

J.D. Shields

MODEL SPECIFICATION
GROUND SUPPORT EQUIPMENT

SATURN S-IVB STAGE

DOUGLAS MODEL SPECIFICATION
DS-2164(A)

SUPERSEDING DS-2164
1 DECEMBER 1965



11

MODEL SPECIFICATION
GROUND SUPPORT EQUIPMENT
SATURN S-IVB STAGE

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END ITEM CONFIGURATION CHART			
SPECIFICATION ISSUE	ECP's	CONTRACT AUTHORITY	PRODUCTION EFFECTIVITY
Basic 1 December 1965	This issue of DS 2164 includes Revisions 1 and 2 of the 15 August 1963 issue of all applicable Supplemental Agreements and/or Change Orders initiated through No. 506	SA 850	
Revised 1 December 1967	<p>Incorporated in this issue are the following ECPs:</p> <p>0370 (SCN 1,15), 0273 (SCN 55), 0272 (SCN 56,57), 0287 (SCN 58), 0285 (SCN 60), 0267 (SCN 61), 0325 (SCN 62), 0382 (SCN 63), 0296-1 (SCN 66,67), 0296-2 (SCN 68), 0296-3 (SCN 69), 0369 (SCN 70), 0378 (SCN 71), 0443-2 R1 (SCN 74), 0458-2 (SCN 77), 0458-1 (SCN 78), 0480 (SCN 79), 0379 (SCN 80), 0514 (SCN 82), 0393-1 (SCN 83), 0393-2 (SCN 84), 0529 (SCN 85), 0569 (SCN 86), 0571 (SCN 87), 0627 (SCN 88), 0664-4 (SCN 89), 0664-3 (SCN 90), 0664-2 (SCN 91), 1007 R1 (SCN 92), 0664-5 (SCN 93), 2098 (SCN 94), 2200 (SCN 96 through 99), 2156R1 (SCN 100), (SCN 101), 2118 (SCN 102), 2314R1 (SCN 103), 0664-7D (SCN 104), 0561R5 (SCN 106), 0664-9D (SCN 107), 9034 (SCN 109)</p> <p>The following SCN's were approved by Supplemental Agreement 1050: SCN 2 thru 14; 16 thru 23; 25 thru 36; and 47, 48, 52, 53, 54, 75, and 76.</p> <p>SCN's 37 thru 46 and 49 thru 51 were approved by Contract Letter I-CO-S-IVB-7-644.</p> <p>ECP's 0370 (SCN 24), ECP 0477 (SCN 81), ECP 2045R1 (SCN 95), were disapproved. SCN's 59, 64, 65, 72, 73, 105, and 108 were cancelled by DAC.</p>		

ABSTRACT

DAC (Douglas Aircraft Company) Model Specification DS-2164(A), Saturn S-IVB Ground Support Equipment, dated 1 December 1965, describes the design requirements for the deliverable S-IVB SE (support equipment) and prime GSE (ground support equipment) of the Saturn V/S-IVB and Saturn IB/S-IVB Programs. This issue revises the descriptions of all the GSE concerned and supersedes all previous issues. This document reflects all contractual changes through 1 December 1967.

The SE and GSE contained herein is divided according to function into the following sections: prime, electrical and electronic, mechanical, battleship, and Instrument Unit test. General requirements, quality assurance provisions, and preparation-for-delivery requirements are also included. The design requirement characteristics of each model are presented in terms of function, design, and components.

This document also reflects S-IV GSE furnished to NASA under Contract NAS7-1 which is authorized for use on Contract NAS7-101. This equipment is shown in Table IV.

PREFACE

This specification is prepared for NASA/MSFC (National Aeronautics and Space Administration/Marshall Space Flight Center) under the NAS7-101 Contract, and is in accordance with MSFC-DRL-021.

Incorporated in this issue are the contract changes as reflected on the end item configuration chart.

The General Design Requirements for the design of the GSE are specified in Section 3.

A cross reference index is located at the end of this specification for locating GSE and SE by model number. Paragraph 1-10 explains the assigning of model numbers.

The GSE and SE designed and used for the Saturn S-IVB program is identified in this specification as follows:

- a. Equipment subject to all the controls of configuration management (prime support equipment) - Section 4
- b. All electrical and electronic support equipment other than battleship support equipment and Instrument Unit test equipment - Section 5
- c. All mechanical, propulsion, and stage servicing support equipment other than prime and battleship support equipment and Instrument Unit test equipment - Section 6
- d. All support equipment designed for the battleship test program at the Sacramento Test Center - Section 8
- e. The support equipment designed for the Instrument Unit test at Huntington Beach - Section 9
- f. Quantity, location, and authorization for each item of GSE and SE - Table 1-1
- g. List of all GSE and SE cancelled from the S-IVB program - Table 1-2.
- h. List of the S-IV GSE used on the S-IVB program - Table 7-1.

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LIST OF ABBREVIATIONS

ABMA	Army Ballistic Missile Agency
ac	alternating current
AMR	Atlantic Missile Range
AND	Air Force/Navy Aeronautic Design Standard
APS	Auxiliary Propulsion System
BTU	British Thermal Unit
CCN	Contract Change Notice
CO	Change Order
cg	center of gravity
cps	cycles per second
DAC	Douglas Aircraft Company
db	decibel
dc	direct current
DDAS	Digital Data Acquisition System
DPS	Douglas Process Standard
EBW	Exploding Bridge Wire
FM	frequency modulation
FTC	Florida Test Center
GFE	Government-furnished equipment
GH ₂	gaseous hydrogen
GN ₂	gaseous nitrogen
GSE	ground support equipment
HB	Huntington Beach
IF	intermediate frequency

LIST OF ABBREVIATIONS (Cont)

IRIG	Inter-Range Instrumentation Group
kc	kilocycle
KSC	Kennedy Space Center
LH ₂	liquid hydrogen
LO ₂	liquid oxygen
LOC	Launch Operations Center
L/UT	Launch Umbilical Tower
mc	megacycle
MS	Military Standard
MSFC	Marshall Space Flight Center
MTO	Mississippi Test Operations
NAS	National Aerospace Standard
NASA	National Aeronautics and Space Administration
PAM	pulse amplitude modulation
PCM	pulse code modulation
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
PU	propellant utilization
R	Rankine
RACS	Remote Automatic Calibration System
RF	radio frequency
RFI	radio frequency interference
SACTO	Sacramento

LIST OF ABBREVIATIONS (Cont)

SM	Santa Monica
SS	single sideband
STC	Sacramento Test Center
vac	volts alternating current
vdc	volts direct current

1. INTRODUCTION

1.1 Scope

This specification presents a detailed description of the GSE required to support the S-IVB stage of the S-IB and S-V Saturn launch vehicles. All statements regarding performance, design criteria, reliability, description, dimensions, and weights shall be interpreted as design objectives. Unless otherwise noted the GSE shall be utilized for both the S-IB and S-V vehicles.

1.2 Function

The function of the GSE shall be to transport, protect, handle, service, test, check out, and monitor the complete Saturn S-IVB stage, its separate assemblies, and its components.

1.3 Classification of Equipment

The GSE described in this specification has been divided into two areas of design responsibility, electrical and electronic, and mechanical and propulsion, which also includes stage servicing. The GSE required on the Battleship test stand to support the S-IVB Program is described in Section 8. The GSE required for the Instrumentation Unit (IU) test at Douglas Huntington Beach (HB) is described in Section 9.

1.4 Delivery of Equipment

Those items of operational GSE which are to be used by Douglas at HB (Huntington Beach), STC (Sacramento), and KSC (Kennedy Space Center) for checkout and testing will be retained by Douglas after customer acceptance. Because of the research and development nature of the S-IVB Program, the Contractor will maintain and modify these items (as required) to obtain compatibility between GSE and stage configurations. Upon

completion of the program, all end-items listed herein will be formally delivered to the customer. Table 1-1 reflects the location of the models and units while Table 1-2 lists those models that have been deleted or cancelled from the contract.

1.5 Revisions

This specification shall be revised on an "as required" basis to include approved changes.

1.6 Illustrations

All illustrations included herein are for reference purposes only and shall not be considered as firm design criteria.

1.7 Facility Relocation

Certain items previously designated for SM (Santa Monica) have been relocated to HB. (See Table 1-1.)*

1.8 Ground Support Equipment Installation

The Ground Support Equipment will be installed at the various using locations by installation drawings prepared by Engineering.

1.9 Maintenance and Calibration

Maintenance and/or calibration drawings will be prepared for all Ground Support Equipment end items. Calibration of stage checkout equipment will be stage significant, i.e., the equipment calibration schedule will be such that the equipment will not run out of calibration during stage checkout.

*Table 1 was Table II on previous issues of this document.

1.10 Model Numbers

Electrical and electronic GSE is assigned model numbers from DSV-4B-100 through DSV-4B-299. Mechanical and propulsion GSE is assigned model numbers from DSV-4B-300 through DSV-4B-499 and DSV-4B-1850 through DSV-4B-1999.

TABLE 1-1
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
102	PAM/FM/FM Component Test Set Assembly	1																	1	(3) Per CCN 7, (2) per C.O. 553 (1) per nego- tiations
103	SS/FM Telemetry Component Test Set	1																	1	(3) Per CCN 7 (2) per C.O. 553 (1) per negotiations
104	Printed Circuit Card Component Test Set	1				1													2	(3) Per Addendum (2) per C.O. 553
105	General Purpose Computer	1	1			1	1	1											5	(5) Per Addendum (6) per S.A. 233, (6) per C.O. 303 (5) I-CO-S-IVB-5-847
105A	Test Controller Complex, SIL																1		1	(1) I-CO-S-IVB-5-847
109	Sequencer Component Test Set	1																	1	(3) Per Addendum, (1) C.O. 121 and 155
110	Power System Elec- trical Component Test Set	2									1								3	(3) Per Addendum (3) per negotiations

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
111	Tape Recorder Component Test Set	1																1	(3) Per CCN 7, (2) per C.O. 553 (1) per negotiations
112	Propulsion Utilization Component Test Set	2								1								3	(3) Per Addendum (3) per negotiations
115	PCM/FM Telemetry Component Test Set	1																1	(3) Per CCN 7, (2) per C.O. 553 (1) per negotiations
118	Computer Interface Unit	1	1		1	1	1									1		6	(5) Per Addendum, (6) S.S. 233, (6) per C.O. 303 (6) per I-CO-S-DAC-L-178-67
120	System Status Display Console															1		1	(7) Per Addendum, (0) C.O. 37, (1p) per C.O. 63 (1) per I-CO-S-DAC-L-178-67
121	Test Operator Station	1	1		1	1	1									1		6	(5) Per Addendum, (6) S.A. 233, (6) per C.O. 303 (6) per I-CO-S-DAC-L-178-67

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
123	DDAS Ground Station	1	1			1	1	1									1		6	(5) Per CCN 7, (6) per S.A. 233, (6) per C.O. 303 (6) per I-CO-S-DAC- L-178-67
125	PAM/FM/FM Telem- etry Ground Station Assembly	1				1		1									1		4	(4) Per CCN 7, (4) per C.O. 303 (4) per I-CO-S-DAC- L-178-67
126	FM Telemetry Single Side Band Station	1				1		1									1		4	(4) Per CCN 7, (4) per C.O. 303 (4) per I-CO-S-DAC- 178-67
127	Wideband Magnetic Tape Unit Recorder	1	1			1	1	1									1		6	(4) Per Addendum, (5) per C.O. 37 (5) per C.O. 303, (6) per C.O. 292 (6) per I-CO-S-DAC- 178-67
128	Frequency Calibra- tion Unit Rack Assembly	1				1		1									1		4	(4) Per Addendum, (4) per C.O. 303 (4) per I-CO-S-DAC- 178-67

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
130	Stimuli Signal Conditioner	1	1			1	1	1									1		6	(5) Per Addendum, (6) per S.A. 233 (6) per C.O. 303 (6) per I-CO-S-DAC- 178-67
131	Response Signal Conditioner	1	1			1	1	1									1		6	(5) Per Addendum, (6) per S.A. 233, (6) per C.O. 303 (6) per I-CO-S-DAC- 178-67
132	Ground Equipment Test Set	1	1			1	1	1									1		6	(5) Per Addendum, (6) per S.A. 233, (6) per C.O. 303 (6) I-CO-S-DAC-L- 178-67
133	Signal Distribution Box	1	1			1	1	1									1		6	(5) Per Addendum, (6) per S.A. 233, (6) per C.O. 303 (6) I-CO-S-DAC-L- 178-67
134	Vehicle External Power Racks	1	1			1	1	1									1		6	(5) Per Addendum, (6) per S.A. 233, (6) per C.O. 303 (6) I-CO-S-DAC-L- 178-67

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization	
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL
135	Safety-Item Monitor	1	1			1	1	1										1		6	(5) Per Addendum, (6) per S.A. 233, (6) per C.O. 303 (6) I-CO-S-DAC-L- 178-67
136	Destruct System Test Set	1				1	1	1										1		5	(5) Per Addendum, (6) per S.A. 233, (6) per C.O. 303 (5) per C.O. 553 (5) per I-CO-S-DAC-L- 178-67
139	Stage Checkout Cable Network, HB-VCL-2		1																	1	(1) Per Addendum, (1) per C.O. 303
140	A3-SIL Cable Network Kit																	1		1	(1) Per Addendum (1) per I-CO-S-DAC- L-178-67
141	Stage Checkout Cable Network, HB-VCL-1	1																		1	(1) Per Addendum
142	Cable Network Kit, Beta 1, SACTO					1														1	(1) Per Addendum
143	Cable Network Kit, Test Stand Beta 3 SACTO						1													1	(1) Per Addendum

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
144	Cable Network Kit, Beta 3 Control Room, SACTO						1												1	(1) Per Addendum
145	Cable Network Kit, Beta 1 Control Room, SACTO					1													1	(1) Per Addendum
146	HB-VCL-2 Stage Checkout Area, Patch Panel Distribution Box	1																	1	(1) Per Addendum and C.O. 303
147	Patch Panel Distri- bution Box																1		1	(1) Per Addendum (1) I-CO-S-DAC-L- 178-67
148	HB-VCL-1 Stage Checkout Area Patch Panel Distribution Box	1																	1	(1) Per Addendum
149	SACTO Beta 1 Test Stand Patch Panel Distribution Box					1													1	(1) Per Addendum
150	SACTO Beta 3 Test Stand Patch Panel Distribution Box						1												1	(1) Per Addendum

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
151	SACTO Beta 1 Control Room Patch Panel Distribution Box						1												1	(1) Per Addendum
152	SACTO, Beta 3 Control Room Patch Panel Distribution Box					1													1	(1) Per Addendum
153	Range Time Generator	1				1		1									1		4	(3) Per Addendum, (4) per C.O. 292 (4) I-CO-S-DAC-L-178-67
154	LH ₂ Loading Control Panel Assembly					1													1	(1) Per Addendum, and C.O. 306
155	Hydraulic and Gimbal Panel Assembly					1													1	(1) Per Addendum
156	Helium Control Panel Assembly					1													1	(1) Per Addendum
157	LOX Loading Control Panel Assembly					1													1	(1) Per Addendum and C.O. 306
159	Control Switching Rack Assembly					1													1	(1) Per Addendum

TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
160	Umbilical Junction Box Rack Assembly					1													1	(1) Per Addendum
161	Junction Box Patch Panel Rack Assembly					1													1	(1) Per Addendum
162	Digital Voltmeter and Vehicle System Power Panel Assembly					1													1	(1) Per Addendum
163	Engine-Firing Con- trol Panel Assembly					1													1	(1) Per Addendum
164	Engine Component Test Panel Assembly					1													1	(1) Per Addendum and C.O. 306
165	Battleship Block- house Cable Network Kit					1													1	(1) Per Addendum
166	Battleship Tunnel Cable Network Kit					1													1	(1) Per Addendum
167	Battleship Test Stand Cable Network Kit					1													1	(1) Per Addendum
168	External Power Rack					1													1	(1) Per Addendum

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
170	Simulated Flight Battery Power Unit	9	4			10	7	2											32	(13) Per C.O. 268 (32) per I-CO-S-IVB- 7-101
171	Simulated Flight Battery Maintenance Unit	1				1													2	(2) Per C.O. 268
172	Engine Sideload Recorder					1													1	(1) Per C.O. 270 (0) per C.O. 302, (1) per C.O. 327
173	SACTO VCL Cable Network							1											1	(1) Per S.A. 233
174	SACTO VCL Patch Panel							1											1	(1) Per S.A. 233
175	Vehicle Transporta- tion Instrumentation Kit																	3	3	(3) Per C.O. 229
176	Simulated Flight Test Kit - KSC											3	1	1					5	(5) Per C.O. 300
181	Amplifier Assembly Unit Engine Side- load					1	1												2	(2) Per C.O. 327

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
184	Electrical Acces- sories checkout Kit																1		1	(1) Per Addendum (1) I-CO-S-DAC-L- 178-67
184A	Electrical Acces- sories Checkout Kit	1																	1	(1) Per Addendum
184B	Electrical Acces- sories Checkout Kit		1																1	(1) Per Addendum
184C	Electrical Acces- sories Checkout Kit					1													1	(1) Per Addendum
184D	Electrical Acces- sories Checkout Kit						1												1	(1) Per Addendum
184E	Electrical Acces- sories Checkout Kit							1											1	(1) Per Addendum
186	APS Pneumatic Regu- lation Portable Test Set													1					1	(3) Per C.O. 382, (1) per C.O. 613
186A	APS Pneumatic Regu- lation Portable Test Set										2								2	(2) Per C.O. 613

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
187	LH ₂ Experimental Ground Test Station																1		1	(1) Per C.O. 374 (1) per I-CO-SD-L- 350-66
188	Auxiliary Propulsion System (APS) Simula- tor																	2	2	(2) Per I-V-S-IVB-TD- 64-66
188A	Auxiliary Propulsion System (APS) Simula- tor, Saturn V, VCL- HB	2																	2	(2) Per I-V-S-IVB- TD-64-66
188B	Auxiliary Propulsion System (APS) Simula- tor, Saturn IB, SACTO Beta I					2	2												4	(2) Per I-V-S-IVB- TD-64-66 (4) per I-CO-S-DAC-L-516-67
188C	Auxiliary Propulsion System (APS) Simula- tor, Saturn V, SACTO Beta 1					2													2	(2) Per I-V-S-IVB- TD-64-66
190	Multiplexer Remote System Component Test Set	1																	1	(2) Per C.O. 383 (1) per negotiations

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
192	Antenna, Open Loop, Command Destruct System	1	1			1	1	2											5	(5) Per I-CO-SD-L- 110, Dated 1-25-64
193	Auxiliary Power Supply	1																	1	(1) Per S.A. 454
194	Cable Network, Environmental Test	1																	1	(1) Per S.A. 454
195	Digital Simulator Control Panel	1																	1	(1) Per S.A. 454
196	Panel Assembly, Range Safety Monitor	1																	1	(1) Per S.A. 454
197	Panel Assembly, Power System Monitor and Control	1																	1	(1) Per S.A. 454
198	Panel Assembly, Propellant Utiliza- tion Control and Monitor	1																	1	(1) Per S.A. 454
199	Panel Assembly, Measurement Control and Monitor	1																	1	(1) Per S.A. 454

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TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
200	Power Supply, Measurement	1																	1	(1) Per S.A. 454
201	Chassis, Ordnance Monitor and Control	1																	1	(1) Per S.A. 454
202	Power Supply, Calibration	1																	1	(1) Per S.A. 454
203	Distribution Box, Circuit Protection	1																	1	(1) Per S.A. 454
204	Patch Panel, Interconnecting Box	1																	1	(1) Per S.A. 454
205	Distribution Box, Umbilical	1																	1	(1) Per S.A. 454
206	Simulator Assembly, Childdown Inverter Load												2	2					4	(4) Per C.O. 715 (4) Per C.O. 986
207	Instrumentation Kit, Vehicle and Pallet, Air Carry																2	2	2	(2) Per C.O. 209

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TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
208	Instrumentation Kit Air Carry, Super Gupply																	1	1	(1) Per C.O. 609
209	Computer Configura- tion Control Unit																		1	(1) Per I-CO-S-IVB- 5-847 (1) per I-CO- S-DAC-L-178-67
212	APS Fuel Trans- ducer Kit									1									1	(1) Per C.O. 210
213	APS Oxidizer Transducer Kit									1									1	(1) Per C.O. 210
214	Rechargeable Battery Kit										1	1	1						3	(3) Per C.O. 941

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
232	Telemetry Systems Control Console	1	1				1									1		4	(5) Per C.O. 37 (6) Per S.A. 233, (6) C.O. 303, (4) per I-CO-S-IVB-7-101 (4) per I-CO-S-DAC-L- 178-67
233	Remote Pneumatic Control Console	1	1													1		3	(5) Per C.O. 37, (6) per S.A. 233 (4) per I-V-S-IVB- TD-64-77, (3) per C.O. 303 (3) per C.O. 292 (3) I-CO-S- DAC-L-178-67
233A	Remote Pneumatic Control Console, SACTO All Systems				1													1	(1) Per C.O. 165, and I-V-S-IVB-TD-64-77 (1) per C.O. 298
233B	Remote Pneumatic Control Console, SACTO Acceptance					1												1	(1) Per C.O. 165, and I-V-S-IVB-TD-64-77 (1) per C.O. 298

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
233C	Remote Pneumatic Control Console, SACTO VCL							1													1	(1) Per C.O. 292
234	Propulsion System Control Console	1	1					1										1			4	(5) Per C.O. 37, (6) per S.A. 233 (6) per C.O. 303 (4) per I-CO-SD-L-1322 (4) I-10-S-DAC-L-178-67
234A	Propulsion System Control Console - BETA					1	1														2	(2) Per I-CO-SD-L-1322
236	Electrical Networks Control Console	1	1					1										1			4	(5) Per C.O. 37, (6) per S.A. 233, (6) per C.O. 303 (4) per I-CO-SD-L-1322 (4) I-10-S-DAC-L-178-67
236A	Electrical Network Control Console					1	1														2	(2) Per I-CD-SD-L-1322
238	Propulsion System Display Unit	1	1			1	1	1										1			6	(5) Per C.O. 37, (6) per S.A. 233, (6) per C.O. 303 (6) I-CO-S-DAC-L-178-67

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
✓ 239	Electrical Net- works Display Unit	1	1		1	1	1									1		6	(5) Per C.O. 37, (6) per S.A. 233 (6) per C.O. 303 (6) I-CO-S-DAC-L- 178-67
✓ 240	Telemetry Systems Display Console	1	1		1	1	1									1		6	(5) Per C.O. 37, (6) per S.A. 233 (6) I-CO-S-DAC-L- 178-67
243	Automatic Propellant Loading Set				1													1	(1) Per Addendum and C.O. 306
247	Digital Voltmeter and Propellant Utilization Panel Assembly				1													1	(1) Per Addendum
248	Propellant Utiliza- tion System Calibra- tion Unit	1			1						1		1			1		5	(1) Per Addendum, (2) per C.O. 232 (5) per C.O. 305
249	GH ₂ /GN ₂ Control Panel Assembly				1													1	(1) Per Addendum, and (1) per C.O. 306
250	Inverter Power Supply Panel Assem- bly				1													1	(1) Per Addendum

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
251	Gimbal Power Supply Panel Assembly				1													1	(1) Per Addendum
252	Transmitter Test Set	1																1	(3) Per C.O. 97, (2) per C.O. 553 (1) per negotiations
253	Auxiliary Signal Distribution Complex	1	1				1									1		4	(5) Per Addendum, (3) per C.O. L-TD- 64-77, 6-9-64 and C.O. 165, (4) per S.A. 233 (4) per C.O. 303 (4) I-CO- S-DAC-L-178-67
253A	Auxiliary Distribu- tion Unit, SACTO				1	1												2	(2) Per C.O. L-TD- 64-77, 6-9-64 and C.O. 165
267	Instrument Unit Substitute	1	1		1	1	1									1		6	(5) Per C.O. 37, (6) per S.A. 233, (6) per C.O. 303 (6) per I-CO-S-DAC- 178-67 (6) I-CO-S- DAC-L-328-67

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
268	Aft Interface Sub- stitute Unit Chassis	1	1			1	1	1									1		6	(5) Per C.O. 37, (6) per S.A. 233 (6) per C.O. 303 (6) per I-CO-S-DAC- 178-67 (6) per I-CO- S-DAC-L-308-67
271	Chilldown Inverter Control Panel Assembly					1													1	(1) Per C.O. 40
278	Pulse Coded Modu- lation (PCM) Ground Station	1				1		1									1		4	(4) Per C.O. 63 (4) per C.O. 303 (4) I-CO-S-DAC-L- 178-67
279	Stage Instrumenta- tion Checkout Unit	1	1					1											3	(1) Per C.O. 63, (2) per C.O. 303 (3) per C.O. 292
280	Multiplexer and Calibrator Compo- nent Test Set	1																	1 1	(3) Per C.O. 97, (2) per C.O. 553 (1) per negotiations
284	Distribution Unit, Forward and Aft Busses Battery Power	2	2			2	2	2											10	(8) Per C.O. 268, (10) per C.O. 292

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
286	Pneumatic Consoles Portable Test Set													1							1	(3) Per C.O. 221 (4) per C.O. 437, (1) per C.O. 613
286A	Pneumatic Consoles Portable Test Set											2						1			3	(3) Per C.O. 613
287	Emergency Battery Rack Assembly, SACTO					2	1														3	(3) Per Addendum
288	Emergency Battery Power Unit - Huntington Beach	2	2					1													5	(3) Per Addendum (4) per S.A. 149, (5) per S.A. 233 (5) per I-CO-S-IVB- 7-101
289	Digital Events Recorder	1	1			1	1	1													6	(5) Per C.O. 144 (6) per S.A. 233 (6) per C.O. 303
294	Auxiliary Control Console					1	1														2	(2) Per C.O. 161
296	Telemetry Signal Distribution Unit	1	1			1	1	1										1			6	(6) Per C.O. 341 (6) I-CO-S-DAC-L- 178-67 (6) I-CO-S- DAC-L-328-67

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
298	System Status Display, Black/White	1	1		1	1	1											5	(5) Per C.O. 257
300	Ground Dolly Transporter, S-IVB Stage																7	7	(2) Cradles per Addendum (5) modified S-IV units per C.O. 26 for total of (7)
301	Cradles Kit, S-IVB Stage																9	9	(6) Per Addendum, (9) per S.A. 66
302	Handling Kit, Stage																7	7	(6) Per Addendum, (10) per S.A. 66, (Configure 3 Models, 302 to 413 and 1 Model 302 to 462), (7) per S.A. 233 (6) per C.O. 292, (7) per C.O. 939
303	Hoist Kit, Forward and Aft	1			1	1				1						1		5	(2) Per Addendum, (4) per S.A. 66, (5) per S.A. 233 (6) per C.O. 366 (5) per C.O. 514

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
303A	Hoist Kit, Forward and Aft											1									1	(1) Per C.O. 514
304	Protective Cover Kit, Environmental, S-IVB Stage																			6	6	(4) Per Addendum, (6) per S.A. 66
305	Tool Kit, Special																			7	7	(6) Per Addendum, (7) per S.A. 66
307	Handling Kit, Flared Aft Interstage																	1	4	5	(4) Per Addendum, (5) per C.O. 366	
308	Access Kit, Fuel Tank Interior	1				1		1				1									4	(3) Per Addendum (4) per C.O. 292
308A	Access Kit, Fuel Tank Interior																	1		1	(1) Per C.O. 312	
309	Cover, Protective, Forward Skirt End					1	1														2	(2) Per Addendum (3) per C.O. 576 (2) per 1164
309A	Cover, Protective, Forward Skirt End														1						1	(1) Per C.O. 1164

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
310	Access Kit, Vertical, Forward Section	1				1	1	2											5	(6) Per Addendum (8) per S.A. 66, (9) per S.A. 233 (5) per C.O. 293 (5) per S.A. 800, (3) C.O. 576 (5) per I-CO-S-DAC-L-817-66
311	Access Kit, Vertical, Flared, Aft Interstage											3				1			4	(6) Per Addendum, (7) per S.A. 233 (3) per C.O. 293 (4) per C.O. 366
313	Aft Umbilical Kit, Static Test Stand					1	1												2	(2) Per Addendum
314	Forward Umbilical Kit, Static Test Stand					1	1												2	(2) Per Addendum
315	Umbilical Kit, Aft Launcher												5				2 +		9	(3) Per Addendum (3+2p) per C.O. 49 (7+2p) per C.O. 160
316	Umbilical Kit, Forward Launcher												5				2 +		9	(3) Per Addendum (3+2p) per C.O. 49 (7+2p) per C.O. 160

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
318	Gas Heat Exchanger					1	1										1		3	(2) Per Addendum, (3) per C.O. 164
319	Automatic Operational Pneumatic Console "A"					1	1												2	(2) Per Addendum
320	Automatic Stage Servicing and Checkout Pneumatic Console "B"					1	1												2	(2) Per Addendum
321	Automatic Stage Checkout Pneumatic Console, HB	1	1														1		3	(5) Per Addendum, (5) per C.O. 303, (3) per C.O. 305 (3)
321A	Automatic Stage Checkout Pneumatic Console, VCL, SACTO							1											1	(1) Per S.A. 233 and C.O. 305 C.O. 292
322	Auxiliary Propulsion System Mobile Oxidizer Servicer									1									1	(1) Per Addendum
323	Auxiliary Propulsion System Mobile Fuel Servicer									1									1	(1) Per Addendum

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
324	Alignment Kit, Engine	1	1		1													3	(3) Per Addendum (3) per C.O. 303
325	Fixture, Engine Actuator Adjustment	1			1		1			2		1						6	(4) Per Addendum, (5) per S.A. 66, (6) per S.A. 233
326	Environmental Con- trol System Kit, SACTO				1	1												2	(2) Per Addendum
327	Battleship Pneuma- tic Console "A"				1													1	(1) Per Addendum
328	Battleship Pneuma- tic Console "C"				1													1	(1) Per Addendum
329	Checkout Acces- sories Kit	1	1		1	1	1											5	(1) Per Addendum
331	Liquid Oxygen Con- trol Valve Complex				1	1												2	(2) Per Addendum
332	Liquid Hydrogen Control Valve Complex				1	1												2	(2) Per Addendum
333	Pneumatic Console "B"				1													1	(1) Per Addendum

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TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
334	Umbilical Kit, GH ₂ Vent, SACTO				1													1	(1) Per Addendum
335	Aft Umbilical Installation Kit, Propulsion - Pneuma- tic Lines				1													1	(1) Per Addendum
339	Align Kit, SACTO				1	1												2	(2) Per Addendum
340	Align Kit, KSC										2		1			1		4	(3) Per Addendum (3) per S.A. 66 (4) per C.O. 366 (5) per C.O. 439 (4) per C.O. 576
341	Handling Sling, Ullage and Attitude Control Module		1							2								3	(4) Per C.O. 85 (4) per C.O. 303, (5) per C.O. 292 (3) per 654 (3) I-CO- S-IVB-6-117, (3) C.O. 127
342	Handling Kit, S-II Retrorocket									1			1					2	(3) Per C.O. 62, (6) per C.O. 114 (6) per C.O. 305 (2) per C.O. 548

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
344	Handling Kit, Attitude Control Module							1						2					3	(2) Per S.A. 66, (3) per S.A. 233 (3) per C.O. 303 (3) per C.O. 654 (3) I-CO-S-IVB-6-117
345	Weigh and Balance Kit, Stage	1						1											2	(2) Per Addendum (2) per C.O. 303
346	Aft Umbilical Kit, Checkout Stand	1	1																2	(2) Per Addendum
347	Forward Umbilical Kit, Checkout Stand	1	1																2	(2) Per Addendum
348	Access Kit, Liquid Oxygen Tank Interior	1				1		1			1								4	(3) Per C.O. 32, (4) per S.A. 233
349	Handling Kit, Engine					1		1											2	(2) Per C.O. 68, (3) per S.A. 233 (2) per C.O. 676
349A	Handling Kit, Engine										1								1	(1) Per C.O. 676
351	Weigh and Balance Kit, Aft Interstage	1																	1	(2) Per S.A. 66 (2) per C.O. 303, (1) per C.O. 328

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
352	Handling Kit, Constant Aft Interstage																	4	4	(4) Per S.A. 66
353	Aft Umbilical Kit, Launch Complex 37B												2						2	(1) Per S.A. 66 (2) per C.O. 160
354	Forward Umbilical Kit, Launch Com- plex 37B												2						2	(1) Per S.A. 66 (2) per C.O. 160
355	Aft Umbilical Kit, Launch Complex 34													2			1		3	(1) Per S.A. 66 (3) per C.O. 160
356	Forward Umbilical Kit, Launch Com- plex 34													2			1		3	(Per S.A. 66, (3) per C.O. 160
357	Access Kit, Verti- cal, Constant Aft Section												1	1					2	(2) Per S.A. 66
358	Hydraulic Pumping Unit	1	1			1	1	1											5	(5) Per Addendum, (6) S.A. 149, (3) per C.O. 249, (5) per C.O. 344

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
359	Servicer, Thermo-conditioning System, Forward Skirt Electronics	1	1		1	1	1											5	(4) Per C.O. 118, (5) per S.A. 233, (5) per C.O. 303
365	Desiccant Kit, Secondary, Saturn S-IVB																15	15	(4) Per Addendum (6) per S.A. 66 (11) per C.O. 862 (12) per C.O. 882 (15) per C.O. 1213
366	Preservation Kit, APS Module, Saturn IB																6	6	(4) Per Addendum (6) per S.A. 66
367	Preservation Kit, APS Module, Saturn V																31	31	(4) Per Addendum (6) per S.A. 66 (15) per C.O. 862 (17) per C.O. 882 (29) per C.O. 1213 (31) per C.O. 1368
368	Beam Kit, Cover Hoist, Saturn S-IVB Stage																6	6	(4) Per Addendum (6) per S.A. 66
372	APS Fuel Valve Complex Control Assembly								2									2	(2) Per C.O. 101, (3) per C.O. 256 (2) per C.O. 428

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
373	APS Oxidizer Valve Complex Control Assembly									2									2	(2) Per C.O. 101, (3) per C.O. 256 (2) per C.O. 256 (2) per C.O. 428
374	APS Pneumatic Dis- tribution Complex Control Assembly									1									1	(1) Per C.O. 101, (3) per C.O. 256 (1) per C.O. 428
375	APS Pneumatic Regu- lation Complex Control Assembly									1									1	(1) Per C.O. 101, (3) per C.O. 256 (1) per C.O. 428
380	Adapter Ring Kit, Transfer Dolly, Low Bay									2									2	(4) Per C.O. 131, (2) per C.O. 305
392	Support Kit, Dummy Interstage and Engine Protective																	7	7	(4) Per Addendum (6) per S.A. 66 (7) per C.O. 1213
396	Aft Umbilical Kit, Checkout Stand, SACTO							1	1										2	(2) Per Addendum (2) per C.O. 489
397	Forward Umbilical Kit, Checkout Stand, SACTO							1	1										2	(2) Per Addendum (2) per C.O. 489

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
398	Aft Umbilical Kit, Checkout, SIL, HB																1		1	(1) Per C.O. 246 (1) per I-CO-S-DAC- L-178-67
399	Forward Umbilical Kit, Checkout, SIL, HB																1		1	(1) Per C.O. 246 (1) per I-CO-S-DAC- L-178-67
400	Battery Handling Kit											1		1					2	(2) Per C.O. 576
402	Forward Interstage Vertical Access Kit, S-IB and S-V											3		1				1p	4 + 1p	(4) Per C.O. 293, (5) per C.O. 366, (5+1p) per C.O. 477, (4+1p) per negotia- tion
403	Destruct Container Kit										1			1					2	(1) Per C.O. 311 (2) Per C.O. 576
404	EBW Init and Det Container Kit, EBW Initiators and Detonators										3*			1					4	(3) Per C.O. 311 (4) per C.O. 576
405	Container Kit, Stage Separation Detonating Fuse										1		1						2	(1) Per C.O. 311 (2) per C.O. 576

*Notes 1 unit will be used with S-II and 1 unit will be used with S-IC

TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
406	Container Kit, Safe and Arm Device											2*									2	(2) Per C.O. 311 (2) per C.O. 576
413	Handling Kit, Saturn IB/S-IVB Test Stages																		1		1	(3) Per S.A. 66 (2) per C.O. 609, (1) per S.A. 800
413A	Handling Kit, S-IB Stage																					
417	Container Kit, Retrorocket Ignition CDF Harness Assembly											1									1	(1) Per C.O. 311
430	Stage Alignment Target Kit																		16	16		(6) Per C.O. 261 (7) per S.A. 361 (16) per S.A. 790
432	Pneumatic Console, Model 432												1	1							2	(5) Per C.O. 221 (6) per C.O. 437, (2) per C.O. 613
432A	Pneumatic Console Model 432A											3						1		4		(4) Per C.O. 613
433	Pneumatic Console "B", Model 433												1	1							2	(5) Per C.O. 221 (6) per C.O. 437, (2) per C.O. 613

*Denotes 1 unit will be used with S-II and 1 unit will be used with S-IC.

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization	
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL
433A	Pneumatic Console, Model 433A S-IVB											3						1		4	(4) Per C.O. 613
436	S-IVB Pneumatic Console, Model 436												1	1						2	(6) Per C.O. 382, (2) per C.O. 613
436A	Pneumatic Console, Model 436A											3								3	(4) Per C.O. 613 (3) per C.O. 748
438	Gas Heat Exchanger, S-IVB Model 438												1	1						2	(5) Per C.O. 221, (2) per C.O. 613
438A	Gas Heat Exchanger, Model 438A											3								3	(3) Per C.O. 613
439	APS Pneumatic Interconnect Kit, LC34													1						1	(1) Per C.O. 548
440	Pneumatic Inter- connect Kit, LC37												1							1	(1) Per C.O. 576
444	Stage Verification Alignment Target Kit, S-IVB/IB																		13	13	(12) Per C.O. 261 (13) per S.A. 361
446	Aft Umbilical Kit, MSFC Breadboard																	1		1	(1) Per C.O. 160

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
447	Forward Umbilical Kit, MSFC Bread- board																1		1	(1) Per C.O. 160
448	Aft Umbilical Kit, Saturn IB Bread- board, MSFC																1		1	(1) Per C.O. 160
450	Desiccant Kit, Static, S-IVB Stage																	11	11	(4) Per Addendum (6) per S.A. 66, (7) per C.O. 882 (8) per C.O. 1066, per C.O. 1213
454	Forward Umbilical Kit, Saturn IB Breadboard, MSFC																1		1	(1) Per C.O. 160
456	Initiator and Detonator Test Kit, S-IVB/IB													1					1	(1) Per C.O. 576
457	Test Kit, Detonator											1							1	(1) Per C.O. 576
462	Handling Kit, Saturn IB/S-IVB, Flight Stage																	6	6	(4) Per C.O. 146, (5) per C.O. 292, (6) per C.O. 939

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
469	Dome Protective Cover Kit, Model 469 Forward										3										3	(4) Per C.O. 293, (5) per C.O. 366, (4) per C.O. 374, (3) per negotiation of C.O. 293 and 366
469A	Dome Protective Cover Kit, Model 469A Forward													1							1	(1) Per C.O. 374
472	APS - LC-39 Fuel Control Assembly											1									1	(1) Per C.O. 715
473	APS - LC-39 Oxidizer Control Assembly											1									1	(2) Per C.O. 715 (1) Per C.O. 738
474	Support Fixture, Actuator, J-2 Engine	1	1			1		1				3	1	1							9	(1) Per C.O. 548 (5) per C.O. 576, (9) per C.O. 648
477	Hose Reel Cart											6	1	1			2				10	(8) Per C.O. 378 (10) per C.O. 510
478	Power Cable Reel Cart											4	1	1			2				8	(8) Per C.O. 378
479	Hydraulic Pumping Unit											4	1	1			2				8	(8) Per C.O. 378

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
481	Stage Roll Kit										1								1	(1) Per C.O. 514
482	Horizontal Access Kit, Fuel Tank Interior														1				1	(1) Per C.O. 479
483	Horizontal Access Kit, LOX Tank Interior														1				1	(1) Per C.O. 479
484	Horizontal Access Kit, Forward Skirt										1								1	(1) Per C.O. 548
485	Horizontal Access Kit, Aft Section										1								1	(1) Per C.O. 548
491	Alignment Fixture Kit, Engine Exit Plane	1	1	1															3	(3) Per C.O. 443
493	APS Checkout Accessory Kit												1	1					2	(1) Per C.O. 548 (2) Per C.O. 576
493A	APS Checkout Acces- sory Kit										2								2	Per C.O. 715
1850	Mainstage, Pneuma- tic Interconnect Kit, LC-34													1					1	(Per C.O. 548

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
1853	APS-LC-34 Propellant Interconnect Kit													1					1	(1) Per C.O. 548 (1) per C.O. 576
1854	APS-LC-37 Propellant Interconnect Kit												1						1	(1) Per C.O. 576
1858	Propulsion Checkout Accessory Kit												1	1					2	(2) Per C.O. 659
1858A	Propulsion Check- out Accessory Kit											3							3	(3) Per C.O. 659
1859	Support Kit, Air Carry - VPG																	2	2	(2) Per C.O. 609
1860	Access and Handling Kit, Air Carry, Super Guppy																	1	1	(1) Per C.O. 609
1861	Tiedown Kit, Air Carry - VPG																	2	2	(2) Per C.O. 609
1862	Environmental Kit, Air Carry - VPG																	2	2	(2) Per C.O. 609
1863	Roller Transfer Kit, Air Carry, Super Guppy	1						1			1								3	(3) Per C.O. 609

TABLE 1-1 (Cont)

GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
1865	Purge Kit, Stage Transporter, Prep- aration, GN ₂	1						1											2	(2) Per C.O. 609
1866	Modification Kit, Cargo Lift Trailer, Super Guppy		1					1						1			1		4	(4) Per C.O. 609
1869	Oxygen Hydrogen Burner Handling Kit	1		1															2	(2) Per C.O. 659
1871	Helium Heater Alignment Kit											2							2	(2) Per C.O. 659, 642
1872	APS Fuel Pressure Instrumentation Kit - SACTO									2									2	(3) Per C.O. 210, (2) I-CO-S-DAC-L- 463-67
1873	APS Oxidizer Pres- sure Instrumenta- tion Kit - SACTO									2									2	(3) Per C.O. 210, (2) I-CO-S-DAC-L- 463-67
1874	APS Fuel Pressure Instrumentation Kit- KSC											3							3	(1) Per C.O. 715 (2) per C.O. 738 (3) per I-CO-S-DAC- L-463-67

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TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
1875	APS Oxidization Pressure Instru- mentation Kit - KSC										3							3	(2) Per C.O. 715 (3) Per I-CO-S-DAC- L-463-67
1876	Handling Dolly, APS Module - S-IB											1	1					2	(2) Per C.O. 715
1877	Handling Dolly, APS Module - S-V											2						2	(2) Per C.O. 715
1878	Jam Weld Platform Kit, Hydrogen Tank									1								1	(1) Per C.O. 788
1879	Protective Cover, Light Weight									1								1	(1) Per C.O. 788
1880	Test Fixture Kit, Gemini Engine Pres- sure	1	1															2	(2) Per C.O. 703
1884	Disconnect Kit, Low Bay									2								2	(2) Per C.O. 829
1888	Storage Equipment Kit						3											7	(3) Per C.O. 1066 (7) Per C.O. 1213
1889	Moisture Monitor Kit						1											3	(1) Per C.O. 1066 (3) per C.O. 1213

TABLE 1-1 (Cont)
GROUND SUPPORT EQUIPMENT LIST
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
1891	Stage Storage Handling Dolly																			1	1	(1) Per C.O. 1213
1892	Constant Aft Inter- stage Cover																			4	4	(4) Per C.O. 1213
1893	Stage Handling Kit																			4	4	(4) Per C.O. 1213
1894	Quick-Opening Hatch Handling Kit																			1	1	(1) Per C.O. 1311

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TABLE 1-2

GROUND SUPPORT EQUIPMENT CANCELLED
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
100	Battery Charger Test Set											1							1	C.O. 128
101	Battery Discharger Component Test Set										1								1	C.O. 128
106	Computer Buffer Component Test Set																			Not required for manual systems
107	Digital Magnetic Tape Unit	Incorporated into Model DSV-4B-105																		
108	Auto Typewriter Punch/Reader																			
113	Destruct Rec/Cont. Comp. Test Set	1											1						2	C.O. 155
114	EBW Firing Unit Component Test Set	1											1						2	C.O. 155
119	Special Purpose Display Console												1						1	C.O. 37
122	Portable Display												1						1	C.O. 37
129	Leak Detection Unit	1				1	1				1									C.O. 641

TABLE 1-2 (Cont)

GROUND SUPPORT EQUIPMENT CANCELLED
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
137	EBW Pulse Checker	1						1	1			1									1	C.O. 157
138	Display Buffer												1								1	C.O. 37
158	Prop. Loading Comp. Cont. Console					1															1	C.O. 306
169	Cable Network Stage Checkout No. 2										1										1	C.O. 303
215	Adapt. Torque Wrench Engine Turbine	1	1			1	1					1		1							7	C.O. 18 and C.O. 27
235	Propulsion System Control Console Manual	1	1		2						1										5	C.L. I-CO-VB-4-150
244	LH2 Loading Computer Relay Chassis					1															1	C.O. 306
245	LH2 Loading Computer Chassis					1															1	C.O. 306
246	LO2 Loading Computer Relay Chassis					1															1	C.O. 306
262	Display Unit Check- out System							1													1	C.O. 63
269	Substitute S-IB													1							1	C.O. 90

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TABLE 1-2 (Cont)

GROUND SUPPORT EQUIPMENT CANCELLED
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center				Kennedy Space Center				Other				Contract Authorization			
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB			MISS. T/F	MSFC	ROTATIONAL
270	Substitute S-IC												1							1	C.O. 90
306	Small Arms Protec- tive Cover																		2	2	C.O. 229
312	Retrorocket Handling Kit - Forward							1					1	1					1	4	C.O. 29
317	Dual Vertical Check- out Stand		1																	1	S.A. 67
337	Stage Vertical Weight Kit																				Not required
338	Flared Aft Inter- stage Weigh and Balance Kit																				Not required
350	Solid Ullage Rocket Handling Kit											2								2	C.O. 425
371	Stage to Constant Int. Alignment Kit											1								1	C.O. 439
407	Ullage Jettison Fuse Container Kit										1										C.O. 576
408	Hose Kit, SACTO, Saturn IB					1	1													2	C.O. 428

TABLE 1-2 (Cont)

GROUND SUPPORT EQUIPMENT CANCELLED
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach			Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization
		VCL 1	VCL 2	DED	BETA 1	BETA 3	VCL 1	VCL 2	GAMMA	VAB KSC	LC-39	LC-37	LC-34	SAB	MISS. T/F	MSFC	ROTATIONAL	TOTAL	
409	Hose Kit, SACTO, Saturn V				1	1												2	C.O. 428
413A	Handling Kit, S-IVB Stage																2	2	C.O. 939
418	APS Fuel Mobile Servicer, Beta					1												1	C.O. 256
419	APS Oxidizer Mobile Servicer, Beta					1												1	C.O. 256
420	APS Pneu. Regula- tion Console, Beta				1	1												2	C.O. 256
421	APS Pneu. Dist. Console, Beta				1	1												2	C.O. 256
463	Aft Umbilical, VCL - SACTO						1											1	C.O. 489
464	Forward Umbilical, VCL-- SACTO						1											1	C.O. 489
467	Hydraulic Pumping Unit			1			1											2	C.O. 344
471	Transportation Tie Down Kit																1	1	C.L. I-CO-S-IVB-4-425

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TABLE 1-2 (Cont)

GROUND SUPPORT EQUIPMENT CANCELLED
SATURN V/S-IVB AND SATURN IB/S-IVB PROGRAMS

Model DSV-4B	Nomenclature	Huntington Beach				Sacramento Test Center					Kennedy Space Center					Other				Contract Authorization		
		VCL 1	VCL 2	DED		BETA 1	BETA 3	VCL 1	VCL 2	GAMMA		VAB KSC	LC-39	LC-37	LC-34	SAB		MISS. T/F	MSFC		ROTATIONAL	TOTAL
492	Nitrogen Fill Truck, KSC DSV-4-																			4	4	C.O. 540
197	EBW Firing Unit Comp. Test Set		1									1									2	C.O. 155
219	Destruct System Component Test Set	1										1									2	C.O. 155

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2. APPLICABLE DOCUMENTS

This section deleted by CO 483.

3. GENERAL REQUIREMENTS

3.1 Design

MS (Military Standard), and (Air Force/Navy Design Standard), and NAS (National Aerospace Standard) standards shall be used where applicable. Ground Support Equipment (GSE) shall be in accordance with Specifications MSFC-STD-110A and MIL-S-8512, as applicable. Electrical engineering design practice shall conform to MSFC (Marshall Space Flight Center) Standard MSFC-STD-163.

3.2 Structural Design Criteria

The following terms and definitions will be used on all S-IVB documentation pertaining to GSE to establish uniform nomenclature with respect to loads, factors of safety, et cetera. Factors of safety and load factors to be used in the design of ground support equipment shall be as listed in the following paragraphs.

3.2.1 Limit Load

Limit load is the maximum load calculated to be experienced by the structure under specified conditions of operation.

3.2.2 Design Load

The design load is the limit load multiplied by the required factor of safety.

3.2.3 Load Factor

The factor by which the steady-state loads are multiplied to obtain the equivalent static effect of dynamic loads.

3.2.4 Factor of Safety

The factor of safety is the ratio of the criterion load or stress to the limit load or stress.

3.2.5 Margin of Safety

The margin of safety is the percentage by which the criterion load or stress exceeds the design load or stress. For example, criterion stress can mean the material yield stress.

3.2.6 Operating Pressure

The operating pressure is the nominal pressure to which the components will be subjected under steady-state conditions in service operations.

3.2.7 Limit Pressure

The limit pressure is the maximum operating pressure, i.e., the operating pressure plus the influence of surge, vehicle acceleration, et cetera.

3.3 Safety Factors

The following safety factors shall be applicable to S-IVB Ground Support Equipment design as minimum values:

a. General Structures

1. Yield factor of safety = 1.00
2. Ultimate factor of safety = 1.50

b. Pneumatic and Combined Pneumatic - Hydraulic Systems:

1. Reservoirs, Actuating Cylinders, Valves, Filters, Switches, Flexible Hose, Tubing, Ducts and Fittings
Proof Pressure = 1.50 x Limit Pressure
Yield Pressure = 2.00 x Limit Pressure
Burst Pressure = 4.00 x Limit Pressure

c. Hydraulic Systems:

1. Reservoirs, Flexible Hose, Tubing, Ducts, and Fittings

Proof Pressure = $1.50 \times$ Limit Pressure

Yield Pressure = $2.00 \times$ Limit Pressure

Burst Pressure = $4.00 \times$ Limit Pressure

2. Valves, Actuating Cylinders, Filters, and Switches

Proof Pressure = $1.50 \times$ Limit Pressure

Burst Pressure = $2.50 \times$ Limit Pressure

d. Limit Load Factors

The limit load factors are defined in Table 3-1.

3.4 Standard Parts

MS, AND, and NAS standard parts, such as nuts and bolts, which have suitable properties may be used when the commercial part can be replaced by a standard part without alteration. The corresponding standard part number shall be referenced in the parts list and on the Contractor's drawings.

3.5 Selection of Specifications and Standards

The selection of specifications and standards for the design of the equipment specified herein shall be made from those appearing in SM-41411. All specifications and standards not listed in SM-41411 shall be selected in the order of precedence established in Paragraph 3.4 of MIL-D-70327, and shall be submitted to MSFC for approval concurrent with their usage.

3.6 Environmental Requirements

The GSE shall be designed to function satisfactorily when subjected to the environmental requirements of ABMA Report DRR-TM-7-60 to the extent of applicability determined by the configuration of each individual item, its intended use, and the nature of any protection normally afforded by shelters, packaging, et cetera. In no case (except in development tests)

TABLE 3-1
DESIGN CRITERIA FOR S-IVB GROUND SUPPORT EQUIPMENT

TYPE OF EQUIPMENT (CATEGORY)	LOAD FACTORS (LIMIT)*				DESCRIPTION OF LOADING CONDITION
		LONG	LATERAL	VERT.	
I. S-IVB TRANSPORTER, (TRANSPORTER, CRADLES, HANDLING RINGS, TIE- DOWNS, AND MISCELLANEOUS ITEMS ATTACHED TO THE TRANSPORTER)	COND. (1)	± 0.75	± 0.50	-3.00	LAND TRANSPORTATION ROAD BUMPS & IRREGULARITIES
	(2)	0	0 ± 0.75	-3.00	TURNING
	(3)	± 1.00	± 0.50	-2.00	QUICK STARTS OR STOPS
	IN EACH CONDITION, INCLUDE THE EFFECT OF A 45 KNOT-WIND.				
	COND. (1)	± 0.5	± 0.6	-2.5	WATER TRANSPORTATION.
	(2)	± 0.5	± 0.6	-1.0	LOAD FACTORS ARE RELATIVE TO SHIP.
II. HOISTING EQUIPMENT (HOIST BEAMS, HOIST RINGS, ROLL RINGS, AND ENGINE HANDLING EQUIPMENT)	IN EACH CONDITION, INCLUDE THE EFFECT OF A 70 KNOT-WIND.				
	COND. (1)	0	0	-3.33	VERTICAL HOISTING
	(2)	0	± 0.578	-3.28	HOIST W/10° (FROM VERTI- CAL PULLOFF TO SIDE.
	(3)	± 0.578	0	-3.28	HOIST W/10° (FROM VERTI- CAL) PULLOFF FORWARD OR AFT.
III. JACKS (FOR LEVELING AND SUPPORT)	IN EACH CONDITION, INCLUDE THE EFFECT OF A 45 KNOT-WIND.				
	COND. (1)	± 0.5	± 0.5	-2.0	LEVELING TRANSPORTER
	(2)	0	0	-3.33	SUPPORT DURING HOISTING OR STAGING OPERATIONS.
IV. WEIGHING EQUIPMENT (LOAD CELLS, SUPPORTS, WEIGH RING, CALIBRA- TION KIT, ETC.)	IN EACH CONDITION, INCLUDE THE EFFECT OF A 45 KNOT-WIND.				
	COND. (1)	0	0	-2.0	VERTICAL WEIGHING
					NOTE: INCLUDE PULLOFF (FROM VERTICAL) IF ANY EXISTS. THE AMOUNT OF PULLOFF WILL DEPEND ON GEOMETRY OF WEIGH SYSTEM.
V. ACCESS AND WORK PLATFORMS (FORWARD & AFT INTERSTAGES & TANK INTERIOR)	NO-WIND LOAD				
	COND. (1)	0	0	-3.33	MEN OR MAN EXERT (S) SUD- DENLY APPLIED LOAD.
VI. "INTERNAL" WORK PLATFORMS**	NO-WIND LOAD				
	COND. (1)	0	0	-2.0	MEN OR MAN EXERT (S) SUD- DENLY APPLIED LOAD.
VII. PROPELLANT & VENT LINE BRACKETRY	NO-WIND LOAD				
	COND. (1)	0	0	-2.0	LOAD DUE TO VIBRATIONAL EFFECTS. SEE VIII FOR DISCONNECT.
VIII. DISCONNECT DEVICES	INCLUDE THE EFFECT OF A 45-KNOT WIND. IN THE CASE OF PRO- PELLANT LINES, ALSO INCLUDE THE DYNAMIC EFFECT OF FLUID FLOW. IF SURVIVAL UNDER HURRICANE CONDITIONS IS TO BE CONSIDERED, USE 109-KNOT WINDS.				
	LOADS WILL BE BASED ON DYNAMIC STUDIES OF THE DIS- CONNECT SYSTEM, TAKING INTO ACCOUNT THE REEL-IN VELOCITY, DROP HEIGHT, ETC. AT TIME VEHICLE IS LAUNCHED.				

* (1) SIGN INDICATES AFT, PORT, & UP.
(-) SIGN INDICATES FORWARD, STARBOARD, & DOWN.

** "INTERNAL" WORK PLATFORMS ARE SO
DESIGNATED IF ANY PART OF THE SUP-
PORT STRUCTURE IS INTEGRAL WITH
THE STAGE.

shall any equipment item or any of its components be required to withstand the effect of any condition of a magnitude greater than that to which the item or component would be exposed in the course of normal storage, handling, transport, and operational use. The GSE shall be subjected to quality inspection before design evaluation and qualification tests to determine conformance with the requirements of the contract specifications and engineering drawings. GSE shall be subjected to design evaluation and acceptance tests, but not to formal qualification. The prelaunch and launch wind environment and gust characteristics specified in MSFC Memorandums M-AERO-G-10-62, M-AERO-G-32-62 shall be used in connection with wind loads.

3.7 Moisture and Fungus Resistance

When required, and except as otherwise required by detail design considerations, equipment exposed to exterior atmospheric conditions shall be constructed of materials which will resist the corrosive action of salt air and damage from moisture and fungi. However, suitable protective coatings which will not lose their protective characteristics during the normal course of inspection, maintenance, and periodic testing may be used. Before application, electrical equipment requiring fungus-proofing shall be coordinated with NASA/MSFC. Protective coatings used, where applicable, shall conform to Specification MIL-V-173.

3.8 Production, Maintenance, and Repair

The design of the GSE shall provide for ease of production, general maintenance, and inspection, and shall also have provisions for calibration. Meters which measure input or control parameters to components, systems, etc., shall measure the parameters at the input plugs or terminals of the components or systems. Means shall be provided to monitor these parameters externally.

Suitable access doors or panels shall be provided, as required, to permit ready access to component parts of the structure, to equipment installations, and to system components such as valves, regulators, and fittings. Removal and replacement times shall be kept to a minimum commensurate with other design considerations.

3.8.1 Cleanliness

Cleanliness of the fuel and oxidizer tanks and all fittings, fixtures, valves, equipment, and piping for the handling or storage of hydrogen, helium, oxygen, or nitrogen, and the cleaning of LO₂ (liquid oxygen) and LH₂ (liquid hydrogen) containers shall be in accordance with MSFC-SPEC-164. Test of materials for LO₂ compatibility shall be performed in accordance with MSFC-SPEC-106.

3.9 Interchangeability and Replaceability

Equipment design shall not specify tolerances more stringent than necessary to achieve the performance, interchangeability, and replaceability required throughout the operational life of the equipment.

3.10 Substitutions

The Contractor may substitute, upon approval of MSFC (or MSFC-delegated authority), parts, equipment, accessories, or construction materials when such substitution is required to render an item capable of performance within the limits specified.

3.11 Preparation of Drawings

Drawings of GSE end-items created for the S-IVB Program shall be prepared as Class II drawings generally in accordance with Specification MIL-D-70327. On all drawings related to GSE electrical interface, the Contractor shall reflect MSFC-released standard nomenclature.

3.12 Life Sciences Program

The objective of the life sciences program will be to achieve optimum system performance through effective utilization of human capabilities. The operational support equipment hardware subsystem and the operator personnel subsystem will be derived from an integrated development program through preliminary, developmental, prototype, and operational stages. There will be mutual interdependence between hardware and personnel. Under this philosophy, equipment and personnel will be viewed both in terms of their unique contributions to the efficient and reliable accomplishment of mission objectives as well as their interaction with other equipment and personnel. Equipment design and personnel task performance descriptions will be system oriented. To retain the advantages of the system-oriented approach engendered by this program, engineering psychologists will participate in each phase of the research and development program from the proposal stage through preliminary design, detailed design, field test, and system operation. In support of this objective, attention will be focused on utilization of human factors engineering and industrial design criteria to optimize the following:

- a. Workspace to conform to anthropometric, visual, and task distribution;
- b. Panel layouts to increase the speed and accuracy with which operators assimilate data, make decisions, and manipulate controls;
- c. Display panels to ensure clear and unmistakable information displays, and attention-getting devices such as visual and auditory warning devices;
- d. Controls for switches, handles, pushbuttons, etc., to conform to positioning accuracy requirements;
- e. Markings to ensure clarity and legibility in coding and in the placement of instructions on operating panels and associated equipment;
- f. Maintainability and accessibility for ease and rapidity of checkout, troubleshooting, and repair;
- g. Ambient environment to ensure that noise, illumination, temperature, and humidity will not impose undue problems on human performance;
- h. Human safety to ensure that human tasks are performed under maximally hazard-free or protected conditions.

All S-IVB GSE shall be designed in accordance with Human Engineering Manual described in Douglas Drawing 1A02680.

3.13 Safety

3.13.1 Controls and Assembly

Controls and assembly sequences shall, wherever possible, eliminate conditions permitting reversal or mismating of fittings, couplings, plumbing, mechanical parts, and electrical wiring.

3.13.2 Guards

Suitable guards shall be provided for cold, hot, and moving parts with which the operator may come in contact during normal operation, and for open sides of platforms and access ladders.

3.13.3 Sharp Edges

Sharp edges, projections, and hinged devices of a hazardous nature shall not be permitted.

3.13.4 Electrical Hazards

Electrical hazards shall be minimized through the use of shields, interlocks, and grounding.

3.13.5 Fire and Explosion Hazards

Danger from fire and explosion shall be avoided by separating hazardous substances from possible ignition sources wherever possible, and by incorporating spark arrestors, suitable vents and drains, hermetically sealed switches, etc., where required. All equipment which constitutes a potential fire or explosion hazard shall be electrically bonded and grounded. Any items which are electrically active during fueling operations shall either be explosion-proofed, or purged. Equipment located on the launch pad shall, when necessary, be contained in a console or container which has been purged with GN₂ (gaseous nitrogen) under positive pressure.

3.13.6 Safety Considerations

The Saturn Life Sciences Section shall review all equipment design to ensure that safety considerations have been suitable incorporated.

3.14 Electrolytic Corrosion of Metal Parts

Whenever practicable, the use of dissimilar metals in immediate contact, which may result in electrolytic corrosion in the presence of moisture, shall be avoided. This has particular reference to dissimilar metals listed in MS Drawing MS-33586. Where the use of such metals in immediate contact cannot be avoided, they shall be adequately insulated from one another unless electrical continuity is required.

3.15 Flow Direction

Flow directions shall be visibly indicated on components (e.g., valves, duct assemblies, etc.) when marking is vital for performance and installation.

3.16 Threaded Fasteners

ABMA Standard ABMA-STD-18 shall be used to determine acceptable torque limits for threaded fasteners.

3.17 Interference Suppression

Interference with electrical or electronic equipment from internal or external sources shall be avoided. Interference controls shall be in accordance with Specification MIL-E-6051 and Douglas Drawing 7883817. An electromagnetic interference control plan, similar to that developed for the S-IV Program, shall be developed for the S-IVB Program.

3.18 Electrical Bonding

Electrical bonding shall be in accordance with Specification MIL-B-5087 and Douglas Drawing 7883816.

3.19 Component Parts

Douglas Drawing 1A57652 shall govern the selection of electrical and electronic component parts intended for use on S-IVB GSE. The Douglas GSE parts list shall make maximum usage of the available MSFC parts list. Douglas shall obtain MSFC approval for electrical/electronic GSE parts not listed in the MSFC parts list (MSFC Standard MSFC-STD-110A).

3.20 Printed-Circuit Design

Printed-circuit design and construction standards shall be in accordance with the requirements established in ABMA Standard ABMA-STD-428.

3.21 Radiographic Inspection

Radiographic inspection procedures and acceptance standards for fusion-welded joints in stainless and heat-resistant steel shall conform to the requirements of MSFC 10509306. MSFC-STD-100 shall provide radiographic acceptance standards for aluminum alloy guided missile castings.

3.22 Reliability

The GSE shall be designed with the highest practicable degree of reliability consistent with program requirements.

3.23 Transportability

All GSE shall be suitable for transportation by C-124 aircraft.

3.24 Identification and Marking

The GSE equipment and its components shall be identified and otherwise marked in accordance with the requirements of Standard MIL-STD-130 (except that Futura medium-style letters shall be substituted in Paragraph 4.3.6 of that Standard) and MSFC-STD-349. Fluid lines shall be marked in accordance with AND Standard AND-10375, as applicable.

3.25 Workmanship

The GSE shall be fabricated and finished so that criteria of appearance and fit, and adherence to specified dimensions and tolerances are observed. These criteria shall apply to all accessories and to all external nonfunctioning parts (e.g., nameplates), as well as to functioning parts. Particular attention shall be given to neatness and thoroughness of marking of parts and assemblies, plating, painting, welding, and to freedom of parts from burrs and sharp edges which could mar associated equipment or cause injury to operating personnel.

3.26 Materials and Processes

Materials and processes shall conform to the applicable specifications and standards listed in Douglas Report SM-41411. When no applicable specification is listed in Douglas Report SM-41411, specifications and standards shall be selected in the order of precedence established in Specification MIL-D-70327. Special attention shall be given to the stringent requirements of temperature, temperature gradients, thermal conductivity, vibration, and loads. Selection of materials shall be based on an optimum compromise of physical, electrical, or other essential design properties, availability, and adaptability to production processes. Physical properties of materials shall conform to applicable requirements. Use of strategic and critical materials shall be kept to a minimum consistent with overall stage requirements.

3.27 Finish

The finish of the GSE shall be in accordance with Douglas Specification F-289.

3.28 Compatibility

Where applicable, lubricants, sealants, threading compounds, packing, and gaskets used in construction of the GSE shall be compatible for use with missile fuels and oxidizers to prevent fuel contamination or explosion. Suitable materials shall be selected from ABMA Report

DSN-TN-3-59. Any new type of material not included therein must be tested for compatibility and approved by MSFC.

3.29 Exploding Bridgewire GSE

The following documents shall govern the general requirements for EBW GSE:

TT-E-529	MIL-W-8604
QQ-S-571	MIL-A-9067
MIL-T-27	FED-STD-595
MIL-S-5002	MIL-STD-8
MIL-H-6088	MIL-STD-10
MIL-P-6808	NAS-523

Ordinance Drawing 9021544

3.30 Propellants and Pressurants

LO₂ shall conform to Federal Specification BB-0-925. Nitrogen shall conform to Specification MIL-P-27401.

3.31 Pneumatic Systems

The design, installation, and test of pneumatic systems used in stage GSE shall conform to Specification MIL-P-5518. Steel air reservoirs, both cylindrical and spherical, shall conform to the requirements established in Specification MIL-P-27401.

3.32 Hydraulic Fluid

The general requirements for petroleum-base hydraulic fluid shall be in accordance with Specification MIL-H-5606.

3.33 Welding, Brazing, and Soldering

Welding shall be performed in accordance with Specification MIL-W-6858 and MIL-W-6873, and ABMA Publications MSFC-DWG-10509308 and ABMA-PD-W-45, as applicable. The Contractor shall certify welding operators for fusion

welding in accordance with ABMA Publication ABMA-PD-W-153. Brazing of silver shall be in accordance with MSFC-DWG-10509307. Soldering of electrical connections shall be performed in accordance with MSFC-PROC-158. Printed-circuit soldering and inspection procedures shall conform to the requirements of MSFC-PROC-158.

3.34 Cable and Connector Installation

Shielded cable intended for installation in S-IVB GSE shall conform to Specification MIL-C-7078. Electrical connectors shall conform to Specification MIL-C-5015.

3.35 Aluminum Tubing

Aluminum alloy tubing used in hydraulic systems shall conform to Specification MIL-T-7081.

3.36 Resin-Acid Coating

Pretreatment of metal surfaces before application of the protective coating system shall conform to Specification MIL-C-8514.

3.37 Hydraulic Systems

The design, installation, test, and data requirements of GSE hydraulic systems shall be in conformance with Specification MIL-H-25475.

3.38 Basic Contract Reference Documents

Contract data requirements other than GSE shall be as specified in the following documents:

- a. Specification and Deviation Document, Saturn S-IVB System (SM-41411).
- b. General Test Plan, Saturn S-IVB System (SM-41412).
- c. Contract End Item Detail Specification (Prime Equipment) Performance/Design and Qualification Requirements and Product Configuration and Acceptance Test Requirements for S-IVB stages 201 through 204 for Saturn IB Program (CP208000A).

- d. Contract End Item Detail Specification (Prime Equipment) Performance/Design and Qualification Requirements and Product Configuration and Acceptance Test Requirements for S-IVB stages 205 through 212 for Saturn IB Program (CP208000B).
- e. Contract End Item Detail Specification (Prime Equipment) Performance/Design and Qualification Requirements and Product Configuration and Acceptance Test Requirements for S-IVB stages 501 through 506 for Saturn V Program (CP209000A).
- f. Contract End Item Detail Specification (Prime Equipment) Performance/Design and Qualification Requirements and Product Configuration and Acceptance Test Requirements for S-IVB stages 507 through 515 for Saturn V Program (CP209000B).

3.39 Systems Design Integration Criteria

3.39.1 Failure Effect Analysis - Deleted by Change Order 326.

3.39.2 Mechanical Automation - The Contractor shall prepare a criticality ranking for all critical components from the above failure effect analysis, and shall follow the automation procedure as outlined in MSFC Memorandum MSFC-MTP-P&VE-E-62-2 in order to determine what should be automated.

3.39.3 Functional Analysis - The Contractor shall prepare a functional analysis on a real-time basis for those systems which function in the pre-firing and the terminal portion of the countdown. The analysis shall describe the system's operational modes, showing cause-and-effect relationships, functional dependency or independency, and instrumentation feedbacks, and shall be in accordance with NASA Publication TN-D-782, as applicable to static firings at Complex Beta, STC.

3.39.4 Functional Logic Diagram - The Contractor shall prepare a functional logic diagram for those systems which function in the prelaunch and the terminal portion of the countdown. The logic diagram shall define the operation of both manual and automatic systems, interlocked instrumentation, safing requirements, et cetera. This diagram shall not show total numbers of components or measuring sensors. The symbols shown in MSFC Drawing 10443377 shall be used to develop this diagram. Provisions shall be made to identify electrical and mechanical functions.

4. PRIME SUPPORT EQUIPMENT

4.1 General

This section provides descriptions of the Prime Support Equipment for the S-IVB program. The Part II CEI Specification for each model of prime equipment is referenced within the description of the equipment.

4.2 Console, Common Bulkhead Vacuum Monitoring (DSV-4-303) 1A86793

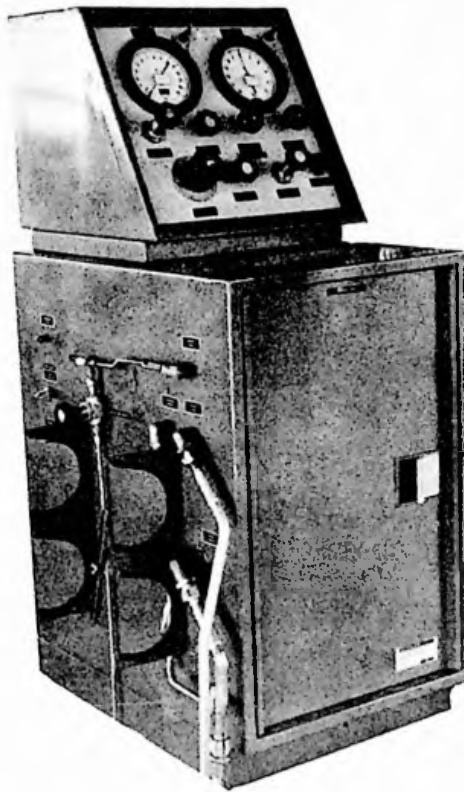
Function - The function of the Common Bulkhead Vacuum Monitoring Console shall be to detect and relieve any rise in pressure in the common bulkhead from the time the propellant is loaded on the S-IVB stage to lift-off.

Design - The console, as shown in Figure 4-1, shall be designed to perform the following functions:

- a. Purge the common bulkhead with GN_2
- b. Purge the console with GN_2
- c. Evacuate the common bulkhead
- d. Detect pressure rises in the bulkhead
- e. Review pressure rises in the bulkhead
- f. Monitor pressure throughout the system
- g. Collect samples of gas which might leak into the bulkhead.

Components - The console shall include the following components:

- a. Vacuum pump
- b. Vacuum valves
- c. Vacuum monitoring instruments
- d. Regulator
- e. Pressure monitoring instruments
- f. Electrical relay chassis.



SM418557

Figure 4-1. Console, Common Bulkhead Vacuum Monitoring (DSV-4B-303)

Dimensions - The approximate dimensions of the console shall be: height, 28 inches; width, 80 inches; depth, 30 inches. (Reference Part II CEI Specification CP 204303A.)

4.3 Access Kit, Vertical Flared, Aft Interstage (DSV-4B-311) 1B55275-1

Function - The function of the Aft Interstage Vertical Flared Access Kit shall be to provide access to the aft section of the stage for maintenance while the stage is in a vertical position.

Design - The design of the kit, as shown in Figure 4-2, will consist of a series of removable work platforms and support arms. Support arms will hook into mounting holes in the vertical interstage stiffeners and frames. Entrance to the aft section will be provided by a door in the aft interstage adjacent to the GFE (Government-furnished equipment) umbilical arm.

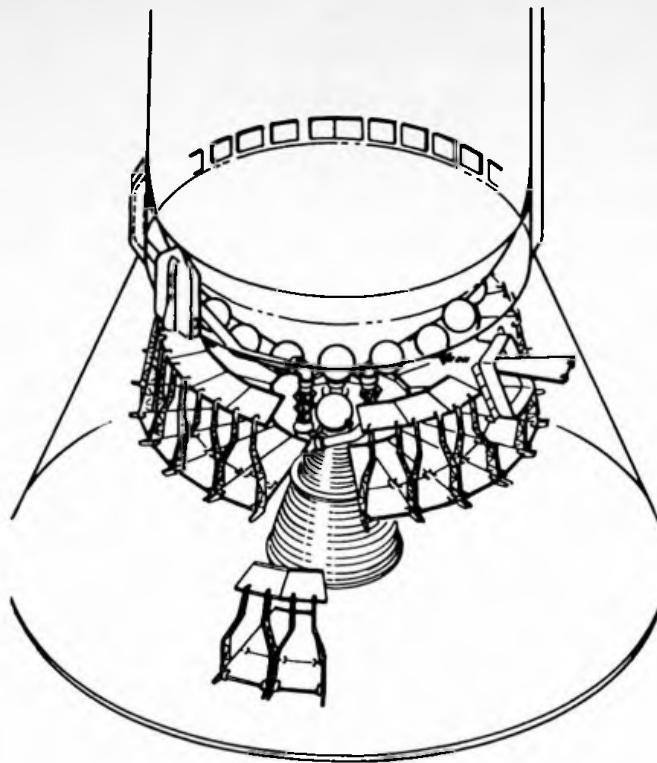


Figure 4-2. Access Kit, Vertical Flared Aft Interstage (DSV-4B-311)

Components - The kit will consist of suitably designed and installed work platforms and support arms. (For use with the S-V stage only.)

(Reference Part II CEI Specification CP 4B0311A.)

4.4 Umbilical Kit, Aft Launcher (DSV-4B-315) 1A57883-1

Function - The function of the Aft Launcher Umbilical Kit shall be to provide support for the electrical cables, pneumatic lines, propellant lines, and the air conditioning adapter duct. An umbilical carrier shall provide attachment to the stage and the necessary mechanism to ensure reliable disconnect at vehicle launch. It shall also provide a grounding system, dual electrical switches to indicate carrier disconnect, and an eject mechanism to provide electrical cable disconnect from the stage for test purposes.

Design - The kit, as shown in Figure 4-3, will be designed to provide (1) attachment to the stage for the electrical cables, (2) an air conditioning duct, (3) propellant transfer lines, and (4) pneumatic transfer lines. The ground halves of the propellant line coupling will provide pneumatically actuated shutoff (butterfly) valves which will close upon disconnect to prevent contamination of the interior of the lines by launch debris. The shutoff valves will be designed to fail at last position and to be pneumatically actuated by 750-psi (pounds per square inch) gaseous helium. The valves will also have (1) electrical switches to indicate valve position and (2) standard MS connectors to connect the electrical lines. Provisions will be made for purging the cavity containing the electrical switches. Valve actuation capability will be provided by KSC. Propellant couplings will be of the MSFC ball-and-cone type, and will be locked to the stage by the carrier.

The umbilical carrier assembly will be designed to maintain an inert atmosphere around the electrical connectors, shutoff valve switches,

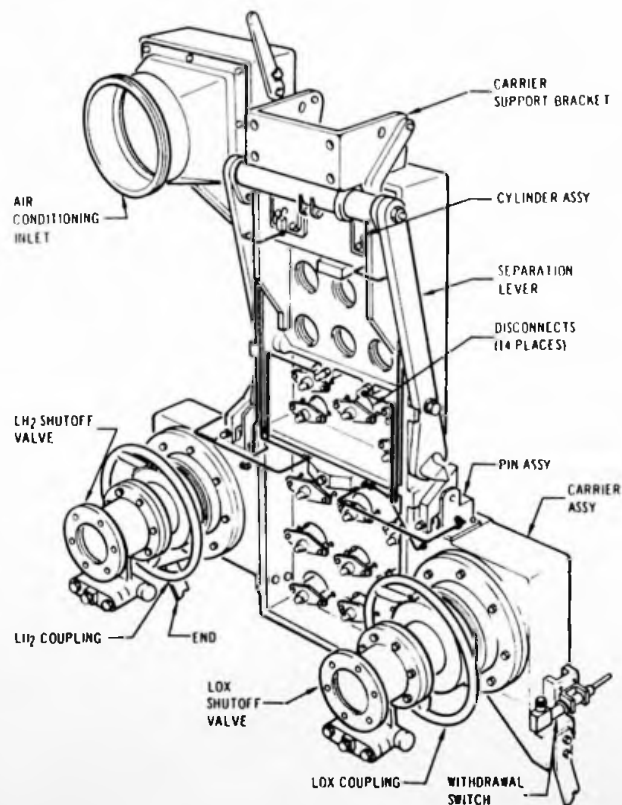


Figure 4-3. Umbilical Kit, Aft Launcher (DSV-4B-315)

propellant couplings, and those quick-disconnects operating at cryogenic temperatures. The carrier will incorporate a switch to signal carrier withdrawal and retraction after disconnect. The switch will be designed as follows:

- a. The switch will be mounted to close when the umbilical carrier is separated from the stage but still supported by support legs.
- b. The switch will be designed to close (rather than open) a circuit, and will be wired directly into the command circuit for the withdrawal and retraction devices.
- c. The switch will be subplate-mounted so that it may be detached to simulate umbilical release without the necessity of actual umbilical disconnect.
- d. The switch will have the following characteristics.
 1. hermetically sealed in accordance with applicable specifications;
 2. MS or hermetically sealed type connector;
 3. double-pole, double-throw;
 4. 28-vdc (volts direct current) rated, 10-amp minimum resistance.

The carrier will be attached to the lower end of the stage by two supports mounted in pivots in the aft interstage, and by two quick-release pins in the aft skirt. The quick-release pins will be designed to disconnect pneumatically when pressure is supplied to the primary separation system, and to disconnect mechanically when the secondary disconnect is operated. The lower carrier supports will be designed to completely disconnect from the stage within 11 degrees of carrier rotation.

An eject mechanism will be included in the design of the kit to disconnect the electrical cables from the stage for test purposes. The mechanism will be capable of pneumatic operation to disconnect the electrical plugs from their receptacles to simulate liftoff.

The grounding system will be designed to maintain stage electrical ground until after electrical umbilical disconnect.

The pneumatic quick-disconnects will be designed to be actuated by carrier disconnect motion.

DAC/KSC interfaces and areas of responsibility have been defined by MSFC and shall be as follows:

- a. Design interface between Douglas and KSC will be the ground side of the ground half of the disconnect couplings.
- b. Douglas will have design and development responsibility for the ground half of the electrical and mechanical disconnects on the launcher umbilical tower at KSC.
- c. KSC will be responsible for designing, testing, and furnishing the air conditioning duct, propellant lines, pneumatic lines, and hydrogen vent lines on the swing arm.
- d. Douglas will supply the electrical connector pigtail to the stage skin grounding system.
- e. Design, development, and hardware responsibility for the aft umbilical withdrawal mechanism, including the disconnect switch cable, will be the responsibility of KSC. Douglas will coordinate disconnect requirements with MSFC to facilitate withdrawal mechanism design.
- f. Pneumatic GN₂ actuation supply and controls for disconnecting the aft umbilical carrier, and purge gas supply and control for the forward and aft umbilical carriers will be the responsibility of KSC.
- g. Douglas will ensure the ability of the umbilicals to disconnect from the stage. The Douglas-supplied umbilical disconnect mechanism will be designed to overcome spring and inertial loads of KSC lines and cables (as defined by MSFC), but will not be required to overcome a jam of the withdrawal mechanism or lines.
- h. KSC will ensure the ability of the umbilical swing arm to clear the stage drift envelope during liftoff.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Propellant coupling (ground half only, including shutoff valves)
- c. Pneumatic quick-disconnects

- d. Eject mechanism
- e. Electrical withdrawal switches
- f. Grounding system.

(For use with S-V stage only.) (Reference Part II CEI Specification CP 4B0315A.)

4.5 Umbilical Kit, Forward Launcher (DSV-4B-316) 1A57884-1

Function - The function of the Forward Launcher Umbilical Kit shall be to support the electrical cables and the GH_2 vent line to the stage. An umbilical carrier shall also provide attachment to the stage and shall be equipped with a grounding system, and an eject mechanism to provide electrical cable disconnect from the stage for test purposes.

Design - The design of the kit, as shown in Figure 4-4, will provide attachment for the electrical plugs and the GH_2 vent coupling. The coupling will be of the MSFC ball-and-cone type, with a poppet shutoff in the ground half, and will be locked to the stage by the carrier.

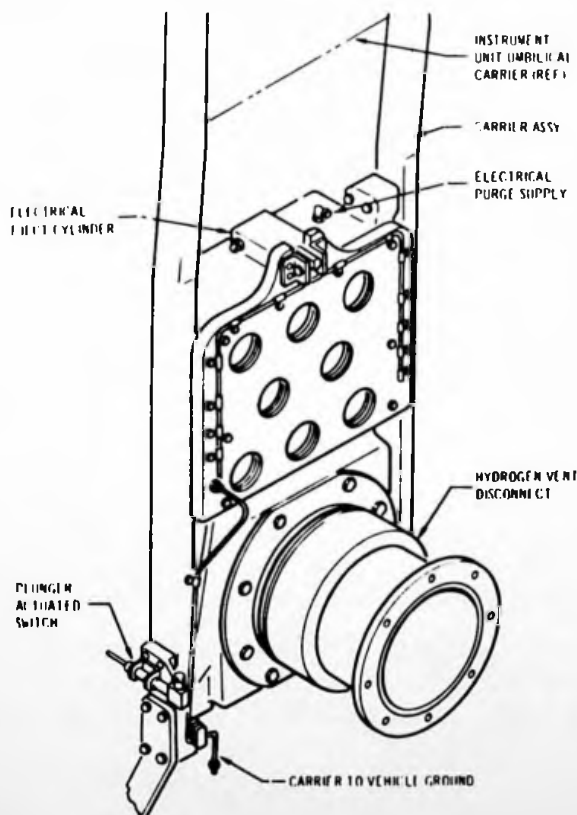


Figure 4-4. Umbilical Kit, Forward Launcher (DSV-4B-316)

The umbilical carrier assembly will be designed to maintain an inert atmosphere around the electrical receptacles.

The carrier will be attached to the lower end of the stage by two side supports. The supports will be attached at the upper end to the instrument unit carrier and in pivot points at the lower end on the stage. The lower carrier supports will be designed to completely disconnect from the stage within 11 degrees of carrier rotation.

An eject mechanism will be included in the design of the kit to disconnect the electrical cables from the stage for test purposes. The mechanism will be capable of pneumatic operation to disconnect the electrical plugs from their receptacles to simulate liftoff.

The grounding system will be designed to maintain stage electrical ground until after electrical umbilical disconnect.

DAC/KSC interfaces and areas of responsibility have been defined by MSFC and shall be as follows:

- a. Design interface between Douglas and KSC will be the ground side of the ground half of the disconnect couplings.
- b. The vent line from the swing arm to the umbilical connector will be the responsibility of KSC.
- c. Douglas will have the design and development responsibility for the ground half of the electrical and mechanical disconnects on the launcher umbilical tower at KSC.
- d. KSC will be responsible for designing, testing, and furnishing the air conditioning duct, pneumatic lines, and hydrogen vent lines on the swing arm.
- e. Douglas will supply the electrical connector to the stage skin grounding system.
- f. Design, development, and hardware responsibility for the forward umbilical withdrawal mechanism, will be the responsibility of KSC. Douglas will coordinate disconnect requirements with MSFC to facilitate withdrawal mechanism design.
- g. Pneumatic GN_2 actuation supply and controls for disconnecting the forward umbilical carrier, and GN_2 purge gas supply and control for the forward and aft umbilical carriers will be the responsibility of KSC.

- h. Douglas will ensure the ability of the umbilical to disconnect from the stage, but will not be required to supply the forward umbilical disconnect mechanism.
- i. KSC will ensure the ability of the umbilical swing arm to clear the stage drift envelope during liftoff.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. GH_2 vent coupling (ground half only, including poppet valves)
- c. Eject mechanism
- d. Grounding system.

(For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0316A.)

NOTE: For further information, see Change Orders, 49, 54, 76, 77, and 207.

4.6 Aft Umbilical Kit, Launch Complex 37B (DSV-4B-353) 1A57909-1

The function, design, and components of this model will be similar to Model DSV-4B-315 except the electrical switch will not be provided.

(See Figure 4-5.) (For use with the S-IB stage only.) (Reference Part II CEI Specification CP4B0353A.)

4.7 Forward Umbilical Kit, Launch Complex 37B (DSV-4B-354) 1A57911-1

The function, design, and components of this model will be similar to Model DSV-4B-316 except the electrical switch will not be provided.

(See Figure 4-6.) (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0354A.)

4.8 Aft Umbilical Kit, Launch Complex 34 (DSV-4B-355) 1A57913-1

The function, design, and components of this model will be similar to Model DSV-4B-315 except the electrical switch will not be provided.

(See Figure 4-5.) (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0355A.)

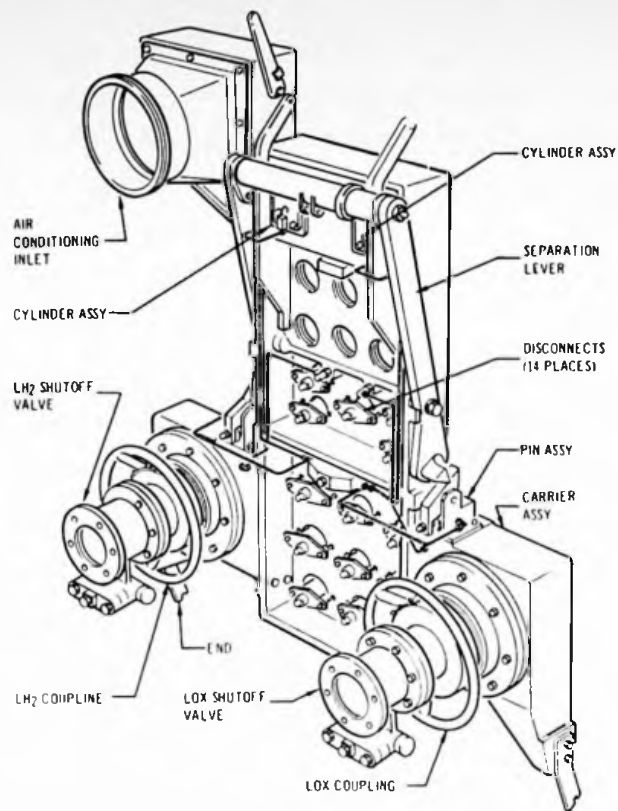


Figure 4-5. Aft Umbilical Kit, Launch Complex 37B (DSV-4B-353)

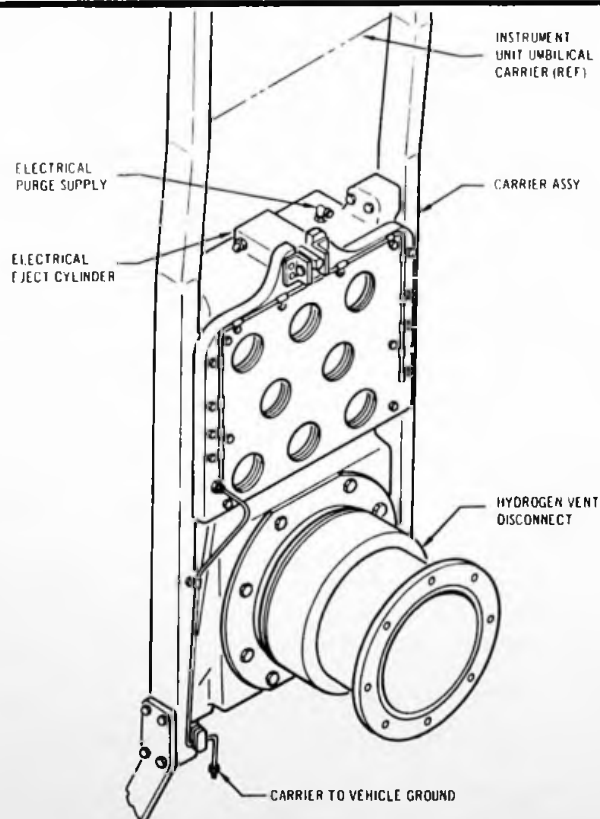


Figure 4-6. Forward Umbilical Kit, Launch Complex 37B (DSV-4B-354)

4.9 Forward Umbilical Kit, Launch Complex 34 (DSV-4B-356) 1A57915-1

The function, design, and components of this model will be similar to Model DSV-4B-316 except the electrical switch will not be provided. (See Figure 4-6.) (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0356A.)

4.10 Forward Interstage Vertical Access Kit, S-IB and S-V (DSV-4B-402) 1B40669-1

Function - The function of the S-IB and S-V Forward Interstage Vertical Access Kit shall be to provide access to the interior of the forward skirt, the instrumentation unit, and portions of the LEM when mated. The kit shall facilitate maintenance and checkout operations such as inspection and repair of electronic components, chill plates and wiring. The kit shall also provide a suitable tracking rail for the IBM Guidance package body.

Design - The design of the kit will consist of machined aluminum support arms, aluminum faced honeycomb access platforms, and guard rails and support posts of aluminum tubing. Steel fittings will be used in highly loaded applications, all components of the kit will be hypergolic compatible.

Components - The kit will consist of the following major components:
(See Figure 4-7.)

- a. Access platform modules
- b. Guard rails
- c. Support posts
- d. Access ladder.

(Reference Part II CEI Specification CP 4B0402A.)

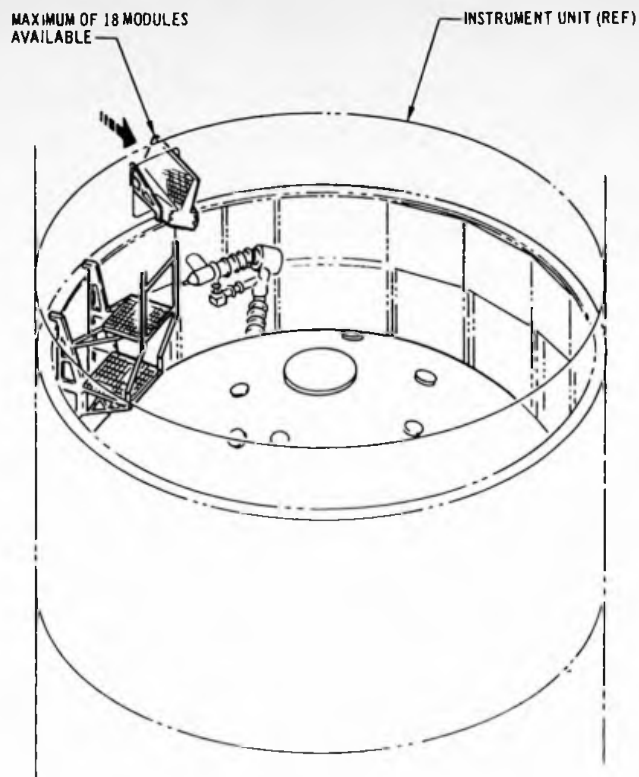


Figure 4-7. Forward Interstage Vertical Access Kit, S-IVB and S-V (DSV-4B-402)

4.11 Pneumatic Console, Model 432 (DSV-4B-432) 1B39430-1

Function - The function of the Model 432 Pneumatic Console shall be 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 at KSC Launch Complexes 34, 37, and 39.

Design - The console will be designed to regulate and control stage-peculiar pneumatic servicing functions and checkout requirements during prelaunch operations. An electrical system will be provided in the console to permit (1) remote control of the solenoid valves and (2) remote indications of valve positions and system pressure and temperature. In addition, the console will be designed to perform the following:

- a. Receive gaseous helium at 6,000 psig nominal, 6,600 psig maximum surge, and 3,500 psig minimum decay from a facility

storage source and regulate and control the distribution of the gas for the following:

1. Helium supply to the Cold Gas Generator (DSV-4B-438)
 2. LH₂ tank repressurization helium supply
 3. APS helium bottle supply
 4. High-pressure switch checkout
 5. Low-pressure switch checkout
 6. Engine high-pressure checkout
 7. LH₂ tank umbilical helium purge supply
 8. LH₂ tank fill nozzle helium purge supply
 9. Helium Supply to the Automatic Stage Servicing and Check-out pneumatic Console "B" (DSV-4B-433)
 10. LO₂ pressure actuation valve and mainstage OK pressure switch checkout
 11. LH₂ and LO₂ system checkout supply
 12. Engine low-pressure checkout
 13. LH₂ debris valve open and close.
- b. Receive GN₂ from Pneumatic Console "B" for console inerting purge.

NOTE: Pneumatic circuits will be designed to regulate and control stage peculiar pneumatic servicing and checkout functions contained in MSFC drawing 13M50098, Saturn V Vehicle Fluid Requirements, or MSFC drawing 13M20098 Saturn IB Vehicle Fluid Requirements.

The console helium supply inlet, gages, and transducers will have hand-operated isolation valves to facilitate on-site service and maintenance operation. All flow control valves and system vent valves will be solenoid-operated and will be remotely controlled by 28-vdc signals. Each solenoid valve will have two electrical position-indication switches (controlled by 28-vdc signals) to provide remote indications of the fully closed valve positions.

Access doors will be provided on the front and back of the console to afford maximum maintenance and operation accessibility. The console will be base-mounted and will have four lifting eyes for ease of handling.

Hand-Operated regulators will be used and will have the capability of being preset.

All critical pressure and temperatures within the console will be sensed by appropriate 0-to-5 vdc transducers and transmitted for remote display.

The console will have provisions for venting gaseous helium to the atmosphere through a common exhaust port.

Components - The console, as shown in Figure 4-8, will consist of an aluminum cabinet housing the following major components:

- a. Pressure gages
- b. Temperature and pressure transducers
- c. Solenoid-operated valves
- d. Hand-operated valves
- e. Check valves
- f. Filters
- g. Regulators
- h. Orifices

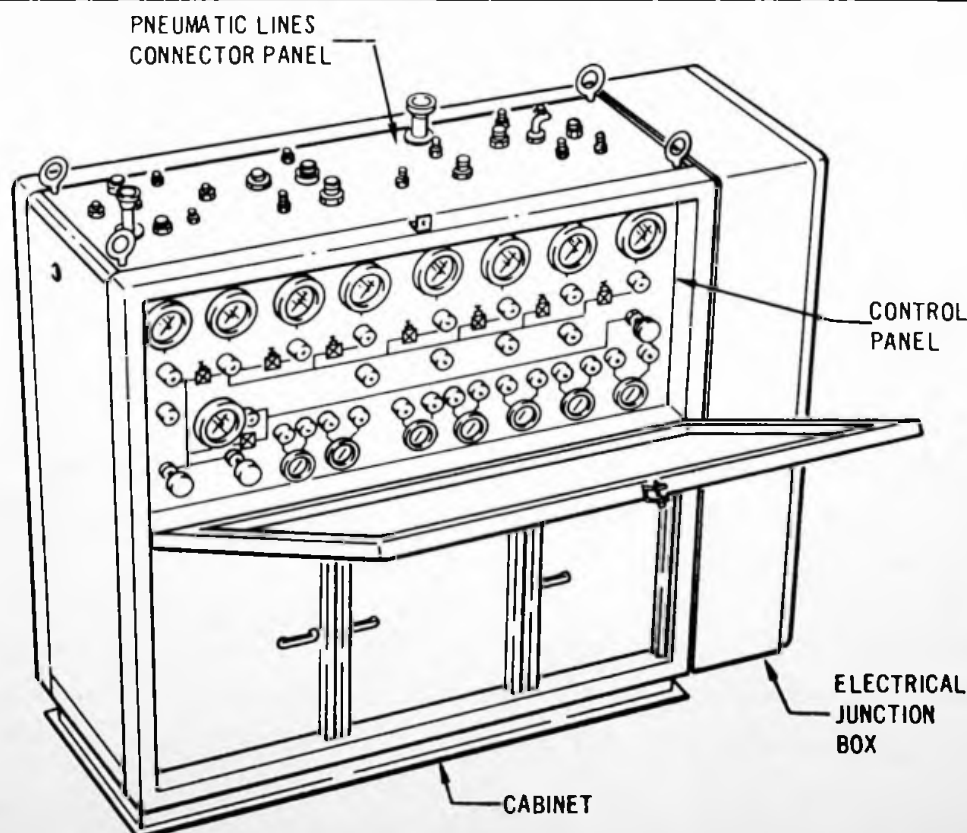


Figure 4-8. Pneumatic Console, Model 432 (DSV-4B-432)

- i. Interconnecting stainless steel pneumatic lines
- j. J-box
- k. Pneumatically controlled valves.

Dimensions - This console will be approximately 72 inches wide, (with J-Box 85-3/4 inches wide) 71-3/4 inches high, 35 inches deep and will weigh approximately 1,500 pounds. (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0432A.)

4.12 Pneumatic Console, Model 432A (DSV-4B-432A) 1B59969-1

Except for identification and minor configuration changes, the function and design will be similar to Model DSV-4B-432. This model will be used at LC 39 in conjunction with Models (DSV-4B-433A and DSV-4B-438A). (See Figure 4-8.) (For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0432AA.)

4.13 Pneumatic Console "B", S-IVB Model 433 (DSV-4B-433) 1B39433-1

Function - The function of the S-IVB Model 433 Pneumatic Console "B" shall be to receive ambient GN_2 , ambient and cold gaseous helium, 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 at KSC Launch Complexes 34, 37, and 39.

Design - The console will be designed to regulate and control stage-peculiar pneumatic servicing functions and checkout requirements during prelaunch operations. An electrical system will be provided in the console to permit (1) remote control of the solenoid valves and (2) remote indications of valve positions and system pressure and temperature. In addition, the console will be designed to perform the following:

- a. Ambient GN_2 - The console will be capable of receiving GN_2 at 6,000 psig nominal, 6,600 psig maximum surge, and 3,500 minimum decay from a facility storage source, and will regulate and control the distribution of the gas for the following:
 - 1. Pneumatic console "A" inerting purge supply
 - 2. Crossover GN_2 supply to Pneumatic Console "A"

3. Aft and forward electrical umbilical ejector supply
 4. LO_2 tank and umbilical purge supply
 5. Pneumatic valve control pressure to the Cold Gas Heat Exchanger
 6. LO_2 debris valve open and close
 7. Console pneumatic valve actuation
 8. Console inerting purge.
- b. Ambient gaseous helium - The console will be capable of receiving ambient gaseous helium for thrust chamber jacket purge.
- c. Cold helium - The console will be capable of receiving cold helium from the Gas Heat Exchanger and will provide this gas for the following:
1. Thrust chamber jacket purge and chilldown supply
 2. Engine control bottle pressure supply
 3. LO_2 tank pressurization bottle supply.

NOTE: Pneumatic circuits will be designed to regulate and control stagepeculiar pneumatic servicing and checkout functions contained in MSFC drawing 13M50098 Saturn V Vehicle Fluid Requirements, or MSFC drawing 1-M20098 Saturn IB Vehicle Fluid Requirements.

The console ambient GN_2 system inlet, gage, and transducer will have a hand-operated isolation valve (as required) to facilitate on-site service and maintenance operations. All flow control valves and system vent valves will be solenoid-operated and will be remotely controlled by 28-vdc signals. Each remotely controlled solenoid valve will have two electrical position-indication switches to provide remote indications of the fully open or fully closed valve positions.

Access door will be provided on the front and back of the console to afford maximum maintenance and operation accessibility. The console will be base-mounted and will have four lifting eyes for ease of handling.

Pressures for valve actuation and functional pneumatic circuits will be controlled by hand-operated and dome regulators. The regulators will be preset using the access doors.

All critical pressures and temperatures within the console will be sensed by appropriate 0-to-5 vdc transducers and transmitted for remote display.

The console will have provisions for venting helium and nitrogen gases through common exhaust ports.

Components - The console, as shown in Figure 4-9, will consist of an aluminum cabinet housing the following major components:

- a. Pressure gages
- b. Pressure and temperature transducers
- c. Solenoid-operated valves
- d. Pneumatically operated valves
- e. Hand-operated valves
- f. Check valves
- g. Filters

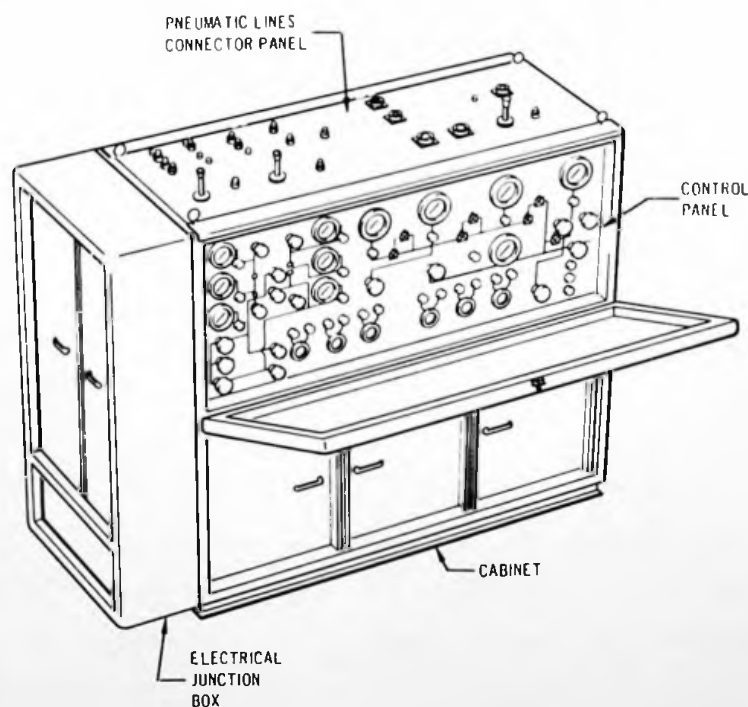


Figure 4-9. Pneumatic Console "B" S-IVB Model 433 (DSV-4B-433)

- h. Regulators
- i. Orifices
- j. Interconnecting stainless steel lines
- k. J-box.

Dimensions - The console will be approximately 72 inches wide (with J-Box, 85-3/4 inches) 71-3/4 inches high, and 35 inches deep. It will weigh approximately 1,500 pounds. (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0433A.)

4.14 Pneumatic Console, Model 433A (DSV-4B-433A) 1B59522-1

Except for identification and minor configuration changes, the function and design will be similar to Model DSV-4B-433. This model will be used at LC 39 in conjunction with Models (DSV-4B-432A and DSV-4B-438A). (See Figure 4-9.) (For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0433AA.)

4.15 S-IVB Pneumatic Console, Model 436 (DSV-4B-436) 1B41197-1

Function - The function of the Model 436 S-IVB Pneumatic Console shall be to receive ambient temperature gaseous nitrogen and helium from facility sources, and regulate and distribute these gases to the APS modules during standby, prelaunch, launch, and post launch operations. The gases shall be utilized for ullage pressurization and vent, facility lines purge, low-pressure switch checkout, high-pressure switch checkout, propellant systems leak check, and simulation of propellant loading.

