipment	5-91
	Launch Vehicle Handling and Auxiliary Equipment	5-95

LIST OF ILLUSTRATIONS

Fig. No.	Title	Page
1-1	Saturn V Mobile Launcher	1-1
1-2	Vertical Assembly Building	1-3
1-3	Electrical Equipment and Cabling Arrangement	1-5
1-4	Mechanical Equipment Arrangement	1-7
2-1	Saturn V Umbilical Carriers	2-2
2-2	S-IC Stage Umbilical Carriers	2-4
2-3	S-IC Stage Aft Umbilical Carriers	2-7
2-4	S-IC Stage Intertank Umbilical Carriers	2-12
2-5	S-IC Intertank Umbilical Ground Carrier Control Test Set	2-14
2-6	S-IC Stage Forward Umbilical Carrier	2-16
2-7	S-II Stage Umbilical Carriers	2-20
2-8	S-II Stage Intermediate Umbilical Carriers	2-22
2-9	S-II Stage Forward Umbilical Carrier	2-24
2-10	S-II Stage LOX/LH_2 Propellant Couplings	2-26
2-11	S-IVB Stage/I. U. Umbilical Carrier	2-29
2-12	S-IVB Stage Aft Umbilical Carrier	2-31
2-13	S-IVB Stage Forward/I. U. Umbilical Carrier	2-34
3-1	S-IC Pneumatic Ground Support Equipment	3-2
3-2	S-IC Pneumatic Console	3-4
3-3	S-IC Pneumatic Checkout Racks	3-7
3-4	S-IC Forward Umbilical Service Console	3-11
3-5	S-IC Pneumatic Portable Testers	3-13
3-6	S-IC Hydraulic Supply and Checkout Unit	3-17
3-7	S-IC Hydraulic Power Unit	3-20
3-8	S-IC Motor Control Center	3-23
3-9	S-IC System Checkout Console	3-25
3-9A	S-IC GSE Hydraulic Performance Tester	3-26A
3-9B	Console Assembly	3-26C
3-9C	Manifold Assembly	3-26E
3-10	S-IC Inert Prefill Unit	3-27
3-11	Hydraulic Pumping Unit	3-29
3-12	System Checkout Console	3-32
3-13	S-IC Flush and Purge Service Truck	3-34
3-14	S-IC RJ-1/Ethylene Glycol Mobile Servicer	3-37
3-15	S-II Pneumatic Ground Support Equipment	3-41
3-16	S-II Pneumatic Consoles (S7-41A, B, C, D)	3-43
3-17	S-II LH_2 Heat Exchanger (A7-71)	3-52
3-18	S-II Pneumatic Console Test Set (C7-70)	3-55
3-19	Portable Vacuum Pump Unit (S7-37)	3-57

LIST OF ILLUSTRATIONS (Cont)

Fig. No.	Title	Page
3-20	Stationary Vacuum Pump (S7-29)	3-59
3-21	Electrical Container Air Servicing Unit (S7-34)	3-61
3-22	Hydraulic Accumulator Precharge Servicing Unit (S7-38)	3-63
3-23	Purge and Thermal Control Nitrogen Servicing Unit (S7-40)	3-65
3-24	Pneumatic Checkout Blanking Plate Set (C7-53)	3-67
3-25	Pneumatic Checkout Console Set (C7-603)	3-69
3-26	Electrical Pneumatic Servicing Console (S7-42)	3-72
3-27	S-IVB Pneumatic Ground Support Equipment	3-74
3-28	S-IVB Pneumatic Console "A" (DSV-4B-432 & 432A)	3-76
3-29	S-IVB Pneumatic Console "B" (DSV-4B-433 & 433A)	3-79
3-30	S-IVB Gas Heat Exchanger (DSV-4B-438)	3-82
3-31	S-IVB Pneumatic Console Test Set (DSV-4B-286 & 286A)	3-85
3-32	S-IVB APS Propellant Servicing Unit (GS6500-1 & -2)	3-87
3-33	S-IVB APS Pneumatic Console (DSV-4B-436A)	3-91
3-34	S-IVB Hydraulic Pumping Unit (DSV-4B-358)	3-94
3-35	Nitrogen Fill Truck (DSV4-186)	3-96
3-36	APS Pneumatic Console Portable Test Set (DSV-4B-186)	3-98
3-37	Vacuum Pumping Unit (DSV4-187)	3-100
3-38	Battleship Pneumatic Console "A" (DSV-4B-327)	3-102
3-39	Battleship Pneumatic Console "B" (DSV-4B-333)	3-104
3-40	Battleship Pneumatic Console "C" (DSV-4B-328)	3-106
3-41	Propellant Transfer and Interconnect Kit (DSV-4B-472 & -473)	3-108
3-42	APS Checkout Accessories Kit (DSV-4B-4934)	3-110
3-43	APS Instrumentation and Checkout Kit (DSV-4B-1874 & -1875)	3-113
3-44	I.U. Pneumatic Ground Support Equipment	3-115
3-45	I.U. Pneumatic Console	3-117
3-46	I.U. Pneumatic Console (500FS)	3-119
3-47	I.U. Pneumatic Console Test Set	3-124
3-48	I.U. Ground Support Cooling Unit	3-126
3-49	GSCU Flow Control Valve Box	3-131
3-50	I.U. Water Accumulator Servicer	3-133
3-51	S-II/S-IVB Mobile Hydraulic Servicer (DSV-4B-479)	3-136

LIST OF ILLUSTRATIONS (Cont)

Fig. No.	Title	Page
3-52	Mobile Pneumatic Checkout Console	3-138
3-53	Mobile Pneumatic Test Set	3-140
3-54	Portable Pneumatic Regulators and Hose Kits	3-142
3-55	Hazardous Gas Detector	3-145
3-56	Saturn V HGD Sensing Line Configuration	3-148
3-57	Hazardous Gas Detector System Functional Block Diagram	3-149
4-1	S-IC Access Equipment	4-2
4-2	S-II Access Equipment	4-15
4-3	LH_2 Tank Servicing Mechanism (A7-35)	4-19
4-4	LH_2 Tank Clean Room (A7-39)	4-21
4-5	LH_2 Tank Servicing Air Conditioner (A7-40)	4-23
4-6	Propellant Tank Pressurization System (S7-44) . . .	4-25
4-7	Engine Compartment Auxiliary Purge Manifold (A7-57)	4-27
4-8	S-IVB Access Equipment	4-29
4-9	I. U. Access Equipment	4-34
5-1	S-IC Handling and Auxiliary Equipment	5-2
5-2	S-II Handling and Auxiliary Equipment	5-26
5-3	S-IVB Handling and Auxiliary Equipment	5-62
5-4	I. U. Handling and Auxiliary Equipment	5-84
5-5	Launch Vehicle Handling and Auxiliary Equipment . .	5-93

INTRODUCTION

This booklet has been prepared to provide a quick reference to Saturn V stage peculiar ground support equipment. It consists of visual presentations and a brief description of each major component. It is intended to quickly familiarize concerned elements with the over-all MSFC launch vehicle ground support equipment and is not intended for design usage.

The booklet has been prepared in five sections. Section I contains the introductory material and a description of the Saturn V mobile launcher (ML). Section II contains information on the umbilical equipment. Section III contains information on the servicing equipment, both fixed and mobile. Section IV contains information on the access equipment. Section V contains information on the handling and auxiliary equipment.

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Per direction from R. Etheridge, I-V-G, on September 6, 1966 no GFD source data listing is required for this booklet.

SECTION I GENERAL

Figure 1-1. Saturn V Mobile Launcher

SATURN V MOBILE LAUNCHER

The mobile launcher (ML) serves as the launch platform for the Saturn V launch vehicle, and contains operational test and launch equipment used during checkout and launch. This is equipment which is installed within the base of the ML and tower structure as well as various items of mobile servicing equipment located on the pad area immediately surrounding the LUT.

The launch platform is a two-story steel structure 25 feet high, 160 feet long, and 135 feet wide. The tower mounted on one end of the launch platform extends 380 feet above the deck.

Service arms, varying in length from 35 to 45 feet, carry electrical, pneumatic, and propellant lines to the launch vehicle. They also provide walkways for checkout personnel entering the interstage areas.

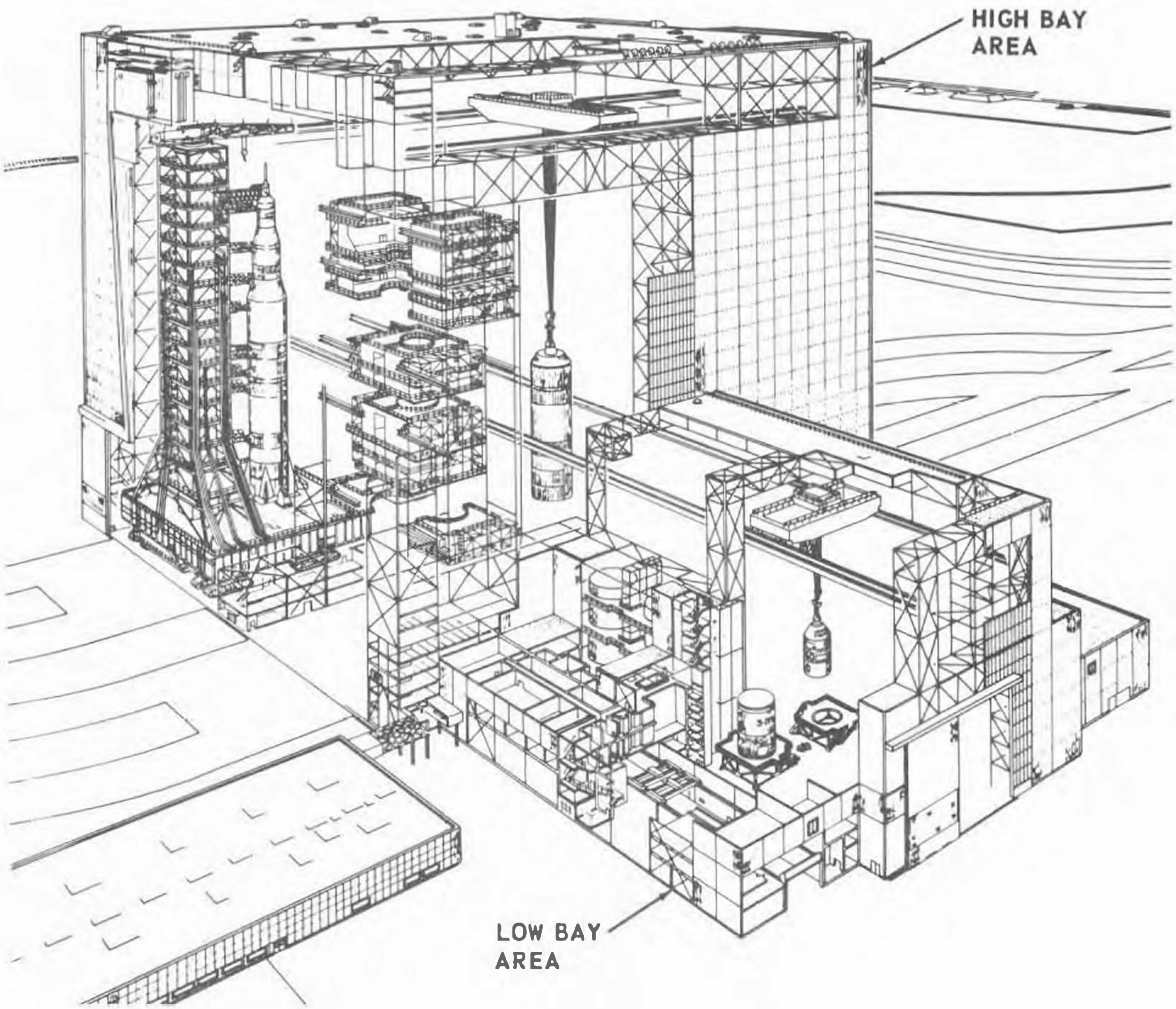


Figure 1-2. Vertical Assembly Building

(FOR INFORMATION ONLY)

Figure 1-3. Electrical Equipment and Cabling Arrangement

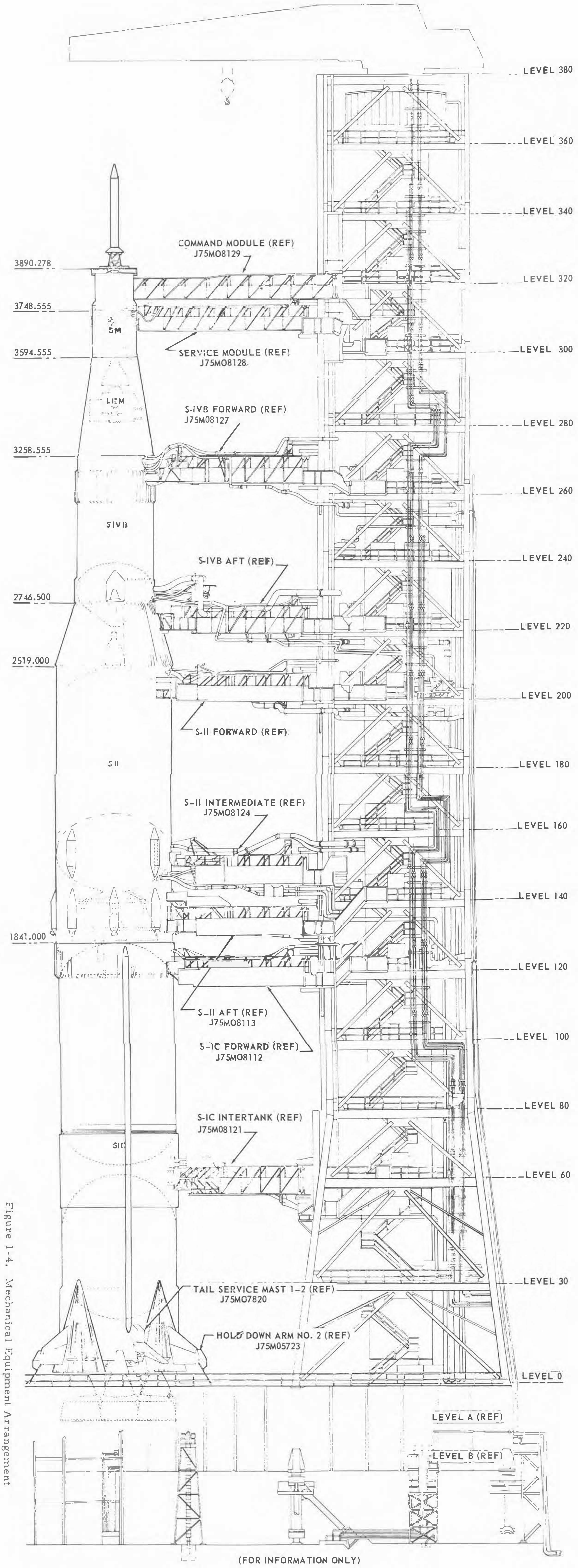


Figure 1-4. Mechanical Equipment Arrangement

SECTION II
UMBILICAL EQUIPMENT

This section presents information on the various stage umbilical systems and associated test and checkout equipment, with a brief description and a visual presentation of each individual item of equipment. The umbilical equipment is used to provide electrical, pneumatic, hydraulic, and fuel service to the Saturn V vehicle emplaced on the ML.

This section will be revised and/or added to as more data on the umbilical equipment becomes available.

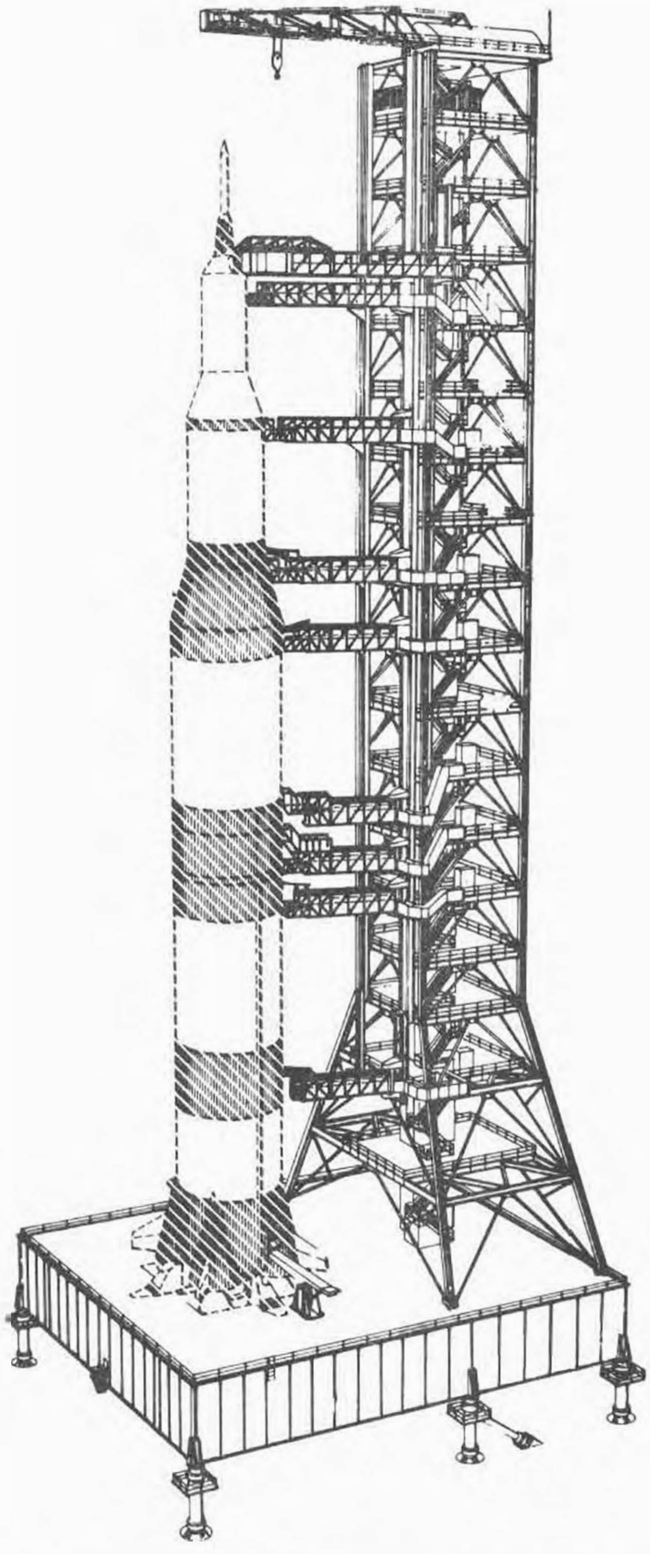


Figure 2-1. Saturn V Umbilical Carriers

SATURN V UMBILICAL CARRIERS

A total of ten umbilical carriers and two propellant couplings secure the various umbilical lines to the Saturn V vehicle. The carriers and couplings are located at the vehicle end of the service arms extending from the tower or at the end of the tail service masts at the base of the ML. The carriers and the supporting brackets or legs extending below the carriers transfer a portion of the weight of the service lines to the vehicle structure.

Eight of the umbilical carriers and the two propellant couplings are in-flight disconnects, disconnecting at vehicle lift-off. Two of the umbilical carriers are pre-flight disconnects, disconnecting from ten to fifteen seconds prior to lift-off.

S-IC STAGE UMBILICAL CARRIERS

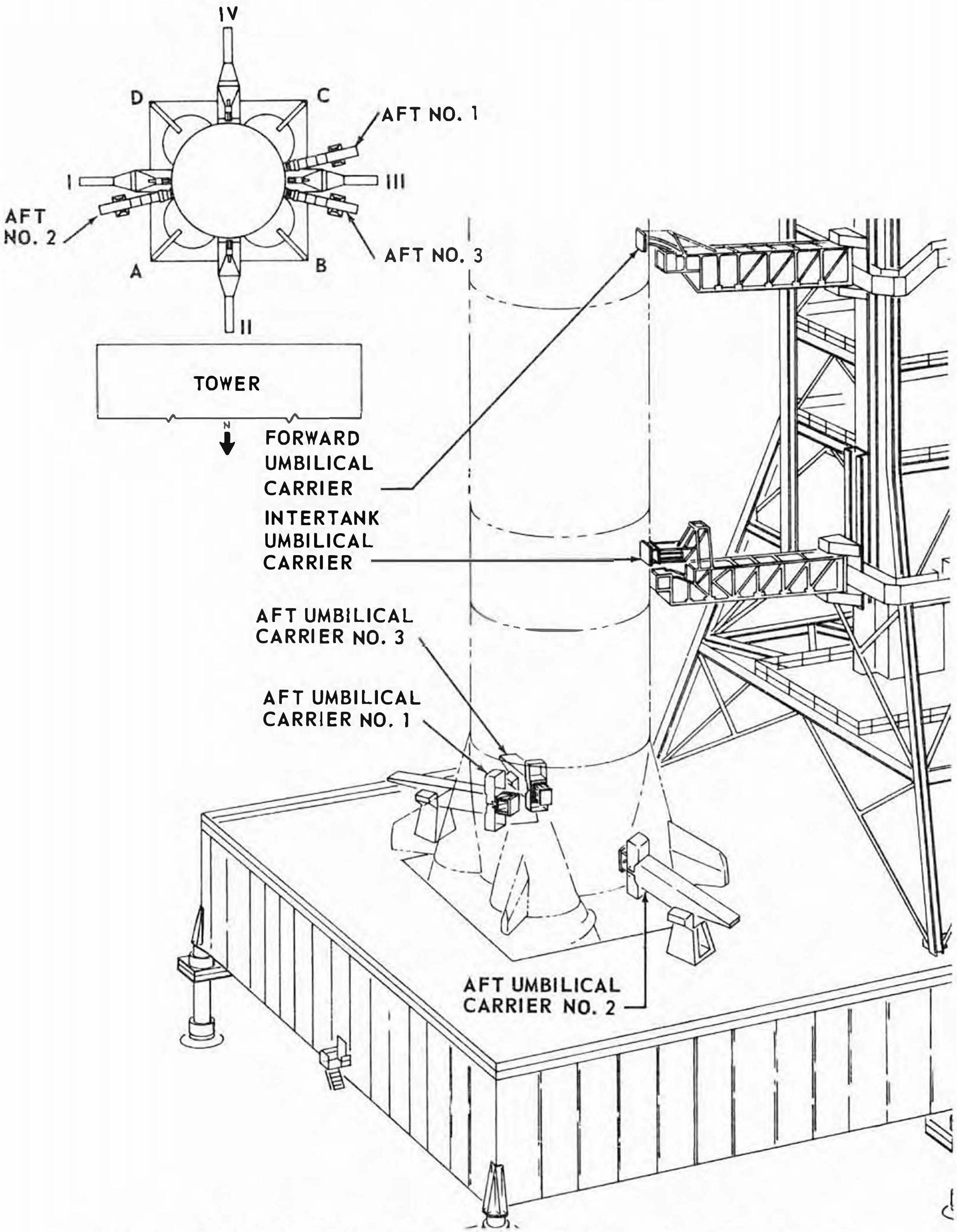


Figure 2-2. S-IC Stage Umbilical Carriers (Sheet 1 of 2)

S-IC STAGE UMBILICAL CARRIERS

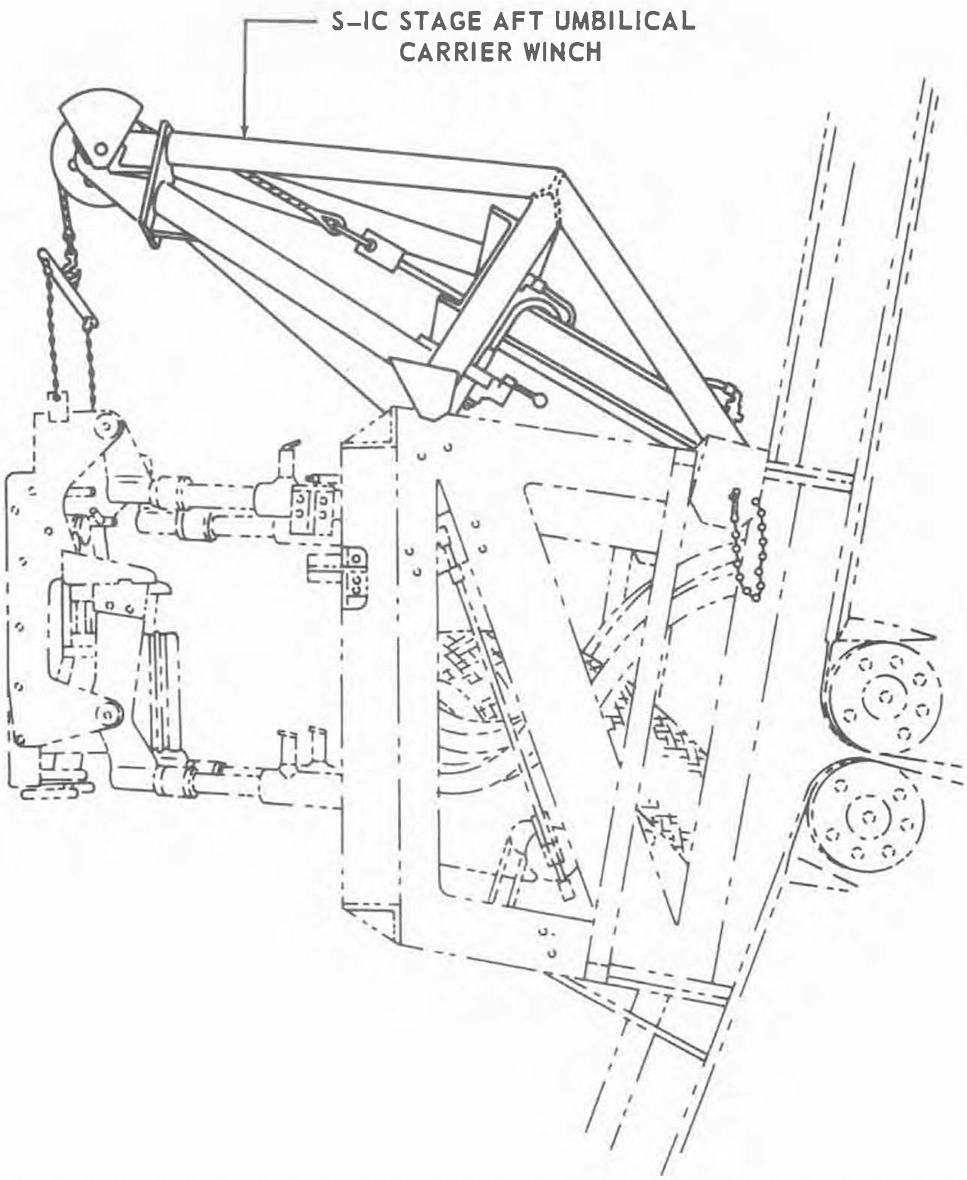


Figure 2-2. S-IC Stage Umbilical Carriers (Sheet 2 of 2)

S-IC STAGE UMBILICAL CARRIERS

The S-IC stage umbilical system consists of three aft umbilical carriers, an intertank umbilical carrier, and a forward umbilical carrier. The carriers are located at the vehicle end of the service arms extending from the tower or at the ends of the tail service masts on the deck of the ML, and secure the following service lines to the S-IC stage of the Saturn V vehicle:

a. Electrical.

b. Pneumatic.

c. Gaseous nitrogen (GN_2).

d. Gaseous helium (GHe).

e. Liquid oxygen (LOX).

f. RP-1.

g. Air conditioning.

The three aft carriers are in-flight disconnects, disconnecting at vehicle lift-off. The intertank and forward carriers are pre-flight disconnects, disconnecting at T-minus-15 seconds and T-minus-10 seconds respectively.

S-IC STAGE UMBILICAL CARRIERS

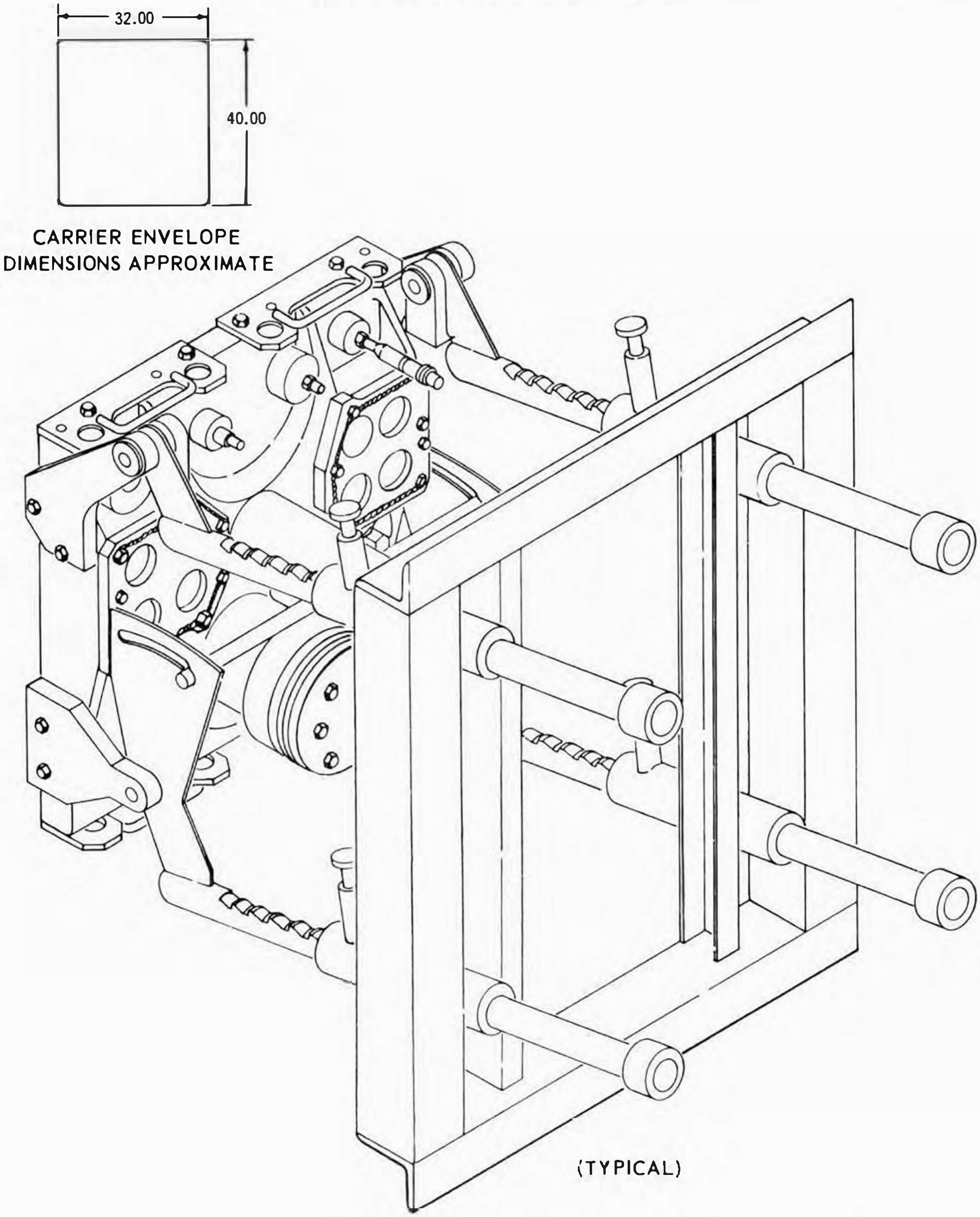


Figure 2-3. S-IC Stage Aft Umbilical Carrier (Sheet 1 of 3)

S-IC STAGE UMBILICAL CARRIERS

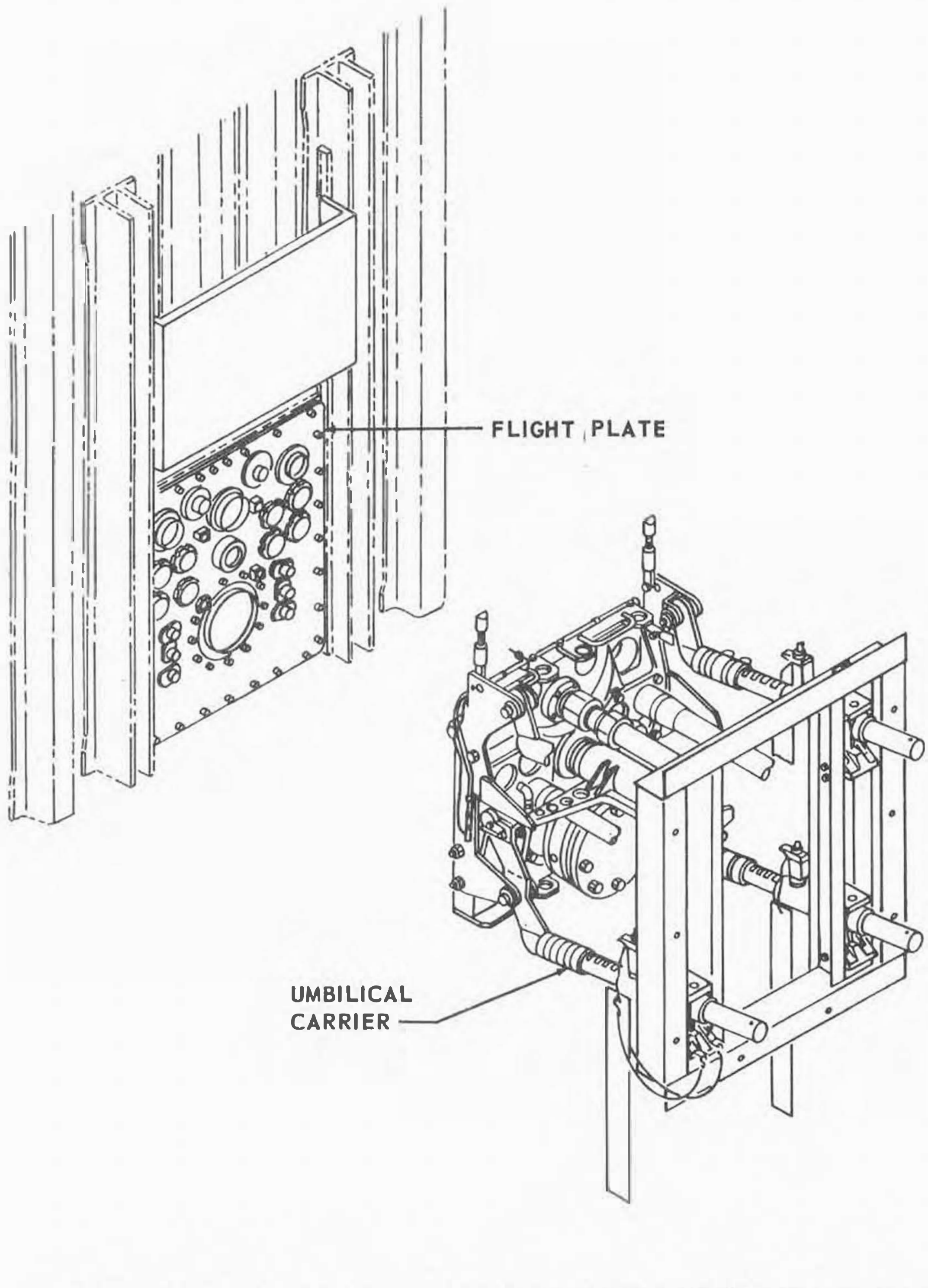


Figure 2-3. S-IC Stage Aft Umbilical Carrier (Sheet 2 of 3)

S-IC STAGE UMBILICAL CARRIERS

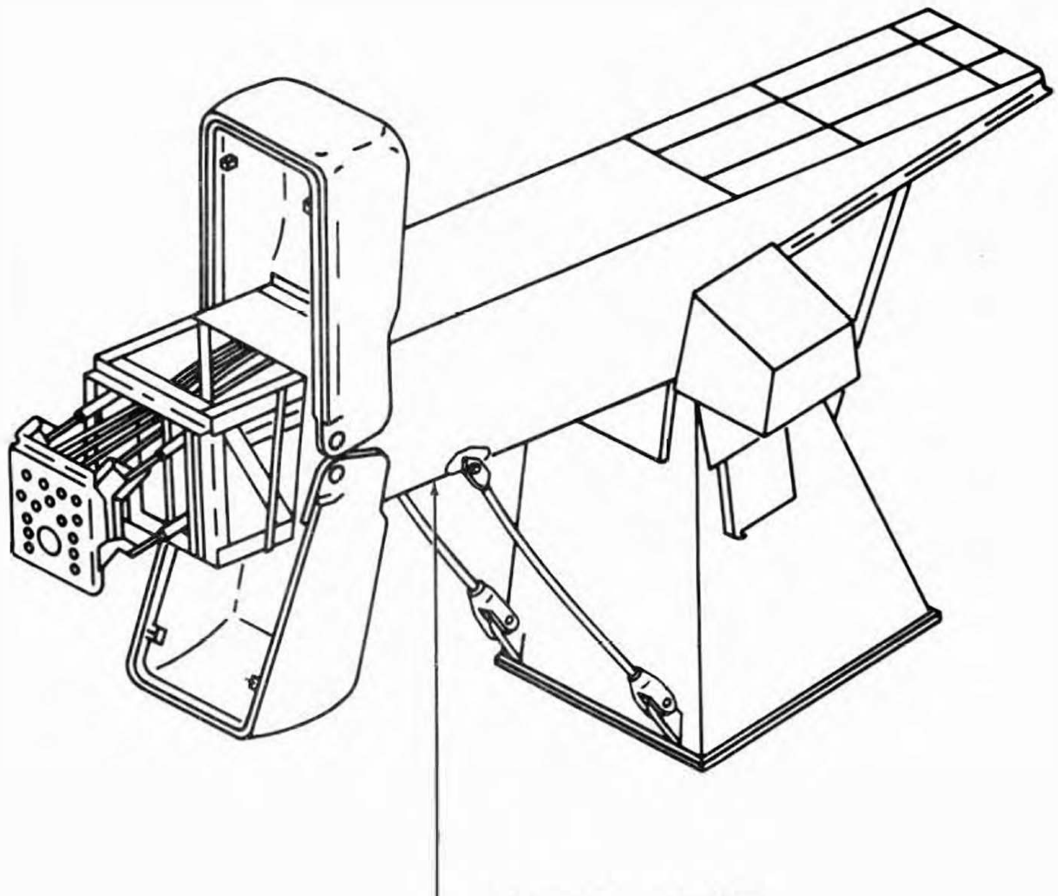


Figure 2-3. S-IC Stage Aft Umbilical Carrier (Sheet 3 of 3)

S-IC STAGE AFT UMBILICAL CARRIERS

1. Functional Description

a. Although the three aft carriers are physically similar, each carrier secures different umbilical service lines to the S-IC stage of the Saturn V launch vehicle.

(1) Aft Umbilical Carrier #1 is located 12° 39' 22 1/2" off Position III toward Position IV. It consists of various pneumatic couplings, eight electrical connectors, and a 6-inch LOX connector. The electrical connectors can be ejected independently of the carrier assembly for simulated flight test and checkout purposes.

(2) Aft Umbilical Carrier #2 is located 12° 39' 22 1/2" off Position I toward Position II. It consists of various pneumatic couplings, eight electrical connectors, and a 6-inch fuel connector. The electrical connectors can be ejected independently of the carrier assembly for simulated flight test and checkout purposes.

(3) Aft Umbilical Carrier #3 is located 12° 39' 22 1/2" off Position III toward Position II. It consists of various pneumatic couplings and two 4-inch air conditioning couplings. This carrier does not contain any electrical connectors.

b. The S-IC Aft Umbilical Flight Plate contains fluid disconnect couplings and connectors. All couplings and connectors on the flight plate are rigidly mounted. The carrier provides for coupling and connector alignment during mating. The vertical motion of the vehicle during lift-off releases an identical locking mechanism on each aft carrier, resulting in disconnection of the three carriers from the vehicle.

(1) Primary Ejection Method: The four telescoping rods follow the rising motion of the vehicle. As the vehicle moves upward, mechanical linkage of the tail service mast withdrawal mechanism forces the yoke of the locking piston away from the vehicle. The locking piston retracts, releasing the locking fingers. The fingers collapse to a diameter smaller than the minimum diameter of the vehicle plate receptacle.

Further retraction of the locking piston releases the trigger pins. The pneumatically loaded push off foot then forces the carrier away from the vehicle plate. After disconnection, pneumatic pressure released from a coupling on the carrier assembly causes the spring return operational control valve in the tail service mast to open. Hydraulic fluid then flows from the tail service mast retract cylinder and the tail service mast withdraws the carrier assembly.

(2) Secondary Ejection Method: If pneumatic failure occurs, the rising motion of the telescoping rods forces the four pushoff pistons against the vehicle plate, disconnecting the carrier from the vehicle. The locking piston is simultaneously retracted through mechanical linkage. The carrier is then unlocked from the vehicle. After disconnection, an electrical switch on the carrier assembly is actuated, causing an electrically operated control valve, parallel with the pneumatic control valve, to open. The tail service mast then withdraws the carrier.

If there is hydraulic or pneumatic failure in the mast retraction system, counterweights in the tail service mast will complete retraction.

2. Remarks

The following precautions are taken to prevent possible explosive conditions in the vicinity of the carriers.

a. The shield of each electrical connector is grounded through a common wire to the vehicle.

b. The electrical connectors in each carrier are purged with GN_2.

3. General

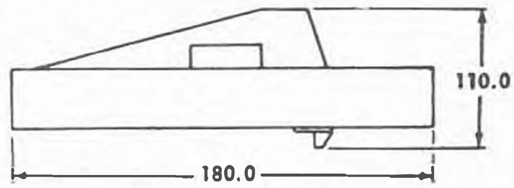
a. Weight, pounds (Approximate)

Aft Umbilical Carrier Assembly #1	630
Aft Umbilical Carrier Assembly #2	630
Aft Umbilical Carrier Assembly #3	630

b. Envelope Dimension, inches (Approximate)

Aft Umbilical Carrier Assembly #1	32 x 40 x 45
Aft Umbilical Carrier Assembly #2	32 x 40 x 45
Aft Umbilical Carrier Assembly #3	32 x 40 x 45

S-IC STAGE UMBILICAL CARRIERS



CARRIER ENVELOPE
DIMENSIONS APPROXIMATE

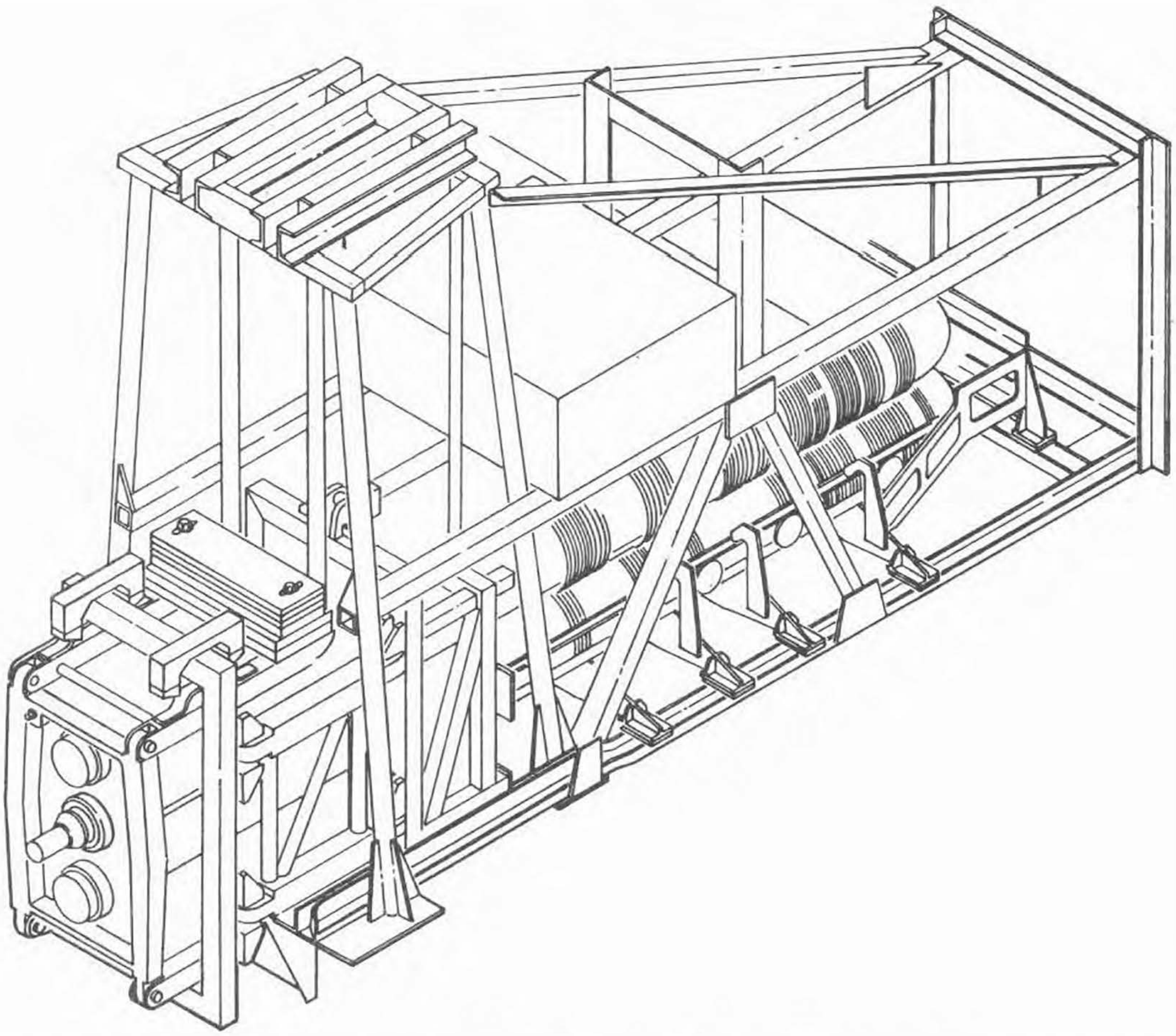


Figure 2-4. S-IC Stage Intertank Umbilical Carrier

S-IC STAGE INTERTANK UMBILICAL CARRIER

1. Functional Description

a. The Intertank Umbilical Carrier contains two 6-inch liquid oxygen (LOX) fill and drain couplings. The carrier is remotely disconnected and withdrawn from the vehicle at approximately T-minus-15 seconds. In case of a hold or abort, the carrier can be automatically reconnected to the vehicle to replenish or drain the LOX tank.

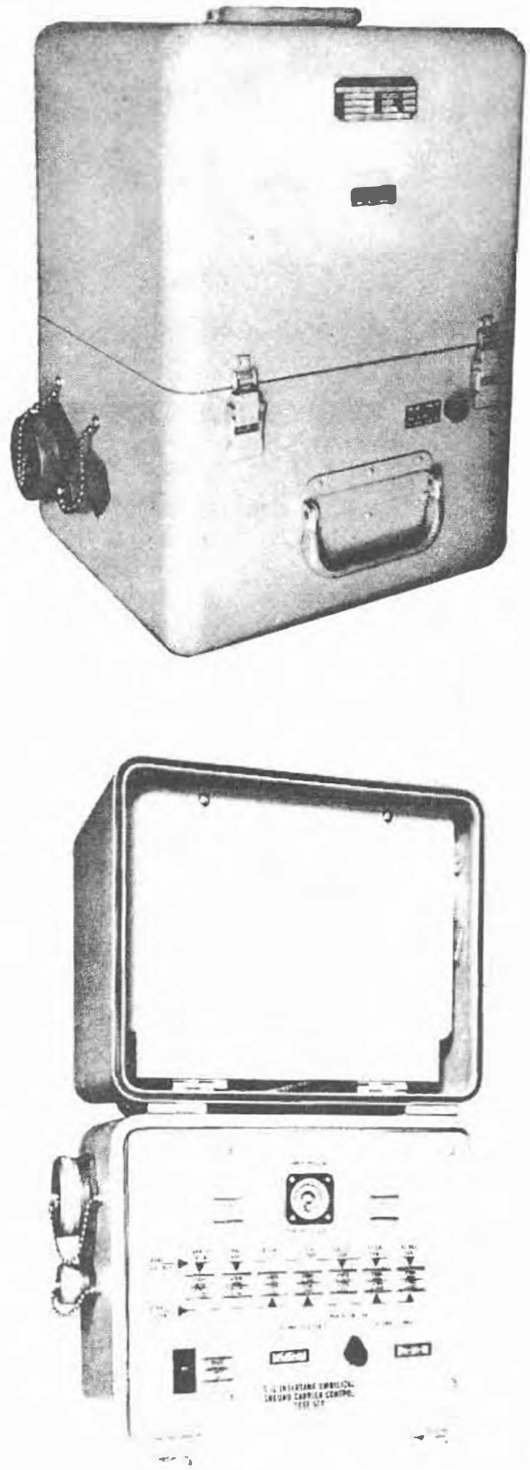
b. Ejection: The LOX lines are drained and then purged with GN_2 just before engine ignition. The carrier assembly is pneumatically disconnected by applying GN_2 at 750 psig to the locking mechanism. The locking piston is retracted, releasing the locking fingers to a diameter smaller than the minimum diameter of the vehicle plate receptacle. Pneumatic pressure simultaneously actuates a switch in the locking mechanism, indicating the locking fingers are released. A solenoid valve then causes the retract cylinder to withdraw the carrier assembly from the vehicle. After the carrier assembly is clear of the vehicle drift envelope, a switch is actuated, initiating service arm rotation. The service arm is then hydraulically rotated to the tower and locked.

2. Remarks

The interior of the carrier is purged with GN_2 as a precaution to prevent possible explosive conditions in the vicinity of the carrier.

3. General

a.	Weight, pounds (Approximate)	5,850
b.	Envelope Dimensions, inches (Approximate)	110 x 63 x 180



B-H 1077

Figure 2-5. S-IC Intertank Umbilical Ground Control Test Set

S-IC INTERTANK UMBILICAL GROUND CARRIER CONTROL TEST SET

1. Functional Description

a. The Intertank Umbilical Ground Carrier Control Test set is required to simulate ML control of the S-IC intertank umbilical ground carrier. The set is used in manual or automatic modes to check out proper operation of the intertank umbilical ground carrier. The test set provides manual control of all valves except the carrier latch, lock release, and purge valves.

b. The test set is portable, with the upper half of the set used to store the two 18 foot cables and the lower half containing the circuitry for monitoring and controlling the intertank umbilical ground carrier. It contains switches and indicators for operation of the intertank umbilical ground carrier on initial installation and following component replacement to indicate proper adjustment and correct operation of the carrier.

c. The manual mode of operation provides individual control of the solenoid valves in the intertank umbilical ground carrier. This permits the carrier to be stopped at any point of travel. After the carrier has stopped, the pressure regulators or limit switches can be adjusted.

d. The automatic mode of connection is used to check out proper operation of the intertank umbilical ground carrier through a complete connection sequence. The switch lights on the test set illuminate in sequence to indicate proper operation of the solenoid valves and limit switches in the carrier. Automatic retraction is used to check out proper operation of the carrier through a complete retract sequence.

2. Facility Requirements

Power	Demand
28 vdc	10 amps

3. General

a.	Weight, pounds (Approximate)	45
b.	Dimensions, inches (Approximate)	19 x 14 x 12

4. Remarks

For additional information, refer to MSFC-MAN-001

S-IC STAGE UMBILICAL CARRIERS

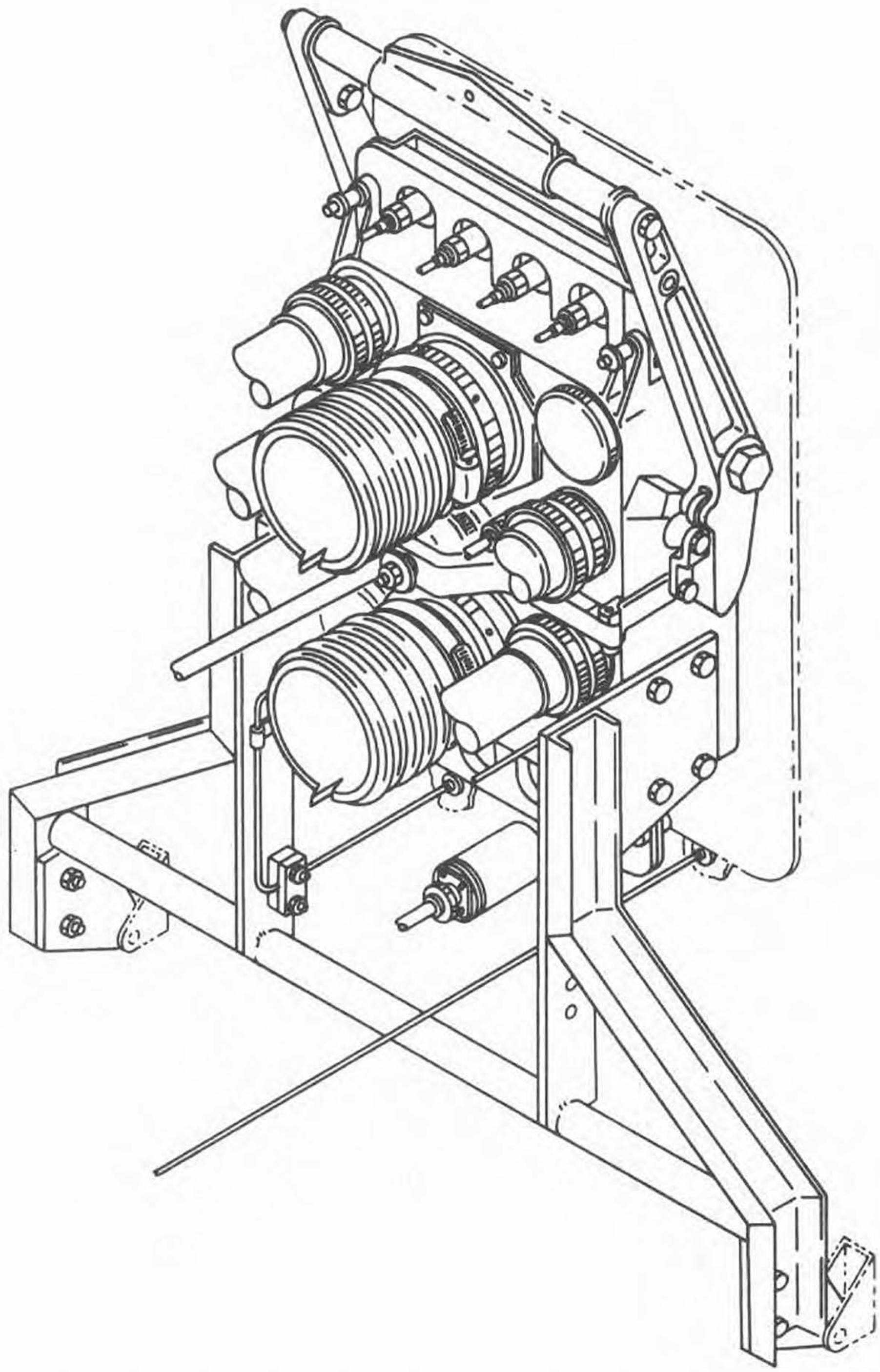


Figure 2-6. S-IC Stage Forward Umbilical Carrier (Sheet 1 of 3)

S-IC STAGE UMBILICAL CARRIERS

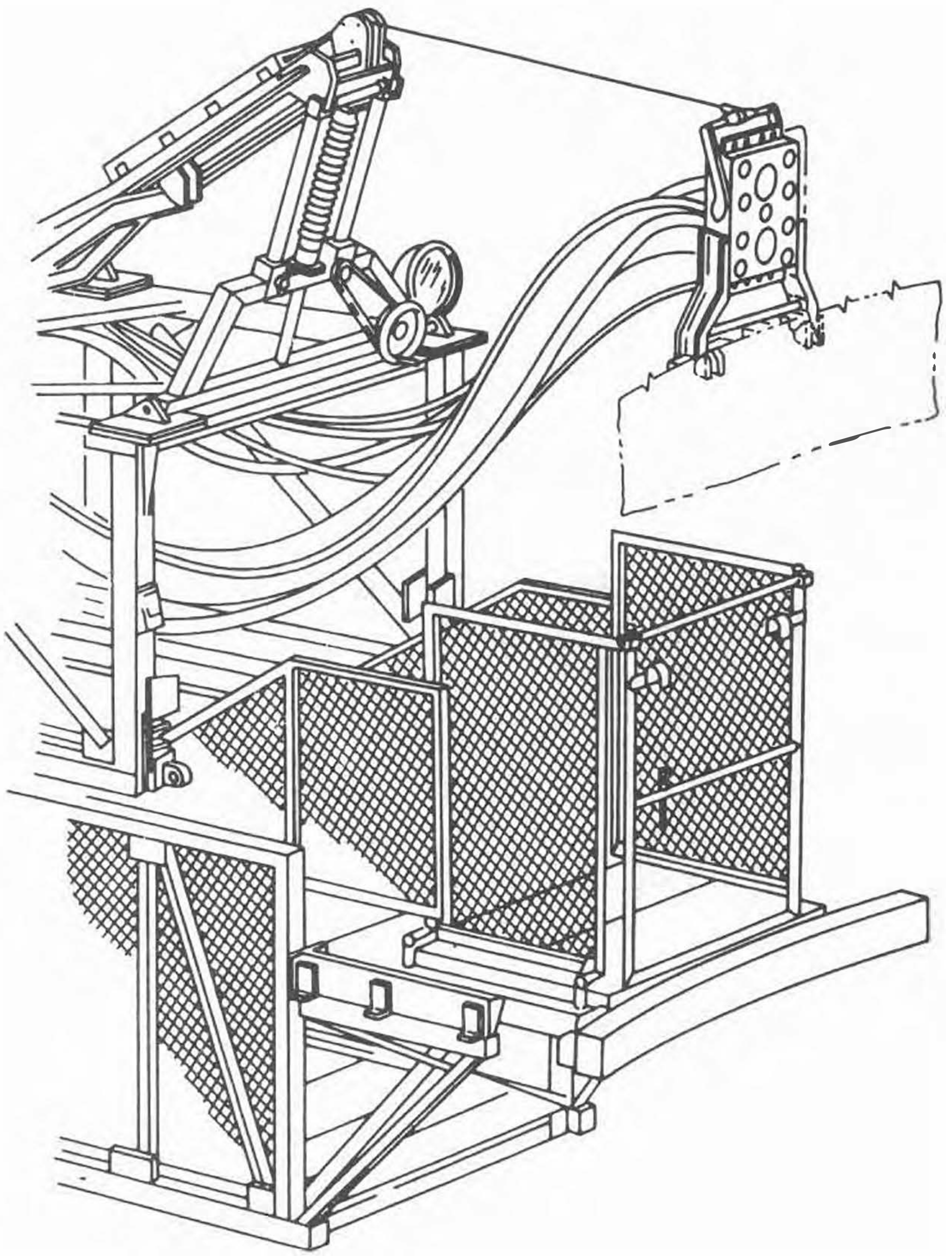


Figure 2-6. S-IC Stage Forward Umbilical Carrier (Sheet 2 of 3)

S-IC STAGE UMBILICAL CARRIERS

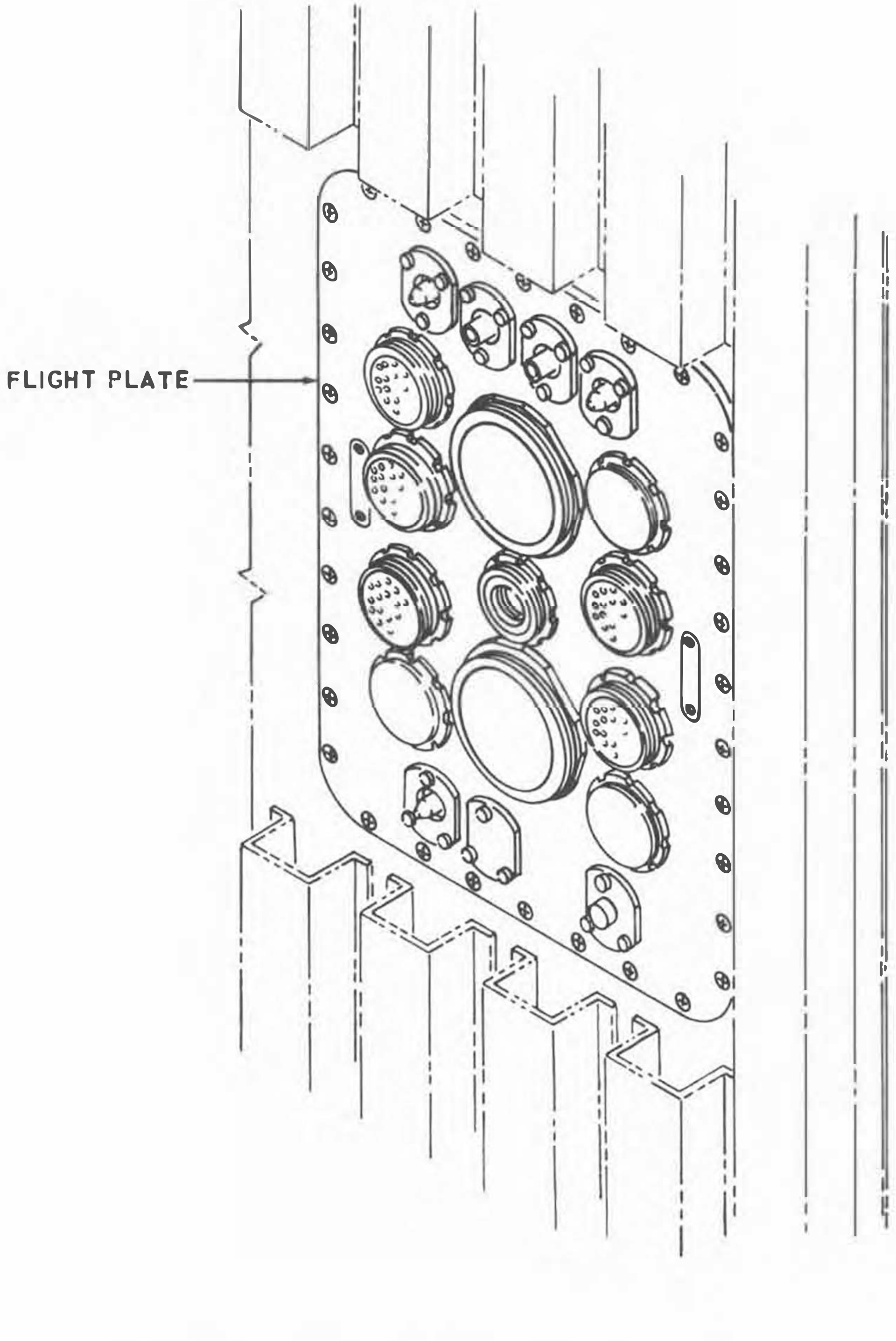


Figure 2-6. S-IC Stage Forward Umbilical Carrier (Sheet 3 of 3)

S-IC STAGE FORWARD UMBILICAL CARRIER

1. Functional Description

a. The Forward Umbilical Carrier contains various pneumatic couplings, eight electrical connectors, and one 4-inch air conditioning coupling. It is a pre-flight disconnect, disconnecting at approximately T-minus-10 seconds prior to lift-off.

b. The S-IC Forward Umbilical Flight Plate contains fluid disconnect couplings and electrical connectors. All couplings and connectors on the flight plate are rigidly mounted. The carrier provides for coupling and connector alignment during mating. The carrier provides both primary and secondary methods of ejecting the service lines from the vehicle.

(1) Primary Ejection Method: The carrier assembly is ejected pneumatically from the vehicle by applying GN_2 at 750 psig to the locking mechanism. The release pin retracts, releasing the locking mechanism. Pneumatic pressure simultaneously forces four pushoff pistons against the vehicle plate, disconnecting the carrier from the plate. A lanyard routed from the carrier to the pneumatically driven block and tackle retraction device then pulls the carrier to the service arm.

(2) Secondary Ejection Method: If pneumatic failure occurs, the lanyard actuates a mechanical release linkage on the carrier that disconnects the umbilical carrier. As the lanyard is withdrawn, the release arm of the mechanical release linkage moves outward, contacting the manual release knob on the locking mechanism, and retracting the release pin. The locking mechanism is released, and the pulloff arms on the sides of the carrier force the carrier away from the vehicle plate. Additional lanyard motion then pulls the carrier to the service arm.

2. Remarks

The following precautions are taken to prevent possible explosive conditions in the vicinity of the carrier.

a. The shield of each electrical connector is grounded through a common wire to the vehicle.

b. The electrical connectors in the carrier are purged with GN_2.

3. General

a. Weight, pounds (Approximate) 57
b. Envelope Dimensions, inches (Approximate) 34 x 30 x 15

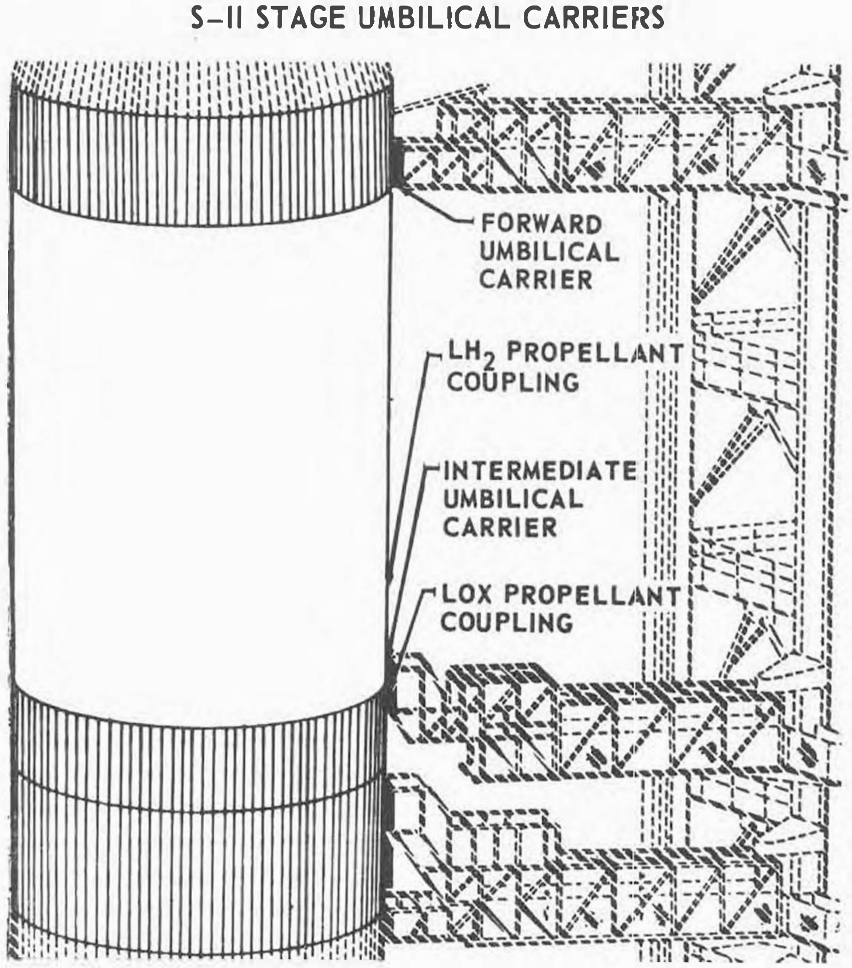


Figure 2-7. S-II Stage Umbilical Carriers

S-II STAGE UMBILICAL CARRIERS

The S-II stage umbilical system consists of an intermediate umbilical carrier, a forward umbilical carrier, and two propellant fill and drain couplings. The carriers and couplings are located at the vehicle end of the service arms extending from the tower and secure the following service lines to the S-II stage of the Saturn V vehicle:

a. Electrical.

b. Pneumatic.

c. Gaseous nitrogen (GN_2).

d. Liquid oxygen (LOX).

e. Liquid hydrogen (LH_2).

f. Air conditioning.

g. Hydrogen vent.

The carriers and the couplings provide primary and secondary methods of ejecting the service lines from the vehicle at lift-off.

S-II STAGE UMBILICAL CARRIERS

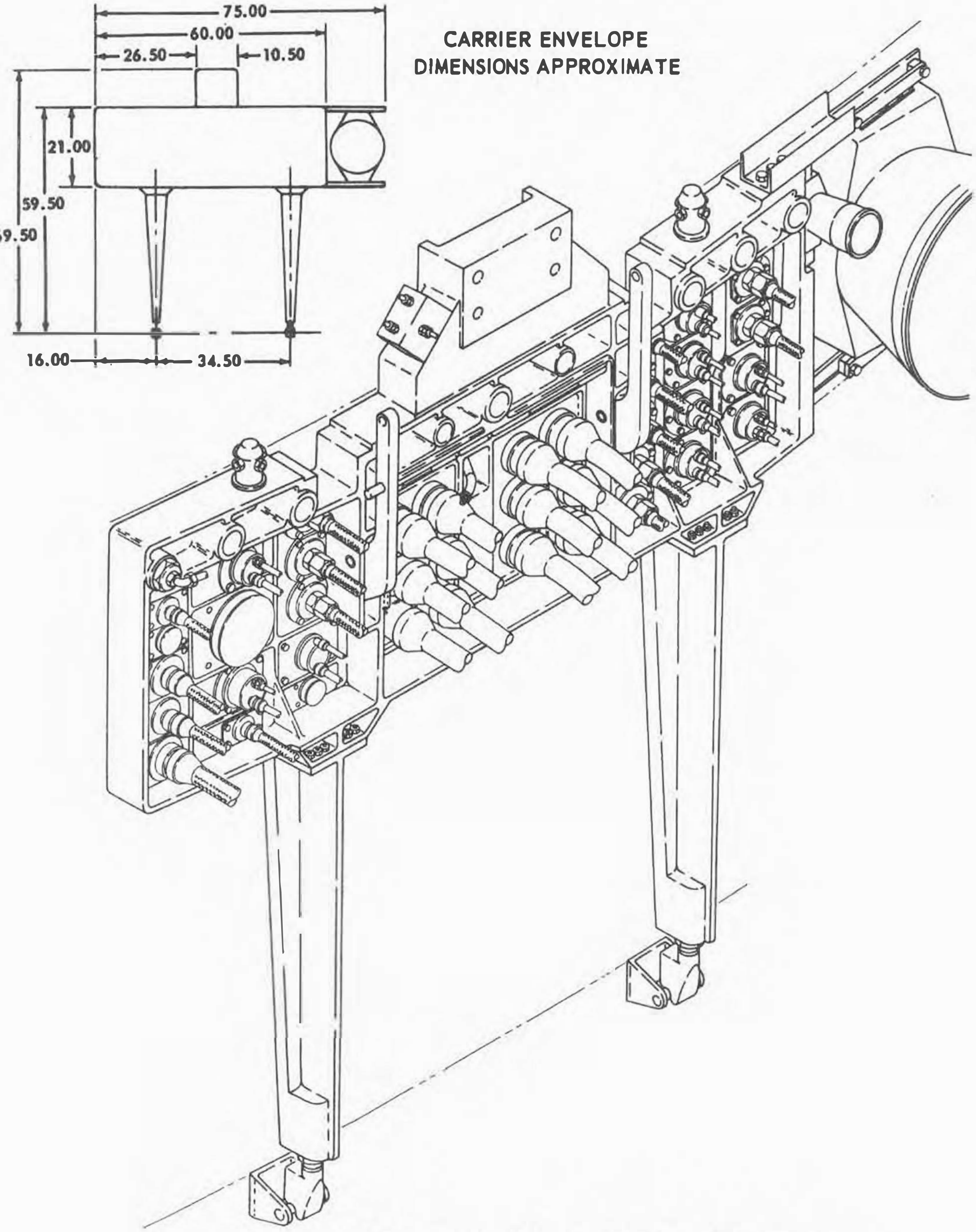


Figure 2-8. S-II Stage Intermediate Umbilical Carrier

S-II STAGE INTERMEDIATE UMBILICAL CARRIER

1. Functional Description

a. The Intermediate Umbilical Carrier is located 73° from Position I toward Position II. It contains 30 pneumatic couplings, 12 electrical connectors, and two air conditioning couplings. The electrical connectors can be ejected independently of the carrier assembly for simulated flight test and checkout purposes.

b. The carrier provides primary and secondary methods of ejecting the service lines from the vehicle at lift-off.

(1) Primary Ejection Method: The carrier is disconnected from the vehicle after the rise-off switches have been actuated. The carrier assembly is ejected pneumatically by applying GN_2 at 1250 psig simultaneously to the pushoff pistons. The release pins then retract, releasing the locking mechanism. The pushoff pistons are forced against the vehicle plate, disconnecting the carrier from the vehicle.

(2) Secondary Ejection Method: If primary pneumatic failure occurs, a pneumatically driven lanyard arrangement actuates the mechanical release linkage, thereby disconnecting the carrier from the vehicle.

(3) If both primary and secondary pneumatic failures occur, the upward motion of the vehicle tightens the lanyard and causes the mechanical release linkage to actuate and disconnect the carrier from the vehicle.

2. Remarks

The following precautions are taken to prevent possible explosive conditions in the vicinity of the carriers:

a. The shield of each electrical connector is grounded through a common wire to the vehicle.

b. The electrical connectors in the carrier are purged with GN_2.

3. General

a. Weight, pounds (Approximate) 500
b. Envelope Dimensions, inches (Approximate) 70 x 75 x 15

S-II STAGE UMBILICAL CARRIERS

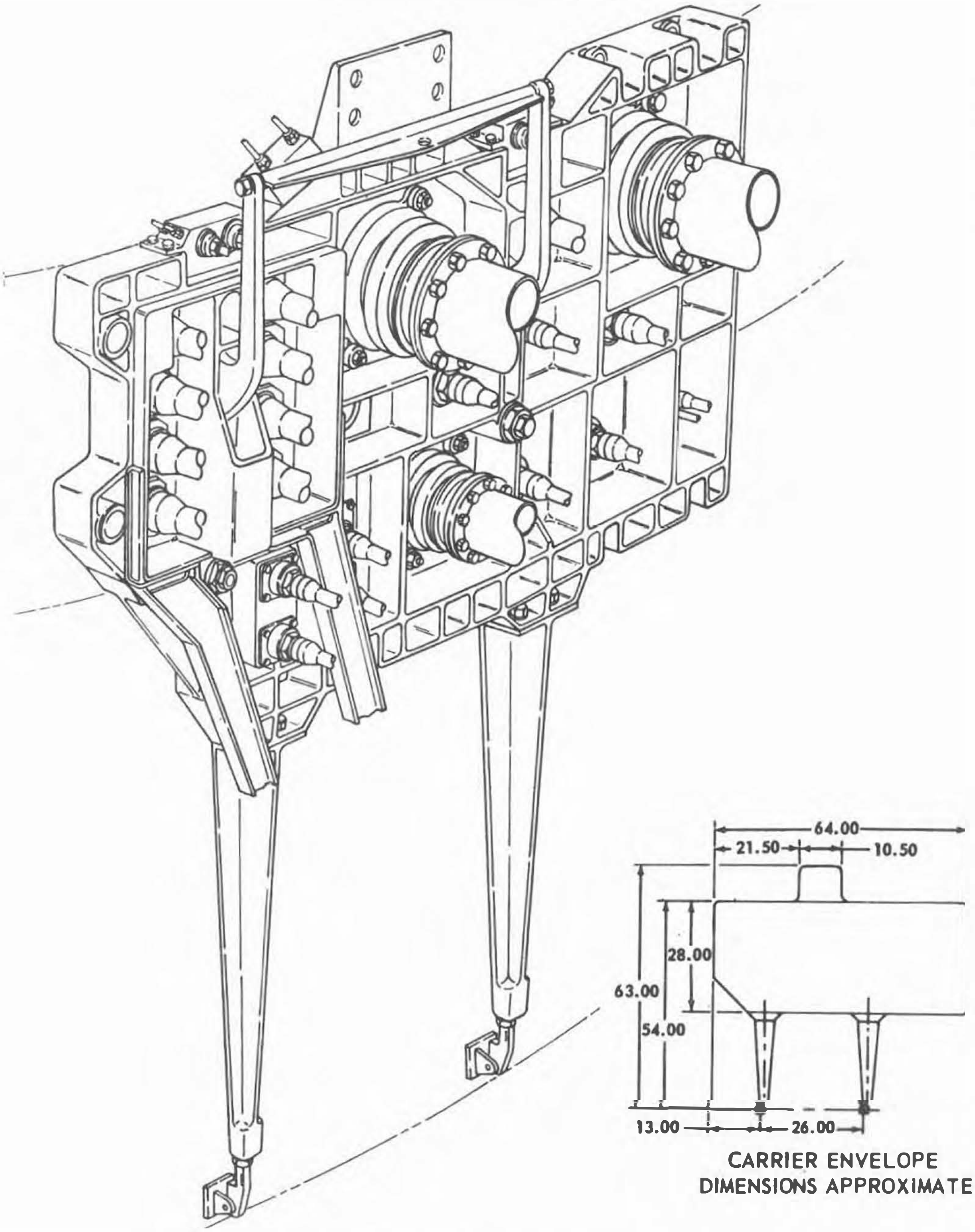


Figure 2-9. S-II Stage Forward Umbilical Carrier

S-II STAGE FORWARD UMBILICAL CARRIER

1. Functional Description

a. The Forward Umbilical Carrier consists of various pneumatic couplings, eight electrical connectors, and two 7-inch GH_2 vent couplings. The electrical connectors can be ejected independently of the carrier assembly for simulated flight test and checkout purposes.

b. The carrier provides primary and secondary methods of ejecting the service lines from the vehicle at lift-off.

(1) Primary Ejection Method: After the vehicle rise-off switches have been actuated, the carrier is ejected pneumatically by applying GN_2 at 1250 psig simultaneously to each locking mechanism and the pushoff pistons. The release pins then retract, releasing the locking mechanism. The pressurized pushoff pistons then force the carrier away from the vehicle, and the pneumatic withdrawal cylinder moves the carrier to the service arm.

(2) Secondary Ejection Method: If primary pneumatic failure occurs, a pneumatically driven lanyard arrangement actuates the mechanical release linkage, disconnecting the carrier from the vehicle.

(3) If both primary and secondary pneumatic failures occur, the upward motion of the vehicle tightens the lanyard and causes the mechanical release linkage to disconnect the carrier from the vehicle.

2. Remarks

The following precautions are taken to prevent possible explosive conditions in the vicinity of the carriers.

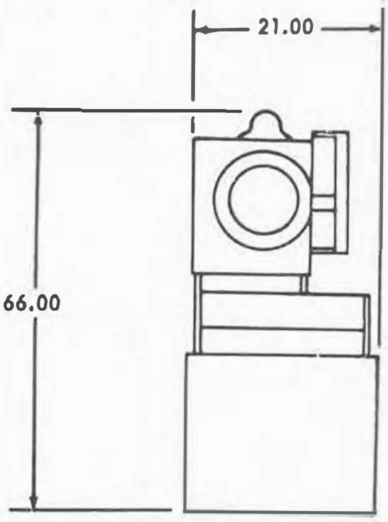
a. The shield of each electrical connector is grounded through a common wire to the vehicle.

b. The carrier is purged between the electrical connectors and the fuel tank vent line with GN_2.

3. General

a. Weight, pounds (Approximate) 580
b. Envelope Dimensions, inches (Approximate) 63 x 64 x 23

S-II STAGE UMBILICAL CARRIERS



CARRIER ENVELOPE
DIMENSIONS APPROXIMATE

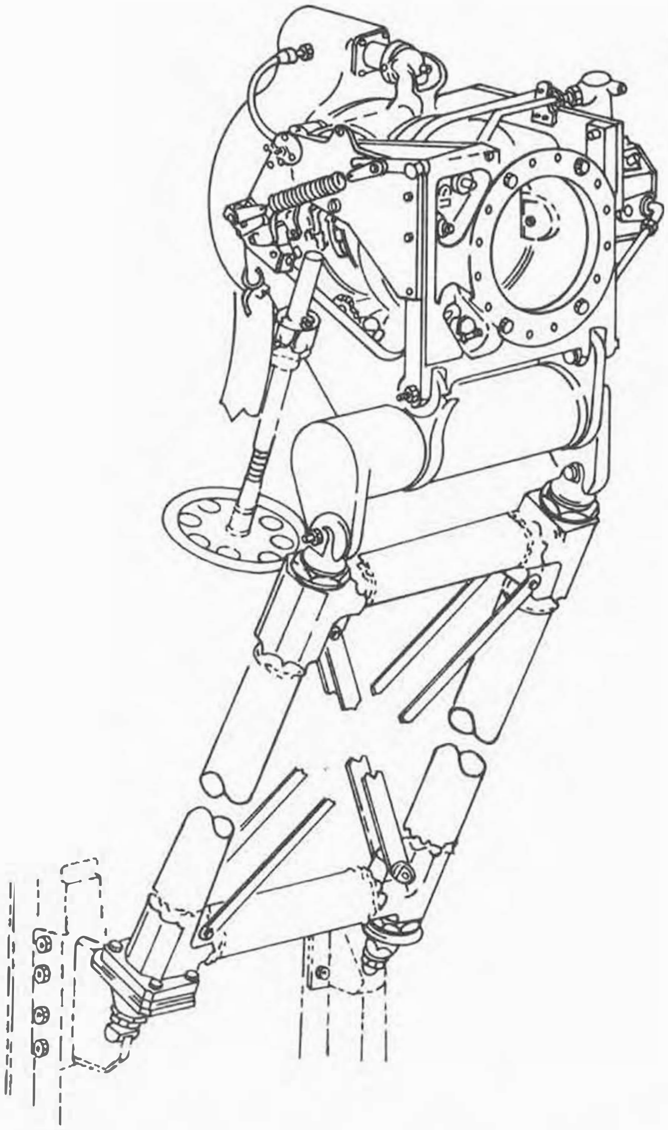


Figure 2-10. S-II Stage LOX/LH_2 Propellant Couplings (Sheet 1 of 2)

S-II STAGE UMBILICAL CARRIERS

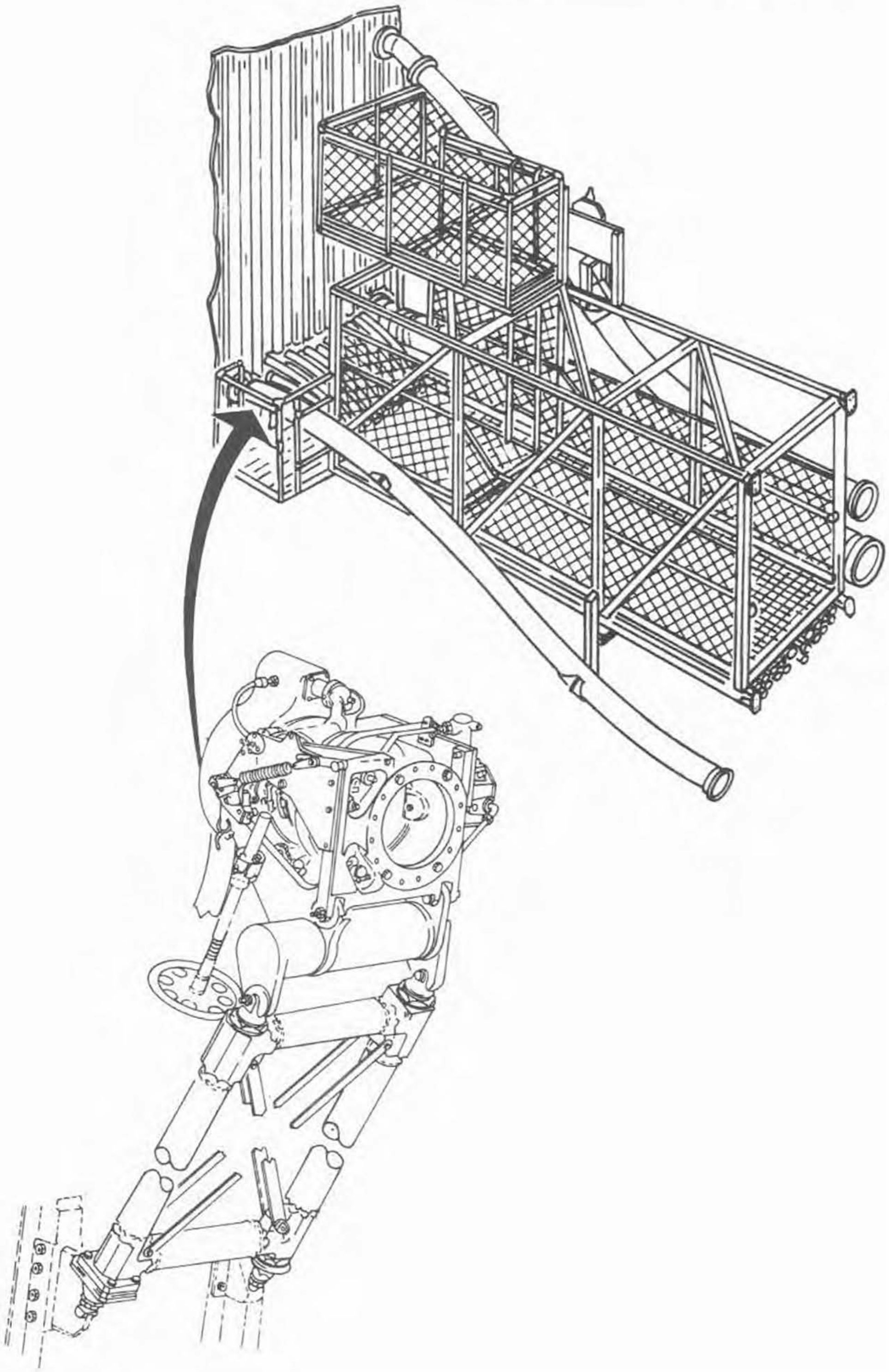


Figure 2-10. S-II Stage LOX/LH_2 Propellant Couplings (Sheet 2 of 2)

S-II STAGE LOX/LH_2 PROPELLANT COUPLINGS

1. Functional Description

a. The two 8-inch propellant couplings are identical. They secure the liquid hydrogen (LH_2) and liquid oxygen (LOX) service lines to the S-II stage of the vehicle. Debris valves are used on these couplings to prevent debris from contaminating the propellant lines at disconnect.

b. Since the couplings are independent of the main carrier, they require their own release systems, both primary and secondary.

(1) Primary Ejection Method: The two propellant couplings are ejected by appling GHe at 750 psig simultaneously to the locking mechanisms and pushoff pistons. The release pins then retract, releasing the locking mechanism. The pushoff pistons then eject the two couplings from the vehicle. A lanyard attached to the release pin of each locking mechanism pulls the couplings and attached propellant lines to the service arm.

(2) Secondary Ejection Method: If pneumatic failure occurs, the lanyards release the locking mechanisms by retracting the release pins and then pull the couplings to the service arm.

2. General

a.	Weight, pounds (Approximate)	125 (each)
b.	Envelope Dimensions, inches (Approximate)	21 x 17 x 30 (each)

S-IVB STAGE/I.U. UMBILICAL CARRIERS

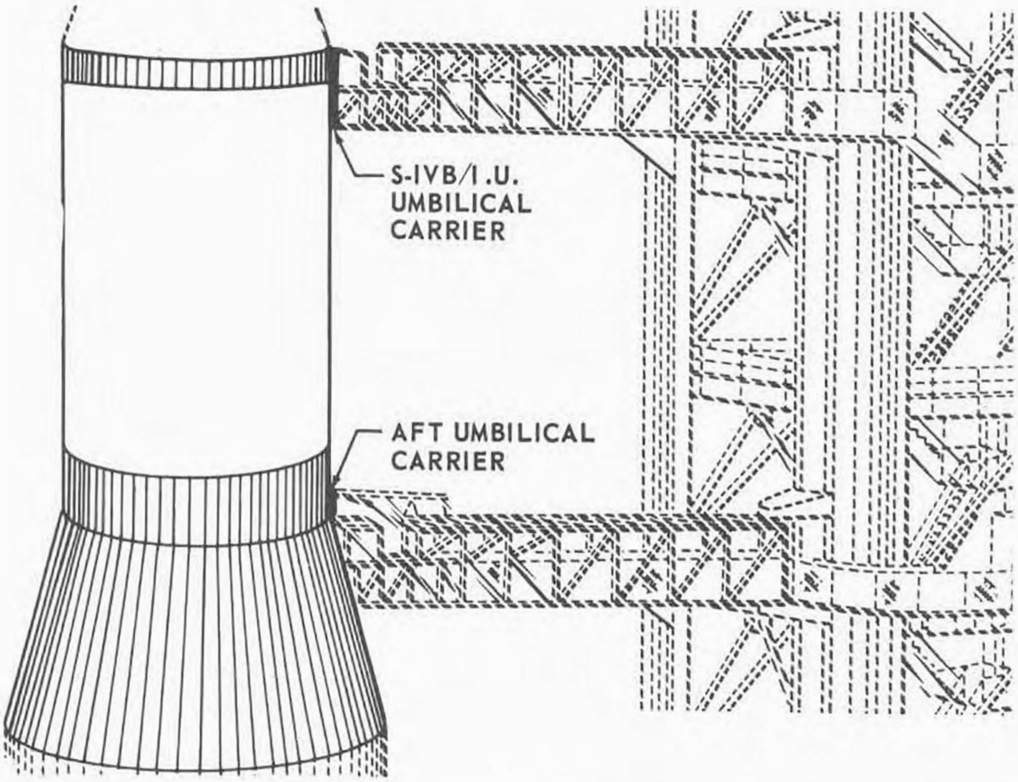


Figure 2-11. S-IVB Stage/I.U. Umbilical Carriers

S-IVB STAGE/I. U. UMBILICAL CARRIERS

The S-IVB stage/I. U. umbilical system consists of the S-IVB aft umbilical carrier and the S-IVB forward/I. U. umbilical carriers bracketed together as a common unit. The carriers are located at the vehicle end of the service arms extending from the tower and secure the following service lines to the S-IVB stage/I. U. of the Saturn V vehicle:

a. Electrical.

b. Pneumatic.

c. Gaseous nitrogen (GN_2).

d. Liquid oxygen (LOX).

e. Liquid hydrogen (LH_2).

f. Air conditioning.

g. Hydrogen vent.

h. Air bearing sphere.

The carriers provide primary and secondary methods of ejecting the service lines from the vehicle at lift-off.

S-IVB STAGE/I.U. UMBILICAL CARRIERS

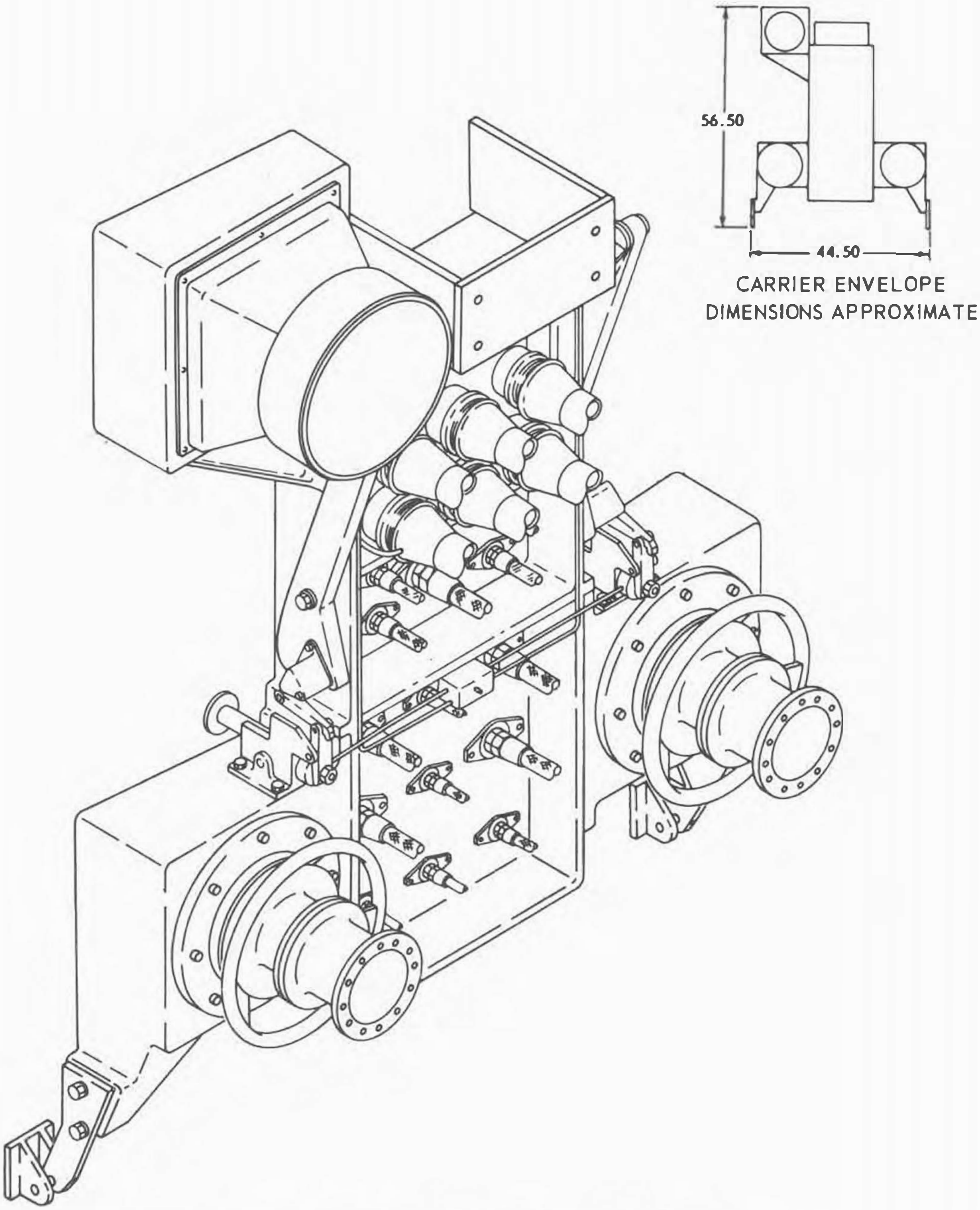


Figure 2-12. S-IVB Stage Aft Umbilical Carrier

S-IVB STAGE AFT UMBILICAL CARRIER

1. Functional Description

a. The Aft Umbilical Carrier contains various pneumatic couplings, six electrical connectors, and two 4-inch LOX and LH2 couplings. The electrical connectors can be ejected independently of the carrier assembly for simulated flight test and checkout purposes. The LOX and LH_2 couplings are contained in the main carrier and disconnect as a unit.

b. The carrier provides primary and secondary methods of ejecting the service lines from the vehicle at lift-off.

(1) Primary Ejection Method: The carrier is unlocked from the vehicle by the two side-mounted pneumatic locking mechanisms after the vehicle rise-off switches have been actuated. To release the locking mechanisms, GN_2 at 1250 psig is simultaneously applied to each mechanism and the pushoff pistons. The release pins retract, unlocking the carrier from the vehicle. The pressurized pushoff pistons then force the carrier away from the vehicle, and the pneumatic withdrawal cylinder moves it to the service arm.

(2) Secondary Ejection Method: If primary pneumatic failure occurs, a pneumatically driven lanyard arrangement actuates the mechanical release linkage, thereby disconnecting the carrier from the vehicle.

(3) If both primary and secondary pneumatic failures occur, the rising motion of the vehicle tightens the lanyard and causes the mechanical release linkage to actuate and disconnect the carrier from the vehicle.

2. Remarks

The following precautions are taken to prevent possible explosive conditions in the vicinity of the carrier.

a. The shield of each electrical connector is grounded to the vehicle.

b. The interior of the carrier is purged in four locations with GN_2.

3. General

a. Weight, pounds (Approximate) 293
b. Envelope Dimensions, inches (Approximate) 57 x 45 x 21

S-IVB STAGE/I.U. UMBILICAL CARRIERS

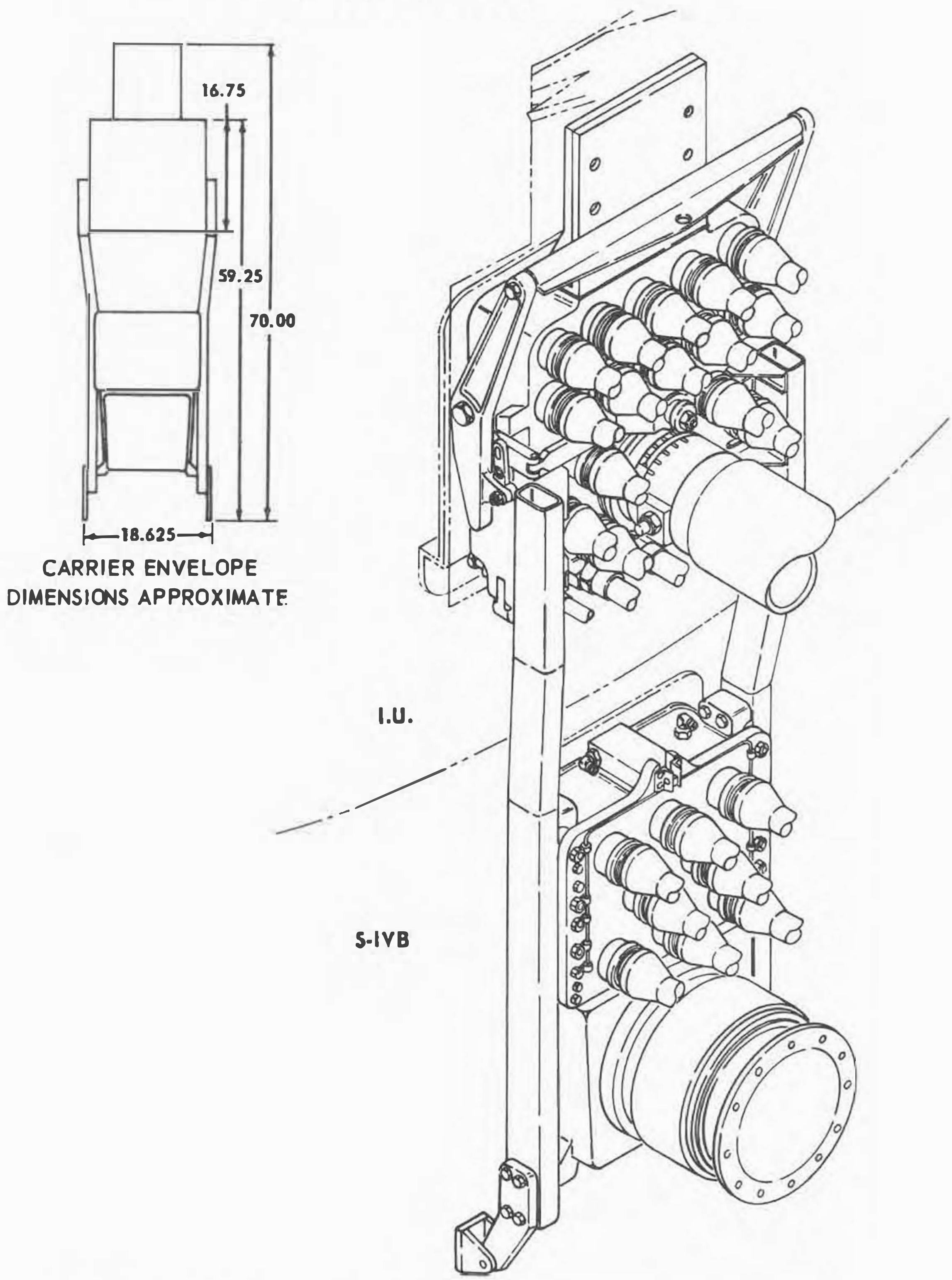


Figure 2-13. S-IVB Stage Forward/I. U. Umbilical Carrier

S-IVB STAGE FORWARD /I. U. UMBILICAL CARRIER

1. Functional Description

a. The S-IVB Forward Umbilical Carrier contains eight electrical connectors and one 6-inch GH_2 vent coupling. The electrical connectors can be ejected independently of the carrier assembly for simulated flight test and checkout purposes. This carrier is connected to the I. U. Umbilical Carrier by side brackets and they are disconnected as a unit.

b. The I. U. Umbilical Carrier consists of five pneumatic couplings, sixteen electrical connectors, and one 6-inch air conditioning coupling.

c. The S-IVB forward carrier and I. U. carrier are held together by side brackets at the end of one common service arm. The ends of the brackets, which extend down past the forward carrier, serve as pivot points for the carrier assemblies when they are disconnected.

(1) Primary Ejection Method: The S-IVB forward carrier and I. U. carrier are disconnected from the vehicle after the vehicle rise-off switches have been actuated. To release the locking mechanism, GN_2 at 750 psig is simultaneously applied to the four pushoff pistons contained in the I. U. carrier. The release pin retracts, unlocking the carriers from the vehicle. The pushoff pistons are forced against the vehicle plate, releasing the carriers from the vehicle. The pneumatic withdrawal cylinder then moves the carriers to the service arm.

(2) Secondary Ejection Method: If primary pneumatic failure occurs, a pneumatically driven lanyard arrangement actuates the mechanical release linkage, disconnecting the carriers from the vehicle.

(3) If both primary and secondary pneumatic failures occur, the upward motion of the vehicle tightens the lanyard and causes the mechanical release linkage to actuate and disconnect the carriers from the vehicle.

2. Remarks

The following precautions are taken to prevent possible explosive conditions in the vicinity of both carriers.

a. The shield of each electrical connector is grounded through a common wire to the vehicle.

b. The interior of the carrier is purged with GN_2.

3. General

a. Weight, pounds (Approximate)

S-IVB Forward Umbilical Carrier	135
I. U. Umbilical Carrier	100

b. Envelope Dimensions, inches (Approximate)

S-IVB Forward/I. U. Umbilical Carrier	70 x 19 x 1

SECTION III
SERVICING EQUIPMENT

This section presents information on the various launch vehicle ground support service units, with a brief description and a visual presentation of each unit. The section is sub-divided into the S-IC stage servicing equipment, the S-II stage, the S-IVB stage, the I. U., and the Launch Vehicle servicing equipment.

The servicing equipment provides ground support to the Saturn V vehicle before lift-off as well as the necessary auxiliary support for service, checkout, and launch operations. This section will be revised and/or added to as more information on the servicing equipment becomes available.

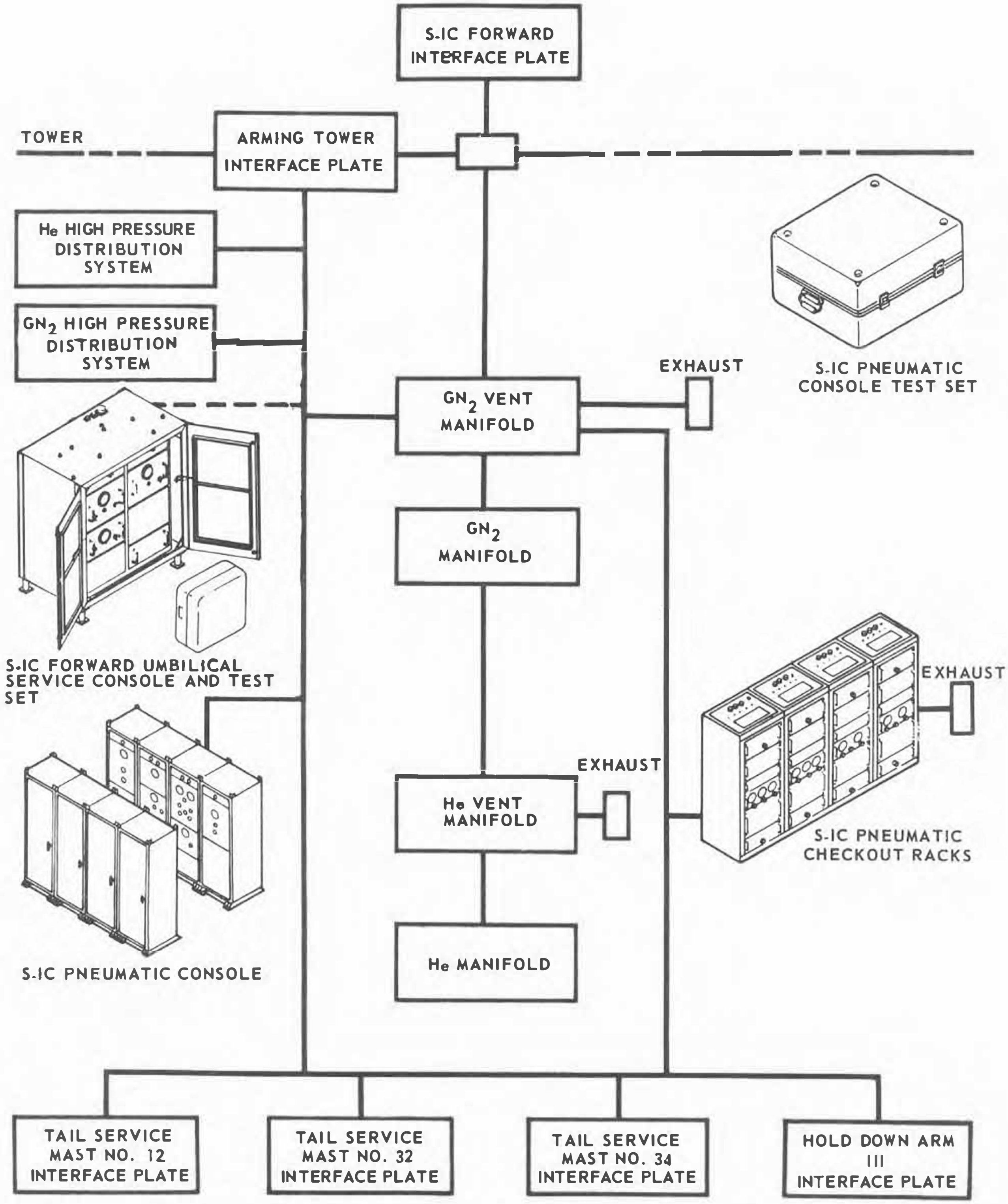


Figure 3-1. S-IC Pneumatic Ground Support Equipment

S-IC PNEUMATIC GROUND SUPPORT EQUIPMENT

1. Functional Description

a. The S-IC Pneumatic Ground Support Equipment supplies pressure regulated nitrogen and helium gases to the S-IC stage to satisfy both operational and test and checkout requirements. The equipment, located in the ML base, consists of the pneumatic console, the pneumatic checkout racks, the forward umbilical service console, and the portable testers.

b. The pneumatic console consists of two groups of racks with four racks in each group. The pneumatic checkout racks consist of four racks in one group. The forward umbilical service console is in a separate cabinet. The portable testers consist of two testers, each in its own "suitcase", for the pneumatic console, and four testers, two to a "suitcase", for the pneumatic checkout racks. In addition, there is a separate test set for the forward umbilical service console.