Design - The facility gaseous nitrogen will be regulated in three stages to a pressure suitable for purging the facility propellant lines after propellant loading or draining operations, and to simulate propellant loading. The facility helium will be regulated in six stages to pressures suitable for propellant bellows ullage pressurization and vent, for propellant system leak check, and for high-pressure and low-pressure switch checkouts. Uncontaminated gaseous nitrogen and uncontaminated

gaseous helium will be vented through separate vent ports. Gaseous nitrogen used to purge the fuel or oxidizer facility lines will be vented through separate fuel or oxidizer vent ports to their respective fuel and oxidizer vent stacks. All regulators in the console will be designed for preset of manual regulation. All valves which require remote operation will be solenoid operated, and will assume a safe position in the event of an electrical failure. In addition, the console will be designed to perform the following:

- a. Receive gaseous helium at 6,000 psig nominal, 6,600 psig maximum surge, and 3,500 minimum decay from a facility storage source and regulate and control the distribution of the gas for the following:
 1. High pressure switch checkout for Module 1
 2. High pressure switch checkout for Module 2
 3. Low pressure switch checkout for Module 1
 4. Low pressure switch checkout for Module 2
 5. Oxidizer ullage pressurization for Module 1
 6. Oxidizer ullage pressurization for Module 2
 7. Fuel ullage pressurization for Module 1
 8. Fuel ullage pressurization for Module 2
 9. Crossover to GN_2 purge system.
- b. Receive gaseous nitrogen from a facility storage source and regulate and control the distribution of the gas for the following:
 1. Fuel facility lines purge for Module 1
 2. Fuel facility lines purge for Module 2
 3. Oxidizer facility lines purge for Module 1
 4. Oxidizer facility lines purge for Module 2.
- c. Receive gaseous nitrogen from a facility storage source for console inerting purge.

NOTE: Pneumatic circuits will be designed to regulate and control stage peculiar pneumatic servicing and checkout functions contained in MSFC drawing 13M50098, Saturn V Vehicle Fluid Requirements, or MSFC drawing 13M20098 Saturn IB Vehicle Fluid Requirements.

Components - The console (Figure 4-10) will consist of a base-mounted cabinet with four lifting eyes, a control and monitor front panel, access doors, and an electrical J-box. The cabinet will house the following components:

- a. Hand valves
- b. Calibration valves
- c. Solenoid valves with position indicators
- d. Relief valves
- e. Check valves
- f. Hand regulators
- g. Pressure transducers
- h. Pressure switches
- i. Desiccants
- j. Filters
- k. Pressure gages with snubbers
- l. Differential pressure gages

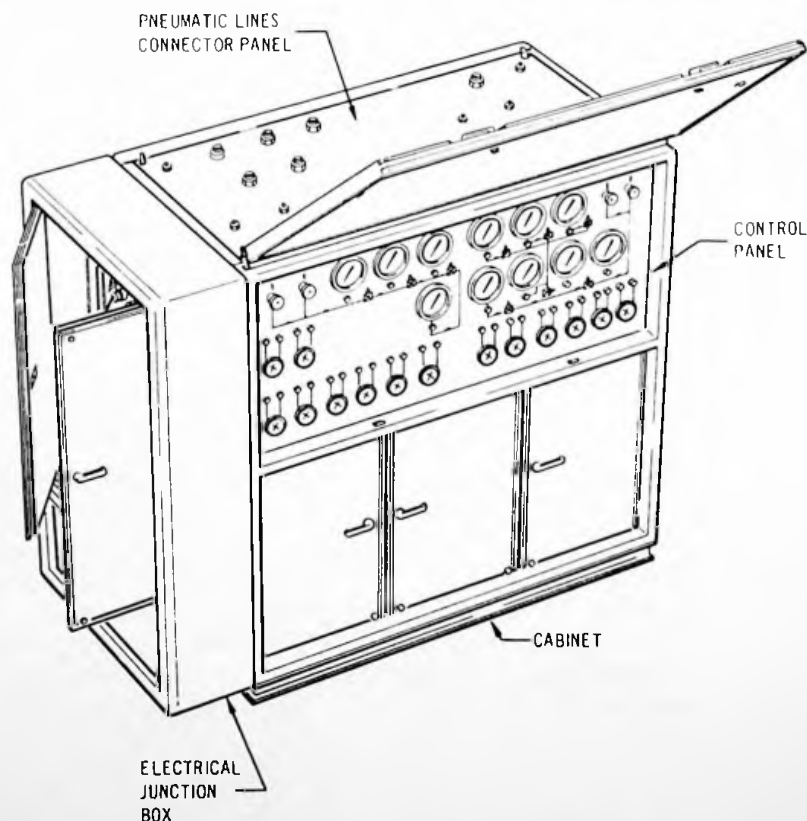


Figure 4-10. S-IVB Pneumatic Console, Model 436 (DSV-4B-436)

- m. Plenum chambers
- n. Orifices
- o. Vent port and bleed plate.

Dimensions - The console will be 85-25/32 inches wide, 35 inches deep, 72 inches high overall, and will weigh approximately 1,500 pounds. A minimum of 3 inches will be maintained between the external bottom surface of the console and the mounting surface. (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0436A.)

4.16 Pneumatic Console, Model 436A (DSV-4B-436A) 1B59550-1

Except for identification and minor configuration changes, the function and design will be similar to Model DSV-4B-436. (See Figure 4-10.) (For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0436AA.)

4.17 Gas Heat Exchanger, S-IVB Model 438 (DSV-4B-438) 1B40689-1

Function - The function of the S-IVB Model 438 Gas Heat Exchanger shall be to perform the following:

- a. Receive ambient gaseous hydrogen at 6,000 psig nominal, 6,600 psig maximum surge, and 2,100 psig minimum decay and regulates for turbine start bottle supply
- b. Provide cold hydrogen gas for engine turbine start bottle pressurization.
- c. Receive ambient helium from Launcher Pneumatic Console "A"
- d. Provide cold helium to Pneumatic Console "B" for the following:
 - 1. Thrust chamber jacket chilldown
 - 2. Engine control bottle pressurization
 - 3. LO₂ tank prepressurization
 - 4. LO₂ tank helium bottles pressurization.

- e. Provides cold helium for fuel tank prepressurization
- f. Receives ambient helium from Pneumatic Console "A".

NOTE: Pneumatic circuits will be designed to regulate and control stage peculiar pneumatic servicing and checkout functions contained in MSFC drawing 13M50098 Saturn V Vehicle Fluid Requirements, or MSFC drawing 13M20098 Saturn IB Vehicle Fluid Requirements.

Design - The gas heat exchanger, as shown in Figure 4-11, will consist of a high-pressure system (heat exchanger), and a gaseous hydrogen control panel assembly. The heat exchanger will use LH_2 as the cooling medium, and will contain multiple circuits to supply cold helium or hydrogen at the required temperatures and pressures for launch operations. The control panel assembly will contain the necessary valves, filters, regulators, indicators, and necessary piping for internal and external connections. The components will be mounted on racks and are designed to distribute gaseous hydrogen and helium to the heat exchanger and the stage during servicing operations.

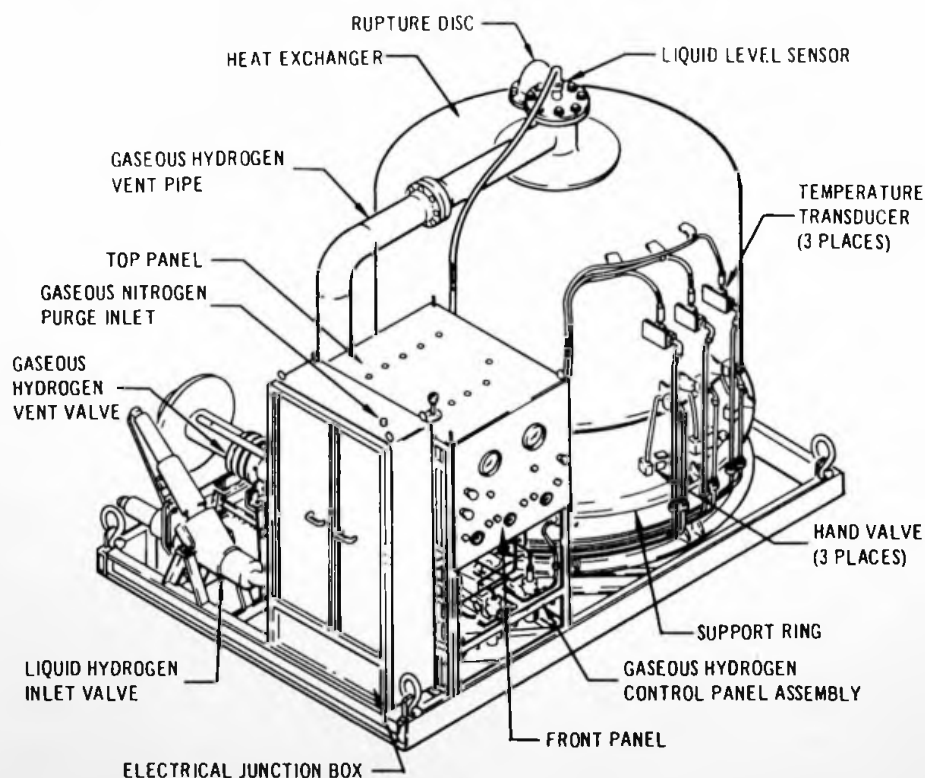


Figure 4-11. Gas Heat Exchanger, S-IVB Model 438 (DSV-4B-438)

The heat exchanger and control panel assembly including the associated cryogenic components will be mounted on a common base structure.

The LH_2 for the high pressure system will be supplied through vacuum jacketed piping. A GH_2 vent and high-pressure connections for helium and hydrogen circuits will also be included. Temperature and valve-position indications from the Gas Heat Exchanger (Model DSV-4B-438) will be monitored at the control area through a remote monitoring system.

An electrical system will also be included and will be mounted adjacent to the control panel assembly. The system will (1) permit remote control of the solenoid-operated valves and (2) provide remote indications of valve positions, pressures, and temperatures.

Components - The gas heat exchanger will consist of the following major components:

- a. Heat exchanger
- b. Inlet and outlet lines
- c. Temperature transducer
- d. Flange connections
- e. Vacuum gage
- f. Mounting attachments
- g. Rupture disk
- h. Level sensing units
- i. Level sensing units
- j. Two J-boxes (one analog, one bilevel).
- k. Gaseous hydrogen control panel assembly
- l. Miscellaneous piping and tubing.
- m. Vacuum probes (compatible with KSC - supplies vacuum readout devices manufactured by General Electric).

Dimensions - The heat exchanger will be approximately 32 inches wide, 102 inches high, and 90 inches deep. (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B0438A.)

4.18 Gas Heat Exchanger, Model 438A (DSV-4B-438A) 1B59993-1

Except for identification and minor configuration changes, the function and design will be similar to Model DSV-4B-438. This model will be used at LC 39 in conjunction with Models (DSV-4B-432A and DSV-4B-433A). (See Figure 4-11.) (For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0438AA.)

4.19 Dome Protective Cover Kit, Model 469 Forward (DSV-4B-469) 1B53104

Function - The function of the Model 469 Forward Dome Protective Cover Kit shall be to provide protection for the forward liquid hydrogen tank dome while maintenance and inspection procedures are being performed in the forward skirt area. The kit shall provide access to the forward bulkhead area, without pressure in the LH₂ tank, and will support a maximum of 2 men. The kit shall be used in conjunction with the Model DSV-4B-402 Forward Interstage Vertical Access Kit, S-IB and S-IVB. (See Figure 4-12.)

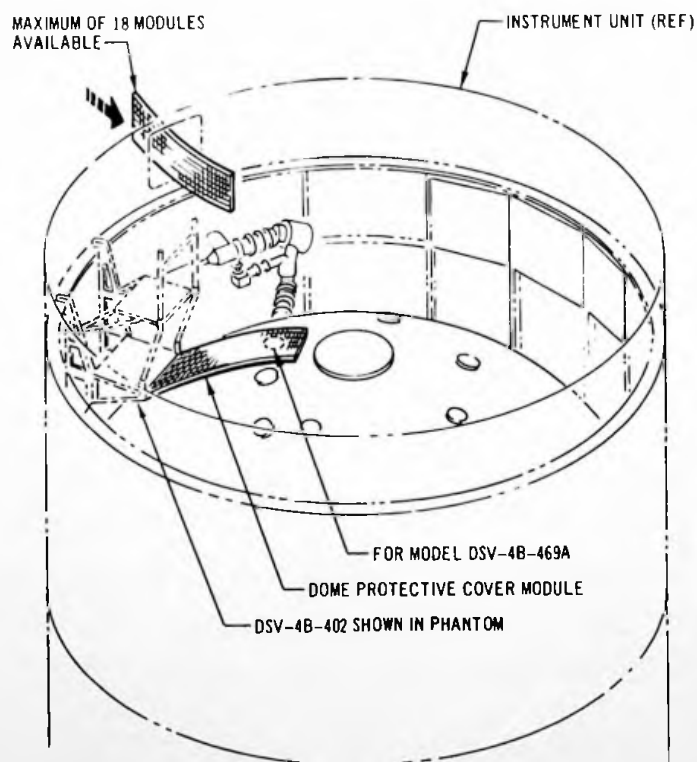


Figure 4-12. Dome Protective Cover Kit, Model 469 Forward (DSV-4B-469)

Design - The design of the kit will consist of a maximum of 18 segments. These segments will interface with Model DSV-4B-402 and will rest directly on the LH₂ tank dome. A mechanical interlock between segments will be provided. A pliable flap between segments will prevent small objects from falling between segments.

Components - The kit will consist of the following components:

- a. Dome Protective Cover Segments
- b. Pliable flaps (Debris shields).

(Reference Part II CEI Specification CP 4B0469A.)

4.20 Dome Protective Cover Kit, Model 469A Forward (DSV-4B-469A)
1B58788-1

Function - The function of the Dome Protective Cover Kit shall be to provide protection for the forward liquid hydrogen tank dome while maintenance and inspection procedures are being performed in the forward skirt area. The kit shall provide access to the forward bulkhead area, without pressure in the LH₂ tank, and will support a maximum of 2 men. Provisions shall be made to protect the dome for the LH₂ orbital experiment and to allow the installation of a protective center section to protect the quick-opening hatch. The kit shall be used in conjunction with the Model DSV-4B-402 Forward Interstage Vertical Access Kit, S-IB and S-IVB. (See Figure 4-12.)

Design - The design of the kit, will consist of a maximum of 18 segments. These segments will interface with Model DSV-4B-402 and will rest directly on the LH₂ tank dome. A mechanical interlock between segments will be provided. A pliable flap between segments will prevent small objects from falling between the segments to protect the dome for the LH₂ orbital experiment. A center protective cover shall be installed to protect the raised center section of the dome which contains the quick-opening hatch.

Components - The kit will consist of the following components:

- a. Dome Protective Cover Segments
- b. Pliable flaps (Debris shields).

(Reference Part II CEI Specification CP 4B0469AA.)

4.21 APS-LC-39 Fuel Control Assembly (DSV-4B-472) 1B64108-1

Function - The function of the APS-LC-39 Fuel Control Assembly shall be to provide the capability for manual (local) control of the transfer and recirculation of the fuel (MMH) to both APS models. It shall also provide control of the fuel bladder ullage in each APS module. This model shall be used concurrently with the APS Oxidizer Control Assembly, LC 39 (DSV-4B-473).

Design - The kit, as shown in Figure 4-13, will be portable and mounted on coasters. It will consist of the necessary valves, gages, filters, ullage metering device, associated tubing and fittings, and external connections to accomplish the propellant loading functions. The kit will be designed to operate in the VAB or the Mobile Service Structure (MSS) on LC 39.

The kit will be capable of the following:

- a. Route fuel to, and recirculate fuel from, each APS module to permit one-at-a-time module loading.
- b. Remove propellant from the APS fuel bladder to provide sufficient ullage for bladder pressurization, or remove excess propellant not required.
- c. Provide indications when propellant is flowing to an APS module and when an APS module fuel bladder is 100 percent full. These indications will be by sight glasses.
- d. Maintain a backpressure on the APS module recirculation port.
- e. Provide indications of inlet or outlet pressure and temperature in the transfer and recirculation lines.

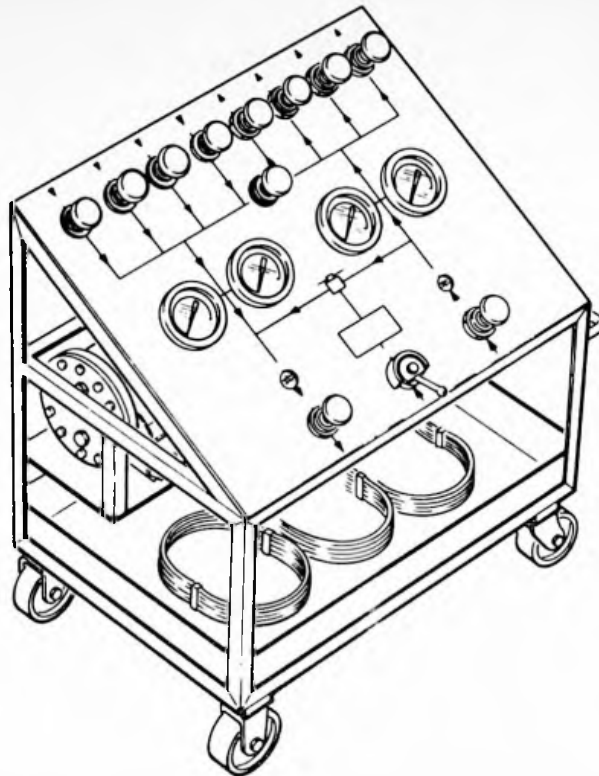


Figure 4-13. APS-LC-39 Fuel Control Assembly (DSV-4B-472)

- f. Direct flow of flushing solution to the outside of the APS module fuel bladder, and back to the servicer. (A sight glass will be attached to the fuel flush port to indicate if the bladder has ruptured.)

Components - The kit will consist of the following components:

- a. Fuel Control Panel.
- b. Flexible hoses (10) for connection between the facility propellant and control gas interfaces, the fuel control panel, and/or the APS modules.
- c. Ullage control assembly.
- d. Carrying case (hoses).

(For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0472A.)

4.22 APS-LC-39 Oxidizer Control Assembly (DSV-4B-473) 1B64107

This model is similar to DSV-4B-472 except that the propellant media shall be oxidizer (N_2O_4) instead of fuel (MMH). This model will be used concurrently with DSV-4B-472. (See Figure 4-13.) (For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B0473A.)

4.23 Hose Reel Cart (DSV-4B-477) 1B44001-1

Function - The function of the Hose Reel Cart shall be to store the hydraulic pressure and return hoses. These hoses shall be used in conjunction with the Hydraulic Pumping Unit (DSV-4B-479), in servicing the S-IVB/V, S-IVB/IB, and S-II stages.

Design - The hose cart will be designed with a storage reel for each hose; a hand crank for winding the hoses individually on the reels will be provided. The cart will be mounted on semi-pneumatic wheels and have eye bolts for hoisting. (See Figure 4-14.)

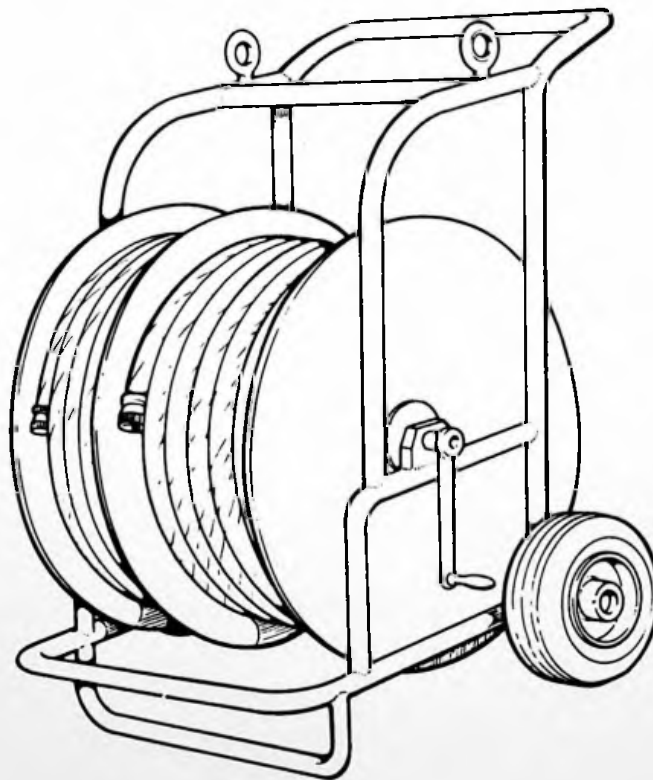


Figure 4-14. Hose Reel Cart (DSV-4B-477)

Components - The hose cart assembly will consist of the following components:

- a. High-pressure hydraulic hose
- b. Return-pressure hydraulic hose
- c. Quick-disconnects
- d. Cart frame, reels, etc.

Dimensions - The hose cart will be approximately 45 inches high, 28 inches long, 38 inches deep, and will weigh approximately 175 pounds. (Reference Part II CEI Specification CP 4B0477A.)

4.24 Power Cable Reel Cart (DSV-4B-478) 1B44002-1

Function - The function of the Power Cable Reel Cart shall be to store the water hoses and electrical power cable. These hoses shall be used in conjunction with the Hydraulic Pumping Unit (DSV-4B-479), in servicing the S-IVB/V, S-IVB/IB, and S-II stages.

Design - The cart will be designed with a storage reel for each water hose and power cable. A hand crank for winding the hoses individually on the reels will be provided. The card will be mounted on semi-pneumatic wheels and have eye bolts for hoisting. (See Figure 4-15.)

Components - The reel cart will consist of the following components:

- a. Water supply hose
- b. Water return hose
- c. Electrical power cable
- d. Quick-disconnects
- e. Cart frame, reels, etc.

Dimensions - The cart will be approximately 45 inches high, 28 inches long, 38 inches deep, and will weigh approximately 175 pounds. (Reference Part II CEI Specification CP 4B0478A.)

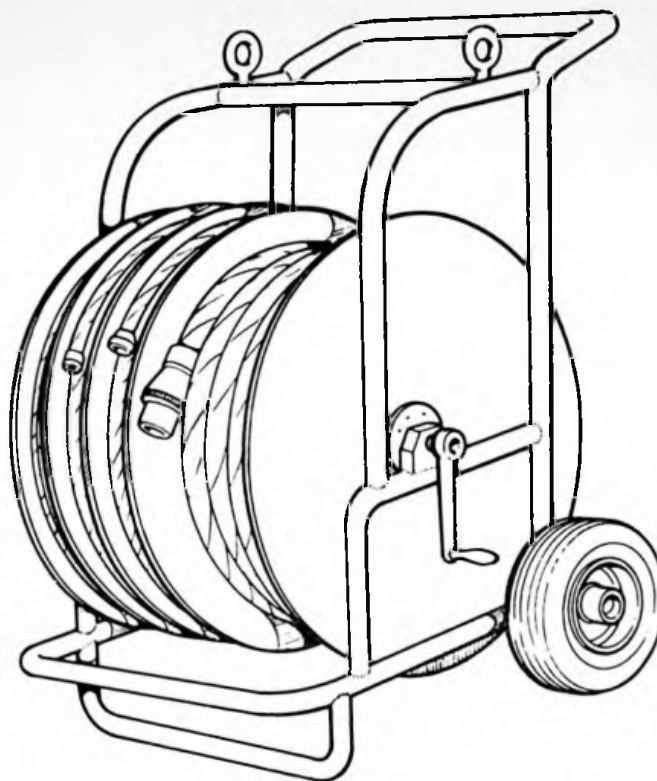


Figure 4-15. Power Cable Reel Cart (DSV-4B-478)

4.25 Hydraulic Pumping Unit (DSV-4B-479) 1B43998-1

Function - The function of the Hydraulic Pumping Unit shall be to supply hydraulic fluid to the S-IVB/V, S-IVB/IB, and S-II stage engine hydraulic system for filling, flushing, cleaning, leak checking, air purging, and functional checking of various subsystem components. The Hydraulic Pumping Unit shall be used in conjunction with Hose Reel Cart (DSV-4B-477), and Power Cable Reel Cart (DSV-4B-478).

Design - The pumping unit will be designed to supply hydraulic fluid at 3750 psig at approximately 7.0 gpm and 3750 to 4500 psig at reduced flows to the flight control hydraulic system. The unit will be mounted on casters and will be capable of being lifted by its eye bolts. The unit

will also have fork-lift capability. The unit will consist of the following major subsystems: (See Figure 4-16.)

- a. Reservoir pressurization subsystem: The reservoir will be pressurized with filtered gaseous nitrogen from a nitrogen storage bottle through a pressure regulator, check valve, and a filter. A relief valve will prevent overpressurization of the reservoir. Gages will monitor reservoir and bottle pressures.
- b. Recirculation and filtration subsystem: An electrically driven, fixed-displacement, gear type pump (rated at 1.4 gpm at 175 psi) will circulate oil from the reservoir sump through a 3-micron absolute, depth type filter and back to the reservoir.
- c. Hydraulic oil (pressure and return) subsystem: A variable-displacement pump, electrically driven and pressure compensated, rated at 7.0 gpm at 3750 psi, will supply hydraulic fluid to the stage hydraulic system through a 3-micron absolute, depth type filter. Supply pressures will be monitored by high and low pressure gages. Return fluid will be filtered through a 10-micron absolute filter and pass through a heat exchanger into the reservoir. System

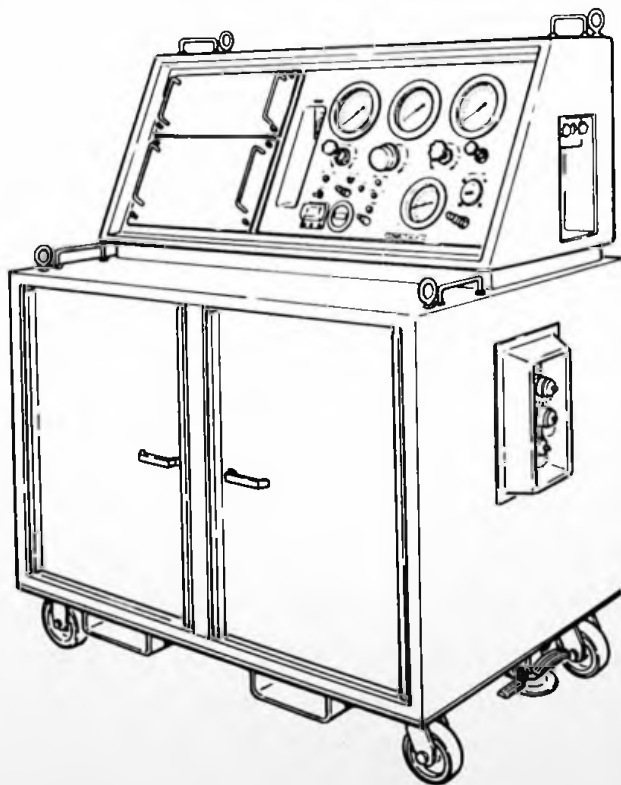


Figure 4-16. Hydraulic Pumping Unit (DSV-4B-479)

temperature will be monitored by a temperature gage and limited by a thermal cutoff switch. A return bypass system with a flowmeter will be provided to measure leakage rates.

- d. Adapters shall be provided as required to accommodate variations between S-IVB/V, S-IVB, and S-II stages.

Components - The pumping unit will consist of the following components:

- a. Variable-displacement pump
- b. Fixed-displacement pump
- c. High-pressure oil relief valve
- d. Oil reservoir (17-gallon nominal capacity)
- e. Flowmeter
- f. Oil and gas filters
- g. Check valves
- h. Relief Valves (15 psig)
- i. Nitrogen bottle (1,500 psig)
- j. Back pressure regulator
- k. Gage savers
- l. Quick-disconnects
- m. Shutoff valves
- n. Miscellaneous electrical components.

Dimensions - The pumping unit will have the following approximate dimensions: height, 75 inches; depth, 35 inches; length, 57 inches; and will weigh approximately 1,600 pounds. (Reference Part II CEI Specification CP 4B0479A.)

4.26 APS-LC-34 Propellant Interconnect Kit (DSV-4B-1853) 1A90310-1

Function - The function of the APS-LC-34 Propellant Interconnect Kit, shall be to provide a means of interconnecting the facility hypergolic propellant interfaces to the APS modules installed on the stage. The kit shall be used on the service tower of LC 34 for propellant loading operations of the APS modules on the stage.

Design - The kit, Figure 4-17, will contain two portable valve panels and the necessary hoses, hardlines, and fittings for installation in the oxidizer (N_2O_4) and fuel (MMH) lines. Operation of the valve panels will control the flow of hypergolic propellants through the fill and recirculating lines, and direct the flow of propellants to the APS undergoing propellant loading. One panel will be used for loading oxidizer and one panel will be used for loading fuel.

Components - The kit will consist of the following components:

- a. Valve panel (2)
 - 1. Hand valves
 - 2. Sight glasses
 - 3. Pressure gages
 - 4. Temperature gages.
- b. Hoses
- c. Hardlines

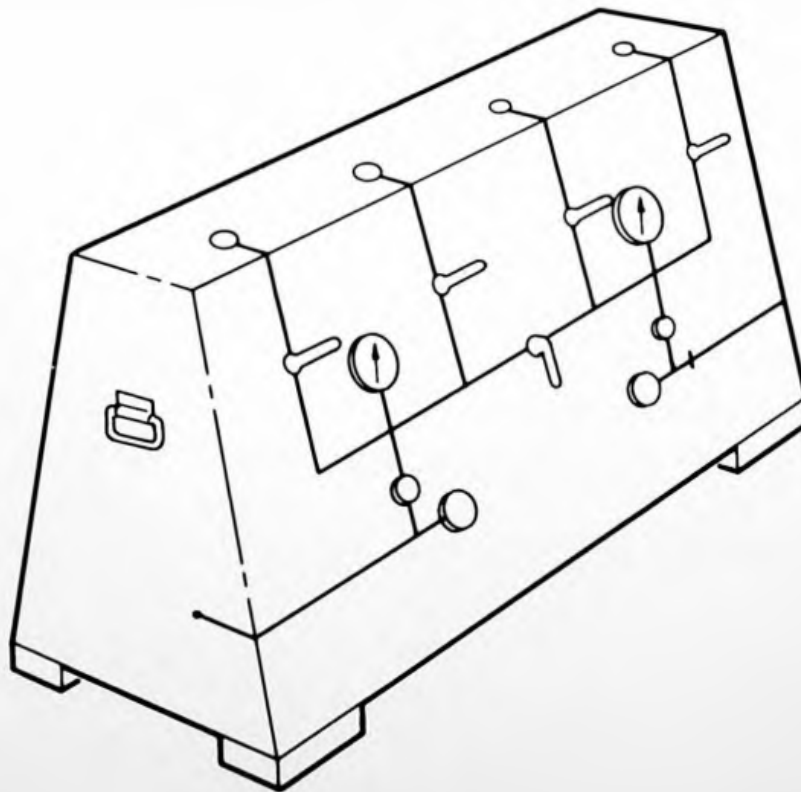


Figure 4-17. APS LC-39 Propellant Interconnect Kit (DSV-4B-1853)

- d. Fittings
- e. Filters.

(For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B1853A.)

4.27 APS-LC-37 Propellant Interconnect Kit, (DSV-4B-1854) 1B61644-1

Except for identification, the function and design of this model is similar to DSV-4B-1853 and will be used on Launch Complex 37. (See Figure 4-17.) (For use with the S-IB stage only.) (Reference Part II CEI Specification CP 4B1854A.)

4.28 Support Kit, Air Carry-VPG (DSV-4B-1859) 1B61059-1

Function - The function of the Air Carry Support Kit-VPG shall be to provide a means for transferring the S-IVB stage from the transporter (Model DSV-4B-300) to the Cargo Lift Trailer (CLT) (GFE), and from the CLT to the Super Guppy. It shall also be used to support the S-IVB/IB Aft Interstage on the CLT when being transported and during air carry by Super Guppy.

Design - The kit, as shown in Figure 4-18, will be designed to permit the transfer of the stage from the transporter to the CLT and from the CLT into the Super Guppy Aircraft with use of hoisting equipment. It will be designed so that the forward cradle can be repositioned to accommodate and support the S-IVB/IB Aft Interstage on the CLT during land transportation and air carry by Super Guppy. The design will include a pallet that will be compatible with the transporter, CLT and the Super Guppy.

Components - The kit will consist of the following components:

- a. Pallet
- b. Cradles
- c. Support fittings.

(Reference Part II CEI Specification CP 4B1859A.)

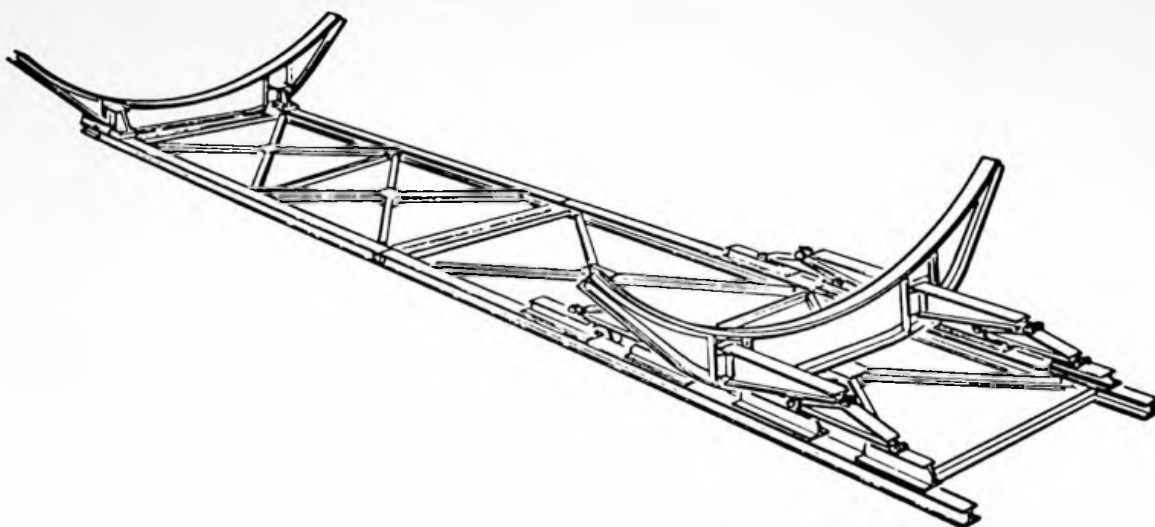


Figure 4-18. Support Kit, Air Carry-VPG (DSV-4B-1859)

4.29 Tie Down Kit, Air Carry-VPG (DSV-4B-1861) 1B61061

Function - The function of the Air Carry Tie Down Kit-VPG shall be to restrain the S-IVB stage when installed in the Super Guppy Aircraft.

Design - The kit, as shown in Figure 4-19, will provide cables and attaching fittings to tie down the stage in the Super Guppy. The kit will prevent forward and aft movement of the stage during flight.

Components - The kit will consist of the following components:

- a. Cables
- b. Attaching fittings.

(Reference Part II CEI Specification CP 4B1861A.)

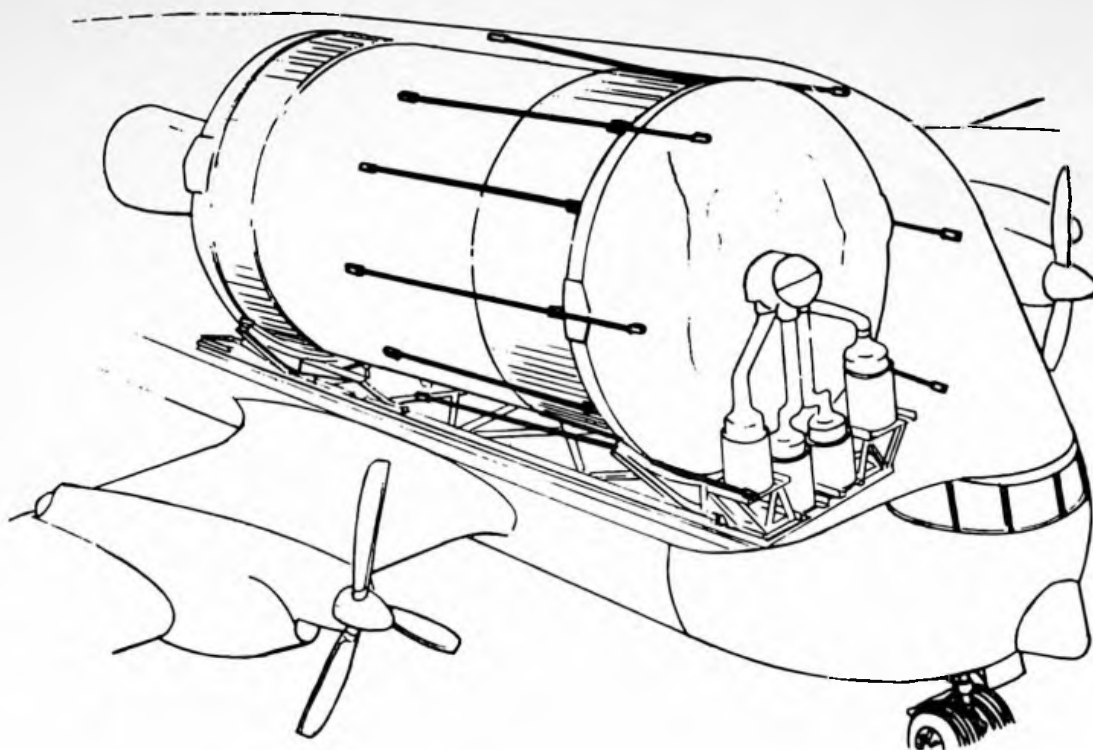


Figure 4-19. Tie Down Kit, Air Carry-VPG (DSV-4B-1861)

4.30 Environmental Kit, Air Carry-VPG (DSV-4B-1862) 1B61062

Function - The function of the Air Carry Environmental Kit-VPG Air Carry shall be to maintain the stage fuel and LOX tanks and the propulsion sub-systems in a clean, dry condition during transportation in the Super Guppy. The kit shall permit free breathing of stage components during changes in ambient pressure and temperature.

Design - The kit, as shown in Figure 4-20, will include a free breathing system that permits the stage fuel and LOX tanks and certain propulsion systems to free-breathe during ascent and descent of the Super Guppy. The pressure differential across the tank walls and domes will not exceed 0.2 psid for the LH_2 tank and 0.63 psid for the LOX tank. If this pressure differential is exceeded, a relief valve will automatically open at a differential of 5.5 +0 -1 inches water gage for the fuel tank and 17.4 +0 -2 inches water gage for the LOX tank. The breather tanks will

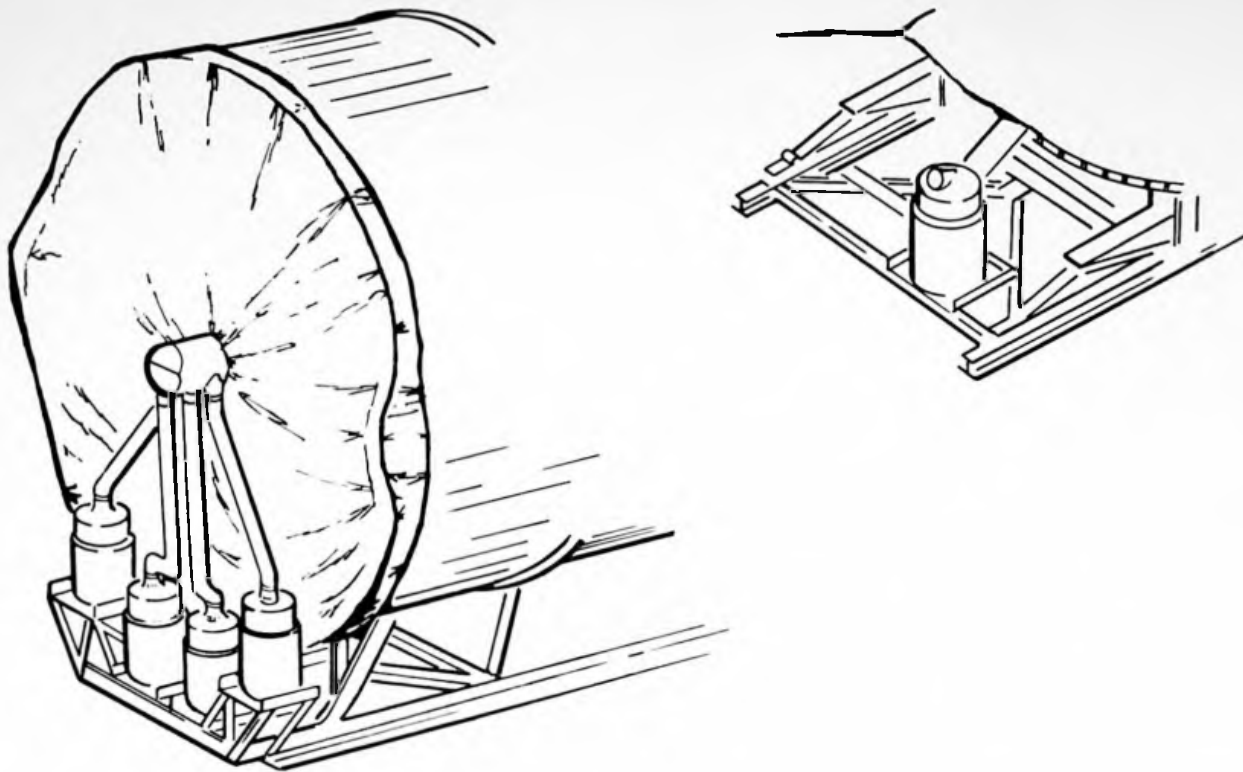


Figure 4-20. Environmental Kit, Air Carry-VPG (DSV-4B-1862)

be charged with moisture absorbent material (alumino-silicates). After stage purging, all vents will be closed with caps containing a desiccant. The kit will include lightweight plastic-coated nylon covers to enclose the forward skirt, aft skirt, and the engine. The covers will be held in place at the handling rings by means of a draw string and hook system. Final closure will be by zippers. The covers will protect the components in the skirt areas and the engine from dust and rain.

Components - The kit will consist of the following components:

- a. Breather assemblies
- b. Forward & Aft covers
- c. Vent caps
- d. Ducts
- e. Tubing

(Reference Part II CEI Specification CP 4B1862A.)

4.31 APS Fuel Pressure Instrumentation Kit - KSC (DSV-4B-1874)
1B65022-1

Function - The function of the APS Fuel Pressure Instrumentation Kit - KSC, shall be to control and monitor the differential pressure across the fuel (MMH) tank bladder during checkout, purge, and prior to loading. It shall sample the ullage and propellant tank gases before loading.

Design - The kit, Figure 4-21, will be portable and will consist of the necessary hand valves, gages, associated tubing and fittings, interface connections, and flexible hoses.

Components - The kit will consist of the following components:

- a. Instrumentation panel
- b. Flexible hoses (10)
For connections between the facility gas interfaces, instrumentation panel, and/or the APS modules.
- c. Carrying case (hoses).

(For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B1874A.)

4.32 APS Oxidizer Pressure Instrumentation Kit - KSC (DSV-4B-1875)
1B65023-1

This model is similar to Model DSV-4B-1874, except that the propellant media shall be oxidizer (N_2O_4) instead of fuel (MMH). (See Figure 4-22.) (For use with the S-V stage only.) (Reference Part II CEI Specification CP 4B1875A.)

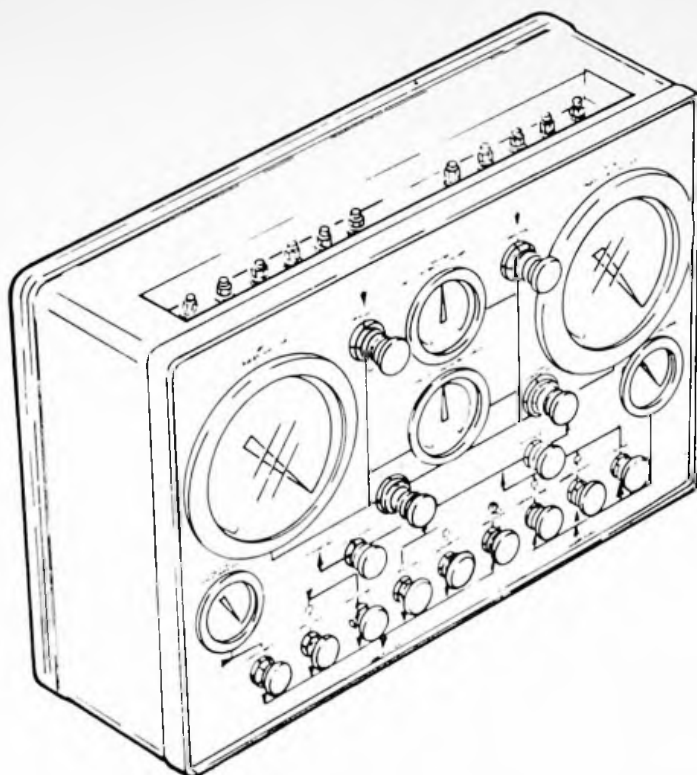


Figure 4-21. APS Fuel Pressure Instrumentation Kit – KSC (DSV-4B-1874)

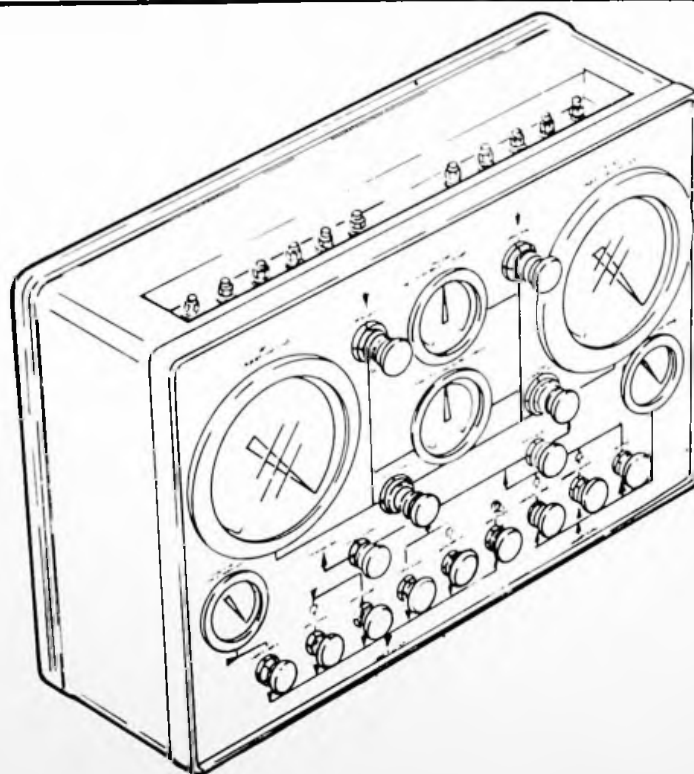


Figure 4-22. APS Oxidizer Pressure Instrumentation Kit – (DSV-4B-1875)

5. ELECTRICAL AND ELECTRONIC SUPPORT EQUIPMENT

5.1 General

This section provides descriptions of electrical and electronic support equipment designed and developed for the S-IVB Program.

5.1.1 System Design Considerations

The function of the stage automatic checkout system shall be to provide complete checkout of the stage and to control and monitor the GSE and the stage during static firing at STC. The system shall be capable of (1) exercising each stage subsystem to the extent required to accurately determine acceptable performance and (2) recording and documentation test performances and results. The system shall have the capability of providing fault isolation to a replaceable module or component within the stage, and shall be generally capable of determining whether a given malfunction has occurred in the checkout equipment or in the stage being tested.

The automatic checkout system will consist of the central computer complex, test operator station, auxiliary test stations, interface control and switching equipment. The test stations will be capable of controlling the system to check out various stage functions by interrogating the stage with programmed stimuli. The response to these stimuli may be in the form of analog, digital, bilevel, or RF (radio frequency) signals, depending on the subsystem undergoing test. The auxiliary test stations will control the systems during checkout of the propulsion system, the electrical networks, the telemetry systems, and the mechanical system. The tests will be controlled by the test operator at the test operator station, with support from the auxiliary test stations.

To minimize the probability of human error, the automatic checkout system shall be designed to provide (1) automatic sequencing and (2) computer interpretation of test results. The checkout computer will be

programmed to take appropriate action to hold or stop at any point during a test if an unexpected response to a stimulus is received. Manual overrides for system holds or stops will be enabled at the discretion of the test operator. Stops or holds may be initiated by auxiliary test stations, if enabled by the test operator. Emergency stops may be initiated by any operator at any time through a computer interrupt channel. Generally, communication between computer and test operator will be accomplished through the keyboard on the digital control panels (digital control panels are located in the test operator console as well as the auxiliary control consoles) and the automatic typewriter.

5.1.2 General Operational Requirements

A test to be performed will be initiated by the test operator at the test operator console. The test operator will have the capability of enabling test control by an auxiliary test station. The appropriate test station will initiate a test causing the computer to generate digital signals which will be converted to hardline outputs in the Stimuli Signal Conditioner (Model DSV-4B-130). The outputs will be routed through a patch panel to the Signal Distribution Units (Model DSV-4B-133 or DSV-4B-253) for conversion to command signals for the stage or mechanical GSE. Responses from the stage or mechanical GSE will be returned to the Signal Distribution Units, which in turn will route signals to the appropriate section of the Response Signal Conditioner (Model DSV-4B-131). Critical hardline signals will also be routed through a patch panel to the Safety-Item Monitor (Model DSV-4B-135).

The Safety-Item Monitor will determine whether the safety item response signals indicate a condition which could result in equipment damage or personnel injury. The monitor will identify the unit causing the hazardous condition, and, if required, will provide a computer interrupt.

The Response Signal Conditioner, when requested by the Computer Interface Unit (Model DSV-4B-118), will convert the requested hardline responses into digital signals and serially transmit them to the Computer Interface Unit.

The Computer Interface Unit will be used for formatting data in and out of the General Purpose Computer (Model DSV-4B-105). The unit will provide level conversions and time synchronization. Included in this unit will be the necessary logic to convert pulse-width - modulated time information from an external time-code generator to a form compatible with the computer input. Random data arriving at the unit too rapid for immediate transfer, will be stored in individual one word registers assigned one each to the various end items until the computer is ready to accept the data. The unit will also be designed to accept parallel digital data from the computer and to transfer the data serially to the system.

The General Purpose Computer will be the control element of the automatic checkout system. The computer will evaluate system responses, make decisions, and perform the arithmetic processing necessary for rigid test control. The computer will also control displays on the various associated control consoles.

The ancillary computer equipment will include an automatic typewriter, tape punch-reader, four magnetic tape units, high speed printer, and tape synchronizer. The automatic typewriter will have two principal uses: the first will be to produce a hardcopy output of data relevant to system operation and malfunctions; the second will be to provide for inserting variations into operating programs at field stations.

The four magnetic tape units will provide the following functions:

- a. Store the executive routine program tape
- b. Store calibration data in the Data Description Tape (DDT)
- c. Store test program tests
- d. Record test results.

The high speed printer will provide on line test results print out, and the tape synchronizer will act as a buffer between the computer and the tape units, by regulating input data speed to the computer, checking input data parity and generating parity to test results tapes.

A general block diagram of the automatic checkout system is provided in Figure 5-1.

5.1.3 System Operation

During integrated operation, in which combinations of tests will be performed under control of the test operator console, the auxiliary test stations will not be enabled for direct entry into the computer, although the test functions may be monitored at these test stations. A test request from the appropriate test station will be transmitted to the test operator console. The test number will appear as a numerical readout on the test operator's test station monitor display. The test operator will have the prerogative of entering the request into the computer. The appropriate decision will be reflected by either an ENTERED or a WAIT indication on the control panel of the request station. Any test station may initiate a HOLD, STOP, or EMERGENCY STOP during integrated operation. During integrated testing, the RESUME or CLEAR command, following a HOLD, STOP, or EMERGENCY STOP, can be generated only by the test operator.

During test of an individual subsystem, the appropriate auxiliary test station will normally be in direct control of the computer. Program requests may be entered directly into the computer when the test station ENTER switch is manually activated by the operator. The normal procedure in this mode of operation will be for the test station operator to indicate a test on his keyboard and press the ENTER pushbutton. The computer will accept the request and store it for normal processing. By monitoring the NEXT TEST numerical readout, the test station operator will be aware of the time his test will be started.

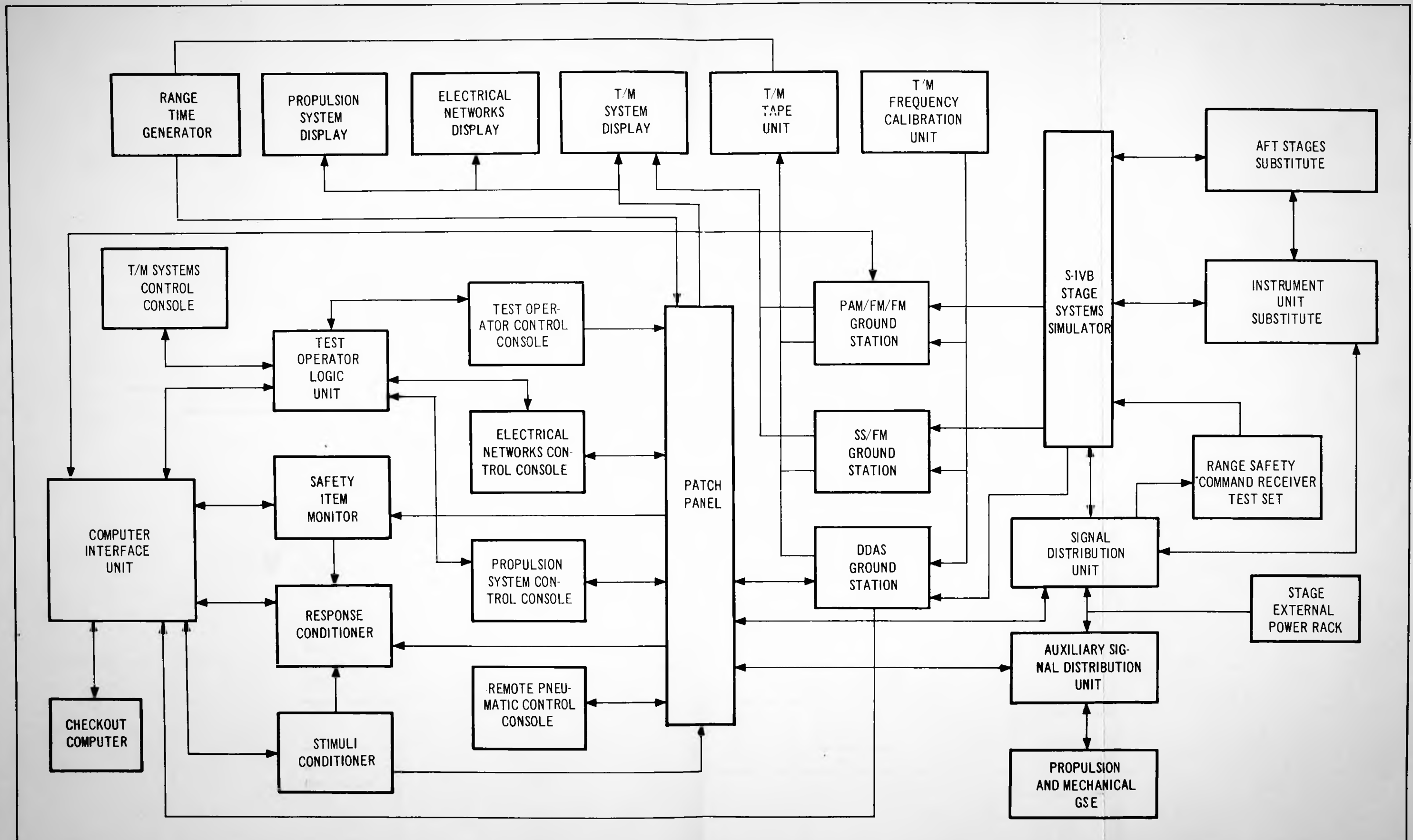
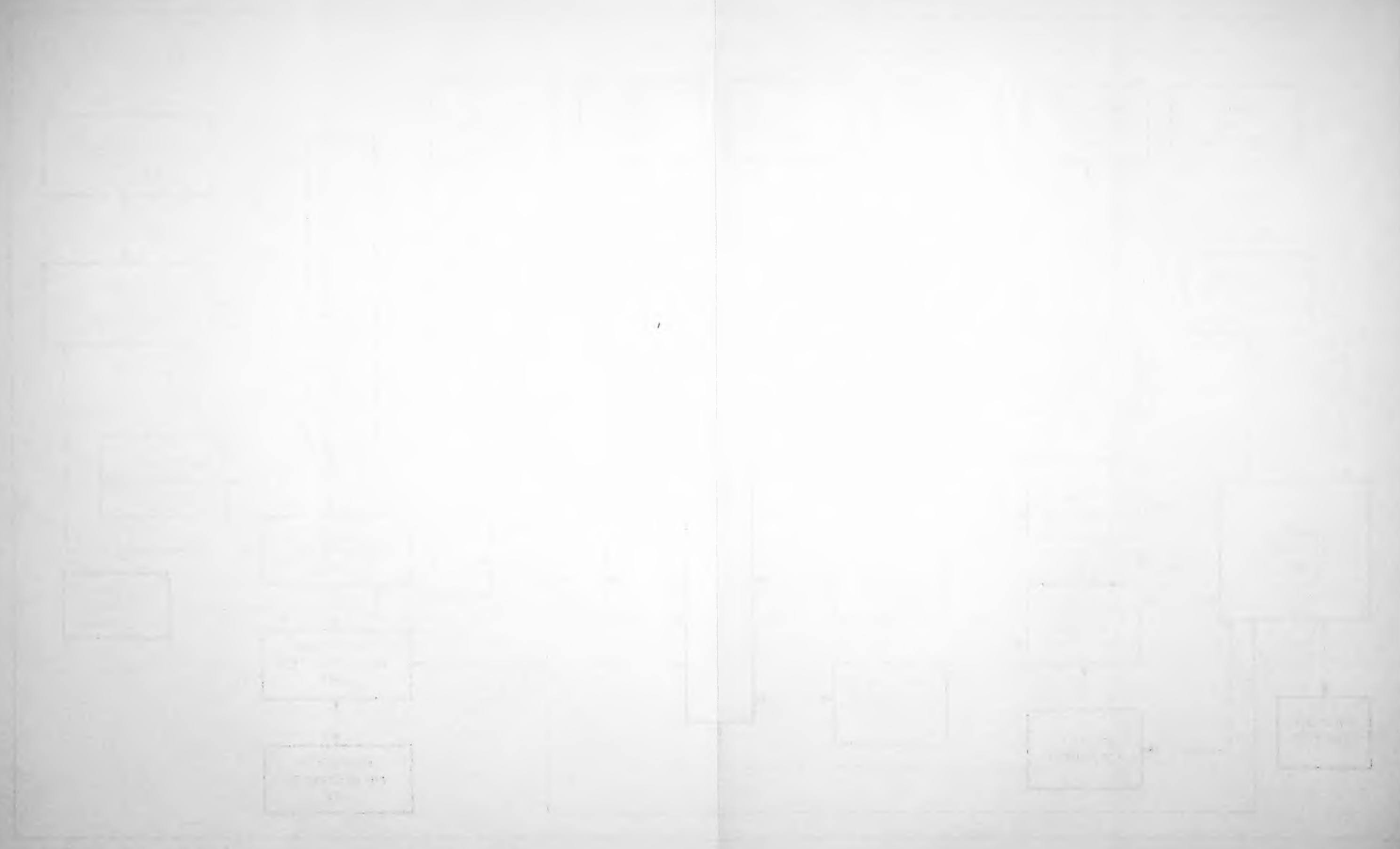


Figure 5-1 S-IVB Checkout System Block Diagram



5.1.4 End-Item Communication

5.1.4.1 End-Item Addresses

In the computer and computer interface unit, end-item information will be identified with an end-item address. An address may be from two to six bits in length. Since registers in the Computer Interface Unit communicate with end-items by hardlines, the end item address will not be transmitted to the end item.

5.1.4.2 Communication Network

Digital communication between end-items and the interface unit will be coded digital pulses at a 200-kc (kilocycle) rate on balanced, twisted-pair, shielded lines. These circuits will reduce data transmission noise, and will provide power and ground isolation between end-items. Special line-driver circuits will convert the internal logic of the end-items to the required pulse form. Line-receiver circuits will convert the pulse information to logic signals. The communication network will be designed to permit transmission over lines up to 2,000 feet in length with no appreciable loss.

5.1.5 Self-Test Capabilities

The automatic checkout system shall be capable of performing system self-tests to verify operational readiness as well as performing the regular on-line, self-test functions which are an integral part of the stage checkout procedures. In addition, the system shall have the capability of performing self-test procedures to isolate a fault-producing part or module within an end-item component.

5.1.6 Component Test Equipment

The component test equipment shall provide functional testing, adjustment, and calibration of the stage and some GSE electrical and electronic components. (A component is defined as a combination of units or parts within a complete operating module or subsystem which provides a

self-contained function necessary for the operation of the module or subsystem.)

The tests performed by this equipment will be conducted on components before initial installation, upon installation of replacement components, or upon reinstallation of components removed for modification, adjustment, or repair. These tests will be performed to confirm that the component is functioning, and that shipping damage or deterioration due to time and environment has not resulted. If a component is found to malfunction during stage checkout, a replacement component will be functionally tested with the test set and installed in the stage. The defective component will then be operated with the test set to locate the trouble and to determine the feasibility of field repair or adjustment.

In some cases, an S-IVB component to be tested will be identical to (or essentially the same as) that used in the S-IV stage. In some cases, the component test equipment designed and built for the S-IV stage may be used as it presently exists. This is notably true for the following:

- a. EBW Initiator Component Test Set (DSV-4-196)
- b. EBW Firing Unit Test Set (DSV-4-197)
- c. Range Safety Command Destruct Receiver Component Test set (DSV-4-219).

S-IVB-peculiar component test sets are as follows:

- a. PAM/FM/FM Telemetry Component Test Set (DSV-4B-102)
- b. SS/FF Telemetry Component Test Set (DSV-4B-103)
- c. Printed-Circuit Card Component Test Set (DSV-4B-104)
- d. Sequencer Component Test Set (DSV-4B-109)
- e. Power System Electrical Component Test Set (DSV-4B-110)
- f. Tape Recorder Component Test Set (DSV-4B-111)
- g. PU System Component Test Set (DSV-4B-112)
- h. PCM/FM Telemetry Component Test Set (DSV-4B-115)

- i. Multiplexer Remote System Test Set (DSV-4B-190)
- j. FM Transmitter Component Test Set (DSV-4B-252)
- k. Multiplexer and Calibrator Component Test Set (DSV-4B-280).

5.1.7 System Programming

A large part of the design effort for the automatic stage checkout system will be devoted to the development of routines for the checkout computers. This effort will be directed toward (1) generation of controls for the system by the computer and (2) coding of stage test procedures. The following types of computer programs are being prepared:

- a. Executive and monitor routines
- b. Computation and data-handling subroutines
- c. Stage checkout programs
- d. Data reduction programs
- e. External equipment and computer self-test programs
- f. On-site interpreter and assembly routines
- g. Off-site program preparation routines and program checkout aids.

5.1.8 Packaging Philosophy

5.1.8.1 Circuitry

The electrical circuitry for the S-IVB Program shall employ as much standardization as practical. Deviations shall occur only when dictated by design necessities. Circuit design shall incorporate simplicity, reliability, and ease of maintenance.

5.1.8.2 Standard Modules

Douglas-designed standard modules shall be utilized as building blocks to develop logic circuitry. Printed-circuit cards shall be standardized, shall have provisions for maximum flexibility, and shall have a minimum number of configurations.

5.1.8.3 Logic Modules

Logic modules shall be designed to provide standard configurations of logic circuitry, such as AND gates, OR gates, inverters, flip-flops, etc., which will yield standard packaging techniques, state-of-the-art design, and human engineering analysis.

5.1.8.4 Printed-Circuit Cards

Printed-circuit cards for GSE will be of standard 5.125 by 7.390 size, and, in general, will be provided with plastic guides on the sides. Plastic keys in the connector will be designed to mate with corresponding slots in the card to prevent assembly of the cards in the wrong position. The cards shall be constructed in accordance with Standard ABMA-STD-428, except as follows: (1) with the exception of the contact fingers, conductor patterns will be solder-plated; contact fingers will be either nickel-rhodium or gold plated; (2) soldering of components will be by the flow-soldering method.

5.1.8.5 Cabinet Types

Cabinets will be standardized in four basic types; (1) vertical cabinet, (2) slope-front console, (3) low-silhouette console, and (4) portable unit. All cabinets shall be capable of RFI (radio frequency interference) shielding in accordance with Standard MIL-I-6181.

5.1.8.5.1 Vertical Cabinets

Vertical cabinets will be of steel construction and will have the following approximate dimensions: depth, 22 inches; width, 21-1/16 or 26-1/16 inches; and height, 77 inches. The cabinets will be designed to accommodate standard 19- or 24-inch panels. Several cabinets with their sides removed may be bolted together to provide for interconnection of wiring between complex units without the use of external cabling. Vertical cabinets used on the static firing test stands, or in other areas exposed to the weather or hazardous conditions, will be standard

Douglas aluminum cabinets with RFI shielding, similar to those currently employed on the S-IV Program. These cabinets will be capable of being continuously purged with clean air or gaseous nitrogen with a purge pressure of 2 inches of water.

5.1.8.5.2 Slope-Front Consoles

The slope-front consoles will be of steel construction, and will accommodate standard 19-inch panels. The consoles may be bolted together to permit grouping of related instrumentation. The console top will have a smooth writing surface, and will be rugged enough to withstand shop treatment from tools and small test equipment.

5.1.8.5.3 Low-Silhouette Consoles

The low-silhouette consoles will be of steel construction, and will accommodate standard 19-inch panels. The consoles may be bolted together to permit grouping of related instrumentation. The console top will be of one-piece construction and standard desk height. The console top will also have a smooth writing surface, and will be rugged enough to withstand shop treatment from tools and small test equipment.

5.1.8.5.4 Portable Units

Any unit designed to be portable will be of a size suitable for housing electronic equipment for the purpose intended. The units will be of lightweight construction with an aluminum case, and will be equipped with provisions for transportation.

5.1.8.5.5 Cabling Requirements

Internal wire bundles will be made as small as practicable, and will ordinarily be routed loosely in panduit. The cabling will be string-tied where it exits through panduit openings. However, when flexibility is required, string-tie (or an approved equal) may be used which will

allow flexibility to be retained and which will provide sufficient rigidity to eliminate the need for cable retractors. Cables attached to slide-mounted drawers and vertical carriages will be of sufficient length to allow complete extension of the unit without strain on the cables. String-ties on cabling within the panduit will not be required. Cables between end-items will be routed beneath false flooring. Disconnect for external cabling receptacles will be provided in a box mounted on the floor of the cabinets and consoles. There will be sufficient space in the box for all cables and for passage of air for unit cooling. A screen to provide proper RFI shielding will be mounted on one of the box faces to accommodate the flow of air. The internal cable harnesses for the test sets will require lacing only; panduit will not be used. The cables which attach to slid-mounted drawers will be supported by cable retractors, as required. Normally, external cables will not be required between test sets. False floor and cable runs will not be necessary for test set installations. External cable requirements for the test sets will consist of facility power cables and various shortlength test cables to the unit under test.

5.1.8.6 Printed-Circuit Card Drawers

Each printed-circuit card drawer will contain two rows of printed-circuit cards, with each row providing suitable space for 18 cards. Input-output connectors will be mounted at the rear of the drawers. Both printed-circuit card receptacles and input-output connectors will be mounted so that their terminals will extend toward the bottom of the drawer. All printed-circuit cards and input-output connectors will be interconnected at this plane using the automatic wire-wrap technique. Drawer slides, front panels, and handles shall be designed in accordance with MSFC Drawing 10443999. A typical cabinet 77 inches high will have a five-drawer capacity.

5.1.8.7 Vertical Carriage

Each vertical carriage will contain three or six rows of printed-circuit cards, each row providing suitable space for 22 cards. Input-output connectors will be mounted at the rear, or along the bottom of each row. Both input-output connectors and the printed-circuit card receptacles will be mounted with their terminals extending toward the center of the cabinet. All printed-circuit cards and input-output connectors will be interconnected using the automatic wire-wrap technique. Drawer slides will be on the side of the cabinet and at the top and bottom of the carriage. Handles will be attached to the frame of the carriage. There will be no front panels. A typical cabinet 77 inches high will hold two vertical carriages.

5.1.8.8 Relay Chassis

The relay chassis and all its components shall be designed in accordance with MSFC Drawing 10443999.

5.1.8.9 Cooling of Equipment

Equipment cooling will be accomplished by introducing cooled air into the subflooring, and into the cabinets and consoles themselves, through RFI screening attached to the cabling box at the bottom of each unit. The air will be directed to the circuit cards and other heat-generating components. It will not be necessary to employ a cooling plenum. Air will be vented from the top of the units through another RFI screen. Return air vents in the ceiling above the units will return the air for recycling.

The component test sets will contain their own cooling blowers. Plenums will be used, as required, for cooling localized hot spots. The air intake and exhaust will be routed through RFI screens in the rear door and rack top, respectively.

5.1.8.10 Color Scheme

Colors used on the GSE shall be in accordance with Douglas Specification F-289.

5.1.8.11 Maintenance

Because of the system's automatic fault-isolation capabilities, a minimum of external equipment will be required to isolate any system failure. To achieve ease of replacement, all units within the equipment chassis will be designed as plug-in modules or as printed-circuit cards. Each modular unit will contain one or more complete circuits to facilitate testing, maintenance, and logistic support.

5.2 PAM/FM/FM Component Test Set Assembly (DSV-4B-102) 1A80850-1

Function - The function of the PAM/FM/FM (Pulse Amplitude Modulation/Frequency Modulation/Frequency Modulation) Component Test Set Assembly shall be to calibrate and fault-isolate the subcarrier oscillator and the time-division multiplexer. These tests will assure a completely operational system before installation in the stage.

Design - The test set will be designed to provide the necessary power, stimuli, and readout equipment to check out and calibrate the subcarrier oscillator and the time-division multiplexer. The test set will also provide the capability of conducting an end-to-end test from the time-division multiplexer through the subcarrier oscillator, FM transmitter, RF power amplifier, and an FM receiver-discriminator. During this test, the pre-emphasis in the subcarrier oscillator will be set to ensure intercomponent compatibility. The test set will also have the capability of looking directly at the output of the time-division multiplexer and subcarrier oscillator, or to monitor the outputs through an FM receiver-discriminator. The test set will be designed for manual operation, and all controls will be located on the front panels above the writing surface.

Components - The test set, as shown in Figure 5-2, will be contained in a four-bay console and will consist of the following components:

- a. Two 28-vdc (volts direct current)
- b. One 50-vdc modular power supply
- c. Three 20-vdc modular power supplies
- d. Electronic counter
- e. Harmonic wave analyzer
- f. Wave analyzer
- g. Square-wave generator
- h. Oscillator
- i. Digital voltmeter
- j. Ac/dc (alternating current/direct current) converter
- k. Oscilloscope and plug-in units
- l. FM receiver
- m. 18 discriminators
- n. Multiplexer control panel
- o. Subcarrier oscillator control panel
- p. Test control monitor panel
- q. RF drawer
- r. Logic drawer
- s. Two storage drawers
- t. Four cabinets
- u. Writing surface
- v. Four blowers.

Dimensions - The test set will have the following approximate dimensions: depth, 25-1/2 inches; width, 84-1/4 inches; and height, 77-1/2 inches. The writing surface will be centrally located 30 inches above the floor, and will be approximately 42-1/8 inches long and 18 inches deep.

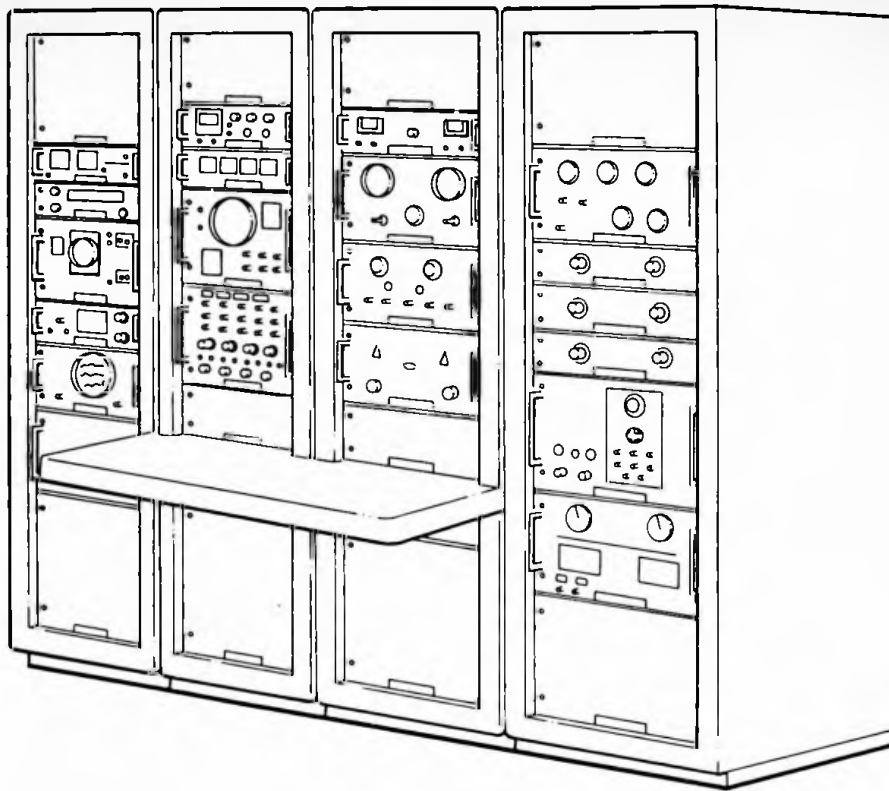


Figure 5-2. PAM/FM/FM Component Test Set Assembly (DSV-4B-102)

5.3 SS/FM Telemetry Component Test Set (DSV-4B-103) 1A82117-1

Function - The function of the SS/FM Telemetry Component Test Set shall be to test, calibrate, and fault-isolate the single-sideband translator assembly. The test set shall be capable of testing the SS/FM (Single Sideband/Frequency Modulation) subsystem from input to output to assure a completely operational system before installation in the stage.

Design - The test set will be designed to perform SS/FM subsystem tests using signal generators as stimuli sources. The output of the translator will be switched directly to a demultiplexer, or routed through an FM transmitter, power amplifier, and FM receiver to the demultiplexer. The test set will be manually operated and all controls will be located on the front panels above the level of the writing surface. The writing surface will be two bays in length to hold the test procedures and the unit under test.

Components - The test set, as shown in Figure 5-3, will be contained in a four-bay console and will consist of the following components:

- a. One 0 to 325-vdc power supply with a 6.3-vdc (volts alternating current) power supply
- b. Three 0 to 36-vdc power supplies
- c. Dual 0 to 36-vdc power supplies
- d. Fifteen random-noise generators
- e. Oscillograph and Take-up unit
- f. Three six channel amplifiers
- g. Running-time meter
- h. Counter
- i. Frequency-selective voltmeter
- j. Oscilloscope with a dual trace vertical amplifier and a sweep delay generator
- k. Differential ac/dc voltmeter
- l. Ac voltmeter
- m. Two test oscillators
- n. FM receiver
- o. 15-channel demultiplexer
- p. Power panel
- q. Control panel
- r. RF drawer
- s. Three storage drawers
- t. Four-bay cabinet
- u. Writing cabinet
- v. Four blowers
- w. Frequency calibrator unit.

Dimensions - The test set will have the following approximate dimensions: depth, 25-1/2 inches; width, 84-1/4 inches; and height, 77-1/2 inches. The writing surface will be centrally located 30 inches above the floor, and will be 42-1/8 inches long and 14 inches deep.

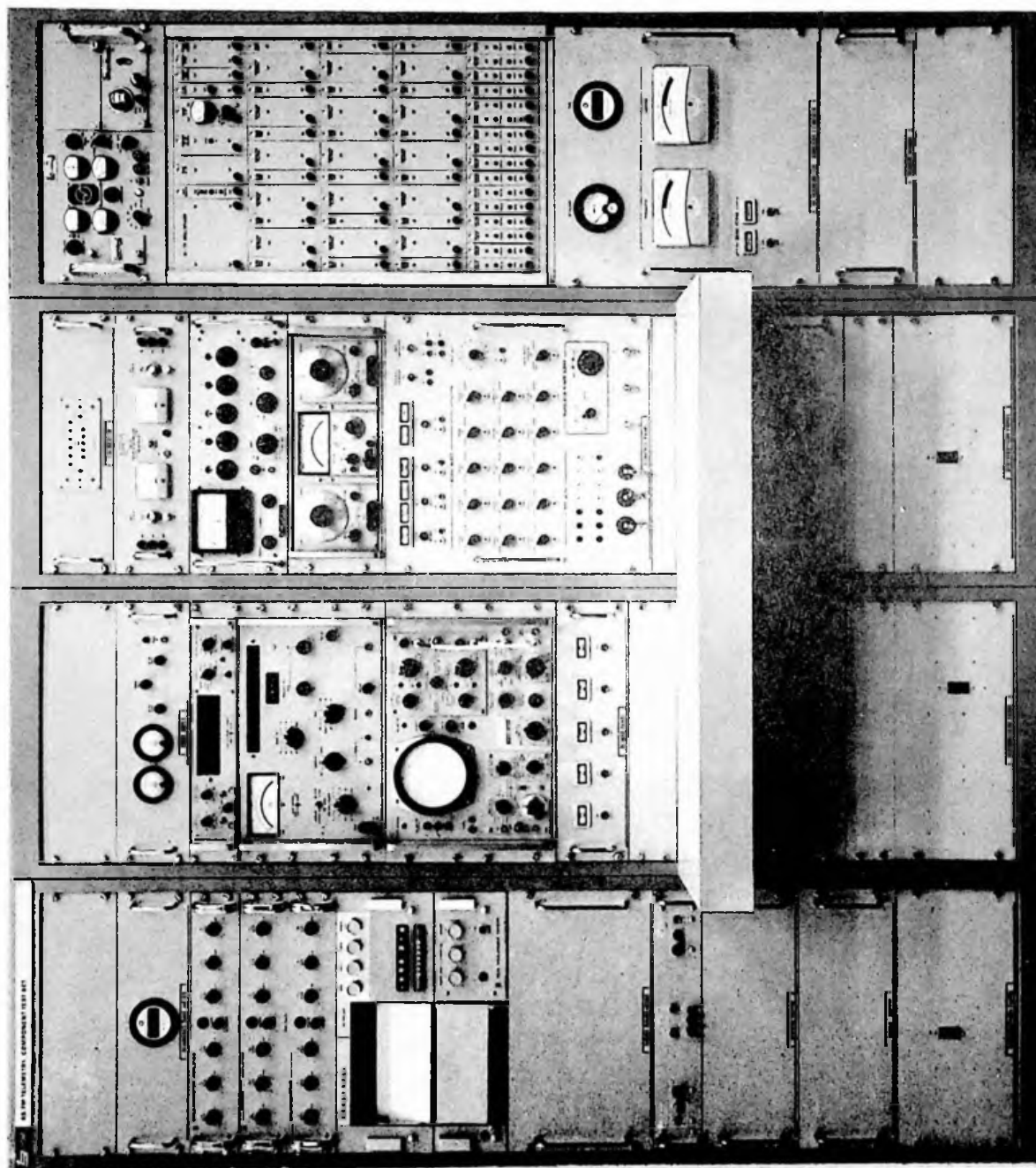


Figure 5-3. SS/FM Telemetry Component Test Set (DSV-4B-103)

SM440112

5.4 Printed-Circuit Card Component Test Set (DSV-4B-104) 1A74706-1

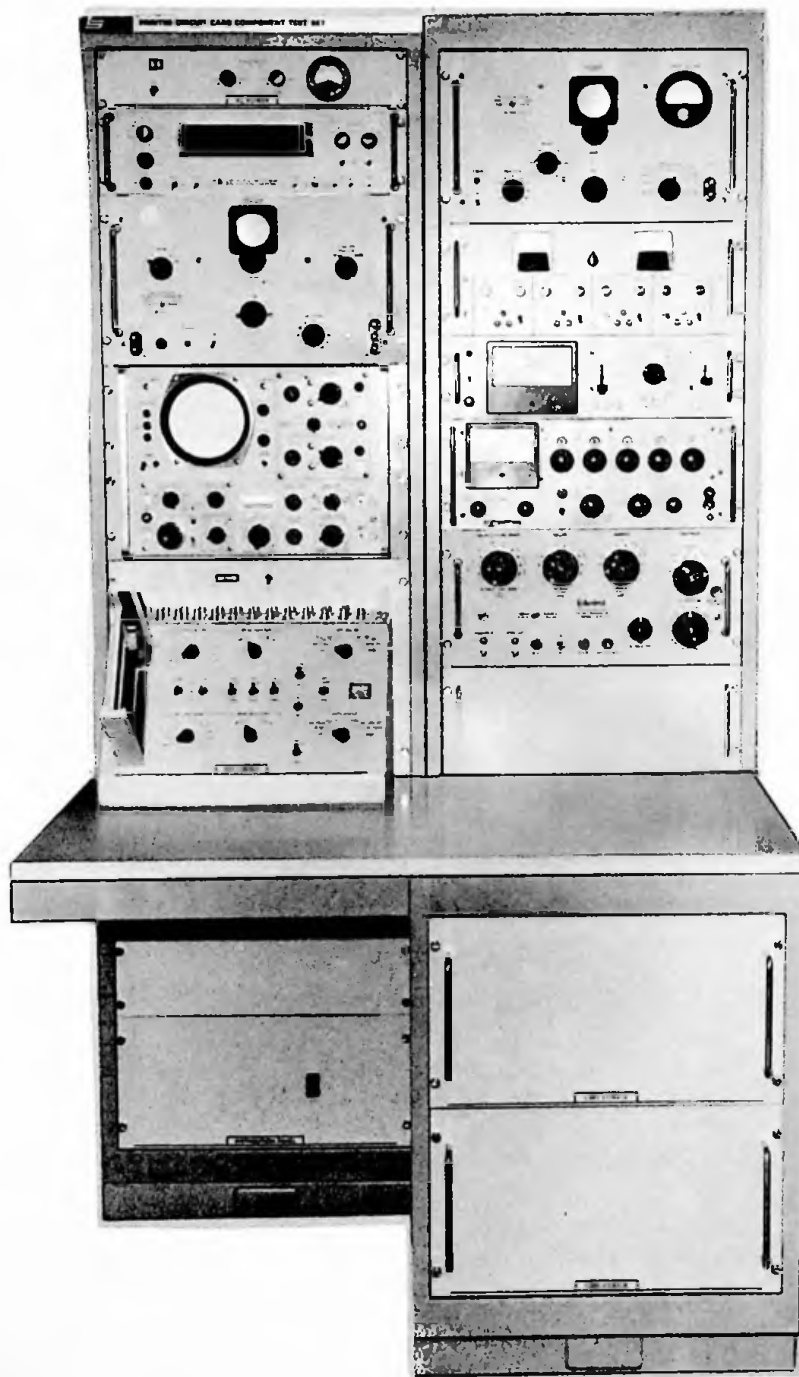
Function - The function of the Printed-Circuit Card Component Test Set shall be to check the printed-circuit cards used as components or modules in the S-IVB GSE. The test set shall be capable of fault-isolation to a specific part or group of parts. The test set shall provide all necessary voltage levels, input stimuli, loads, and output monitoring.

Design - The design of the test set will consist of two racks of equipment and a receptacle for the unit under test. The test set will be designed for manual operations, and will be completely self-contained and independent of any external equipment. Storage space will be provided for the adapters.

Components - The test set, as shown in Figure 5-4, will consist of the following components:

- a. Racks
- b. Chassis
- c. Receptacles and adapters
- d. Pulse generator
- e. Signal generator
- f. Power supplies
- g. Loads
- h. Dual-trace oscilloscope
- i. Frequency counter
- j. Ac/dc vacuum tube voltmeter
- k. Clip-on milliamper probe
- l. Ohmmeter
- m. Function generator
- n. Power amplifier.

Dimensions - The test set will have the following approximate dimensions: depth, 51 inches (including shelf); width, 42-1/8 inches; and height, 77-1/2 inches.



5.5 General Purpose Computer (DSV-4B-105)

5.5.1 General Purpose Computer

Function - The General Purpose Computer shall be used in each systems checkout area to (1) execute stored program instructions for control of the computer complex and (2) control the input/output equipment associated with the computer and operator displays. The computer shall be capable of evaluating stage responses and of making decisions where required. In addition, the computer shall have the capability of performing self-test routines, and of performing tests on the equipment controlled by the computer.

Design - The computer, as shown in Figure 5-5, will be a Control Data Corporation Model CDC-924A general purpose computer, or equivalent. The computer will be a stored-program type computer with a magnetic-core storage capability of 32,768 words. The input/output facilities, consisting of three input and three output channels, will be capable of receiving or transmitting up to 2,500,000 bits per second. These channels will be compatible with the peripheral equipment, i.e., tape punch-reader, line printer, magnetic tape unit, and interfacing. The computer will have an inherent supply of 64 instructions which will provide for fixed-point arithmetic, indexing, input/output storage searching, masking, shifting, loading and storing, various jumps and stops, and logical operations. Other characteristics of the computer will be:

- a. Parallel mode of operation
- b. 24-bit word length
- c. Single address logic, one instruction per word (6-bit operation code, 3-bit index designer, 15-bit execution address)
- d. Six index registers
- e. Programmed interrupt
- f. Indirect addressing.

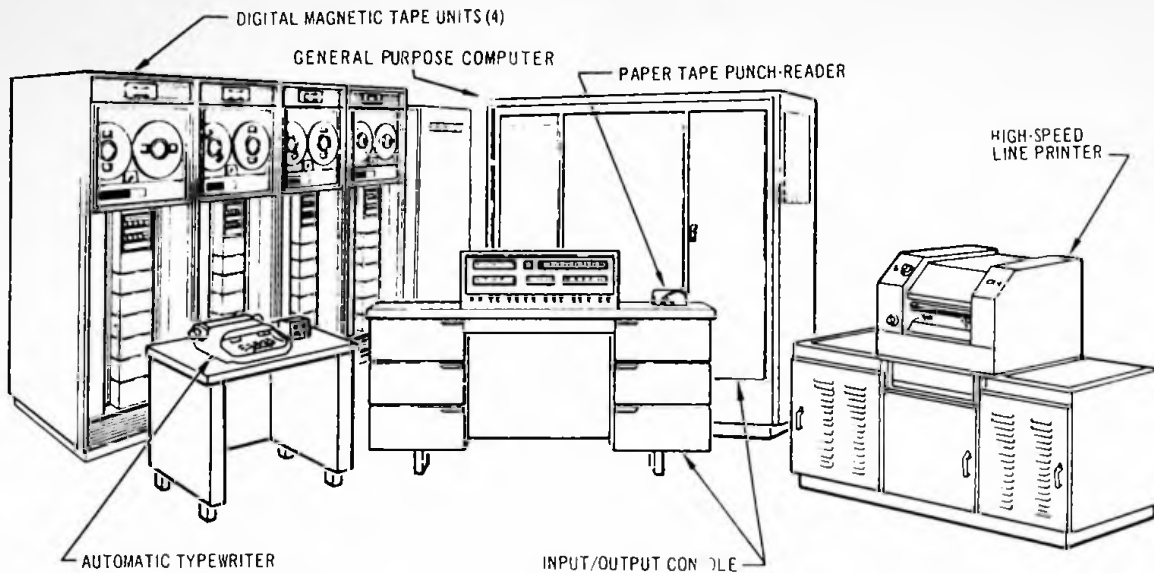


Figure 5-5. General Purpose Computer (DSV-4B-105)

Operation of the computer will be sequenced by an internally-stored program in the random-access memory. The peripheral equipment will be capable of direct access to this common memory to permit continuity of input/output operations. Since the computer will be a single-address type, one address will be explicitly referred to by one instruction.

Components - The checkout computer will contain essentially the same components as found in comparable computers. These components will incorporate the following functional subsystems:

- a. Core memory
- b. Arithmetic unit
- c. Control unit
- d. Input/output buffering.

5.5.2 Digital Magnetic Tape Unit

Function - The tape transport assemblies of the digital magnetic tape unit shall be used to record the responses and decisions of the computer, to recompile computer programs and update the stage-peculiar data in the computer, and to record test results. A separate tape assembly shall be used to perform each function.

Design - The magnetic tape unit, as shown in Figure 5-5 , will be designed to be compatible with the checkout computer. The unit will be designed to store digital information on standard digital magnetic tapes, and will be capable of retrieving the information, as required. A tape synchronizer will allow the tape assemblies to record with either low density (200 bits/inch) or high density (556 bits/inch), as selected by the program. The synchronizer will also permit the recording density to be changed manually from the control panel on the tape handler when the magnetic tape unit is in standby mode. The four transport assemblies will be capable of operating with standard 0.5-inch recording tape, and will be designed to perform read-and-write operations at a tape speed of 75 inches per second.

Interrupt-sensing instructions will allow the computer to determine the source of a program interrupt. One instruction will be peculiar to the write channel. This instruction will allow the programmer to skip over approximately 3 inches of tape when the NEXT WRITE operation is performed, thereby providing the capability of passing a bad spot on the tape. The READ RECORD instruction and the READ FILE instruction will apply only to the READ mode of operation. Programming the proper function codes will cause the tape unit to move to a FILE mark before stopping. This will allow (1) buffering of a complete file of information or (2) searching either forward or backward for an END-OF-FILE mark. During READ operations, an instruction will also be available to permit the tape to move forward one record. This will allow the programmer to skip over records he does not wish to buffer into the computer.

Components - The digital magnetic tape unit will consist of four complete rack-mounted tape assemblies and a separate rack-mounted tape synchronizer which provides the control electronics for the tape unit.

5.5.3 Automatic Typewriter

Function - The function of the automatic typewriter shall be to (1) introduce information into the computer to effect changes to programs and stored data and (2) provide a means of communication between the operator and computer. In addition, the typewriter shall provide a detailed, hard-copy output from the computer of component failures during stage testing and checkout operations.

Design - The typewriter will be designed to accept input information at normal typing speeds, and will print output data at a rate of approximately 10 characters per second. The typewriter will be designed to be compatible with the computer. The typewriter will communicate with the computer on one input cable and one output cable. The control and data lines will be activated by the typing of selected codes. The typewriter will contain a keyboard control circuit which will load characters or functions from the coder into the keyboard register. During input, this circuit will provide for sampling of the keyboard common contacts and will allow the circulation of data in the keyboard register. The circuit will prevent the return of an INPUT-READY signal to the computer, except when a request for KEYBOARD INPUT or STATUS REQUEST is made.

Components - The automatic typewriter, as shown in Figure 5-5 , will contain a standard carriage, motorized roller, keyboard, power supply, and the necessary circuitry to allow computer control.

5.5.4 Input/Output Console

Function - The input/output console shall be the control section of the checkout computer. The console shall contain all necessary indicators and switches to operate the computer. The contents of the computer

operational registers will be indicated on projection displays for each octal digit in the register. The five register display groups will consist of arithmetic, index register data, program address, function code, and execution address. The console shall also provide a continuous display of events, and shall permit independent computer operation at the discretion of the operator in the manual or automatic mode. A paper tape punch-reader will be provided as one of the input/output assemblies. This assembly will be supplied by a vendor as part of the General Purpose Computer.

Design - The console will be designed to permit ease of access, both visual and physical, to all panel indicators and controls. Key-lever switches will control the various modes of operation as indicated by the following:

- a. Start-step key
- b. Internal/external clear keys
- c. Three selective stop keys
- d. Three selective jump keys
- e. Reader-mode switch
- f. Reader-motor switch
- g. Punch select switch
- h. Punch-motor switch
- i. Storage-test keys
- j. Power switch.

Components - The console, as shown in Figure 5-5 , will include a conventional paper tape punch-reader and the necessary indicators, controls, and projection displays to permit monitoring of computer events.

5.5.5 High-Speed Line Printer

Function - The high-speed line printer shall provide a means of producing large quantities of information in a relatively short time. The printer shall provide a high-speed hard-copy of detailed information both during testing and after testing is completed.

Design - The line printer will be designed to print up to 1,000 lines a minute with 120 characters per line. The 64 standard characters will be provided in all print positions. The line printer will be compatible with the computer.

Components - The line printer assembly will consist of a rotating-drum print wheel with associated print hammers. Print ribbons will be ready-mounted on disposable mandrels for ease of replacement. Forced-air cooling will be provided by blowers within the cabinet.

Dimensions - The line printer assembly and all its necessary control circuits will be contained in a single cabinet which will have the following approximate dimensions: depth, 31 inches; width, 72 inches; and height, 56 inches. The assembly, circuits, and cabinet together will weigh approximately 890 pounds. The line printer is shown in Figure 5-5 .

5.6 Test Controller Complex, SIL (DSV-4B-105A) 1B62674-1

This model is similar to DSV-4B-105 but will not include the four digital magnetic tape units and the data synchronizer. This model will function as a support computer or as an Automatic GSE Controller when used in conjunction with Model DSV-4B-209, Computer Configuration Control Unit and leased peripheral equipment. The support computer complex will provide a means to prepare, produce and distribute Automatic Checkout Test Program Tapes and associated software for S-IVB Stages. (See Figure 5-5 .)

5.7 Sequencer Component Test Set (DSV-4B-109) 1A59156-1

Function - The function of the Sequencer Component Test Set shall be to test the stage sequencer, the forward and the aft power distribution assemblies and to isolate malfunctions down to a module, i.e., relay, resistor, or diode.

Design - The test set, as shown in Figure 5-6, will be designed with sufficient versatility to accommodate anticipated changes in missions. The test set will be capable of performing the following functions:

- a. Applying inputs or specified time duration and amplitude to simulate the signals the instrumentation unit may deliver;
- b. Checking outputs for proper wiring;
- c. Isolating faults within each output;
- d. Checking telemetry resistors for proper value;
- e. Checking arc-suppression circuits for proper operation;
- f. Measure time delay module output.

Components - The test set will consist of the following major components:

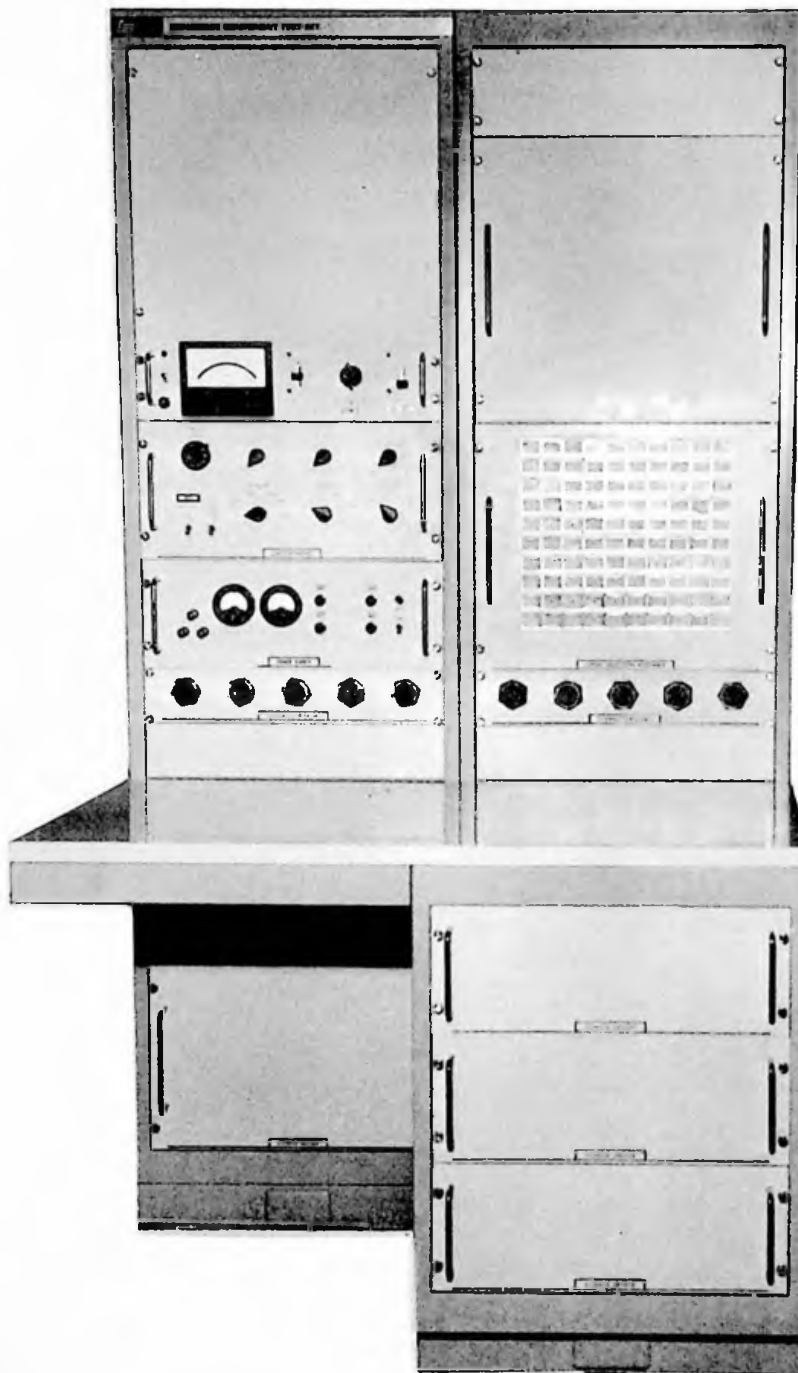
- a. Power supply
- b. Control panel
 1. Indicators
 2. Switches
- c. Patch panel
- d. VTVM
- e. Counter.

Dimensions - The approximate dimensions of the sequencer test set will be depth, 51 inches (including shelf); width, 42-1/8 inches; and height, 77-1/2 inches.

5.8 Power System Electrical Component Test Set (DSV-4B-110) 1A78098-1

Function - The function of the Power System Electrical Component Test Set shall be to test the stage inverter/converters and the stage chilldown system inverter.

Design - The test set will be designed to apply various loads to the stage inverter/converters while output voltages, current, frequencies, power factors, phase differences, and harmonic distortions are monitored.



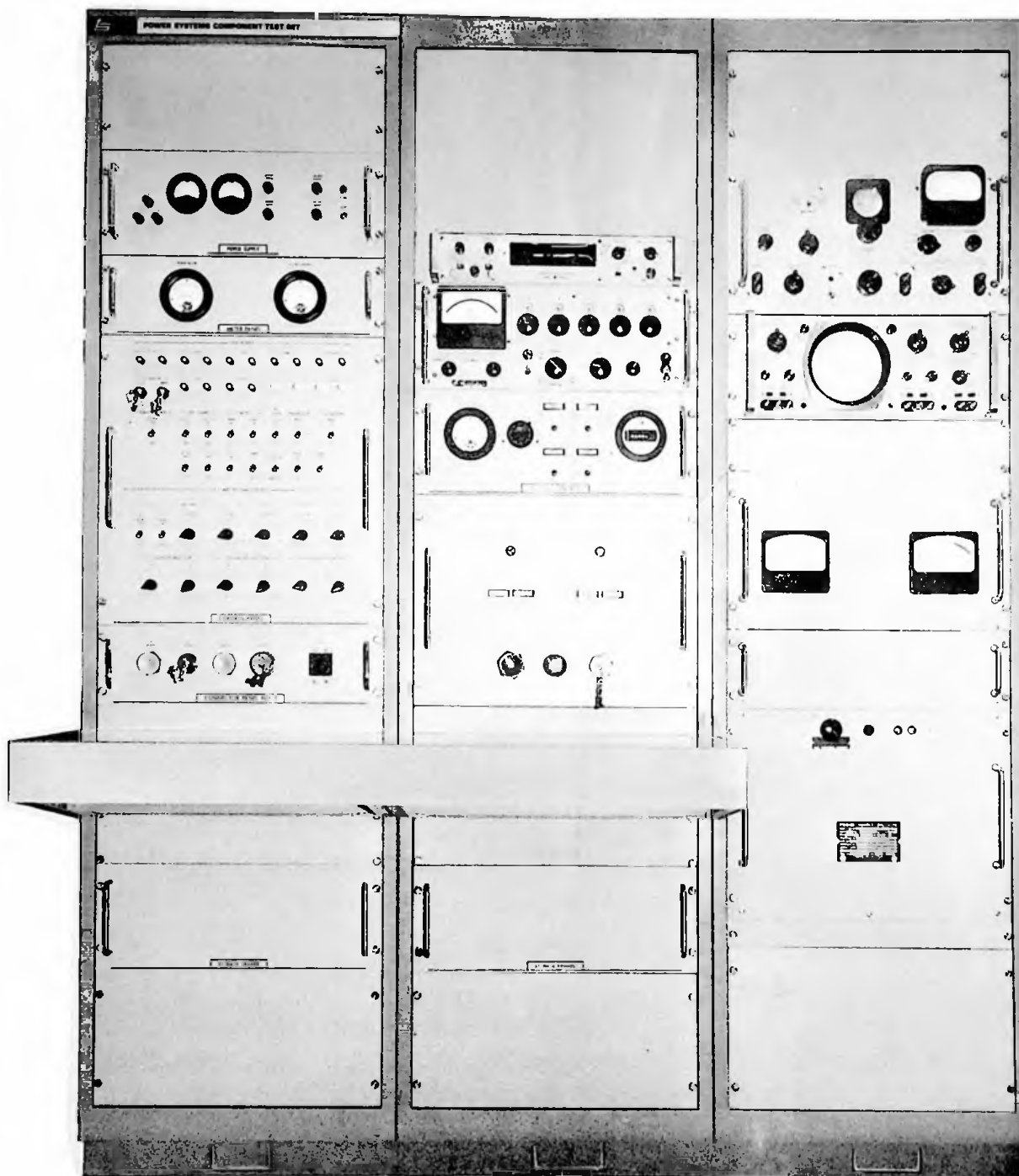
The test set will also allow various loads to be applied to the stage chilldown system inverter while voltages, current, and frequencies are monitored. In addition, the test set will be capable of the following:

- a. Simulating S-IVB stage batteries;
- b. Checking thermistors for proper operation;
- c. Checking telemetry resistors for proper value;
- d. Simulating on-stage loads.

Components - The test set, as shown in Figure 5-7, will contain the following major components:

- a. Cabinet (three-bay AMCO rack)
- b. Two variable power supplies
- c. Distortion analyzer
- d. Frequency counter
- e. Oscilloscope
- f. Differential voltmeter
- g. Meter panel
 1. Ac/milliammeter
 2. Power factor meter
- h. Control panels
 1. Equipment selector switches
 2. Load switches
 3. Resistive and inductive loads
 4. Power switches
 5. Test jacks
 6. Running-time meter
 7. Dc voltmeter
- i. Connector panels
 1. Connections for inverters.

Dimensions - The approximate dimensions of the test set will be as follows: depth, 25-1/2 inches; width, 63-1/4 inches; and height, 77-1/2 inches.



5.9 Tape Recorder Component Test Set (DSV-4B-111) 1A81100-1

Function - The function of the Tape Recorder Component Test Set shall be to check the airborne tape recorder. The test set shall provide the operating voltages, input stimuli, and output monitoring facilities required to isolate faults down to the component level within the tape recorder module. The test set shall be capable of testing the recorder for data transfer accuracy. Bit dropouts will be recorded for each block of data transferred as a function of the data presented to the "write" amplifiers. The test set shall be capable of measuring dynamic skew at the playback speed, and shall measure the speed/compression ratio and speed accuracy.

Design - The test set, as shown in Figure 5-8, will be contained in two racks with a work table attached at desk height. The test set will be designed to be manually operated, and will be independent of all other equipment. The test set will generate the desired block of data to be used as input stimuli, and will have the necessary output storage to store the readout data during the time required to compare the readout data with the input data.