2. Facility Requirements

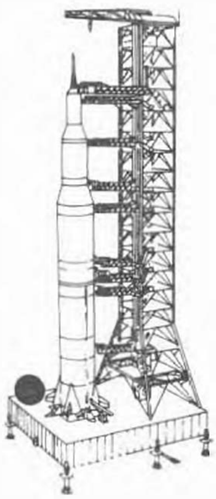
a. Power	Demand
(1) 110 vac, 60 cps, single phase	To be determined
(2) 28 vdc	To be determined

b. Gaseous Media

(1) Nitrogen at 3800 psig minimum to 6600 psig maximum.

(2) Helium at 3800 psig minimum to 6600 psig maximum.

S-IC PNEUMATIC GROUND SUPPORT EQUIPMENT



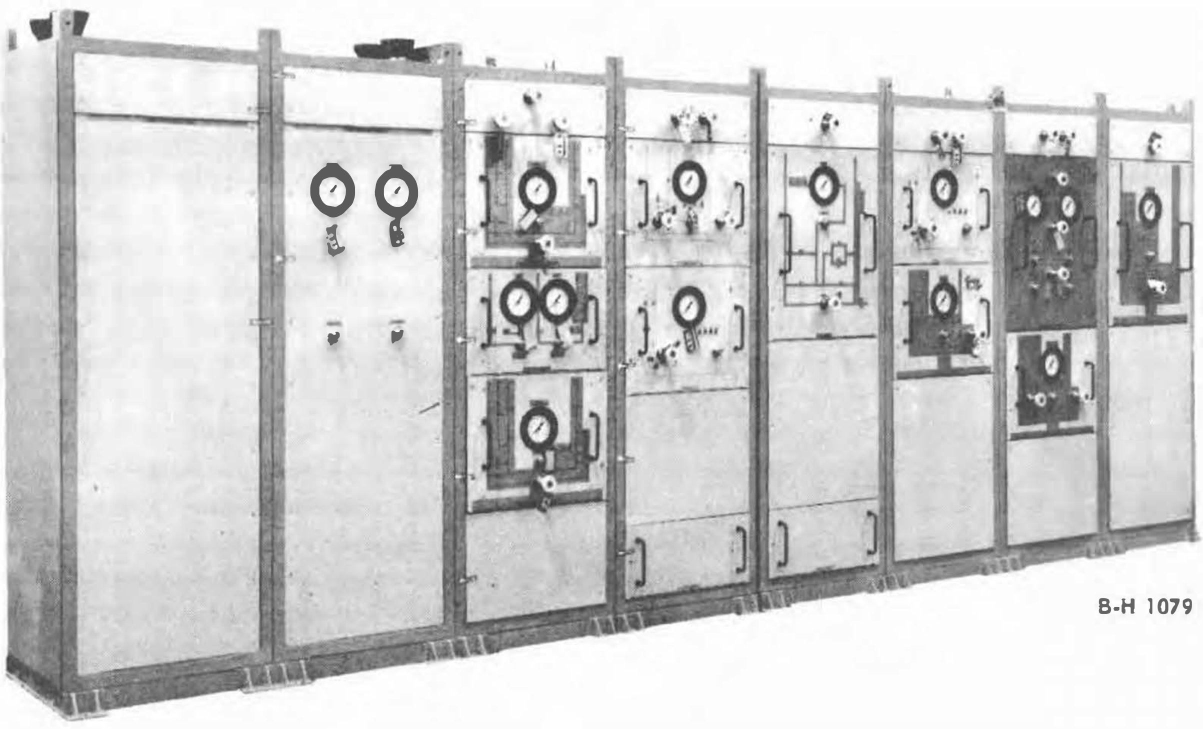


Figure 3-2. S-IC Pneumatic Console

S-IC PNEUMATIC CONSOLE

1. Functional Description

a. The S-IC Pneumatic Console consists of a primary regulation module and eleven secondary regulation modules. The primary regulation module regulates facility gases to provide stable input to the secondary regulation modules. The secondary regulation modules supply operating pressures directly to the S-IC stage and to the pneumatic checkout racks.

b. The pneumatic console modules and their primary functions are as follows:

(1) The helium and nitrogen primary regulation module is the first stage of pneumatic regulation in the pneumatic console. It is capable of regulating to approximately 3500 psig erratic facility supplies of helium and nitrogen varying from 3800 to 6600 psig.

(2) The LOX tank prepressurization module supplies helium at approximately 1840 psig at a flow rate of 240.0 pounds per minute to the LOX tank ullage to ensure a positive LOX supply at the turbopumps.

(3) The LOX and fuel tank purge module supplies a positive pressure in both stage tanks to prevent atmospheric contamination or tank damage during extreme temperature drops. The module has an output of five to eight psig at low flow rates.

(4) The fuel tank prepressurization module supplies helium at 2065 (±25) psig to the tank ullage, prior to engine ignition, to ensure a positive fuel supply at the turbopumps. Flow rate is 240 pounds per minute, maximum.

(5) The LOX bubbling module introduces helium into the LOX suction lines above the prevalves to prevent geysering and temperature stratification. Module output is approximately 395 psig at 0.78 pounds per minute.

(6) The helium bottle fill module pressurizes the airborne helium bottles in two separate steps. The first requirement is set by the design strength of the bottles at ambient temperatures, which is limited to approximately 1600 psig. Normal loading rate is 31 pounds per minute. This pressure is reached before LOX loading when the bottles are warm. The second requirement is based on the amount of helium used by the stage during flight for pressurization of the fuel tank ullage. This pressure, 3260 psig, is reached after LOX loading when the bottles are cold. The nominal loading rate is 58 pounds per minute.

(7) The valve control module supplies nitrogen to operate three LOX fill and drain valves, the fuel fill and drain valve, the LOX interconnect valve no. 2, and the LOX and fuel prevalves. Delivered flow rate to each valve is approximately 6.0 pounds per minute at approximately 725 psig.

(8) The control pressure bottle fill module pressurizes the stage nitrogen storage spheres during two pressurization cycles. The first cycle calls for a pressure of approximately 1500 psig prior to fuel loading. The second cycle calls for approximately 3250 psig, the desired in-flight supply. Delivered flow rate is 36.0 pounds per minute.

(9) The high and low pressure test module supplies high pressure nitrogen at approximately 3300 psig and 42.0 pounds per minute and low pressure nitrogen at approximately 750 psig at 6.0 pounds per minute to the pneumatic checkout racks.

(10) The fuel bubbling module injects nitrogen at approximately 105 psig at 0.60 pounds per minute and a flow of 15,000 scim into the fuel suction duct during LOX loading and replenishing. This nitrogen agitates the fuel and reduces temperature and density variations in the fuel.

(11) The LOX dome purge module prevents contaminants from entering the LOX injection parts of the F-1 engine and gas generator. The module provides two nitrogen purge rates at separate time intervals. The lower purge rate, 95 psig and 75.0 pounds per minute, is initiated whenever the covers are removed from the engines or when the fuel is aboard the stage. The higher purge rate, 755 psig and 525.0 pounds per minute, is initiated just prior to engine ignition and provides a blowout of the LOX injectors in case of engine cutoff and abort.

2. General

a.	Weight, pounds (Approximate)	6000
b.	Location in ML (Base)	Compartment A-13

S-IC PNEUMATIC GROUND SUPPORT EQUIPMENT

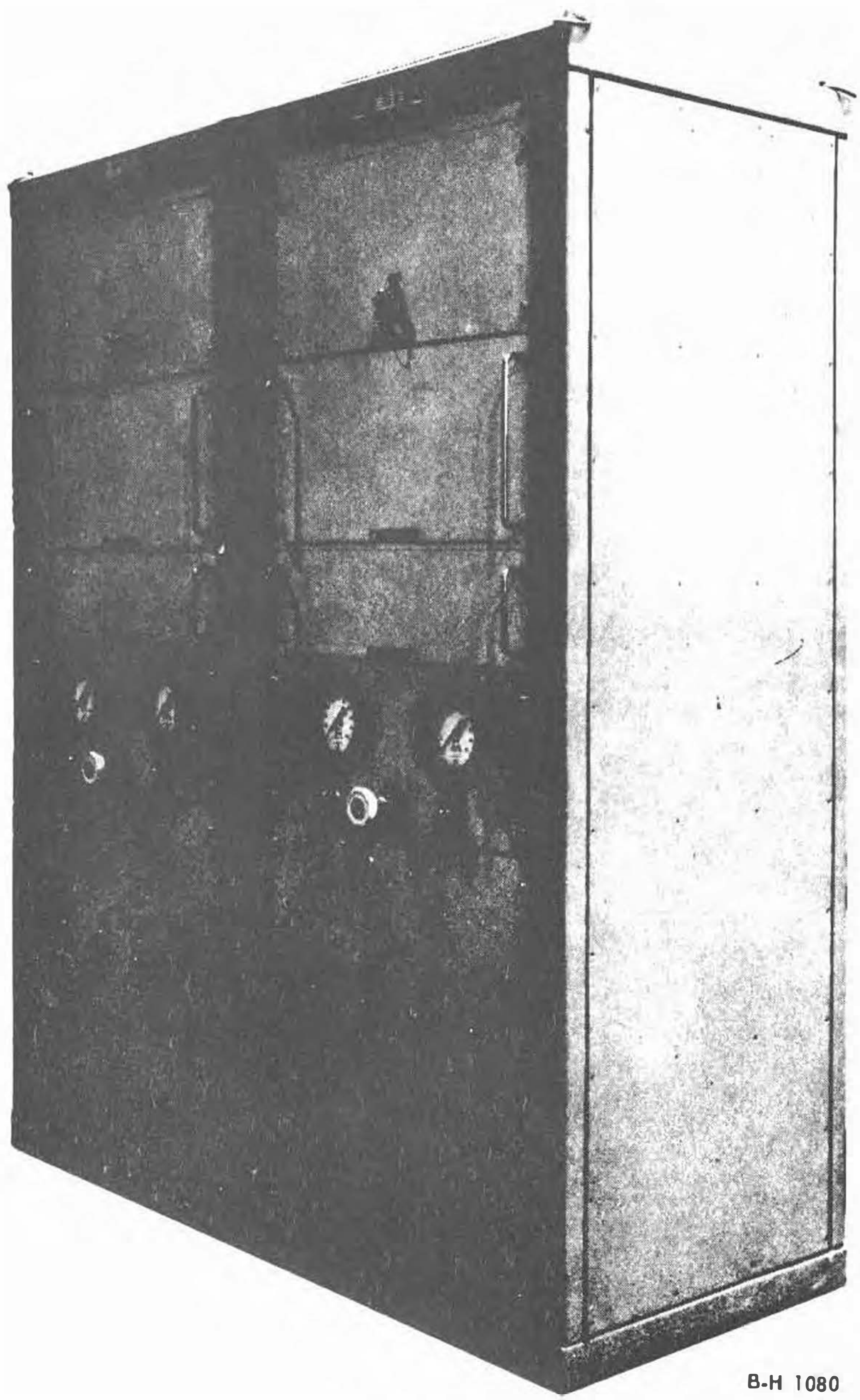


Figure 3-3. S-IC Pneumatic Checkout Racks 1 and 2 (Sheet 1 of 2)

S-IC PNEUMATIC GROUND SUPPORT EQUIPMENT

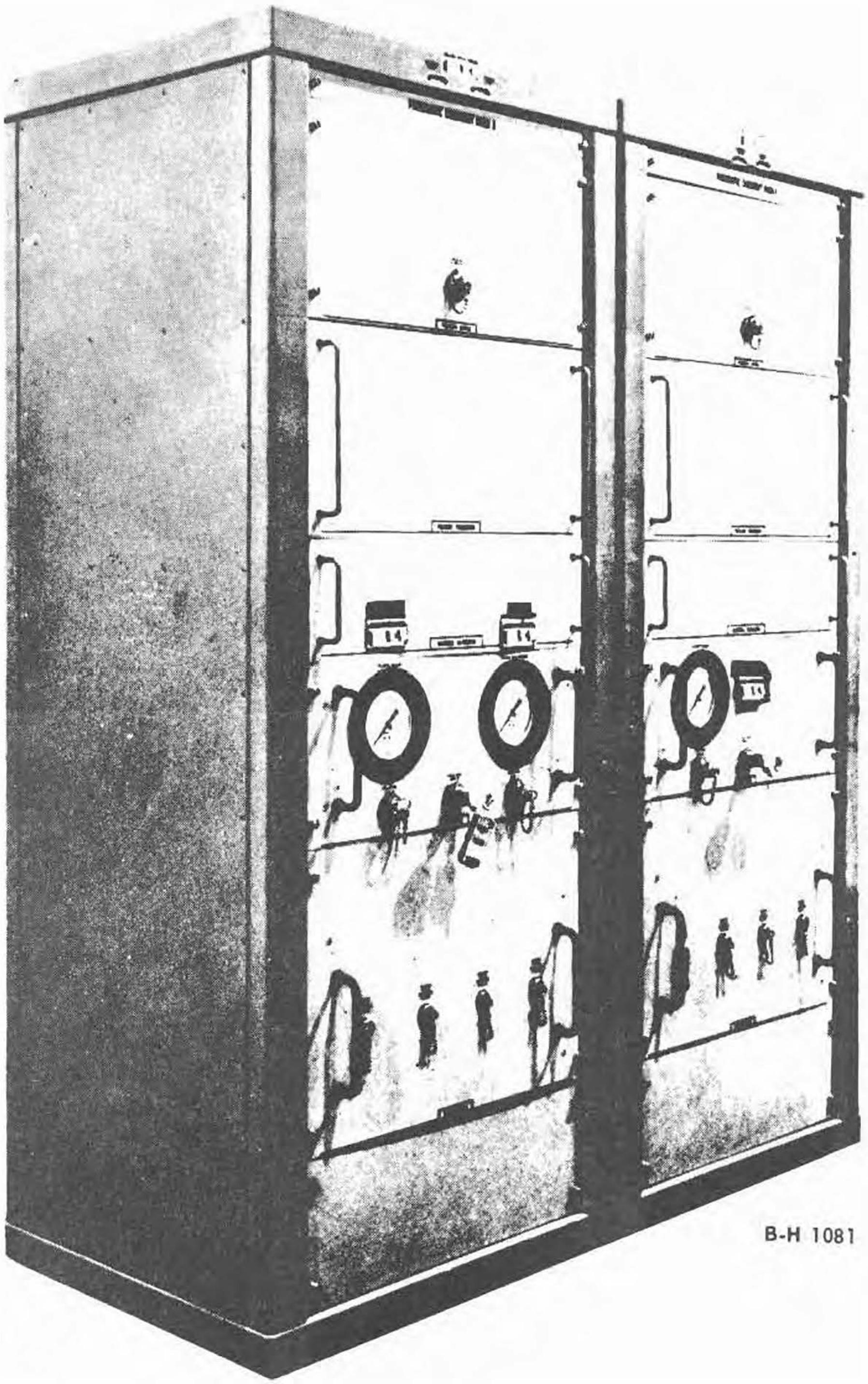


Figure 3-3. S-IC Pneumatic Checkout Racks 3 and 4 (Sheet 2 of 2)

S-IC PNEUMATIC CHECKOUT RACKS

1. Functional Description

a. The S-IC Pneumatic Checkout Racks provide pressure regulated nitrogen gas for test and checkout of pressure switches and pneumatically actuated valves in the S-IC stage propulsion systems. The racks regulate, control, and monitor the gaseous media required to check out the S-IC stage. Normal operation is by commands from the computer; certain functions can also be commanded by the launch crew in the Launch Control Center (LCC) when required.

b. The S-IC Pneumatic Checkout Racks consist of four racks which supply pressures directly to the stage to check operation of various pressure switches and pneumatically actuated valves.

c. Pneumatic Checkout Rack #1 provides regulated GN2 to the following stage components for the following purposes:

(1) Calibration verification of the engine cutoff pressure switches at 47 psig.

(2) Calibration verification of the LOX tank pressure switches at 25 psig.

(3) Test actuation of the GOX flow control valve at 10 psig.

d. Pneumatic Checkout Rack #2 provides regulated GN2 to the following stage components for the following purposes:

(1) Calibration verification of the fuel tank pressure switches at 50 psig.

(2) Calibration verification of the purge system pressure switches at 100 psig.

(3) Test actuation of the ignition monitor valve at 50 psig.

e. Pneumatic Checkout Rack #3 provides regulated GN_2 to the following stage components for the following purposes:

(1) Calibration verification of the control pressure system pressure switches at 3,200 psig.

(2) Calibration verification of the control pressure system pressure switches at 750 psig.

(3) Test actuation of the GOX flow control valve at 1,500 psig.

f. Pneumatic Checkout Rack #4 provides regulated GN_2 to the following stage components for the following purposes:

(1) Calibration verification of the helium pressure switches at 3,200 psig.

(2) Calibration verification of the "Thrust OK" pressure switches at 1,775 psig.

2. General

a. Weight, pounds (Approximate)	3,600
b. Location in ML (Base)	Compartment B-13

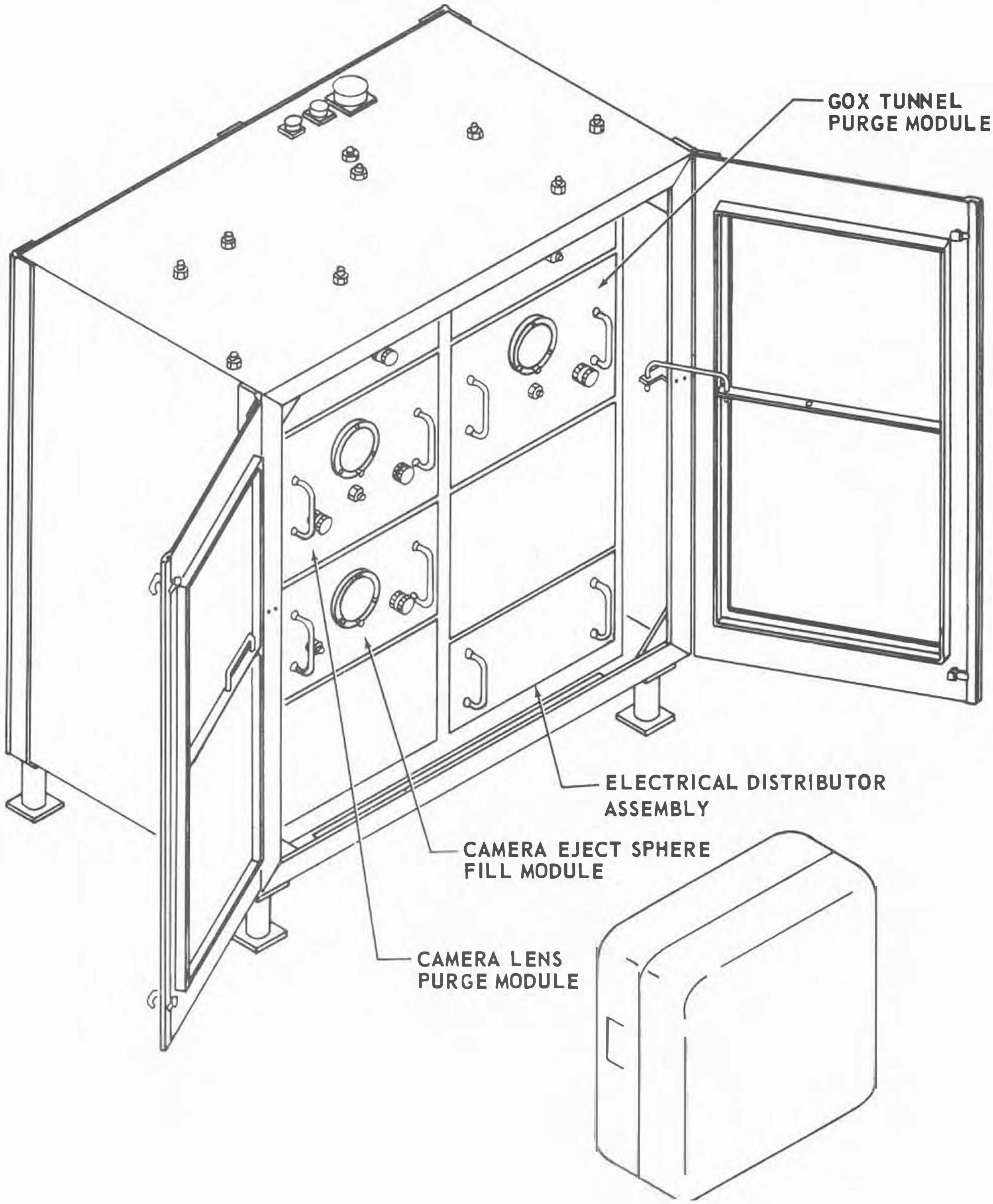


Figure 3-4. S-IC Forward Umbilical Service Console and Test Set

S-IC FORWARD UMBILICAL SERVICE CONSOLE

1. Functional Description

a. The forward umbilical service console consists of three nitrogen regulation modules and an electrical distribution drawer. Facilities air at 1248 ($\pm$250) SCIM and 50 psig is supplied to the console for continuous purge of the cabinet interior. Escape of purge air from the cabinet is controlled by a calibrated bleed.

b. The forward umbilical service console modules and their primary functions are as follows:

(1) The camera lens purge module supplies heated nitrogen at 350 psig and 4.0 pounds per minute, and at 100 psig and 0.75 pounds per minute, to the camera system for lens purge and strobe light purge.

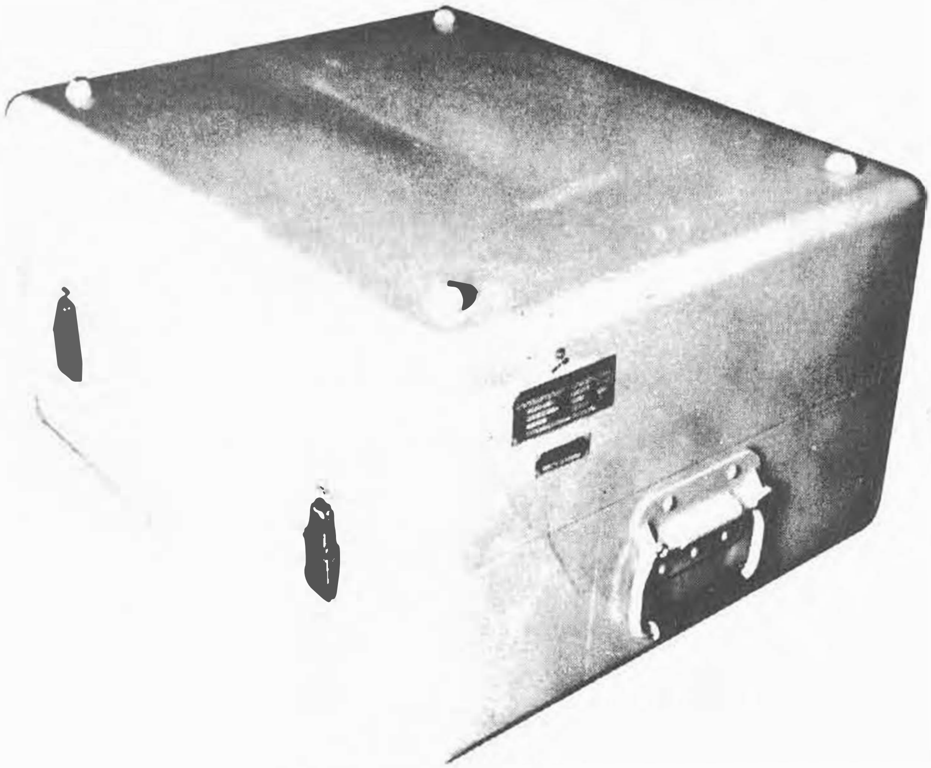
(2) The camera eject sphere fill module supplies nitrogen at 3000 psig and 10 pounds per minute (maximum) to a storage container for camera ejection. It also supplies nitrogen regulated to 3000 psig to the camera lens purge module.

(3) The GOX tunnel purge module supplies nitrogen at 3000 psig and 81 pounds per minute to the forward umbilical plate for GOX tunnel purging.

2. General

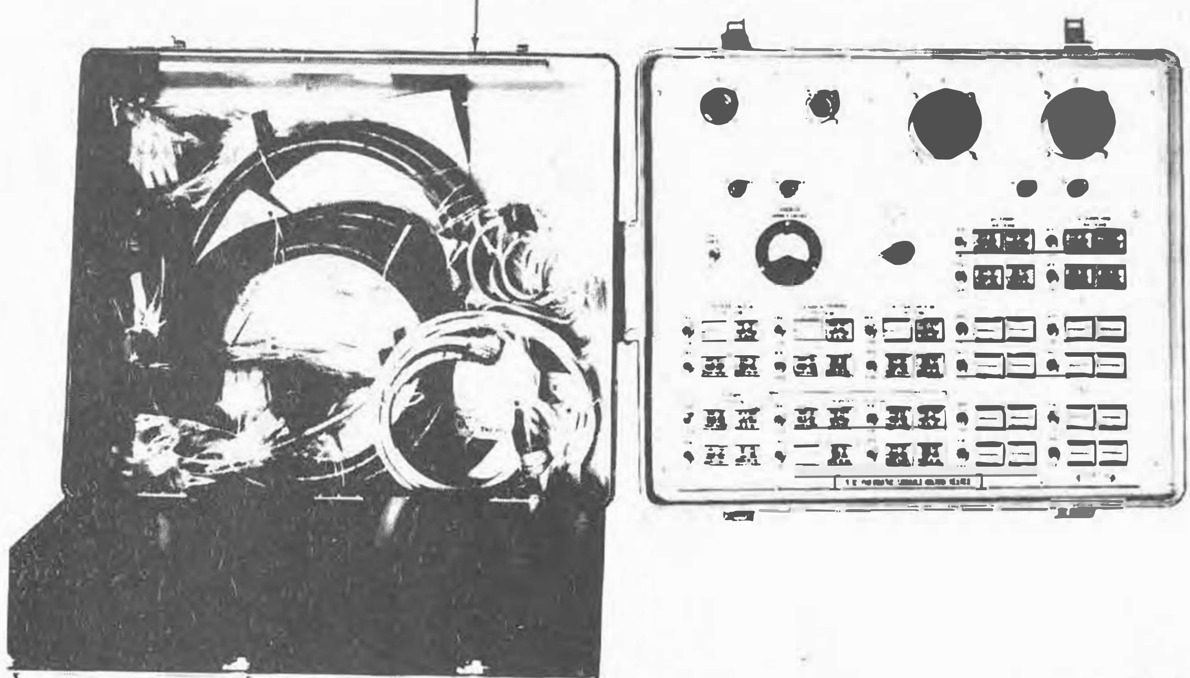
a. Weight, pounds (Approximate)	3,000
b. Location in ML (Base)	Compartment A-13

S-IC PNEUMATIC GROUND SUPPORT EQUIPMENT



B-H 1082

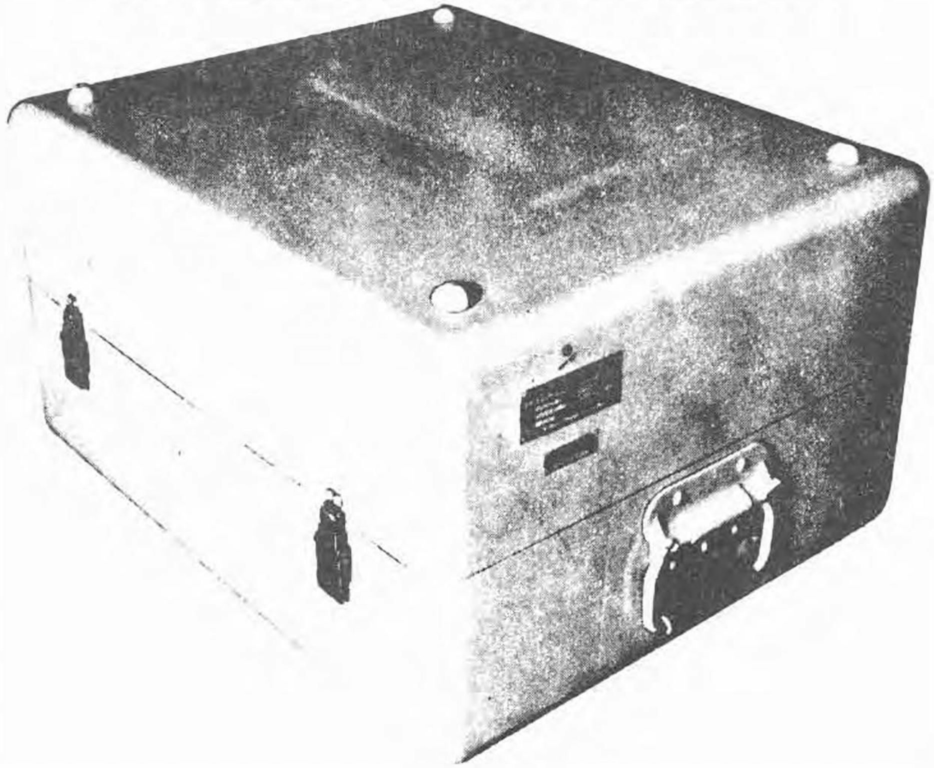
HELIUM TESTER



B-H 1083

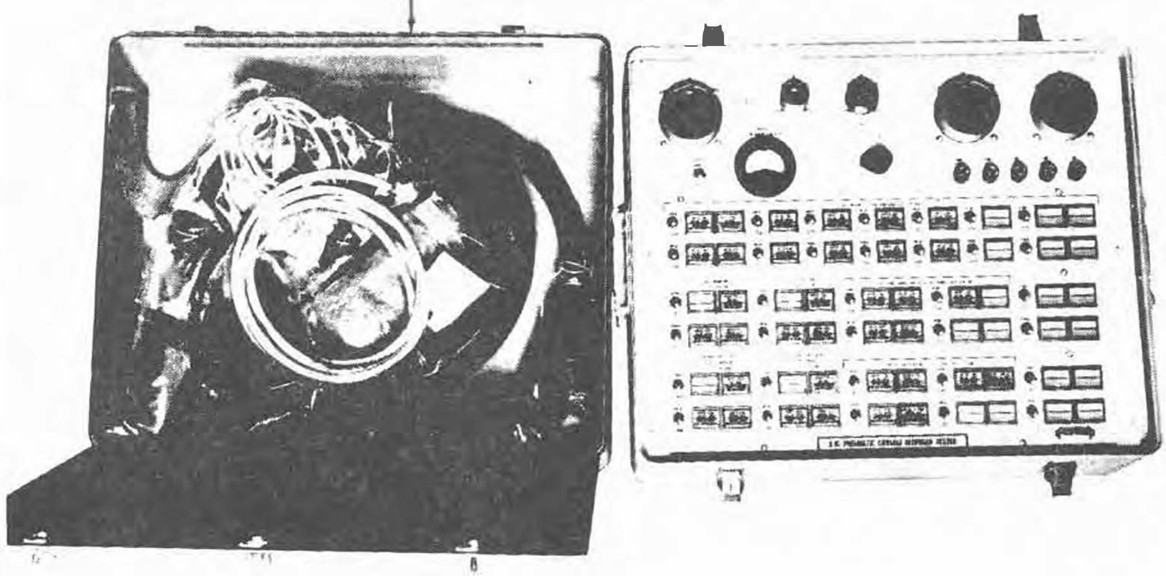
Figure 3-5. S-IC Pneumatic Portable Testers (Sheet 1 of 3)

S-IC PNEUMATIC GROUND SUPPORT EQUIPMENT



BH-1082

NITROGEN TESTER



B-H 1084

Figure 3-5. S-IC Pneumatic Portable Testers (Sheet 2 of 3)

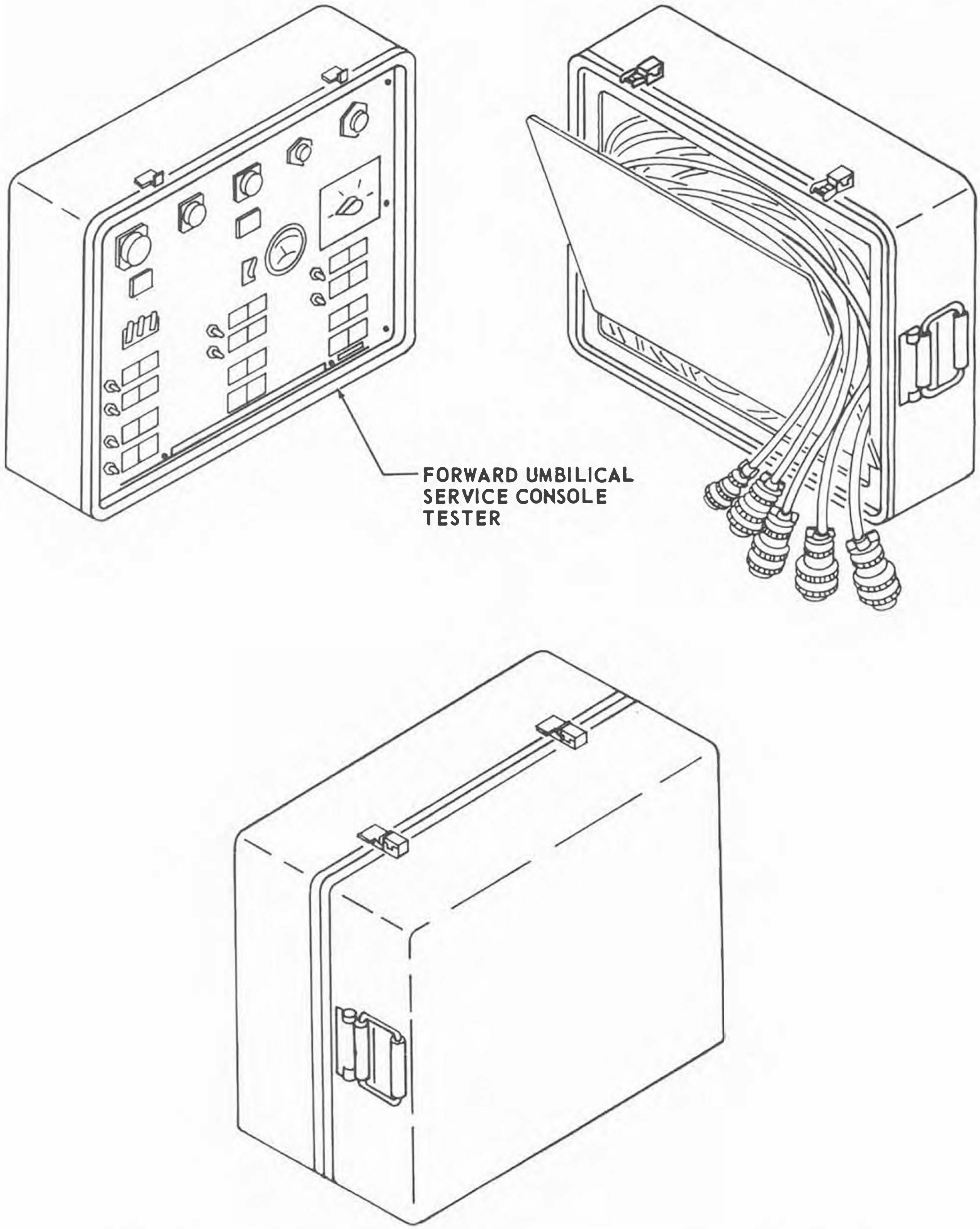


Figure 3-5. S-IC Pneumatic Portable Testers (Sheet 3 of 3)

S-IC PNEUMATIC PORTABLE TESTERS

1. Functional Description

a. The S-IC Pneumatic Portable Testers are provided for checking continuity of electrical components of the pneumatic console and checkout racks. Two testers are used for testing the pneumatic console, each in its own "suitcase", and four testers are used for testing the checkout racks, two to a "suitcase". In addition to these, a separate tester is provided, in its own "suitcase", for the forward umbilical service console.

b. The pneumatic console testers consist of a selector switch, voltmeter, toggle switches, and indicator lights mounted on a panel in a "suitcase". The selector switch and voltmeter are used to test pressure transducers in the console. Electrical power is applied to solenoid valves in the console by the toggle switches. Position switches on the valves control lights on the tester panel indicating when the valves are opened or closed. Other lights on the tester panels indicate whether pressure switches are actuated or deactuated. The pressure switches and transducers are actuated by applying pneumatic pressure to the system.

c. A separate tester is provided for each of the four pneumatic checkout racks. Each tester consists of a voltmeter, toggle switches, and indicator lights mounted on a panel. The voltmeters are used to check the output of the checkout rack pressure transducers and servo amplifiers. The voltmeter dials are calibrated in psi and indicate line pressures. Electrical power is applied to solenoid valves in the checkout racks by the toggle switches. Position switches on the valves control lights on the tester panels indicating valves are open or closed. Other lights on the tester panels indicate whether the pressure switches are actuated or deacuated. The pressure switches and transducers are actuated by applying pneumatic pressure to the system.

d. The forward umbilical service console tester is used to test the two racks of the service console that supply gases to the forward stage umbilical and contain the following modules:

(1) Camera eject sphere fill module
(2) Camera lens purge module
(3) GOX - tunnel purge module.

2. General

a.	Weight, pounds (Approximate)	45 (each)
b.	Dimensions, inches (Approximate)	23 x 19 x 12

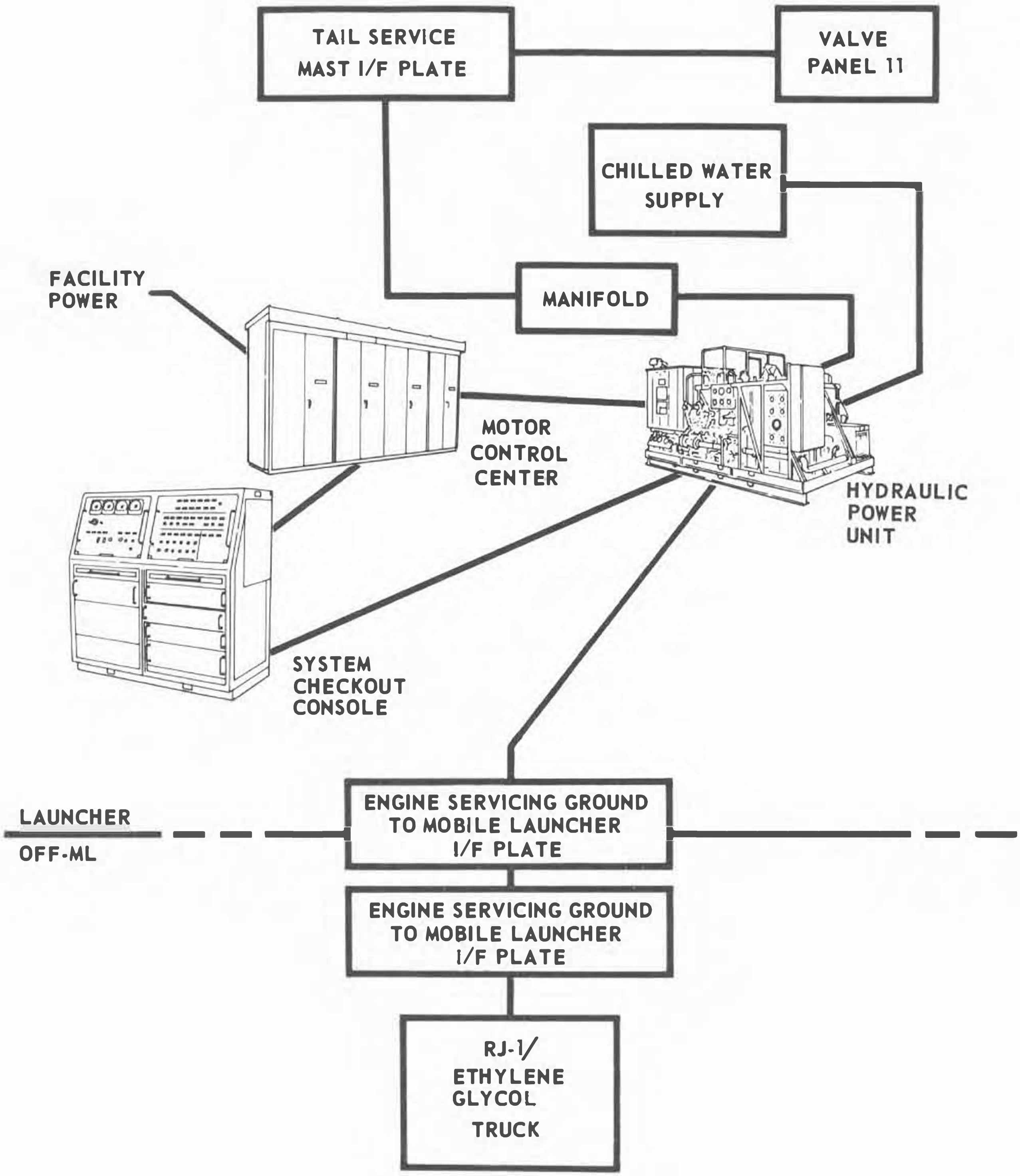


Figure 3-6. S-IC Hydraulic Supply and Checkout Unit

S-IC HYDRAULIC SUPPLY AND CHECKOUT UNIT

1. Functional Description

a. The S-IC Hydraulic Supply and Checkout Unit is required for functional gimbal of the four outboard engines of the S-IC stage, checkout of the S-IC "Thrust OK" pressure switches, and control of the engine valves of the five F-1 engines during initial firing and thrust build-up. Six primary systems accomplish these functions; they are the fuel, servo hydraulic, pneumatic, cooling water, hydraulic waste, and electrical systems.

(1) The fuel system supplies fluid, at a controlled pressure over a wide range of flow rates, to the fuel system of the S-IC booster. Pressures range from 0 to 2500 psig and flows range from 0 to 260 gpm.

(2) The servo hydraulic system provides high pressure hydraulic fluid to operate the servo valves on the three main pumps. These valves control the displacement of the three main pumps to maintain a constant output pressure despite changes in flow demand.

(3) The pneumatic system uses GN_2 for supplying a low pressure blanket on top of the main hydraulic reservoir as a fire protection device, providing precharge gas to the accumulators in the fuel and servo oil systems, and providing gas pressure for the operation of the three large selector valves which control the main hydraulic fluid loop.

(4) The cooling water system is essential to the proper operation of the unit to prevent overheating.

(5) The hydraulic waste system is required due to the three servo valves having a built-in leakage factor to maintain a dynamic error in the servo control system at all times.

(6) The electrical system provides power to operate the various pump motors on the hydraulic power unit, provides control circuits for selecting the mode of operation and providing necessary interlocks and control programming, provides an electronic servo system which controls the displacement of the main pumps to maintain a uniform output pressure, and provides instrumentation for monitoring the operation of critical functional elements.

b. The unit is activated at approximately T-minus-8 hours and continues to operate until it is automatically shut down at approximately T-plus-5 seconds by the "Thrust OK" pressure switches.

c. The S-IC hydraulic supply and checkout unit consists of the hydraulic power unit, the motor control center, and the system checkout console.

2. Facility Requirements

a. Power	Demand
(1) 480 vac, 60 cps, 3 phase	600 amps
(2) 120 vac, 400 cps, single phase	5 amps
(3) 28 vdc	25 amps

b. Cooling water
125 gpm at 60 psig and 45° F.

c. Gaseous Nitrogen (GN_2)
3,000 psig maximum

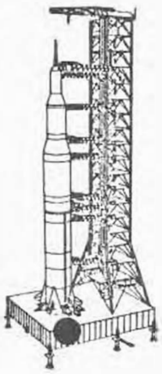
3. General

Weight, pounds (Approximate) 38,100 (total unit)

4. Remarks

For additional information, refer to MSFC-MAN-006.

S-IC HYDRAULIC SUPPLY AND CHECKOUT UNIT



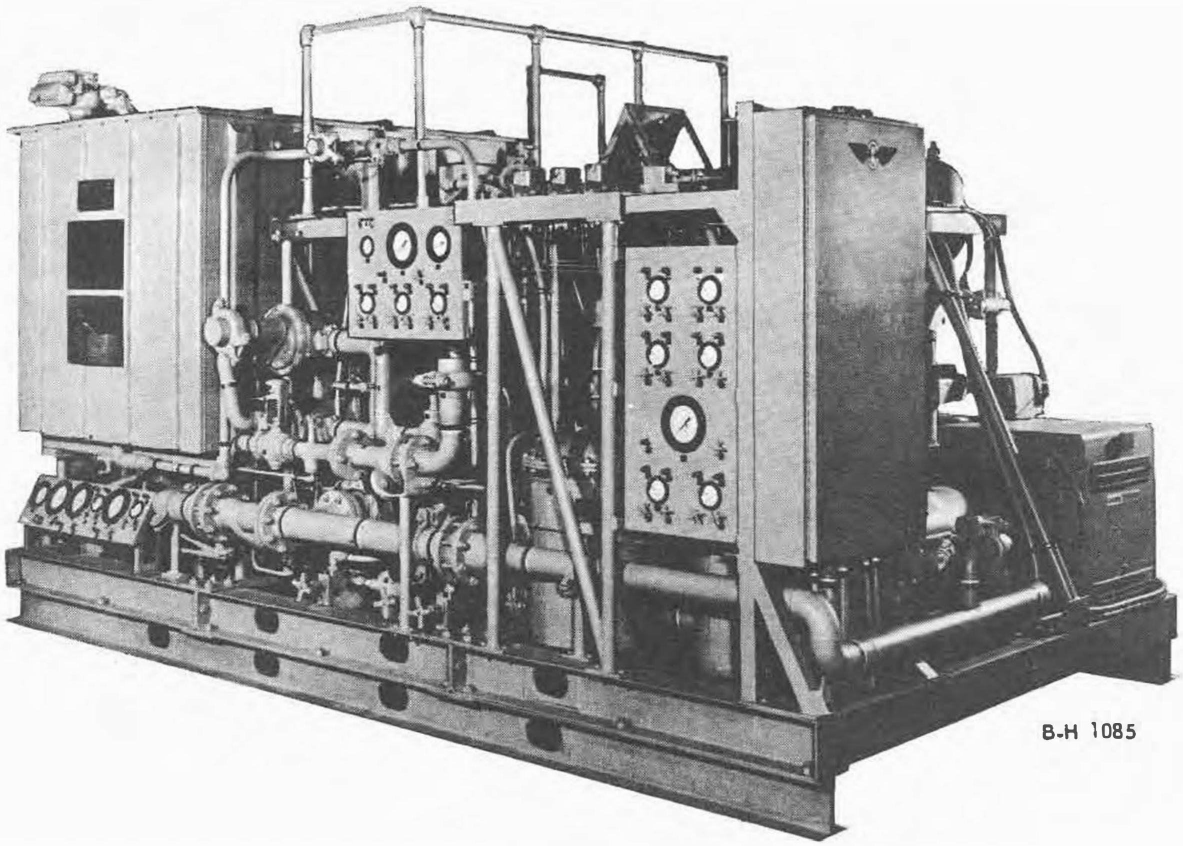


Figure 3-7. Hydraulic Power Unit

HYDRAULIC POWER UNIT

1. Functional Description

a. The Hydraulic Power Unit contains the 800 gallon fuel reservoir, three high pressure pumps driven by 150 hp motors, the supercharge pump, and associated filters, valves, accumulators, and other hydraulic components. The hydraulic power unit is connected to the S-IC stage by a hydraulic line, with a pressure transducer located at the booster end of this line providing the pressure sensing input to the servo system which controls the output pressure of the hydraulic power unit. The unit is built in three modules, Module I containing the reservoir and associated fill and drain connections, and Modules II and III containing the high pressure pumps and associated hydraulic components. This modular construction facilitates shipment and installation of the unit.

b. The hydraulic power unit performs three main functions; stage, flush, and drain.

(1) The stage function is the primary operating function when the unit is connected to the booster. Fluid is drawn from the reservoir through a filter to the supercharge pump. This pump increases the pressure of the fluid for application to the main pumps, and filters the fluid through the first and second stage filters. The high pressure fluid from the three main pumps passes through two stages of filtration and is applied to the umbilical line. Fluid is returned from the booster to the heat exchanger and from the heat exchanger to the reservoir.

(2) The flush function is used to circulate the fluid through the unit at relatively low pressure to purify the fluid as it passes through the filters. After the fluid in the unit has been flushed, the unit may also be used to flush the fluid in the booster.

(3) The drain function is used to drain the fuel reservoir, to reduce all possible excess weight before moving the ML. The fluid is pumped to an outside receiver using the supercharge pump, down to approximately 170 gallons. Additional fluid may be drained, if necessary, by use of a manual drain valve.

2. General

a. Weight, pounds, (Approximate)

(1) Dry	20,000
(2) Wet	27,000

b. Reservoir

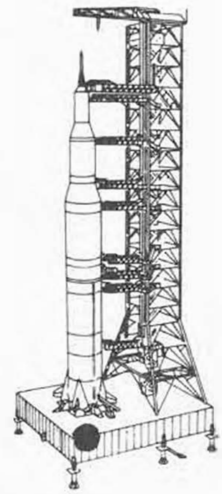
(1) Fluid capacity, gallons (Approximate)	1,000
(2) Fluid	RJ-1
(3) Fluid specific gravity	0.863

c. Dimensions, inches (Approximate)	168 x 94 x 102
d. Location in ML (Base)	Compartment AB-4

3. Remarks

For additional information, refer to MSFC-MAN-006

S-IC HYDRAULIC SUPPLY AND CHECKOUT UNIT



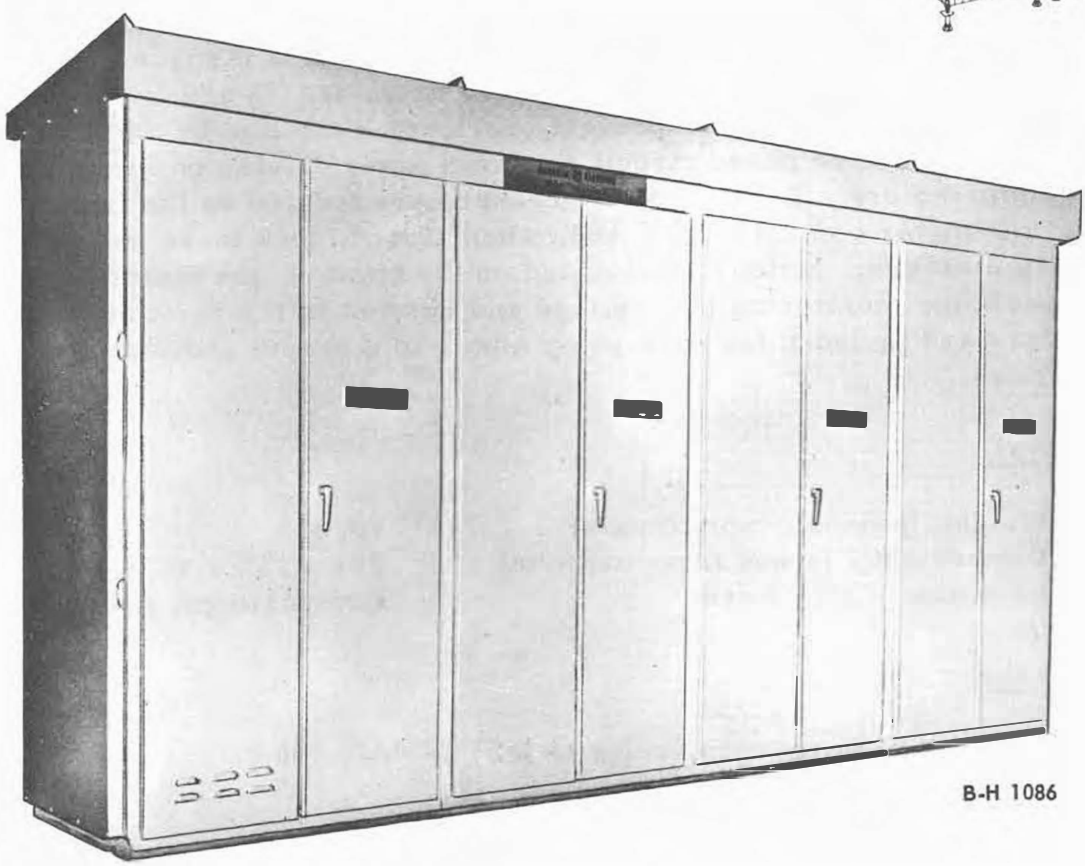


Figure 3-8. Motor Control Center

MOTOR CONTROL CENTER

1. Functional Description

a. The Motor Control Center contains circuit breakers, transformers, relays, and safety interlocks for distributing electrical power to the hydraulic power unit and the system checkout console. It is divided into four modules. The first module contains circuit breakers and electrical controls for the incoming line and auxiliary equipment, such as the supercharge pump, servo pump, and recirculating pump. The other three identical modules contain circuit breakers and control circuits for each of the three 150 hp high pressure pump motors.

b. To energize the system, circuit breakers in the motor control center must first be closed. Single phase circuit breakers operate the motor control circuits which protect the motors against overheating, and incorrect phasing. The motor control circuits also control space heaters in the motors and in the motor control center cabinets. In addition, they include time delay relays which prevent overloading the line by starting all motors at once. Three phase circuit breakers apply driving power to the various pump motors. These circuit breakers are located on the front panels of the motor control center and, when closed, lock these panels shut as a safety measure. Meters are located on the front of the motor control center panels for monitoring line voltage and current in the various circuits. Hour meters are included for each pump motor to measure individual running times.

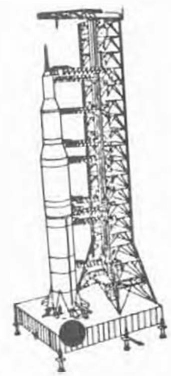
2. General

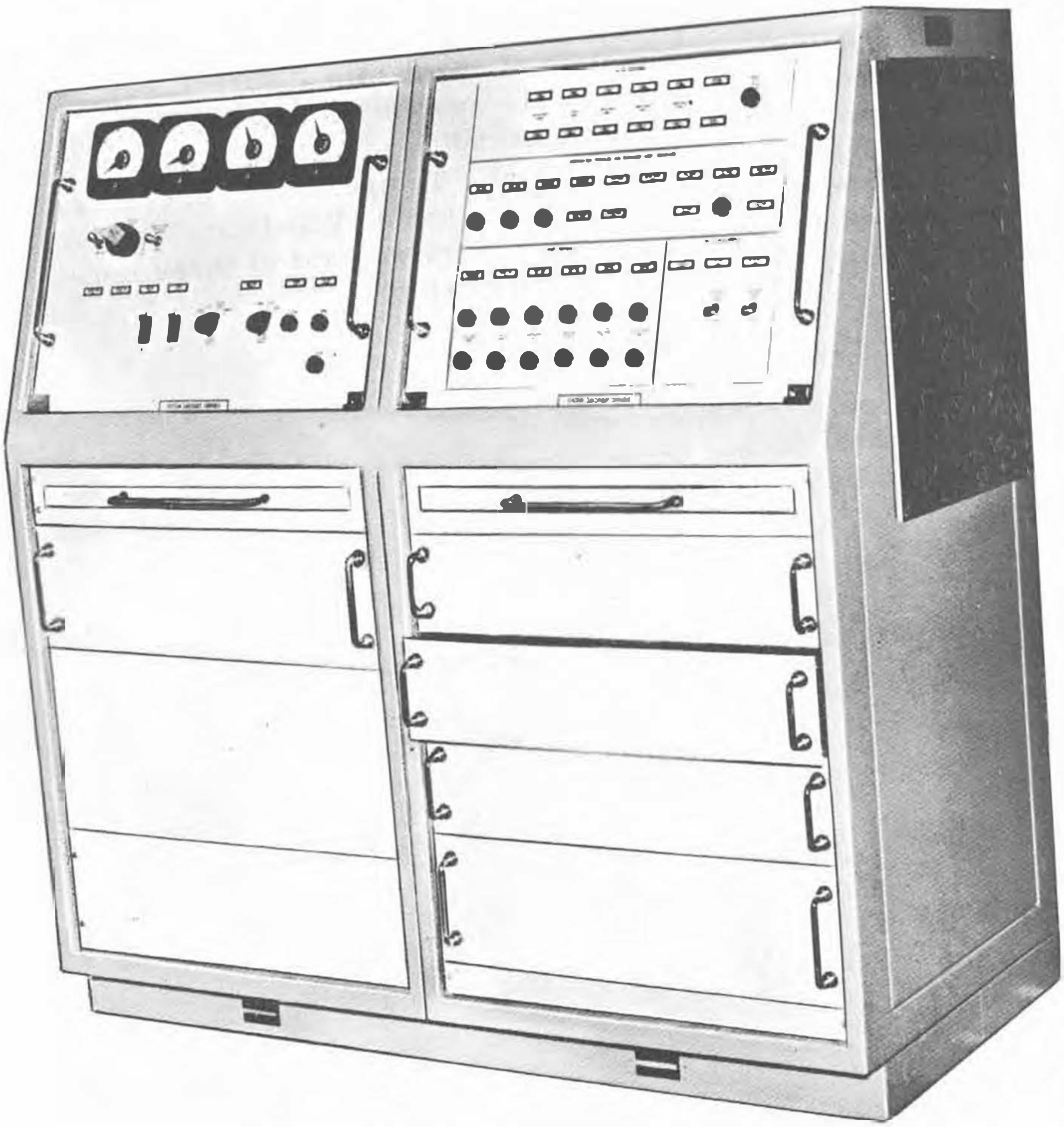
a.	Weight, pounds (Approximate)	10,000
b.	Dimensions, inches (Approximate)	204 x 112 x 42
c.	Location in ML (Base)	Compartment A-2

3. Remarks

For additional information, refer to MSFC-MAN-006

S-IC HYDRAULIC SUPPLY AND CHECKOUT UNIT





B-H 1087

Figure 3-9. System Checkout Console

SYSTEM CHECKOUT CONSOLE

1. Functional Description

a. The System Checkout Console contains two service panels and six drawers. The upper left service panel contains the primary controls and indicators for operating the Hydraulic Supply and Checkout Unit. The upper right monitor panel contains secondary controls and indicators. The six drawers in the base of the console contain relays, amplifiers, control circuit cards, and interconnecting wiring. One drawer is left empty for the installation of communications equipment by NASA. The two panels and six drawers of the console may be replaced as modules to facilitate maintenance.

b. Numerous indicator lights located on both the service panel and the monitor panel provide indication of normal or abnormal system operating conditions. All filters in the system have pressure switches connected to them to sense a clogged condition. These pressure switches activate indicators on the monitor panel. Temperature, pressure, and reservoir level indicators on the monitor panel all indicate abnormal conditions. Reset switches are provided for several of these indicators since false warnings may occur during startup.

2. General

a. Weight, pounds (Approximate)	1,100
b. Dimensions, inches (Approximate)	52 x 53 x 26
c. Location in ML (Base)	Compartment A-2

3. Remarks

For additional information, refer to MSFC-MAN-006.

S-IC GSE HYDRAULIC PERFORMANCE TESTER

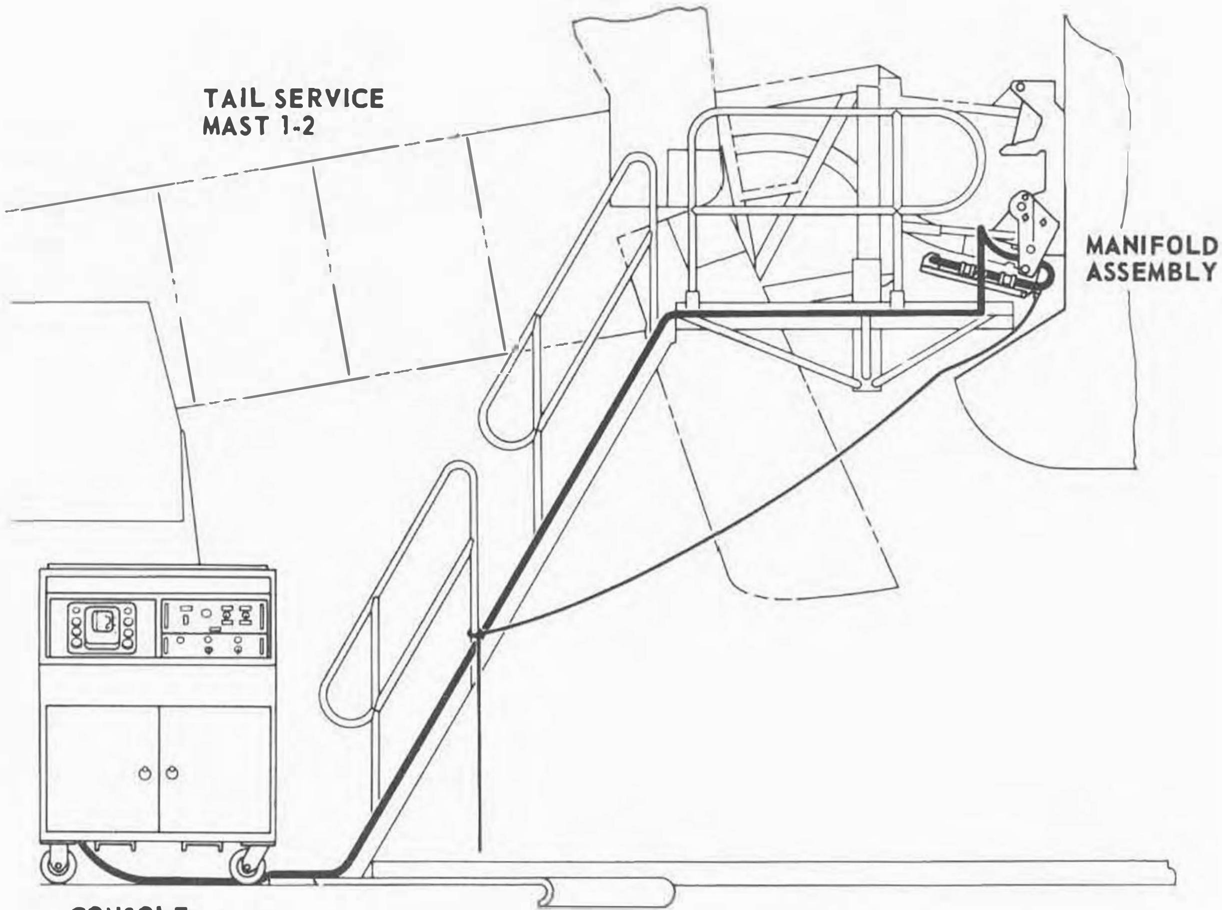


Figure 3-9A. S-IC GSE Hydraulic Performance Tester

S-IC GSE HYDRAULIC PERFORMANCE TESTER

1. Functional Description

a. The hydraulic tester is used to check out the S-IC hydraulic supply and checkout unit after installation on the Mobile Launcher. The hydraulic tester simulates the step function flow requirements of the S-IC F-1 engines start sequence. The hydraulic tester is positioned on the Mobile Launcher deck near the tail service mast 1-2 when checkout of the S-IC hydraulic supply and checkout unit is required. After checkout is complete, the hydraulic tester is removed from the deck of the Mobile Launcher.

b. The hydraulic tester has two modes of operation, manual and automatic. The manual mode of operation permits opening the solenoid valves in the manifold assembly for any length of time to set the flow control valves to the desired flow rates. After the flow rates are set, the hydraulic tester is placed in the automatic mode of operation. The time delay circuit controls the opening and closing of the solenoid valves in the proper sequence to simulate the demands of the S-IC F-1 engine hydraulic valves.

c. The hydraulic tester consists of two major assemblies, the console assembly and the manifold assembly. The assemblies are connected by a 14-wire cable assembly.

2. Facility Requirements

Power	Demand
115 vac, 60 cps, single phase	800 watts (max.)

3. General

Weight, pounds (Approximate)	640 (total unit)

4. Remarks

For additional information, refer to MSFC-MAN-003 and MSFC-MAN-031.

S-IC GSE HYDRAULIC PERFORMANCE TESTER

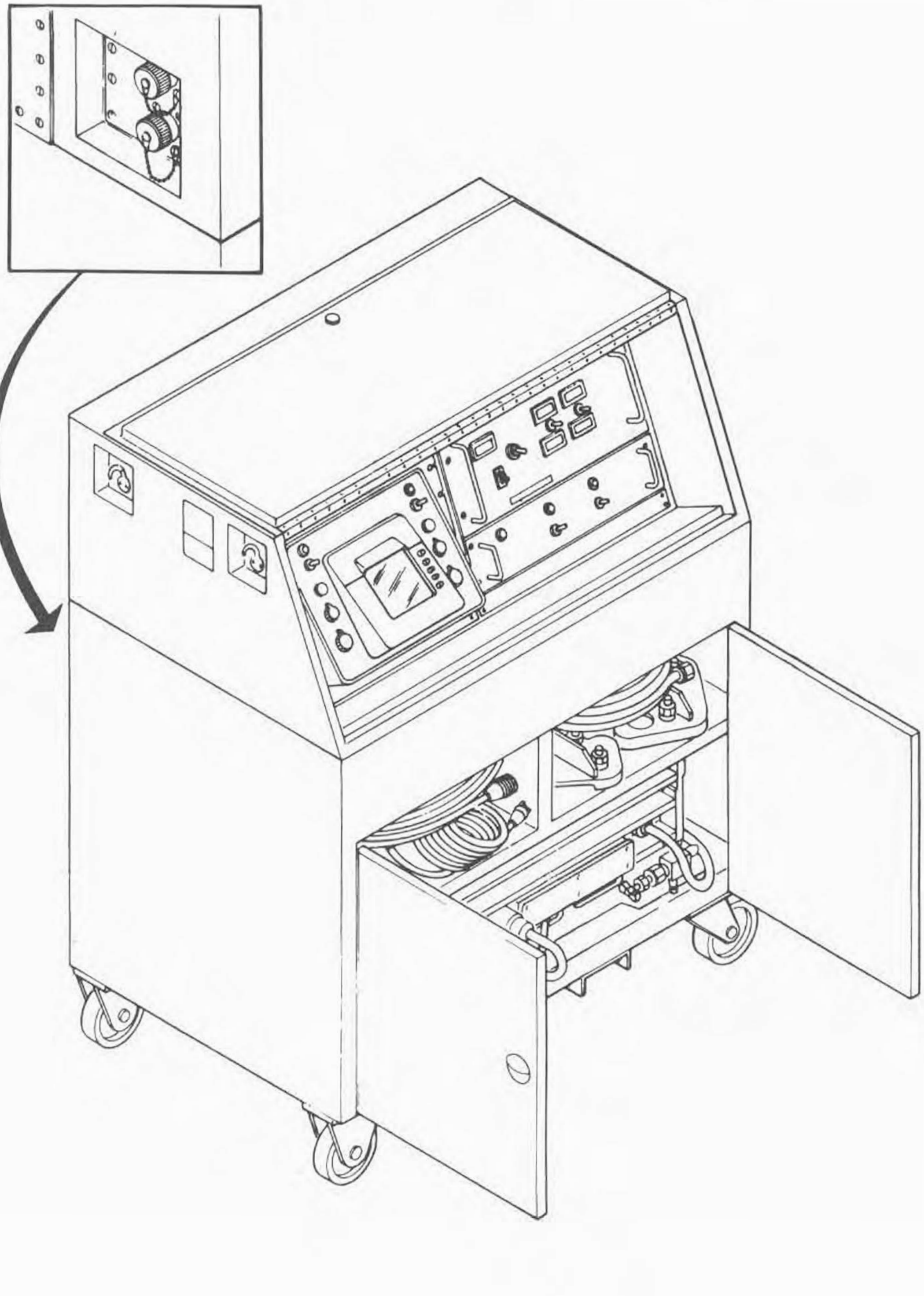


Figure 3-9B. Console Assembly

CONSOLE ASSEMBLY

1. Functional Description

a. The console assembly contains a two-channel recorder, a 28-volt dc power supply, and a control panel for controlling and monitoring flow through the manifold assembly.

b. The recorder operates from 115-volt, ac, 60-cycle power. The recorder provides a visible, two-channel chart recording of the signals received from the transducer in the manifold assembly. The chart paper is changed from the front of the recorder.

c. The power supply operates from 115-volt, ac, 60-cycle power and it is set for an output voltage of 28 volts dc. The power supply provides the control voltage for operating the circuitry in the control panel and manifold assembly.

d. The control panel contains switches and indicator lights for monitoring and controlling the solenoid valves in the manifold assembly. Pressing the START AUTO CYCLE pushbutton will energize the time-delay circuit and automatically open and close the solenoid valves in the proper sequence. The automatic cycle will take approximately one second.

2. General

a. Weight, pounds (Approximate)	530
b. Dimensions, feet (Approximate)	3.5 x 2.25 x 4

3. Remarks

For additional information, refer to MSFC-MAN-003 and MSFC-MAN-031.

S-IC GSE HYDRAULIC PERFORMANCE TESTER

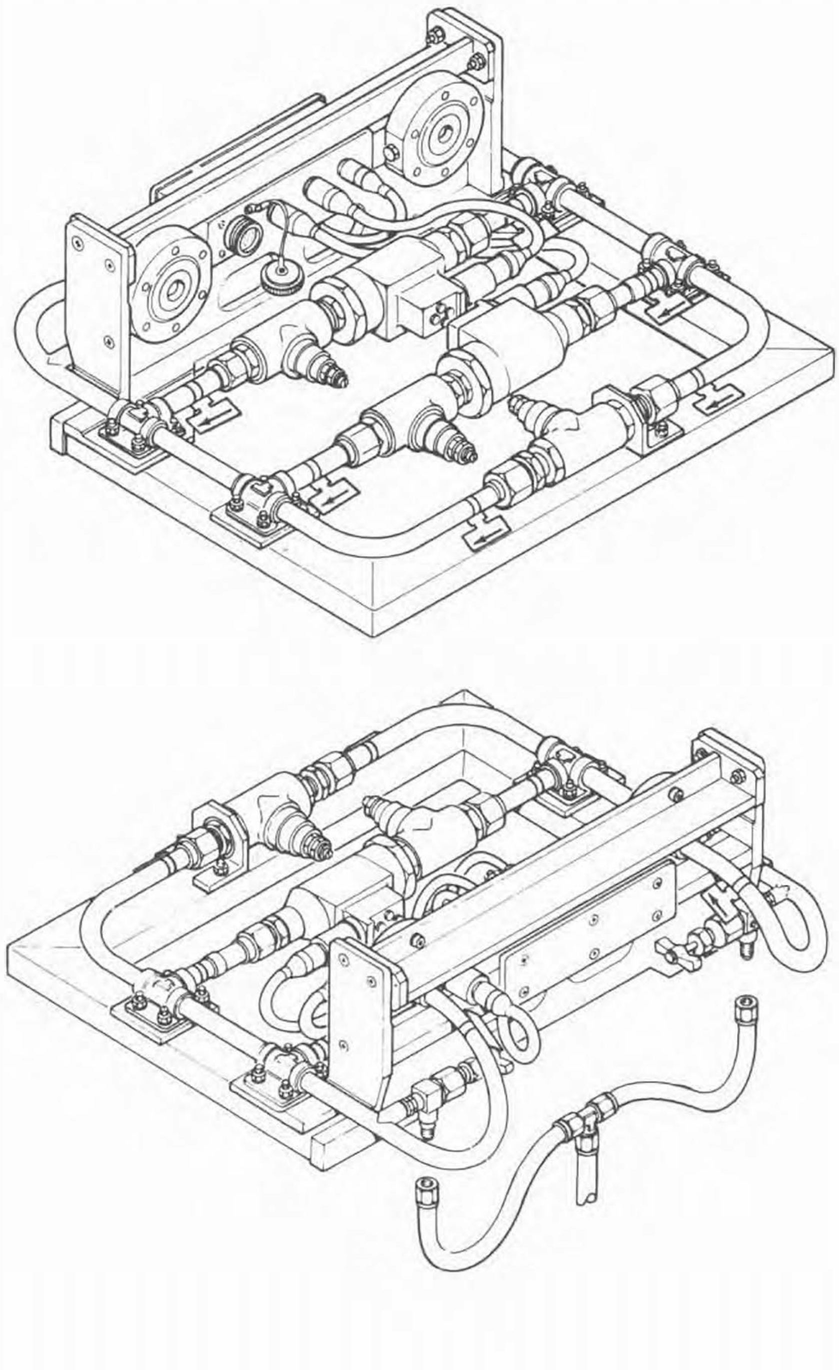


Figure 3-9C. Manifold Assembly

MANIFOLD ASSEMBLY

1. Functional Description

a. The manifold assembly consists of a pipe manifold, two fast-acting solenoid valves, three flow control valves, and a pressure transducer. The manifold is connected and supported by a bracket from the umbilical attach plate at tail service mast 1-2 when checkout of the S-IC hydraulic supply and checkout unit is required.

b. The pressure transducer converts the manifold assembly pressure to an electrical signal. The electrical signal is routed from the pressure transducer to the recorder via the 14-wire cable.

c. The solenoid valves are used to simulate the demands of the S-IC F-1 engine hydraulic valves. Power is routed from the rear of the control panel to the solenoid valves via the 14-wire cable.

2. General

a.	Weight, pounds (Approximate)	110
b.	Dimensions, inches (Approximate)	22 x 28 x 9

3. Remarks

For additional information, refer to MSFC-MAN-003 and MSFC-MAN-031.

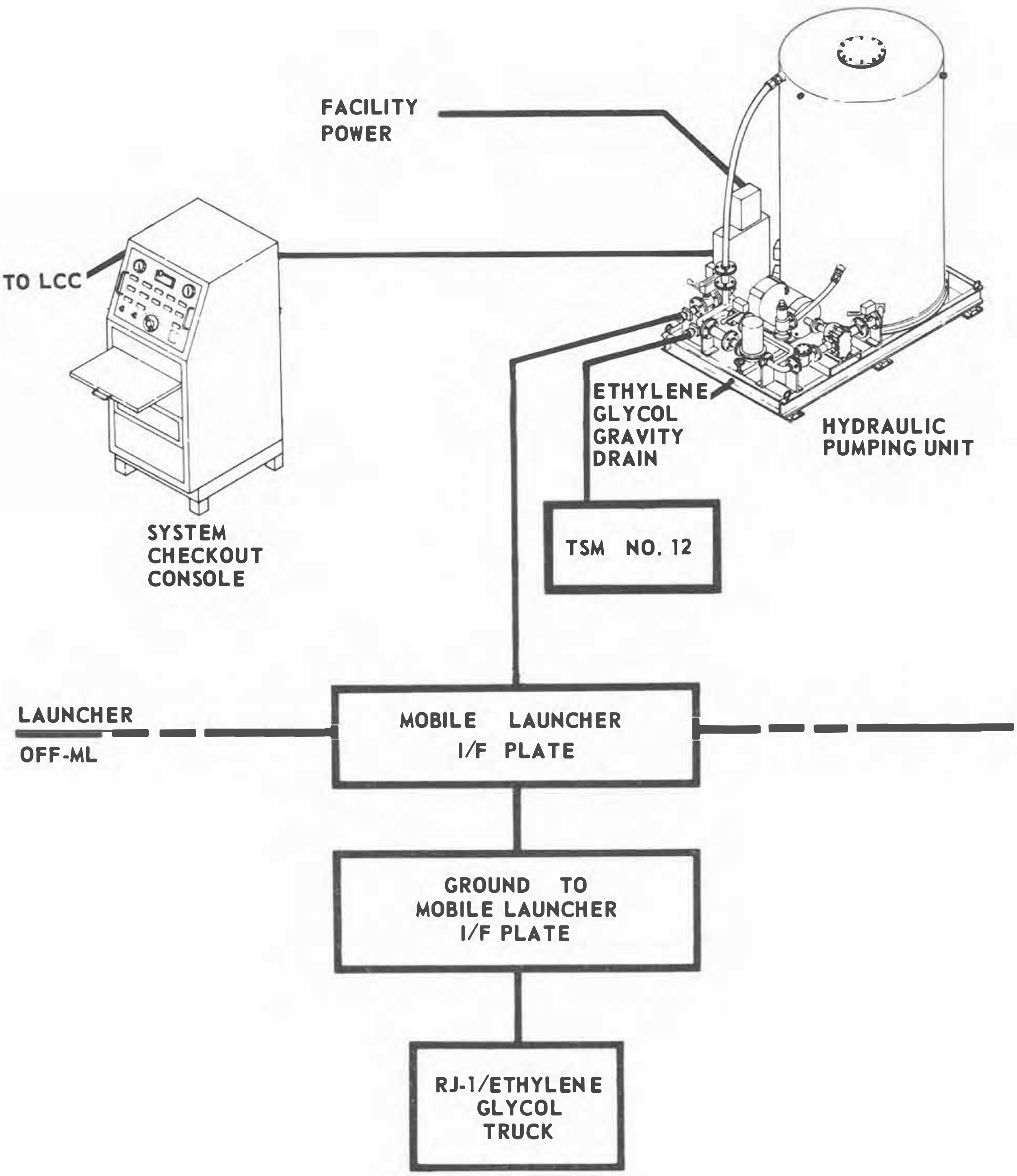


Figure 3-10. S-IC Inert Prefill Unit

S-IC INERT PREFILL UNIT

1. Functional Description

a. The S-IC Inert Prefill Unit is required to supply an aqueous solution of ethylene-glycol to the F-1 engine thrust chamber jackets of the S-IC stage of the Saturn V launch vehicle. The unit consists of two main assemblies, the Hydraulic Pumping Unit and the System Checkout Console. It is being purchased under MSFC design specification No. 10M01695.

b. At approximately T-8 hours, the pumping unit is activated to fill the F-1 engine thrust chamber fuel jackets. When the jacket liquid level sensors sense a full condition, the checkout console deactivates the pumping unit.

c. Engine gimbaling tests cause inert fluid to spill from the fuel jackets, necessitating the filling of the jackets again.

d. At approximately T-5 minutes, to compensate for any ethylene glycol spillage, the pump is again activated to top the engine fuel jackets. When the engine liquid level sensors indicate a full condition the unit goes into a 30 second overrun, thus ensuring that the fuel jackets are completely full.

2. Facility Requirements

Power	Demand
a. 440 vac, 60 cps, 3 phase	18 kva
b. 28 vdc	10 amps
c. 5 vdc	1 amp

3. General

Weight, pounds (Approximate)	14, 100 (total unit)

4. Remarks

For additonal information, refer to MSFC-MAN-007.

S-IC INERT PREFILL UNIT

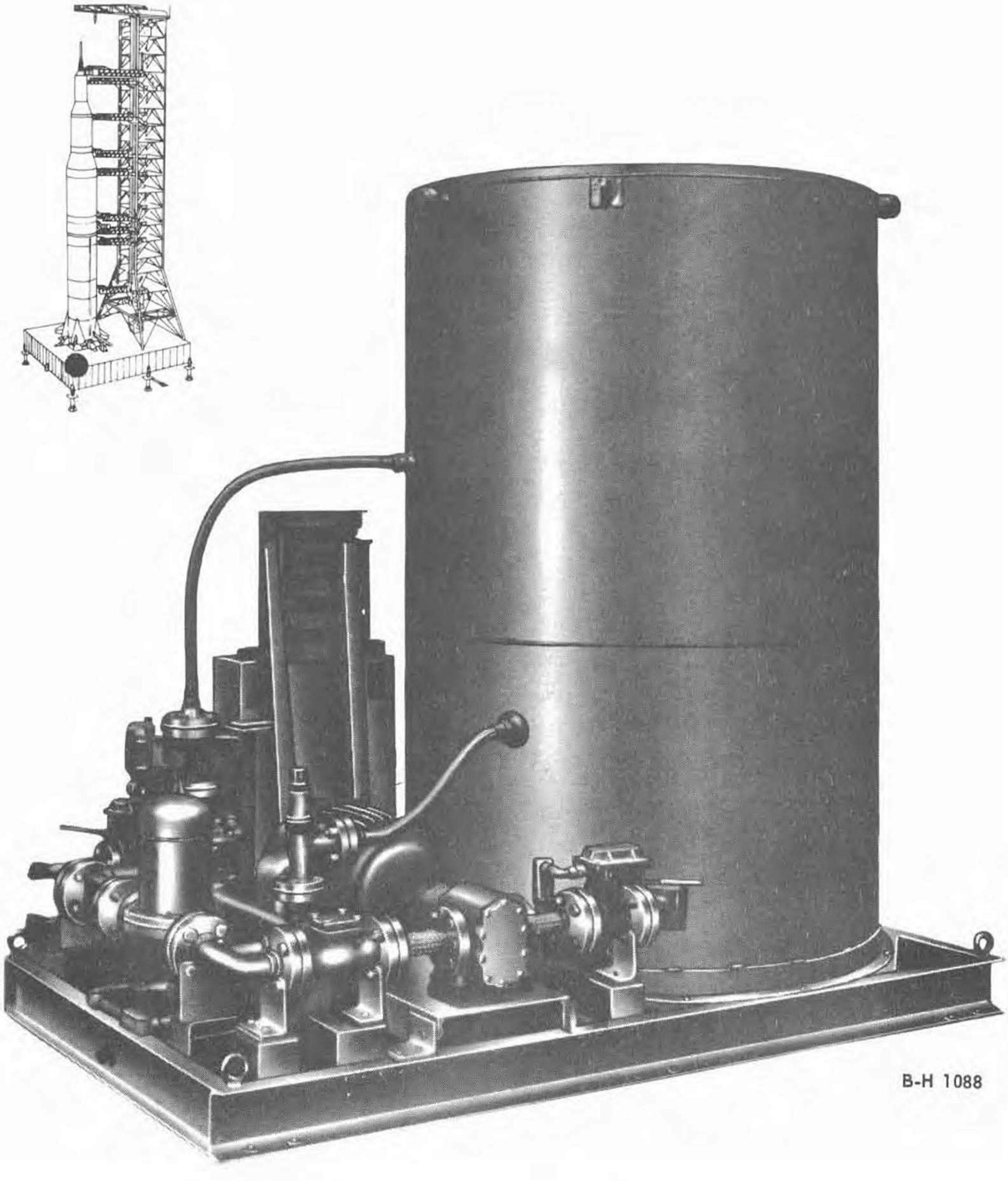


Figure 3-11. Hydraulic Pumping Unit

HYDRAULIC PUMPING UNIT

1. Functional Description

a. The Hydraulic Pumping Unit is a skid mounted assembly consisting of a 770 gallon storage reservoir, an electric motor driven pump, and the necessary filters, piping, valves, transducers, and electrical controls to supply ethylene glycol to the F-1 engines. The reservoir is equipped with three filtered vents, a drain valve, and high and low liquid level sensors. A 15 hp electric motor drives a positive displacement pump to supply fluid at 50 gpm with an operating pressure of 200 to 350 psig.

b. To fill the fuel jackets, the pump is activated to pump ethylene glycol from the reservoir through a filter, flow transducer, and pressure transducer. The transducers are connected to the checkout console to provide data on pressure, rate of flow, and total flow. A relief valve is provided to allow fluid to flow back into the reservoir in case pressure builds up downstream of the pressure transducer.

2. General

a. Weight, pounds (Approximate)	
(1) Dry	5,000
(2) Wet	13,100
b. Reservoir	
(1) Fluid capacity, gallons (Approximate)	770
(2) Fluid	Ethylene Glycol
(3) Fluid specific gravity	1.265
c. Location in ML (Base)	Compartment B-2

3. Remarks

For additional information, refer to MSFC-MAN-007.

S-IC INERT PREFILL UNIT

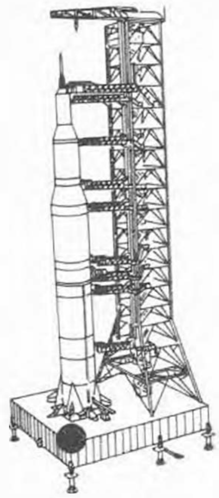


Figure 3-12. System Checkout Console

SYSTEM CHECKOUT CONSOLE

1. Functional Description

a. The System Checkout Console contains the local electrical controls, monitors, signal conditioners, and most of the logic associated with the Inert Prefill system operations. It controls the operation of the hydraulic pumping unit and monitors the delivery pressure, rate·of flow, and total flow of the ethylene glycol.

b. The console can operate the pumping unit in either the local or remote mode: The local mode is used for local operation from the console; the remote mode permits automatic operation from the LCC. The console can also be placed in a Service and Test mode, for test and/or service of the unit, or placed on Standby, to prevent operation. Indicator lights on the console provide indication of normal or abnormal system operating conditions.

2. General

a.	Weight, pounds (Approximate)	1,000
b.	Location in ML (Base)	Compartment B-2

3. Remarks

For additional information, refer to MSFC-MAN-007.

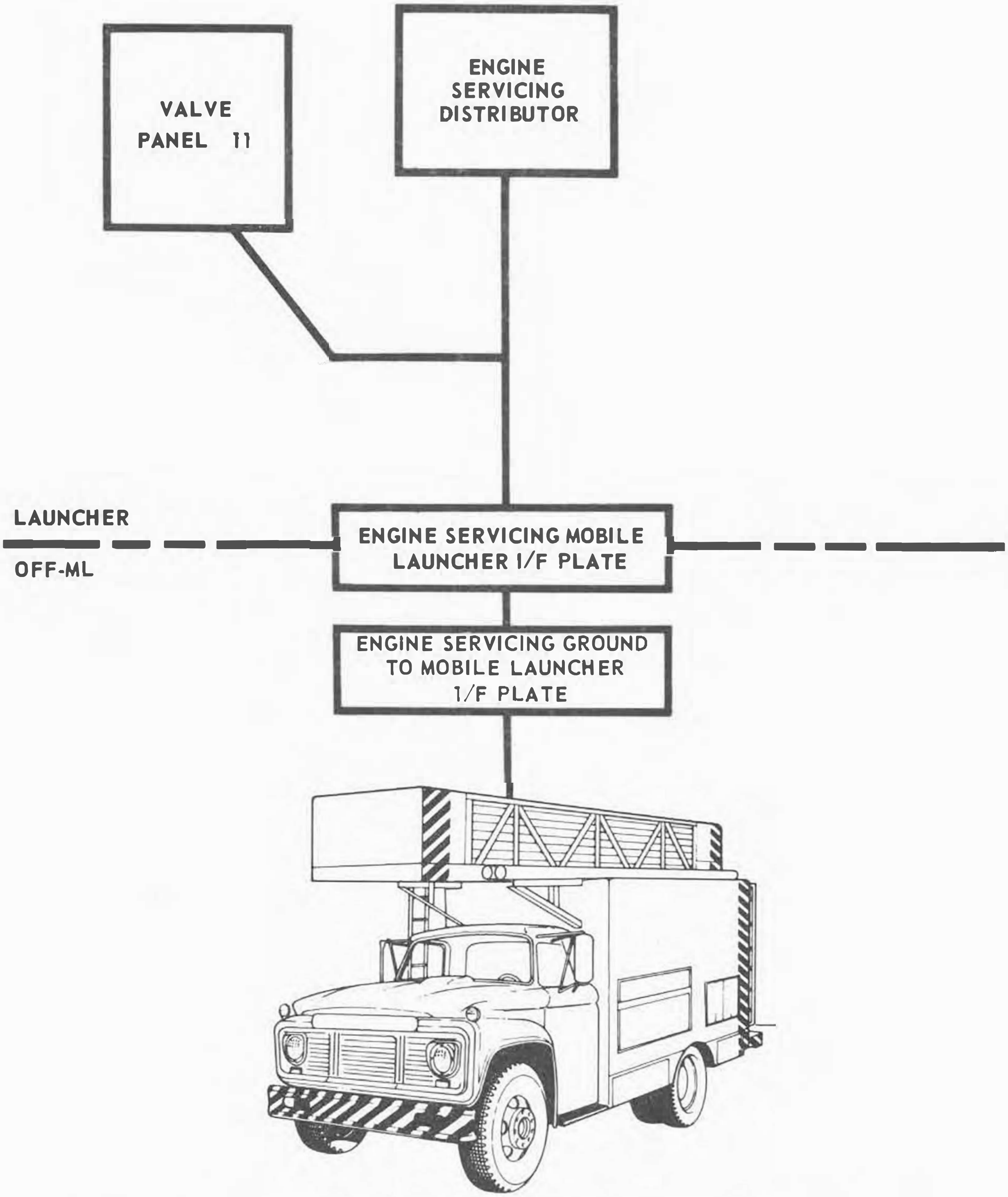


Figure 3-13. S-IC Flush and Purge Service Truck (Sheet 1 of 2)

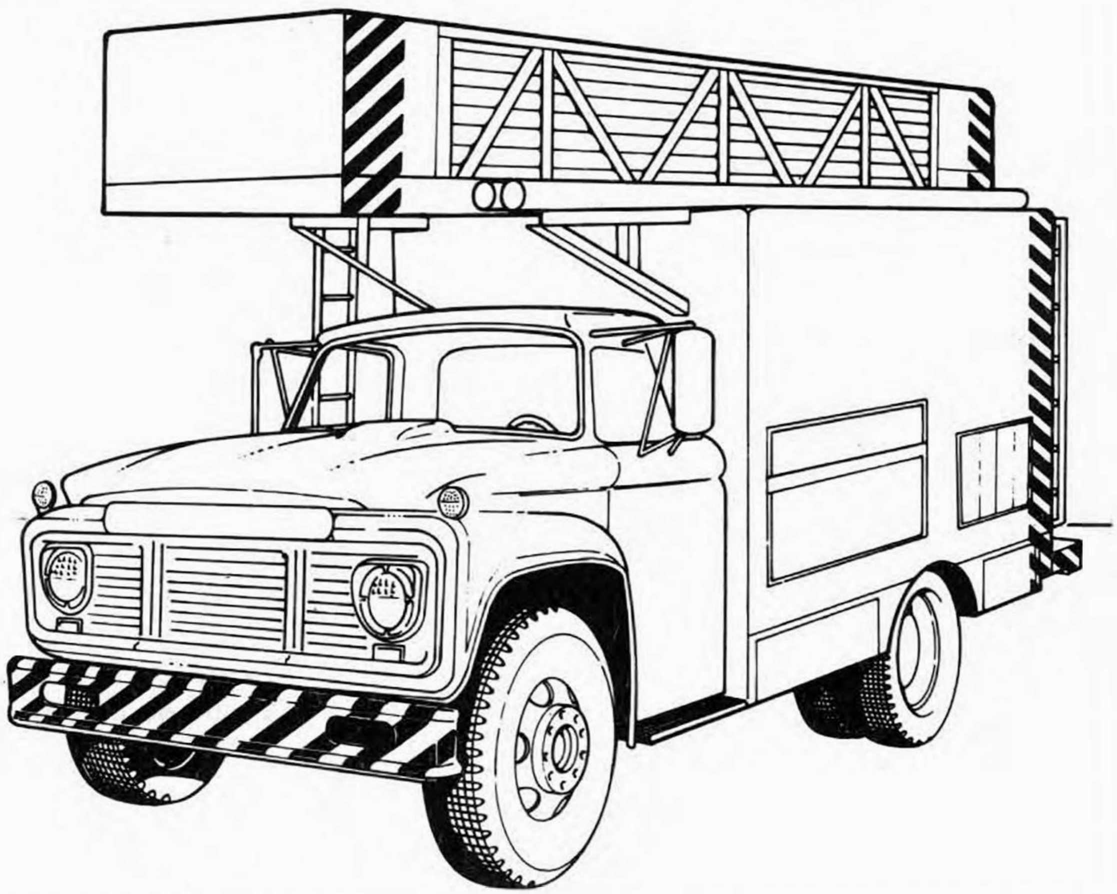


Figure 3-13. S-IC Flush and Purge Service Truck (Sheet 2 of 2)

S-IC FLUSH AND PURGE SERVICE TRUCK

1. Functional Description

a. The S-IC Flush and Purge Service Truck is designed to provide a sufficient flow of trichlorethylene and regulated gaseous nitrogen to perform flush and purge functions on the S-IC F-1 engines after static firing or abort situations. Servicing operations include flushing the LOX dome and fuel jacket with trichloroethylene and purging the hypergol chamber, turbopump bearing LOX dome, and fuel jacket with gaseous nitrogen (GN_2). The entire system is mounted on a motor truck chassis which provides the area to accommodate complete operation.

b. The service truck is capable of providing trichlorethylene at a pressure of 300 psi and a flow rate of 10 $\pm$2 gpm. The pump is obtainable with other pressure ratings if necessary to supply 90 psi at the engine connection point.

c. The servicer consists of a reservoir, a pumping unit, a residual pumping unit, a LOX dome blender, a GN_2 manifold, a turbopump bearing oil system, an electrical system, and necessary service equipment, such as hoses and the necessary cabling. The servicer is capable of being operated and monitored from either the local or remote mode.

2. Facility Requirements

a.	Power 440/480 VAC, 60 cps, 3 phase	Demand To be determined
b.	Gaseous Nitrogen (GN_2) 1,000 psig	

3. General

a.	Weight, pounds (Approximate)	
	(1) Dry	6,720
	(2) Wet	17,700
b.	Reservoir	
	(1) Fluid capacity	1,000 gallons
	(2) Fluid	Trichlorethylene
	(3) Fluid Specific Gravity	1.470

4. Remarks

For additional information, refer to MSFC-MAN-025.

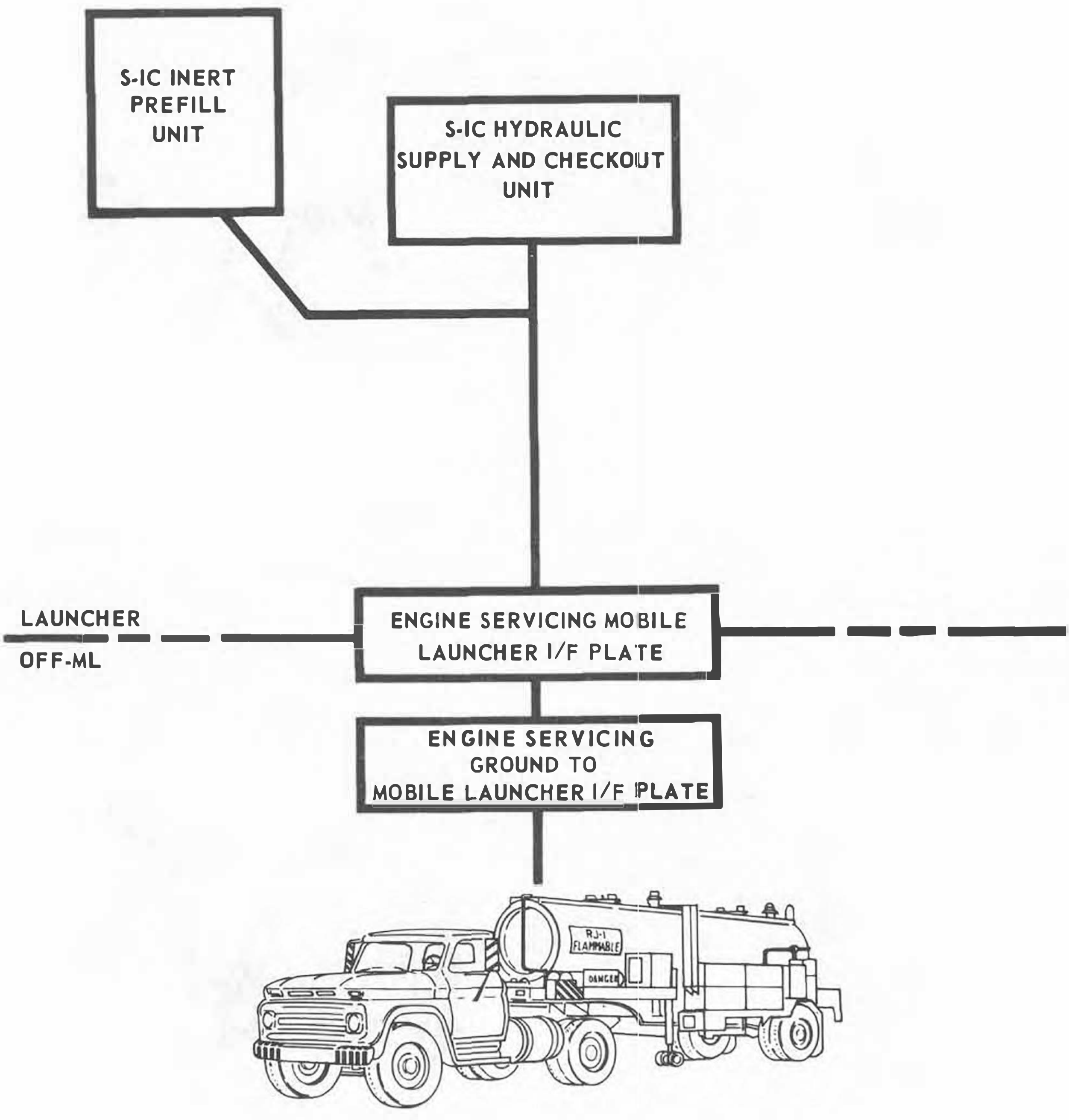
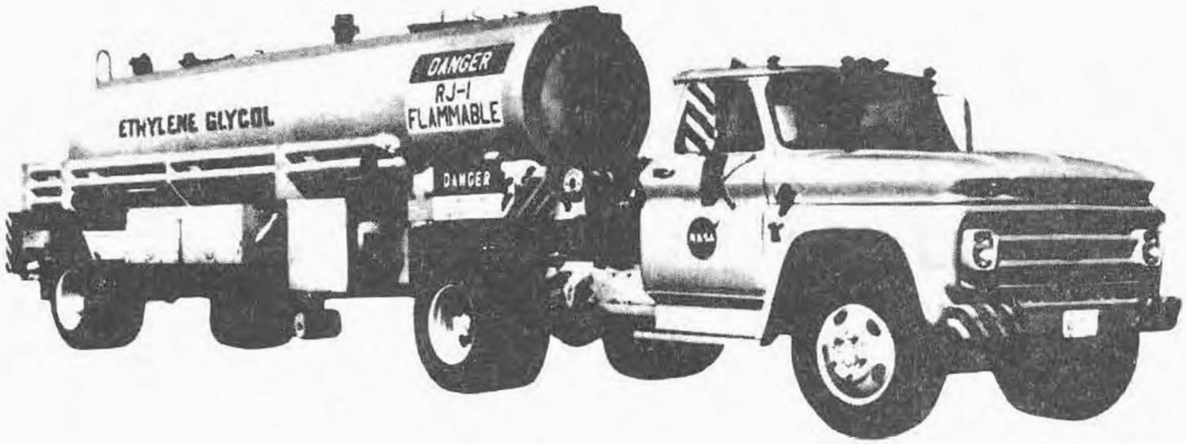
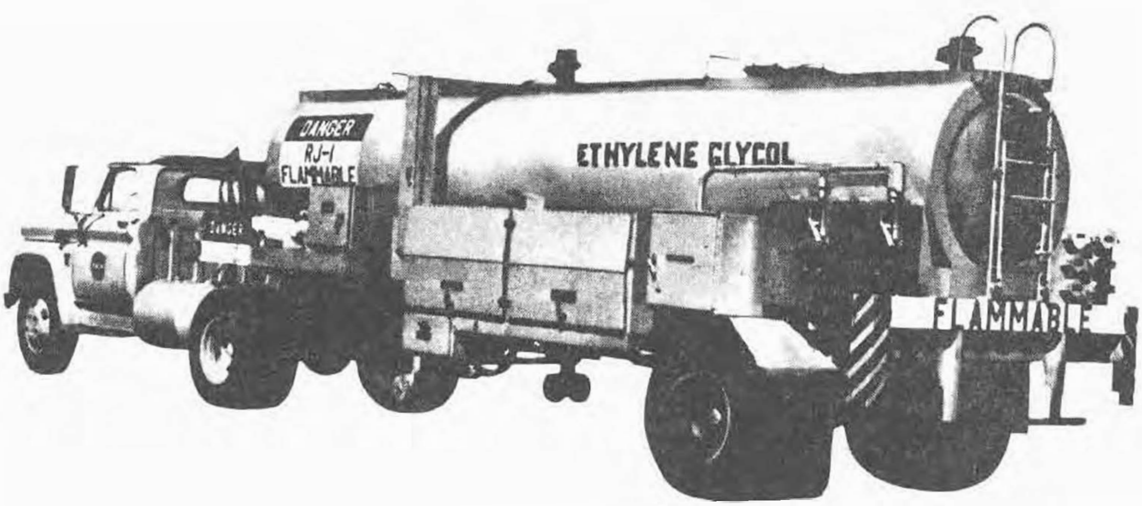


Figure 3-14. S-IC RJ-1/Ethylene Glycol Mobile Servicer (Sheet 1 of 2)





B-H 1091

Figure 3-14. S-IC RJ-1/Ethylene Glycol Mobile Servicer (Sheet 2 of 2)

S-IC RJ-1/ETHYLENE GLYCOL MOBILE SERVICER

1. Functional Description

a. The S-IC RJ-1/Ethylene Glycol Mobile Servicer is a trailer mounted unit used for transporting RJ-1 and ethylene glycol and filling the S-IC Supply and Checkout Unit and S-IC Inert Prefill Unit reservoirs.

b. The servicer consists of two tanks, a gaseous nitrogen (GN_2) system, an RJ-1 pumping system, an ethylene glycol pumping system, an electrical system, and necessary service equipment, such as hoses and cabling. The servicer tanks are filled from storage barrels by use of trailer onboard equipment. Each tank incorporates individual pumping systems and separate service equipment to prevent contamination of either system. During the tank filling operation the fluid is metered to provide an accurate load and filtered to prevent foreign particles from being transferred to the tanks. Both systems are capable of continually circulating the fluid through the filter system.

c. The servicer is also capable of draining the two unit reservoirs. The servicer is connected to the ML at the same connect points used for filling and can receive and meter the fluids from the ML reservoirs by means of gravity flow or ML pumping facilities.

2. Facility Requirements

Power	Demand
440 vac, 60 cps, 3 phase	To be determined

3. General

a. Weight, pounds (Approximate)

(1) Dry	22,100
(2) Wet	40,000

b. Reservoir

(1) Fluid capacity	2,000 gallons (2 tanks, 1,000 gal. each)

(2) Fluid — RJ-1/Ethylene Glycol

(3) Fluid Specific Gravity

RJ-1	0.863
Ehtylene Glycol	1.265

4. Remarks

For additional information, refer to MSFC-MAN-024.

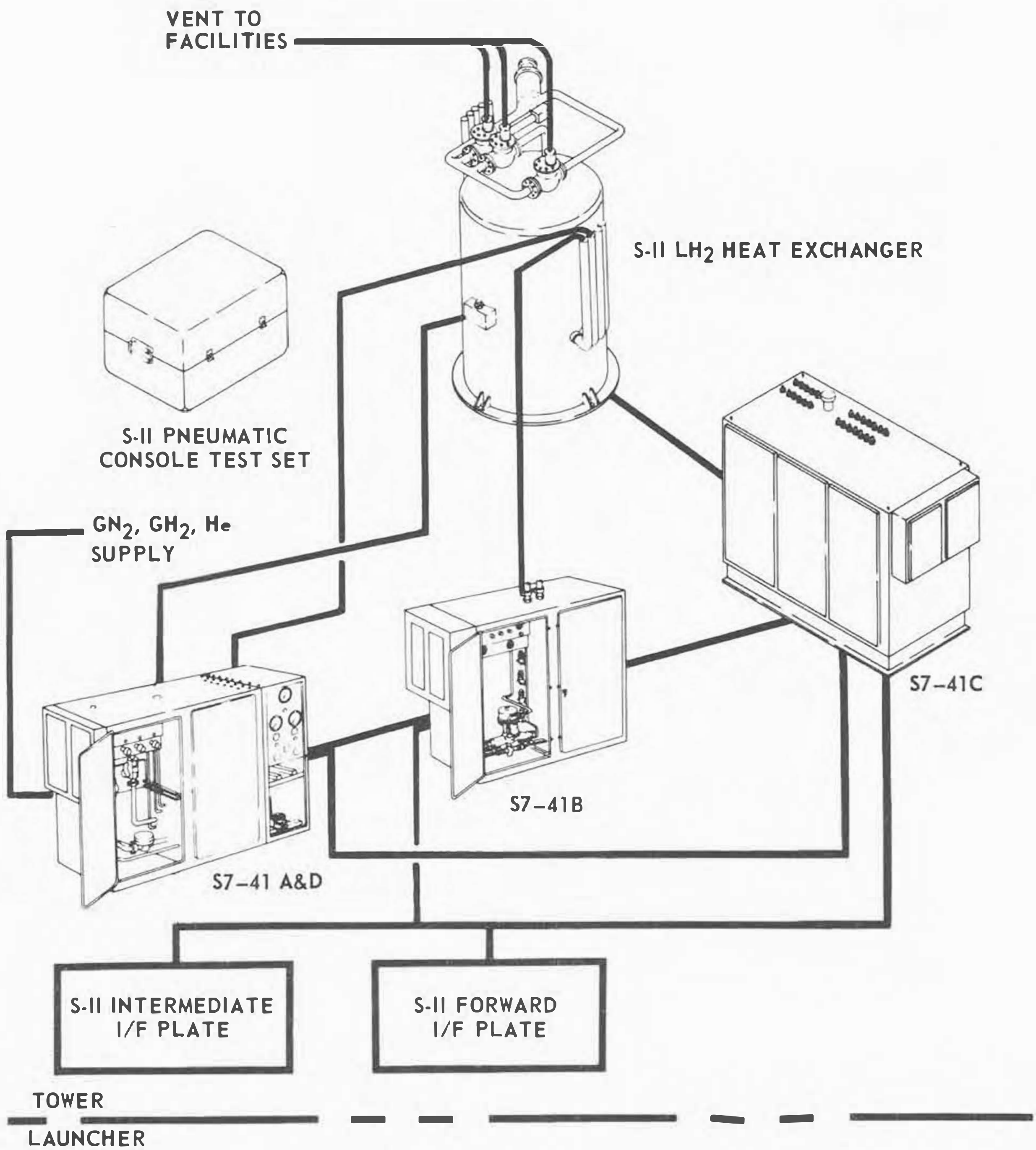


Figure 3-15. S-II Pneumatic Ground Support Equipment

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT

1. Functional Description

The S-II Pneumatic Ground Support Equipment is comprised of the following basic and distinct units:

a. S-II Pneumatic Consoles (four consoles).

b. S-II LH_2 Heat Exchanger.

c. S-II Pneumatic Console Test Set (seven "suitcases").

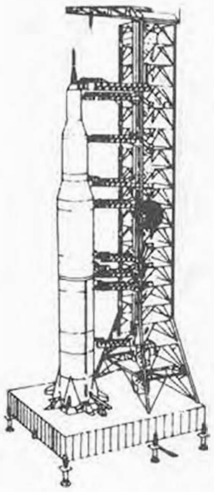
2. Facility Requirements

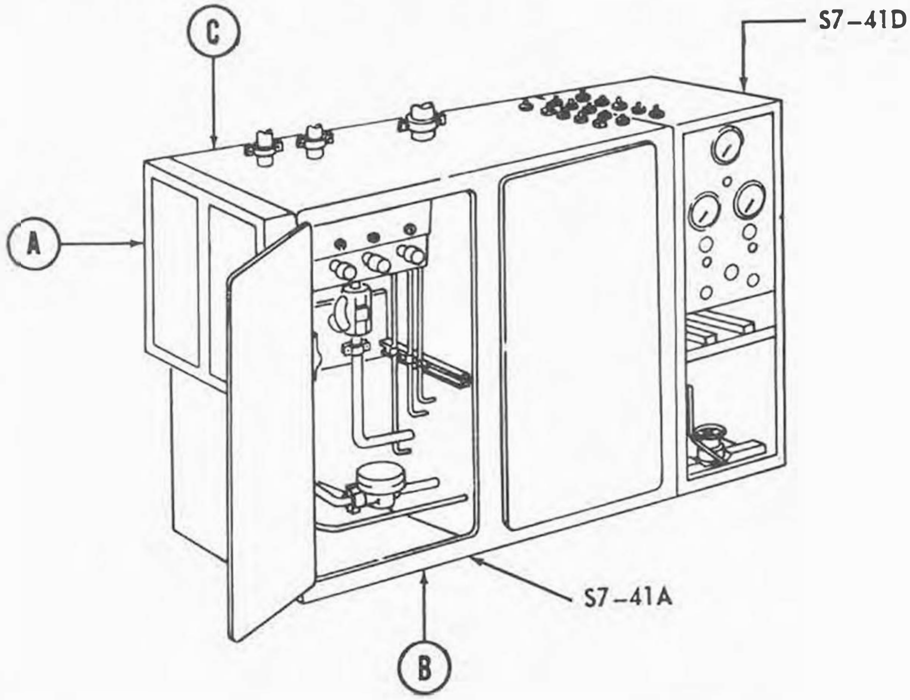
a. Power	Demand
(1) 115 vac, 60 cps, single phase	To be determined
(2) 28 vdc	To be determined

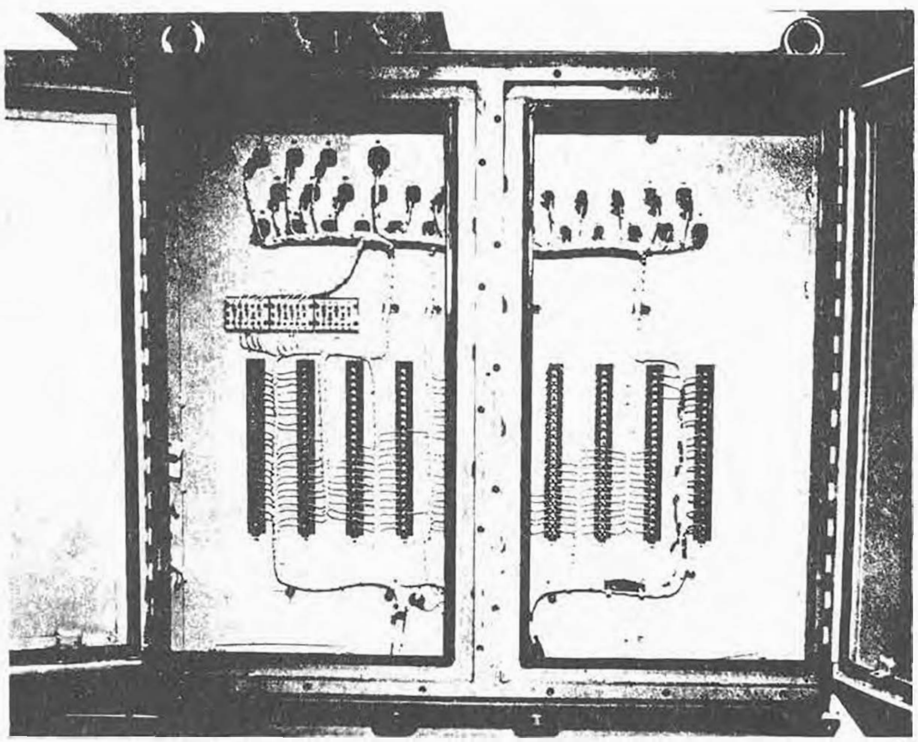
b. Gaseous Media

(1) Hydrogen at 3800 psig min. to 6600 max.
(2) Nitrogen at 3800 psig min. to 6600 max.
(3) Helium at 3800 psig min. to 6600 max.

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT



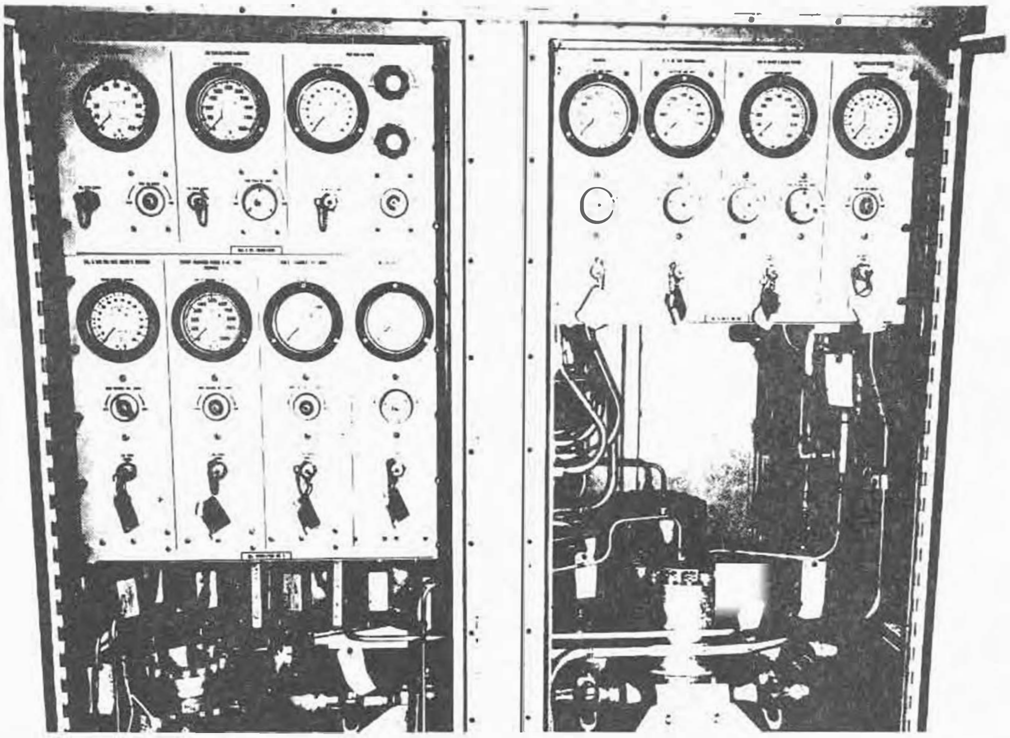




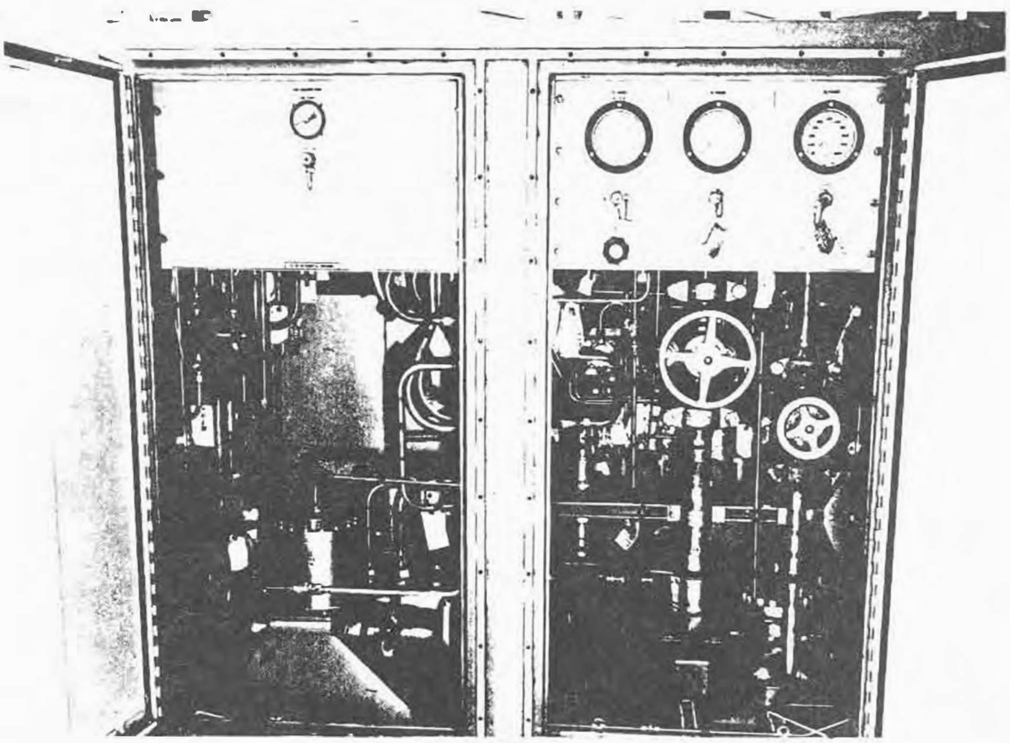
DETAIL A

Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 1 of 7)

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT



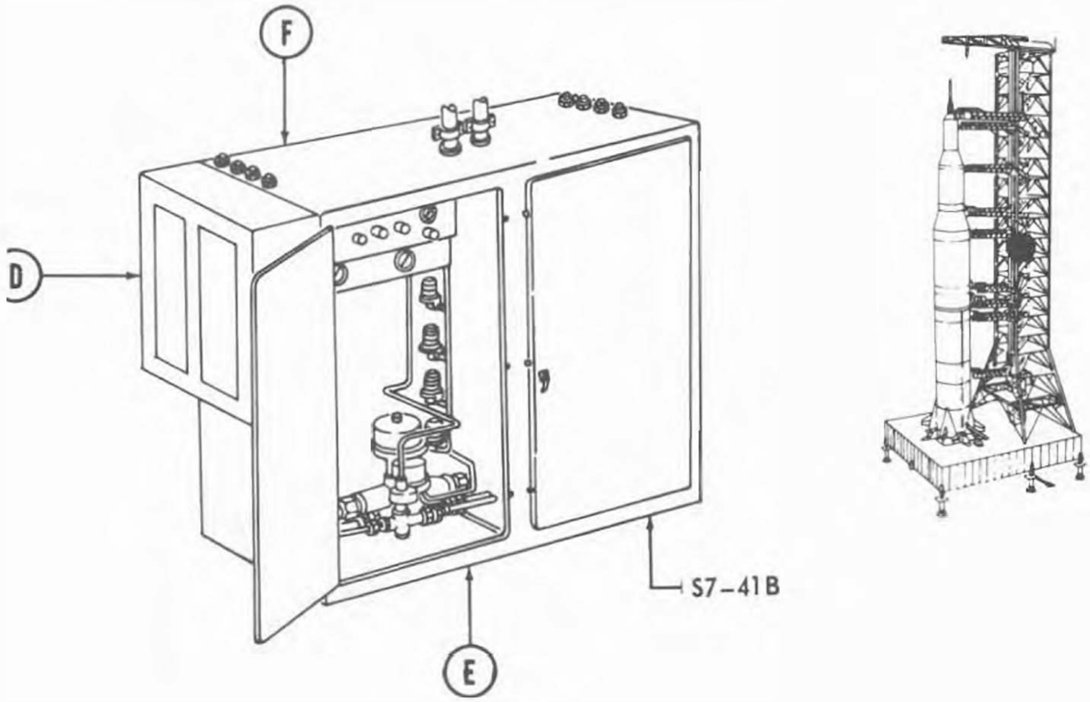
DETAIL B

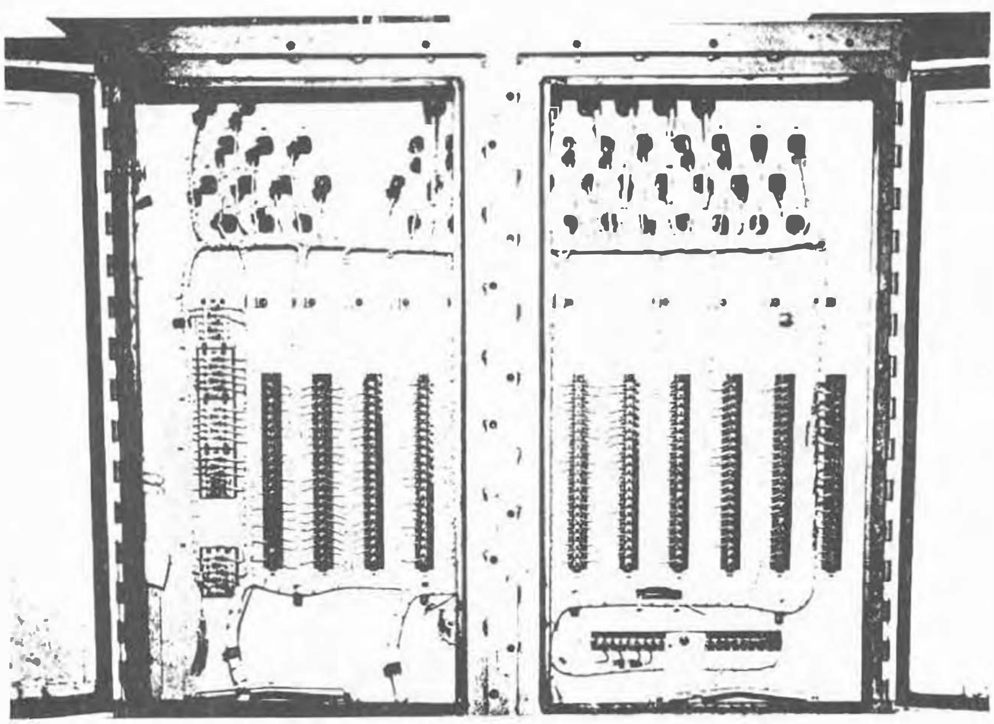


DETAIL C

Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 2 of 7)

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT

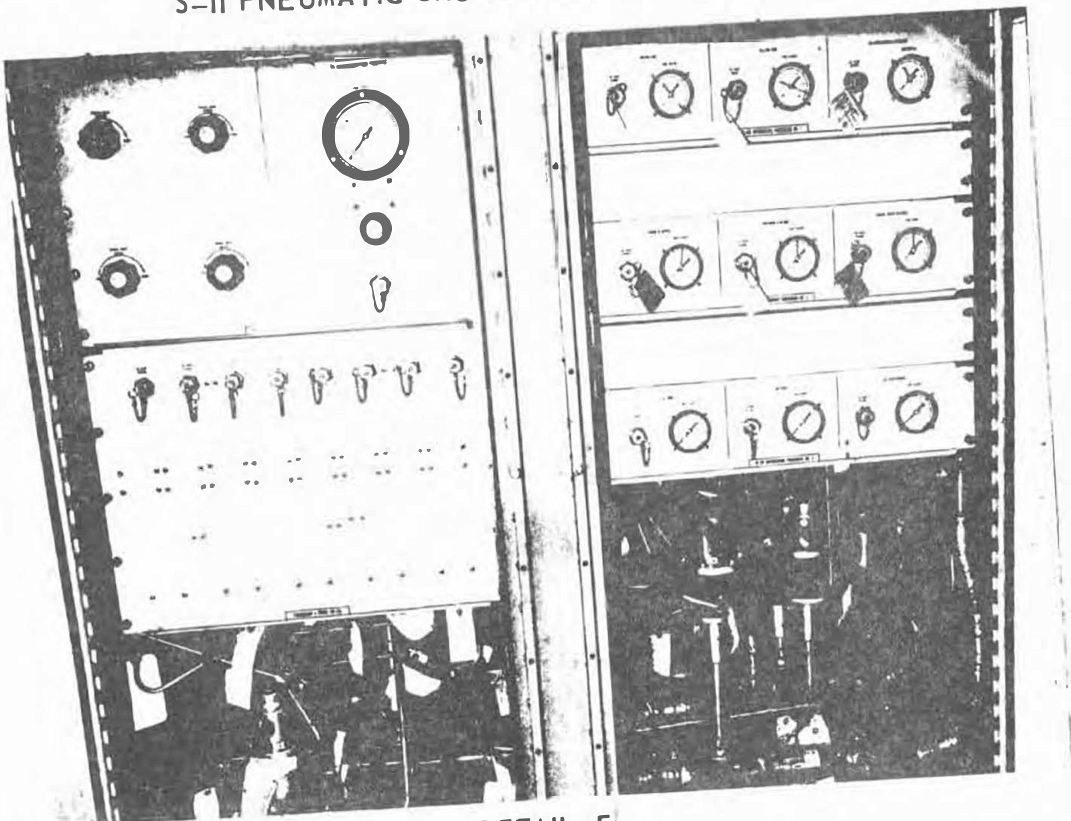




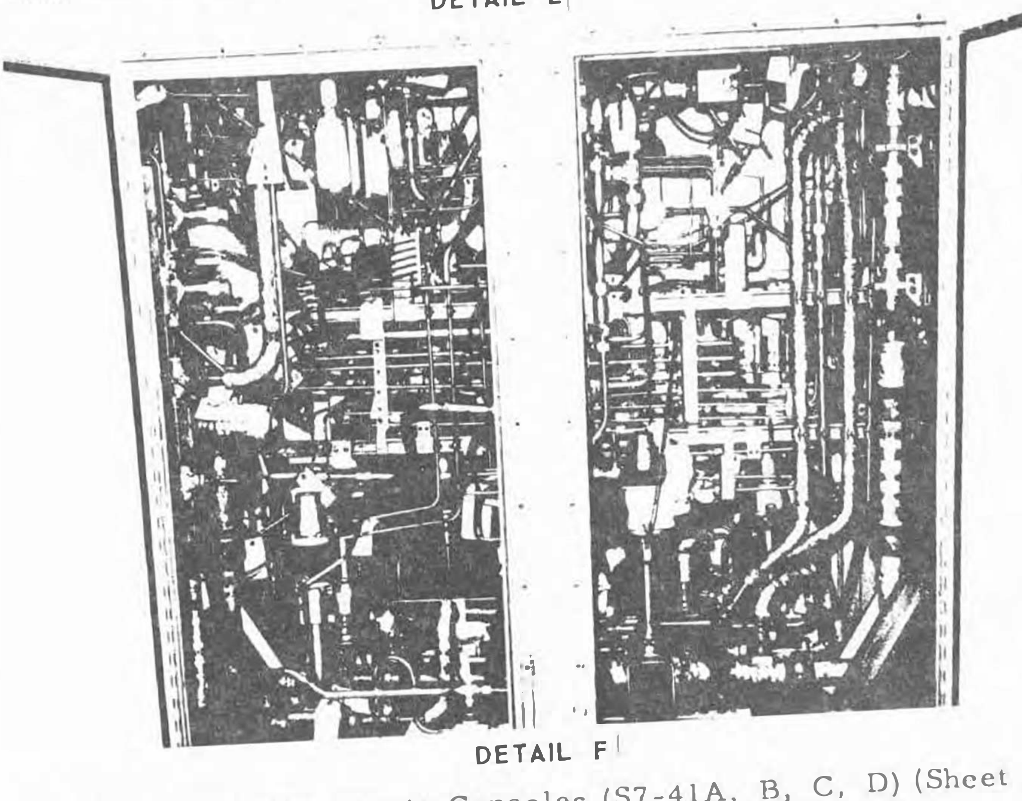
DETAIL D

Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 3 of 7)

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT



DETAIL E



DETAIL F

Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 4 of 7)

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT

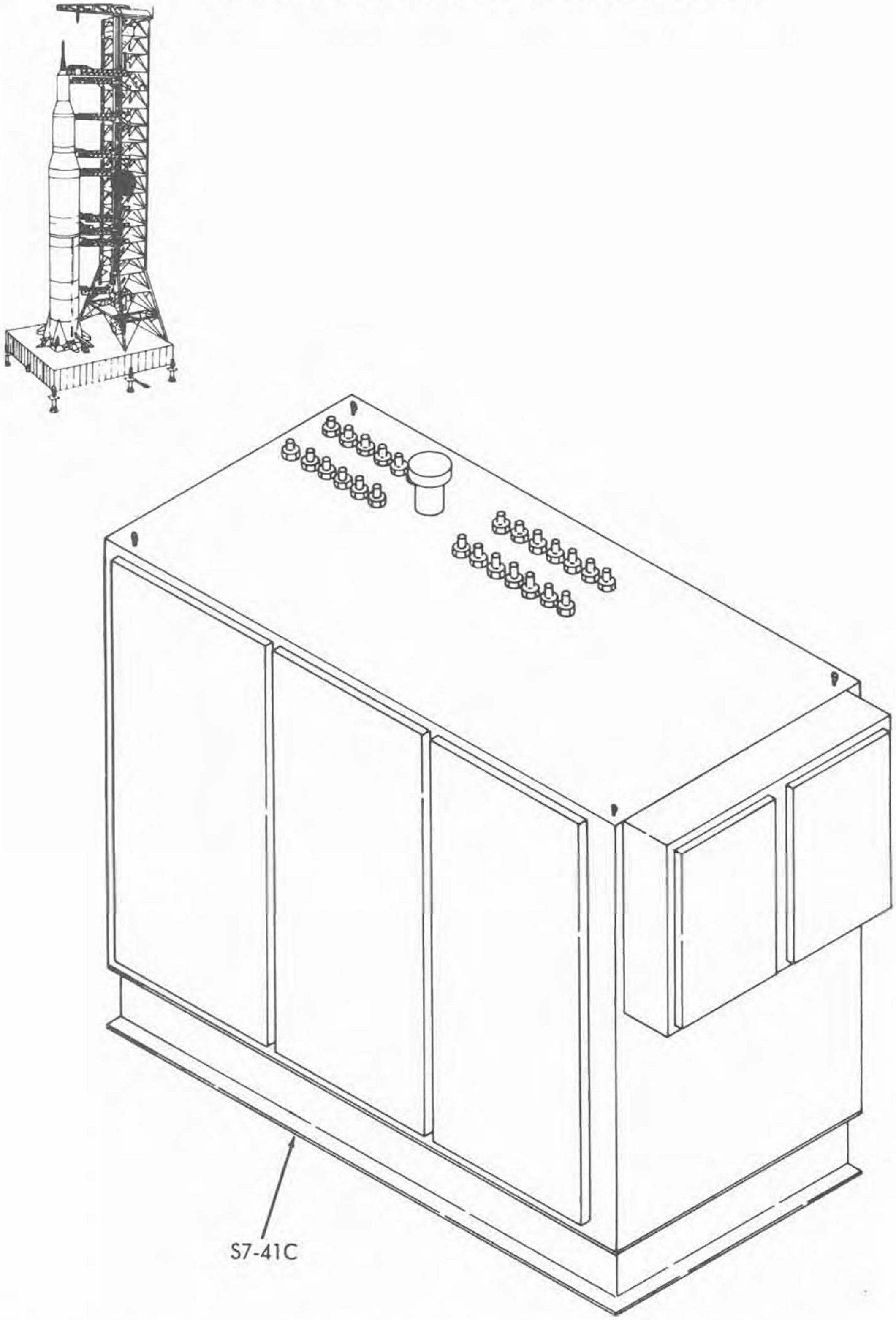
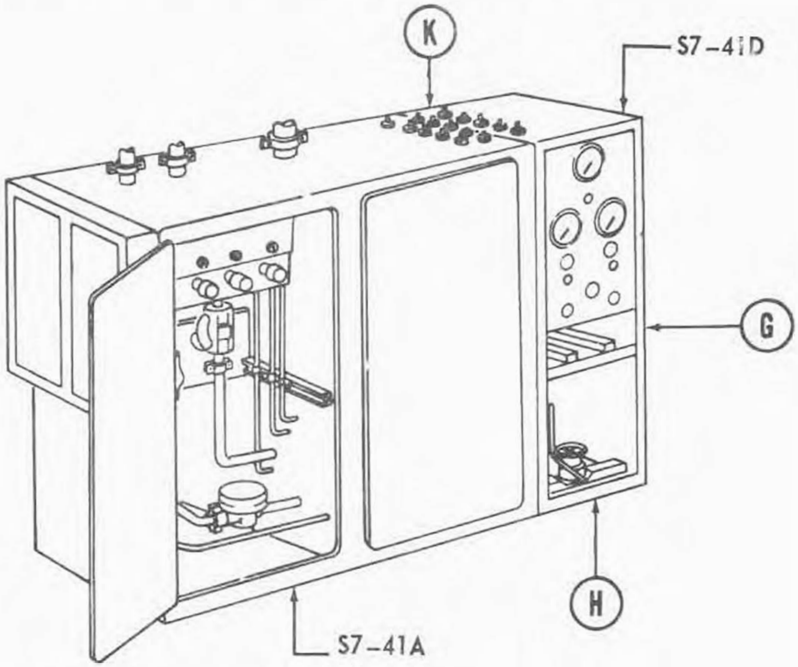
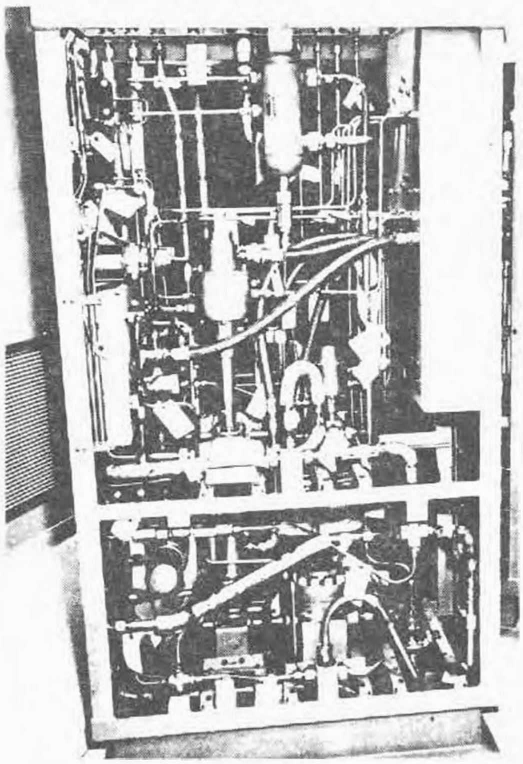


Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 5 of 7)

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT

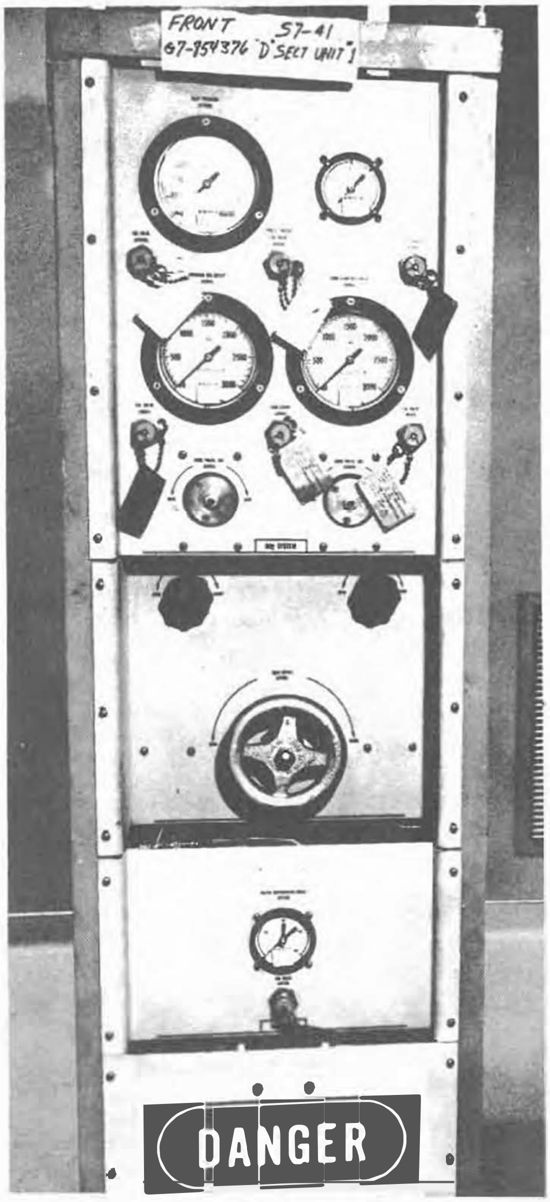




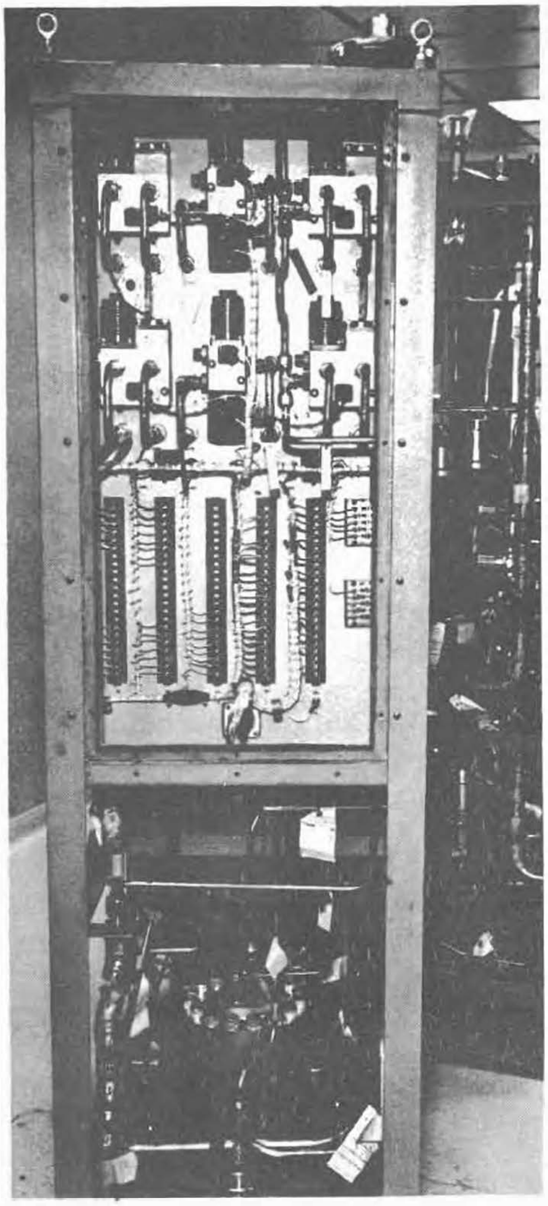
DETAIL G

Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 6 of 7)

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT



DETAIL H



DETAIL K

Figure 3-16. S-II Pneumatic Consoles (S7-41A, B, C, D) (Sheet 7 of 7)

S-II PNEUMATIC CONSOLES (S7-41 A, B, C, D)

1. Functional Description

The S-II Pneumatic Consoles regulate, control, and monitor the gaseous media required by the S-II stage during standby, prelaunch, launch, and post launch operations. They are normally operated by commands from the computer and launch sequencer. Certain functions can also be commanded by the launch crew in the Launch Control Center (LCC) if necessary. The following S-II stage requirements are supplied by the S-II Pneumatic Consoles:

a. Turbine start bottle purge, chill down, and pressurization.

b. Fuel tank purge, pre-pressurization and pressure drain.

c. Fuel tank helium supply bottle pressurization.

d. LOX tank helium supply bottle pressurization.

e. Oxidizer tank positive pressure.

f. Oxidizer tank purge, pre-pressurization, pressure drain, and post drain purge.

g. LOX return line helium injection.

h. Engine helium bottle purge, pre-pressurization, and pressurization.

i. Pre-valves and recirculation system actuation system pre-pressurization and pressurization, and camera ejection system pressurization.

j. Engine thrust chamber purge and chill down.

k. Oxidizer fill line drain and inerting.

l. Fuel fill line drain and inerting.

m. Turbine start bottle GH_2 vent control pressure.

n. Engine turbopump purge.

o. LH_2 disconnect shroud purge.

p. Forward and aft umbilical carrier cryogenics couplings purge supply.

q. Fuel tank pressurization system purge.

r. LH_2 umbilical debris valve actuating pressure, open and close.

s. Fuel tank helium supply (disconnect valve actuation pressure).

t. LH_2 tank vent valves, fill and drain valve, and purge valve actuation pressure.

u. LOX umbilical debris valve actuating pressure, open and close.

v. LOX tank helium supply (disconnect valve actuation pressure).

w. LOX tank vent valves and fill & drain valve actuation pressure.

x. Recirculation bottle helium supply (disconnect valve actuation pressure).

y. LH_2 and LOX tank pressurization regulator checkout.

z. LH_2 and LOX tank pressure switch, regulator, and vent valves checkout.

aa. J-2 engine main stage pressure OK switch and main LOX P/A control valve checkout.

ab. Fuel tank helium inserting purge (post-drain).

ac. Recirculation LH_2 line purge.

ad. Fuel and oxidizer tank standby pressure.

ae. Forward and aft umbilical electrical ejection supply.

af. Fuel tank and oxidizer tank pressure switches, regulator and vent valves remote pressure sensing.

2.	<u>General</u>	Demand
	a. Weight, pounds (Approximate)	A, D - 4300 B - 3600 C - 3000
	b. Location in ML (Tower)	180 foot level.

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT

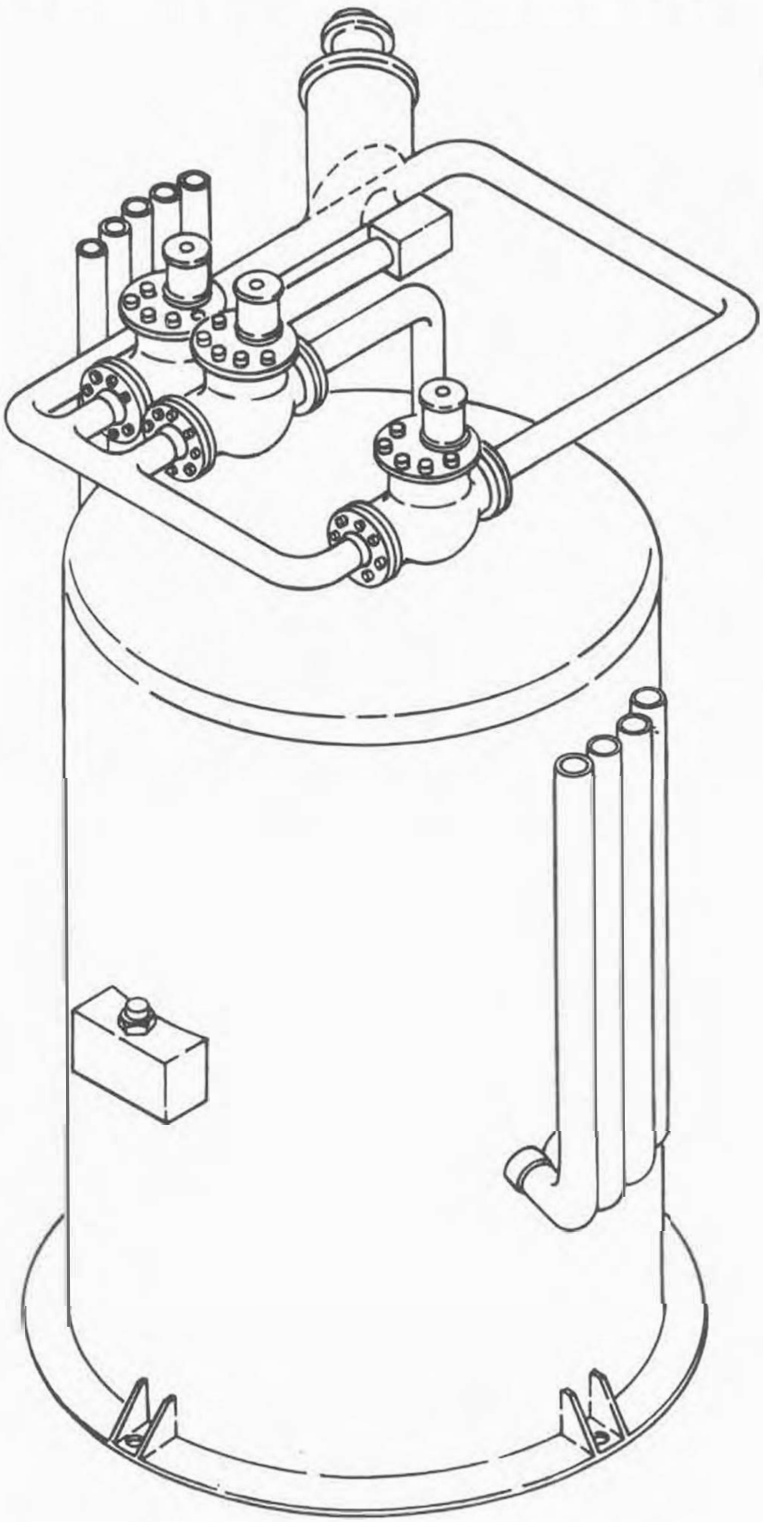


Figure 3-17. S-II LH_2 Heat Exchanger (A7-71)

S-II LH_2 HEAT EXCHANGER (A7-71)

1. Functional Description

a. The heat exchanger is a vertical, flooded type with multiple circuits contained in a Dewar type vessel fabricated from stainless steel. The heat exchanger also includes:

(1) A liquid hydrogen inlet which terminates in a distribution chamber.

(2) Pneumatic circuits leading to a manifold and a gaseous hydrogen vent.

(3) Provisions for evacuating the annular space between the inner and outer walls to provide insulation.

(4) Inlet and outlet connections for three cooling circuits (On circuit bus - 2 outlets).

(5) A servo feedback temperature controlled LH_2 level system.

(6) Provisions for complete controlled inerting.

b. Three stainless steel coils provide three separate and individual circuits to carry the gases through the liquid hydrogen. The outlet of each circuit incorporates a temperature transducer. Cold gases, provided by the heat exchanger, are for the following:

(1) Fuel tank pressurization.

(2) Fuel tank helium supply bottle pressurization.

(3) LOX tank pre-pressurization.

(4) LOX tank supply bottle pressurization.

(5) Turbine start bottle purge, chill down, and fill.

(6) Engine helium bottle purge, pre-pressurization, and pressurization.

(7) Thrust chamber jacket chill down.

2. General

a.	Weight, pounds (Approximate)	5400 pounds
b.	Location in ML (Tower)	180 foot level

S-II PNEUMATIC GROUND SUPPORT EQUIPMENT

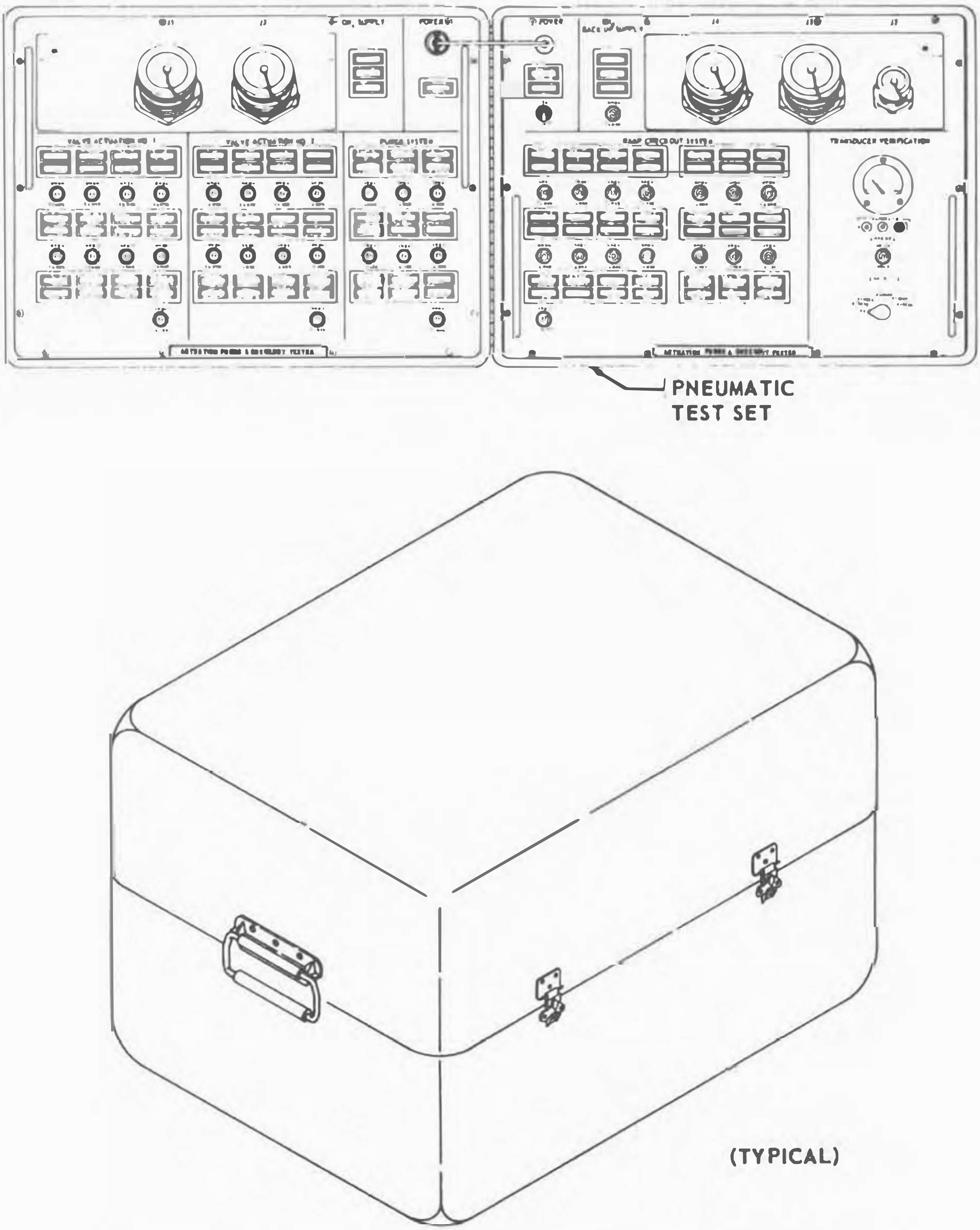


Figure 3-18. S-II Pneumatic Console Test Set (C7-70)

S-II PNEUMATIC CONSOLE TEST SET (C7-70)

1. Functional Description

The test set is comprised of components packaged in portable "suitcases". Three "suitcases" are used for the test set components and four "suitcases" contain the necessary cabling associated with the test set. The set is used to test electrical and electro-pneumatic components in the S-II Pneumatic Consoles and the S-II LH_2 Heat Exchanger.

2. General

a.	Weight, pounds (Approximate)	To be determined
b.	Dimensions, inches (Approximate)	24 x 18 x 16 (each)

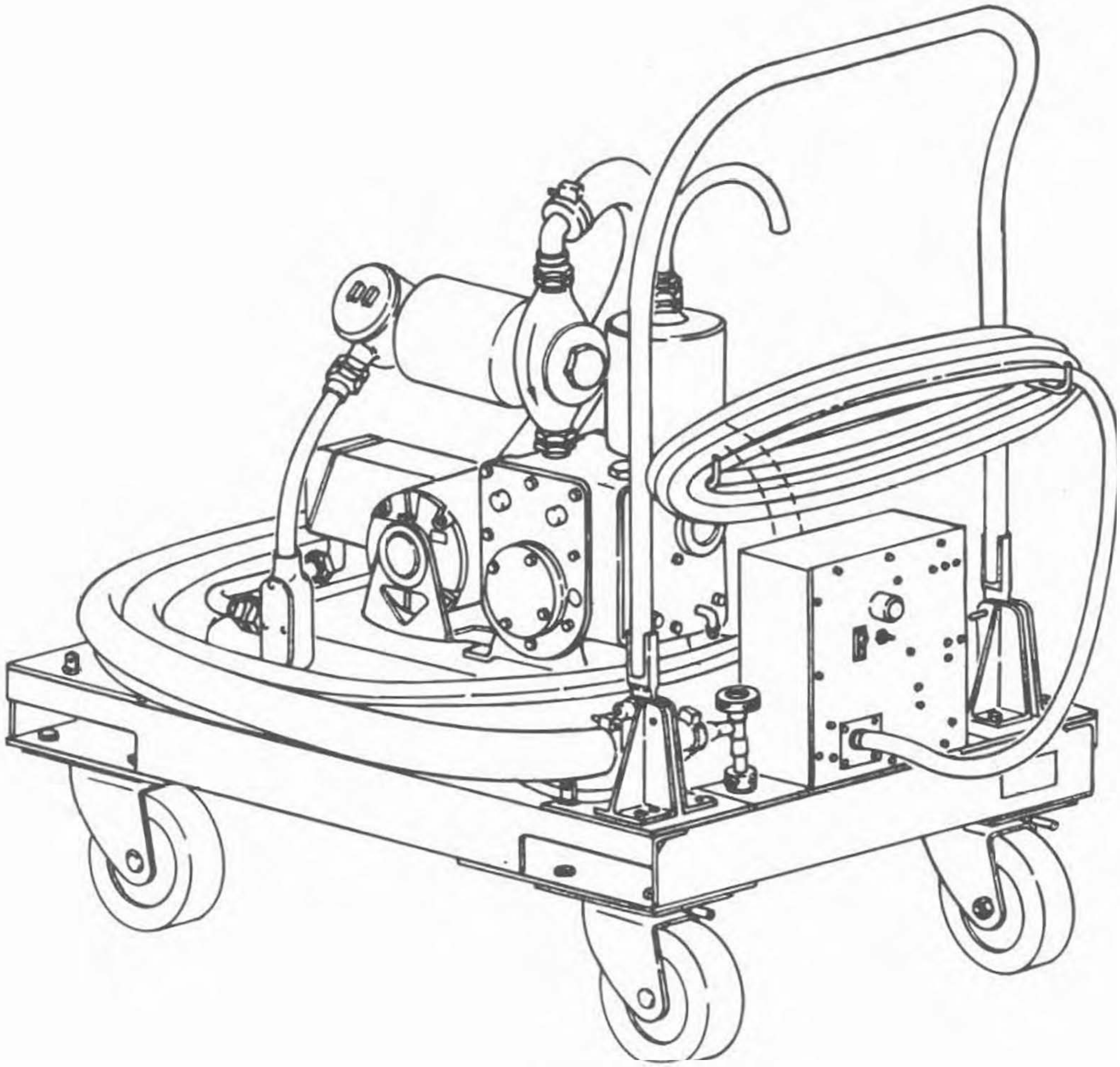


Figure 3-19. Portable Vacuum Pump Unit (S7-37)

PORTABLE VACUUM PUMP UNIT (S7-37)

1. Functional Description

a. The Portable Vacuum Pump Unit is required to evacuate to a residual pressure of less than 10 microns of mercury absolute, vacuum insulation spaces in the S-II stage engine feed lines and GSE vacuum jacketed piping and components. The unit consists of the following major components and subsystems:

(1) The pump, a compound, oil sealed, high vacuum, mechanical, air cooled unit of approximately 8 cfm displacement.

(2) The motor, a 3/4 hp explosion proof unit belt-connected to the pump.

(3) The motor starter, a momentary switch with a relay locked in. A circuit breaker with 15 amp overload protection is provided, and the circuit breaker and relay are explosion proof.

(4) The inlet solenoid valve, a one inch, zero leakage unit, with a 110 vac coil.

(5) The current monitor, interlocked with the motor, to de-energize the solenoid valve in case of motor failure.

(6) Various adapters, hoses, and cables.

b. The pump unit will be rolled to a convenient location adjacent to the line to be evacuated. After connection to the line by means of an adapter, the pump unit will reduce the pressure in the line, with the time required to do this depending on the volume and initial pressure of the line to be evacuated.

2. Facility Requirements

Power	Demand
110 vac, 60 cps, single phase	To be determined

3. General

Weight, pounds (Approximate)	To be determined

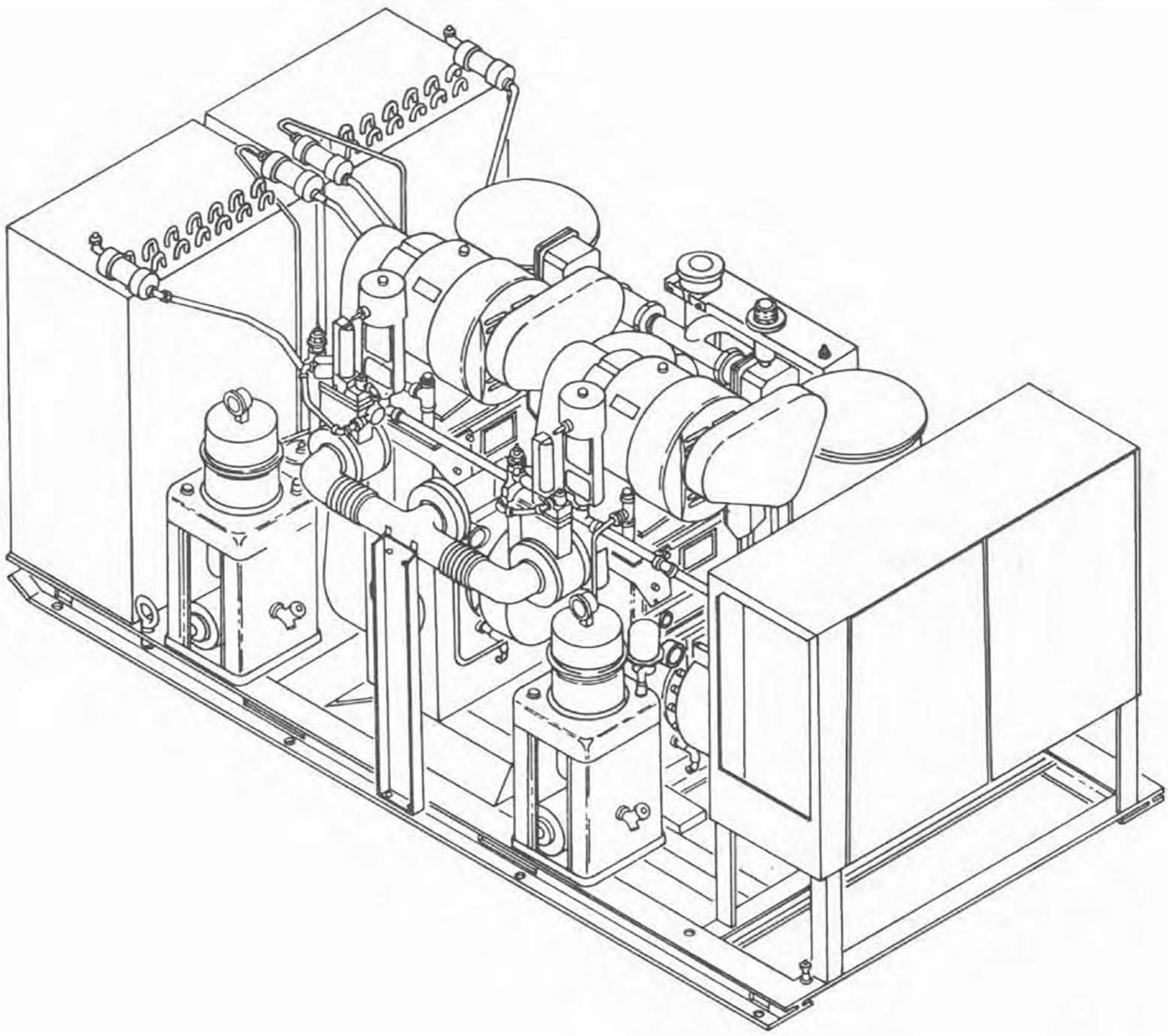


Figure 3-20. Stationary Vacuum Pump (S7-29)

STATIONARY VACUUM PUMP (S7-29)

1. Functional Description

a. The stationary vacuum pump S7-29 is a dual, redundant, pumping unit used to evacuate the interior of the S-II stage common bulkhead of hydrogen or oxygen contaminants after the completion of the stage propellant tanking checkout. In addition, the S7-29 vacuum pump may be used to evacuate contaminants from the S-II stage tank insulation.

b. The S7-29 vacuum pump consists of two completely independent vacuum pumps and associated components which share a common inlet manifold, exhaust manifold, and mounting skid. Each pump is provided with a drive motor, lubricating oil reconditioner, pump coolant system, inlet shutoff valve, outlet oil separator, outlet check valve, electrical power controls, and instrumentation. The cooling system for each of the vacuum pumps consists of a circulating pump, temperature switches for remote indication, a temperature control valve which bypasses coolant around the heat exchanger at low temperatures, and a fan-equipped heat exchanger.

c. Although the two pumps are connected to a common inlet and outlet manifold, the pumps may be operated individually or simultaneously, as interaction between the pumps is prevented by a vacuum shutoff valve at each pump inlet and by a check valve at each pump outlet. All fluid connections to the unit are made through couplings grouped on a connector panel at the right side of the skid, and all electrical connections are made through connectors on the underside of the electrical enclosure at the front of the skid.

2. Facility Requirements

a.	Power	Demand
	(1) 480 volts ac, 60 cps, 3 phase	To be determined.
	(2) 28 volts dc	To be determined.
b.	Gaseous nitrogen	140 + 10 psig

3. General

a.	Storage temperature range	-65°F to + 160°F
b.	Operating temperature range	0°F to + 125°F
c.	Weight, pounds (approximate)	To be determined
d.	Dimensions, inches (approximate)	To be determined

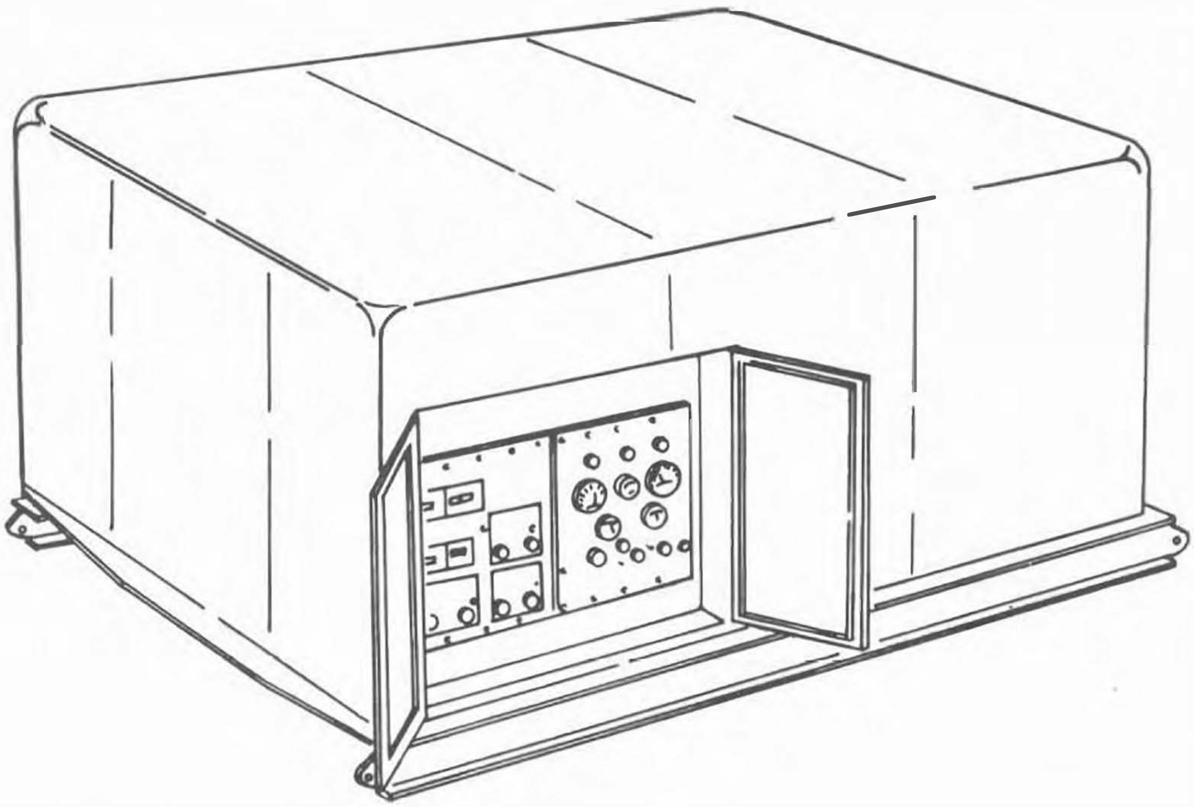


Figure 3-21. Electrical Container Air Servicing Unit (S7-34)

ELECTRICAL CONTAINER AIR SERVICING UNIT (S7-34)

1. Functional Description

a. The Electrical Container Air Servicing Unit is required to provide air to the electrical containers through the S-II stage thermal control system with no propellants on board. It services the thermal control system of the stage during electrical system checkout. The unit includes a compression system, a pressure control system, an electrical system, and a trailer-mounted enclosure.

(1) The compression system, a centrifugal compressor, is a motor driven unit. The motor speed is controlled by variable secondary resistances (wound-rotor motor drive). The compressor is rated at 1,000 scfm at a discharge pressure of 5 psig.

(2) The pressure control system consists of pressure regulators, pressure gages, relief protection, and flow indicators. The pressure regulators are capable of precise regulation to within ± 0.1 psig over the range of 0.5 to 5.0 psig. The pressure gages monitor discharge pressure by indicating the pressure regulator sensing pressure. Relief protection is provided to prevent overpressurization of the S-II stage thermal control system. Flow indicators are provided in each of the pressure control systems to monitor the discharge rate of flow. The indicators have a range of from zero to 500 scfm.

(3) The electrical system consists of circuit breakers, the power circuit, relief protection, an electric motor, and various indicators and meters.

b. The unit is manually operated, with no provisions for remote control or monitoring. The unit takes ambient air and compresses, filters, regulates, and discharges it into the respective fluid distribution system.

2. Facility Requirements

Power	Demand
440 vac, 60 cps, 3 phase	To be determined

3. General

a.	Weight, pounds (Approximate)	To be determined
b.	Dimensions, inches (Approximate)	To be determined

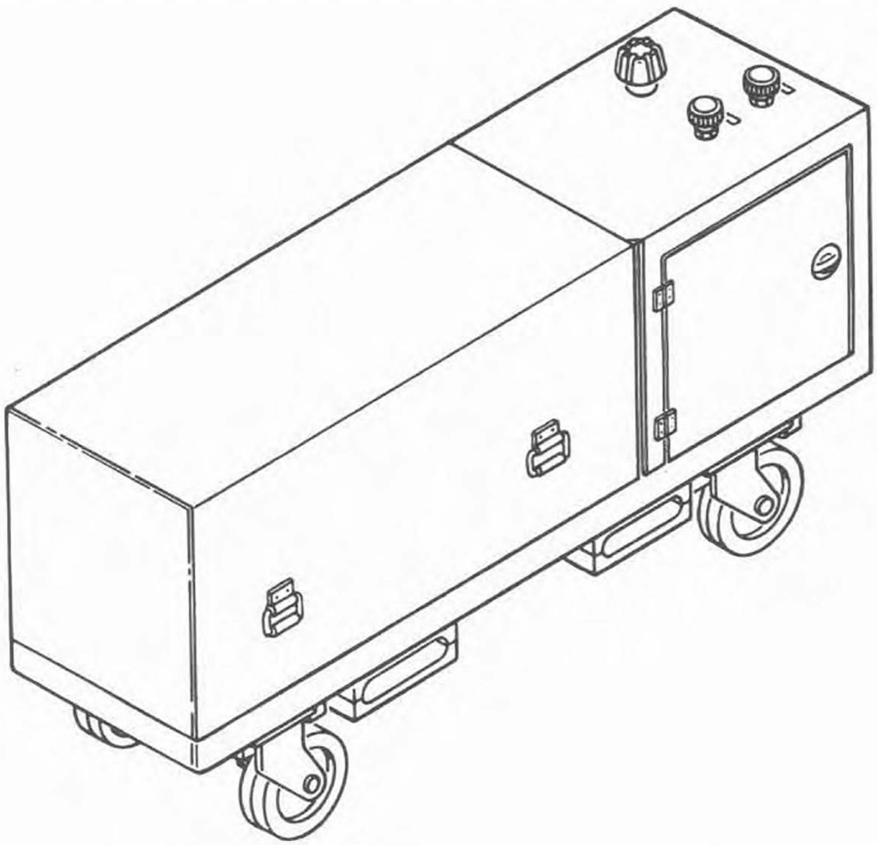


Figure 3-22. Hydraulic Accumulator Precharge Servicing Unit (S7-38)

HYDRAULIC ACCUMULATOR PRECHARGE SERVICING UNIT (S7-38)

1. Functional Description

a. The Hydraulic Accumulator Precharge Servicing Unit is required to provide gaseous nitrogen at the required pressures to precharge the pneumatic side of the accumulator reservoir. The precharge unit includes a storage system, a pressure regulator system, and the mobile enclosure.

b. The storage system consists of the gas cylinders for storage of the high pressure gaseous nitrogen for extended periods of time, the high pressure regulator for receiving gaseous nitrogen up to 6, 000 psig and reducing the pressure to approximately 3, 000 psig, the high pressure gage for indicating the pressure of the stored gaseous nitrogen, and the secondary pressure gage for indicating the discharge pressure of the high pressure regulator.

c. The pressure regulator system contains a pressure gage for indicating the accumulator reservoir pressure, a charging valve for attachment of the precharge unit to the accumulator reservoir, a relief valve downstream of the pressure regulator to prevent overpressurization of the accumulator reservoir in the event the pressure regulator fails, and a hose assembly for transferring the gaseous nitrogen from the precharge unit to the accumulator reservoir.

Additional data will be furnished at a later date.

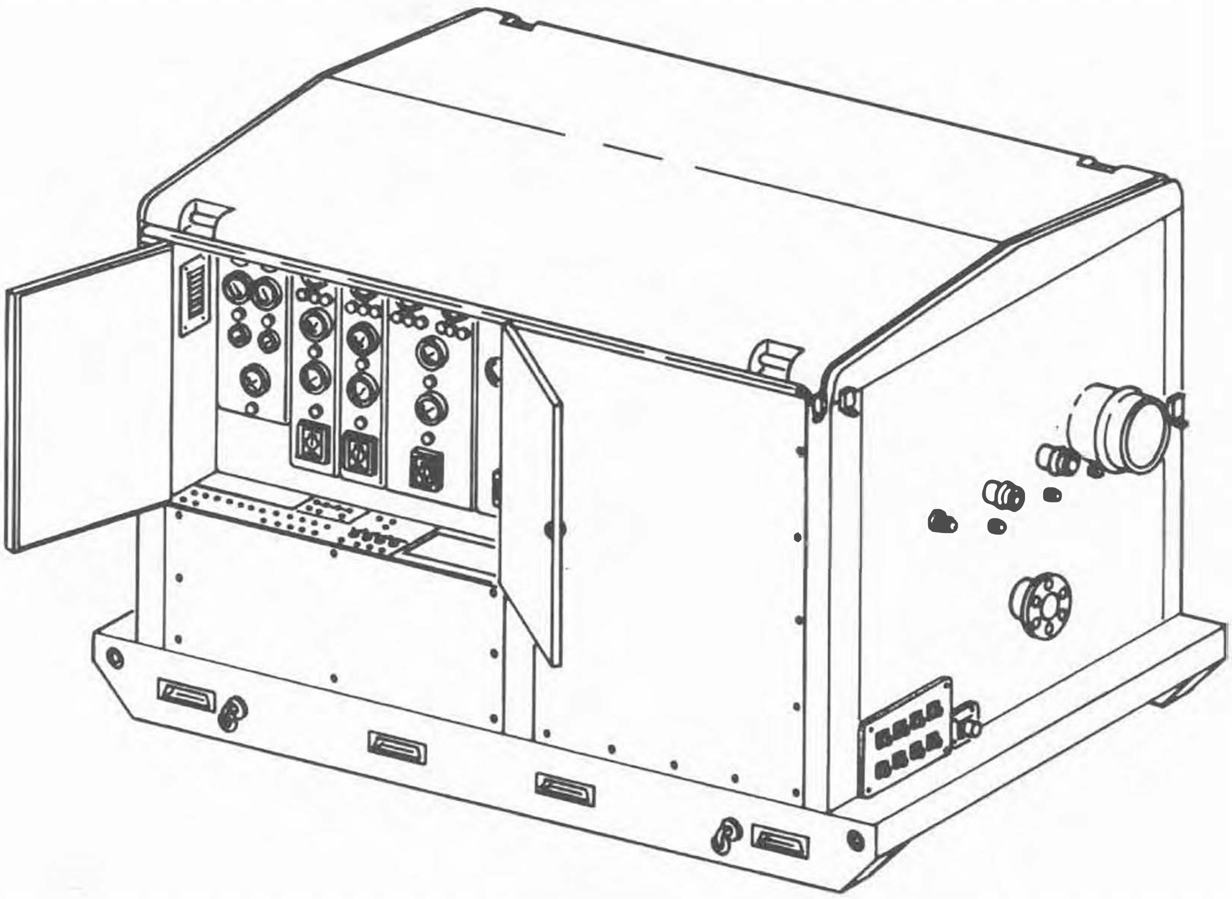


Figure 3-23. Purge and Thermal Control Nitrogen Servicing Unit (S7-40)

PURGE AND THERMAL CONTROL NITROGEN SERVICING UNIT (S7-40)

1. Functional Description

The Purge and Thermal Control Nitrogen Servicing Unit is required to condition and purge equipment containers and the engine compartment.

Additional data will be furnished at a later date.

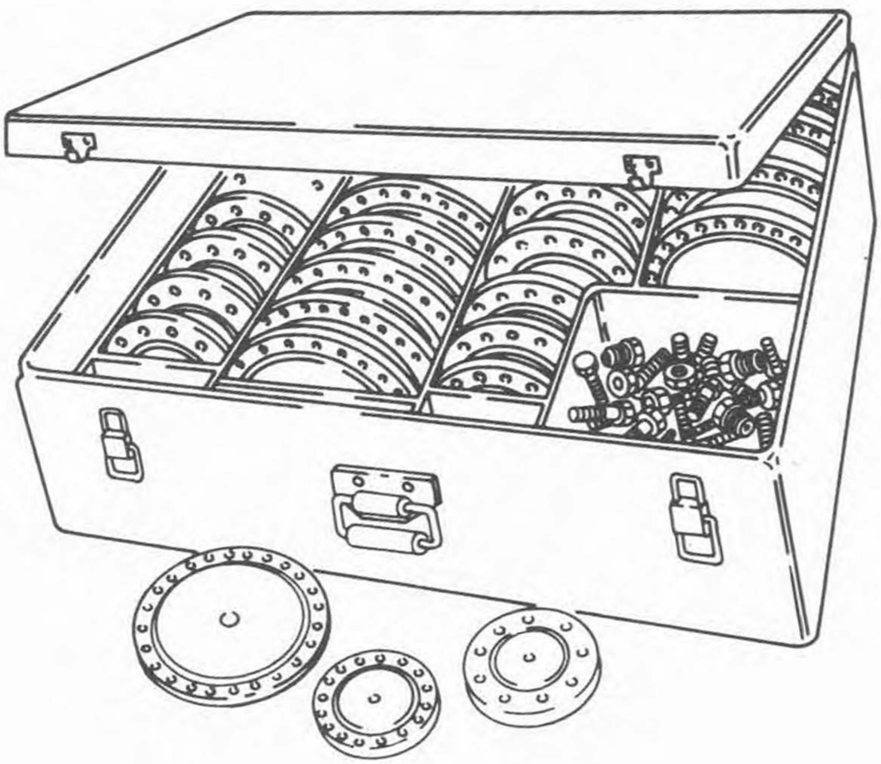


Figure 3-24. Pneumatic Checkout Blanking Plate Set (C7-53)

PNEUMATIC CHECKOUT BLANKING PLATE SET (C7-53)

1. Functional Description

The Pneumatic Checkout Blanking Plate Set is required for calibration of the GSE pneumatic systems.

Additional data will be furnished at a later date.

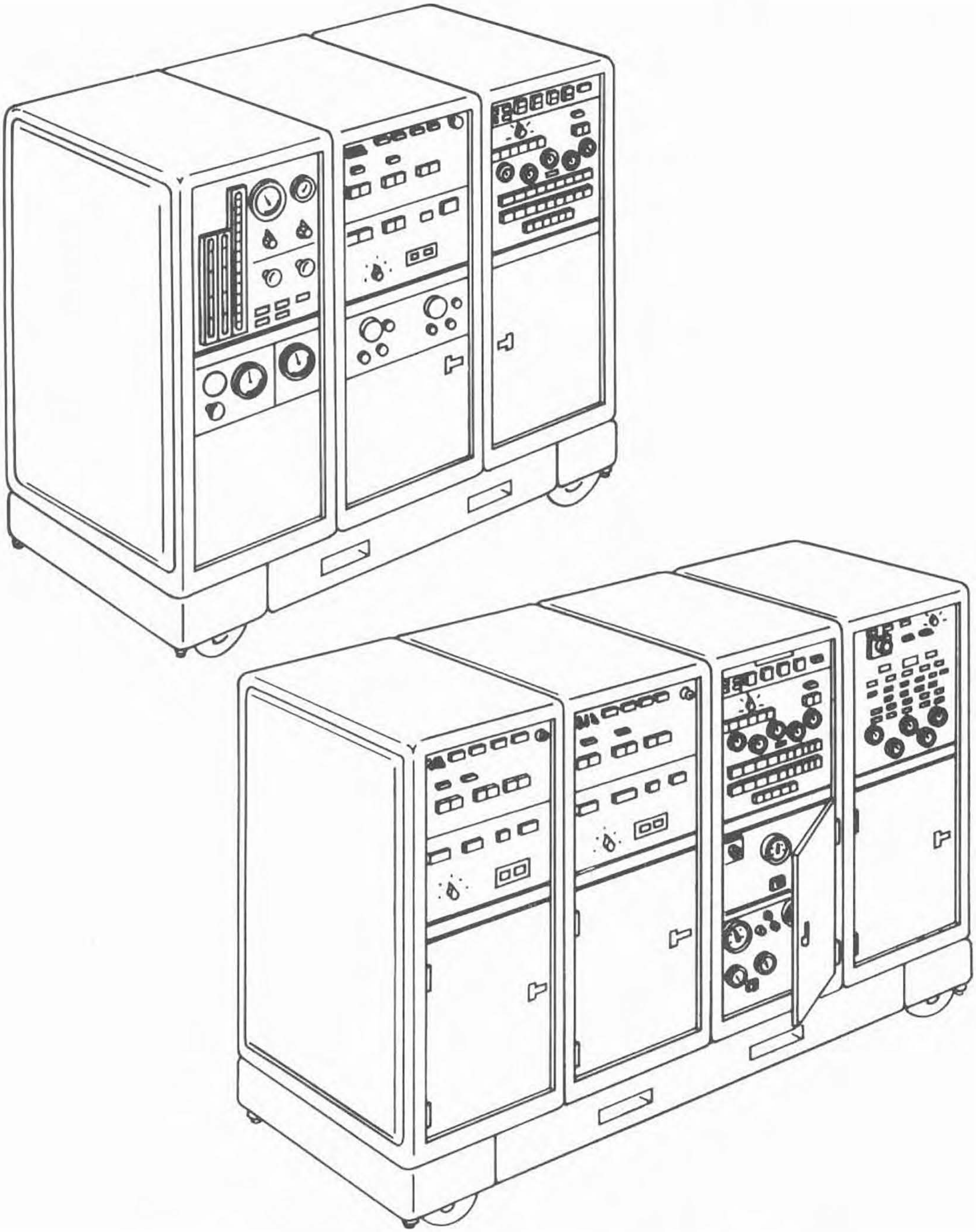


Figure 3-25. Pneumatic Checkout Console Set (C7-603)

PNEUMATIC CHECKOUT CONSOLE SET (C7-603)

1. Functional Description

a. The Pneumatic Checkout Console Set is required to provide gaseous nitrogen and helium for leak and functional checkout of the S-II stage engine, pressurization, and propellant systems. The console set includes the following major components and subsystems; electrical control systems, electrical control panels, pneumatic control systems, and pneumatic control panels.

b. The console can be operated and monitored by any of the following modes: remote automatic, by a programmed computer; remote manual, by an operator from a control and monitor panel provided in a remote equipment rack; and local manual, by an operator at the console from the console control and monitor panel.

c. The electrical control system main operating voltage level is 28 vdc although 120 vac, 60 cycle, single phase power is used for timing functions. Each of the major voltage subsystems is suitably protected with overload and short circuit devices. The console interfaces electrically with input control power sources, input and output connections to a remote control station, and the S-II stage.

d. Three electrical control panels are provided for location of the circuit protective devices, switch lights, push button switches, selector switches, indication switches, and meters required for internal console and stage functioning. Components are functionally arranged to minimize operator movement during testing.

e. The console receives gaseous helium and nitrogen at 1,500 psig at ambient temperature. The pneumatic control system provides gaseous helium and nitrogen to the S-II stage at flow rates up to 1,000 scfm.

(1) The console is capable of providing gaseous helium for the following functions.

(a) Manual leak check of the engine LH_2 and LOX turbopump purge and seal drain system.

(b) Manual leak check of the LH_2 and LOX engine feed systems and components.

(c) Manual leak check of the engine thrust chamber.

(d) Manual leak check of the engine gas generator and exhaust systems.

(e) Manual leak check of the gas generator chilldown bleed and control valves.

(f) Manual leak check of the engine hydrogen start tank, fill, and vent system.

(g) Leak and functional check of the hydrogen start tank, engine helium bottle, and pneumatic control system.

(h) Manual flow and functional check of the LH_2 tank pressurization purge systems.

(i) Manual leak and functional check of the LH_2 and LOX recirculation system, components, and actuation systems.

(2) The console is capable of providing gaseous nitrogen for the following functions.

(a) Manual leak check of the LH_2 and LOX tank prepressurization system and helium spheres.

(b) Automatic functional checkout of the LH_2 and LOX pressurization system pressure switches and tank vent valves.

(c) Automatic and manual functional checkout of the LH_2 and LOX tank pressurization system regulation, solenoid valves, and vent valves.

(d) Independent actuation of S-II stage system components and disconnect valves, remote or local.

2. Facility Requirements

To be determined.

3. General

a.	Weight, pounds (Approximate)	To be determined.
b.	Dimensions, inches (Approximate)	288 x 60 x 36

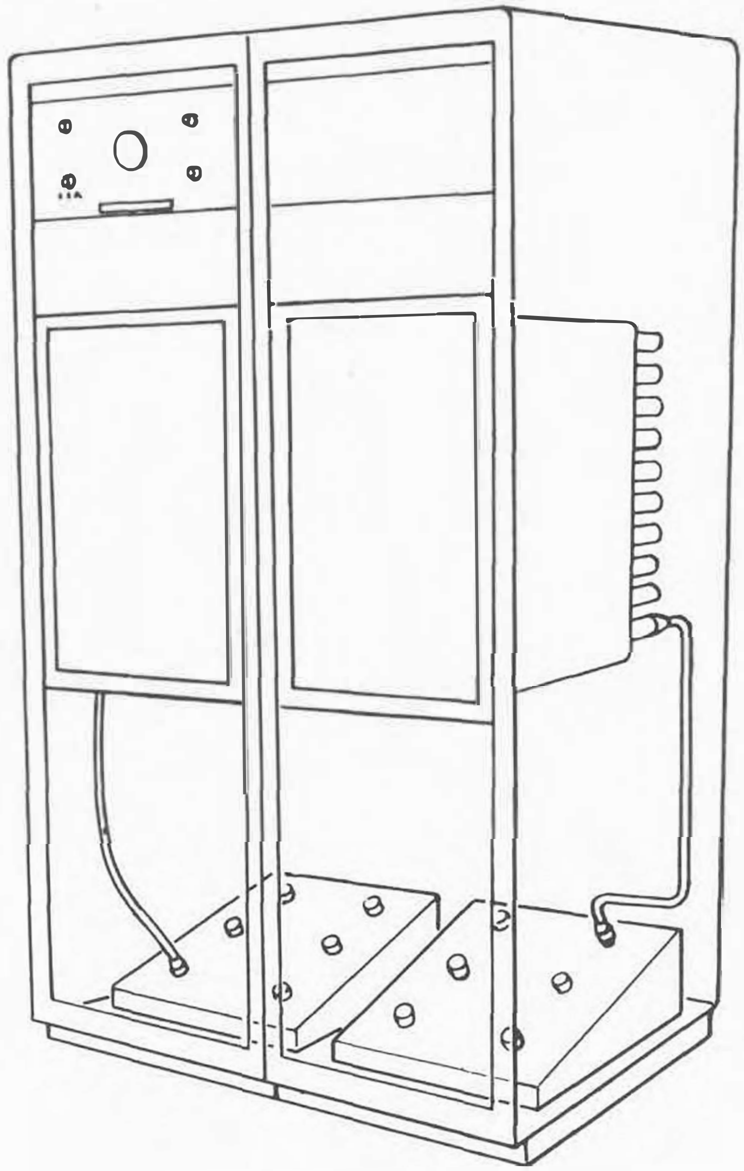


Figure 3-26. Electrical Pneumatic Servicing Console (S7-42)

ELECTRICAL PNEUMATIC SERVICING CONSOLE (S7-42)

1. Functional Description

The Electrical Pneumatic Servicing Console is required to provide remote electrical control for the S-II Pneumatic Consoles.

Additional data will be furnished at a later date.

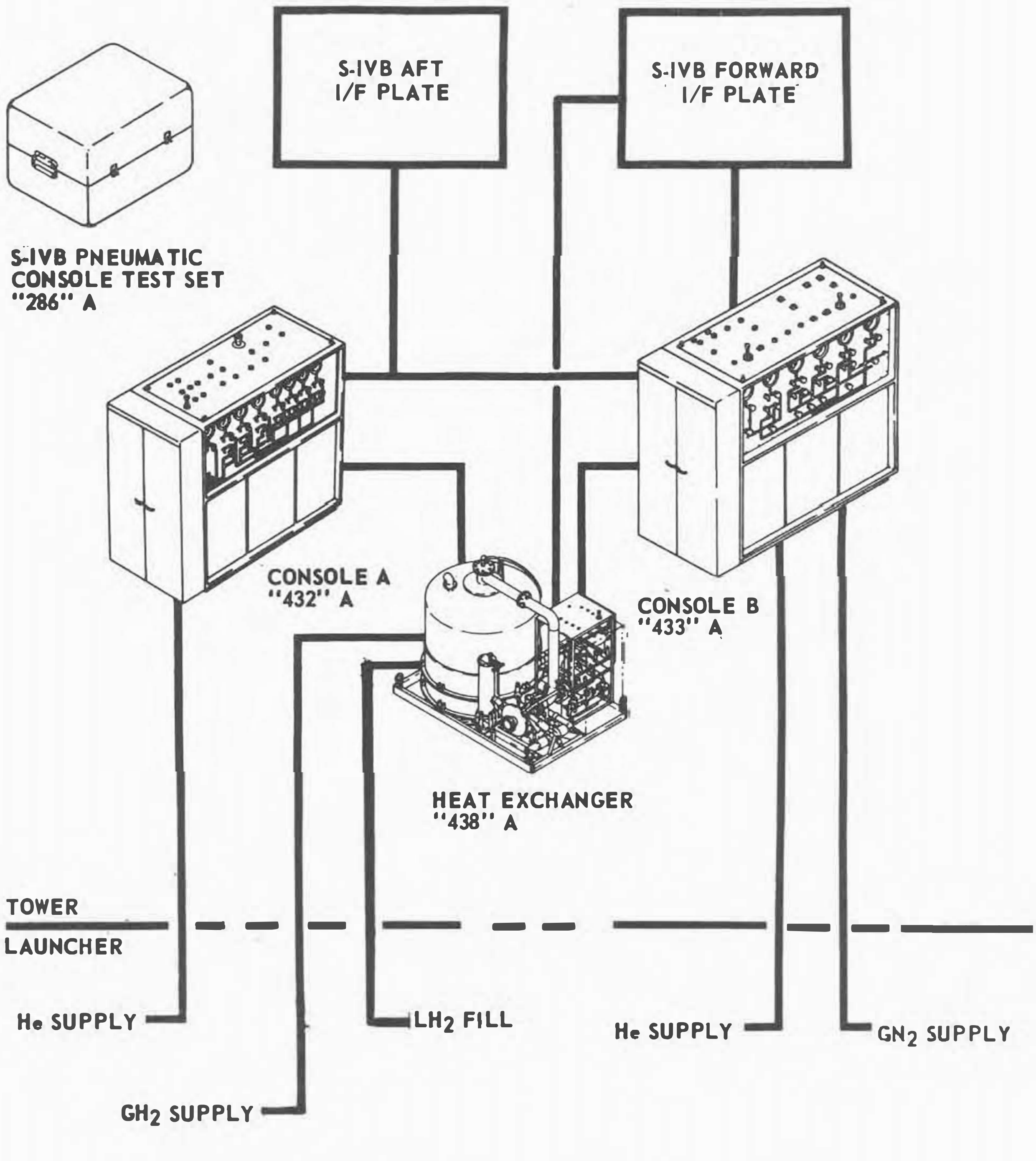


Figure 3-27. S-IVB Pneumatic Ground Support Equipment

S-IVB PNEUMATIC GROUND SUPPORT EQUIPMENT

1. Functional Description

The S-IVB Pneumatic Ground Support Equipment is composed of the following basic and distinct units:

a. S-IVB Pneumatic Console (A and B).

b. S-IVB Gas Heat Exchanger.

c. S-IVB Pneumatic Console Test Set.

2. Facility Requirements

a. Power	Demand
(1) 115 vac, 60 cps, single phase	To be determined
(2) 28 vdc	To be determined

b. Gaseous Media

(1) Hydrogen at 3800 psig minimum.
(2) Nitrogen at 3800 psig minimum.
(3) Helium at 3800 psig minimum.

S-IVB PNEUMATIC GROUND SUPPORT EQUIPMENT

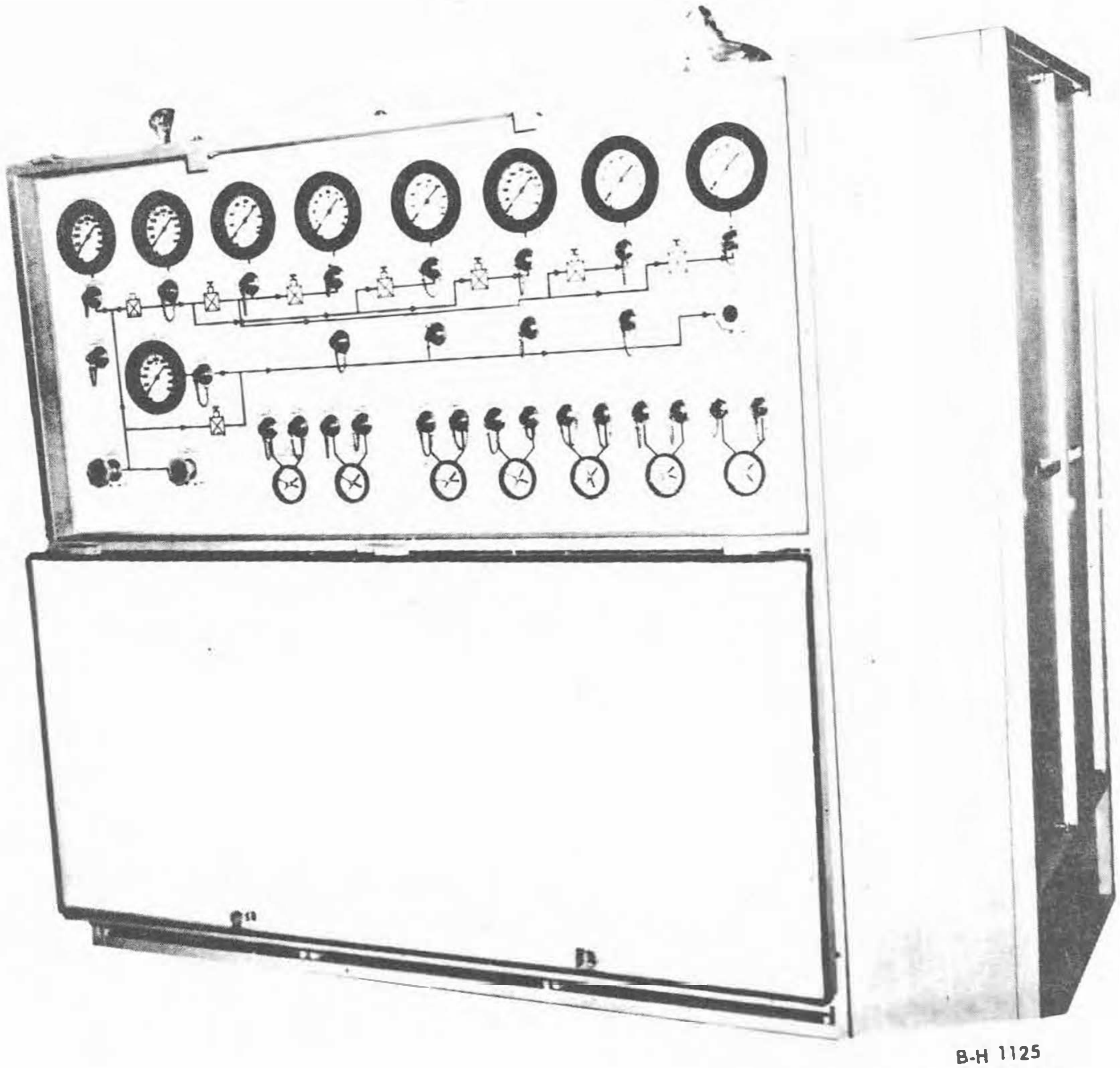


Figure 3-28. S-IVB Pneumatic Console "A" (DSV-4B-432&-432A)

S-IVB PNEUMATIC CONSOLE "A" (DSV-4B-432 & 432A)

1. Functional Description

a. The S-IVB Pneumatic Console "A" is required to receive gaseous helium and nitrogen and to regulate and control the distribution of these gases to meet stage propulsion system requirements for leak and functional checkout, propellant loading, propulsion system purging (required during countdown operations), and propellant unloading operations.

b. The console regulates and controls stage peculiar pneumatic servicing functions and checkout requirements during prelaunch operations. An electrical system is provided in the console to permit remote control of the solenoid valves and pressure regulators and to permit remote indications of valve positions and system pressure and temperature. In addition, the console receives GN_2 at 750 psig and a flow rate of 45 pounds per minute from pneumatic console "B" and provides this gas for umbilical GN_2 purge at 750 psig and a flow rate of 1.5 pounds per minute. Also, it receives helium at 6,000 psig from a facility storage source and regulates and controls the distribution of the gas for the following:

(1) Helium supply to the cold gas generator at 3,100 plus or minus 100 psig at flow rates of 10 and 40 pounds per minute.

(2) LH_2 tank pre-pressurization helium supply at 3,100 plus or minus 100 psig at a flow rate of 5 pounds per minute.

(3) APS bottle supply at 3,100 plus or minus 100 psig at a flow rate of 1 pound per minute.

(4) High pressure switch checkout at 1,600 to 3,000 psig.

(5) Low pressure switch checkout at 100 to 600 psig.

(6) Engine high pressure checkout at 700 psig.

(7) LH_2 tank umbilical helium purge supply at 50 psig at a flow rate of 1.5 pounds per minute.

(8) LH_2 tank fill nozzle helium purge supply at 50 psig at a flow rate of 0.016 pounds per minute.

(9) Helium supply to pneumatic console "B" at 50 psig at a flow rate of 1 pound per minute.

(10) LOX pressure actuation valve and "Mainstage OK" pressure switch checkout at 750 psig.

(11) LH_2 and LOX system checkout supply at 20 to 50 psig.

(12) Engine low pressure checkout at 20 to 50 psig.

(13) LH_2 debris valve open and close at 750 psig.

(14) Helium supply to H-X Purge Supply at 50 psig.

2. Facility Requirements

Power	Demand
28 vdc	25 Amp, maximum

3. General

a. Weight, pounds (Approximate)	1,600
b. Location in ML (Tower)	240 foot level
c. Dimensions, inches (approximate)	
(1) Length	72
(2) Width	35
(3) Height	72
d. Inlet pressures, psig	
(1) Helium	6,000
(2) Nitrogen	750
	50
e. Regulated output pressures (psig)	
(1) Helium	0 to 3,100
(2) Nitrogen	0 to 750

S-IV B PNEUMATIC GROUND SUPPORT EQUIPMENT

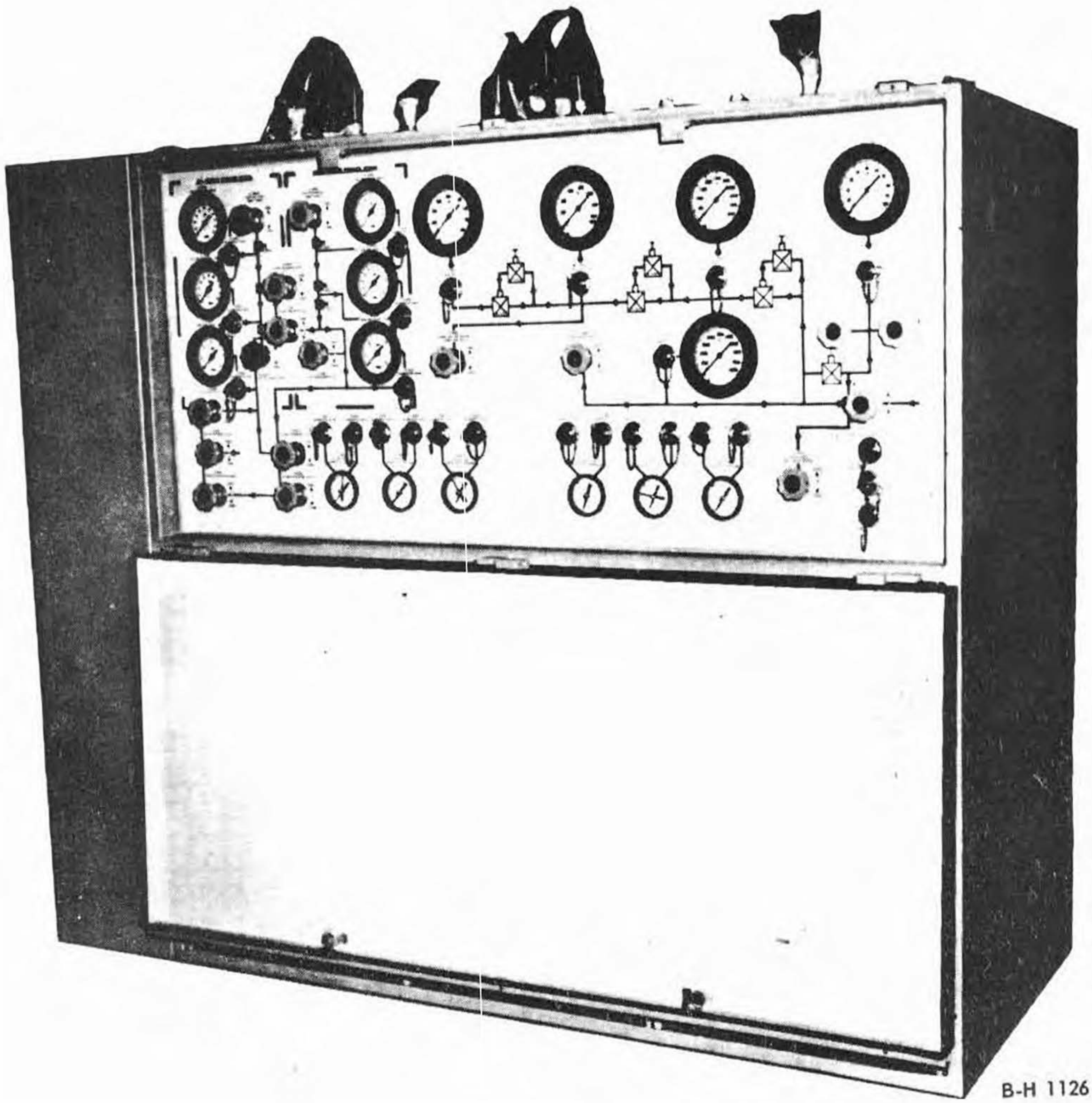


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Figure 3-29. S-IVB Pneumatic Console "B" (DSV-4B-433& -433A)

S-IVB PNEUMATIC CONSOLE "B" (DSV-4B-433&-433A)

1. Functional Description

a. The S-IVB Pneumatic Console "B" is required to receive ambient GN_2, ambient and cold helium, and regulate and control the distribution of the gases to meet the propulsion system requirements for leak and functional checkouts, propellant loading, propulsion system purging (required during countdown operations), and propellant unloading operations.

b. The console regulates and controls stage peculiar pneumatic servicing functions and checkout requirements during prelaunch operations. An electrical system is provided in the console to permit remote control of the solenoid valves and pressure regulators and to permit remote indications of valve positions and system pressure and temperature. In addition, the console receives ambient helium at 50 psig for thrust chamber jacket purge at 50 psig. It also receives GN_2 at 6,000 psig from a facility storage source and regulates and controls the distribution of this gas for the following:

(1) Pneumatic console "A" inerting purge supply at 50 psig.

(2) Valve operating supply to pneumatic console "A" at 750 psig.

(3) Aft and forward electrical umbilical ejector supply at 750 psig.

(4) LOX tank and umbilical purge supply at 50 psig at a flow rate of 1.5 pounds per minute.

(5) Pneumatic valve control pressure to the cold gas heat exchanger at 750 psig.

(6) LOX debris valve open and close at 750 psig.

(7) Console pneumatic valve actuation at 750 psig.

c. In addition, the console receives cold helium at 3,000 psig from the gas heat exchanger and provides this gas for the following:

(1) Thrust chamber jacket purge and chilldown supply at 750 psig at a flow rate of 10 pounds per minute.

(2) Engine control bottle pressure supply at 3,000 psig at a flow rate of 10 pounds per minute.

(3) LOX tank pressurization bottle supply at 3,000 psig at a flow rate of 20 pounds per minute.

2. Facility Requirements

Power	Demand
28 VDC	25 Amp, maximum

3. General

a. Weight, pounds (Approximate)	1,800
b. Location in ML (Tower)	240 foot level
c. Dimensions, inches (Approximate)	
(1) Length	86
(2) Width	35
(3) Height	72
d. Input pressures, psig	
(1) Ambient helium	50
	6,000
(2) Cold helium (-410°F)	3,000
(3) Nitrogen	6,000
e. Regulated output pressures, psig	
(1) Ambient helium	5
	50
(2) Cold helium (-410°F)	750
	3,000
(3) Nitrogen	5
	50
	500
	750

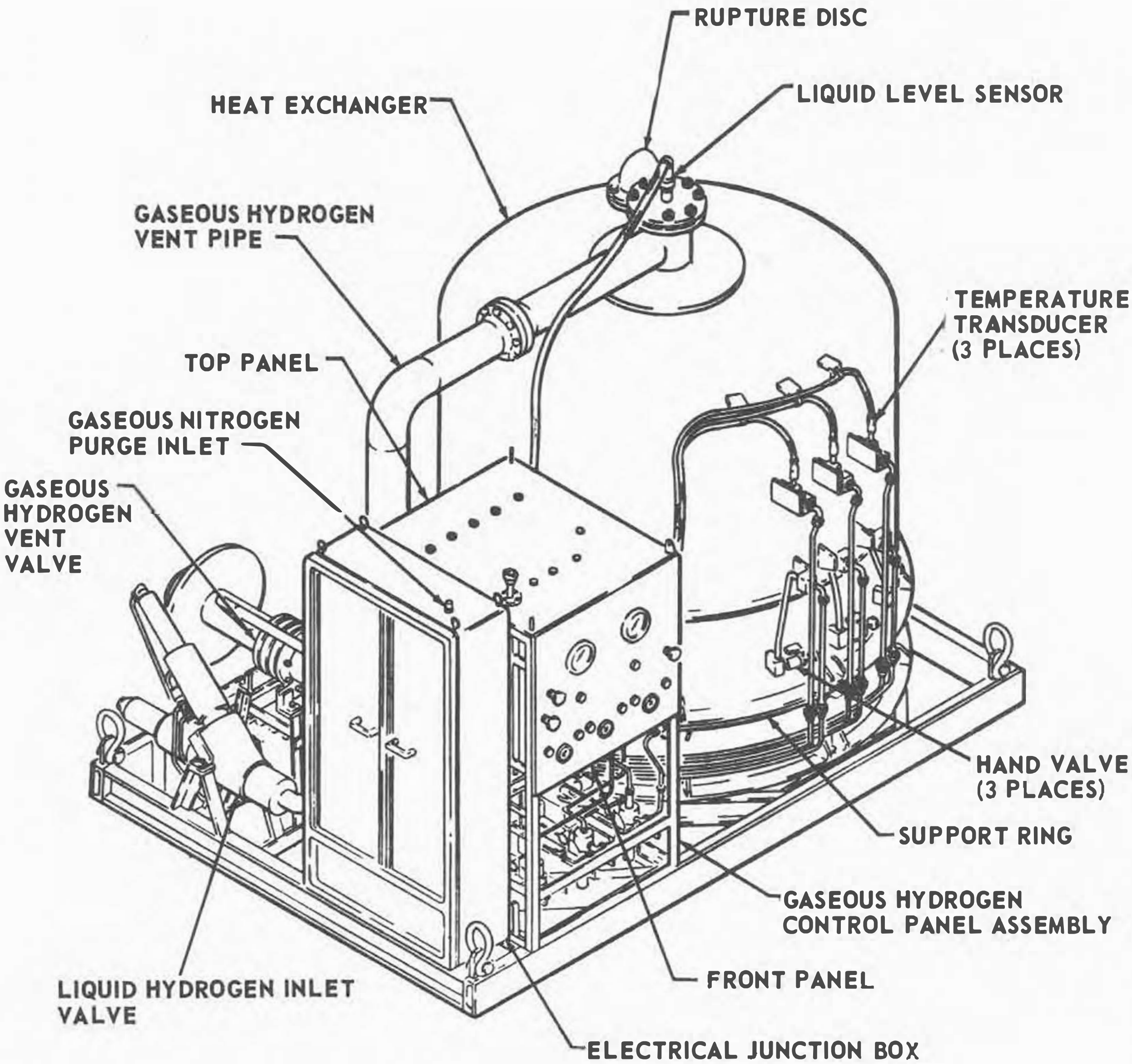


Figure 3-30. S-IVB Gas Heat Exchanger (DSV-4B-438)

S-IVB GAS HEAT EXCHANGER (DSV-4B-438)

1. Functional Description

a. The S-IVB Gas Heat Exchanger is required to perform the following:

(1) Receive GH_2 at 6,000 psig and regulate to 1,500 psig for turbine start bottle supply.

(2) Provide cold hydrogen gas at 1,500 psig for engine turbine start bottle pressurization.

(3) Receives ambient helium at 3,100 plus or minus 100 psig from pneumatic console "A".

(4) Provide cold helium to pneumatic console "B" for thrust chamber jacket chilldown, engine control bottle pressurization, LOX tank prepressurization, and LOX tank helium bottles pressurization.

(5) Provide cold helium for fuel tank prepressurization.

(6) Receives ambient helium at 50 psig from pneumatic console "A".

b. The gas heat exchanger consists of a high pressure system (heat exchanger) and a gaseous hydrogen control panel assembly. The heat exchanger uses LH_2 as the cooling medium, and contains multiple circuits to supply cold helium or hydrogen at the required temperatures and pressures for launch operations. The control panel assembly contains the necessary valves, filters, regulators, indicators, and necessary piping for internal and external connections. The components are mounted on racks and distribute gaseous hydrogen and helium to the heat exchanger and the stage during servicing operations.

c. The LH_2 is supplied through vacuum jacketed piping. A GH_2 vent and high pressure connections for helium and hydrogen circuits are included. Temperature and valve position indicators from the gas heat exchanger are monitored at the control area through a remote monitoring system.

d. An electrical system is also included, mounted adjacent to the control panel assembly. The system permits remote control of the solenoid operated valves and provides remote indications of valve positions, pressures, and temperatures.

2. Facility Requirements

Power	Demand
28 VDC	5 Amp

3. General

a.	Weight, pounds (Approximate)	5,680
b.	Location in ML (Tower)	240 foot level
c.	Dimensions, inches (Approximate)	
	(1) Length	132
	(2) Width	90
	(3) Height	108

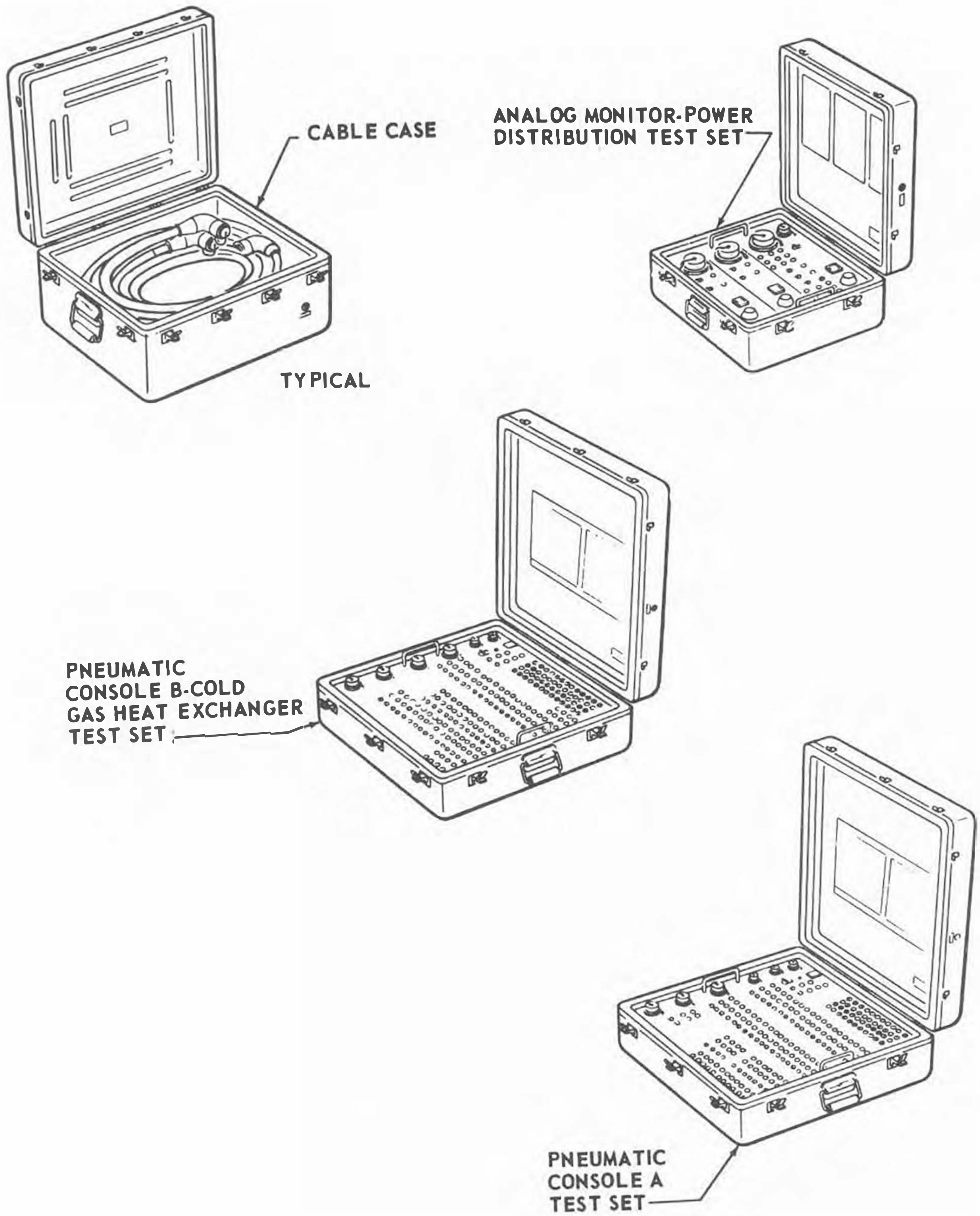


Figure 3-31. S-IVB Pneumatic Console Test Set (DSV-4B-286 & 286A)

S-IVB PNEUMATIC CONSOLE TEST SET (DSV-4B-286& -286A)

1. Functional Description

The S-IVB Pneumatic Console Test Set is composed of components packaged in portable "suitcases". The DSV-4B-286 is used to test the electrical components of the S-IVB pneumatic consoles DSV-4B-432 and -433 and Gas Heat Exchanger DSV-4B-438. The DSV-4B-286A is used to test consoles DSV-4B-432A and 433A and Gas Heat Exchanger DSV-4B-438A. Each complete Test Set (DSV-4B-286 or DSV-4B-286A) is composed of an Analog Monitor Test Set, a Console A Test Set, a Console B Test Set, and four cable cases.