Components - The test set will consist of the following components:

- a. Two cabinets
- b. Chassis (card drawers)
- c. Plugs and receptacles
- d. Digital comparator
- e. Digital word generator
- f. Dual-trace oscilloscope
- g. Pulse generator
- h. Power supplies
 1. Two - 28 vdc
 2. Three - 20 vdc
 3. One - 50 vdc

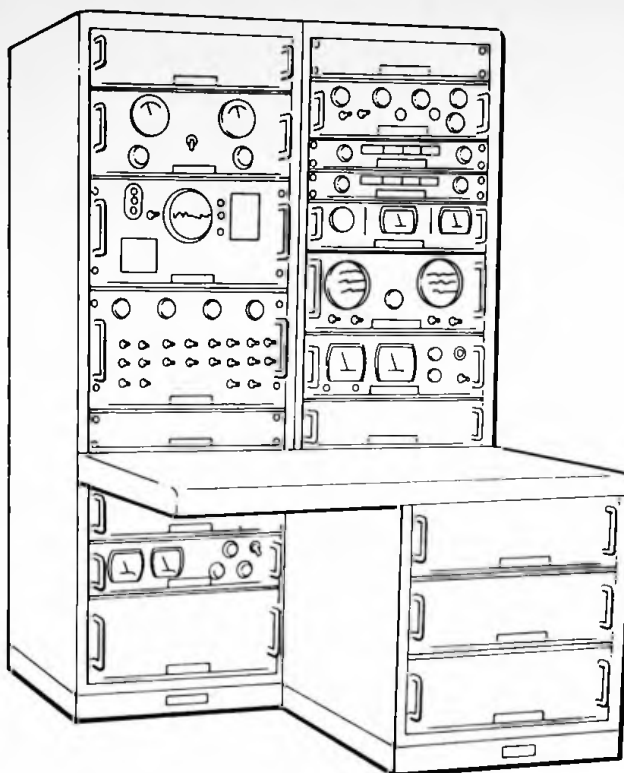


Figure 5-8. Tape Recorder Component Test Set (DSV-4B-111)

- i. Two frequency counters
- j. 70 KC ± 30 percent discriminator
- k. 9 KC ± 25 percent discriminator.

Dimensions - The tape recorder test set will have the following approximate dimensions: depth, 25-1/2 inches; width, 42-1/8 inches; and height, 77-1/2 inches.

5.10 Propellant Utilization Component Test Set (DSV-4B-112) 1A59160-1

Function - The function of the Propellant Utilization (PU) Component Test Set shall be to provide the capability for testing and calibrating the PU electronic assembly.

Design - The design of the S-IVB PU test set will be similar to the existing S-IV test set. The major areas of difference will be:

- a. Reduction from six valve positioners to one;
- b. Removal of the valve positioner checkout portion of the test set;
- c. Packaging the test set in 6-foot cabinets;
- d. Providing temperature-controlled ovens for precision capacitors.

The test set will be capable of the following:

- a. Simulating the sensing units in the stage propellant tanks to provide signals representative of propellant levels. The probe simulators will be capable of simulating any propellant level, from empty to full, simultaneously in both tanks. The simulators will also be capable of providing the necessary range of propellant mass ratio.
- b. Providing the capability for checking propellant mass-indicating circuits as follows:
 1. Linearity to 0.05 percent (voltage output versus simulated mass input);
 2. Response to step and velocity inputs.
- c. Providing the capability for checkout of the summing and shaping network as follows:
 1. Gain (high and low) as the simulated mass ratio is changed;
 2. Null output with correct mass ratio input;
 3. Response to step inputs.
- d. Providing the capability for checking the valve-positioner amplifier as follows:
 1. Null voltage and valve offset with a null input;
 2. Gain;
 3. Phase shift.
- e. Providing the capability for checking the valve-slewing capabilities of the PU system.

- f. Providing the capability for making the following adjustments:
 - 1. Quadrature adjustment and rate feedback adjustments in the servo-balanced bridges;
 - 2. Fuel bias adjustment;
 - 3. Dc offset and gain adjustment in the summing and shaping network.
- g. Monitoring the following telemetry outputs:
 - 1. LO_2 mass;
 - 2. LH_2 mass;
 - 3. Mixture ratio error (summing error).
- h. Checking the overall system response by simulating the necessary valve position as the simulated mass ratio is varied.
- i. Providing the capability for troubleshooting the PU electronics assembly and isolating a malfunction down to a single module.

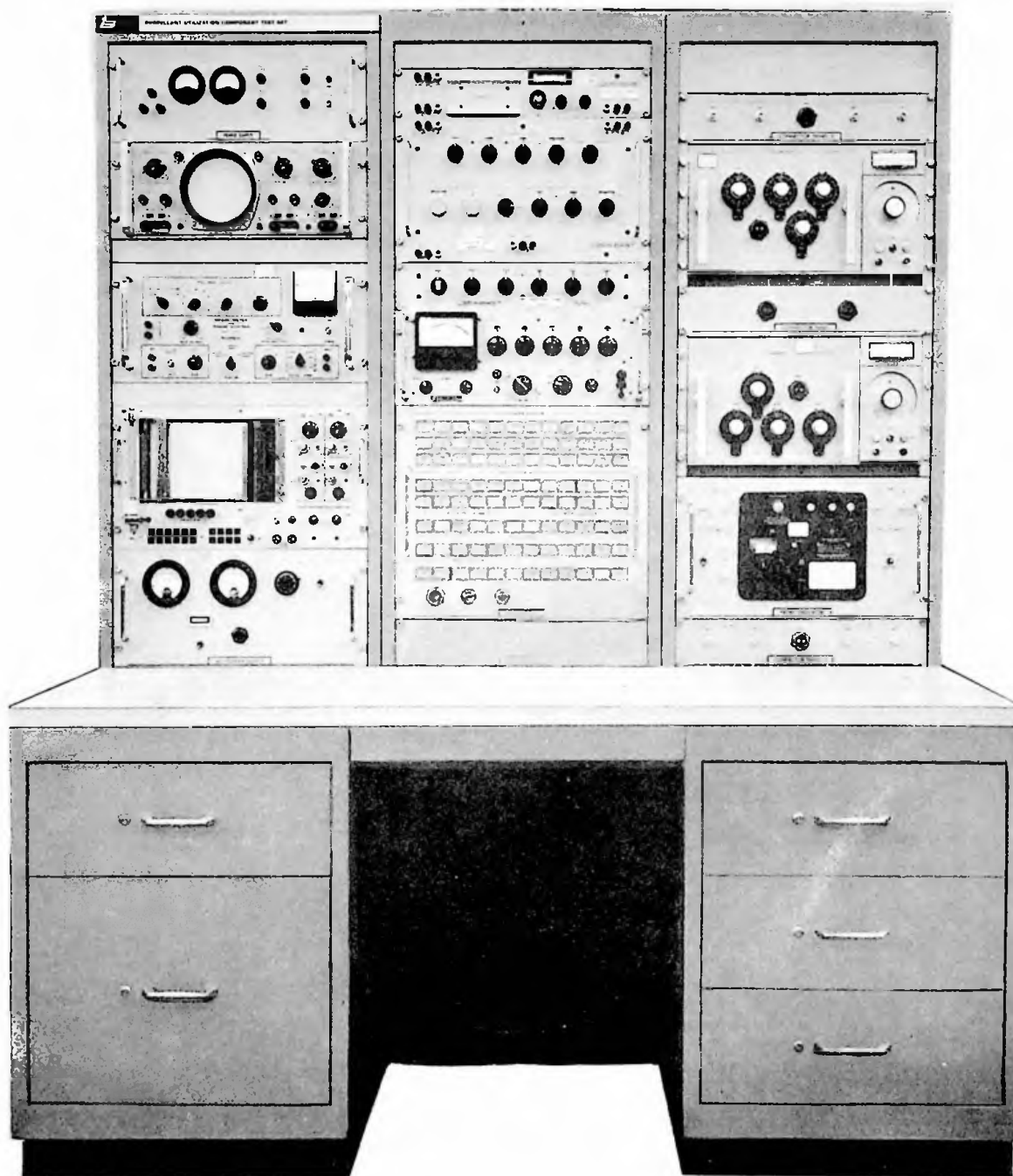
Components - The PU test set will contain the following subassemblies:

- a. Tank probe simulators: fixed-point, variable (manual), and variable (motor-driven)
- b. Control and display panel
- c. Ac/dc differential voltmeter
- d. Recorder
- e. Voltage divider
- f. Phasemeter
- g. Power supply
- h. Capacitance-measuring system
- i. Oscilloscope.

Dimensions - The approximate dimensions of the PU test set will be: width, 63 inches; depth, 51 inches (including shelf); and height, 77-1/2 inches. The test set is shown in Figure 5-9.

5.11 PCM/FM Telemetry Component Test Set (DSV-4B-115) 1A78089-1

Function - The function of the PCM/FM Telemetry Component Test Set shall be to adjust, calibrate, and evaluate all components of the PCM/FM (Pulse Code Modulation/Frequency Modulation) telemetry system. The test



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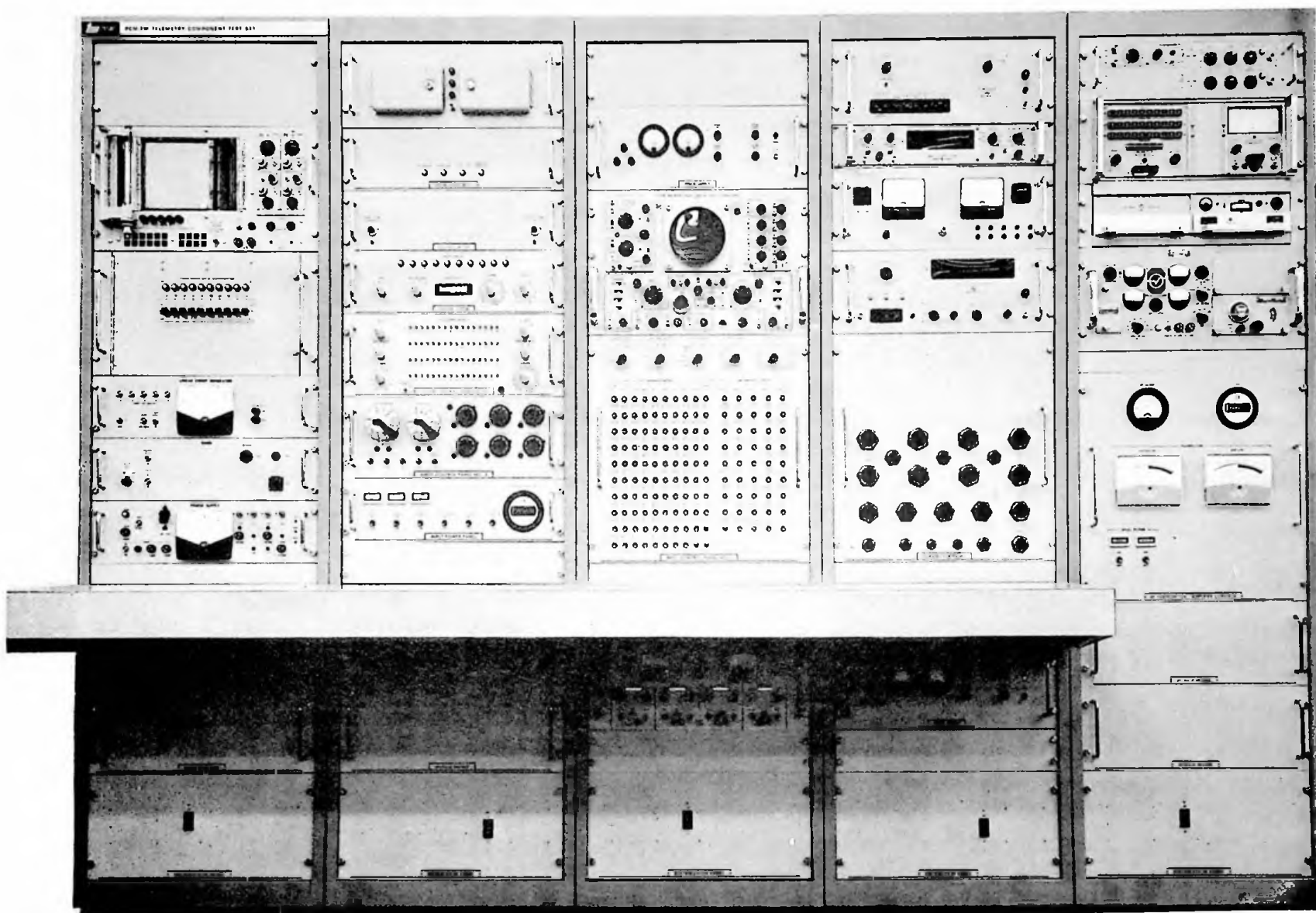
Figure 5-9. Propellant Utilization Component Test Set (DSV-4B-112)

set shall also be capable of testing the complete system from multiplexer inputs to output data to assure a completely operational system before installation in the stage. The test set shall be contained in a five-bay console. A writing surface will be provided four bays in length for holding test procedures and the unit under test. The test set shall be designed for manual operation, with all controls located on the front panels above the writing surface.

Design - The test set will be designed to test, calibrate, and fault isolate the digital data acquisition assembly. The test set will also be capable of performing subsystem, closed-loop tests using multiplexes as stimuli sources. The assembly output will be switched directly to the PCM decommutator, or routed through an FM transmitter, power amplifier, and FM receiver to the PCM decommutator.

Components - The test set, as shown in Figure 5-10, will consist of the following components:

- a. 28-vdc power supply
- b. One 0 to 50-vdc modular power supply
- c. Three 0 to 24-vdc modular power supplies
- d. 24 to 32-vdc power supply
- e. PCM decommutator power supply
- f. Oscilloscope and oscillator
- g. Digital voltmeter
- h. Ac/ohms converter
- i. Pulse generator
- j. Discriminator and receiver
- k. Counter
- l. Bit synchronizer
- m. Strip chart recorder
- n. Automatic A/D converter test set
- o. RF drawer
- p. PCM simulator
- q. Correlator and data control panels



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Figure 5-10. PCM/FM Telemetry Component Test Set (DSV-4B-115)

- r. Quick-look panel
- s. Two input control panels
- t. Input power control panels
- u. Connector panel
- v. Patch panel
- w. Storage drawers
- x. Writing surface
- y. Five cabinets
- z. Blowers.

Dimensions - The test set will have the following approximate dimensions: depth, 25-1/2 inches; width, 105-5/6 inches; and height, 77-1/2 inches. The writing surface will be located 30 inches above the floor, and will be 84-1/4 inches long and 14 inches deep.

5.12 Computer Interface Unit (DSV-4B-118) 1A59937-1

Function - The function of the Computer Interface Unit (CIU) shall be to perform conversion of waveforms and information formats required for communication between the computer and the following end-items:

- a. Test Operator Station (DSV-4B-121)
- b. Stimuli Signal Conditioner (DSV-4B-130)
- c. Response Signal Conditioner (DSV-4B-131)
- d. Safety-Item Monitor (DSV-4B-135)
- e. DDAS Ground Station (DSV-4B-123)
- f. PAM/FM/FM Telemetry Ground Station Assembly (DSV-4B-125)
- g. Range Time Generator (DSV-4B-153)
- h. System Status Display Console (DSV-4B-120)
- i. Black/White System Status Display (DSV-4B-298)
- j. Ground Instrumentation Station (DSV-4B-526).

The CIU shall be capable of accepting or generating parallel information for intercommunication with the checkout computer, and of accepting or

generating serial data with the end-items listed above. In addition, the CIU shall be capable of accepting and generating special control signals, as required.

Design - The CIU will be designed to provide circuits for conversion of (1) computer logic levels to Douglas Aircraft Company logic levels, (2) parallel to serial transmission, (3) Douglas Aircraft Company logic levels to serial balanced-line transmission pulses, (4) serial pulse to Douglas Aircraft Company logic level, (5) serial pulse to parallel, and (6) Douglas Aircraft Company logic levels to computer logic levels. In addition, circuits for generating basic timing and synchronization signals for the checkout system will be provided, as well as an interval-timer to present time base operations. The design of the CIU will include a means for routing input and output signals to the appropriate end-items, and for controlling, merging, distributing, and interlocking information required for proper transfer of data to and from the computer. A means for generating a computer-interrupt and sense-signals to indicate special system status conditions will also be provided. All serial output signals will be capable of reliable transmission over a distance of up to 2,000 feet.

When the checkout computer transmits a data word with its associated end-item address to the CIU in a parallel fashion, the end-item address will be decoded and the data word stored in the proper output register. The CIU will transmit the data word, in a serial fashion, to the designated end-item when it has been enabled. When the CIU receives an input word from an end-item, the input word will be converted into a parallel format with an associated end-item address and entered into the proper buffer through a computer input channel. The CIU will send an interrupt signal to the computer when (1) an EMERGENCY STOP appears by hardline, (2) a safety item is out of tolerance, (3) the PCM data train is out of synchronization, or (4) the 1-millisecond timer completes its count.

Components - The interface unit, as shown in Figure 5-11, will contain the following components:

- a. Input, sequence, and interlock-control registers
- b. Serial-to-parallel and parallel-to-serial conversion registers
- c. System timer
- d. Interrupt register
- e. Clock-generation circuits
- f. Line-driver and line-receiver circuits
- g. Level-conversion circuits
- h. Logic power supply.

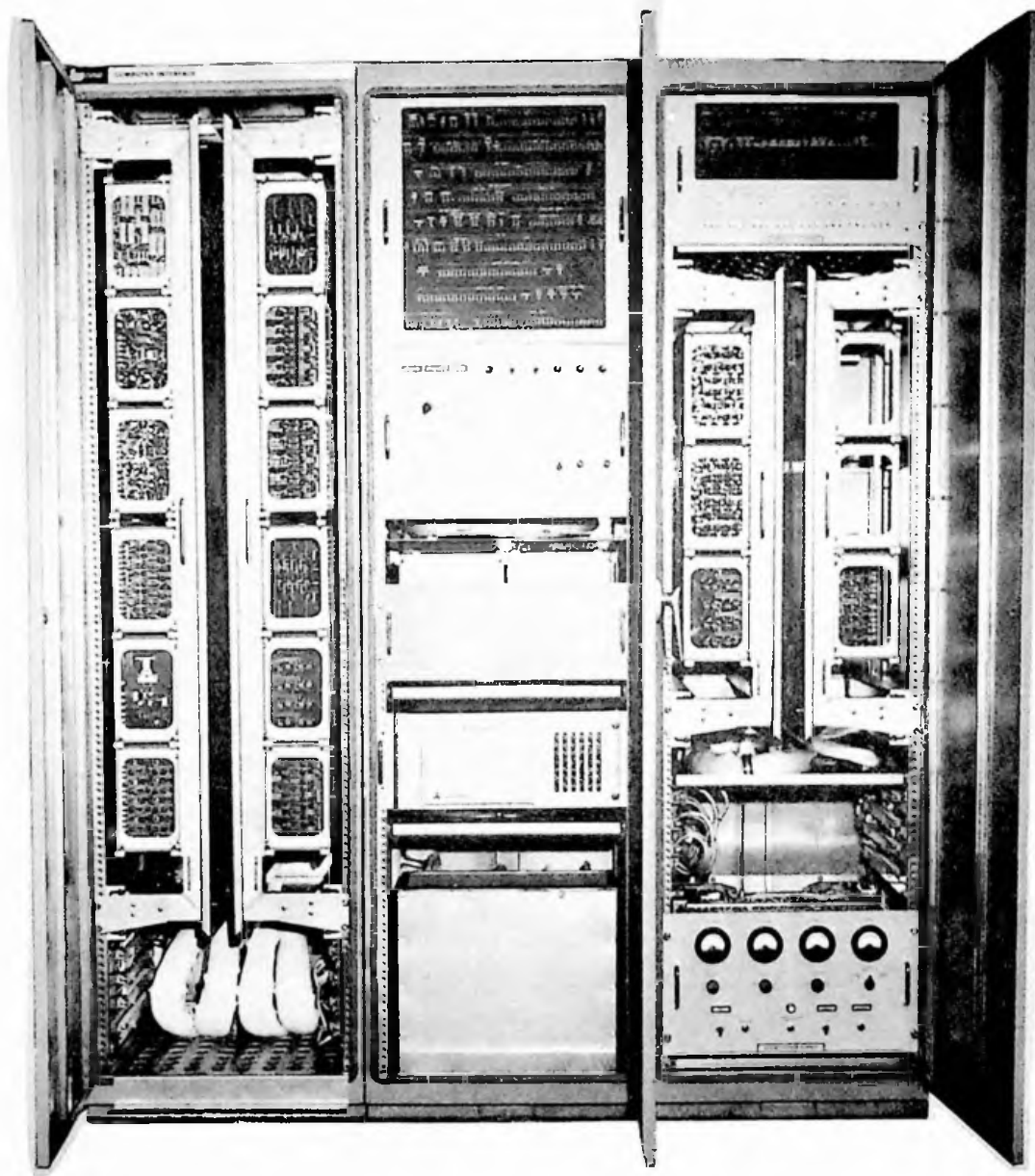
5.13 System Status Display Console (DSV-4B-120) 1A59938-1

Function - The function of the System Status Display Console shall be to present to operating personnel, and other interested observers, the status of that portion of the system under test or any other portion of the system desired by the operating personnel.

Design - The System Status Display Console will consist of three sub-assemblies - a control console, two bays containing the video generation and control logic, and a color television receiver. Ninety-six color slides (part of Electrical Accessories Checkout Kit, DSV-4B-184), will be used as static background information with alpha-numeric characters superimposed to present the dynamic data on the system under test. Any one of the ninety-six slides will be selected by either computer or manual control. (See Figure 5-12.)

Components - The System Status Display will consist of the following components:

- a. Revolving drum memory
- b. 35 mm slide projector
- c. Color television monitor
- d. Rack assemblies



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Figure 5-11. Computer Interface Unit (DSV-4B-118)

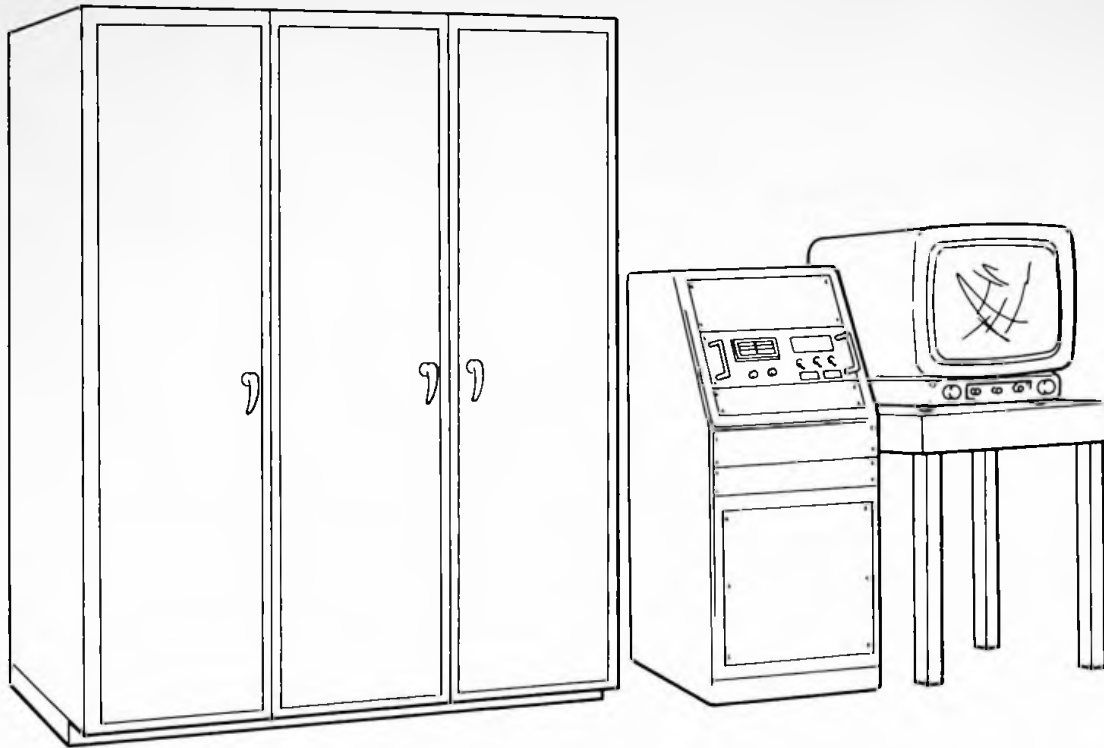


Figure 5-12. System Status Display Console (DSV-4B-120)

- e. Control console
 - 1. Indicators
 - (a) Line receiver disabled
 - (b) Self test enabled
 - (c) Dynamic test enabled
 - (d) Display operative
 - (e) Load mode
 - (f) Normal mode
 - (g) Operator/computer
 - (h) Computer slide number (numeric)
 - 2. Controls
 - (a) Manual slide select
 - (b) Enter
 - (c) Character position; horizontal and vertical.

5.14 Test Operator Station (DSV-4B-121) 1A59939-1

Function - The Test Operator Station shall function as the primary master control station for the automatic checkout system during all tests performed by the GSE. Controls and indicators will be provided to effectively operate and monitor the test functions when the master station is in control. Complete monitor facilities will be provided when control is assigned to one of the other three test stations.

Design - The station, as shown in Figure 5-13, will be designed to conduct checkout operations from one central location. Ease of maintenance will be provided by simulating computer transmissions to the automatic system. Test requests and commands for interruption or termination of a test will have priority over requests and commands generated at other test stations, even when an external station has been recognized by the test operator. The station will consist of two main units: the test operator console and the test operator logic unit. The console will provide control switches and indicators to monitor and control all computer operations. The logic unit will provide power supplies, logic circuits, and communication circuitry for interstation and checkout equipment operation. A detailed description of the console and the logic unit is given in the following paragraphs.

5.14.1 Test Operator Console

Function - The controls and visual displays of the console shall allow the test operator to exercise complete control of all tests. The console shall contain provisions for monitoring test results from the three external test stations. The operator will be able to assign priority and transfer the requests to the automatic system, or transfer the test control to a remote test station. In this event, the console shall serve as a monitor station, while retaining the capability of reassuming control.

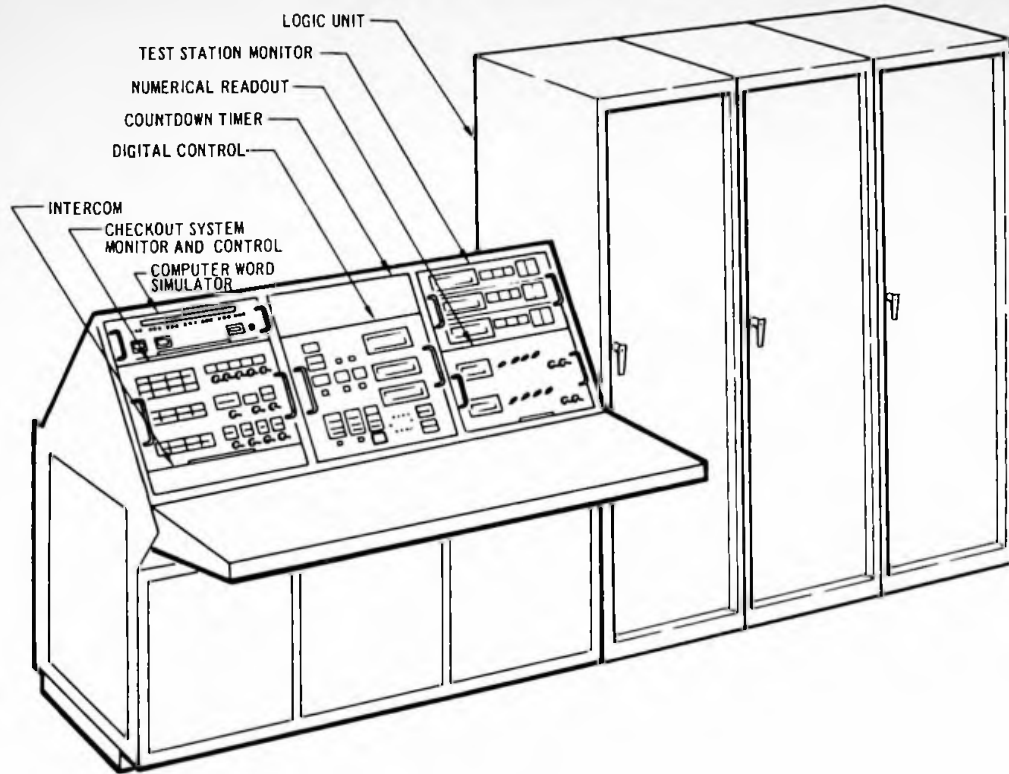


Figure 5-13. Test Operator Station (DSV-4B-121)

Components - The console will contain the following main panels:

- a. Digital control panel
- b. Test station monitor panel
- c. Checkout system monitor and control panel
- d. Computer simulator panel
- e. Numerical readout panel.

The above panels are described in the following paragraphs.

- a. Digital Control Panel - The digital control panel will contain numerical readout indicators and other displays to show the number of the test in progress, the next test to be processed, STOPS or HOLDS in the program, and the existence of any fault or malfunction detected by the system. Controls for initiating commands and test numbers will be provided.

This panel will contain the following controls and indicators:

Controls -

KEYBOARD SWITCHES - The keyboard will consist of eight pushbutton switches (from 0 through 7) which will allow entry of a test number into the computer in an octal format.

ENTER - The enter button will place the contents of the keyboard register into the external equipment.

RESET - The reset button will clear the keyboard register when an entry is to be changed.

HOLD - The hold switch will cause the automatic system to stop at the next hold point in the test program.

STOP - The stop switch will halt the automatic system at the next hold point in the test program, and return to a preprogrammed stop point.

EMERGENCY STOP - This switch will cause an immediate stop in the program and will cause the automatic system to perform a preprogrammed emergency shutdown routine.

RESUME - The resume switch will continue the test program after a HOLD or STOP has been initiated.

CLEAR - The clear switch will cause the automatic system to return to the starting point of a test program by executing all reset routines required to place the system in its initial state. This control will also remove a test request which has been entered but not processed.

ENABLE CONDITIONAL STOPS - This switch will cause the automatic system to halt at each programmed stop point to await action by the test operator.

ENABLE CONDITIONAL HOLDS - This switch will cause the automatic system to halt at each programmed hold point to await action by the test operator.

STORE PROGRAM POINT - The switch will cause the automatic system to halt and store its present program and to wait for the next operator request. After instructions from the operator are performed, the program will be returned to the stored program point when the switch is again operated.

Indicators -

TEST IN PROGRESS - This will be a six-digit octal numerical readout displaying the test identification number of the test being processed.

NEXT TEST - This will be a six-digit octal numerical readout displaying the identification number of the next test to be processed by the automatic system.

KEYBOARD - This will be a six-digit octal numerical readout indicating the last combination of octal digits inserted into the register from the manual keyboard.

HOLD, STOP, EMERGENCY STOP - These indicators will show when the automatic checkout system is in one of these conditions, and whether the condition was initiated by the operator or by the automatic system.

OLDSTOL ACTIVE - This indicator shows when the operator is on line from typewriter rather than from test operators console.

SIM DISABLED - This indicator shows when the computer will not accept any SIM Interrupts.

SINGLE STEP ACTIVE - This indicator shows that one step will be executed each time resume is pushed.

SIM INTERRUPT IN PROCESS - This indicator is to indicate 78 operator that SIM Interrupt has occurred and is being processed when it has been processed indicator will stay on and stop, hold or emergency stop will come on.

FAULT - This indicator will show that the automatic system has determined the existence of a fault or malfunction, and whether the fault is judged to be in the stage under test or in the automatic checkout system.

COMPUTER READY - This indicator illuminates when the computer is operative and capable of processing test programs on request.

CONDITIONAL HOLDS ENABLED, CONDITIONAL STOPS ENABLED, PROGRAM POINT STORED - These indicators will show when the automatic system is in one of these operating modes.

- b. Test Station Monitor Panel - The test station monitor panel will contain displays for (1) numerical readouts of test requests generated by the three external test stations and (2) indicators to monitor commands to the computer system from these external stations. Controls will be provided for the operator to transfer the test numbers requested by external test stations to the automatic system during periods when the test stations are not enabled for direct entry. The following controls and indicators will be provided on the panel:

Controls -

ENTER AND WAIT - These controls will be used by the test operator for action on the test number indicator in response to requests appearing on displays.

TEST STATION ENABLE - This control will be used to allow an external station to enter a request appearing on the numerical readout directly into the automatic system.

Indicators -

TEST NUMBER (six digit, octal) - This indicator will show the test requested by the operator at each external test station.

HOLD, STOP, EMERGENCY STOP, MANUAL CONTROL SWITCH ACTIVATED, MANUAL CONTROL SWITCH OFF - These indicators will accompany each test number display to show when any of the test stations have initiated such conditions.

- c. Checkout System Monitor and Control Panel - Controls provided on this panel (as listed below) will be for manual control to safe the stage in an emergency.

Controls -

ENABLE-OFF-DISABLE - This switch will provide the capability of manual control from the external test stations.

MANUAL CONTROL ACTIVATE - This control applies 28 vdc to the external equipment. (Five ON-OFF switches will be provided to control the input power to the following power supplies: GSE power supply, forward No. 1, forward No. 2, aft No. 1, and aft No. 2.)

ENABLE/DISABLE ON-OFF - These switches will enable or disable the backup power of the above power supplies.

STAGE EXTERNAL COMMAND POWER - This switch will apply the GSE power supply output to the stage forward and aft command buses.

COMPUTER (OPERATIVE, INOPERATIVE) RESET - This switch will turn off computer inoperative indicator and will turn on computer operative indicator.

Indicators -

An "operative" (white) condition will be displayed for the following:

1. Computer interface unit (DSV-4B-118)
2. Stimuli signal conditioner (DSV-4B-130)
3. Response signal conditioner (DSV-4B-131)
4. Safety-item monitor (DSV-4B-135)
5. Test operator logic unit (no model number)
6. DDAS ground station (DSV-4B-123)

7. PAM/FM/FM telemetry ground station (DSV-4B-125)
8. Range safety command destruct receiver component test set (DSV-4B-219)
9. Instrument unit substitute (DSV-4B-267)
10. System status display (DSV-4B-120)

LOCAL-SENSE, BACK-UP POWER ON - These amber indicators will be provided for the GSE and Forward power supplies. Only LOCAL SENSE will be provided for the 56-volt aft No. 2 power supply.

ENABLED-DISABLED - These indicators will reflect manual control status of the remote test stations.

ACTIVATED - This indicator will show manual control status of the Test Operator Station.

FORWARD ON, AFT ON - These indicators will show the status of stage external power.

- d. Computer Simulator Panel - The computer simulator panel will provide for (1) parallel entry of 24-bit words to the system on Channel 6, and (2) indicators to monitor system responses or data requests on Channel 5.

Controls -

ON-OFF - This switch enables operation. Twenty-four toggle switches (numbered 0 to 23 from right to left) will be provided for manual insertion of word bits.

ENTER - This pushbutton control will allow parallel transfer of the 24-bit word to the Computer Interface Unit.

INPUT RESUME - This pushbutton control will simulate the command normally generated by the computer.

Indicators - Twenty-four lamp indicators will be provided to monitor the computer interface outputs on Channel 5.

An amber ON indicator will show when the computer simulator panel is activated.

- e. Numerical Readout Panel - Two sets of the following controls and indicators will be provided on the numerical readout panel.

Controls -

DATA REQUEST SELECT - This selector switch will allow the operator to enter octal four-digit request number.

DATA REQUEST INITIATE - This toggle switch will allow transfer of the data request to the external equipment.

ENABLE CONTINUOUS REQUEST - This toggle switch will provide for a continuous updating of the requested data.

Indicators -

DATA VALUE - This four-character, alpha-numeric display will show information received as a result of a data request by the operator.

5.14.2 Test Operator Logic Unit

Function - The Test Operator Logic Unit (TOLU) shall provide a digital communication link between all test stations and the external equipment. The TOLU shall also provide storage for information and commands generated by the test operator console (TOC) (and other test stations), and shall have a remote automatic control capability which may be used by certain end-items. The TOLU shall contain an internal panel for rapid determination of faults occurring within the unit.

Components - The TOLU will consist of the following three racks of equipment:

- a. Rack No. 1: This rack will contain all the magnetic latching relays used in decoding and storing information from the four test station consoles.
- b. Rack No. 2: This rack will consist of two power supplies - one to provide the power for the logic unit circuits, and the other to provide voltage for numerical indicators on the four test station panels.
- c. Rack No. 3: This rack will contain the solid-state circuitry for the receiving and transmitting register. Switch scanning, encoding, decoding, and storage circuits will also be included.

5.15 Digital Data Acquisition System Ground Station (DSV-4B-123)
1A59941-1

Function - The function of the Digital Data Acquisition System (DDAS) Ground Station shall be to receive PCM data from a stage telemetry system and demodulate the data for individual channel analysis. The input signal shall be a serial-commutated pulse train. The incoming data shall be regenerated and sent to external areas for computer storage and analysis. The ground station shall be capable of converting

PCM data to analog information for transfer to external display units. The control switching for remote or local operation of the ground station shall also be provided.

Design - The ground station will be designed to be compatible with the Computer Interface Unit and will provide data and sync indication to the Computer Interface Unit. Processing of input data will be required from only one source at a time. Open-loop and closed-loop RF transmission from the stage will be routed to the receiver front-end for demodulation. All closed-loop inputs will be routed through the source-selector coaxial switch, and from there to the pre-detection module in the receiver. The receiver input selection will have a calibrate position for coupling a precise frequency to the receiver for calibration.

The PCM serial data will be supplied to the ground station by one of the following sources:

- a. RF transmission (open-loop);
- b. RF transmission, by coaxial cable (closed-loop);
- c. RF (600 KC) directly from the voltage-controlled oscillator composite outputs by coaxial cable (closed-loop); (these composite outputs will be processed through the receiver second IF before decommutation);
- d. PCM/FM data from a digital data simulator located in the station equipment;
- e. Playback PCM data from the Telemetry Magnetic Tape Unit.

The ground station will contain a receiver to demodulate the RF signal and distribute it to the decommutation equipment. The output from the receiver will be made available for magnetic recording. The ground station will be contained in three 6-foot equipment racks, with cooling blowers included for proper ventilation.

Components - The ground station, as shown in Figure 5-14, will be contained in three standard 6-foot equipment racks. The components will include:

- a. FM Receiver
- b. Bit Synchronizer

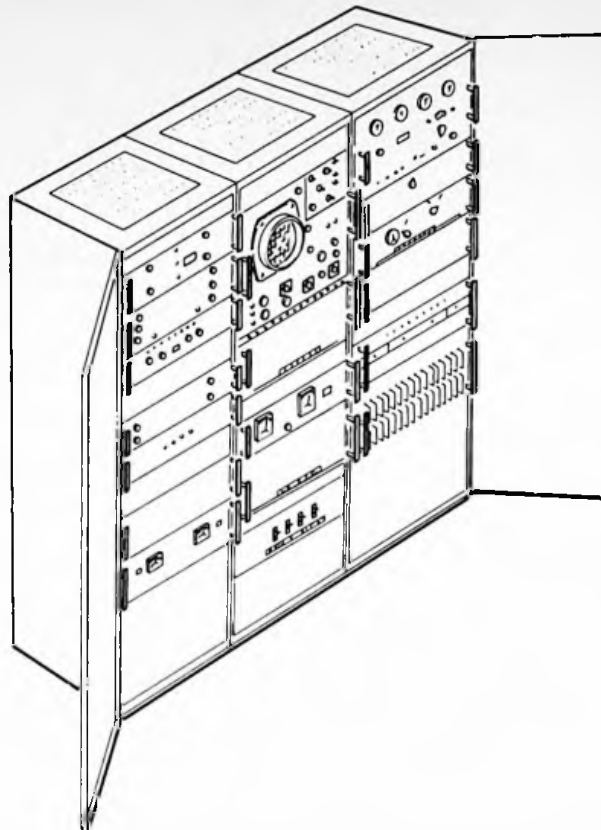


Figure 5-14. Digital Data Acquisition System Ground Station (DSV-4B-123)

- c. Correlator
- d. Data Control Unit
- e. Data Switch Unit, including an 816-pin patchboard
- f. Quick-look display unit
- g. Twenty digital-to-analog modules and calibrators
- h. Data register (8-ten bit words)
- i. Discrete drawer
- j. Power Supplies
- k. Digital Signal Simulator
- l. Source Selector
- m. RF Switch
- n. Computer Interface Drawer.

5.16 PAM/FM/FM Telemetry Ground Station Assembly (DSV-4B-125) 1A59942-1

Function - The function of the PAM/FM/FM Telemetry Ground Stations Assembly shall be to act as a monitoring and receiving station for frequency-modulated data from the PAM/FM/FM and FM/FM stage telemetry transmission

systems. The incoming PAM data will be digitized and transmitted to the computer. FM/FM data will also be transmitted to the computer upon request. The individual channels will be displayed locally on a raster monitor, or sent to external areas for recording and display purposes, as determined by the ground station control networks. Operation of the station shall be controlled either locally or remotely through the automatic computer system.

Design - The ground station, as shown in Figure 5-15, will be designed to accept multiplexed data and demodulate the data for further processing. The ground station will be designed to receive data in the following forms:

- a. Closed-loop and open-loop frequency-modulated RF signals by the ground station antenna and direct coaxial cable;
- b. Composite FM subcarrier frequencies from the stage by coaxial cable;
- c. Composite FM subcarrier frequencies from the Magnetic Tape Unit Wideband Recorder (DSV-4B-127).

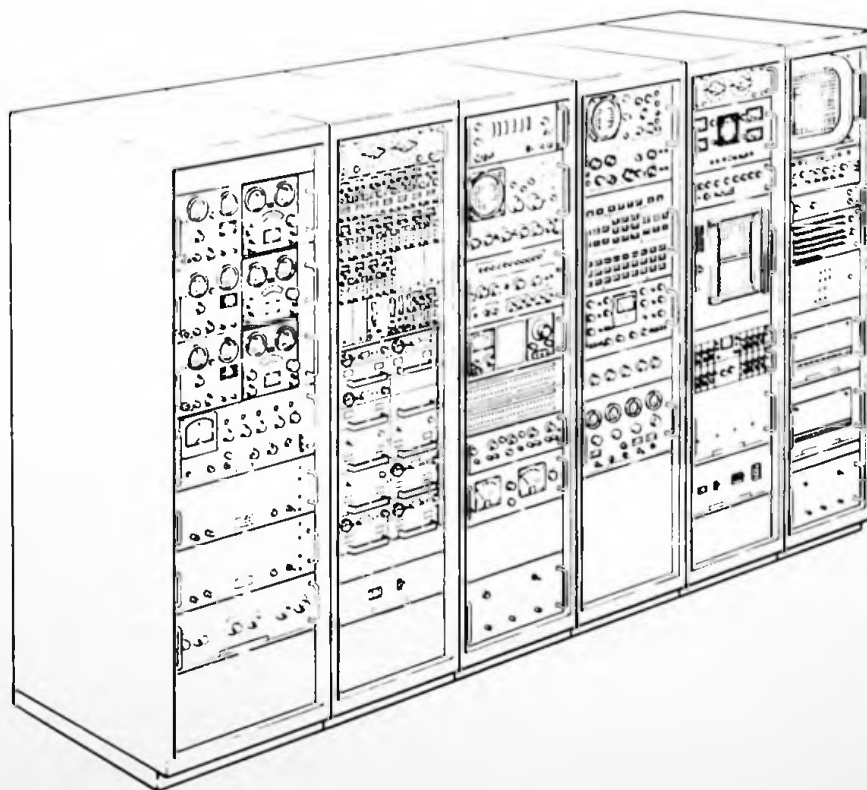


Figure 5-15. PAM/ FM/FM Telemetry Ground Station Assembly (DSV-4B-125)

The ground station will be capable of receiving data simultaneously from three telemetry transmitting systems. The FM signal from each source will be demodulated in a separate receiver, the outputs of which will be made available to the Magnetic Tape Unit Wideband Recorder and a selector switch. The selector switch will allow the operator or computer to select any one of the receiver outputs or tape inputs for discrimination. The station will contain discriminators for the standard IRIG channels 1 through 18, plus three 70-kc (± 30 percent) channels. Standard discriminator analog outputs will be connected to a patch panel for discriminator adjustment and display accessibility. The nonstandard discriminator output will be routed to decommutation equipment for further processing and system use.

Components - The ground station will be contained in six standard 6-foot equipment racks. The components of the station will include receivers, discriminators, decommutation subsystem, intercom, cathode ray tube displays, and the necessary power supplies, logic, and switching circuits to ensure optimum station performance during normal operation.

5.17 FM Telemetry Single Sideband Station (DSV-4B-126) 1A59943-1

Function - The function of the FM Telemetry Single Sideband Station shall be to act as the receiving station for SS-multiplexed signals from the stage SS/FM telemetry transmission subsystem. The incoming data will be demultiplexed and demodulated into individual channels. The receiver output will be routed to the Telemetry Magnetic Tape Unit and to the single-sideband demultiplexer. The demultiplexer channels will be displayed locally on an oscilloscope and routed to external areas for further processing. Operation of the station shall be controlled manually by the operator.

Design - The ground station will be designed to accept multiplexed data and demultiplex the data for use in the system. The ground station will be designed to receive data in the following forms:

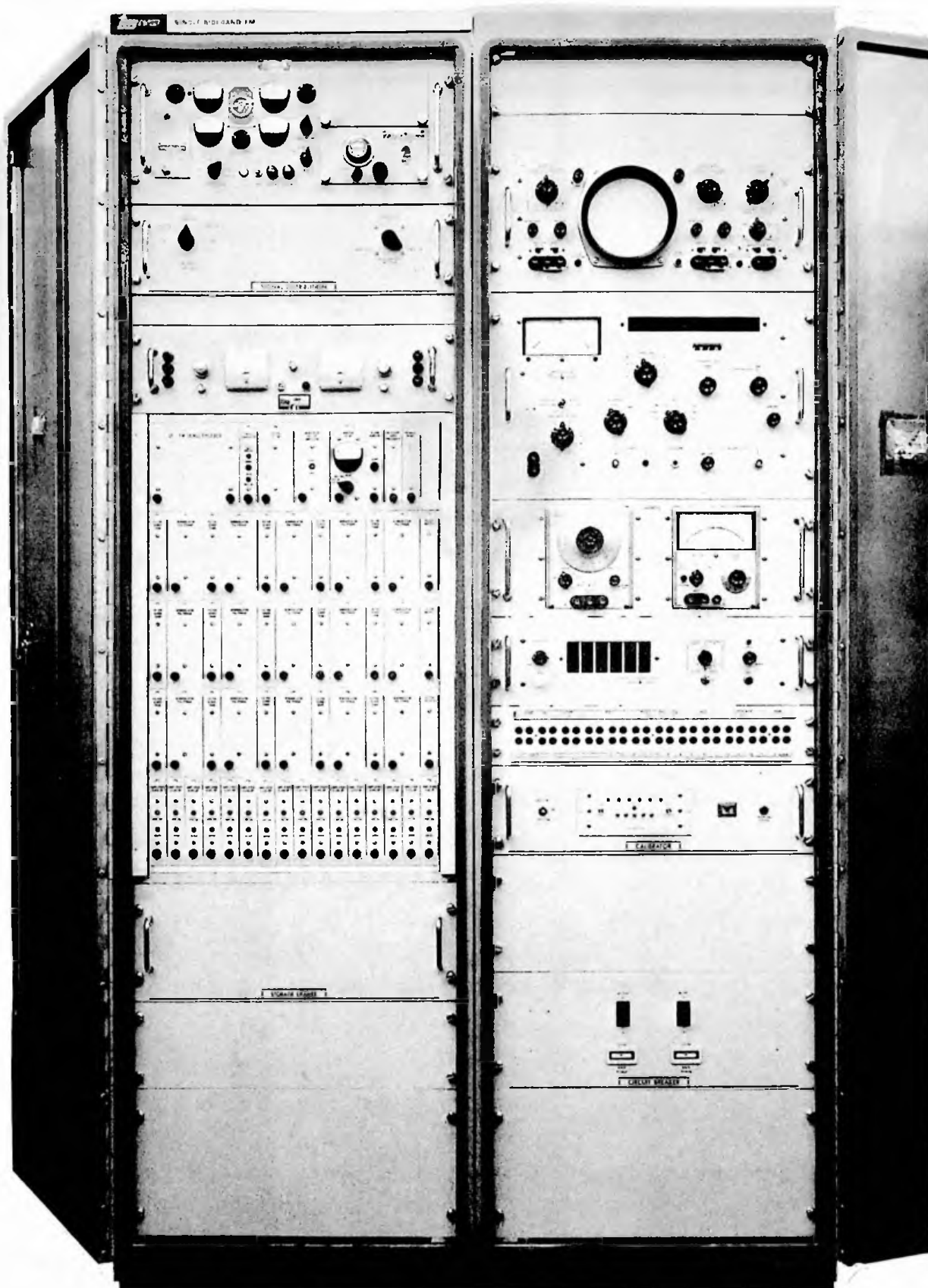
- a. SS/FM signals by open loop and closed loop;
- b. Complex SS signals from the stage by coaxial cable;
- c. Complex FM signals from the telemetry tape unit.

The ground station will be capable of receiving and demodulating incoming RF signals from the stage telemetry system. The receiver will be switchable for open-loop or closed-loop RF reception. A selector switch will select receiver output or will direct composite signals from the stage. The output of the switch will be the input of the single-sideband demultiplexer. The single-sideband signals will be recorded on the Telemetry Magnetic Tape Unit, with signals provided by two paths. The two FM signals, modulated with the single-sideband composite, will be selectable through a coaxial switch. When open-loop or closed-loop RF signals are available, the recorder signals will be supplied from the receiver. When a signal is available as a direct video composite, the signal will be directly recorded. The controls and indicators required for proper operation of the ground station will be provided on the equipment panels.

Components - The ground station, as shown in Figure 5-16, will be contained in two standard 6-foot equipment racks. The components of the station will include a receiver, demultiplexer, frequency counter, vacuum tube voltmeter, oscilloscope, sweep oscillator, RF switch, RF patch panel, IRIG discriminator and the necessary power supply to operate the ground station.

5.18 Magnetic Tape Unit Wideband Recorder (DSV-4B-127) 1A77890-1

Function - The function of the Magnetic Tape Unit Wideband Recorder shall be to receive and store telemetered signal data for eventual playback and data analysis. The signal data will be supplied to the recorder unit from the output of the RH receivers, bit synchronizer, and time-code generator. During playback, the stored data will be sent to decommutators,



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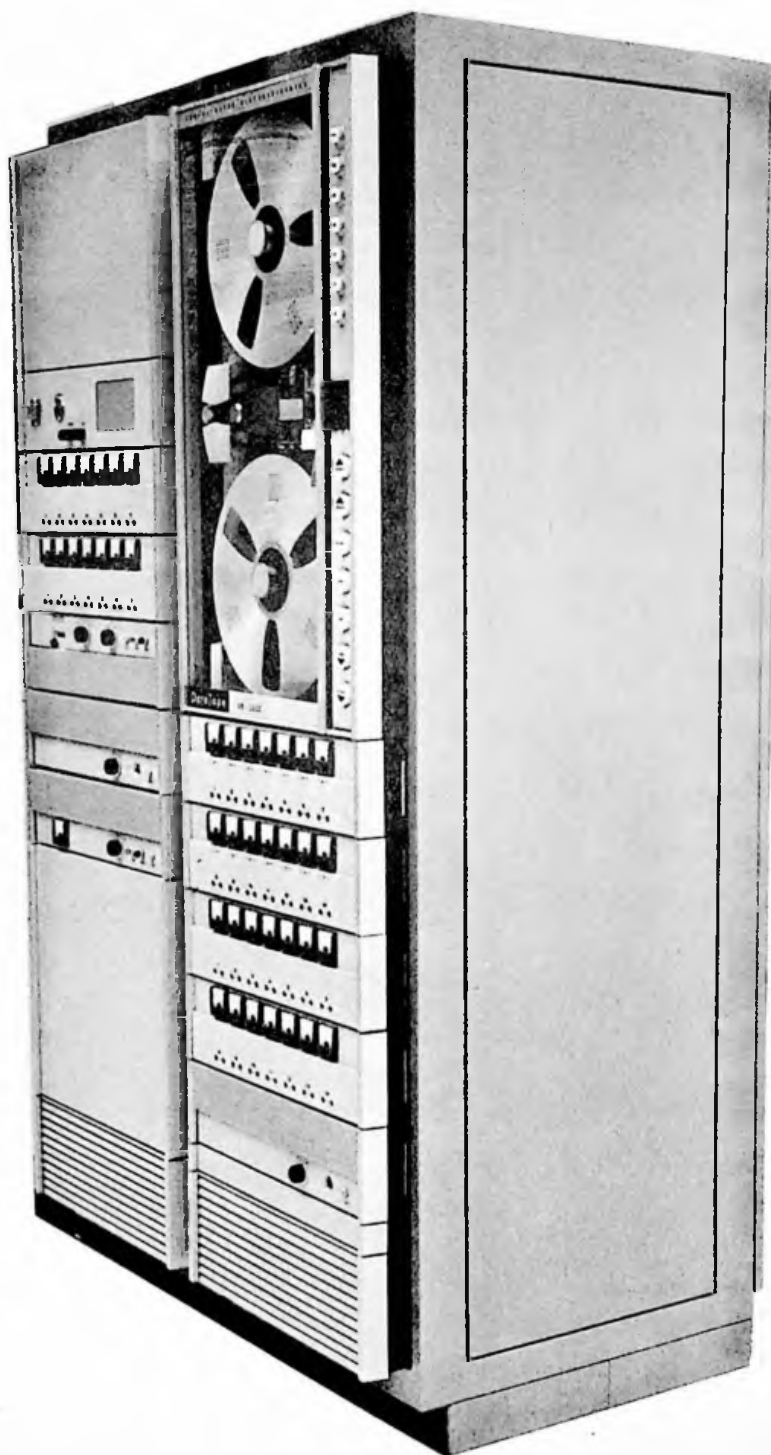
Figure 5-16. FM Telemetry Single Sideband Station (DSV-4B-126)

a demultiplexer, and subcarrier discriminators. A description of the receiving, storage, and playback capabilities of the unit are given in the following subparagraphs.

- a. PAM/FM data will be received by direct-record electronics through three channels of composite information. The unit shall record the data for playback. The composite will consist of standard IRIG subcarrier channels 2 through 14, plus a 70-kc channel.
- b. PCM data will be received on one channel by FM electronics and recorded by the unit for playback.
- c. SS/FM data, consisting of 15 data channels, a service channel, and one 76-kc pilot tone, will be received by FM electronics and one channel and recorded for playback.
- d. Central time and speed control servo signals will be received by direct-record electronics through a single-input channel and recorded for playback.

Design - The recorder/reproducer portion of the unit will be designed as a 14-track recorder capable of operation using standard 1-inch magnetic tape on 14-inch reels. The recorder will be capable of (1) operation at any one of several selectable tape speeds and (2) either on-line or off-line operation. During off-line playback, the tape will be run back and forth through the unit by means of a tape shuttle, using manual tape-footage counters as search end-points. The data stored on the magnetic tape will be made available at the data outputs by integral-reproduce electronics. A data output will be provided for each data channel. These outputs will deliver the data to various electronic subassemblies for further processing. The unit will be capable of complete local control, as well as partial control by the computer. Partial control will consist of enabling or disabling the record function, i.e., starting and stopping the tape in the record mode. The unit will be contained in two 6-foot racks.

Components - The unit, as shown in Figure 5-17, will contain a recorder/reproducer tape transport, a tape degausser, and the necessary electronic and mechanical assemblies required for proper operation. A control panel containing the individual controls for the different modes of operation will also be provided as part of the unit.



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Figure 5-17. Magnetic Tape Unit Sideband Recorder (DSV-4B-127)

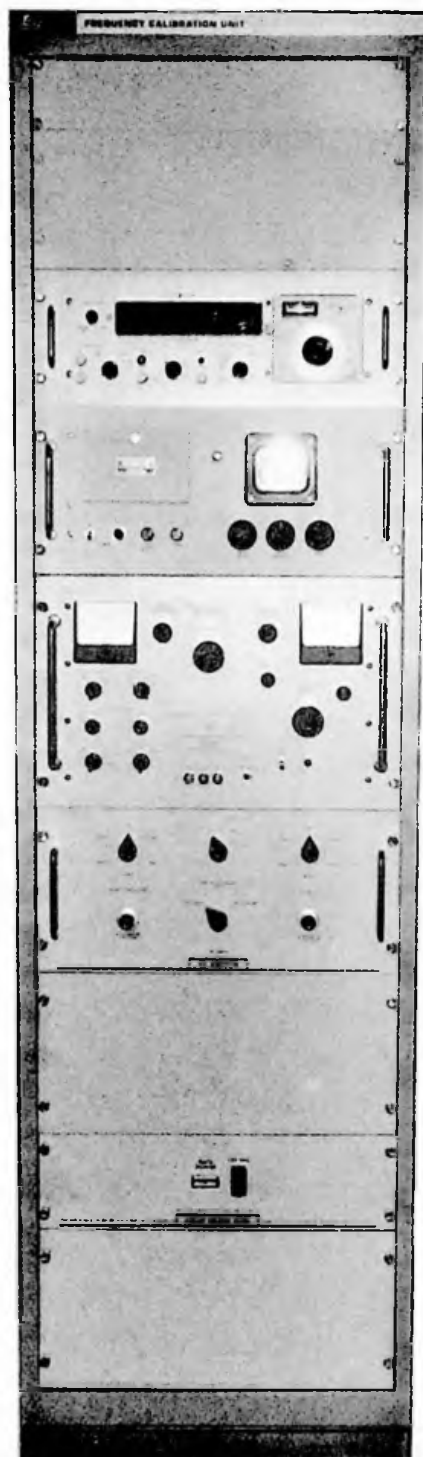
5.19 Frequency Calibration Unit Rack Assembly (DSV-4B-128) 1A72909-1

Function - The function of the Frequency Calibration Unit Rack Assembly shall be to measure the frequency of the telemetry signals received by each telemetry ground station. The unit shall also supply frequencies to calibrate the telemetry signals. The unit shall be manually controlled and shall contain the necessary equipment to measure and display the RF signals received.

Design - The unit will be designed to display and measure the frequency of a 30-mc (megacycle) signal supplied by the first IF amplifier in each telemetry receiver. This signal will be coupled to a 30-mc bandpass amplifier and shown on a spectrum display unit through coaxial switches. The 30-mc amplifier, with a bandpass of 0.25 mc, will be used to improve the selectivity of the frequency measuring system by reducing adjacent channel cross-talk. The output of the 30-mc bandpass amplifier will be coupled to an electronic counter which will display the first IF frequency received. The spectrum display will provide a visual image of the spectrum in the 30-mc range, and will provide an indication of the signal to which the receiver is tuned, as well as an indication of the adjacent frequencies. The complete unit will be mounted into a standard 6-foot equipment rack. The unit is shown in Figure 5-18.

Components - The unit will contain a frequency measuring section, a spectrum display section, and a standard frequency section. The rack panels comprising the unit are described in the following paragraphs:

- a. Frequency measuring panel - This panel will contain a numerical, frequency-counter readout and the necessary controls and indicators to maintain proper operation of the frequency-measuring section during receiver calibration.
- b. Spectrum display panel - This panel will contain a modular cathode ray tube unit capable of panoramically displaying a wide range of frequencies in the 30-mc range. The cathode ray tube module will contain the controls and indicators required for normal display and frequency adjustment.
- c. Coaxial switch panel - This panel will contain an RF switch to (1) supply the receivers with signal-generator output and (2) switch the receiver IF's into the circuit for calibration and frequency measurement.



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Figure 5-18. Frequency Calibration Unit Rack Assembly (DSV-4B-128)

- d. Signal generator panel - This panel will contain a commercial signal generator which will have variable frequency in the required ranges and FM modulation capability at selected deviation.

5.20 Stimuli Signal Conditioner (DSV-4B-130) 1A59946-1

Function - The function of the Stimuli Signal Conditioner shall be to generate hardline stimuli for testing of stage hardware. The stimuli conditioner shall be capable of (1) simulating signals normally received from the stage instrument package and (2) supplying control signals to test stand and facilities units to complement automatic testing of the stage system.

Design - The stimuli conditioner will be designed to receive and interpret the digital, serial-form computer commands, and to apply the appropriate stimuli to the stage subsystems upon computer command. The digital inputs will be converted to the proper hardline output through decoding, gating, digital-to-analog conversion, or special circuitry to supply the proper output for each digital input. The hardline signals will be supplied to other parts of the system. The conditioner will supply one type of bilevel command where signals form and duration do not have rigid tolerance levels; it will supply another type of bilevel command to operate solid-state loads. The signal form for solid-state loads is critical; the duration tolerance will be specified in milliseconds.

In addition, the stimuli conditioner will be capable of supplying various types of analog signals to the external equipment. When the digital input is received by the stimuli conditioner, the conditioner will determine whether the required output is to be analog or bilevel. When the required output is analog or close-tolerance bilevel, the conditioner will decode the subaddress part of the input for the proper output conversion.

Gating will be provided in the stimuli conditioner to switch the output to the proper lines when the decoding operations have been completed. Decoding and switching operations will be performed to control the electro mechanical loads in the external equipment.

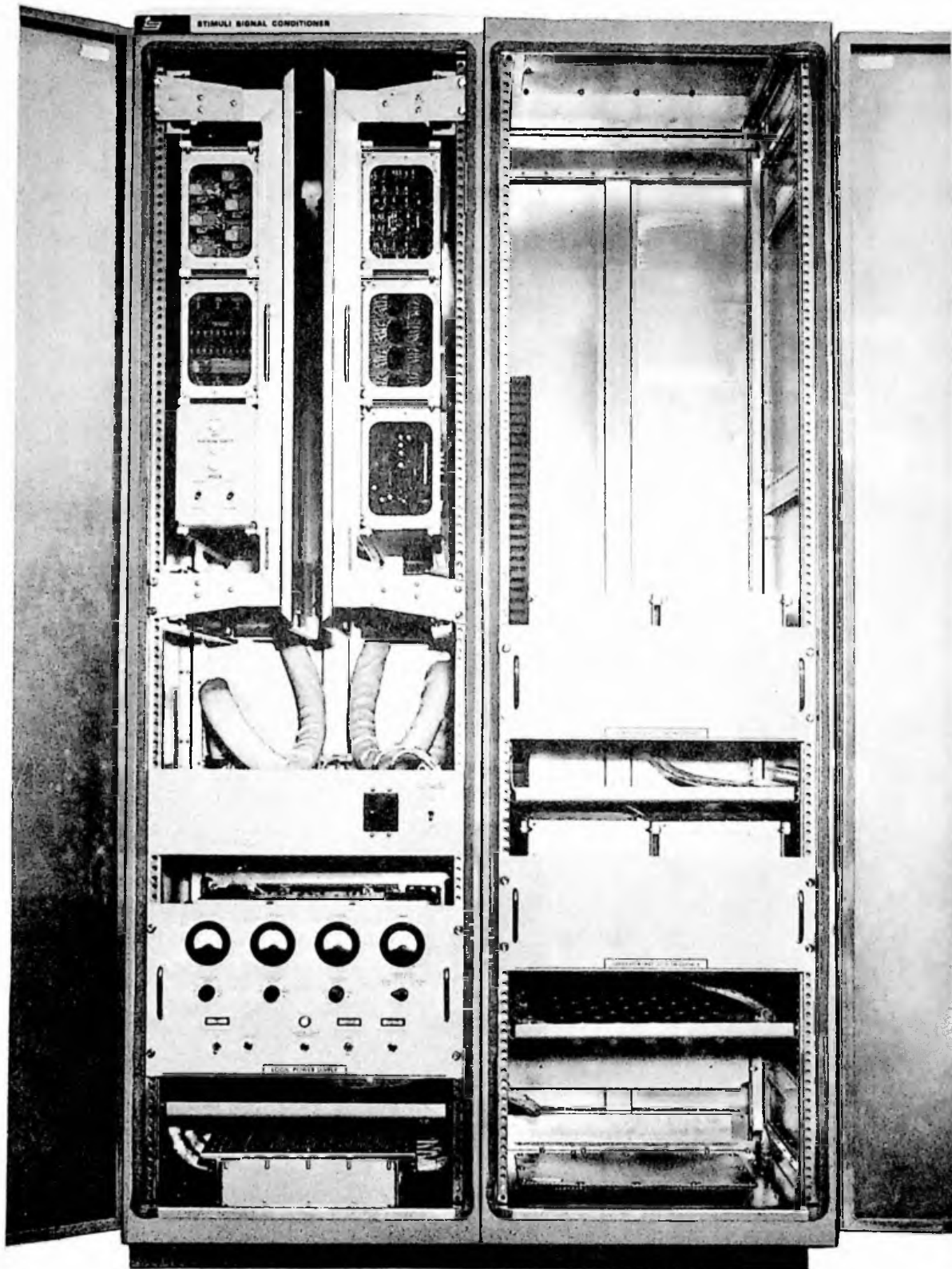
Components - The stimuli conditioner, as shown in Figure 5-19, will consist of the following major components:

- a. Relay drivers
- b. Programmable voltage supplies
- c. Reference supplies
- d. Memory devices to provide static control of relays on the basis of transient set and reset commands
- e. Address-recognition and element-selection logic
- f. Power supply for relay banks and drivers, and separate regulation for externally supplied power.

5.21 Response Signal Conditioner (DSV-4B-131) 1A59947-1

Function - The function of the Response Signal Conditioner shall be to (1) provide the necessary signal isolation and buffering to condition the stage and facility signals, (2) convert analog and bilevel signals from the electromechanical portion of the system into digital information, and (3) transfer this information to the digital portion of the system. The conditioner shall digitize conditioned signals (as required) for automatic control and response evaluation during testing, and shall select the appropriate analog signal or group of discrete signals as requested by the Computer Interface Unit.

Design - The response conditioner will be designed to normalize all signals and digitize all hardline analog signals emanating from the stage. The conditioner will contain (1) an analog multiplexer and an analog-to-digital converter to select and digitize analog signals, (2) bilevel sensors and a bilevel multiplexer to select and convert bilevel signals to digital data, (3) logic and control circuitry to accomplish decoding and selection of the required data, and (4) input-output circuitry to communicate with the external digital equipment. When the response conditioner receives a serial digital data request from the external equipment, it will decode the request to determine the particular information requested. After multiplexing and digitizing the information, the conditioner will present a digital data word representing this information into an output register. The original address and the resulting



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Figure 5-19. Stimuli Signal Conditioner (DSV-4B-130)

data word will be stored in the output register and transmitted to the external equipment.

Components - The response conditioner, as shown in Figure 5-20, will consist of the following major components:

- a. Dc isolator - conditioner circuits
- b. Digital control logic
- c. Multiplexer
- d. Analog-to-digital converter
- e. Input-decoding logic
- f. Power supply.

5.22 Ground Equipment Test Set (DSV-4B-132) 1A59948-1

Function - The function of the Ground Equipment Test Set shall be to provide an overall check of the GSE system when the stage is not connected. The test set (with a proper self-test program) shall be capable of

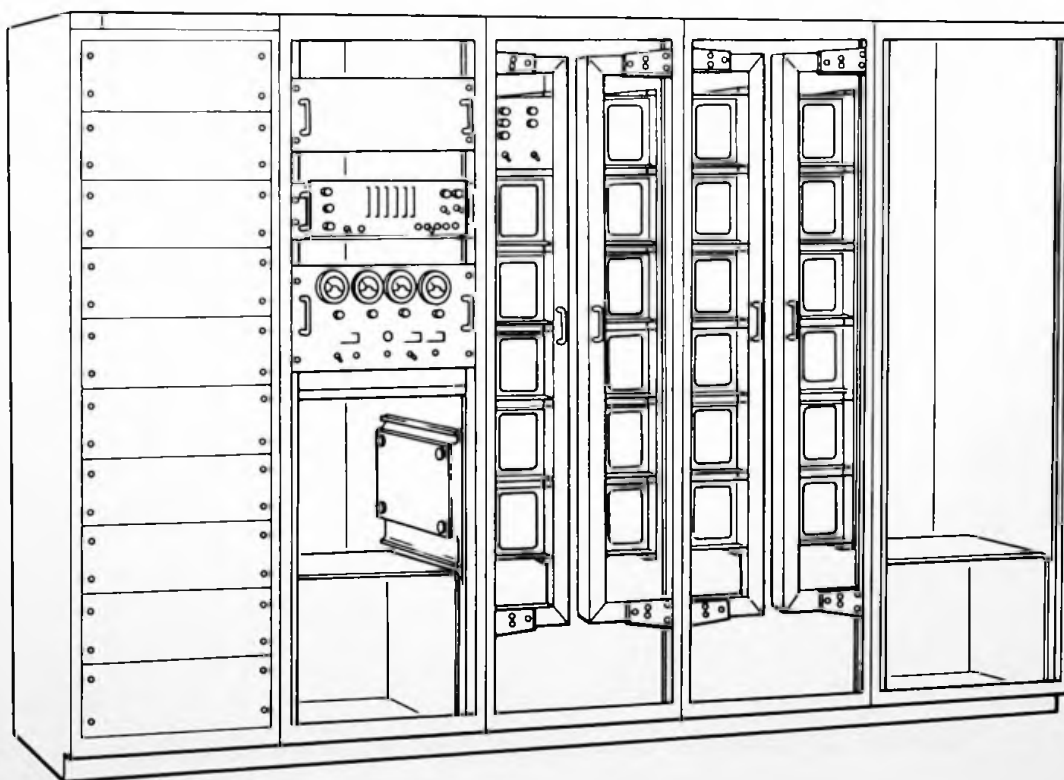


Figure 5-20. Response Signal Conditioner (DSV-4-131)

verifying the satisfactory operation of that portion of the GSE not checked or verified by the self-test programs and routines of the automatic system.

Design - The test set will be designed to perform checkout procedures involving proper utilization of patchboards, patch cords, connectors, and the necessary cabling and wiring for their interconnection. Since the test set will contain no active electromechanical components, the performance characteristics of the test set will be passive in nature. The test set will be designed to include a signal distribution unit and the cables and receptacles normally connected to the stage. The test set will also include routing and patching of discrete signals. The patchboards will contain a code for identifying all connection points. Connections between points will be made by patch cords. (Patch boards are part of Electrical Accessories Checkout Kit, DSV-4B-184.)

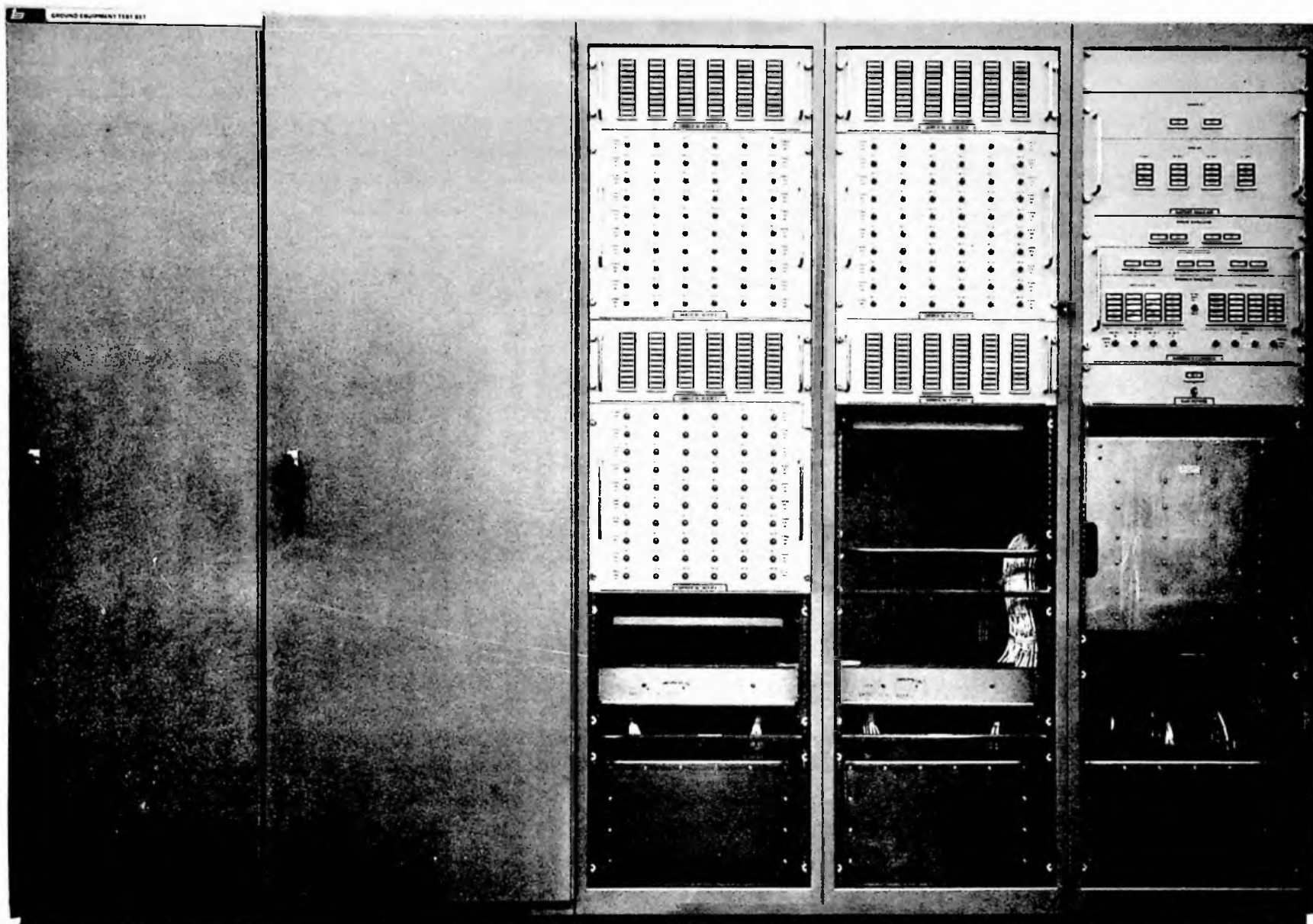
Components - The test set, as shown in Figure 5-21, will consist of five racks of equipment and will contain the following major components:

- a. Interconnecting cables
- b. Signal distribution unit.

5.23 Signal Distribution Box (DSV-4B-133) 1A59949-1

Function - The function of the Signal Distribution Box shall be to provide (1) an end distribution point between the GSE and the stage and (2) control switching and sequencing required for proper routing and application of signals. The box shall perform switching and distributing functions for fault-isolation and calibration purposes, and shall provide redundant manual control of interlocking critical functions, as may be required by the appropriate patching of relay provided for this purpose.

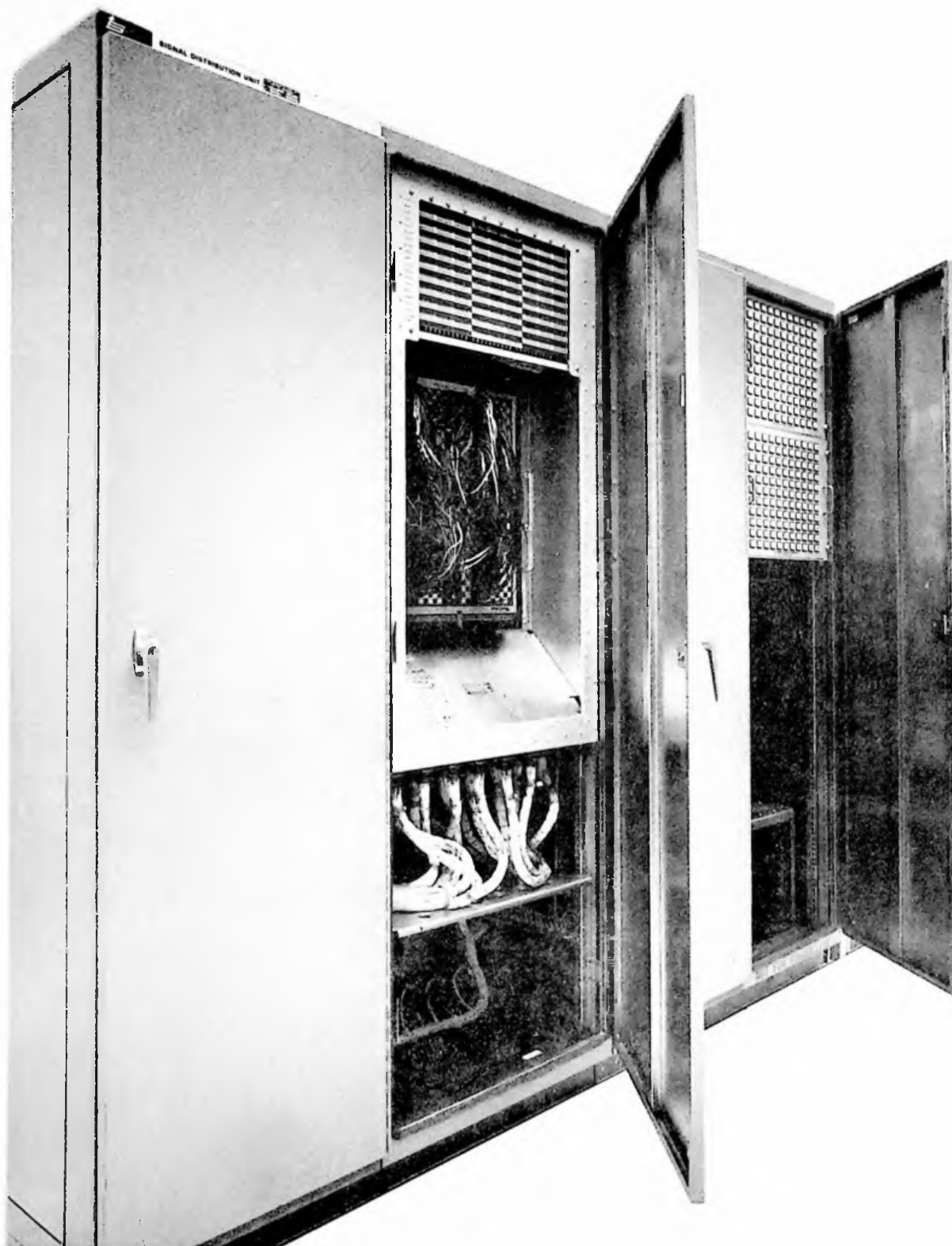
Design - The box, as shown in Figure 5-22, will be designed to accomplish the above functions through control relays, the coils of which will be arranged electrically in matrix form. The relay matrix arrangement will form a portion of a master matrix which will be controlled by external equipment. The control switching of high-current circuits will be



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Figure 5-21. Ground Equipment Test Set (DSV-4B-132)

DS-2164(A)



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Figure 5-22. Signal Distribution Box (DSV-4B-133)

performed through the matrix, as will the manual equipment switching between the stage and GSE. The box will be contained in two groups of four standard 72-inch equipment racks. The controls will be accessible and easily read from the front. In addition, the box will be designed to:

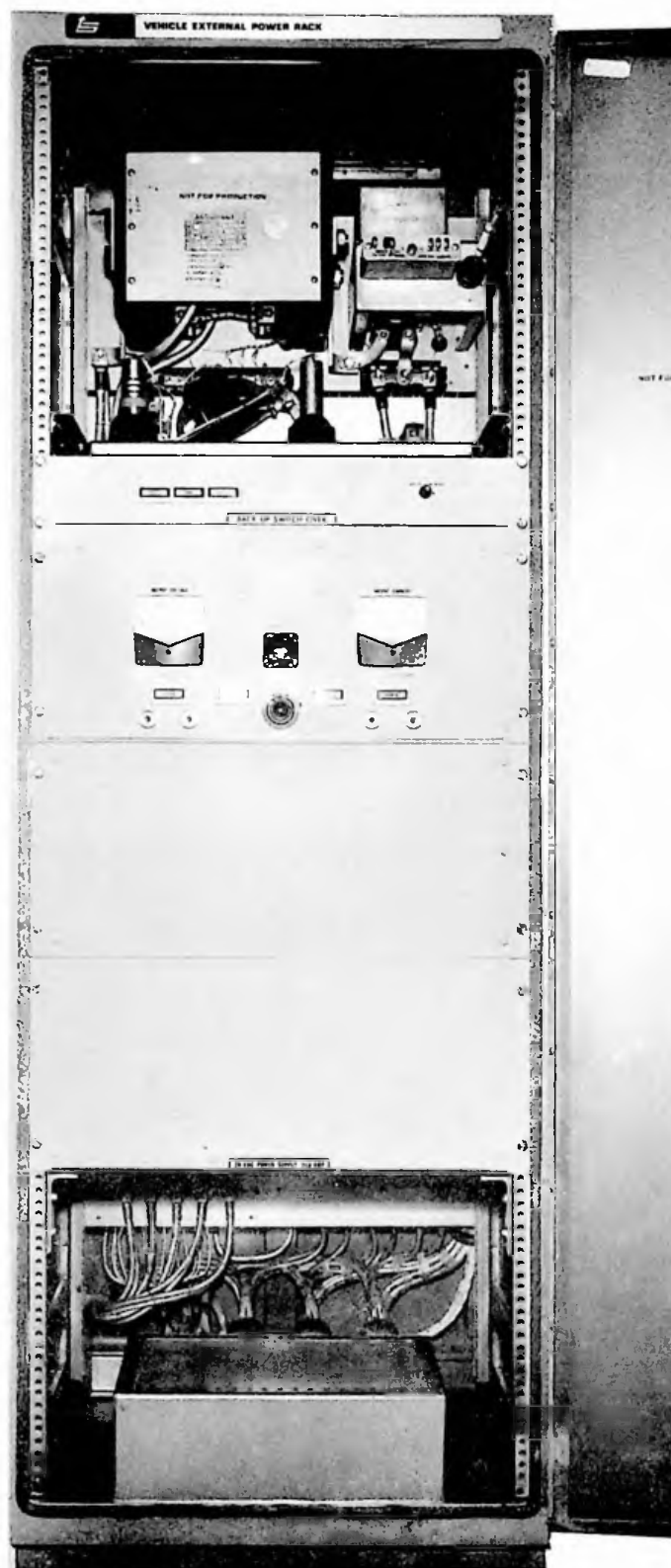
- a. Distribute power to switching relays which control circuits of 1 ampere or greater;
- b. Electrically disconnect hardwires (interface or umbilical) which would be disconnected at launch; (This operation will be normally controlled from the computer program, although manual control of the stage disconnect will be possible when the system is not under computer control; interlocks will be provided to prevent manual intervention when the system is under control of the computer.)
- c. Provide test points to isolate problems between the stage and GSE without disconnecting any cables to the stage;
- d. Perform switching of stage control and response lines between the automatic GSE and test stand manual control.

Components - The box will contain the necessary electronics and logic circuitry to ensure proper performance during system operation.

5.24 Vehicle External Power Racks (DSV-4B-134) 1A59950-1

Function - The function of the Vehicle External Power Racks shall be to provide ground power source for the stage systems and GSE. The regulated power supplied by the power racks will also be used within the GSE as a simulated stage internal power source. Four of the five power racks shall contain a Solid State Switching Unit to (1) sense the dc level of the power source and (2) switch the input to an emergency battery backup (Emergency Battery Rack Assembly, SACTO, DSV-4B-287 and Emergency Battery Power Unit, HB, DSV-4B-288) when the level is not within the predetermined tolerance levels.

Design - The power racks, as shown in Figure 5-23, will be designed to provide primary power and the circuitry necessary to switch to backup power for all 28-vdc stage busses. The power supplies will be backed up with a separate battery source (DSV-4B-287 and DSV-4B-288) during hot-firing operations in case of a power supply malfunction. The power



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Figure 5-23. Vehicle External Power Racks (DSV-4B-134)

rack will provide switching for remote start-and-stop control from either the automatic GSE or the manual test stand equipment. In addition, the power rack will provide remote or local sensing and will supply an indication of this sensing to the automatic GSE. An indication will also be provided to the GSE when the power source has been transferred to the emergency batteries. The power supplies will be contained in five 24-inch standard component racks.

Components - The Vehicle External Power Racks will consist of the following components:

- a. Receptacles
- b. Chassis
- c. Contactors
- d. Resistors
- e. Relays
- f. Four 28-vdc power supplies
- g. One 56-vdc power supply
- h. Cabinet (5-single bay AMCO racks)
- i. Diodes
- j. Silicon-controlled rectifiers
- k. Fans.

5.25 Safety-Item Monitor (DSV-4B-135) 1A59951-1

Function - The function of the Safety-Item Monitor shall be to provide a continuous check of all parameters within the external equipment classified as safety items, and to provide information to external equipment when a malfunction exists or when a tolerance deviation is sensed. (A safety item, as used herein, is defined as an item which would cause equipment damage or injury to personnel during a malfunction or operational failure.) The monitor shall also provide (1) isolation between the stage and the computer portion of the GSE system, (2) level sensing of all safety-items on a parallel basis, and (3) there shall be an inhibit capability for each input.

Design - The monitor, as shown in Figure 5-24, will be designed to determine potential safety hazards by continuously comparing actual inputs with expected inputs. Information on the expected state of each parameter will be supplied to the monitor by the external equipment and stored for the comparison routine. When comparison is unfavorable, indicating the existence of a potential hazard, a signal will be sent to the computer via the CIU for action. The monitor will be capable of inhibiting the output information during the period required to change the values of the anticipated signals. The output information will also be inhibited during the change in the state of monitored parameters.

The monitor will contain flip-flops to serve as memory elements for all safety functions. The indicators will be externally arranged so that (1) state comparison may be accomplished by the operator at the same time the electronic state comparison takes place internally, and (2) the state of the input-receiving register may be determined.

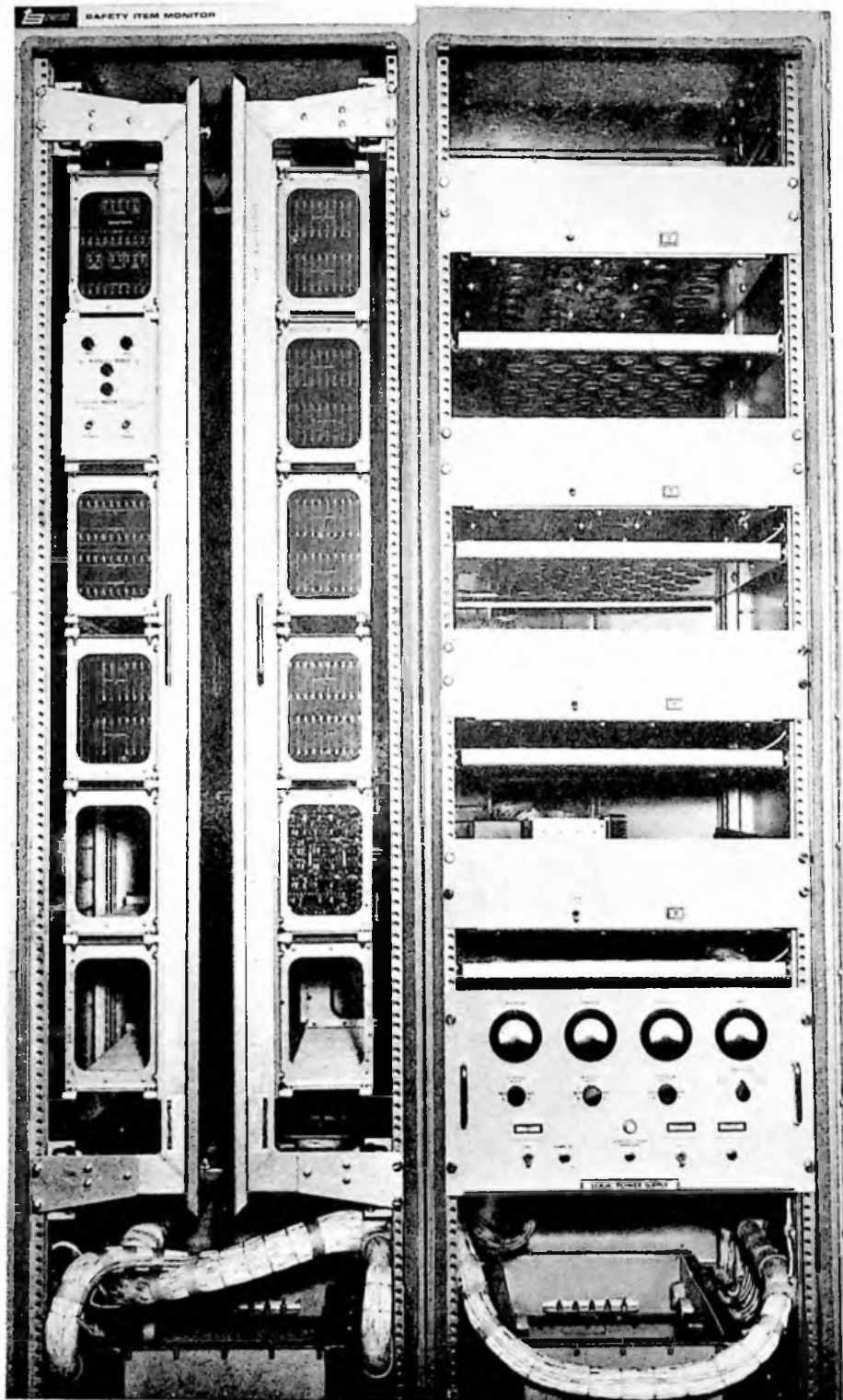
Components - The monitor will contain the following components:

- a. Dc isolator - conditioner circuits
- b. Ac isolator - comparator circuits
- c. Input decoding logic
- d. Digital control logic
- e. Logic power supply
- f. Analog power supply.

5.26 Destruct System Test Set (DSV-4B-136) 1A59952-1

Function - The function of the Destruct System Test Set shall be to provide RF stimulation (via open loop or closed loop) to the stage destruct system so that the test set controllers and the input sensitivity of the receivers may be tested.

Design - The test set, as shown in Figure 5-25, will be designed to (1) transmit modulated RF signals to the stage and (2) select the modulation frequencies by remote addressing and manual switching. The test



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Figure 5-24. Safety-Item Monitor (DSV-4B-135)

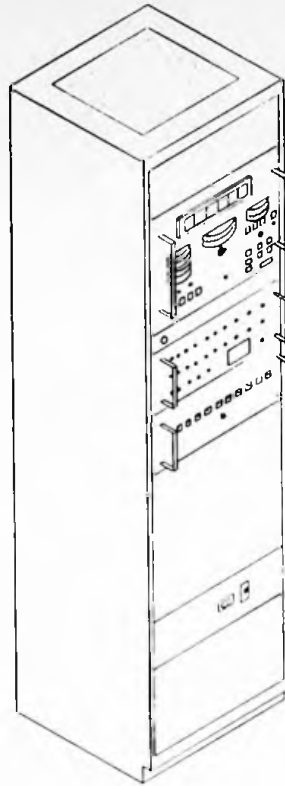


Figure 5-25. Destruct System Test Set (DSV-4B-136)

set will be designed similar to the comparable model on the S-IV Program, except that the test set will be capable of remote control by the automatic checkout system.

Components - The test set will contain the following major components:

- a. Signal generator
- b. Audio-frequency coder
- c. Encoder indicator panel
- d. Test code plugs (GFE).

5.27 Stage Checkout Cable Network, HB-VCL 2 (DSV-4B-139) 1A69542-1

Function - The function of the HB-VCL-2 Stage Checkout Cable Network shall be to provide electrical interconnection of the GSE test stations and the stage or unit under test.

Design - The cables will be of standard design with molded end assemblies. Junction boxes will be used (as required) to change cable sizes.

Components - Number, type, and size of conductors and length of cable will be determined by design requirements.

5.28 A3-SIL Cable Network Kit (DSV-4B-140) 1A67113-1

Except for identification, the function, design and components of this cable network will be similar to Model DSV-4B-139.

5.29 Stage Checkout Cable Network, HB-VCL-1 (DSV-4B-141) 1A69543-1

Except for identification, the function, design, and components of this cable network will be similar to Model DSV-4B-139.

5.30 Cable Network Kit, Beta 1, SACTO (DSV-4B-142) 1A83831-1

Function - The function of the SACTO Beta 1 Cable Network Kit shall be to provide electrical interconnections outside of the control center to the stage under test. (This kit interfaces with SACTO Beta 1 Control Room Cable Network Kit, DSV-4B-145.)

Design - The cables will be of standard design with molded end assemblies. Junction boxes will be used (as required) to change cable sizes.

Components - Number, type, and size of conductors and length of cable will be determined by design requirements.

5.31 Cable Network Kit, Beta 3 Test Stand, SACTO (DSV-4B-143) 1A69544-1

Except for identification, the function, design, and components of this cable network will be similar to Model DSV-4B-142. (This kit interfaces with SACTO Beta 3 Control Room Cable Network Kit, DSV-4B-144.)

5.32 Cable Network Kit, Beta 3 Control Room, SACTO (DSV-4B-144) 1A69545-1

Function - The function of the SACTO Beta 3 Control Room Cable Network Kit shall be to provide electrical interconnections inside of the Control Center.

Design - The cables will be of standard design with molded end assemblies. Junction boxes will be used (as required) to change cable sizes.

Components - Number, type, and size of conductors and length of cables will be determined by design requirements.

5.33 Cable Network Kit, Beta 1 Control Room, SACTO (DSV-4B-145) 1A83830-1

Except for identification, the function, design, and components of this cable network will be similar to Model DSV-4B-144.

5.34 HB-VCL-2 Stage Checkout Area Patch Panel Distribution Box (DSV-4B-146) 1A59944-1

Function - The function of the HB-VCL-2 Stage Checkout Patch Panel Distribution Box shall be to allow connection of conductors from the GSE to conductors of the stage. The distribution box shall also provide an interface between the GSE and facility items.

Design - Each checkout and testing area will require five bays of cabinets - two for bilevel and three for analog signal patching. Amplifiers for both gain and isolation will be used as signal conditioning units. The distribution box will be contained in a standard 72-inch rack.

Components - The distribution box, as shown in Figure 5-26, will consist of the following components:

- a. Patch cords*
- b. Patchboards*
- c. Receptacles

*These components are part of Electrical Accessories Checkout Kit Model DSV-4B-184.



SSC007565 Figure 5-26. HB-VCO-2 Stage Checkout Area Patch Panel Distribution Box (DSV-4B-146)

- d. Rack assemblies
- e. Internal wiring.

5.35 Patch Panel Distribution Box (DSV-4B-147) 1A59956-1

Except for identification, the function, design, and components of the distribution box will be similar to Model DSV-4B-146. (See Figure 5-26.)

5.36 HB-VCO-1 Stage Checkout Area Patch Panel Distribution Box
(DSV-4B-148) 1A59957-1

Except for identification, the function, design, and components of the distribution box will be similar to Model DSV-4B-146. (See Figure 5-26.)

5.37 SACTO Beta 1 Test Stand Patch Panel Distribution Box
(DSV-4B-149) 1A59958-1

Except for identification, the function, design, and components of the distribution box will be similar to Model DSV-4B-146. (See Figure 5-26.)

5.38 SACTO Beta 3 Test Stand Patch Panel Distribution Box
(DSV-4B-150) 1A59959-1

Except for identification, the function, design, and components of the distribution box will be similar to Model DSV-4B-146. (See Figure 5-26.)

5.39 SACTO Beta 1 Control Room Patch Panel Distribution Box
(DSV-4B-151) 1A59960-1

Except for identification, the function, design, and components of the distribution box will be similar to Model DSV-4B-146. (See Figure 5-26.)

5.40 SACTO Beta 3 Control Room Patch Panel Distribution Box
(DSV-4B-152) 1A59961-1

Except for identification, the function, design, and components of the distribution box will be similar to Model DSV-4B-146. (See Figure 5-26.)

5.41 Range Time Generator (DSV-4B-153) 1A59962-1

Function - The function of the Range Time Generator shall be to provide a reference real time for use during stage checkout at HB and SACTO.

Design - The generator will be designed to generate and display range time, and will be capable of manual reset, start, and stop. The generator will have several outputs so that digital clocks in several locations may be controlled by the single generator.

Components - The generator, as shown in Figure 5-27, will include the following components:

- a. Timing generator
- b. Display units
- c. Interconnecting cables
- d. Distribution units.

5.42 Simulated Flight Battery Power Unit (DSV-4B-170) 1B39147-1

Function - The function of the Simulated Flight Battery Power Unit shall be to provide dc power to the stage during simulated flight checkout. The unit shall be connected to the stage through the simulated Forward and Aft Busses Battery Power Distribution Unit (DSV-4B-284). Model DSV-4B-170 also provides emergency battery power for the stage external power rack (DSV-4B-134) and is included as part of Models DSV-4B-287 and -288.

Design - The unit will be designed to provide the necessary connectors, electrical equipment, and dc batteries to furnish power to the stage during a simulated flight test. The unit will be a four-wheeled cart with a stationary locking mechanism. The cart will hold four 15-volt batteries which may be coupled together to form two 30-volt units. The batteries will provide power to the following:

- a. Stage forward No. 1 bus - 80 amps at 28 vdc for one hour;
- b. Stage forward No. 2 bus - 8 amps at 28 vdc for one hour;



- c. Stage aft No. 1 bus - 100 amps at 28 vdc for 45 minutes, and 112 amps at 28 vdc for 5 minutes;
- d. Stage aft No. 2 bus - 127 amps at 56 vdc for 35 minutes, with 600-amp surges decaying to 127 amps in 5 seconds.

Each 30-volt unit will have an 80-amp/hour power capacity and will provide dual 30-volt electrical outputs.

This unit, when used as part of Models DSV-4B-287 and -288, will be designed to provide emergency battery power for the stage external power rack (DSV-4B-134) in case of a power supply failure.

Components - The unit, as shown in Figure 5-28, will consist of the following major components:

- a. Cart
- b. Four 15-volt batteries with connectors
- c. Cables, connectors, etc.

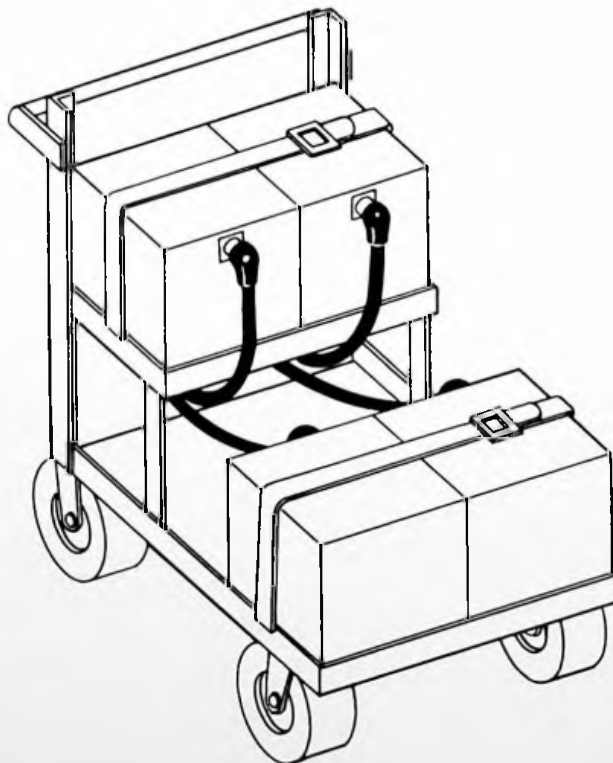


Figure 5-28. Simulated Flight Battery Power Unit (DSV-4B-170)

5.43 Simulated Flight Battery Maintenance Unit (DSV-4B-171) 1B39148-1

Function - The function of the Simulated Flight Battery Maintenance Unit shall be to maintain the Simulated Flight Battery Power Units (DSV-4B-170), SACTO Emergency Battery Rack Assembly (DSV-4B-287), and HB Emergency Battery Power Unit (DSV-4B-288).

Design - The simulated Flight Maintenance Unit, as shown in Figure 5-29, will be designed to provide charging, trickle charging, and discharging of the above batteries. Each Simulated Flight Battery Maintenance Unit will be designed to consist of the following units:

- a. Two chargers, each capable of charging a complete Simulated Flight Battery Power Unit within 12 hours, will be contained within separate free standing racks.
- b. Two trickle chargers, each capable of trickle charging two Simulated Flight Battery Power Units, will be contained in separate wall mounted cabinets.
- c. One discharger, capable of discharging and checking the capacity of one 15-volt, 80 amp/hour battery, will be contained within a free standing rack.

Components - The simulated flight battery maintenance unit will consist of the following components:

- a. Three free standing racks
- b. Two wall mounted cabinets
- c. Two trickle chargers
- d. Two chargers
- e. One discharger and load bank
- f. Interconnecting cables and connectors
- g. Load bank ventilating fans.

5.44 Engine Sideload Recorder (DSV-4B-172) 1B42535-1

Function - The Engine Sideload Recorder, rack mounted, shall provide a visual and permanent record of the engine side loads. The amplified outputs of the unlatch restrainer kit load cells will be displayed on a strip chart.

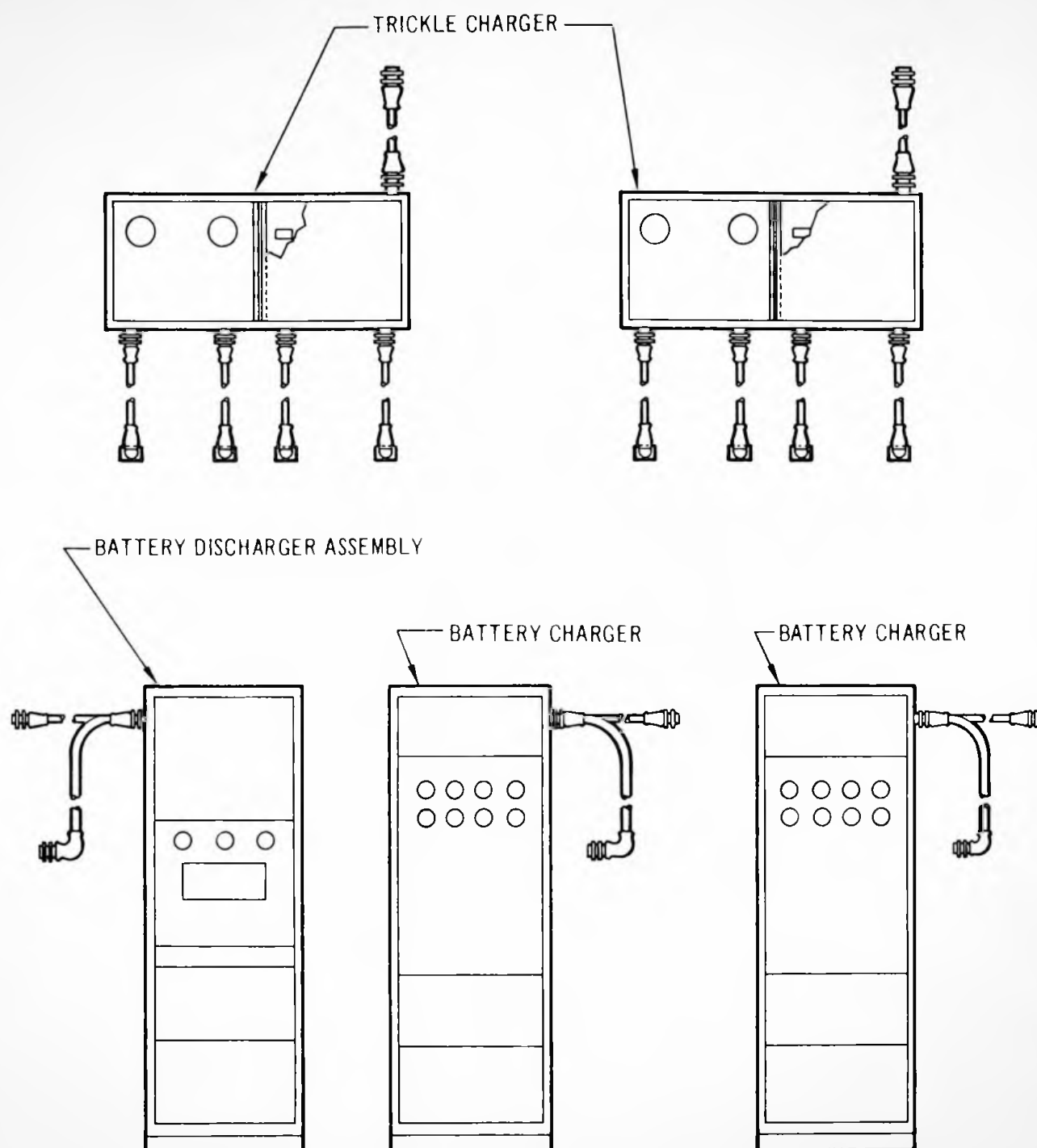


Figure 5-29. Simulated Flight Battery Maintenance Unit (DSV-4B-171)

Design - The recorder will be designed to provide the necessary records and time generation to record the engine side loads with respect to real time. The recorder will be capable of accepting a minimum of eight (8) inputs of 0 ± 5 volts and a range time second marker signal. (See Figure 5-30.)