2. General

a. Analog Monitor Test Set

Weight	40 pounds
Height	12 inches
Width	22 inches
Depth	21 inches
Operating Voltage	28 VDC, 10 Amp max.

b. Console A Test Set

Weight	67 pounds
Height	12 inches
Width	28 inches
Depth	28 inches
Operating Voltage	28 VDC, 25 Amp max.

c. Console B - Heat Exchanger Test Set

Weight	72 pounds
Height	12 inches
Width	28 inches
Depth	28 inches
Operating Voltage	28 VDC, 25 Amp max.

d. Cable Case (Typical)

Weight	90 pounds
Height	12 inches
Width	26 inches
Depth	24 inches

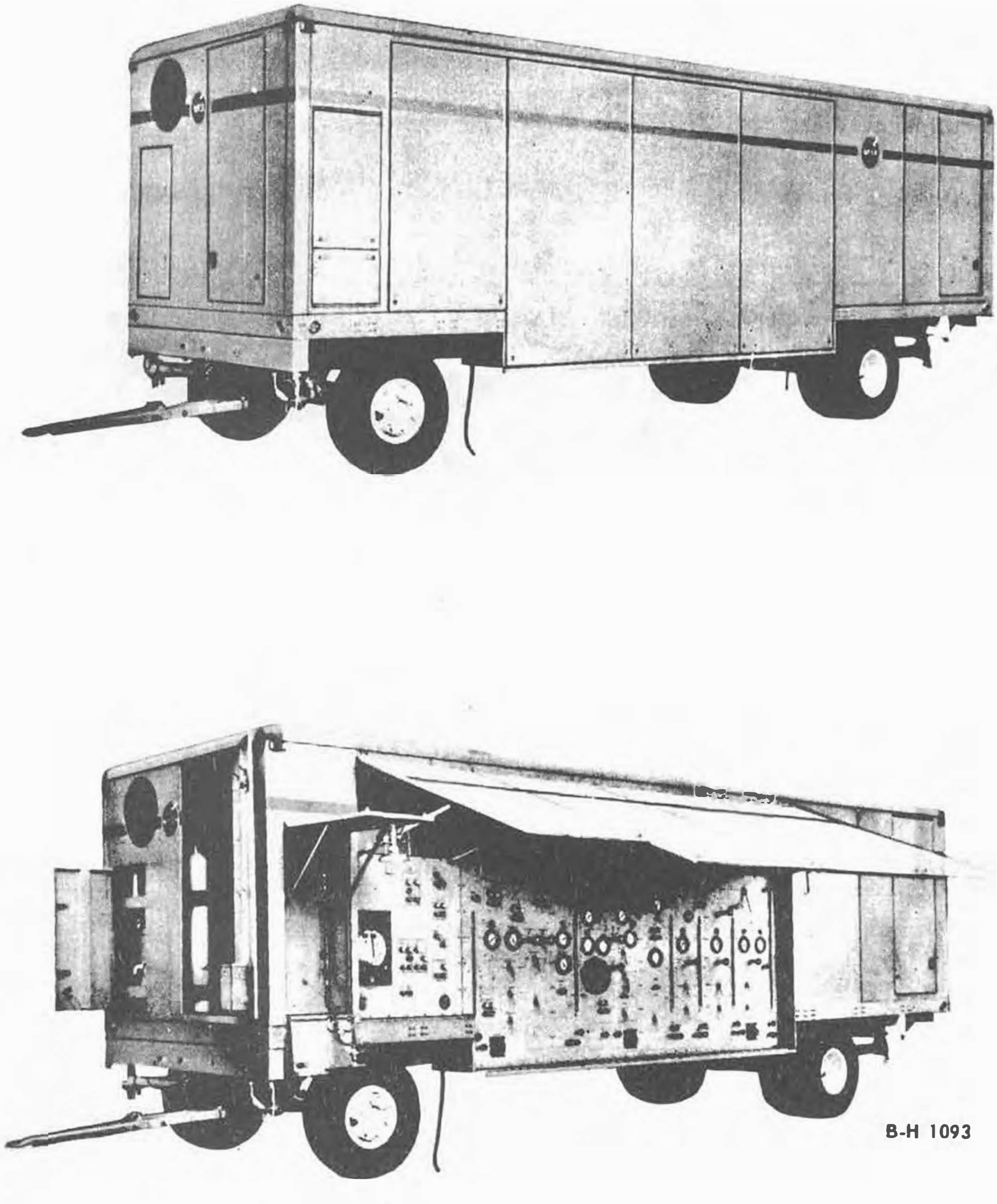


Figure 3-32. S-IVB APS Propellant Servicing Unit (GS6500-1 & -2)
(Sheet 1 of 2)

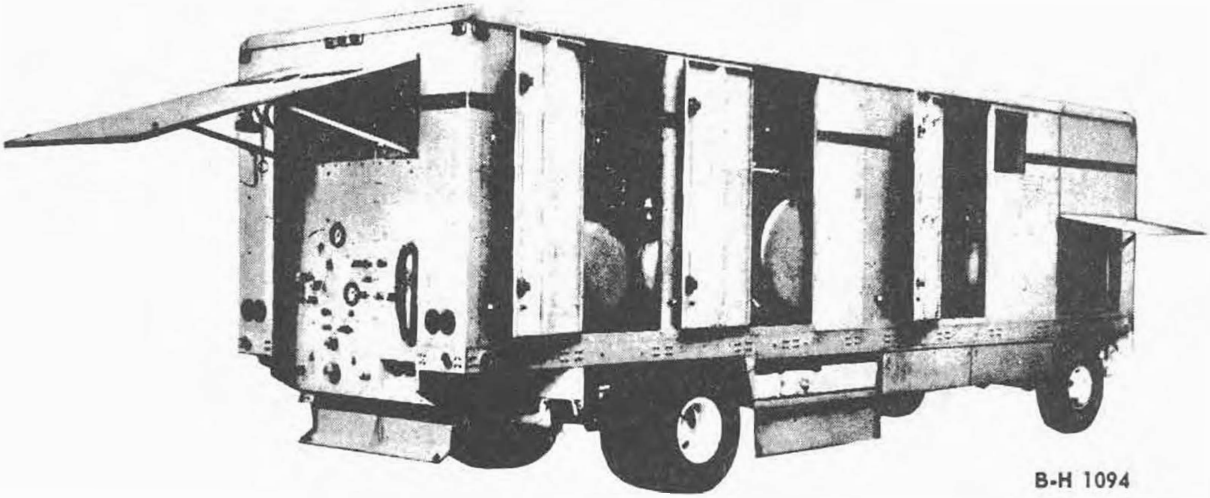


Figure 3-32. S-IVB APS Propellant Servicing Unit (GS6500-1 &-2)
(Sheet 2 of 2)

S-IVB APS PROPELLANT SERVICING UNIT (GS6500-1 & -2)

1. Functional Description

a. The S-IVB APS (Auxiliary Propulsion System) Propellant Servicing Unit is composed of two distinct mobile servicers, an oxidizer mobile servicer (GS6500-2) and a fuel mobile servicer (GS6500-1). Except for identification, the design of the fuel mobile servicer is identical to the oxidizer mobile servicer.

b. The servicing unit is required for loading, unloading, purging, and flushing the propellant tanks in the S-IVB stage auxiliary propulsion system.

c. The oxidizer mobile servicer is a storage and transfer system capable of transporting nitrogen tetroxide (oxidizer) from the facility storage area and transferring the oxidizer to the stage APS modules. The transfer of nitrogen tetroxide uses a closed loop system capable of venting purged gases before and after transfer operations. In the event of electrical or pneumatic failure, all valves assume a safe or normal position. All pneumatically operated valves and pressure indicators are capable of local or remote manual sequencing and monitoring.

d. The fuel mobile servicer is a propellant storage and transfer system capable of transporting the APS fuel (monomethyl hydrazine - MMH) from the facility storage area and transferring the fuel to the stage APS modules. The description and operation of the fuel mobile servicer and the oxidizer mobile servicer are similar.

e. The mobile servicers are designed to receive facility GN_2 and to regulate and distribute it to meet system requirements. The GN_2 system is designed to prevent contamination of the GN_2 supply by toxic vapors or propellants. All purged gases from propellant transfer operations are collected and disposed of by a venting system. The servicers will carry a limited supply of GN_2 to maintain a blanket pressure within the tanks during transit from the facility storage area or at any other time when they are not receiving or transferring oxidizer or propellant.

2. Facility Requirements

a. Power — Demand
480 vac, 60 cps, 3 phase — To be determined
12 vac — (For transit purposes)

b. Treating Water
60 gpm, 125 psig, 50° to 80° F

c. Gaseous Nitrogen (GN_2)
3,000 psig, 100 scfm, ambient temperature

3. General

a. Weight, pounds (Approximate)
One servicer (dry) — 22,000

b. Reservoir
(1) Supply Tanks
(a) One 200 gal., 300 psig operating pressure.
(b) Three 120 gal., 300 psig operating pressure.

(2) Drain Tanks
(a) One 200 gal., 50 psig operating pressure
(b) One 400 gal., 50 psig operating pressure

(3) GN_2 Storage Bottles
Two, 1.5 cubic foot, 2,200 psig maximum pressure

(4) Fluids

Fluids	Specific Gravity
(a) Oxidixer - Nitrogen Tetroxide (N_2O_4)	1.45
(b) Fuel - Monomethylhydrazine (MMH)	0.875

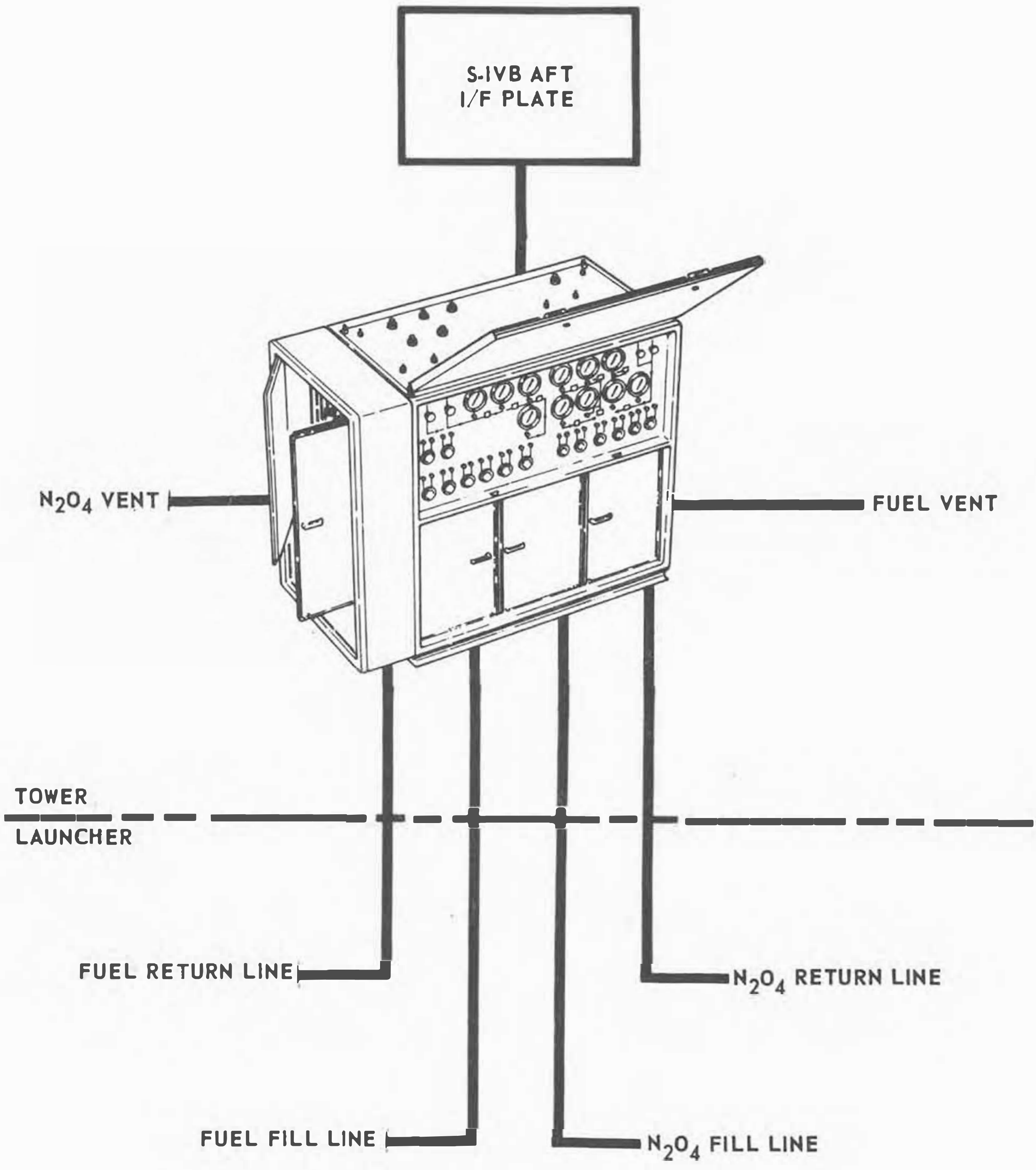
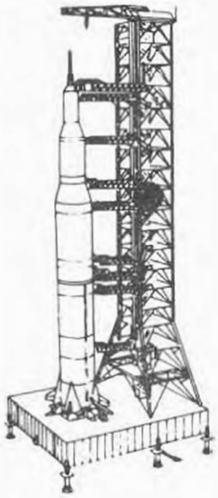
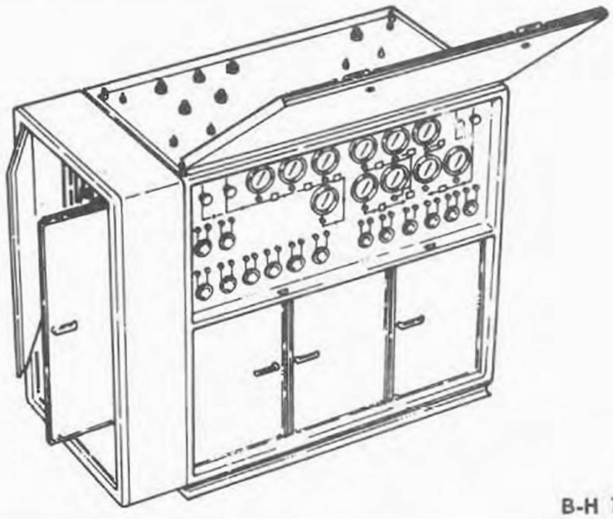


Figure 3-33. S-IVB APS Pneumatic Console (DSV-4B-436A) (Sheet 1 of 2)





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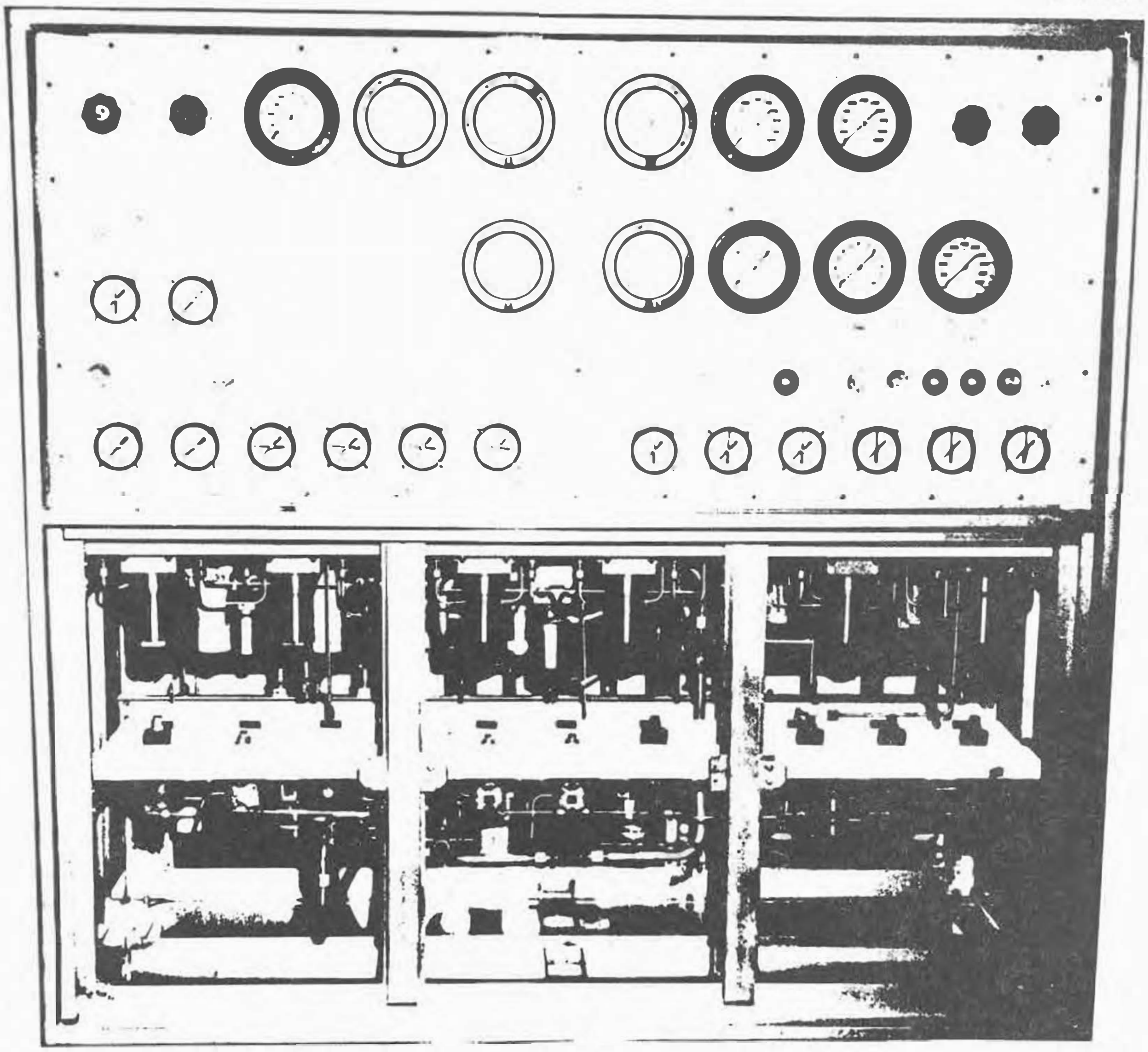


Figure 3-33. S-IVB APS Pneumatic Console (DSV-4B-436A) (Sheet 2 of 2)

S-IVB APS PNEUMATIC CONSOLE (DSV-4B-436A)

1. Functional Description

The S-IVB APS Pneumatic Console is required for regulating and distributing gaseous helium and nitrogen to the S-IVB APS modules during checkout and loading operations.

Additional data will be furnished at a later date.

2. Facility Requirements

a. Power	Demand
(1) 120 vac, 60 cps, single phase	To be determined
(2) 120 vac, 400 cps, single phase	To be determined
(3) 28 vdc	To be determined
(4) 5 vdc	To be determined

b. Gaseous Media
   (1) Nitrogen at 6,000 psig, 30 scfm
   (2) Helium at 6,000 psig, 30 scfm

3. General

a. Weight, pounds (Approximate)	1,000
b. Location in ML (Tower)	220 foot level

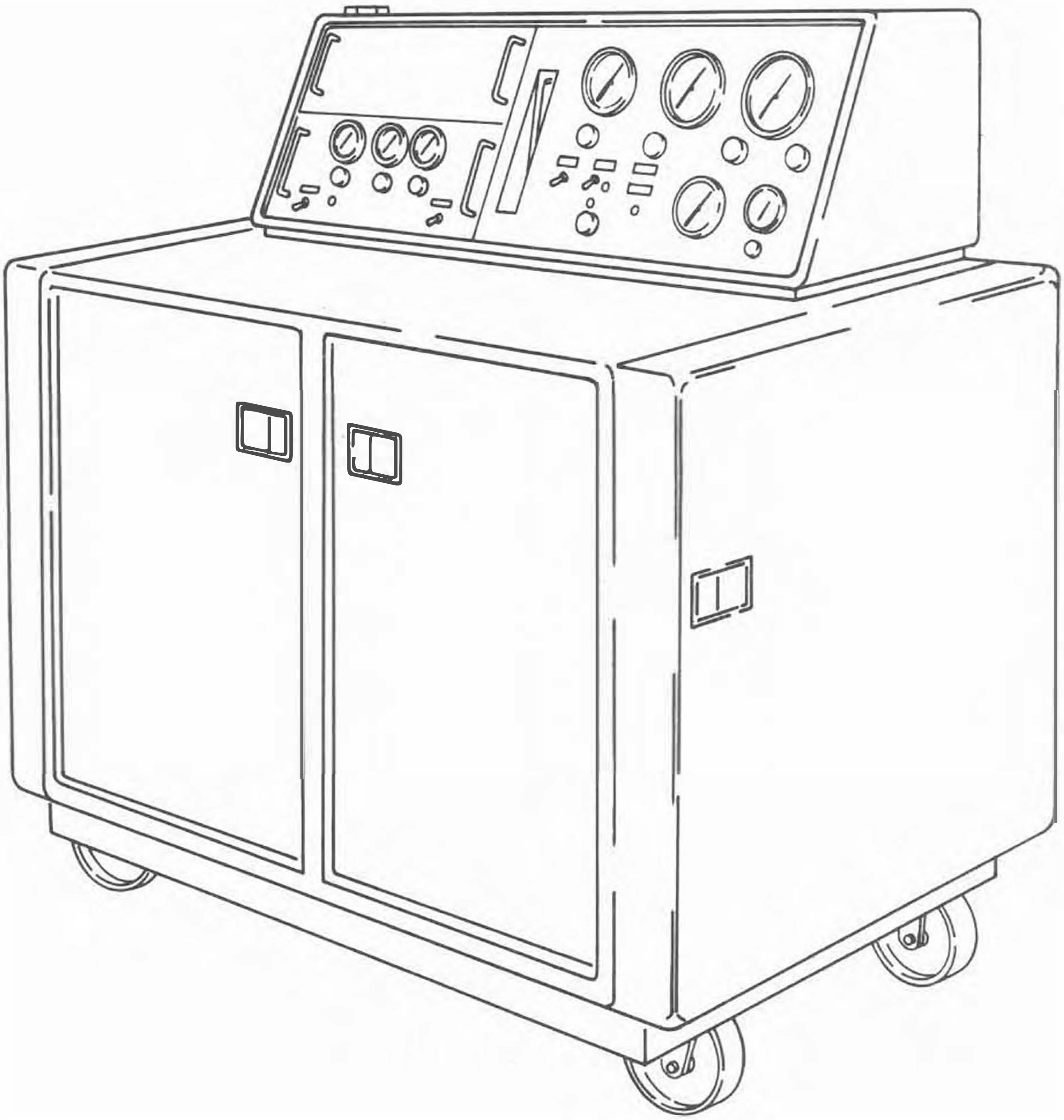


Figure 3-34. S-IVB Hydraulic Pumping Unit (DSV-4B-358)

S-IVB HYDRAULIC PUMPING UNIT (DSV-4B-358)

1. Functional Description

The S-IVB Hydraulic Pumping Unit is required to supply hydraulic fluid to the stage engine hydraulic system for filling, flushing, cleaning, leak checking, air purging, and functional checking of subsystem components. It supplies hydraulic fluid at 3, 500 psig and at approximately 1. 4 gpm to the flight control hydraulic system. The unit consists of the following major subsystems.

a. Reservoir pressurization subsystem: The reservoir is pressurized with filtered gaseous nitrogen (GN_2) from a nitrogen storage bottle through a pressure regulator, check valve, and filter. A relief valve prevents overpressurization of the reservoir. Gages permit reservoir and bottle pressures to be monitored.

b. Recirculation and filtration subsystem: An electrically driven, fixed displacement, gear type pump rated at 1. 4 gpm at 175 psig circulates oil from the reservoir sump through a filter and back to the reservoir.

c. Hydraulic oil subsystem: An electrically driven, pressure compensated, variable displacement pump rated at 1. 4 gpm at 3, 500 psig supplies hydraulic fluid to the stage hydraulic system through a filter. Supply pressures may be monitored by high and low pressure gages. Return fluid is filtered and passes through a heat exchanger into the reservoir. System temperature is monitored by a temperature gage and limited by a thermal cut-off switch. A return bypass system with a flowmeter is provided to measure system leakage rates.

2. Facility Requirements

To be determined.

3. General

a.	Weight, pounds (Approximate)	1, 700
b.	Dimensions, inches (Approximate)	72 x 65 x 35
c.	Reservoir capacity	17 gallons

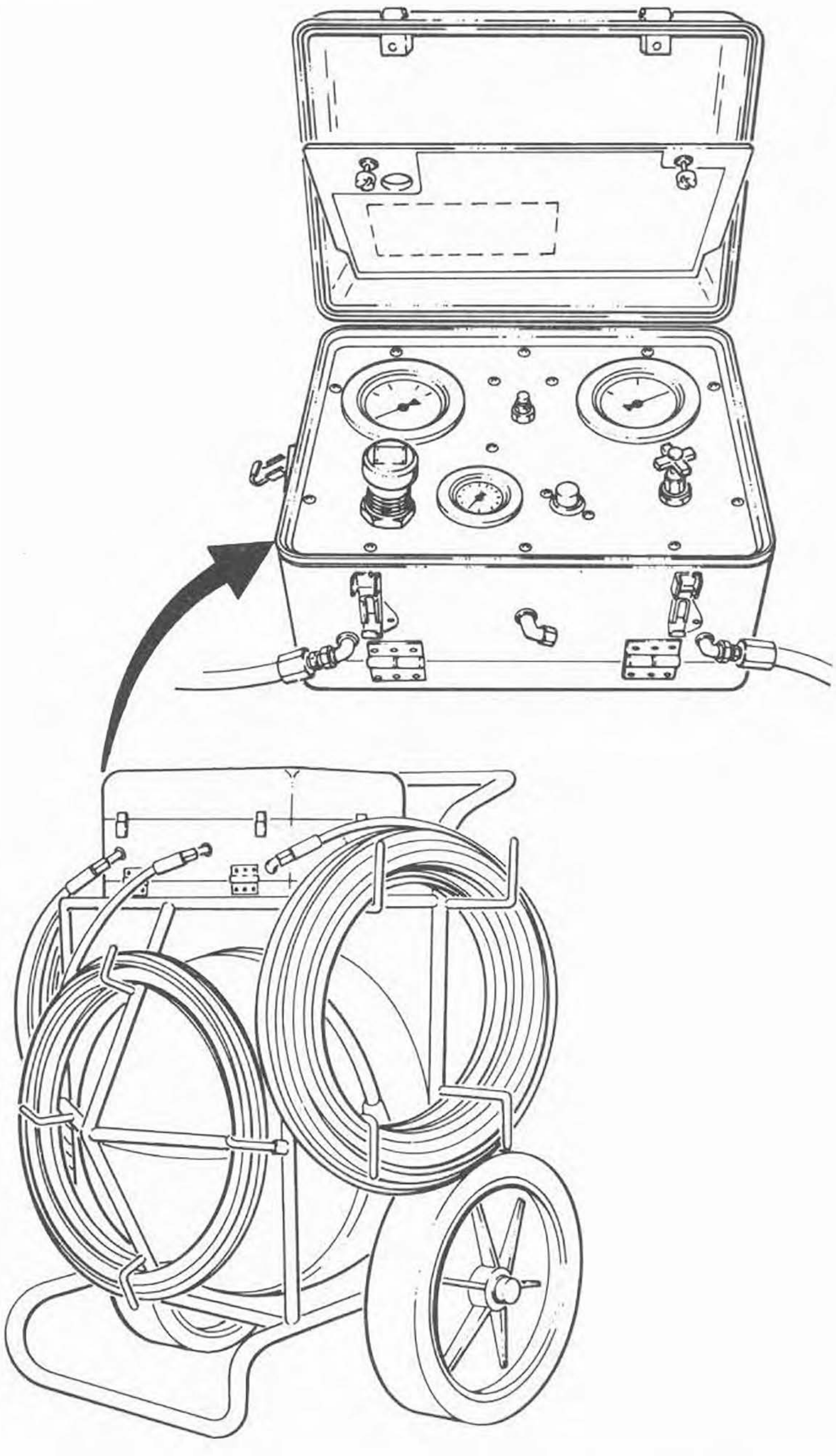


Figure 3-35. Nitrogen Fill Truck (DSV4-186)

NITROGEN FILL TRUCK (DSV4-186)

1 Functional Description

a. The Nitrogen Fill Truck is required to pressurize the pneumatic side of the stage hydraulic accumulator. The fill truck is also used to purge the airborne electronic equipment containers.

b. The truck is designed to virtually eliminate backflow possibilities which might contaminate the purge nitrogen and, subsequently, the fuel tanks. The truck is capable of pressurizing the pneumatic side of the accumulator. The air bottle is charged with nitrogen to 3,000 psig. The truck is capable of providing a 15 psig and a 5 psig nitrogen supply sufficient for purging the airborne electronic equipment containers. The fill truck is also capable of filling the hydraulic servicer GN_2 bottle.

c. The fill truck consists of the following major components: an air bottle (2,570 cubic inches); air fill valve; 5,000 psi gage; low pressure gage; check valve; needle valves; 5 psi relief valve; air valves suitable for adapting to the air fill valve on the accumulator, electronic equipment containers, and the hydraulic servicer; high pressure flexible hose; medium pressure flexible hose; pressure regulators; an equipment container; and a hand truck, similar to a two-wheeled welding truck.

2. Facility Requirements

To be determined.

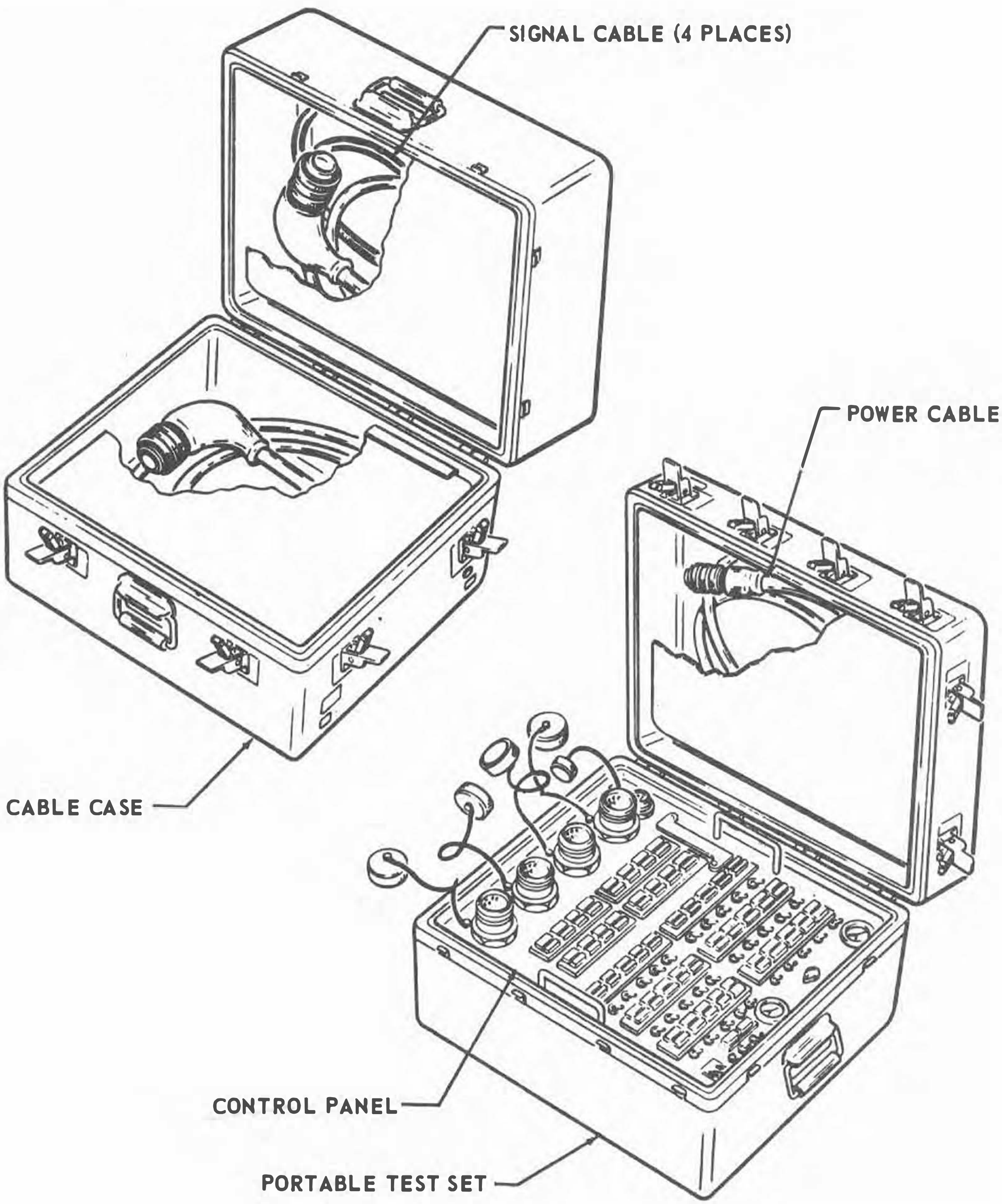


Figure 3-36. APS Pneumatic Console Portable Test Set (DSV-4B-186)

APS PNEUMATIC CONSOLE PORTABLE TEST SET (DSV-4B-186)

1. Functional Description

a. The APS Pneumatic Console Portable Test Set is used for functional checkout of Pneumatic Console DSV-4B -436. During functional checkout of the pneumatic console, the test set provides electrical control of pneumatic solenoid valves and displays the status of pressure switches and valves in the pneumatic console.

b. The test set consists of a portable test set and a cable case. The portable test set contains a control panel consisting of 4 signal cable receptacles, 1 power cable receptacle, 11 light assemblies, 31 signal toggle switches, 2 circuit breakers, 1 fuse, 1 power toggle switch, 2 meters, 1 rotary selector swtich, 2 variable resistors, and 2 low voltage test jacks. The variable resistors and low voltage test jacks are mounted under a removable calibration cover adjacent to the top bank of light assemblies and above the right handle. A power cable is stowed in the cover of the portable test set. The cable case contains 4 signal cables.

2. Facility Requirements

Power	Demand
28 VDC	10 Amp, maximum

3. General

a. Portable Test Set

(1) Weight, pounds (Approximate)	75
(2) Power cable length, feet	15
(3) Dimensions, inches (Approximate)	
Height	26
Width	21
Depth	11

b. Cable Case

(1) Weight, pounds (Approximate)	80
(2) Signal cable length, feet	10
(3) Dimensions, inches (Approximate)	
Height	21
Width	20
Depth	12

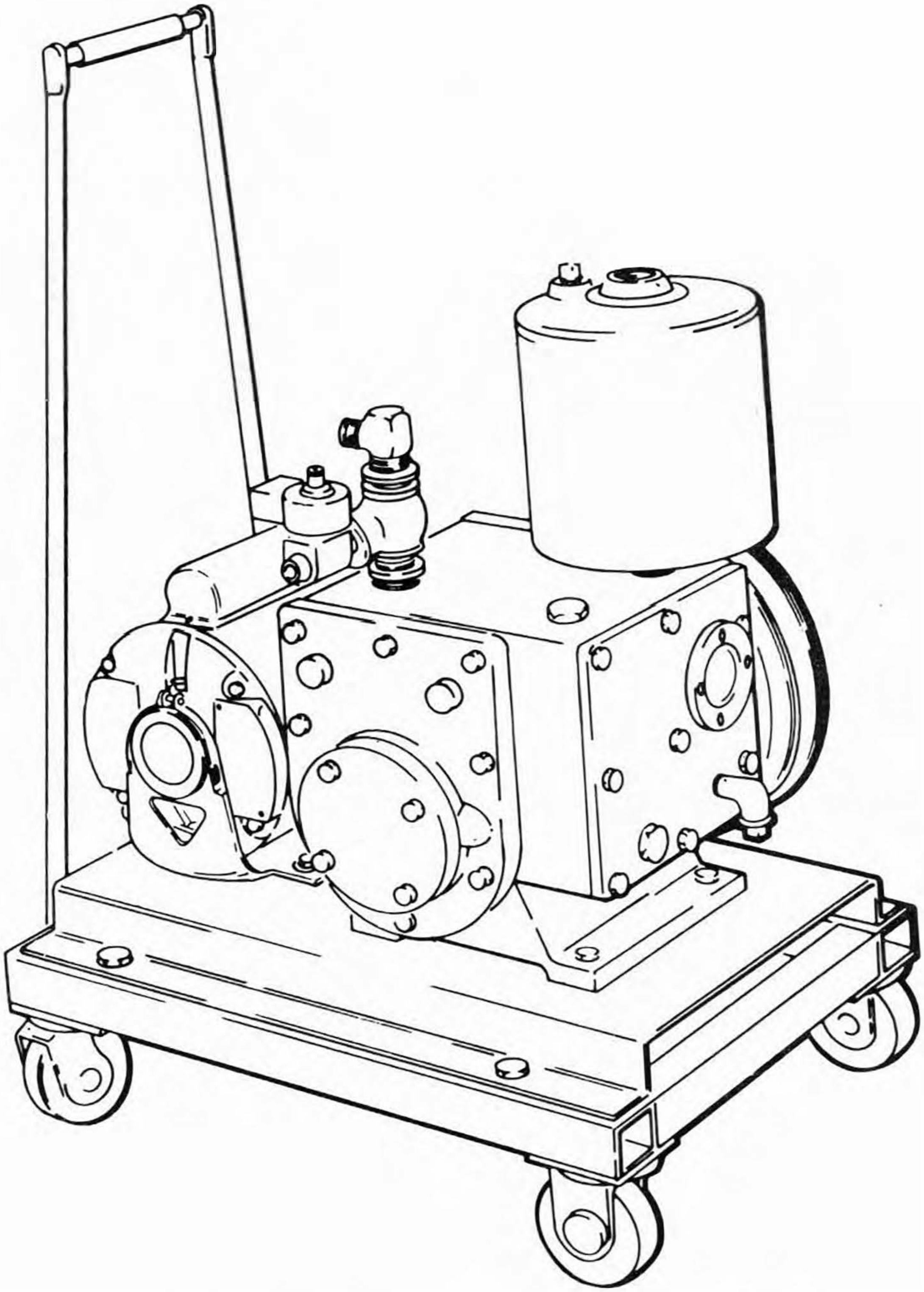


Figure 3-37. Vacuum Pumping Unit (DSV4-187)

VACUUM PUMPING UNIT (DSV4-187)

1. Functional Description

a. The Vacuum Pumping Unit is required to evacuate, to 10 microns of mercury, the individual vacuum jackets of the various stage and GSE components to the required values before countdown or when a vacuum jacket has reached its specified maximum allowable vacuum reading. The unit is also capable of evacuating its own capped suction hose and of maintaining within the hose an absolute pressure of five microns of mercury for at least one hour.

b. The pumping unit is an electrically operated mechanical pump, mounted on wheels for mobility. The unit uses low-vapor-pressure oil as a lubricant and sealing fluid, and has a separate tank to recover the oil from the discharge gas. A safety guard is provided on the drive belt, and a manually operated switch is provided for the electric drive motor. A ten foot flexible hose, included as part of the unit, is attached to the inlet port of a solenoid operated valve which is normally closed when the unit is not operating. The unit consists of a pump, a flexible hose assembly, an oil recovery tank, and a portable support assembly.

2. Facility Requirements

To be determined.

3. General

a.	Weight, pounds (Approximate)	150
b.	Dimensions, inches (Approximate)	30 x 26 x 18

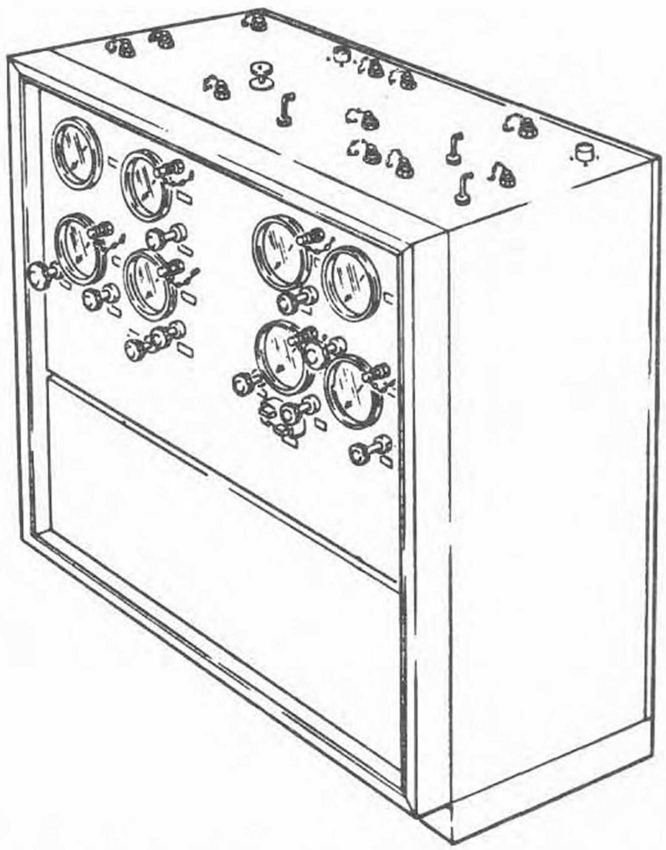


Figure 3-38. Battleship Pneumatic Console "A" (DSV-4B-327)

BATTLESHIP PNEUMATIC CONSOLE "A" (DSV-4B-327)

1. Functional Description

a. The Battleship Pneumatic Console "A" is required to provide ambient GN_2 and helium at the proper pressures to meet the battleship tank propulsion system requirements during checkout and countdown at SACTO test stand Beta 1.

b. The console is designed to receive, regulate, and control ambient GN_2 and helium and to supply the gases, as required, to the battleship tank during checkout and countdown operations. The console is purged with GN_2 under positive pressure to maintain an inert atmosphere within the cabinet. All bleed valve outlets are routed to bulkhead fittings on the console for overboard disposal. Components are provided within the console to reduce, monitor, and control the GN_2 and helium pressures supplied to the battleship tank. All valves required to operate during a countdown are designed to be manually controlled and electrically actuated from the test control center. All critical pressures are sensed by pressure transducers and monitored by the pneumatic system control panel. Where pressure regulation is critical for a successful countdown, increasing or decreasing of pressure is controlled from the test control center, as required. All propellant tank loading, unloading, and purging operations are accomplished by actuation of valves controlled from the test control center. In the event of electrical or pneumatic failure during countdown, all remotely controlled valves assume a safe or normal position. GN_2 is used in place of helium for certain checkout and purging operations. The console is capable of manual operation during checkout and manual/remote operation during countdown. The console is also designed to supply ambient helium to the gas heat exchanger.

2. Facility Requirements

To be determined.

3. General

a.	Weight, pounds (Approximate)	900
b.	Dimensions, inches (Approximate)	72 x 60 x 36

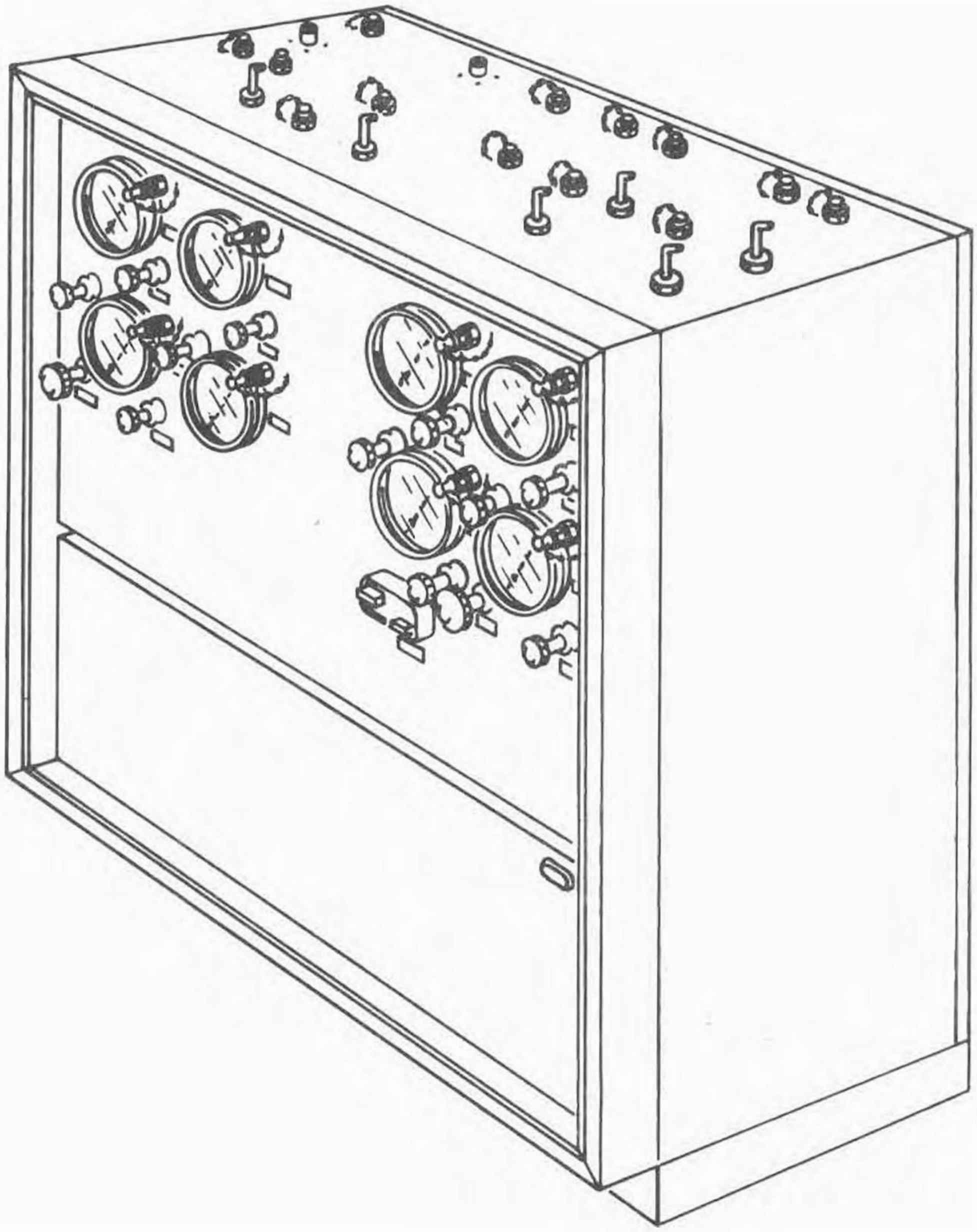


Figure 3-39. Battleship Pneumatic Console "B" (DSV-4B-333)

BATTLESHIP PNEUMATIC CONSOLE "B" (DSV-4B-333)

1. Functional Description

a. The Battleship Pneumatic Console "B" is required to provide ambient GN_2, ambient helium, and cold helium at the proper pressures to meet the Battleship tank propulsion system requirements during checkout and countdown at SACTO Test Stand Beta 1.

b. The console is designed to receive and control ambient and cold helium, and to receive, regulate, and control ambient GN_2. The console is also capable of supplying the gases, as required, to the Battleship tank during checkout and countdown operations. The console is purged with GN_2 under positive pressure to maintain an inert atmosphere within the cabinet. All bleed valve outlets are routed to bulkhead fittings on the console for overboard disposal. Components are provided within the console to reduce, monitor, and control the GN_2 and helium pressures supplied to the Battleship tank. All valves required to operate during a countdown are designed to be manually controlled and electrically actuated from the test control center. All critical pressures are sensed by pressur transducers and monitored by the pneumatic system control panel. Where pressure regulation is critical for a successful countdown, increasing or decreasing of pressure is controlled from the test control center. In the event of electrical or pneumatic failure during countdown, all remotely controlled valves assume a safe or normal position. The Battleship LH_2 tank prepressurization valves are closed by an electrical signal from the LH_2 tank pressure switch. Four monitor systems are connected to the Battleship tank during checkout for monitoring Battleship tank pressures. The console is capable of manual operation during checkout and manual/remote operation during countdown.

2. Facility Requirements

To be determined.

3. General

a.	Weight, pounds (Approximate)	850
b.	Dimensions, inches (Approximate)	72 x 60 x 36

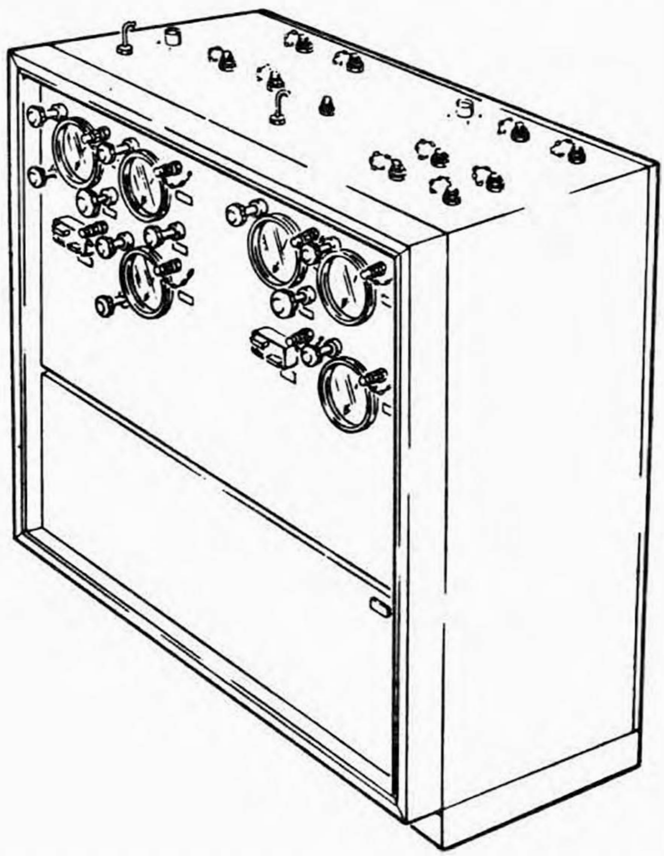


Figure 3-40. Battleship Pneumatic Console "C" (DSV-4B-328)

BATTLESHIP PNEUMATIC CONSOLE "C" (DSV-4B-328)

1. Functional Description

a. The Battleship Pneumatic Console "C" is required to provide ambient and cold GH_2 and helium at the proper pressures to meet the Battleship tank propulsion system requirements during checkout and countdown at SACTO test stand Beta 1.

b. The console is designed to receive, regulate, and control ambient and cold GH_2 and helium, and to supply these, as required, to the Battleship tank during checkout and countdown operations. The console is also capable of receiving GN_2 for pneumatic valve actuation pressure within the console. The console is purged with GN_2 under positive pressure to maintain an inert atmosphere within the cabinet. All GH_2 bleed and vent valve outlets are routed to bulkhead fittings on the console and, in turn, connected to the hydrogen vent and disposal system. All other bleed valve outlets are routed to bulkhead fittings on the console for overboard disposal. Components are provided within the console to reduce, monitor, and control ambient and cold GH_2 and helium pressures supplied to the Battleship tank. All valves required to operate during a countdown are designed to be manually controlled and electrically actuated from the test control center. All critical pressures are sensed by pressure transducers and monitored by the pneumatic system control panel. Where pressure regulation is critical for a successful countdown, increasing or decreasing of pressure is controlled from the test control center as required. All propellant tank loading, unloading, and purging operations are accomplished from the test control center. In the event of electrical or pneumatic failure during countdown, all remotely controlled valves assume a safe or normal position.

2. Facility Requirements

To be determined.

3. General

a.	Weight, pounds (Approximate)	900
b.	Dimensions, inches (Approximate)	72 x 60 x 36

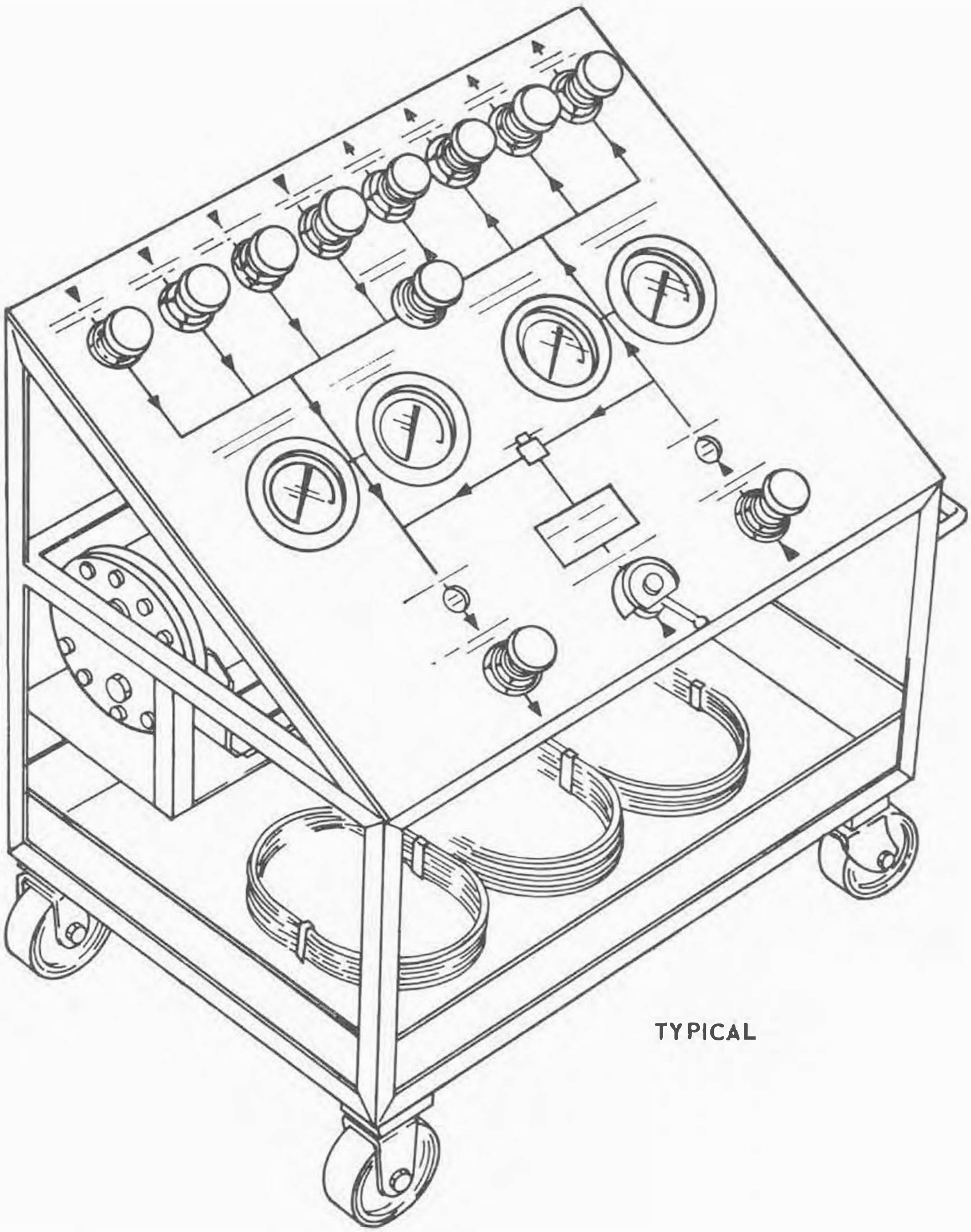


Figure 3-41. Propellant Transfer and Interconnect Kit (DSV-4B-472 & -473)

PROPELLANT TRANSFER AND INTERCONNECT KIT (DSV-4B-472 & -473)

1. Functional Description

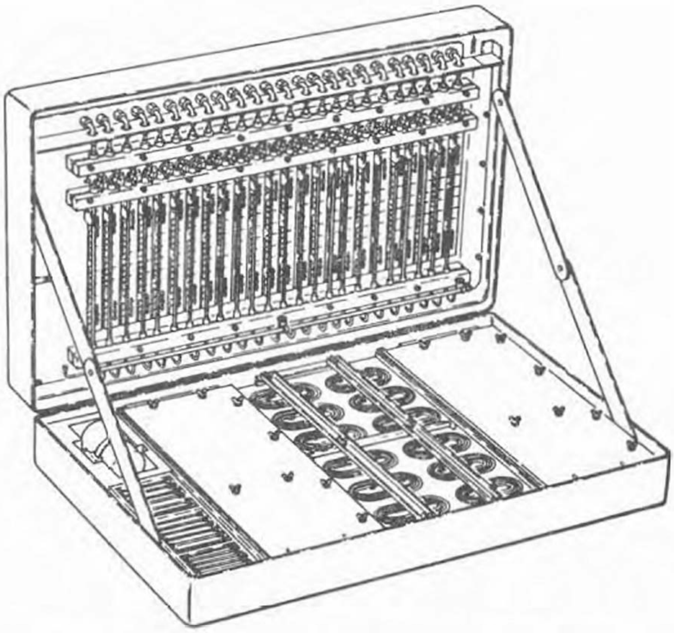
a. The Propellant Transfer and Interconnect Kit is composed of the Fuel Transfer and Interconnect Module (DSV-4B-472) and the Oxidizer Transfer and Interconnect Module (DSV-4B-473). The modules are similar in design and construction, but differing in the propellant media which each handles. The DSV-4B-472 handles monomethylhydrazine (MMH) fuel, while the DSV-4B-473 handles nitrogen tetroxide (N_2O_4) oxidizer, and the two modules are used concurrently.

b. Each Propellant Transfer and Interconnect module consists of nine (9) flexible interconnect hoses and a control panel. The hoses provide connections between the facility propellant and control gas interfaces, the propellant control panel and/or the APS modules. The control panel is portable and provides the capability for manual (local) control of the transfer and recirculation of the propellant to both APS modules and to control the propellant bladder ullage in each APS module. Also packaged with the control panel are the necessary valves, gages, tubing, fixtures, and connections required to accomplish the propellant loading functions.

2. Facility Requirements - None

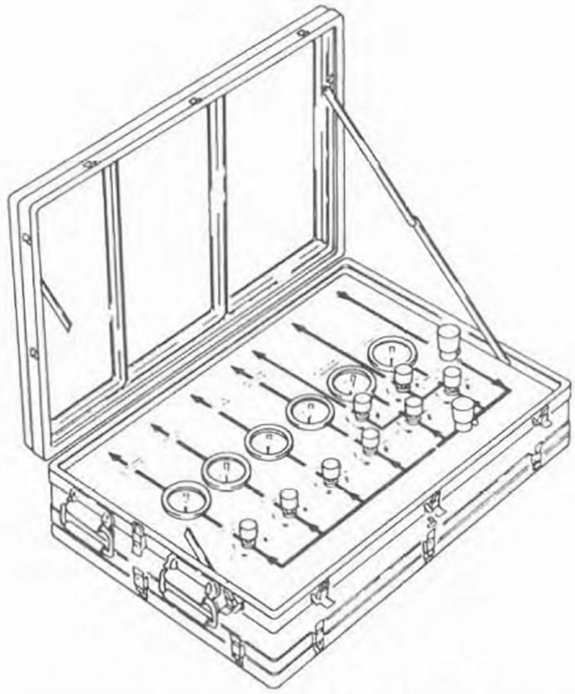
3. General

a.	Weight per module, pounds (Approximate)	250
b.	Dimensions, inches (Approximate)	54 x 48 x 30



CHECKOUT ACCESSORIES CASE ASSEMBLY

Hose Case Assy. not shown
(To be added when available)



PRESSURE DECAY CASE ASSEMBLY

Figure 3-42. APS Checkout Accessories Kit (DSV-4B-493A)

APS CHECKOUT ACCESSORIES KIT (DSV-4B-493A)

1. Functional Description

a. The APS Checkout Accessories Kit consists of three portable case assemblies containing all components necessary for performing the S-IVB/V stage APS Unit fluid displacement leak test and the pressure decay leak test. The three aluminum case assemblies are described in the following paragraphs.

b. Checkout Accessories Case Assembly. This case contains all components necessary for the fluid displacement leak test, and consists of calibrated fluid displacement tubes, plastic tube assemblies, engine closure fixtures, conoseal leak isolation port adapters, umbilical connection adapters, and miscellaneous fittings.

c. Pressure Decay Case Assembly. This case contains all the components (except for engine closure fixtures and metal hose assemblies) required for the pressure decay leak test. The engine closure fixtures provided for the fluid displacement leak test shall also be used for the pressure decay leak test. The metal hose assemblies are provided in a separate case assembly. The Pressure Decay Case Assembly's components consist of filters, pressure gages, hand valves, regulators, tubing, and fittings.

d. Hose Case Assembly. This case contains the metal hose assemblies required to accomplish the pressure decay leak test, and is used in conjunction with the Pressure Decay Case Assembly.

2. Facility Requirements

a. Electrical Power - None	
b. Gaseous Nitrogen (GN_2)	750 psig source for pressure decay test

3. General

a. Checkout Accessories Case Assembly	
(1) Weight, pounds (Approximate)	150
(2) Dimensions, inches (Approximate)	29 x 47 x 10
(3) Part Number	1B64445
b. Pressure Decay Case Assembly	
(1) Weight, pounds (Approximate)	75

(2)	Dimensions, inches (Approximate)	24 x 35 x 10
(3)	Part Number	1B64280

c. Hose Case Assembly

(1)	Weight	To be determined
(2)	Dimensions	To be determined
(3)	Part Number	1B64970

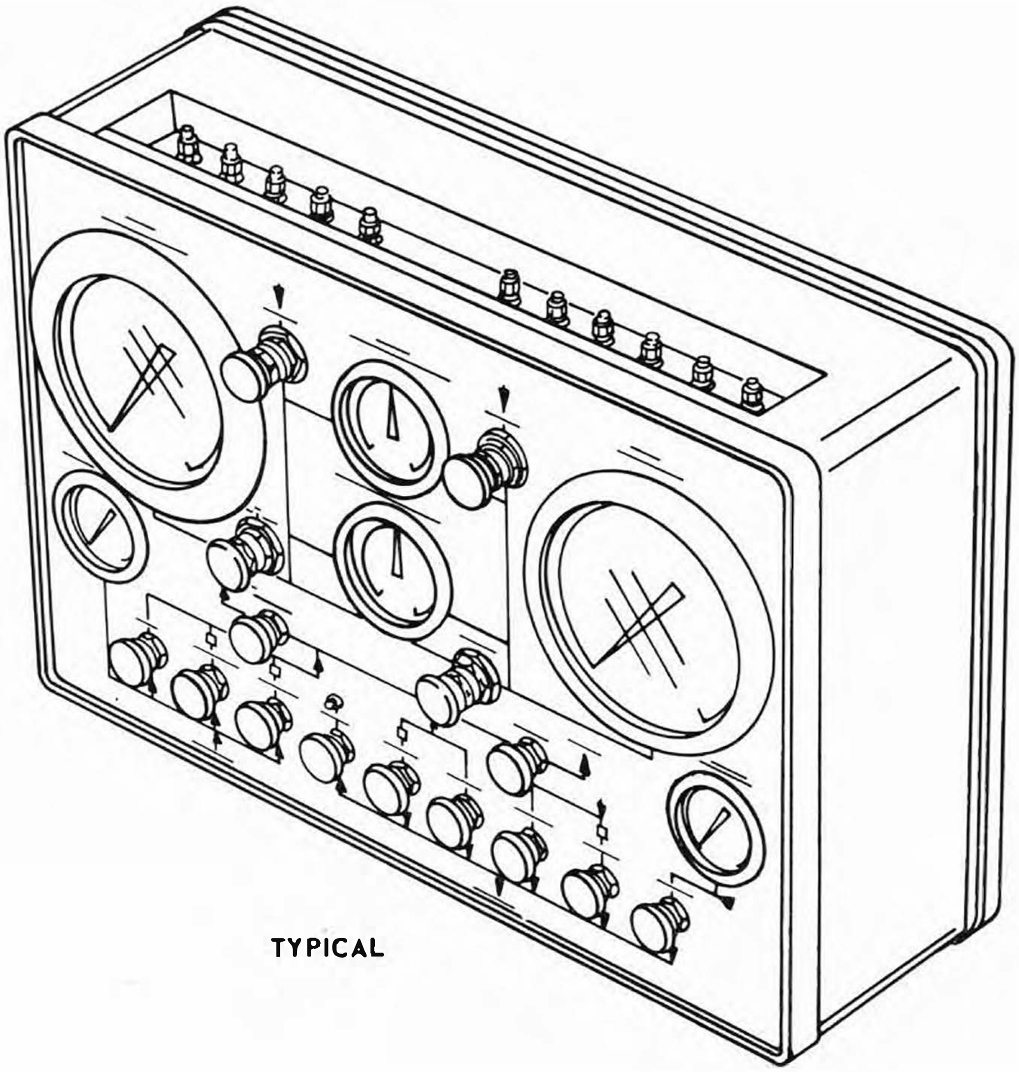


Figure 3-43. APS Instrumentation and Checkout Kit (DSV-4B-1874 & 1875)

APS INSTRUMENTATION AND CHECKOUT KITS (DSV-4B-1874 & -1875)

1. Functional Description

a. This equipment consists of an APS Fuel Instrumentation and Checkout module (DSV-4B-1874), which handles monomethylhydrazine (MMH) fuel; and an APS Oxidizer Instrumentation and Checkout module (DSV-4B-1875), which handles nitrogen tetrozide (N_2O_4) oxidizer. Except for the respective propellant media which each of the two modules handles, they are similar in design and construction.

b. Each module consists of the following components:

(1) A portable case contains the necessary hand valves, gages, associated tubing and fittings, and external interface connections to control and monitor the differential pressure across the propellant tank bladder during checkout and purge, or prior to loading. and to sample the ullage and propellant tank gases before loading.

(2) A set of flexible hoses is required for connections between the facility gas interfaces, these (-1874 and -1875) modules, and/or the APS modules, as follows:

(a) One (1) each Propellant Sensing
(b) One (1) each Flush Vent
(c) One (1) each Ullage Sensing
(d) One (1) each Recirculation
(e) One (1) each Fill
(f) One (1) each Pressurization & Vent
(g) Two (2) each Fuel Bladder Pressurization & Vent (multiple use). This hose is used between (1) the swing arm interface and module, (2) swing arm interface and instrumentation kit, and (3) module and fuel control panel in the abort condition.
(h) Two (2) each Fuel Facility Lines Purge (multiple use). This hose is used between the swing arm interface and the instrumentation kit.

NOTE: The method of providing this set of hoses is to be determined, and will be described herein when available.

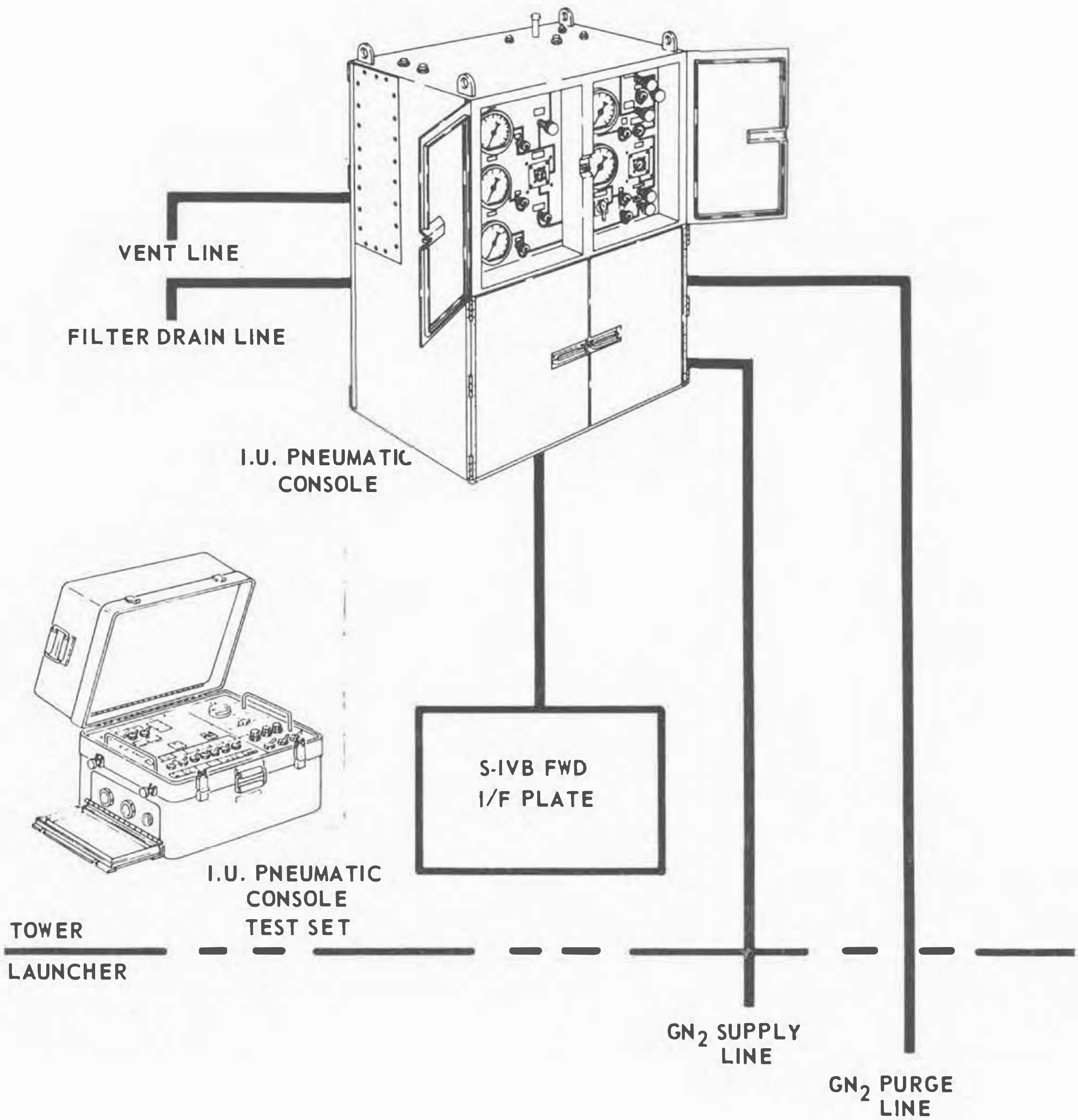


Figure 3-44. I. U. Pneumatic Ground Support Equipment

I. U. PNEUMATIC GROUND SUPPORT EQUIPMENT

1. Functional Description

The I. U. Pneumatic Ground Support Equipment is composed of the following basic and distinct units:

a. I. U. Pneumatic Console

b. I. U. Pneumatic Console Test Set

2. Facility Requirements

a. Power	Demand
(1) 28 vdc	To be determined
(2) 5 vdc	To be determined

b. Gaseous Nitrogen
6, 000 psig

I.U. PNEUMATIC GROUND SUPPORT EQUIPMENT

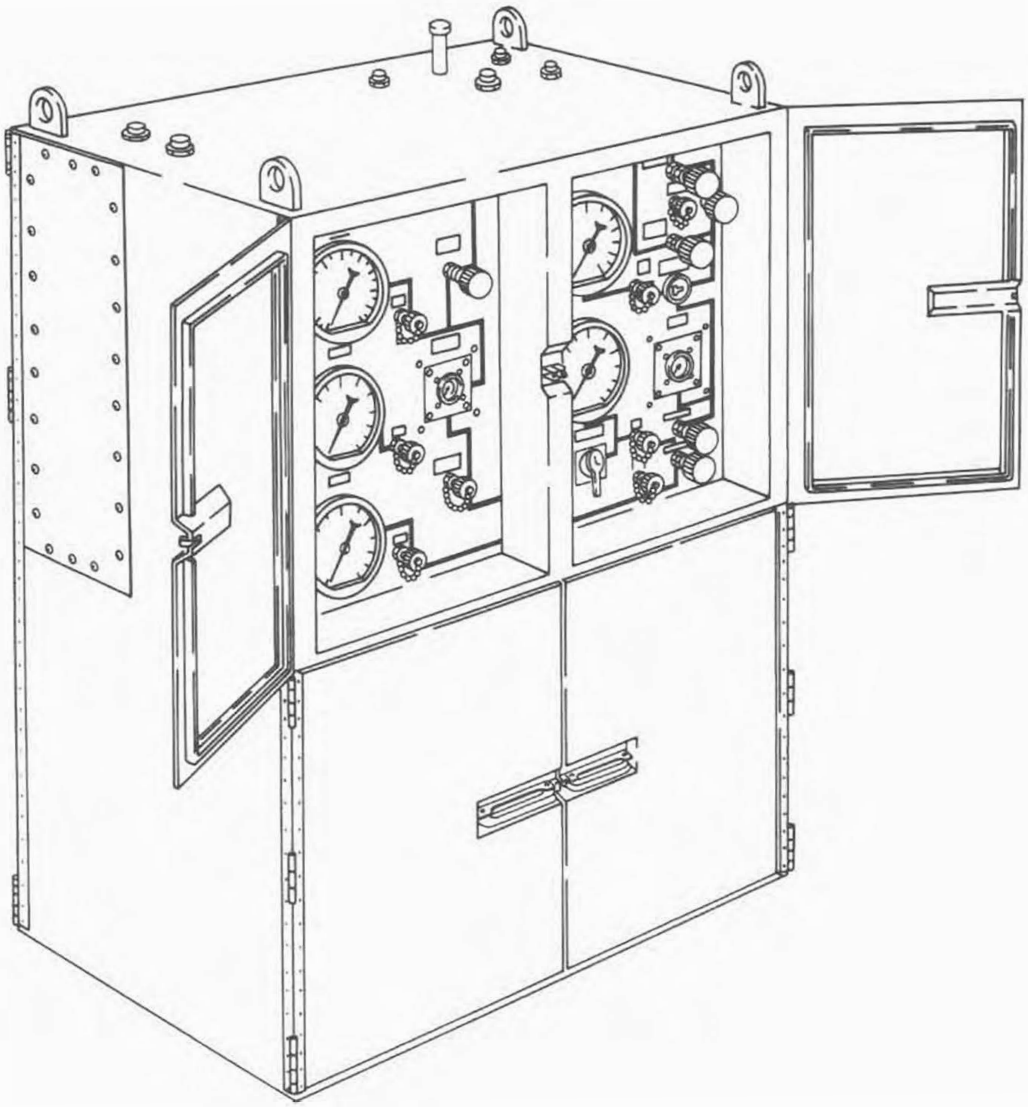


Figure 3-45. I. U. Pneumatic Console

I. U. PNEUMATIC CONSOLE

1. Functional Description

The I. U. Pneumatic Console is required to supply the conditioned gaseous nitrogen (GN_2) required to fill the air bearing spheres, and also provides the capability of checking the I. U. stage "calips" switches. Additional data will be furnished at a later date.

2. General

a.	Weight, pounds (Approximate)	1200 lbs.
b.	Location in ML (Tower)	280 foot level

I. U. PNEUMATIC GROUND SUPPORT EQUIPMENT

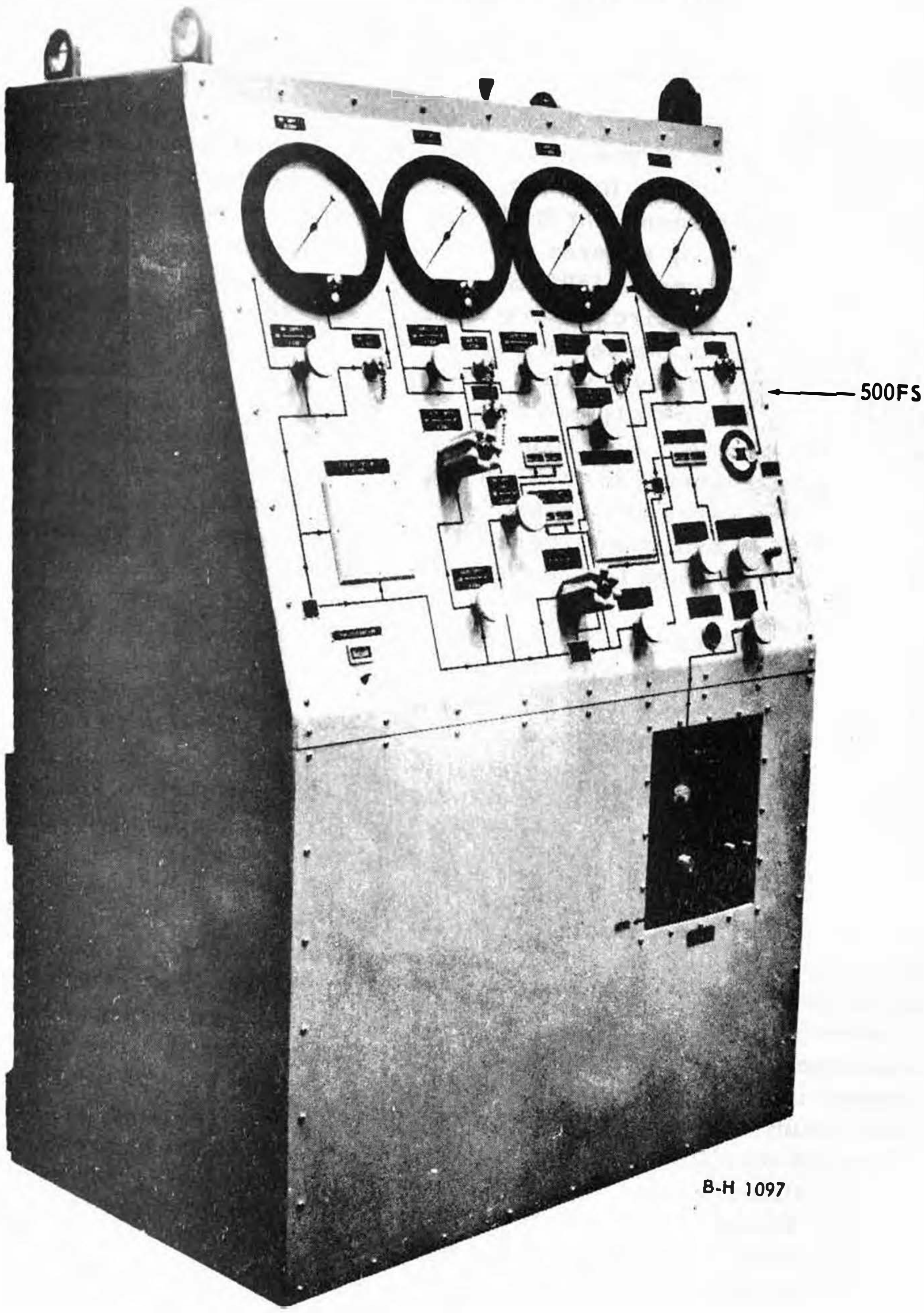


Figure 3-46. I. U. Pneumatic Console (500FS)

I.U. PNEUMATIC CONSOLE (500FS)

1. Functional Description

a. The I.U. Pneumatic Console (500FS) is a cabinet-type pneumatic valve panel consisting of pneumatic and electrical circuitry and components required to regulate, monitor, and control pneumatic pressures supplied to the instrument unit flight simulator to pressurize, check out, and test the air bearing spheres and related pneumatic and electro-mechanical circuitry. The console (500FS) provides two models of operations, local and remote. All circuits are controlled locally. In addition to local control components in the bearing spheres circuit, a solenoid valve is used, bypassing the manual valve, to provide remote on-off capability. Local control of all circuits is accomplished through use of manual valves located on the console. Local and remote monitoring of critical circuit pressures and component operational positions is attained by using direct-reading pressure gages and pressure switches for local observation, and pressure switches and transducers connected electrically to remotely located slaved indicators for remote observation.

b. The 500FS console operates in similar manner as the I.U. Pneumatic Console in the operational location. The principles of operation are identical, both functioning to provide controlled pneumatic pressure to the instrument unit. However, the I.U. Pneumatic Console is capable of remote operation while to 500FS console, with one exception, is controlled locally. The bearing spheres circuit may be actuated from a remote location, after the system has been locally adjusted for desired bearing spheres pressure.

c. Pneumatic and electrical circuits in the 500FS console are conventional types encountered in high pressure gas systems. Functionally, the pneumatic system may be divided into six systems or circuits: supply inlet, spheres pressure regulating, CALIPS pressure switch checkout, spheres supply, moisture analysis, and vent. Electrical circuitry and components used provide the capability for remote enable of the bearing spheres circuit and local and remote monitoring of circuit pressures. Local remote monitoring capability for circuit pressures is provided by pressure switches connected electrically to indicator lights and slaved indicators. Local and remote monitoring of the remote enable solenoid valve is provided by a position indicator switch which is a part of the component assembly.

(1) Supply inlet system: GN_2 at 3,500 psig is supplied by the facility GN_2 pneumatic source to the 500FS console. The GN_2 supply inlet line incorporates an inlet supply manual shutoff valve that isolates the 500FS console in the event of a malfunction requiring depressurization and repair, and at times when functions served by the console are not required. The supply inlet system also incorporates pressure monitoring and filtering systems. Local venting is provided through a manual valve, and system overpressurization is prevented by a relief valve set at approximately 3,600 psig.

(2) Spheres pressure regulating circuit: The spheres pressure regulating circuit consists of a dome loaded primary regulator, a manually operated reference pressure regulator, and pressure monitoring, relief, and venting capabilities. Pneumatic pressure leaving the inlet filter passes through the primary regulator where pressure is reduced to the required value for circuit application. Primary regulator dome pressure is controlled by a manually operated reference pressure regulator. Pre-pressure reference pressure is taken from the supply inlet at 3,500 psig, passed through the pre-pressure reference regulator, and applied to the primary regulator dome. Venting of the primary regulator dome circuit is provided through a manual valve. Venting of the spheres pressure regulating circuit is also provided through a manual valve. Circuit overpressurization is prevented by a relief valve set at approximately 3,450 psig.

(3) CALIPS pressure switch checkout circuit: The CALIPS checkout circuit functions to verify operational reliability of flight simulator calibration switches. These switches are used for remote monitoring and control of the bearing sphere pneumatic pressure and stabilized platform system. CALIPS checkout circuit control and monitoring components, with the exception of the high accuracy transducer and two pressure switches, are locally operated and monitored. The circuit receives 3,500 psig GN_2 from the inlet supply line downstream from the inlet filter. The circuit is actuated by a manual valve and GN_2 is supplied to the regulator where it is reduced to 3,300 psig for circuit application. Local monitoring is provided by a panel mounted pressure gage equipped with a pressure snubber for surge protection and a calibration valve for calibration tests. A high accuracy transducer monitors system pressure and transmits signals to a slaved indicator. Two pressure switches are used to determine control of the coarse feed manual valve leading to vent. A relief valve set at 3,400 psig prevents system overpressurization.

(4) Spheres supply circuit: The bearing spheres circuit is the most critical circuit of the 500FS console system. It incorporates additional filters and purifiers (molecular, sieve-type, desiccant chambers) to assure clean, dry GN_2 to the instrument unit flight simulator bearing spheres. The circuit is pressurized through the spheres supply manual valve. From the spheres supply valve, the media passes through a filter equipped with a hand valve and check valve for filter drain. From the filter, the media passed through three absorption-type desiccant chambers that further purify the GN_2 by removing water, oil, or foreign substance. Leaving the desiccant chambers, the GN_2 passes through an additional filter for additional filtration prior to leaving the 500FS console for flight simulator application. Leaving the final filter, the media passes through an orifice that prevents surging of downstream flight simulator and console components. A check valve prevents bearing spheres depressurization in the event of 500FS console malfunction, thereby assuring sufficient pressure for instrument unit gyros to be shut down, and to prevent back pressure from entering the desiccant chambers. The spheres fill circuit incorporates a monitoring system consisting of a pressure snubber, calibration valve, pressure gage, and pressure switch. The pressure switch is connected electrically to, and controls, a filter-dryer time indicator which functions to record total operating time since bearing spheres circuit filters and desiccant chambers were last changed. A two-position solenoid valve, installed normally closed to pressure, is provided prior to console exit to provide remote enabling capabilities for the flight simulator bearing spheres circuit. The solenoid valve is bypassed by a manual valve that is used for local bearing spheres pressurization. Immediately downstream of these components the spheres fill circuit is tapped, with one line leading through a manual valve to an external connector to provide for gas analysis equipment, and one line leading through a manual valve for moisture analysis circuit application. Spheres fill circuit is provided through a manual valve.

(5) Moisture analysis: The moisture analysis circuit functions to monitor moisture content of system media. The moisture analysis circuit consists of a manual valve, a manually adjusted regulator, and an electrolytic hygrometer. Pressure is supplied to the moisture analysis circuit through a manual valve and a manual regulator, where pressure is reduced to 100 psig, monitored by a gage, and passes into the hygrometer. The hygrometer incorporates visual monitoring of moisture content and an external relief to protect the circuit from overpressurization.

(6) Vent system: The 500FS console vent system consists of manual valves located at strategic points in each operable pneumatic system or circuit. Each vent line incorporates a check valve, located immediately downstream of the vent valves, to prevent back pressure from entering an operational circuit. Vent lines from each circuit are joined to a single vent line from the 500FS console.

2. Facility Requirements

To be determined

3. General

a. Weight, pounds (Approximate) 975 pounds

b. Dimensions, inches (Approximate) 76 x 48 x 30

I. U. PNEUMATIC GROUND SUPPORT EQUIPMENT

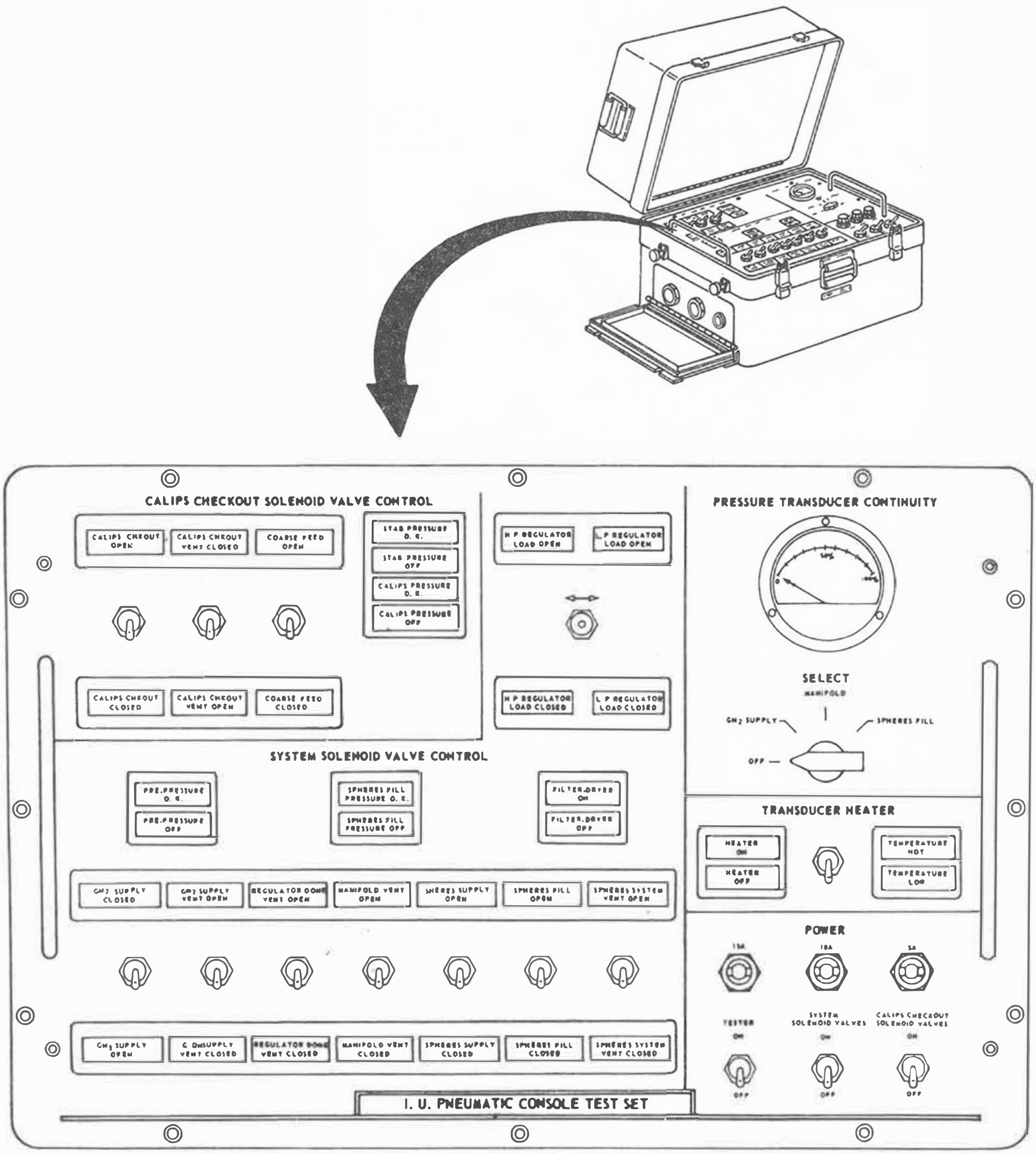


Figure 3-47. I. U. Pneumatic Console Test Set

I. U. PNEUMATIC CONSOLE TEST SET

1. Functional Description

The I. U. Pneumatic Console Test Set is comprised of components packaged in portable "suitcases". It is used to test the electrical components of the I. U. Pneumatic Console.

Additional data will be furnished at a later date.

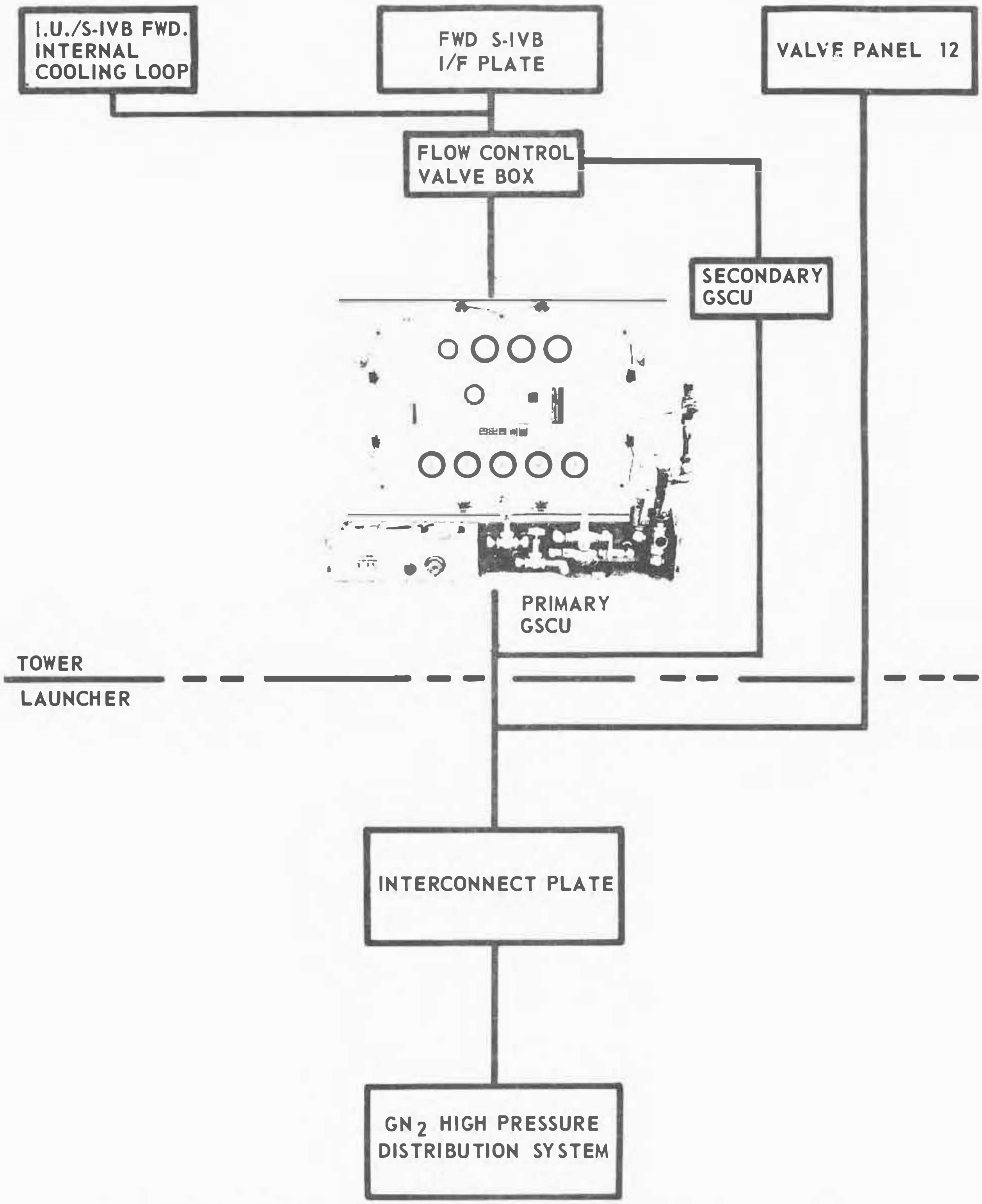


Figure 3-48. I. U. Ground Support Cooling Unit (Sheet 1 of 3)

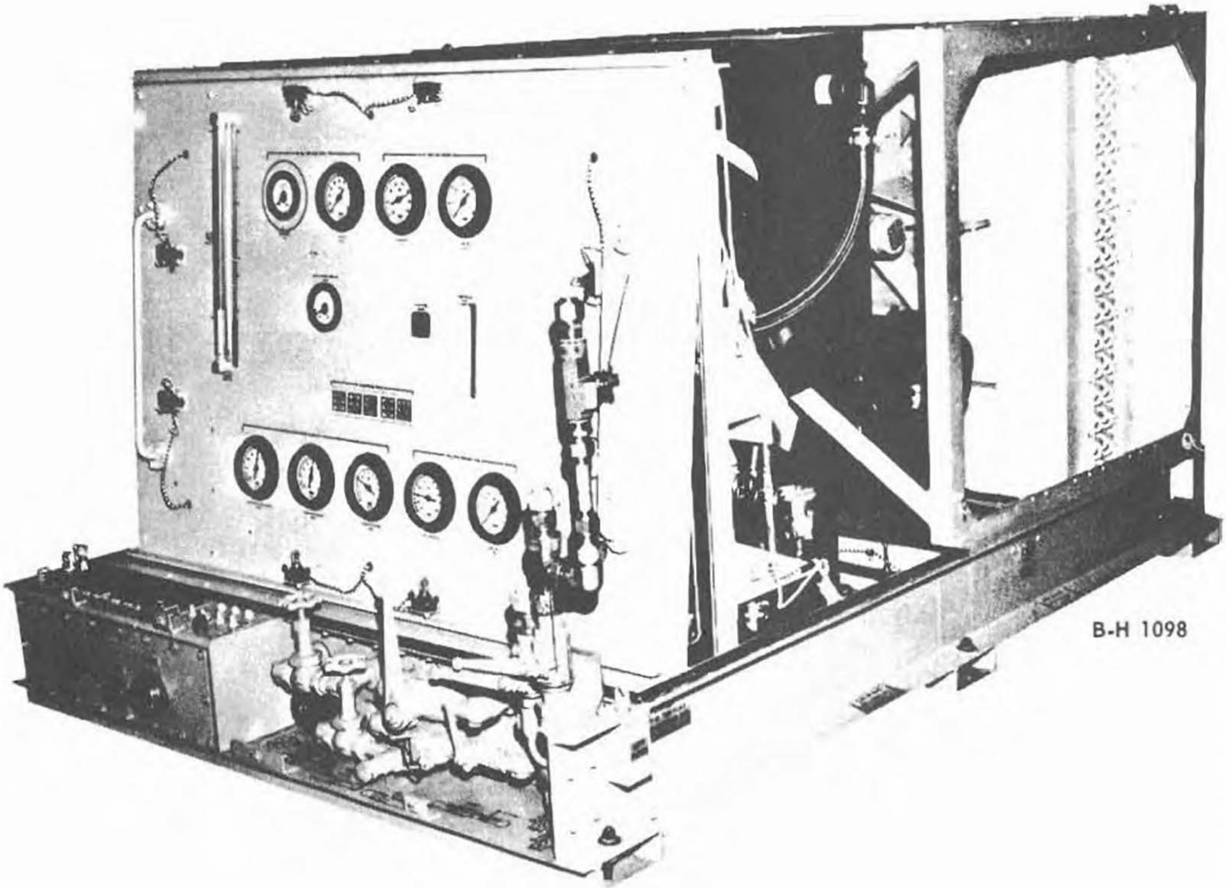


Figure 3-48. I. U. Ground Support Cooling Unit (Sheet 2 of 3)

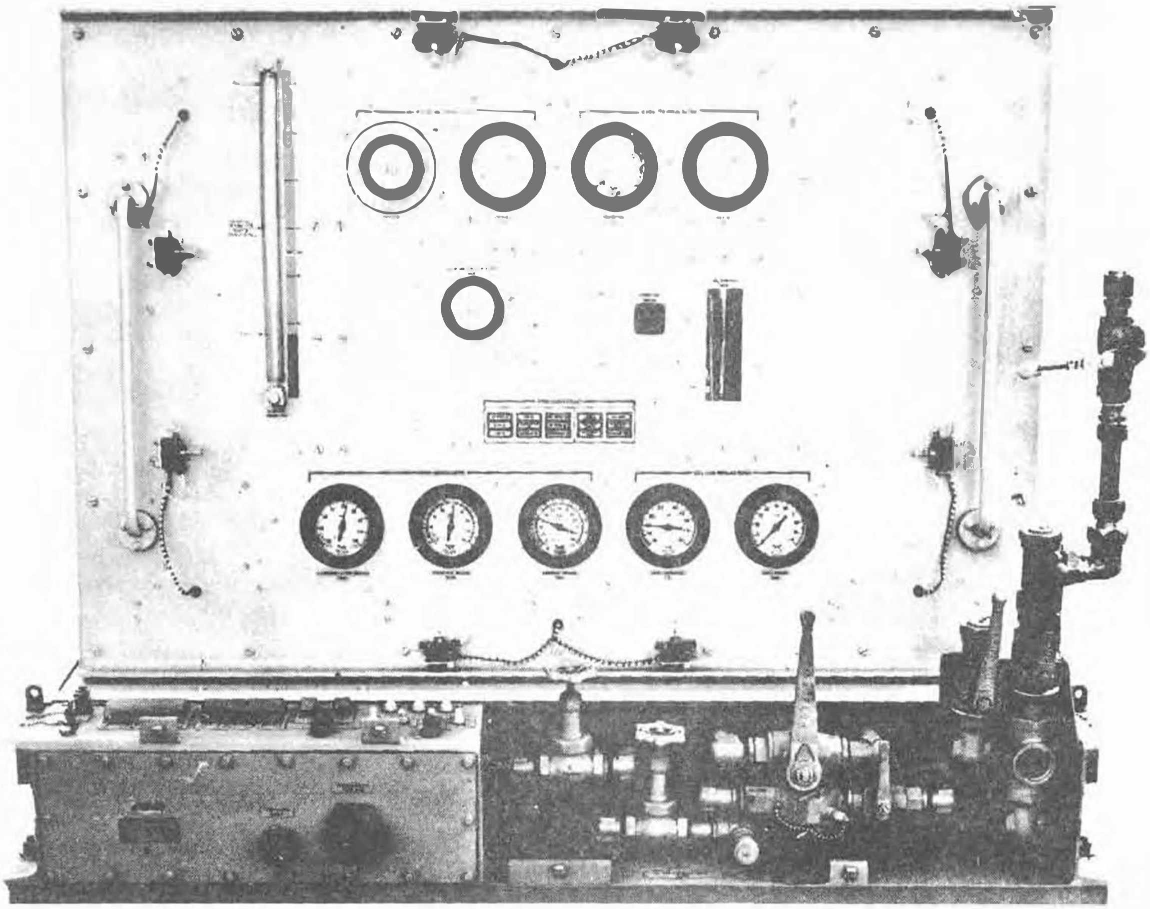


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Figure 3-48. I. U. Ground Support Cooling Unit (Sheet 3 of 3)

IU GROUND SUPPORT COOLING UNIT

1. Functional Description

a. The IU Ground Support Cooling Units (GSCU) (Figure 3-48), located on the umbilical tower, are used during prelaunch operations to supply refrigerated water-methanol coolant to a heat exchanger located in the Instrument Unit thermal conditioning system. Two GSCU's are provided. The primary unit is used for normal operation, and a secondary unit provides backup. The mode of operation is regulated through a flow control valve box that is controlled from the LCC. A utilization diagram is shown in figure 3-48. Either unit can be recirculated while the other unit is in operation. The units have a cooling capacity of 10 KW (34,120 BTU/hr.) The GSCU's also have facilities for filling, draining, and purging the water-methanol loop in the IU thermal conditioning system.

b. Each GSCU contains a refrigeration system, a coolant system, and a GN_2 drain and purge system. The refrigeration system includes a motor driven compressor, a fan cooled condenser, a filter drier, an expansion valve, and a heat exchanger. Freon 12 is the refrigerant. The coolant system includes a reservoir, a circulating pump, a filter, a flow regulator, an automatic temperature controller, and ancillary equipment. The coolant is a 40-60 (by weight) water-methanol mixture. The drain and purge system includes the regulators and hand valves necessary to reduce facility 6000 psig GH_2 operating pressure and route the GN_2 for drain and purge operations. Also, the drain and purge system includes a GN_2 heater to provide warm GN_2 for inerting the flight system and components. The cooling mode of operation can be controlled remotely, but the fill, drain, and purge operations are controlled locally. All electrical equipment is located in pressurized compartments that are purged with GN_2 at a pressure of 3 inches of water.

c. In the cooling mode of operation, warm coolant is pumped from the reservoir through the heat exchanger, where it is cooled. From the heat exchanger, the refrigerated coolant is routed through the flow control valve box to the IU thermal conditioning system heat exchanger, where the coolant absorbs heat from the onboard electronic component cooling loop. The warmed coolant is returned to the reservoir through the flow control valve box. The onboard cooling loop is filled from the GSCU by operating hand valves located on the IU swing arm. If it becomes necessary to drain the IU thermal conditioning system cooling loop, the system is purged with 40 to 65 psig GN_2 that is routed from the GSCU through the flow control valve box. The onboard coolant is forced into the GSCU reservoir by the GN_2. After the onboard system is drained, the GN_2 purge is vented from the system through the purge bypass valve.

2. Facility Requirements

a. Power — Demand

(1) 440 vac, 60 cps, 3 phase — 30 kva
(2) 28 vdc — 12 amps
(3) 5 vdc — 1 amp

b. Gaseous Nitrogen (GN_2)

(1) 6,000 psig, 200 scfm
(2) 50 psig, 3,000 scim

3. General

a. Part Number

(1) 8A00-0000 — Serial Nos. 2 thru 8
(2) 8B00-0000 — Serial Nos. 9 thru 15

b. Dimensions (inches) — 50 x 63 x 91

c. Weight (approximate, pounds)

(1) Complete unit (dry) — 3,000
(2) Complete unit (wet) — 3,525

d. Reservoir

(1) Coolant capacity (gallons) — 70
(2) Coolant, water-methanol — 40-60 by weight
(3) Coolant specific gravity — 0.90

e. Location on ML — 260-foot level

4. Remarks

For additional information, refer to MSFC-MAN-008.

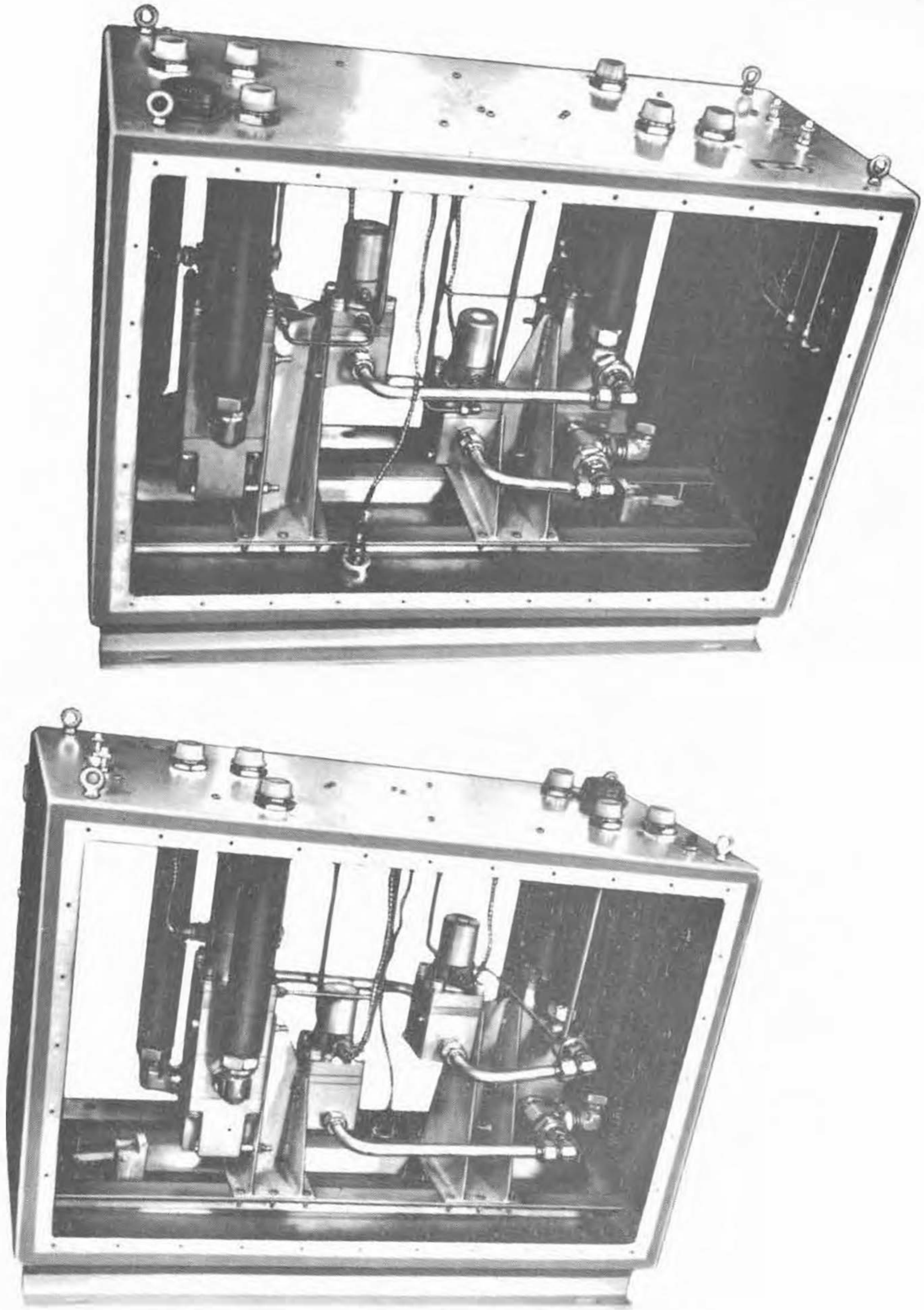

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Figure 3-49. GSCU Flow Control Valve Box (RM1801A)

GROUND SUPPORT COOLING UNIT FLOW CONTROL VALVE BOX (RM1801A)

1. Functional Description

a. The Flow Control Valve Box, RM1801A (Figure 3-49) is designed to select either the primary or secondary Ground Support Cooling Unit (GSCU) to supply water-methanol coolant to the vehicle Instrument Unit. During normal operation, the primary GSCU circulates coolant through the Flow Control Valve Box (FCVB), the Instrument Unit, and the upper portion of the S-IVB Stage. The secondary GSCU, if desired, may be operated by recirculating coolant through a bypass valve in the FCVB.

b. Should a failure of the primary GSCU occur, an operator-initiated command from the LCC would energize the selector valve in the FCVB. This valve, in turn, would pneumatically actuate the valves in the FCVB, causing the primary GSCU coolant to be recirculated and the secondary GSCU coolant to supply the vehicle. The FCVB is located on the ML at the 250-foot level, adjacent to the primary GSCU (Figure 1-4).