Components - The recorder will consist of the following components:

- a. Recorder
- b. Power supply
- c. Enclosure - rack frame (Amco Engr. R.I. Series 1400)
- d. Panels
- e. RFI shielding and bonding in accordance with established standards
- f. Lift hooks - hooks or eyelets shall be incorporated in the top to facilitate handling.

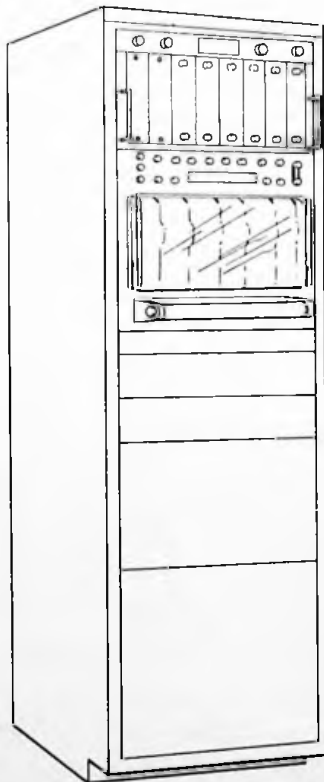


Figure 5-30. Engine Sideload Recorder (DSV-4B-172)

5.45 SACTO VCL Cable Network (DSV-4B-173) 1B51207-1

Function - The function of the SACTO VCL Cable Network shall be to provide electrical interconnection of the GSE test stations and the stage or unit under test.

Design - The cables will be of standard design with molded end assemblies. Junction boxes will be used (as required) to change cable sizes.

Components - Number, type, and size of conductors and length of cable will be determined by design requirements.

5.46 SACTO VCL Patching Panel (DSV-4B-174) 1B39756-1

Function - The function of the SACTO VCL Patching Panel shall be to allow connection of conductors from the GSE to conductors of the stage. The distribution box shall also provide an interface between the GSE and facility items.

Design - The checkout and testing area will require five bays of cabinets - two for bilevel and three for analog signal patching. Amplifiers for both gain and isolation will be used as signal conditioning units. The distribution box will be contained in a standard 72-inch rack.

Components - The distribution box will consist of the following components:

- a. Patch cords*
- b. Patch boards*
- c. Receptacles
- d. Rack assemblies
- e. Internal wiring

(*These components are part of Electrical Accessories Checkout Kit DSV-4B-184.)

5.47 Vehicle Transportation Instrumentation Kit (DSV-4B-175) 1B39697-1

Function - The Vehicle Transportation Instrumentation Kit shall be used in conjunction with the NASA furnished Instrumentation Trailer and Power Unit, to monitor the Saturn S-IVB Stages on all phases of water and land transportation. The system monitors such parameters as temperature, pressure, vibration and relative humidity during the stage shipments. The kits shall be utilized as rotational equipment and shall be removed from the stage and returned to A3 at the completion of each shipment.

Design - The kit will be designed to be compatible with the Douglas stage instrumentation requirements. The design will include transducers, cables, bracketry and interface hardware. The transducers will consist of accelerometers for vibration measurements on the tank skin, engine area, skirt area and cradles; relative humidity sensors to measure the percent relative humidity under the covers at either end of the stage; temperature probes to measure temperature at either end of the stage; differential pressure transducers to measure the difference in pressure between the tank interior and the ambient air. The cables will connect the transducers to the NASA trailer to provide excitation and signal lines. The cables will also provide a permanent connection to the stage so that instrumentation can be accomplished during transfer and lifting operations to and from the transportation vessel. Attenuator and remote control boxes used as interface hardware will also be used in the NASA trailer to allow the automatic operation of the recording equipment whether the operator is present or not. (See Figure 5-31.)

Components - The instrumentation kit will consist of the following components:

- a. Vibration accelerometers (16)
- b. Differential Pressure Transducers (2)
- c. Temperature Sensors (2)
- d. Relative Humidity Sensors (2)
- e. Signal Attenuator Box, including 14 cable assemblies (1)
- f. Tape Recorder Remote Control Box, including 3 cable assemblies (1)

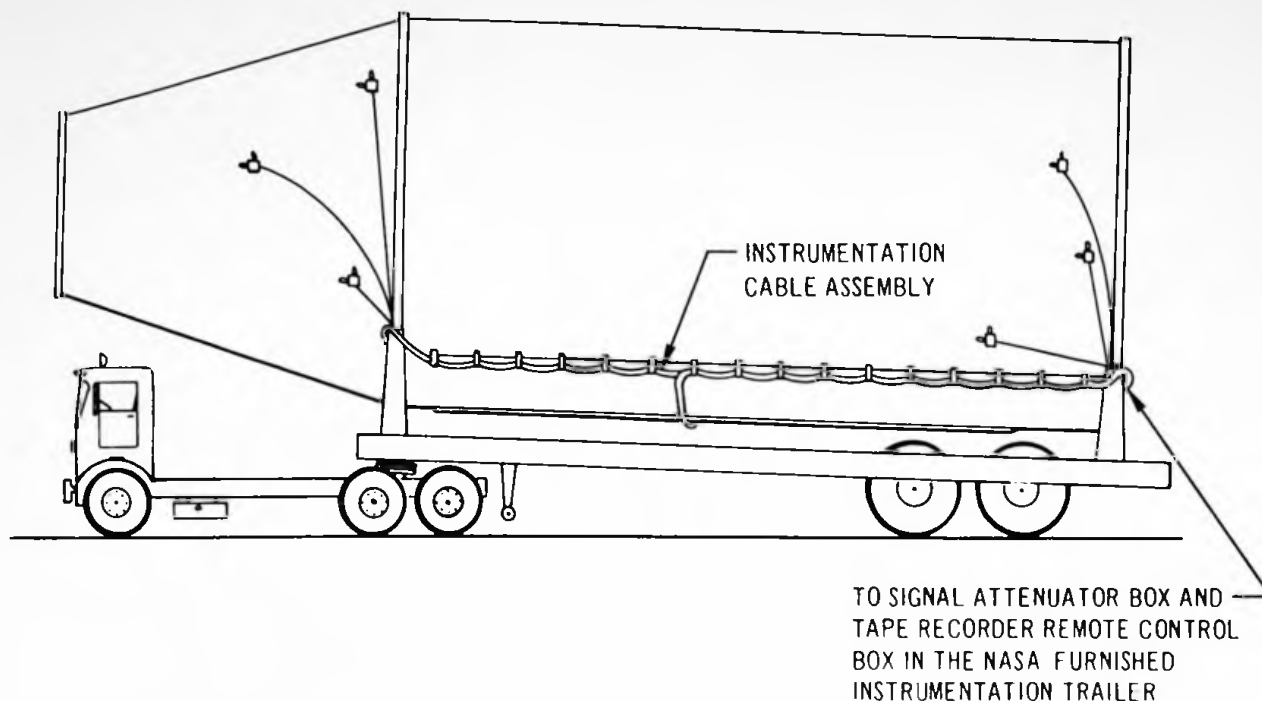


Figure 5-31. Vehicle Transportation Instrumentation Kit (DSV-4B-175)

- g. 200 ft cable assemblies (25)
- h. 10 and 25 ft jumper cable assemblies (25)
- i. Cable adapters for support of 200 ft cables (2).

5.48 Simulated Flight Test Kit - KSC (DSV-4B-176) 1B44325-1

Function - The function of the Simulated Flight Test Kit - KSC shall be to connect cable-amplifier assemblies to stage cables from the stage power transfer switches and to stage cables from the PAM multiplexers. At power transfer, the assemblies shall connect the stage battery circuits to the stage GSE ground power circuits. The current sensing amplifier shall provide an indication through the normal flight measurement channels of current through the switch contacts. The amplifier shall have the same characteristics as the amplifier which is used in the flight battery assemblies to monitor battery current.

Design - The kit will consist of three battery current amplifier substitutes. The forward battery simulation unit will substitute for both forward batteries. Two identical units will substitute for the aft batteries. The unit will contain magnetic amplifiers which are identical to those used in the flight batteries. Connectors will be provided to route ground power through to the battery input of the various E/I switches and the magnetic amplifier output to the T/M System. The units will mount in or on the vehicle battery racks without the use of loose hardware. Each unit's weight will not exceed 40 pounds. The design will be compatible with both Saturn V and Saturn IB stages. The units will be designed to be portable, weatherproof and with cable storage space. (See Figure 5-32.)

Components - The kit will consist of the following components:

- a. Magnetic amplifiers
- b. Terminal strips
- c. Solid conductor bar

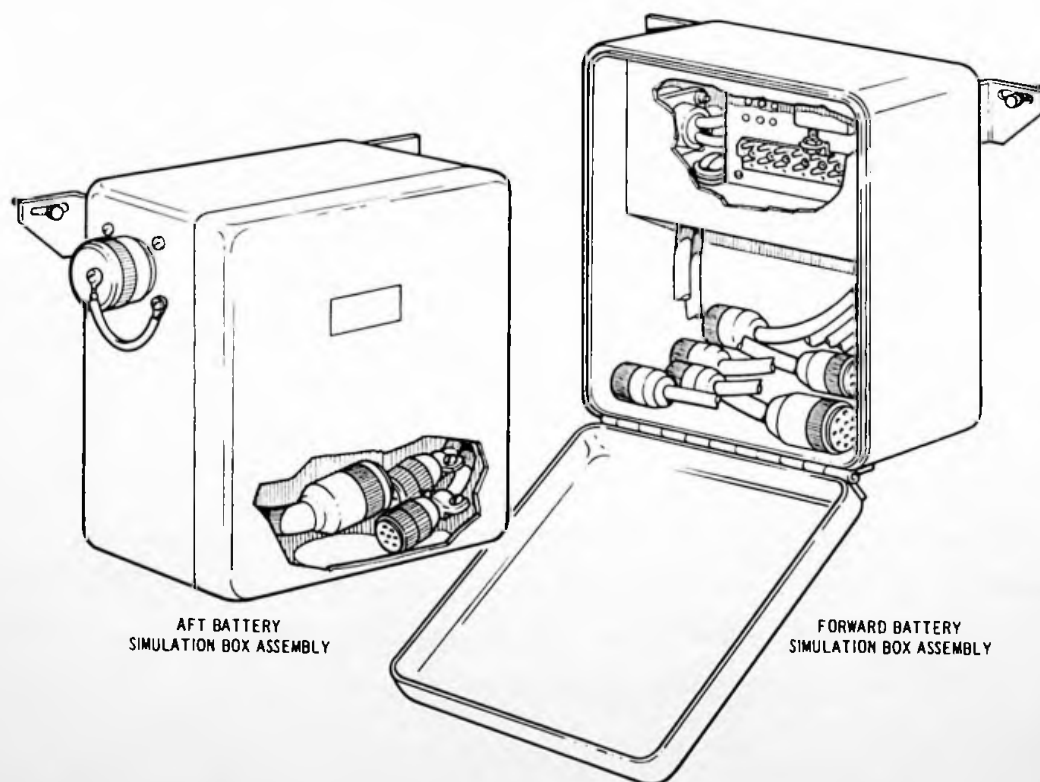


Figure 5-32. Simulated Flight Test Kit - KSC (DSV-4B-176)

- d. Receptacles
- e. Cable assemblies
- f. Boxes.

5.49 Amplifier Assembly Unit, Engine Sideloads (DSV-4B-181) 1B42939-1

Function - The function of the Engine Sideloads Amplifier Assembly Unit shall be to boost a millivolt signal from the engine sideload strain gages to a proper level. Temperature converters shall be included to monitor the purge outlets and to provide control signals.

Design - The unit will consist of a standard equipment rack with amplifier and temperature converters for low level signal conversion on the test stand. The amplifiers will condition the engine sideload strain gage outputs. The temperature converters will condition the aft and forward purge outlet temperature signals for monitoring and environmental control.

R.F.I., shielding and bonding will be incorporated according to accepted standards to facilitate handling, hooks or eyelets will be affixed to the top of each rack. (See Figure 5-33.)

Components - The unit will consist of the following components:

- a. Four amplifiers
- b. Three converters.

Dimensions - The unit will have the following approximate dimensions: height, 77 inches, width, 22 inches, depth, 25 inches.

5.50 Electrical Accessories Checkout Kit (DSV-4B-184) 1B44045-1

Function - The function of the Electrical Accessories Checkout Kit shall be to collect the miscellaneous electrical items and subassemblies required for use at the Systems Integration Lab (SIL) DAC-HB.

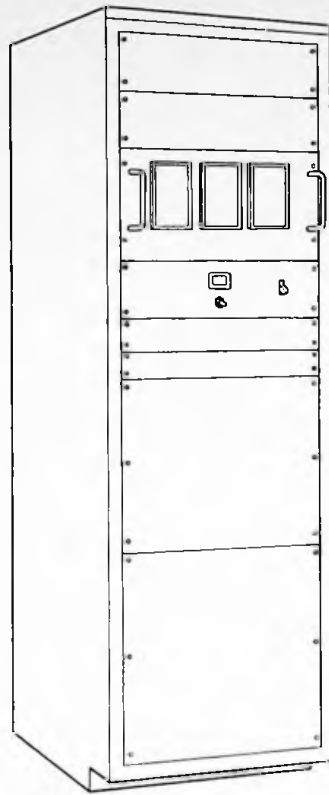


Figure 5-33. Amplifier Assembly Unit, Engine Sideloads (DSV-4B-181)

Design - The design of the kit will consist of a multi-bay cabinet to store the miscellaneous electrical items and subassemblies. These items will include the program boards used with Ground Equipment Test Set, DSV-4B-132, Signal Distribution Box, DSV-4B-133, Patch Panel Distribution Box, DSV-4B-147, Auxiliary Signal Distribution Complex, DSV-4B-253, and the 35mm slides for use with model DSV-4B-120, System Status Display. The interchangeable board assemblies will be programmed with patch cords to allow for maximum flexibility to create the necessary circuits required for a given operation. The 35 mm slides used with the Black/White System Status Display (DSV-4B-298) will provide the test console operator with the test parameters and measurements of the various subsystems under test. The slides will be stored in metal slide files.

Components - The kit will consist of the following components:

- a. Program board assemblies (19)
- b. Patch cords
- c. 35mm slides
- d. Taper pin extraction tool.

5.51 Electrical Accessories Checkout Kit (DSV-4B-184A) 1B44042-1

This model is similar to Model DSV-4B-184 except that program board assemblies used with Patch Panel Distribution Box (DSV-4B-148) will be stored in place of Patch Panel Distribution Box (DSV-4B-147), and the 35mm slides of Black/White System Status Display (DSV-4B-298) will be stored in place of the slides for Model DSV-4B-120. This model will be used at VCL No. 1, DAC-HB.

The kit will also contain a GSE Test Set certification adapter which will be used to verify component operation and circuit continuity of the Gound Equipment Test Set (DSV-4B-132). This equipment will consist of two portable carrying cases housing panel mounted connectors and banana jacks. Patch cords and adapter cables will also be provided and stored in the carrying case.

Components - The accessory kit will consist of the following components:

- a. Program board assemblies (19)
- b. Patch cords
- c. 35mm slides
- d. Certification adapter
- e. Taper pin extraction tool.

5.52 Electrical Accessories Checkout Kit (DSV-4B-184B) 1B44044-1

This model is similar to Model DSV-4B-184 except that the program board assemblies used with HB-VCL-2 Stage Checkout Area Patch Panel Distribution Box (DSV-4B-146) will be stored in place of Patch Panel Distribution Box (DSV-4B-147) and the 35mm slides of Black/White Systems Status Display (DSV-4B-298) will be stored in place of the slides for Model SDV-4B-120. This model will be used at VCL No. 2, DAC-HB.

5.53 Electrical Accessories Checkout Kit (DSV-4B-184C) 1B44043-1

This model is similar to Model DSV-4B-184 except that program board assemblies used with Patch Panel Distribution Boxes (DSV-4B-149 and -152), and SACTO Auxiliary Distribution Unit (DSV-4B-253A) will be stored in place of HB-VCL-2 Stage Checkout Area Patch Panel Distribution Box (DSV-4B-146) and Auxiliary Signal Distribution Complex (DSV-4B-253) respectively. This model will be used at SACTO, Beta I Complex.

5.54 Electrical Accessories Checkout Kit (DSV-4B-184D) 1B44047-1

This model is similar to Model DSV-4B-184 except that the program board assemblies used with Patch Panel Distribution Boxes (DSV-4B-150 and -151) and Auxiliary Distribution Unit (DSV-4B-253A) will be stored in place of Patch Panel Distribution Box (DSV-4B-148) and Auxiliary Signal Distribution Complex (DSV-4B-253) respectively. This model will be used at SACTO, Beta III Complex.

5.55 Electrical Accessories Checkout Kit (DSV-4B-184E) 1B44048-1

This model is similar to Model DSV-4B-184 except that the program board assemblies used with SACTO VCL Patch Panel (DSV-4B-174) will be stored in place of HB-VCL-2 Stage Checkout Area Patch Panel Distribution Box (DSV-4B-146). This model will be used at VCL/SACTO.

5.56 APS Pneumatic Regulation Portable Test Set (DSV-4B-186) 1B52838-1

Function - The function of the APS Pneumatic Regulation Portable Test Set shall be to manually check out the S-IVB Pneumatic Console - Model 436 (DSV-4B-436).

Design - The test set will be contained in two suitcase type containers; one will house the cable assemblies and one will house the instrumentation. The "plug-swap" techniques will be employed for connection to the console. There will be four 10-foot cables and one 15-foot cable. The test set will be designed to check the electrical continuity of solenoid

valves talkback, pressure switches, pressure transducers, and actuation of valve solenoids. (See Figure 5-34.)

Components - The test set will consist of the following components:

- a. Ammeters
- b. Circuit breakers
- c. Light talkbacks
- d. Switches
- e. Cables.

Dimensions - The test set will have the following approximate dimensions:

- a. Instrumentation container: width, $21\frac{7}{32}$ inches; length, $26\frac{1}{4}$ inches; height, $11\frac{5}{32}$ inches.
- b. Cable container: width, $20\frac{1}{4}$ inches; length, $21\frac{1}{4}$ inches; height, 10 inches.

(For use with the S-IB stage only.)

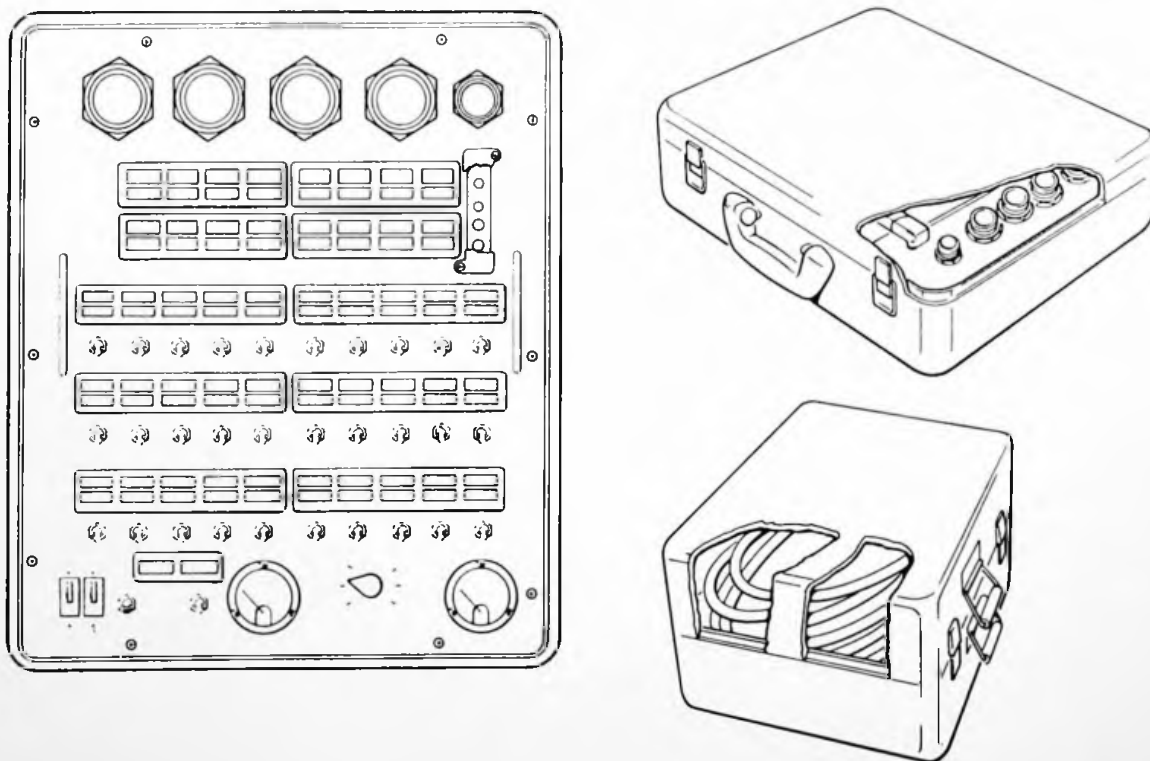


Figure 5-34. APS Pneumatic Regulation Portable Test Set (DSV-4B-186)

5.57 APS Pneumatic Regulation Portable Test Set (DSV-4B-186A) 1B62725

Except for identification and minor configuration changes, the function and design will be similar to Model DSV-4B-186. This model will be used to checkout APS pneumatic Regulation and Distribution Console (DSV-4B-436A) (See Figure 5-34.) (For use with the S-V stage only.)

5.58 LH₂ Experimental Ground Test Station (DSV-4B-187) 1B56145

Function - The function of the LH₂ Experimental Ground Test Station will be to provide all necessary GSE modifications or additions to implement checkout of a S-IVB stage equipped with the LH₂ Experiment Hardware. It is used at Sacramento Test Center Beta Stand for the SA-203 stage only.

Design - The single bay rack assembly, as shown in Figure 5-35, will be designed to accommodate the Government Furnished Equipment required to checkout and monitor the hydrogen tank TV system. It will be equipped

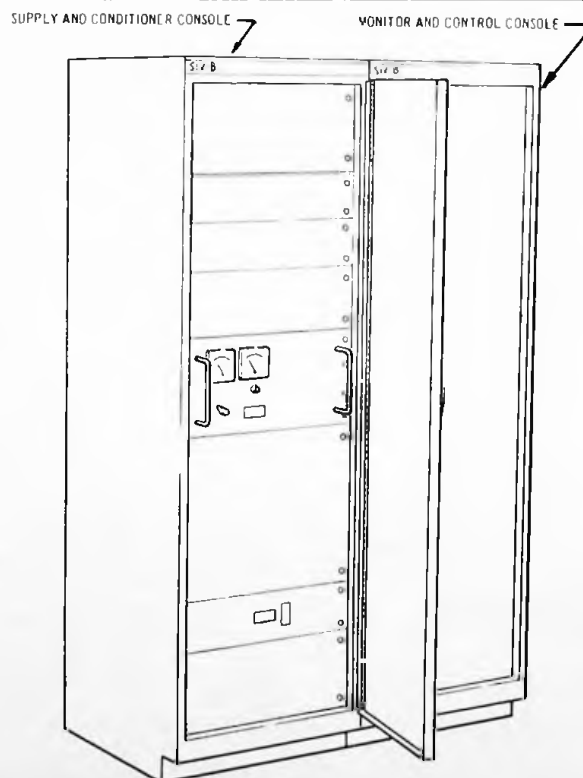


Figure 5-35. LH₂ Experimental Ground Test Station (DSV-4B-187)

with an RFI tight door and outputs to remote real time monitors in the Blockhouse. The only external control will be a shutdown signal from the Blockhouse. In addition to the actual rack assembly, kits will be created as part of Model 187 to modify Models 133, 143, 144, and 184 as required to accommodate the experiment peculiar hardware on the stage.

Components - The following GFE components will be installed in Model 187 during pre-check and static firing of a LH_2 Experimental Stage.

- a. Hi-rate camera control unit
- b. Lo-rate camera control unit (3 pieces)
- c. Techtronics No. 527 waveform analyzer (in half panel mount)
- d. Conrac 8 inch hi-rate monitor (in half panel mount)
- e. 2-RCA line drive amplifiers (with 2,000 foot compensators)
- f. Lo-rate long persistency monitor scope
- *g. 14 inch hi-rate TV monitor
- *h. Oscilloscope, modified to a lo-rate TV monitor.

NOTE: The intended use for this model has been completed. Therefore, it has been shipped to MSFC on a Form DD-250 for NASA's use.

(*Installed in Blockhouse)

5.59 Auxiliary Propulsion System (APS) Simulator (DSV-4B-188) 1B50740

Function - The function of the Auxiliary Propulsion System (APS) Simulator shall be to electrically simulate the APS modules to checkout the stage APS electrical circuitry during stage checkout, and to determine that all related stage electrical components and electrical subsystems are functional. The simulator shall simulate only one APS module. The unit will be used at Douglas-HB.

Design - The APS simulator, as shown in Figure 5-36, will be electrical in nature and will not include pneumatic or fluid components. The simulator will be designed to mount on the stage during checkout. The simulator measurement signals will be fixed values and will be provided by

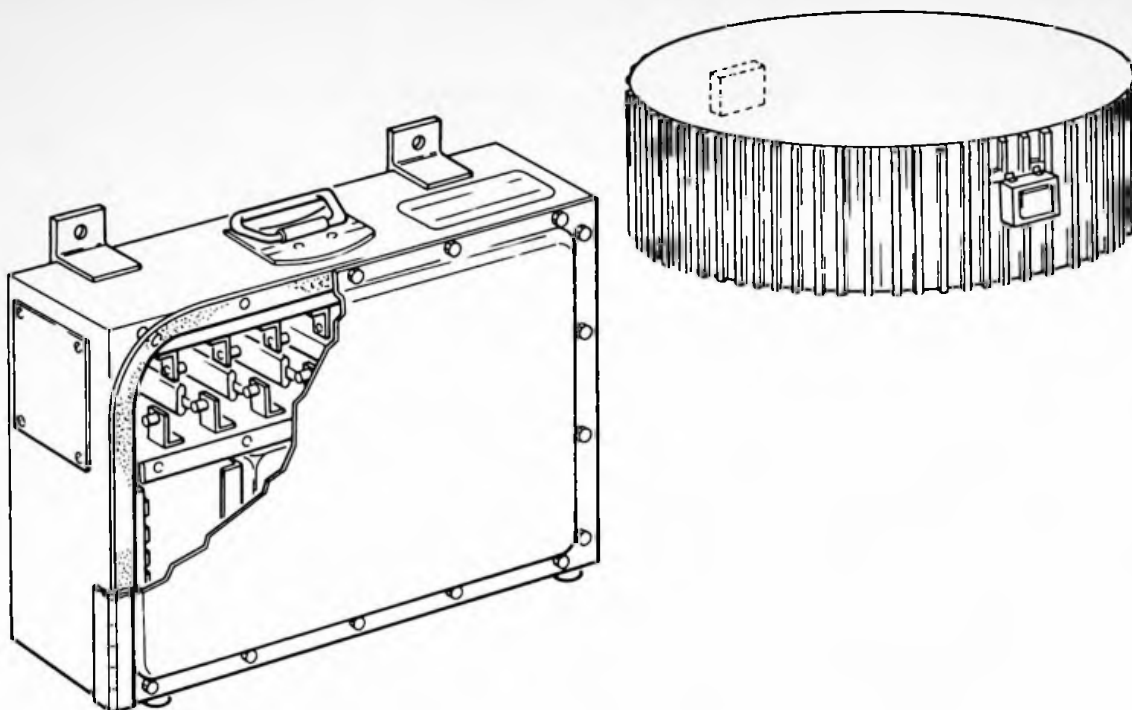


Figure 5-36. Auxiliary Propulsion System (APS) Simulator (DSV-4B-188)

resistor networks. Relay will simulate pressure switches to provide talkback on operation of valves simulated by resistors.

Components - The simulator will consist of the following components:

- a. Carrying case
- b. Relays
- c. Resistors.

(For use with the S-IB stage only.)

5.60 Auxiliary Propulsion System (APS) Simulator, Saturn V, VCL-HB
(DSV-4B-188A) 1B54661

The function, design and components of the simulator will be similar to Model DSV-4B-188. This unit is used at Douglas-HB. (For use with the S-V stage only.)

5.61 Auxiliary Propulsion System (APS) Simulator, Saturn IB, SACTO
Beta I (DSV-4B-188B) 1B56715

The function, design and components of the simulator will be similar to Model DSV-4B-188 except that the unit will be mounted in the umbilical room, and will include the cables to connect the unit to the stage. This unit also requires jumper cables inside of the unit. This unit is used at SACTO. (For use with the S-IB stage only.)

5.62 Auxiliary Propulsion System (APS) Simulator, Saturn V, SACTO
Beta I (DSV-4B-188C) 1B56722

The simulator is similar to Model DSV-4B-188B except for identification, and this model does not include the internal jumper cable. The function is identical to Model DSV-4B-188B. This unit is used at SACTO. (For use with the S-V stage only.)

5.63 Multiplexer Remote System Component Test Set (DSV-4B-190)

Function - The function of the Multiplexer Remote System Component Test Set shall be to test and calibrate the Low-Level Remote Analog Sub-Multiplexer Assembly Model 102 (MSFC Specification 50M60202) or the High-Level Remote Analog Sub-Multiplexer Assembly Model 101 (MSFC Specification 50M60203) prior to installation in the stage.

Design - The Test Set will be manual in operation. When testing the sub-multiplexer as a component, the test set will provide all necessary power and stimulus, and capability to monitor any two output channels. The test set will consist of a two bay console with a writing surface provided for the unit under test and for checkout procedures. Storage drawers will be connected to the front of the right hand bay to furnish storage area and provide for the support for the writing surface. (See Figure 5-37.)

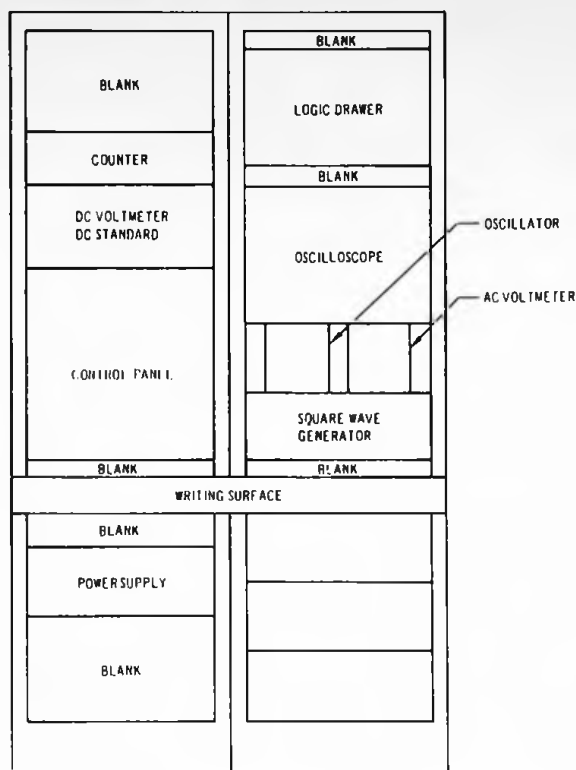


Figure 5-37. Multiplexer Remote System Component Test Set (DSV-4B-190)

Components - The test set will contain the following major components:

- a. Oscilloscope
- b. Square wave generator
- c. Oscillator
- d. DC voltmeter
- e. Power supply
- f. Counter.

Dimensions - The test set will have the following approximate dimensions: height, 77-1/2 inches; width, 42 inches; and depth, 52 inches.

5.64 Antenna, Open Loop, Command Destruct System (DSV-4B-192) 1B53355-1

Function - The function of the Command Destruct System Open Loop Antenna shall be to provide open loop range safety signals to the vehicle during Electro/Magnetic Interference (EMI) checks. The antenna shall be used with the Destruct System Test Set (DSV-4B-136).

Design - The design of the antenna will be a standard uni-direction (406-470 mc/s) antenna. It will be capable of receiving the RF output of the micro dot 412A signal generator.

Components - The system as shown in Figure 5-38, will consist of the following components:

- a. Antenna
- b. Attaching brackets and hardware
- c. Interconnecting cable.

5.65 Auxiliary Power Supply (DSV-4B-193)

Function - The function of the Auxiliary Power Supply shall be to provide a ground power source of regulated 28-vdc for S-IVB test specimens. The regulated power output shall be available at five circuit protected receptacles to allow maximum flexibility under a variety of applications. Presently, this unit shall be used on the Environmental Test Program,

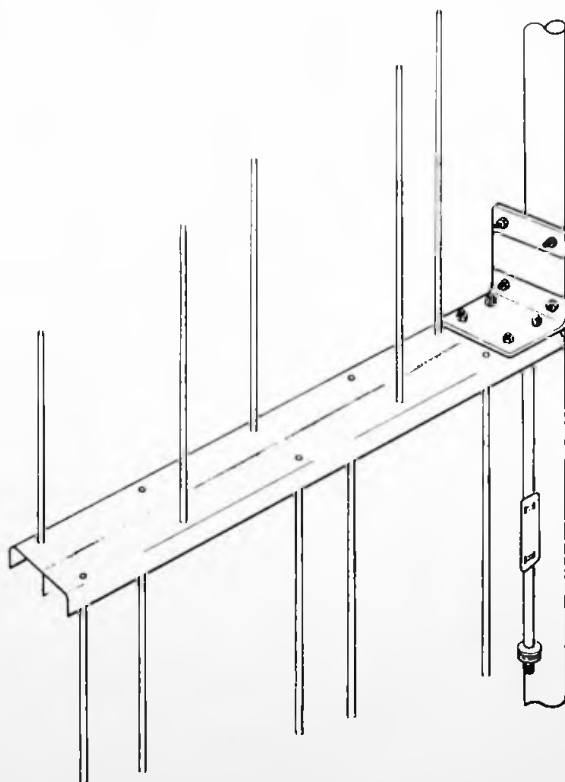


Figure 5-38. Antenna, Open Loop, Command Destruct System (DSV-4B-192)

S-IVB/IU 500 FS. In this installation, it shall (1) provide external power to one of the test specimen busses (2) simulate battery power for inflight mode of operation, and (3) provide GSE control power for ac operation of the manual ground support equipment.

Design - The power supply as shown in Figure 5-39, will be a static ac to dc converter utilizing 3 phase 60 cycle input power and developing 24 to 36 volts of regulated dc power at 250 amps. The equipment design incorporates the features of remote on-off control, remote voltage adjusting, and remote voltage and current monitoring. Local control by switches on the front panel can be activated by installing a jumper connector within the unit. Remote voltage sensing capabilities are incorporated to facilitate regulation at the load. Unique solid state circuitry assures rapid response to transients resulting in extremely stable regulation. If remote sensing should be lost, the power supply reverts to local sensing automatically.

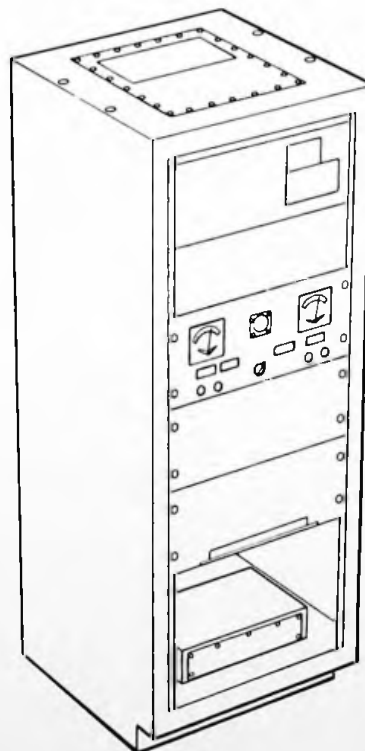


Figure 5-39. Auxiliary Power Supply (DSV-4B-193)

Components - The power supply rack will consist of the following components:

- a. Receptacles
- b. Wire
- c. Circuit breakers
- d. Terminal strips
- e. Current sensor amplifier
- f. Switches
- g. Meters
- h. Indicating lamp assemblies
- i. Christie SCR Power Supply
- j. Vertical cabinet (one bay).

5.66 Digital Simulator Control Panel (DSV-4B-195) 1B56694

Function - The Digital Simulator Control Panel shall be used to supply binary words or their equipment to the S-IVB test specimen during the Environmental Test Program, S-IVB/IU 500 FS. The signals derived shall control the RACS central decoder for calibration data prior to "lift-off" and shall also simulate switch selector functions during simulated flight. All functions must be manually initiated.

Design - This control panel will be a standard 19 inch chassis designed to mount in a standard slope front console. Twenty (20) double throw switches will be capable of commanding forty (40) switch selector functions. These manual switches directly replace the airborne switch selector. Mag latch relays in the GSE will act as a memory for these functions and control forty (40) indicator lights to monitor the last commands initiated. (See Figure 5-40.)

RACS calibration will be accomplished with a thirteen bit binary word which is constructed and initiated by four rotary switches and three pushbutton switches. The binary word formed can be verified before transmission to the airborne central decoder. This verification will be displayed as binary bits on a row on indicator lamps.

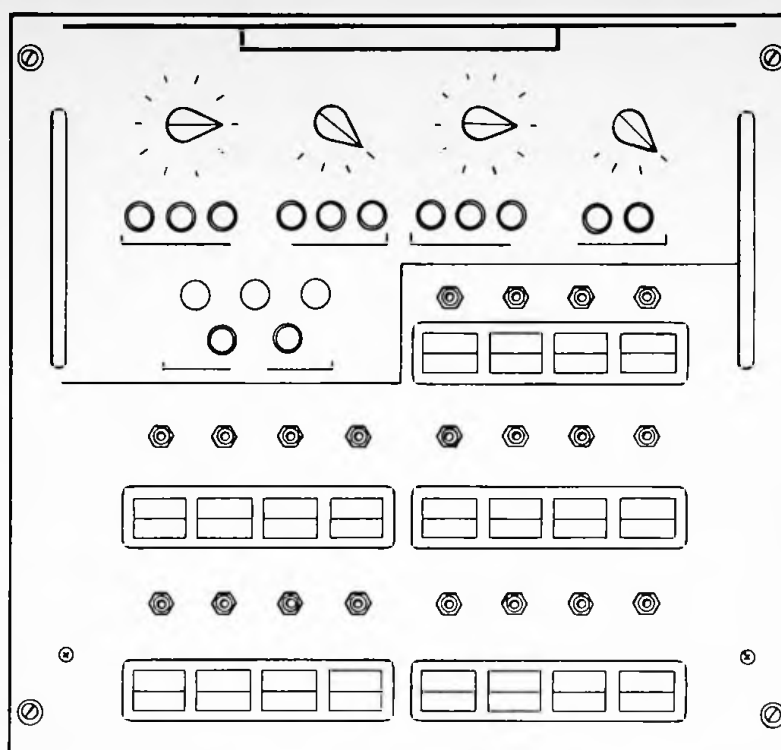


Figure 5-40. Digital Simulator Control Panel (DSV-4B-195)

Components - The digital simulator control panel will consist of the following components:

- a. Receptacles
- b. Wire
- c. Toggle switches
- d. Pushbutton switches
- e. Rotary selector switches
- f. Indicator light assemblies.

5.67 Simulator Assembly, Chillydown Inverter Load (DSV-4B-206) 1B64437-1

Function - The function of the Chillydown Inverter Load Simulator Assembly shall be to simulate the electrical load of one S-IVB Stage chillydown pump inverter motor during checkout (dry) of the stage.

Design - The simulator will be connected to the output side of inverter during checkout. The simulator, and necessary cables will be mounted on the stage during checkout.

Components - The simulator assembly will consist of the following components:

- a. Motor (3-phase, dual-winding, 56-vac)
- b. Fan
- c. Power resistors
- d. Cables.

5.68 Instrumentation Kit, Vehicle and Pallet, Air Carry (DSV-4B-207)
1B58659-1

Function - The function of the Air Carry Vehicle and Pallet Installation Kit shall be to monitor the S-IVB stage during air carry by the Super Guppy Aircraft. The kit shall be used in conjunction with Super Guppy Air Carry Instrumentation Kit (DSV-4B-208).

Design - The kit consisting of transducers, cables, junction boxes and associated hardware will be compatible with Douglas stage instrumentation requirements. The kit transducers will include accelerometers for vibration measurements on the tank skin, engine area, and cradles; relative humidity sensors to measure the dew point; temperature probes to measure temperature of the stage; differential pressure transducer to measure the difference in pressure between the tank interior and ambient air. The kit will be designed to be rotational and will be removed from the stage at the completion of each shipment. The transducer cables will connect to Model DSV-4B-208 for excitation and signal transmission.

Components - The kit will consist of the following components:

- a. Vibration accelerometer (11)
- b. Differential (2)
- c. Temperature Sensor (4)
- d. Relative humidity sensor (3)

- e. Acoustic Measurement (1)
- f. Junction box (5)
- g. Cables (37)
- h. Mounting bracketry.

5.69 Instrumentation Kit, Air Carry, Super Guppy (DSV-4B-208) 1B57308-1

Function - The function of the Super Guppy Air Carry Instrumentation Kit shall be to perform the following functions:

- a. Supply electrical power to the transducers of the Air Carry Vehicle and Pallet Instrumentation Kit (DSV-4B-207)
- b. Record instrumentation inputs of (DSV-4B-207)
- c. Preflight checkout of electrical circuits to the Emergency Vent Valves
- d. Remote indication and control of the Emergency Vent Valve System
- e. Real time monitoring of tank differential pressure, temperature and dew point.

Design - The kit will consist of recorders, power supplies, inverters, power distribution equipment, system time equipment and cables. The design will include equipment to package, install, set-up, checkout, and operate the system in conjunction with Model DSV-4B-207, in the Super Guppy aircraft.

Components - The kit will consist of the following components:

- a. Cabin Rack Assembly Support
- b. Differential Pressure Monitor Console Assembly, containing a strip chart and a system monitor and control panel.
- c. Environmental Monitor Console Assembly, containing a strip chart and a remote time code display panel.
- d. Power Distribution and System Time Console Assembly containing a digital voltmeter, an electronic counter, a power distribution panel, a power supply panel and a time code generator.
- e. A Tape Recorder Console Assembly containing a magnetic tape recorder, a magnetic tape recorder calibrator, an oscilloscope and an emergency vent simulator unit.

- f. Three dc to ac inverters.
- g. A Wiring Harness Assembly, installed in the aircraft.
- h. 24 interconnecting and interfacing cable assemblies.

5.70 Computer Configuration Control Unit (DSV-4B-209) 1B59222-1

Function - The function of the Computer Configuration Control Unit shall be to provide a means to isolate the GSE from computer complex during support mode of operation.

Design - The unit, as shown in Figure 5-41, will be enclosed in a one bay rack consisting of 4 drawers. It will be designed to switch the MAPE switching unit to Channel 5-160 mode during support mode of operation. The unit will switch the line printer and tape controller to Channel 3 and 4. Magnetic latch relays will be used exclusively in the unit.

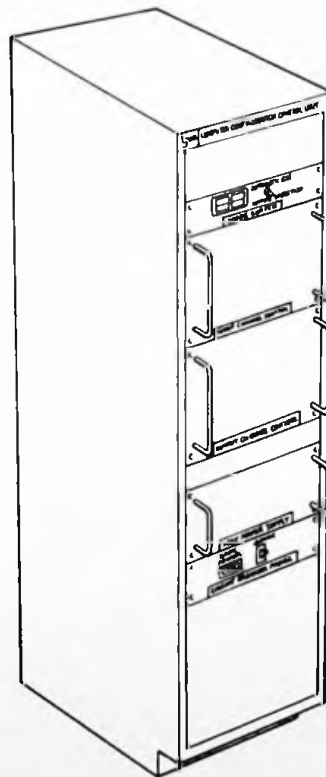


Figure 5-41. Computer Configuration Control Unit (DSV-4B-209)

Components - The unit will consist of the following components:

- a. Rack (4 drawer)
- b. Mode Switch
- c. Input Channel Control
- d. Output Channel Control.

5.71 APS Fuel Transducer Kit (DSV-4B-212) 1B70386-1

Function - The function of the APS Fuel Transducer Kit shall be to provide transducers, cables, and pneumatic connectors to be used in conjunction with the APS Fuel Pressure Instrumentation Kit - SACTO (DSV-4B-1872). The kit shall be used during checkout of S-IVB/V APS bladder, and for recording the results. This model shall be shared between GAMMA Complex and the M and A Building at STC.

Design - The kit will include a transducer box, transducers, cabling from the transducer box to the J-box, and pneumatic connectors from Model DSV-4B-1872.

Components - The kit will consist of the following components:

- a. Transducer box
- b. Transducers
- c. Cables
- d. Pneumatic connectors.

(For use with the S-V stage only.)

5.72 APS Oxidizer Transducer Kit (DSV-4B-213) 1B70387-1

This model is similar to DSV-4B-212 except that it is configured to be used in conjunction with APS Oxidizer Pressure Instrumentation Kit - SACTO (DSV-4B-1873). This model shall be shared between GAMMA Complex and the M and A Building at STC. (For use with the S-V stage only.)

5.73 Rechargeable Battery Kit (DSV-4B-214) 1B66557-1

Function - The function of the Rechargeable Battery Kit shall be to provide dc power to Saturn S-IVB/IB and S-IVB/V Stages during prelaunch checkout tests at KSC.

Design - The kits will be designed as follows:

- a. The rechargeable batteries shall be comprised of groups of off-the-shelf commercial nickel-cadmium sintered plate alkaline secondary battery cells.
- b. Battery capacity shall be scaled to the requirements of the CDDT (Countdown Demonstration Test) and will not equal the flight type battery capacity. Battery consists of three (3) 28 vdc, 23 A.H. capacity units and one (1) 56 vdc, 23 A.H. capacity units.
- c. The design shall not require a change to the stage or MSFC furnished ESE (Electrical Support Equipment). Batteries shall be compatible with the variable recharger at KSC.
- d. Batteries shall be mounted in the stage during CDDT. Brackets shall be provided in each kit to mount the batteries in either a S-IVB/IB or S-IVB/V configuration.
- e. The batteries shall electrically simulate the flight batteries.

Components -

- a. Batteries with connectors
- b. Junction boxes
- c. Interconnecting cables
- d. Mounting hardware.

5.74 Telemetry System Control Console (DSV-4B-232) 1A65726-1

Function - The Telemetry System Control Console shall function as the monitor and control station for the automatic checkout equipment during subsystem testing. Direct entry into the computer will be enabled by the master control station. During integrated testing, the console shall serve as a monitor station only; control shall be maintained by the master station. In this operating mode, all test requests will be monitored by the master test station.

Design - The console will be designed to provide the operator with convenient controls and monitor facilities for all functions performed at the console. Control and observation will be maintained during check-out procedures by manual entry of test identifications, priority instructions, halts, and starts. Information received by external equipment will be verified by displays at the console. Tests may be terminated before completion, or interrupted while in progress. The operator will be able to override a test by manual entry of new test numbers.

Components - The console, as shown in Figure 5-42, will consist of the following two panels:

- a. Digital Control Panel - The panel will provide the necessary controls and indicators to provide effective operation and monitoring of the automatic checkout equipment. The following controls and indicators will be provided:

Controls -

KEYBOARD SWITCHES - The keyboard will consist of eight pushbutton switches (from 0 through 7) which will allow entry of a test number into the computer in an octal format.

ENTER - The enter button will place the contents of the keyboard register into the external equipment.

RESET - The reset button will clear the keyboard register when an entry is to be changed.

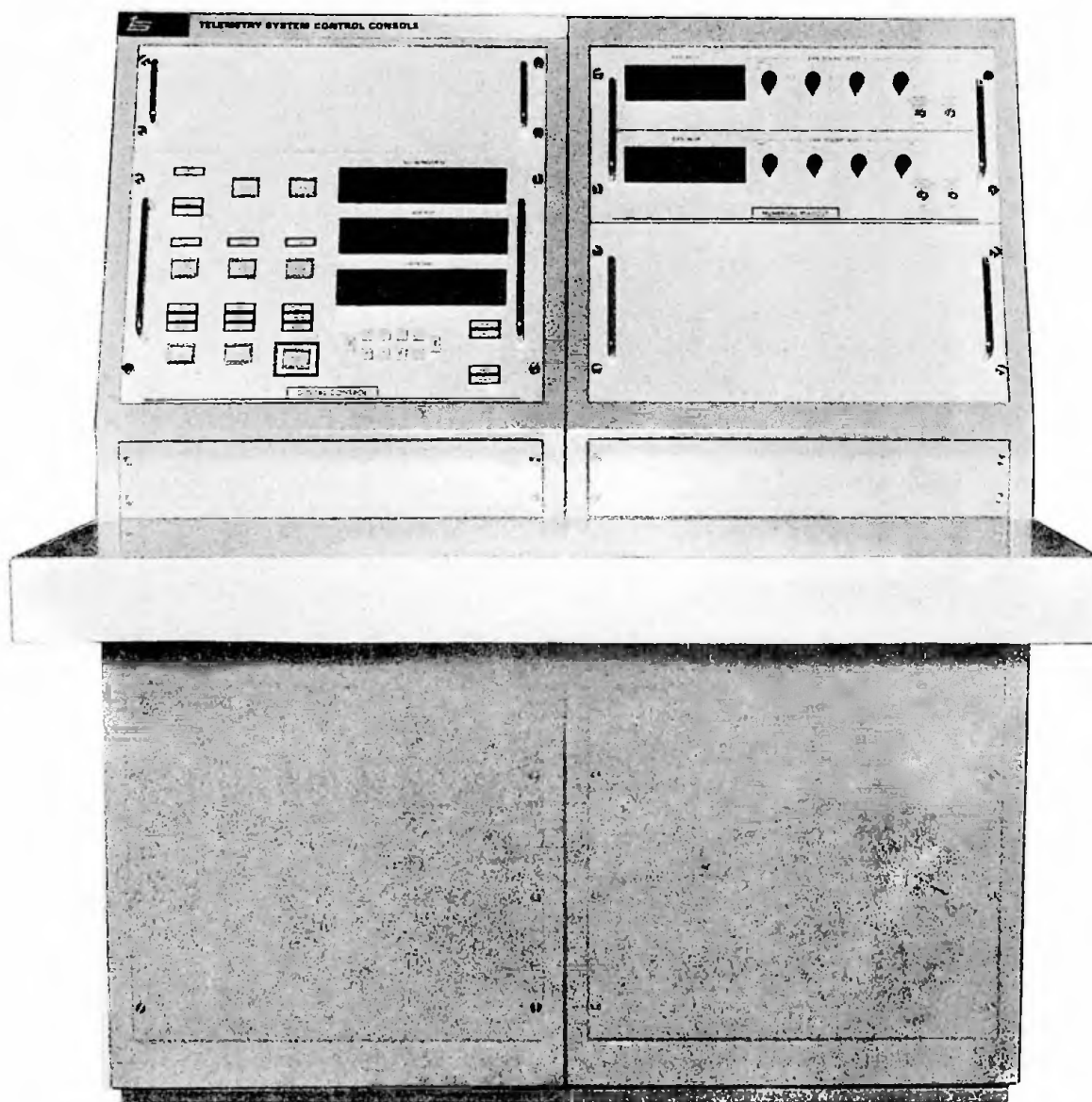
HOLD - The hold switch will cause the automatic system to stop at the next hold point in the test program.

STOP - The stop switch will cause the automatic system to progress to the next hold point in the test program, and to return to a preprogrammed stop point.

EMERGENCY STOP - This switch will cause the automatic system to come to an immediate stop in the program and perform a predetermined shutdown routine.

RESUME - The resume switch will continue the test program after a HOLD or STOP has been initiated.

CLEAR - The clear switch will cause the automatic system to return to the starting point of a program after a HOLD or STOP. This control will also remove a test request which has been entered but not yet processed. An EMERGENCY STOP condition will not be cleared by this switch.



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Figure 5-42. Telemetry System Control Console (DSV-4B-232)

ENABLE CONDITIONAL STOPS - This switch will cause the automatic system to halt at each programmed stop point to await action by the test operator.

ENABLE CONDITIONAL HOLDS - This switch will cause the automatic system to halt at each programmed hold point to await action by the test operator.

STORE PROGRAM POINT - This switch will cause the automatic system to halt and store its present program, and wait for an operator request. After instructions from the operator are performed, the program will be returned to the stored program point when the switch is again operated.

Indicators -

TEST IN PROGRESS - This will be a six-digit octal numerical readout displaying the test identification number of the test being processed.

NEXT TEST - This will be a six-digit octal numerical readout displaying the identification number of the next test to be processed.

KEYBOARD - This will be a six-digit octal numerical readout indicating the last combination of octal digits inserted into the register from the manual keyboard.

DISABLED-ENABLED - These indicators will show whether or not the console is capable of direct entry into the automatic checkout system.

ENTERED-WAIT - These indicators will show what action has been taken by the operator of the master test station in response to a test request generated by the console during periods when the console is not capable of direct entry into the automatic system.

HOLD, STOP, EMERGENCY STOP - These indicators will show when the automatic checkout system is inactive because of one of these conditions, and whether that condition was initiated by the operator or by the automatic system.

STAGE FAULT-GSE FAULT - These indicators will show that the automatic system has determined the existence of a fault or malfunction, and whether the fault is in the stage under test or in the automatic checkout system.

COMPUTER READY - This indicator will show when the computer is operative and capable of processing test programs on request.

CONDITIONAL HOLDS ENABLED, CONDITIONAL STOPS ENABLED, PROGRAM POINT STORED - These indicators will show when the automatic system is in one of these operating modes.

- b. Numerical Readout Panel - Two sets of the following controls and indicators will appear on the numerical readout panel.

Controls -

DATA REQUEST SELECT - This selector switch will allow the operator to enter an octal four-digit request number.

DATA REQUEST INITIATE - This toggle switch will provide transfer of the data request to the external equipment.

ENABLE CONTINUOUS REQUEST - This toggle switch will provide for a continuous updating of the requested data.

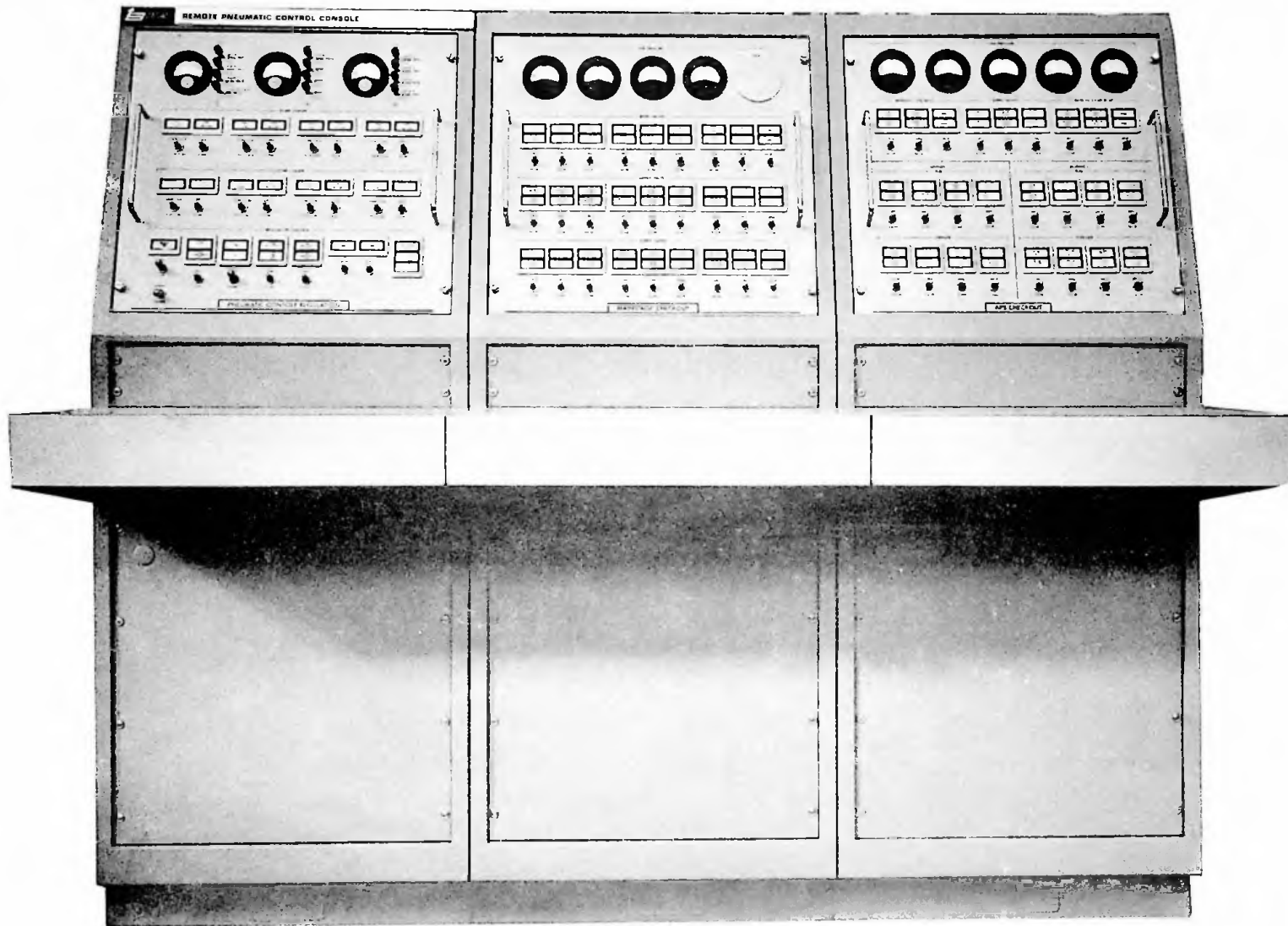
Indicators -

DATA VALUE - This four-character, alpha-numeric display will show information received as a result of a data request by the operator.

5.75 Remote Pneumatic Control Console (DSV-4B-233) 1A65727-1

Function - The Remote Pneumatic Control Console shall form a part of the propulsion checkout system by providing complete manual backup capability for the Automatic Stage Servicing Checkout Pneumatic Console (DSV-4B-321). The console shall have the capability of controlling and monitoring all pneumatic valve operations and pressure regulation functions within the scope of the checkout pneumatic console. Manual control will be exercised when enabled from an external source.

Design - The console, as shown in Figure 5-43, will consist of a regulation panel, APS (Auxiliary Propulsion System) checkout panel, and main-stage checkout panel. The console will be designed to completely control the checkout pneumatic console (1) as an emergency measure when an "unsafe stage" condition exists or (2) for locating trouble in the system. The console will also be capable of pneumatic system calibration and regulation. Electrical power supplied to the console will be 28 and 5 vdc. All analog outputs will be 0 to 5 vdc, and all bilevel outputs will be 0 or 28 vdc. Legend lights will indicate valve positions, power ON-OFF, and test stand operation. Meter-pressure readings in psia (pounds per square inch absolute) will be visible on each panel. Full-scale adjustments of meters will be provided, as well as a meter-switching capability for monitoring multiple pressures.



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Figure 5-43. Remote Pneumatic Control Console (DSV-4B-233)

Components - The three panels of the console will contain the following controls and indicators:

a. Regulation panel -

Controls -

START LOADING, STOP LOADING; OPEN VENT, CLOSE VENT -
Controls for all dome leader stages (1 through 8)

OPEN/CLOSE - GN_2 and helium console supply valves

ON/OFF, ENABLE/DISABLE - Pneumatic power

STAND NO. 1, STAND NO. 2 - Test stand selector switch for
Automatic Stage Servicing Checkout Pneumatic Console.

5-vdc ON/OFF

Indicators -

Meters - One pressure meter with switching capability will
be provided for each of the following groups:

1. First, second, and third dome pressure, and console
supply pressure;
2. Fourth stage dome pressure;
3. Fifth, sixth, seventh, and eighth stage dome pressures.

Illuminated legend lights -

OPEN/CLOSED - All console supply valves

LOADING VENT CLOSED - Separate indicators for each of the
dome loading stages

PNEUMATIC POWER ON - Pneumatic power

MANUAL CONTROL ACTIVE, MANUAL DISABLE - Indicates opera-
tional status for manual control

STAND NO. 1, STAND NO. 2 - Operates with selector switch

5-vdc POWER SUPPLY ON, 5-vdc POWER SUPPLY OFF - Operates
with ON-OFF switch for 5-vdc power supply

b. Mainstage panel -

Controls - OPEN/CLOSE control will be provided for each
valve function as follows:

1. First stage bleed
2. Second stage bleed
3. Third stage bleed
4. Repress bottles supply
5. LO_2 tank prepressurization supply

6. Engine control supply
7. LH_2 tank prepressurization supply
8. Start bottle supply
9. Anti-backflow valve backup supply
10. Fourth stage bleed
11. Fifth stage bleed
12. Sixth stage bleed
13. Seventh stage bleed
14. Backup pressure switch supply
15. LO_2 system pressure switch supply
16. LH_2 system pressure switch supply
17. Spheres pressure switch supply
18. Engine high-pressure supply
19. Engine low-pressure supply
20. Eighth stage bleed
21. GN_2 bleed valve
22. Aft umbilical ejection
23. Fwd umbilical ejection
24. LOX pressure actuate sequence
25. Backup pressure XDCR isolation
26. LH_2 system pressure XDCR isolation
27. LOX system pressure XDCR isolation

Indicators - Meters will be provided for each of the following line pressure measurements:

1. Second stage
2. Fourth stage
3. Fifth stage
4. Sixth stage
5. GN_2 prepressurization supply

OPEN/CLOSED - This nomenclature appears on the legend lights which will operate with each control switch on the mainstage panel.

c. APS panel -

Controls - OPEN-CLOSE toggle switches will be provided for actuating each of the following valves on APS Module Nos. 1 and 2:

1. Oxidizer bellows collapse supply
2. Fuel bellows collapse supply
3. Oxidizer facilities lines purge
4. Fuel facilities lines purge
5. Low-pressure switch checkout supply
6. Oxidizer leak check supply
7. Fuel leak check supply
8. High-pressure switch checkout supply

OPEN-CLOSE toggle switches will also be provided for the following supply valves:

1. Bellows manifold
2. Fill manifold
3. Helium bottles

Indicators - Meters will be provided for measurement of the following line pressures:

1. Eighth stage
2. Seventh stage
3. Third stage
4. First stage

OPEN/CLOSED - Illuminated legend lights will be operated with each control switch on the APS panel.

5.76 Remote Pneumatic Control Console, SACTO All Systems (DSV-4B-233A)
1A78634-1

Function - The SACTO All Systems Remote Pneumatic Control Console shall form a part of the propulsion checkout system at SACTO Complex Beta 1 by providing manual backup capability and information feedback for the following consoles of the mainstage and APS pneumatic systems:

- a. Gas Heat Exchanger (DSV-4B-318)
- b. Automatic Operational Pneumatic Console "A" (DSV-4B-319)

- c. Automatic Stage Servicing and Checkout Pneumatic Console "B" (DSV-4B-320)
- d. Liquid Oxygen Valve Control Complex (DSV-4B-331)
- e. Liquid Hydrogen Valve Control Complex (DSV-4B-332).

This capability will form a portion of the automatic checkout system.

Design - When enabled from an external source, the console will provide manual control of the above GSE, and will monitor the operation of their respective valves, pressure switches, regulators, transducers, and thermostats.

The console, as shown in Figure 5-44, will consist of panels for main-stage, APS pneumatic control, and numerical readout. Each panel will contain the necessary pressure meters, indicators, and switches to control the appropriate consoles. Full-scale adjustment of the meters, as well as switches for disabling the electrical command power of the pneumatic system, will also be provided.

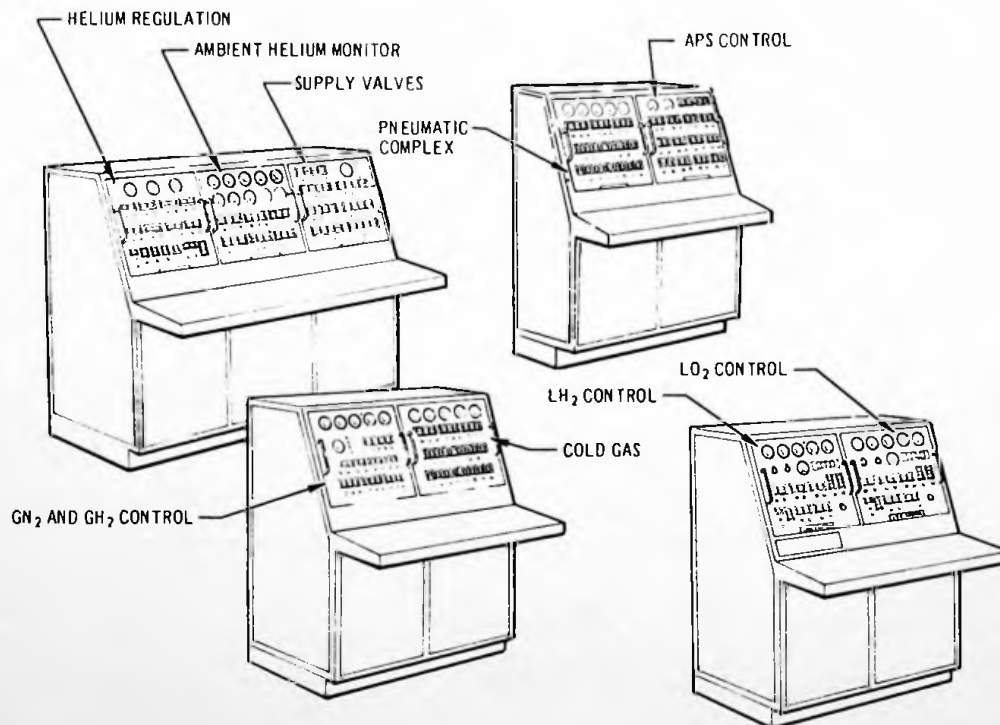


Figure 5-44. Remote Pneumatic Control Console (DSV-4B-233A, DSV-4B-233B)

Components - The console will have the following control panels:

- a. Mainstage pneumatic section -
 1. Helium regulation
 2. Ambient helium monitor
 3. Supply valve control
 4. GN_2 and GH_2 control
 5. Cold gas control
 6. LO_2 control
 7. LH_2 control
- b. APS section -
 1. Pneumatic complex
 2. APS control
- c. Numerical Readout Panel - Two sets of the following controls and indicators will appear on the numerical readout panel.
 1. Controls

Data Request Select - This selector switch will allow the operator to enter an octal four-digit request number.

Data Request Initiate - This toggle switch will provide transfer of the data request to the external equipment.

Enable Continuous Request - This toggle switch will provide for a continuous updating of the requested data.
 2. Indicators

Data Valve - This four-character, alpha-numeric display will show information received as a result of a data request by the operator.

5.77 Remote Pneumatic Control Console, SACTO Acceptance (DSV-4B-233B)
1A39212-1

The function, design, and components of this console are similar to Model DSV-4B-233A.

5.78 Remote Pneumatic Control Console, SACTO VCL (DSV-4B-233C) 1B52840-1

Function - The SACTO VCL Remote Pneumatic Control Console shall form a part of the propulsion checkout system, SACTO-VCL, by providing complete manual backup capability for the SACTO VCL Automatic Stage Checkout

Pneumatic Console (DSV-4B-321A). The console shall have the capability of controlling and monitoring all pneumatic valve operations and pressure regulation functions within the scope of the checkout pneumatic console. Manual control will be exercised when enabled from an external source.

Design - The console will consist of a regulation panel, APS (Auxiliary Propulsion System) checkout panel and mainstage checkout panel. The console will be designed to completely control the checkout pneumatic console (1) as an emergency measure when an "unsafe stage" condition exists or (2) for locating trouble in the system. The console will also be capable of pneumatic system calibration and regulation. Electrical power supplied to the console will be 28 and 5 vdc. All analog outputs will be 0 to 5 vdc, and all bilevel outputs will be 0 or 28 vdc. Legend lights will indicate valve positions, power on-off, and test stand operation. Meter-pressure readings in psia (pounds per square inch absolute) will be visible on each panel. Full-scale adjustments of meters will be provided, as well as, meter-switching capability for monitoring multiple pressures. (See Figure 5-45.)

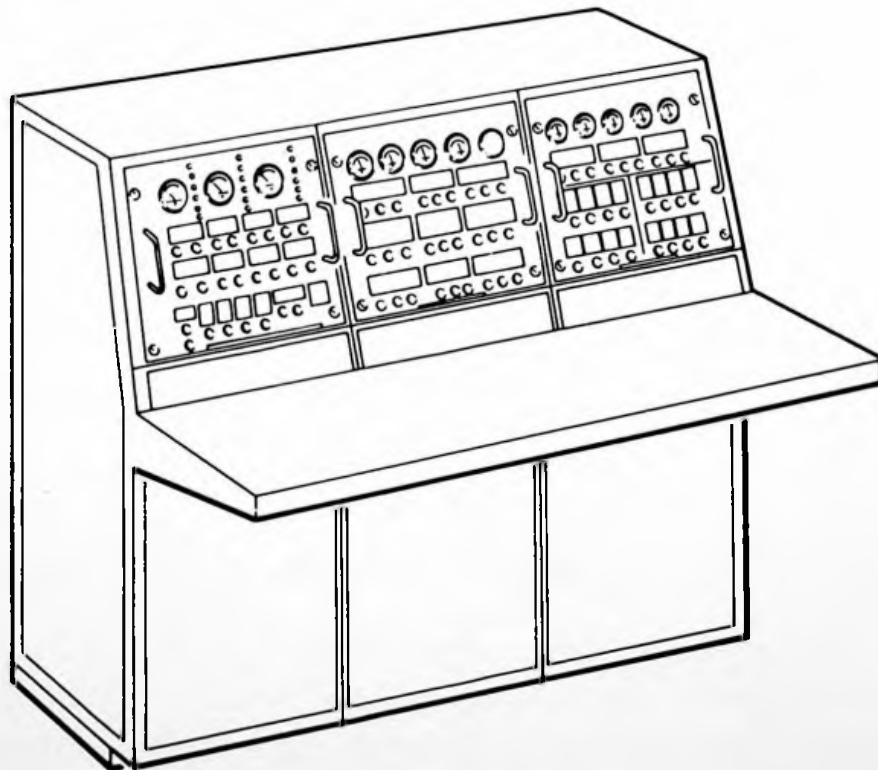


Figure 5-45. Remote Pneumatic Control Console, SACTO VCL (DSV-4B-233C)

Components - The three panels of the console will contain the following controls and indicators:

a. Regulation Panel -

Controls -

START LOADING, STOP LOADING;

OPEN VENT, CLOSE VENT - Controls for all dome leader stages (1 through 8)

OPEN/CLOSE - GN_2 and helium console supply valves

ON/OFF, ENABLE/DISABLE - Pneumatic power

STAND NO. 1, STAND NO. 2 - Test Stand Selector switch for Automatic Stage Servicing Checkout Pneumatic Console

Indicators -

Meters - One pressure meter with switching capability will be provided for each of the following groups:

1. First, second, and third dome pressure, and console supply pressure;
2. Fourth stage dome pressure;
3. Fifth, sixth, seventh, and eighth stage dome pressures.

Illuminated Legend Lights -

OPEN/CLOSED - All console supply valves

LOADING VENT CLOSED - Separate indicators for each of the dome loading stages

PNEUMATIC POWER ON - Pneumatic Power

MANUAL CONTROL ACTIVE, MANUAL DISABLE - Indicates operational status for manual control

STAND NO. 1, STAND NO. 2 - Operates with Selector Switch

5-vdc POWER SUPPLY ON, 5-vdc POWER SUPPLY OFF - operates with ON-OFF switch for 5-vdc power supply.

b. Mainstage Panel -

Controls - OPEN/CLOSE controls will be provided for each valve function as follows:

1. First stage bleed
2. Second stage bleed
3. Third stage bleed
4. Depress bottles supply
5. LO_2 tank prepressurization supply

6. Engine control supply
7. LH₂ tank prepressurization
8. Start bottle supply
9. LO₂ PU valve supply
10. Anti-back FLOW VALVE backup supply
11. Fourth stage bleed
12. Fifth stage bleed
13. Sixth stage bleed
14. Seventh stage bleed
15. Backup pressure switch supply
16. LO₂ system pressure switch supply
17. LH₂ system pressure switch supply
18. Spheres pressure switch supply
19. Engine high-pressure supply
20. Engine low-pressure supply
21. Eighth stage bleed

Indicators - Meters will be provided for each of the following line pressure measurements:

1. Second stage
2. Fourth stage
3. Fifth stage
4. Sixth stage

One spare, nonswitching meter will be provided.

OPEN/CLOSED - This nomenclature appears on the legend lights which will operate with each control switch on the mainstage panel.

c. APS Panel -

Controls - OPEN-CLOSE toggle switches will be provided for actuating each of the following valves on APS Module Nos. 1 and 2:

1. Oxidizer bellows collapse supply
2. Fuel bellows collapse supply
3. Oxidizer facilities lines purge
4. Fuel facilities lines purge
5. Low-pressure switch checkout supply
6. Oxidizer leak check supply

7. Fuel leak check supply
8. High-pressure switch checkout supply

OPEN-CLOSE toggle switches will also be provided for the following supply valves:

1. Bellows manifold
2. Fill manifold
3. Helium bottles

Indicators - Meters will be provided for measurement of the following line pressures:

1. Eighth stage
2. Seventh stage
3. Third stage
4. First stage

OPEN/CLOSED - Illuminated legend lights will be operated with each control switch on the APS Panel.

5.79 Propulsion System Control Console (DSV-4B-234) 1A65728-1

Function - The function of the Propulsion System Control Console shall be to provide controls and indicators for monitoring and controlling tests performed by the Automatic Checkout System on the Stage Propulsion System. Redundant manual control of certain propulsion system components shall also be provided to circumvent a malfunction or failure in the Automatic System. The console will also be capable of limited manual checkout capability in case the automatic system is not available. The digital control functions will be enabled for the console during subsystem testing only. During integrated test, the console shall serve as a monitor station only; all test requests shall be referred to the Test Operation Station.

Design - The console will be designed to include the necessary panels for Digital Operation and for manual control. The manual control panels shall contain switches and indicators for effective manual operation within the scope of the manual control operation of the propulsion system control console.

Components - The console, as shown in Figure 5-46, will consist of the following two types of panels:

- a. Digital Control Panel - This panel will provide the necessary controls and indicators to ensure effective operation and control of the Automatic System. The action of a switch will be converted into Digital information in the external equipment for transfer to the Automatic System.

Inputs from the Automatic System will be converted to visual indications. The controls and indicators on this panel will be identical to those provided for the Telemetry System Control Console (See Paragraph 5.74.)

- b. Numerical Readout Panel - This panel will provide the necessary controls and numerical indications to allow the console operator to request information from the Automatic System, independent of the test program. Two of these panels (containing four monitors) will be provided on the console. The controls and indicators on this panel will be identical to those provided for the Telemetry System Control Console. (See Paragraph 5.74.)

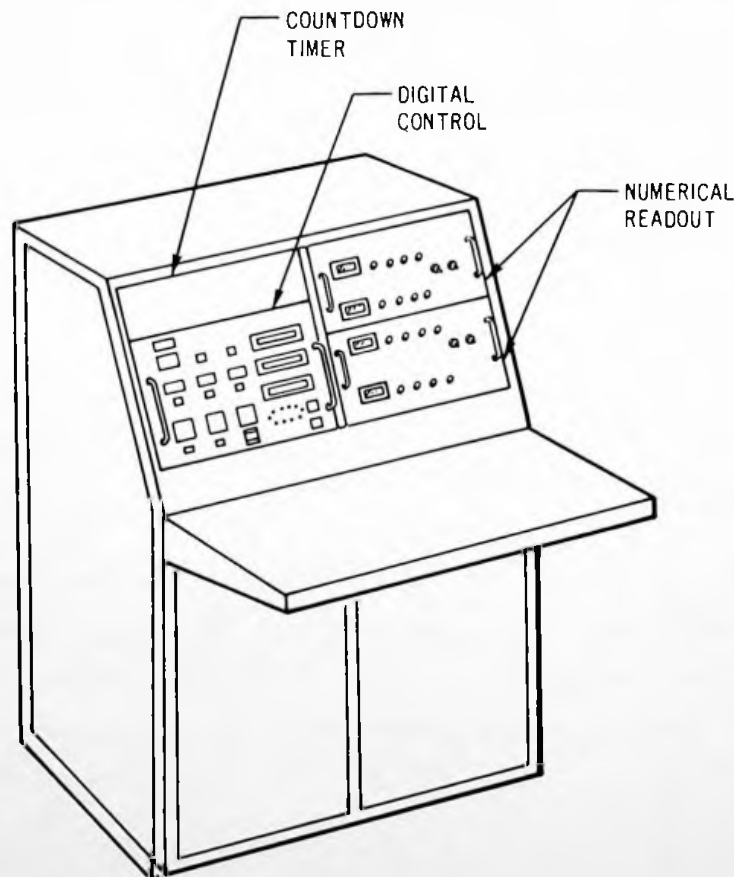


Figure 5-46. Propulsion System Control Console (DSV-4B-234)

c. Mainstage Propulsion Control Panel main fuel tank controls -

<u>Control Switches</u>	<u>Control Valves</u>	<u>Associated Indicator Lights</u>
OPEN/CLOSE	Vent	VENT OPEN/CLOSED
OPEN/CLOSE	Prepressurization Control	PREPRESS CONTROL OPEN CMD
OPEN/CLOSED	Fill and Drain	FILL AND DRAIN OPEN/CLOSED
OPEN/CLOSE	Control He Shutoff	CONTROL HE SHUTOFF CLOSE CMD
FLIGHT/GROUND	Bi-directional Vent	BI-DIRECT VENT FLIGHT/GROUND
OPEN/CLOSED	Ambient He Sphere Dump	AMBIENT HE SPHERE DUMP OPEN CMD
ON	Vent Boost	VENT BOOST CLOSE ON CMD
ON	Fill and Drain Boost	FILL AND DRAIN BOOST CLOSE ON CMD

Main oxidizer tank controls -

OPEN/CLOSED	Vent	VENT OPEN/CLOSED
OPEN/CLOSED	Fill and Drain	FILL AND DRAIN OPEN/CLOSED
OPEN/CLOSED	Cold He Dump	COLD HE DUMP OPEN CMD
ON	Vent Boost	VENT BOOST CLOSE ON CMD
ON	Fill and Drain Boost	FILL AND DRAIN BOOST CLOSE ON CMD

Main Engine Controls -

OPEN/CLOSE	Start Tank Vent	START TANK VENT OPEN CMD
OPEN/CLOSE	Engine Control Bottle Vent	ENGINE CONTROL BOTTLE VENT OPEN CMD
OPEN/CLOSE	LOX and LH ₂ Chilldown Valves	LOX AND LH ₂ CHILLDOWN VALVES OPEN/CLOSED
OPEN/CLOSE	Fuel Tank Prevalve; Oxidizer Tank Prevalve	FUEL TANK PREVALVE OPEN/CLOSED OXIDIZER TANK PRE- VALVE OPEN/CLOSED

<u>Control Switches</u>	<u>Control Valves</u>	<u>Associated Indicator Lights</u>
CUTOFF	Main Engine Cutoff Command	VEHICLE/GSE CUTOFF COMMAND ON
CUTOFF RESET	Main Engine Cutoff Reset Command	
d. <u>APS Manual Control Panel - (Both Modules Fuel and Oxidizer)</u>		
OPEN/CLOSED	Fuel Tank He Dump	FUEL TANK HE DUMP OPEN CMD
OPEN/CLOSED	Fuel Tank Vent	FUEL TANK VENT OPEN CMD
OPEN/CLOSED	Fuel Tank Fill and Drain	FUEL TANK FILL AND DRAIN OPEN CMD
OPEN/CLOSED	Fuel Tank Emer He Dump	FUEL TANK EMER HE DUMP OPEN CMD
OPEN/CLOSED	He Supply Valve	HE SUPPLY VALVE CLOSE CMD
OPEN/CLOSED	He Sphere Dump	HE SPHERE DUMP COMMAND
OPEN/CLOSED	Oxidizer Tank He Dump	OXIDIZER TANK HE DUMP CMD
OPEN/CLOSED	Oxidizer Tank Vent	OXIDIZER TANK VENT OPEN CMD
OPEN/CLOSED	Oxidizer Tank Fill and Drain	OXIDIZER TANK FILL AND DRAIN OPEN CMD
OPEN/CLOSED	Oxidizer Tank Emer He	OXIDIZER TANK EMER HE OPEN CMD
He CONTROL RESET ON	He Pressure Regulator	HE REGULATOR OK/ FAILURE

Indications Only -
(Both Modules)

Fuel Tank 100% Full

Fuel Tank 85% Full

Oxidizer Tank 100% Full

Oxidizer Tank 85% Full

Control SwitchesAssociated Indicator
Lights

Miss. Controls and Indications -

Indication Only -

Fwd Cmd Power

Aft Cmd Power

ACTIVATE/OFF

MANUAL CONTROL ACTIVE
 MANUAL CONTROL ENABLE
 MANUAL CONTROL DISABLE
 APS FIRING ENABLE

APS FIRING CUTOFF

APS FIRING CUTOFF

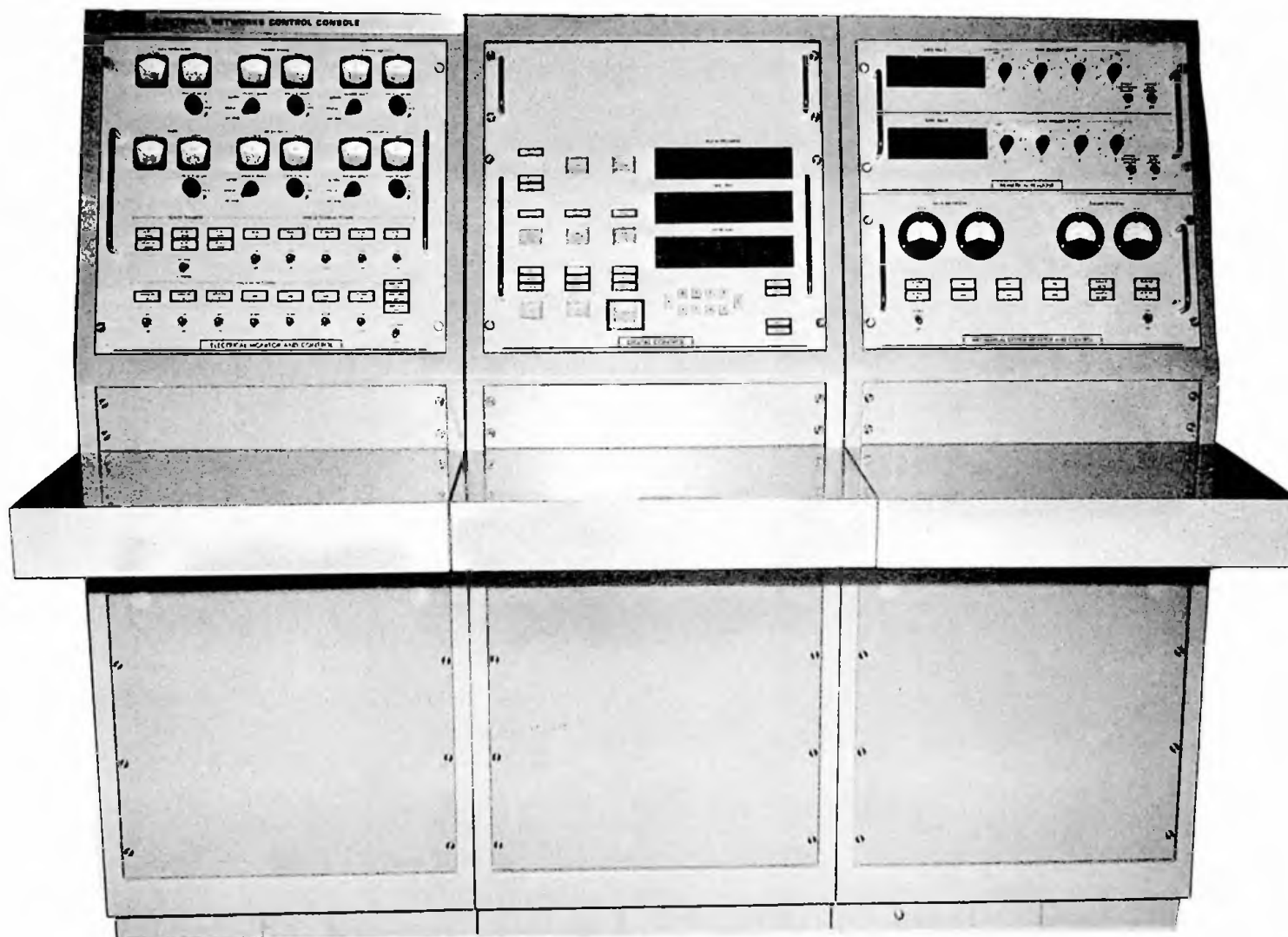
5.80 Propulsion System Control Console - Beta (DSV-4B-234A) 1B63464-1

This model is similar to DSV-4B-234 except that some of the indicator lights, switches, and meters are regrouped and reidentified to provide a more efficient operation in the manual mode at Beta I and Beta III. (See Figure 5-46.)

5.81 Electrical Networks Control Console (DSV-4B-236) 1A65730-1

Function - The function of the Electrical Networks Control Console shall be to provide the capability of monitoring and controlling tests performed by the automatic checkout system. The console shall contain manual controls for that portion of the stage electrical and mechanical systems which shall be used in the event of a failure in the automatic system. For subsystem testing, the digital control portion of the console shall be enabled by the test operator station for direct entry into the automatic system. When integrated tests are performed, the console shall serve as a monitor station only; any test request generated by this station shall be executed by the test operator station.

Design - The console, as shown in Figure 5-47, will be designed to provide convenient physical access and visibility of controls and indicators to the console operator. The console will provide for manual entry of test identification numbers. When a number is entered, a digital word will be



transferred to the automatic system. Hardline inputs and outputs to the console will be visibly displayed. The console will be capable of test termination or interruption, as well as override of a test in progress by entry of new test numbers.

Components - Four operating panels will be provided in the console:

- a. Digital control panel
- b. Mechanical systems monitor and control panel
- c. Electrical systems monitor and control panel
- d. Numerical readout panel.

The above panels are described in the following paragraphs.

- a. Digital control panel - The controls and indicators on this panel will be identical to those on the digital control panel described for the Telemetry System Control Console.
- b. Mechanical systems monitor and control panel -
 - Controls - Switches will be provided for ON-OFF manual control of the auxiliary hydraulic pump motor and the Hydraulic Pumping Unit (DSV-4B-358) pump motor.
 - Indicators - Two dc voltmeters will be provided to read the voltage applied to the pitch and yaw actuator valves. Two meters will be provided to indicate main engine pitch and yaw positions. Legend lights will be provided to show high or normal oil temperature for the hydraulic system reservoir. The lights will also indicate ON or OFF conditions for both pump motors. Spare indicator lights will be provided.
- c. Electrical system monitor and control panel -
 - Controls - The following controls will be provided on the electrical networks monitor and control panel. The primary function of these switches will be to assume manual control in the event of a failure or malfunction in the automatic checkout system.
 - 1. Four ON-OFF control switches to control the application of the stage external power supplies to the two forward and aft buses;
 - 2. An ON-OFF control switch to control the application of the stage external power to the battery simulator cables;
 - 3. A control switch for internal-external power transfer of the stage power system;

4. An ON-OFF control switch for RF SILENCE ON; (The ON position will disable the stage telemetry transmitter.)
5. ON-OFF control switches for sequencer power, talkback power, and DDAS system power;
6. A MANUAL CONTROL ACTIVATE switch to enable operation of all manual control switches on the electrical networks control console.

Indicators - The panel will provide the console operator with the following visual displays and indicators:

1. Four dc voltmeters to display the status of the stage forward power and aft power systems; (One meter will be provided for each power system, with switches provided to select battery, stage bus, or external power supply for each of the system. Ammeters will also be included to display the current drain on each power supply. The forward power and aft power systems will each have two buses which will be monitored separately.)
 2. A dc voltmeter to display the status of the GSE power supply; (An ammeter will also be included to display the current drain on the power supply.)
 3. Indicators to verify responses to each of the commands generated by the control switches;
 4. Indicators for use in conjunction with the MANUAL CONTROL ACTIVATE switch for ACTIVE, ENABLED, and DISABLED conditions.
- d. Numerical Readout Panel - The controls and indicators on this panel will be identical to those on the numerical readout panel described for the Telemetry System Control Console.

5.82 Electrical Networks Control Console - Beta (DSV-4B-236A) 1B63476-1

This model is similar to DSV-4B-236 except that some of the indicator lights, switches, and meters are regrouped and reidentified to provide a more efficient operation in the manual mode at Beta I and Beta III. (See Figure 5-47.)

5.83 Propulsion System Display Unit (DSV-4B-238) 1A65732-1

Function - The function of the Propulsion System Display Unit shall be to provide recorded performance of the propulsion system for immediate on-line data evaluation and permanent reference.

Design - The unit, as shown in Figure 5-48, will be designed to accommodate analog input signals. The analog recorders will be contained in standard 6-foot equipment racks with adequate controls for power, local operation, and chart speed. The analog recorders will be operated by local control only, and will employ ink writing on the charts. Analog signals will be recorded as amplitude variation with time. The unit will have the capacity of 16 simultaneous recordings of analog information. The time reference will be supplied from external equipment.

Components - The unit will provide controls for each recorder as follows:

- a. Power ON-OFF switches
- b. Analog signal controls
 1. Selector switches to select 16 of the 52 available signals
 2. Zero and scale-adjust controls
 3. Amplifier damping and gain controls.

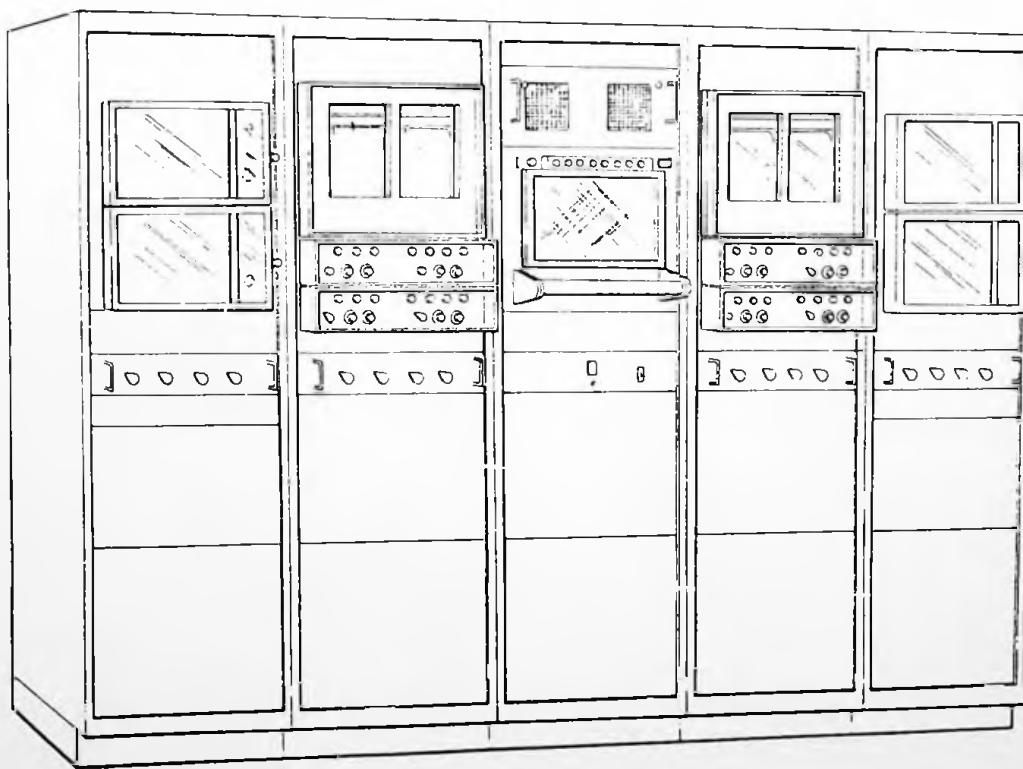


Figure 5-48. Propulsion System Display Unit (DSV-4B-238)

5.84 Electrical Networks Display Unit (DSV-4B-239) 1A65733-1

Function - The function of the Electrical Networks Display Unit shall be to provide (1) recorded performance of the stage electrical and mechanical operation, and (2) immediate on-line data evaluation.

Design - The unit, similar to DSV-4B-238, will be designed to accommodate analog input signals. The analog recorders will be contained in standard 6 foot equipment racks with adequate controls for power, local operation, and chart speed. The analog recorders will be operated by local control only, and will employ ink writing on the charts. Analog signals will be recorded as amplitude variation with time. The unit will have the capacity of 24 simultaneous recordings of analog information. The time reference will be supplied from external equipment. (See Figure 5-49.)

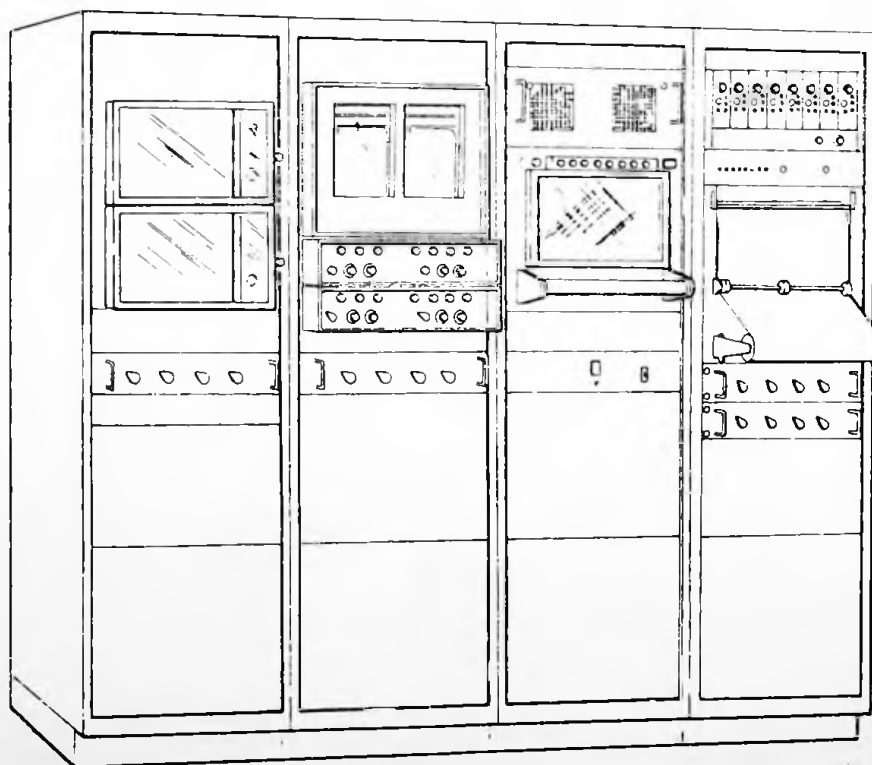


Figure 5-49. Electrical Networks Display Unit (DSV-4B-239)

Components - The unit will provide controls for each recorder as follows:

- a. Power ON-OFF switches
- b. Analog signal controls
 - 1. Selector switches to select 13 of the 52 available signals (four channel recorders)
 - 2. Selector switches to select 26 of the 52 available signals (eight channel recorders)
 - 3. Amplifier damping and gain control.

5.85 Telemetry Systems Display Console (DSV-4B-240) 1A69003-1

Function - The function of the Telemetry Systems Display Console shall be to display and record demodulated and decommutated data received from the four telemetry ground stations, i.e., SS/FM, PAM/FM/FM, DDAS, and PCM. The console shall be capable of simultaneously recording 54 inputs on three high-speed optical recording oscillographs. The console shall provide for expansion to 63 inputs without mechanical redesign.

Design - The input signals to the console will be selected for display and recording by means of a central patch panel contained as part of the console. All controls for recording speed, light intensity, power, etc., will be manual or will be an integral part of each oscillograph recorder. The console will be contained in a four-bay rack assembly. Input data to the recorders will be obtained from the following sources:

- a. FM/FM - Twenty-three channels of analog outputs will be obtained from standard IRIG (Inter-Range Instrumentation Group) discriminators. Voltage level will be from 1 to 10 volts across 500 ohms.
- b. PAM - Thirty channels of analog data will be obtained from decommutation gates. Voltage level will be from 0 to 5 volts across 330 ohms.
- c. DDAS - Fifty channels will be obtained from the digital-to-analog gates. Voltage level will be 0 to 10 volts, and the output impedance will be 100 ohms.

- d. SS/FM - Fifteen channels will be obtained from the demultiplexer at 50 to 3,000 cps. In addition, the following channels will also be obtained:
 - 1. One special service channel from the demultiplexer at 50 cps to 1.2 kc;
 - 2. One alarm channel from the demultiplexer;
 - 3. One sweep calibrate signal, 20 cps to 3 kc, 2.0 volts peak-to-peak into 250 ohms;
 - 4. One acoustical calibrate signal, 300 cps to 9 kc, 2.6 volts root mean square into a 600-ohm load.
- e. PCM - Twenty channels will be obtained from the digital-to-analog gates. Voltage level will be 0 to 10 volts.
- f. Timing - Four channels of timing signals will be provided. Each recorder will use one channel for recording time. The selection of three timing pulses and 51 different data channels will be provided by the patch panel.

Components - The console, as shown in Figure 5-50, will contain three recording devices, each capable of 36-channel simultaneous operation by means of highly sensitive galvanometers and moving strips of photographic material. Each recorder will contain 18 data galvanometers.

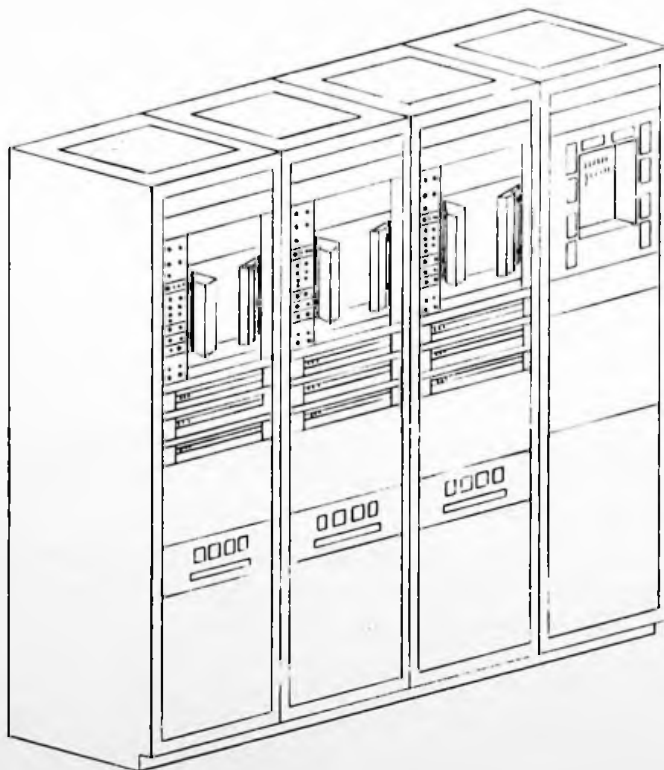


Figure 5-50. Telemetry System Display Console (DSV-4B-240)

5.86 Propellant Utilization System Calibration Unit (DSV-4B-248)
1A68014-1

Function - The function of the Propellant Utilization System Calibration Unit shall be to perform the following functions:

- a. Simultaneously simulate LO_2 and LH_2 tank propellant loads from 0 to 100 percent to calibrate propellant tanks empty and full points;
- b. Verify operation of the automatic checkout relays and obtain propellant mass values for the GSE;
- c. Enable presetting of the propellant programmed mixture ratio;
- d. Verify operation of the PU valve servo monitor and potentiometers.

Design - The unit will consist of two variable air capacitors (one dual, one single) and a dc differential voltmeter installed in a portable carrying case. Interconnecting cables will be provided and will be stored in the carrying case.

Components - The unit, as shown in Figure 5-51, will consist of the following components:

- a. Carrying case
- b. Capacitors
- c. Differential voltmeter
- d. Interconnecting cables.

Dimensions - The unit will be approximately 17-1/2 inches high, 32 inches long, and 20 inches wide.

5.87 Transmitter Test Set (DSV-4B-252) 1A71751-1

Function - The function of the Transmitter Test Set shall be to test the FM Transmitter and/or the RF power amplifier. The test set shall also be capable of being interconnected with the PAM/FM/FM, SS/FM, and PCM/FM Telemetry Component Test Sets for individual subsystem calibration.

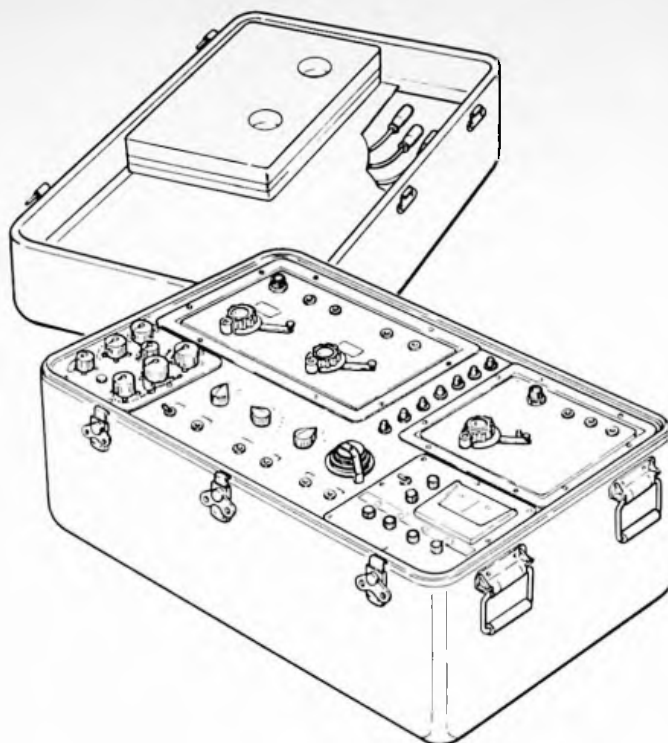


Figure 5-51. Propellant Utilization System Calibration Unit (DSV-4B-248).

Design - The test set will be designed to provide the necessary power, stimuli and readout equipment to completely check out the FM transmitter and/or the RF power amplifier. Specifically, the test set will be capable of: (1) checking the efficiency of the transmitter and/or amplifier, (2) detecting the incidental FM of both transmitter and amplifier, and (3) demodulating and detecting distortions, spurious RF, frequency response, center frequency of the transmitter, deviation linearity and sensitivity of the transmitter, and power gain and bandwidth of the amplifier. The test set will be contained in a four-bay console. A writing surface will be provided two bays in length for holding test procedures. The test set will be designed for manual operation, with all controls located on the front panels above the writing surface. The unit under test will be mounted in a shielded drawer to reduce RFI.

Components - The test set, as shown in Figure 5-52, will contain the following components:

- a. Telemetering indicator power supply and indicator
- b. 28-vdc power supply
- c. Wave analyzer
- d. Ac/dc converter
- e. Digital voltmeter
- f. Pulse generator
- g. Frequency counter
- h. IF (intermediate frequency) visual display
- i. Oscilloscope
- j. Oscillator
- k. FM receiver
- l. RF spectrum analyzer
- m. Power oscillator
- n. Power meter (calorimeter)

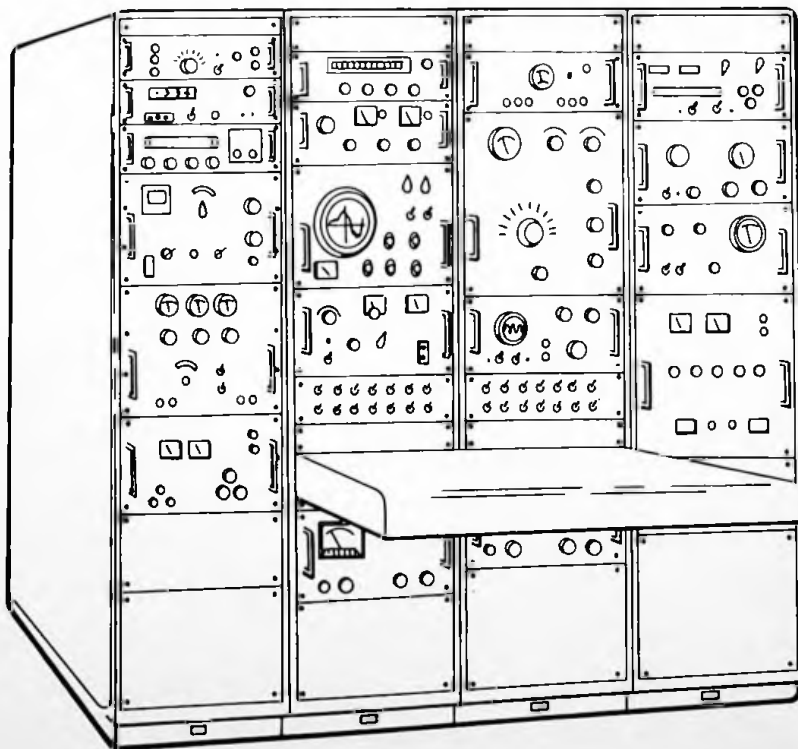


Figure 5-52. Transmitter Test Set (DSV-4B-252)

- o. RF drawer
- p. Transmitter-amplifier input monitor panel
- q. Three (3) patch panels
- r. Two (2) storage drawers
- s. FM deviation meter
- t. Four (4) cabinets
- u. Writing surface
- v. Blowers.

Dimensions - The test set will have the following approximate dimensions: depth, 25-1/2 inches; width, 84-1/4 inches; and height, 77-1/2 inches. The writing surface will be centrally located 30 inches above the floor, and will be 42-1/8 inches long and 14 inches deep.

5.88 Auxiliary Signal Distribution Complex (DSV-4B-253) 1A87185-1

Function - The function of the Auxiliary Signal Distribution Complex shall be to transmit control and response signals between the Stimuli and/or Response Signal Conditioners (DSV-4B-130 and -131, respectively) and the GSE listed below during "dry checkout" operations.

- a. Vehicle External Power Rack (DSV-4B-134)
- b. HB-VCL-1 Stage Checkout Cable Network (DSV-4B-141)
- c. HB-VCL-1 Stage Checkout Area Patch Panel Distribution Box, (DSV-4B-148)
- d. HB Automatic Stage Checkout Pneumatic Console (DSV-4B-321)
- e. Hydraulic Pumping Unit (DSV-4B-358)
- f. Forward Skirt Electronics Thermoconditioning System Servicer (DSV-4B-359).

This relationship is illustrated in Figure 5-53.

Design - The unit will provide the necessary equipment to operate as an interface between the GSE listed above and the Response and/or Stimuli Signal Conditioners. Self-check capabilities for fault isolation, inter-lock lines, and miscellaneous circuits will be incorporated. Manual controls will be included for all commands. Patch boards will be used to provide maximum flexibility.

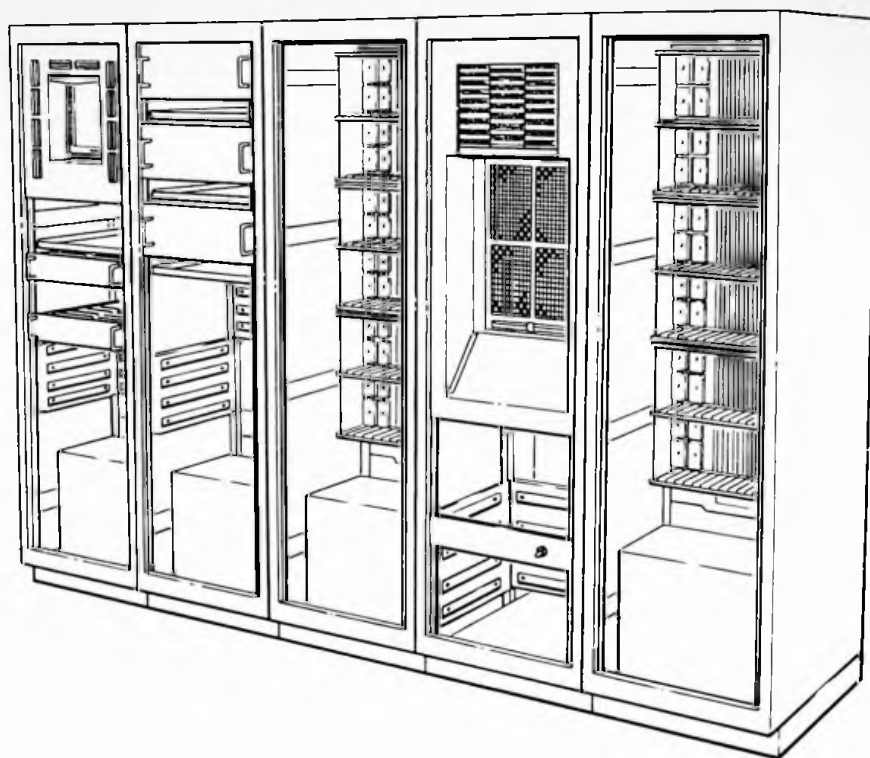


Figure 5-53. Auxiliary Signal Distribution Complex (DSV-4B-253)

Components - The complex will consist of the following major components:

- a. Patch boards (Part of Model DSV-4B-184)
- b. Diodes
- c. Relays
- d. Switches
- e. Interlock lines
- f. 5-vdc power supply
- g. 28-vdc power supply
- h. Miscellaneous circuits.

5.89 Auxiliary Distribution Unit, SACTO (DSV-4B-253A) 1B38342-1

The function, design, and components for this unit will be identical to Model DSV-4B-253, except that additional circuit breakers, interlock lines, connectors, and analog relays will be provided for "wet checkout" operations. (See Figure 5-53 .)

5.90 Instrument Unit Substitute (DSV-4B-267) 1A89817-1

Function - The function of the Instrument Unit Substitute shall be to provide all electrical signals or loads normally supplied to the stage by the instrument unit. When the stage is being checked by the automatic checkout system without the instrument unit attached, the substitute shall provide the necessary electrical interface requirements between the automatic checkout equipment and the forward interface of the stage.

Design - The substitute, as shown in Figure 5-54, will be designed as the replacement for the instrument unit during all checkout operations in which the S-IVB stage only is being tested. In order that all operational phases of the stage may be evaluated, the electrical data provided by the substitute will include both prelaunch and inflight signals. The substitute will be contained in a standard equipment rack. All circuits for the interface functions will be fused. Relays will be provided for isolation or control, as required. Power supplies will also be provided to generate transducer power and attitude control nozzle signals.

Components - The front panel of the unit will contain 80 fuse indicators, with designations of their respective functions. The power suppliers will be a 5-vdc output for the transducers (with regulation and sensing) and a 28-vdc, 1-ampere maximum for the relays. The ON-OFF control for the power supplies will control 115-vac input to the supplies. The equipment rack for this unit will also contain the Aft Interface Substitute Unit Chassis (DSV-4B-268).

5.91 Aft Interface Substitute Unit Chassis (DSV-4B-268) 1A89815-1

Function - The function of the Aft Interface Substitute Unit Chassis shall be to simulate the electrical signals and responses received by the S-IVB stage from the S-IB, S-IC, and S-II stages.

Design - The substitute will be designed to be remotely controlled by the automatic checkout system, and will provide a contact closure which may be opened upon command by the external equipment. The substitute, as

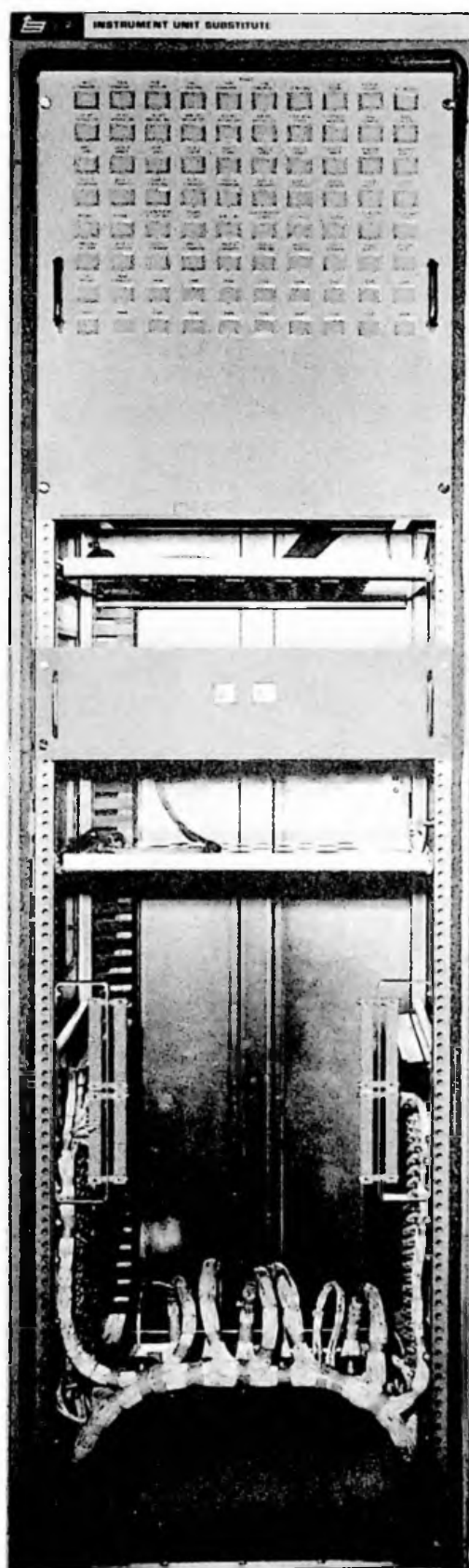


Figure 5-54. Instrument Unit Substitute and Aft Interface Substitute Unit Chassis (DSV-4B-267, DSV-4B-268)
SM425929

shown in Figure 5-54, will be contained in an equipment rack as part of the Instrument Unit Substitute. A dc voltage supplied from the stage will be connected to one pole of a relay and returned to the stage by the normally closed contacts. This voltage will be interrupted when the relay is energized by a SIMULATE S-II SEPARATION command from the check-out equipment. An output signal will also be supplied to the external equipment through the normally open contacts of the relay to indicate S-II SEPARATED.

Components - The substitute will contain a double-pole, double-throw, crystal-can relay, with a minimum contact rating of 2 amperes and a nominal operating voltage of 24 to 32 vdc. (This model mounts in the Instrument Unit Substitute, Model DSV-4B-267.)

5.92 Pulse Coded Modulation (PCM) Ground Station (DSV-4B-278) 1A97516-1

Function - The function of the Pulse Coded Modulation (PCM) Ground Station shall be to receive PCM data from a stage telemetry system and to demodulate the data for individual channel analysis. The input signal will be a serial-commutated pulse train from the PCM/FM/DDAS telemetry system.

Design - The design of the ground station will be identical to the DDAS Telemetry Ground Station, except that it will not be computer-controlled. It will, however, be available for all off-line evaluation and display. The ground station will be designed to be a manual test unit depending only upon an input for operation. Processing of input data will be required from only one source at a time. Open-loop transmission from the stage will be routed to the receiver front-end for demodulation. All closed-loop inputs will be routed through the source-selector coaxial switch, and from there to the predetection module in the receiver. The receiver input selection will have a calibrate position for coupling a precise frequency to the receiver for calibration.

The PCM serial data will be supplied to the ground station by one of the following sources:

- a. RF transmission (open-loop);
- b. RF transmission, by coaxial cable (closed-loop);
- c. RF (600 kc) directly from the voltage-controlled oscillator composite outputs by coaxial cable (closed-loop); (These composite outputs will be processed through the receiver second IF before decommutation.)
- d. PCM/FM data from a digital data simulator located in the station equipment;
- e. Playback PCM data from the Telemetry Magnetic Tape Unit.

The ground station will contain a receiver to demodulate the RF signal and distribute it to the decommutation equipment. The output from the receiver will be made available for magnetic recording. The ground station will be contained in three 6-foot equipment racks, with cooling blowers included for proper ventilation.

Components - The station, as shown in Figure 5-55, will contain the following major components:

- a. FM receiver
- b. Bit synchronizer
- c. Correlator
- d. Data control unit
- e. Data switch unit, including an 816-pin patchboard
- f. Quick-look display unit
- g. Twenty digital-to-analog modules and calibrators
- h. Data register (8-ten bit words)
- i. Discrete drawer
- j. Power supplies
- k. Digital signal simulator
- l. Source selector
- m. RF switch.

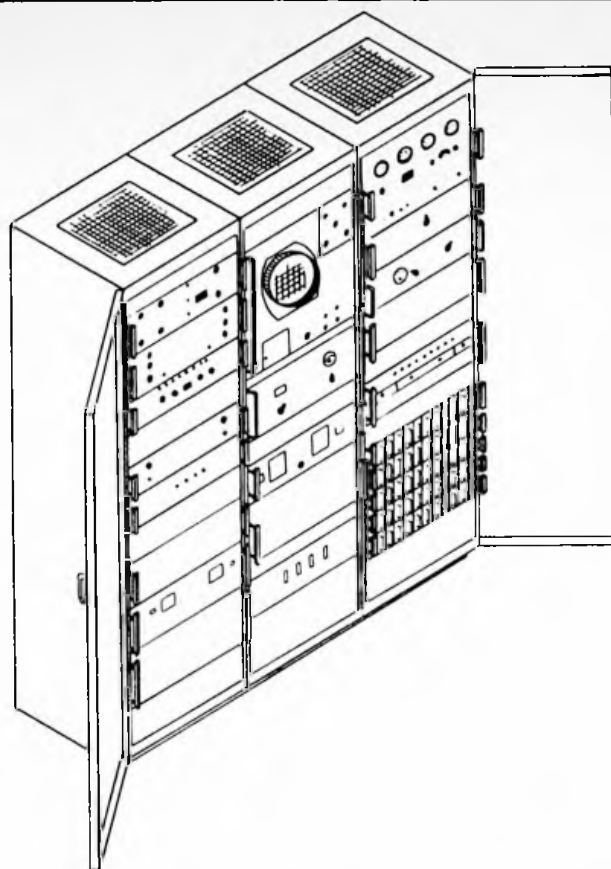


Figure 5-55. Pulse Coded Modulation (PCM) Ground Station (DSV-4B-278)

5.93 Stage Instrumentation Checkout Unit (DSV-4B-279) 1B28115-1

Function - The function of the Stage Instrumentation Checkout Unit shall be to provide the necessary equipment to monitor and record telemetry input signals to each channel of the stage PAM/FM/FM, PCM/FM, and SS/FM equipment. When a signal voltage to the PAM/FM/FM and PCM/FM equipment is monitored, it will be converted to a digital form and printed. The channel number will also be printed on the same line. In the automatic mode, the equipment shall have the capability of recording approximately 10 voltages per second. The equipment shall also be capable of operation in the manual mode. In addition to the printed record, channel identification and voltage will be indicated on the front panel at all times.

Monitoring of the SS/FM and VCO signal voltages will be performed in the manual mode only. Recording will be done two channels at a time on a direct-writing oscillograph in the 0 to 3,000-cps range. Channel identification will be obtained by means of additional galvanometers.

Design - The unit, as shown in Figure 5-56, will consist of three racks of equipment. Adapter cables will be inserted between the stage cables and the telemetry inputs to obtain input signals. The signals will be routed to the switching matrix of the checkout unit. Telemetry circuits will not be broken when the switching matrix is connected.

Components - The unit will consist of the following major components:

- a. A switching unit which will provide a sequential input of all measurements to the PAM/FM/FM and PCM/FM telemetry equipment for (1) display on a digital voltmeter or (2) sequential switching of any two measurements to the SS/FM equipment.
- b. A console which will provide the following:
 1. A direct-writing oscillograph, with a dual-channel input and a frequency response of 0 to 3,000 cps, for recording the above selected signal inputs to the SS/FM telemetry equipment;
 2. A remote digital voltmeter unit for (1) controlling the PAM/FM/FM and PCM/FM measurements at the switching unit and (2) presenting a panel display of the voltage being measured; accuracy will be ± 1 digit in 4 places;

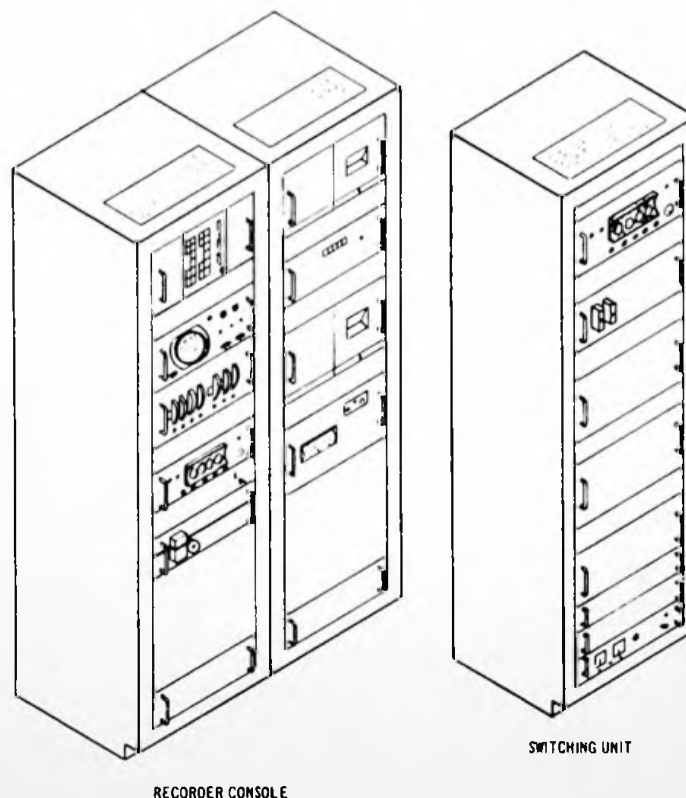


Figure 5-56. Stage Instrumentation Checkout Unit (DSV-4B-279)

3. A power supply, with calibrate voltage from 0 to 5-vdc in 1-volt steps;
 4. A manual RACS (Remote Automatic Calibration System) panel to allow operation of the on-board RACS during operation of the recorders; this panel will be connected in parallel with the RACS contained in the Signal Distribution Unit;
 5. A high-speed printer for digital printout of the sampled voltages;
 6. An oscilloscope for observing vibration data, et cetera;
 7. A control panel for controlling the switching matrices in the switching unit;
- c. A junction box which will provide terminal strips for making T-connections to the adapter cables inserted between the vehicle conversion equipment and the telemetry equipment.

5.94 Multiplexer and Calibrator Component Test Set (DSV-4B-280)
1A81000-1

Function - The function of the Multiplexer and Calibrator Component Test Set shall be to test, calibrate, and troubleshoot the following assemblies:

- a. Central calibrator assembly
- b. Vibration multiplexer
- c. Time-division multiplexer
- d. Calibration command channel decoder assembly
- e. Calibration command central decoder assembly
- f. FM/DDAS (Frequency Modulation/Digital Data Acquisition System) relay assembly.

Design - The test set will be designed to provide the necessary power, stimuli, and monitoring equipment to check the following:

- a. Dc and ac calibration signals of the central calibration unit;
- b. Channel identification, reverse current, and crosstalk of the vibration multiplexer;
- c. Input-output impedances, channel identification, and linearity of the time-division multiplexer;
- d. Output encoding and input impedance of the calibration command and channel decoder assembly;

- e. Rise-and-fall times, pulse duration, and output encoding of the calibration command central decoder assembly;
- f. Proper relay operation, inhibit circuitry, input impedance, and crosstalk of the FM/DDAS assembly.

The test set will be contained in a three-bay console. A writing surface will be provided to hold test procedures and the unit under test. The test set will be designed for manual operation, and all controls will be located on the front panels above the writing surface.

Components - The test set, as shown in Figure 5-57, will consist of the following components:

- a. Two 40-vdc power supplies
- b. Four 0-20-vdc modular power supplies
- c. Ac/dc converter
- d. Digital voltmeter
- e. Counter
- f. Oscilloscope

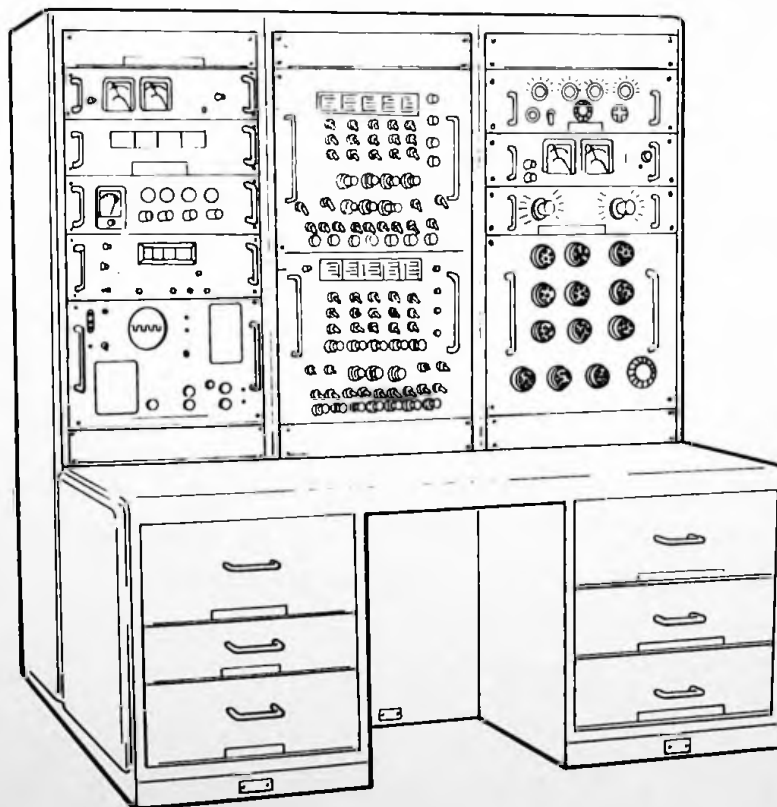


Figure 5-57. Multiplexer and Calibrator Component Test Set (DSV-4B-280)

- g. Audio oscillator
- h. Function generator
- i. Discriminator
- j. Two control panels
- k. Patch and connector panel
- l. Five storage drawers
- m. Three cabinets
- n. Writing surface
- o. Three blowers.

Dimensions - The test set will have the following approximate dimensions: height, 77-1/2 inches; width, 63-3/16 inches and depth, 51 inches. The writing surface will be located 30 inches above the floor, and will be 63-3/16 inches long and 14 inches deep.

5.95 Distribution Unit, Forward and Aft Busses Battery Power (DSV-4B-284)
1B38908-1

Function - The function of the Forward and Aft Busses Battery Power Distribution Unit shall be to distribute dc power during simulated flight checkout of the stage. In addition, the Power Distribution Unit shall furnish power to the stage during subsystem testing as required.

Design - The unit will be designed to provide the required switches, cabling, indicators, and electrical equipment to properly connect the Simulated Flight Battery Power Unit (DSV-4B-170) to the Vehicle and monitor polarity and current. The unit will be used by coupling dc batteries to the vehicle busses as follows:

- a. Stage Forward No. 1 Bus a 30 volt 80 A-H battery
- b. Stage Forward No. 2 Bus a 30 volt 80 A-H battery
- c. Stage Aft No. 1 Bus a 30 volt 80 A-H battery
- d. Stage Aft No. 2 Bus a 60 volt 80 A-H battery.

Switching will be arranged to allow remote control. The Simulated Flight Battery Power Distribution Unit can be configured to supply power to the Forward No. 1 and No. 2 Vehicle busses or the Aft No. 1 and No. 2 Vehicle busses. (See Figure 5-58.)

Components - The unit will contain the following major components:

- a. Switches
- b. Relays
- c. Connectors
- d. Shunts
- e. Amplifiers 0-5v output
- f. Amplifier power supplies ± 15 volts.

5.96 Pneumatic Consoles Portable Test Set (DSV-4B-286) 1B38354

Function - The function of the Pneumatic Consoles Portable Test Set shall be to locally checkout all of the electrical circuitry of the Pneumatic Stage Servicing Consoles (DSV-4B-432, -433, and the cold Gas Heat

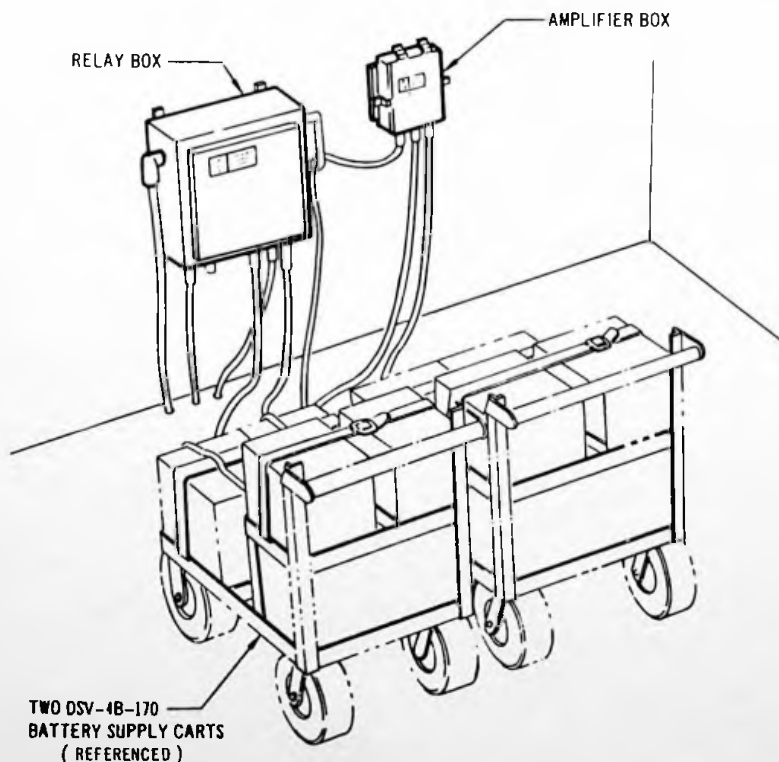


Figure 5-58. Distribution Unit, Forward and Aft Busses Battery Power (DSV-4B-284)

Exchanger DSV-4B-438). The test set provides local manual control of all solenoid valves and dome loaders. Valve position talkbacks are displayed on the set by illuminated indicators. Switchable meters are provided to check voltage level of analog circuits.

Design - The test set will consist of seven (7) suitcase-type containers; three house the electronic portions of the test set, and four are cable containers which provide the cables to electrically connect the test set to units being tested and to appropriate 28-vdc power source. (See Figure 5-59.)

The electronic cases are designated:

- A1 - Test Set, Pneumatic Console A
- A2 - Test Set, Pneumatic Console B - Cold Gas Heat Exchanger
- A3 - Test Set, Analog Monitor - Power Distribution.

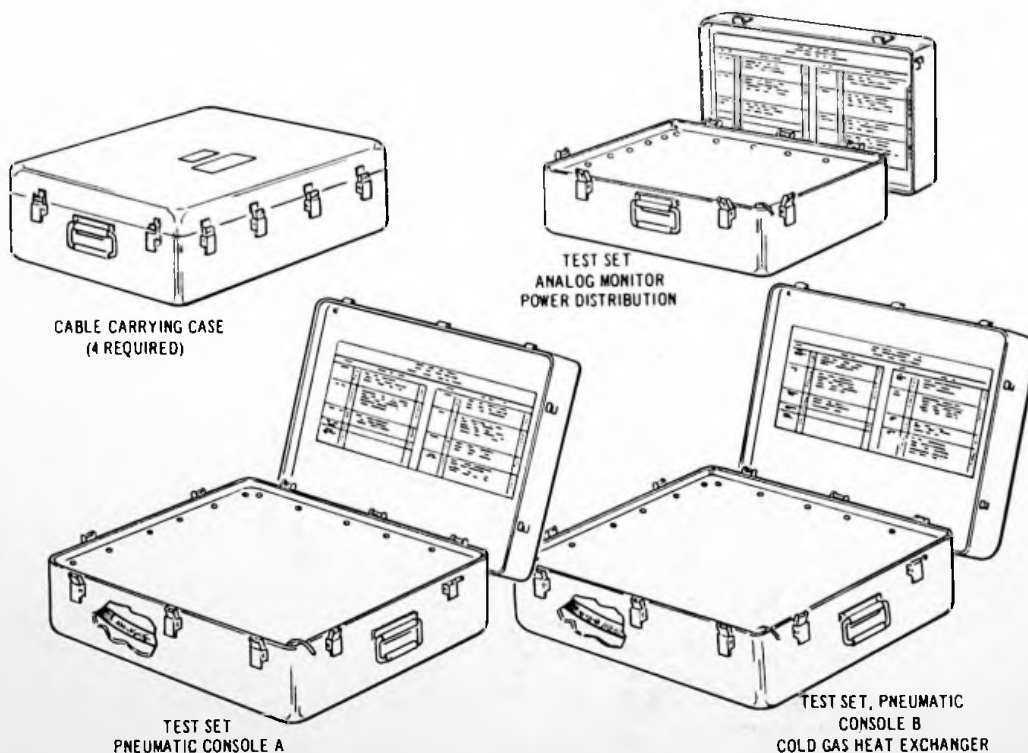


Figure 5-59. Pneumatic Consoles Portable Test Set (DSV-4B-286)

Components - The test set will consist of aluminum cases, designed to withstand any, and all, environments which it will see in normal service. All the electronics are assembled panels which are attached to the inside of the case. These consist of the following major components:

- a. Electric Connectors (Receptacle)
- b. Electric Switches
- c. Circuit Breakers
- d. Indicating-type fuses
- e. Volt and Amp Meters
- f. Indicating Lights.

Dimensions - The dimensions and approximate weights of the cases are as follows:

- a. A1: height, 28-1/4 inches; width, 28-1/4 inches; depth, 10-1/8 inches
- b. A2: height, 28-1/4 inches; width, 28-1/4 inches; depth, 10-1/8 inches
- c. A3: height, 19 inches; width, 22 inches; depth, 10 inches
- d. Cable Cases: height, 24 inches; width, 26 inches; depth, 12 inches and weighs approximately 90 pounds.

(For use with the S-IB stage only.)

5.97 Pneumatic Consoles Portable Test Set (DSV-4B-286A) 1B59200-1

Except for identification and minor configuration changes, the function and design will be similar to Model DSV-4B-286. This model will be used to checkout Pneumatic Consoles (DSV-4B-432A, DSV-4B-433A) and the Gas Heat Exchanger (DSV-4B-438A). (See Figure 5-59.) (For use with the S-V stage only.)

5.98 Emergency Battery Rack Assembly, SACTO (DSV-4B-287) 1B32384-1

Function - The function of the SACTO Emergency Battery Rack Assembly shall be to provide emergency battery power for the Vehicle External Power Racks (DSV-4B-134) in case of a power supply failure. The unit shall be designed for use at hot-firing locations.

Design - The assembly, as shown in Figure 5-60, will be designed to provide backup power for the three 28-volt stage busses and the GSE bus. Four separate battery sources (one 30-volt, 240 amp/hour source and three 30-volt, 80 amp/hour sources) will be provided. Each battery source will be "trickle-charged" while connected to the external power rack. The switching of batteries to the busses will be accomplished within the external power rack. Fuses will provide short-circuit protection for the cables. The trickle-charger and fuses will be contained in a wall-mounted cabinet. Twelve 15-volt, 80 amp/hour batteries which comprise the four battery sources (one 30-volt, 240 amp/hour source and three 30-volt, 80 amp/hour source) will be installed on three carts and connected to the external power rack through the wall-mounted cabinet. Each battery cart equipped with four batteries and associated equipment is designated Model DSV-4B-170 and is included as part of Model DSV-4B-287.

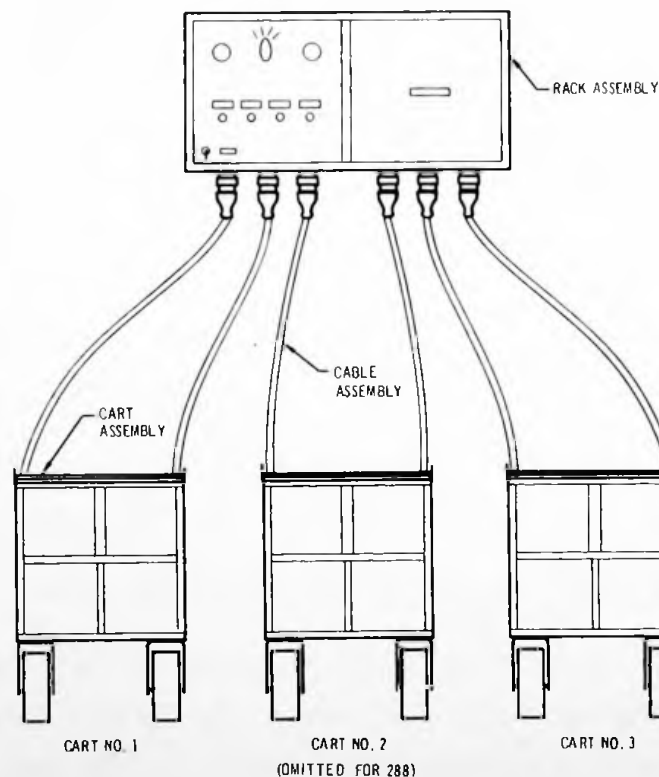


Figure 5-60. Emergency Battery Power Unit (DSV-4B-287 and DSV-4B-288)

Components - The assembly will consist of the following major components:

- a. Nickel/cadmium batteries
- b. Fuses
- c. Battery carts
- d. Trickle-charger
- e. Wall-mounted cabinet
- f. Cables, connectors, etc.

5.99 Emergency Battery Power Unit - Huntington Beach (DSV-4B-288)

Function - The function of the Huntington Beach Emergency Battery Power Unit shall be to provide emergency battery power for the Vehicle External Power Racks (DSV-4B-134) in case of a power supply failure. The unit shall be designed for use at locations other than hot-firing locations.

Designs - The unit, as shown in Figure 5-60, will be designed to provide backup power for the three 28-volt busses and the GSE bus. Four separate battery sources (30-volt, 80 amp/hour capacity each) will be provided. Each battery source will be trickle-charged while connected to the external power rack. The switching of batteries to the busses will be accomplished within the external power rack. Fuses will provide short-circuit protection for the cables. The trickle-charger and fuses will be contained in a wall-mounted cabinet. Eight 15-volt, 80-amp/hour batteries (which comprise the four battery sources) will be installed on two carts and connected to the external power rack through the wall-mounted cabinet. Each battery cart equipped with four batteries and associated equipment is designated Model DSV-4B-170 and is included as part of Model DSV-4B-287.

Components - The unit will contain the following major components:

- a. Nickel/cadmium batteries
- b. Fuses
- c. Battery carts
- d. Trickle-charger

- e. Wall-mounted cabinet
- f. Cables, connectors, etc.

5.100 Digital Events Recorder (DSV-4B-289) 1B39013-1

Function - The function of the Digital Events Recorder shall be to provide recorded performance of the bilevel portion of the stage checkout operations.

Design - The recorder will be designed to provide (1) printed data for immediate evaluation and (2) a punched paper tape for reuse by the evaluator for post-test analysis. The recorder will be capable of scanning 720 input lines and recording change of stage, time of change, and a predetermined identification number for each input line. The recorded events will be compared with a prestored order-of-events table contained in the memory of the recorder. During operation, only those events which occur out of sequence will appear as output. The time reference will be supplied from an external source.

Components - The recorder, as shown in Figure 5-61, will consist of the following major components:

- a. General purpose computer (maximum 8,000 word memory)
- b. Line printer
- c. Paper tape punch and reader
- d. Typewriter for input control.

5.101 Auxiliary Control Console (DSV-4B-294) 1B37433-1

Function - The function of the Auxiliary Control Console shall be to provide the console operator the controls and indicators necessary for monitoring and controlling the Mechanical Ground Support Equipment during subsystem testing. In addition, this console shall serve as a monitoring station during integrated systems testing.

*For further information, see S.A. 233 and C.O. 303.

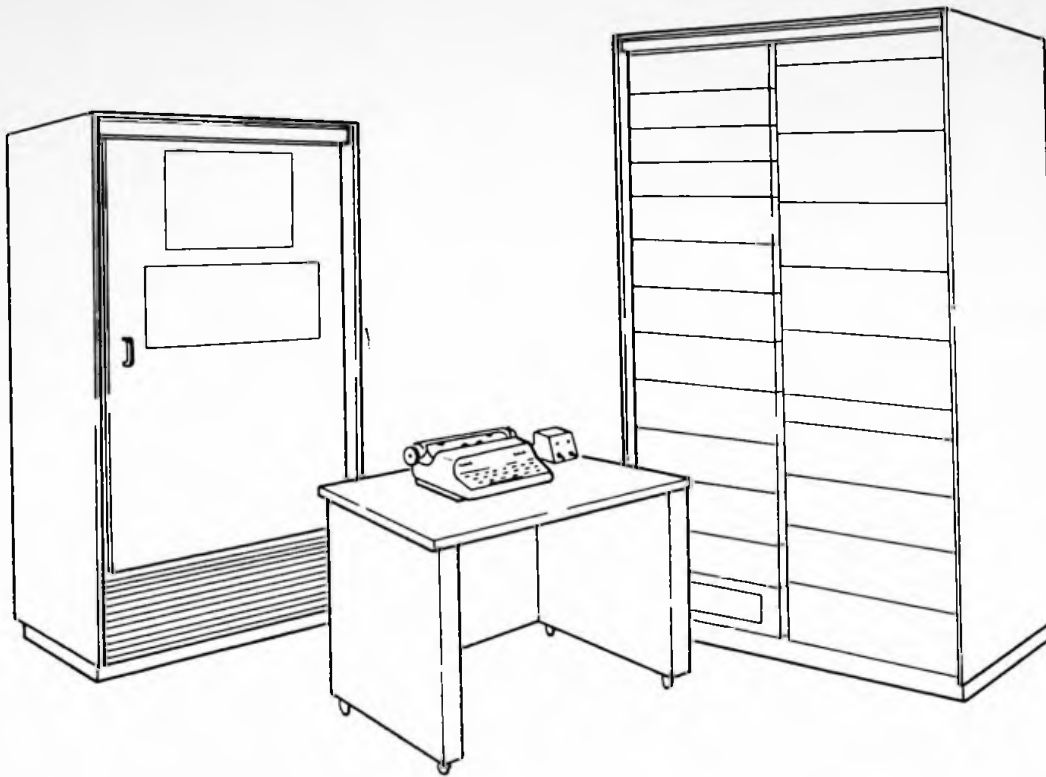


Figure 5-61. Digital Events Recorder (DSV-4B-289)

Design - The Auxiliary Control Console will be designed to contain the required controls and indicators for monitoring and controlling tests performed by the following mechanical ground support equipment, in the Automatic and Manual modes.

- a. Forward Skirt Electronics Thermoconditioning System Servicer (DSV-4B-359)
- b. Engine Destrainer Unlatch Mechanism (DSV-4B-618)
- c. Environmental Control System Kit (DSV-4B-326)
- d. Engine Bell Extension Servicer (DSV-4B-639).

Components - The console, as shown in Figure 5-62, will consist of the following major components:

- a. Forward Instrumentation Thermal Conditioner Control Panel
 - 1. Switch and indicators
- b. Engine Bell Extension Servicer Control Panel
 - 1. Indicators
 - 2. Switches

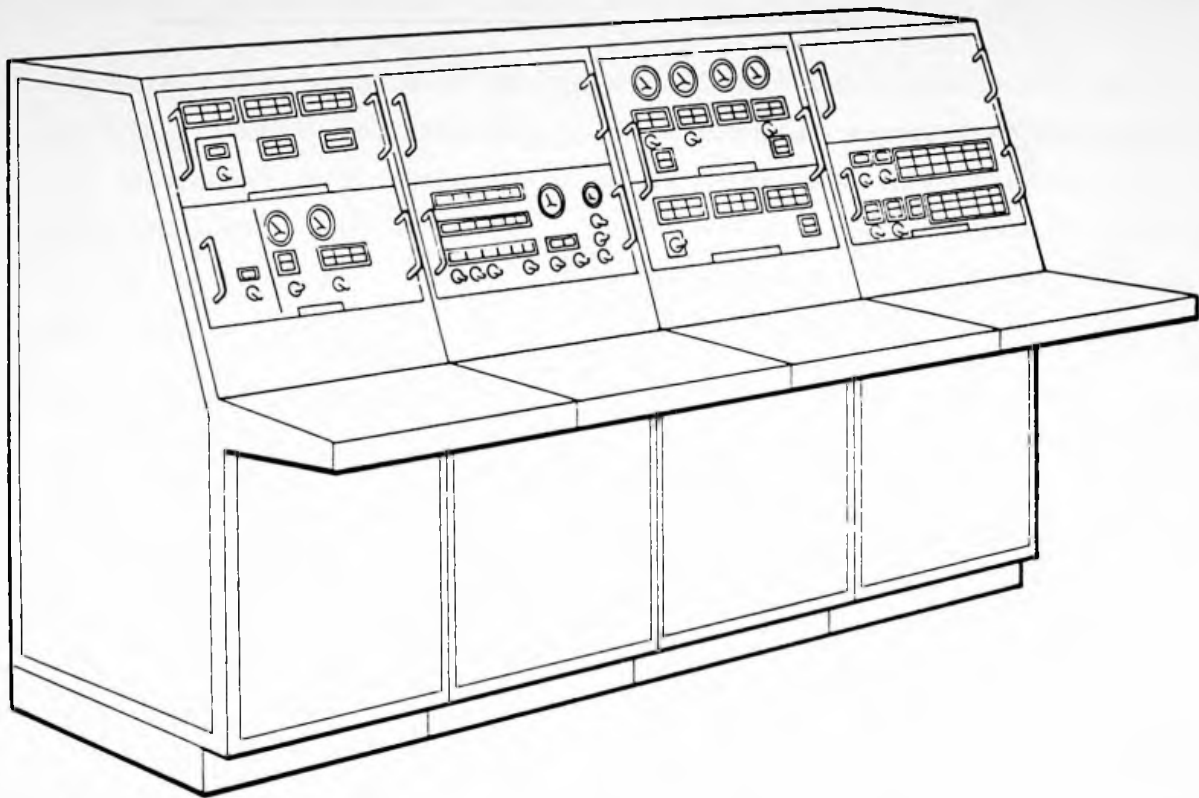


Figure 5-62. Auxiliary Control Console (DSV-4B-294)

3. Pressure and temperature meters
4. Power source for all switches (manual control) shall be ± 28 vdc.
- c. Vehicle Forward Skirt GN_2 Purge Control Panel
 1. Indicators
 2. Switches
 3. Two (2) dc meters (1 pressure, 1 temperature)
- d. Vehicle Aft Skirt Environmental Control Panel
 1. Indicators
 2. Switches
 3. Controls
 - a) Potentiometer (3)
 - b) Differential amplifier
 - c) Level detector
 - d) Step level logic
 - e) Relay drivers
- e. Engine Restrainer Unlatch Mechanism Control Panel.

5.102 Telemetry Signal Distribution Unit (DSV-4B-296) 1B41812-1

Function - The function of the Telemetry Signal Distribution Unit shall be (1) provide line matching and junctioning for "closed loop" RF and composite T/M links between the Vehicle and the ground stations (2) provide signals for checkout and calibration of the single sideband translator, various acoustical pickups, and flowmeters (3) provide termination loads and signal pickoffs for the Vehicle T/M "open loop" RF System during "umbilical-drop" tests.

Design - The single bay rack assembly as shown in Figure 5-63, will be designed to accommodate the various signal generators and line matching devices required to accomplish the units functions. The rack will contain adequate controls for power and local operation, and it will interface with the Automatic GSE System for signal switching functions.

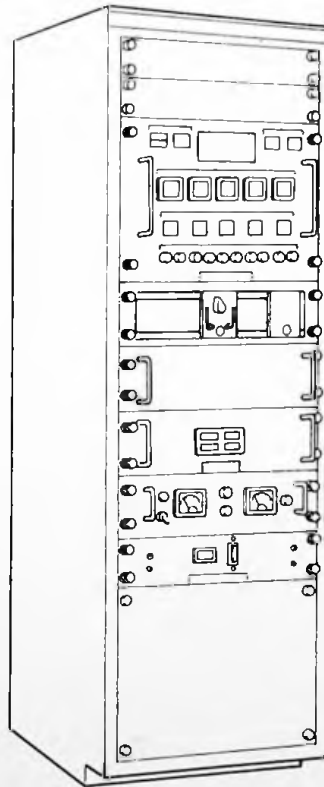


Figure 5-63. Telemetry Signal Distribution Unit (DSV-4B-296)

Components - The unit will consist of the following components:

- a. Power On-Off switches
- b. Analog Signal Controls
 - 1. Single Sideband Sweep Calibrate Oscillator
 - 2. Audio Frequency Acoustical Calibrate Oscillator to select 1 of 5 discrete frequencies
 - 3. Amplifier gain controls (not a front panel control)
- c. Control Commands:
 - 1. Open loop - Closed loop, signal distribution.

5.103 Systems Status Display, Black/White (DSV-4B-298) 1B37968-1

Model DSV-4B-298 is similar to Model DSV-4B-120 except for identification and the use of monochrome television equipment.

5.104 Inert EBW Safety and Arming Device (DSV-4-319) 1A02446-503

Function - The Inert EBW Safety and Arming Device shall be used to prevent alignment of the exploding bridgewire detonators and destruct harness leads during stage shipment, EBW systems reliability checks, and continuity checks.

Design - The device shall contain a solid rotor without explosive leads, presenting a barrier between the two exploding bridgewire detonators and the two destruct harness leads, thereby preventing the possibility of explosion.

Components - The device shall consist of the following components:

- a. Body
- b. Housing
- c. Rotor
- d. Switches.

6. MECHANICAL SUPPORT EQUIPMENT

6.1 General

Function - The function of the mechanical and propulsion support equipment shall be to provide the necessary hardware to transport, handle, environmentally protect, service, test, check out, and monitor the complete S-IVB stage and its components. The principal items of mechanical support equipment and their respective functions are described in the following paragraphs.

6.2 Nitrogen Fill Cart (DSV-4-186) 1B52838-1

Function - The Nitrogen Fill Cart shall be used to pressurize the pneumatic side of the stage hydraulic accumulator. The nitrogen fill cart shall also be used to purge the airborne electronic equipment containers and fill the hydraulic servicer GN_2 bottle.

Design - The nitrogen fill cart, as shown in Figure 6-1, will be designed so that the ultra-clean fuel tank purge nitrogen may be routed through the fill cart to charge the oil-contaminated hydraulic accumulators. The fill cart will virtually eliminate backflow possibilities which might contaminate the purge nitrogen and the fuel tanks. The fill cart will be capable of pressurizing the pneumatic side of the engine actuator accumulator. The air bottle will be charged with nitrogen to 3,000 psig and will be capable of completely charging the actuator accumulator. The pressure in the accumulators will be monitored. The fill cart will be capable of providing a nitrogen supply sufficient to purge the airborne electronic equipment containers. The fill cart will be capable of filling the hydraulic servicer GN_2 bottle.

Components - The nitrogen fill cart will consist of the following components:

- a. Air bottle - 2,570 cubic inches
- b. Air fill valve

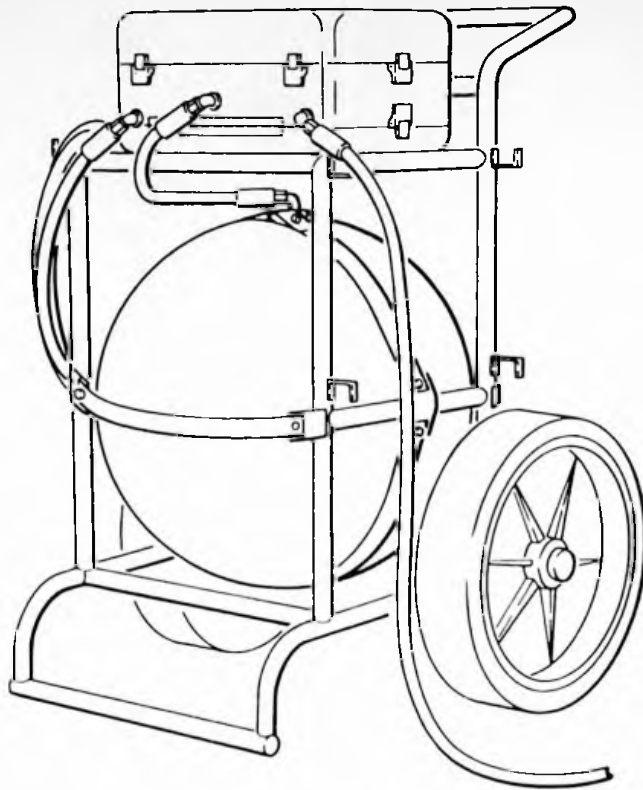


Figure 6-1. Nitrogen Fill Cart (DSV-4B-186)

- c. Gage - high pressure (5,000 psi)
- d. Gage - low pressure (30 psi)
- e. Check valve
- f. Needle valve (3)
- g. Relief valve (5 psi)
- h. Air valve adapters (3) suitable for adapting to the air fill valves on the engine actuator accumulators, electronic equipment containers, and hydraulic servicer.
- i. Dust caps (4)
- j. High pressure hose (flex)
- k. Medium pressure hose (flex)
- l. Hand truck - similar to a two-wheel welder's truck
- m. Pressure regulator
- n. Equipment container
- o. Pressure gage.

6.3. Vacuum Pumping Unit (DSV-4-187) 7865711-1

Function - The Vacuum Pumping Unit shall provide a means of periodically evacuating, as required, the annuluses of vacuum-jacketed propellant transfer lines, engine feed lines, LH₂ supply line to the helium precool heat exchanger, and gas generator-helium heater lines to the required valves. The unit shall be used at SACTO to simulate altitude conditions for the engine thrust control valves during static firing. Prior to a countdown the pumping unit shall be connected to the individual vacuum jackets of the stage and the vacuum jacket of the propellant transfer lines to pump the annuluses down to the required valves.

Design - The unit as shown in Figure 6-2, will be an electrically operated portable unit designed for evacuating the vacuum jackets of the stage and the vacuum jackets of the propellant transfer lines. The unit will be designed to evacuate the annuluses of the following components:

- a. Stage
 1. Engine feeder line
 2. Helium heater lines
- b. Ground support equipment
 1. Propellant main fill lines (from LH₂ and LO₂ main-fill and topping control systems to stage)
 2. LH₂ and LO₂ main-fill and topping control systems
 3. LH₂ to helium heat exchanger
 4. Helium precool heat exchanger.

Dimensions - The unit will have the following approximate dimensions: height, 26 inches; length, 30 inches; width, 18 inches; and will weigh approximately 150 pounds.

6.4 Ground Dolly Transporter, S-IVB Stage (DSV-4B-300) 1A57853-1

Function - The S-IVB Stage Ground Dolly Transporter shall provide support, mobility, and shock isolation to the S-IVB stage during all normal land and sea travel. The transporter shall also be capable of transporting

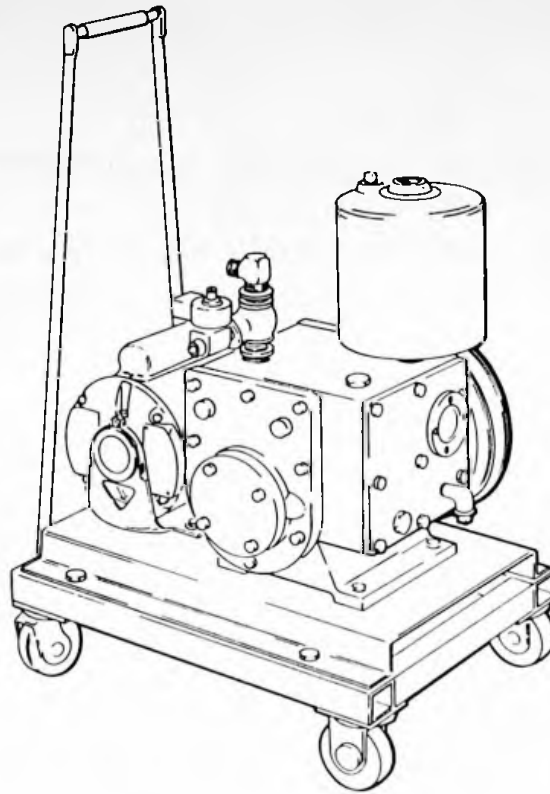


Figure 6-2. Vacuum Pumping Unit (DSV-4B-187)

necessary stage hardware. It will not, however, transport the aft interstage.

Design - The transporter, as shown in Figure 6-3, will consist of a builtup base frame, mounted on a four-wheeled undercarriage at the rear end and two sets of drop-legs at the forward end. The undercarriage will provide a three-point suspension system, two points at the rear and the third a steerable point at the front end where the transporter is supported by the towing tractor. This will be a commercial tractor type GMC or equivalent. The transporter will be provided with tires of low pressure and high flexibility characteristics to eliminate the need for a spring suspension system at the rear end. Air-over-hydraulic disc brakes will be installed in all rear wheels. Separate mechanical actuation of the brakes for parking will be provided on the two rearmost wheels. The transporter will utilize tiedown rings and jacking or shoring pads during water transportation. Adequate clearance lights will be

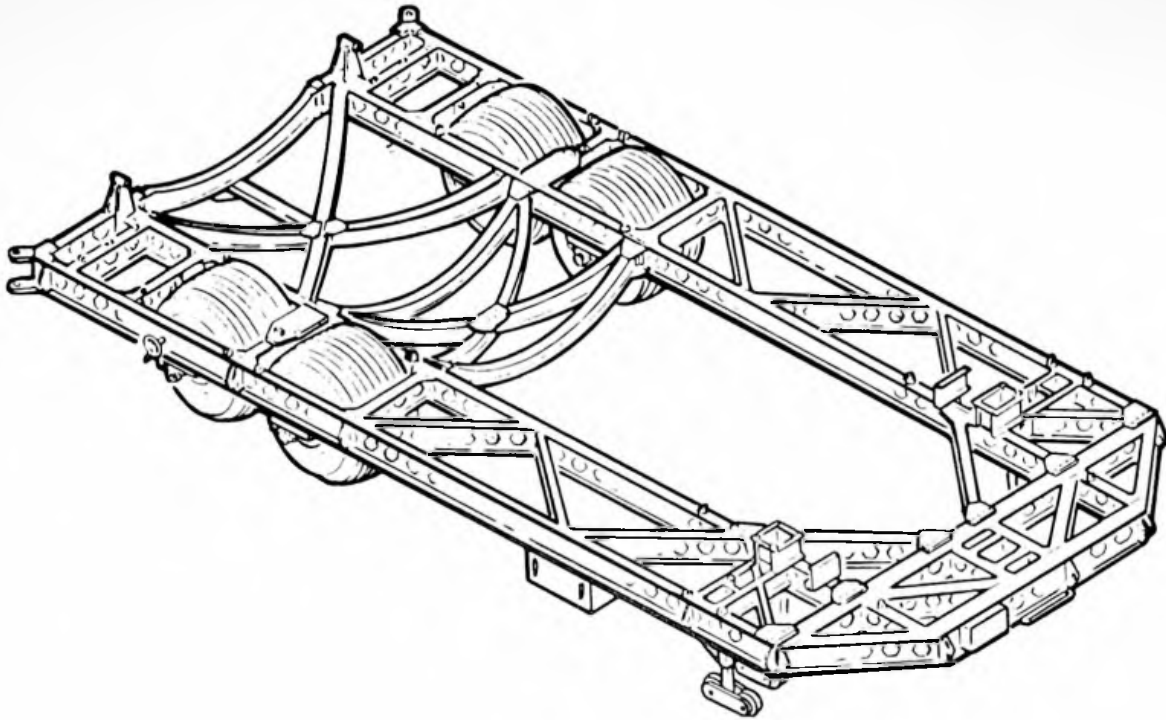


Figure 6-3. Ground Dolly Transporter, S-IVB Stage (DSV-4B-300)

incorporated on the transporter for night operation. Standard electrical and pneumatic line connections to the tractor will also be provided. The transporter will be designed for easy disassembly for road or air shipment. The transporter will be equipped with drop-legs for (1) static storing and (2) forward and backward movement for short distances at very slow speeds.

The transporter will be capable of traveling at speeds of 5 to 10 miles per hour over paved roads and will be fitted with all safety devices in accordance with Interstate Commerce Commission regulations. It will have a pintle hook and lines to the rear for towing instrumentation equipment.

Components - The transporter will have the following components:

	<u>Total Components Required for Seven Transporters</u>
a. Undercarriage	2*
b. Built-up base frame	2*
c. King plate assembly	7
d. Drop-leg brackets Sets (2 pair each)	7
e. Drop-legs Sets (2 pair each)	7
f. Clearance lights, tail lights, and stop lights	2*
g. Standard Electrical, hydraulic, and pneumatic line connections Sets (2)	2*
h. Cradle tiedowns	7
i. Pintle hook	7
j. Pneumatic lines to the rear	7
k. Electrical lines to the rear	7

Dimensions - The dimensions of the unloaded transporter will be approximately as follows: height, 63 inches at forward end when mounted on the prime mover without stage cradles; width, 268 inches; length, 495 inches; and weight, 22,500 pounds.

With the stage installed, the dimensions of the loaded transporter will be approximately as follows: height, 360 inches; width, 338 inches; length, 690 inches; and weight, 59,200 pounds.

6.5 Cradles Kit, S-IVB Stage (DSV-4B-301) 1A57855-1

Function - The function of the S-IVB Stage Cradles Kit shall be to provide (1) support for the stage during all phases of land and water transportation, (2) support for the stage during horizontal weighing, and (3) storage of the stage without the transporter.

*Five additional units will be obtained for use on the S-IVB Program from the converted S-IV transporter (Model DSV-4-144)

Design - The cradles will be designed to attach to the fore and aft rings to support the stage. The cradles shall also attach directly to the transporter for overland transportation. Removable ladders will be provided for access to the hoist fittings of the handling kit.

Components - The cradles, as shown in Figure 6-4, will consist of the following components:

- a. Forward cradle
- b. Aft cradle
- c. Cradle hoist sling
- d. Ladders.

6.6 Handling Kit, Stage (DSV-4B-302) 1A57857-1

Function - The function of the Stage Handling Kit shall be to hoist and mount the stage in such a manner that the induced handling loads will be transmitted safely into the stage structure.



Figure 6-4. Cradles Kit, S-IVB Stage (DSV-4B-301)

Design - The kit, as shown in Figure 6-5, will consist of segmented metal rings bolted to the forward and aft skirts.

Components - The kit will consist of the following components:

- a. Forward handling ring assembly
- b. Aft handling ring assembly.

(For use with the S-V stage only.)

6.7 Hoist Kit, Forward and Aft (DSV-4B-303) 1A57859-1

Function - The function of the Forward and Aft Hoist Kit shall be to (1) lift the stage onto the transporter, (2) lift the stage from the transporter to all ground and water carriers, and (3) provide a means for vertical assembly and staging.

Design - The kit will be designed to provide the necessary hardware to lift the stage vertically and horizontally.



Figure 6-5. Handling Kit, Stage (DSV-4B-302)

Components - The kit, as illustrated in Figure 6-6, will consist of the following components:

- a. Forward spreader bar hoisting assembly
- b. Aft spreader bar hoisting assembly
- c. Hoist beam
- d. Two (spare) short cable assemblies (157 inches)
- e. Two (spare) long cable assemblies (537 inches)
- f. Hoisting spacers (4)
- g. Hoist beam adapters (4)
- h. Hoisting shafts (2).

6.8 Hoist Kit, Forward and Aft (DSV-4B-303A) 1A57859-501

Function - The Forward and Aft Hoist Kit shall provide horizontal hoisting of the S-IVB stage in the SAB-KSC, to permit installation of Model DSV-4B-481, Stage Roll Kit, onto the cradles of the transporter, Model DSV-4B-301. This kit will perform all of the functions of Model DSV-4B-303.

Design - The kit will be designed to provide the necessary hardware to lift the stage vertically and horizontally.

Components - The kit, as shown in Figure 6-7, will consist of the following components:

- a. Forward spreader bar assembly (2)
- b. Aft spreader bar assembly (2)
- c. Hoist beam
- d. Two (spare) short cable assemblies (157 inches)
- e. Two (spare) long cable assemblies (537 inches)
- f. Hoisting spacers (4)
- g. Hoist beam adapters (4)
- h. Hoisting shafts (2)
- i. Inserts (8)
- j. Retainers (8)

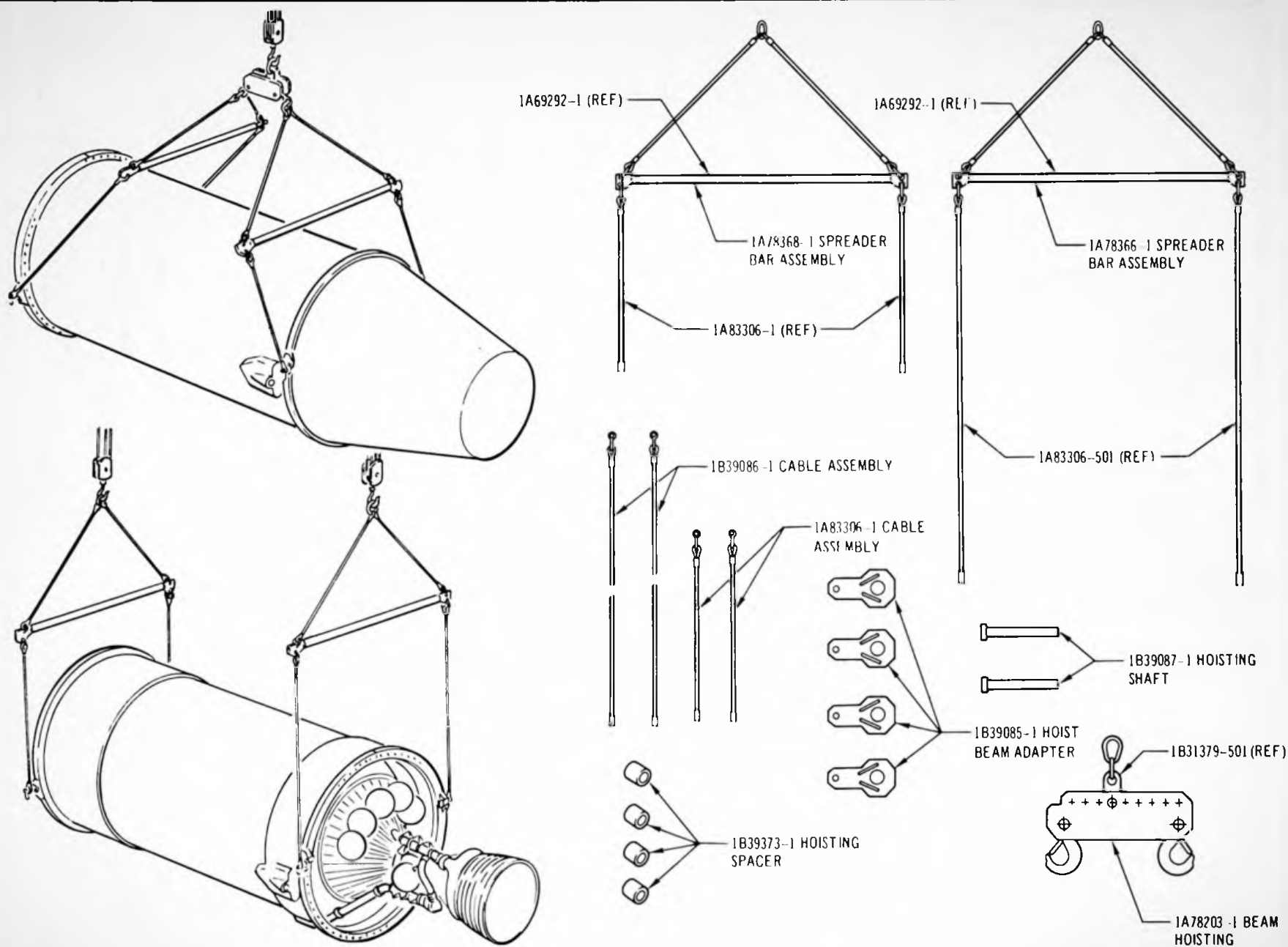


Figure 6-6. Hoist Kit, Forward and Aft (DSV-4B-303)

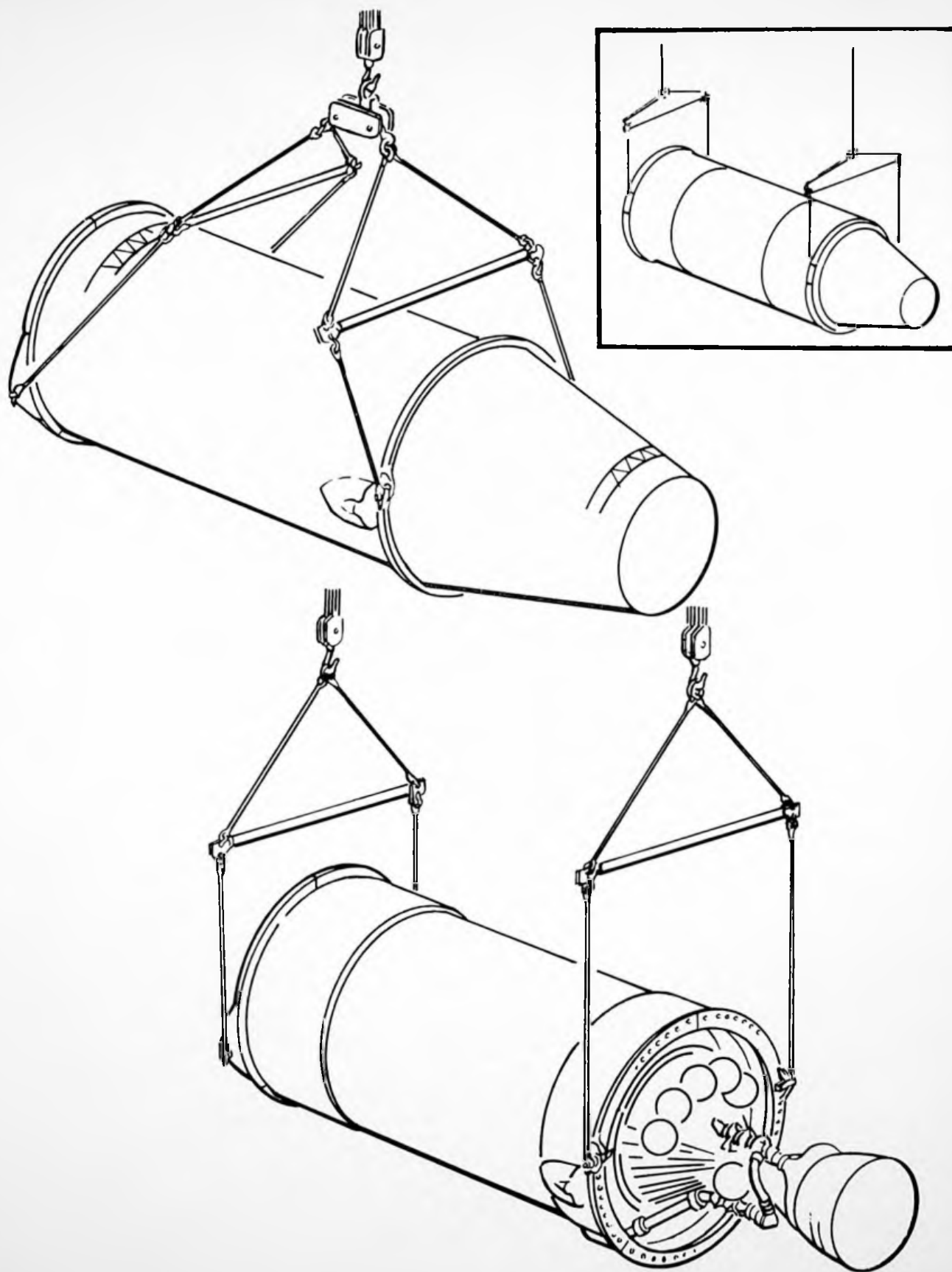


Figure 6-7. Forward and Aft Hoist Kit (DSV-4B-303A)

6.9 Protective Cover Kit, Environmental, S-IVB Stage (DSV-4B-304)
1A57861

Function - The function of the S-IVB Stage Environmental Protective Cover Kit shall be to provide environmental protection for S-IVB stages during all phases of transport (land or sea).

Design - The kit will consist of four parts; forward end cover, center cover, and aft end cover. The covers will be sealed in spline rings which are part of (DSV-4B-462 and DSV-4B-302) handling kits, and support kit (DSV-4B-392). Final closure will be by self-sealing zippers. A series of longitudinal and girth lacings will keep the cover taut after zippers are secured. The desiccant kit (DSV-4B-450) will attach to the tubing couplings at the desiccant plate cover. The desiccant kit will permit free breathing of the stage fuel and oxidizer tanks and the cover. A protective pad will cover the upper half of the cylindrical portion of the stage when the stage is in the horizontal position on the transporter (DSV-4B-300). (See Figure 6-8).

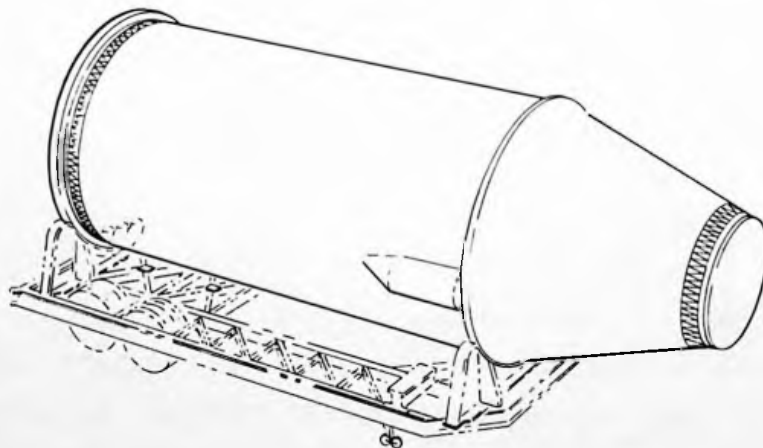


Figure 6-8. Protective Cover Kit, Environmental (DSV-4B-304)

Components - The kit will consist of the following components:

- a. Forward cover
- b. Aft cover
- c. Center cover
- d. Support Kit cover
- e. Protective Pad
- f. Desiccant plates.

6.10 Tool Kit, Special (DSV-4B-305) 1A57863-1

Function - The function of the Special Tool Kit shall be to furnish all tools required for adequate maintenance and handling of the stage.

Design - The kit, as shown in Figure 6-9, will be mounted on the stage transporter, and will consist of standard and nonstandard tools required for maintenance and handling of the stage.

Components - The tool kit will contain the following components:

- a. Large-bore inflating device
- b. Coupler check unit
- c. Tire repair kit
- d. Valve cores
- e. Valve caps
- f. Allen type wrench set
- g. Adjustable hook spanner wrench
- h. Pin spanner
- i. Hose assemblies
- j. Assorted adjustable and open-end wrenches
- k. Torque wrench adapter
- l. Special socket
- m. Socket wrenches and adapter
- n. Mallet.

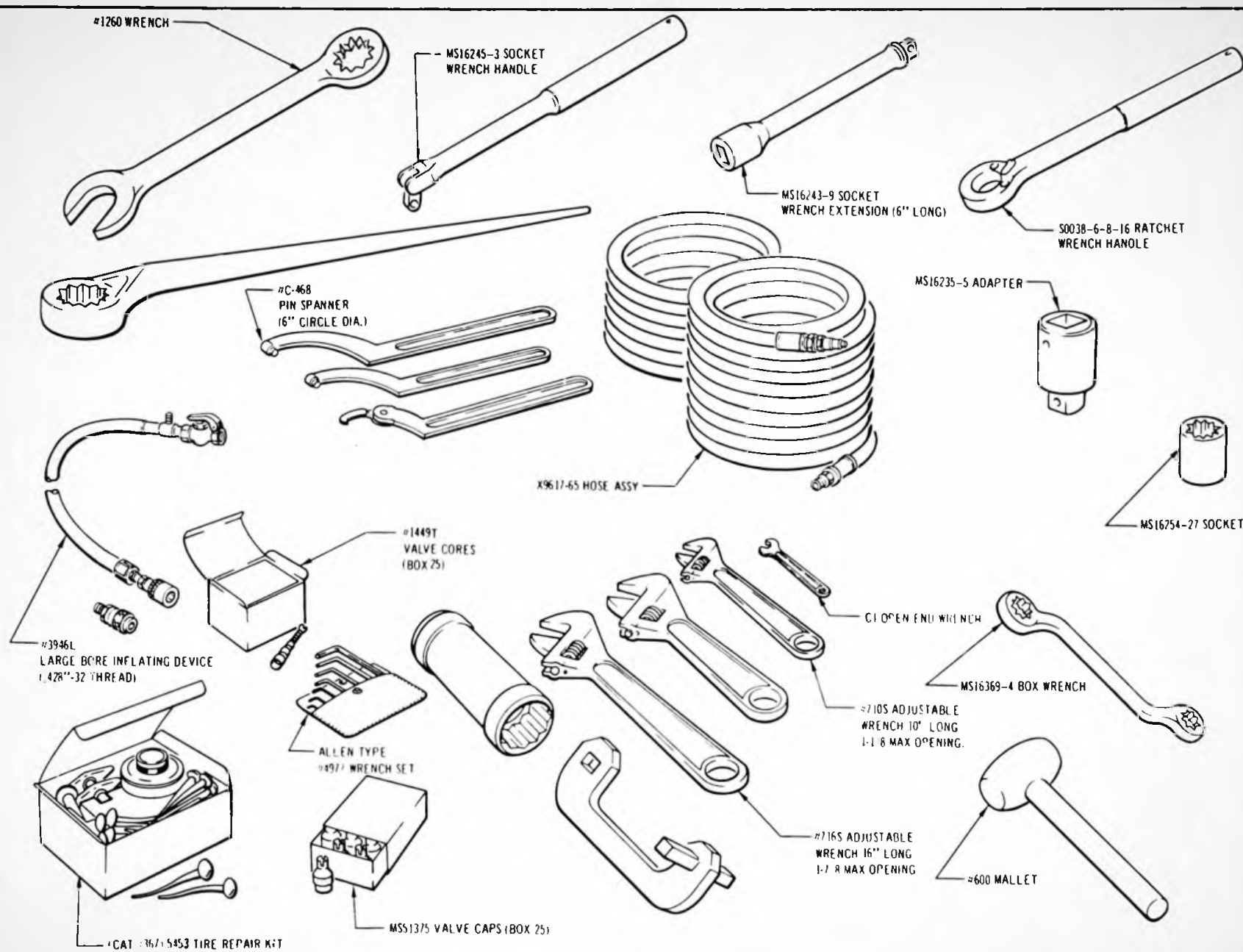


Figure 6-9. Special Tool Kit (DSV-4B-305)

6.11 Handling Kit, Flared Aft Interstage (DSV-4B-307) 1A57867-1

Function - The function of the Flared Aft Interstage Handling Kit shall be to provide a means of transporting (for short distances) and handling the aft interstage.

Design - The kit will be designed to provide a means for maintaining the interstage section shape. The design will also incorporate the necessary equipment to handle and provide weather protection for the interstage during transportation. Provisions for short-distance movement will also be provided.

Components - The kit, as shown in Figure 6-10, will consist of the following components:

- a. Dolly assembly: A rigid base to which the aft interstage section will be attached during limited transportation.
- b. Hoist beam: A structure to be attached to the forward end of the aft interstage section on the dolly to provide a means of lifting.

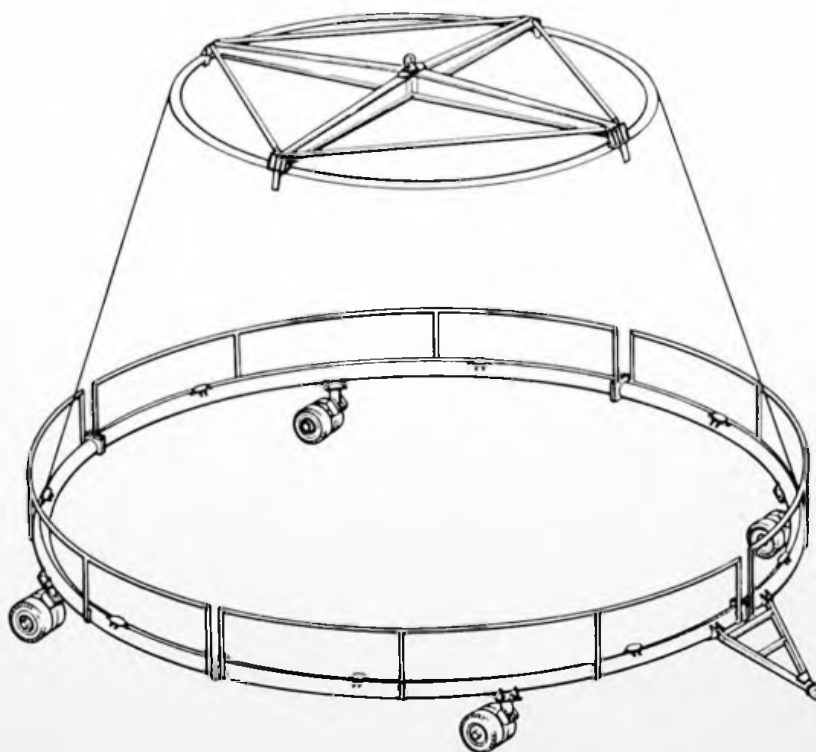


Figure 6-10. Handling Kit Flared Aft Interstage (DSV-4B-307)

- c. Weather protection cover: A cover of neoprene-coated nylon, or similar suitable material, to protect the aft interstage section from adverse weather conditions.

(For use with S-V Stage only.)

6.12 Access Kit, Fuel Tank Interior (DSV-4B-308) 1A57869-1

Function - The function of the Fuel Tank Interior Access Kit shall be to provide access while the stage is in a vertical position. The kit shall facilitate maintenance and checkout operations, such as inspection and repair of tank wall insulation, fuel-sensing probes, and helium storage spheres. The kit will also provide interior lighting in the tank.

Design - The design of the kit, as shown in Figure 6-11, will provide the following two main assemblies:

- a. A tubular support structure which will be attached to the forward hoist ring and which will span the forward LH_2 tank dome;

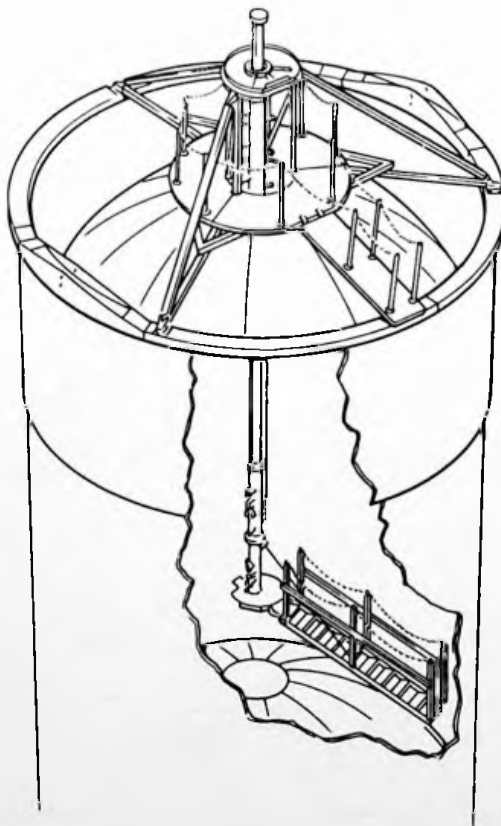


Figure 6-11. Access Kit, Fuel Tank Interior (DSV-4B-308)

- b. A platform and tube assembly which will be suspended from the support structure and inserted into the tank interior.

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. Flood lights and protective covers will also be included in the design of the kit.

Components - The kit will consist of the following components:

- a. Folding work platform
- b. Center shaft and mechanism
- c. Support structure
- d. Floodlights
- e. Protective covers.

6.13 Access Kit, Fuel Tank Interior (DSV-4B-308A)

The function, design and components of the access kit shall be similar to the DSV-4B-308 except for the omission of the 1A83045 support. The access kit shall be supported by Model DSV-4B-502. (See Figure 6-12.)

6.14 Cover, Protective, Forward Skirt End (DSV-4B-309) 1A57871-1

Function - The function of the Forward Skirt End Protective Cover shall be to provide protection for the forward area of the stage from rain and other environmental hazards while the stage is on the test stand. It shall also provide an adequate working environment for necessary activity on forward skirt stage equipment. Model DSV-4B-601 will replace DSV-4B-309 during static firing.

Design - The cover, as shown in Figure 6-13, will be constructed of neoprene-coated nylon, and aluminum, and will be of lightweight construction for easy installation. The cover will have a segmented ventilating duct installed around the underside of the roof. The duct will distribute the air uniformly in the enclosure.

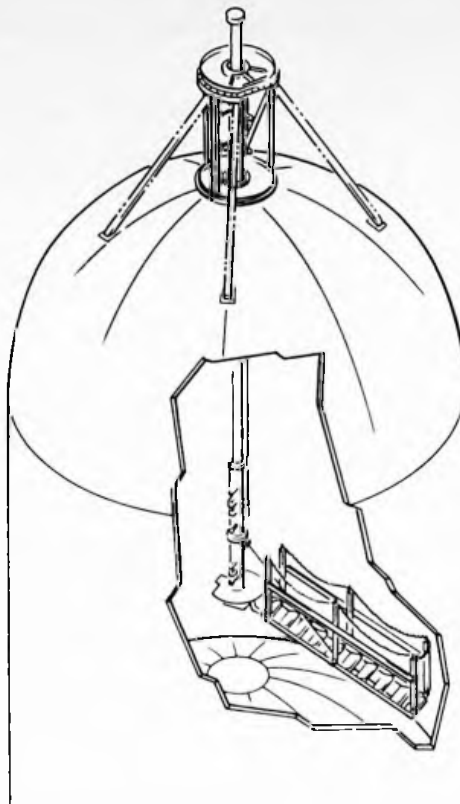


Figure 6-12. Access Kit, Fuel Tank Interior (DSV-4B-308A)

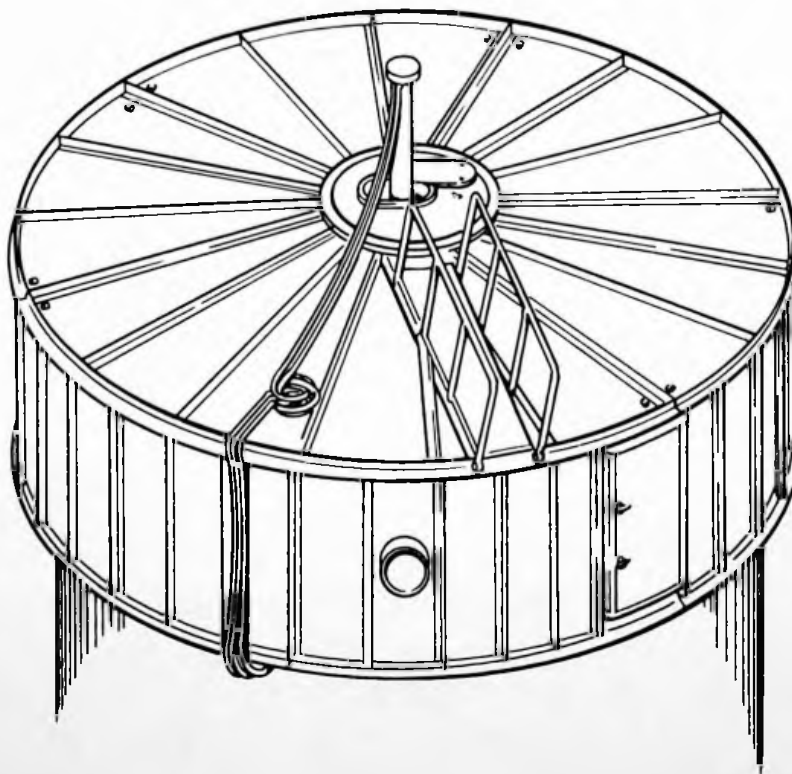


Figure 6-13. Cover, Protective, Forward Skirt End (DSV-4B-309)

Components - The cover will consist of the cover itself and all necessary attaching hardware. The ventilation subsystem will consist of a segmented ventilating duct with an outside connection on the wall. A flexible duct will connect the wall fitting with a facility source of conditioned air.

6.15 Cover, Protective, Forward Skirt End (DSV-4B-309A) 1A57871

Function - Same as for DSV-4B-309 peculiar to KSC.

Design - Same as for DSV-4B-309 except air conditioner return duct is added inside panel.

Components - Same as DSV-4B-309 except air conditioning duct added.

6.16 Access Kit, Vertical, Forward Section (DSV-4B-310) 1A57873-1

Function - The function of the Forward Section Vertical Access Kit shall be to provide access to the forward section of the stage for maintenance while the stage is in a vertical position.

Design - The design of the kit, as shown in Figure 6-14, will provide for a walkway constructed of removable platforms. These sections will attach to a lightweight metal frame work which indexes into mounting holes in the forward skirt structure. The walkway will be designed for ease of installation, and will provide full circumferential access.

Components - The kit will consist of suitably designed and installed work platforms.

6.17 Aft Umbilical Kit, Static Test Stand (DSV-4B-313) 1A57879-1

Function - The function of the Static Test Stand Aft Umbilical Kit shall be to provide and support the electrical cables, pneumatic lines, propellant lines, and air conditioning adapter duct to the stage. An umbilical carrier shall provide attachment to the stage and shall be equipped with (1) a grounding system, and (2) an eject mechanism to provide electrical cable disconnect from the stage for test purposes.

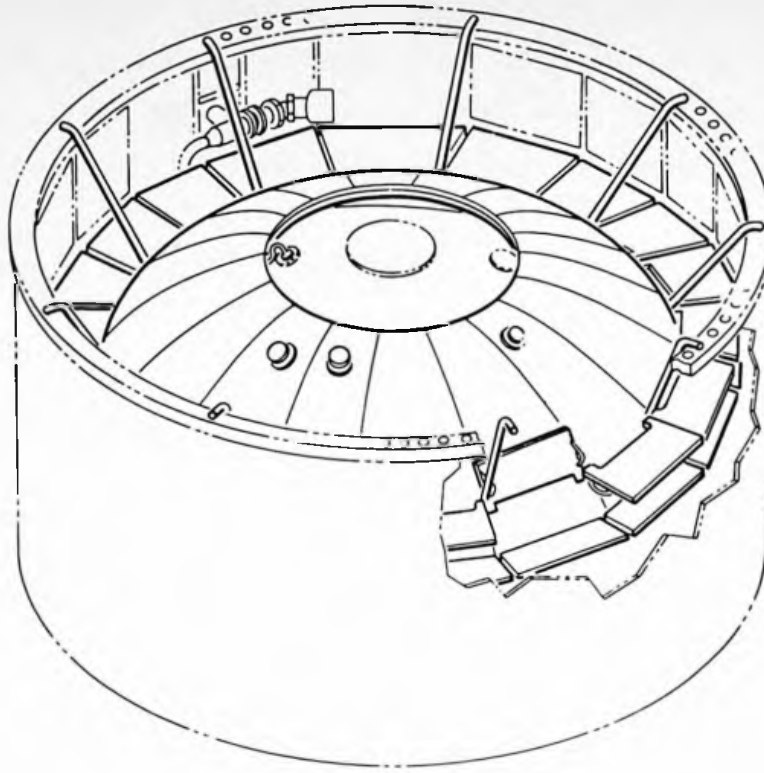


Figure 6-14. Access Kit, Vertical, Forward Section (DSV-4B-310)

Design - The design of the kit, as shown in Figure 6-15, will provide (1) electrical cables to connect the J-boxes to the stage, (2) propellant transfer lines, and (3) pneumatic lines (ranging from 1/4 to 3/4 inch in diameter) to connect the pneumatic consoles to the stage for the transfer of GH_2 (gaseous hydrogen), GN_2 , and gaseous helium. The propellant transfer lines connecting the valve complexes to the stage will be of 6-inch stainless steel, convoluted, vacuum-jacketed flexible hose. These lines will be provided with hard-line, flange type connectors for direct attachment to the stage when the external removable halves of the propellant couplings are removed.

The umbilical carrier assembly will be designed to maintain an inert atmosphere around the electrical receptacles and those quick-disconnects operating at cryogenic temperatures. An eject mechanism will be included in the design of the carrier for pneumatic operation to disconnect the electrical plugs from their receptacles to simulate liftoff.

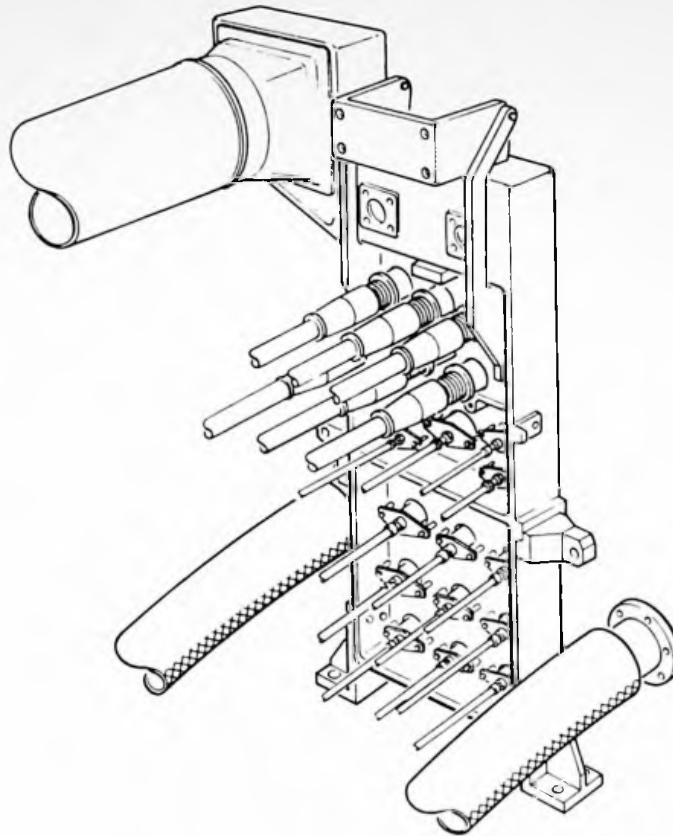


Figure 6-15. Aft Umbilical Kit, Static Test Stand (DSV-4B-313)

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Hose assemblies
- c. Flanged propellant lines
- d. Brackets
- e. Electrical cables with connectors
- f. Air conditioning adapter duct
- g. Pneumatic quick-disconnects
- h. Eject mechanism.

6.18 Forward Umbilical Kit, Static Test Stand (DSV-4B-314) 1A57881-1

Function - The function of the Static Test Stand Forward Umbilical Kit shall be to provide and support the electrical cables and the GH_2 vent line to the stage. An umbilical carrier shall provide attachment to the

stage and shall be equipped with (1) a grounding system, and (2) an eject mechanism to provide electrical cable disconnect from the stage for test purposes.

Design - The design of the kit, as shown in Figure 6-16, will provide (1) a GH_2 vent line, and (2) electrical cables to connect the J-boxes to the stage. The GH_2 vent line will be of 8-inch stainless steel, convoluted, vacuum-jacketed flexible hose equipped with hard-line, flange type connections for direct attachment to the stage when the external half of the GH_2 vent coupling is removed.

The carrier assembly will be designed to support the electrical plugs and to maintain an inert atmosphere around the electrical receptacles. The carrier will be bolted to the stage by two side supports. An eject mechanism will be included in the design of the carrier for pneumatic operation to disconnect the electrical plugs from their receptacles to simulate liftoff.

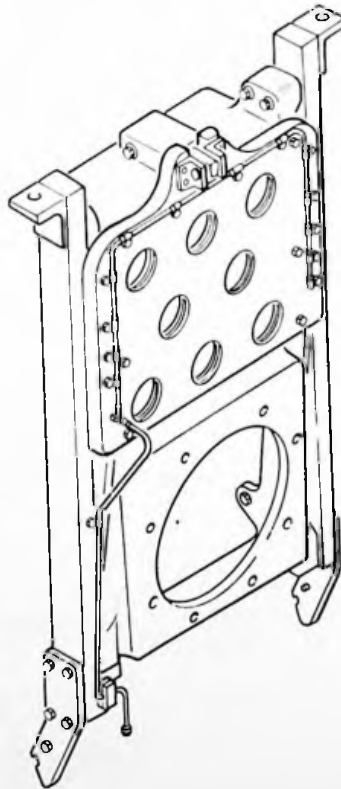


Figure 6-16. Forward Umbilical Kit Static Test Stand (DSV-4B-314)

*For further information, see Change Orders 49, 54, 76, 77 and 207.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Flanged GH_2 vent line hose assembly
- c. Electrical cables with connectors
- d. Eject mechanism.

6.19 Gas Heat Exchanger (DSV-4B-318) 1A71500-1

Function - The function of the Gas Heat Exchanger shall be to (1) receive gaseous hydrogen at 1500 psig (pounds per square inch gage) from the Pneumatic Console "A" (DSV-4B-319) and (2) provide cold hydrogen gas at a temperature of 140 degrees R (Rankine) for filling the J-2 engine turbine start bottle. The heat exchanger shall also receive helium at 3,000 psig minimum from the pneumatic console and shall provide (1) helium at 50 degrees R for filling the LO_2 tank pressurization bottles and for chilldown of the engine thrust chamber, (2) helium at 100 degrees R for filling the J-2 engine pneumatic control bottle, for LH_2 tank prepressurization, and LOX tank prepressurization.

Design - The heat exchanger, as shown in Figure 6-17, will be a vertically installed, flooded type unit with multiple circuits contained in a Dewar vessel. The inner vessel of the Dewar will contain a LH_2 inlet below and a vent and liquid-level sensor mounted on top. The space between the inner vessel and the surrounding outer vessel will be evacuated by the Vacuum Pumping Unit (DSV-4-187) to provide insulation. The outer vessel will be provided with a burst disc to prevent overpressurization should LH_2 leak into the vacuum jacket.

Three stainless steel coils will provide three separate and individual circuits to carry the gases through the LH_2 . Two coils will be for helium at 3,000 psig and at flowrates of 20 and 40 pounds per minute; the other coil will be for gaseous hydrogen at 1500 psig at a flowrate of 5 pounds per minute. The outlet of each circuit will incorporate a temperature transducer.

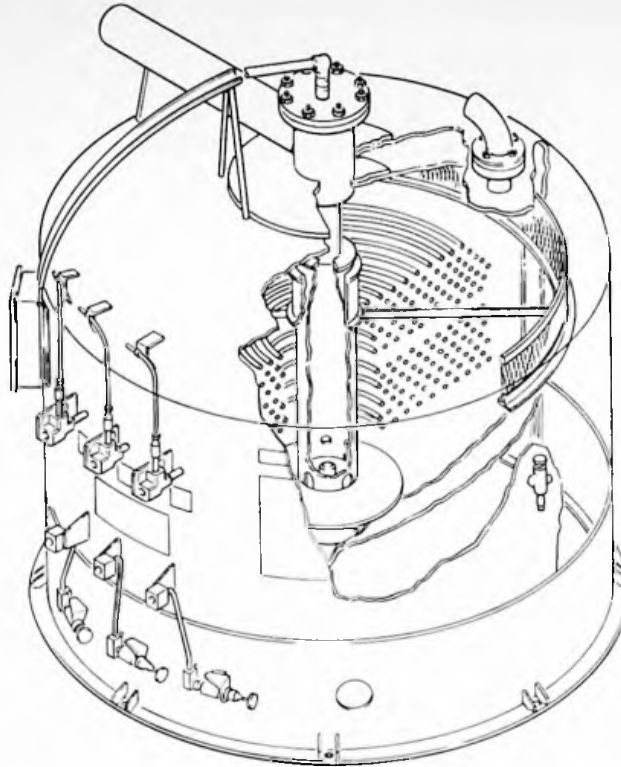


Figure 6-17. Gas Heat Exchanger (DSV-4B-318)

The level in the heat exchanger will be regulated by a three point liquid level control system designed for LH_2 service. The lowest point in the probe will actuate to open the heat exchanger supply valve located in the LH_2 valve complex. The middle point of the probe will actuate to close the supply valve. The highest point in the probe will actuate to signal an alarm and close the LH_2 supply valve.

Components - The heat exchanger will consist of the following components:

- a. LH_2 inlet terminating in a distribution chamber
- b. A gaseous hydrogen vent
- c. Three cooling circuits with individual inlet and outlet connections
- d. Structural supports for the heat exchanger and its components
- e. Inner vessel
- f. Outer vessel.

In addition, provisions will be made for (1) evacuating the annular space between the inner and outer walls of the vessel and (2) mounting the instrumentation units used in monitoring gas temperature, liquid level, and vacuum pressure.

Dimensions - The heat exchanger will be approximately 6-1/2 feet high, 7 feet in diameter, and will weigh approximately 4,500 pounds.

6.20 Pneumatic Console, Model 319 (DSV-4B-319) 1A98160-1

Function - The function of the Model 319 Pneumatic Console (Pneumatic Console "A") shall be 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.

Design - The console will be designed to regulate and control stage-peculiar pneumatic servicing functions and checkout requirements during prelaunch operations. An electrical system will be provided in the console to permit (1) remote control of the solenoid valves and pressure regulators and (2) remote indications of valve positions and system pressures and temperatures. In addition, the console will be designed to perform the following:

- a. Receive gaseous helium at 6,000 psig from a facility storage source and regulate and control the distribution of the gas for the following:
 1. Helium supply to the Gas Heat Exchanger (DSV-4B-318) at a 3,100 psig plus or minus 100 psi at flow rates of 20 and 40 pounds per minute.
 2. LH₂ tank repressurization helium supply at 3,100 psig plus or minus 100 psi and at a flow rate of 5 pounds per minute.
 3. APS bottle supply at 3,100 psig plus or minus 100 psi and 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. LH₂ tank umbilical helium purge supply at 50 psig and at a flow rate of 1-1/2 pounds per minute.
 8. LH₂ tank fill nozzle helium purge supply at 50 psig and at a flow rate of 0.016 pounds per minute.
 9. Helium supply to the Automatic Stage Servicing and Checkout Pneumatic Console "B" (DSV-4B-320) at 50 psig and at a flow rate of 1 pound per minute.
 10. LO₂ pressure actuation valve and mainstage OK pressure switch checkout at 750 psig.
 11. LH₂ and LO₂ system checkout supply at 20 to 50 psig.
 12. Engine low-pressure checkout at 20 to 50 psig.
- b. Receive GN₂ from Pneumatic Console "B", at 750 psig for LH₂ tank purge and 2,500 psig for console inerting purge.

The console helium supply inlet, gages, and transducers will have hand-operated isolation valves to facilitate on-site service and maintenance operations. All flow control valves and system vent valves will be solenoid-operated and will be remotely controlled by 28-vdc signals. Each solenoid valve will have two electrical position-indication switches (controlled by 28-vdc signals) to provide remote indications of the fully open or fully closed valve positions.

All pressure regulators will be remotely controlled through their respective solenoid operated dome loaders.

All critical pressures and temperatures within the console will be sensed by appropriate 0-to-5 vdc transducers and transmitted for remote display.

The console will have provisions for venting gaseous helium to the atmosphere through a common exhaust port.

Access door will be provided on the front and back of the console to afford maximum maintenance and operation accessibility. The console will be base-mounted and will have four lifting eyes for ease of handling.

Components - The console, as shown in Figure 6-18, will consist of an aluminum cabinet housing the following major components:

- a. Pressure gages
- b. Temperature and pressure transducers
- c. Solenoid-operated valves
- d. Hand-operated valves
- e. Check valves
- f. Filters
- g. Regulators
- h. Orifices
- i. Interconnecting stainless steel pneumatic lines
- j. J-box.

Dimensions - This pneumatic console will have the following approximate dimensions: height, 6 feet; width, 6 feet; depth, 3 feet; weight, 1,500 pounds.

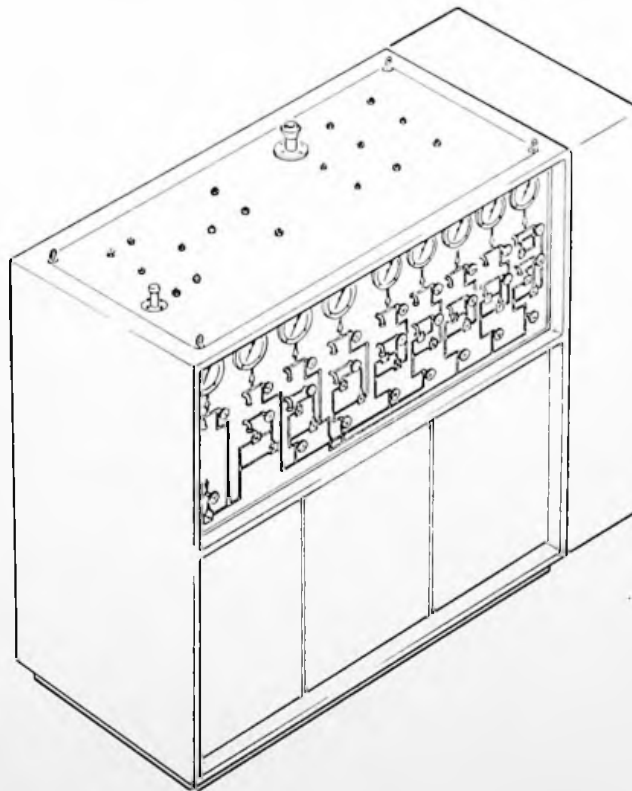


Figure 6-18. Model 319 Pneumatic Console (DSV-4B-319)

6.21 Model 320 Pneumatic Console (DSV-4B-320) 1A98161-1

Function - The function of the Model 320 Pneumatic Console (Pneumatic Console "B") shall be to provide ambient and cold gaseous hydrogen and helium for stage propulsion system requirements during checkout, and for pressurization and propellant loading operations during countdown.

Design - Pneumatic Console "B", as shown in Figure 6-19, will be capable of remote and automatic control by signals from the GSE programmer. All flow control valves and system bleed valves will be capable of remote positioning, remote operation, or both. All critical pressures will be sensed by pressure transducers and monitored by the GSE programmer. All valves will assume the safe or normal position in the event of electrical or pneumatic failure.

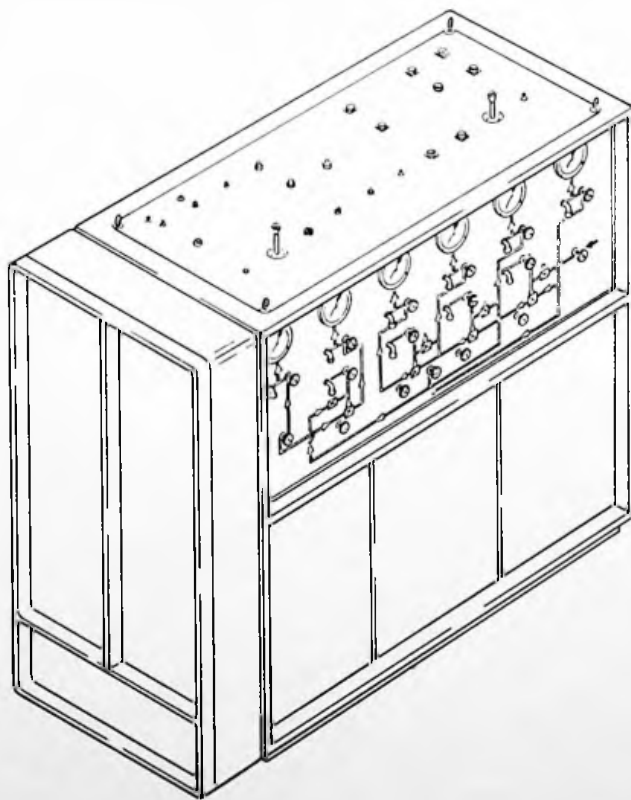


Figure 6-19. Model 320 Pneumatic Console (DSV-4B-320)

In addition, pneumatic console "B" will be designed to perform the following functions:

- a. Receive gaseous nitrogen at 2,500 psig from a facility storage source, regulate and control the distribution of the gas for the following:
 1. Console inerting supply at 2,500 psig
 2. Console pneumatic valve actuation pressure supply at 750 psig
 3. AFT electrical umbilical eject supply at 750 psig
 4. FWD electrical umbilical eject supply at 750 psig
 5. Console "A" inerting supply at 2,500 psig
 6. Console "A" pneumatic valve actuation pressure supply at 750 psig
- b. Receive gaseous hydrogen at 2,500 psig from a facility storage source, regulate and control the gas for supply to circuit No. 1 of the gas heat exchanger at 1,500 psig.
- c. Receive hydrogen gas at 1,500 psig and 140 degrees R from the gas heat exchanger, and monitor and control the gas for pressurization of the J-2 engine turbine start bottle
- d. Receive helium gas at 3,000 psig and 50 degrees R from the gas heat exchanger, and monitor and control the gas for pressurizing the stage LO₂ tank pressurization bottles. (The gas will also be reduced through an orifice to 600 psig at 100 degrees R for prepressurizing the stage LH₂ tank.)
- e. Receive helium gas at 3,000 psig and 100 degrees R from the gas heat exchanger, and monitor and control the gas for pressurization of the J-2 engine control bottle. (This gas will also be reduced through an orifice to 750 psig at 50 degrees R for chilldown of the engine thrust chamber jacket.)
- f. Receive ambient helium gas at 50 psig from pneumatic console "A" and monitor and control the gas for J-2 engine thrust cone purge.
- g. Receive ambient helium gas at 2,000 psig from pneumatic console "A" for turbine start bottle post-test purge.