2. Facility Requirements

a. Power	28 vdc
b. GN_2	Control, 750 psig Purge, 50 psig

3. Leading Particulars

a. Part Number	SE700048-1
b. Dimensions (inches)	29.25 x 19.12 x 39.87
c. Weight (Dry)	300 pounds (Approximate)

4. Remarks

For additional information, refer to MSFC-MAN-036.

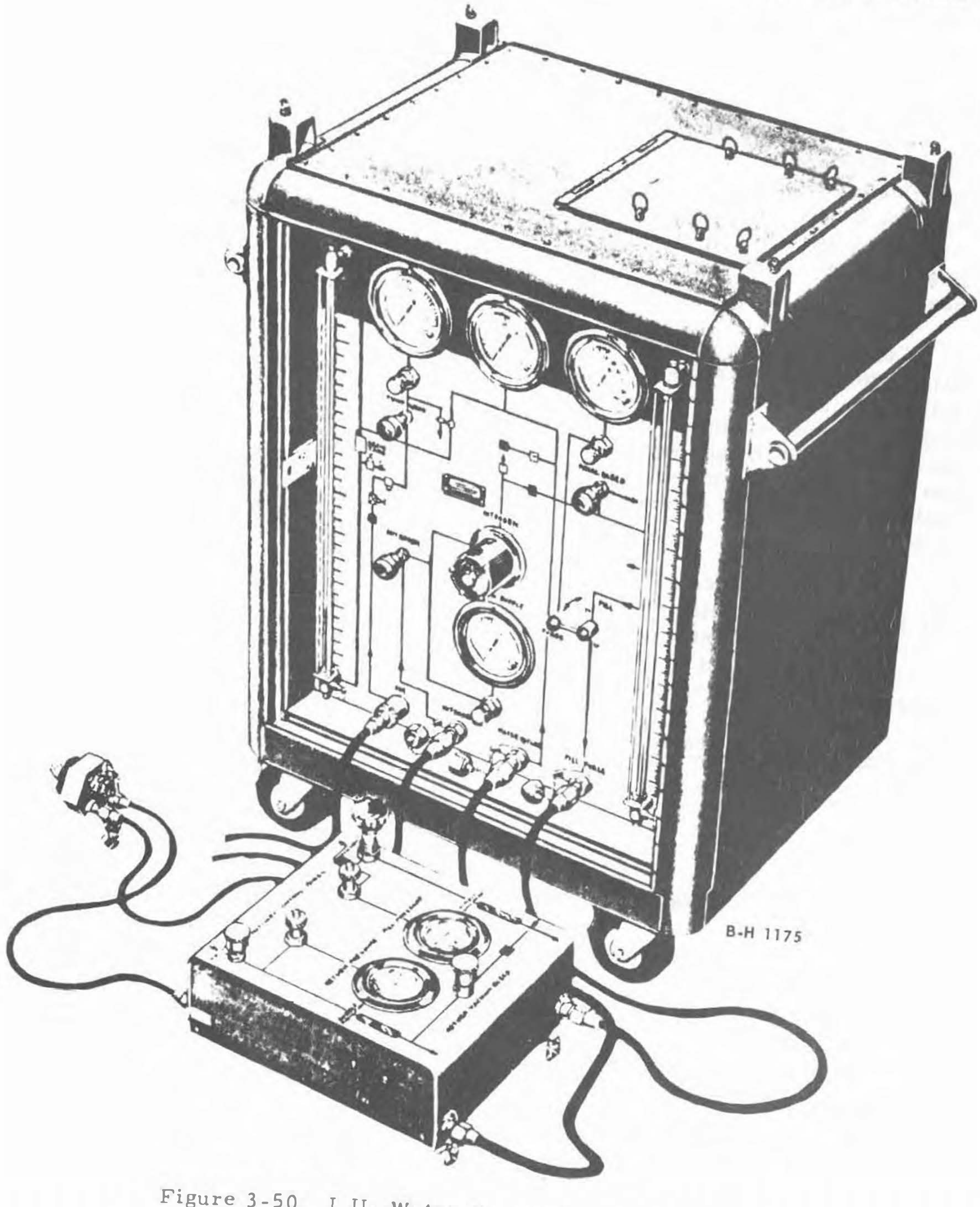


Figure 3-50. I. U. Water Accumulator Servicer

IU WATER ACCUMULATOR SERVICER

1. Functional Description

a. The IU Water Accumulator Servicer (Figure 3-50) is used to fill the IU thermal conditioning system water accumulator assembly with distilled water and to drain the accumulator if required. The servicer includes a four-wheeled mobile service cart, an auxiliary control panel, an adapter assembly, and interconnecting hoses. The auxiliary control panel, adapter assembly, and hoses are stored inside the cart when not in use.

b. When a requirement exists to fill or drain the IU water accumulator, the mobile service cart is wheeled into position near the Instrument Unit. The auxiliary control panel is attached to the water accumulator, and the adapter assembly is installed in the fill-and-drain port. Hoses interconnecting the adapter assembly, the auxiliary control panel, and the service cart are installed. Facility GN_2 is connected to the service cart, and the service cart regulators and hand valves are adjusted for the mode of operation.

c. Distilled water is transferred from the service cart fill tank to the IU water accumulator using GN_2 pressure. Water is drained from the water accumulator into the service cart drain tank using an air driven vacuum pump located in the service cart. The accumulator fill or drain operations are controlled and monitored from the auxiliary control panel.

2. Facility Requirements

a. GN_2	6000 psig maximum
b. Air	150 psig
c. Distilled Water	25 gallons

3. Leading Particulars

a. Part Number	SE700061-1
b. Dimensions (inches)	29 x 35 x 52

c. Weight (approximate, pounds)

Dry	550
Wet	750

d. Reservoir capacities

Fill Tank	25 gallons
Drain Tank	25 gallons

4. Remarks

For additional information, refer to MSFC-MAN-038.

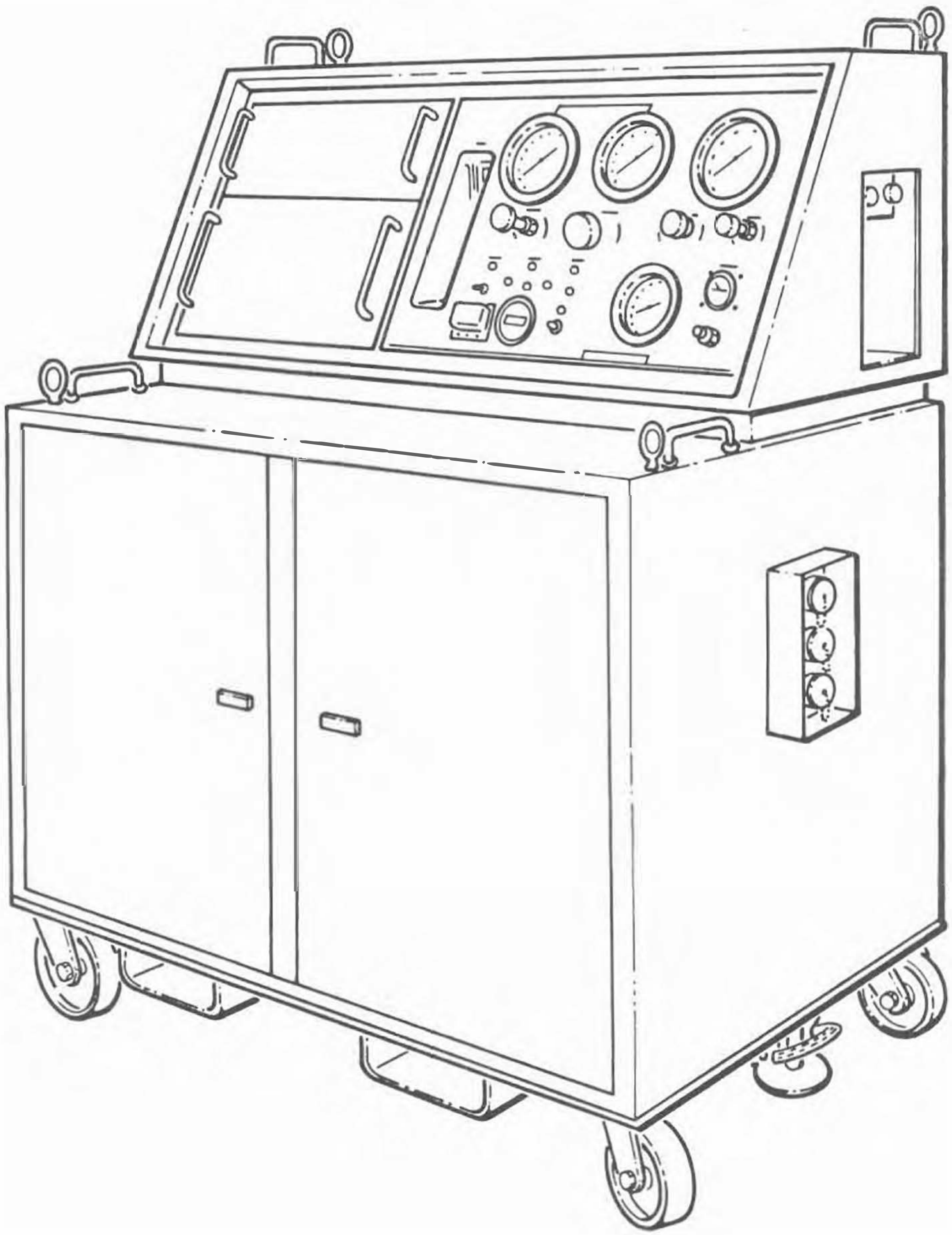


Figure 3-51. S-II/S-IVB Mobile Hydraulic Servicer (DSV-4B-479)

S-II/S-IVB MOBILE HYDRAULIC SERVICER (DSV-4B-479)

1. Functional Description

a. The S-II /S-IVB Mobile Hydraulic Servicer is required to supply hydraulic fluid to the J-2 engine thrust vector control system on the S-II and S-IVB stages. Servicing operations include filling, flushing, cleaning, leak checking, air purging, and functional checking of various subsystem components.

b. The pumping unit supplies hydraulic fluid at approximately 3, 500 psig and at approximately 1. 4 gpm to the flight control hydraulic system. The unit consists of the following major subsystems:

(1) The reservoir pressurization subsystem: The reservoir is pressurized with filtered gaseous nitrogen (GN_2) from a nitrogen storage bottle through a pressure regulator, check valve, and filter. A relief valve prevents overpressurization of the reservoir. Gages monitor reservoir and bottle pressures.

(2) Recirculation and filtration subsystem: An electrically driven, fixed displacement, gear type pump circulates oil from the reservoir through a filter and back to the reservoir.

(3) Hydraulic oil subsystem: A variable displacement, electrically driven, pressure compensated pump supplies hydraulic fluid to the stage hydraulic systems through a filter. Supply pressures are monitored by high and low pressure gages. Return fluid is filtered and passed through a heat exchanger into the reservoir. System temperature is monitored by a temperature gage and limited by a thermal cut-off switch. A return bypass system with a flowmeter measures system leakage rates.

2. Facility Requirements

a. Power	Demand
440 vac, 60 cps, 3 phase	25 kva
b. Gaseous Nitrogen (GN_2)	
1, 500 psig, 660 cubic inches	

3. General

a. Weight, pounds (Approximate)	1, 550
b. Dimensions, inches (Approximate)	67 x 57 x 35
c. Reservoir	
(1) Fluid capacity, gallons	17
(2) Fluid specific gravity	0. 87

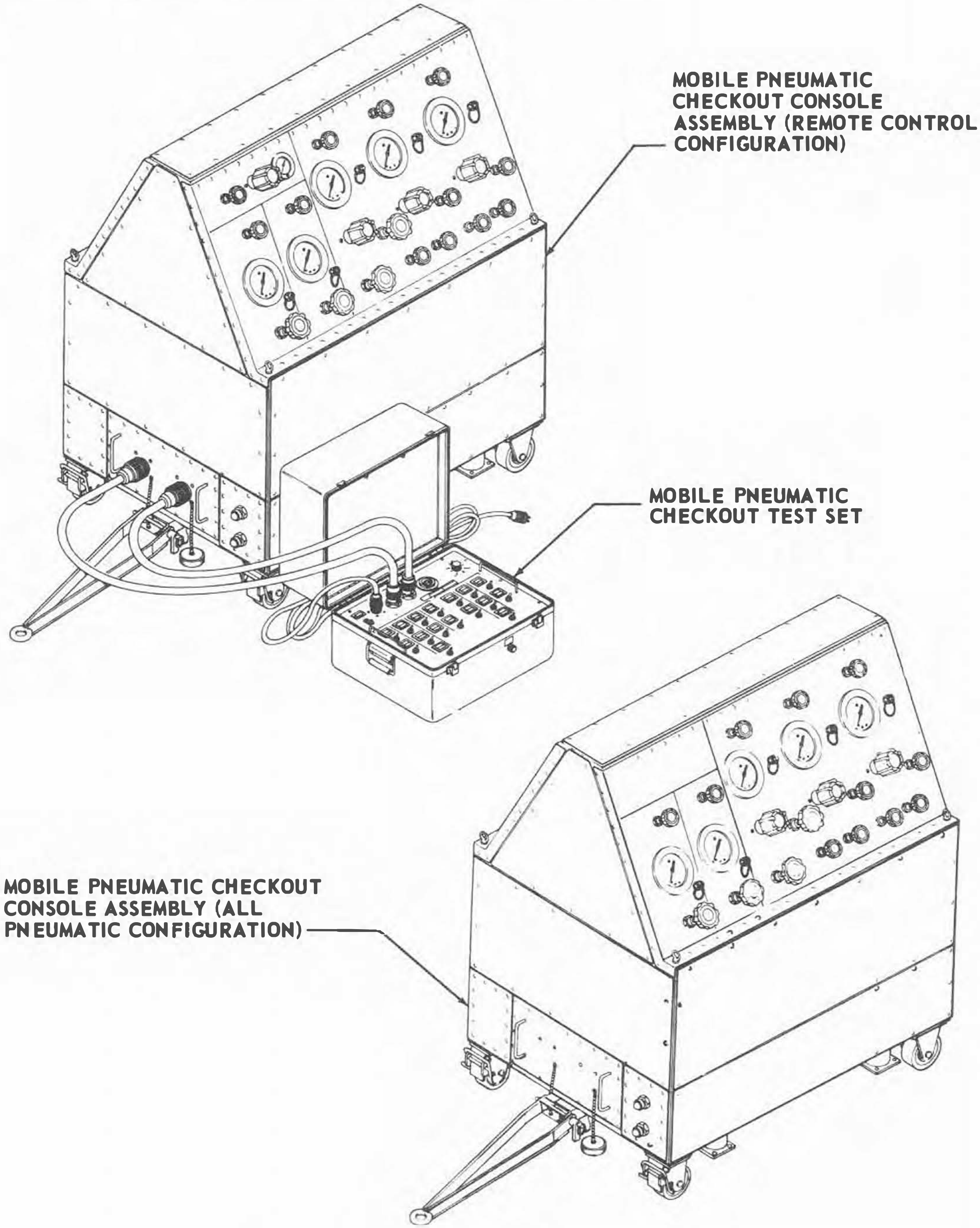


Figure 3-52. Mobile Pneumatic Checkout Console

MOBILE PNEUMATIC CHECKOUT CONSOLE

1. Functional Description

a. The Mobile Pneumatic Checkout Console is required to provide regulated gaseous nitrogen (GH_2) and gaseous helium (GHe) for Saturn V vehicle testing. The console supplies these gaseous at ambient temperatures for leak and functional testing of stage volumes and components. Overall flexibility enables the console to be used on all Saturn V stages.

b. The console operates from facility supplied GN_2 and GH_e, supplied at ambient temperature, to furnish output circuits in the following ranges:

(1) GN_2 at zero to 100 psig, zero to 1,000 psig, and zero to 3,500 psig.
(2) GHe at zero to 100 psig, zero to 1,000 psig, zero to 1,500 psig and zero to 3,500 psig.

c. To facilitate monitoring and control functions, the console has gages and transducers for pressure sensing in all seven operating circuits. The output pressure of any circuit may be read when the console is properly activated.

d. The console is designed and constructed for maximum installation flexibility. Mounted on wheels, the console possesses mobile towing and hard mounting capabilities.

2. Facility Requirements

a.	Power	Demand
	28 vdc	To be determined

b. Gaseous Media
(1) GN_2 at 6,000 psig
(2) GHe at 6,000 psig

3. General

a.	Weight, pounds (Approximate)	600
b.	Dimensions, inches (Approximate)	57 x 52 x 36

4. Associated Equipment

The following equipment is required for use with the Mobile Pneumatic Checkout Console:

a. Mobile Pneumatic Test Set
b. Portable Pneumatic Regulators and Hose Kits

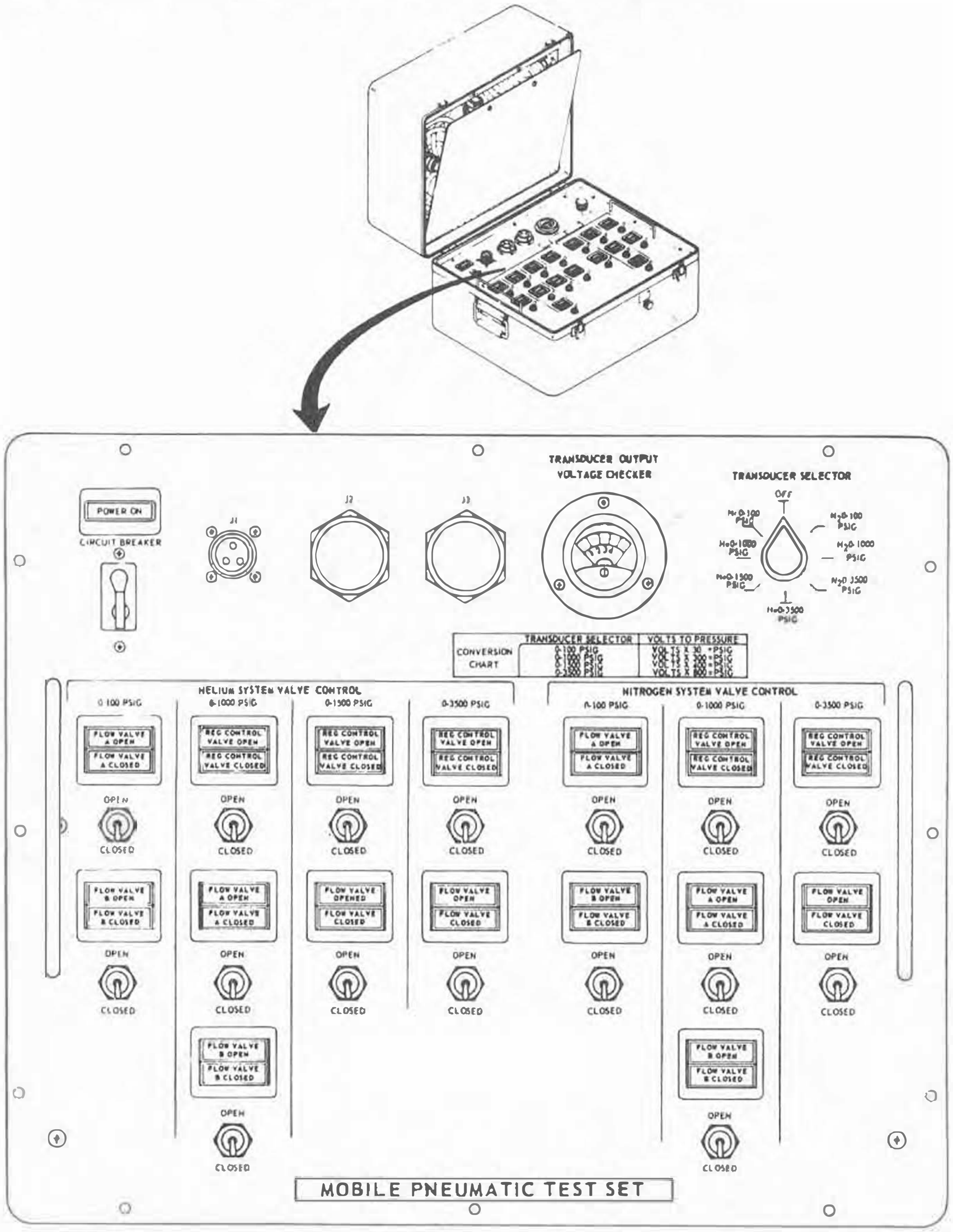


Figure 3-53. Mobile Pneumatic Test Set

MOBILE PNEUMATIC TEST SET

1. Functional Description

a. The Mobile Pneumatic Test Set is required to provide manual control and monitoring of the mobile pneumatic checkout console. It may also be used for remote control at locations where normal control equipment is not available.

b. The test set is designed and constructed for "suitcase" type portability. It contains storage area for the three cables required for operation. It contains the necessary gages, switches, and indicators to perform the appropriate Saturn V test, control, and monitor functions.

c. The test set is connected through one input cable and appropriate connectors to facility power. Two output cables with appropriate connectors provide electrical interfacing between the test set and the console. The test set manually selects, controls, and provides position indication for each solenoid valve in the console. Pressures within the console are also monitored by the test set. The console pressure to be tested is picked by a panel mounted selector switch and a voltmeter which displays the output of the console pressure transducers.

2. Facility Requirements

Power	Demand
28 vdc	To be determined

3. General

a. Weight, pounds (Approximate)	45
b. Dimensions, inches (Approximate)	23 x 19 x 16

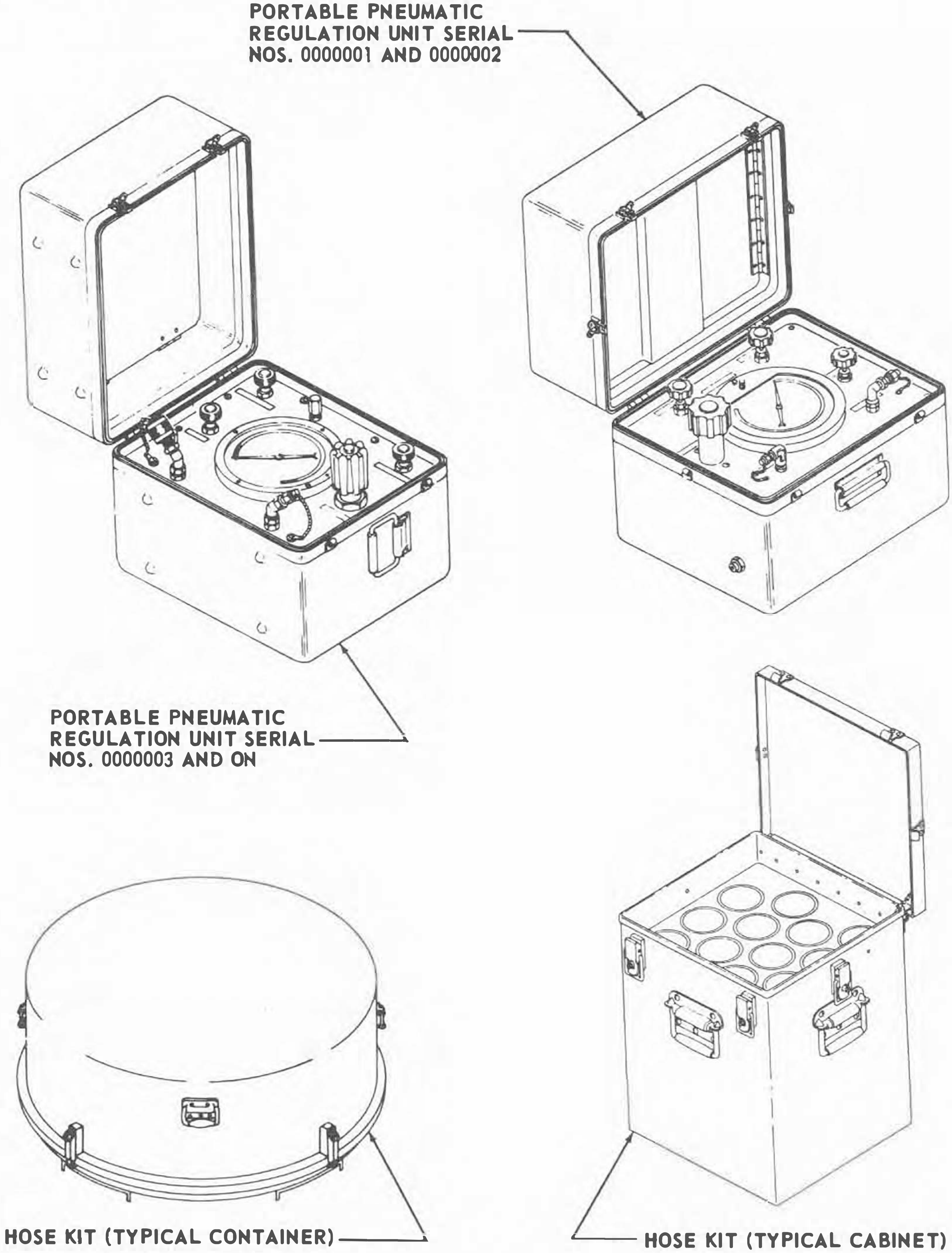


Figure 3-54. Portable Pneumatic Regulators and Hose Kits

PORTABLE PNEUMATIC REGULATORS AND HOSE KITS

1. Functional Description

a. The portable regulator is an entirely pneumatic device and no electrical inputs are required. It is contained in an aluminum carrying case with a ten-foot long outlet hose and coupling assembly stored in the lid. There are two types of portable regulators. These are similar in function, operation and appearance. The portable regulators are of the low-flow type and provide a regulated, filtered pressure of gaseous helium or nitrogen for stage testing. Input for the high pressure portable regulators is from the 6000 psig facility GHe/GN_2 pressure. Input for the low pressure regulators is from the Mobile Pneumatic Checkout Console. The input and output pressures of the six types of portable regulators are as follows:

Pressures (psig)	Input	1000	1000	3500	3500	6000	6000
	Regulated output	0-25	0-50	0-100	0-500	0-1000	0-4000

b. The hose kit functions as the pneumatic interface between the console, portable regulator and the Saturn V vehicle. The portable regulator contains its own outlet hose, but inlet hoses for this unit are part of the hose kit. The hose kit consists of high pressure pneumatic hoses and couplings, with containers and cabinets for these items. Two lengths of hoses are provided. Twenty-foot hoses are used as inlet and outlet hoses for the console and as inlet hoses for the portable regulator. One-foot hoses provide a pneumatic link between these outlet hoses and the stage adapter fittings, which are connected directly to the launch vehicle. Round containers are used to store 20-foot length hoses. Cabinets are used for the one-foot lengths. The weight of each container with its hose and coupling assemblies is such that it can be carried by two men, with the exception of one container which is provided with aluminum channels for fork lifting. Quick-disconnect couplings are provided for all the 1000 psig hoses. All couplings are equipped with a protective plug and cap that also can serve as a safety link when the hoses are connected together, since the plug and cap of adjoining hoses can be connected. The hoses are designed for use with dry air, gaseous nitrogen, gaseous helium and gaseous hydrogen. Hoses in two pressure ranges are provided, 4000 and 6600 psig. The 6600 psig inlet hoses are used with the 6000 psig facility pressure source and supply this pressure either to the console or to the high-pressure portable regulators. The 4000 psig hoses are used as console outlet hoses. All hoses can operate in ambient temperatures of -65°F to +165°F.

2. Facility Requirements - not applicable.

3. General

a. Portable Regulators

Serial Nos.	Dimensions, inches	Weight, pounds
0000001 and 0000002	19 x 16 x 13	77 (with outlet hose)
0000003 and on	19 x 16 x 15	77 (with outlet hose)

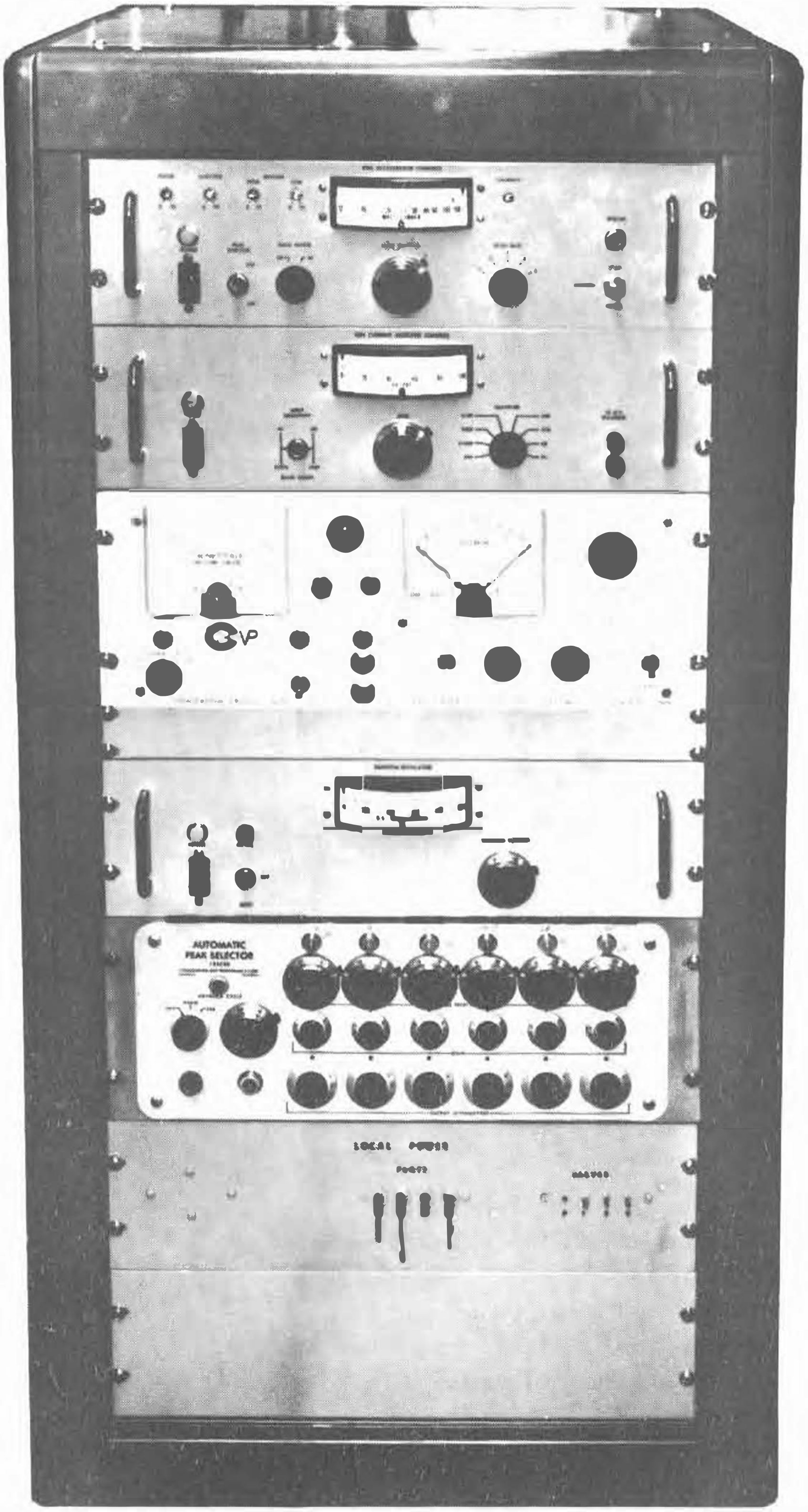
b. Hose Kits

Part Number	Weight (pounds)	Dimensions (Inches) Dia.	Height	Hose Op. Press. Psig	Size (Dia x Length)
22A12005-102-12	90	37	6	4,000	3/8" x 20'
22A12005-103-12	90	37	6	4,000	3/8" x 20'
22A12005-104-12	*244	43	16	6,600	3/4" x 20'
22A12005-105-12	90	37	6	4,000	3/4" x 20'
22A12005-107-12	90	37	6	4,000	3/4" x 20'
22A12005-108-12	90	37	6	6,600	3/8" x 20'
22A12005-109-11	90	18 x 17 x 17		4,000	3/8" x 12"
22A12005-110-11	90	19 x 15 x 15		4,000	3/4" x 12"
22A12005-102-13	90	37	6	4,000	3/8" x 20'
22A12005-103-13	90	37	6	4,000	3/4" x 20'
22A12005-104-13	*244	43	16	6,600	3/4" x 20'
22A12005-105-13	90	37	6	4,000	3/4" x 20'

*To be handled on a skid, by fork lift.

c. The ambient temperature limits for use of this equipment is as follows:

Portable Regulators	0^oF to $+165^oF$
Hose Kits	-65^oF to $+165^oF$



B-H 1174

Figure 3-55. Hazardous Gas Detector

HAZARDOUS GAS DETECTION SYSTEM

1. Functional Description

a. The hazardous gas detection system provides the capability of monitoring for leaks or hazardous gas conditions in specific areas of the S-IC stage, the S-II stage, the S-IVB stage, and the I. U. This capability is provided prior to propellant loading and through ground operations until umbilical disconnect at lift-off.

b. The hazardous gas detection system is set up to detect and analyze for:

(1) GH_2 Gaseous Hydrogen
(2) GOX Gaseous Oxygen
(3) N_2O_4 Nitrogen Tetroxide
(4) He Helium
(5) N_2 Nitrogen
(6) Hydrazine derivatives

c. Specific stage areas are sensed as follows:

(1) S-IC aft interstage area: for GOX
(2) S-IC forward interstage area: for GOX and GH_2
(3) S-II engine area: for GOX and GH_2
(4) S-II forward/S-IVB aft interstage: for GH_2, GOX, Hydrazine derivatives, and N_2O_4 (also He, if desired)
(5) S-IVB forward interstage: for GH_2, N_2O_4, and Hydrazine derivatives
(6) In the IU: for GH_2, N_2O_4, and Hydrazine derivatives.

d. The control panels of the HGD unit (figure 3-54, from top to bottom) are:

(1) Ion accelerator control panel
(2) Ion current amplifier control panel
(3) Ionization gage control panel
(4) Emission regulator panel
(5) Automatic peak selector panel
(6) Local power control panel

e. The four main HGD systems and their primary functions are:

(1) The sample inlet system provides samples of gaseous vapor from sensing manifolds in the vehicle (figure 3-56).

(2) The main vacuum system draws the gas sample from the sample inlet system and, by cooling with an LN_2 cold trap, reduces the kinetic energy of the gas molecular.

(3) The gas analyzer system uses mass spectrometer techniques to qualitatively and quantitatively analyze the gas vapor from the sample inlet system. A leak or hazardous gas condition can be identified, by manual cycling, in approximately 4-1/2 minutes.

(4) The control and monitor system provides for either local or remote control of the system, and provides a permanent monitoring record. Local controls are mounted in a rack adjacent to the system equipment rack. A remote control panel is provided in the LCC blockhouse. Strip chart recorders are installed at both control panels, and provide a permanent monitoring readout. Manual selection of vehicle area to be monitored and a specific gas of interest is available at both the local and remote control panels.

NOTE

See figure 3-57 for a functional block diagram of the overall system.

2. General - leading particulars and general information will be added when they become available in more detail.

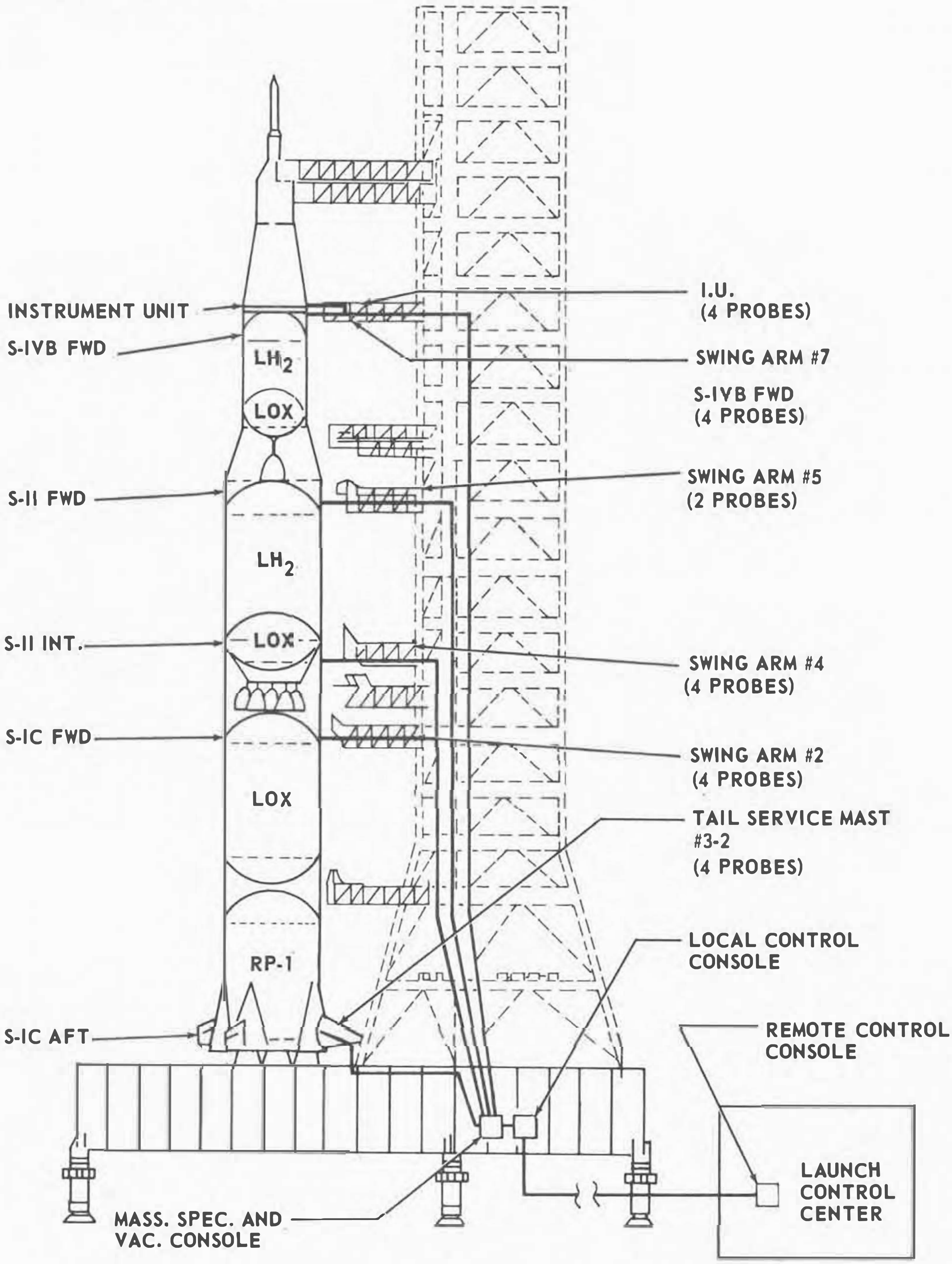


Figure 3-56.1 Saturn V HGD Sensing Line Configuration

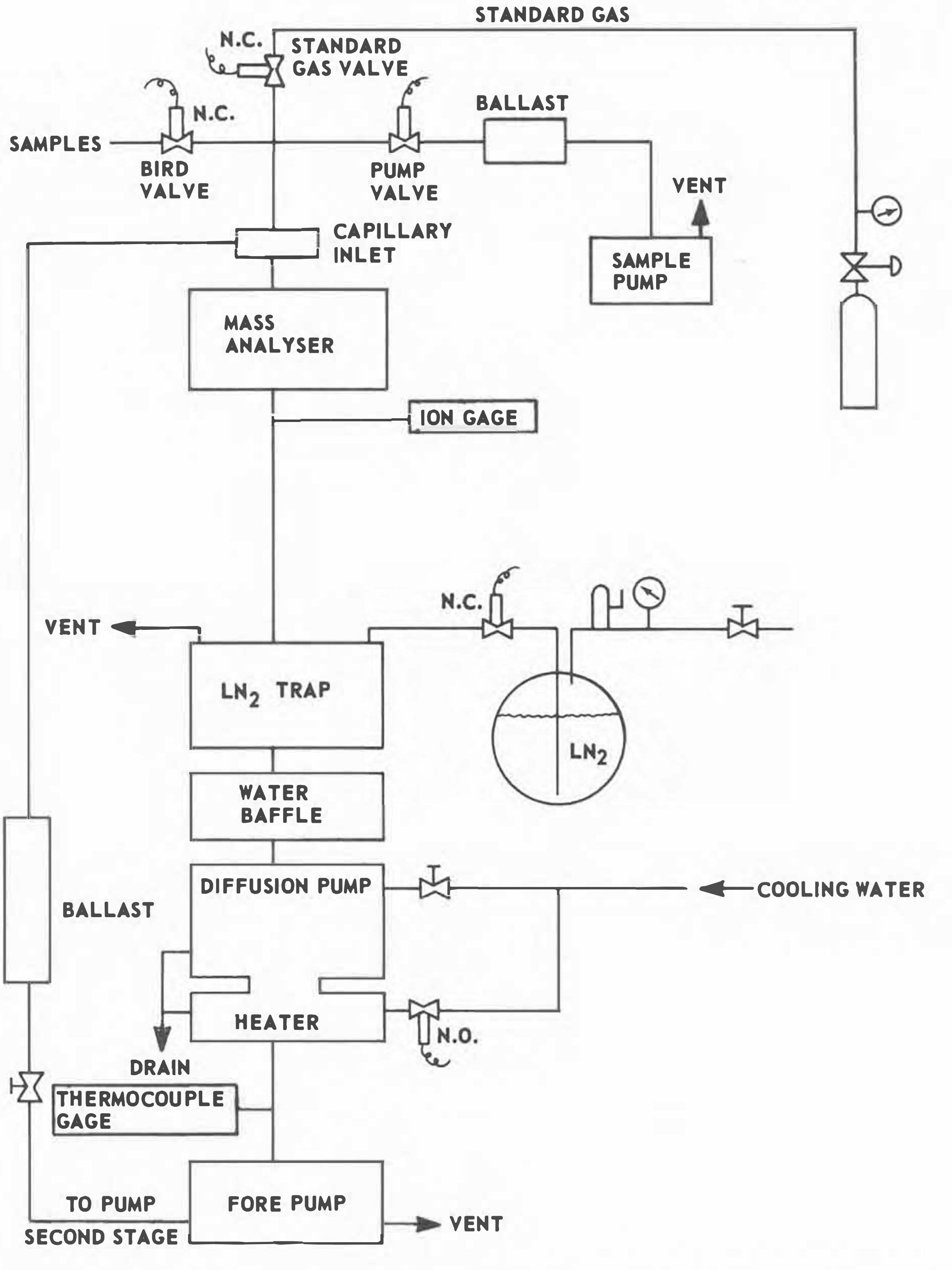


Figure 3-57. Hazardous Gas Detection System Functional Block Diagram

SECTION IV
ACCESS EQUIPMENT

This section presents information on the various stage access equipment, with a brief description and a visual presentation of each individual item of equipment. The section is sub-divided into the S-IC stage access equipment, the S-II stage, the S-IVB stage, and the I. U.

The access equipment provides access for personnel engaged in checkout, maintenance, servicing, or inspection operations on the various stages. This section will be revised and/or added to as more data on the access equipment becomes available.

S-IC ACCESS EQUIPMENT

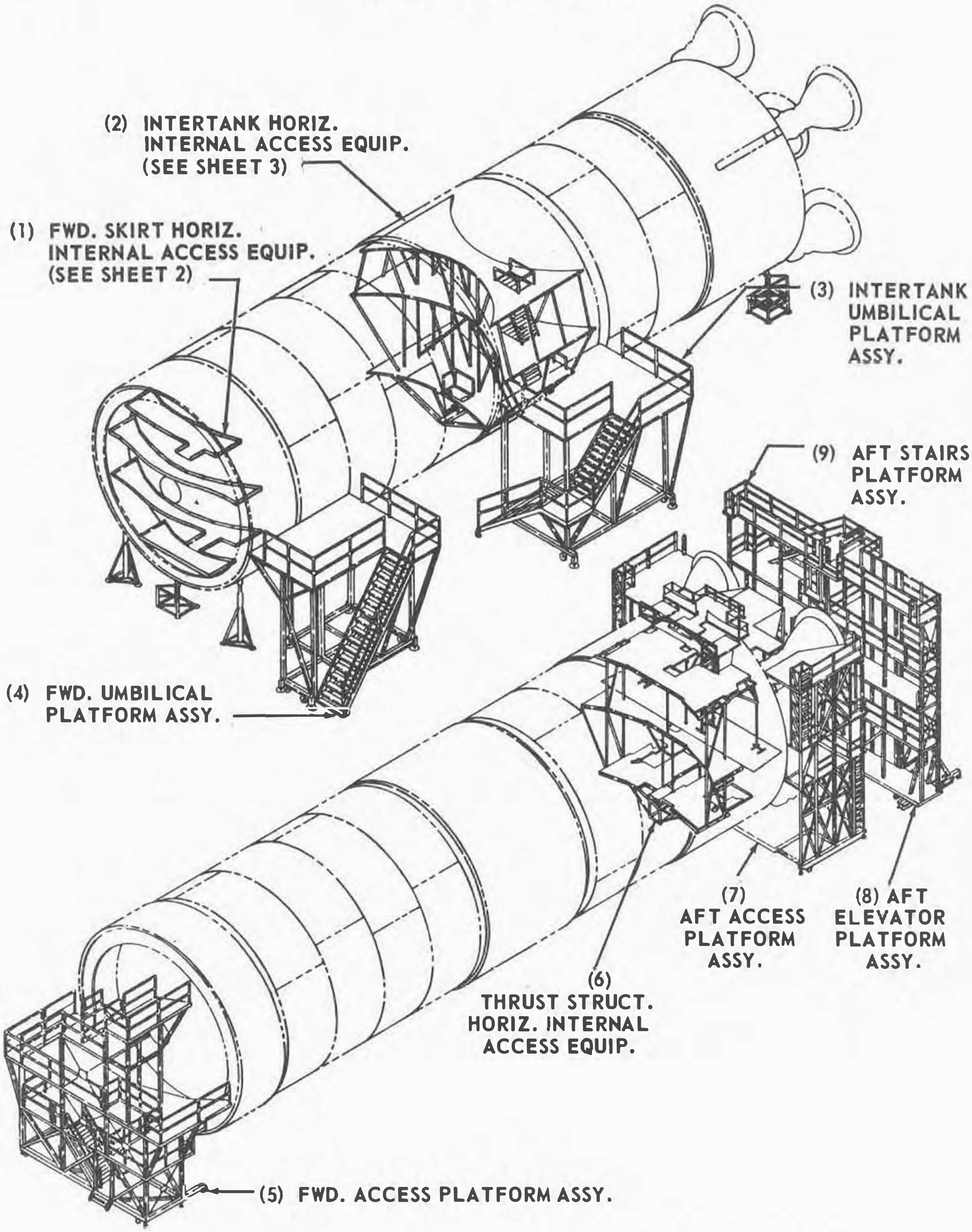


Figure 4-1. S-IC Access Equipment (Sheet 1 of 10)

S-IC ACCESS EQUIPMENT

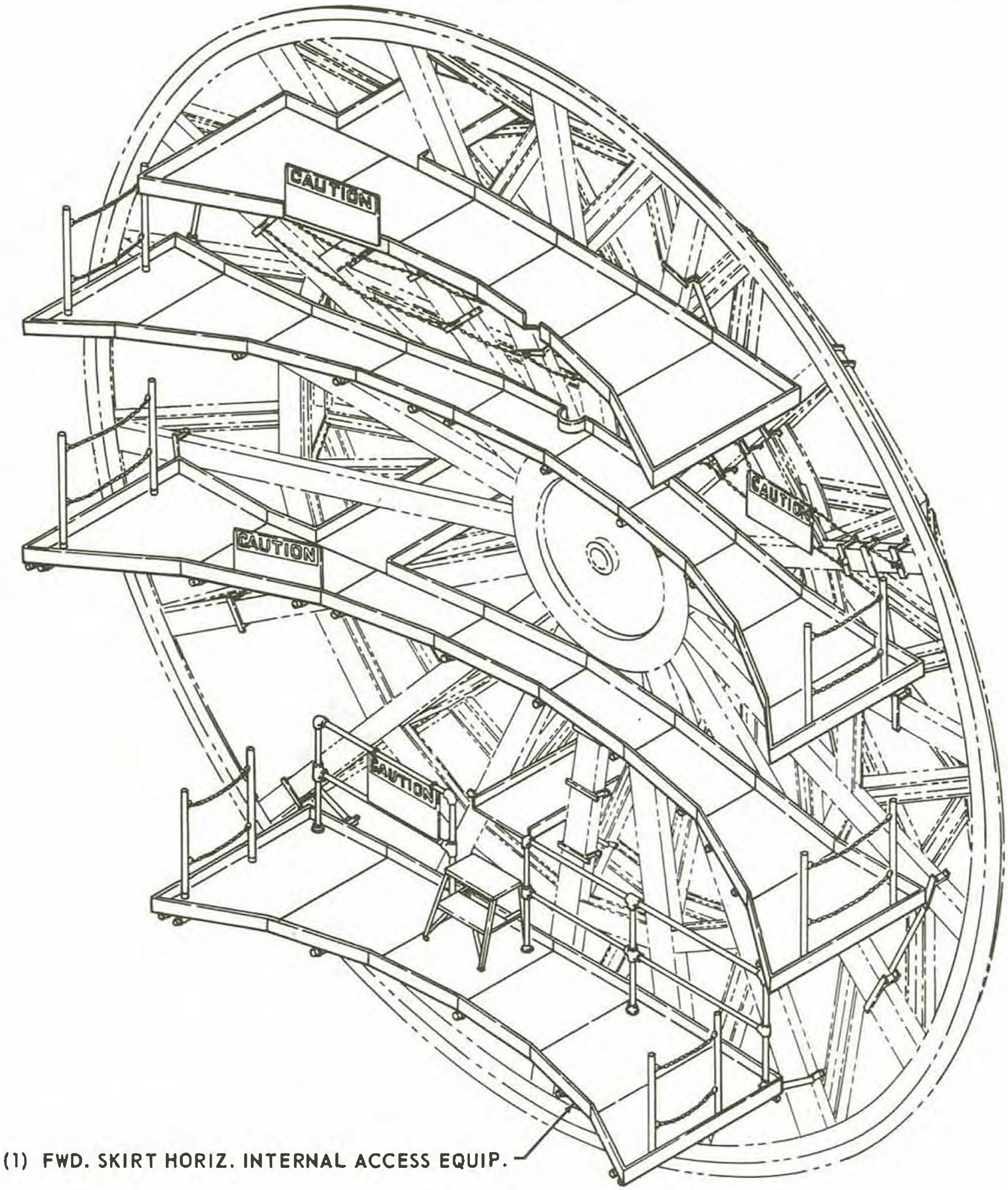


Figure 4-1. S-IC Access Equipment (Sheet 2 of 10)

S-IC ACCESS EQUIPMENT

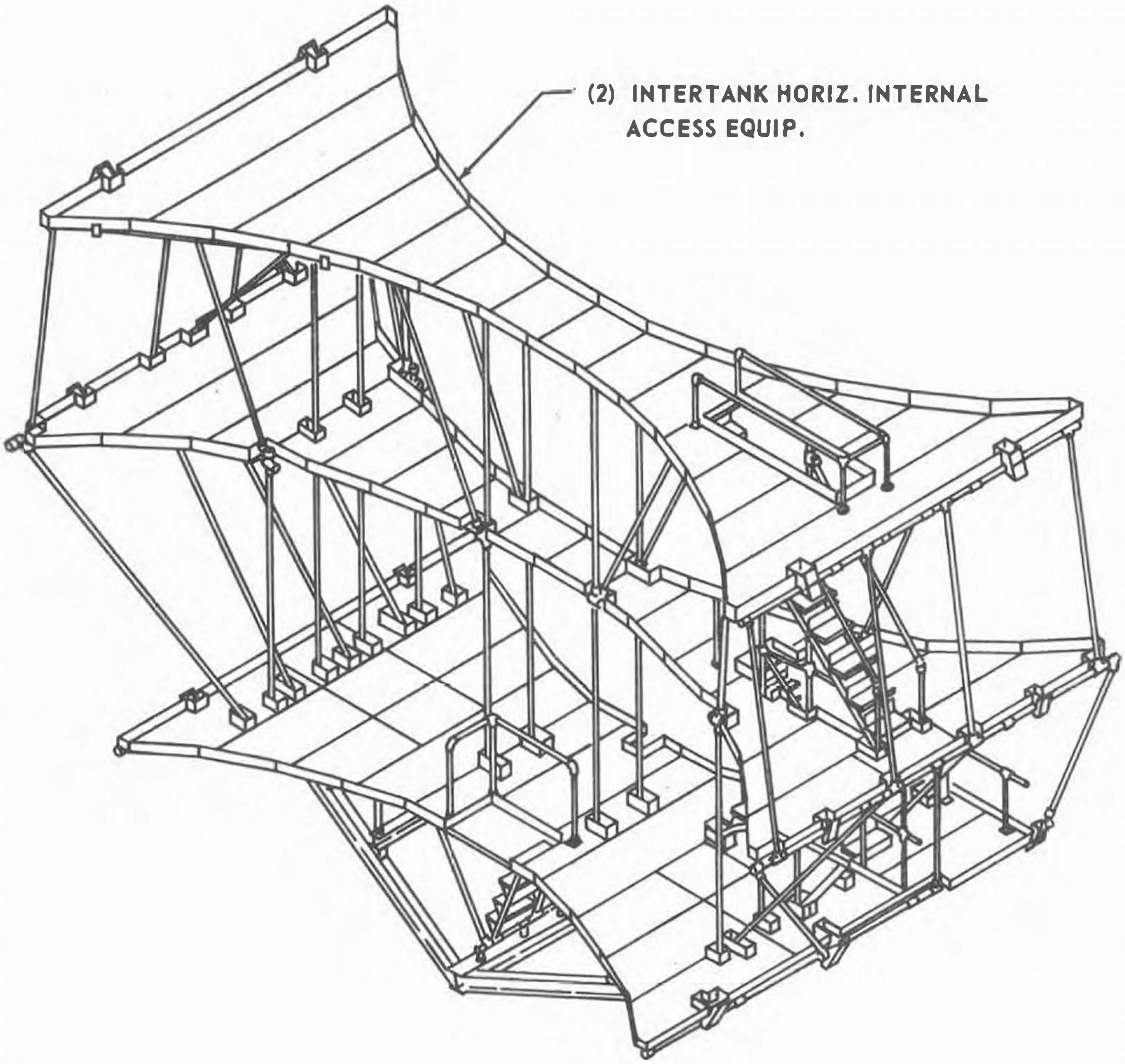
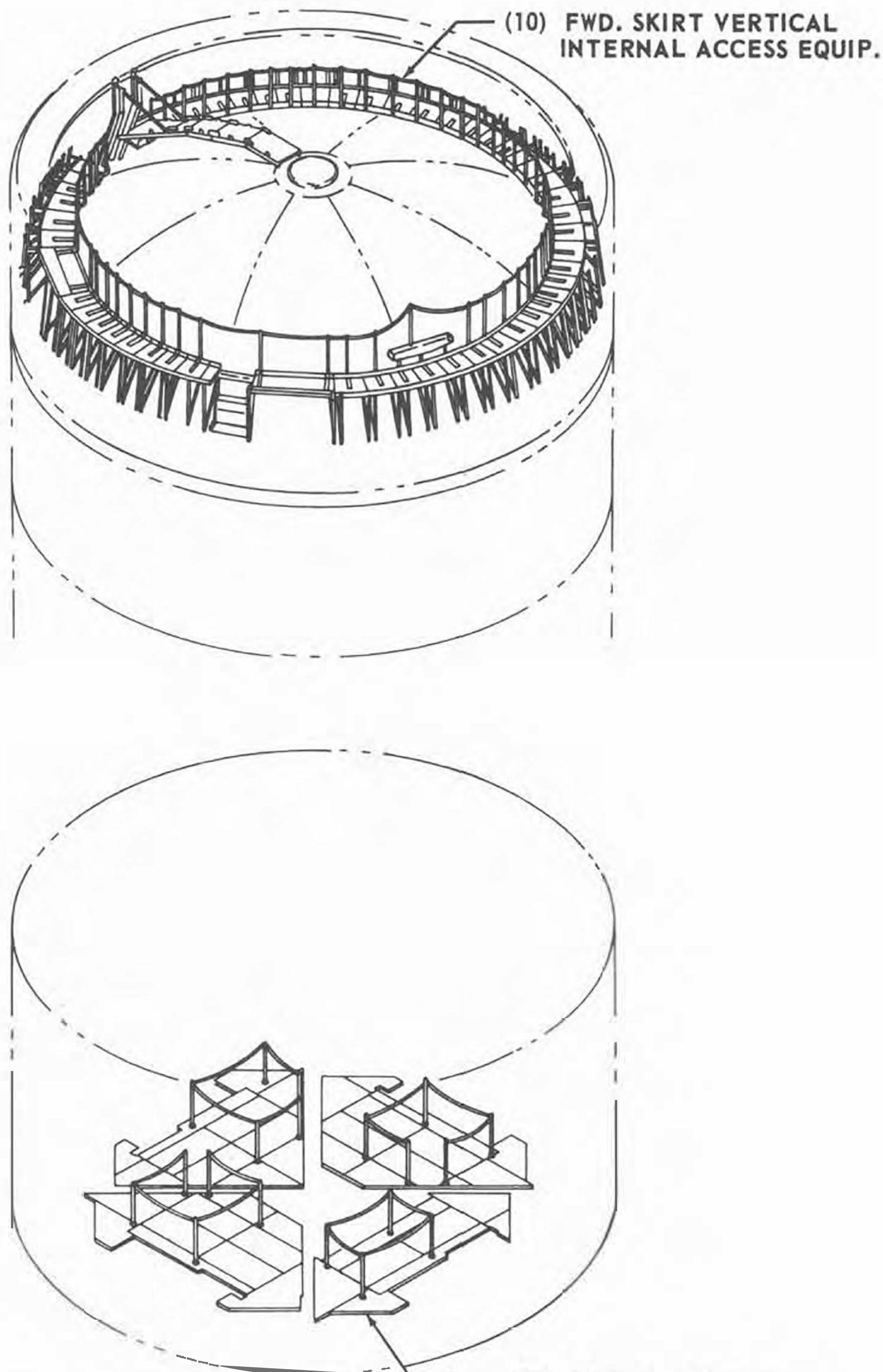


Figure 4-1. S-IC Access Equipment (Sheet 3 of 10)

S-IC ACCESS EQUIPMENT



NOTE: LADDER (NOT SHOWN) GOES WITH THIS SET

Figure 4-1. S-IC Access Equipment (Sheet 4 of 10)

S-IC ACCESS EQUIPMENT

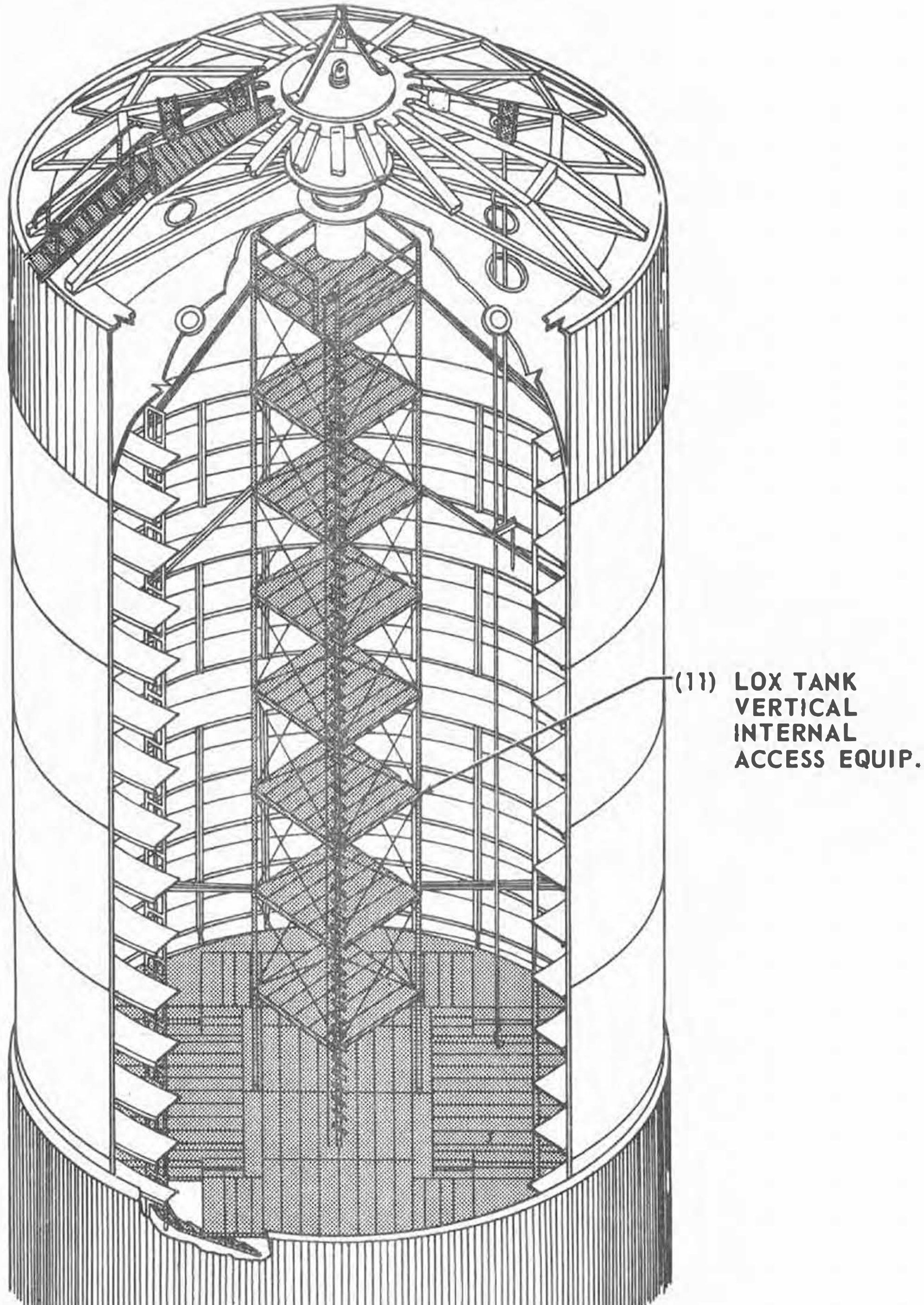


Figure 4-1. S-IC Access Equipment (Sheet 5 of 10)

S-IC ACCESS EQUIPMENT

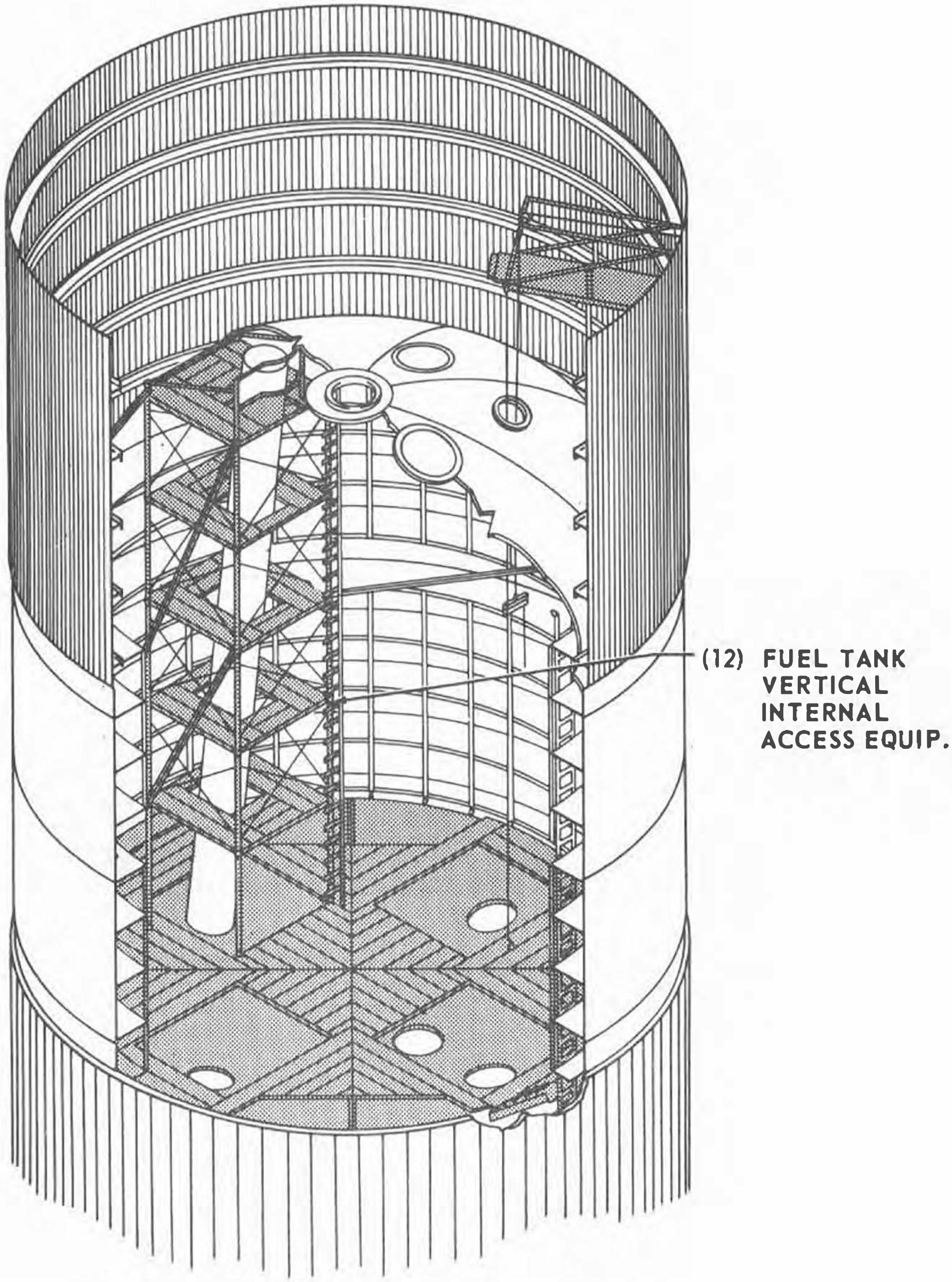


Figure 4-1. S-IC Access Equipment (Sheet 6 of 10)

S-IC ACCESS EQUIPMENT

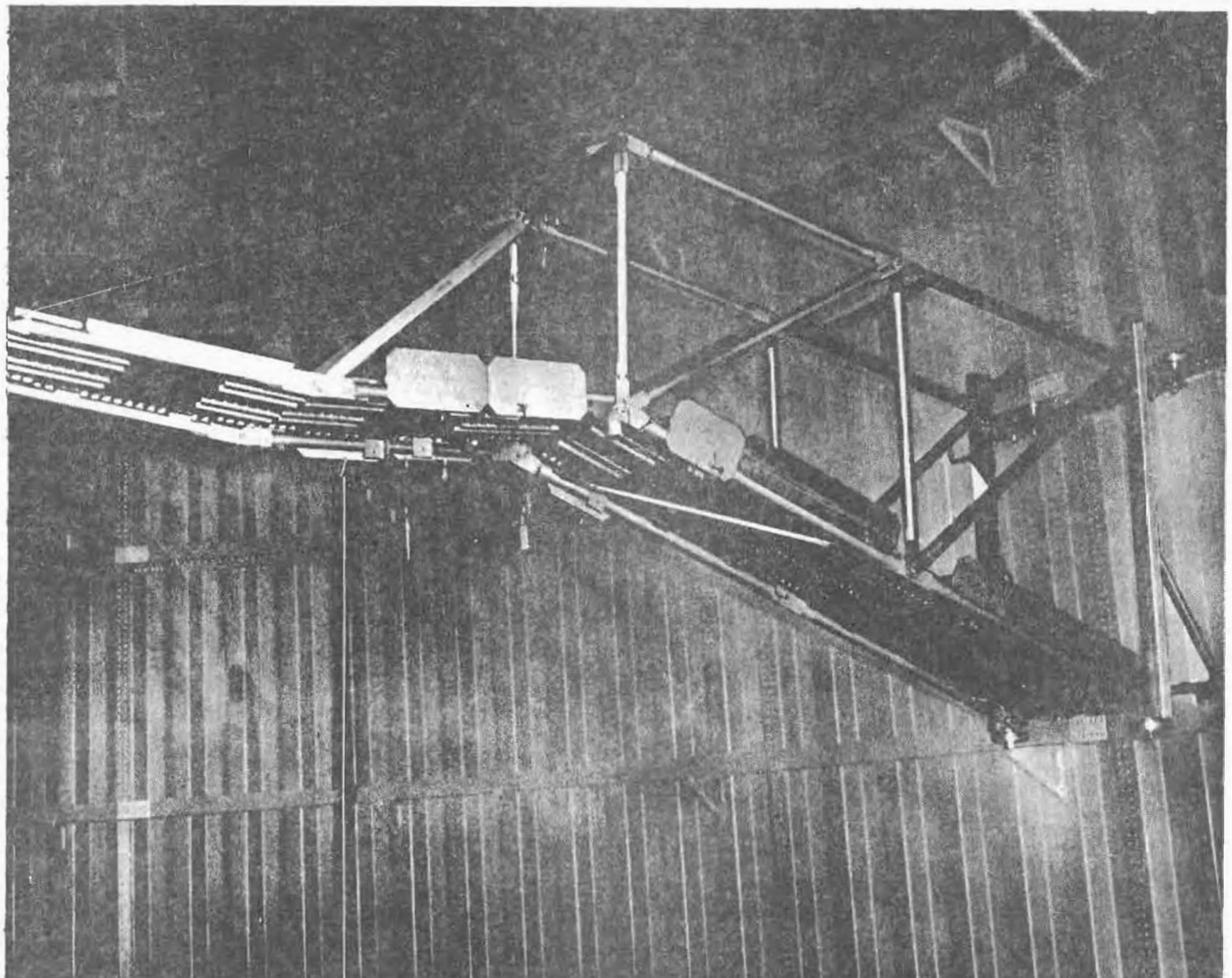
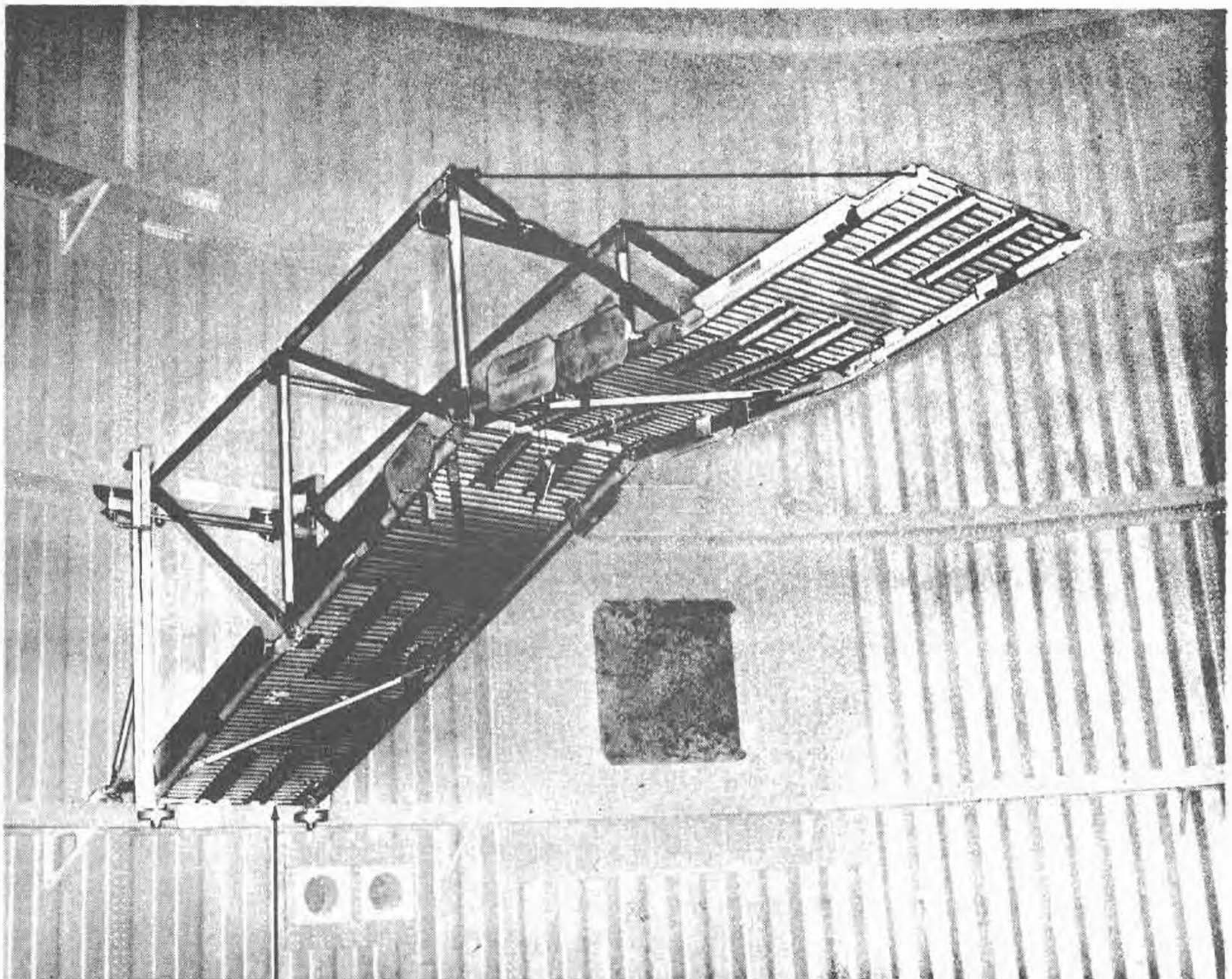


Figure 4-1. S-IC Access Equipment (Sheet 7 of 10)

S-IC ACCESS EQUIPMENT



B-H 1101

(14) INTERTANK VERTICAL ACCESS EQUIPMENT

Figure 4-1. S-IC Access Equipment (Sheet 8 of 10)

S-IC ACCESS EQUIPMENT

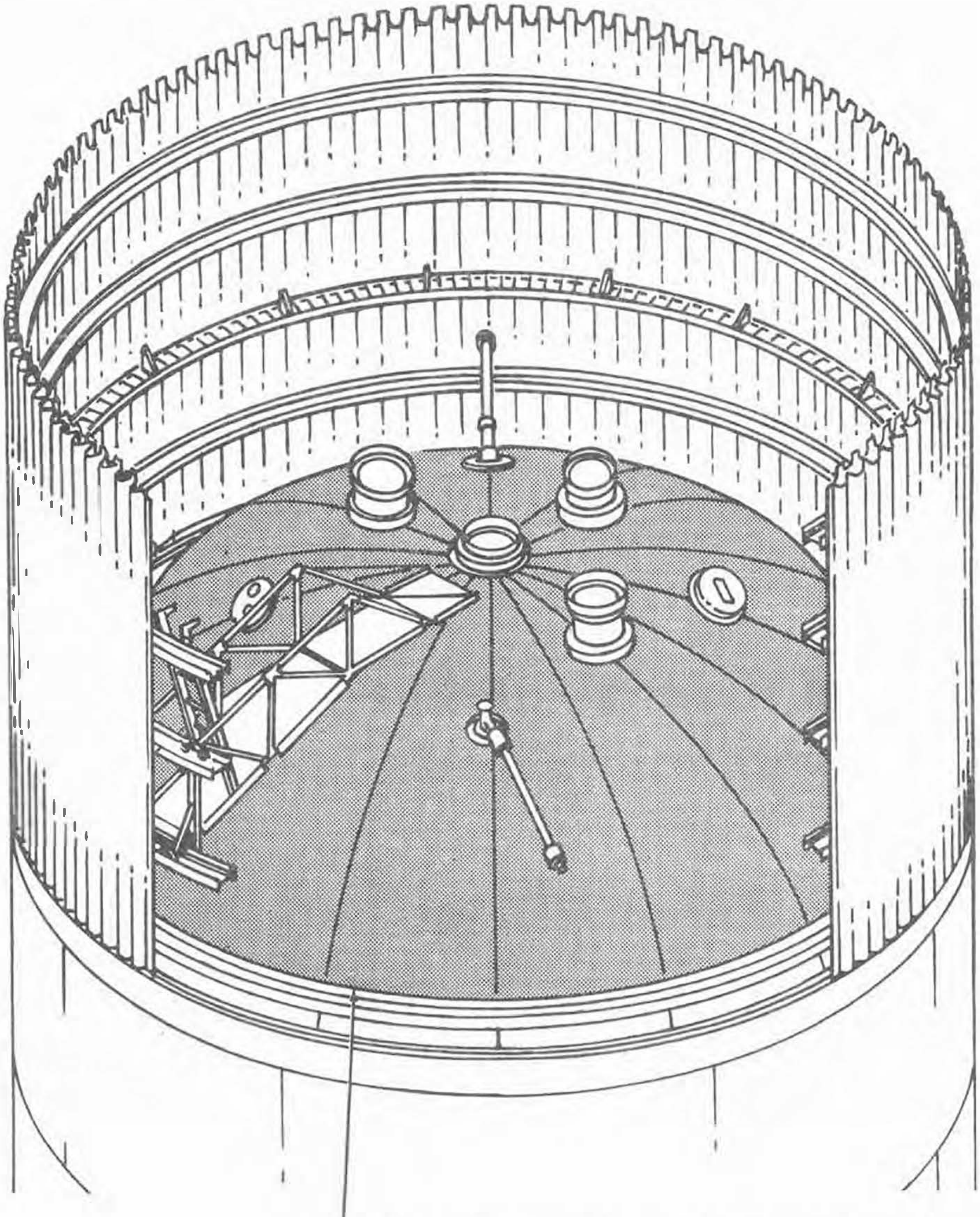


Figure 4-1. S-IC Access Equipment (Sheet 9 of 10)

S-IC ACCESS EQUIPMENT

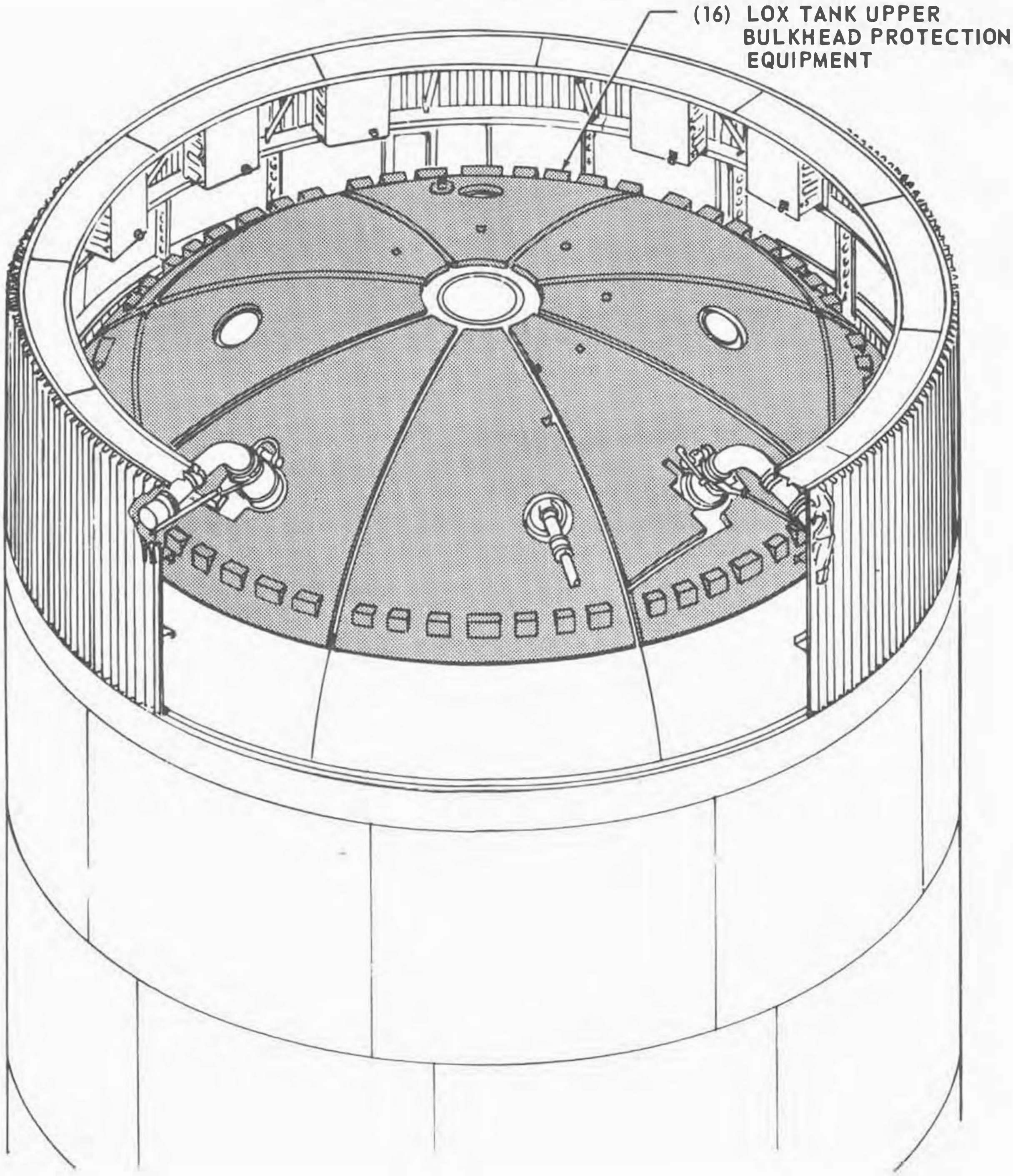


Figure 4-1. S-IC Access Equipment (Sheet 10 of 10)

S-IC ACCESS EQUIPMENT

1. Forward Skirt Horizontal Internal Access Equipment (65B36093) - The forward skirt internal access equipment consists of four platforms that attach to the inner spokes of the forward handling ring and provide access in the forward skirt area for test, checkout and servicing operations. Approximate platform dimensions are 70 x 42 x 5 inches.

2. Intertank Horizontal Internal Access Equipment (65B36240) - The intertank structure horizontal internal access equipment consists of four platform levels designed for installation in the intertank area to provide access for test, checkout, and servicing operations. Approximate platform dimensions are 166 x 29 x 8 inches.

3. Intertank Umbilical Platform Assembly (65B31042) - The intertank umbilical platform provides personnel and equipment access to the intertank umbilical plate and to the intertank access door. It provides access for installation and removal of the intertank platforms and serves as a structure on which to mount several items of test and communications equipment. The platform weighs approximately 1,500 pounds and the approximate dimensions are 177 x 156 x 120 inches.

4. Forward Umbilical Platform Assembly (65B31012) - The forward umbilical platform provides personnel and equipment access to the forward umbilical plate and the adjacent access door. It also serves as a structure for mounting a pneumatic pressure test rack and several other items of supporting test and communications equipment. The platform weighs approximately 2,000 pounds and the approximate dimensions are 177 x 156 x 156 inches.

5. Forward Access Platform Assembly (65B31100) - The forward access platform provides personnel access to locations at the forward end of the S-IC stage as required to support test and checkout operations. It also provides access to the interstage internal platforms through the forward handling ring. The platform weighs approximately 9,500 pounds and the approximate dimensions are 404 x 386 x 176 inches.

6. Thrust Structure Horizontal Internal Access Equipment (65B36098) - The thrust structure internal access equipment consists of three platform levels designed for installation in the thrust structure area to provide access for test, checkout, and servicing operations. Approximate dimensions are 75 x 24 x 6 inches.

7. Aft Access Platform Assembly (65B31138) - The aft access platform provides personnel and equipment access to the S-IC stage thrust structure and to the five F-1 engines and associated equipment. It also provides access to the internal thrust structure platforms and serves as a structure for mounting eight pneumatic pressure test racks and other items of supporting test and communications equipment. The platform weighs approximately 25,000 pounds and the approximate dimensions are 475 x 472 x 162 inches.

8. Aft Elevator Platform Assembly (65B31323) - The aft elevator platform provides personnel and equipment access to the various levels of the aft access platform. A 1000 pound capacity elevator with a 4 x 5 foot floor area is installed as an integral part of the platform. The elevator is designed primarily for freight loading and uses a manual control system. This platform, used in conjunction with the aft stairs platform, provides continuous access across the aft end of the F-1 engines at each major working level. The platform weighs approximately 13,000 pounds and the approximate dimensions are 434 x 237 x 102 inches.

9. Aft Stairs Platform Assembly (65B31227) - The aft stairs platform provides personnel access to the various levels of the aft access platform. Stairs are not provided between all levels of the aft access platform because of space limitations. The aft stairs platform, used in conjunction with the aft elevator platform, provides continuous access across the aft end of the F-1 engines at each major working level. The platform weighs approximately 9,000 pounds and the approximate dimensions are 434 x 237 x 102 inches.

10. Forward Skirt Vertical Internal Access Equipment (65B36352) - The forward skirt vertical access platform provides 100% accessibility in the forward skirt area for installation, servicing, and checkout of instrumentation, fixtures, plumbing, electrical items, and protective covers. The largest component weighs approximately 35 pounds and the approximate dimensions are 81 x 12 x 20 inches.

11. LOX Tank Vertical Internal Access Equipment (65B36398) - This equipment is used to gain access to the inside of the LOX tank for repairs and checkout, when the stage is in the vertical position. The heaviest component weighs approximately 80 - 120 pounds and the largest component is approximately 145 x 7 inches.

12. Fuel Tank Vertical Internal Access Equipment (65B36443) - This equipment is used to gain access to the inside of the fuel tank for repairs and checkout, when the stage is in the vertical position. The heaviest component weighs approximately 80 - 120 pounds and the largest component is approximately 120 x 7 inches.

13. Thrust Structure Vertical Internal Access Platform Assembly (65B36325) - This equipment provides access to all components in the inside of the thrust structure area when the stage is in the vertical position. The approximate dimensions are 106 x 16 x 5 inches.

14. Intertank Vertical Internal Access Equipment (65B36628) - The intertank vertical internal access equipment is used to gain access to all components in the intertank area when the stage is in the vertical position. The approximate platform dimensions are 44 x 29 x 6 inches.

15. Fuel Tank Upper Bulkhead Protection Equipment (65B63046) - The fuel tank upper bulkhead protection equipment consists of a segmented mat used to provide protection to the fuel tank upper bulkhead against falling objects capable of causing a maximum load of 50 foot-pounds.

16. LOX Tank Upper Bulkhead Protection Equipment (65B63044) - The LOX tank upper bulkhead protection equipment consists of a segmented mat used to provide protection to the LOX tank upper bulkhead against falling objects capable of causing a maximum load of 50 foot-pounds.

S-II ACCESS EQUIPMENT

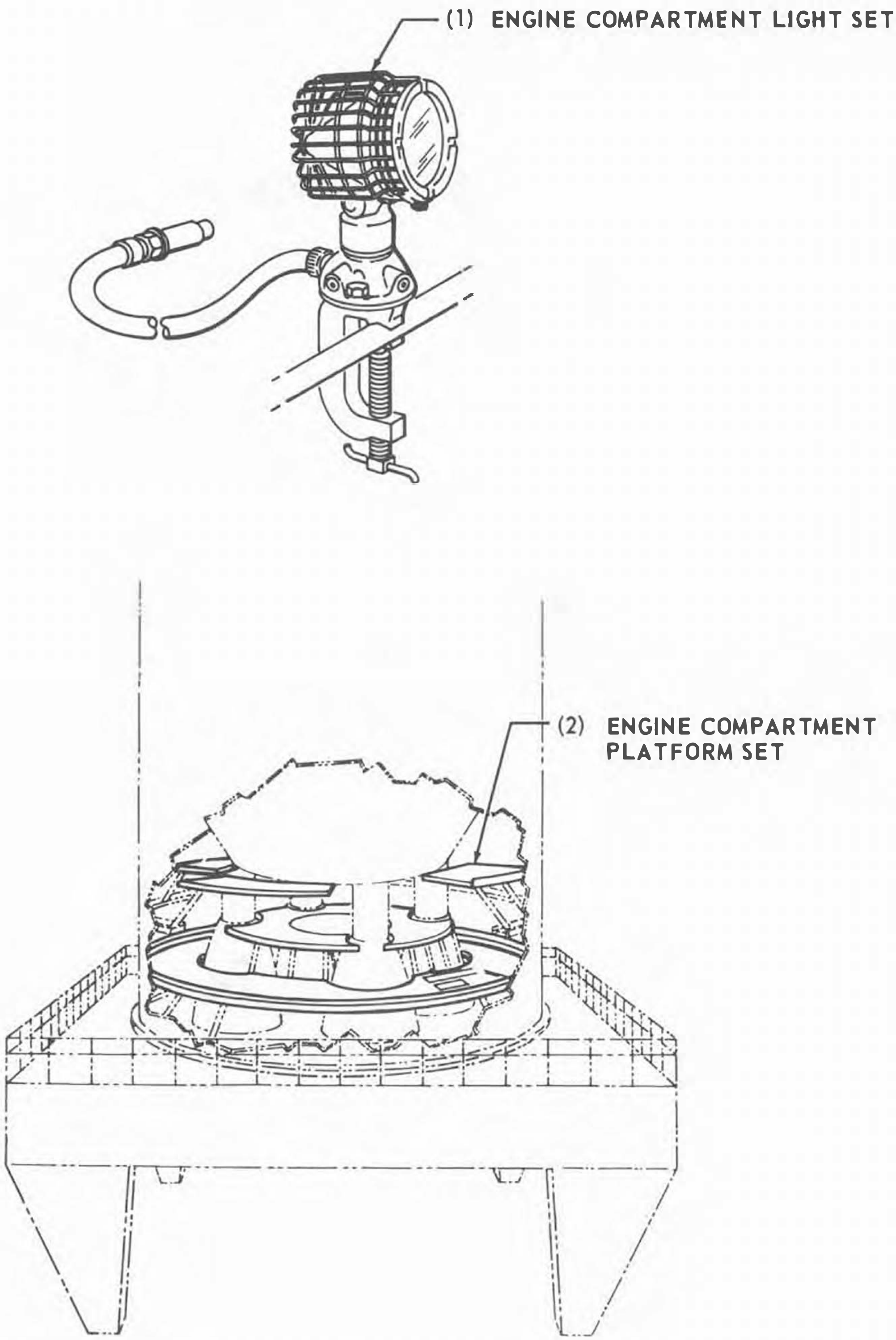
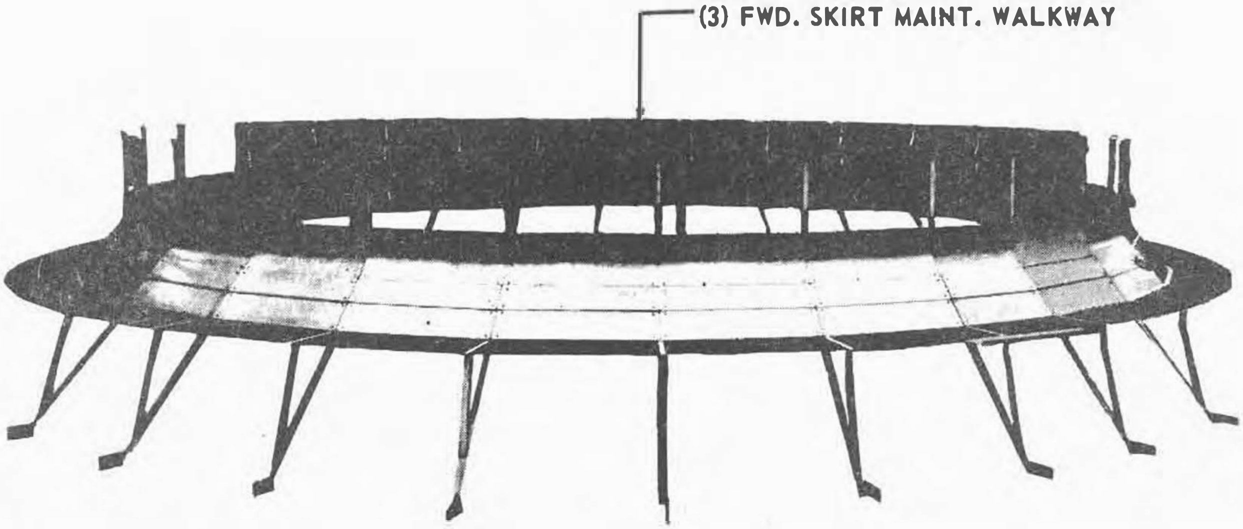


Figure 4-2. S-II Access Equipment (Sheet 1 of 3)

S-II ACCESS EQUIPMENT



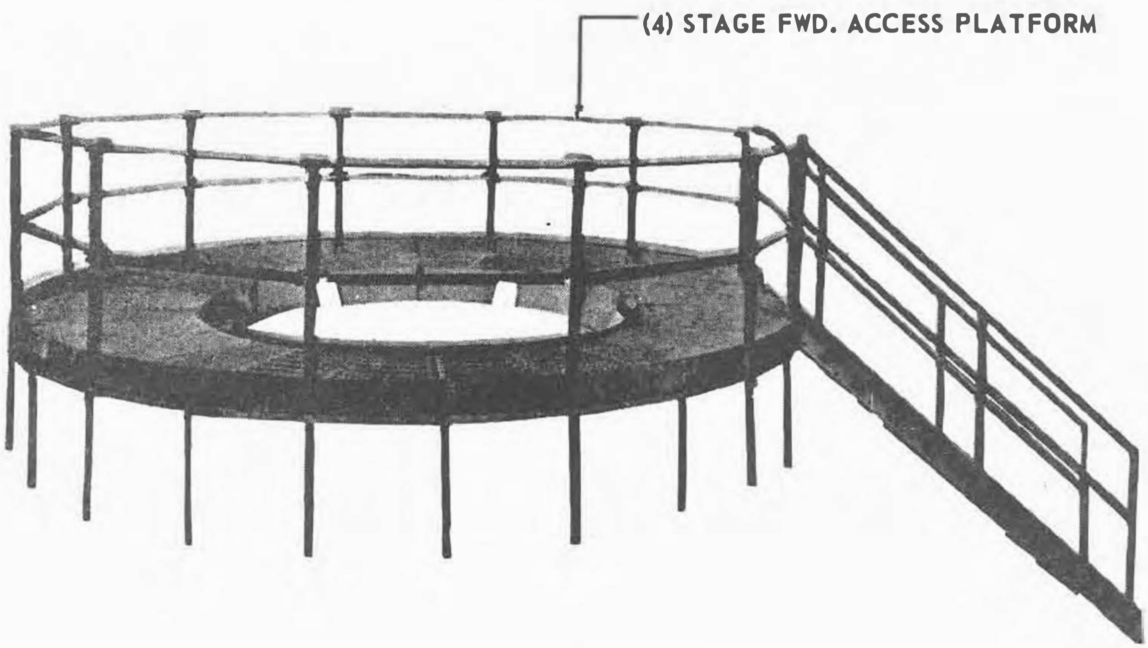
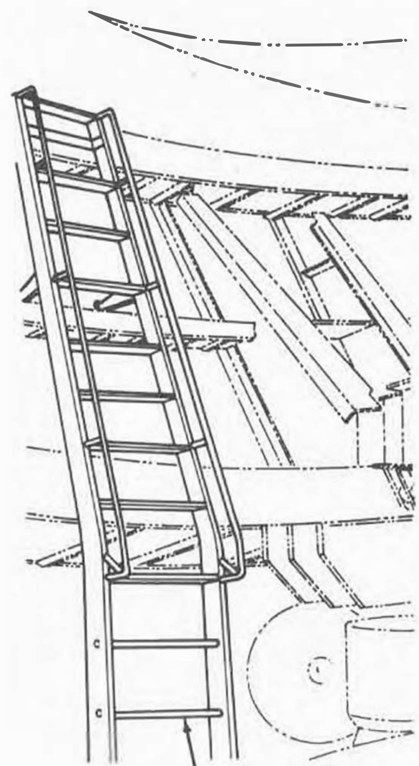


Figure 4-2. S-II Access Equipment (Sheet 2 of 3)

S-II ACCESS EQUIPMENT



(5) THRUST CONE INTERNAL ACCESS LADDER

Figure 4-2. S-II Access Equipment (Sheet 3 of 3)

S-II ACCESS EQUIPMENT

1. Engine Compartment Light Set (A7-14) - Each light set is intended to provide adequate illumination of the interstage area during system test and maintenance. Thirty lamps per set are clamped to the handrail surrounding the area to provide an average illumination of 100 foot-candles. Light set hardware includes the lamp assemblies, clamps, safety shields, cables, and connectors. Power requirements per set are 15 kw, 120 vac, 60 cps, single phase.

2. Engine Compartment Platform Set (A7-84) - Data to be furnished at a later date.

3. Forward Skirt Maintenance Walkway (A7-38) - The forward skirt maintenance walkway is used for personnel access to stage components located on, or in the vicinity of, the S-II forward skirt inner wall. The walkway is designed specifically for personnel support and is not intended for use with mobile or heavy maintenance equipment. The major components of the walkway are as follows: 29 platform assemblies, constructed of aluminum honeycomb and surfaced with anti-skid material; 29 siding assemblies made from aluminum alloy sheet; 29 siding assemblies of nylon sheet suspended by railing of mylar rope, for safety purposes; and the platform and railing support assemblies made from aluminum alloy tubing.

4. Stage Forward Access Platform (A7-44) - The stage forward access platform provides means for personnel to gain access to the stage erecting sling connection, to attach or detach a facility crane hook to the stage erecting sling for hoisting operations, and to gain access to the LH_2 tank access door for tank entry. The platform attaches to the forward hoisting frame and incorporates steps and handrails. The platform is aluminum grating and the handrails, steps, and other structural components are aluminum, the total assembly weighing approximately 1500 pounds.

5. Thrust Cone Internal Access Ladder (A7-85) - Data to be furnished at a later date.

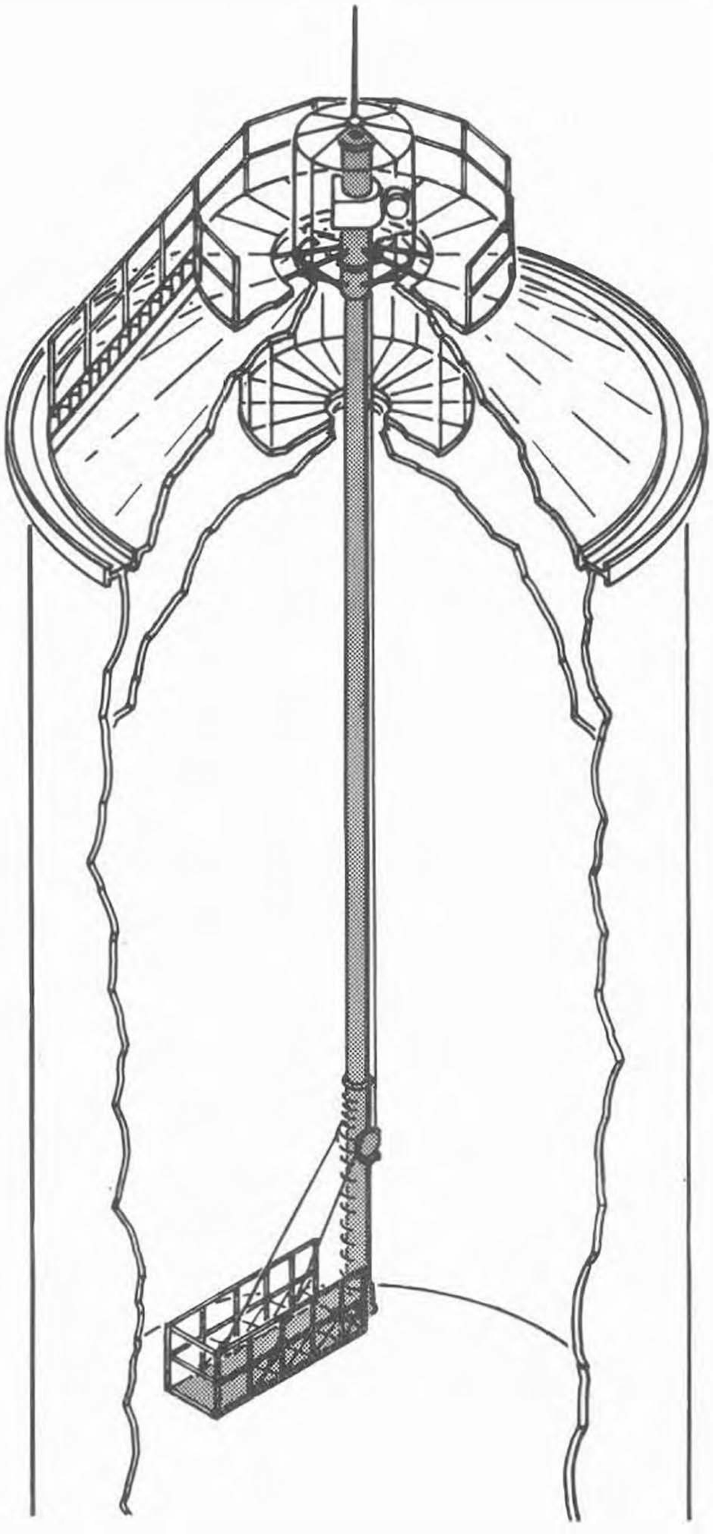


Figure 4-3. LH_2 Tank Servicing Mechanism (A7-35)

LH_2 TANK SERVICING MECHANISM (A7-35)

1. Functional Description

a. The LH_2 Tank Servicing Mechanism provides means for LH_2 tank access during instrument installation, maintenance, and inspection operations. The mechanism supporting members are installed on the forward hoisting frame hoist fittings and the shaft is then installed in segments.

b. The mechanism includes the following major components and subsystems:

(1) The overhead support, to support all necessary personnel and equipment required for tank maintenance.

(2) The vertical shaft, attached to the overhead support above the stage and extending through the tank access hatch into the LH_2 tank to a depth required for servicing.

(3) The sleeve, riding the outside diameter of the vertical shaft, to support a work platform and allow mechanical positioning of the platform.

(4) The work platform, attached to the lower portion of the sleeve to allow positioning both vertically and horizontally. The platform has handrails and the length is adjustable to suit tank access needs.

(5) Positioning motors and controls, to position the work platform vertically on the vertical shaft and radially about the vertical shaft.

c. The positioning speeds for the platform are 10 fpm vertically and 0.5 radians per minute radially.

2. Facility Requirements

To be determined.