Components - Pneumatic console "B" will consist of an aluminum cabinet housing the following components:

- a. Pressure gages
- b. Pressure transducers
- c. Solenoid-operated valves

- d. Pneumatically operated valves
- e. Check valves
- f. Relief valves
- g. Filters
- h. Orifices
- i. Stainless steel pneumatic lines.

Dimensions - Pneumatic console "B" will have the following approximate dimensions: height, 6 feet; width, 6 feet; depth, 3 feet; and weight, approximately 1,500 pounds.

6.22 Automatic Stage Checkout Pneumatic Console, HB (DSV-4B-321) 1A68801-1

Function - The function of the HB Automatic Stage Checkout Pneumatic Console shall be to receive, regulate, and control the distribution of helium gas to meet the leak and functional checkout requirements of the stage and APS equipment during dry checkout exercises. (Operational Pneumatic Console "A" shall be used in wet exercises, countdowns, and leak and functional checks before propellant loading.)

Design - The checkout pneumatic console, as shown in Figure 6-20, will be designed to (1) control the gases required for checkout of the stage systems (including APS equipment) and (2) select the component, range, and specific valve undergoing checkout. The console will also have engine and system checkout capability. All flow control valves and system bleed valves will be controlled remotely and automatically by a GSE programmer. The console components will be capable of manual operation when the automatic checkout system is switched from automatic to manual control. All critical pressures within the console will be sensed by pressure transducers and monitored from the control area by the GSE programmer. All valves will assume the safe or normal position in the event of an electrical or pneumatic failure.

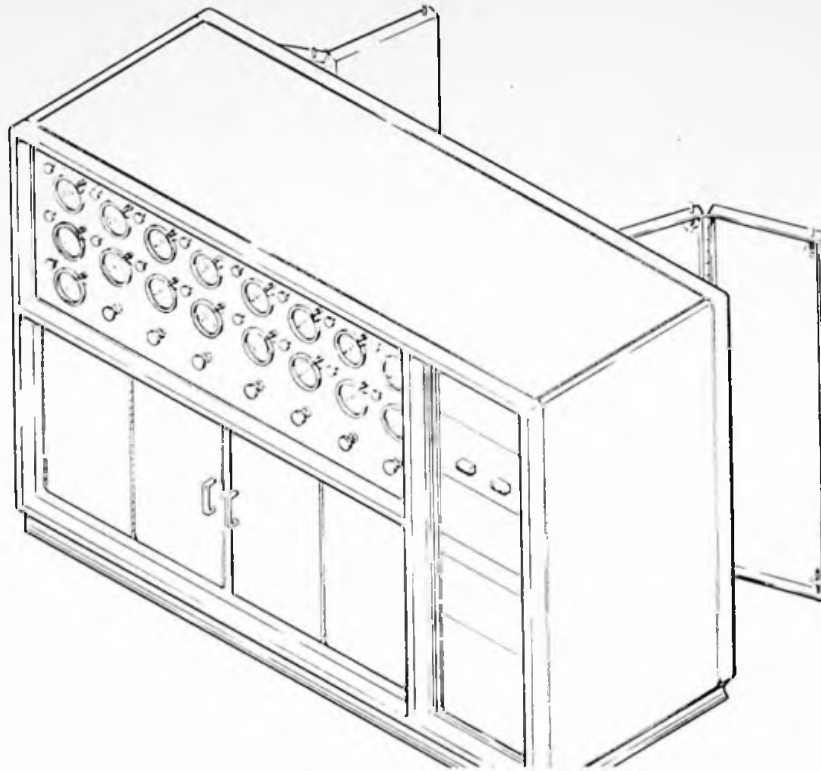


Figure 6-20. Automatic Stage Checkout Pneumatic Console, HB (DSV-4B-321)

The console will be capable of performing the following functions for checkout operations:

- a. Receive gaseous helium at 6,000 psig and regulate the pressure to 3,200 psig for distribution to other pressure regulating stages.
- b. Regulate helium pressure from 3,200 psig to a range of 3,000 psig to 120 psig for the following:
 1. Engine high pressure
 2. Stage back pressure switch
- c. Regulate helium pressure from 3,200 psig to a range of 3,000 psig to 1,500 psig for the following:
 1. Spheres pressure switch
 2. APS Module 1 high pressure switch
 3. APS Module 2 high pressure switch
- d. Regulate helium pressure from 3,200 psig to 1,500 psig for subsequent reduction and for the following:
 1. Prepressurization bottles
 2. LOX tank prepressurization

3. Engine control bottle
4. APS helium bottles
- e. Regulate helium pressure from 1,500 psig to 475 psig for the following:
 1. LH₂ tank prepressurization
 2. Stage pre valve ground control
- f. Regulate helium pressure from 1,500 psig to a range of 750 psig to a 400 psig for the following:
 1. Forward umbilical carrier electrical ejection
 2. Turbine start bottle
 3. LOX pressure actuated sequence valve
 4. Aft umbilical carrier electrical ejection
- g. Regulate helium pressure from 750 psig to a range of 250 psig to 25 psig for the following:
 1. LH₂ system pressure switches
 2. Engine low pressure switch
 3. APS Module 1 oxidizer bellows collapse
 4. APS Module 2 oxidizer bellows collapse
 5. APS Module 1 fuel bellows collapse
 6. APS Module 2 fuel bellows collapse
 7. APS Module 1 oxidizer facility lines purge
 8. APS Module 2 oxidizer facility lines purge
 9. APS Module 1 fuel facility lines purge
 10. APS Module 2 fuel facility lines purge
- h. Regulate helium pressure from 750 to a range of 275 psig to 25 psig for the following:
 1. APS Module 1 low pressure switch
 2. APS Module 2 low pressure switch
 3. LOX system pressure switches
- i. Provide vent capabilities for the following:
 1. APS Module 1 fuel tank
 2. APS Module 2 fuel tank
 3. APS Module 1 oxidizer tank
 4. APS Module 2 oxidizer tank

Components - The checkout pneumatic console will consist of an aluminum cabinet containing the following components:

- a. Pressure gages
- b. Pressure transducers
- c. Solenoid-operated valves
- d. Pneumatically operated valves
- e. Check valves
- f. Relief valves
- g. Hand isolation valves
- h. Filters
- i. Regulators
- j. Orifices
- k. Interconnecting stainless steel pneumatic lines.

6.23 Automatic Stage Checkout Pneumatic Console, VCL, SACTO (DSV-4B-321A)
1B44643-1

This GSE item is similar to Model DSV-4B-321.

Function - The function of this console shall be identical to the Automatic Stage Checkout Pneumatic Console (DSV-4B-321).

Design - In addition to the features of the DSV-4B-321, the design of this console incorporates the following:

- a. Accept gaseous nitrogen at 2,200 psig and regulates the gas to 450 \pm 50 psig for,
 1. Pressurizing the stage LOX tank with GN_2 for leak checking
 2. Pressurizing the stage LH_2 tank with GN_2 for leak checking
- b. Separate venting of the APS fuel systems
- c. Separate venting of the APS oxidizer systems.

Components - Components are similar to the Automatic Stage Checkout Pneumatic Console (DSV-4B-321).

6.24 Auxiliary Propulsion System Mobile Oxidizer Servicer (DSV-4B-322)
1A71450-1

Function - The APS Mobile Oxidizer Servicer shall be a trailer-mounted oxidizer storage and transfer system capable of transporting nitrogen tetroxide (oxidizer) from the facility storage area and of transferring the oxidizer to the stage APS modules.

Design - The oxidizer mobile servicer, as shown in Figure 6-21, will be designed to receive, transport, and transfer nitrogen tetroxide to service each APS module oxidizer tank. The transfer of nitrogen tetroxide will utilize a closed-loop system capable of venting purged gases before and after transfer operations. In the event of electrical or pneumatic failure, all valves will assume a safe or normal position. All pneumatically operated valves, pressure indicators, etc., will be capable of local or remote manual sequencing and monitoring.

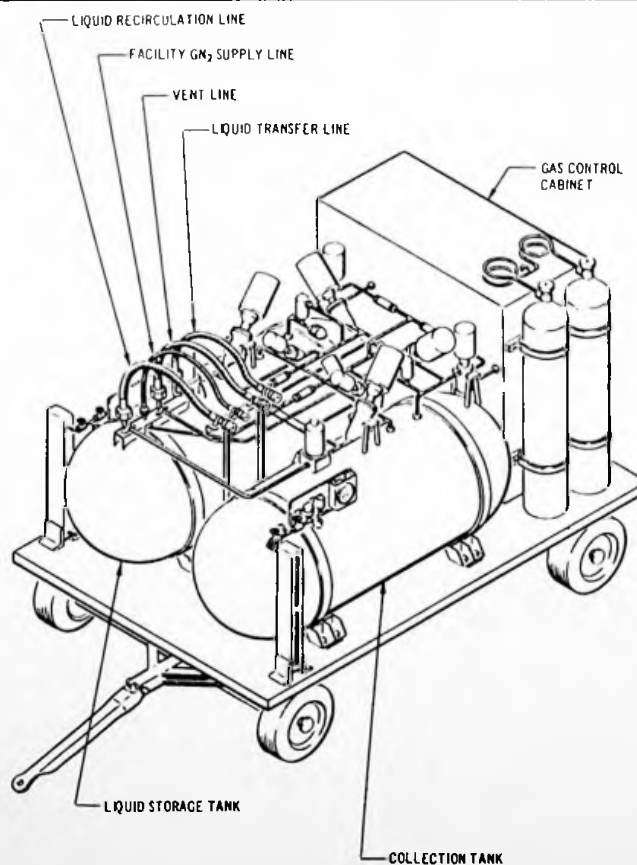


Figure 6-21. Auxiliary Propulsion System Mobile Oxidizer Service (DSV-4B-322)

The mobile servicer will be designed to receive facility GN_2 , and to regulate and distribute it to meet system requirements. The GN_2 system will be designed to prevent contamination of the GN_2 supply by toxic vapors or propellants. All purged gases from propellant transfer operations will be collected and disposed of by a venting system. The mobile servicer will also be designed to carry a limited supply of GN_2 to maintain a blanket pressure within its tanks during transit from the facility storage area, or at any other time when the servicer is not receiving or transferring nitrogen tetroxide. In addition, the oxidizer mobile servicer will be capable of the following:

- a. Transferring the oxidizer at a flow rate of 5 gpm (gallons per minute)
- b. Receiving GN_2 at 2,500 psig, and regulating and controlling the gas for the following operations:
 1. Electrical junction box purge at $1/4$ psig
 2. Pressurization of the liquid storage tank between 0 and 100 psig
 3. Pressurization of the liquid collection tank between 0 and 100 psig
 4. Valve actuation pressure at 150 psig
 5. Blanket pressure between 0 and 15 psig
- c. Providing the following electrical input requirements:
 1. 28 vdc for (1) remote control of solenoid-operated valves and (2) remote monitoring provisions for valve-position switches and pressure switches
 2. 28 vdc for remote monitoring provisions for pressure transducers
- d. Providing blanket pressure, between 10 and 15 psig, from self-contained "K" bottles, for the liquid storage and liquid collection tanks.
- e. Providing oxidizer bladder ullage control by removal of a predetermined amount of oxidizer after the APS bladder is 100 percent full.

Components - The oxidizer mobile servicer will consist of the following components:

- a. Trailer
- b. A 240-gallon liquid storage tank

- c. A 240-gallon liquid collection tank
- d. Pneumatically operated valves
- e. Solenoid-operated valves
- f. Regulators
- g. Orifices
- h. Relief valves
- i. Filters
- j. Burst discs
- k. Gages
- l. Transducers
- m. Flexible hoses
- n. Liquid-level indicators
- o. Two GN₂ "K" bottles (capacity 224 standard cubic feet, 2,500 psig at 70 degrees F)
- p. Miscellaneous interconnecting lines
- q. Bladder ullage control assembly consisting of
 - 1. Pneumatic actuator
 - 2. Propellant accumulator chamber
 - 3. Check valves
 - 4. 4-way solenoid valve with manual override and snubbers
 - 5. Electrical position-indicator switches
 - 6. Graduated control device.

6.25 Auxiliary Propulsion System Mobile Fuel Servicer (DSV-4B-323)
1A71475-1

Function - The APS Fuel Mobile Servicer shall be a trailer-mounted propellant storage and transfer system capable of (1) transporting the APS fuel (monomethylhydrazine) from the facility storage area and (2) transferring the fuel to the stage APS modules.

Design - Except for identification, the design of the mobile fuel servicer will be identical to the mobile oxidizer servicer (Model DSV-4B-322). (See Figure 6-21.)

Components - The components comprising the mobile fuel servicer will be similar in nature to the components listed for the mobile oxidizer servicer.

Dimensions - The dimensions of the mobile fuel servicer will be approximately the same as the dimensions of the mobile oxidizer servicer.

6.26 Alignment Kit, Engine (DSV-4B-324) 1A67439-1

Function - The function of the Engine Alignment Kit shall be to (1) align the J-2 engine with the stage and (2) determine the geometric center of the engine by measuring the radius of the area at the throat and bottom of the engine nozzle.

Design - The design of the kit, as shown in Figure 6-22, will consist of a center shaft with a rotating arm and dial indicator at the throat of the shaft, and a similar but larger rotating arm and dial indicator at the bottom of the shaft.

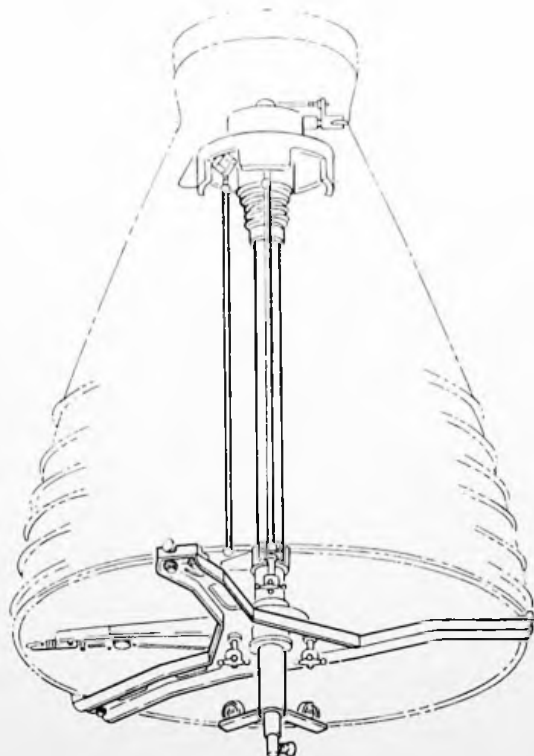


Figure 6-22. Alignment Kit, Engine (DSV-4B-324)

Components - The kit will consist of the following components:

- a. Center shaft assembly
- b. Support assembly
- c. Two dial indicators
- d. Two inclinometers
- e. Telescopic mount
- f. Telescope.

6.27 Fixture, Engine Actuator Adjustment (DSV-4B-325) 1A67441-1

Function - The function of the Engine Actuator Adjustment Fixture shall be to measure actuator length while the actuator is on the bench or installed on the stage. It shall also provide a device to torque the actuator lock nut and a puller for removing the actuator pins.

Design - The fixture as shown in Figure 6-23 will be designed to index into the tooling pads provided on the actuator ends. Adapter arms are provided to allow measurement of both pitch and yaw actuators, the torque device will be designed to clamp to the actuator piston and apply torque to the actuator locknut. The pin puller will screw into the actuator pins and bear against the engine to withdraw the pins.

Components - The fixture will consist of the following components:

- a. Fixture
- b. Adapter arms
- c. Calibration bar
- d. Pin puller
- e. Torque device.

6.28 Environmental Control System Kit, SACTO (DSV-4B-326) 1A78604-1

Function - The function of the SACTO Environmental Control System Kit shall be to adequately purge the aft interstage area and the forward skirt area in order to minimize fire and explosion hazard during test

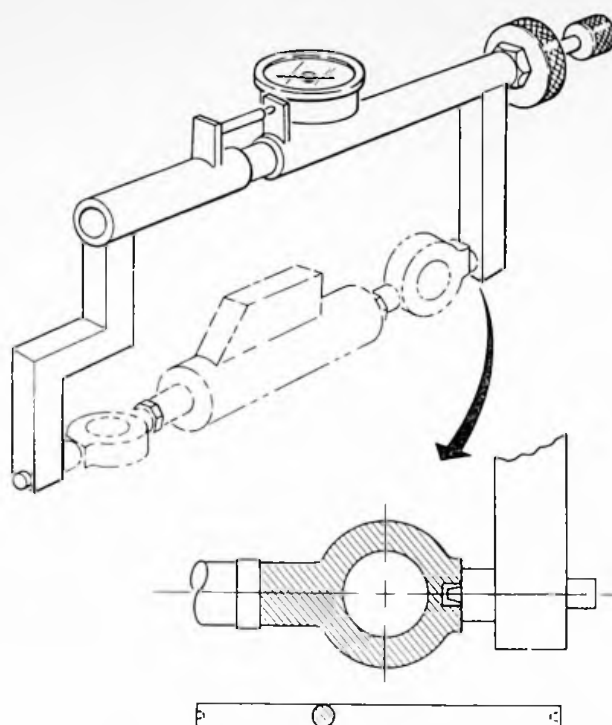


Figure 6-23. Fixture, Engine Actuator Adjustment (DSV-4B-325)

firings and while propellants are being loaded or stored in the stage. The system shall provide a temperature-controlled environment to maintain proper operating temperature for the equipment in the aft interstage. The system shall purge the cavity formed by the protective firing cover and the forward dome and skirt.

Design - The system will be designed to admit 3,500 scfm of conditioned GN_2 air through the umbilical inlet to the aft interstage environmental distribution system during propellant loading and during test firings. During these operations, the environmental control system will be capable of maintaining the temperature of all equipment in the aft interstage (except batteries) above 0 degrees F. The temperature of the batteries will be maintained above 60 degrees F. The flow of GN_2 air will be sufficient to dilute dangerous gaseous contamination and to minimize fire and explosion hazard. GN_2 flow will begin one (1) minute before firing and continue until one (1) hour after firing. GN_2 pressure for flow is

supplied by the GN_2 facility. In the event of a protracted hold (up to 14 hours) and during cold flow the remote operated butterfly valve will switch to flow position. A blower in the test stand supplies shop air; GN_2 is supplied from a remote facility.

The forward skirt is enclosed by STE Model DSV-4B-601 "Protective Firing Cover" and will be purged continuously by 500 scfm of GN_2 . Purge will begin thirty (30) minutes prior to tanking and continue until one (1) hour after firing. This GN_2 flow will be maintained through any hold period up to 14 hours.

Components - The system, as shown in Figure 6-24, will consist of the following components:

- a. Blower
- b. Electric heaters
- c. Remote operated butterfly valve
- d. Temperature control systems
- e. Temperature and pressure instrumentation
- f. Insulated ducting
- g. Interface GN_2 piping between GN_2 facility and unit inlets.

6.29 Checkout Accessories Kit (DSV-4B-329) 1A92953-1

Function - The function of the Checkout Accessories Kit shall be to facilitate checkout of the stage and engine installation in conjunction with Pneumatic Consoles A and B (DSV-4B-319 and 320, respectively) and the propellant loading skids.

Design - The kit will provide the necessary equipment to supply helium for partial checkout of the J-2 engine. The kit will supply a portable vacuum gage for checking the pressure in the vacuum jackets of the propellant transfer and engine feed lines. The kit will also supply a portable test gage to be used as a standard in checking the test stand pressure gages.

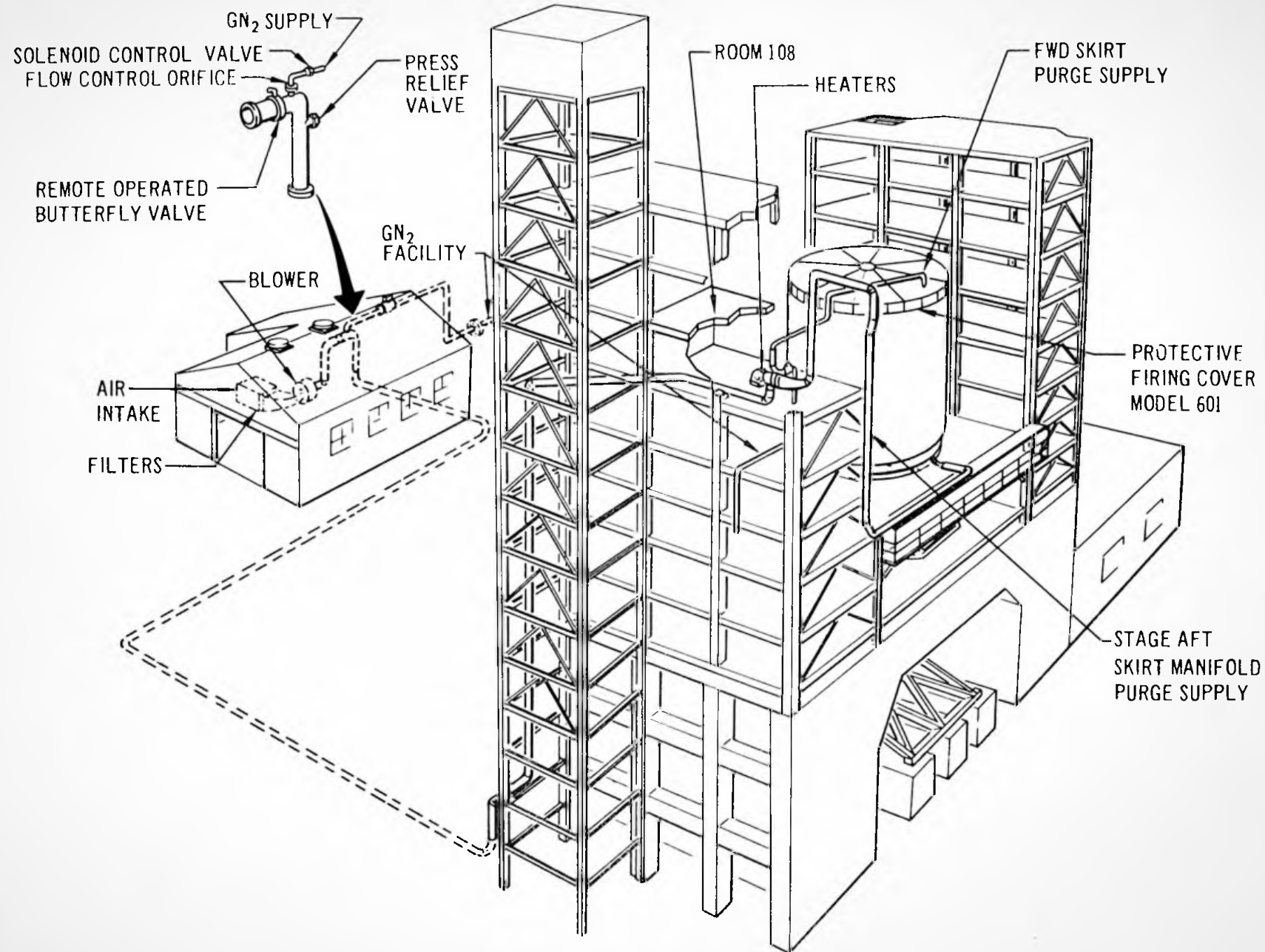


Figure 6-24. Environmental Control System, SACTO (DSV-4B-326)

Components - The panel, as shown in Figure 6-25, will consist of the following components:

- a. Pneumatic fittings and adapters
- b. Flexible hoses
- c. Vacuum gage
- d. Hand valves
- e. Vacuum valve operators
- f. Filter.

6.30 Liquid Oxygen Valve Control Complex (DSV-4B-331) 1A59088-501

Function - The function of the Liquid Oxygen Valve Control Complex shall be to control the flow of LO_2 to the stage LO_2 tank and achieve the following requirements:

- a. Transfer LO_2 at a chilldown flowrate of 300 gpm until approximately 5 percent of the tank capacity is aboard

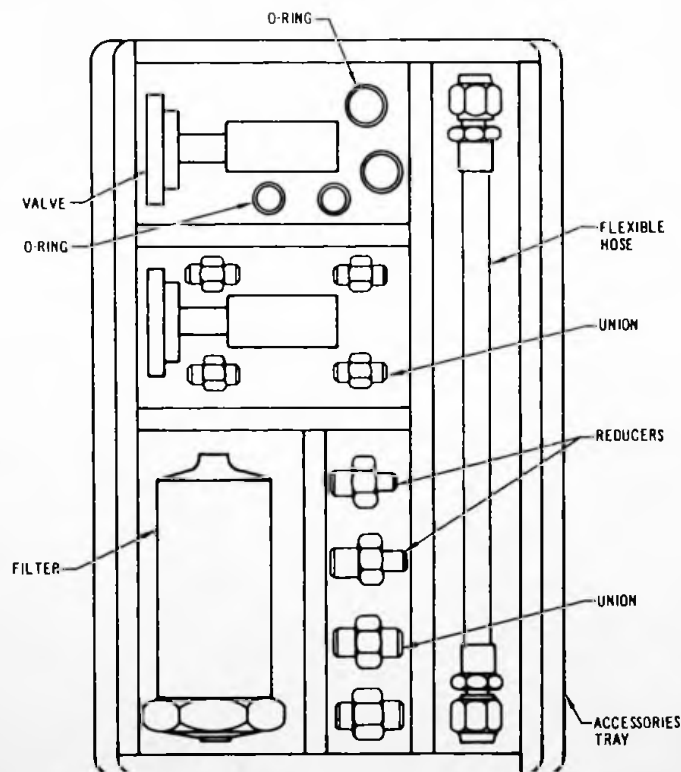


Figure 6-25. Checkout Accessories Kit (DSV-4B-326)

- b. Transfer LO_2 at a fast fill flowrate of 1,000 gpm until approximately 93 percent of the specified load is aboard
- c. Transfer LO_2 at a slow fill flowrate of 300 gpm until 100 percent of the specified load is aboard during the prepressurization
- d. Maintain the liquid level in the stage LO_2 tank at 100 percent of the specified load before tank prepressurization.

Design - The valve control complex, as shown in Figure 6-26, will be designed to receive LO_2 from a facility storage source and to control the flow to the LO_2 tank through the main fill or replenish valves.

All components in direct contact with LO_2 will be insulated. Valves and filters installed in the complex will be designed so that they may be repaired and serviced without being removed from the installed position. Supply lines connecting to the complex will utilize flanged connections. A relief valve will be provided downstream of the main fill and replenish valves to prevent overpressurization within the lines. All remotely controlled valves will assume a safe or normal position in the event of an electrical or pneumatic failure during countdown.

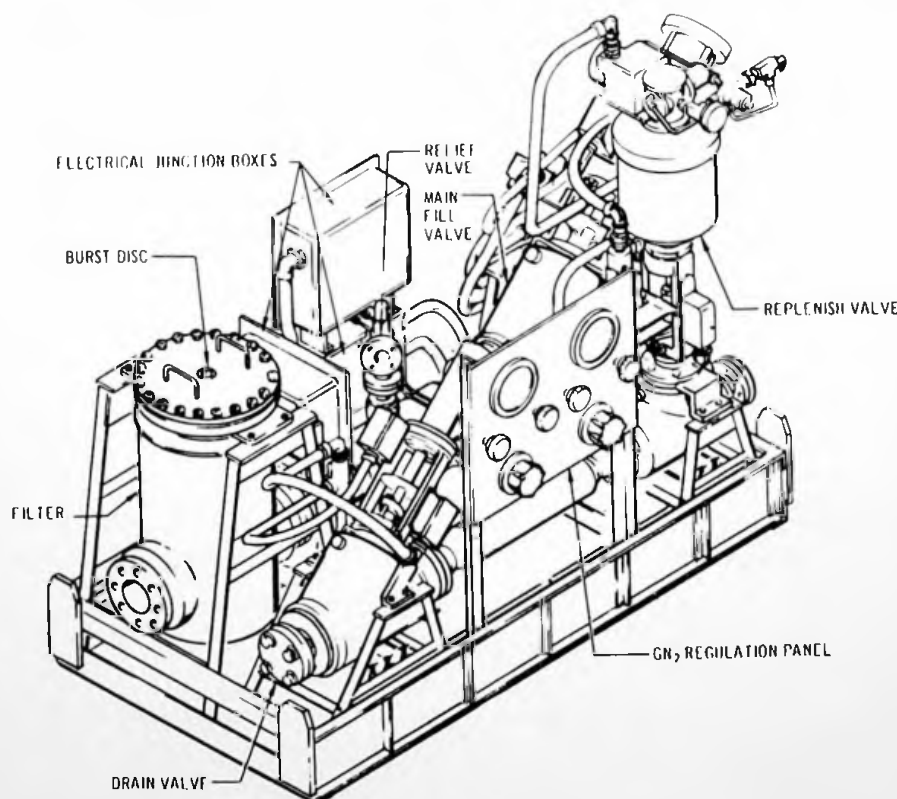


Figure 6-26. Liquid Oxygen Valve Control Complex (DSV-4B-331)

Liquid oxygen will enter the control system through individual inlets for main fill and replenish operations. Each inlet will be controlled by a pneumatically operated control valve. The LO_2 will be filtered and passed through an outlet into the LO_2 umbilical transfer line. The replenish supply outlet will be connected to the main fill line upstream of the main fill valve. The drain valve and relief valve outlets will be directly and safely vented into the air. Pneumatically operated valves will be actuated with gaseous nitrogen through individual, remotely controlled, solenoid-operated valves. The stage LO_2 tank PU system will automatically control the replenish and main fill valves during stage LO_2 loading operation.

Components - The valve control complex will consist of the necessary pneumatically operated valves required to control the flow of LO_2 from a facility storage source to the stage LO_2 tank. The complex will be mounted on an aluminum support assembly.

Dimensions - The valve control complex will be approximately 42 inches high, 77 inches long, 40 inches wide, and will weigh approximately 1,500 pounds.

6.31 Liquid Hydrogen Valve Control Complex (DSV-4B-332) 1A59200-501

Function - The function of the Liquid Hydrogen Valve Control Complex shall be to control the flow of LH_2 (as required) to the stage LH_2 tank gas heat exchanger. To meet these requirements, the valve control complex shall be capable of the following:

- a. Transferring LH_2 at a chilldown flowrate of 500 gpm until approximately 5 percent of the tank capacity is aboard
- b. Transferring LH_2 at fast fill flowrate of 3,000 gpm until approximately 93 percent of the specified load is aboard
- c. Transferring LH_2 at a slow fill flowrate of 500 gpm until 100 percent of the specified load is aboard before tank pre-pressurization
- d. Maintaining the liquid level in the stage LH_2 tank at 100 percent of the specified load before or during tank prepressurization

- e. Transferring LH_2 to the gas heat exchanger at a sufficient flowrate to (1) cool and maintain ambient helium gas at 50 and 100 degrees R and (2) maintain the gaseous hydrogen at 140 degrees R.

Design - The valve control complex, as shown in Figure 6-27, will be designed to receive LH_2 from a facility storage source and to control the LH_2 flow to the stage LH_2 tank, and the gas heat exchanger.

All components in direct contact with LH_2 will be insulated and all lines will be vacuum jacketed. Valves and filters installed in the complex will be designed so that they may be repaired and serviced without being removed from the installed position. The filter will be designed to withstand an internal explosion. Thus, only readily replaceable parts will be damaged in the event of an internal filter explosion. The filter will be vented to carry any LH_2 from the filter rupture diaphragm to an area safe for disposal. Supply lines and umbilical lines connecting to the complex will be welded. All interconnecting lines within the complex will be welded wherever practical to minimize leakage. A relief

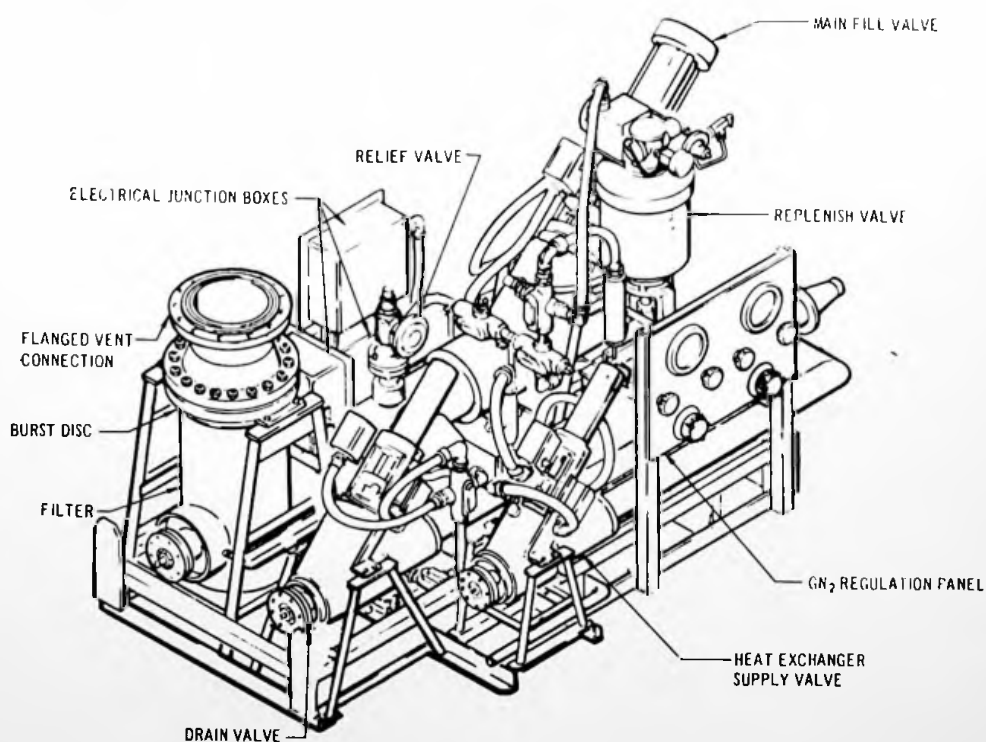


Figure 6-27. Liquid Hydrogen Valve Control Complex (DSV-4B-332)

valve will be provided downstream from the main fill and replenish connections to prevent overpressurization within the lines. All remotely controlled valves will assume a safe or normal position in the event of an electrical or pneumatic failure during countdown.

Components - The LH_2 Valve Control Complex will consist of the necessary pneumatically operated valves required to control the flow of LH_2 from a facility storage source to the stage LH_2 tank. The complex will be mounted on an aluminum support assembly and will govern the flow of LH_2 at the desired flowrates for the main fill and replenish operations. The complex will also contain valves for controlling the supply of LH_2 to the gas heat exchanger.

Dimensions - The LH_2 Valve Control Complex will be approximately 108 inches long, 54 inches wide, 50 inches high, and will weigh approximately 1,800 pounds.

6.32 Alignment Kit, SACTO (DSV-4B-339) 1A57891-1

Function - The function of the SACTO Alignment Kit shall be to provide the necessary hardware for aligning and installing the stage on the Dummy aft interstage. The kit shall be used on the Saturn IB/S-IVB and Saturn V/S-IVB.

Design - The kit, as shown in Figure 6-28, will be designed to accurately align the stage with the Dummy aft interstage.

Components - The kit will consist of the following components:

- a. Aligning pins
- b. Collar and screw
- c. Case.

6.33 Alignment Kit, KSC (DSV-4B-340) 1A57893-1

Function - The function of the KSC Alignment Kit shall be to provide the necessary hardware for aligning, installing, and staging the S-IVB stage at KSC (All Interfaces).

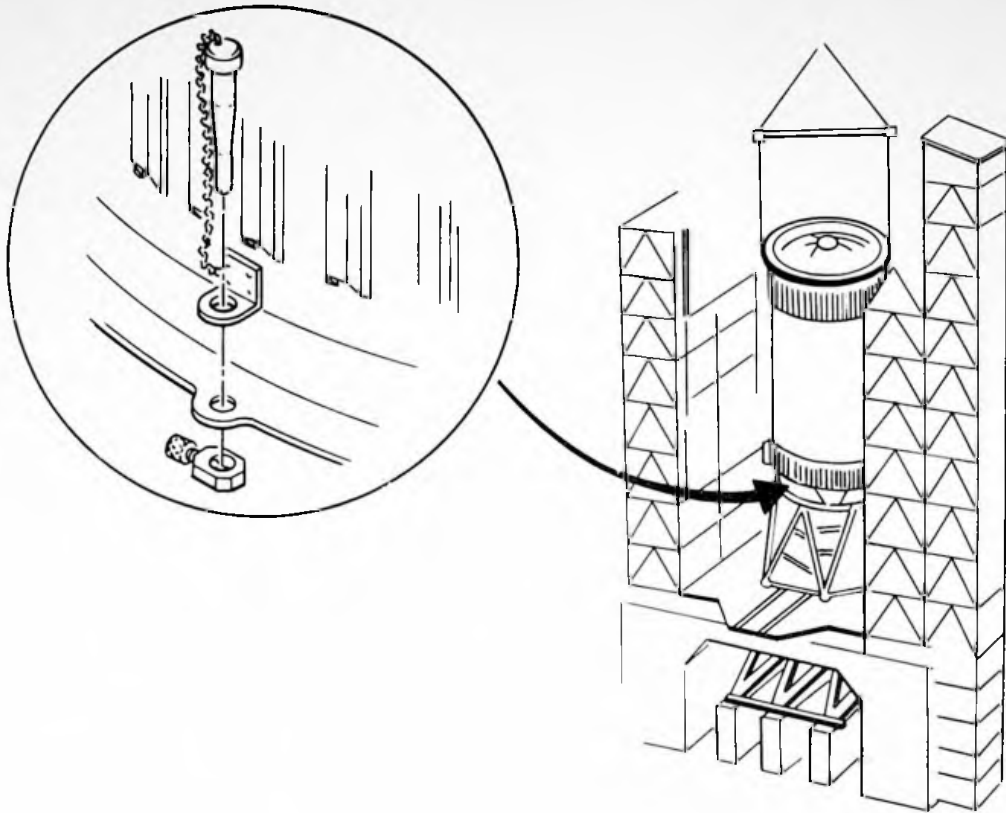


Figure 6-28. Alignment Kit, SACTO (DSV-4B-339)

Design - The kit, as shown in Figure 6-29, will consist of pins designed for ease of installation and accurate alignment.

Components - The kit will consist of the following components:

- a. Aligning pins
- b. Collar and screw
- c. Case.

6.34 Handling Sling, Ullage and Attitude Control Module (DSV-4B-341) 1A57895-1

Function - The function of the Ullage and Attitude Control Module Handling Sling is to provide a means by which the module can be hoisted from a horizontal position and swung vertically for positioning on the Saturn V/ S-IVB Stage or Sacramento Test Stand facilities.



Figure 6-29. Alignment Kit, (DSV-4B-340)

Design - The sling will be of beam-and-cable design, and will be capable of being raised and lowered by a mobile or tower crane.

Components - The sling, as shown in Figure 6-30, will consist of the following components:

- a. Hoist cables
- b. Yoke assembly
- c. Spreader bar.

(For use with the S-V stage only.)

6.35 Handling Kit, S-II Retrorocket (DSV-4B-342) 1A57897-1

Function - The function of the S-II Retrorocket Handling Kit shall be to provide a means for installing and removing a retrorocket from the Saturn IB/S-IVB and V/S-IVB aft interstage while the stage is in a vertical position.

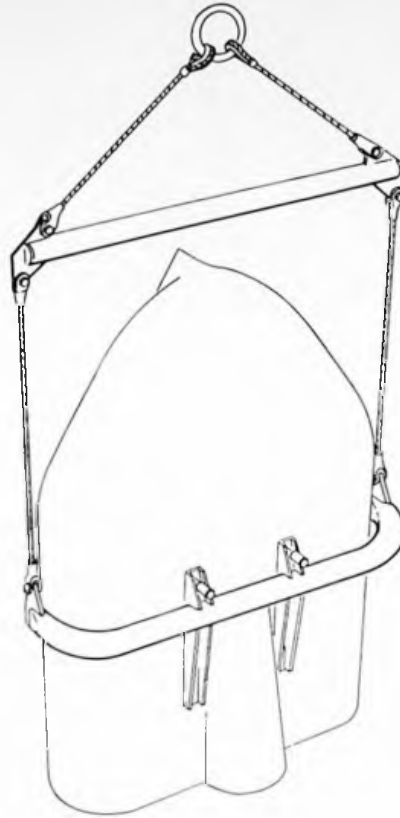


Figure 6-30. Handling Sling, Ullage and Attitude Control Module (DSV-4B-341)

Design - The handling kit will be of beam-and-cable design, and will be capable of being hoisted by a crane.

Components - The handling kit, as shown in Figure 6-31, will consist of the following components:

- a. Hoist sling
- b. Spreader bar
- c. Cables and fittings.

6.36 Handling Kit, Attitude Control Module (DSV-4B-344)

Function - The function of the Attitude Control Module Handling Kit shall be to provide a means by which the module can be hoisted from a horizontal position and swing vertically for positioning on the Saturn IB/S-IVB Stage or Sacramento Test Stand facilities.

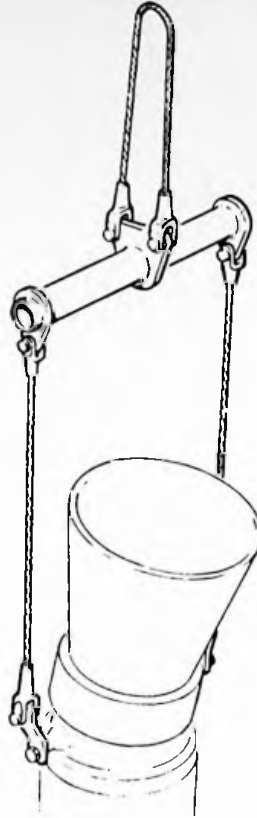


Figure 6-31. Handling Kit, S-II Retro Rocket (DSV-4B-342)

Design - The Sling will be of beam-and-cable design, and will be capable of being raised and lowered by a mobile or tower crane.

Components - The sling, as shown in Figure 6-32, will consist of the following major components:

- a. Hoist cables
- b. Attach plates
- c. Spreader bar.

(For use with the S-IB stage only.)

6.37 Weigh and Balance Kit, Stage (DSV-4B-345) 1A57907-1

Function - The function of the Stage Weigh and Balance Kit shall be to determine the weight and center of gravity of the stage at HB and STC.

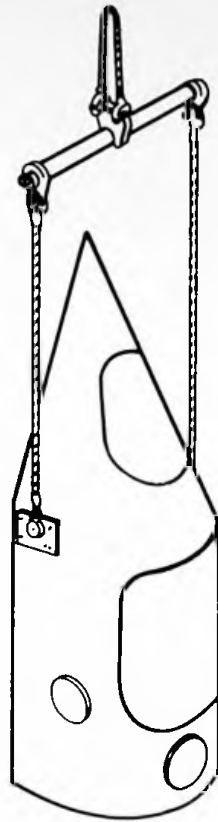


Figure 6-32. Handling Kit, Attitude Control Module (DSV-4B-344)

Design - The kit, as shown in Figure 6-33, will consist of two tripod jacks, each provided with air-bearing type pads on each tripod leg and an anchor-jack. Load cells with electrical readout equipment will be attached to the top of each tripod jack and the anchor jack, one under the stage aft roll ring and two under the stage forward roll ring.

Components - The kit will consist of the following components:

- a. Tripod jacks
- b. Load cells
- c. Electrical readout equipment
- d. Anchor jack
- e. Flexible pivots
- f. Forward structural supports
- g. Aft structural supports.

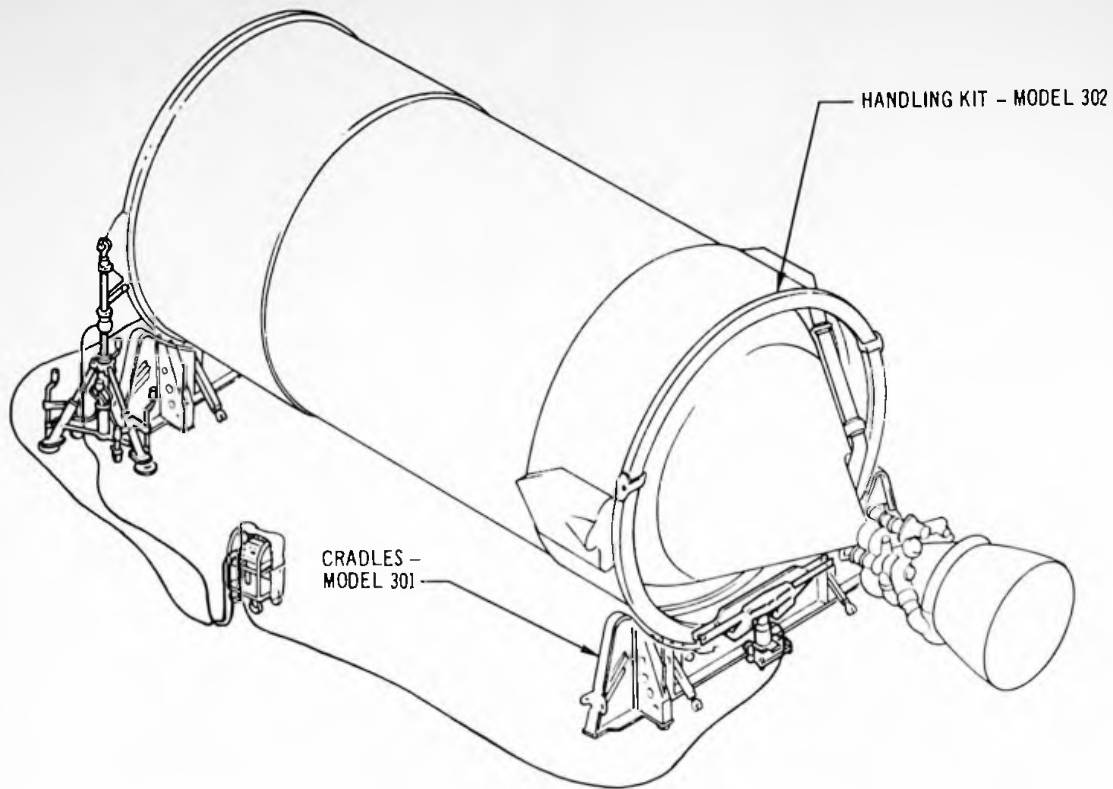


Figure 6-33. Weigh and Balance Kit, Stage (DSV-4B-345)

6.38 Aft Umbilical Kit, Checkout Stand (DSV-4B-346) 1A57917-1

Function - The function of the Checkout Stand Aft Umbilical Kit shall be to provide and support the electrical cables, pneumatic lines, and air conditioning adapter duct to the stage. An umbilical carrier shall provide attachment to the stage and shall be equipped with (1) a grounding system, and (2) an eject mechanism to provide electrical cable disconnect from the stage for test purposes.

Design - The design of the kit, as shown in Figure 6-34, will consist of electrical cables and plugs to connect the J-boxes to the stage, pneumatic lines to connect the pneumatic consoles to the stage, and an air conditioning adapter duct. The carrier will house the ground halves of the quick-disconnects and will support the electrical plugs and maintain their attachment to the stage. The carrier will be attached to the stage by two quick-release pins. The eject mechanism will be designed for

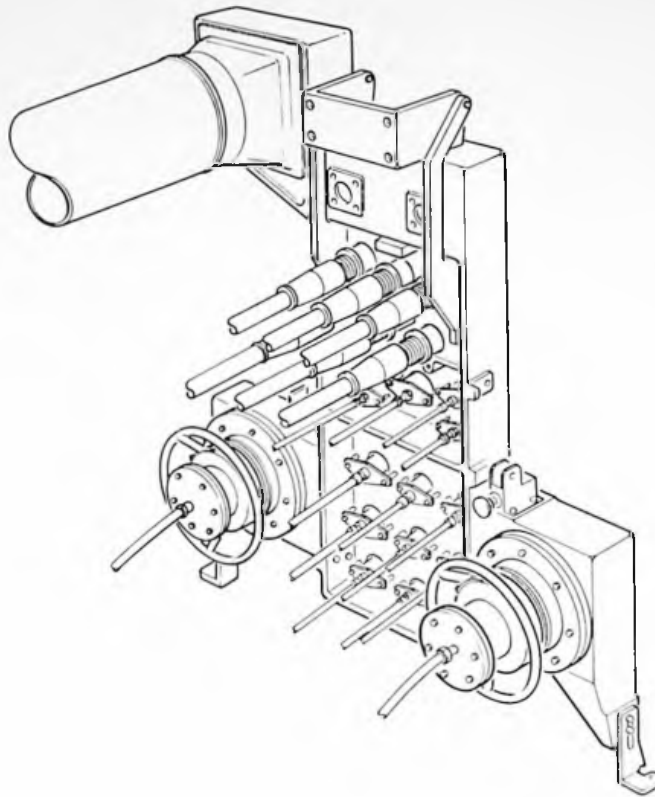


Figure 6-34. Aft Umbilical Kit, Checkout Stand (DSV-4B-346)

pneumatic operation to disconnect the electrical plugs from their receptacles to simulate lift-off. An electrical grounding system will also be provided.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Electrical cables with connectors
- c. Pneumatic hoses, and quick-disconnects
- d. Air conditioning adapter duct
- e. Eject mechanism
- f. Propellant coupling adapters for leak testing.

6.39 Forward Umbilical Kit, Checkout Stand (DSV-4B-347) 1A57919-1

Function - The function of the Checkout Stand Forward Umbilical Kit shall be to provide and support the electrical cables and helium vent to the

stage. An umbilical carrier shall provide attachment to the stage, and shall be equipped with, (1) a grounding system, and (2) an eject mechanism to provide electrical cable disconnect from the stage for test purposes.

Design - The design of the kit, as shown in Figure 6-35, will consist of electrical cables to connect the J-boxes to the stage, a GH_2 vent coupling, and a hose assembly to attach the vent coupling to the vent stack for the disposal of test helium. The carrier will be attached to the stage by two side supports. The eject mechanism will be designed for pneumatic operation to disconnect the electrical plugs from their receptacles to simulate lift-off. An electrical grounding system will also be provided.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Electrical cables with connectors

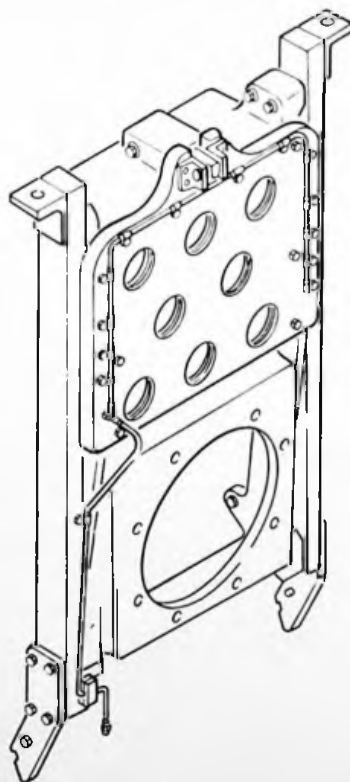


Figure 6-35. Forward Umbilical Kit, Checkout Stand (DSV-4B-347)

- c. Eject mechanism
- d. Helium vent hose assembly.

6.40 Access Kit, Liquid Oxygen Tank Interior (DSV-4B-348) 1A58653-1

Function - The function of the Liquid Oxygen Tank Interior Access Kit shall be to provide personnel access to the interior of the LO₂ tank to facilitate maintenance, checkout, and inspection operations when the stage is in a vertical position. The kit will also be utilized for installing, adjusting, and checking out the instruments used during testing operations.

Design - The design of the kit, as shown in Figure 6-36, will consist of ladders, supports, and platforms, of suitable size and construction, which will be inserted through the engine thrust structure and into the LO₂ tank. The platforms will be of multi-level construction to provide complete access to the interior of the tank, and will be capable of

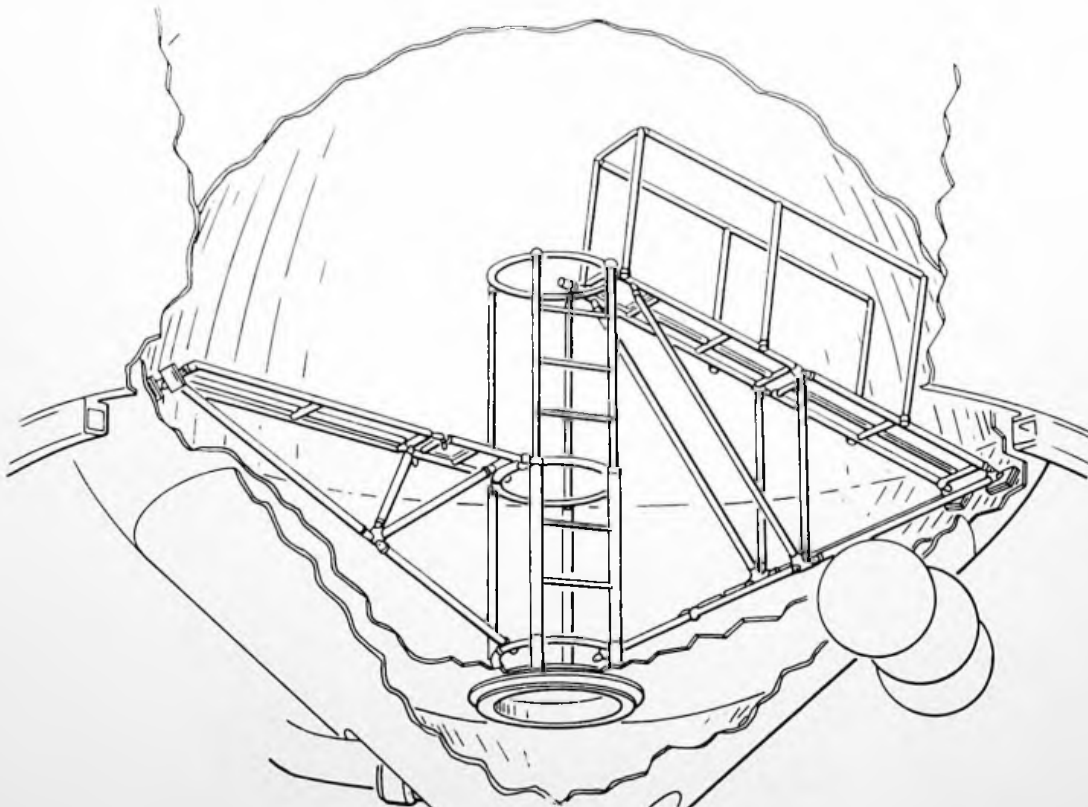


Figure 6-36. Access Kit, Liquid Oxygen Tank Interior (DSV-4B-348)

360-degree rotation within the tank. The ladders and platforms will be supported by a plate attached to the LO₂ tank flange and by pads resting on the tank.

Components - The kit will consist of the following components:

- a. Ladder
- b. Mounting fitting
- c. Protective pads
- d. Platforms
- e. Supports.

Cleaning, storing and shipping of components - Components of the kit will be cleaned, flushed, drained, and purged dry in accordance with applicable procedures, and will be packaged for storage in suitable bags. A protective enclosure will be provided, when necessary, for shipment and transport.

6.41 Handling Kit, Engine (DSV-4B-349) 1B27087-1

Function - The function of the Engine Handling Kit shall be used to raise the J-2 engine in a vertical position for installation on the stage in conjunction with vertical installer (GFE).

Design - The kit will be designed to provide a beam assembly supporting four pulleys. The beam assembly will attach to one stage engine actuator attach point and a fitting on the aft interstage, or dummy aft interstage. The pulleys will support cables attached to the J-2 engine and to the winches on the GFE sling hoist vertical installer. The (GFE) installer has been modified by adding three screw jacks to provide engine installation capability without using the cable system. This method can be used at STC on the Beta Test Stands and in the VCL.

Components - The kit, as shown in Figure 6-37, will consist of the following components:

- a. Beam assembly
- b. Bracket

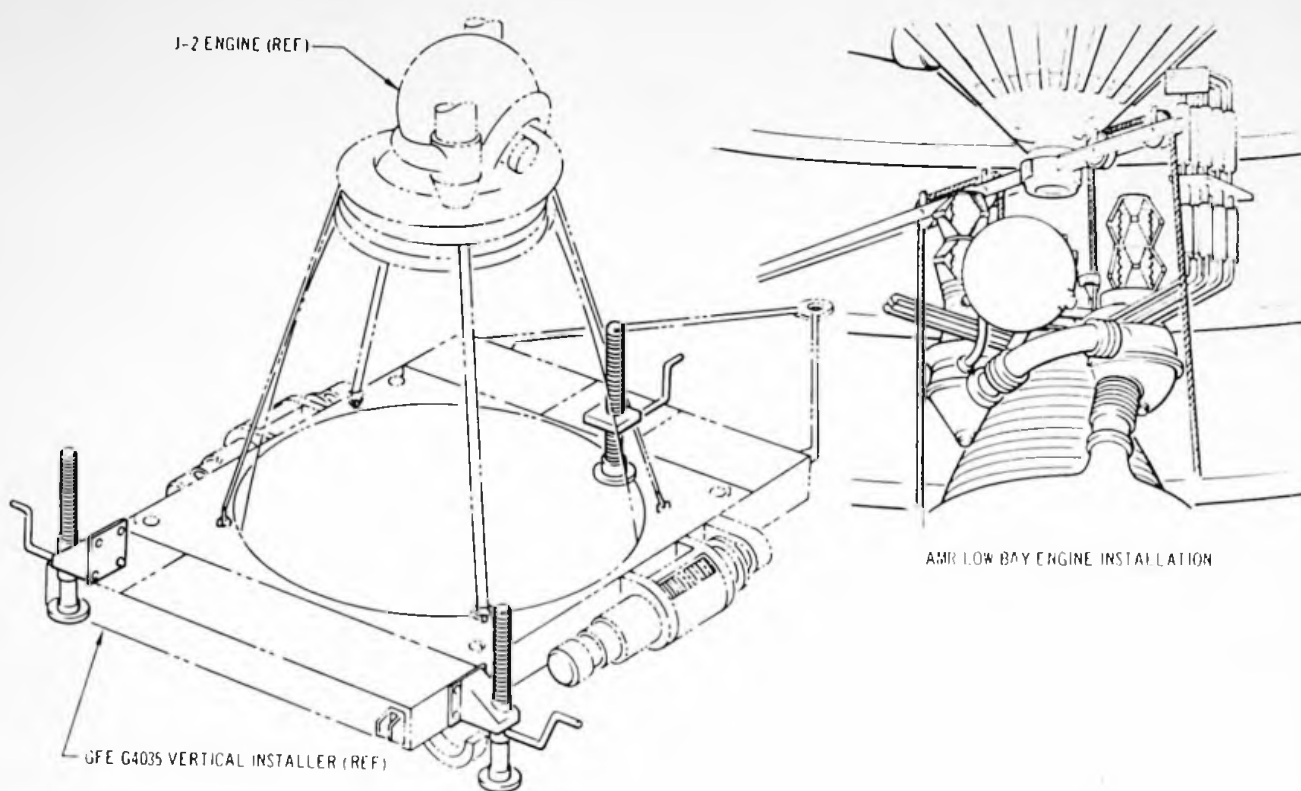


Figure 6-37. Handling Kit, Engine (DSV-4B-349)

- c. Vertical installer (GFE)
- d. Jacks on vertical installer.

6.42 Handling Kit, Engine (DSV-4B-349A) 1B27087-501

Except for identification and the addition of one extension beam, the function design, and components of the handling kit will be similar to Model DSV-4B-349. The additional beam will adapt to the Constant Aft Interstage which can be modified to accept this kit. (See Figure 6-37.)

NOTE: Ancillary GFE must be utilized when removing the J-2 engine with the stages stacked.

6.43 Weigh and Balance Kit, Aft Interstage (DSV-4B-351) 1A57903-1

Function - The function of the Aft Interstage Weigh and Balance Kit shall be to determine the weight and longitudinal C.G. of the Saturn IB/S-IVB constant Aft Interstage and the Saturn V flared Aft Interstage.

Design - The kit, as shown in Figure 6-38, will be designed to support either the constant or flared Aft Interstage in the horizontal and 15 degree position. A cross beam will be provided to attach to either Aft Interstage and provide three adapters for securing the weighing equipment of Model DSV-4B-345. (Load cells, flexures adapters and tripod jacks.) Three rigid tripods, with a large base diameter, will support the cross beam while the tripod jacks and load cells (DSV-4B-345) are positioned under the load points and during the weighing operation, to prevent accidental tipping of the Aft Interstage. One rigid stand will be used to support portable jack (DSV-4B-345) when weighing the Aft Interstage in the horizontal position. The load cell readings in the horizontal and 15 degree position will be used to calculate the location of the longitudinal C.G.

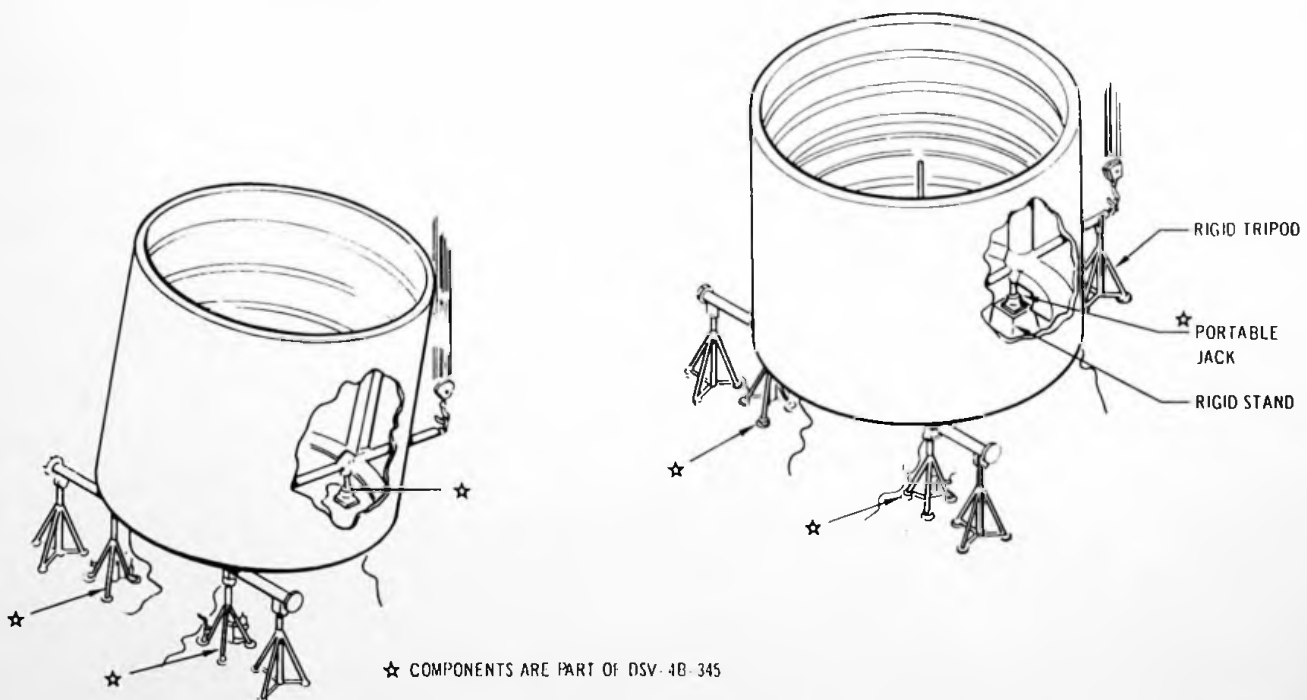


Figure 6-38. Weigh and Balance Kit, Aft Interstage (DSV-4B-351)

Components - The kit will consist of the following components:

- a. Cross beam
- b. Rigid tripods
- c. Rigid stands.

(For use with the S-IB stage only.)

6.44 Handling Kit, Constant Aft Interstage (DSV-4B-352)

Function - The function of the Constant Aft Interstage Handling Kit shall be to transport (for short distances) and handle the Saturn IB/S-IVB aft interstage.

Design - The handling kit will be designed to maintain the correct shape of the interstage, and will provide the necessary equipment for handling. Weather protection provisions will be included in the design, as well as provisions for short-distance movement (shop or on-site).

Components - The kit, as shown in Figure 6-39, will consist of the following major components:

- a. Dolly assembly
- b. Hoist beam
- c. Weather protection cover.

(For use with the S-IB stage only.)

6.45 Access Kit, Vertical, Constant Aft Section (DSV-4B-357)

Function - The function of the Constant Aft Section Vertical Access Kit shall be to provide access within the aft interstage for maintenance while the stage is in a vertical position.

Design - The kit, as shown in Figure 6-40, will consist of work platforms and support structure designed to provide access within the aft interstage at two levels. The platforms will hook onto attachments on the aft interstage. The platforms and support hardware will be installed through the aft interstage access door.

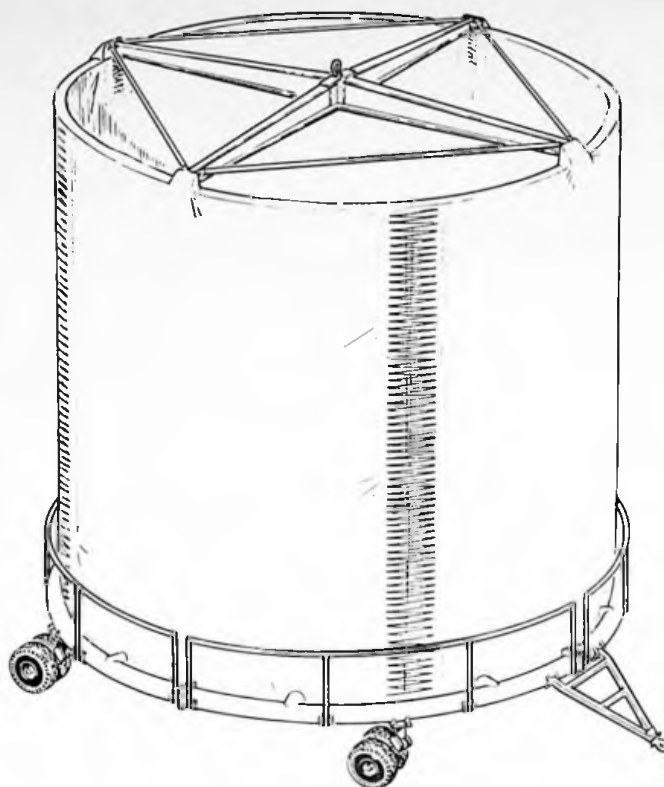


Figure 6-39. Handling Kit, Constant Aft Interstage (DSV-4B-352)

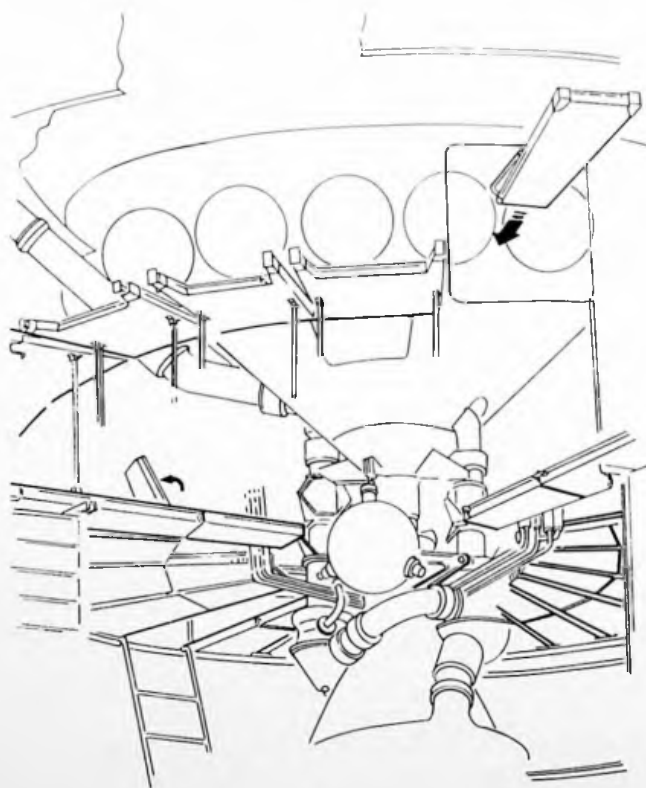


Figure 6-40. Access Kit, Vertical, Constant Aft Section (DSV-4B-352)

Components - The kit will consist of suitably designed and installed work platforms and support hardware.

(For use with the S-IB stage only.)

6.46 Hydraulic Pumping Unit (DSV-4B-358) 1A67443-1

Function - The function of the Hydraulic Pumping Unit shall be to supply hydraulic fluid to the stage engine hydraulic system for filling, flushing, cleaning, leak checking, air purging, and functional checking of various subsystem components.

Design - The pumping unit, as shown in Figure 6-41, will be designed to supply hydraulic fluid at 3,750 psig and at approximately 7.0 gpm to the flight control hydraulic system. The unit will be mounted on casters and will be capable of being lifted by its eye bolts. The unit will

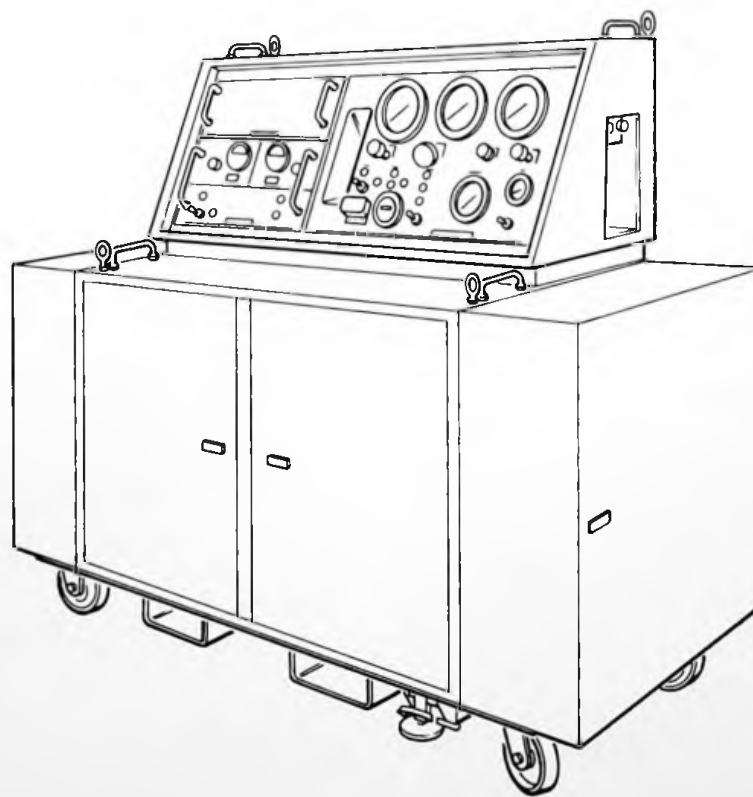


Figure 6-41. Hydraulic Pumping Unit (DSV-4B-358)

also have fork-lift capability. The unit will consist of the following major subsystems:

- a. Reservoir pressurization subsystem: The reservoir will be pressurized with filtered gaseous nitrogen from a nitrogen storage bottle through a pressure regulator, check valve, and filter. A relief valve will prevent overpressurization of the reservoir. Gages will monitor reservoir and bottle pressures.
- b. Recirculation and filtration subsystem: An electrically driven, fixed-displacement, gear type pump (rated at 1.4 gpm at 175 psi) will circulate oil from the reservoir pump through a 3-micron absolute, depth type filter and back to the reservoir.
- c. Hydraulic oil (pressure and return) subsystem: A variable-displacement pump, electrically driven and pressure compensated, rated at 7.0 gpm at 3,750 psi, will supply hydraulic fluid to the stage hydraulic system through a 3-micron absolute, depth type filter. Supply pressures will be monitored by high and low pressure gages. Return fluid will be filtered through a 10-micron absolute filter and pass through a heat exchanger into the reservoir. System temperature will be monitored by a temperature gage and limited by a thermal cutoff switch. A return bypass system with a flowmeter will be provided to measure system leakage rates.

Components - The pumping unit will consist of the following components:

- a. Variable-displacement pump
- b. Fixed-displacement pump
- c. High-pressure oil relief valve
- d. Oil reservoir (17-gallon nominal capacity)
- e. Flowmeter
- f. Oil and gas filters
- g. Check valves
- h. Relief valves (15 psig)
- i. Nitrogen bottle (1,500 psig)
- j. Gage savers
- k. Quick-disconnects
- l. Shutoff valves
- m. Miscellaneous electrical components.

Dimensions - The pumping unit will have the following approximate dimensions: height, 67 inches; depth, 35 inches; length, 72 inches; and will weigh approximately 1,700 pounds.

6.47 Servicer, Thermoconditioning System, Forward Skirt Electronics
(DSV-4B-359) 1A78829-1

Function - The function of the Forward Skirt Electronics Thermoconditioning System Servicer shall be to provide the required temperature environment to the thermoconditioning system forward skirt electronics by supplying temperature-controlled fluid to the system during fueling and standby operations. The servicer shall also provide the necessary instrumentation for system test and adjustment.

Design - The servicer will be designed as a mobile unit and will incorporate the necessary components to cool (or heat) and circulate a water/methyl alcohol solution (or plain water) through the stage forward skirt thermoconditioning system. The servicer will provide gas pressure at least twice as high as maximum system operation pressure for system leak testing. The servicer will be explosion-proof, and will meet the general requirements of the National Electrical Code, Article 500, for Class I, Group B equipment. The servicer will also have remote-operation capability for use during fueled-stage testing. In addition, the servicer will be designed to perform the following functions:

- a. Pressurize the system with halogen and nitrogen gas to 53 psig for leak testing
- b. Fill the system with a water/methyl alcohol solution (plus inhibitor) or water
- c. Maintain an inlet pressure to the stage of 42 psig (maximum) at a coolant flow rate of 3,500 pounds per hour
- d. Provide a cooling capacity of 12,000 BTU's (British Thermal Unit) per hour, with a stage inlet temperature of between 40 and 60 degrees F
- e. Provide a heating capacity of 12,000 BTU's per hour, with a stage inlet temperature between 40 and 60 degrees F
- f. Remove the coolant from the stage system
- g. Measure flow and system pressure-drops for cold plate orifice adjustment.

Components - The servicer, as shown in Figure 6-42, will consist of the following major components:

- a. Coolant reservoir
- b. Hermetically sealed refrigeration unit (compressor, condensor, and shell-and-tube heat exchanger)
- c. Pressure gages and regulators
- d. Flow indicator and regulator
- e. Temperature gages and transducers
- f. Hand-operated valves
- g. Pump
- h. Halogen pressure source and leak detector
- i. Miscellaneous relays, resistors, quick-disconnects, filters, contactors, switches, and hoses.
- j. Heater
- k. GN_2 unit purge pressure source (explosion-proof requirements).

Dimension - The servicer will be approximately 79 inches high, 83 inches long, and 49 inches wide.

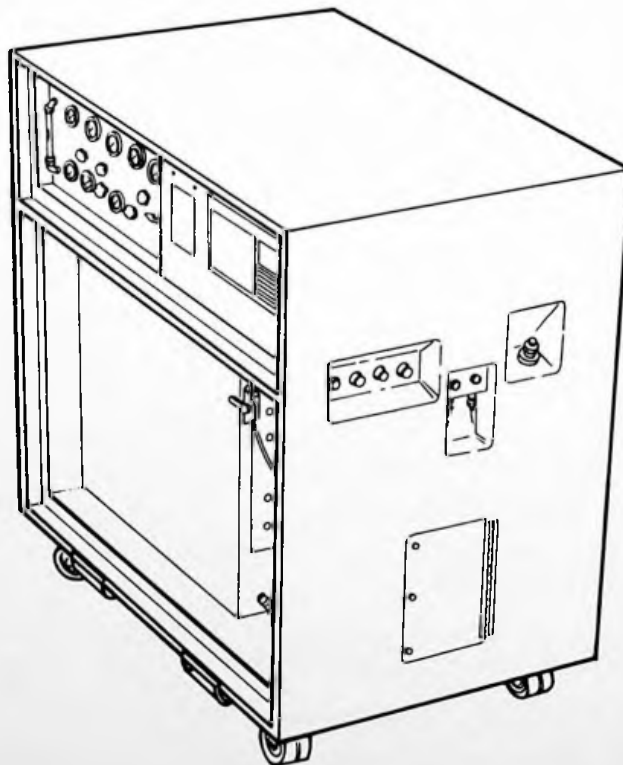


Figure 6-42. Servicer, Thermoconditioning System, Forward Skirt Electronics (DSV-4B-359)

6.48 Desiccant Kit, Secondary, Saturn S-IVB (DSV-4B-365) 1B56998

Function - The function of the Saturn S-IVB Secondary Desiccant Kit shall be to permit free breathing of the fuel and oxidizer tanks during stage checkout, while the stage is being handled at the test stands, in the vertical checkout laboratories, and prior to staging at KSC. It shall also provide desiccant caps to seal the umbilical end of the LOX and LH₂ fill and drain lines and the hydrogen vent lines. The caps shall contain a solid adsorber to maintain these lines in a LOX clean condition.

Design - The kit will be designed to be connected in series with the static Desiccant Kit Model DSV-4B-450 during land and sea transportation and while the stage is unpressurized in the test stands. The kits will be connected through an interface plate in the Protective Cover Kit Model DSV-4B-304 for transportation. The kit will consist of containers for the silica gel and visual indicators to check the relative humidity of the gas in the tanks. A container will be mounted on the forward and aft skirts and will be connected through stage pressurization lines for the fuel and oxidizer tanks.

Components - The kit will consist of the following components:

- a. Secondary desiccant containers
- b. Flexible hoses
- c. Special fittings for attachment to stage systems
- d. Mount brackets
- e. Desiccant caps.

6.49 Preservation Kit, APS Module, Saturn IB (DSV-4B-366) 1B56994

Function - The function of the Saturn IB APS Module Preservation Kit, shall be to permit free breathing of the aft disconnect covers and the engines' nozzles. The kit shall prevent moisture from entering the system and preclude expulsion of residual hypergolics from the APS systems.

Design - The design of the kit will include breathers containing a moisture vapor adsorber and hypergolic adsorber. Containers to fit the engines' nozzles will also be included. The desiccant will prevent moist air to enter the system. The hypergolic adsorber will prevent any residual fuel or oxidizer to escape under the Protective Cover Kit Model DSV-4B-304. A container will be provided for each engine and one for each aft cover. Each component will have a moisture indicator card to check condition of the silica gel. Indication of excessive quantities of hypergolics beyond the capacity of the adsorber will be unique desiccant color changes.

Components - The kit will consist of the following components:

- a. Cover breather adsorber assemblies
- b. Engine breather adsorber assemblies
- c. Mounting brackets.

(For use with the S-IB stage only.)

6.50 Preservation Kit, APS Module, Saturn V (DSV-4B-367) 1B56996

Function - The function of the Saturn V APS Module Preservation Kit, shall be to permit free breathing of the aft disconnect covers and the engines nozzles. The kit shall prevent moisture from entering the system and preclude expulsion of hypergolics from the APS system.

Design - The design of the kit will include breather assemblies containing desiccants and hypergolic adsorber. Containers will be provided for the aft disconnect covers and the four engine nozzles. The desiccant will prevent moisture from entering the APS system. Monitoring of moisture of hypergolic expulsion conditions will be done by use of a color comparison card adjacent to the container viewing port.

Components - The kit will consist of the following components:

- a. Cover breather adsorber assemblies
- b. Engine breather adsorber assemblies
- c. Mounting brackets.

6.51 Beam Kit, Cover Hoist, Saturn S-IVB Stage (DSV-4B-368) 1B57200

Function - The function of the Saturn S-IVB Stage Cover Hoist Beam Kit shall be to hoist, position, install, and remove the protective pad and the center section of the environmental cover (DSV-4B-304) for the S-IVB stage.

Design - The design of the kit, as shown in Figure 6-43, will consist of a beam constructed of two channels placed together. A locking mechanism, that is actuated between the channels, will be used to control the movement of the handling straps that are attached to the cover. The design incorporates an integral sling for hoisting the beam.

Components - The kit will consist of the hoist beam with an integral sling, strap rollers and strap extensions.

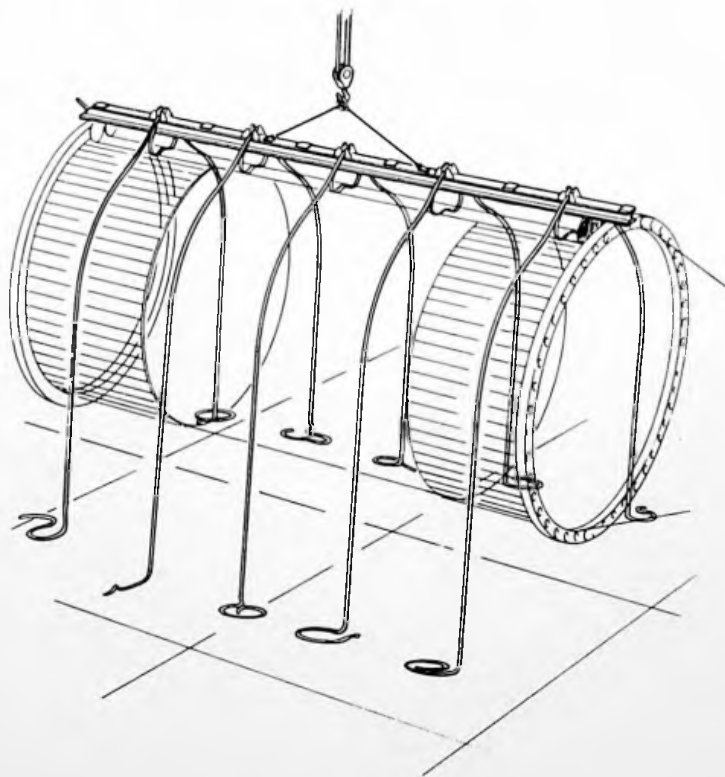


Figure 6-43. Beam Kit, Cover Hoist, Saturn S-IVB Stage (DSV-4B-368)

6.52 APS Fuel Valve Complex Control Assembly (DSV-4B-372) 1A77006-1

Function - The function of the APS Fuel Valve Complex Control Assembly shall be to control the transfer of monomethylhydrazine to the stage APS modules.

Design - The assembly, as shown in Figure 6-44, will be designed to perform the following specific functions:

- a. Route the fuel to, and recirculate the fuel from, each of the APS modules
- b. Receive the fuel through a transfer line from the APS Fuel Mobile Servicer (DSV-4B-323), and control the fine and rapid flow of fuel to the modules
- c. Route the recirculated fuel from the modules to the mobile servicer during loading operations
- d. Sense the fuel in the recirculation line by means of a transducer
- e. Permit line drainage and ambient GN₂ purge of the fuel transfer and recirculation lines from the modules after loading operations

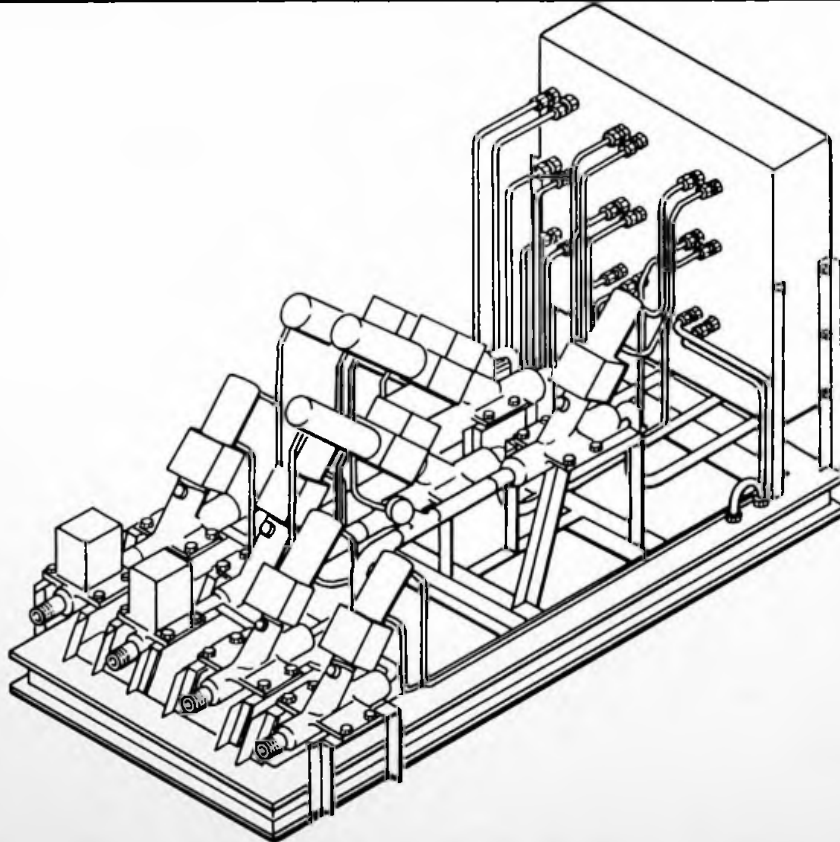


Figure 6-44. APS Fuel Valve Complex Control Assembly (DSV-4B-372, DSV-4B-373)

- f. Isolate the purged transfer and recirculation lines before the hot GN_2 purge of the modules
- g. Receive the hot GN_2 purge gas from the APS Pneumatic Distribution Control Complex Assembly (DSV-4B-374), route the gas through the fuel recirculation line to hot-purge the modules, and vent the hot GN_2 from the modules through the fuel transfer line to the facility fuel vent stack
- h. Maintain an inert GN_2 atmosphere in the electrical junction box.

Components - The assembly will consist of the following major components:

- a. Solenoid-operated valves
- b. Pneumatically operated valves
- c. Orifices
- d. Check valves
- e. Δp transducer
- f. Miscellaneous interconnecting stainless steel lines.

Dimensions - The assembly will be approximately 2-1/2 feet wide, 5 feet long, 3 feet high, and will weigh approximately 470 pounds.

6.53 APS Oxidizer Valve Complex Control Assembly (DSV-4B-373) 1A77005-1

Function - The function of the APS Oxidizer Valve Complex Control Assembly shall be to control the transfer of nitrogen tetroxide (oxidizer) to the stage APS modules.

Design - The assembly will be designed to accomplish the same functions for the oxidizer transfer and recirculation system as the fuel valve complex performs for the APS fuel system. The assembly is similar to that shown in Figure 6-44.

Components - The assembly will consist of components similar to those listed for the APS Oxidizer Valve Control Complex Assembly.

Dimensions - The dimensions of the assembly will be approximately the same as those listed for the APS Oxidizer Valve Control Complex Assembly.

6.54 APS Pneumatic Distribution Complex Control Assembly (DSV-4B-374)
1A77004-1

Function - The function of the APS Pneumatic Distribution Complex Control Assembly shall be to (1) receive nitrogen and helium gases from the APS Pneumatic Regulation Complex Control Assembly (DSV-4B-375) at the required pressures and (2) control the distribution of these gases for APS module checkout and purging, and oxidizer and fuel operations (as required).

Design - The assembly will be designed to perform the following functions:

- a. Receive GN_2 from the APS Pneumatic Regulation Complex Control Assembly and distribute it at various system pressures to the APS module oxidizer and fuel systems for the following:
 1. Ambient purge supply
 2. Hot purge supply
 3. Pneumatic valve actuation pressure for the oxidizer and fuel valve complexes
- b. Receive helium gas from the APS Pneumatic Regulation Complex Control Assembly and distribute it at various system pressures to the APS module oxidizer and fuel systems for the following:
 1. Oxidizer and fuel systems automatic leak check transducer checkout
 2. Module pressure switch checkout
 3. Oxidizer and fuel bellows leak check
 4. Helium spheres supply
 5. Oxidizer and fuel bellows collapse
 6. Helium spheres minimum liftoff check
- c. Control venting of the bellows collapse pressure to permit module propellant loading.

All valves installed in the assembly which require remote operation will be solenoid-operated. In the event of an electrical failure, all remotely controlled valves will assume a safe position.

A flanged GN_2 heater will be included with the design of the assembly. The heater will consist of (1) an electrically operated heating element, (2) two identical lines through which GN_2 will flow, (3) a heater control

switch, and (4) a temperature-sensing device for remote monitoring. The heater will be designed to receive ambient GN_2 at 15-60 psig, and to heat the gas to approximately 400 degrees F (Fahrenheit) to purge and/or vaporize any residual propellant in the module system.

Components - The assembly will consist of an aluminum cabinet housing, a GN_2 heater, and various valves, filters, and pressure switches. The assembly is shown in Figure 6-45.

Dimensions - The assembly will be approximately 4 feet wide, 4 feet high, 2-1/2 feet deep and will weigh approximately 200 pounds.

6.55 APS Pneumatic Regulation Complex Control Assembly (DSV-4B-375)
1A77003-1

Function - The function of the APS Pneumatic Regulation Complex Control Assembly shall be to (1) receive GN_2 and gaseous helium from a facility storage source and (2) regulate these gases to the required pressures for

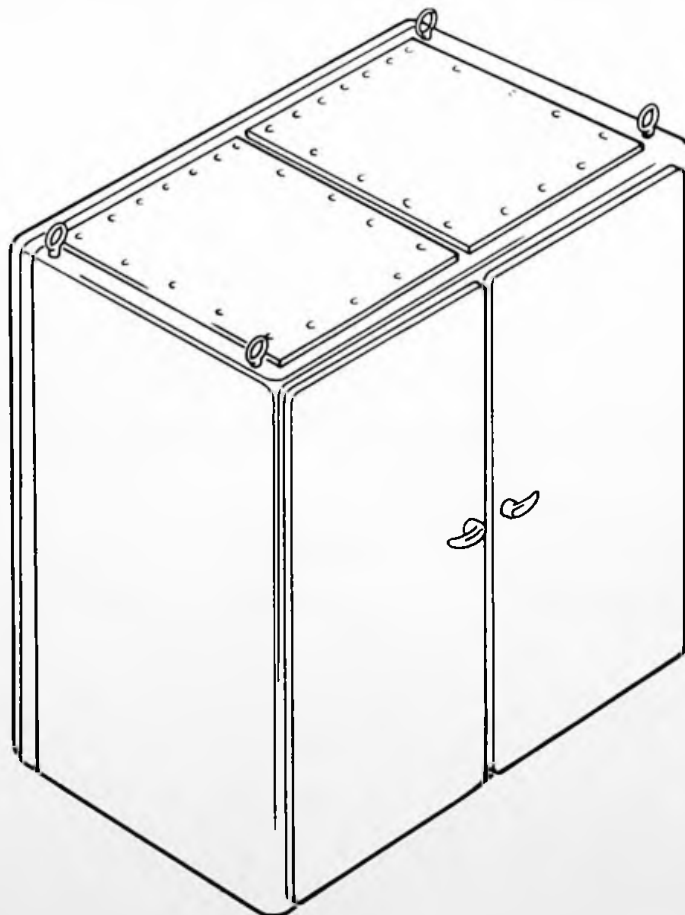


Figure 6-45. APS Pneumatic Distribution Complex Control Assembly (DSV-4B-374)

APS system purging, module checkout, and propellant transfer operations. All regulators contained in the assembly shall be designed for manual or remote operation.

Design - The assembly will be designed to perform the following functions:

- a. Receive GN₂ at 2,500 psig and regulate the gas to meet the following system requirements:
 1. 150 psig for pneumatic valve actuation pressure
 2. 15-60 psig for propellant transfer, recirculation lines purge, and module system purge
- b. Receive gaseous helium at 6,000 psig and regulate the gas to meet the following system requirements:
 1. 25 psi for oxidizer and fuel systems automatic leak check transducer checkout
 2. 230 and 275 psi respectively, for module high-pressure and low-pressure switch check
 3. 2,940 psi for helium spheres minimum liftoff pressure
 4. 200 psia for propellant tank bellows leak check
 5. 50 psi for propellant tank bellows collapse pressure.

Components - The assembly will consist of an aluminum cabinet housing, associated piping and miscellaneous valves and regulators. The assembly is shown in Figure 6-46.

Dimensions - The assembly will be approximately 4 feet wide, 2-1/2 feet high, 2-1/2 feet long, and will weigh approximately 200 pounds.

6.56 Adapter Ring Kit, Transfer Dolly, Low Bay (DSV-4B-380) 1B43530-1

Function - The function of the stage Low Bay Transfer Dolly Adapter Ring Kit, shall be to provide a suitable support for the flared aft interstage and the dummy interstage and engine protective support kit (DSV-4B-392) while on the low bay transfer dolly. The adapter ring kit shall be capable of easy removal from the transfer dolly.

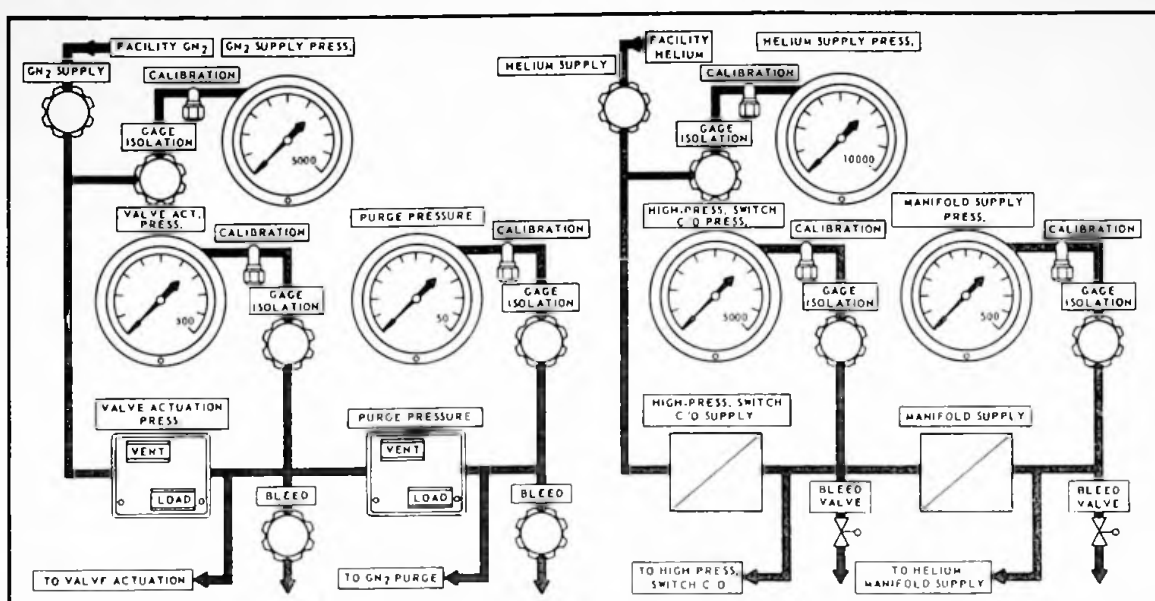


Figure 6-46. APS Pneumatic Regulation Complex Control Assembly (DSV-4B-375)

Design - The adapter, as shown in Figure 6-47, will be constructed of structural steel. The lower flange and fittings will be drilled to the hole pattern existing in the low bay transfer dolly and the upper flange and fittings will be drilled to the hole pattern in the aft interface of the aft interstage.

Components - The adapter will consist of the adapter ring itself and all necessary attaching hardware.

6.57 Support Kit, Dummy Interstage and Engine Protective (DSV-4B-392) 1B57202

Function - The function of the Dummy Interstage and Engine Protective Support Kit shall be to shield the engine end of the stage from extensive structural damage. The kit shall support the fabric engine cover. The support kit shall support the stage in a vertical attitude for removal of the aft handling ring.

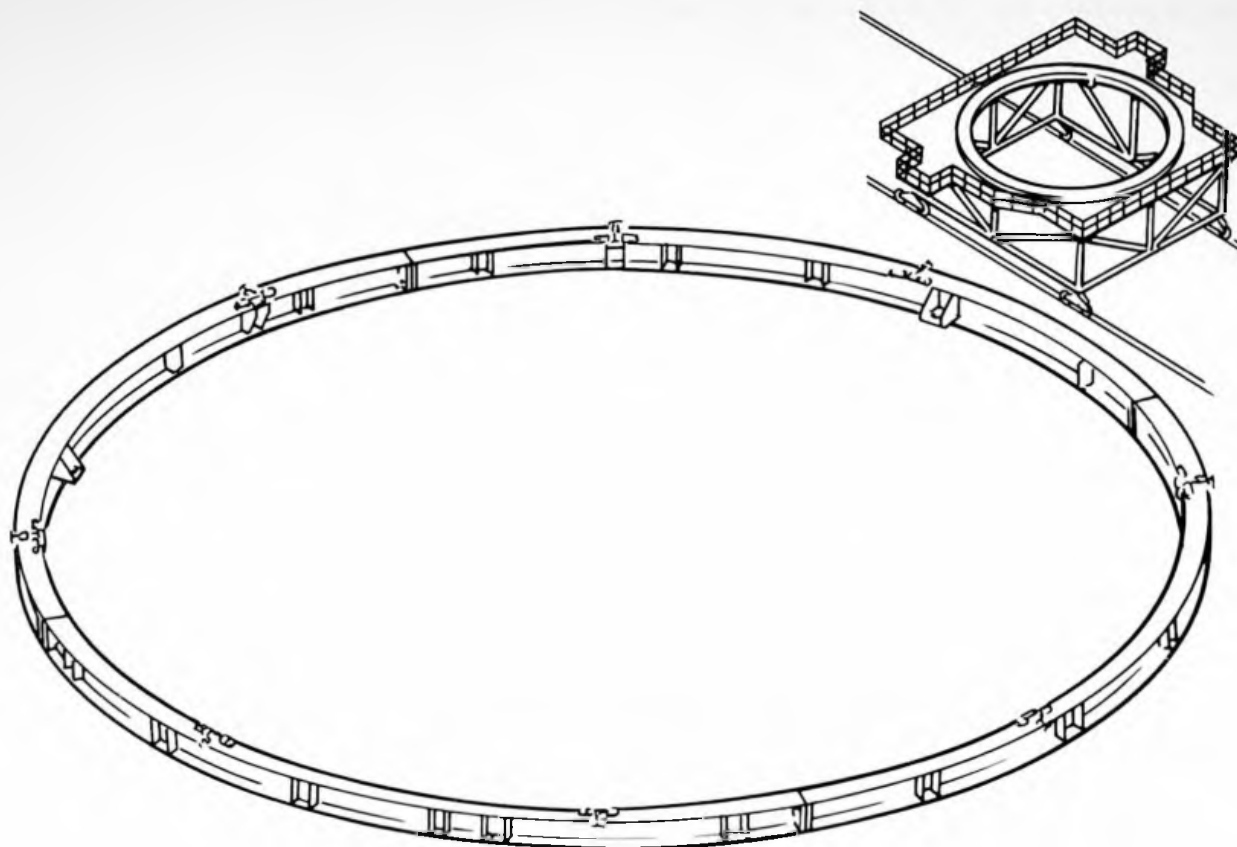


Figure 6-47. Adapter Ring Kit, Transfer Dolly, Low Bay (DSV-4B-380)

Design - The design of the kit, as shown in Figure 6-48, will incorporate V-shaped tubular structures and two rings. The small end of these tubular structures will attach to the forward ring (small) and the large end of the structure will hinge to the aft ring (large). The kit is designed so that the structures may be disconnected from the forward ring and swung outward to form a large conical shaped stand. Connecting links will be provided to tie the structure together in this (open) position. Platforms, attached near the large end of the structure, will be positioned down to form an access walkway around the top of the stand.

Components - The kit will consist of the following components:

- a. Large ring
- b. Small ring
- c. V-shaped tubular structures (8)
- d. Platform sections (8)
- e. Tubular connecting links (8).

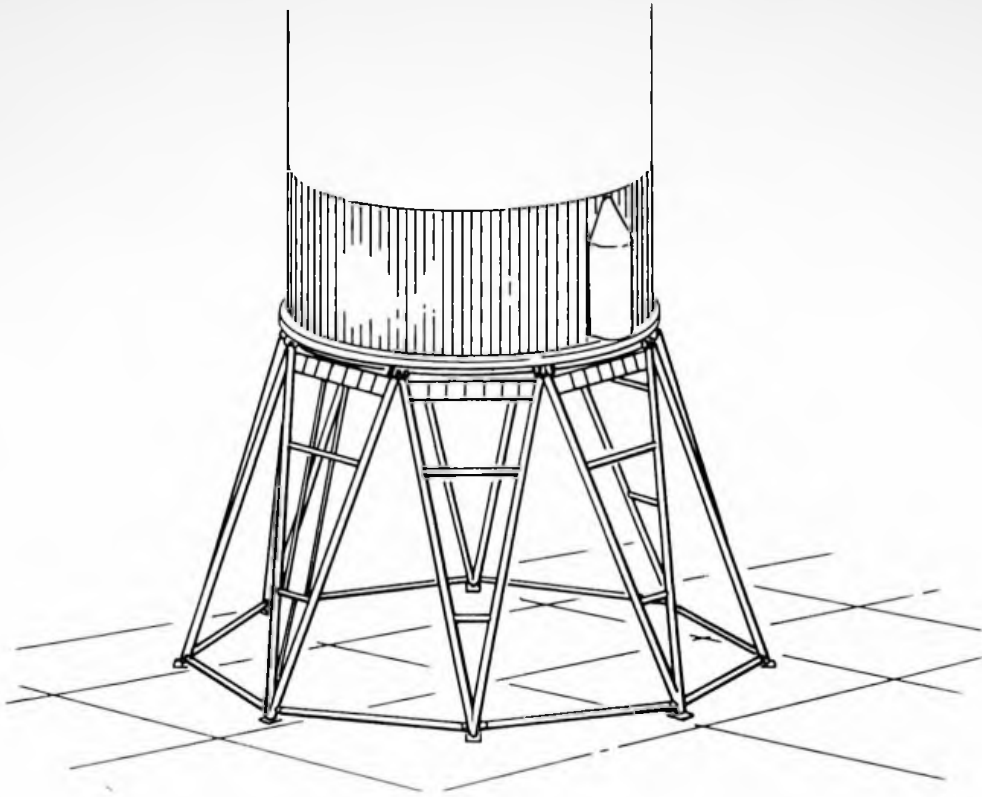


Figure 6-48. Support Kit, Dummy Interstage and Engine Protective (DSV-4B-392)

6.58 Aft Umbilical Kit, Checkout Stand, SACTO (DSV-4B-396) 1A96569-1

Except for minor modifications, the function, design, and components for this model shall be similar to Model DSV-4B-346. (See Figure 6-49.)

6.59 Forward Umbilical Kit, Checkout Stand, SACTO (DSV-4B-397) 1A96567-1

Except for minor modifications, the function, design, and components for this model shall be similar to Model DSV-4B-347. (See Figure 6-35.)