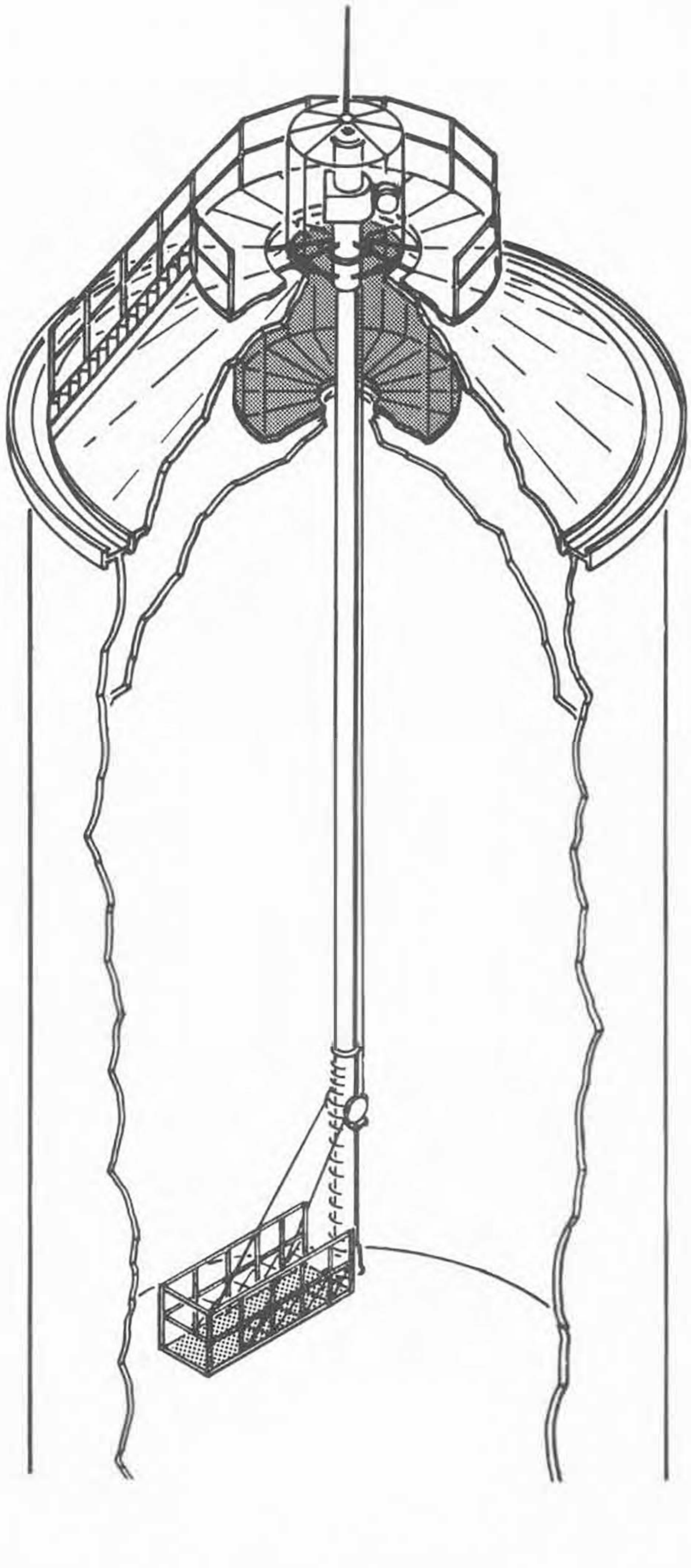


Figure 4-4. LH_2 Tank Clean Room (A7-39)

LH_2 TANK CLEAN ROOM (A7-39)

1. Functional Description

a. The LH_2 Tank Clean Room provides a dust-free, controlled environment enclosure encompassing the work area over the LH_2 tank entry access door. The room provides an uncontaminated area for personnel and equipment while maintenance operations are in progress.

b. The room consists of the following major components and subsystems:

(1) The support structure, to encompass the clean room, attached to the forward hoisting frame.

(2) The room, installed in the support structure, consisting of a change area and a standby area separated by a bulkhead containing a door. The change area provides space for personnel and equipment preparing to enter the standby area. The standby area provides access to the LH_2 tank.

c. The clean room provides uncontaminated conditions while servicing and maintaining the equipment inside the LH_2 tank. The room is constructed of transparent, non-reinforced material with a bellows at the top and bottom of the standby area to permit passage of the tank servicing mechanism into the LH_2 tank.

Additional data will be provided at a later date.

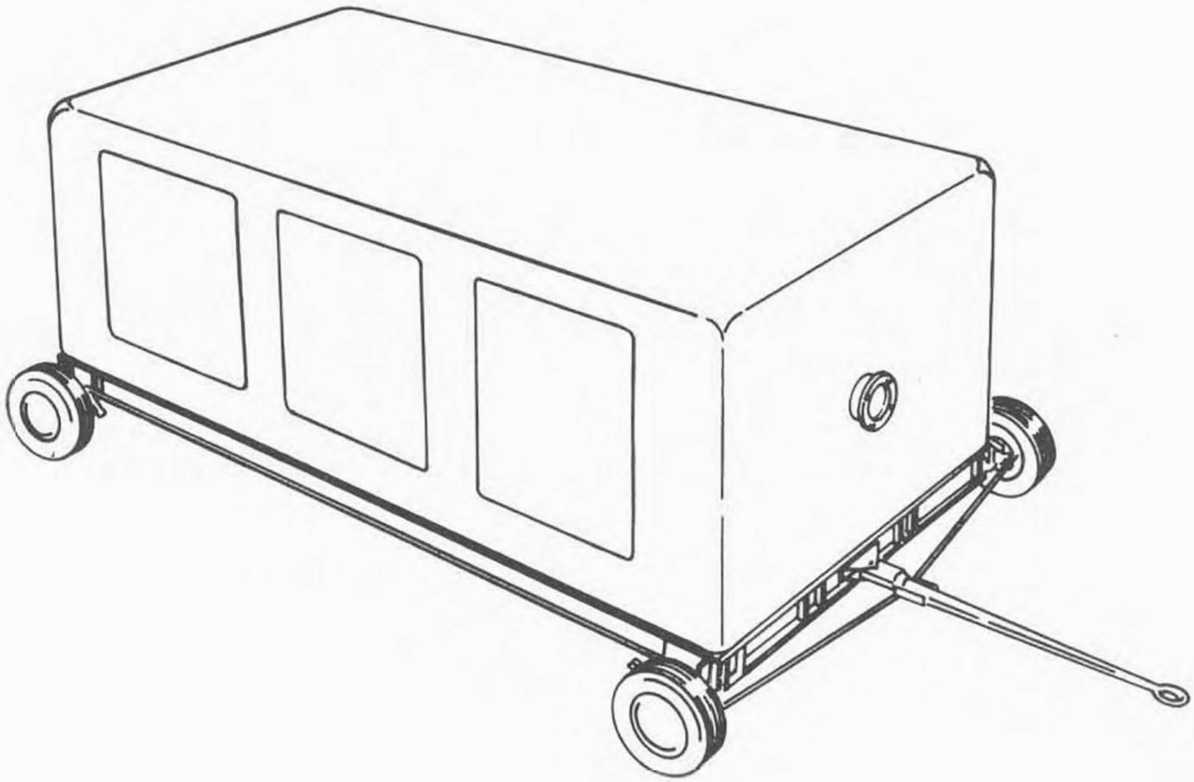


Figure 4-5. LH_2 Tank Servicing Air Conditioner (A7-40)

LH_2 TANK SERVICING AIR CONDITIONER (A7-40)

1. Functional Description

a. The LH_2 Tank Servicing Air Conditioner is required for purging the LH_2 tank and for supplying conditioned air to the tank. It is capable of a maximum flow rate of 2000 cfm, against a static pressure of 7 inches of water, to maintain a tank outlet temperature of 80° F.

b. The air conditioner includes the following major components and subsystems:

(1) The refrigeration system, which includes a compressor, condenser, evaporator, and a conditioned air blower. The refrigeration system receives high temperature ambient air, removes a maximum of 210,000 BTU/H from the air, and supplies warm air to the tank.

(2) The heating system, which includes electric strip heaters and a conditioned air blower. The heating system receives low temperature ambient air, adds a maximum of 220,000 BTU/H to the air, and supplies warm air to the tank.

(3) The control system, to regulate the flow rates, pressures, and output temperatures of both the conditioned air and the refrigerating media.

c. The air conditioner is completely enclosed in a lightweight metal enclosure containing access doors and air intake and exhaust openings, and is mounted on a four wheel trailer capable of being towed at low speeds.

2. Facility Requirements

To be determined.

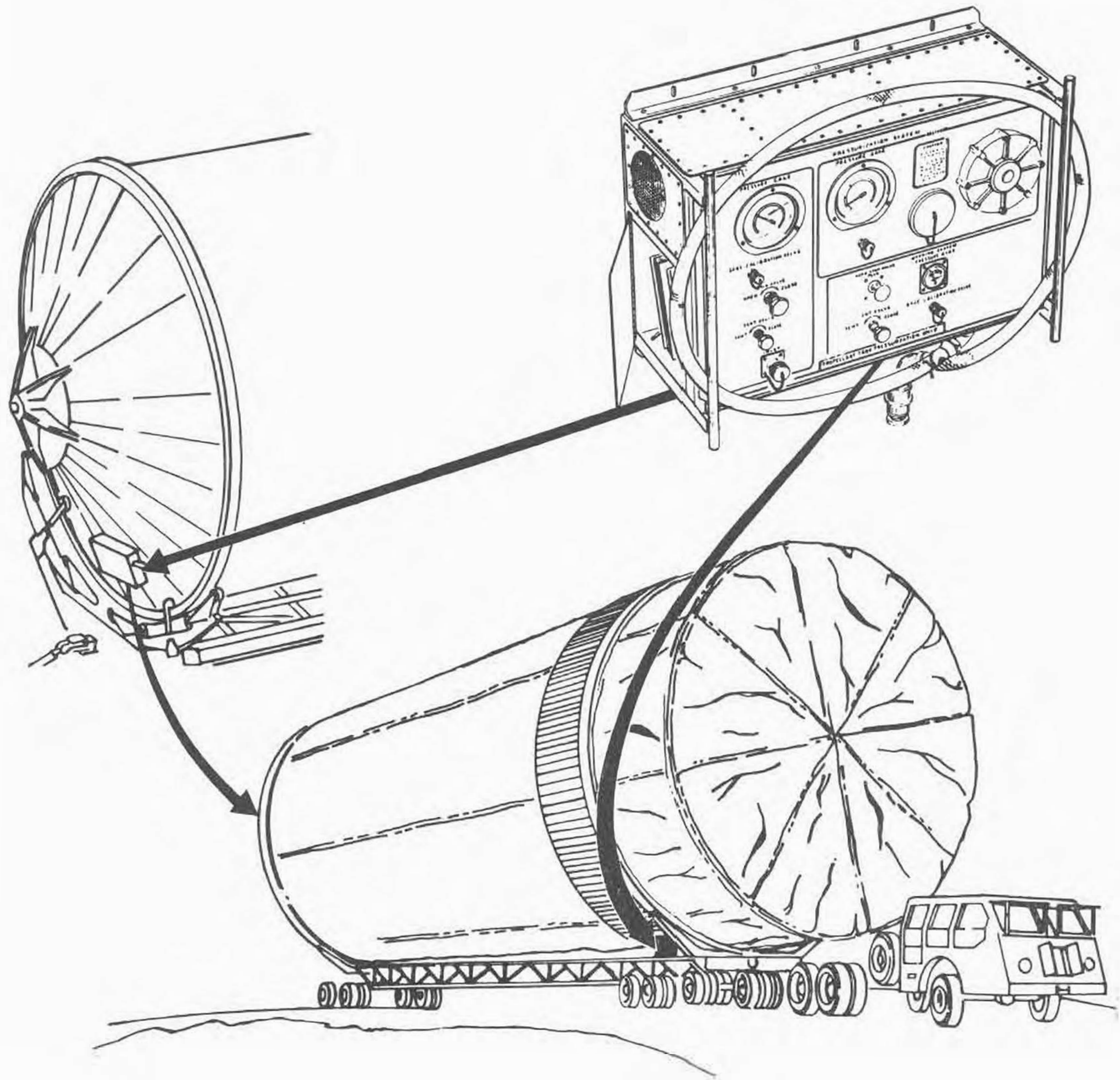


Figure 4-6. Propellant Tank Pressurization System (S7-44)

PROPELLANT TANKS PRESSURIZATION SYSTEM (S7-44)

1. Functional Description

a. The S7-44 propellant tank pressurization unit is a pneumatic system used to pressurize and maintain positive pressure in the S-II stage propellant tanks during standby, storage, and transportation. Two units are used to pressurize the LH_2 tank and LOX tank on the S-II stage. One unit is mounted on the H7-21 static firing skirt to pressurize the LOX tank; the other is mounted on the H7-24 forward hoisting frame to pressurize the LH_2 tank. Both units are mounted in an uncontrolled atmosphere. The S7-44 unit regulating components are preset to regulate input pressures ranging from 300 to 2200 psig of gaseous nitrogen, or gaseous helium to an output pressure of 3.5 to 7 psig.

b. The S7-44 unit consists of a weather-resistant cabinet which houses the components for the pressurizing and warning systems, a calibration probe, and an attaching hose. Components mounted inside the cabinet are the warning system pressure regulator, two pneumatic pressure-actuated valves, warning system pressure tank, horn filter, check valve, warning system relief valve, and the associated plumbing. The pressure outlet connector is mounted on the cabinet side panel. A storage compartment is provided on the side of the cabinet to stow the unit manual. Supplied as part of the S7-44 unit is a 25-foot flexible hose with disconnects which connect the S7-44 unit to the S-II stage tank and a calibration probe which is stored on a clip in the side panel. The probe is used during calibration of pressure gages.

2. General

a.	Dimensions, inches (Approximate)	30 x 13 x 20
b.	Weight, pounds (Approximate)	90
c.	Fluid Media	
	Gaseous Nitrogen	MIL-BB-N-411, Type I, Class I, Grade B, or equivalent
	Gaseous Helium	Bureau of Mines, type A, or equivalent
d.	Pneumatic System	
	Input Pressure	300 to 2200 psig
	Output Pressure	3.5 to 7 psig

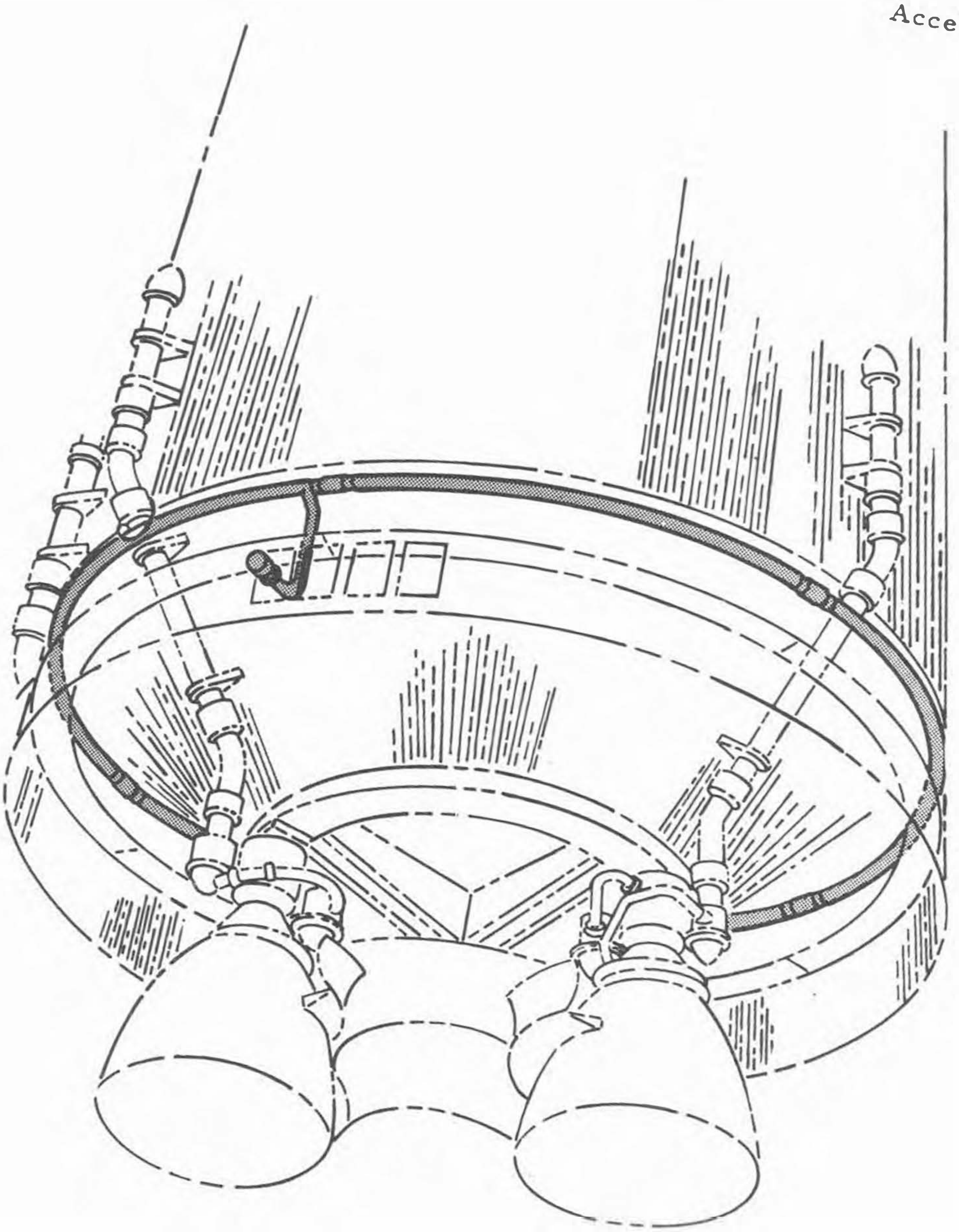


Figure 4-7. Engine Compartment Auxiliary Purge Manifold (A7-57)

ENGINE COMPARTMENT AUXILIARY PURGE MANIFOLD (A7-57)

1. Functional Description

The engine compartment auxiliary purge manifold provides a GN_2 purge between the static firing skirt and the thrust structure during static firings.

Additional data will be furnished at a later date.

S-IVB ACCESS EQUIPMENT

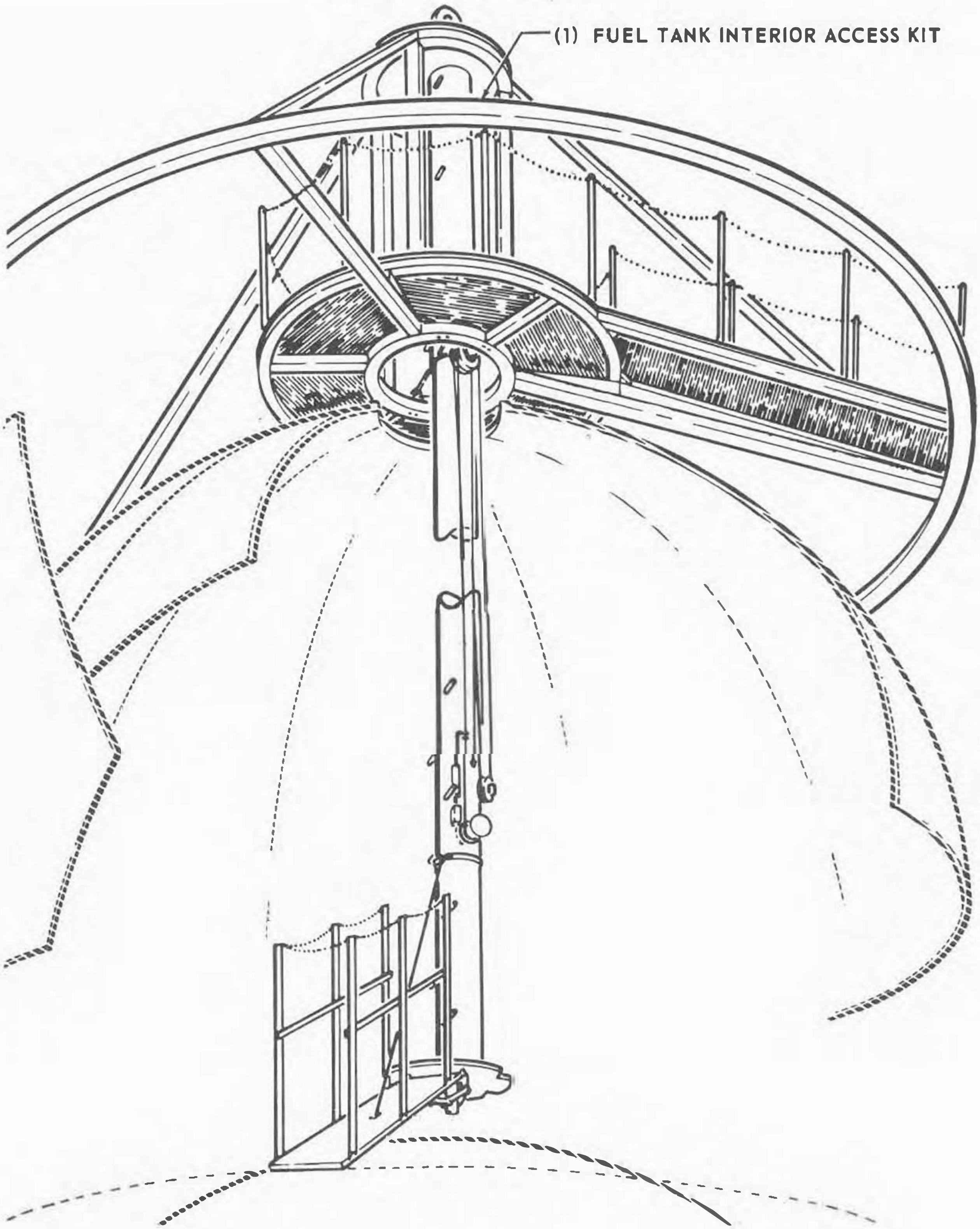


Figure 4-8. S-IVB Access Equipment (Sheet 1 of 4)

S-IVB ACCESS EQUIPMENT

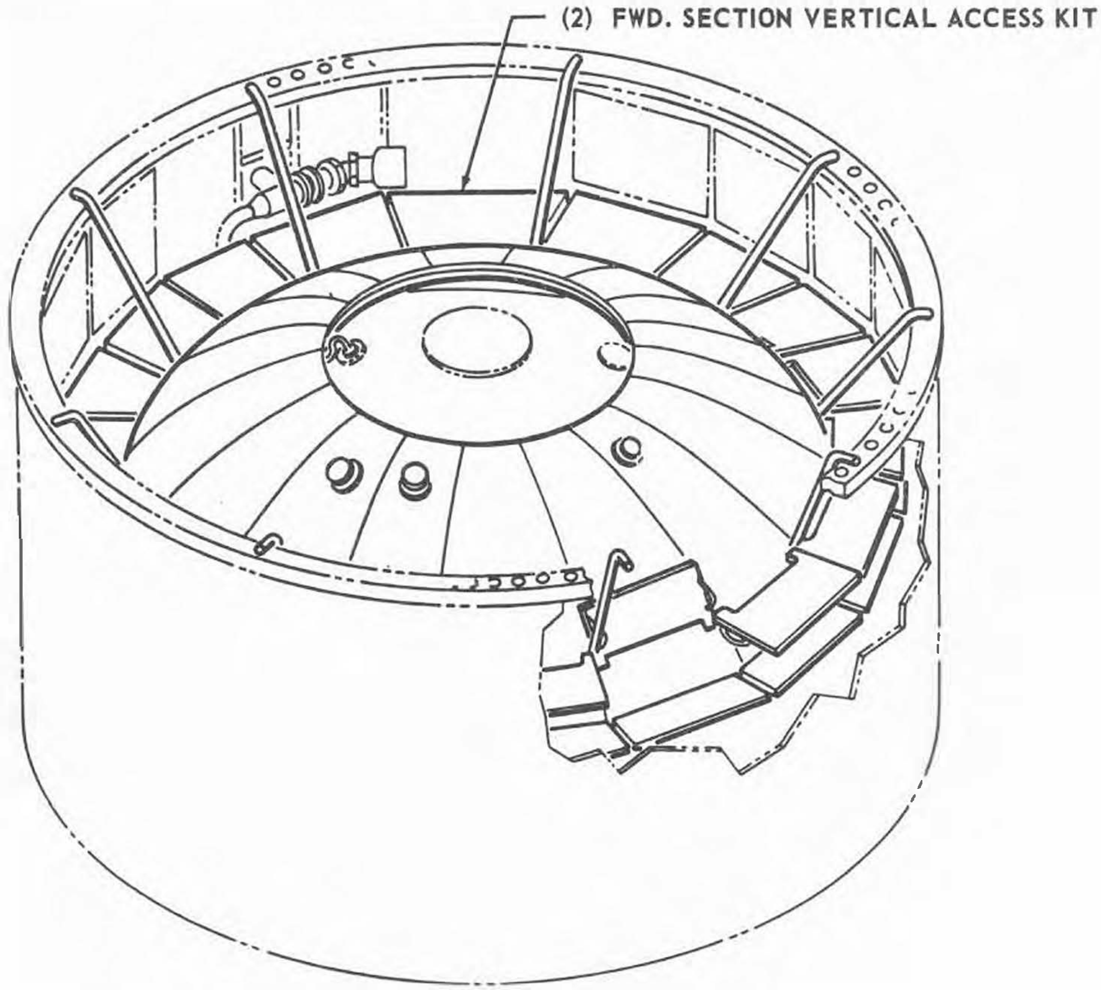


Figure 4-8. S-IVB Access Equipment (Sheet 2 of 4)

S-IVB ACCESS EQUIPMENT

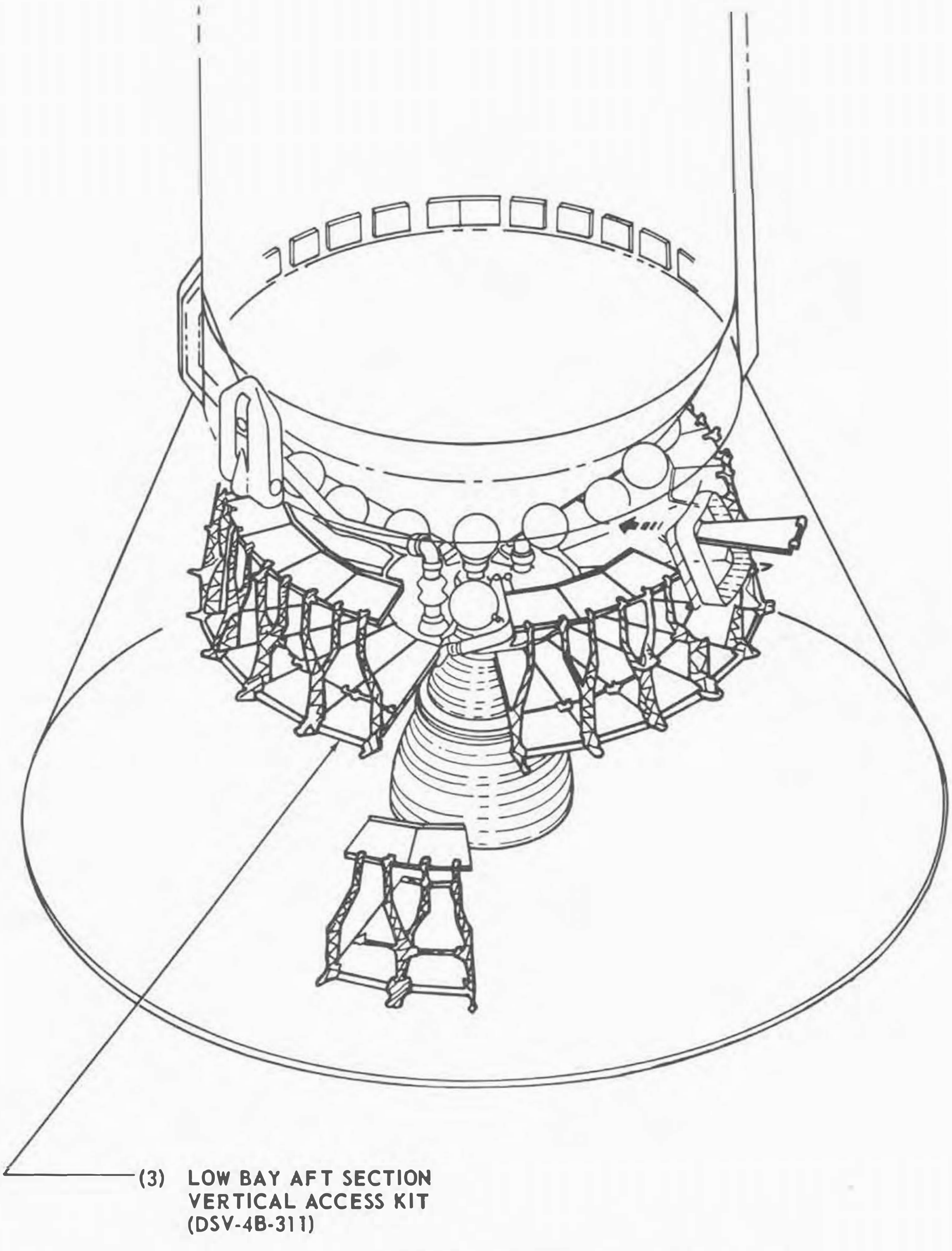


Figure 4-8. S-IVB Access Equipment (Sheet 3 of 4)

S-IVB ACCESS EQUIPMENT

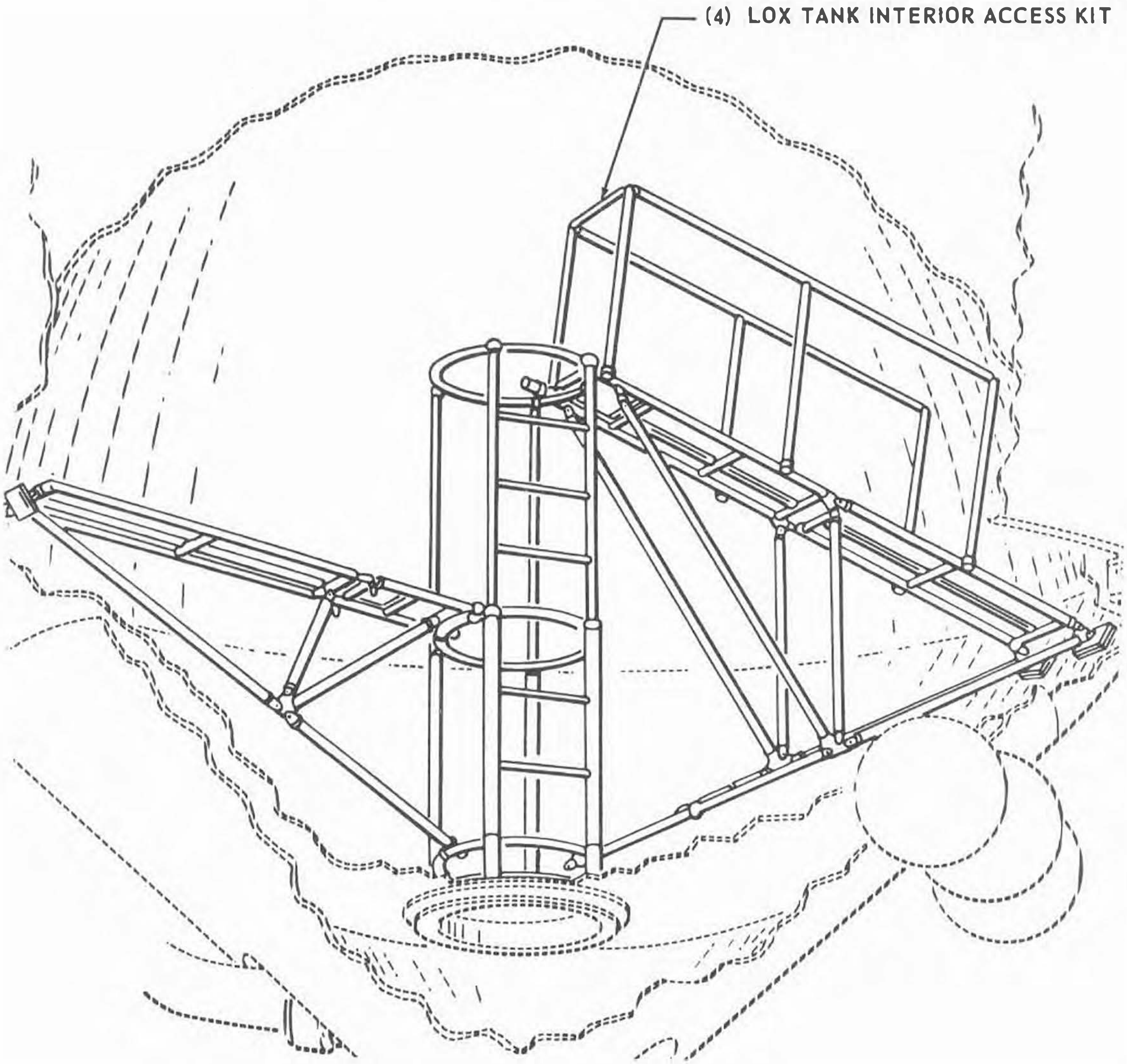


Figure 4-8. S-IVB Access Equipment (Sheet 4 of 4)

S-IVB ACCESS EQUIPMENT

1. Fuel Tank Interior Access Kit (DSV-4B-308) - The fuel tank interior access kit shall provide access, while the stage is in a vertical position, for maintenance and checkout operations, such as inspection and repair of tank wall insulation, fuel sensing probes, and helium storage spheres. It will also provide interior lighting in the tank. The kit will consist of the following components: a folding work platform, the center shaft and mechanism, support structure, floodlights, and protective covers. The tube assembly will support the platform and will move in a vertical direction. Both rotational and vertical movement will be accomplished by means of air-driven motors.

2. Forward Section Vertical Access Kit (DSV-4B-310) - The forward section vertical access kit shall provide access to the forward section of the stage for maintenance operations, while the stage is in a vertical position. The kit will provide for a walkway constructed of removable platforms. These sections will attach to brackets permanently fixed to the inside of the forward skirt. The walkway will be designed for ease of installation and will provide full circumferential access.

3. Low Bay Aft Section Vertical Access Kit (DSV-4B-311) - The aft section vertical access kit shall provide access to the aft section of the stage for maintenance operations, while the stage is in a vertical position. The kit will consist of a series of removable work platforms. These platforms will attach to the vertical interstage stiffeners. Cables will support the extremities of the work platform. Entrance to the aft section will be provided by a door in the aft interstage adjacent to the umbilical arm.

4. LOX Tank Interior Access Kit (DSV-4B-348) - The LOX tank interior access kit shall provide access to the interior of the LOX tank for maintenance, checkout, and inspection operations, while the stage is in a vertical position. It will also be used for installing, adjusting, and checking out the instruments used during testing operations. The kit will consist of ladders, supports, and platforms, inserted through the engine thrust structure and into the LOX tank. The platforms will be of multi-level construction to provide complete access to the interior of the tank, and will be capable of 360° rotation within the tank. The ladders and platforms will be supported by a plate attached to the LOX tank flange and by pads resting on the tank. The kit will also provide lighting equipment to illuminate the interior of the tank.

I.U. ACCESS EQUIPMENT

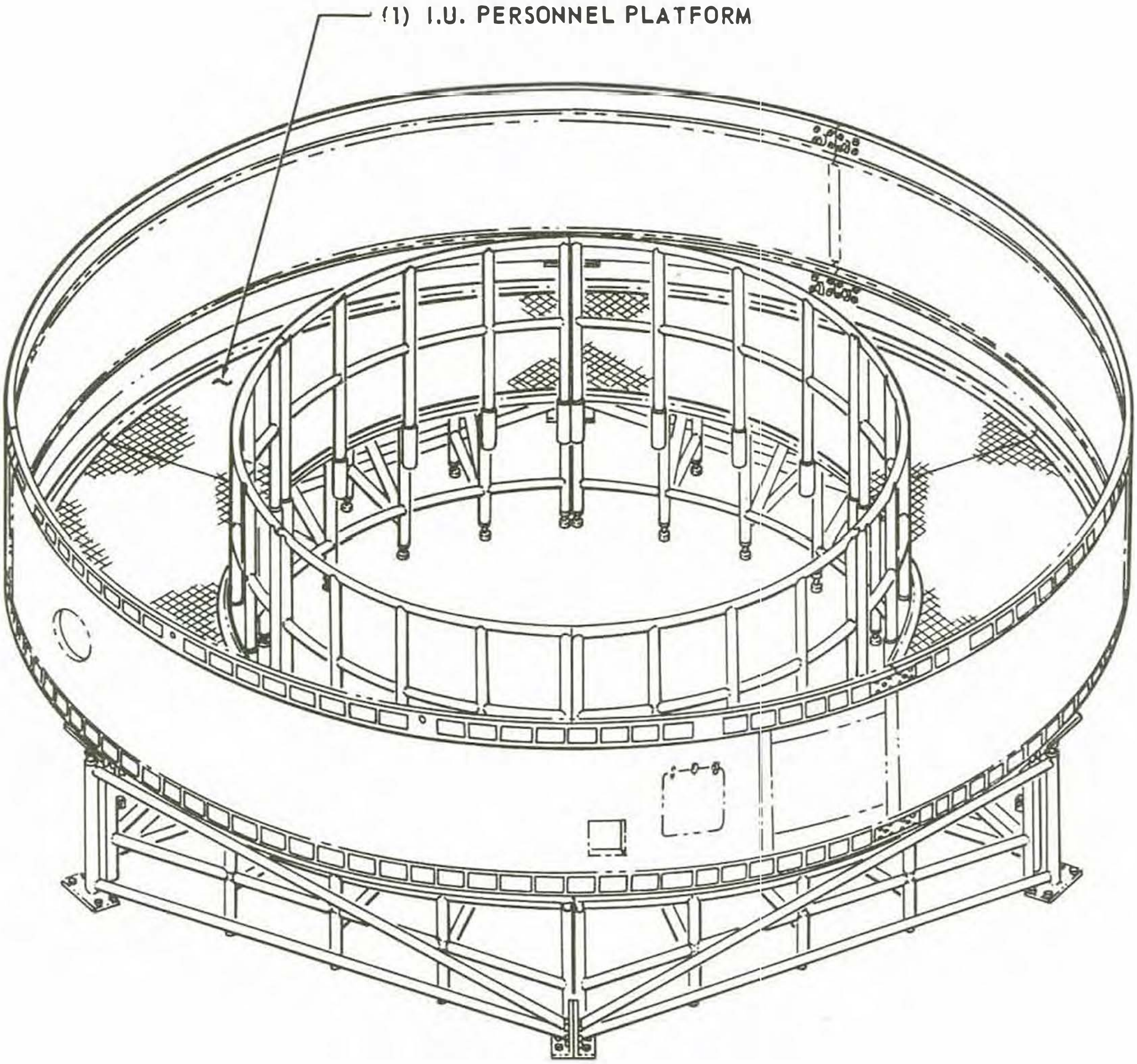


Figure 4-9. I. U. Access Equipment

I. U. ACCESS EQUIPMENT

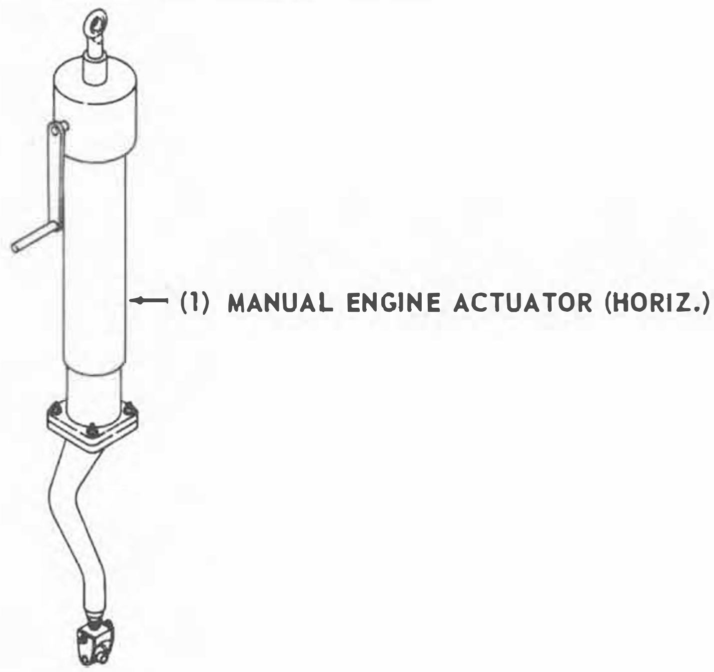
1. I. U. Personnel Platform - The inside work platform assembly is used to provide convenient access and work space for personnel within the I. U. during final assembly.

SECTION V
HANDLING AND AUXILIARY EQUIPMENT

This section presents information on the various stage handling and auxiliary equipment, with a brief description and a visual presentation of each individual item of equipment. The section is sub-divided into the S-IC stage handling and auxiliary equipment, the S-II stage, the S-IVB stage, the I. U., and the launch vehicle handling and auxiliary equipment.

The handling and auxiliary equipment is required for use in conjunction with handling, installation, removal, alignment, or maintenance operations on the various stages. This section will be revised and/or added to as more data on the handling and auxiliary equipment becomes available.

S-IC HANDLING & AUXILIARY EQUIPMENT



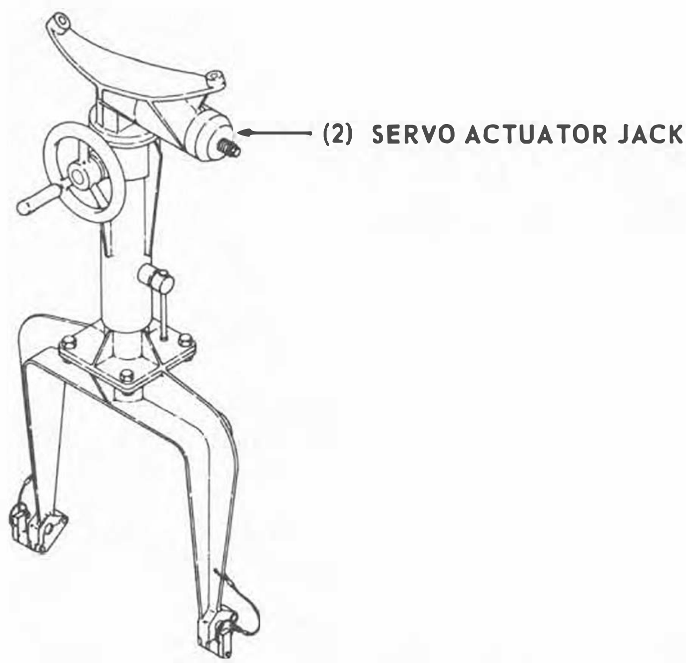
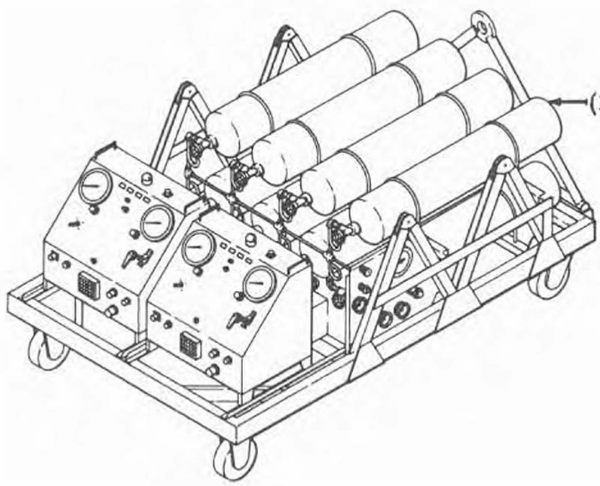


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 1 of 17)

S-IC HANDLING & AUXILIARY EQUIPMENT



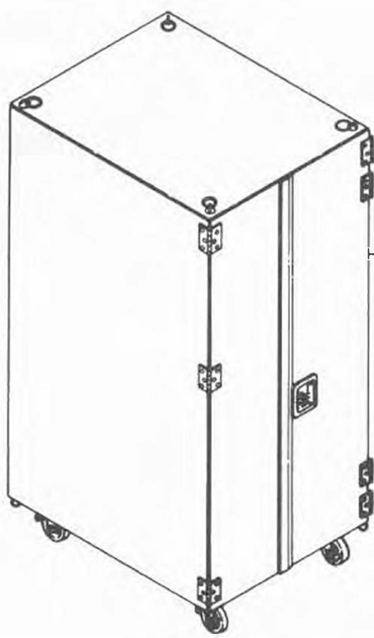
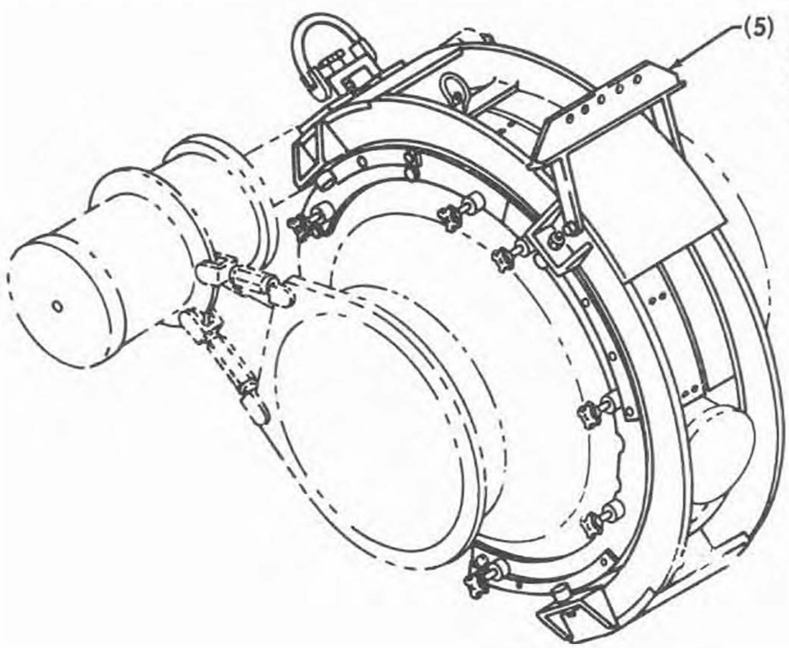


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 2 of 17)

S-IC HANDLING & AUXILIARY EQUIPMENT



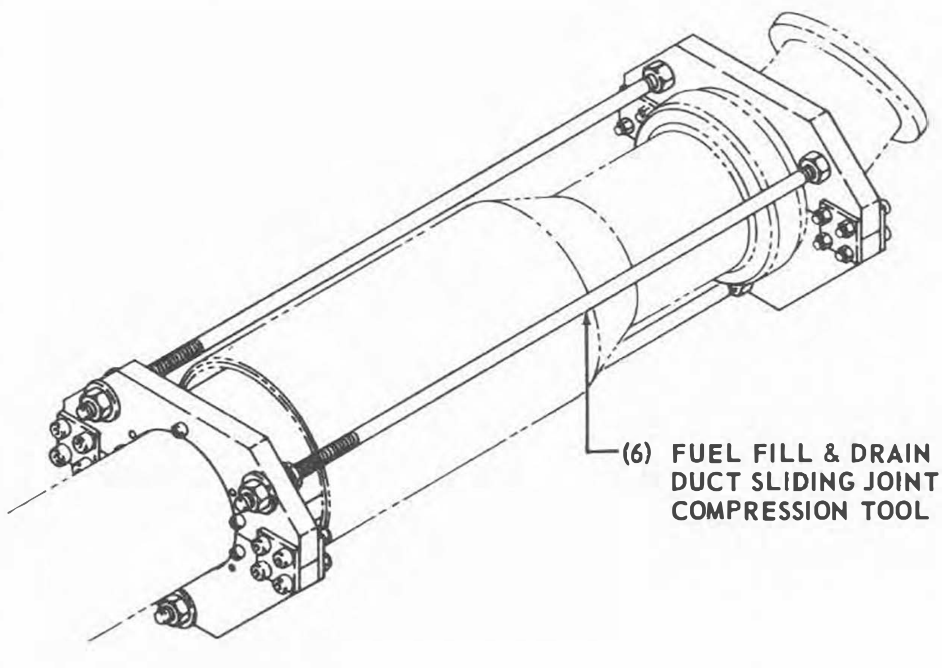
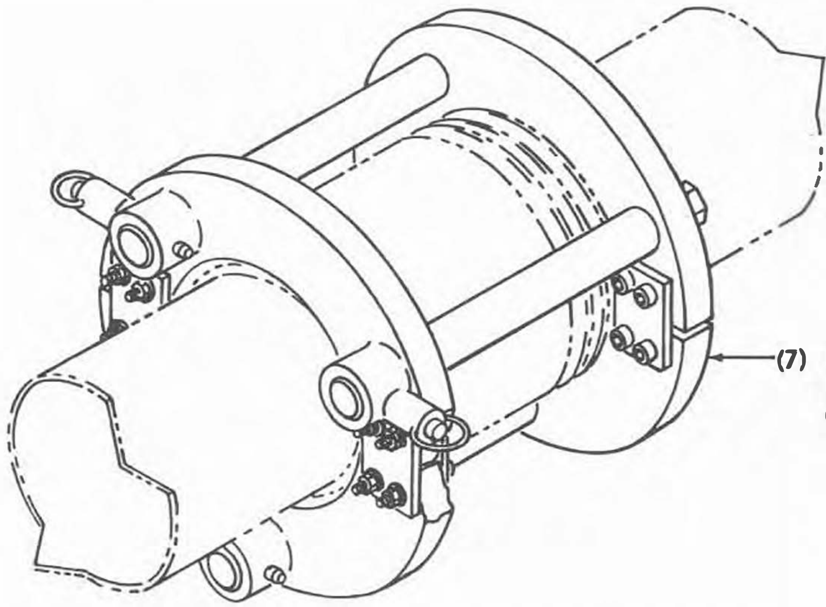


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 3 of 17)

S-IC HANDLING & AUXILIARY EQUIPMENT



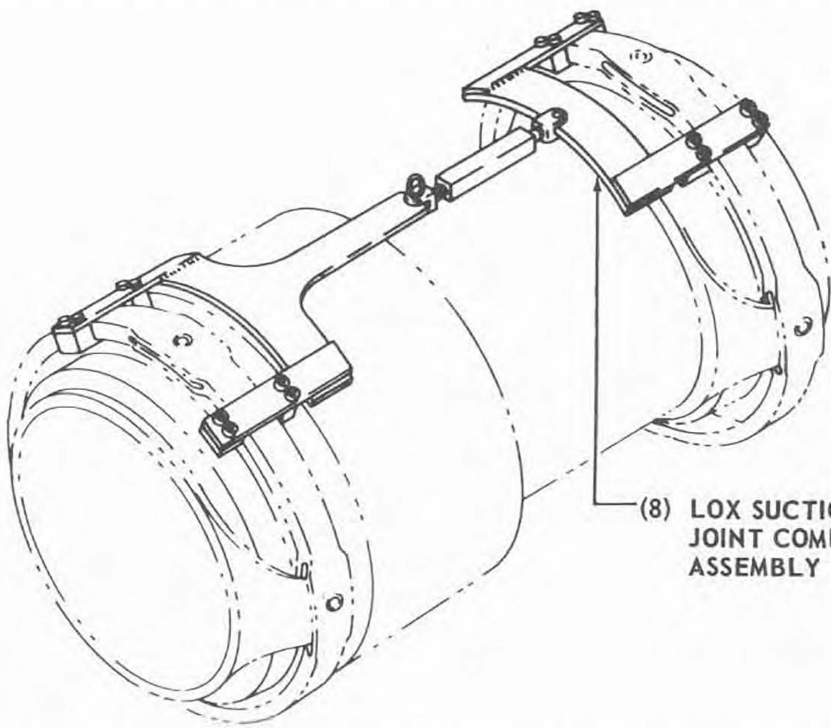
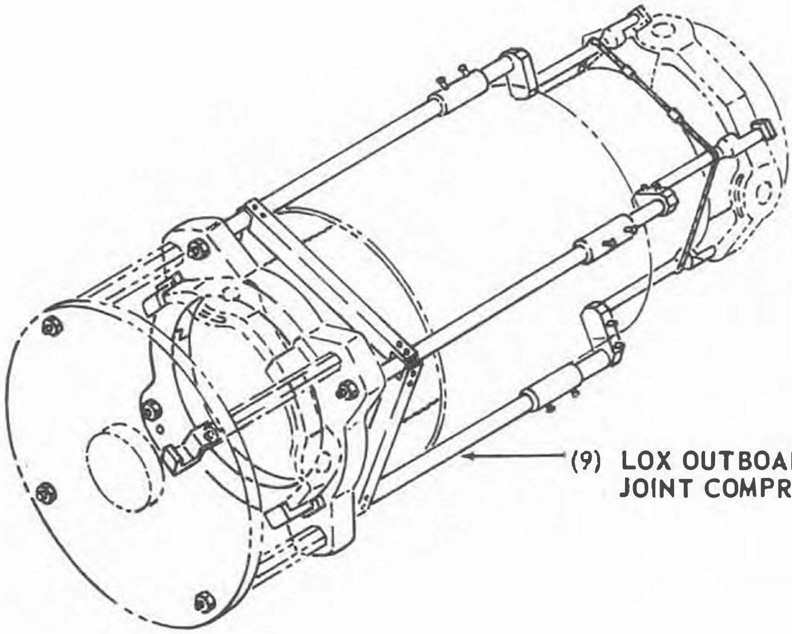


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 4 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



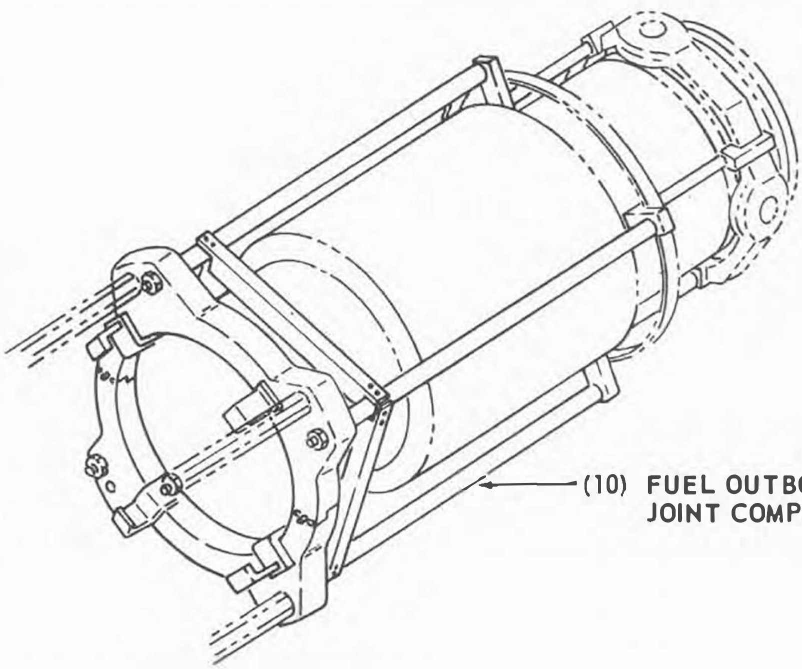
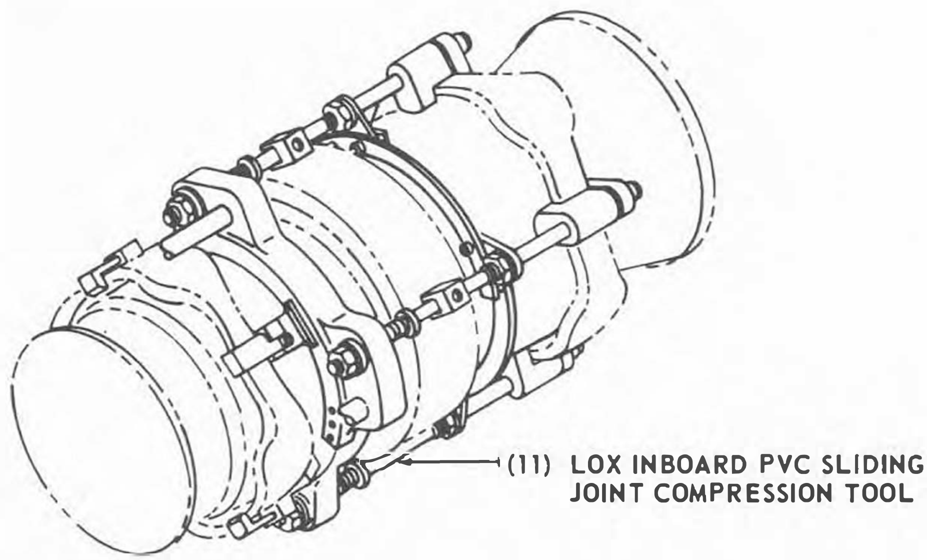


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 5 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



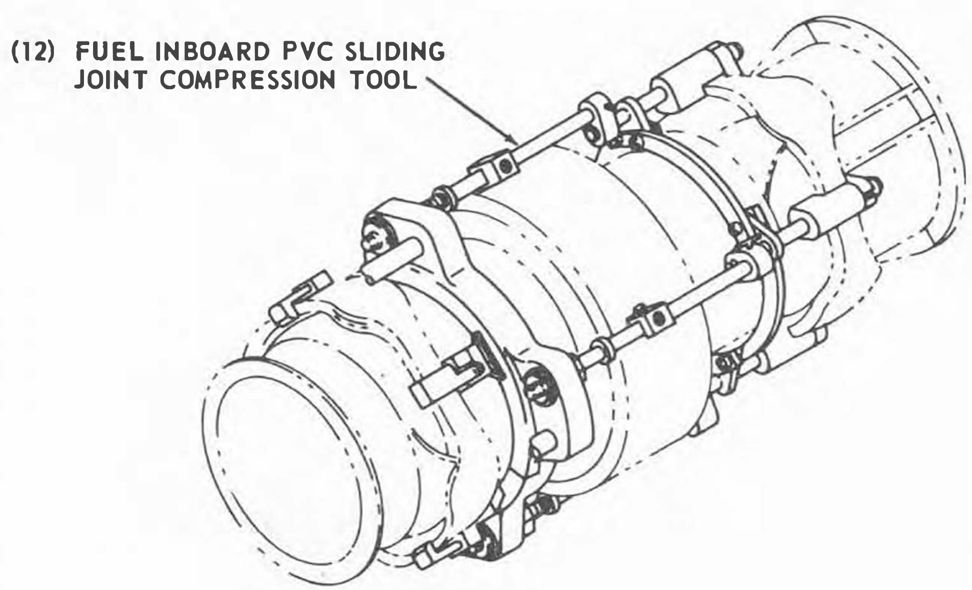


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 6 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT

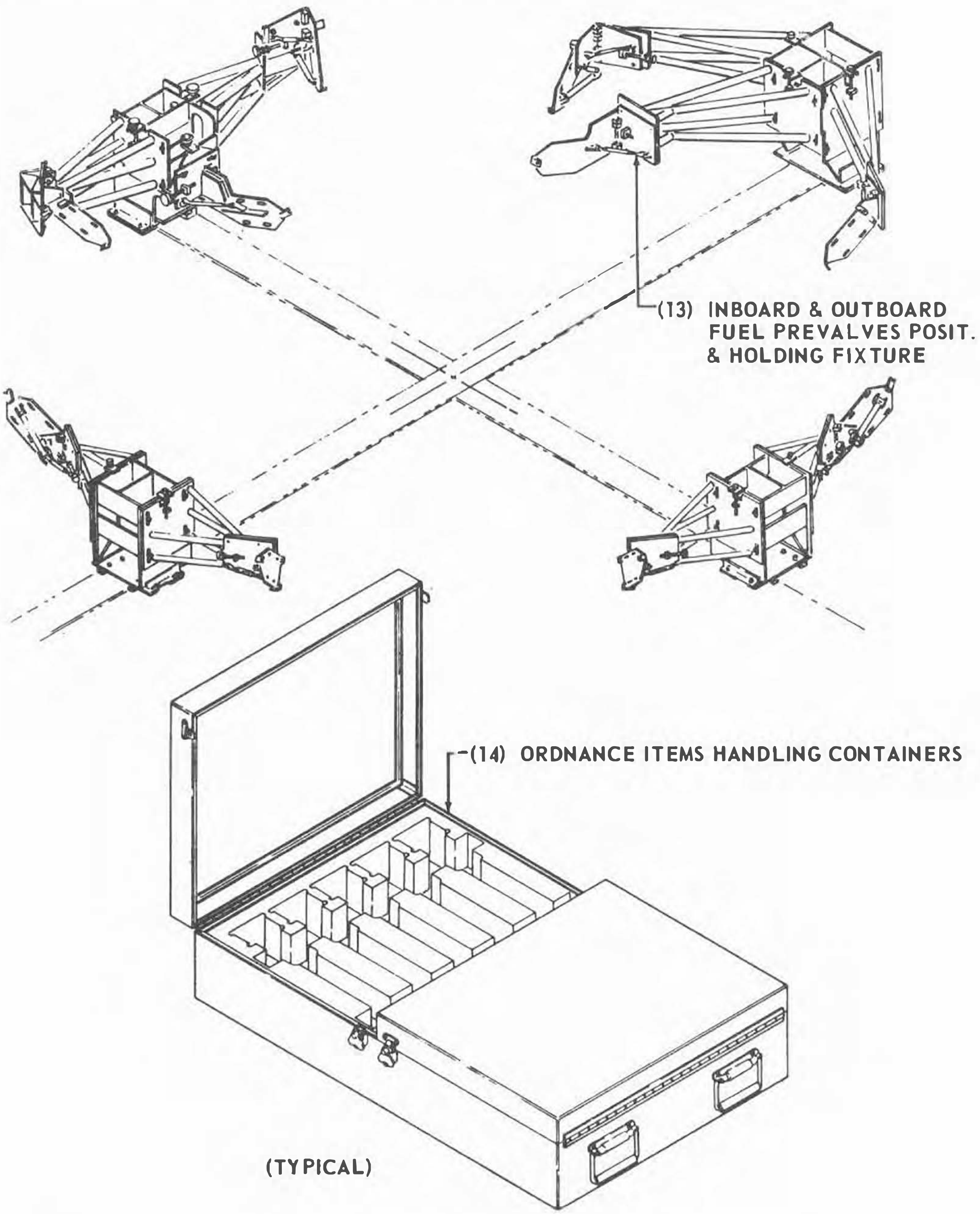


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 7 of 17)

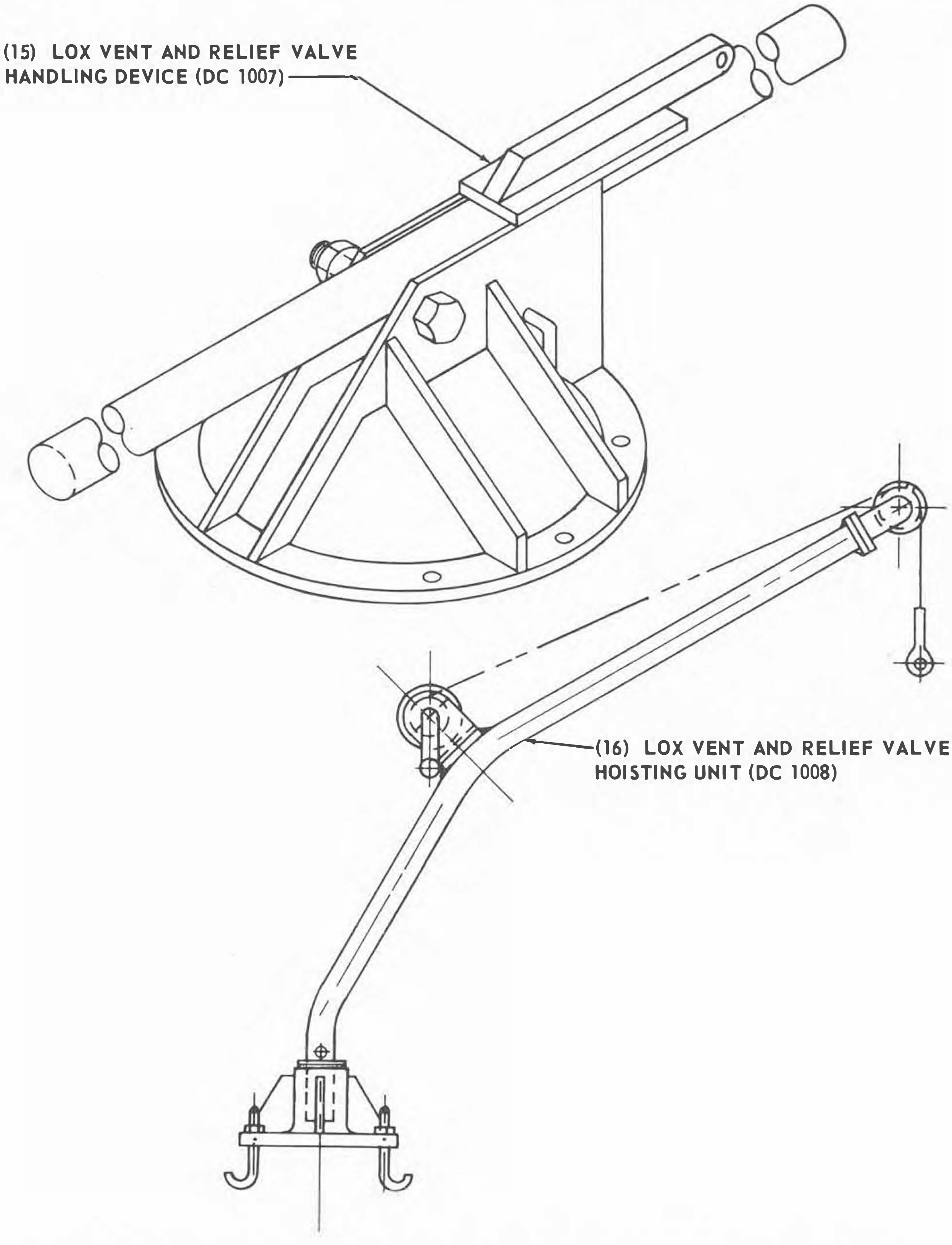


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 8 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT

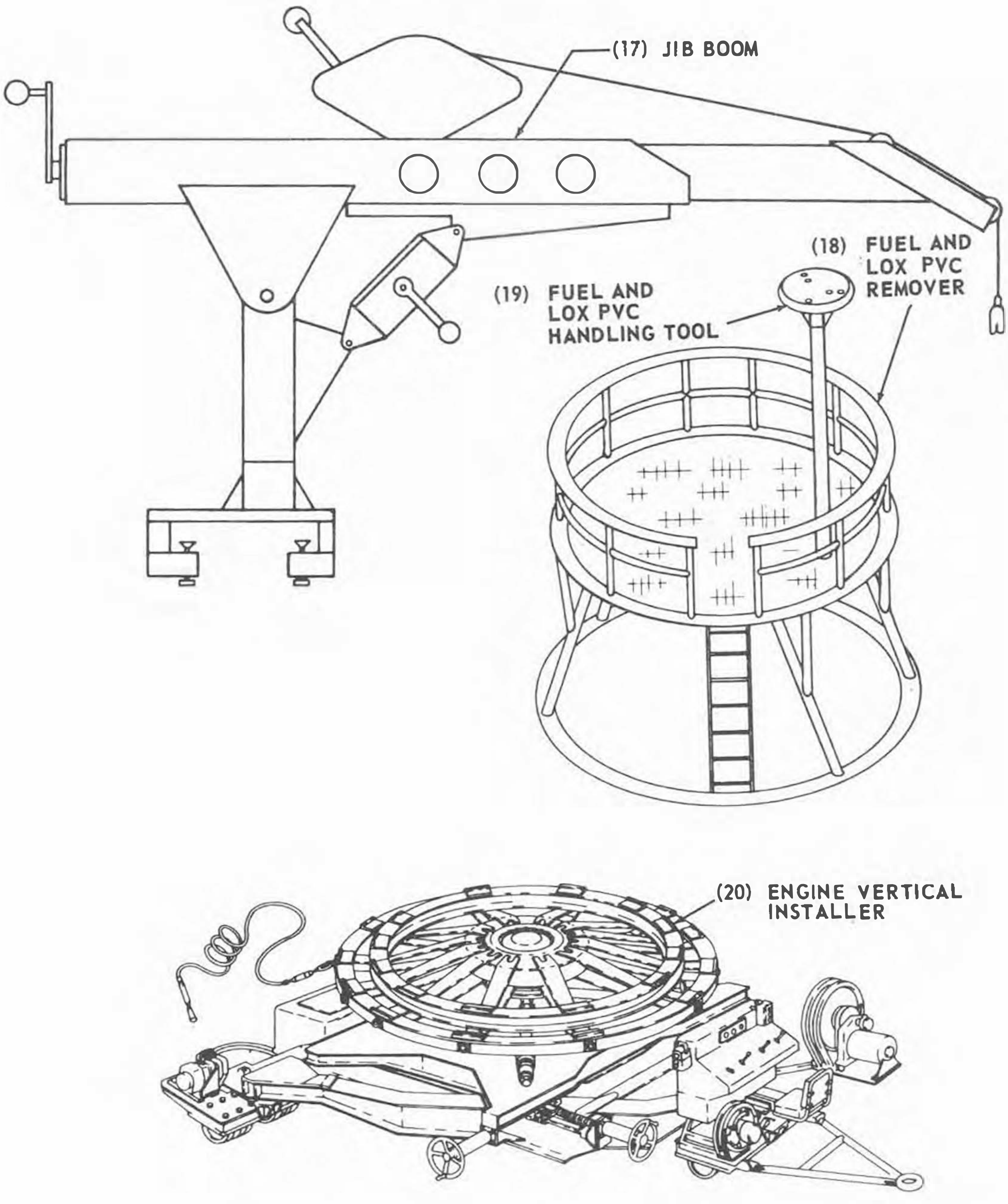
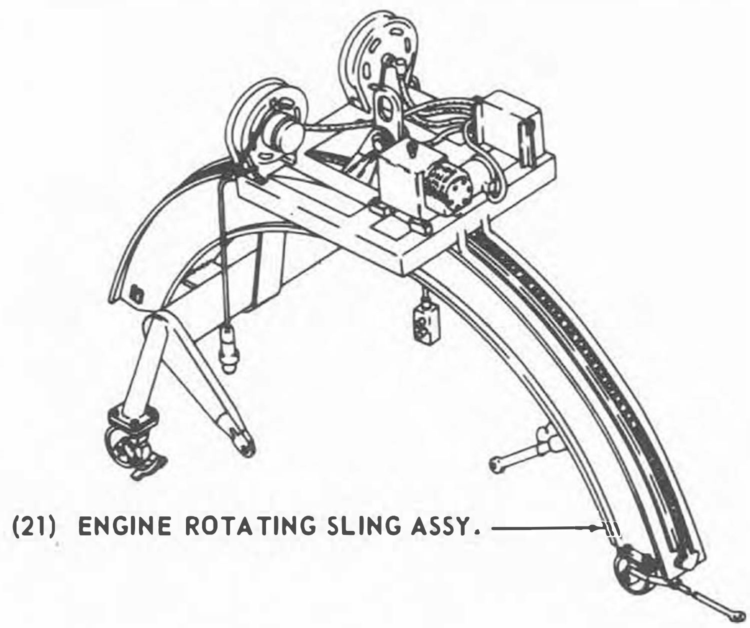


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 9 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



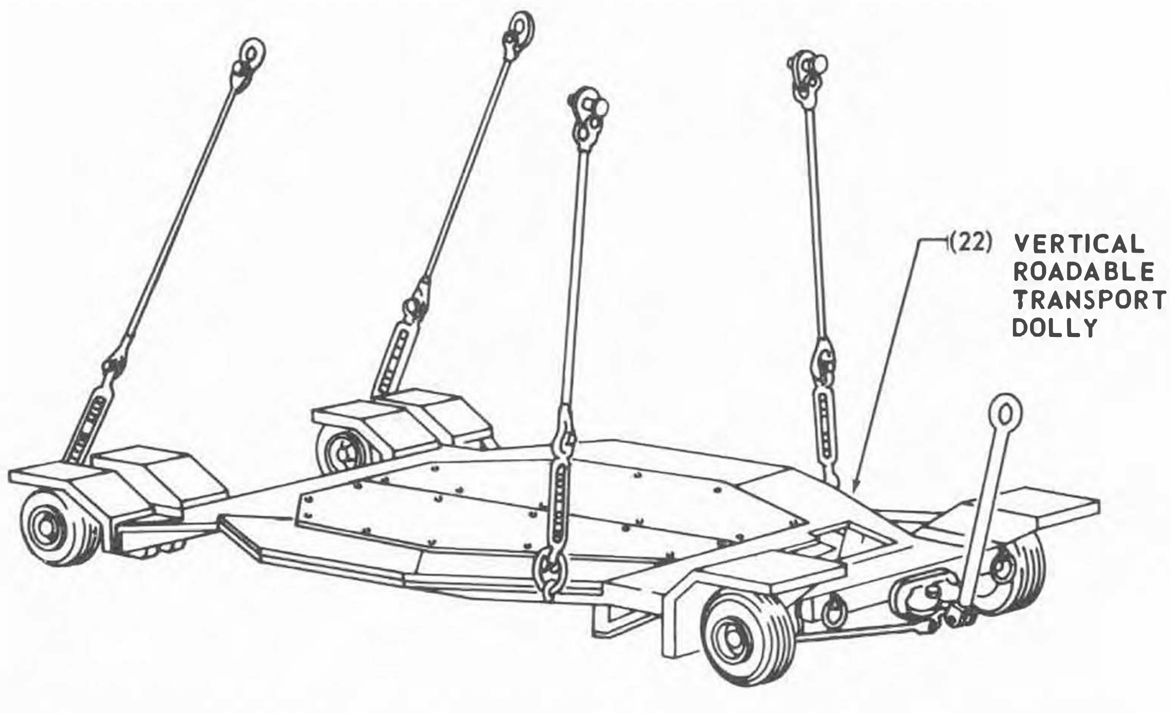


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 10 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT

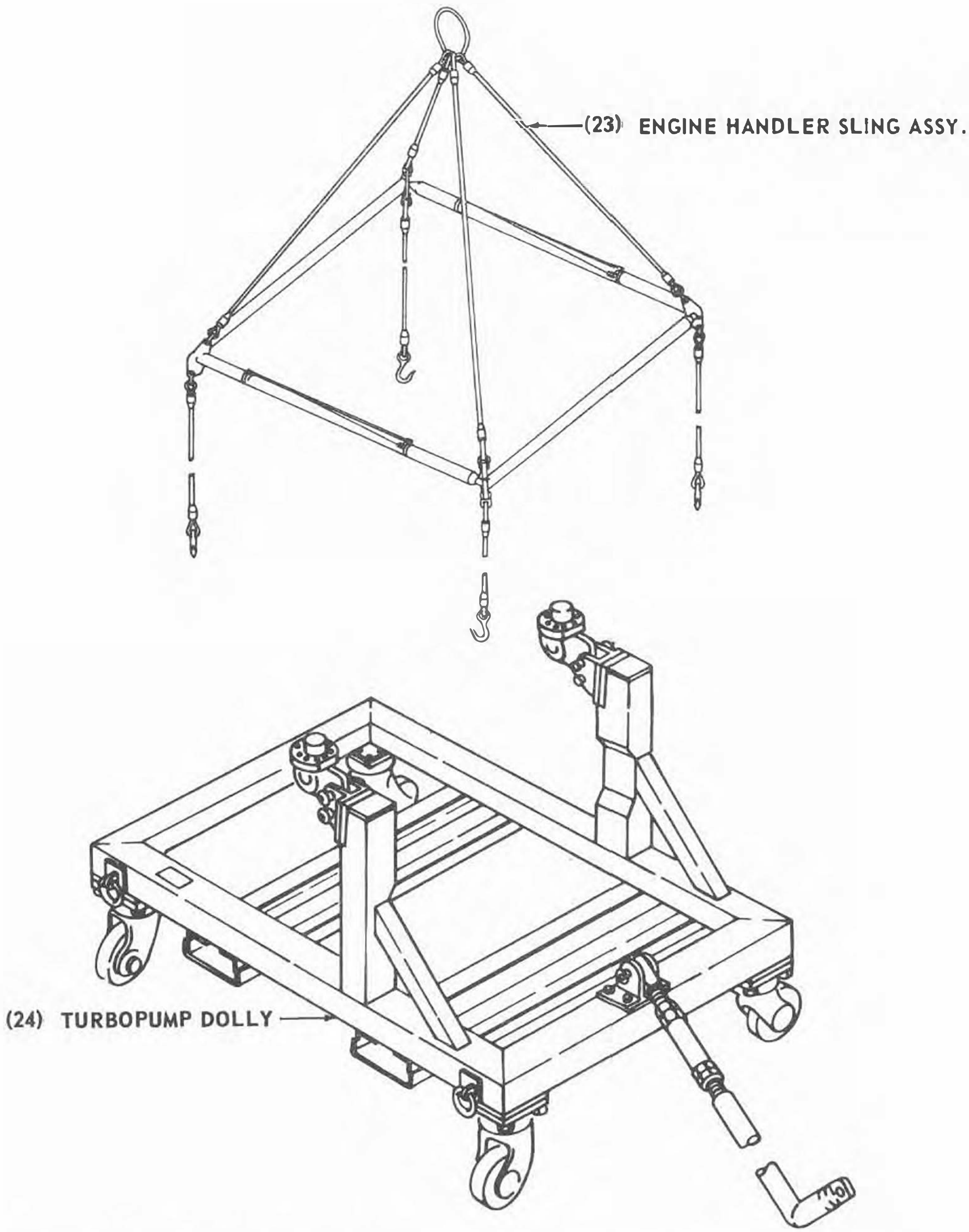
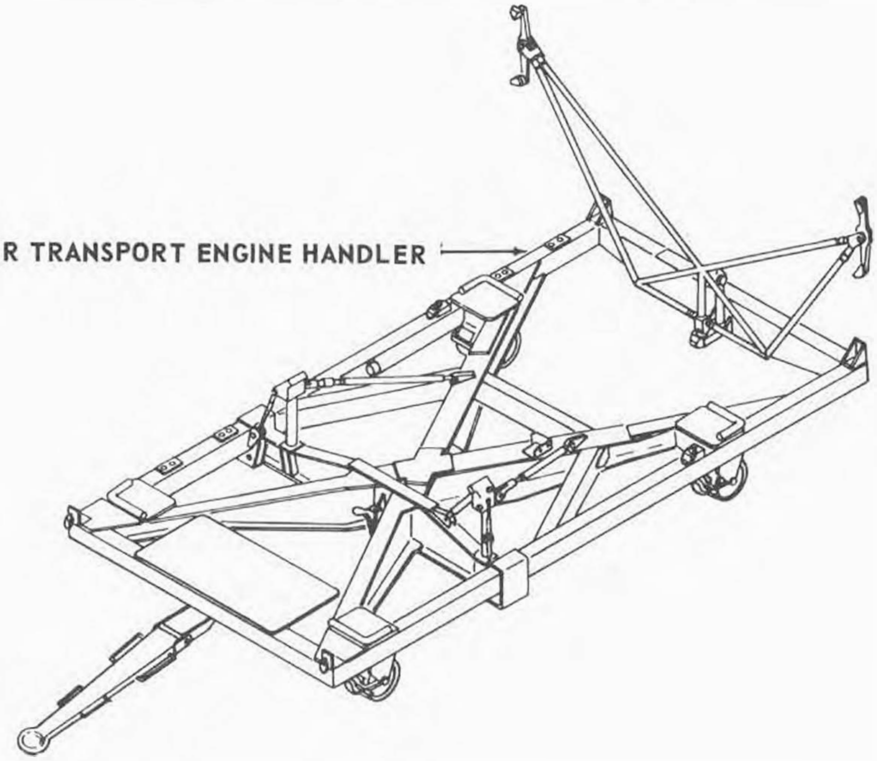


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 11 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



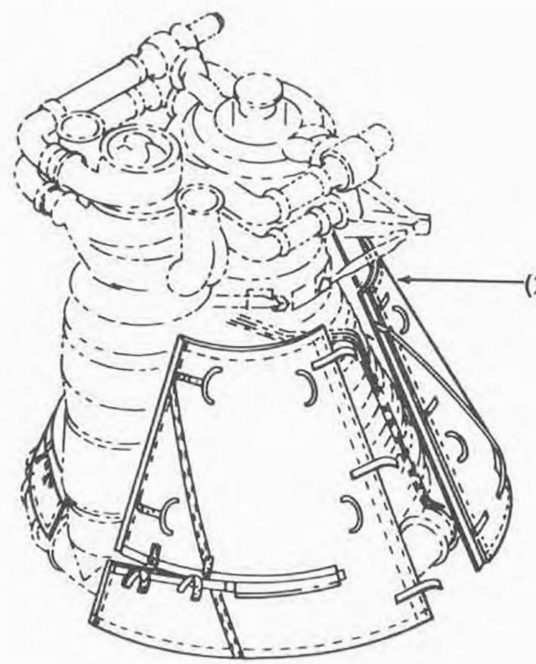
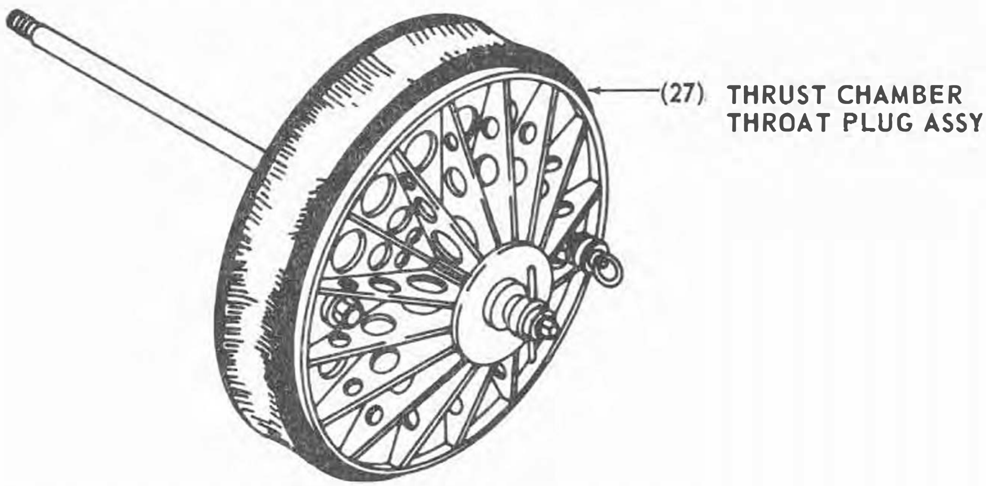


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 12 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



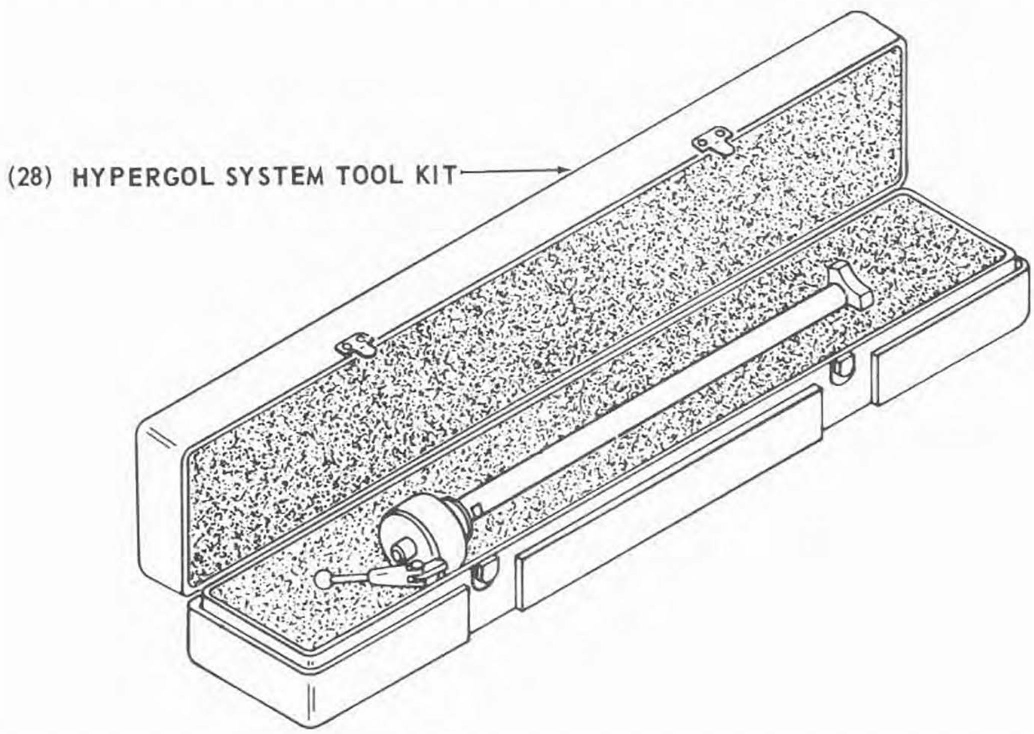
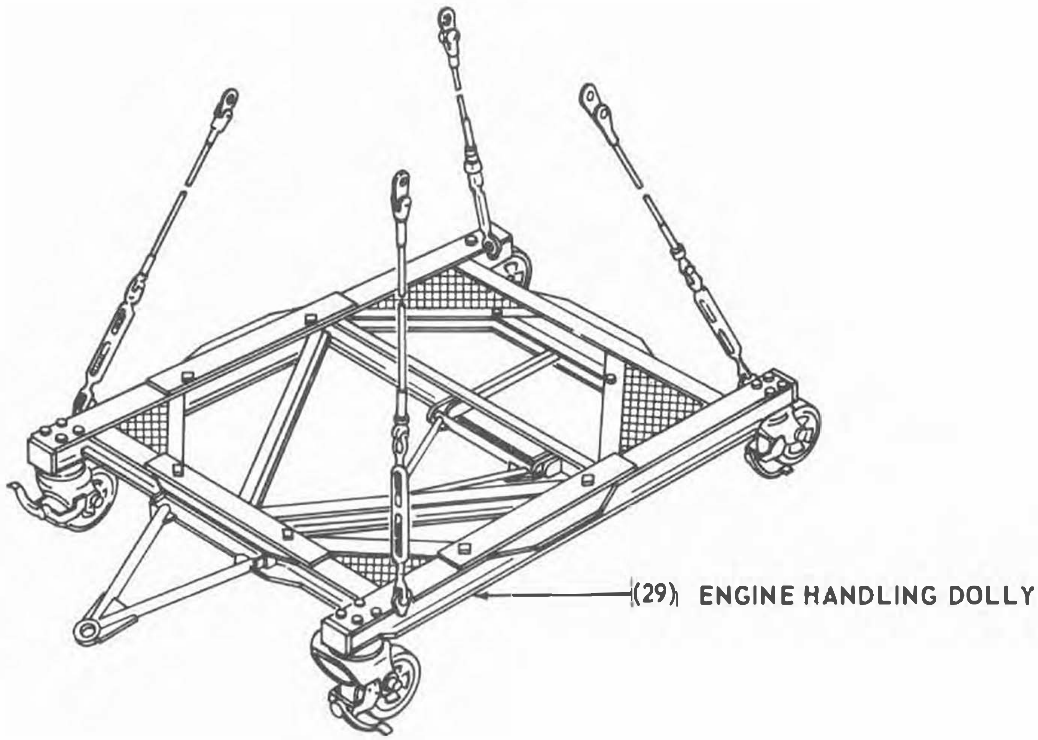


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 13 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



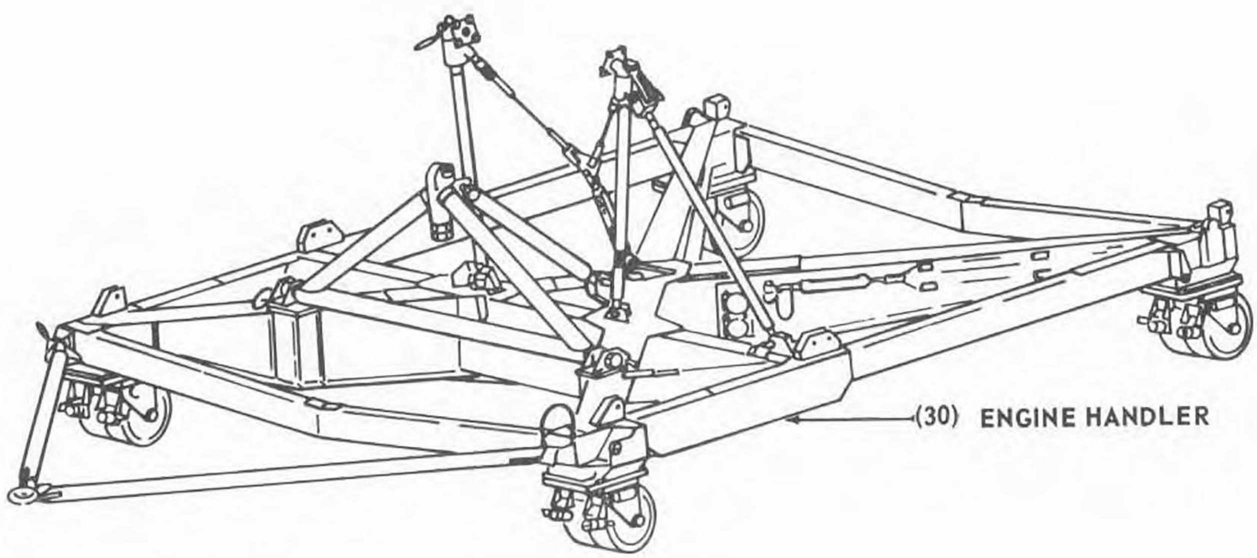
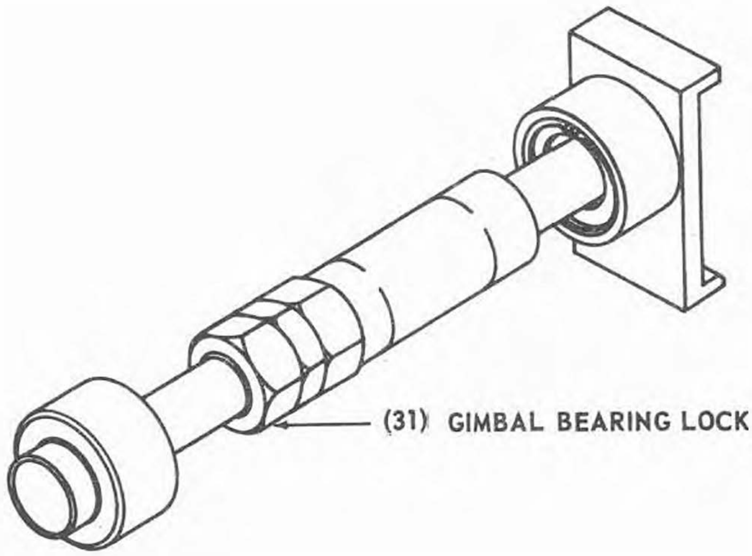


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 14 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT



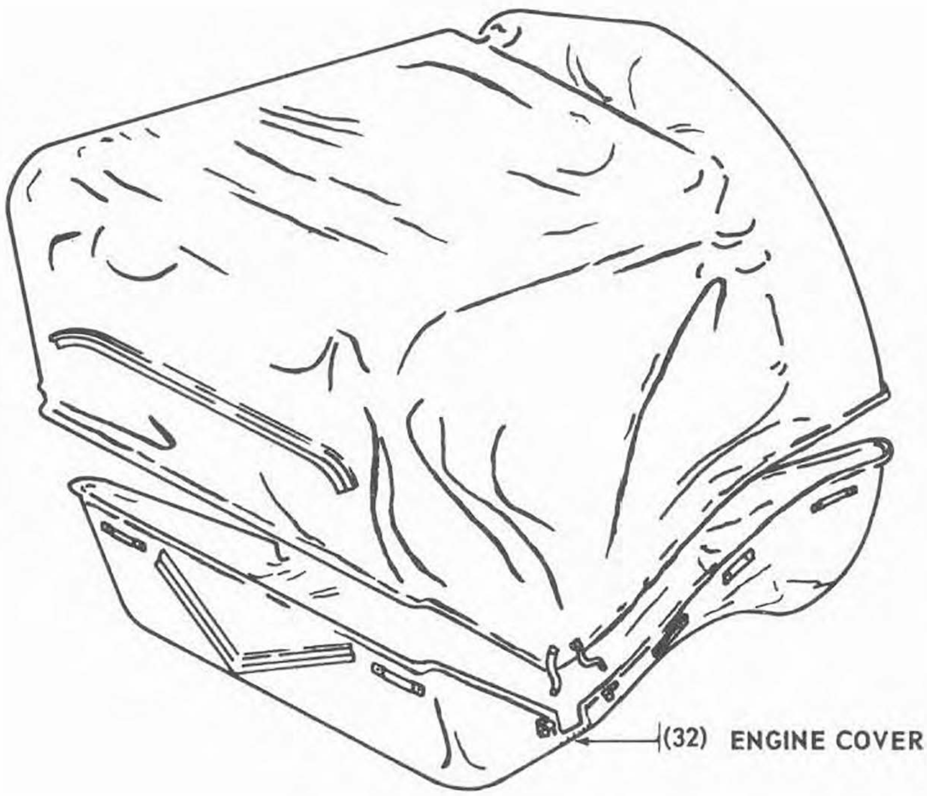


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 15 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT

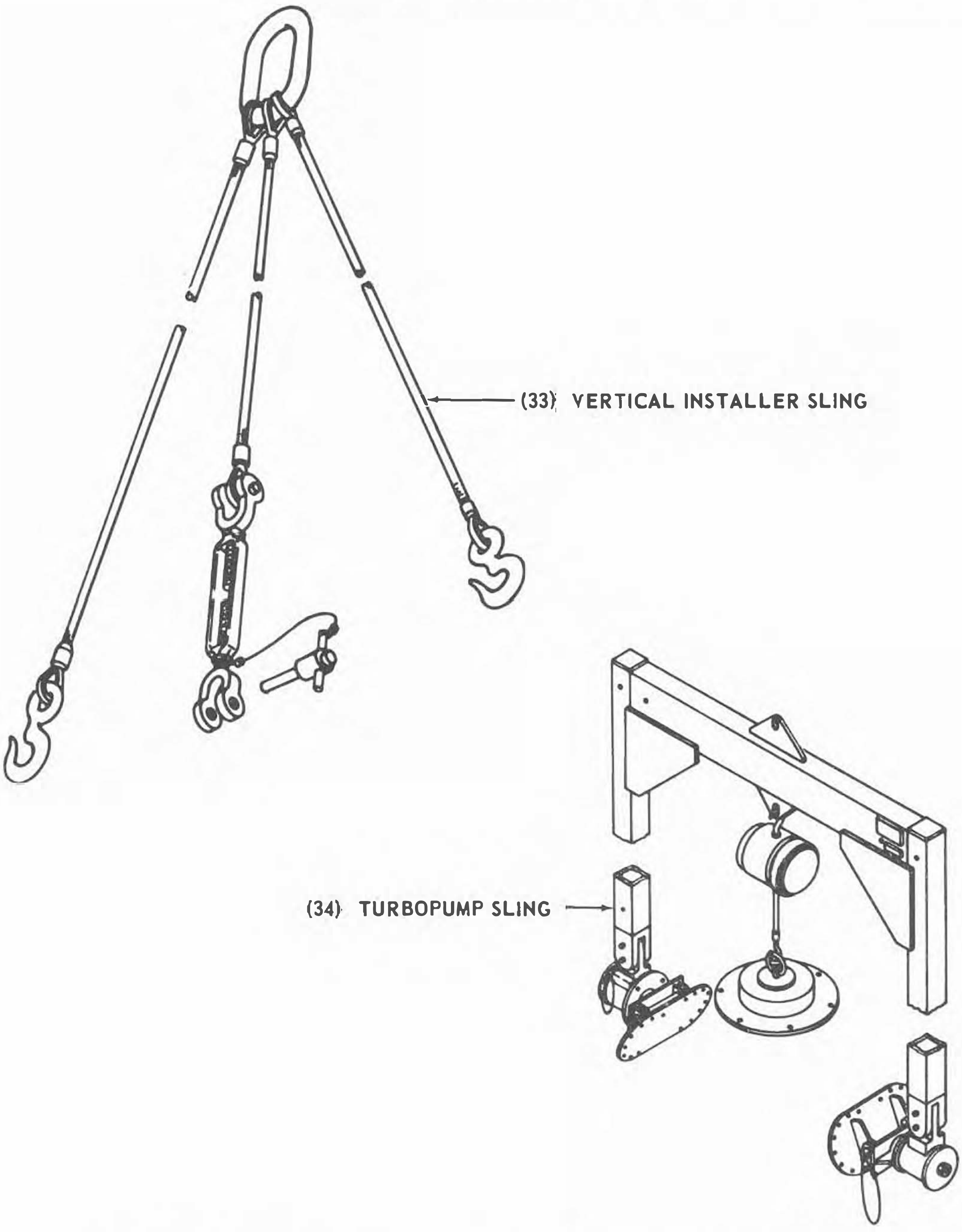


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 16 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT

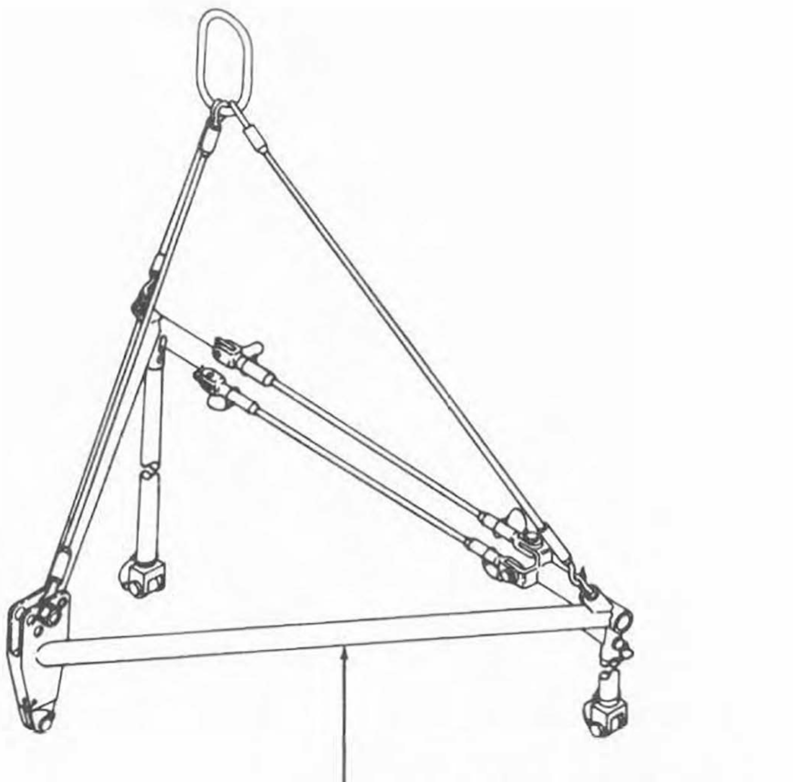


Figure 5-1. S-IC Handling and Auxiliary Equipment (Sheet 17 of 17)

S-IC HANDLING AND AUXILIARY EQUIPMENT

1. Manual Engine Actuator (Horizontal) (65B61064) - The manual engine actuator allows manual gimbaling of the stage mounted F-1 engines and also restrains the engine during cleaning or replacement of the F-1 engine servo actuator. Its dimensions are approximately 10 x 10 x 92 inches.

2. Servo Actuator Jack (65B61046) - The servo actuator jack is used when disconnecting the stage end of the F-1 engine servo actuator to allow cycling and calibration of the servo actuator during stage test and checkout operations.

3. Propellant Tank Pressure Monitor and Control System (65B64146) - The pressure monitor and control system maintains the closed tank in a LOX clean condition while providing a small positive gage pressure to prevent tank collapse from atmospheric pressure changes. The system weighs approximately 2,050 pounds and has dimensions of approximately 39 x 58 x 91 inches.

4. Forward Skirt Vertical Platforms Storage and Handling Racks (SK5-6110-2001) - The racks are used for storage of the S-IC stage forward skirt area platforms. There are a total of nine racks, eight as shown with one door and three sides enclosed. The other rack has two doors and two sides enclosed. The racks are constructed mostly of aluminum, and rack dimensions are approximately 40 x 50 x 82 inches each.

5. Horizontal Assembly LOX Prevalves Positioning and Holding Fixture (P& HF-435-8536) - The horizontal assembly LOX prevalves positioning and holding fixture is used to position and hold the LOX prevalve and emergency drain valve assemblies in place during installation or removal, at the inboard and outboard locations, while the stage is in a horizontal attitude.

6. Fuel Fill and Drain Duct Sliding Joint Compression Tool (AT-435-8544) - The fuel fill and drain duct sliding joint compression tool is used to compress the fuel fill drain duct sliding joint into position for installation.

7. LOX Drain Duct Sliding Joint Compression Tool (AT-435-8572) - The LOX drain duct sliding joint compression tool is used to compress the LOX drain duct sliding joint in the horizontal or vertical position.

8. LOX Suction Duct Sliding Joint Compress or Expand Assembly Tool (AT-408-8051) - The LOX suction duct sliding joint compress or expand assembly tool is used to compress or expand the inboard and outboard LOX suction duct sliding joints in the horizontal or vertical position.

9. LOX Outboard PVC Sliding Joint Compression Tool (AT-435-8502) - The LOX outboard PVC sliding joint compression tool is used to compress the PVC outboard LOX duct during installation and removal in either the vertical or horizontal position. The tool must be installed on the LOX duct to provide rigidity so that the LOX duct may be handled as required.

10. Fuel Outboard PVC Sliding Joint Compression Tool (AT-435-8502) - The fuel outboard PVC sliding joint compression tool is used to compress the PVC outboard fuel duct during installation and removal in either the vertical or horizontal position. The tool must be installed on the fuel duct to provide rigidity so that the fuel duct may be handled as required.

11. LOX Inboard PVC Sliding Joint Compression Tool (AT-435-8513) - The LOX inboard PVC sliding joint compression tool is used to compress the PVC inboard LOX duct during installation and removal in either the vertical or horizontal position. The tool is installed on the LOX duct to provide rigidity so that the LOX duct may be handled as required.

12. Fuel Inboard PVC Sliding Joint Compression Tool (AT-435-8514) - The fuel inboard PVC sliding joint compression tool is used to compress the PVC inboard fuel duct during installation and removal in either the vertical or horizontal position. The tool is installed on the fuel duct to provide rigidity so that the fuel duct may be handled as required.

13. Inboard and Outboard Fuel Prevalves Positioning and Holding Fixture (P&HF-435-8509) - The inboard and outboard fuel prevalves positioning and holding fixture is used for positioning and holding the inboard and outboard fuel prevalves during installation and removal.

14. Ordnance Items Handling Containers (SK65B7615) - Data to be furnished at a later date.

15. The LOX Vent and Relief Valve Handling Device (DC-1007) - This handling sling provides the means to hold the S-IC LOX Vent and Relief Valve during removal and installation of attaching parts and while transporting the valve to and from the installed position when the S-IC Stage is positioned on the LUT.

16. The LOX Vent and Relief Valve Hoisting Unit (DC-1008) - This hoisting unit provides the means to support, lift, and transfer the LOX Vent and Relief Valve during removal and installation and while transporting the valve to and from the installed position when the S-IC Stage is positioned on the LUT and mated with the S-II Stage.

17. Jib Boom (Ht-435-8543) - The Jib Boom mounts on the center S-IC engine support beams, approximately 100"outboard from stage centerline, in any of the four stage quadrants. It is used to lift the S-IC LOX and fuel prevalves and PVC's. It weighs approximately 225 pounds, and is approximately 32 inches high by 74 inches long, with a maximum arm reach from its support center of 54 inches.

18. Fuel and LOX PVC Remover (90M02744) - This tool is used atop the Vertical Engine Installer (with the PVC Handling tool) to raise and lower the PVC's. The PVC Remover is approximately 12'-11" tall and has a diameter of 9'-10" at its base.

19. Fuel and LOX PVC Handling Tool (90M03426) - This tool is mounted on a 3-inch O. D. x 4'-5" long carbon steel pipe, which in turn is mounted on the Fuel and LOX PVC Remover. It is used to raise and lower the PVC's. It is approximately 35" in diameter and 13" high.

20. Engine Vertical Installer (G4049) - The engine vertical installer is an electro-hydraulic operated, self-propelled, lifting and positioning unit for the engine. The vertical installer consists of a two pressure hydraulic system, electrical system, control console, manually operated tilting mechanism, manually operated horizontal positioning cranks, a hydraulically operated azimuth drive, a pair of hydraulically operated drive wheels and gearboxes, and a three stage lifting cylinder, all supported on a triangular frame. It may be operated manually with control valves on the control panel or remotely using the remote control box. The weight of the installer is approximately 27,000 pounds and the dimensions in inches are approximately 230 x 206 x 70.

21. Engine Rotating Sling Assembly (G4050) - The engine rotating sling 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 speed decreaser-power gear, two reels, wheels, and sprockets. The sprockets engage the roller change links which are attached to the periphery of the arc-shaped beam. Casters attached to the sling in a tricycle arrangement provide limited mobility. The sling weighs approximately 4,000 pounds and the dimensions in inches are approximately 278 x 206 x 70.

22. Vertical Roadable Transport Dolly (G4051) - The vertical roadable engine dolly consists of a flat-bed chassis mounted on six wheels with pneumatic tires. Four wheels, with parking brakes, are located at the rear of the dolly and two wheels are located at the front. A two bar and steering linkage are attached to the front of the dolly. Four cable assemblies are also included to tie down the engine to the dolly. The dolly weighs approximately 6,100 pounds and the dimensions in inches are approximately 180 x 140 x 28.

23. Engine Handler Sling Assembly (G4052) - The engine handler sling consists of four separator bars, eight cables, and a sling. The separator bars have a self-aligning, 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. 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. The sling weighs approximately 600 pounds.

24. Turbopump Dolly (G4056) - 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 the turbopump in the vertical position. Lifting eyes and forklift guides are also included for lifting the dolly with the turbopump installed. The dolly weighs approximately 500 pounds and the dimensions in inches are approximately 76 x 56 x 54.

25. Air Transport Engine Handler (G4044) - The air transport engine handler is a four wheeled, rectangular chassis incorporating a drawbar, steering linkage, individual wheel brakes, 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 adapter blocks. The left front mount also includes a sway bar. The turnbuckles and drag braces provide minor adjustments. The rear mount includes two yokes, a truss, a truss plug, and a spring-loaded compensator. Tiedown rings are incorporated on the chassis at each of the corners. Lift rings are also provided on the chassis. The handler weighs approximately 4,500 pounds and the dimensions in inches are approximately 196 x 96 x 28.

26. Thrust Chamber Protective Cover Assembly (G4048) - The thrust chamber protective cover assembly consists of four separate sections, each of which is designed to cover a specific quarter section of the thrust chamber. Each section is constructed of a hard outer shell and a protective inner padding resting against the thrust chamber tubes. When installed on the thrust chamber, the cover sections are secured together with straps and buckles. The cover protects the exposed fuel tubes from possible damage during maintenance and shipping.

27. Thrust Chamber Throat Plug Assembly (G3136) - The thrust chamber throat plug is a wheel-like device incorporating an expandable seal, support, retainer, shaft, and spacer. The seal incorporates a firm neoprene rubber material cemented to the circumference of a synthetic rubber tube coated with nylon fabric and a valve stem vulcanized to the side of the tube. Both the support and the retainer are constructed of aluminum alloy and incorporate rib and lightening hole construction to reduce weight. A neoprene bead is incorporated on the outer rims of the support and the retainer and the support contains a burst diaphragm and a quick disconnect. The shaft is a solid steel tube threaded on both ends. The spacer is an aluminum alloy tube.

28. Hypergol System Tool Kit (G3135) - The hypergol system tool kit consists of a hypergol system tool and a container. The tool consists of a retainer, piston, shaft, fitting, and cap, constructed of aluminum alloy, and a push rod and lever constructed of steel. The container exterior is constructed of plastic and it is lined with padding. The container dimensions in inches are approximately 24 x 5 x 5.

29. Engine Handling Dolly (G4058) - 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 individual wheel brakes. A tow bar is attached to the front of the dolly. Four cables, to secure the engine to the dolly, are stowed in a compartment at the rear of the dolly. Engine tiedown and dolly tiedown rings are provided at each corner of the chassis. The dolly weighs approximately 4,000 pounds and the dimensions in inches are approximately 159 x 125 x 20.

30. Engine Handler (G4069) - The engine handler is a rectangular chassis mounted on four dual casters with individual caster brakes and a detachable towbar. Cross members form a three point engine mounting structure. The mounting structure consists of engine attach fittings, struts, supports, and a guy assembly. Lugs, welded to cross members and chassis, are provided for stowing the fittings, struts, supports, and guy assembly. The handler weighs approximately 4,000 pounds and the dimensions in inches are approximately 192 x 144 x 28.

31. Gimbal Bearing Lock (G4059) - 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 then screwed one within the other to provide the adjustment. The lock is used to immobilize the gimbal bearing. Four locks are positioned around the gimbal bearing and are adjusted, as required, to center and immobilize the gimbal.

32. Engine Cover (G4047) - The engine cover consists of a lightweight frame, a fabric cover, and a container. The frame is constructed of 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. The container is a bag made of the same material as the cover. The container measures 36 x 72 inches, with a drawstring closure.

33. Vertical Installer Sling (G4060) - 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 lift eye. The sling weighs approximately 200 pounds.

34. Turbopump Sling (G4057) - 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 mounting pads are oval-shaped, low carbon steel plate with mounting holes and mounting flanges. 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. The unit weighs approximately 425 pounds and the dimensions in inches are approximately 98 x 76 x 22.

35. Engine Vertical Sling (G4054) - The engine vertical sling consists of a triangular-frame spreader bar, three cables, two links, two legs, and a lifting eye. The longest of the three cables is fastened to a plate on the spreader bar, and all three cables are centrally connected to the lifting eye. The two legs are removable from the spreader bar and are fastened to the bar by means of lockpins. The two links are stowed on the frame and, when used, are attached to the frame and the two short cables with lockpins. The sling weighs approximately 200 pounds.

S-II HANDLING AND AUXILIARY EQUIPMENT

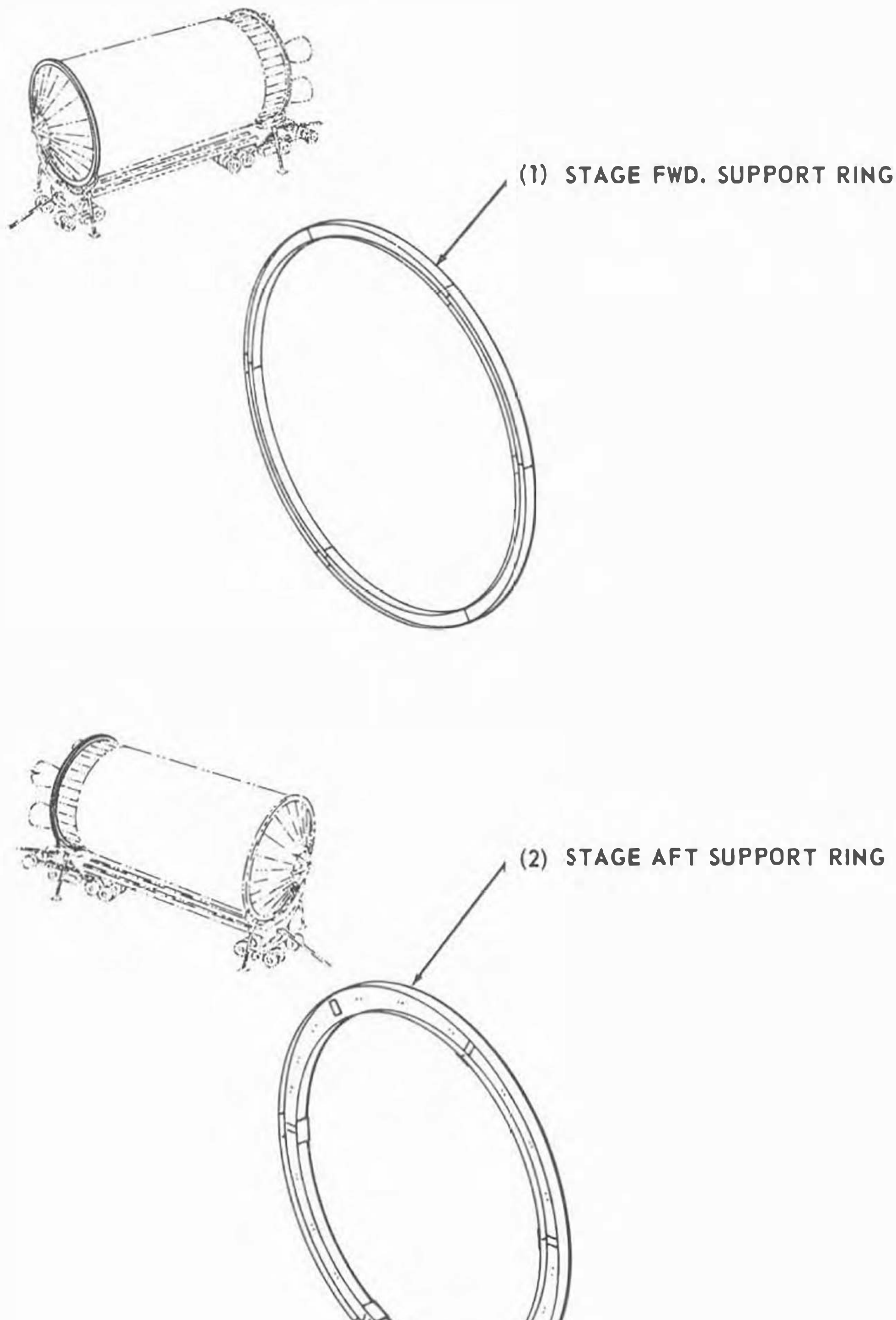


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 1 of 25)

S-II HANDLING & AUXILIARY EQUIPMENT

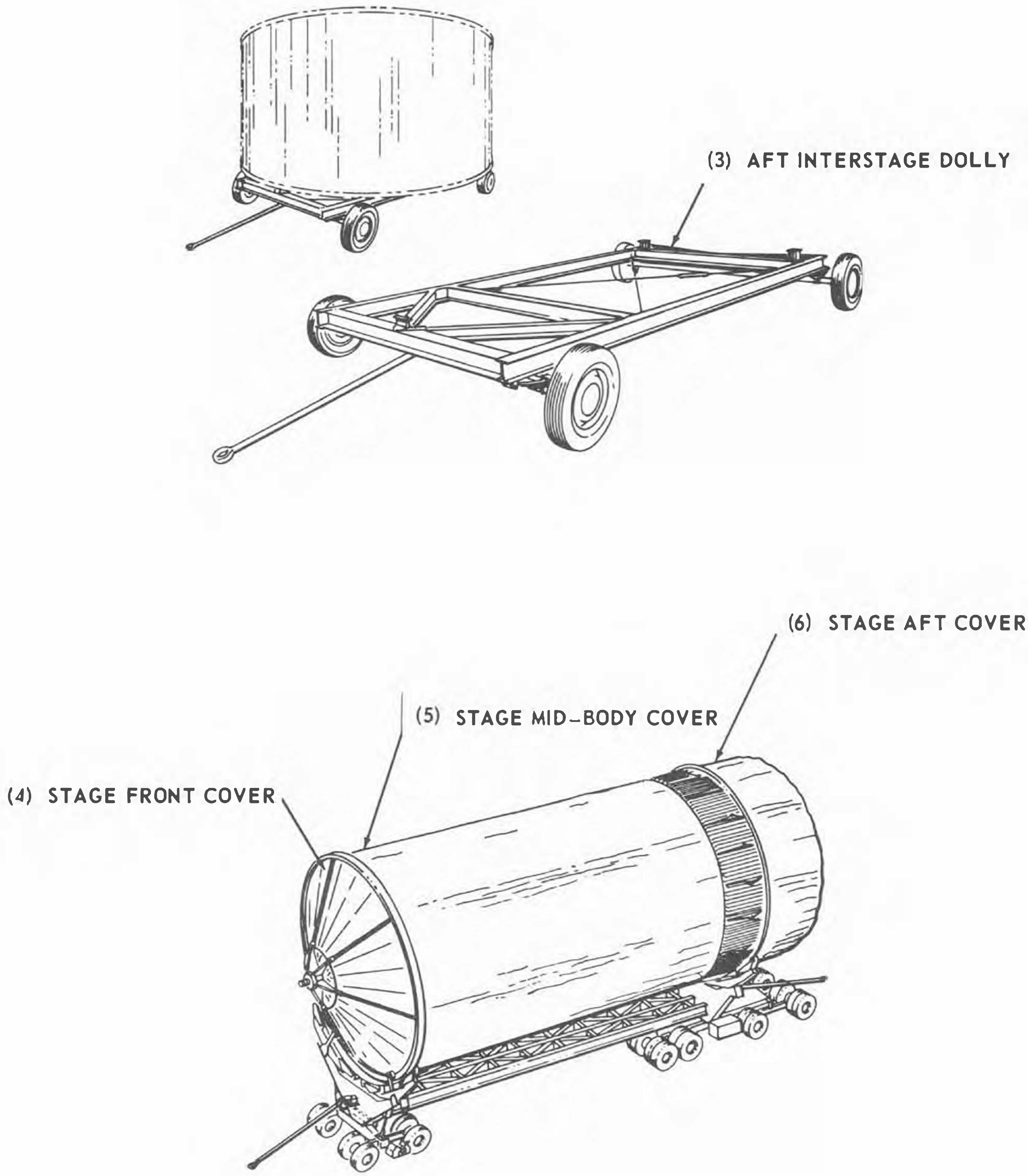
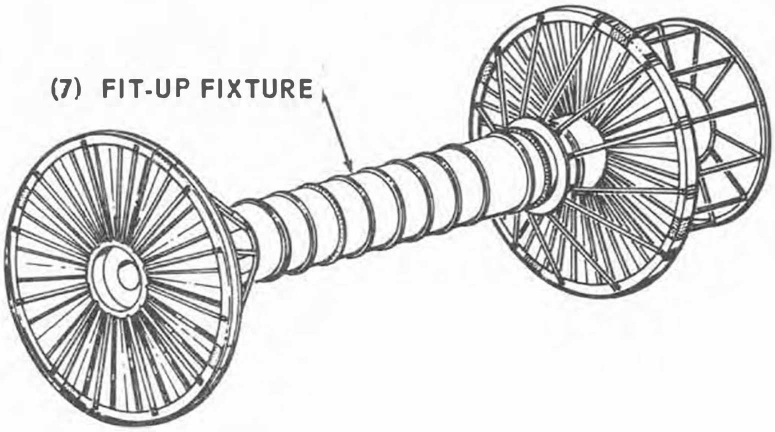


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 2 of 25)

S-II HANDLING & AUXILIARY EQUIPMENT



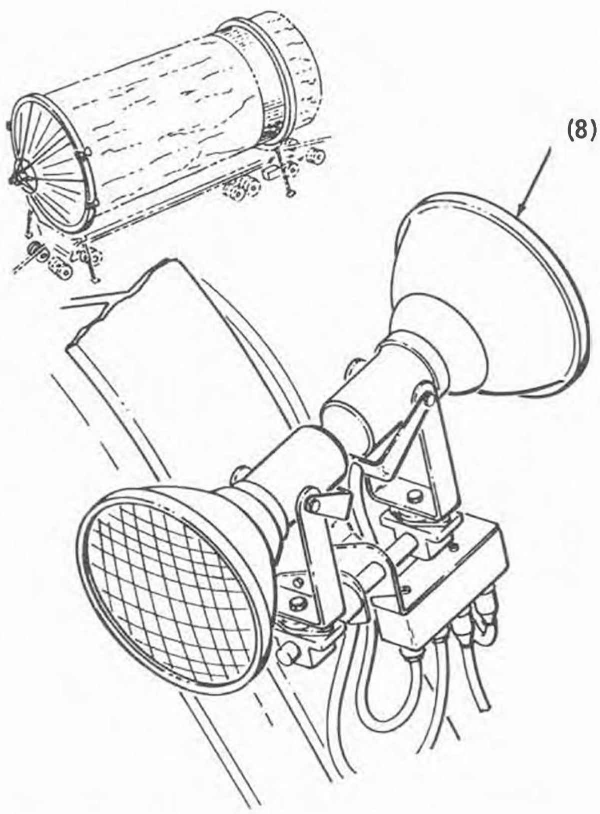
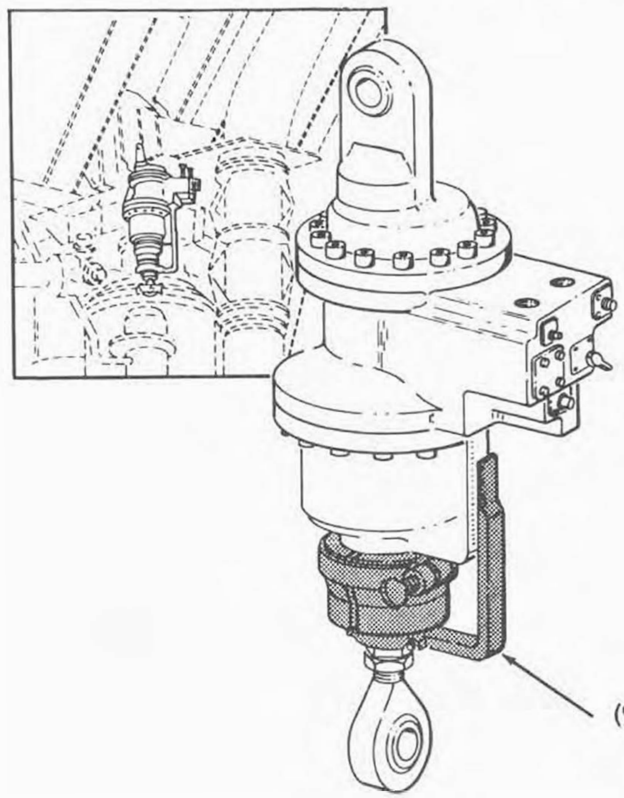


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 3 of 25)

S-II HANDLING & AUXILIARY EQUIPMENT



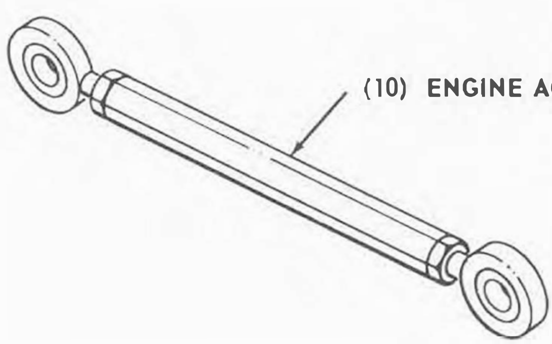


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 4 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

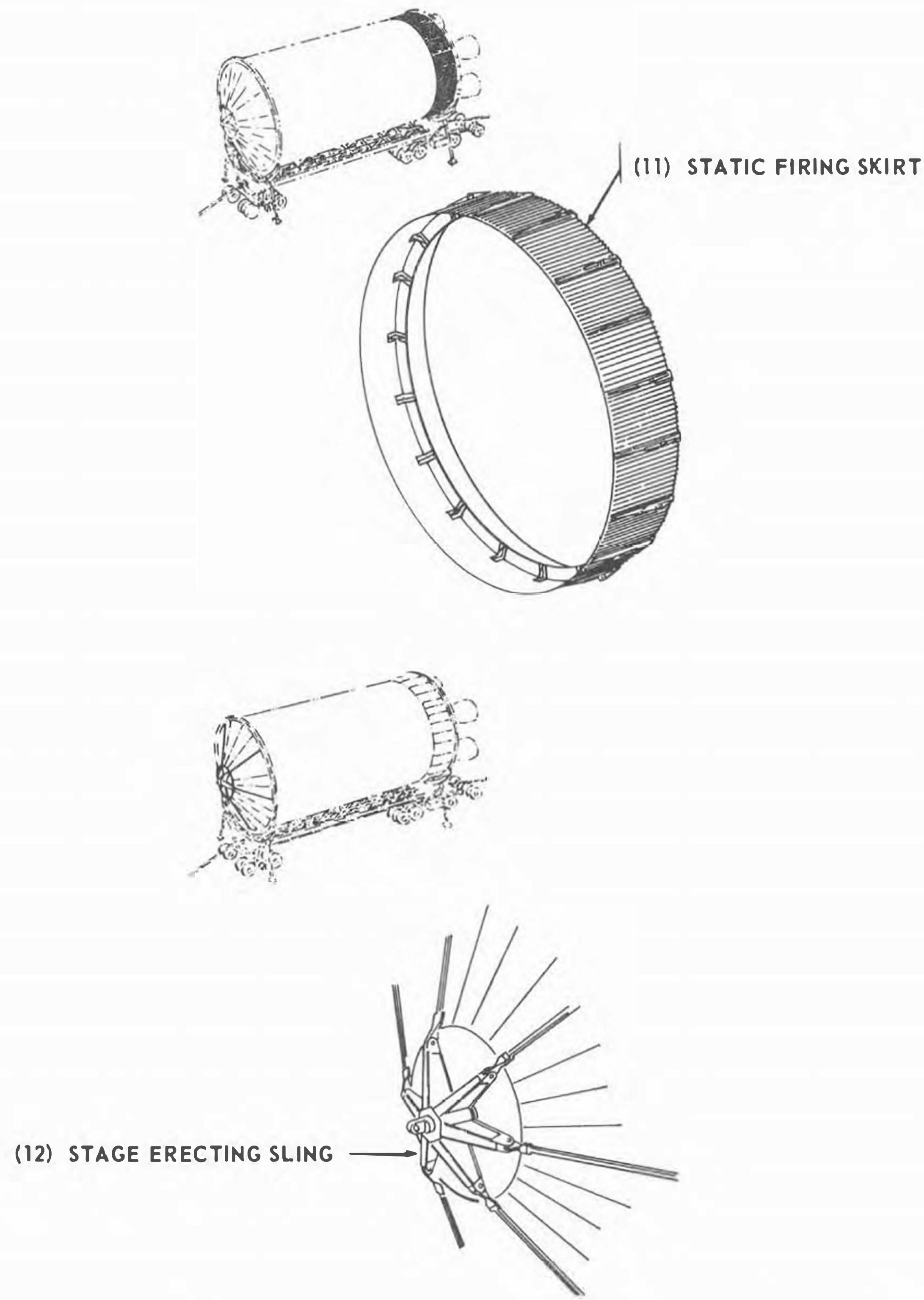
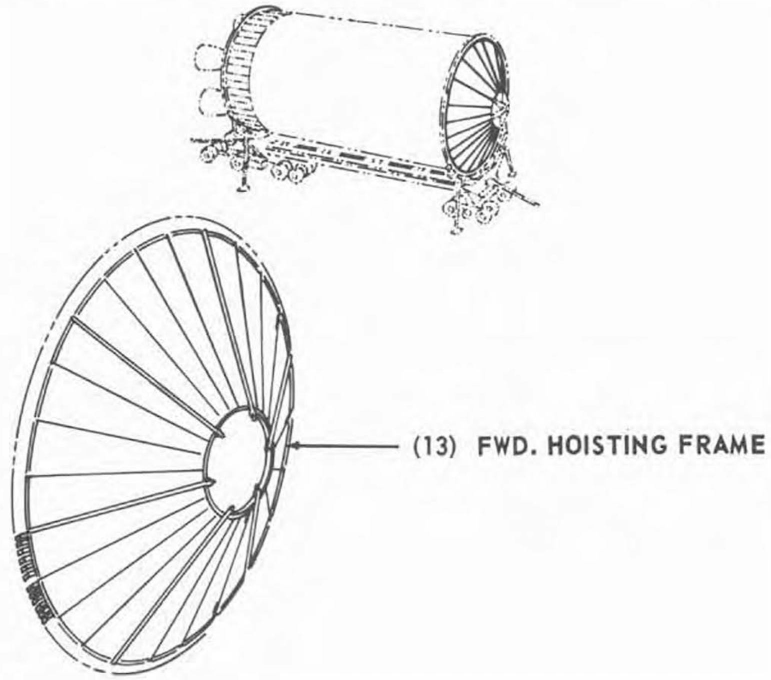


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 5 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



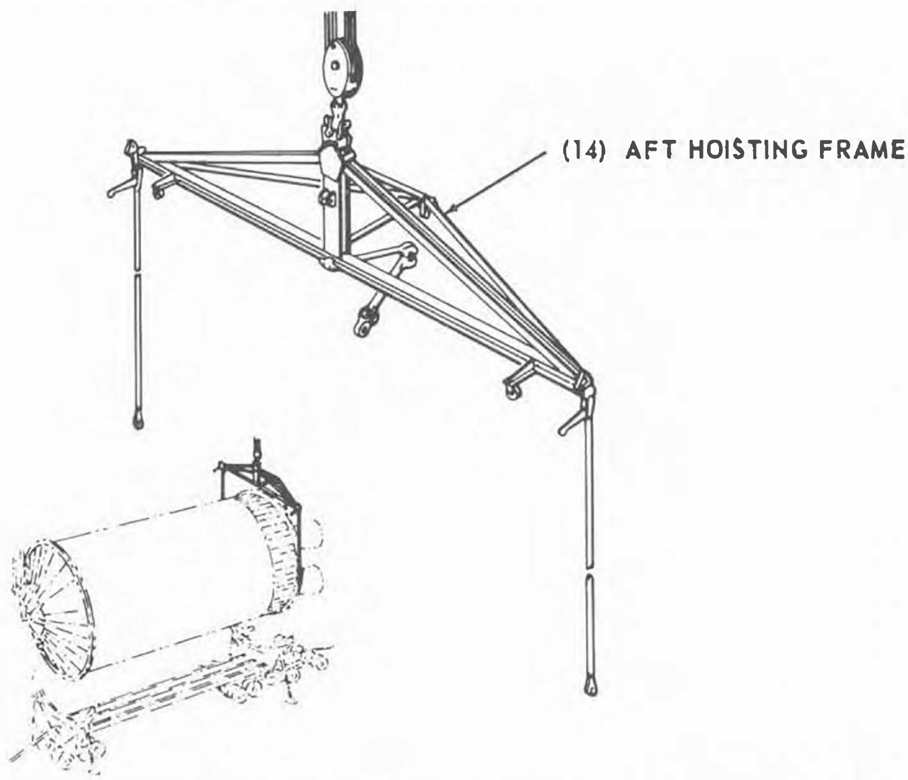
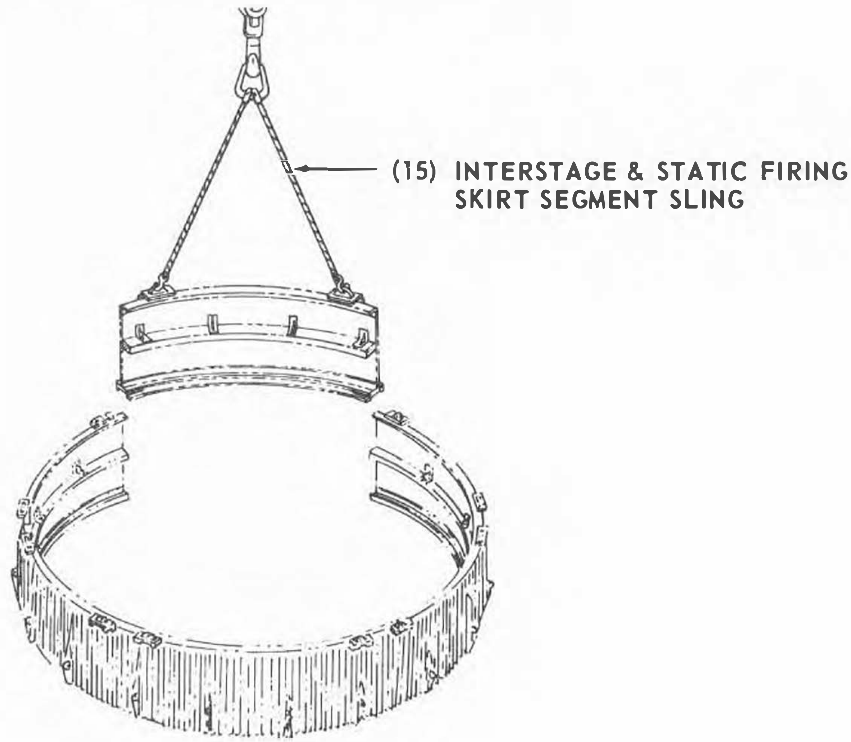


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 6 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



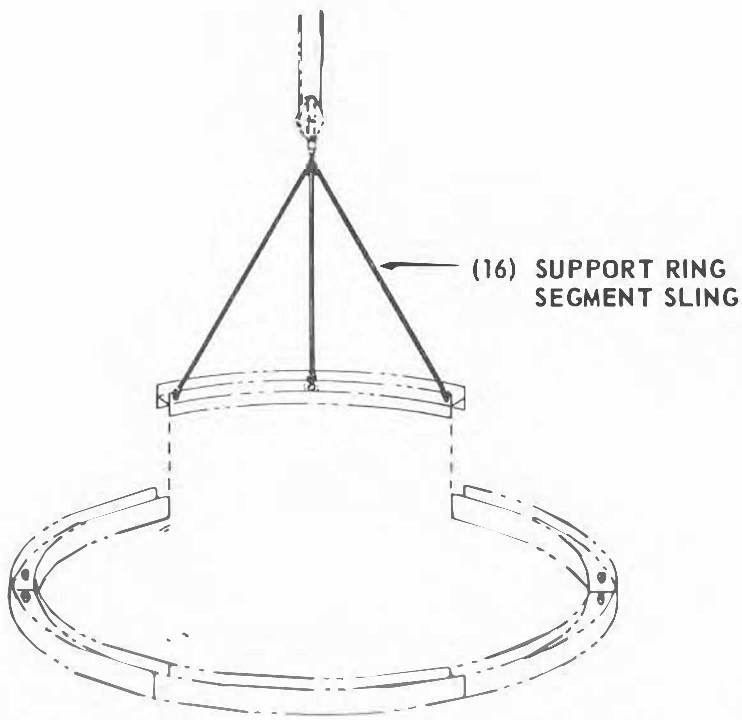
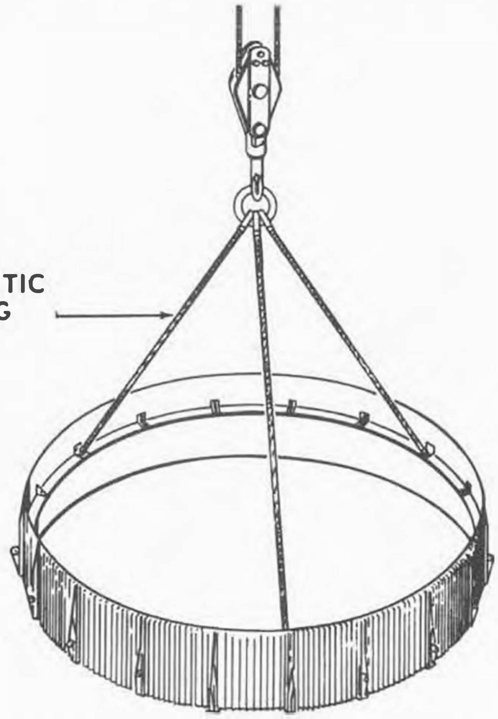


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 7 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

(17) INTERSTAGE & STATIC FIRING SKIRT SLING



(18) ENGINE PROTECTIVE FRAME

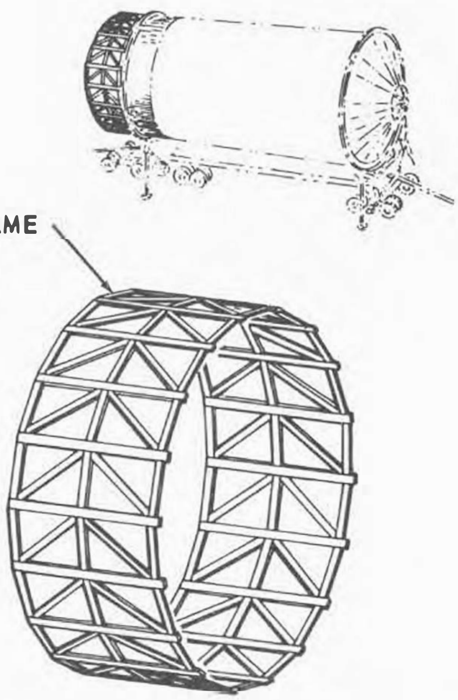


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 8 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

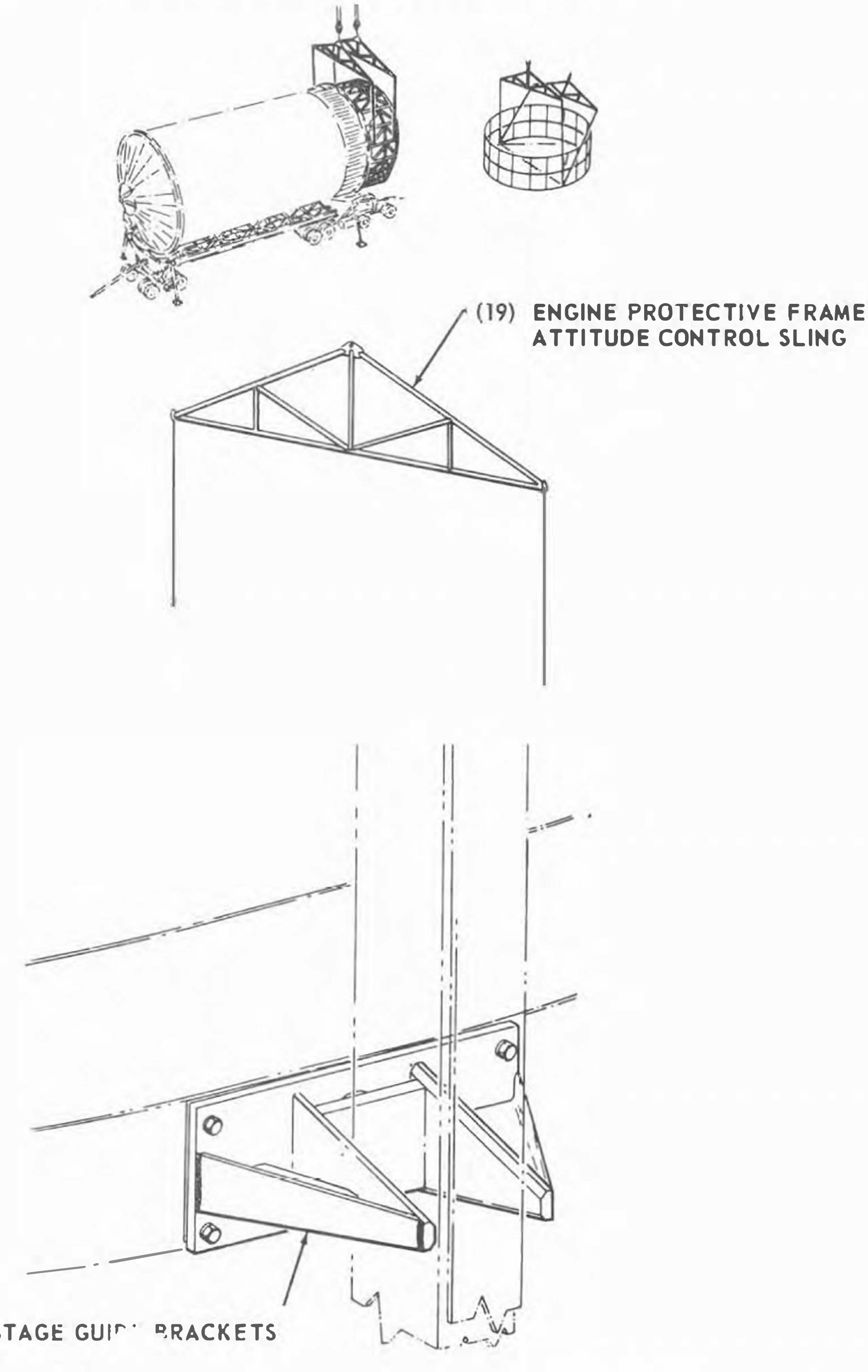
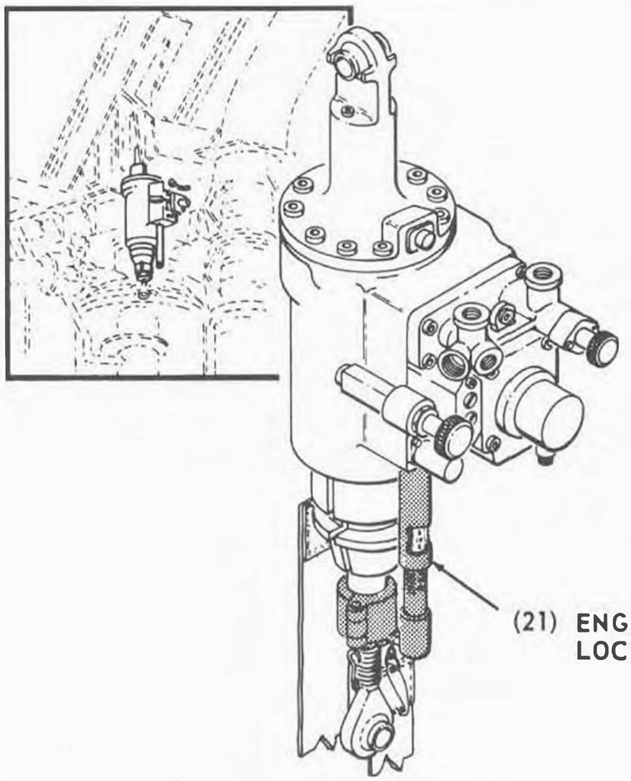


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 9 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



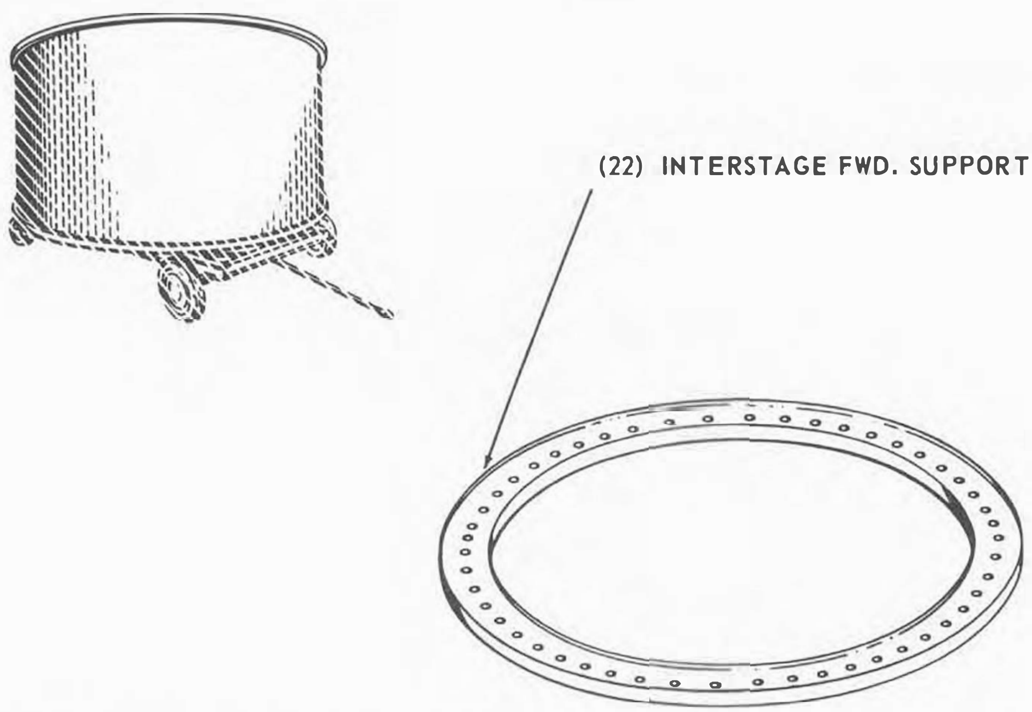
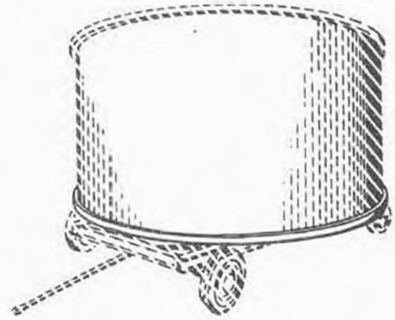
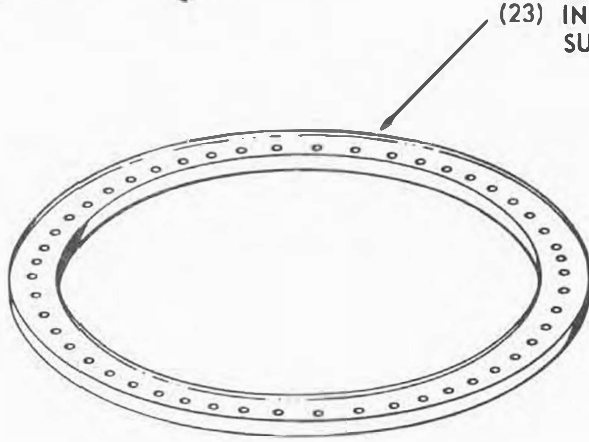


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 10 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT





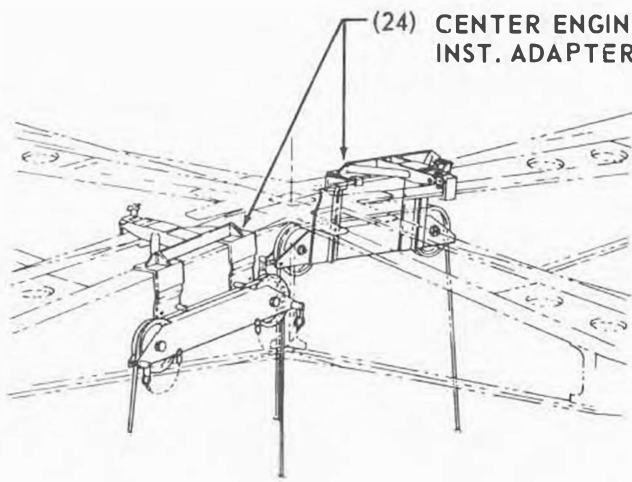


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 11 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

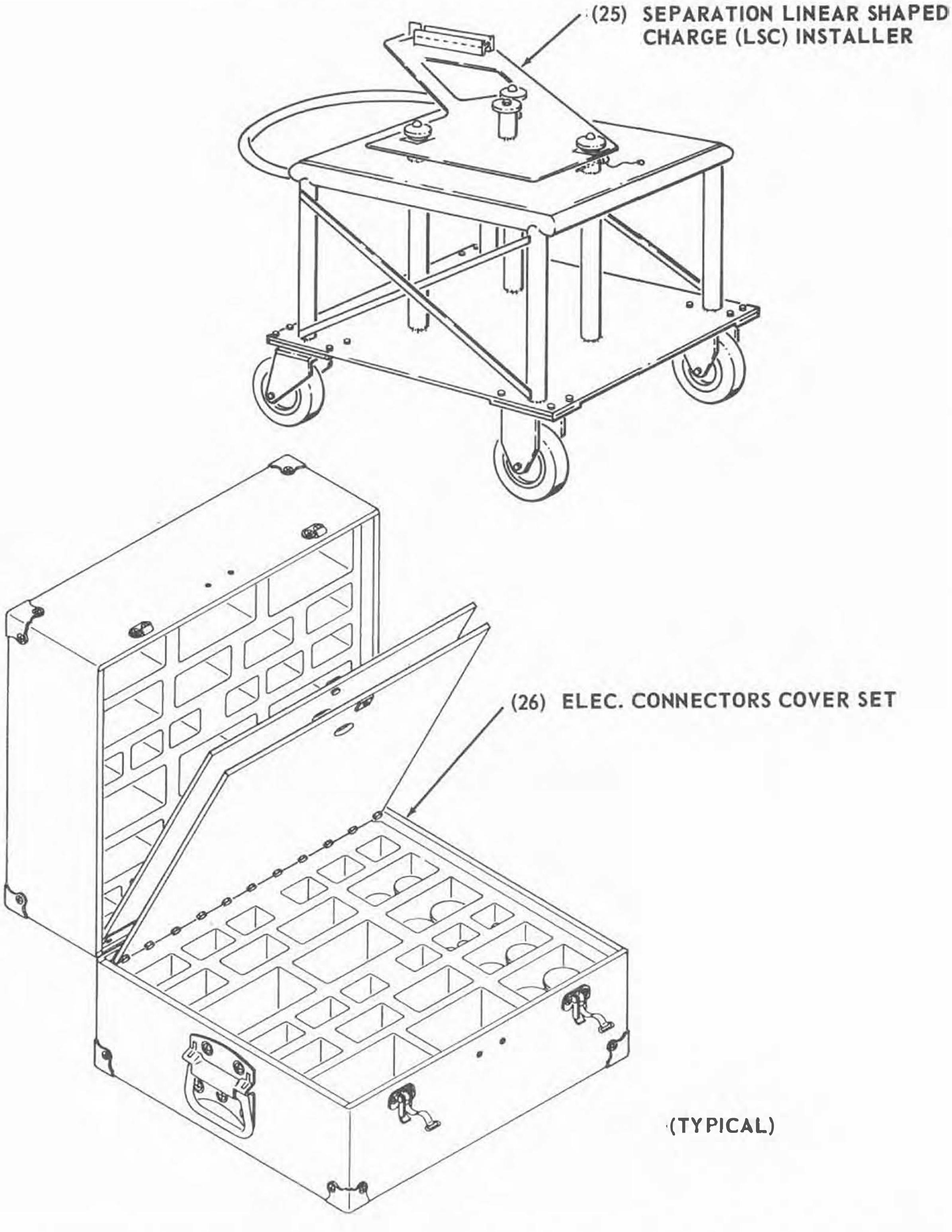
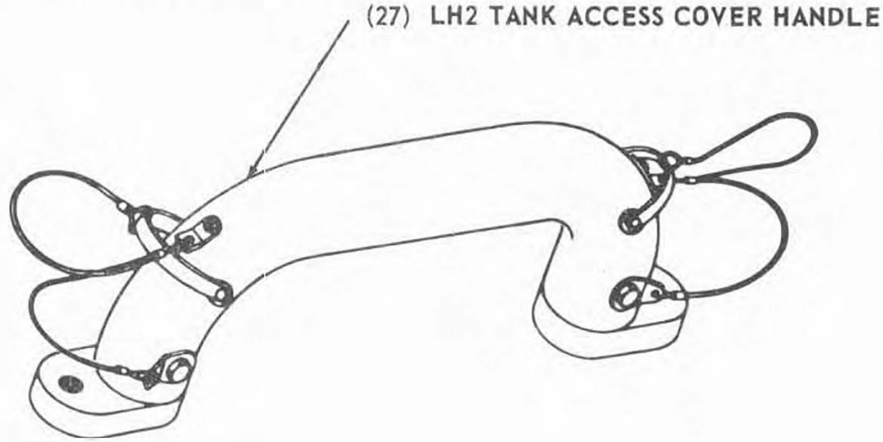


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 12 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



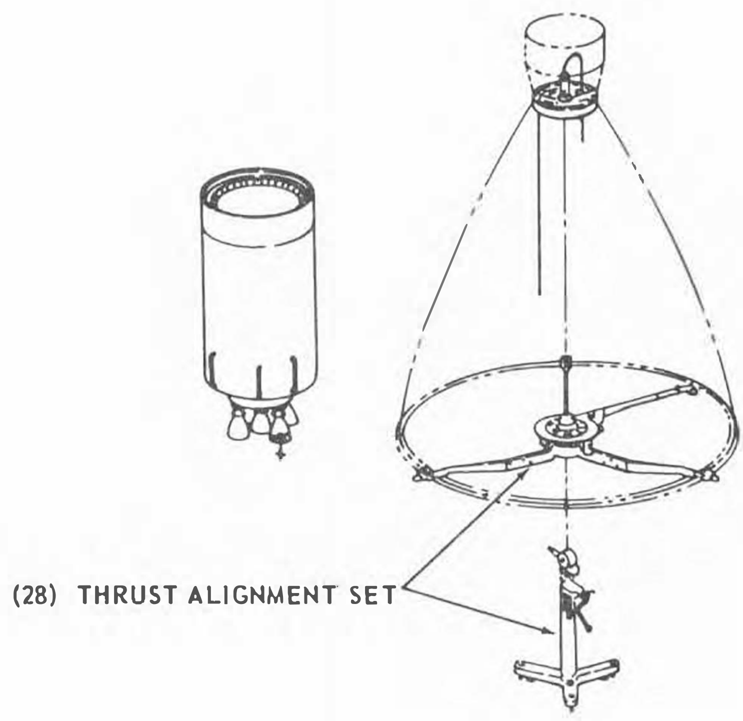
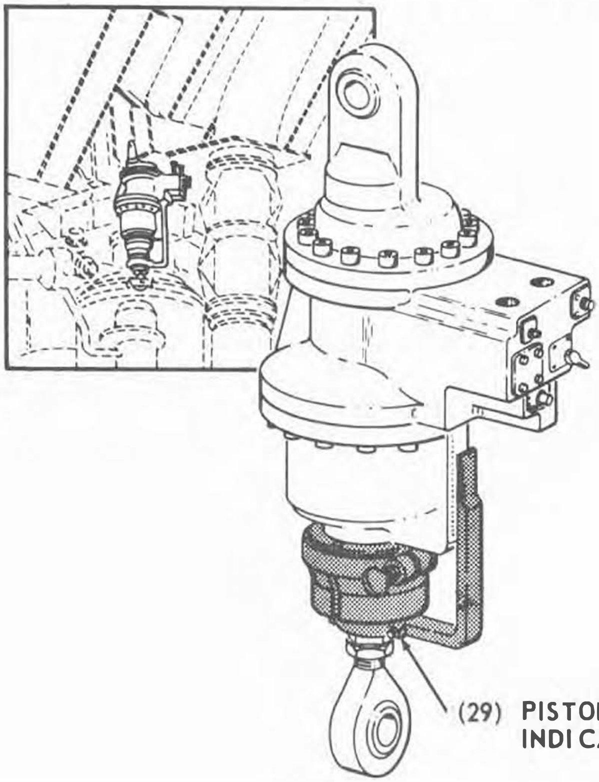


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 13 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



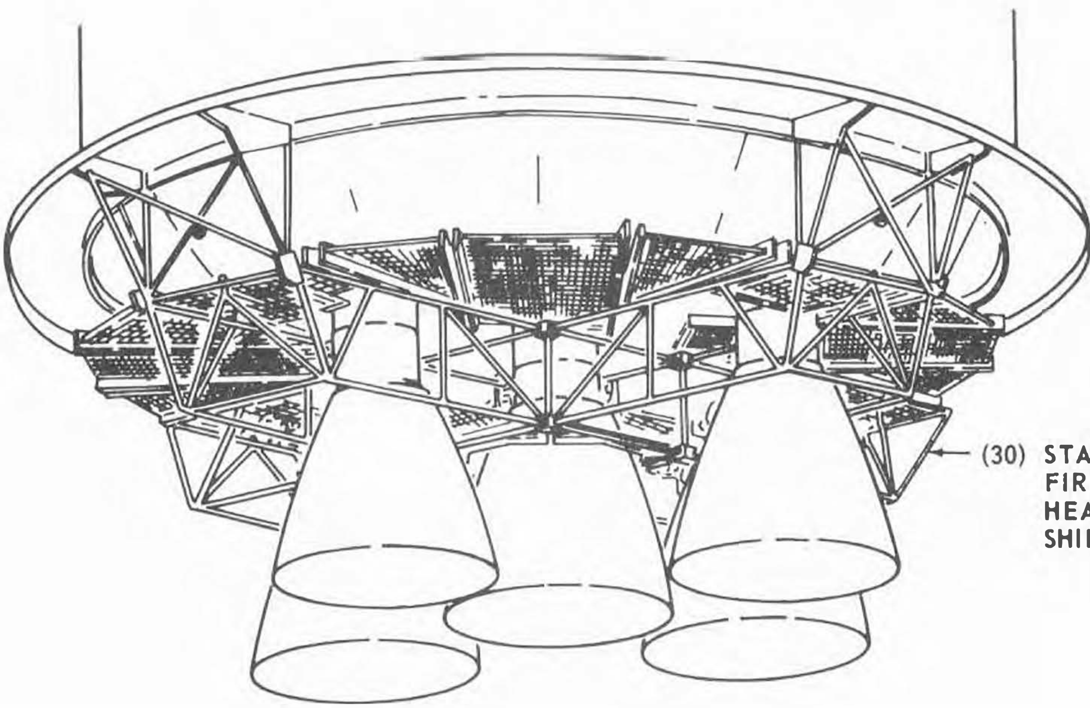
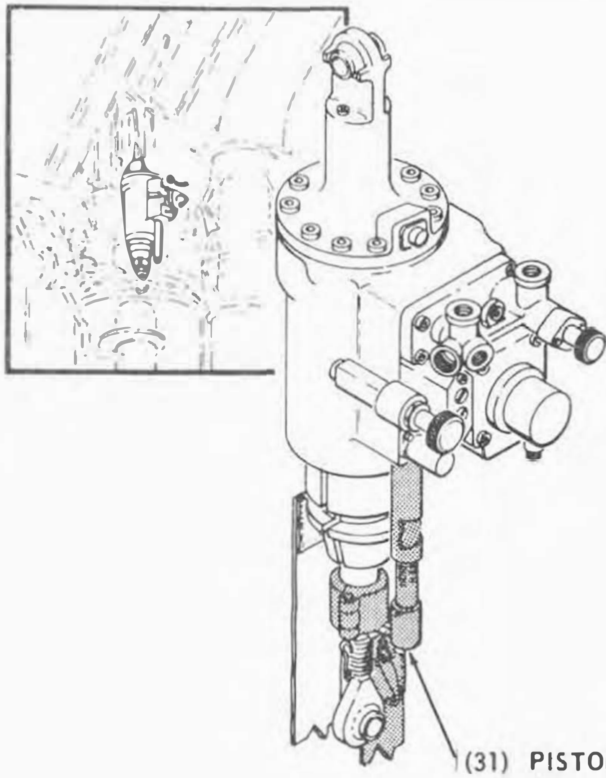


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 14 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



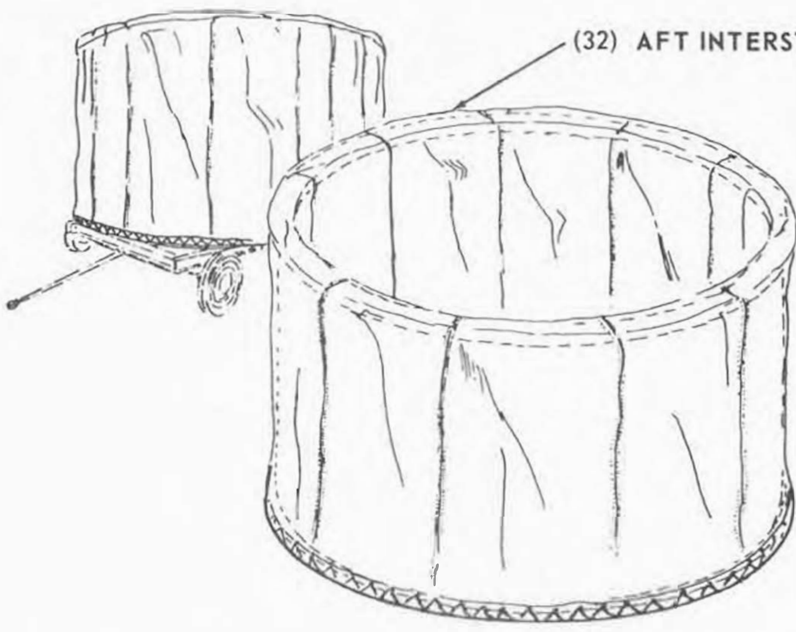
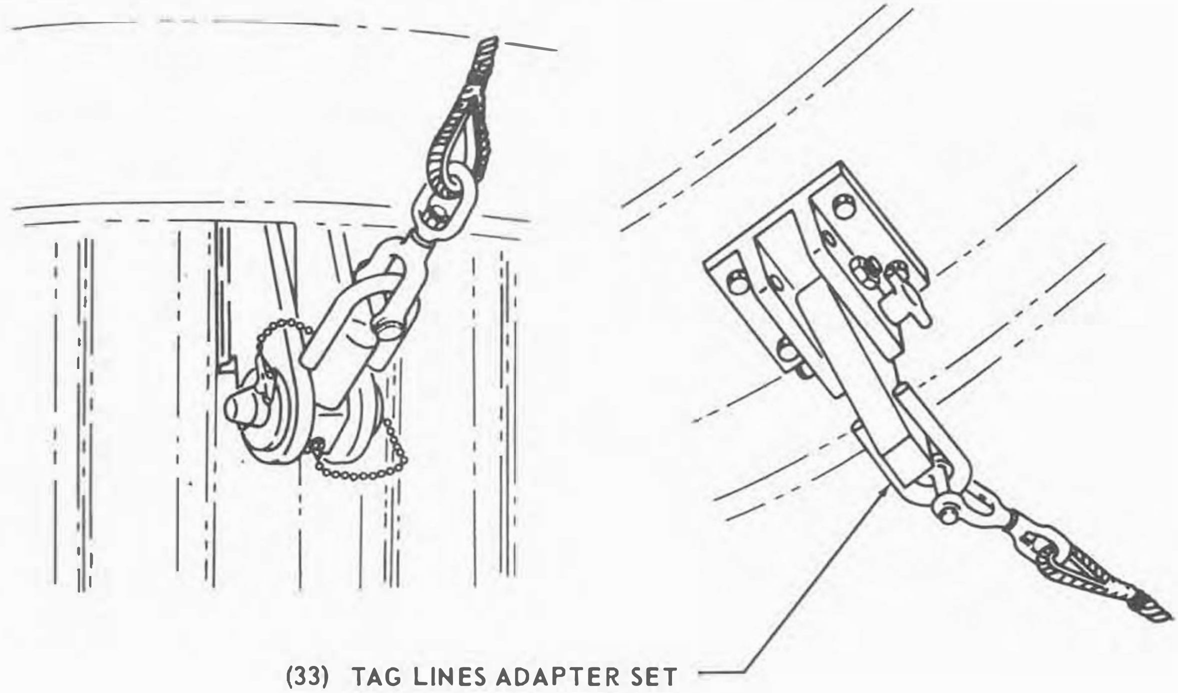


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 15 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



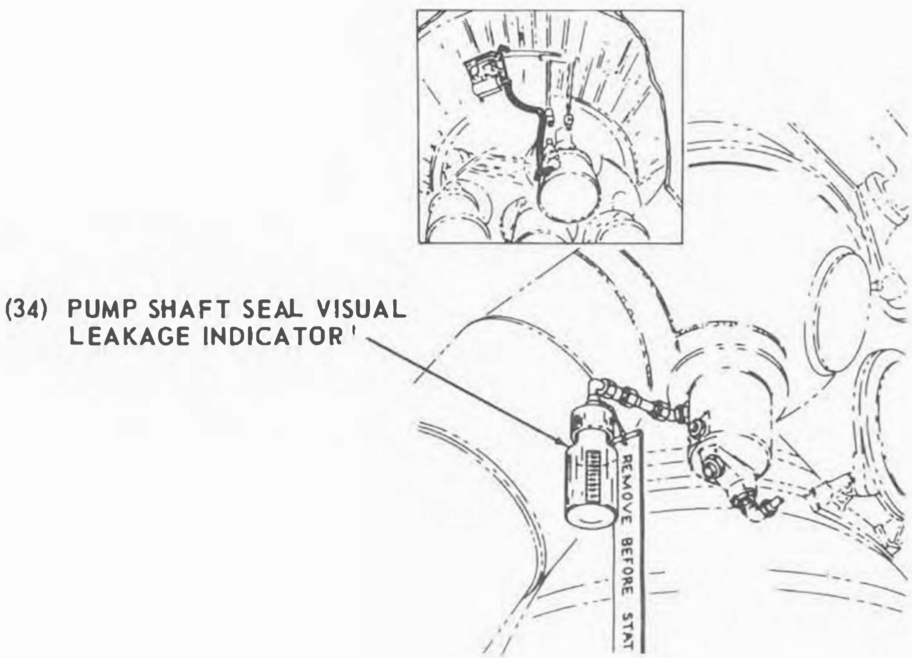


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 16 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

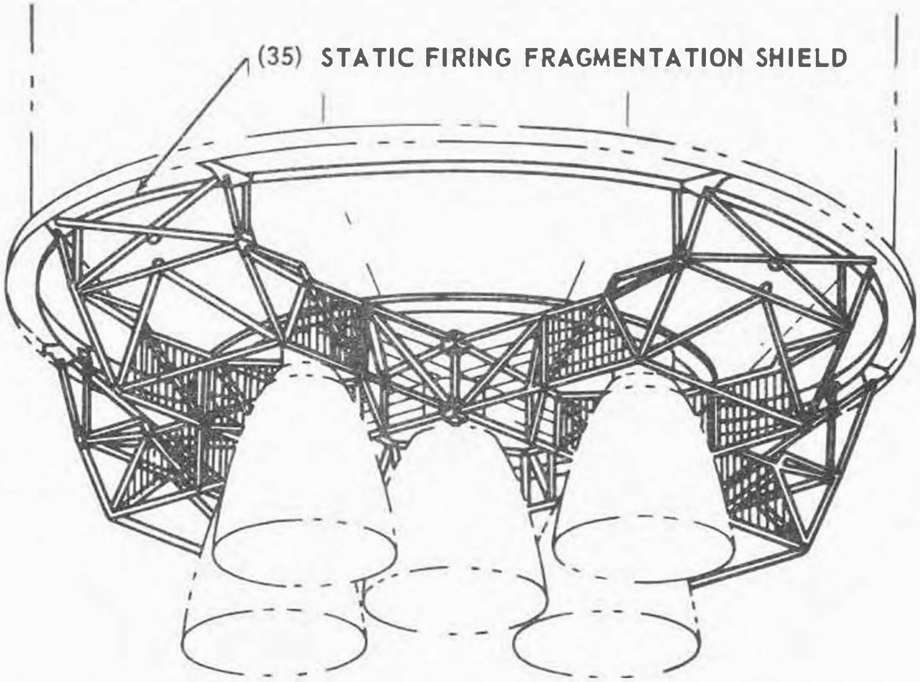
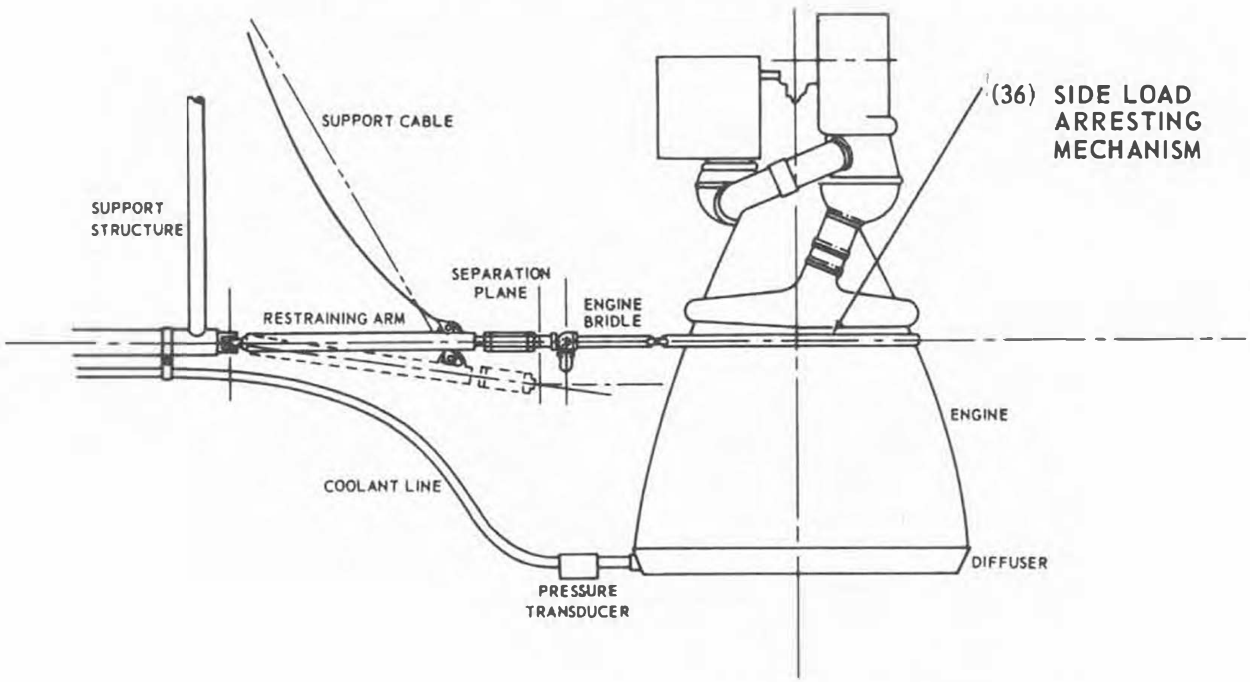


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 17 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



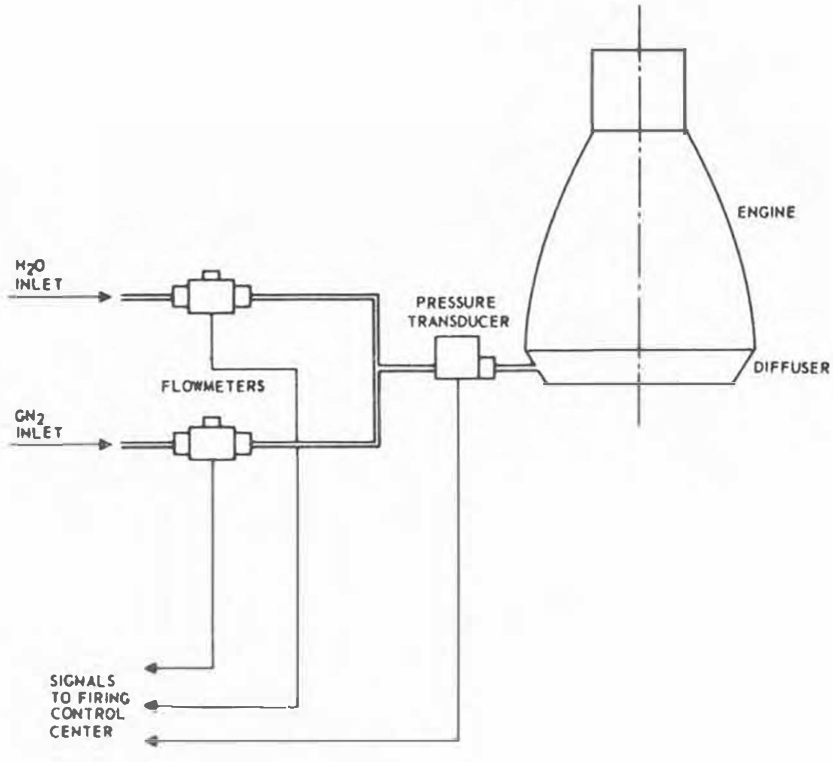
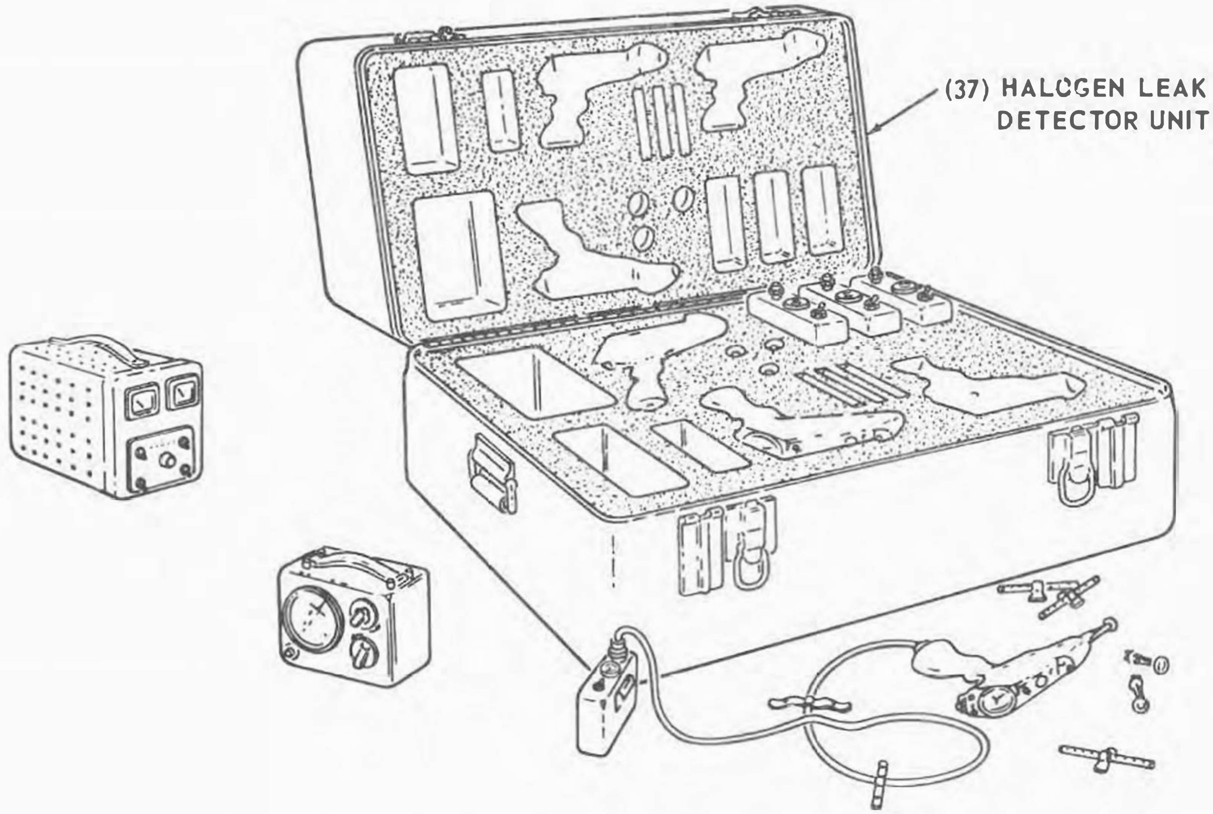


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 18 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT



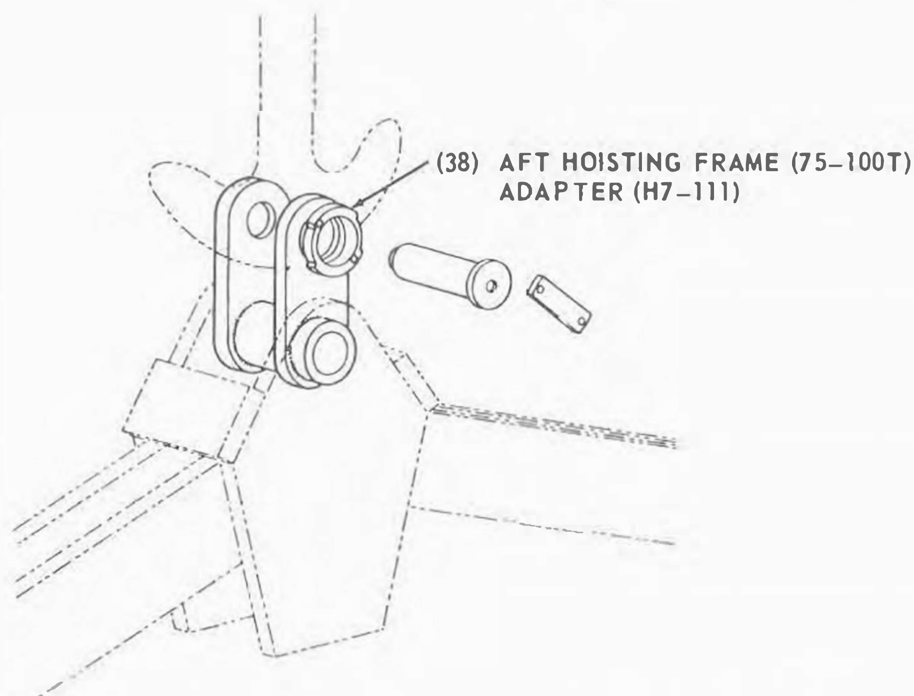
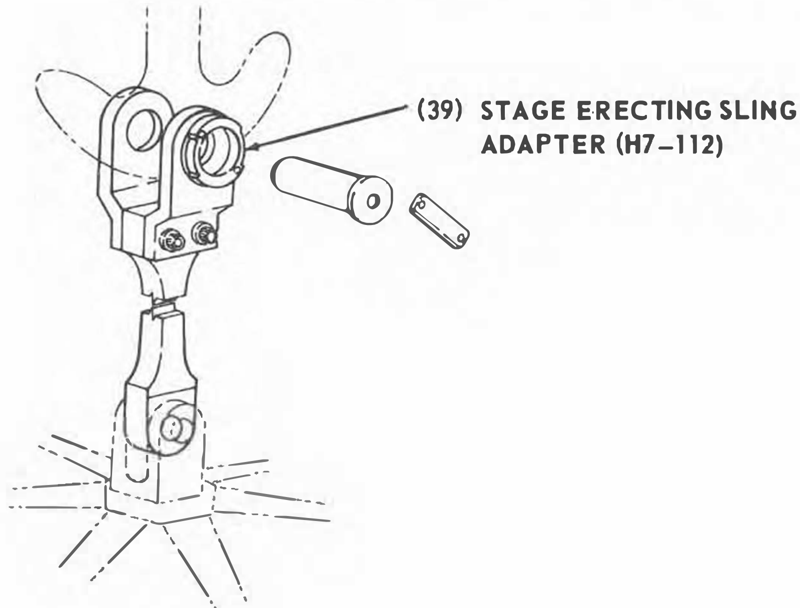


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 19 of 25)



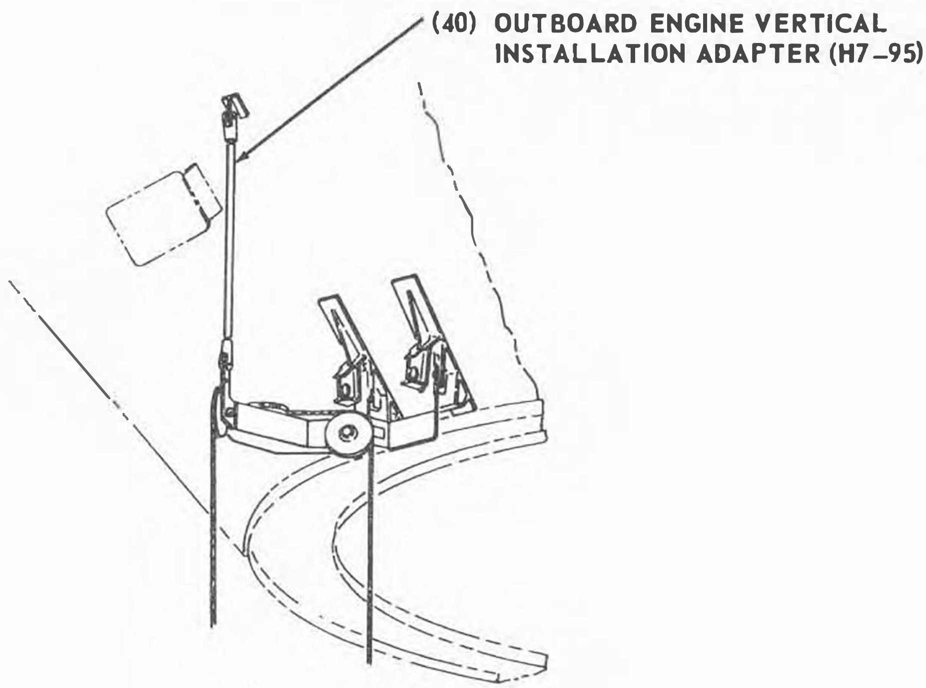
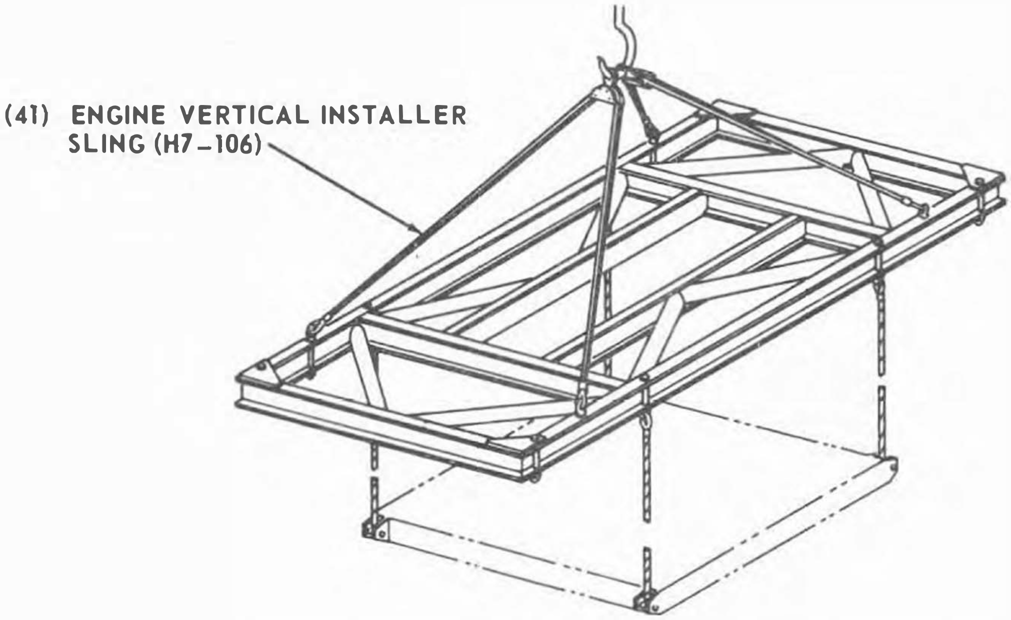
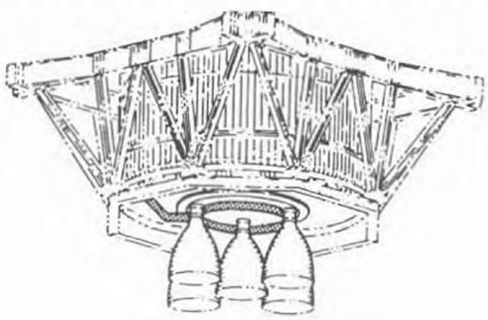


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 20 of 25)





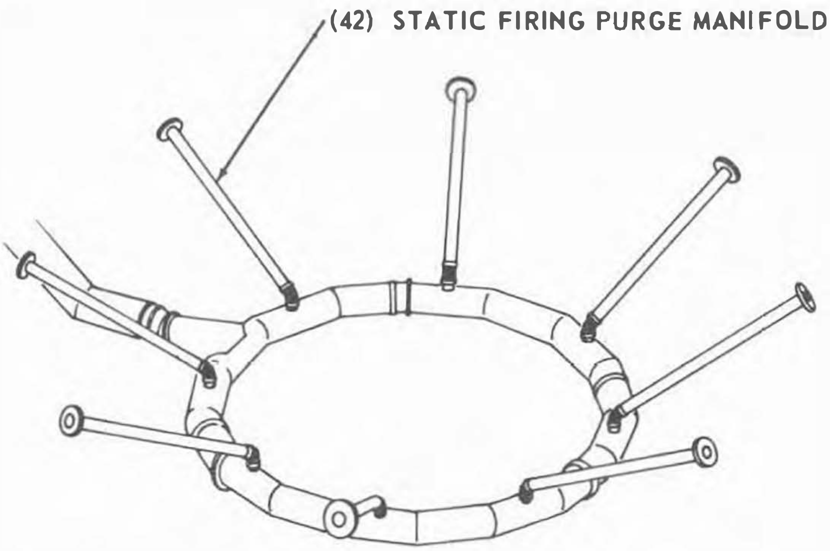
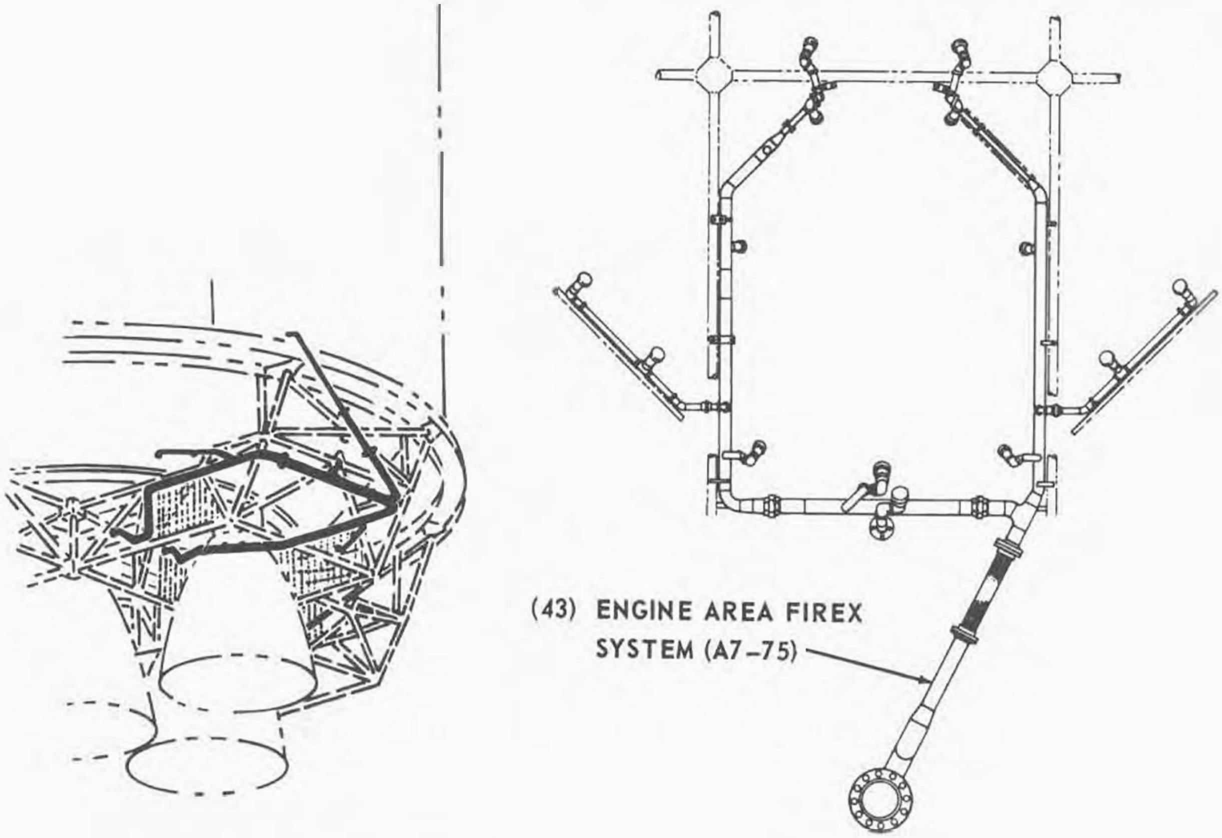


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 21 of 25)



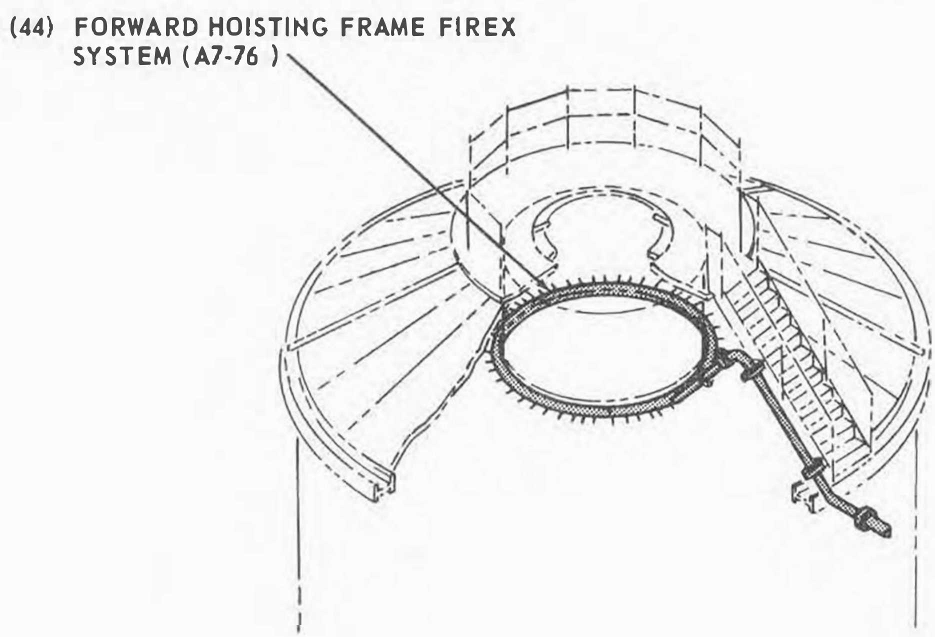


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 22 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 23 of 25)

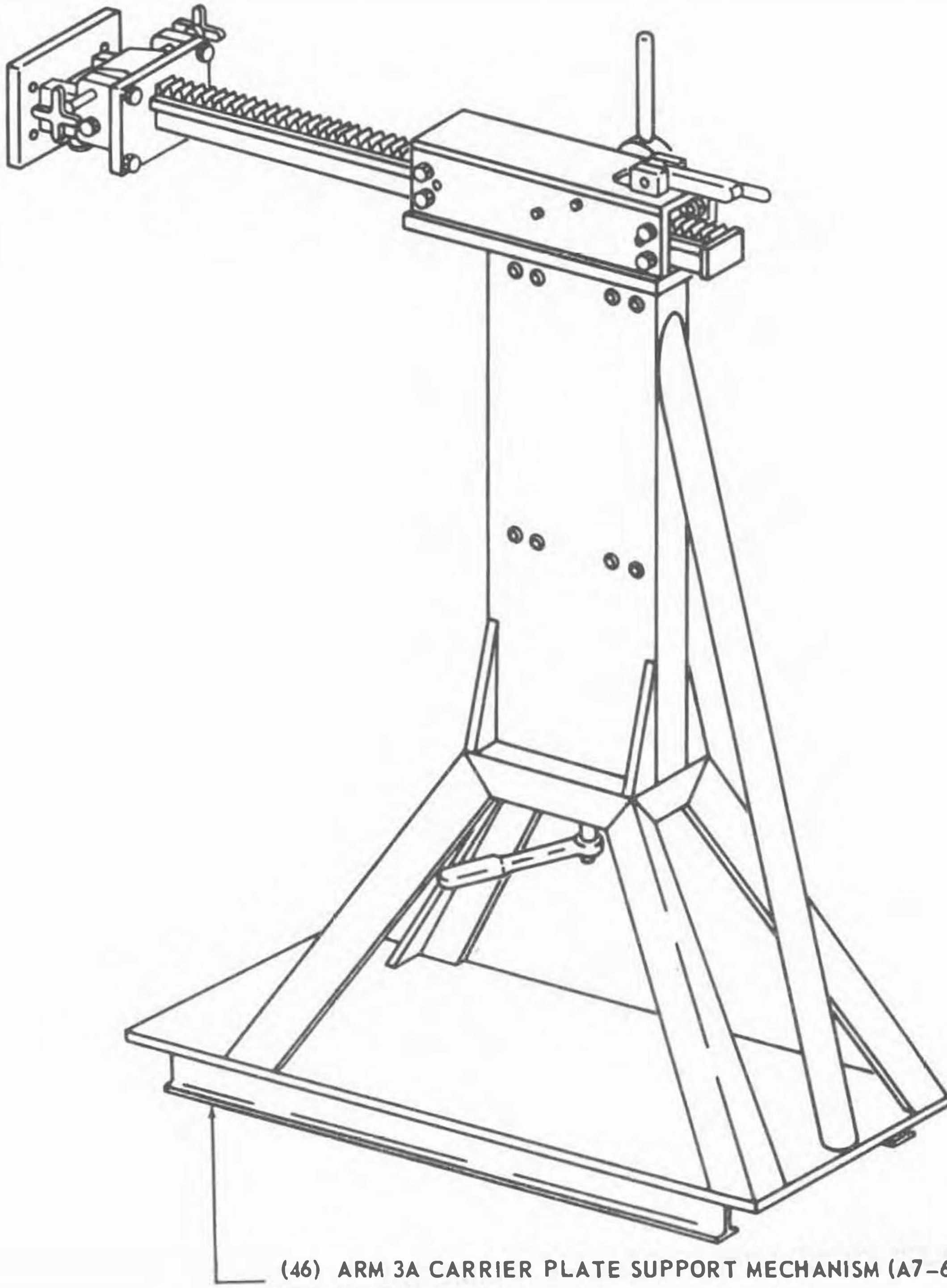


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 24 of 25)

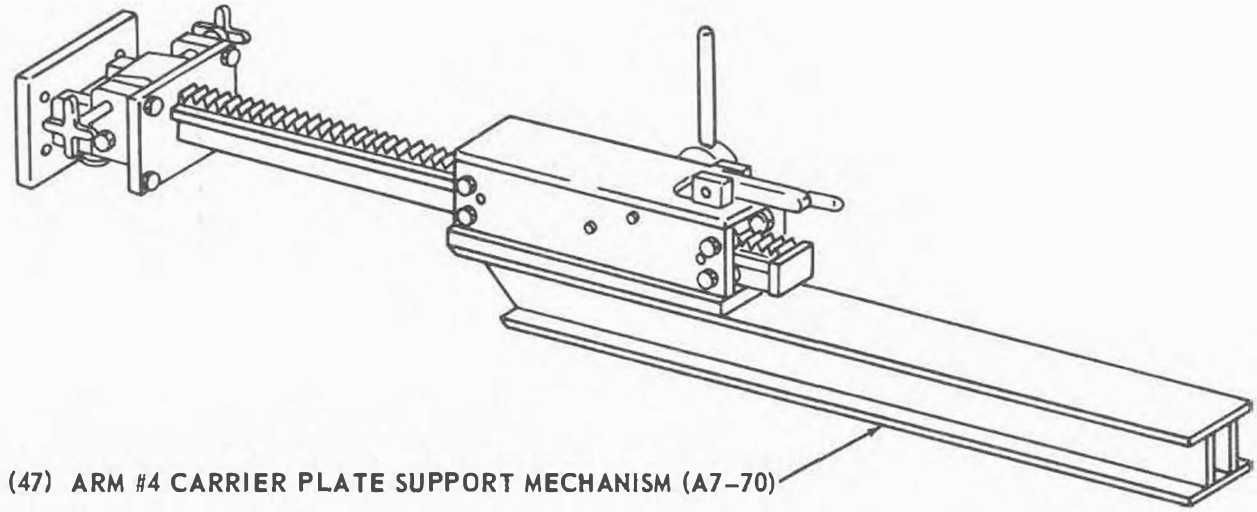


Figure 5-2. S-II Handling and Auxiliary Equipment (Sheet 25 of 25)

S-II HANDLING AND AUXILIARY EQUIPMENT

1. Stage Forward Support Ring (H7-2) - The forward support ring provides the means for attaching forward hoisting equipment to the stage, and also provides forward support for the stage during transportation and horizontal handling operations. The ring is constructed from 6 welded I-beam segments which, when assembled, form a ring approximately 33 feet in diameter and weighing approximately 4,000 pounds.

2. Stage Aft Support Ring (H7-3) - The aft support ring provides the means for attachment of the aft hoisting frame for stage erecting or lowering procedures. The ring is constructed from 6 welded I-beam segments which, when assembled, form a ring approximately 33 feet in diameter and weighing approximately 6,700 pounds.

3. Aft Interstage Dolly (H7-8) - The aft interstage dolly provides mobility and support for the aft interstage when in a vertical attitude. It is a trailer-type device using a box frame primary structure with two transversing tension rods diagonally spanning the major section of the frame. The dolly can be steered from either end by locking out the opposite end. For parking purposes, the dolly is equipped with air/hydraulic brakes on all four wheels which can be locked by actuating a lever at either end. Three mounting pads on the dolly frame are provided for aft interstage attachment. Each mounting pad secures the aft interstage by anchor nuts through the interstage aft support ring. Tapered guide pins from the forward midpoint mounting pad are used for aft interstage alignment.

4. Stage Front Cover (H7-9) - The stage front cover provides necessary protection for the forward portion of the stage against all environmental conditions encountered during transport and storage. The cover is designed to be readily installed or manually removed from the stage. It has fasteners around its periphery for securing it to the next adjacent cover, the stage forward body cover. The stage front cover is a flexible, water repellant, lightweight fabric material, the exterior surface of which is aluminized to reflect heat.

5. Stage Mid-body Cover (H7-11) - The stage mid-body cover provides necessary protection for the midsection of the stage against all environmental conditions encountered during transport and storage. The cover is designed to be readily installed or removed from the stage. It has fasteners around its periphery for securing it to adjacent covers, the stage forward cover and the stage aft cover. The stage mid-body cover is a flexible, water repellant, lightweight sandwich material which can be installed or removed using the body cover roller mechanism. It is composed of an aluminized heat reflective exterior, a fabric center, and a cushion-type interior.

6. Stage Aft Cover (H7-14) - The stage aft cover provides necessary protection for the aft portion of the stage against all environmental conditions encountered during transport and storage. The cover is designed to be readily installed or manually removed from the stage. It has fasteners around its periphery for securing to the next adjacent cover, the aft interstage cover. The stage aft cover is a flexible, water repellant, lightweight material, the exterior surface of which is aluminized to reflect heat.

7. Stage Fit-up Fixture (H7-17) - The stage fit-up fixture simulates the external shape, size, and weight of the S-II Stage. It is designed to demonstrate and verify the adequacy of the proposed concepts of handling and transporting the stage. The stage fit-up fixture consists of a skeleton-type structure of commercial steel shapes which duplicate the stage size and shape and those areas which contact or connect to the transport ground support equipment.

8. Transport Illumination Set (H7-18) - The transport illumination set supplies "en route" illumination requirements such as clearance and maintenance lighting. Hardware includes lamps, reflectors, clamps, cables, sockets, and connectors.

9. Engine Actuator Lock #1 (H7-19) - The engine actuator lock provides the means for locking the hydraulic actuators on the outboard gimballing engines in the "null" position. With the engine actuator locks installed, the engine is rendered secure for handling, transportation, and personnel safety during maintenance. The lock consists of a split 2-piece sleeve machined to adapt to a flange on the actuator body and to a groove in the piston rod. The lock is held in place around the actuator with a large hose clamp. A "REMOVE BEFORE FLIGHT" warning streamer is provided with each lock. One lock is required per engine actuator.

10. Engine Actuator Simulator (H7-20) - The engine actuator simulator is a link assembly consisting of two rod ends with an adjustable barrel or turnbuckle between the rod ends. The actuator simulator is installed whenever an engine actuator is removed, to maintain the engine in a neutrally locked position. Attaching hardware is the same as that used for engine actuator installation. One simulator is required per engine actuator.

11. Static Firing Skirt (H7-21) - The static firing skirt provides a temporary structural medium between the stage and the aft support ring. It is used in conjunction with the aft support ring to make the connection and tiedown for static firings, and transmits the thrust loads through the aft support ring to the static firing stand. The skirt is fitted with internal and external lift points to facilitate handling. It is cylindrically shaped, approximately 6 feet long, 33 feet in diameter, and weighs approximately 13,500 pounds.

12. Stage Erecting Sling (H7-23) - The stage erecting sling transfers the stage weight from the forward hoisting frame to the crane hook to provide the forward lift point for stage hoisting operations. In addition, the sling is used to install or remove the forward support ring and forward support frame. The stage erecting sling incorporates six arms, equally spaced, which extend outward from a central plate, with a clevis on each arm. Each arm is identified by number and corresponds to the related hoisting frame segment. The clevises are joined to the forward hoisting frame by six attaching pins. The central plate attaches to a crane hook through an adapter and double shackle assembly. The sling weighs approximately 2,400 pounds.

13. Forward Hoisting Frame (H7-24) - The forward hoisting frame transmits the diametrical load of the stage to the stage erecting sling during all phases of hoisting operations. The frame is a cone-shaped structure tapering from approximately 33 feet at the outer diameter to approximately 10 feet at the inner diameter. It weighs approximately 3,700 pounds. On the base of the forward hoisting frame are 144 mounting flanges used for installing the frame to the forward support ring. The stage erecting sling attachments are provided by six hoist fittings equally spaced around the inner circumference of the hoisting frame cone neck. The forward hoisting frame is spliced in 12 segments to permit disassembly for transport or storage.

14. Aft Hoisting Frame (H7-25) - The aft hoisting frame attaches to the aft support ring and the static firing skirt, providing means for controlling the position of the aft end of the stage during stage erecting or lowering operations. The aft hoisting frame uses three attach points: a clevis connection on the aft end of the static firing skirt, and two socket connections on the aft support ring. All three connections are made through bearings mounted in the aft hoisting frame. The aft hoisting frame weighs approximately 10,000 pounds.

15. Interstage and Static Firing Skirt Segment Sling (H7-27) - This sling provides support for the static firing skirt segments during hoisting operations.

16. Support Ring Segment Sling (H7-28) - The support ring segment sling is used for hoisting the forward and aft stage support ring segments while attaching or removing them from the stage. The sling consists of a lifting ring, two hoist cables, and lifting hooks at the attaching end of the cables. The attach points on the ring segment are located so that the center of gravity of the segment falls below the lifting ring. This permits lifting of the ring segment into the horizontal position without the use of a counterweight to offset the eccentric loading.

17. Interstage and Static Firing Skirt Sling (H7-30) - The interstage and static firing skirt sling is used to lift and position the assembled interstage or static firing skirt. The sling is constructed of three stainless steel cables, 1 inch in diameter and 24 feet 7 inches long, joined together by a single lifting link. The opposite end of each cable contains a lifting hook designed to attach to lifting eyes mounted to the interstage or static firing skirt.

18. Engine Protective Frame (H7-72) - The engine protective frame provides a cover for the five J-2 engines, shielding them from possible damage during transport and handling operations. The frame is a truss-type assembly attaching to the aft support ring and extends over the engines approximately 13 feet. The assembly includes four hoisting links on the upper horizontal beams for handling operations. The frame weights approximately 2,100 pounds.

19. Engine Protective Frame Attitude Control Sling (H7-76) - This sling provides support when rotating the engine protective frame to a vertical position and when installing or removing the engine protective frame from the stage.

20. Stage Guide Brackets (H7-79) - The stage guide brackets attach to the aft support ring and are required to align the stage with the static firing test stand. As the stage is lowered and rotated into approximate position, the guide brackets engage their respective guide rails on the test stand, to hold the stage in correct radial alignment. There are two brackets located 180^{o} apart on the aft support ring. Each bracket weighs approximately 38 pounds.

21. Engine Actuator Lock #2 (H7-89) - The engine actuator lock is a removable mechanical locking device designed to prevent any movement of the four outboard gimbaled J-2 engines. The locking device positions the hydraulic servoactuator piston in the "null" position and prevents any movement of the piston in either direction. The locking device is used during ground handling, storage, transportation, and maintenance. It consists of a split-cylindrical mechanical lock, one end of which clamps securely around the end of the servoactuator body and the other end around the actuator piston. A "REMOVE BEFORE FLIGHT" warning streamer is provided with each lock. One lock is required per engine actuator.

22. Interstage Forward Support Ring (H7-92) - The interstage forward support ring is required to: maintain concentricity of, and stiffen, the forward end of the interstage during handling and checkout operations; provide a means for attaching the interstage protective covers to the interstage; and provide an adapter interface for bolting the interstage to the transfer dolly and the S-II checkout dolly. The ring is constructed from steel channel segments and, when assembled, weighs approximately 3,150 pounds. The existing interstage bolt hole pattern is used for support ring attachment. In addition, the ring includes tag line and hoisting sling fittings required for interstage handling and support ring installation.

23. Interstage Aft Support Ring (H7-93) - The interstage aft support ring is required to: maintain concentricity of, and stiffen, the aft end of the interstage during handling and checkout operations; provide a means for attaching the interstage protective covers to the interstage; and provide an adapter interface for bolting the interstage to the transfer dolly and the S-II checkout dolly. The ring is constructed from steel channel segments and, when assembled, weighs approximately 3,150 pounds. The existing interstage bolt hole pattern is used for support ring attachment. In addition, the ring includes tag line and hoisting sling fittings required for interstage handling and support ring installation.

24. Center Engine Vertical Installation Adapter (H7-94) - The center engine vertical adapters are used for installing and removing the center J-2 engine on the S-II Stage. The adapter pulleys guide the hoisting cables of the vertical engine installer which operates from a level below the engine installed position. The adapters consist of a welded steel assembly with pulleys attached. The adapters are designed to bolt to the engine support structure.

25. Separation Linear Shaped Charge (LSC) Installer (H7-97) - The separation LSC installer is used to unwind LSC from the storage reels during separation system installation.

26. Electrical Connector Cover Set (A7-6) - The electrical connector cover set consists of necessary protective covers for each electrical umbilical and interstage connector. The covers are used during those periods when any electrical umbilicals and interstage connections are disconnected for reasons of repair and/or maintenance and provide protection from any unnatural environments.

27. LH_2 Tank Access Cover Handle (H7-99) - The LH_2 tank access cover handle is required to lift off the LH_2 tank access cover.

28. Thrust Alignment Set (A7-15) - The thrust alignment set is a specially designed adjustable integrating fixture. Throat and exit radii measurements of the thrust chamber are taken with this fixture. The fixture consists of a target tube with two supporting spider assemblies, one on each end of the fixture. The forward spider locates aft of the throat of the thrust chamber, and the aft spider locates forward of the exit end of the thrust chamber. Mounted on the target tube forward of the forward spider is one arm, and aft of the aft spider is another arm, each extending perpendicular to the target tube. These arms can be turned completely around the longitudinal axis of the target tube and indicator gauges mounted at their extremities read the variations in the inner circumference of the chamber throat and exit. The target tube is centered in the thrust chamber by the adjustment of the throat and exit adjusting knobs. The throat indicator is positioned on the smallest diameter of the throat by an adjusting ring at the aft end of the fixture. The exit indicator is positioned two inches forward of the aft end of the thrust chamber. The set provides verification of correct J-2 engine alignment when the stage is in the vertical attitude.

29. Piston Position Indicator #1 (A7-34) - The indicator is a sliding scale for rigging and guidance checkout of the hydraulic actuation system in cold gimbaling of the engine. It is composed of an indicator rod in a tube mounted parallel to the actuator piston axis. The nonlinear scale engraved on the rod can be seen through a cutout in the tube where a pointer is provided. The indicator is installed by enclosing the split collar around the matching groove in the piston rod, then inserting the ball-lock pin. The guide stud is then inserted into the actuator body and the two screws are tightened. The indicator rod is then adjusted to a null (midstroke) position and the setscrew is tightened. Scale readings will correspond to engine position in degrees.

30. Static Firing Heat Shield (A7-47) - The static firing heat shield is a stainless steel reflector designed to be installed in the engine compartment during static firing to provide thermal protection for the LO_2 tank bulkhead and vehicle hardware. The purpose is to reflect radiative heat from the engine flame plumes and flame deflector.

31. Piston Position Indicator #2 (A7-48) - The piston position indicator #2 provides a visual indication of the hydraulic servo-actuator piston position. One indicator is required for each J-2 engine actuator.

32. Aft Interstage Cover (H7-13) - The aft interstage cover provides necessary protection for the interstage section of the stage against all environmental conditions encountered during transport and storage. The cover is designed to be readily installed or removed from the stage. It has fasteners around its periphery for securing to adjacent covers, the stage aft body cover and the stage aft cover. The aft interstage cover is a flexible, water repellant, lightweight sandwich material which can be installed or removed using the body cover roller mechanism. It is composed of an aluminized heat reflective exterior, a fabric center, and a cushion-type interior.

33. Tag Lines Adapter Set (H7-29) - The tag lines adapters and lines are required to control the free end of the stage during erection procedures. The tag line adapters are readily attached at various positions on the stage to give maximum control at all times. The length of the lines is sufficient to give control from the ground for all attach positions on the stage. The tag lines and adapters are also used to steady and control the S-II interstage during hoisting procedures. There are two sets of tag line adapters; one set mounts on the forward support ring forward web, and one set mounts on the static firing skirt forward of the aft support ring.

34. Pump Shaft Seal Visual Leakage Indicator (A7-36) - The pump shaft seal visual leakage indicator consists of a graduated plastic bottle and tubing designed to attach to the auxiliary or main hydraulic pumps to accumulate fluid leaking past the pump seal.

35. Static Firing Fragmentation Shield (A7-37) - The static firing fragmentation shield is a sectionalized frame and stainless steel screen assembly designed to be installed around the J-2 engines when the S-II Stage is installed in the static firing stand. The shield is provided to protect the LOX tank bulkhead, LOX and LH_2 inlet ducts, thrust structure electrical components, and adjacent J-2 engines and components from explosions of engines or engine components.

36. Side Load Arresting Mechanism (A7-51) - The side load arresting mechanism includes two distinct systems, the load restraining mechanism and the coolant and purge system. The load restraining mechanism arrests the side load during the ground level, engine start phase only. It consists of two horizontal arms for each outboard engine, mounted at 45^o to stage centerline. The arms have a self-aligning rod end connection to the test stand support structure and are connected to the engine bridle with a clevis pin before firing. When the engine reaches mainstage, approximately 5.5 seconds after start, an explosive cartridge is automatically detonated to remove the bolt at the separation fitting, permitting the arm to fall clear. The engine is then free to gimbal. No provision is made for reconnection of the restraining arms during firing tests. The coolant and purge system supplies water to the engine diffuser which eliminates side load during the shutdown phase. The system consists of the GN_2 line with inlet valve and flowmeter; the water line with inlet valve and flowmeter; and the coolant line with pressure transducer. A tee joins these three lines together. The coolant line is attached to the diffuser inlet and the other lines are attached to facility supply sources. During the thrust chamber chilldown phase and until the engines start, GN_2 is fed into the diffuser at 0.04 to 0.06 pounds per second and 130 to 180^o F. to warm and purge the system of any water remaining from previous operations. Simultaneously with engine start, GN_2 is shut off and water is supplied to the diffuser for duration of firing. In the event coolant flow falls below minimum prescribed pressure, combined signals from transducer and water flowmeter shut off the engine automatically in 0.5 seconds, preventing damage to the diffuser and subsequent damage to actuators and gimbal.

37. Halogen Leak Detector Unit (A7-55) - The halogen leak detector unit is a portable halogen-sensitive leak detection assembly used for checking the integrity of propellant system components. It consists of the following items: a metal housing enclosure containing three control units, three gun-type detector units, three pencil-type probes, and one calibration unit; the control unit, an electrically operated unit equipped with air pump, ion chamber, multi-range readout dial, and audio alarm; gun-type probe, a slave unit for remote readout equipped with its own ion chamber and readout dial plus a long electric cord-the probe also has a switch for readout at the control unit, if desired; pencil-type probe, a small diameter nozzle for probing difficult-access areas, equipped with a hose for attachment to the control unit where readout is made; and the halogen leak standard, a lightweight precision device containing halogen gas used to calibrate the control unit or the gun-type probe if quantitative leak detection is required. The leak detector unit is used to probe for leaks in bellows, flexible hoses, and many stage areas where access is difficult or

where halogen methods are most applicable. At static firing test sites, the equipment may be used before or after firings.

38. Aft Hoisting Frame (75-100T) Adapter (H7-111) - The aft hoisting frame adapter permits attachment of the facility crane hook to the aft hoisting frame (H7-25). The adapter consists of a steel link with a bushed hole at either end. The crane hook end is clevis-shaped and attached to the drilled hook by a clevis pin. The adapter is 12 inches in length and 7 inches in diameter and weighs 100 lbs.

39. Stage Erecting Sling (75-100T) Adapter (H7-112) - The stage erecting sling adapter permits attachment of the facility crane hook to the stage erecting sling (H7-23). The adapter consists of a steel link with a bushed hole at either end. The crane hook end is clevis-shaped and is attached to the crane hook by a clevis pin. The erecting sling end is also attached by a clevis pin. The adapter is 106 inches in length and 7 inches in diameter and weighs 900 lbs.