6.60 Aft Umbilical Kit, Checkout, SIL, HB (DSV-4B-398) 1A96311-1

Function - The function of the SIL HB Checkout Aft Umbilical Kit shall be to provide and support the electrical cables to the SIL simulated aft skirt. The umbilical carrier shall provide attachment to the skirt and shall be equipped with an eject mechanism to provide electrical cable disconnect from the skirt for test purposes.

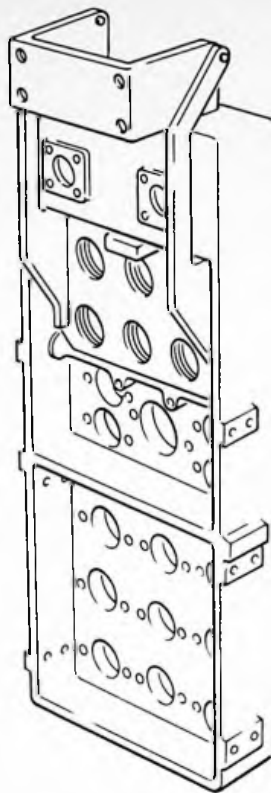


Figure 6-49. Aft Umbilical Kit, Checkout SIL, HB (DSV-4B-398)

Design - The design of the kit, as shown in Figure 6-49, will provide electrical cables to connect the checkout GSE to the simulated aft skirt. The umbilical carrier will bolt directly to the skirt and will be equipped with a pneumatically operated eject mechanism to disconnect the umbilical connectors to simulate vehicle liftoff.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Eject mechanism
- c. Electrical cables.

6.61 Forward Umbilical Kit, Checkout, SIL, HB (DSV-4B-399) 1A96313-1

Function - The function of the HB SIL Checkout Forward Umbilical Kit shall be to provide and support the electrical cables to the SIL simulated forward skirt. The umbilical carrier shall provide attachment to the skirt

and shall be equipped with an eject mechanism to provide electrical cable disconnect from the skirt for test purposes.

Design - The design of the kit, as shown in Figure 6-50, will provide electrical cables to connect the checkout GSE to the simulated forward skirt. The umbilical carrier will bolt directly to the skirt and will be equipped with a pneumatically operated eject mechanism to disconnect the umbilical electrical connections to simulate vehicle liftoff.

Components - The kit will consist of the following components:

- a. Umbilical carrier
- b. Eject mechanism
- c. Electrical cables.

6.62 Battery Handling Kit (DSV-4B-400) 1B59849

Function - The function of the Battery Handling Kit shall be to provide a means for installing the battery in the aft skirt of the stage while

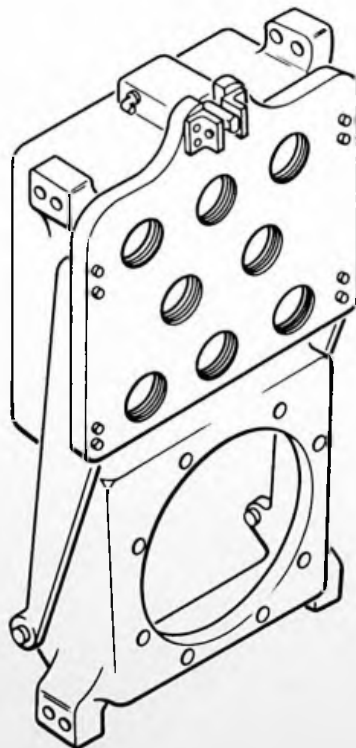


Figure 6-50. Forward Umbilical Kit, Checkout SIL, HB (DSV-4B-399)

the stage is in a vertical position and stacked as part of the launch vehicle.

Design - The design of the kit, as shown in Figure 6-51, will provide for transporting the battery to the aft skirt area of the stage. The kit will be capable of raising, lowering, tilting and rotating the battery for ease of installing the battery on the aft skirt of the stage.

Components - The kit will consist of the following components:

- a. Dolly
- b. Carrier (6)
- c. Handle (2)
- d. Card
- e. Pad (3).

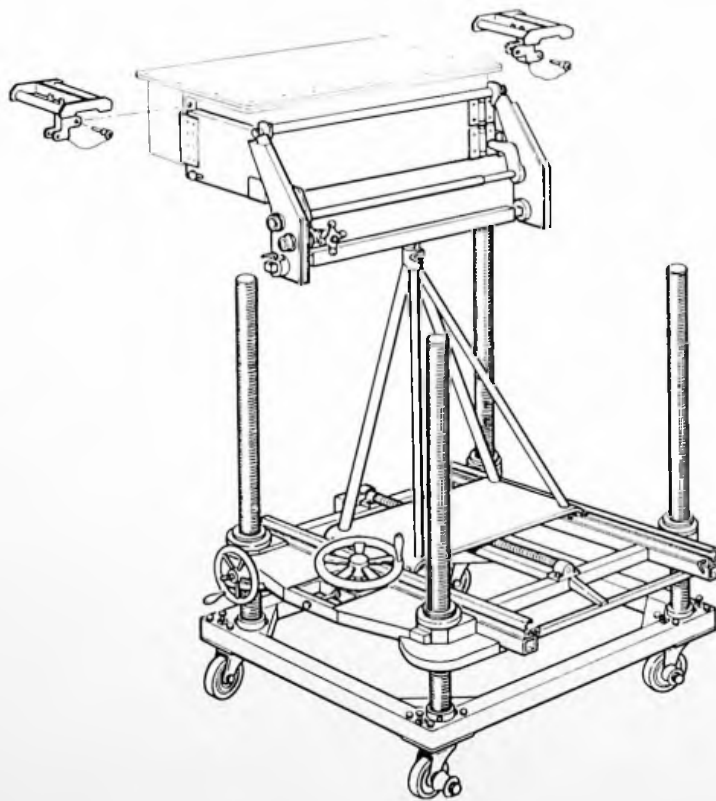


Figure 6-51. Battery Handling Kit (DSV-4B-400)

6.63 Destruct Container Kit (DSV-4B-403) 1B41743-1

Function - The function of the Destruct Container Kit is to provide containers for handling and storage of the LOX Tank Linear Shape Charge Destruct Train, LOX Tank Confined Detonating Fuse Interconnect Harnesses, LH₂ Tank Destruct Linear Shape Charge, and the LH₂ Confined Detonating Fuse Interconnect Harnesses.

Design - Two containers will be designed out of aluminum with polyurethane foam interior. The foam will have compartments for individual items. External provisions for inspection and serial numbers will be provided. (See Figure 6-52.)

Dimensions - The containers will have the following approximate dimensions:

- a. Height, 9 inches; width, 16 inches; depth, 72 inches
- b. Height, 9 inches; width, 37 inches; depth, 42 inches.

6.64 Container Kit, EBW Initiators and Detonators (DSV-4B-404) 1B41741-1

Function - The function of the EBW Initiator and Detonator Container Kit is to provide a container for handling and storage of the exploding bridge wire detonators.

Design - The container will be designed out of aluminum with polyurethane foam interior. The foam will have compartments for individual items. External provisions for inspection and serial numbers will be provided.

Dimensions - The container will have the following approximate dimensions: height, 5 inches; width, 9 inches; depth, 12 inches. (See Figure 6-53.)

6.65 Stage Separation Detonating Fuse Container Kit (DSV-4B-405) 1B41739-1

Function - The function of the Stage Separation Detonating Fuse Container Kit is to provide a container for handling and storage of the stage separation mild detonating fuse harness.

DS-2164(A)

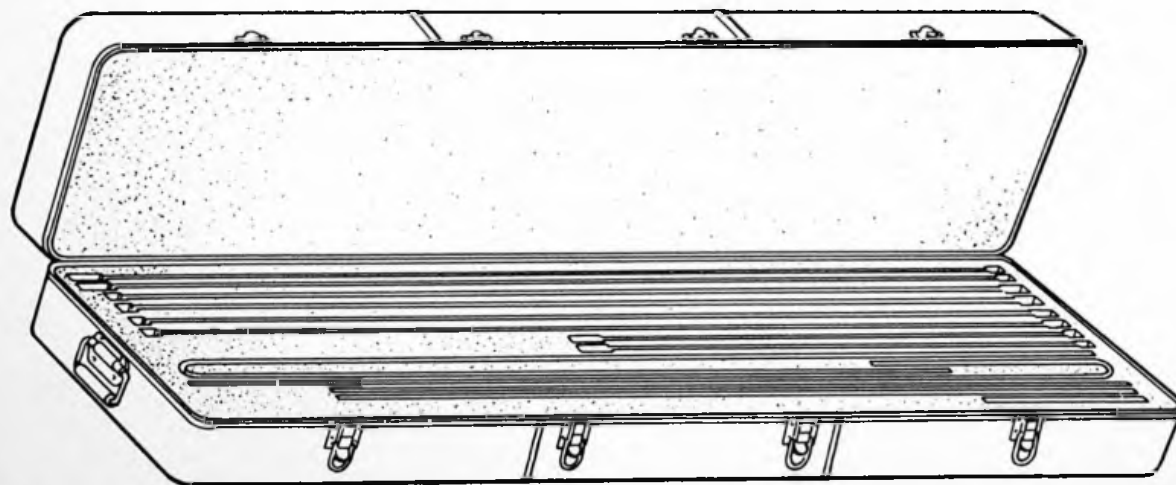
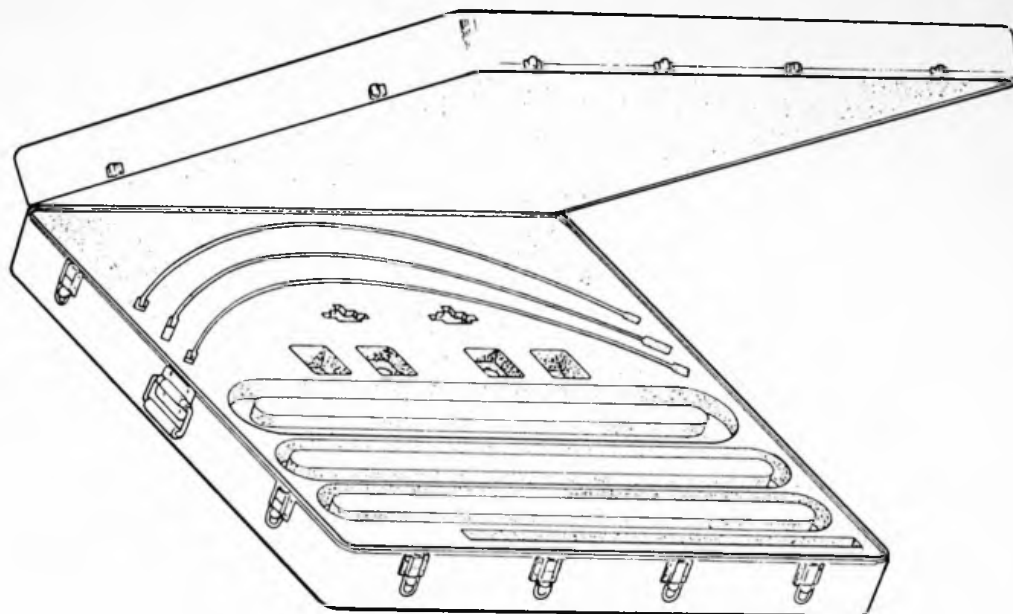


Figure 6-52. Destruct Container Kit (DSV-4B-403)

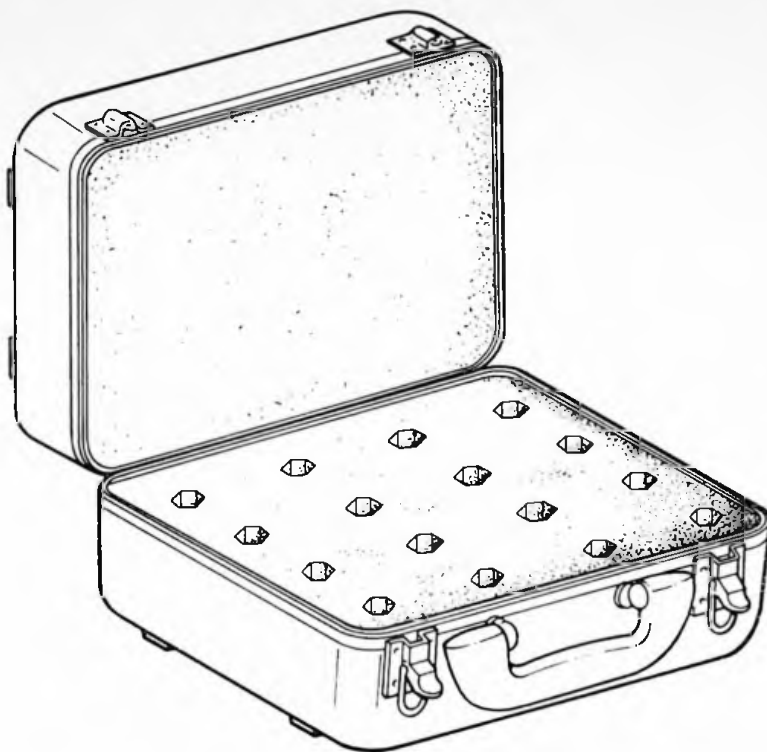


Figure 6-53. Container Kit, EBW Initiators and Detonators (DSV-4B-404)

Design - The container will be designed out of aluminum with polyurethane foam interior. The foam will have compartments for individual items. External provisions for inspection and serial numbers will be provided.

Dimensions - The container will have the following approximate dimensions: height, 6 inches; width, 21 inches; depth, 21 inches. (See Figure 6-54.)

6.66 Container Kit, Safe and Arm Device (DSV-4B-406) 1B41737-1

Function - The function of the Safe and Arm Device Kit is to provide a container for handling and storage of the Flight Safe and Arm Device with Detonators.

Design - The container will be designed out of aluminum with polyurethane foam interior. The foam will have compartments for individual items. External provisions for inspection and serial numbers will be provided.

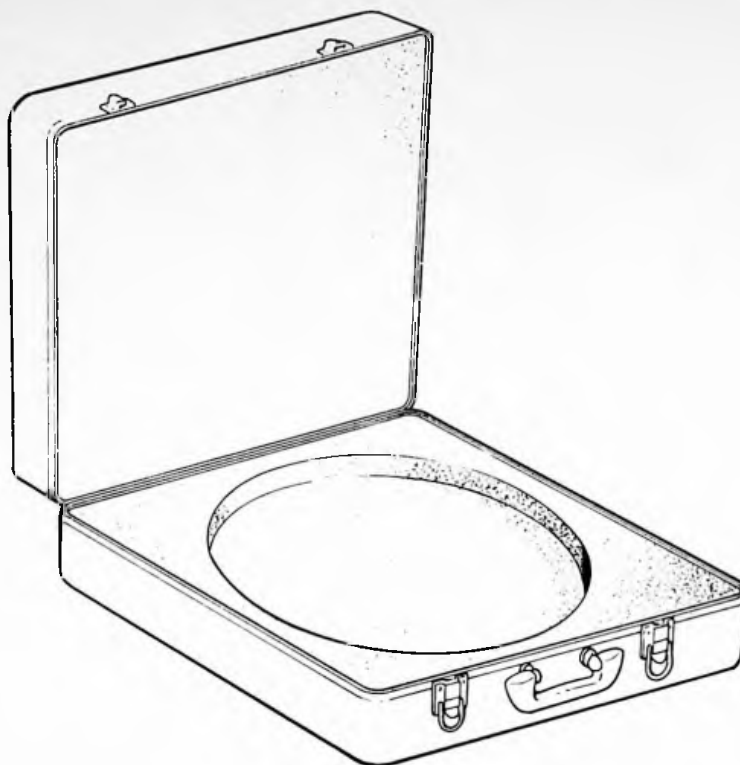


Figure 6-54. Container Kit, Stage Separation Detonating (DSV-4B-405)

Dimensions - The container will have the following approximate dimensions: height, 5 inches; width, 13 inches; depth, 18 inches. (See Figure 6-55.)

6.67 Handling Kit, Saturn IB/S-IVB Test Stages (DSV-4B-413)

Except for identification, the function and components of this kit will be similar to Model DSV-4B-302. The design incorporates a hole pattern which restricts the mounting of the support rings to the Saturn IB/S-IVB test stages only. (See Figure 6-5.) This kit will be used to hoist and mount the Saturn IB/S-IVB configurations of the Dynamics, All-Systems, and Facility Checkout Stages.

(For use with the S-IB stage only.)

6.68 Handling Kit, S-IB Stage (DSV-4B-413A) 1B37715-503

This model is similar to Model DSV-4B-413, except that attach points are provided on the support rings for air-carry of the stage. (See Figure 6-5.)

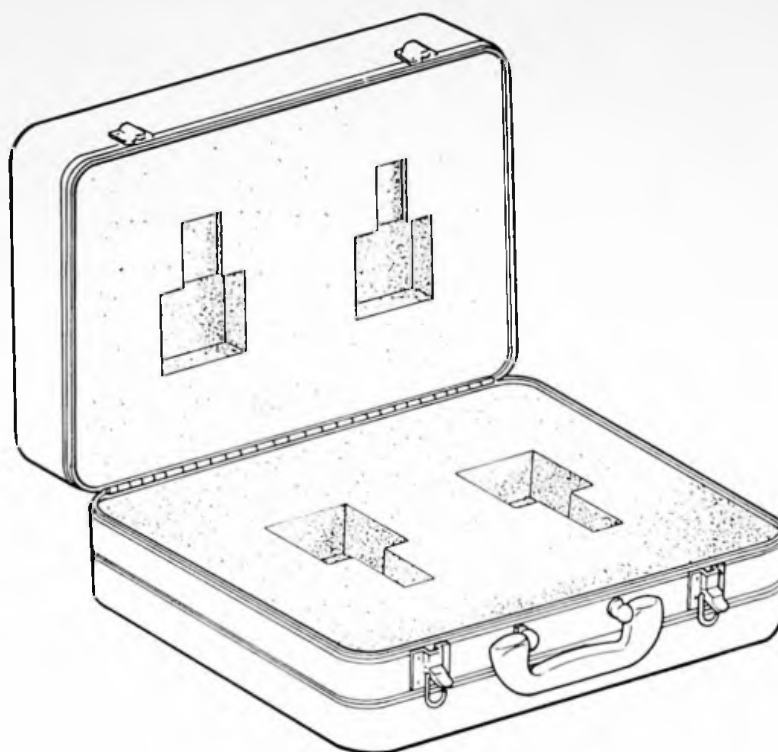


Figure 6-55. Container Kit, Safe and Arm Device (DSV-4B-406)

6.69 Container Kit, Retrorocket Ignition CDF Harness Assembly (DSV-4B-417)
1B41733-1

Function - The function of the kit is to provide a container for handling and storage of the retrorocket confined detonating fuse harness assemblies.

Design - The container will be designed out of aluminum with polyurethane foam interior. The foam will have compartments for individual items. External provisions for inspection and serial numbers will be provided.

Dimensions - The container will have the following approximate dimensions: height, 5 inches; width, 13 inches; depth, 18 inches. (See Figure 6-56.)

(For use with the S-V stage only.)

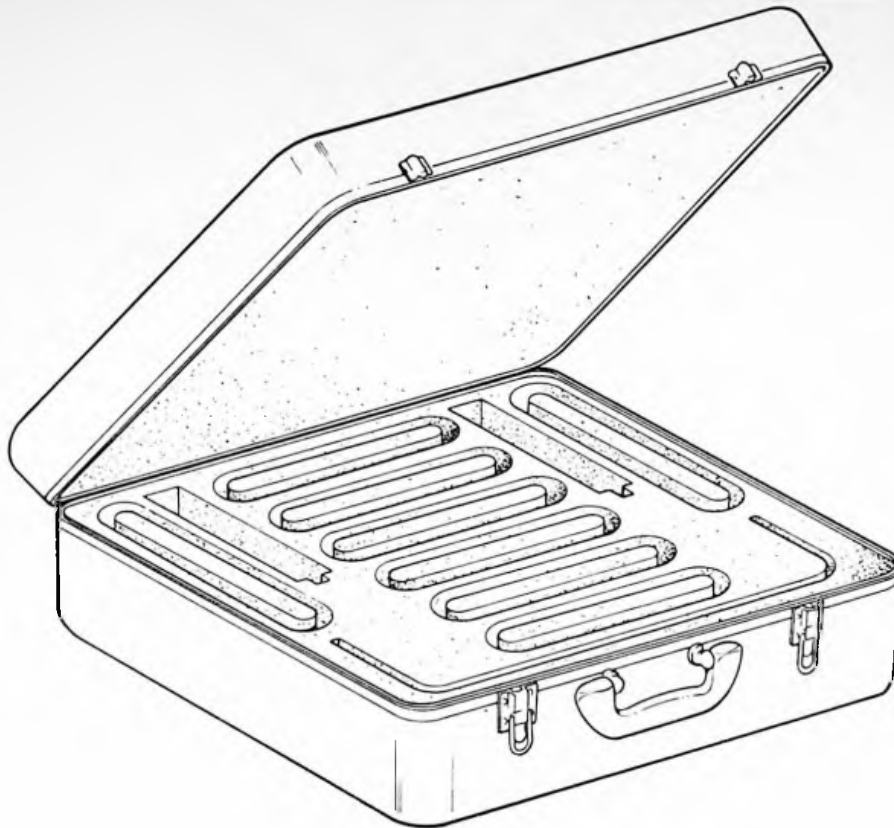


Figure 6-56. Container Kit, Retrorocket Ignition CDF Harness Assembly (DSV-4B-417)

6.70 Stage Alignment Target Kit (DSV-4B-430) 1B40516-1

Function - The function of the Stage Alignment Target Kit shall be to provide targets located at the position planes on the aft interstage. The targets shall be factory aligned using stage tooling and shall be used to verify vehicle alignment.

Design - The target kit will be designed to attach four targets to the aft interstage on the position planes as close as possible to the aft end of the interstage. The targets and their attaching brackets will be designed to be removable. (See Figure 6-57.)

Components - The target kit shall consist of the following components:

- a. Targets
- b. Attach brackets.

(For use with the S-V stage only.)

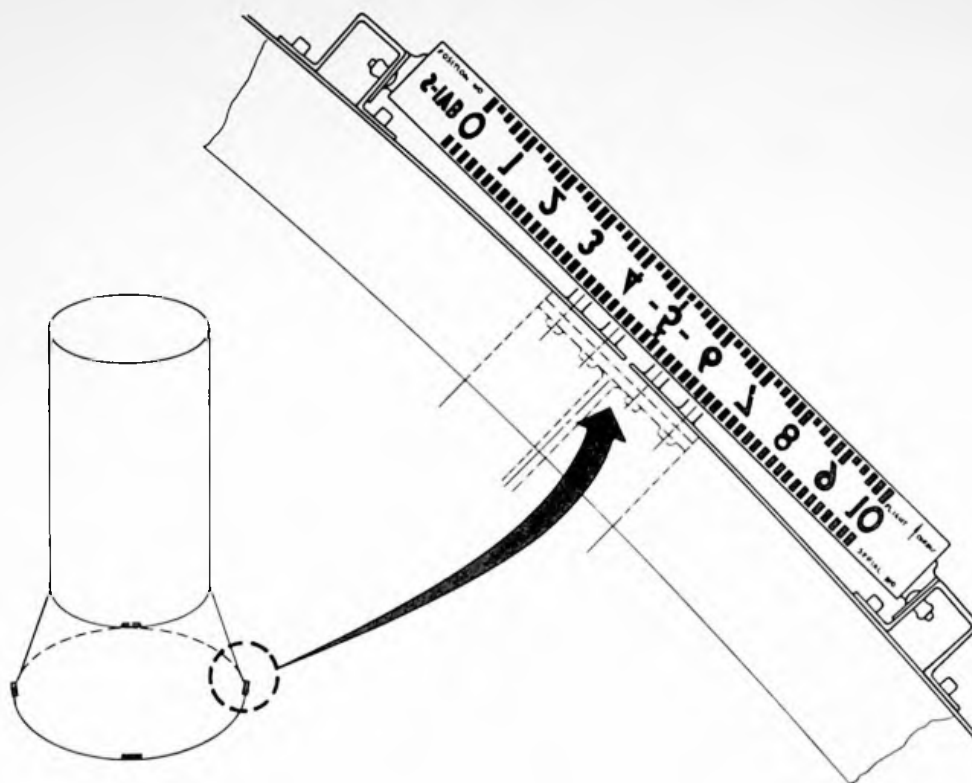


Figure 6-57. Stage Alignment Target Kit (DSV-4B-430)

6.71 APS Pneumatic Interconnect Kit, LC 34 (DSV-4B-439) 1A90320-1

Function - The function of the LC 34 APS Pneumatic Interconnect Kit, shall be to provide a means for pneumatic connections from facility gas supplies to the APS Pneumatic Regulation and Distribution Console (DSV-4B-436), and from DSV-4B-436 to the APS modules on the S-IVB/IB Stage.

Design - The kit will include hardlines, fittings, and hoses required for installation on LC 34. The kit will be designed to withstand facility pressures for helium and nitrogen of 6,000 psig, and regulated pressures to the LC 34 of 23 to 3,000 psig. The kit will be designed for use on the service tower of LC 34.

Components - The kit will consist of the following components:

- a. Hardlines
- b. Fittings
- c. Hoses.

(For use with the S-IB stage only.)

6.72 APS Pneumatic Interconnect Kit, LC 37 (DSV-4B-440) 1B61765-1

Function - The function of the LC 37 APS Pneumatic Interconnect Kit, shall be to provide a means for pneumatic connections from the NASA interface panel at Model DSV-4B-436 to the APS modules and the oxidizer interface panel.

Design - The kit will consist of eight (8) flex lines from the NASA interface panel at Model DSV-4B-436 to the APS modules: Four (4) to each module and one (1) flex line from the oxidizer interface panel to the oxidizer vent fitting on the NASA interface panel at Model DSV-4B-436.

Components - The kit will consist of the following components:

- a. Flex lines
- b. Fittings.

(For use with the S-IB stage only.)

6.73 Stage Verification Alignment Target Kit, S-IVB/IB (DSV-4B-444) 1B40515-1

The function, design, and the targets of the target kit will be identical to the DSV-4B-430 target kit. The attaching brackets will be different due to structural differences in the interstages.

(For use with the S-IB stage only.)

6.74 Aft Umbilical Kit, MSFC Breadboard (DSV-4B-446) 1B34037-1

Function - The function of the MSFC Breadboard Aft Umbilical Kit shall be to (1) support electrical cables, pneumatic lines, and an air conditioning duct to the MSFC Saturn V breadboard and (2) provide a means of disconnecting the electrical cables from the stage to simulate vehicle liftoff.

Design - The umbilical kit will be designed for use with the Saturn V/S-IVB configuration only. An umbilical carrier will house the ground halves of the pneumatic quick-disconnects, and will support the electrical plugs and keep them attached to the stage until disconnect. The carrier will also be designed for attachment to the stage. A pneumatic eject mechanism will be included to disconnect the electrical plugs from their receptacles to simulate liftoff.

Components - The kit, as shown in Figure 6-58, will consist of the components listed below. (No stage components or parts or GSE cables will be required.)

- a. Umbilical carrier
- b. Air conditioning adapter duct
- c. Eject mechanism
- d. Pneumatic quick-disconnects (ground half only).

(For use with the S-V stage only.)

6.75 Forward Umbilical Kit, MSFC Breadboard (DSV-4B-447) 1B34039-1

Function - The function of the MSFC Breadboard Forward Umbilical Kit shall be to (1) support electrical cables to the MSFC Saturn V breadboard and (2) provide a means of disconnecting these cables from the stage to simulate vehicle liftoff.

Design - The umbilical kit will be designed for use with the Saturn V/S-IVB configuration only. The kit will be designed similar to the KSC Launch Complex 37B Forward Umbilical Kit (DSV-4B-354). The electrical cables will be supported by an umbilical carrier attached to the stage by two

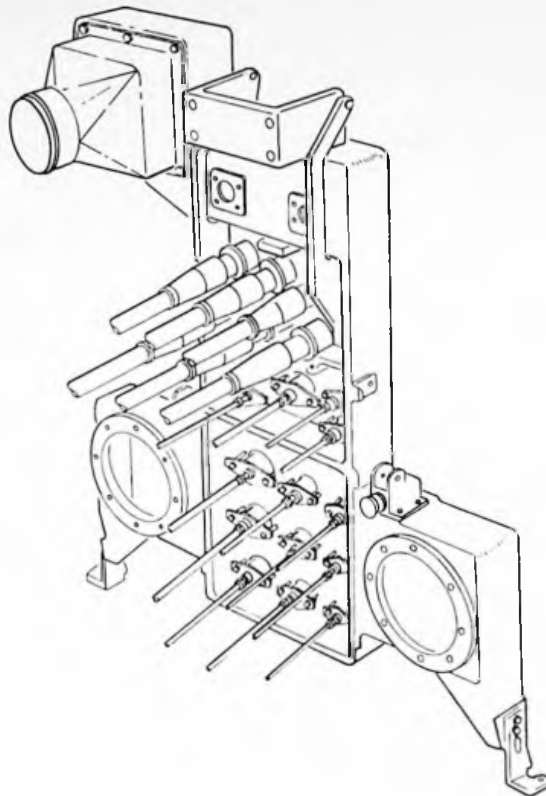


Figure 6-58. Aft Umbilical Kit, MSFC Breadboard (DSV-4B-446)

side supports. The upper ends of these supports will be attached to the instrument unit umbilical carrier; the lower ends will be located in pivot points on the stage. A pneumatic eject mechanism will be designed to disconnect the electrical plugs from their receptacles to simulate liftoff.

Components - The kit, as shown in Figure 6-59, will consist of the components listed below. (No stage components or parts or GSE cables will be required.)

- a. Umbilical carrier
- b. Eject mechanism.

(For use with the S-V stage only.)

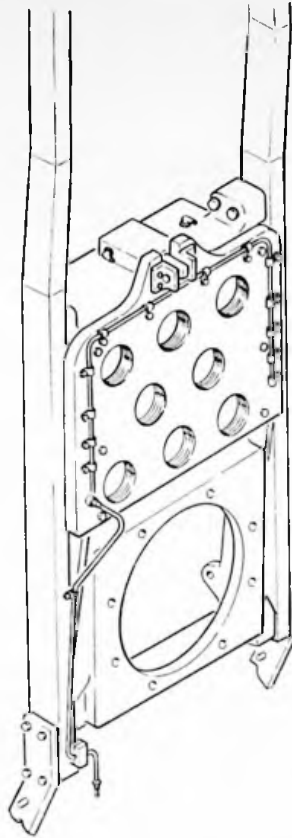


Figure 6-59. Forward Umbilical Kit, MSFC Breadboard (DSV-4B-477)

6.76 Aft Umbilical Kit, Saturn IB Breadboard, MSFC (DSV-43-448)

Function - The function of the MSFC Saturn IB Breadboard Aft Umbilical Kit shall be to provide an umbilical carrier to support electrical cables and pneumatic lines to the MSFC breadboard layout. The umbilical carrier shall be equipped with an eject mechanism to provide electrical cable disconnect from the simulated stage during testing, and shall provide both the stage and ground half of the umbilical plates.

Design - The umbilical kit will be designed to be attached by brackets to the stage umbilical plate. The pneumatic eject mechanism will be designed to disconnect the electrical plugs from their receptacles to simulate liftoff.

Components - The kit, as shown in Figure 6-60, will consist of the following major components:

- a. Umbilical carrier
- b. Eject mechanism
- c. Aft stage umbilical plate with stage half of the electrical connectors.

(For use with the S-IB stage only.)

6.77 Desiccant Kit, Static, S-IVB Stage (DSV-4B-450) 1B57000

Function - The function of the S-IVB Stage Static Desiccant Kit shall be to provide a humidity controlled atmosphere for the stage while enclosed in the Protective Cover Kit Model DSV-4B-304. It shall permit free breathing of the fuel and oxidizer tanks through the Secondary Desiccant Model DSV-4B-365, into this kit, and back into the cover. A breather assembly attached to the desiccant plate in Model DSV-4B-304 shall permit the cover to breather ambient air through a desiccant bed.

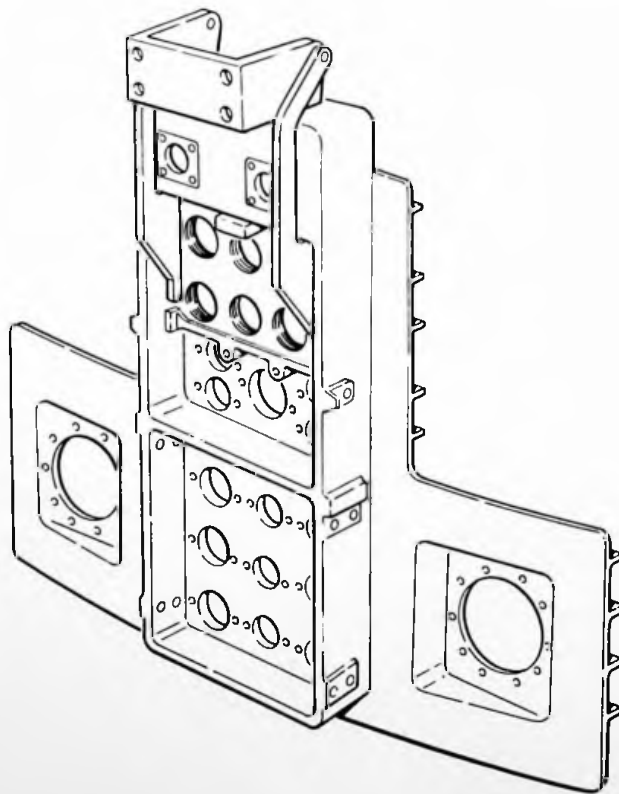


Figure 6-60. Aft Umbilical Kit, Saturn IB Breadboard, MSFC (DSV-4B-488)

Design - The arrangement and connection system of the kit will be accomplished in a manner which requires that any ingested air, due to ambient temperature of barometric changes, will flow through three desiccant beds. Each breather, one for the cover, one for the LH₂ tank, and one for the LOX tank, will contain a visual relative humidity indicator. The indicators will show conditions on the visual relative humidity indicator. The indicators will show conditions on the critical side of the breather. For transportation, the breathers will be mounted on the Cradles of Model DSV-4B-301. A differential pressure gage will permit visual monitoring of the difference in ambient and stage atmosphere pressures under the Protective Cover.

Components - The kit will consist of the following components:

- a. Breather Assemblies
- b. Flexible Hoses
- c. Differential Pressure Gage
- d. Clamps.

6.78 Forward Umbilical Kit, Saturn IB Breadboard, MSFC (DSV-4B-454)

Function - The function of the MSFC Saturn IB Breadboard Forward Umbilical Kit shall be to provide an umbilical carrier for the MSFC breadboard layout. An eject mechanism attached to the umbilical carrier will provide electrical cable disconnect from the stage during testing.

Design - The carrier will be attached to the stage by two side supports. The upper ends of the supports will be attached to the instrument unit umbilical carrier; the lower ends will be located in pivot points on the stage. The pneumatically operated eject mechanism will be designed to disconnect the electrical plugs from their receptacles to simulate liftoff.

Components - The kit, as shown in Figure 6-61, will consist of the following major components:

- a. Umbilical carrier
- b. Eject mechanism.

(For use with the S-IB stage only.)

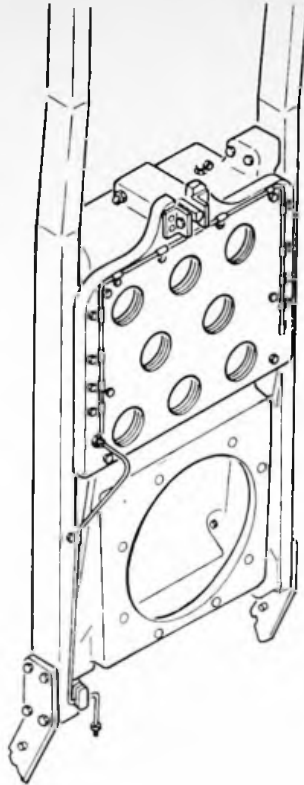


Figure 6-61. Forward Umbilical Kit, Saturn IB Breadboard, MSFC (DSV-4B-454)

6.79 Initiator and Detonator Test Kit, S-IVB/IB (DSV-4B-456) 1B57789-1

Function - The function of the S-IVB/IB Initiator and Detonator Test Kit, shall be to provide explosive test chambers for final checkout of the exploding bridgewire (EBW) systems while installed on the stage and using stage power.

Design - The kit, as shown in Figure 6-62, will include small explosive test chambers equipped with a pressure-activated switch. An expendable detonator or initiator will be installed into a test chamber and electrically connected to a firing unit on the stage. The firing unit will be charged and triggered, firing the detonator or initiator. A pressure will be created in the chamber, activating a pressure switch which will give a GO/NO-GO indication when the pressure reaches 100 psi. The test chambers will be fabricated from fragmentation-resistant high strength, corrosion resistant steel.

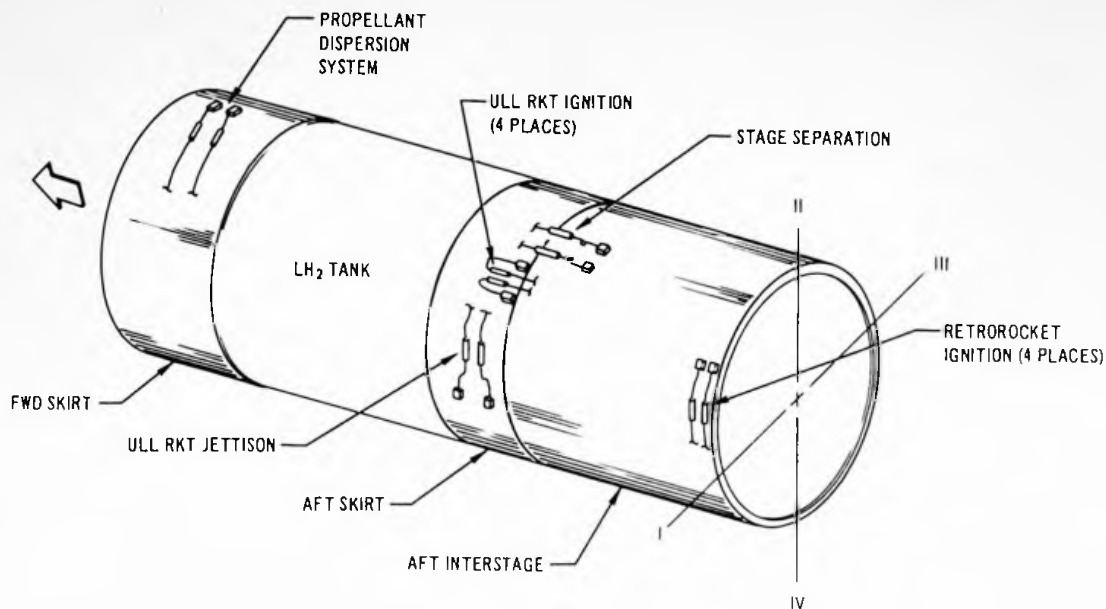


Figure 6-62. Initiator and Detonator Test Kit, S-IVB/IB (DSV-4B-456)

Components - The kit will consist of the following components:

- a. Chamber Assemblies (20)
- b. Reducer (1)
- c. Gaskets and nuts.

Dimensions - The detonator chamber assembly will be 7 inches in length and a maximum cross-section of 1-3/4 inch hex. The initiator chamber will be 10 inches in length and a maximum cross-section of 2-1/2 inch hex.

(For use with the S-IB stage only.)

6.80 Detonator Test Kit, S-IVB/V (DSV-4B-457) 1B58705-1

The design of this kit is similar to Model DSV-4B-456. (See Figure 6-63, for mounting locations.) The function of this kit shall be to test detonators only.

(For use with the S-V stage only.)

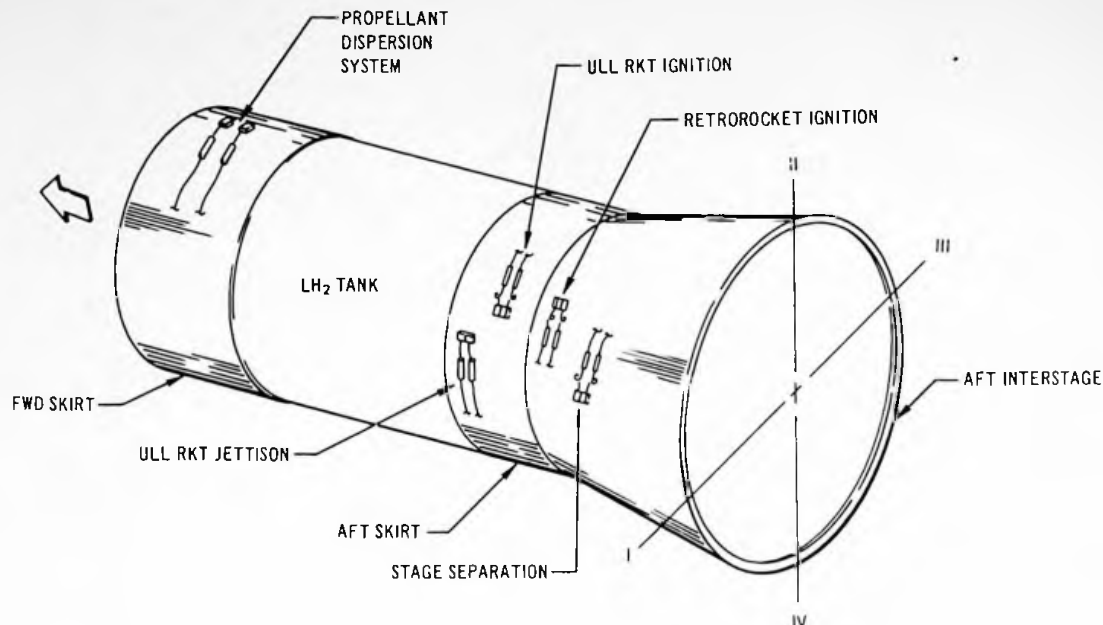


Figure 6-63. Detonator Test Kit, S-IVB/V (DSV-4B-457)

6.81 Handling Kit, Saturn IB/S-IVB Flight Stages (DSV-4B-462)

Except for identification, the function and components of this kit will be similar to Model DSV-4B-302. The design incorporates a hole pattern which restricts the mounting of the support rings to the Saturn IB/S-IVB flight stages only. (See Figure 6-5.) This kit will be used to hoist and mount the Saturn IB/S-IVB flight stages.

(For use with the S-IB stage only.)

6.82 Support Fixture, Actuator, J-2 Engine (DSV-4B-474) 1B56669-1

Function - The function of the J-2 Engine Actuator Support Fixture, shall be to prevent the engine from gimbaling. The fixture shall support the engine actuators, during functional tests of the actuators.

Design - The fixture, as shown in Figure 6-64, will provide hardware which will be used in place of the actuator to stabilize the engine. It will also support the actuators while being tested.

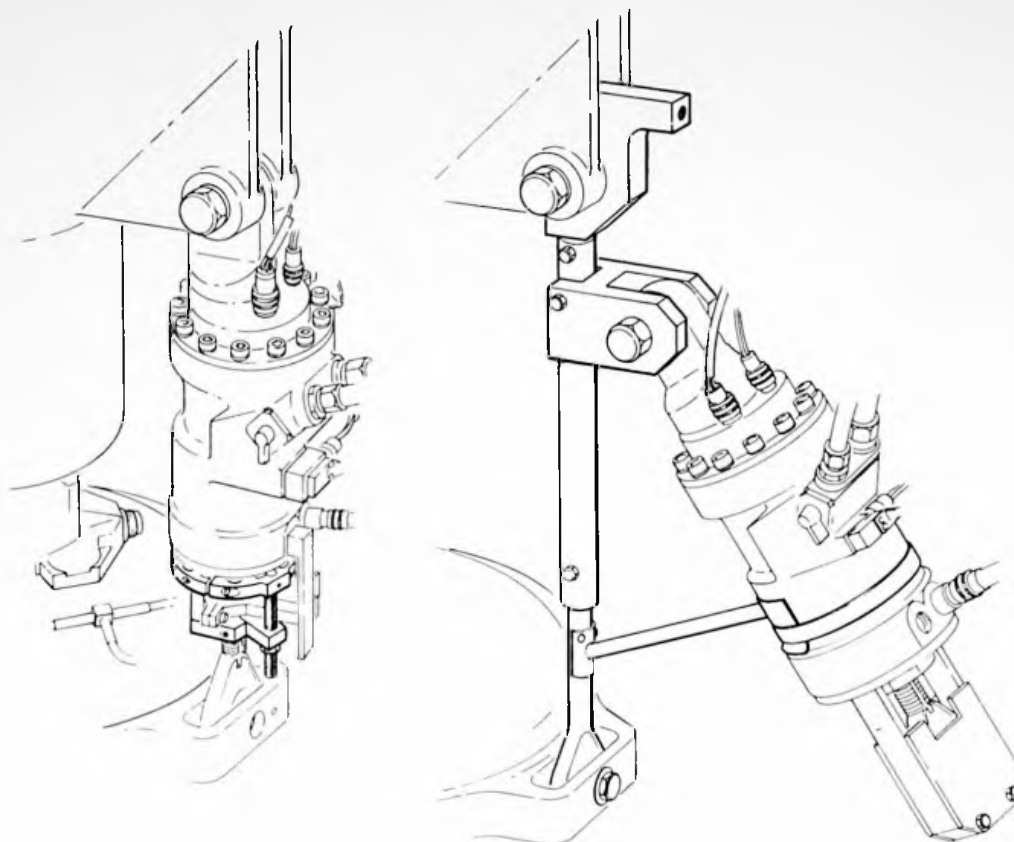


Figure 6-64. Support Fixture, Actuator, J-2 Engine (DSV-4B-474)

Components - The fixture will consist of the following components:

- a. Fixture (4)
- b. Cap (4)
- c. Bracket (2)
- d. Clamp (4)
- e. Support (2)
- f. Pin (2)
- g. Case
- h. Strip.

6.83 Stage Roll Kit (DSV-4B-481) 1B56081

Function - The function of the Stage Roll Kit shall be to provide roll capability for the stage while in the horizontal position on the transporter, Model DSV-4B-300.

Design - The kit, as shown in Figure 6-65, will be designed to provide the necessary hardware to be attached to the cradles, Model DSV-4B-301 for the roll capabilities. The design will provide for the prevention of the stage moving horizontally while being rolled.

Components - The kit will consist of the following components:

- a. Roll drive (2)
- b. Channel (7)
- c. Plate (1)
- d. Cable assembly (3)
- e. Jack assembly (4)
- f. Jack handle (2)
- g. Pad (4)
- h. Adapter (2)
- i. Clamp assembly (4).

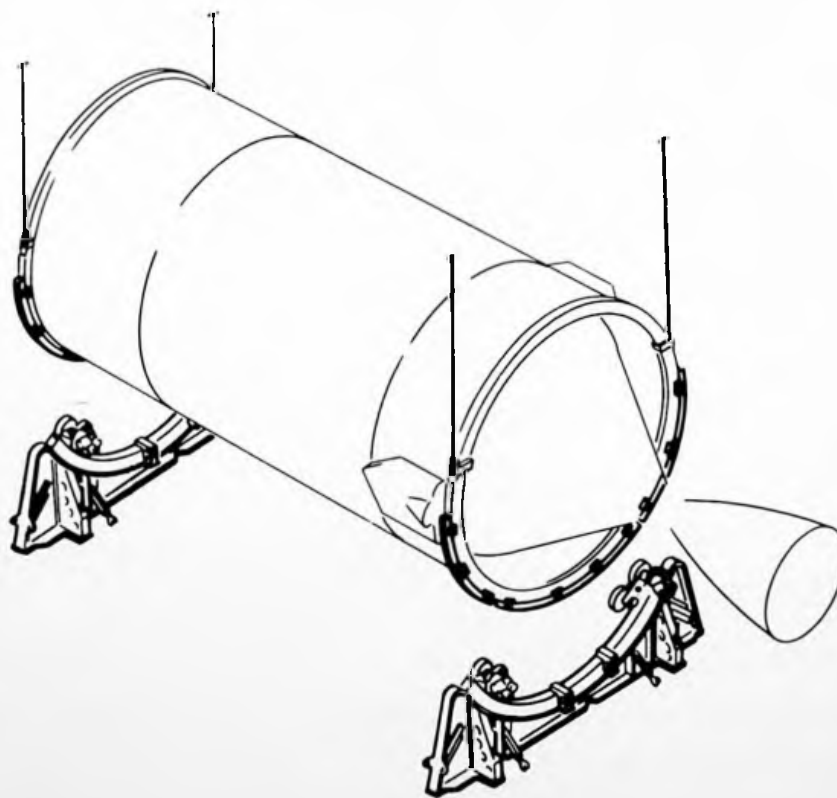


Figure 6-65. Stage Roll Kit (DSV-4B-481)

6.84 Horizontal Access Kit, Fuel Tank Interior (DSV-4B-482) 1B54533-1

Function - The function of the Fuel Tank Interior Horizontal Access Kit shall be to provide access into the LH_2 tank with the stage in the horizontal position. Utilizing the stage roll capability, it shall also provide access to the interior surfaces of the tank. The kit shall be used to support personnel for inspection and repair of the tank and tank components.

Design - The design of the kit, as shown in Figure 6-66, will incorporate a modified S-IV horizontal access kit (DSV-4B-264). The kit will have a folding ladder for access into the LH_2 tank and 2 rigid ladders for access to the forward dome, sidewalls and common bulkhead. The folding ladder will attach to the support ring. The folding ladders will be installed and removed from the LH_2 tank by an installation fixture. The installation fixture will be supported by two frame supports.

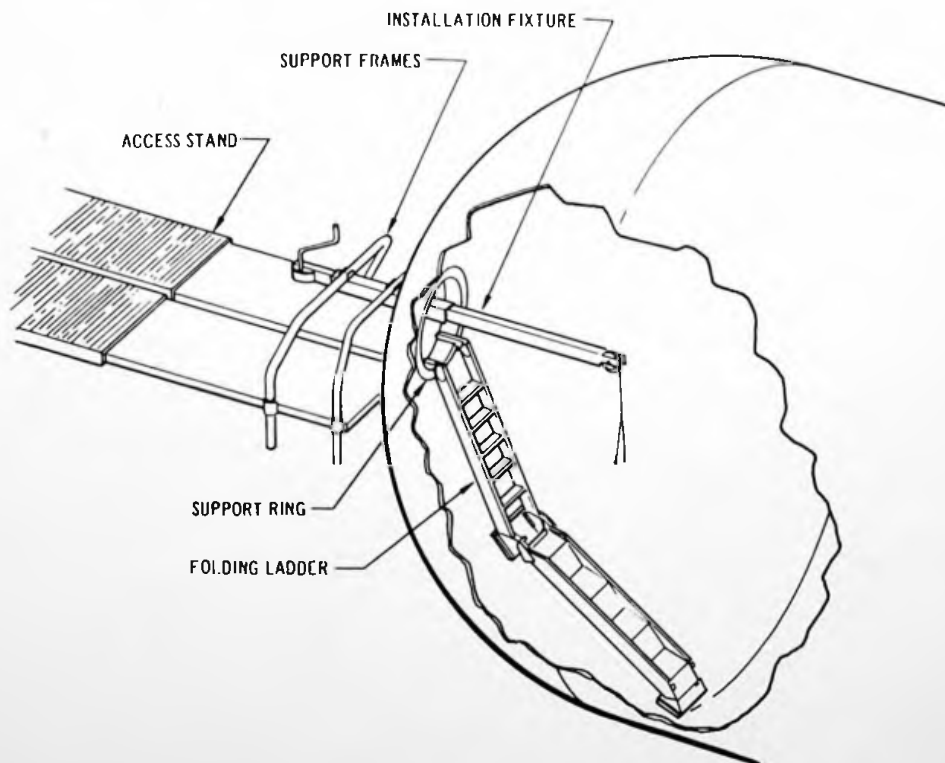


Figure 6-66. Horizontal Access Kit, Fuel Tank Interior (DSV-4B-482)

Components - The kit will consist of the following components:

- a. Folding ladder
- b. Rigid ladder (2)
- c. Support rings
- d. Installation fixture
- e. Protective pads (6)
- f. Frame supports (2).

6.85 Horizontal Access Kit, LOX Tank Interior (DSV-4B-483) 1B54538-1

Function - The function of the LOX Tank Interior Horizontal Access Kit shall be to provide access into the LOX tank with the stage in the horizontal position. Utilizing the stage roll capability, it shall also provide access to the interior surfaces of the tank. The kit will be used to support personnel for inspection and repair of the tank and tank components.

Design - The design of the kit, as shown in Figure 6-67, will incorporate two pneumatic ladders; one for access into the tank and one for access to the common bulkhead and aft dome. The deflated ladder will be inserted into the LOX tank through the opening in the aft dome. The ladder will be installed inside the tank and pressurized to 4 or 5 psi. It will extend to 3 feet wide and 14 feet long. A support ring, which protects the aft dome cover attach fittings, will provide an attach point for the ladder. It will be supported at each end by bearings on the tank walls. Each ladder will be exhausted outside of the tank before removal.

Components - The kit will consist of the following components:

- a. Support rings
- b. Pneumatic ladder (2).

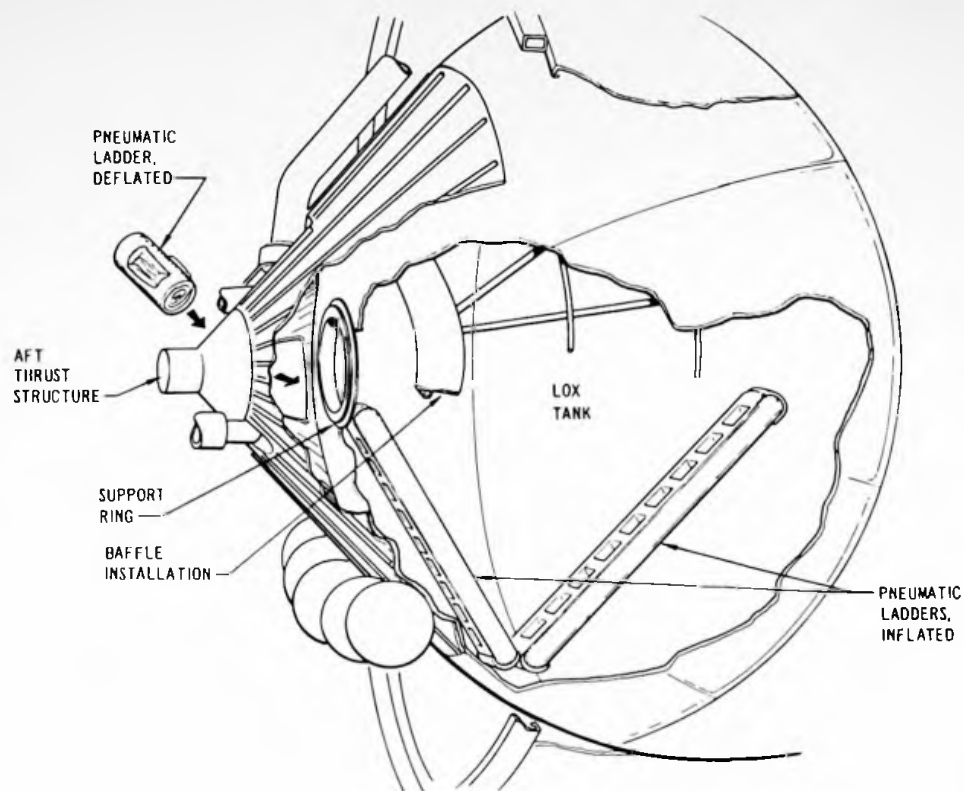


Figure 6-67. Horizontal Access Kit, LOX Tank Interior (DSV-4B-483)

6.86 Horizontal Access Kit, Forward Skirt (DSV-4B-484) 1A80495-1

Function - The function of the Forward Skirt Horizontal Access Kit shall be to provide access to the interior of the forward skirt area when the stage is in the horizontal position. The kit shall be used to support personnel for inspection and installation, removal or repair of components.

Design - The kit, as shown in Figure 6-68, will provide hardware to assemble a movable steel platform structure with telescopic platforms. The platforms will be extended and retracted by manual operated cable winding mechanisms. The platform structure will include screw jacks with which to immobilize itself while in use.

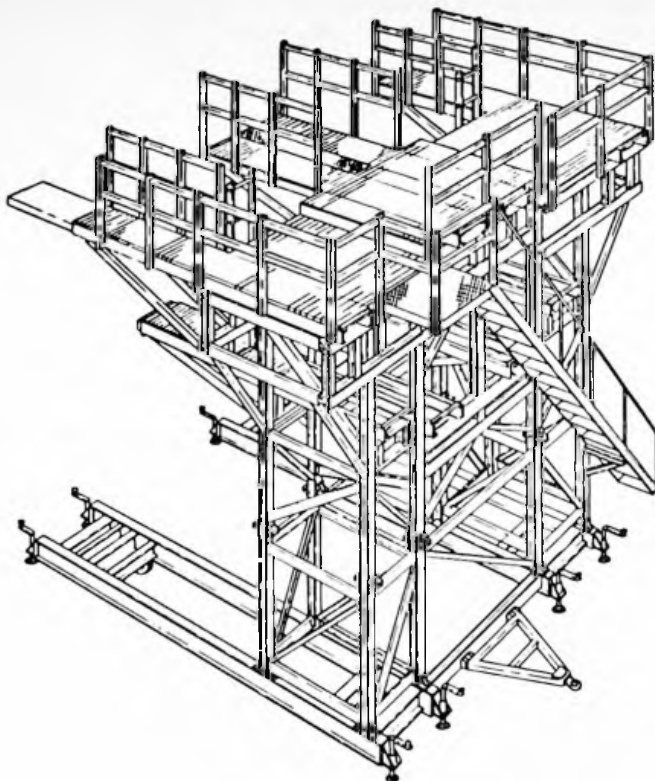


Figure 6-68. Horizontal Access Kit, Forward Skirt (DSV-4B-484)

Components - The kit will consist of the following components:

- a. Platforms
- b. Cable winding mechanisms
- c. Screw jacks
- d. Rails and ladders
- e. Tow bar.

6.87 Horizontal Access Kit, Aft Section (DSV-4B-485) 1A80496-1

Function - The function of the Aft Section Horizontal Access Kit shall be to provide access to the interior of the aft section of the stage when the stage is in the horizontal position. The kit shall be used to support personnel for inspection and installation, removal or repair of components.

Design - The kit, as shown in Figure 6-69, will provide hardware to assemble a movable steel platform structure with telescopic platforms. The platforms will be extended and retracted by manual operated cable winding mechanisms. The platforms structure will include screw jacks with which to immobilize itself while in use.

Components - The kit will consist of the following components:

- a. Platforms
- b. Cable winding mechanisms
- c. Screw jacks
- d. Rails and ladders
- e. Tow bar.

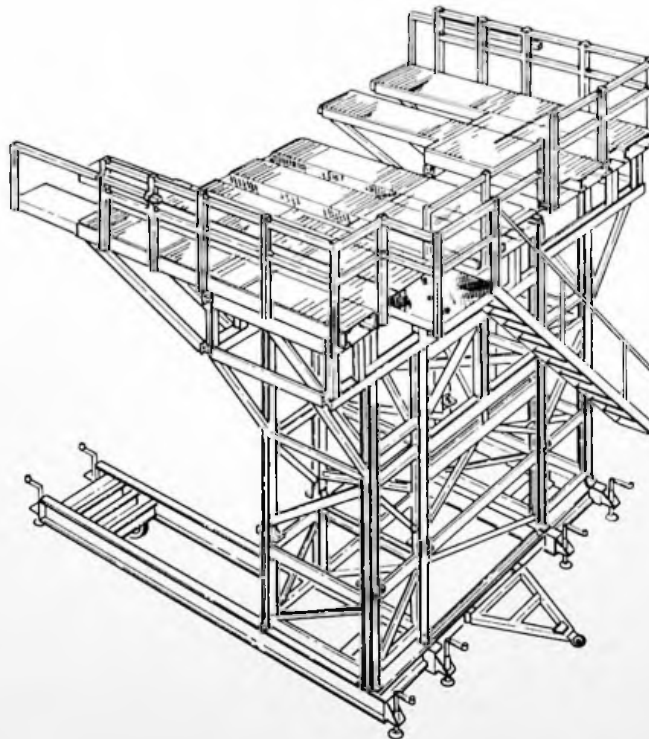


Figure 6-69. Horizontal Access Kit, Aft Section (DSV-4B-485)

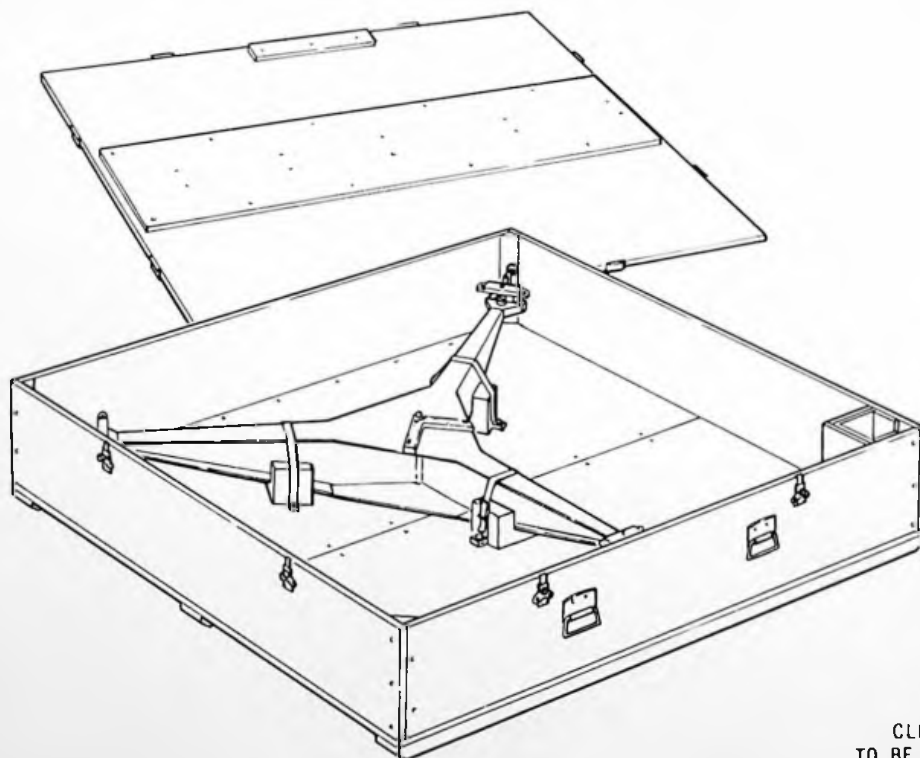
6.88 Alignment Fixture Kit, Engine Exit Plane (DSV-4B-491) 1B54580-1

Function - The function of the Engine Exit Plane Alignment Fixture Kit shall be to provide a reference plane parallel to the plane established by the three tooling holes located in the chamber exit flange of the J-2 engine.

Design - The design of the kit, as shown in Figure 6-70, will incorporate a welded and bolted aluminum fixture, which will be of minimum weight and maximum stiffness. The alignment fixture will be designed to be attached to the J-2 engine exit flange.

Components - The kit will consist of the following components:

- a. Alignment fixture
- b. Case
- c. Clinometer (2).



CLINOMETER (2 REQ)
TO BE OBTAINED FROM DSV-4B-324

Figure 6-70. Alignment Fixture Kit, Engine Exit Plane (DSV-4B-491)

6.89 APS Checkout Accessory Kit (DSV-4B-493) 1B57012-1

Function - The function of the APS Checkout Accessory Kit shall be to leak check various test points on the S-IVB/IB APS module by means of a fluid displacement leak test method. The test shall be performed prior to loading the APS module with propellants, or at any time it may be required to verify the integrity of the module.

Design - The kit, as shown in Figures 6-71 and 6-72, will consist of two portable aluminum cases, APS Checkout Accessories Case Assembly, and APS Pressurization Case Assembly. Each test point on the APS module to be leak checked (Fluid Displacement Leak Test Method) will be connected, by means of an adapter and plastic tubing, to a displacement tube on the APS Checkout Accessories Case Assembly. The APS module will then be pressurized. Any gas leakage through the test point will displace the water level down the displacement tube, and the amount of leakage will be read in standard cubic centimeters directly from a movable scale mounted on the tube. The kit will be designed to perform a Pressure Decay Leak Test

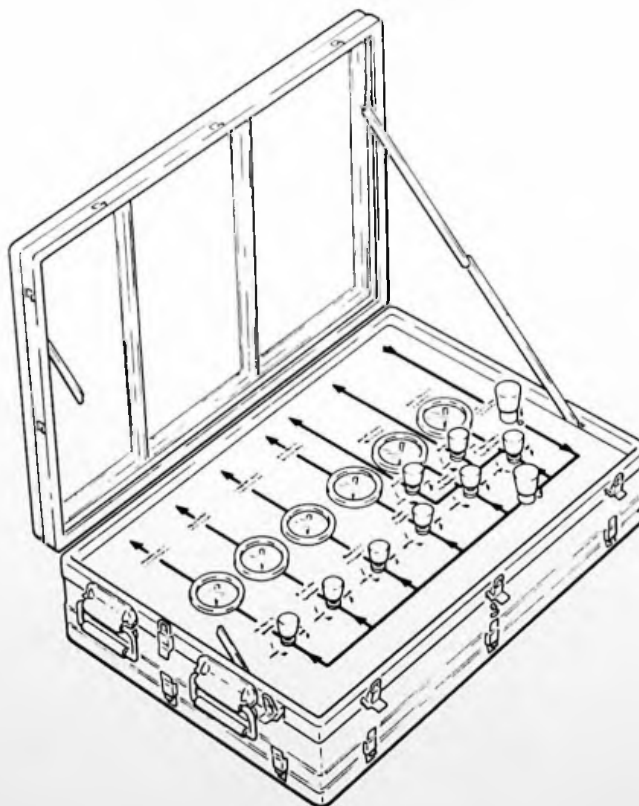


Figure 6-71. APS Pressurization Case Assembly (DSV-4B-493, & 493A)

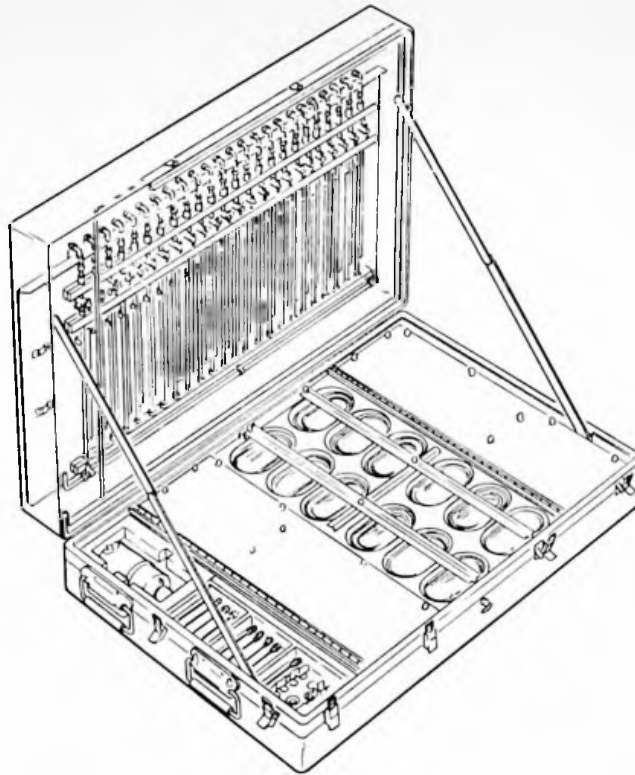


Figure 6-72. APS Checkout Accessories Case Assembly Kit (DSV-4B-493)

of the APS module. Each of the three engines of the APS module will be pressurized with gaseous nitrogen with the use of engine closure fixtures. The oxidizer and fuel ullage relief valves will also be pressurized during the test. After pressurization, the engine, oxidizer and fuel ullage relief valves will be sealed by a hand valve. The pressure will be monitored on a pressure gage for an elapsed period of time for pressure decay and leakage rate.

Components - The kit will consist of the following components:

- a. APS Checkout Accessories Case Assembly
 - 1. Bottle assembly
 - 2. Tube assemblies
 - 3. Hose assemblies
 - 4. Glass tubes
 - 5. Movable scale

- 6. Stopcocks
- 7. Elbows
- b. APS Pressurization Case Assembly
 - 1. Engine closure fixtures
 - 2. Overboard vent port adapters
 - 3. Conoseal leak isolation port adapters
 - 4. Umbilical connection adapters
- c. Metal hose assemblies (GFE).

Dimensions - The approximate dimensions of the case assemblies shall be: APS Checkout Accessories Case, 47 inches long, 29 inches wide, 10 inches deep, and will weigh 150 pounds; APS Pressurization Case, 40 inches long, 24 inches wide, 10 inches deep, and will weigh 100 pounds.

(For use with the S-IB stage only.)

6.90 APS Checkout Accessory Kit (DSV-4B-493A) 1B64550-1

Function - The function of the APS Checkout Accessory Kit shall be to leak check various test points on the S-IVB/V APS module by means of (1) a fluid displacement method and (2) a pressure decay method. The leak tests shall be performed prior to loading the APS module with propellants, and at any time it may be required to verify the integrity of the module.

Design - The kit will consist of three portable aluminum cases. The equipment shall be capable of checking fluid displacement and pressure decay, hoses also being supplied.

Components - The kit will consist of the following components:

- a. APS Pressurization Case Assembly 1B64280-1 (Pressure Decay Leak Test Method)

This case (See Figure 6-73) houses pressure regulators, pressure gages, hand valves, filters, and metal tubes and fittings.

Each of the four engines of the APS module will be sealed with an engine closure fixture and pressurized with gaseous nitrogen. After pressurization, each engine will be sealed by hand valve and the pressure in each will be monitored on a pressure gage for an elapsed period of time. A decay in pressure will indicate leakage and leakage rate.

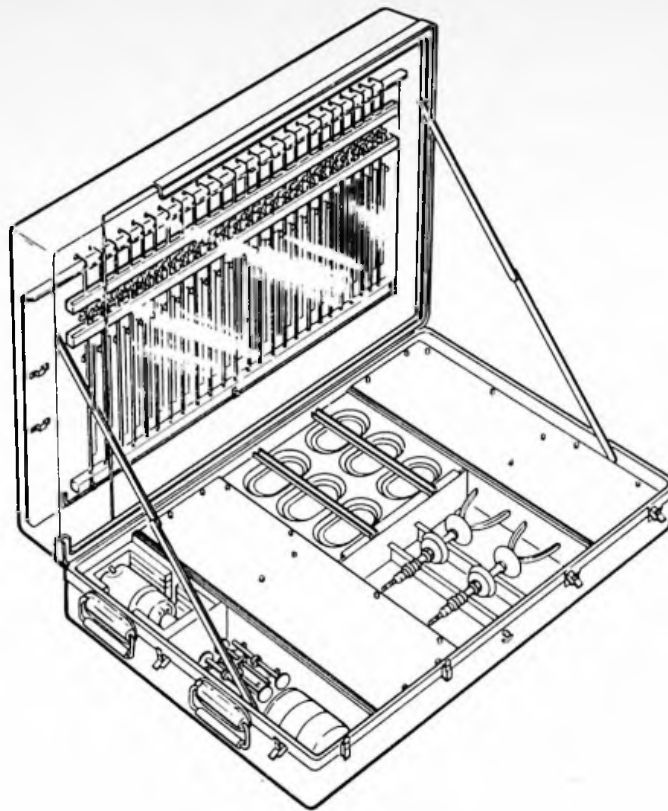


Figure 6-73. APS Checkout Accessory Case Assembly (DSV-4B-493A)

Dimensions - The case assembly will have the following approximate dimensions: length = 35 inches; width = 24 inches; depth = 10 inches. The weight will be approximately 90 pounds.

- b. APS Checkout Accessories Case Assembly 1B64445-1 (Fluid Displacement Leak Test Method)

This case (See Figure 6-74) houses glass fluid displacement tubes and stopcocks plastic tubes (Tygon), engine closure fixtures, Conoseal leak isolation port fittings, and umbilical connection adapters.

Each test point on the APS module to be leak checked will be connected, by means of an adapter and plastic tubing, to a fluid displacement tube in this case. The APS module will then be pressurized. Any gas leakage through a test point will displace the water level down the displacement tube, and the amount of leakage will be read in standard cubic centimeters directly from a movable scale mounted adjacent to the tube.

Dimensions - The case assembly will have the following approximate dimensions: length = 47 inches; width = 29 inches; depth = 10 inches. The weight will be approximately 150 pounds.

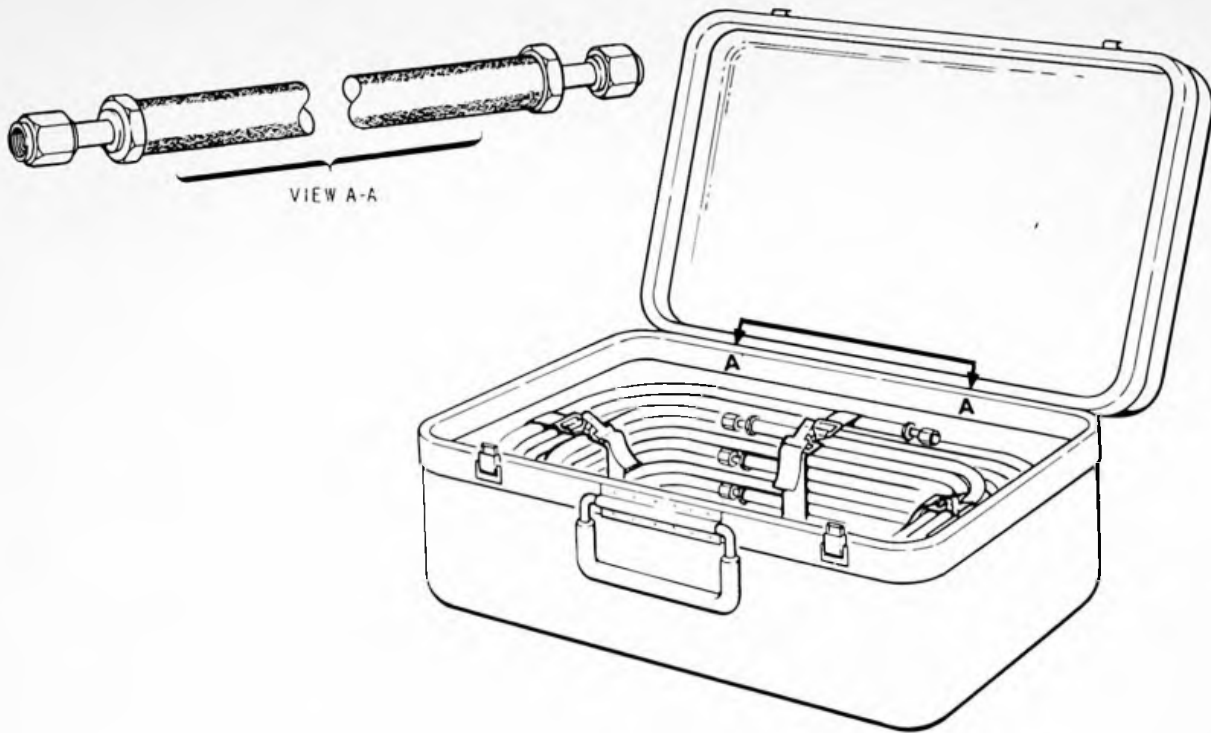


Figure 6-74. APS Hose Case Assembly (DSV-4B-493A)'

c. APS Hose Case Assembly 1B64970-1

This case (See Figure 6-74) houses the flexible metal hose assemblies. The hose will be used to connect the APS Pressurization Case Assembly to a facility gas source and to the APS module.

Dimensions - The case assembly will have the following approximate dimensions: length = 18 inches; width = 12 inches; depth = 8 inches. The weight will be approximately 35 pounds.

(For use with the S-V stage only.)

6.91 Mainstage Pneumatic Interconnect Kit, LC 34 (DSV-4B-1850) 1B05404-1

Function - The function of the LC 34 Mainstage Pneumatic Interconnect Kit shall be to provide means for interconnecting ground support equipment (GSE), and interconnecting the GSE with the umbilical tower and umbilical swing arm interfaces.

Design - The kit will include lines, line supports, fittings and hand valves required for propellant and pneumatic installation of the Pneumatic Console "A" (DSV-4B-432), and Automatic Pneumatic Console "B" (DSV-4B-433) at the 100-foot level of the umbilical tower. Propellant and pneumatic installation of the Gas Heat Exchanger (DSV-4B-438) will be made at the 110-foot level. The kit will be designed to transfer facility gaseous nitrogen, hydrogen and helium.

Components - The kit will consist of the following components:

- a. Lines
- b. Line supports
- c. Fittings
- d. Hand valves.

(For use with the S-IB stage only.)

6.92 Propulsion Checkout Accessory Kit (DSV-4B-1858) 1B56606-1

Function - The function of the Propulsion Checkout Accessory Kit shall be to facilitate checkout of the S-IVB/IB flight stages and engine installation in conjunction with Pneumatic Console "A" (DSV-4B-432), Pneumatic Console "B" (DSV-4B-433) and Gas Heat Exchanger (DSV-4B-438).

Design - The kit will provide the necessary equipment to supply helium for checkout of the S-IVB/IB stages.

Components - The kit will consist of the following components:

- a. Case
- b. Pneumatic fittings and adapters
- c. Hand valves
- d. Vacuum valve operators
- e. Filter
- f. Flange adapters.

(For use with the S-IB stage only.)

6.93 Propulsion Checkout Accessory Kit (DSV-4B-1858A) 1B66059-1

Function - The function of the Propulsion Checkout Accessory Kit shall be to facilitate checkout of the S-IVB/V flight stages, engine installation, and helium heater installation. The kit shall be used in conjunction with Pneumatic Console "A" (DSV-4B-432A), Pneumatic Console "B" (DSV-4B-433A) and Gas Heat Exchanger (DSV-4B-438A).

Design - The kit will provide the necessary equipment to supply helium for checkout of the S-IVB/V stages.

Components - The kit will consist of the following components:

- a. Case
- b. Pneumatic fittings and adapters
- c. Hand valves
- d. Vacuum valve operators
- e. Filter
- f. Flange adapters.

(For use with the S-V stage only.)

6.94 Access and Handling Kit, Air Carry, Super Guppy (DSV-4B-1860) 1B61060

Function - The function of the Super Guppy Air Carry Access and Handling Kit shall be to provide access to the upper areas of the Stage and the inner forward area of the Super Guppy. The kit shall be used to support personnel for attaching restraining hardware to the stage and Super Guppy (Model DSV-4B-1861, Tiedown Kit, Air Carry, Super Guppy).

Design - The kit, as shown in Figure 6-75, will provide hardware to assemble a lightweight type of scaffolding. The kit will be designed to be installed inside the forward section of the Super Guppy.

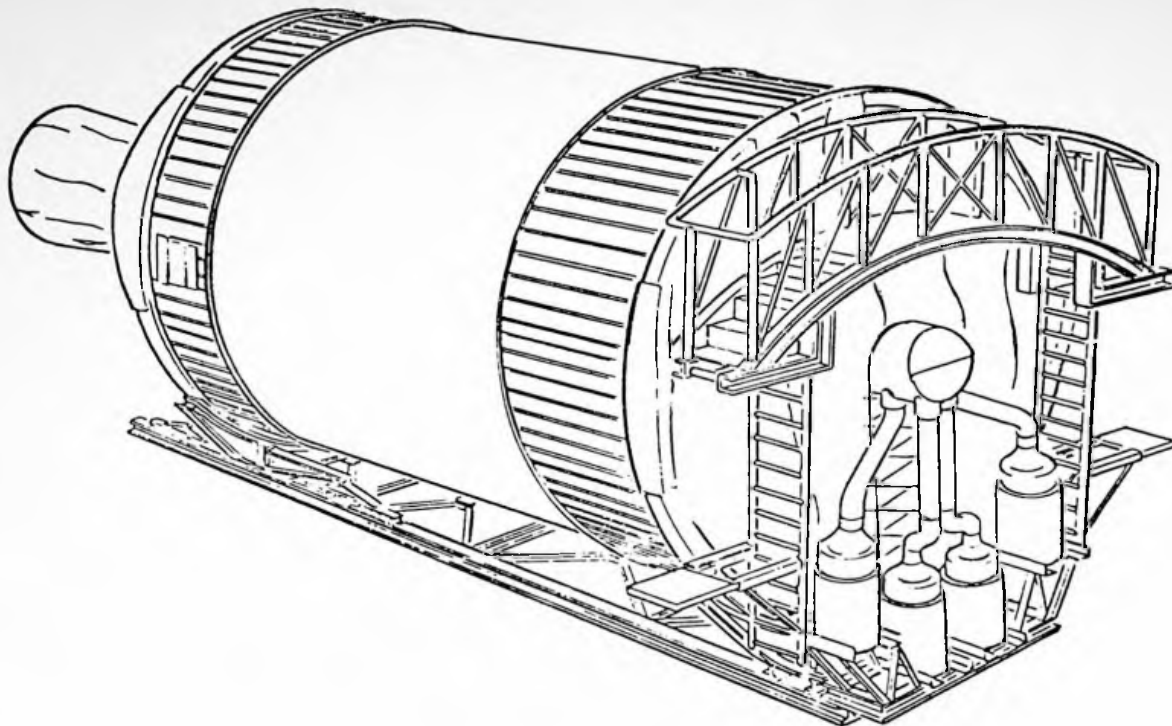


Figure 6-75. Access and Handling Kit, Air Carry, Super Guppy (DSV-4B-1860)

Components - The kit will consist of the following components:

- a. Platforms
- b. Stand
- c. Ladder (2)
- d. Pin (12).

6.95 Roller Transfer Kit, Air Carry, Super Guppy (DSV-4B-1863) 1B61063

Function - The function of the Super Guppy Air Carry Roller Transfer Kit shall be to provide a means of adapting the transporter (Model DSV-4B-300) to facilitate the transferring of the stage to the Cargo Lift Trailer (CLT) (GFE) and from the CLT to the transporter when the stage is shipped by the Super Guppy.

Design - The kit, as shown in Figure 6-76, will include an integrated framework of I-beam construction with two conveyer type tracks with

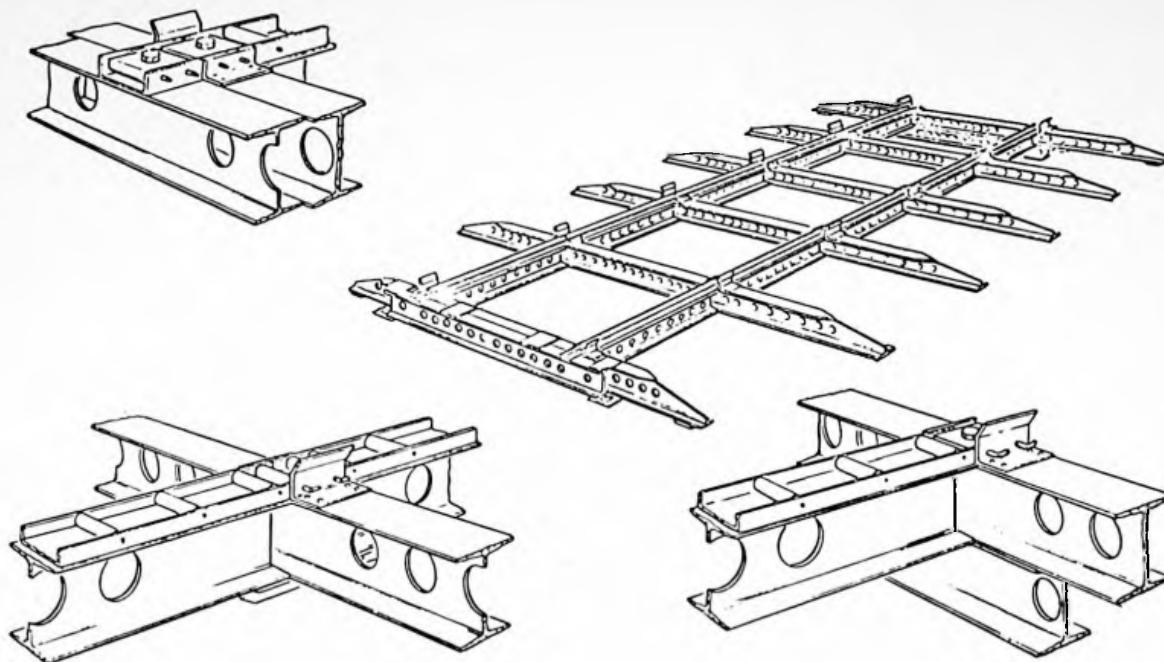


Figure 6-76. Roller Transfer Kit, Air Carry, Super Guppy (DSV-4B-1863)

rollers. The kit will be designed to be compatible with the Support Kit, Air Carry, Super Guppy (Model DSV-4B-1859).

Components - The kit will consist of the following components:

- a. Beam (5)
- b. Track (12)
- c. Support (10)
- d. Bar (4)
- e. Shore (8)
- f. Spacer (6)
- g. Toe (2).

6.96 Purge Unit, Stage Transportation, Preparation, GN₂ (DSV-4B-1865)
1B61117-1

Function - The function of the Purge Unit, Stage Transportation Preparation, GN₂ shall be to dry the S-IVB stage during preparation for transportation. The purge with GN₂ shall reduce the moisture content of the atmosphere in the stage to a condition which shall preclude condensation of moisture during any mode of transportation.

Design - The unit, as shown in Figure 6-77, will connect to the stage through the vent systems, fuel and LOX fill and drain connections, and into the engine transducer ports. The GN₂ purge will be performed sequentially on the piping subsystems while simultaneously purging the fuel and LOX tanks. The GN₂ source will be stored in a trailer at 2,500 psi. Regulators in the purge unit will reduce the pressure of the source gas to 550 psig for purge pressure and 475 psig for valve actuating pressure. The unit will operate stage modules to open the propulsion subsystem valves which will permit the GN₂ to flow through the fuel and

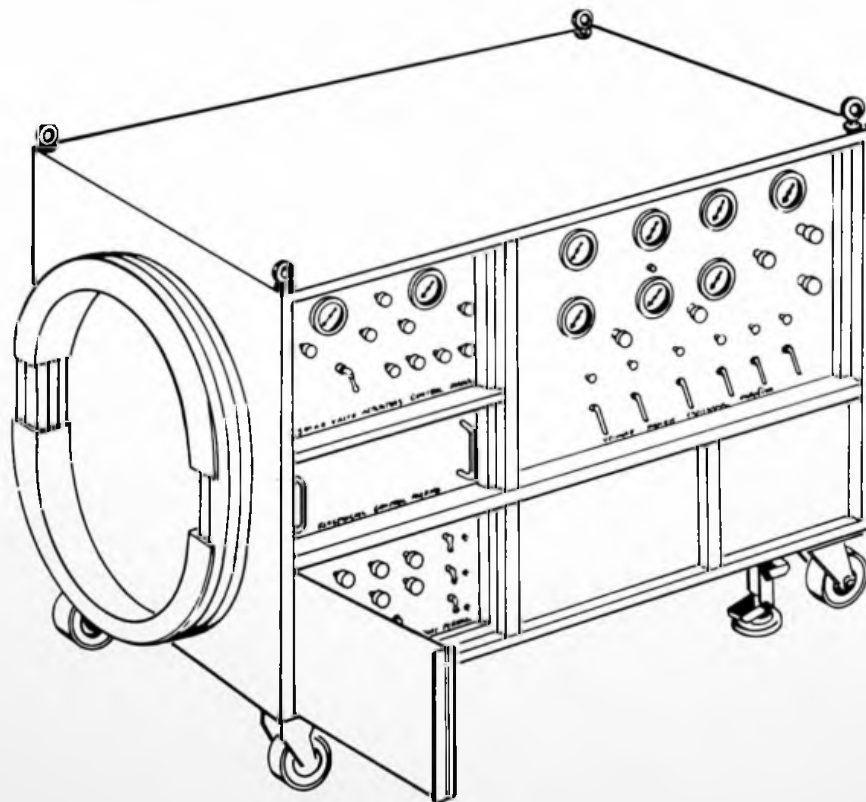


Figure 6-77. Purge Unit, Stage Transportation, Preparation, GN₂ (DSV-4B-1865)

LOX vent systems, and stage tanks. Flow will be maintained continuously until the desired dew point is achieved. The rate of flow through the stage tanks and subsystems is determined by the requirements of the mode of transportation. The stage will then be protected by the Super Guppy Air Carry Stage Preservation Kit (DSV-4B-1862) for air carry and the Protective Cover Kit (DSV-4B-304), the Secondary Desiccant Kit (DSV-4B-365), and the Static Desiccant Kit (DSV-4B-450) for surface transportation.

Components - The kit will consist of the following components:

- a. Purge unit
- b. Hoses
- c. Cables
- d. Regulators
- e. Valves
- f. Gages
- g. Instrumentation connectors.

6.97 Modification Kit, Cargo Lift Trailer, Super Guppy (DSV-4B-1866)
1B61386-1

Function - The function of the Super Guppy Cargo Lift Trailer shall be to provide a means of adapting the CLT (GFE) to facilitate the transferring of the stage from the transporter, to the CLT, to the Super Guppy. It shall also be used to transfer the stage from the Super Guppy, to the CLT, to the transporter (DSV-4B-300).

Design - The kit, as shown in Figure 6-78, will include two conveyor-type tracks with rollers. The kit will be compatible with the Support Kit, Air Carry, Super Guppy (DSV-4B-1859).

Components - The kit will consist of the following components:

- a. Tracks
- b. Rollers
- c. Adjustable side rollers.

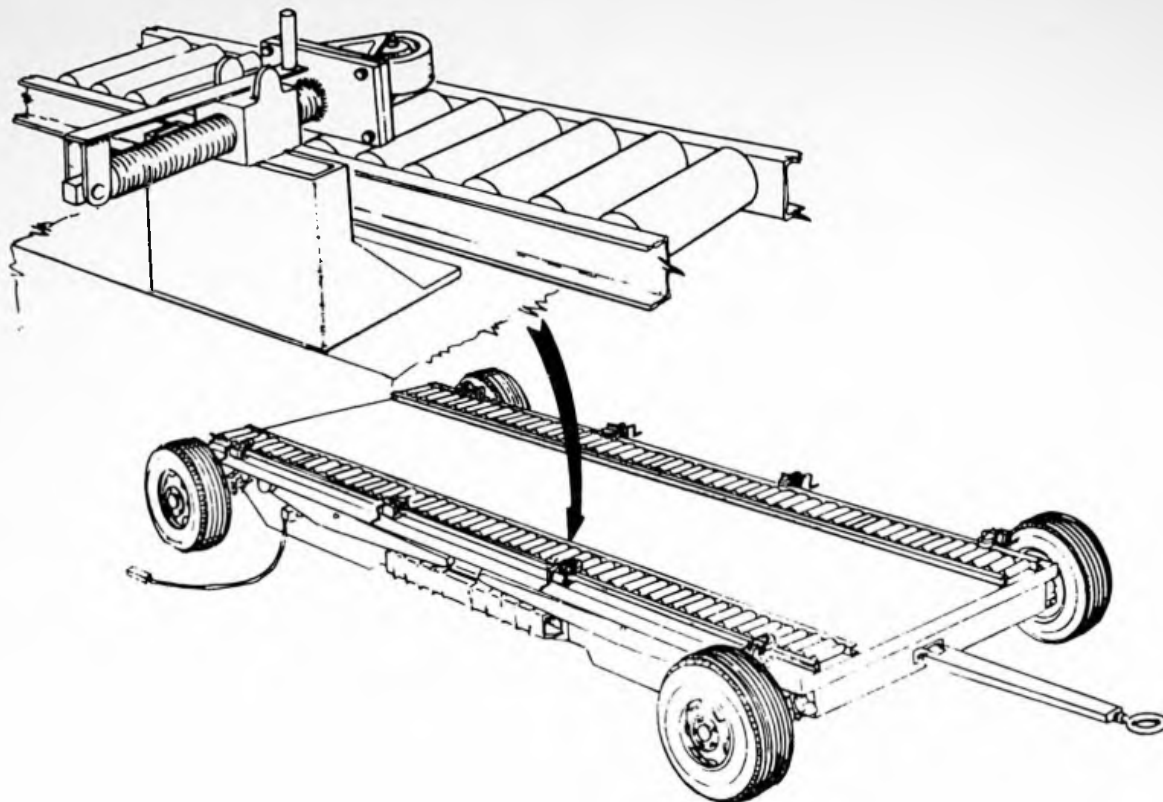


Figure 6-78. Modification Kit, Cargo Lift Trailer, Super Guppy (DSV-4B-1866)

6.98 Oxygen Hydrogen Burner Handling Kit (DSV-4B-1869) 1B64985-1

Function - The function of the Oxygen Hydrogen Burner Handling Kit shall be to provide a means for handling and storage of the O_2H_2 burner.

Design - The kit will be a container designed out of aluminum and will have internal supports for the O_2H_2 burner. The container will also include handles for removal of the O_2H_2 burner from the container and means of supporting the O_2H_2 burner for installation on the stage.

Dimensions - The kit will have the following approximate dimensions: height, 17 inches; width, 37 inches; depth, 16 inches.

(For use with the S-V stage only.)

6.99 Helium Heater Alignment Kit (DSV-4B-1871) 1B65617-1

Function - The function of the Helium Heater Alignment Kit shall be to provide alignment of the Oxygen/Hydrogen burner nozzle relative to the center of gravity of the S-IVB stage.

Design - The kit, as shown in Figure 6-79, will include an alignment fixture and an inclinometer. It is designed to mechanically align the O_2H_2 burner nozzle on a centerline that passes through the center of gravity point of the stage.

Components - The kit will consist of the following components:

- a. Alignment fixture
- b. Inclinometer.

(For use with the S-V stage only.)

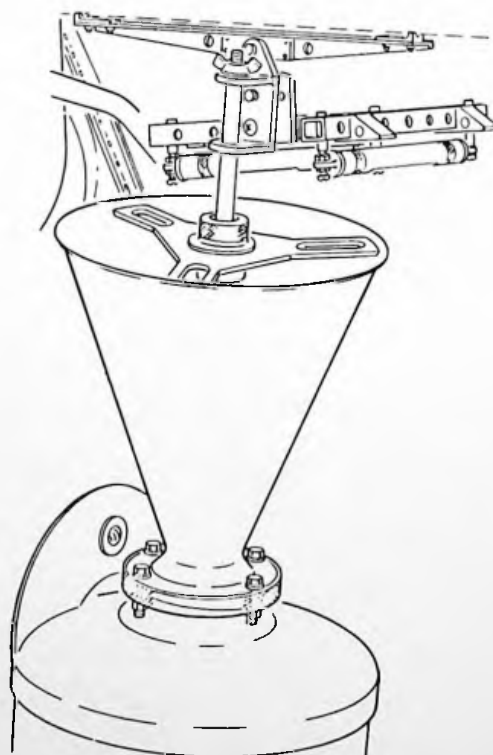


Figure 6-79. Helium Heater Alignment Kit (DSV-4B-1871)

6.100 APS Fuel Pressure Instrumentation Kit - SACTO (DSV-4B-1872)
1B64291-1

Function - The function of the APS Fuel Pressure Instrumentation Kit - SACTO, shall be to control and monitor the differential pressure across the fuel (MMH) tank bladder during checkout, purge, and prior to loading. It shall sample the ullage and propellant tank gases before loading.

Design - The kit will be portable and will consist of the necessary hand valves, gages, associated tubing and fittings, interface connections, and flexible hoses.

Components - The kit will consist of the following components:

- a. Instrumentation panel
- b. Flexible hoses (10)
For connections between the facility gas interfaces, instrumentation panel, and/or the APS modules.
- c. Carrying case (hoses).

6.101 APS Oxidizer Pressure Instrumentation Kit - SACTO (DSV-4B-1873)
1B64292-1

Function - The function of the APS Oxidizer Pressure Instrumentation Kit - SACTO, shall be to control and monitor the differential pressure across the oxidizer (N_2O_4) tank bladder during checkout, purge, and prior to loading. It shall sample the ullage and propellant tank gases before loading.

Design - The kit will be portable and will consist of the necessary hand valves, gages, associated tubing and fittings, interface connections, and flexible hoses.

Components - The kit will consist of the following components:

- a. Instrumentation panel
- b. Flexible hoses (10)
For connections between the facility gas interfaces, instrumentation panel, and/or the APS modules.
- c. Carrying case (hoses).

6.102 Handling Dolly, APS Module - S-IB (DSV-4B-1876) 1B61572-1

Function - The function of the APS Module Handling Dolly - S-IB shall be to provide a means of transporting one Saturn S-IVB/IB APS module to LC 34 or LC 37 and to facilitate installation of the module while the S-IVB stage is in the vertical position.

Design - The dolly, as shown in Figure 6-80, will be steel frame construction and will be mounted on casters. The dolly will have two adapter plates for mounting the APS module. It will have four lifting eyes for attachment of a sling (400 pound capacity).

Components - The handling dolly will consist of the following components:

- a. Dolly
- b. Adapter plates
- c. Sling.

(For use with S-IB stage only.)

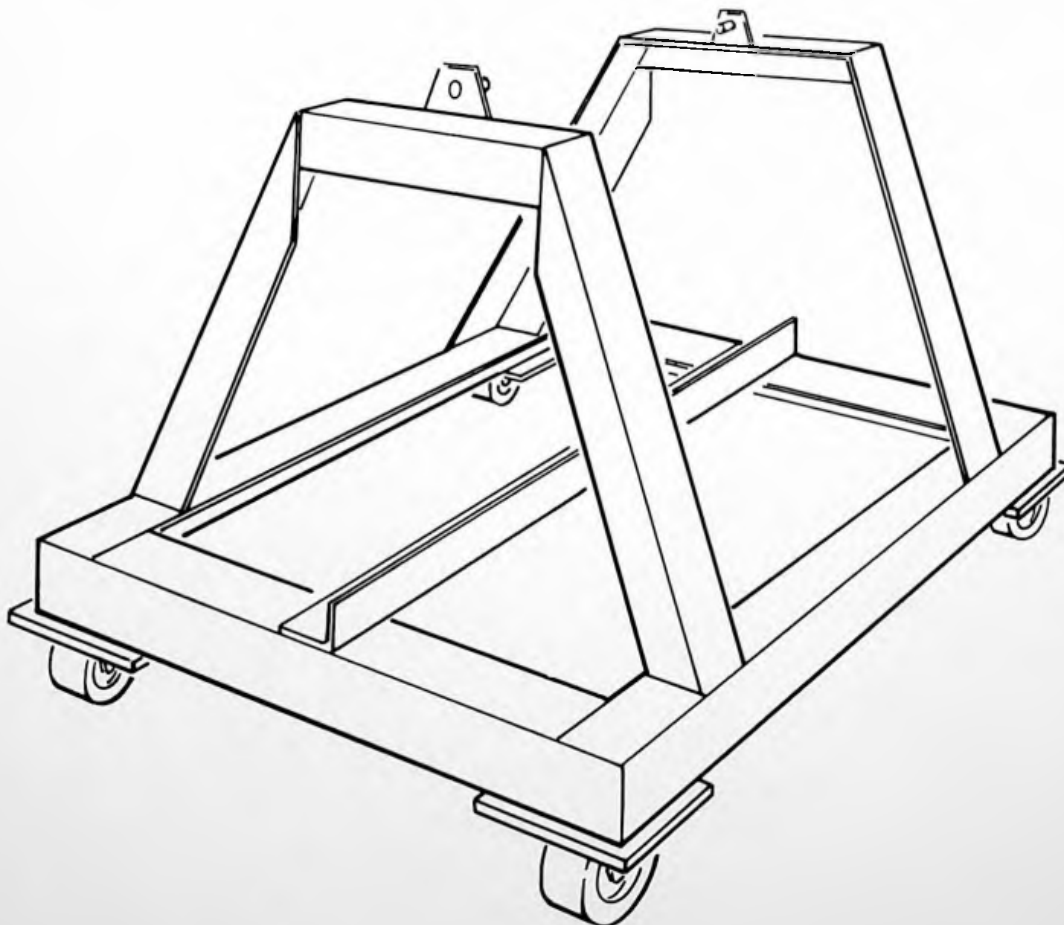


Figure 6-80. Handling Dolly APS Module, (DSV-4B-1876)

6.103 Handling Dolly, APS Module - S-V (DSV-4B-1877) 1B64252-1

Function - The function of the APS Module Handling Dolly - S-V shall be to provide a means of transporting one Saturn S-IVB/V APS module to Mobile Launchers and to facilitate installation of the module while the S-IVB stage is in the vertical position.

Design - The dolly, similar to that shown in Figure 6-80, will be of frame construction and will be mounted on casters. The dolly will have an adapter for mounting the APS module.

Components - The Handling Dolly will consist of the following components:

- a. Dolly
- b. Adapter.

(For use with the S-V stage only.)

6.104 Jamb Weld Platform Kit, Hydrogen Tank (DSV-4B-1878) 1B61582-1

Function - The function of the Hydrogen Tank Jamb Weld Platform Kit shall be to provide the platforms for the support of personnel to facilitate structural modifications to the hydrogen tank forward dome interior.

Design - The kit will consist of platforms and supporting structure that will be supported by Model DSV-4B-308 (Fuel Tank Interior Access Kit).

Components - The kit will consist of the following components:

- a. Platforms
- b. Support assembly
- c. Post assemblies
- d. Shaft
- e. Deck
- f. Fittings.

6.105 Protective Cover, Lightweight (DSV-4B-1879) 1B61887-1

Function - The function of the Lightweight Protective Cover, shall be to provide environmental protection for the S-IVB stage during transportation and erection operations at KSC.

Design - The cover will be constructed of a lightweight, flexible, waterproof impregnated fabric. The cover will be secured by lacing and tiedown cords.

6.106 Test Fixture Kit, Gemini Engine Pressure (DSV-4B-1880) 1B63897-1

Function - The function of the Gemini Engine Pressure Test Fixture Kit shall be to provide a means to support the receiving inspection and checkout of the 100 pound Gemini engine.

Design - The kit will consist of the necessary hardware and components to perform inspection and checkout procedures.

Components - The kit will consist of the following components:

- a. Pressure test fixture and throat plug (1)
- b. Pressure test fixture adapter (4)
- c. Electrical connector assemblies with plugs for dielectric strength tests (6).

6.107 Disconnect Kit, Low Bay (DSV-4B-1884) 1B65781-1

Function - The function of the Low Bay Disconnect Kit shall be to provide pneumatic connections between the Boeing Company supplied pneumatic console and hose assemblies in the VAB Low Bay at KSC, and the S-IVB stage umbilicals.

Design - The kit will consist of umbilical openings and disconnect assemblies.

Components - The kit will consist of the following components:

- | | | | |
|----|-----------------------------------|---------------|-----|
| a. | Disconnect Assembly, Engine | (1A49958-513) | (2) |
| b. | Disconnect Assembly, Engine | (1A49958-531) | (6) |
| c. | Disconnect Assembly, Engine | (1A49958-533) | (1) |
| d. | Disconnect, Cold Helium | (7851844-1) | (1) |
| e. | Disconnect, Fuel Tank Prepressure | (7851861-501) | (1) |
| f. | Disconnect, Helium Control | (7851823-505) | (2) |

(For use with the S-V stage only.)

6.108 Storage Equipment Kit (DSV-4B-1888) 1B67535

Function - The function of the Storage Equipment Kit is to facilitate monitoring of environmental control systems during stage storage.

Design - The function of the kit shall be to:

- a. Relocate the desiccant cans (GSE Models DSV-4B-365 and -450) for accessibility
- b. Support the monitoring of the propellant tank moisture content
- c. Permit distant viewing of the stage desiccant
- d. Protect the forward end of the stage
- e. Interface with GSE Model DSV-4B-1889.

Components - The kit consists of the following components:

- a. Ducting for (a) above
- b. Tubing and fittings for (b) above
- c. Hardware for (c) above
- d. A forward protective cover for (d) above.

6.109 Moisture Monitor Kit (DSV-4B-1889)

Function - The function of the Moisture Monitor Kit shall be to accurately measure the amount of moisture in the propellant tank of the stage.

Design - Portable unit to interface with Model DSV-4B-1888.