40. Outboard Engine Vertical Installation Adapter (H7-95) - The outboard engine vertical installation adapter provides the required change in direction of the engine installer hoisting cable in order to raise and lower the outboard engines vertically. The adapter is made up of two separate pulley assemblies which attach to the center engine beam and thrust structure. Each pulley assembly consists of three pulley wheels mounted on a bracket. The outboard pulley assembly is suspended on one end from the thrust structure by an adjustable shaft. The inboard pulley assembly is clamped to the center engine support beam.

41. Engine Verticle Installer Sling (H7-106) - The engine verticle installer sling is a universal sling designed to hoist various items of equipment. The sling consists of a large rectangular dual-frame assembly incorporating a removable inner frame, two dual-cable slings, two single-cable slings, and four plastic-coated hoisting cables.

42. Static Firing Purge Manifold (A7-73) - The static firing purge manifold provides gaseous nitrogen to the interior of the S-II stage thrust structure prior to and during static firing to ensure an inert atmosphere in this area. The purge manifold consists of a ring-shaped manifold an inlet duct, eight outlet ducts, and attaching hardware. The manifold is installed on the thrust structure of the S-II stage around the center engine and manifold of the outer engines.

43. Engine Area Firex System (A7-75) - The engine area firex system is a water dispersion system designed to protect the J-2 engines, electrical containers, liquid hydrogen prevalves, and stage thrust structure in the event of an engine fire. The firex system consists of four engine-position manifolds, eight electrical container auxiliary manifolds, four facility interconnect lines, four flexible connectors, and attaching hardware. The four manifolds are attached to the upper portion of the static firing fragmentation shield framework (A7-37) and delivers water at a rate of 25,000 gallons per minute at pressures of 125 to 150 psi. Each manifold mounts 14 fog nozzles and a single cellar nozzle. The cellar nozzles extend vertically above the manifold and protect the stage thrust structure.

44. Forward Hoisting Frame Firex System (A7-76) - The forward hoisting frame firex system is designed to extinguish any fires which may occur in the stage forward skirt area during static firing by filling that area with gaseous nitrogen (GN_2). The firex system consists of a circular manifold, mounted inside the forward hoisting frame (H7-24), a pass-through pipe, a flexible line assembly, and attaching hardware. The manifold is mounted around the floor of the LH_2 tank clean room (A7-39) and distributes the nitrogen through 24 wide-spray full-jet nozzles and 23 plain-tube nozzles. The system is supplied and controlled through a facility source and is capable of dispensing 60,000 standard cubic-foot-per-minutes at 100 psi.

45. Vertical Engine Installer Sling (H7-106) - Additional data will be provided at a later date.

46. Arm 3A Carrier Plate Support Mechanism (A7-69) - Additional data will be provided at a later date.

47. Arm #4 Carrier Plate Support Mechanism (A7-70) - Additional data will be provided at a later date.

S-IVB HANDLING AND AUXILIARY EQUIPMENT

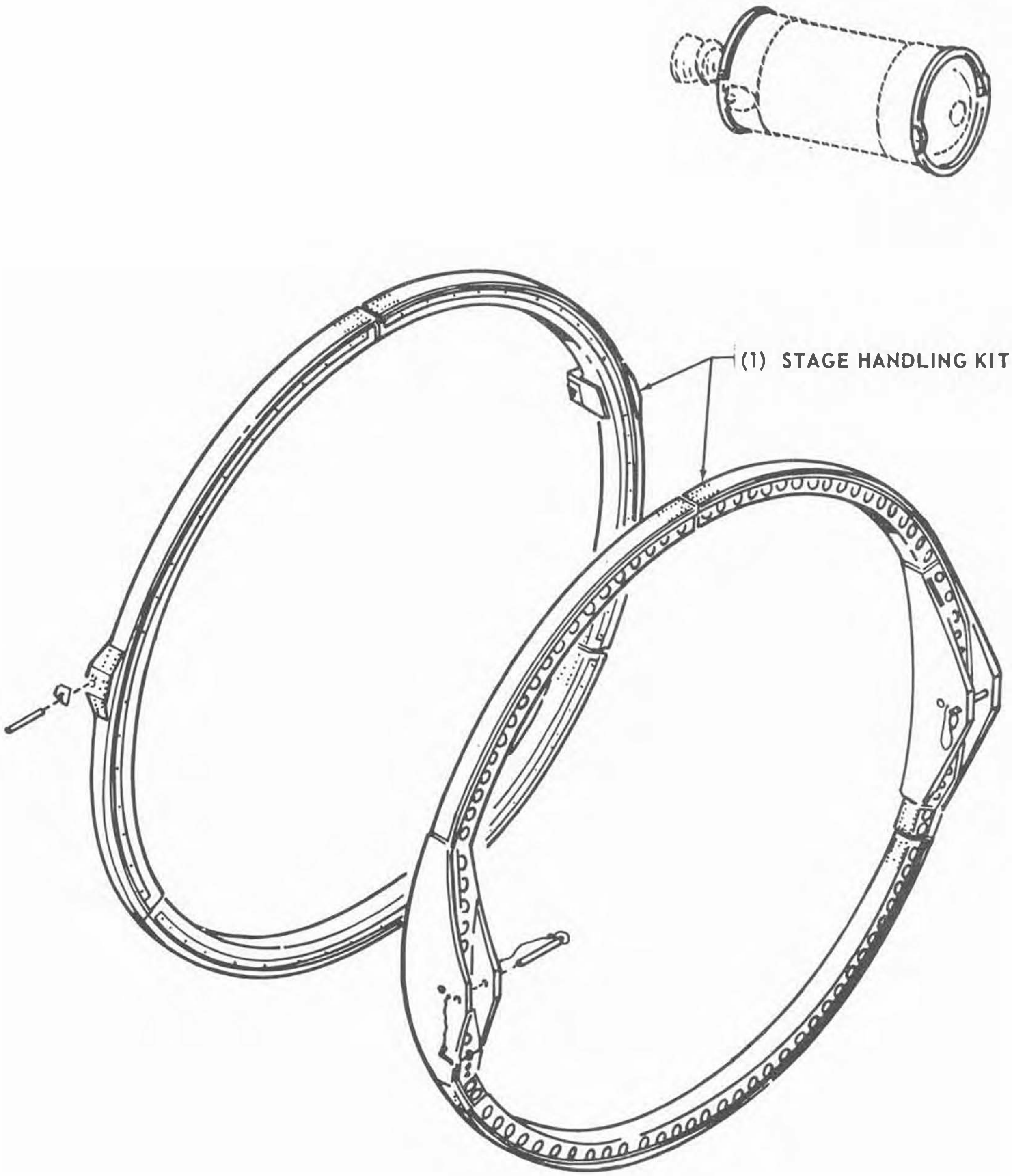


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 1 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

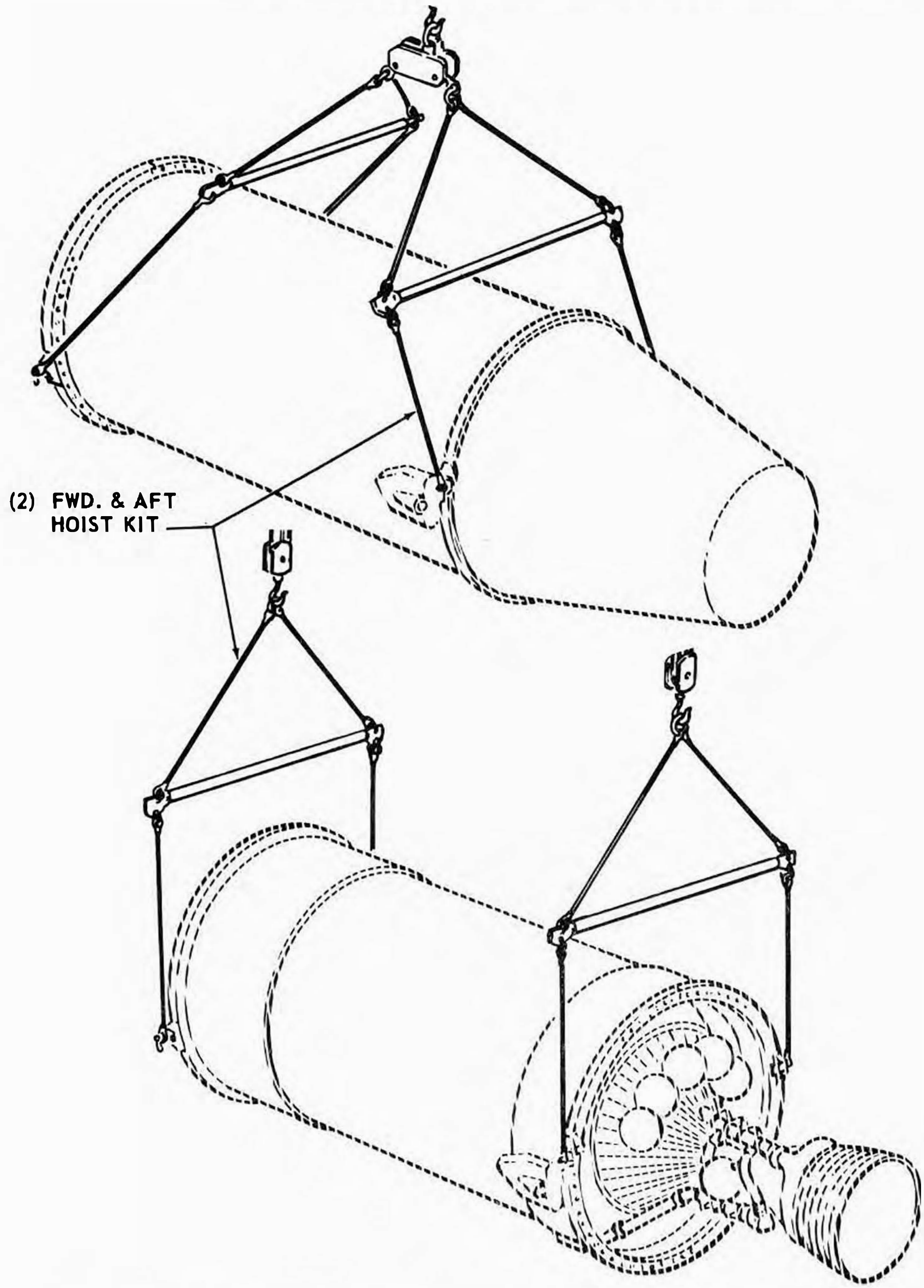


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 2 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

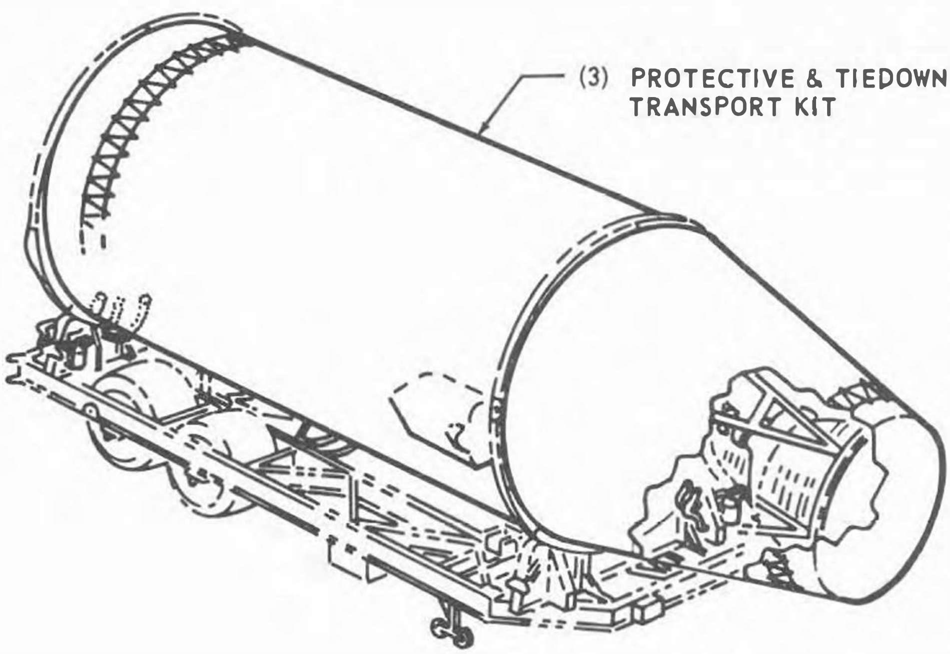
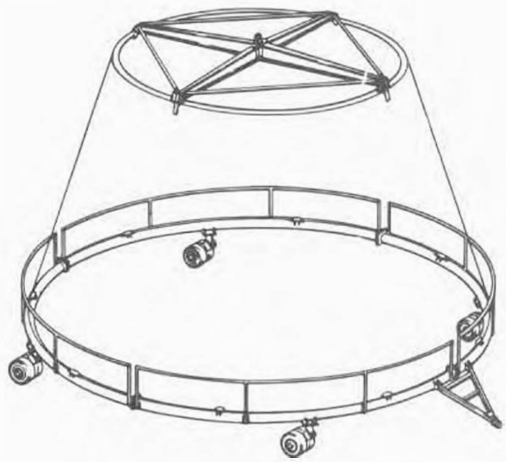


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 3 of 18)

S-IVB HANDLING AND AUXILLIARY EQUIPMENT



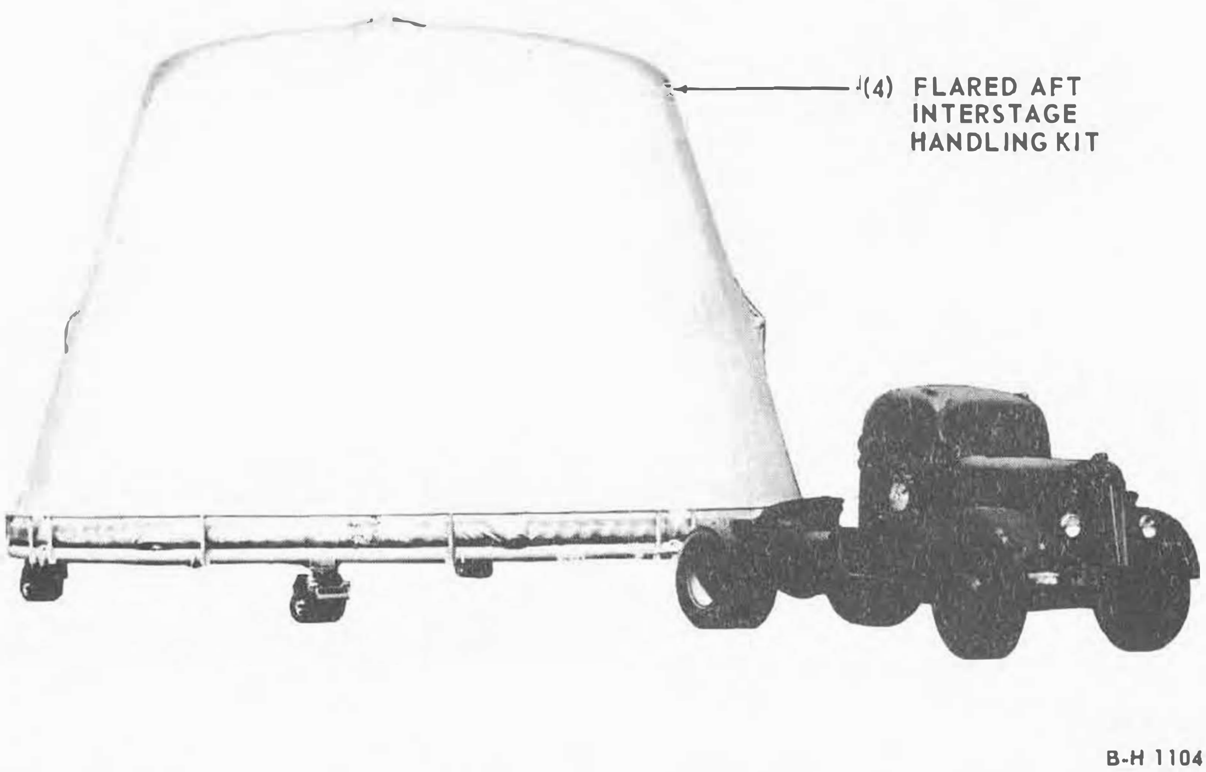


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 4 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

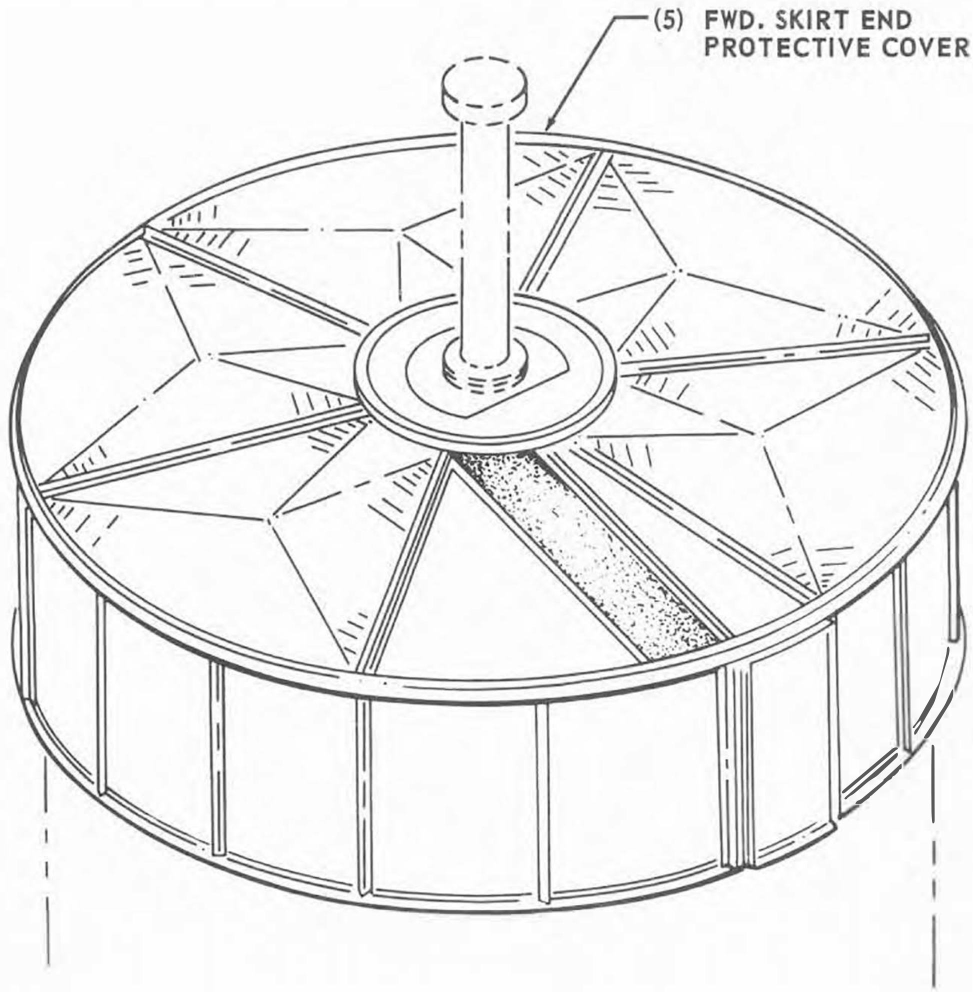


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 5 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

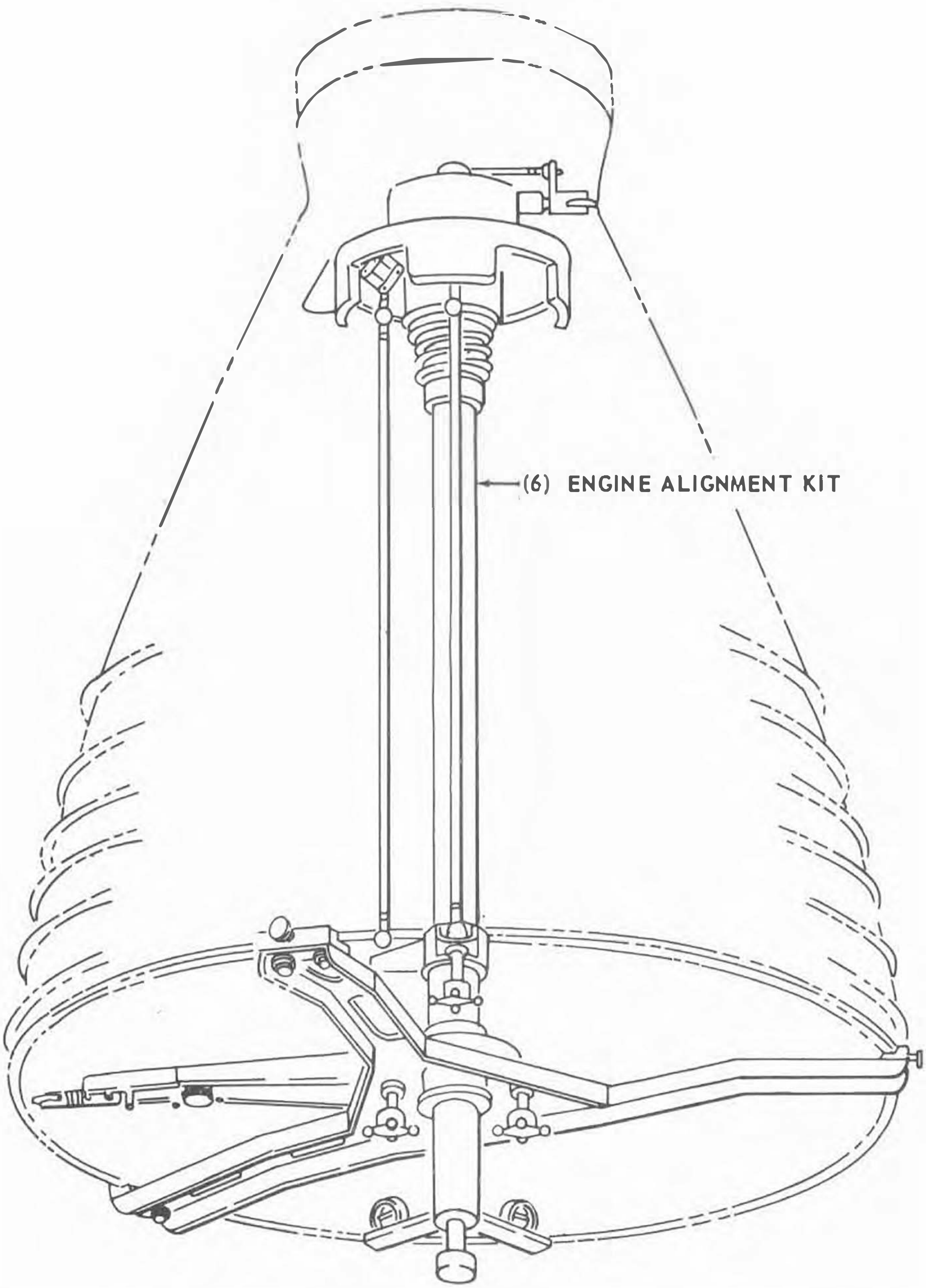


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 6 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

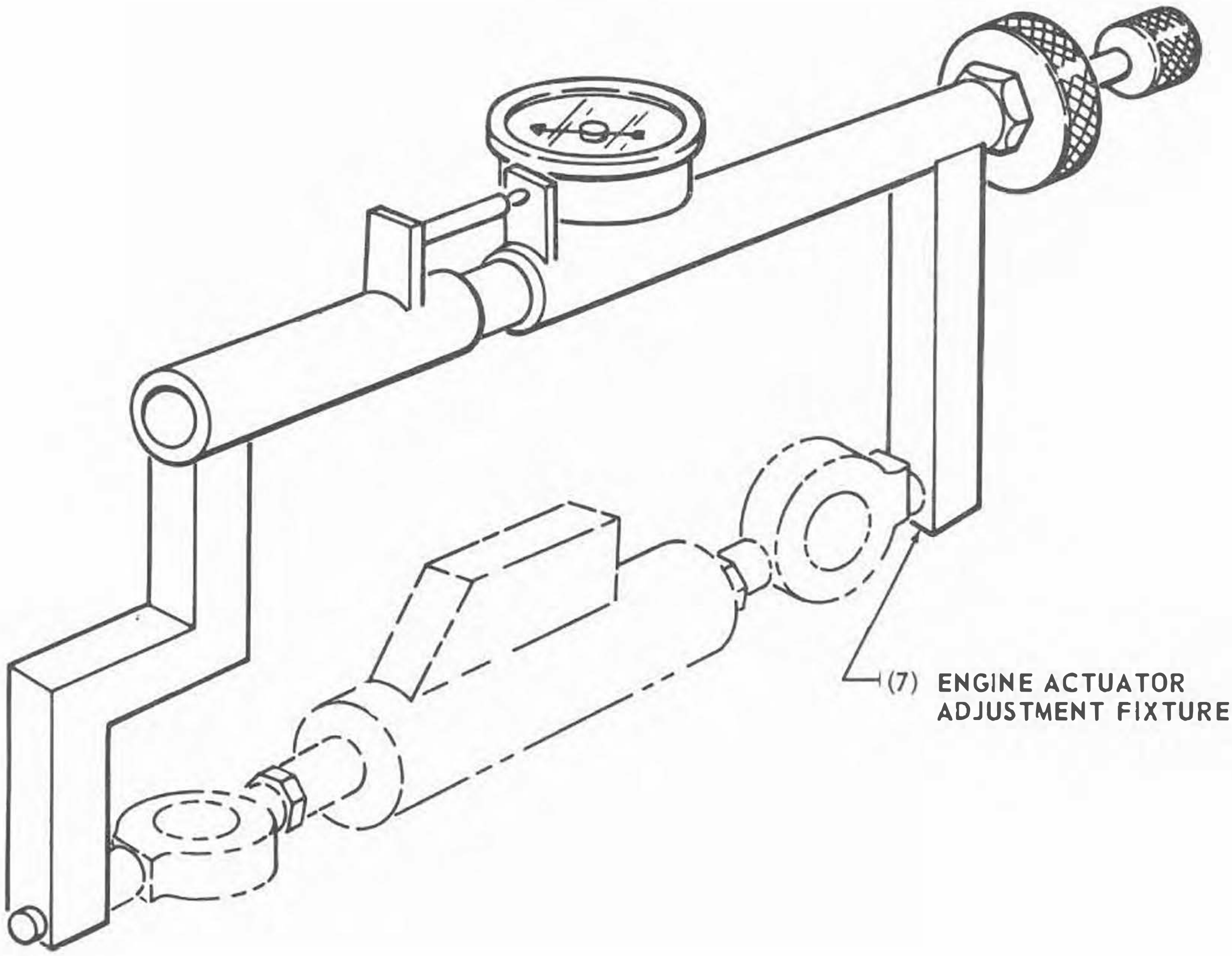


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 7 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

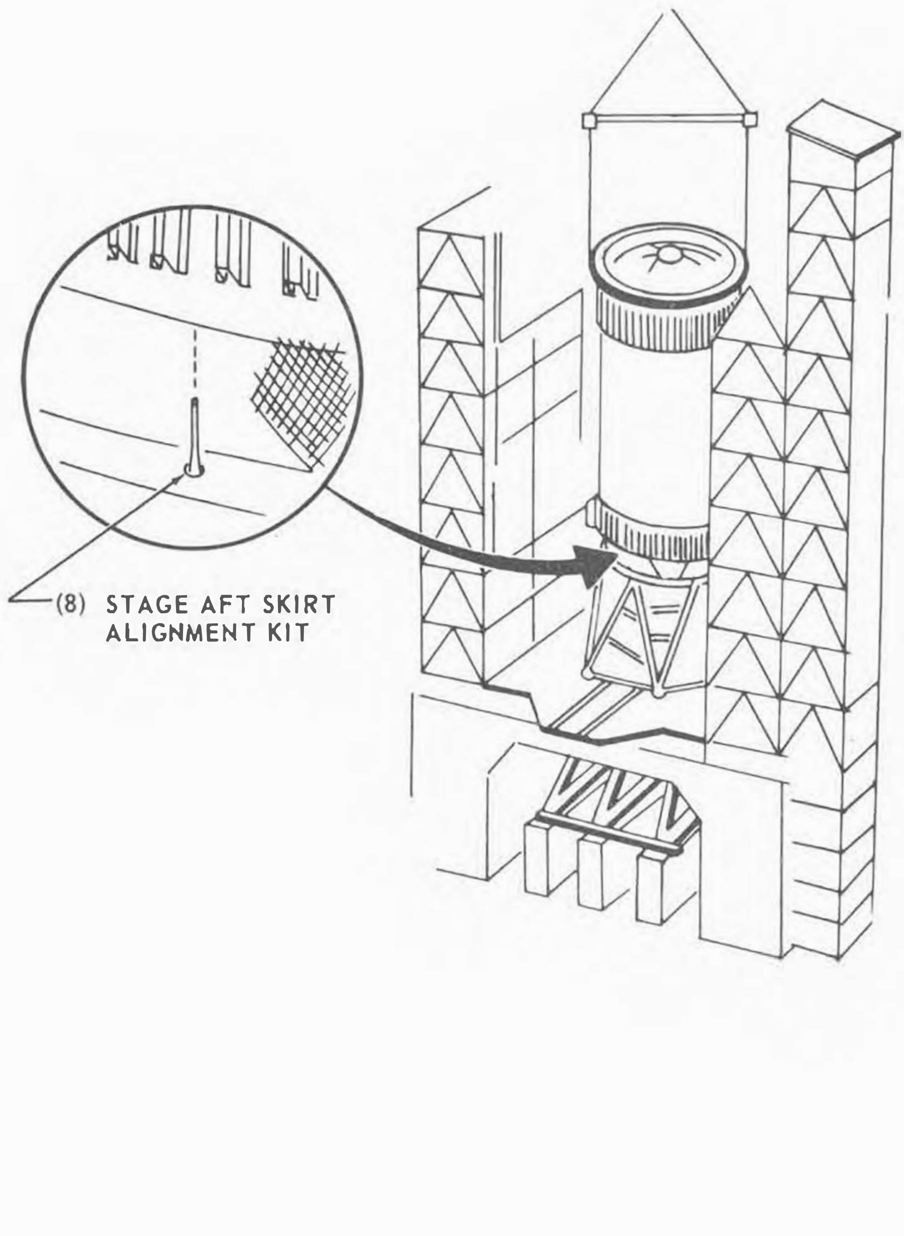


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 8 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

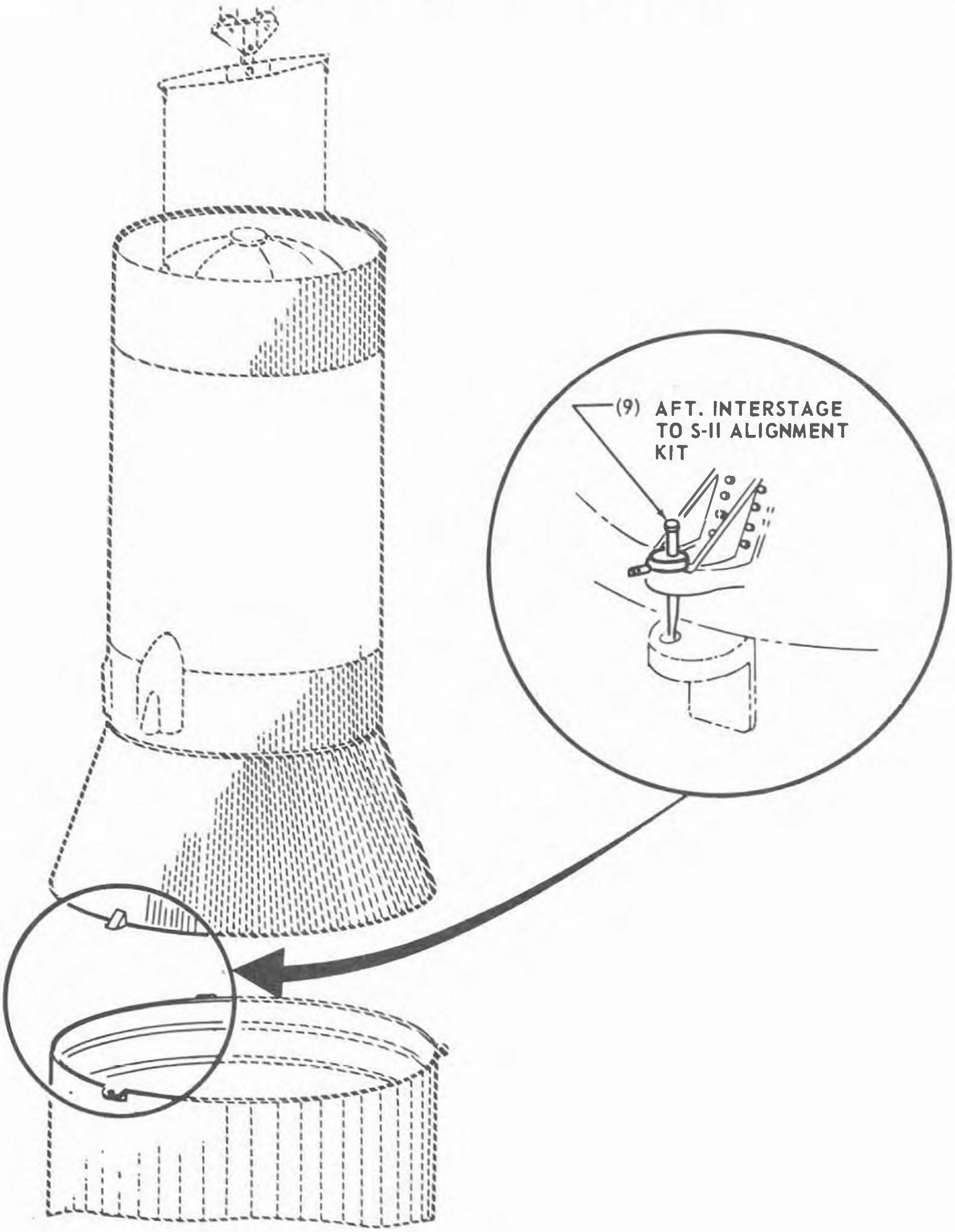


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 9 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

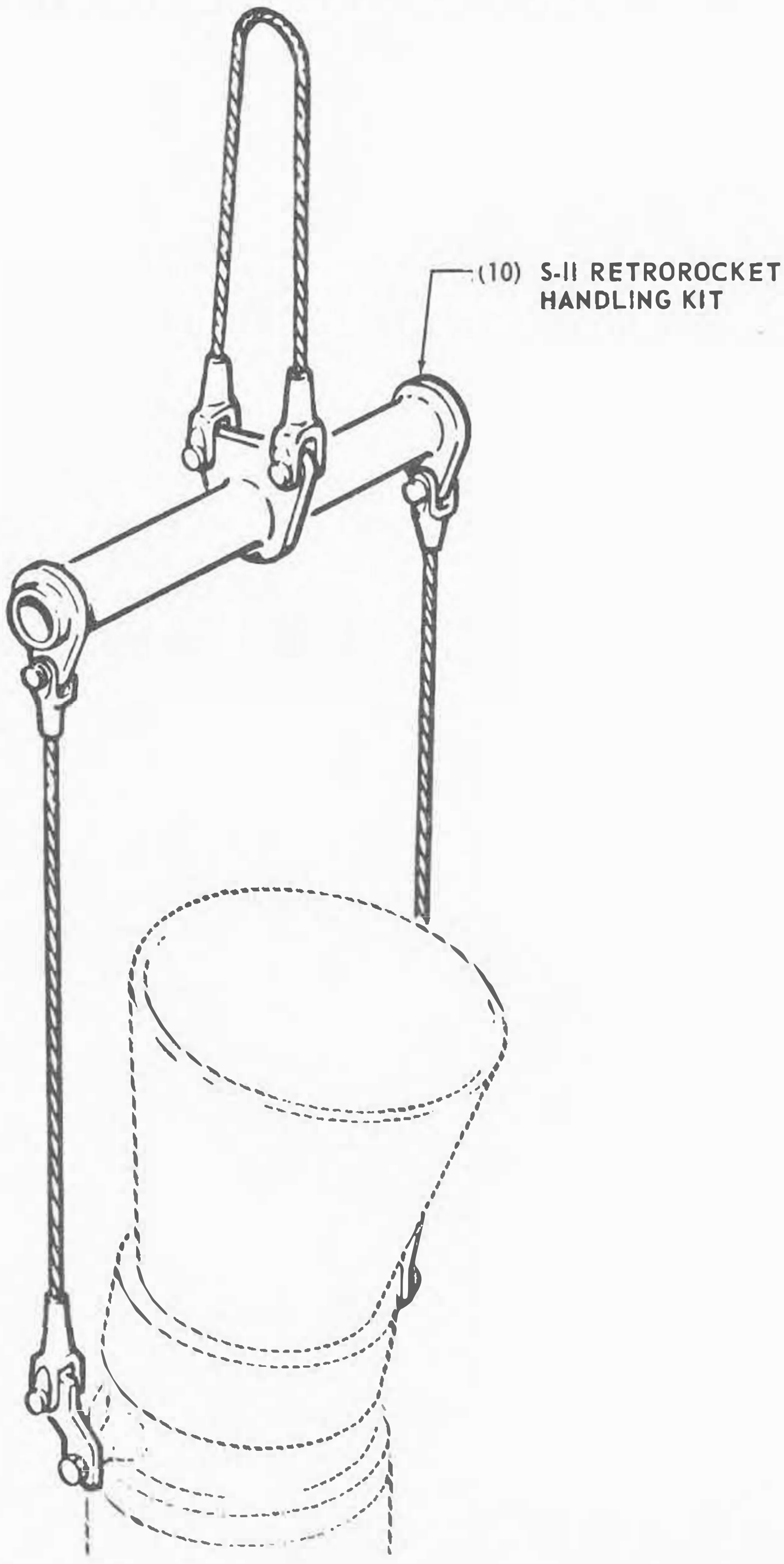


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 10 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

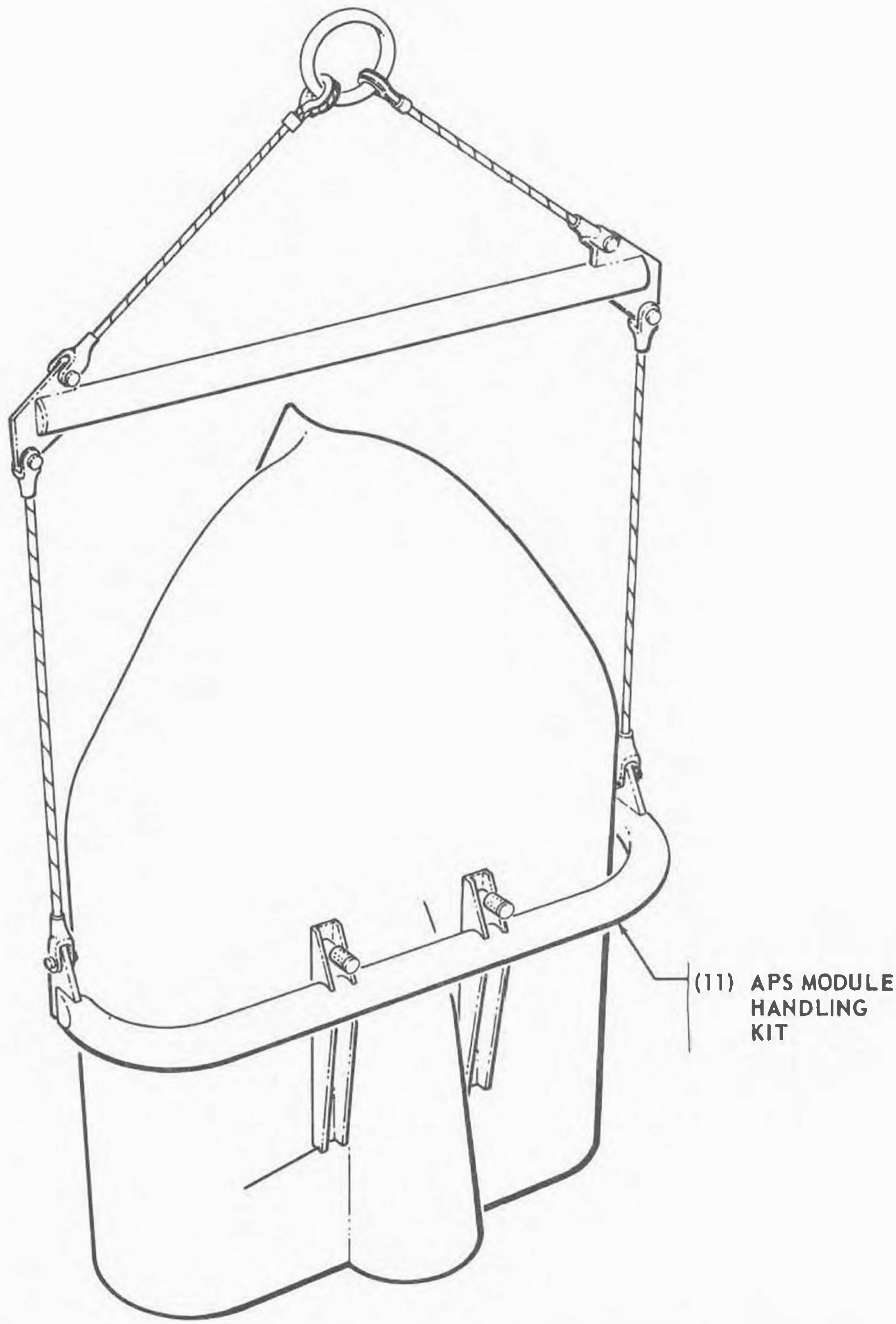
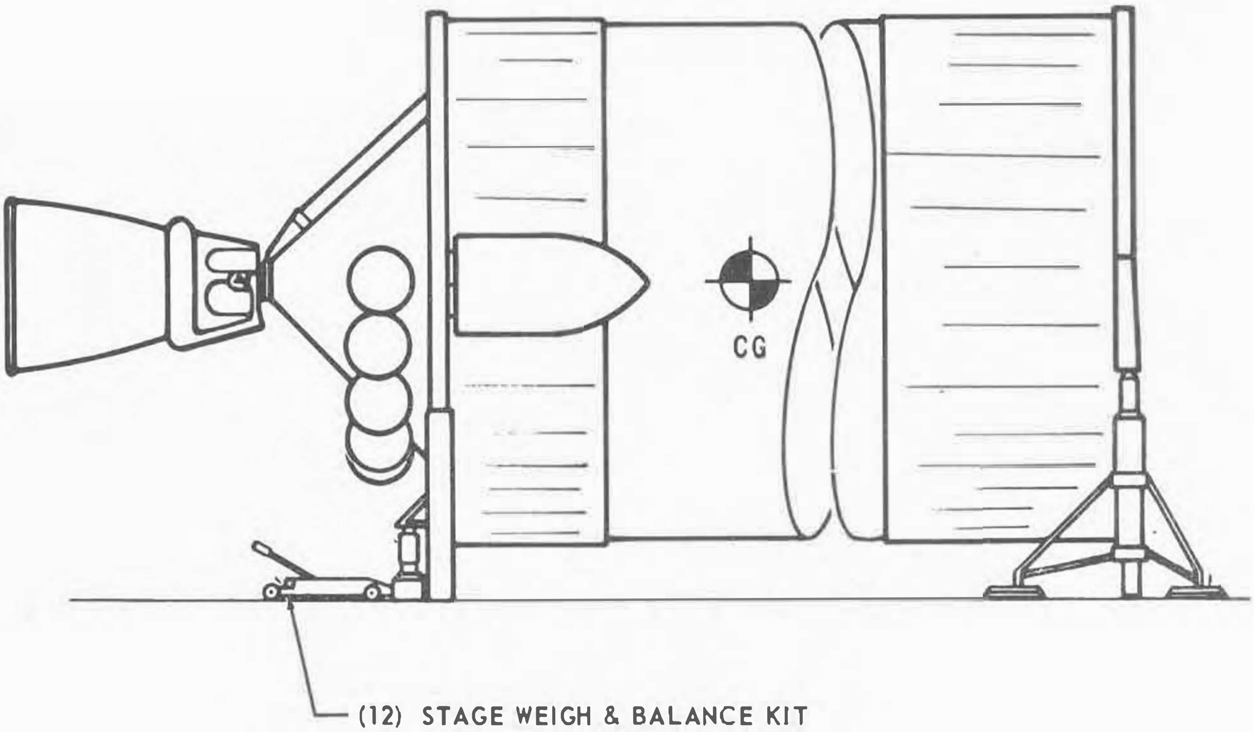


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 11 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT



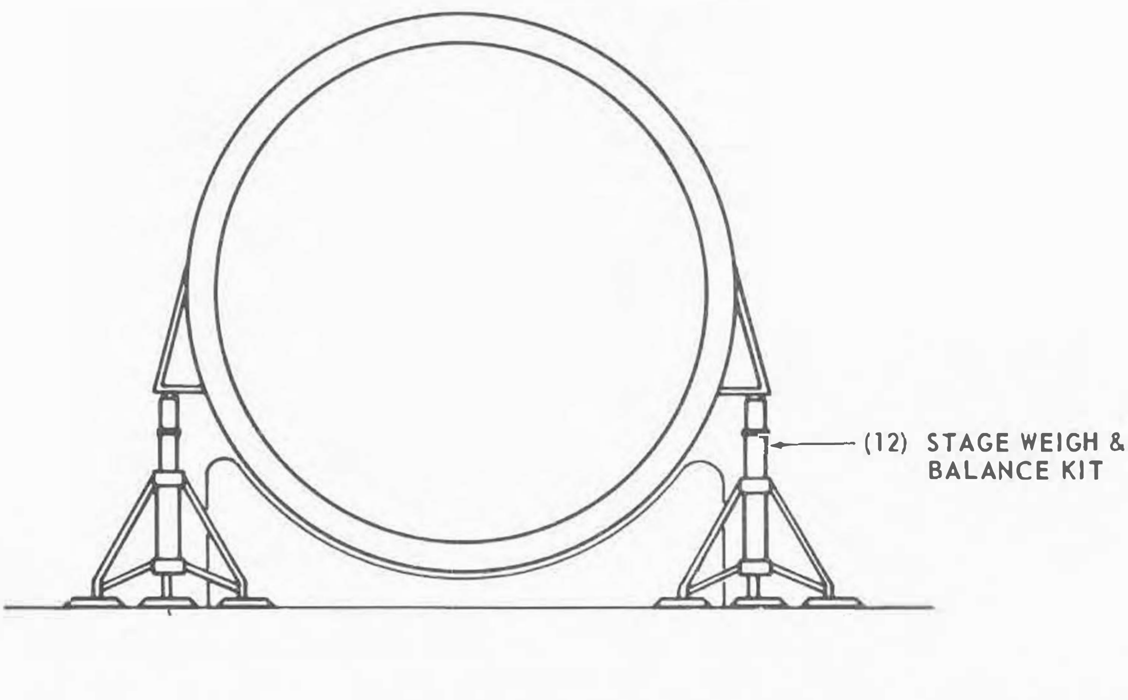


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 12 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

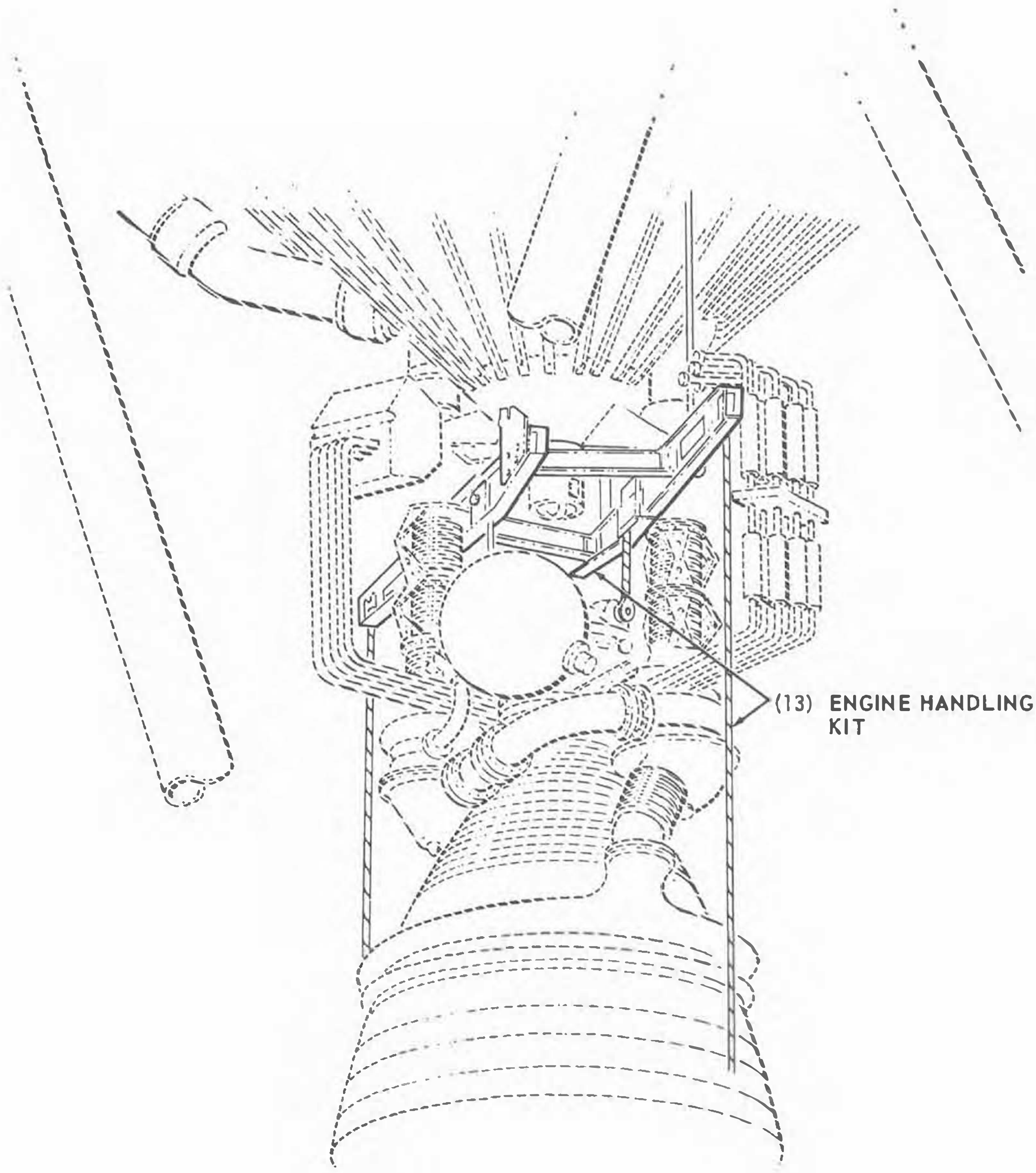


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 13 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

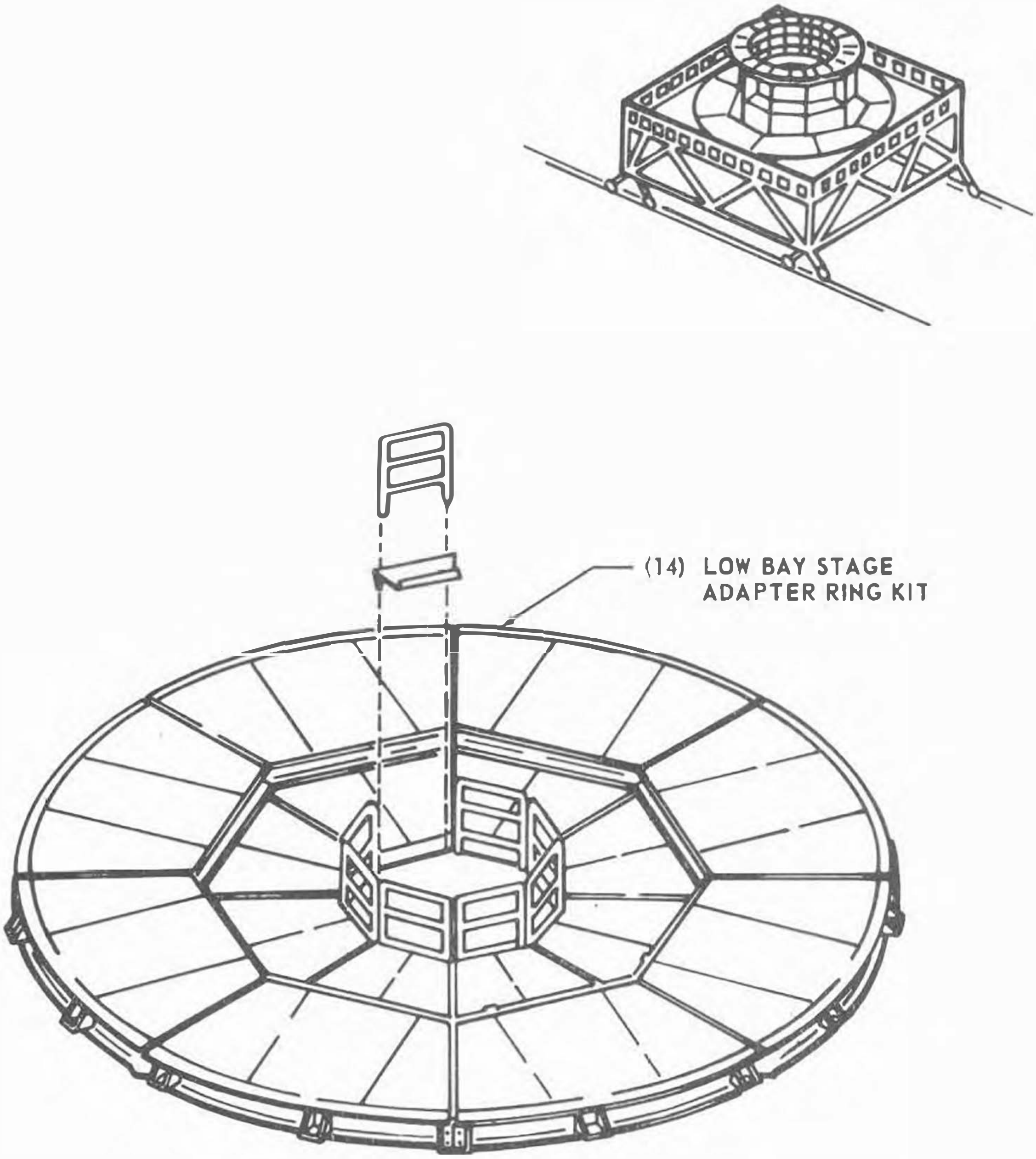


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 14 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

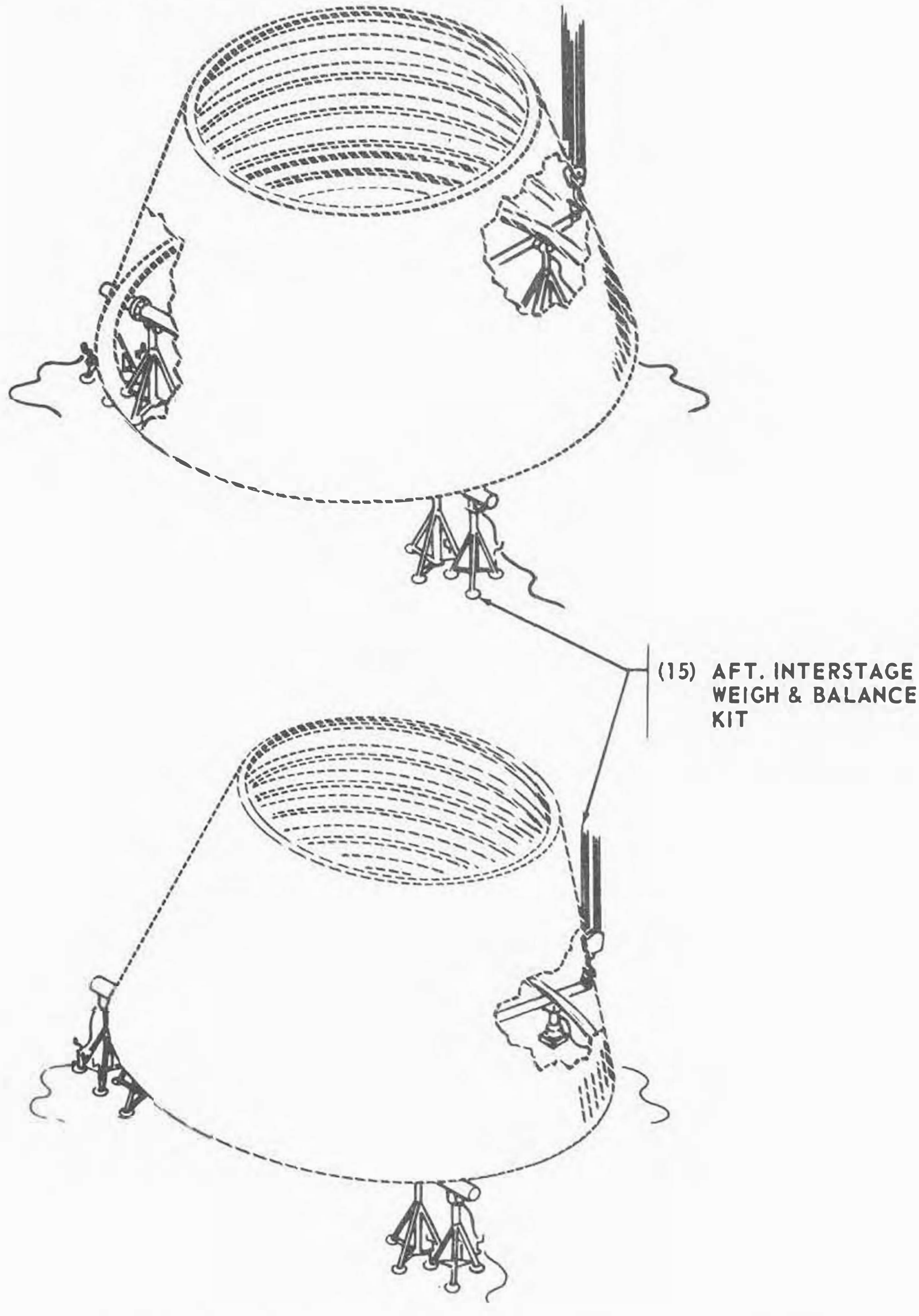


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 15 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

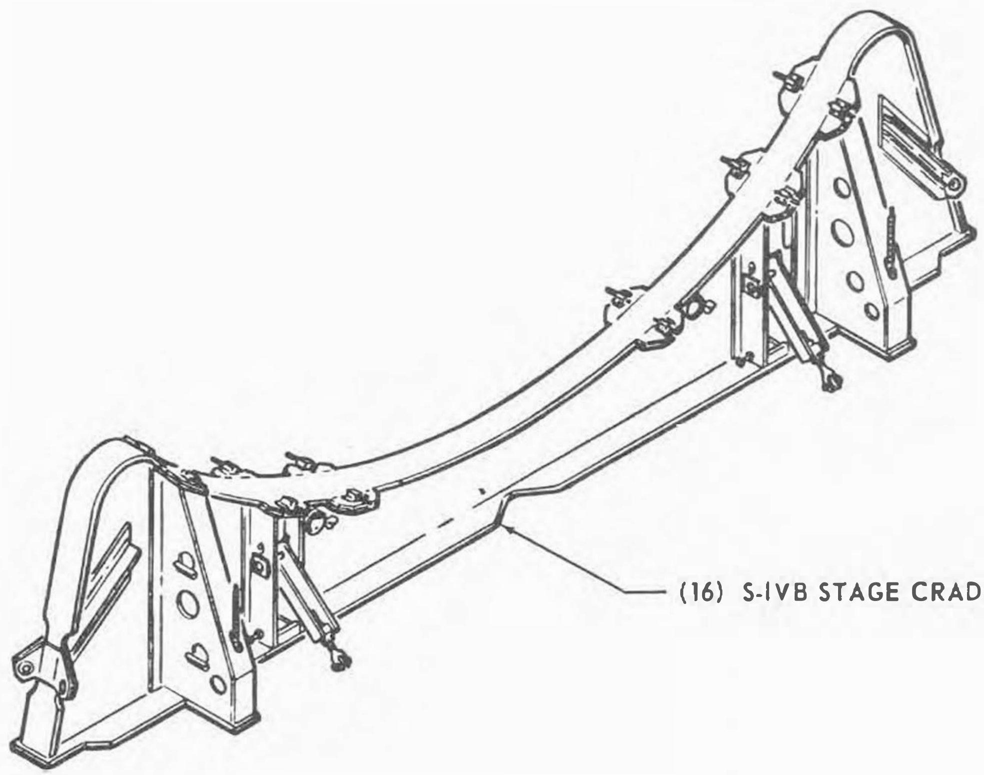


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 16 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

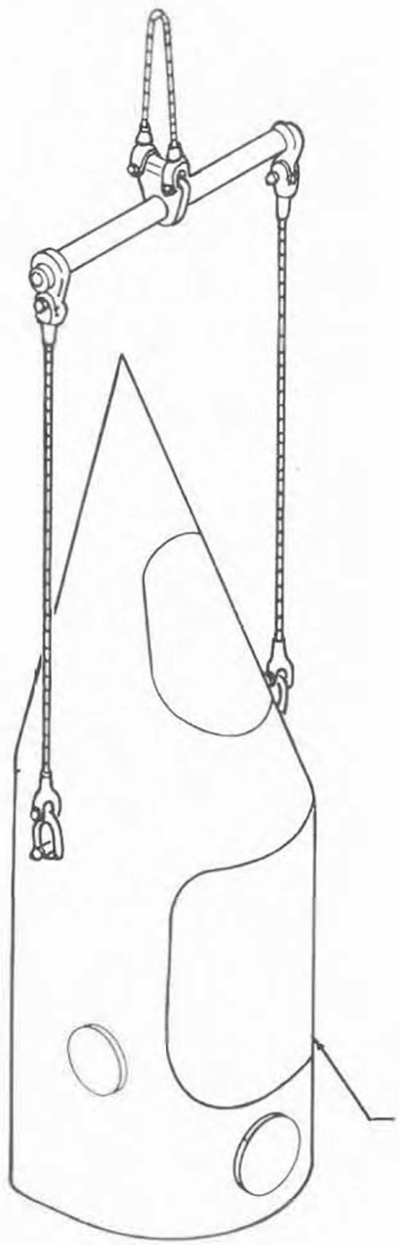


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 17 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

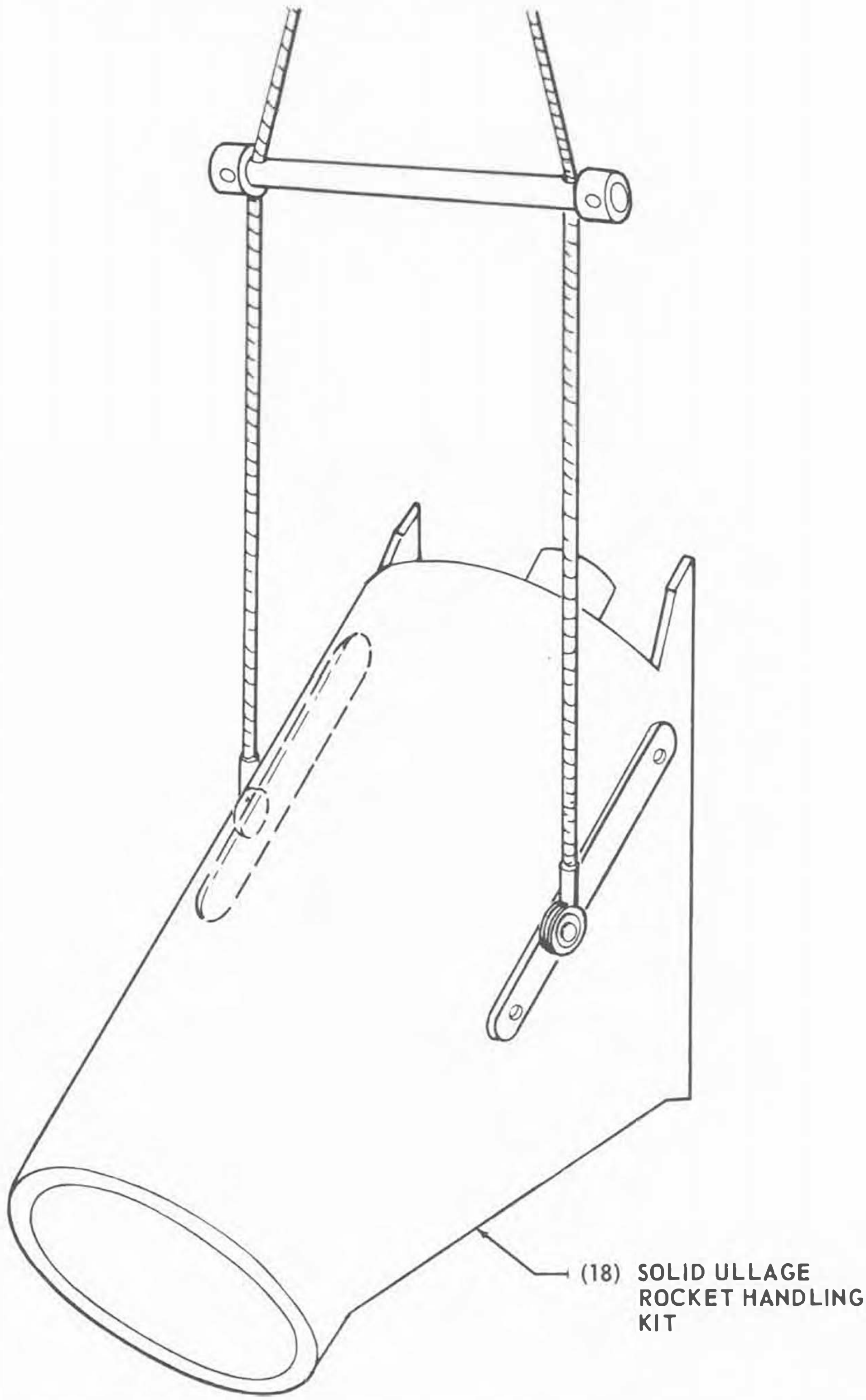


Figure 5-3. S-IVB Handling and Auxiliary Equipment (Sheet 18 of 18)

S-IVB HANDLING AND AUXILIARY EQUIPMENT

1. Stage Handling Kit (DSV-4B-302) - The stage handling kit, consisting of the forward handling ring assembly and the aft handling ring assembly, shall be used to hoist and mount the stage in such a manner that the induced handling loads will be transmitted safely into the stage structure. The kit will consist of segmented metal rings bolted to the forward and aft skirts.

2. Forward & Aft Hoist Kit (DSV-4B-303) - The forward and aft hoist kit, consisting of the forward spreader bar hoisting assembly, the aft spreader bar hoisting assembly, and the hoist beam, shall be used to: lift the stage onto the transporter; lift the stage from the transporter to all ground and water carriers; and provide a means for vertical assembly and staging.

3. Protective & Tiedown Transport Kit (DSV-4B-304) - The transport kit will be used to provide environmental protection during all phases of transport, and will consist of the following components: the forward cover assembly, a fabric cover to protect the interior of the forward skirt; the aft cover assembly, a fabric cover to protect the engine and the interior of the aft skirt; the body cover assembly, a fabric cover to protect the center section of the stage, with a sponge rubber (or equivalent) pad on top of the stage under the center cover to protect from falling objects; the engine-nozzle cover and seals, used to protect the engine from damage; the tank desiccant system, a static desiccant system for the LOX and LH_2 tanks, designed to be easily converted to a dynamic system; and the engine-protective and ring-removal structure, a lightweight structure to provide support for the aft cover assembly and protection for the J-2 engine during handling and transportation. This structure will also support the stage in a vertical position for removal of the aft handling ring assembly.

4. Flared Aft Interstage Handling Kit (DSV-4B-307) - The flared aft interstage handling kit shall provide a means of transporting (for short distances) and handling the aft interstage. The kit will consist of the following components: the dolly assembly, a rigid base to which the aft interstage section will be attached during limited transportation; the hoist beam, a structure attached to the forward end of the aft interstage section on the dolly to provide a means of lifting; and the weather protection cover, a cover of neoprene-coated nylon or similar material to protect the aft interstage section from adverse weather conditions.

5. Forward Skirt End Protection Cover (DSV-4B-309) - The forward skirt end protective cover shall provide protection for the forward area of the stage from adverse weather conditions while the stage is on the test stand. It will be constructed of neoprene-coated nylon, fiberglass, or metal, and will be of lightweight construction for easy installation.

6. Engine Alignment Kit (DSV-4B-324) - The engine alignment kit, consisting of the center shaft assembly, the support assembly, two dial indicators, and two inclinometers, shall align the J-2 engine with the stage and determine the geometric center of the engine by measuring the radius of the area at the throat and bottom of the engine nozzle.

7. Engine Actuator Adjustment Fixture (DSV-4B-325) - The engine actuator adjustment fixture shall be used to adjust the length of the hydraulic actuators while on the bench or installed on the stage. The fixture will hold the actuators and end fittings in proper relation to each other while the actuators are being adjusted to the proper length. The kit includes a fixture, a dial indicator, and a nominal-length calibrating tool.

8. Stage Aft Skirt Alignment Kit (DSV-4B-339) - The stage aft skirt alignment kit shall provide the necessary hardware, consisting of aligning pins and attaching hardware, to accurately align and install the stage on the aft interstage.

9. Aft Interstage to S-II Alignment Kit (DSV-4B-340) - The aft interstage to S-II alignment kit shall provide the necessary hardware, consisting of aligning pins and attaching hardware, to accurately align and install the S-IVB stage on the S-II stage.

10. S-II Retrorocket Handling Kit (DSV-4B-342) - The S-II retrorocket handling kit, consisting of the hoist sling, the spreader bar, and the cables and fittings, shall be used for installing and removing an S-II retrorocket from the S-IVB aft interstage while the stage is in a vertical position. The kit will be of beam-and-cable design, and will be capable of being hoisted by a crane.

11. APS Module Handling Kit (DSV-4B-341) - The APS module handling kit shall be used to install and remove an APS module while the stage is in a vertical attitude. The kit will be of beam-and-cable design, capable of being raised and lowered by a mobile or tower crane. The kit will consist of hoist cables, the yoke assembly, and the spreader bar.

12. Stage Weigh & Balance Kit (DSV-4B-345) - The stage weigh and balance kit shall be used to determine the weight and center of gravity (CG) of the stage. The kit will consist of two tripod jack structures, each provided with a fixed jack and air bearing type pads on each tripod leg. Load cells with electrical readout equipment will be attached to the top of each tripod jack and fixed jack, one under the stage aft roll ring and two under the stage forward roll ring.

13. Engine Handling Kit (DSV-4B-349) - The engine handling kit shall be used to raise the J-2 engine in a vertical attitude for installation on the stage. The kit will provide two sets of removable brackets and support pulleys which will attach to the stage structure above the J-2 engine gimbal point. The pulleys will support cables attached to the J-2 engine and to the winches on the sling hoist vertical installer.

14. Low Bay Stage Adapter Ring Kit (DSV-4B-380) - The low bay stage adapter ring kit shall be used to provide support for the stage on the transfer dollies. The kit will also support the low bay aft section vertical access kit. It will be a bolted steel structure 404 by 15 1/2 inches, with a 104 inch opening provided in the center to permit removal of the J-2 engine. A sliding platform spinning the 104 inch opening will also be provided, for access to the engine bell. The kit will weigh approximately 35,000 pounds.

15. Aft Interstage Weigh & Balance Kit (DSV-4B-351) - The aft interstage weigh and balance kit shall be used to determine the weight and center of gravity (CG) of the aft interstage.

16. S-IVB Stage Cradles (DSV-4B-301) - The stage cradles are used to provide support for the stage during all phases of land and water transportation, support for the stage during horizontal weighing, and storage of the stage without the transporter. The cradles are designed to attach to the forward and aft rings to support the stage. The cradles also attach directly to the transporter for overland transportation. The set consists of a forward and an aft cradle.

17. Attitude Control Module Handling Kit (DSV-4B-344) - The handling kit is used to install and remove an attitude control module while the stage is in a vertical position. The kit consists of beams and cables designed to lift the module and transfer it from a horizontal position to an installed position.

18. Solid Ullage Rocket Handling Kit (DSV-4B-350) - The solid ullage rocket handling kit is used to install and remove an ullage rocket module while the stage is in a vertical position. The kit consists of a wire rope sling and spreader bar designed to lift the ullage rocket module and transfer it from a horizontal position to an installed position.

I.U. HANDLING AND AUXILIARY EQUIPMENT

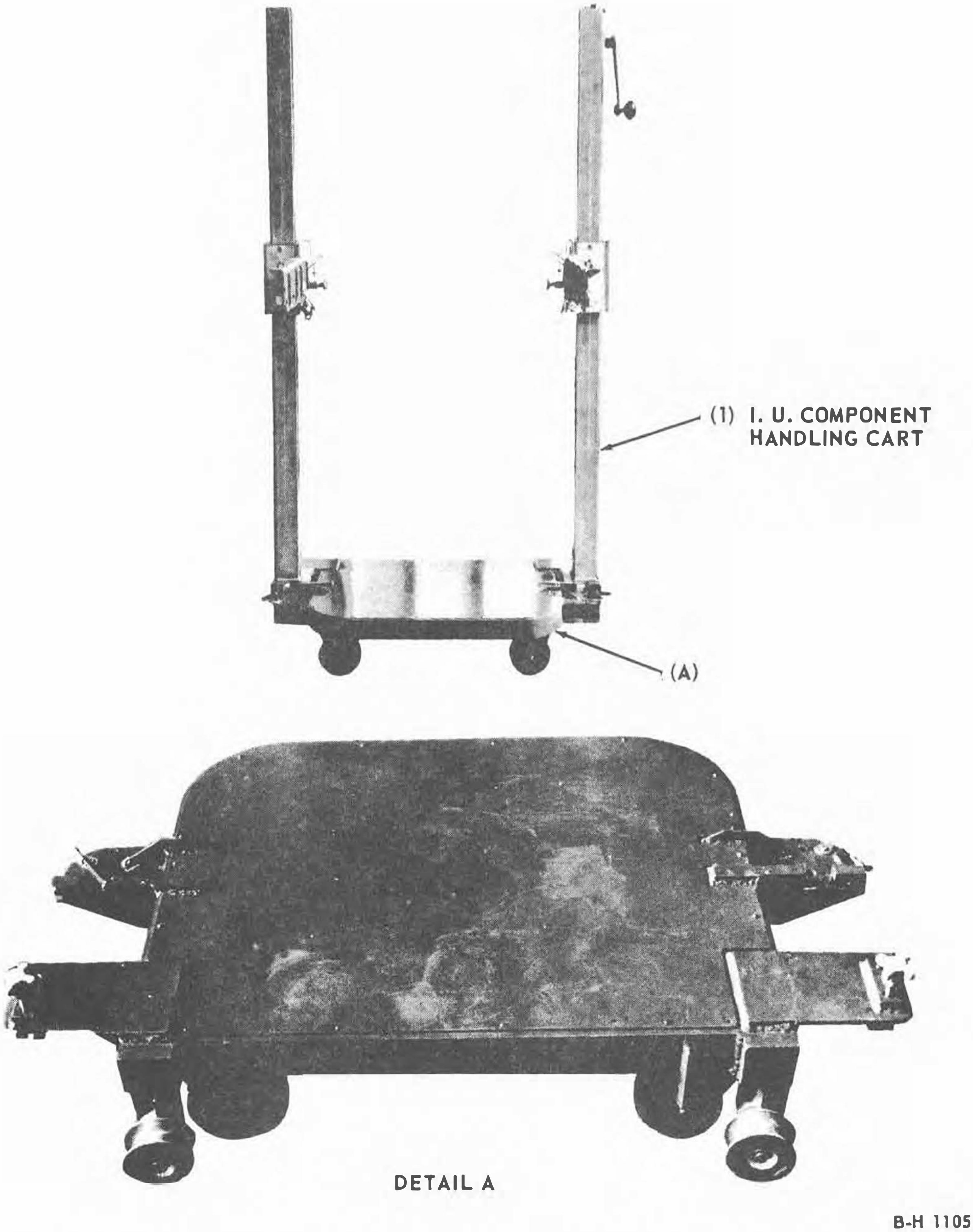


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 1 of 7)

I. U. HANDING AND AUXILIARY EQUIPMENT

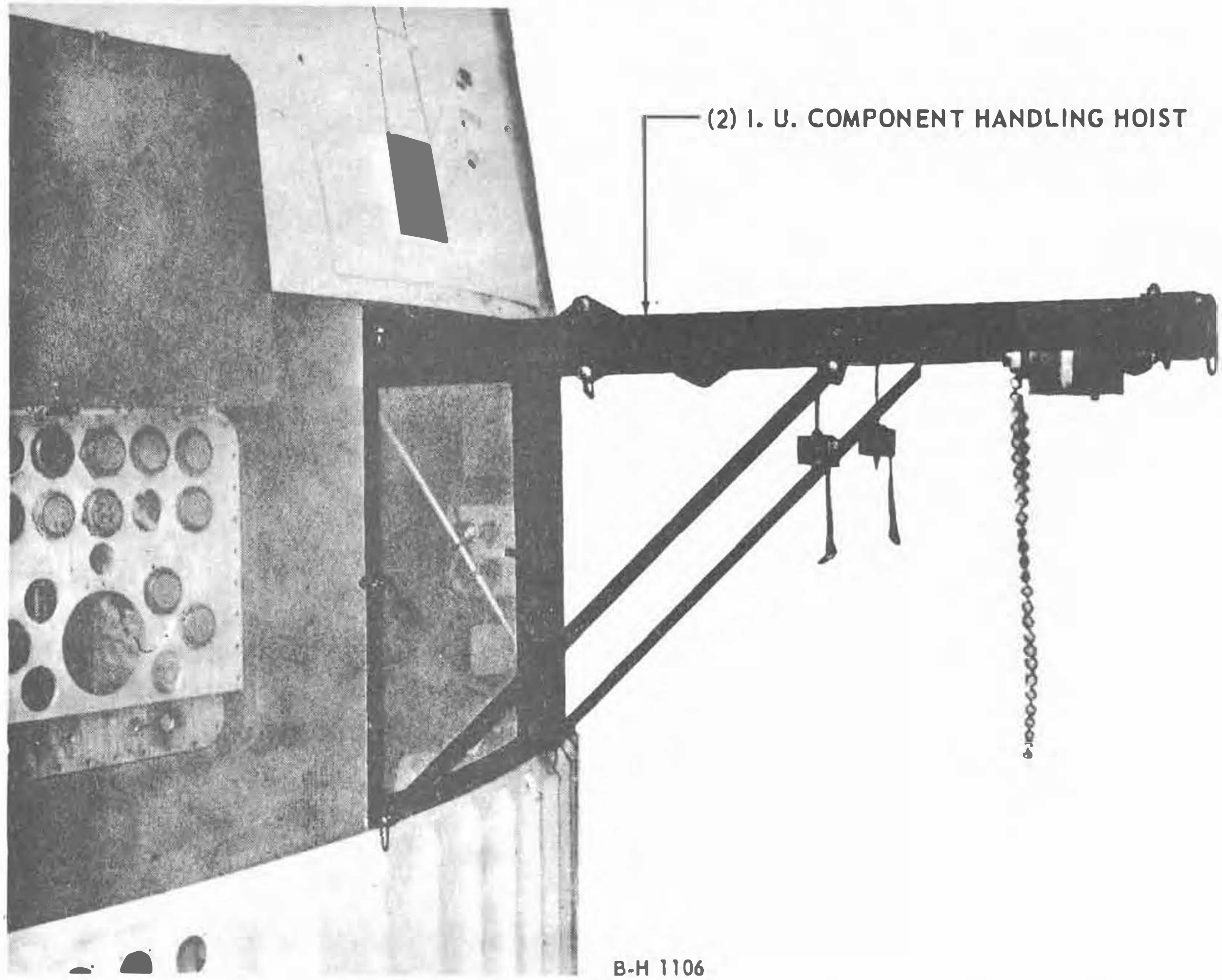


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 2 of 7)

I.U. HANDLING AND AUXILIARY EQUIPMENT

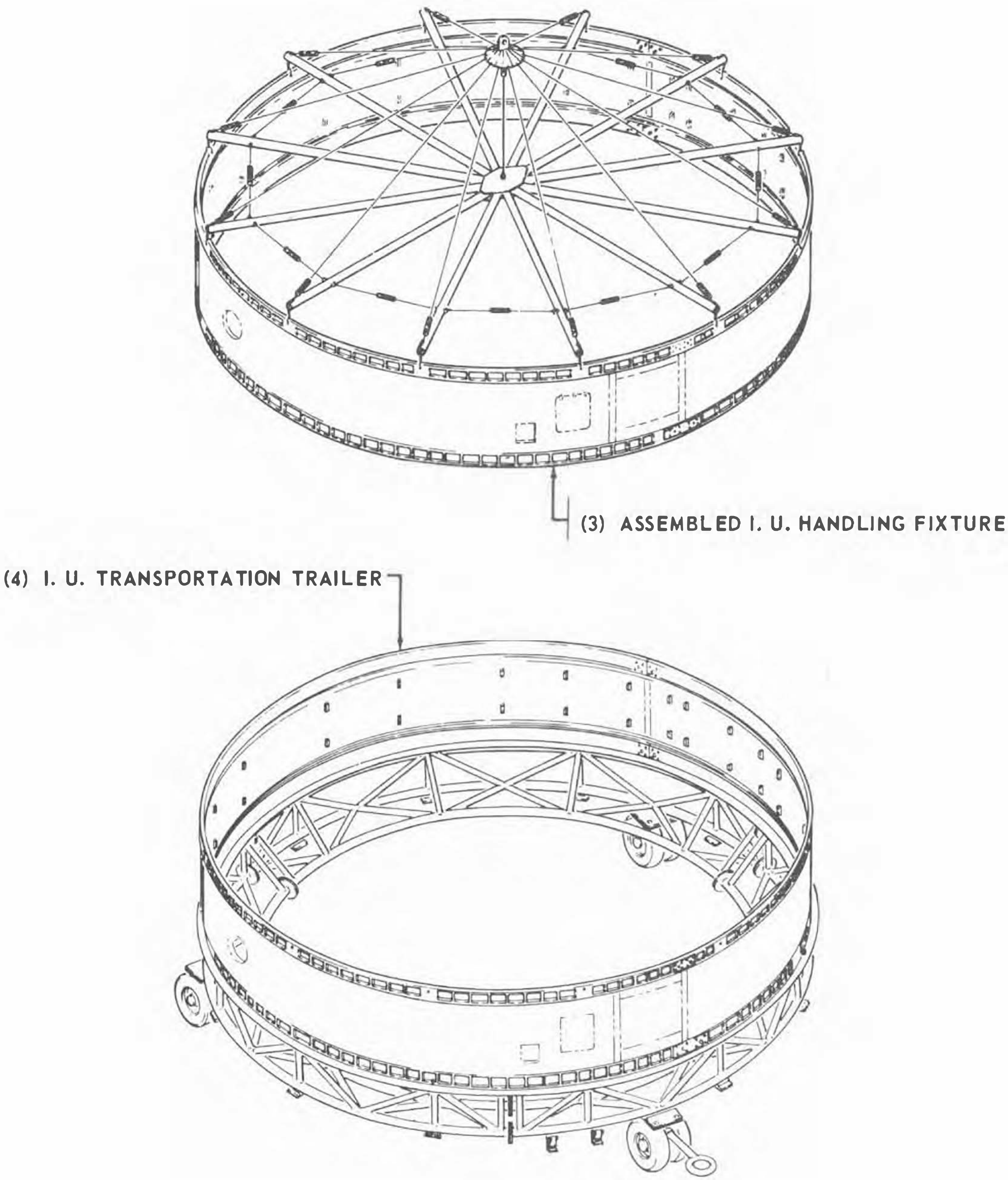
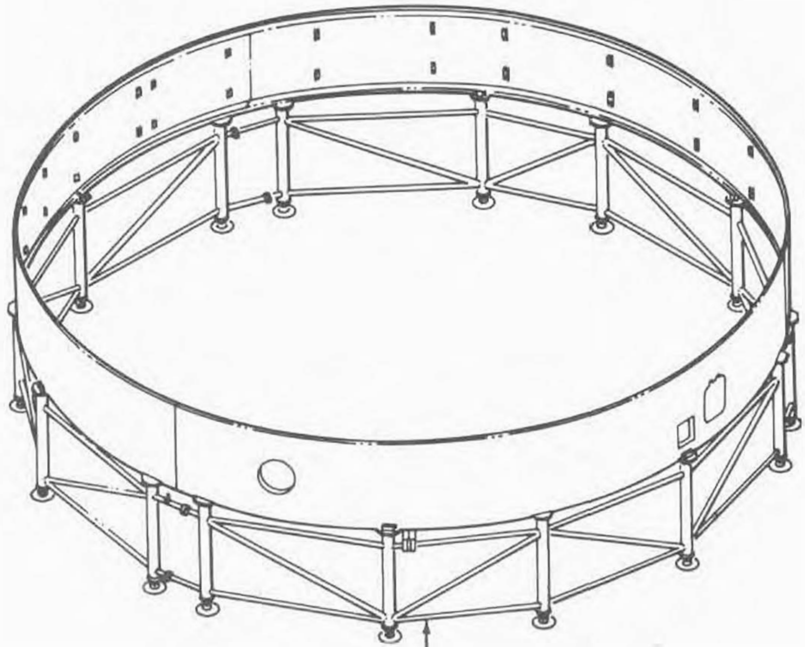


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 3 of 7)

I.U. HANDLING AND AUXILIARY EQUIPMENT



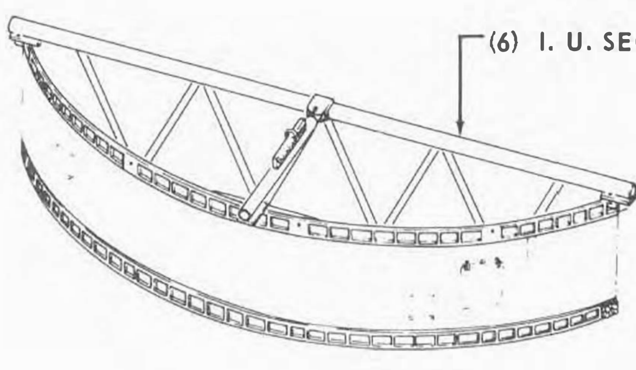
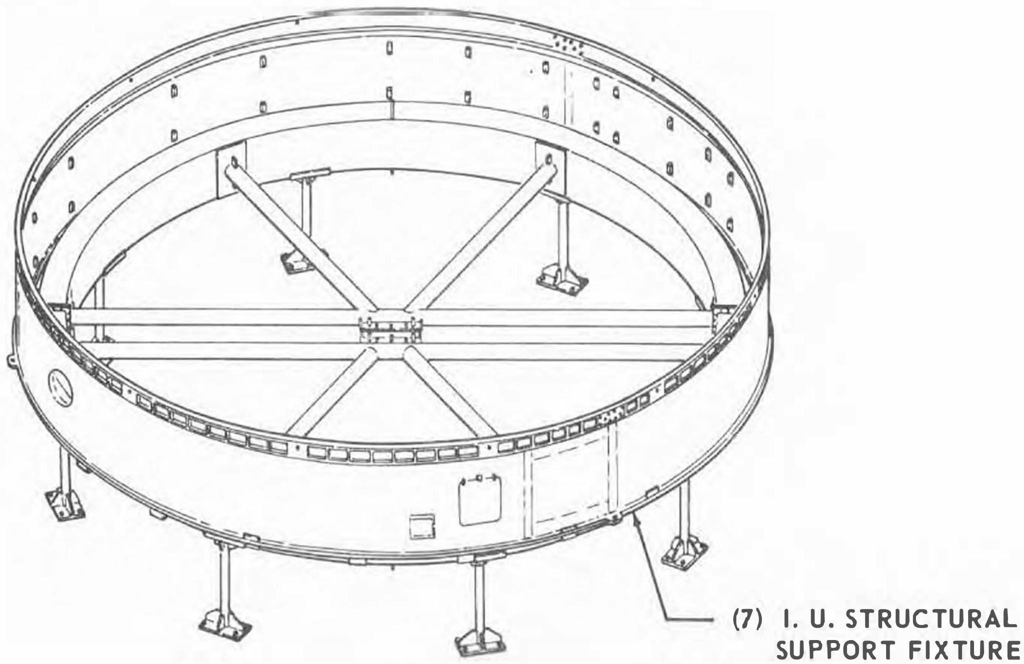


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 4 of 7)

I.U. HANDLING AND AUXILIARY EQUIPMENT



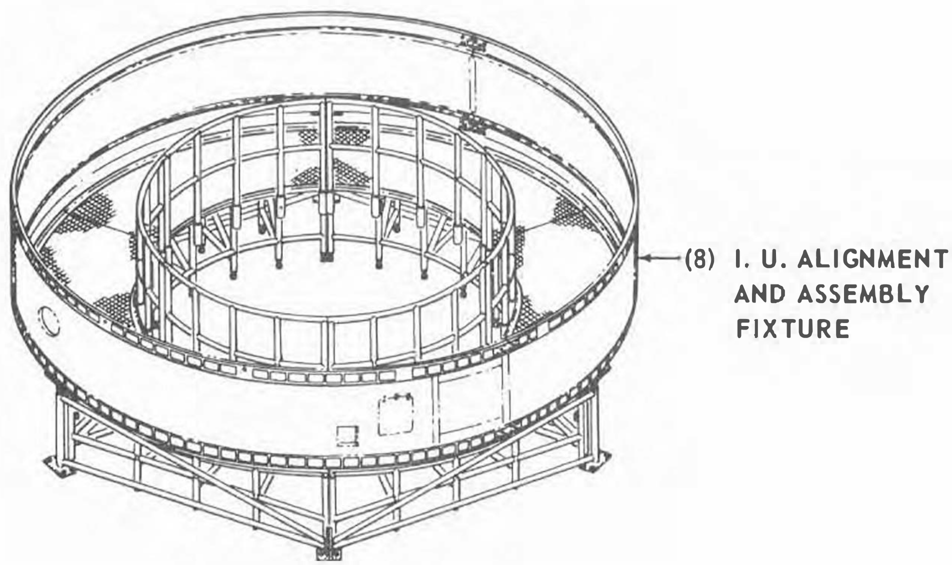


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 5 of 7)

I.U. HANDLING AND AUXILIARY EQUIPMENT

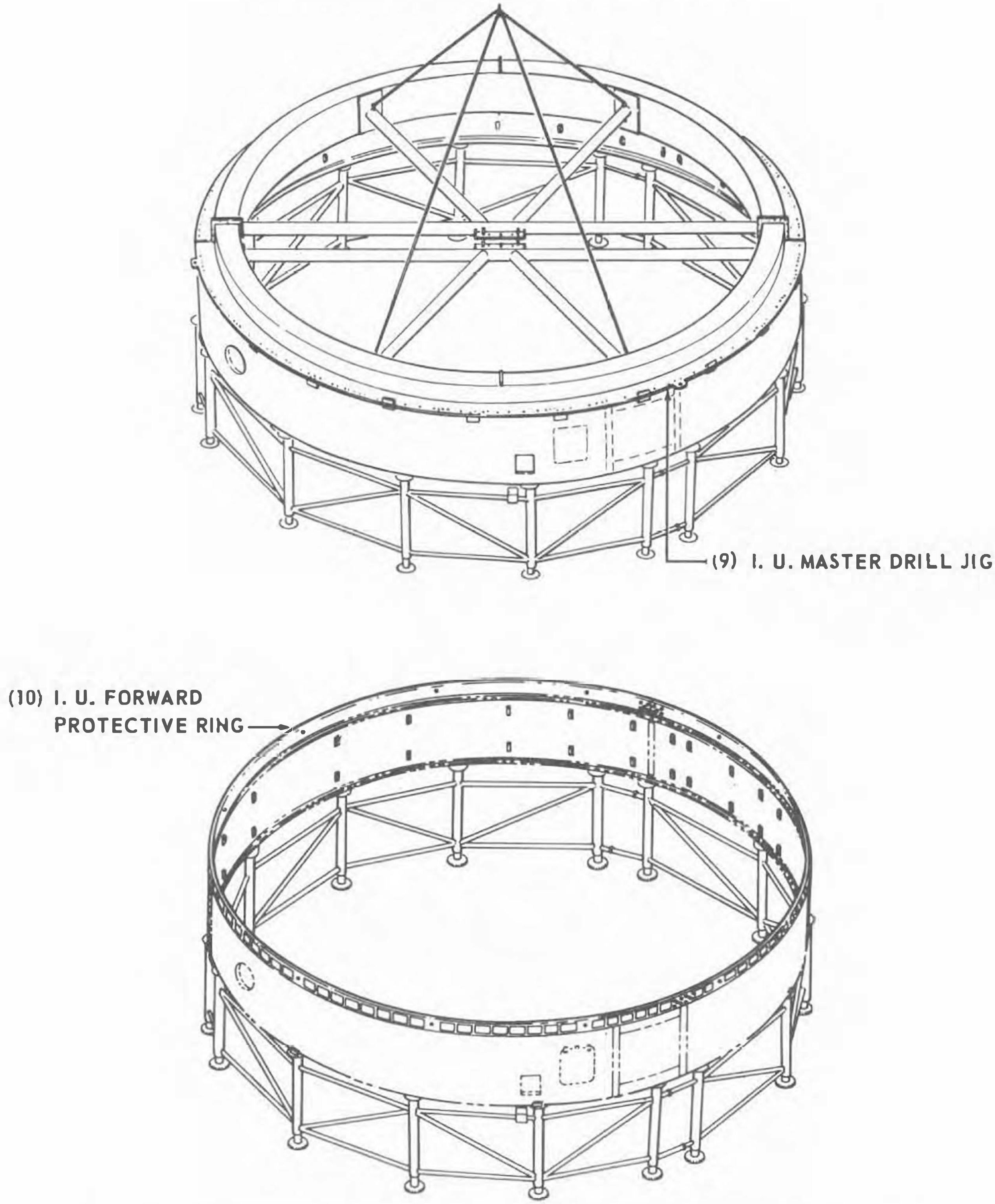


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 6 of 7)

I.U. HANDLING AND AUXILIARY EQUIPMENT

(11) I. U. AFT PROTECTIVE RING

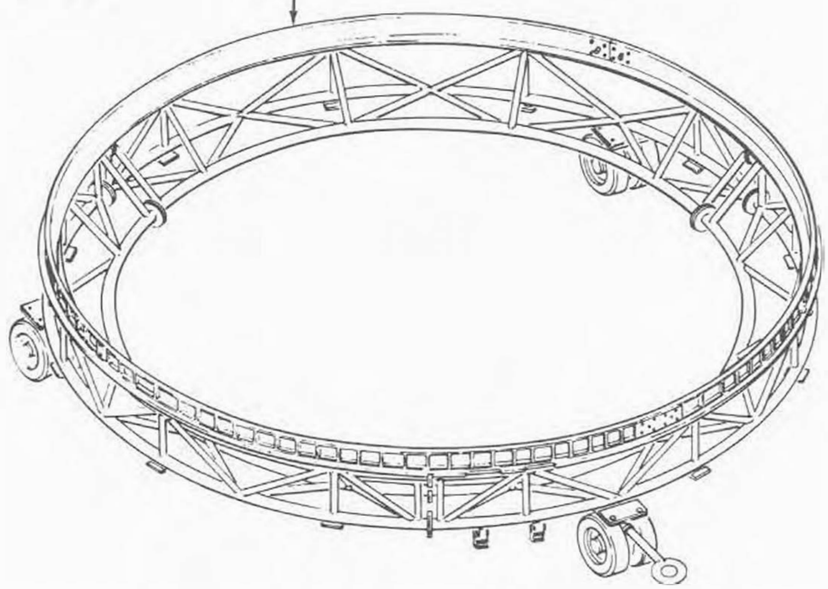


Figure 5-4. I. U. Handling and Auxiliary Equipment (Sheet 7 of 7)

I. U. HANDLING AND AUXILIARY EQUIPMENT

1. I. U. Component Handling Cart - The component handling cart is used to install components in the I. U. after it has been assembled and erected at K. S. C. All I. U. components weighing over 30 pounds will be handled by the cart. The cart is designed to move inside the I. U. using the S-IVB Stage forward skirt work platforms and a forward skirt reinforcement ring for rolling surfaces. The cart work platform is movable either horizontally or vertically; horizontal movement is accomplished manually by pulling or pushing the platform along telescoping rails, and vertical movement is accomplished by hand-cranking through a gear train and a chain and sprocket arrangement. The cart is designed to fold into a module suitable for insertion through the I. U. access opening.

2. I. U. Component Handling Hoist - The component handling hoist is used to lift and move I. U. components located outside the I. U. through the I. U. access opening and onto the work platform of the component handling cart located inside the I. U. The hoist includes a collapsible support frame, hoist rails and mechanism, air motor drive, and hoisting cables.

3. Assembled I. U. Handling Fixture - The assembled I. U. handling fixture is used to lift and position the I. U. with the forward protective ring secured in place on the I. U. The aft protective ring may or may not be attached to the I. U.

4. I. U. Transportation Trailer - The I. U. transportation trailer is used to support the aft protective ring during installation and to transport the I. U. with the aft protective ring and the forward protective ring installed.

5. I. U. Structural Assembly Fixture - The structural assembly fixture is used to support and align the I. U. segment assemblies and the required splice components while splicing the three segment assemblies together.

6. I. U. Segment Handling Fixture - The segment handling fixture is used to lift and position a 120 degree segment of the I. U. with a 120 degree segment of both the forward and aft protective rings attached.

7. I. U. Structural Support Fixture - The structural support fixture is used to support the I. U. interface drill jig while drilling the aft interface holes in the I. U.

8. I. U. Alignment and Assembly Fixture - The 260 inch alignment and assembly fixture is used to support and align the I. U. during installation of final assembly components.

9. I. U. Master Drill Jig - The master drill jig is used as a guide to drill the forward and aft interface holes in the I. U.

10. I. U. Forward Protective Ring - The forward protective ring is used to protect the I. U. during assembly, transportation, and shipment. It is also used in conjunction with the handling fixture for lifting and positioning the I. U.

11. I. U. Aft Protective Ring - The aft protective ring is used to provide rigidity and protect the I. U. during assembly, transportation, and shipment.

LAUNCH VEHICLE HANDLING AND AUXILIARY EQUIPMENT

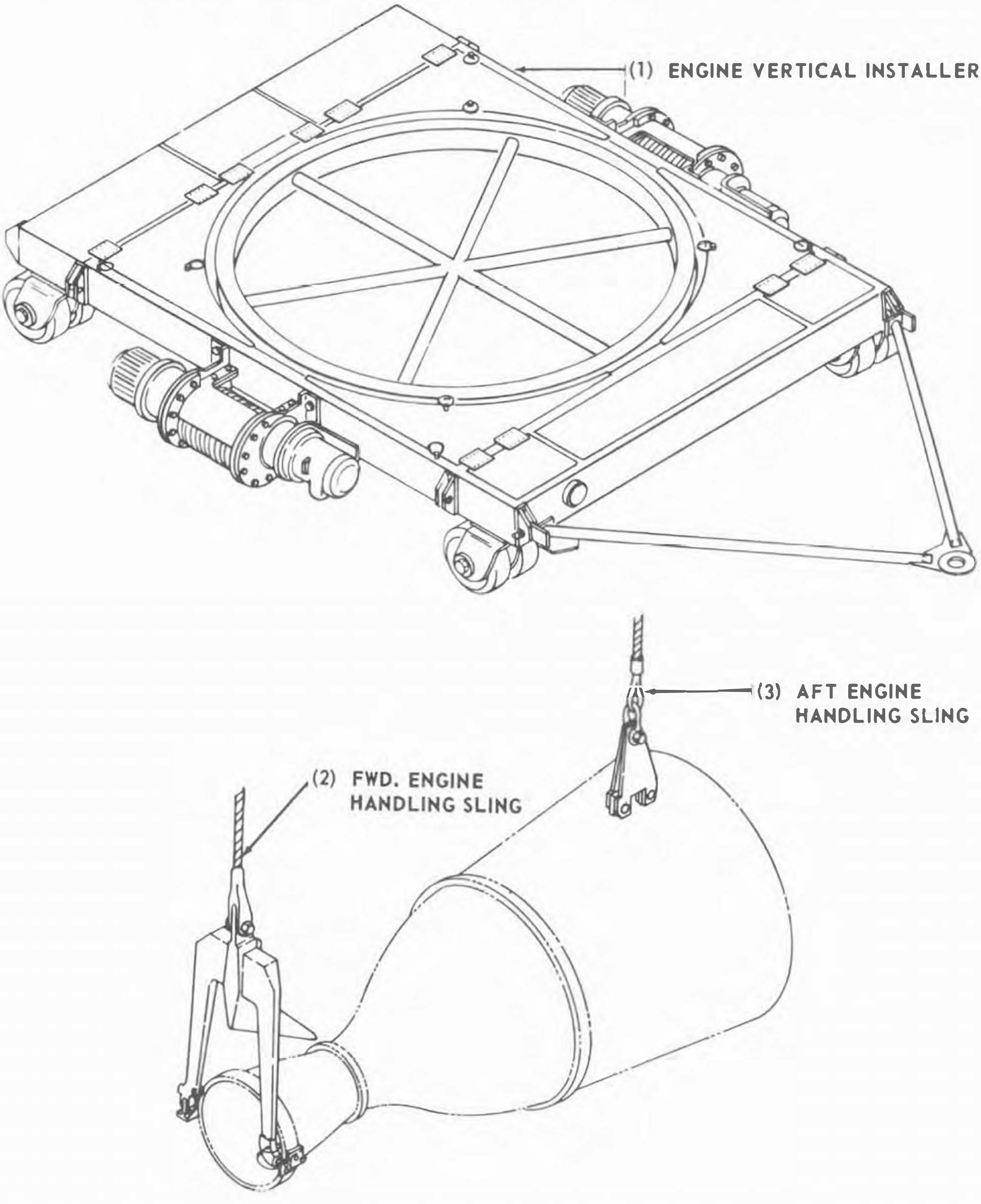


Figure 5-5. Launch Vehicle Handling and Auxiliary Equipment (Sheet 1 of 2)

LAUNCH VEHICLE HANDLING AND AUXILIARY EQUIPMENT

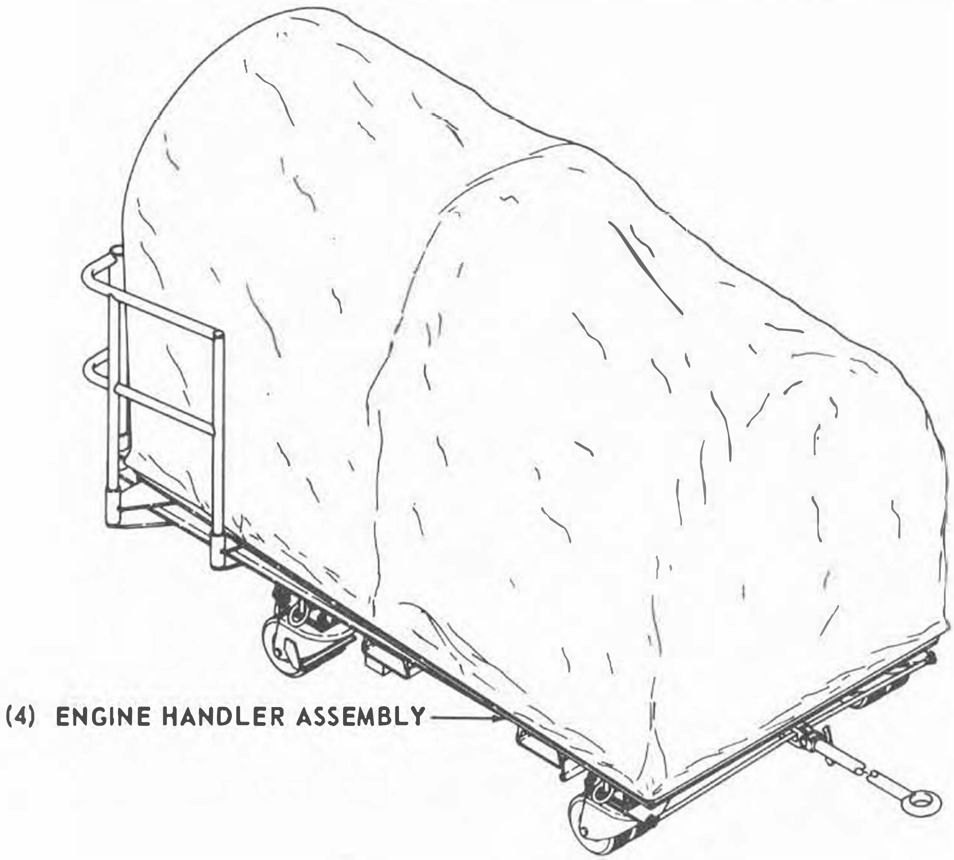


Figure 5-5. Launch Vehicle Handling and Auxiliary Equipment (Sheet 2 of 2)

LAUNCH VEHICLE HANDLING AND AUXILIARY EQUIPMENT

1. Engine Vertical Installer (G4035) - The engine vertical installer is a platform mounted on castors, containing an engine support ring mounted on roller bearings to permit 360 degree manual rotation of the engine. The installer is equipped with a four corner tie-down harness attached to a belt ring which fastens around the engine just below the manifold, securing the engine during handling operations. Operation of the engine hoists is controlled from either a remote control cable or the installer-mounted control switch box.

2. Forward Engine Handling Sling (G4042) - The forward engine handling sling is used in conjunction with the aft engine handling sling to rotate or lift the engine to the horizontal or vertical position.

3. Aft Engine Handling Sling (G4045) - The aft engine handling sling is used in conjunction with the forward engine handling sling to rotate or lift the engine to the horizontal or vertical position.

4. Engine Handler Assembly (G4064)

   Data to be furnished at a later date.