Components - The kit will consist of the following:

- a. Moisture monitor
- b. Vacuum pump
- c. Flow meter
- d. Incidental hardware

6.110 (Deleted)

6.111 Stage Storage Handling Dolly (DSV-4B-1891) 1B71960-1

Function - The function of the Stage Storage Handling Dolly is to move the S-IVB stage into and out of storage buildings that do not permit the use of Model DSV-4B-300, S-IVB Stage Ground Transporter Dolly.

Design - The dolly will be of a low profile design, having provisioned for attachment of Model DSV-4B-301, S-IVB Stage Cradles Kit. A vertical load factor of -1.5 shall be applied to the design and arrangement of the wheels.

Components - The dolly will consist of a built-up base frame mounted on wheel casters.

6.112 Constant Aft Interstage Cover (DSV-4B-1892) 1B40223-1

Function - The function of the Constant Aft Interstage Cover is to provide protection to the S-IVB/IB interstage when stored either inside or outside on the DSV-4B-352, Constant Aft Interstage Handling Kit or on blocks.

Design - The cover will be constructed of neoprene-covered nylon, aluminum on one side, white on the other side, and will be of lightweight construction for easy installation.

Components - The cover will consist of the cover itself and all necessary attaching straps and lacing.

6.113 Stage Handling Kit (DSV-4B-1893) 1B68028-1

Function - The function of the Stage Handling Kit shall be to mount both the S-IVB/IB and S-IVB/V stages in such a manner that the induced loads will be transmitted safely into the stage structure.

Design - The kit will consist of segmented metal rings, with one set of pads for use with the S-IV/IB stage and the other set of pads for use with the S-IVB/V stage.

Components - The kit will consist of the following components:

- a. Forward handling ring assembly
- b. Aft handling ring assembly.

7. GOVERNMENT-FURNISHED EQUIPMENT7.1 General

Detailed Government-furnished equipment (GFE) commitments will be jointly agreed to by the Government and Douglas Aircraft Company and will be listed in the following document and table:

- a. Government-Furnished Property Requirements Document, SM 42433.
- b. Table 7-1, S-IV Ground Support Equipment used on S-IVB Program.

TABLE 7-1
S-IV GROUND SUPPORT EQUIPMENT USED ON S-IVB PROGRAM

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
100	GSE Test Set	5865814-1		1				7	I-CO-SD-L-1345
102	Stage Power Control and Monitor Panel	5865816-1		1	2			1,2,6	S.A. 454, I-CO-SD-L-1123
103	Instrumentation Power Control and Monitor Panel	5871407-1		1	1			1,2	S.A. 454, I-CO-S-IV-L-86-65
104	Stage Power Control and Monitor Chassis	2865817-1			2			2.7	I-CO-SD-L-1123
109	Propulsion System Preparation and Control Panel	5865820-1			3			1,3,6	I-CO-SD-L-1123
110	Propulsion System Preparation and Control Chassis	5865821-1			2			1,3	I-CO-SD-L-1123
112	Hydraulic Control and Monitor Panel	5865823-1			1			1	S.A. 454
114	Gimbal Control Panel	5865825-1			1			2	I-CO-SD-L-1123
118	S-IV Hydraulic Servicer	5866098-1	1					1X	A3-130-5.9.11.8-L-2628*
122	Pneumatic System Control Panel	5865830-1			2			1,2	I-CO-SD-L-1123
125	Flight Sequence Recorder Chassis	1A24183-1			6			2,6,7,9, 10,13	I-CO-SD-L-1123
126	Recorder Isolation AMP Chassis	1A39348-1			5			2,4,5,7, 10	I-CO-SD-L-1123

TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
127	Recorder Relay Chassis	5865834-1			3			2,3,6	I-CO-SD-L-1123
129	Pneumatic System Control Chassis	586535-1			1			1	I-CO-SD-L-1418
130	Propellant Loading Control and Monitor Panel	5865836-1			2			1,2	I-CO-SD-L-1123
133	Fuel Loading Computer Relay Chassis	5865839-1			2			1,2	I-CO-SD-L-1123
140	Helium Precool Heat Exchanger	5864566-1	1		2			1,2,4	I-CO-SD-L-1123
141	Operation and Test Stand, Pneumatic Console "A"	5864045-1			1			2	I-CO-SD-L-1123
143	LOX Main Fill and Top Control System	5864268-1			2			1,2	I-CO-SD-L-1123
144	Transporter Assembly	5851496-1					DSV-4B-300	1,2,3,4,5	I-CO-SD-L-1123
146	Transport Handling Kit	7851494-1			2		DSV-48-303A	2,3,4,6	I-CO-SD-L-750
147	Kit, Static Desiccant	7865717-1			5			1,2,3,4,5	I-CO-SD-L-1123
151	Special Tool Kit	7866387-1			2			3,4	I-CO-SD-L-1123
155	Test Set Charger - S-IV	5865872-1			1			2	I-CO-SD-L-657

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TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
161	Test Set, Valve Actuator	5865786-1	3		2			1,2,3,4,5	I-CO-SD-L-1123/1242
169	Access Kit, Forward Section	7866391-1			1			1	I-CO-SD-L-1123
170	Access Kit, Aft Section	1A23426-1					DSV-4B-484	2	I-CO-SD-L-1123
170	Access Kit, Aft Section	1A23426-1					DSV-4B-485	3	I-CO-SD-L-1123
171	Pneumatic Console, Vehicle Check-out Area	7866240-1			1			3	I-CO-SD-L-1123
173	Forward Interstage End Protective Cover	5866392-1			1			1	I-CO-SD-L-1123
174	Tank Interior Access Kit	1A19810-1			1			1	I-CO-SD-L-1123
177	Cable Network Hangar - AMR	5865850-1				1		1	A3-130-5.9.11.8-L-2628*
182	T/M Ground Power Supply Console	1A18968-1		1	2			2,3,7	S.A. 454, I-CO-SD-L-1123
183	DSV-4-183, PDM/FM/FM Test Console	5882850-1	1					3	I-CO-SD-L-1123
186	Nitrogen Fill Cart	5871194-1	1	1	1	2		1,2,3,4,5	I-CO-S-IV-L-11-65
187	Vacuum Pumping Unit	7865711-503		1	1	4		1,2,3,4 7,8	I-CO-SD-L-1123, I-CO-SD-L-940
188	Operation and T/S Checkout, Pneumatic Console "B"	5864046-1				1		2	I-CO-SD-L-1123

TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
189	Liquid Hydrogen Fill and Top, Sacramento	5864267-1			2			1,2	I-CO-SD-L-1123
191	Ordnance Monitor and Control Chassis	5865857-1		1				1	S.A. 454
195	LOX Loading Computer, Relay Chassis	5866259-1			2			1,2	I-CO-SD-L-1123
196	Test Set - EBW Initiator	5866057-1				2		1,4	I-CO-SD-L-940
197	Test Set - EBW Firing Unit	5886383-1		1				1	I-CO-SD-L-1474
204	Test Set - Exciter Helium and Engine	5884000-1			3			1,2,3	I-CO-SD-L-1123
205	Inverter, Ground Power Supply	1A02998-1		1	1			1,2	I-CO-SD-L-1123 S.A. 454
207	Instrumentation Service Line, Umbilical Electrical Subs Only Balance	1A23046-1			1			1	I-CO-SD-L-1123
209	PDM/FM/FM Checkout Set, Dual Channel (Receiver only of S/N 3)	5882844-1			2			1,3	I-CO-SD-L-657
212	J-Box, Aft Interface	5865819-1			1			3	I-CO-SD-L-1123
217	Relay Assembly, Stage System Stat. No. 1	5884847-1			1			2	I-CO-SD-L-1123
218	Relay Assembly, Stage System Stat. No. 2	5884852-1			1			4	I-CO-SD-L-1123

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TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
219	Test Set, Command Destruct	1A66769-1		1	1			2,3	I-CO-SD-L-657
222	Alignment Kit, Sacramento	1A21661-1			1			1	I-CO-SD-L-1123
223	Telemetry Test Evaluation	5882730-501		1				1	I-CO-SD-L-742
224	Telemetry Test Evaluation	5882730-1		1				1	I-CO-SD-L-742
225	Panel Destruct, S-IV	5886530-1		1				1	S.A. 454
226	Relay Assembly, Stage System Stat. No. 3	5886529-1			1			3	I-CO-SD-L-1123
229	Vent Line, GAS H2 Instrument	1A23107-1			1			1	I-CO-SD-L-1123
231	Signal Conditioning Console	5884723-1			1			2	I-CO-SD-L-1123
233	Ship and Store Container	1A21014-1				8		1,2,3,4,5, 6,7,8	I-CO-SD-L-1601
234	Sling Set, Ullage and Retrorocket	1A21016-1				3		1,2,3	I-CO-SD-L-1601
235	Weigh and Balance Equipment	1A22982-1					DSV- 4B- 345	1	C.O. 317
236	Weigh and Balance Equipment	1A22981-1					DSV- 4B- 345	1	C.O. 317
238	Checkout Access Kit - Pneumatic Console	7865700-1		2	3	3		1,2,3,4,5, 6,7,8	I-CO-SD-L-1015

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TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
243	Pulse Sensor, EBW	1A37495-1					Tulsa 2	1,54	I-CO-SD-L-1123
243	Pulse Sensor, EBW	1A37495-1				30		55 thru 64 74 thru 93	I-CO-SD-L-1123
244	Power Supply, EBW Checkout System	1A35138-1		1	2			2,3,4	I-CO-SD-L-1150
245	Recorder, EBW Checkout System	1A35843-1			2			2,3	I-CO-SD-L-1123
247	Protective Cover (Ocean Going Barge)	7851501-1		1				1	I-CO-I/IBD-6-736
251	Protective Cover (River Barge)	7883046-1			1			1	I-CO-SD-L-857
252	Control Panel, Recorder EBW Checkout	1A37504-1			3			2,3,4	I-CO-SD-L-1123
257	Propulsion System Tool Kit	1A37792-1				1		3	I-CO-SD-L-1198
260	Test Set, PU System	1A58865-1		1	2	2		1,3,4,5,6	I-CO-SD-L-1123, I-CO-SD-L-1198
264	Horizontal Tank Access Kit	1A65947-1			1	1		1,2	I-CO-SD-L-1123
265	J-Box, Circuit Protection Hanger	1A59724-1		1				1	S.A. 454
266	J-Box, Circuit Protection Stand	1A59642-1			2			2,3	I-CO-SD-L-1123
267	J-Box, Umbilical (SM)	1A67886-1		1				1	S.A. 454
268	Electrical Accessories Checkout Kit	1A86759-1		1	1	1		1,2,3	I-CO-SD-L-1509, I-K-C-4029-65

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TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
269	Air Conditioner, Mobile	1A78647-1			3			1,2,3	I-CO-SD-L-1123
277	Repair Kit, LH ₂ Tank	1A67608-1			1	1		1,2	I-CO-SD-L-862 I-CO-SD-L-1123
278	Recorder, System Test Panel	1A69187-1			3			1,3,5	I-CO-SD-L-1123
279	Adapter and Tiedown, Pregnant Guppy	1A88962-1				Rotated		1	I-CO-SD-L-1123
290	Duct Kit, Oxygen Tank Hanger	1A96339-1			1			2	I-CO-SD-L-1496
291	Duct Kit, Hydraulic Tank Hanger	1A96338-1			1			2	I-CO-SD-L-1496
292	Filter Assembly, Air Conditioner	1A8203-1			3	2		1,2,3,4 5	I-CO-SD-L-1198, I-CO-SD-L-1123
296	Panel, Vehicle Component Simulator	1A78178-1			2			3,5	I-CO-SD-L-1123
297	Checkout Kit, S&A Device	1A80348-1				1		1	I-CO-SD-L-940
298	Checkout Kit, Stray Voltage	1A80349-1				2		1,2	I-CO-SD-L-940
299	J-Box, Aft Interconnect	1A78609-1			1			5	I-CO-SD-L-1123
300	J-Box, Forward Interstage	1A78610-1			1			5	I-CO-SD-L-1123
303	Monitoring System, Vacuum Common Bulkhead	1A86793-1			2	2		1,2,3,4	I-CO-SD-L-1123, I-K-C-4036-65, I-CO-SD-L-657

TABLE 7-1 (Cont)

MODEL DSV-4-	NOMENCLATURE	PART NO.	LOCATION					SERIAL NO.	CONTRACT AUTHORIZATION
			SM	HB	STC	KSC	OTHER		
304	Access Kit, Vertical Forward Interstage	1A87318-1				1		2	I-CO-SD-L-1198
305	Panel, Vacuum Monitor and Control	1A88400-1			2	2		1,2,3,4	I-CO-SD-L-657, I-CO-SD-L-1123, I-K-C-4036-65
306	Conversion Kit - Trans.	1A71598-1					DSV- 4B- 481	2,3,4,5	I-CO-SD-L-657
312	Cable Network, Instrumentation Simulator	1A89895-1			1			1	I-CO-SD-L-1123
319	EBW Inert S&A Device	1A02446-503				10		1 thru 10	I-CO-SD-L-1379
320	GSE Test Set Cert. Adapter Kit	1A97672-1		1	1			1,2	I-CO-SD-L-1123
324	Dynamic Desiccant System	1B28475-1			2			1,2	I-CO-SD-L-75
328	Propulsion Pneumatic Checkout Cart	1A80590-1				1		1	I-CO-S-IV-L-86-65

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8. BATTLESHIP SUPPORT EQUIPMENT

8.1 General

A system of manually operated GSE will be installed at STC for Battleship firing during the early part of the Saturn S-IVB Program. This equipment will perform the necessary functions required to allow a comprehensive test-firing program for the J-2 engine system. Most of the units in the system will be similar to the GSE fabricated for the S-IVB Program. The following paragraphs identify and describe the GSE required on the S-IVB Battleship Program.

8.2 LH₂ Loading Control Panel Assembly (DSV-4B-154) 1A60002-1

Function - The function of the LH₂ Loading Control Panel Assembly shall be to monitor and provide manual control for solenoid operated valves in the liquid hydrogen loading lines on the LH₂ shed, and to control the LH₂ pre-valve, recirculation valve, tank pressurization valve, tank pressurization, and tank and line purges. The panel shall be capable of transferring control of the liquid hydrogen loading valves to the Automatic Propellant Loading Set (DSV-4B-243), and shall provide a continuous readout of stage LH₂ mass.

Design - The panel will provide switches and indicator lights to control and monitor the solenoid actuated valves on the LH₂ shed, Pneumatic Consoles A & B, and the Battleship. Meters will be provided to monitor loading line and tank pressures. A digital readout will provide a continuous display of LH₂ mass from signals obtained from the Automatic Propellant Loading Set. In addition, the panel will be designed to perform the following functions:

- a. Select automatic or manual loading control
- b. Monitor point level and depletion sensors in the LH₂ tank.

Components - The panel, as shown in Figure 8-1, will consist of the following components:

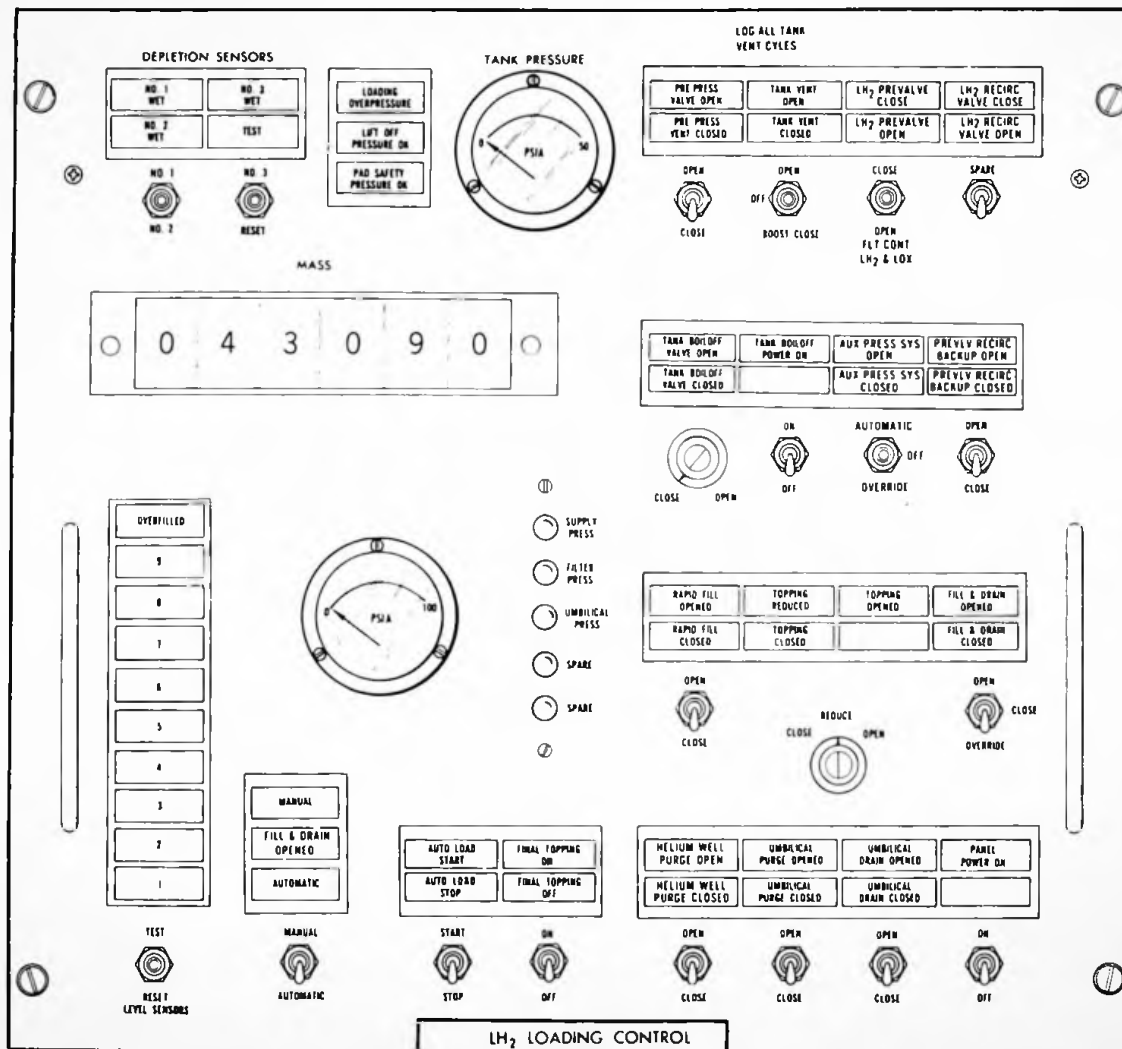
- a. Chassis
- b. Panel
- c. Meters
- d. Resistors
- e. Capacitors
- f. Switches
- g. Light Assemblies
- h. Receptacles
- i. Digital display
- j. Potentiometers
- k. Terminal boards.

8.3 Hydraulic and Gimbal Control Panel Assembly (DSV-4B-155) 1A60003-1

Function - The function of the Hydraulic and Gimbal Control Panel Assembly shall be to provide control for the Battleship electric auxiliary pump motor, and to monitor hydraulic system fluid level, pressures, and temperatures. The panel shall also provide signals and controls to command engine gimbaling, and shall be capable of accepting external gimbaling commands. The panel shall display the gimbal commands and engine position in both yaw and pitch positions.

Design - The panel will provide meters to monitor the hydraulic oil temperature and pressure throughout the closed-loop Battleship hydraulic system. Switches and indicators will be provided to operate and monitor the hydraulic system auxiliary pump motor. The panel will also incorporate the electrical circuitry required to control the inputs to the gimbal amplifiers which provide the gimbaling signals to the gimbal servo motors. Meters for monitoring engine deflection and gimbal-signal currents will also be provided. In addition, the panel will be designed to perform the following functions:

- a. Control is auxiliary pump motor start and stop while the Battleship stage is in ground, flight, or coast modes
- b. Monitor "Auxiliary Pump Motor ON" indication



- c. Monitor "Reservoir Oil Level Low" indication
- d. Provide controls to select internal or external gimbal commands
- e. Provide connectors to accept external gimbal commands
- f. Provide "ON-OFF" control of a tape recorder which supplies external gimbal commands.

Components - The panel, as shown in Figure 8-2, will consist of the following components:

- a. Chassis
- b. Panel
- c. Terminal boards
- d. Meters
- e. Switches
- f. Light assemblies
- g. Receptacles
- h. Resistors
- i. Capacitors
- j. Diodes
- k. Potentiometers.

8.4 Helium Control Panel Assembly (DSV-4B-156) 1A60004-1

Function - The function of the Helium Control Panel Assembly shall be to monitor and control Pneumatic Console A. The assembly shall control and monitor helium at 0-600 psia, 0-3,500 psia, and 0-7,000 psia. It shall control and monitor the 3,100 psia helium regulator and bleed valve, 1,500 psia helium supply, 50-750 psia regulator, and the 50 psia supply. The assembly shall control and monitor the engine control helium bottle, repressurization helium bottles, vehicle control helium bottles, and the tank pressurization cold helium bottles. It shall control and monitor the Heat Exchanger. It shall purge the start bottle, LOX vent valve, engine, and thrust chamber. It shall checkout the vehicle helium pressure system; helium high pressure checkout valve, high and low pressure engine checkout valves.

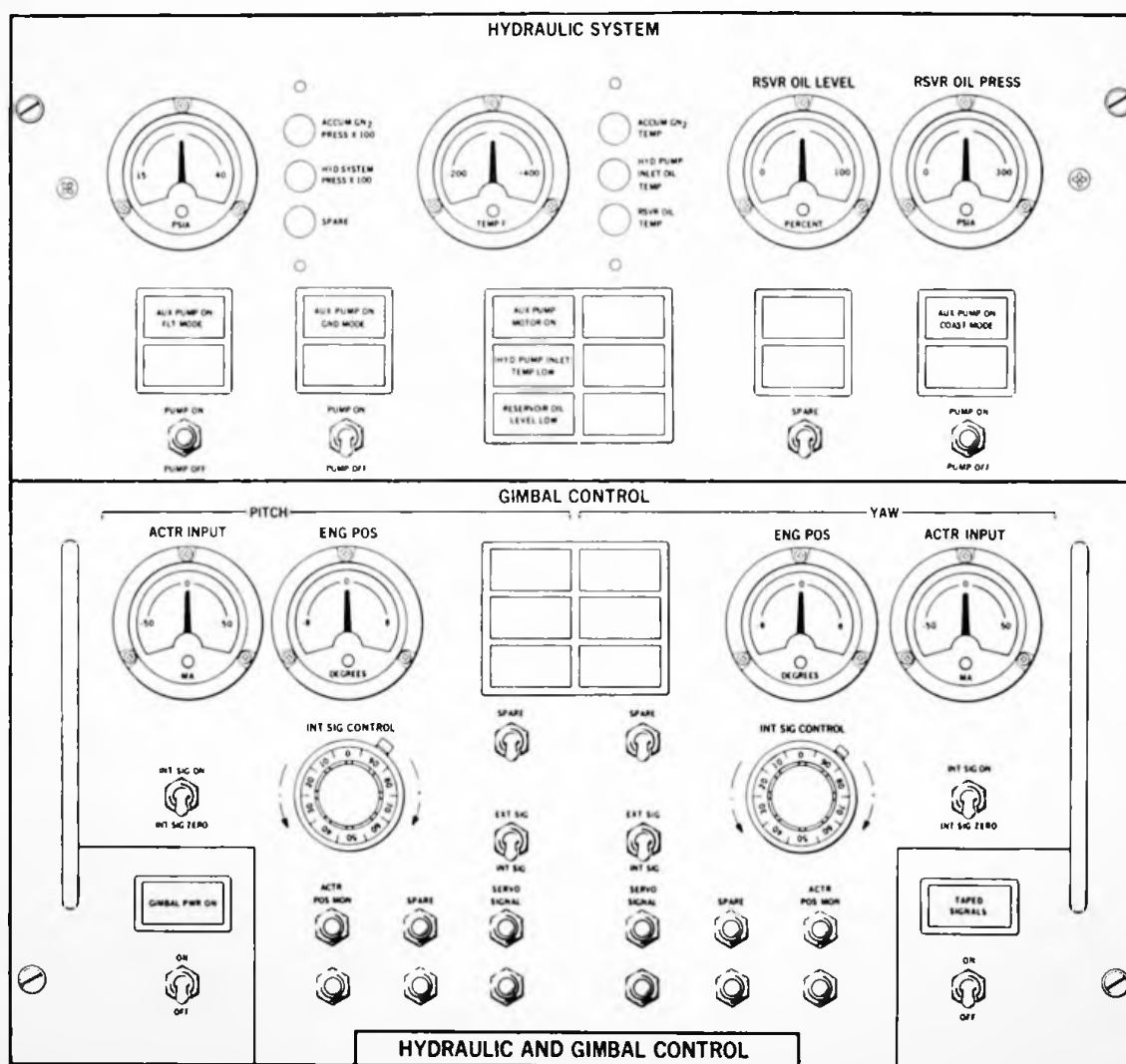


Figure 8-2. Hydraulic and Gimbal Control Panel Assembly (DSV-4B-155)

Design - The panel will provide meters to monitor pressures in the helium, GH_2 , and GN_2 supply systems. Controls will be provided to control pressure regulators and valves throughout the pneumatic system. Indicator lamps will be provided to show valve positions.

Components - The panel, as shown in Figure 8-3, will consist of the following components:

- a. Chassis
- b. Panel
- c. Switches
- d. Indicator lamps
- e. Meters
- f. Resistors
- g. Potentiometers
- h. Capacitors
- i. Terminal boards
- j. Receptacles.

Dimensions - The control panel will have the following approximate dimensions: depth, 19 inches, width, 19 inches; and height, 17 inches.

8.5 LOX Loading Control Panel Assembly (DSV-4B-157) 1A60006-1

Function - The function of the LOX Loading Control Panel Assembly shall be to monitor and provide manual control for solenoid operated valves in the liquid oxygen loading lines on the LOX sled, and to control the LOX pre-valve, recirculation valve, tank pressurization, and tank and line purges. The panel shall be capable of transferring control of the liquid oxygen loading valves to the Automatic Propellant Loading Set (DSV-4B-243), and shall provide a continuous readout of stage LOX mass.

Design - The panel will provide switches and indicator lights to control and monitor the solenoid actuated valves on the LOX sled, Pneumatic Consoles A and B, and the Battleship. Meters will be provided to monitor loading line and tank pressures. A digital readout will provide

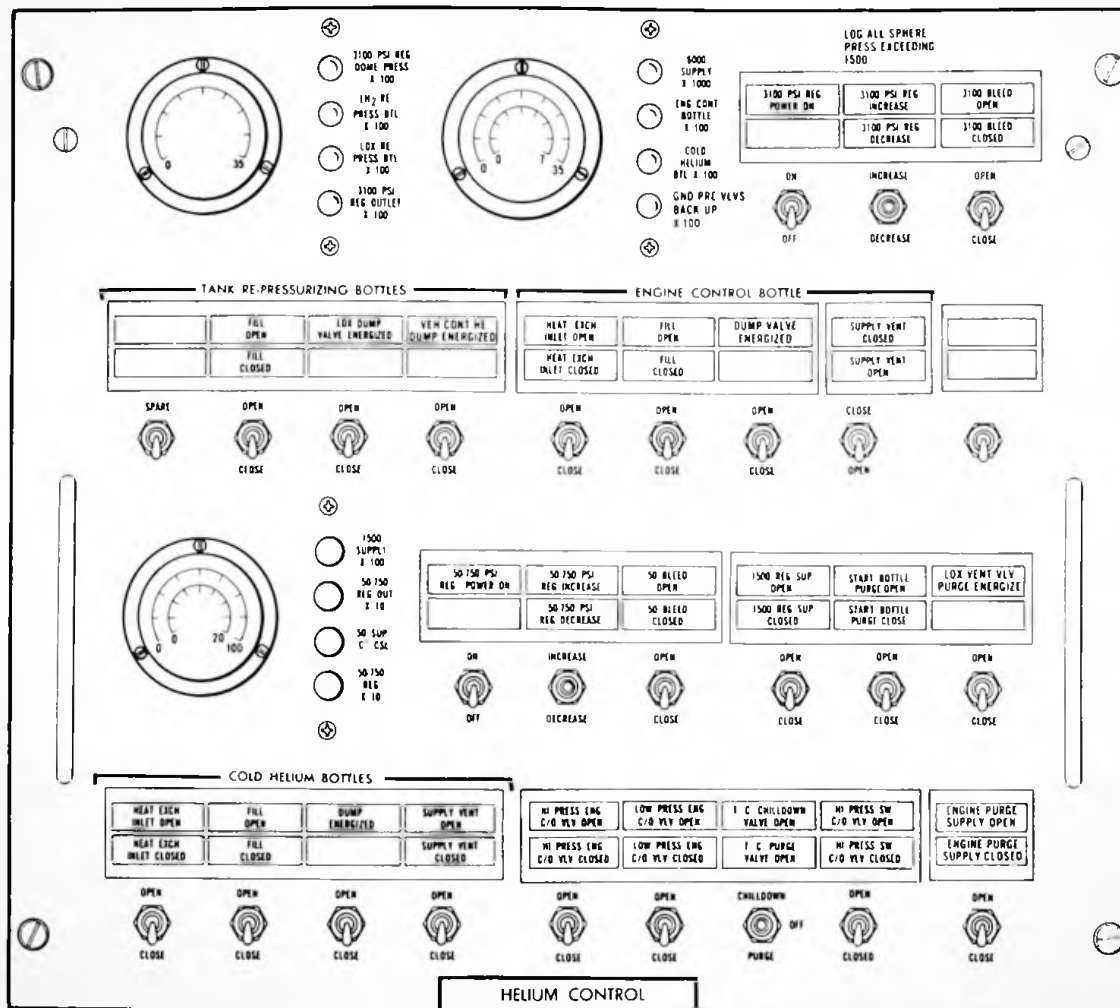


Figure 8-3. Helium Control Panel Assembly (DSV-4B-156)

continuous display of LOX mass from signals obtained from the Automatic Propellant Loading set. In addition, the panel will be designed to perform the following functions:

- a. Select automatic or manual loading control
- b. Monitor point level and depletion sensors in the LOX tank.

Components - The panel, as shown in Figure 8-4, will consist of the following components:

- a. Chassis
- b. Panel
- c. Switches
- d. Light assemblies
- e. Meters
- f. Resistors
- g. Potentiometers
- h. Digital display
- i. Receptacles
- j. Capacitors
- k. Terminal boards.

8.6 Control Switching Rack Assembly (DSV-4B-159) 1A60010-1

Function - The function of the Control Switching Rack Assembly shall be to provide a relay chassis for switching power from the test stand into the stage, the LO₂ and LH₂ loading sleds, and the pneumatic consoles to energize the solenoids. The rack shall also provide an interface between the umbilical J-box facilities and the control and monitor panels chassis.

Design - The switching rack, as shown in Figure 8-5, will consist of two AMCO 19-inch racks containing five relay chassis.

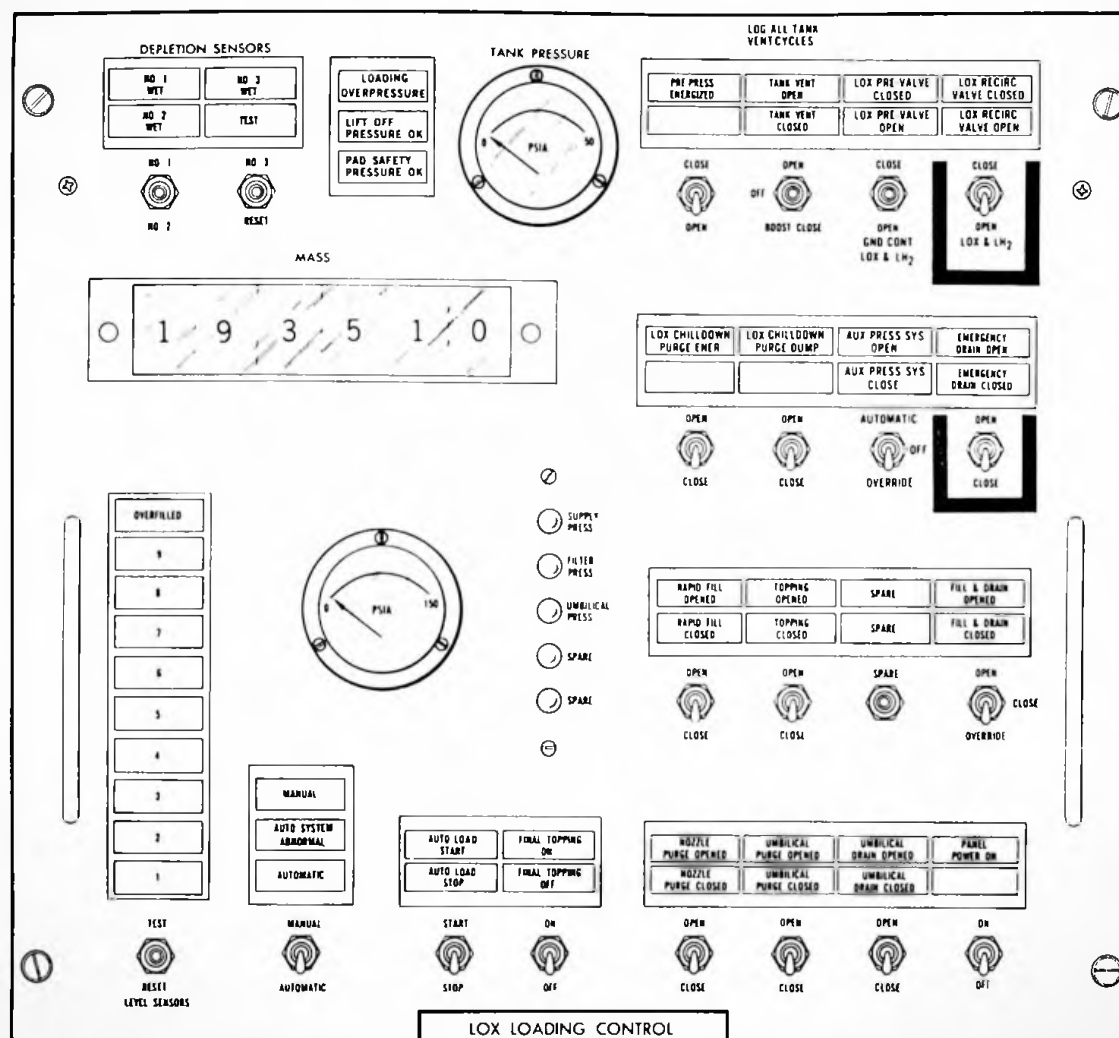


Figure 8-4. LOX Loading Control Panel Assembly (DSV-4B-157)

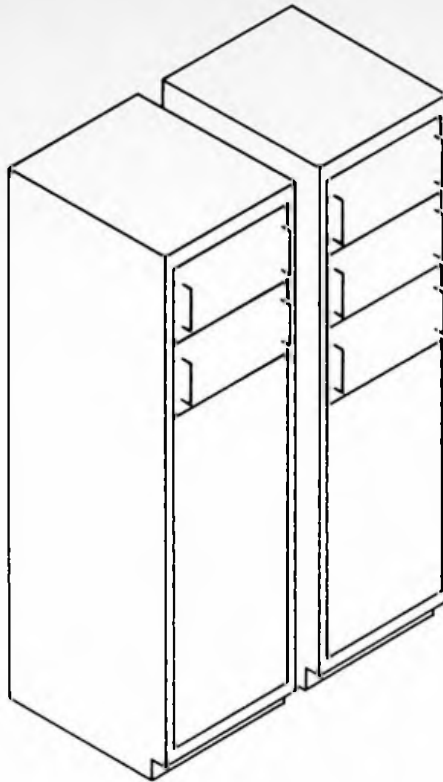


Figure 8-5. Control Switching Rack Assembly (DSV-4B-159).

Components - The switching rack will consist of the following components:

- a. Rack assemblies
- b. Chassis
- c. Panels
- d. Relays
- e. Diodes
- f. Resistors
- g. Capacitors
- h. Receptacles.

Dimensions - The approximate dimensions of the switching rack will be as follows: height, 51 inches; width, 42-1/2 inches; and depth, 28 inches.

8.7 Umbilical Junction Box Rack Assembly (DSV-4B-160) 1A60017-1

Function - The function of the Umbilical Junction Box Rack Assembly shall be to provide a convenient and flexible means of interconnecting the

electrical GSE with the Battleship stage and pneumatic consoles. The junction box shall also provide (1) circuit-protection fuses between the stage and GSE and (2) power distribution boxes to distribute power from the power supplied to the patch panels and to the stage.

Design - The junction box will consist of four AMCO 24-inch racks.

Components - The junction box, as shown in Figure 8-6, will consist of the following components:

- a. Rack assemblies
- b. Terminal strips
- c. Patch cords
- d. Patch panels
- e. Test point boards
- f. Receptacles
- g. Connectors
- h. Fuses (with blowout indicator lamps)
- i. Cables.

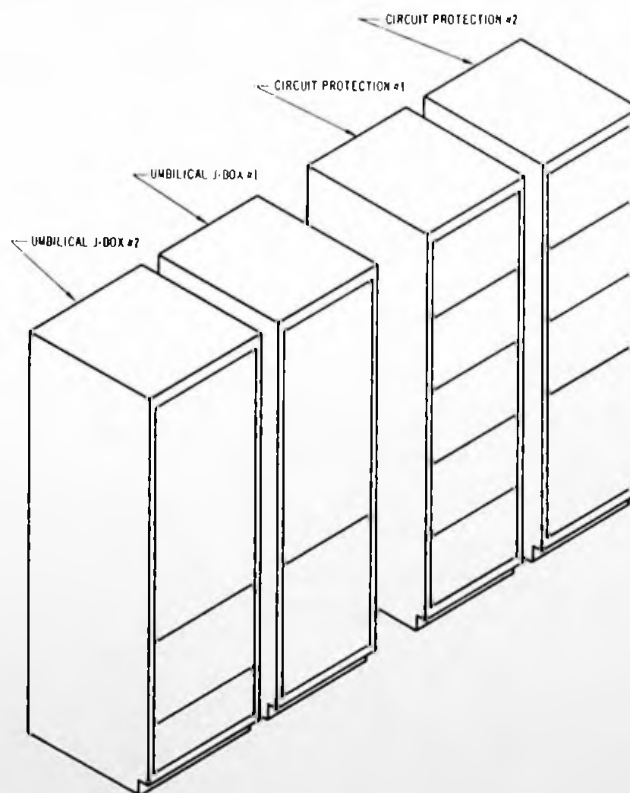


Figure 8-6. Umbilical Junction Box Rack Assembly (DSV-4B-160)

Dimensions - The approximate dimensions of the junction box rack will be as follows: height, 77 inches; width, 94 inches; and depth, 27 inches.

8.8 Junction Box Patch Panel Rack Assembly (DSV-4B-161) 1A60225-1

Function - The function of the Junction Box Patch Panel Rack Assembly shall be to provide a convenient and flexible means of interconnecting the blockhouse electrical GSE for checkout and control of the Battleship stage.

Design - The junction box will consist of two AMCO 24-inch racks.

Components - The junction box, as shown in Figure 8-7, will consist of the following components:

- a. Rack assemblies
- b. Terminal strips
- c. Patch cords

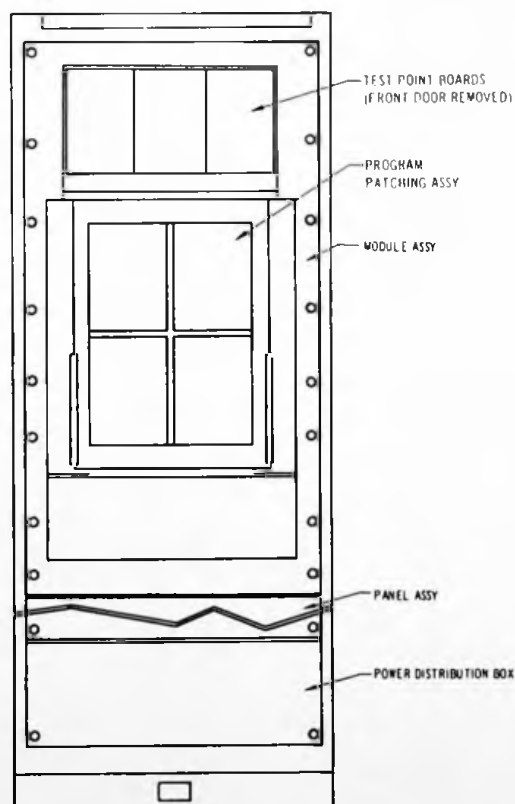


Figure 8-7. Junction Box Patch Panel Rack Assembly (DSV-4B-161)

- d. Patch panels
- e. Test point boards
- f. Receptacles
- g. Connectors
- h. Cables.

Dimensions - The approximate dimensions of the patch panel rack will be as follows: height, 78 inches; width, 52 inches; and depth, 30 inches.

8.9 Digital Voltmeter and Vehicle System Power Panel Assembly (DSV-4B-162) 1A60216-1

Function - The function of the Digital Voltmeter and Vehicle System Power Panel Assembly shall be to provide remote control for activating power to the Battleship stage and GSE. The panel shall also monitor the power supply voltages throughout the power systems.

Design - The panel will be designed to provide ON-OFF control of the stage forward and aft power buses, inverter, inverter power supply, and transducer power supply. The panel will also provide ON-OFF control of the sequencer, pressure switch, and liquid-level and point level sensors power. Stage forward and aft bus voltages will be monitored on a panel meter. Inverter running-time will be monitored by a running-time meter. An integrating digital voltmeter will be provided to measure voltages and frequency in the inverter and to monitor the engine ignition and control buses.

Components - The panel, as shown in Figure 8-8, will consist of the following components:

- a. Chassis
- b. Panel
- c. Meters
- d. Light assemblies
- e. Switches
- f. Running-time meter

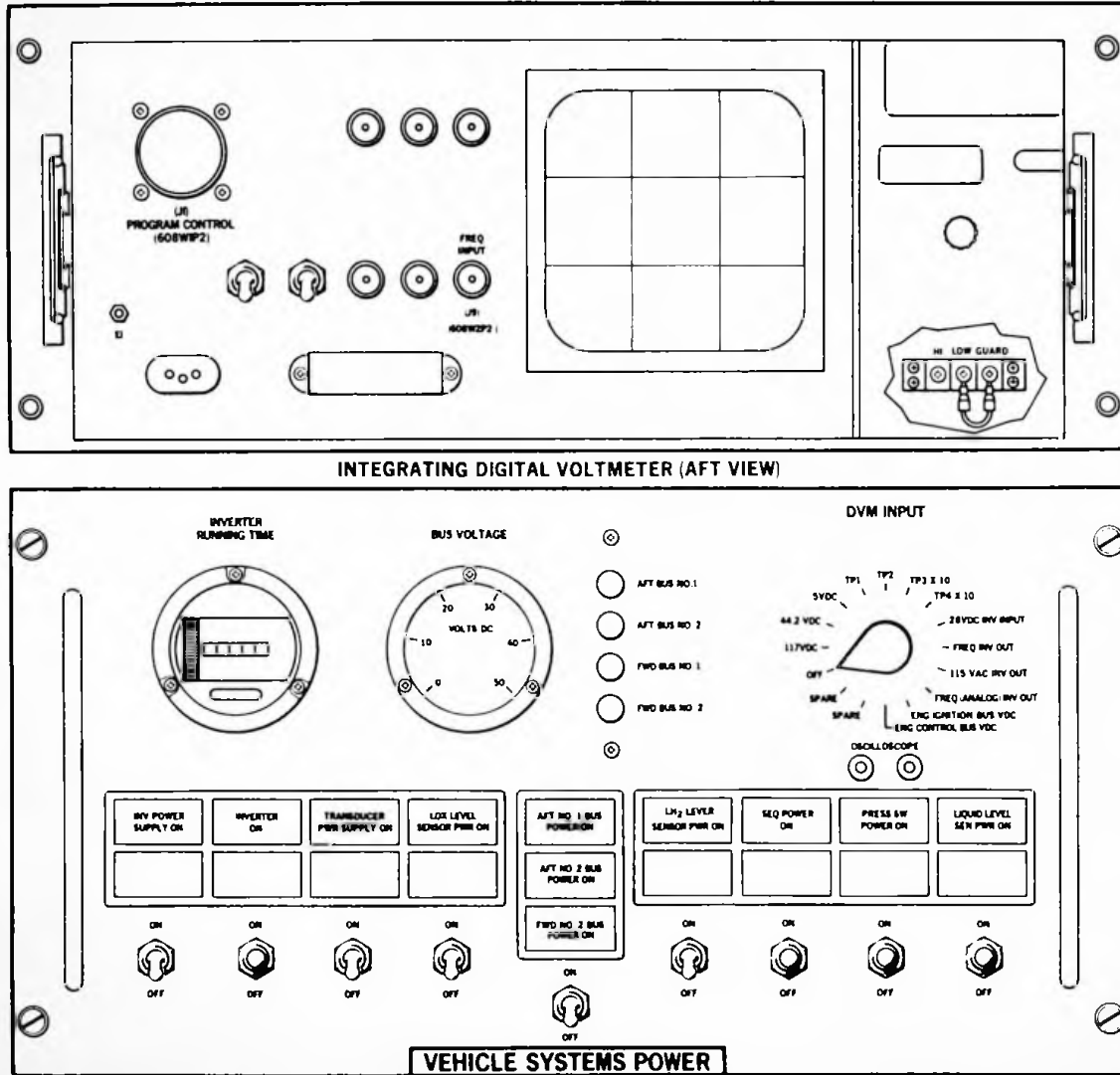


Figure 8-8. Digital Voltmeter and Vehicle System Power Panel Assembly (DSV-4B-162)

- g. Digital Voltmeter
- h. Resistors
- i. Potentiometers
- j. Capacitors
- k. Terminal boards
- l. Receptacles
- m. Test points
- n. Transformer
- o. Diodes.

Dimensions - The approximate dimensions of the power panel will be as follows: height, 17 1/2 inches; width, 19 inches; and depth, 20 inches.

8.10 Engine-Firing Control Panel Assembly (DSV-4B-163) 1A60001-1

Function - The function of the Engine-Firing Control Panel Assembly shall be to provide the necessary circuitry to control and monitor engine firing on the Battleship test stand through the automatic engine-firing system. The panel shall also be capable of providing a sequence test of the engine before actual engine firing.

Design - The panel will be designed to control and monitor the engine power and heater requirements. The panel will provide manual control to (1) initiate engine firing or engine cutoff and (2) reset the firing control panel logic after an automatic or manual engine cutoff. Panel indicator lights will show whether engine cutoff resulted from a manual command or an automatic command from the engine sequencer. Conditions required for engine firing will be built into the logic network in the engine-firing command circuit and displayed on the panel as the prestart status. Engine-firing operations will be shown in sequences as the "start confirmation." After engine cutoff, the last-confirmation indicator illuminated will show the last operation completed before cutoff. Conditions requiring engine cutoff (but not included in the engine sequencer cutoff logic) will be shown in the engine-start confirmation as cutoff indications.

Components - The panel, as shown in Figure 8-9, will consist of the following components:

- a. Chassis
- b. Panel
- c. Terminal boards
- d. Switches
- e. Light assemblies
- f. Relays
- g. Diodes
- h. Resistors
- i. Transistors
- j. Receptacles.

8.11 Engine Component Test Panel Assembly (DSV-4B-164) 1A60024-1

Function - The function of the Engine Component Test Panel Assembly shall be to provide remote manual control of J-2 engine components for checkout purposes.

Design - The panel will be designed to provide manual activation of engine control solenoids, and to monitor by indicator lights the conditions of engine valves affected by these solenoids. Additional lights will monitor necessary pretest conditions, and switches will be provided to enable pre-test setup. The panel will also be designed to test fire the engine thrust chamber and gas generator spark igniters.

Components - The panel, as shown in Figure 8-10, will consist of the following components:

- a. Chassis
- b. Panel
- c. Terminal boards
- d. Switches
- e. Light assemblies
- f. Relays
- g. Diodes
- h. Receptacles.

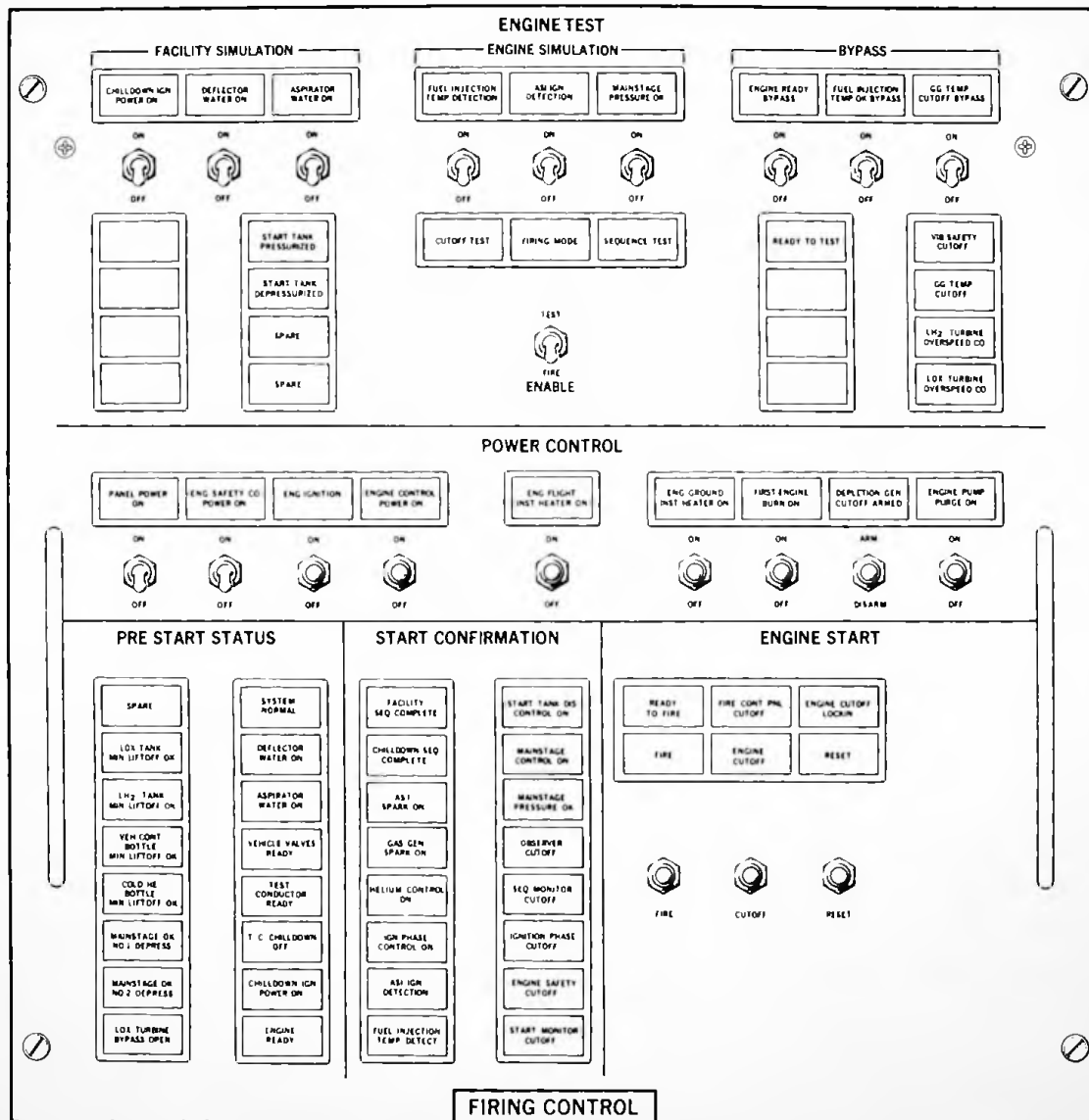


Figure 8-9. Engine - Firing Control Panel Assembly (DSV-4B-163)

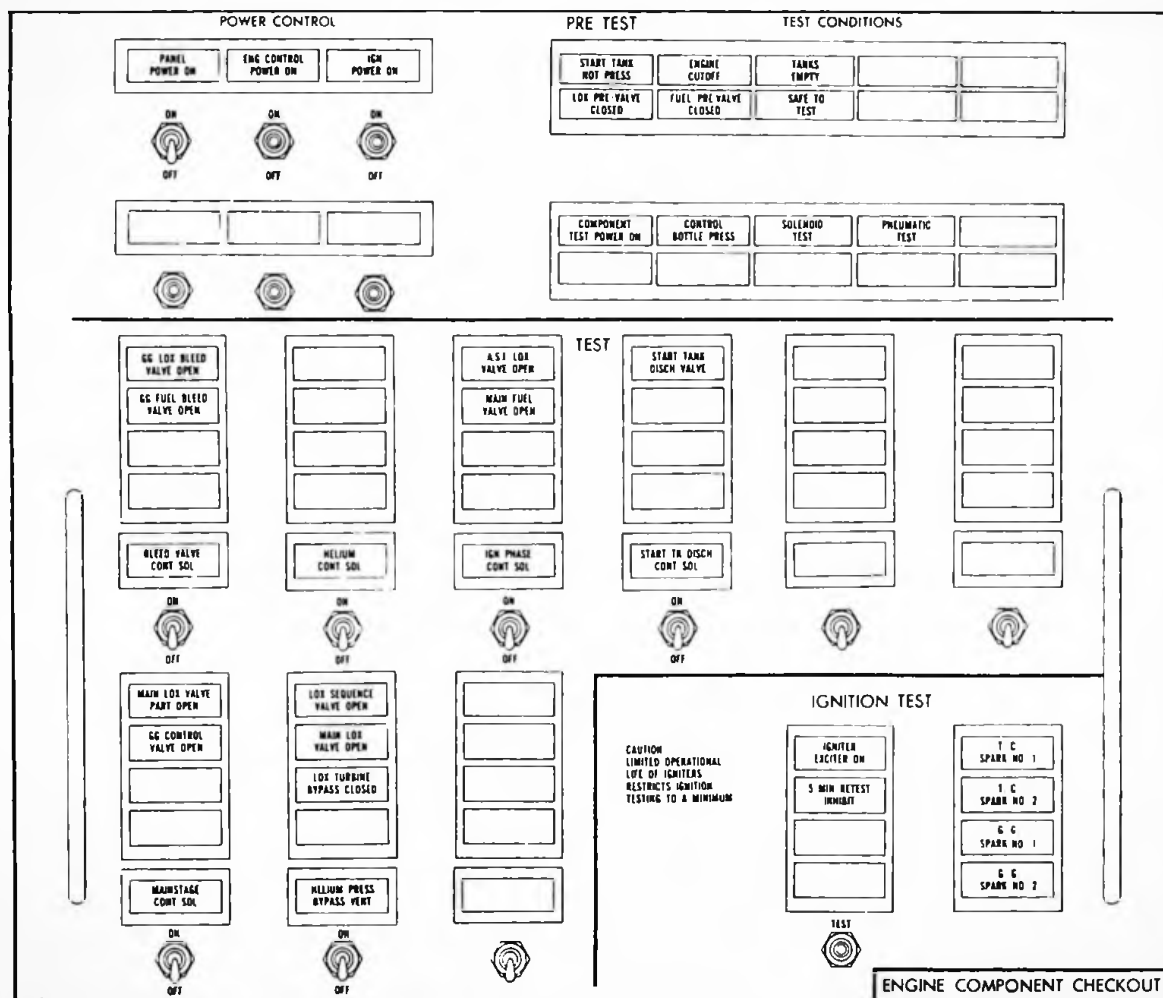


Figure 8-10. Engine Component Test Panel Assembly (DSV-4B-164)

8.12 Battleship Blockhouse Cable Network Kit (DSV-4B-165) 1A60061-1

Function - The function of the Battleship Blockhouse Cable Network Kit shall be to interconnect the blockhouse GSE through the patch panel junction box to the test stand equipment and Battleship vehicle.

Design - The cable network, as shown in Figure 8-11, will be designed to provide approximately 40 cable assemblies with molded connectors.

Components - The cable network will consist of suitable cable assemblies and connectors.

8.13 Battleship Tunnel Cable Network Kit (DSV-4B-166) 1A60063-1

Function - The function of the Battleship Tunnel Cable Network Kit shall be to interconnect the blockhouse and test-start GSE through the patch panel junction box on one end, and through the umbilical junction box on the other end.

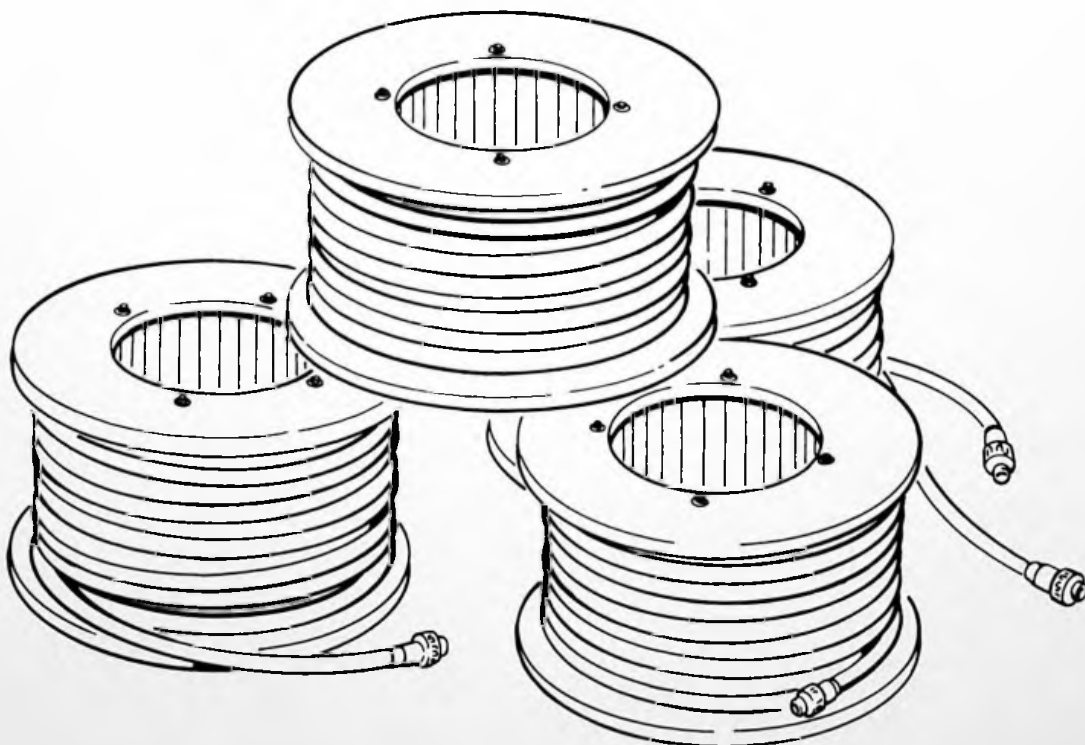


Figure 8-11. Battleship Blockhouse Cable Network Kit (DSV-4B-165)

Design - The cable network kit will be designed to provide approximately 50 cable assemblies with molded connectors.

Components - The cable network kit, similar to that shown in Figure 8-11, will consist of suitable cable assemblies and connectors.

8.14 Battleship Test Stand Cable Network Kit (DSV-4B-167) 1A60065-1

Function - The function of the Battleship Test Stand Cable Network Kit shall be to (1) interconnect the electrical and electronic end items at the Battleship test stand and (2) connect the Battleship test stand equipment to the Contractor-furnished terminal distributors.

Design - The cable network kit will be designed to provide approximately 100 cable assemblies for use on the Battleship test stand.

Components - The cable network kit, similar to that shown in Figure 8-11, will consist of suitable cable assemblies and connectors.

8.15 External Power Rack (DSV-4B-168) 1A60231-1

Function - The function of the External Power Rack shall be to provide a 56 vdc power supply, a gimbal power supply and inverter and transducer power supplies. The external power rack shall include a power distribution rack for routing power inputs to the power supplies and an external power control chassis for distribution of the power supply outputs.

Design - The rack will consist of two (2) standard rack assemblies with removable chassis. (See Figure 8-12.)

Components - The rack will consist of the following components:

- a. Rack assemblies
- b. Chassis
- c. Panels
- d. Transformers
- e. Transistors

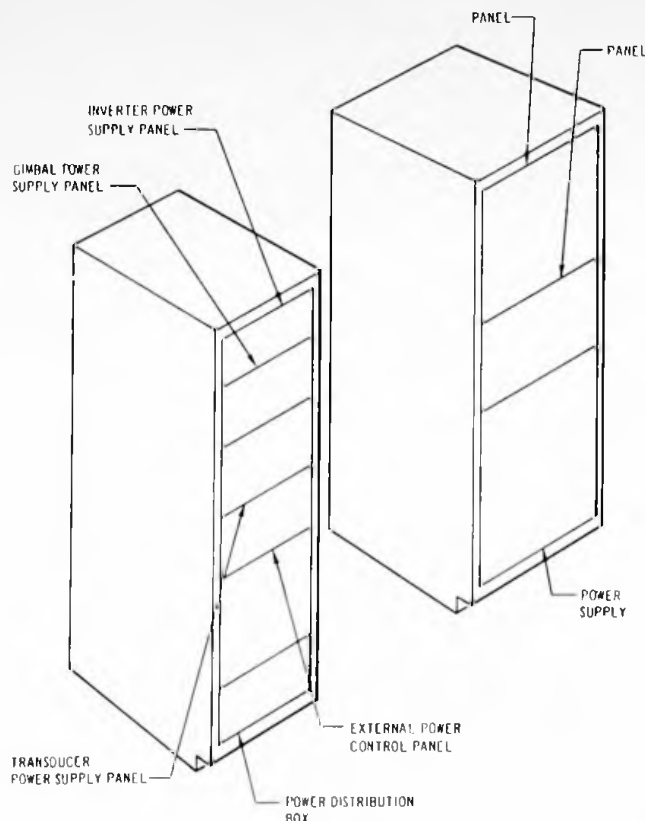


Figure 8-12. External Power Rack (DSV-4B-168)

- f. Relays
- g. Diodes
- h. Capacitors
- i. Resistors
- j. Terminal Strips
- k. Receptacles.

8.16 Automatic Propellant Loading Set (DSV-4B-243) 1A93200-1

Function - The function of the Automatic Propellant Loading Set shall be to provide the necessary commands to load a predetermined mass of fuel and oxidizer into the Battleship propellant tanks. The system shall also provide a continuous digital readout of the mass of propellants in the tanks.

Design - The loading set will receive digitized data from the Vehicle Propellant Utilization System (via the Ground Instrumentation System, CDC 924-A Computer, and Computer Interface Unit). These data contain LH_2 and LOX mass, and position commands for each of seven propellant loading valves. The system will display LH_2 mass and LOX mass decimally, and will display the memory of each valve control command. The loading set will also transmit LH_2 mass and valve control signals to the LH_2 Loading Control Panel, and LOX mass and valve control signals to the LOX Loading Control Panel.

Components - The loading set as shown in Figure 8-13, will consist of the following components:

- a. Chassis
- b. Panels
- c. Terminal boards
- d. Potentiometers

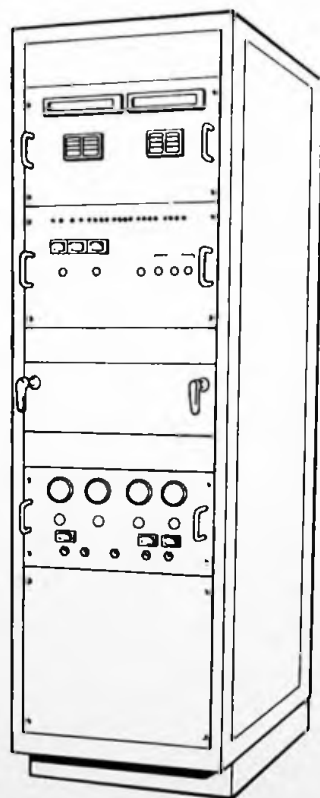


Figure 8-13. Automatic Propellant Loading Set (DSV-4B-243)

- e. Relays
- f. Receptacles
- g. Enclosure.

8.17 Digital Voltmeter and Propellant Utilization Panel Assembly
(DSV-4B-247) 1A60205-1

Function - The function of the Digital Voltmeter and Propellant Utilization Panel Assembly shall be to provide the controls and indicators required for (1) operation of the PU electronics assembly and (2) partial checkout of the closed-loop PU system. The panel shall also be capable of monitoring voltages throughout the PU system.

Design - The panel will control the PU electronics assembly by (1) switching test voltages into the PU electronics assembly to simulate increasing or decreasing propellant mixture ratio and (2) simultaneously monitoring the changes in the mixture ratio valve position on the digital voltmeter. Switches will be provided to command self-testing of the PU electronics assembly LH_2 and LO_2 bridges. Voltages which require measurement during the bridge tests will be displayed on the digital voltmeter. The panel will provide ON-OFF control for the fuel boiloff bias signal. The bias signal will allow the PU electronics to permit an excess of LH_2 required for predicted boiloff. An ac meter will be provided for readout of the LH_2 and LO_2 bridge amplifiers and the valve-loop power amplifiers.

Components - The panel, as shown in Figure 8-14, will consist of the following components:

- a. Chassis
- b. Panel
- c. Terminal boards
- d. Resistors
- e. Switches
- f. Indicator lights
- g. Panel meter
- h. Digital voltmeter

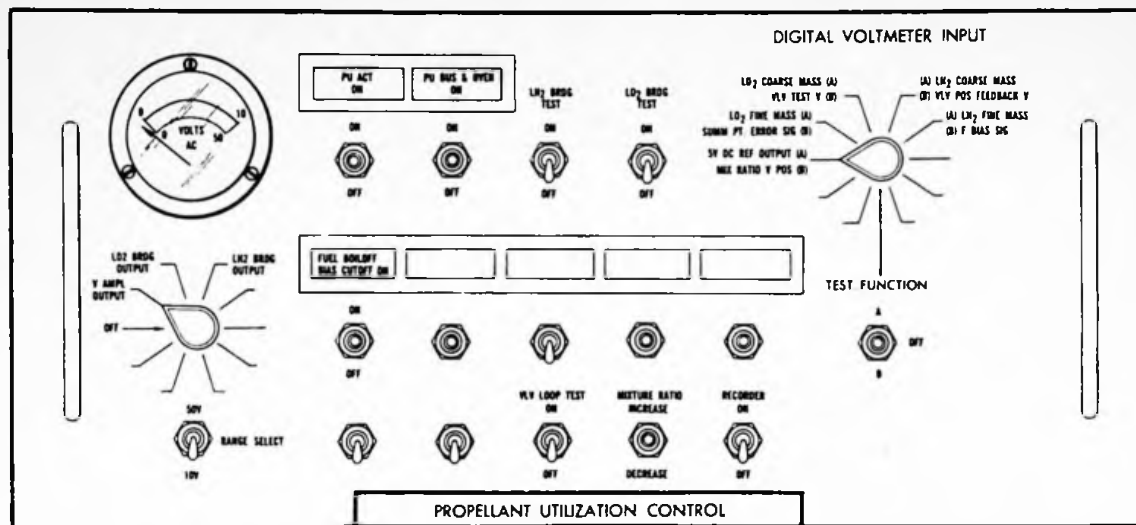


Figure 8-14. Digital Voltmeter and Propellant Utilization Panel Assembly (DSV-4B-247)

- i. Receptacles
- j. Relays
- k. Diodes.

Dimensions - The panel will have the following approximate dimensions: height, 17 1/2 inches; width, 19 inches; and depth, 21 1/2 inches.

8.18 GH₂/GN₂ Control Panel Assembly (DSV-4B-249)

Function - The function of the GH₂/GN₂ Control Panel Assembly shall be to provide operation and monitoring of the gaseous hydrogen and nitrogen systems.

Design - The panel assembly will be designed to:

- a. Control and monitor the 1500 psia and 2500 psia gaseous hydrogen system.
- b. Control and monitor the engine start bottle pressurization and vent system.

- c. Control and monitor the evaporator and heat exchanger.
- d. Control and monitor the gaseous nitrogen system.

Control junctions are defined as opening and closing valves, initiating purges, chilldowns, tests, and adjusting regulators.

Monitor junctions are defined as indicator lamp showing status of valve position, vent positions, and regulator increase/decrease function. Other monitor functions are liquid hydrogen level, temperatures, and pressures.

Components - The panel, as shown in Figure 8-15, will consist of the following components:

- a. Panel
- b. Chassis
- c. Meters
- d. Switches
- e. Indicator lamps.

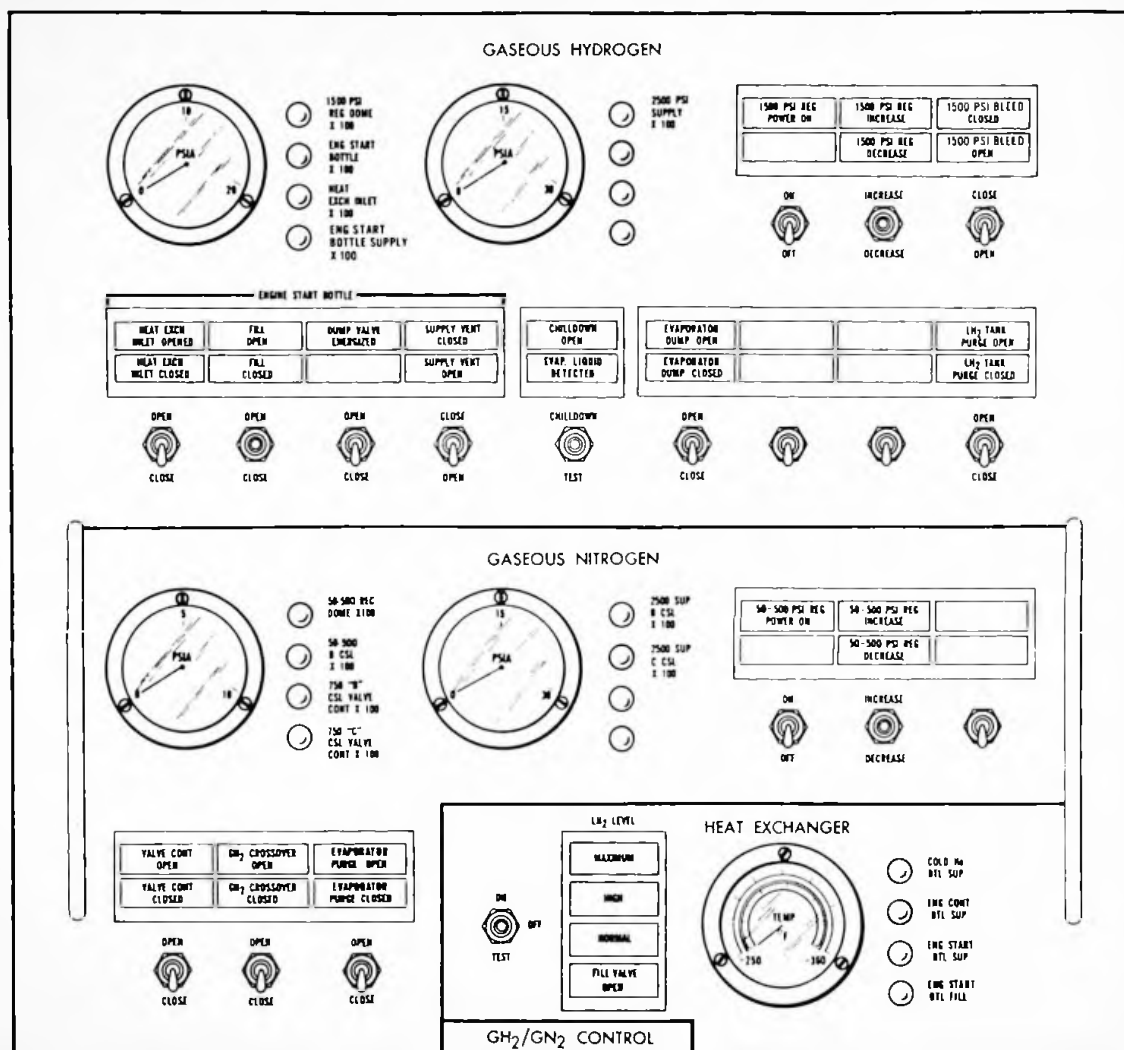
8.19 Inverter Power Supply Panel Assembly (DSV-4B-250) 1A60015-1

Function - The function of the Inverter Power Supply Panel Assembly shall be to supply regulated 28-vdc power to the stage inverter.

Design - The design of the power supply, as shown in Figure 8-16, will provide 32-vdc, adjustable from 24 v to 34-vdc, at 15 amperes. Load and line regulation will be ± 2 percent. Ripple will not exceed 50 mv peak-to-peak volts. The unit shall be remote sensing, reverting to local sensing upon opening of remote sense lines. A 26 to 32-vdc signal will indicate sensing mode. Input and output grounds will be isolated from each other and will not be grounded internally. An external circuit chassis ground terminal will be provided.

Components - The power supply will consist of the following major components:

- a. One 15-amp transistorized power supply
- b. Capacitors

Figure 8-15. GH₂/GN₂ Control Panel Assembly (DSV-4B-249)

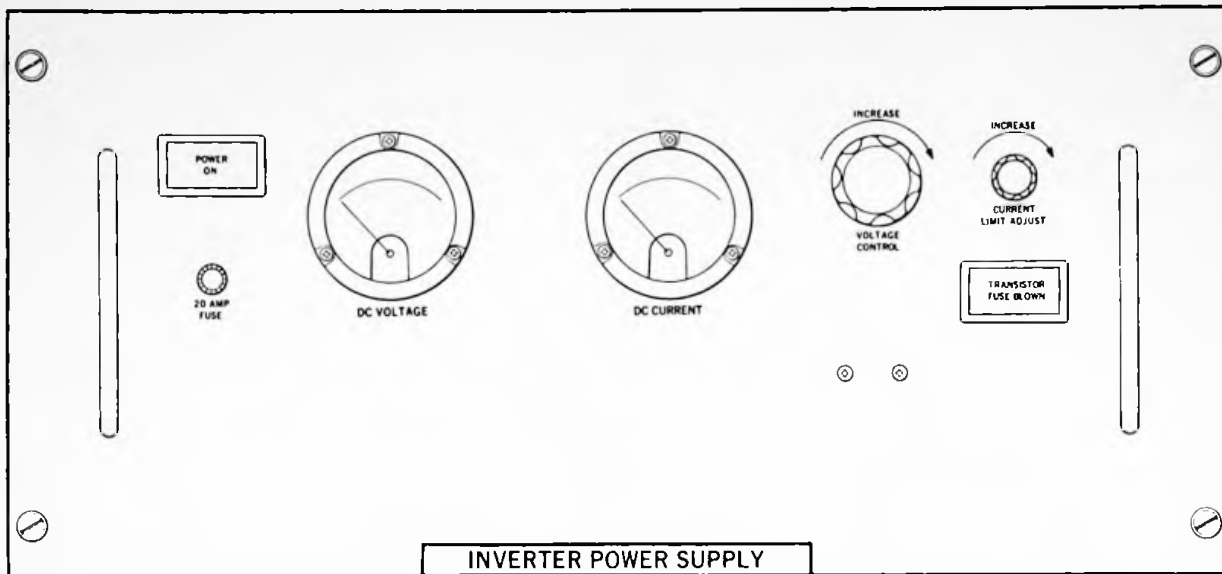


Figure 8-16. Inverter Power Supply Panel Assembly (DSV-4B-250)

- c. Resistors
- d. Transducers
- e. Meters
- f. Switches
- g. Indicator lamps
- h. Potentiometers.

Dimensions - The power supply will have the following approximate dimensions: height, 8-3/4 inches; width, 19 inches; and depth, 20 inches.

8.20 Gimbal Power Supply Panel Assembly (DSV-4B-251) 1A60330-1

Function - The function of the Gimbal Power Supply Panel Assembly shall be to provide ± 50 milliamperes current to the engine actuator coils. (This will normally be taken from the instrumentation unit.)

Design - The power supply, as shown in Figure 8-17, will be designed to be a self-contained unit. The power supply will require an input of 115 vac, and the outputs of the pitch and yaw constant-current amplifiers will be continuously variable between plus and minus 5 vdc, with regulation of ± 1 percent.

Components - The power supply will consist of the following major components:

- a. Two 25-volt input signal power supplies
- b. Two ± 55 -volt excitation power supplies
- c. Two constant-current amplifiers
- d. Chassis
- e. Panel
- f. Plus
- g. Miscellaneous transformers, transistors, and resistors.

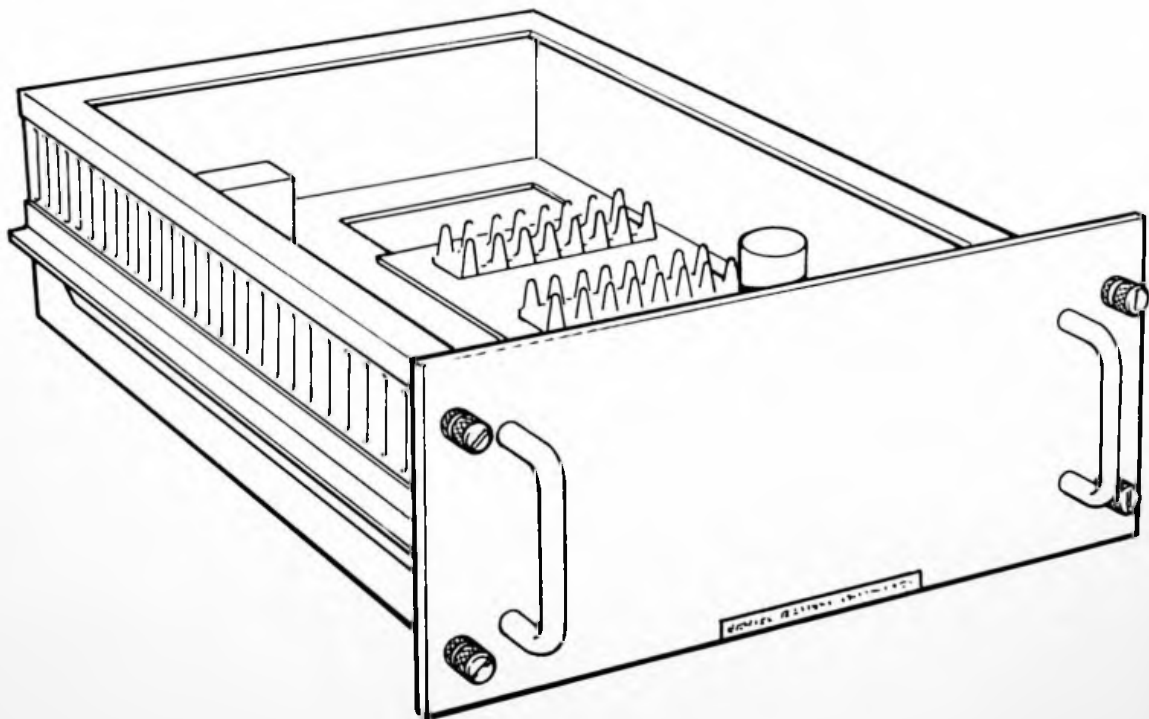


Figure 8-17. Gimbal Power Supply Panel Assembly (DSV-4B-251)

8.21 Chilldown Inverter Control Panel Assembly (DSV-4B-271) 1A60311-1

Function - The function of the Chilldown Inverter Control Panel Assembly shall be to control and monitor the LO_2 and LH_2 childdown inverters and recirculating pumps. The panel shall also monitor the magnitude of the inverter output currents and voltages and shall display the waveforms either locally on the panel oscilloscope or externally, by connecting to an oscilloscope.

Design - The panel will be designed to provide the necessary switches and indicator lights to control and monitor the inverters and recirculation pumps. The panel will contain test point jacks and an oscilloscope for viewing the inverter output waveforms. The panel will also have the capability of connecting to a portable oscilloscope for more detailed analysis of the waveforms. In addition, the panel will be capable of monitoring inverter output voltages, currents, frequency, running time, RPM (revolutions per minute), and temperature.

Components - The panel, as shown in Figure 8-18, will consist of the following components:

- a. Chassis
- b. Panel
- c. Switches
- d. Light assemblies
- e. Meters
- f. Resistors
- g. Trim potentiometers
- h. Receptacles
- i. Output jacks
- j. Panel oscilloscope.

Dimensions - The panel will have the following approximate dimensions: height, 17 inches; width, 19 inches; and depth, 19 inches.

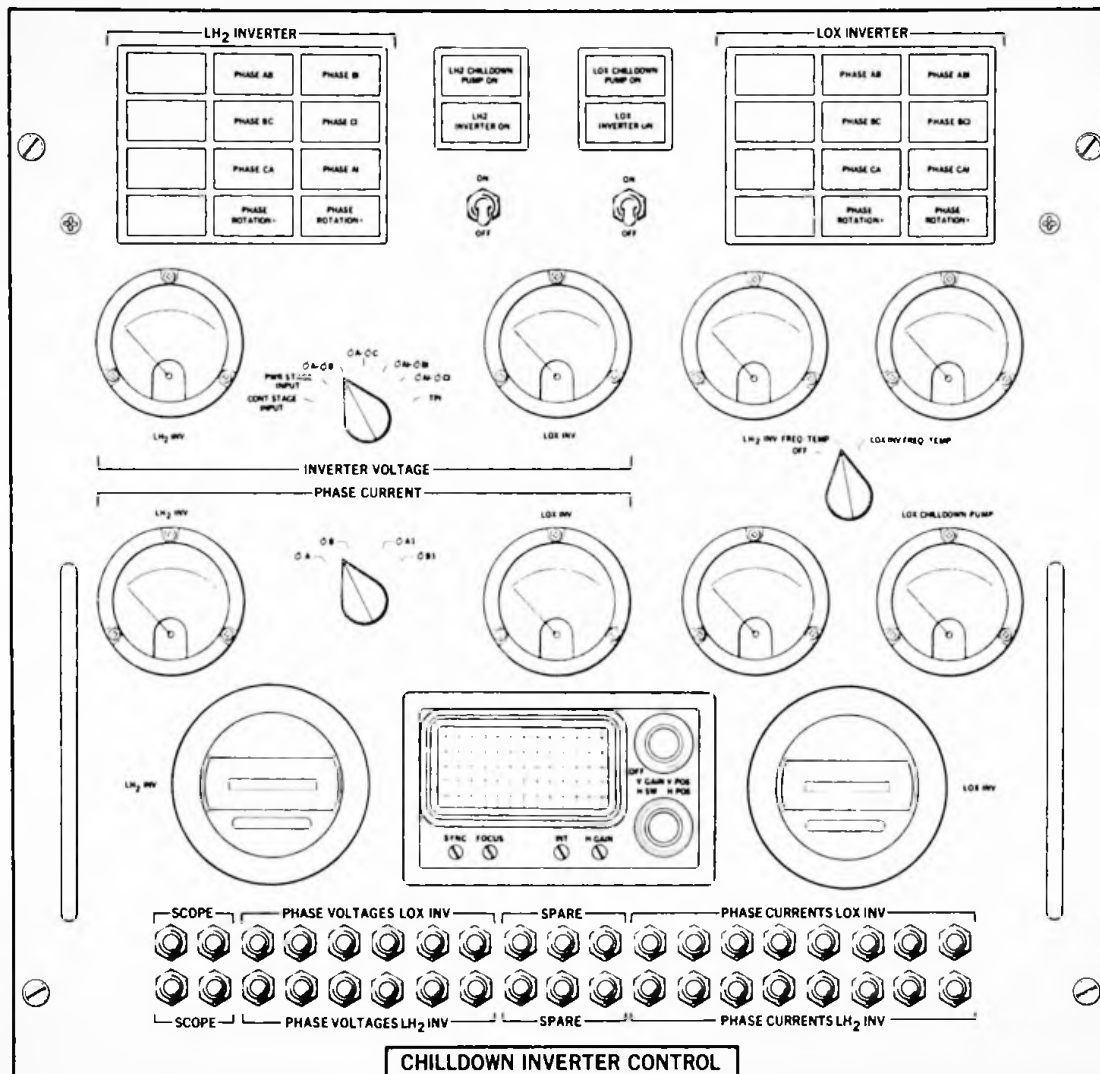


Figure 8-18. Chilledown Inverter Control Panel Assembly (DSV-4B-271)

8.22 Battleship Pneumatic Console "A" (DSV-4B-327) 1A57741-1

Function - The function of Battleship Pneumatic Console "A" shall be to provide ambient GN_2 and helium at the proper pressures to meet the Battleship tank propulsion system requirements during checkout and count-down at SACTO test stand Beta 1.

Design - The Pneumatic Console "A" will be 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 will be purged with GN_2 under positive pressure to maintain an inert atmosphere within the cabinet. All bleed valve outlets will be routed to bulkhead fittings on the console for overboard disposal. Components will be 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 will be designed to be manually controlled and electrically actuated from the test control center. All critical pressures will be 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 will be controlled from the test control center, as required. All propellant tank loading, unloading, and purging operations will be 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 will assume a safe or normal position. GN_2 will be used in place of helium for certain checkout and purging operations. The console will be capable of manual operation during checkout and manual/remote operation during countdown. The console will also be designed to supply ambient helium to the gas heat exchanger.

Components - The Pneumatic Console "A", as shown in Figure 8-19, will consist of an aluminum cabinet housing the following components:

- a. Pressure gages
- b. Pressure transducers

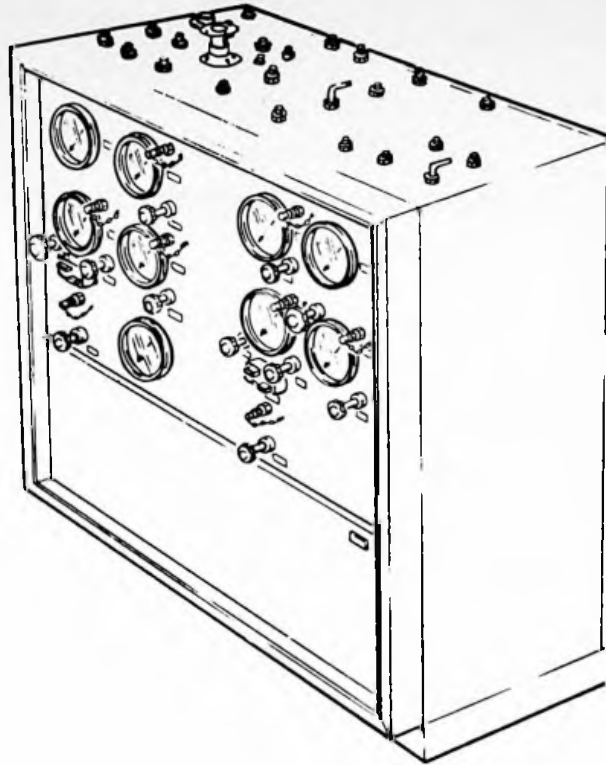


Figure 8-19. Battleship Pneumatic Console "A" (DSV-4B-327)

- c. Temperature transducers
- d. Solenoid-operated valves
- e. Hand-operated valves
- f. Dome regulators
- g. Hand-operated regulators
- h. Solenoid-operated regulators
- i. Check valves
- j. Relief valves
- k. Orifices
- l. Filters
- m. Stainless steel pneumatic lines.

Dimensions - The Pneumatic Console "A" will have the following approximate dimensions: height, 6 feet; width, 5 feet; depth, 3 feet; and weight, approximately 900 pounds.

8.23 Battleship Pneumatic Console "C" (DSV-4B-328) 1A57739-1

Function - The function of Battleship Pneumatic Console "C" shall be 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.

Design - The Pneumatic Console "C" will be designed to receive, regulate, and control ambient and cold GH_2 and helium, and to supply the gases, as required, to the Battleship tank during checkout and countdown operations. The console will also be capable of receiving GN_2 for pneumatic valve actuation pressure within the console. The console will be purged with GN_2 under positive pressure to maintain an inert atmosphere within the cabinet. All GH_2 bleed and vent outlets will be routed to bulkhead fittings on the console, and in turn, connected to the hydrogen vent and disposal system. All other bleed valve outlets will be routed to bulkhead fittings on the console for overboard disposal. Components will be 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 will be designed to be manually controlled and electrically actuated from the test control center. All critical pressures will be 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 will be controlled from the test control center, as required. All propellant tank loading, unloading, and purging operations will be accomplished from the test control center. In the event of electrical or pneumatic failure during countdown, all remotely controlled valves will assume a safe or normal position.

Components - The Pneumatic Console "C," as shown in Figure 8-20, will consist of an aluminum cabinet housing the following components:

- a. Pressure gages
- b. Pressure transducers
- c. Temperature transducers
- d. Solenoid-operated valves

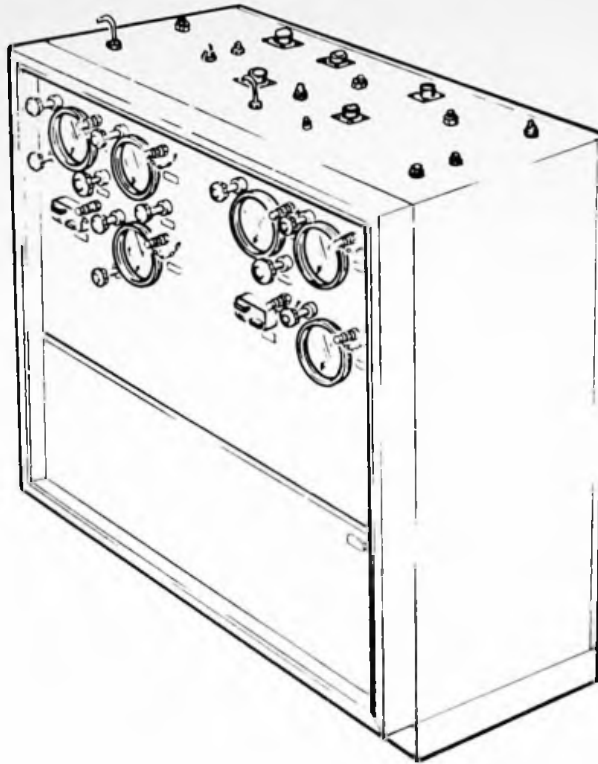


Figure 8-20. Battleship Pneumatic Console "C" (DSV-4B-328)

8.24 Pneumatic Console "B" (DSV-4B-333) 1A57740-1

Function - The function of Pneumatic Console "B" shall be 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.

Design - The Pneumatic Console "B" will be designed to receive and control ambient and cold helium, and to receive, regulate, and control ambient GN_2 . The console will also be capable of supplying the gases, as required, to the Battleship tank during checkout and countdown operations. The console will be purged with GN_2 under positive pressure to maintain an inert atmosphere within the cabinet. All bleed valve outlets will be routed to bulkhead fittings on the console for overboard disposal. Components will be 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 will be designed to be manually controlled and electrically actuated from the test control center. All critical pressures will be 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 will be controlled from the test control center. In the event of electrical or pneumatic failure during countdown, all remotely controlled valves will assume a safe or normal position. The Battleship LH₂ tank prepressurization valves will be closed by an electrical signal from the LH₂ tank pressure switch. Four monitor systems will be connected to the Battleship tank during checkout for monitoring Battleship tank pressures. The console will be capable of manual operation during checkout and manual/remote operation during countdown.

Components - The Pneumatic Console "B," as shown in Figure 8-21, will consist of an aluminum cabinet housing the following components:

- a. Pressure gages
- b. Pressure transducers
- c. Temperature transducers
- d. Solenoid-operated valves
- e. Hand-operated valves
- f. Pneumatically operated valves
- g. Dome regulators
- h. Hand-operated regulators
- i. Solenoid-operated regulators
- j. Relief valves
- k. Orifices
- l. Filters
- m. Stainless Steel pneumatic lines
- n. Check valves.

Dimensions - The Pneumatic Console "B" will have the following approximate dimensions: height, 6 feet; width, 5 feet; depth, 3 feet; and weight, approximately 850 pounds.

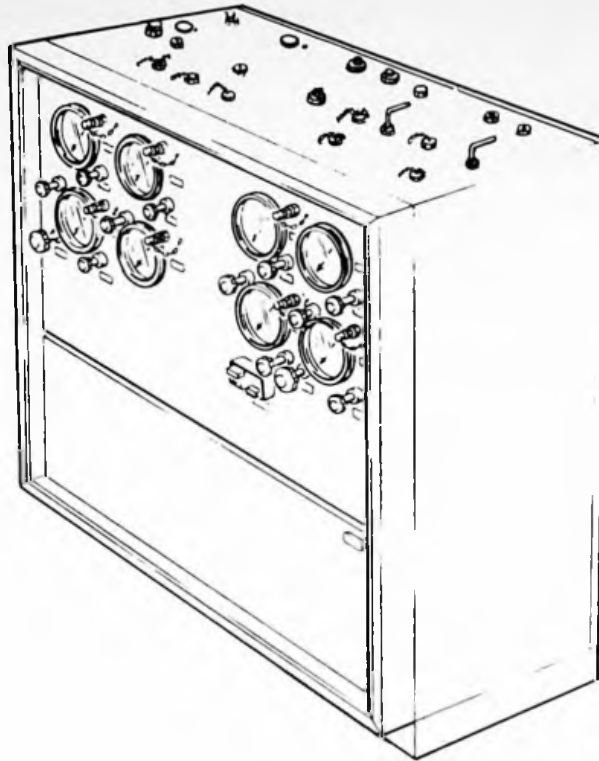


Figure 8-21. Pneumatic Console "B" (DSV-4B-333)

8.25 Umbilical Kit, GH₂ Vent, SACTO (DSV-4B-334) 1A92818-1

Function - The function of the SACTO GN₂ Vent Umbilical Kit shall be to provide the interconnecting line required for the transmission of gases from the Battleship LH₂ tank to the Facility vent system.

Design - The kit will consist of a flexible vent hose with a purging connection at one end and a flexible purging line. The flexible purging line will be connected to the flexible vent line. This kit will be designed to accomplish the following: (See Figure 8-22.)

- a. Transfer GH₂ from the Battleship LH₂ tank to the facility vent system
- b. Transfer blanket pressure gas or purge gas from the Battleship LH₂ tanks to the facility vent system
- c. Purge the vent line from a facility source.

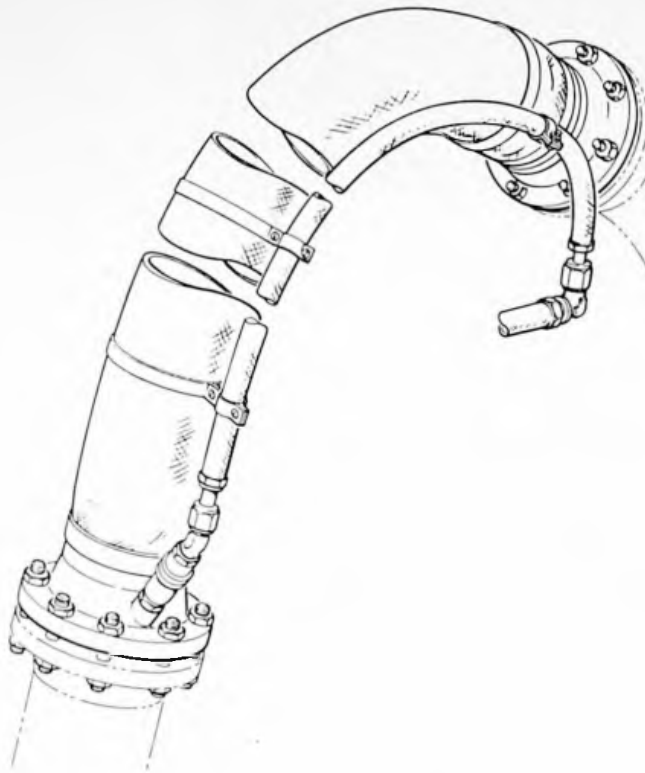


Figure 8-22. Umbilical Kit, GH₂ Vent SACTO (DSV-4B-334)

Components - The following will comprise the forward umbilical kit:

- a. Convoluted, flexible, stainless steel hose for venting the Battleship LH₂ tank
- b. Convoluted, flexible, stainless steel hose for vent purging.

8.26 Aft Umbilical Installation Kit, Propulsion - Pneumatic Lines
(DSV-4B-335)

Function - The function of the Propulsion - Pneumatic Lines Aft Umbilical Kit shall be to provide the inter-connecting lines required for the transmission of propellants and gases from the facility/GSE sources to the Battleship Stage Tanks during static test operation.

Design - The aft umbilical kit as shown in Figure 8-23, will consist of required sizes of flexible hoses and will be designed to accomplish the following:

- a. Transfer liquid oxygen from a facility source to the Battleship LOX tank.

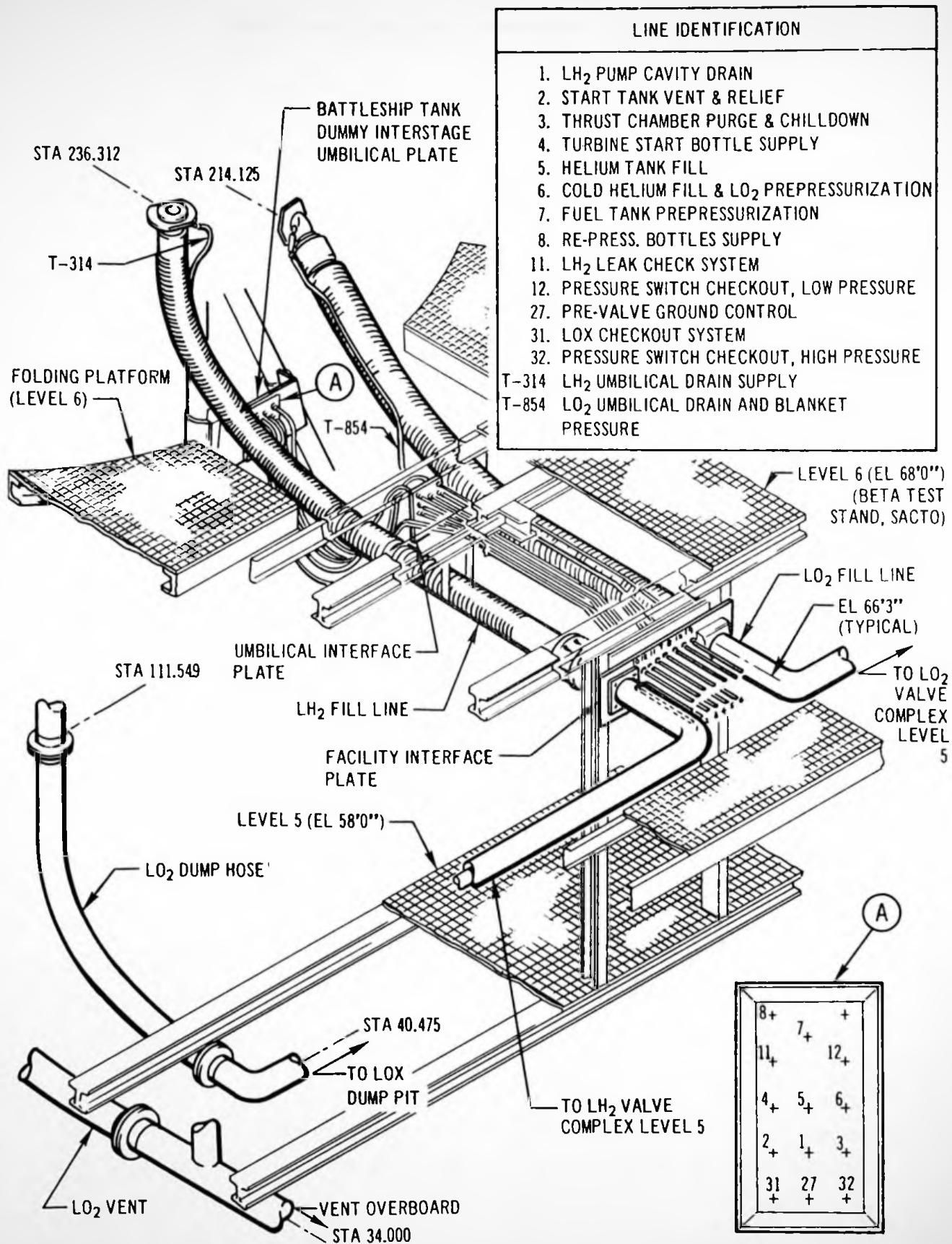


Figure 8-23. Aft Umbilical Installation Kit, Propulsion - Pneumatic Lines (DSV-4B-335)

- b. Transfer liquid hydrogen from a facility source to the Battleship LH₂ tank.
- c. Transfer ambient helium gas from GSE to Battleship subsystems during checkout and service operations.
- d. Transfer cold helium gas from GSE to Battleship subsystems during servicing operations.
- e. Transfer ambient nitrogen gas from GSE to Battleship LOX and LH₂ tanks during servicing operations.
- f. Transfer ambient and cold hydrogen gas from GSE to Battleship J-2 engine during servicing operations.

Components - The following components will be included in the aft umbilical kit as shown in Figure 8-23.

- a. Vacuum-jacketed hose with flanged ends.
- b. Vacuum-jacketed hose with a flanged end and a welded end.
- c. High pressure type flexible hoses with insulation for cold gas service.
- d. High pressure type flexible hoses.
- e. Low pressure type flexible hoses.



9. INSTRUMENT UNIT TEST EQUIPMENT9.1 General

The following support equipment comprised the items required for the Instrument Unit Test performed at the Douglas Aircraft Company., Huntington Beach.

DSV-4B-193	Power Supply Auxiliary
DSV-4B-194	Cable Network, Environmental Test
DSV-4B-195	Control Panel, Digital Simulator
DSV-4B-196	Panel Assembly, Range Safety Monitor
DSV-4B-197	Panel Assembly, Power System Monitor and Control
DSV-4B-198	Panel Assembly, Propellant Utilization Control and Monitor
DSV-4B-199	Panel Assembly, Measurement Control and Monitor
DSV-4B-200	Power Supply, Measurement
DSV-4B-201	Chassis, Ordnance Monitor and Control
DSV-4B-202	Power Supply, Calibration
DSV-4B-203	Distribution Box, Circuit Protection
DSV-4B-204	Patch Panel, Interconnecting Box
DSV-4B-205	Distribution Box, Umbilical

10. QUALITY ASSURANCE PROVISIONS

10.1 General

Quality assurance provisions covering the Contractor-designed equipment designated herein shall be in general accordance with NASA Publication NPC-200-2. Inspection provisions for suppliers of space materials, parts, components, and service shall be in general accordance with NASA Publication NPC-200-3. Quality control provisions for the S-IVB Program will be as defined in SM-41891, Quality Program Plan, Saturn S-IVB System.

10.2 Testing

The items of GSE used will be supplied in such small quantities that their fabrication will be accomplished on a prototype basis. Accordingly, they shall be qualified for functional operation as research and development items. The general test plan covering GSE testing requirements is defined in Douglas Aircraft Company Report SM-41412.

10.3 Load-Bearing Structures

Inspection of critical load-bearing structures shall be in accordance with the applicable design requirements drawings.

11. PREPARATION-FOR-DELIVERY REQUIREMENTS

11.1 General

Lubrication, preservation, packaging, packing, labeling and marking for Contractor-designed equipment designated herein shall be in accordance with Level C of Federal Standard FED-STD-102, the preparation-for-delivery requirements of the contract, the detailed item specification, and other applicable specifications. All labor and materials required for preparation for delivery shall be furnished by the Contractor. This shall include any disassembly either specified or considered necessary for protection during transit and storage.

11.2 Rust Prevention

All exposed unpainted machined surfaces which could corrode shall be lightly coated with a rust preventive compound. If extended storage of the GSE or its components is specified in the contract or detailed specifications, the unpainted surfaces shall be coated with rust preventive compounds in accordance therewith. Ordinarily, rust preventive compounds shall be lightly applied when extended storage is not expected, and heavily applied for extended storage.

11.3 Packing

Each assembly and major component shall be packaged, crated, boxed, or otherwise prepared for delivery as required by the contract and as specified by the detailed component specification. Packages shall be constructed in a manner permitting periodic inspection for corrosion, deterioration, and other damage. The packages shall be constructed in a manner that will allow the inspected items to be repacked in the original container. When necessary, the package shall be constructed to immobilize and cushion the item against shock and damage during shipping and handling. The Contractor shall furnish all labor and materials for packing, shall make such disassemblies as are necessary, and shall provide proper protection of machined surfaces from corrosion and injury.

11.4 Markings for Shipment and Storage

Markings for shipment and storage shall be in accordance with Standard MIL-STD-129.

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