

*Gace*

# SATURN S-IVB TRAINING GRAPHICS

SEPTEMBER 1963

PREPARED AS A TRAINING SERVICE BY:  
SATURN TRAINING-LOGISTICS SUPPORT

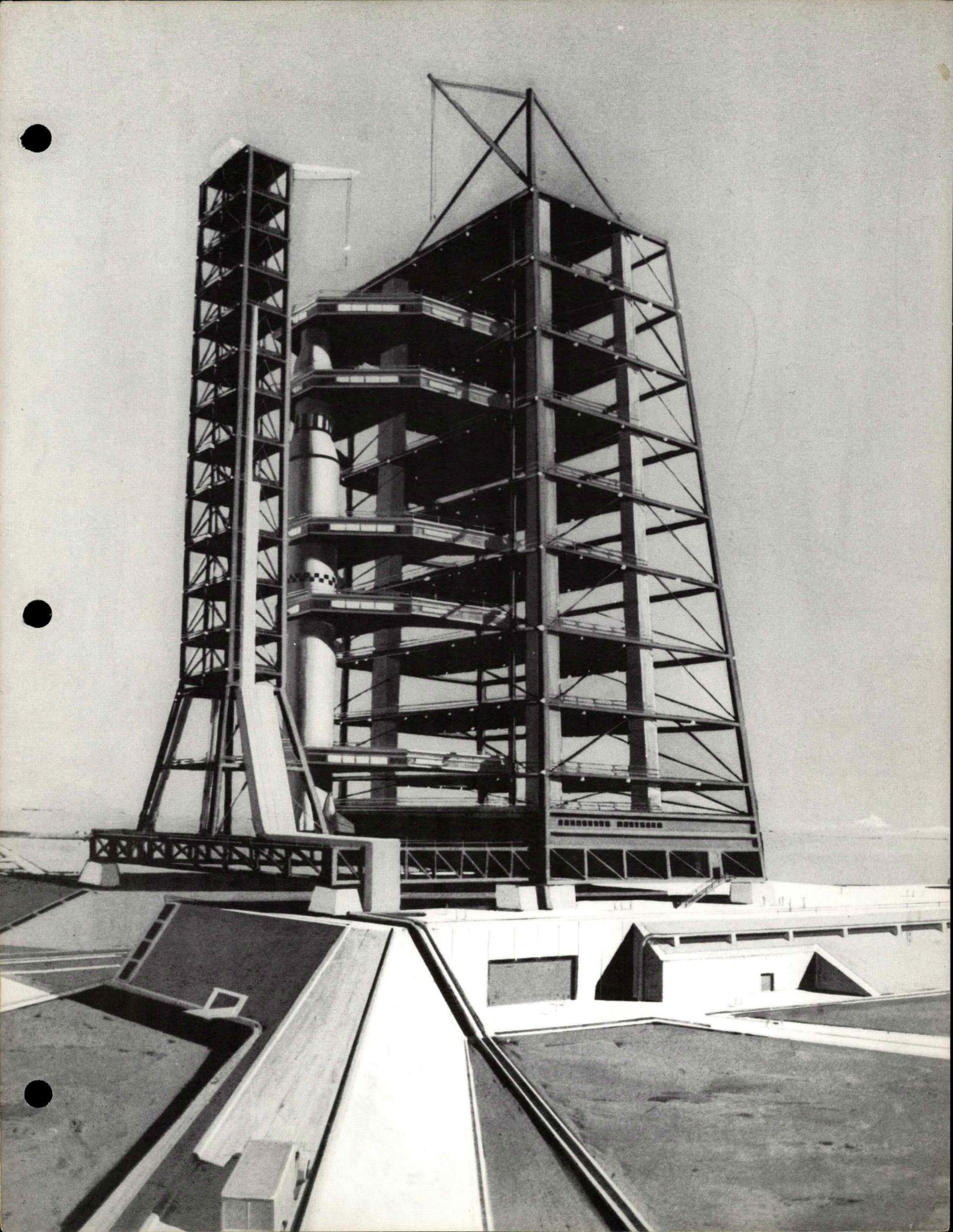
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ORIGINAL ART ON FILE IN  
A2-260 ILLUSTRATIONS GROUP

**MISSILE & SPACE SYSTEMS DIVISION  
DOUGLAS AIRCRAFT COMPANY, INC.  
SANTA MONICA/CALIFORNIA**

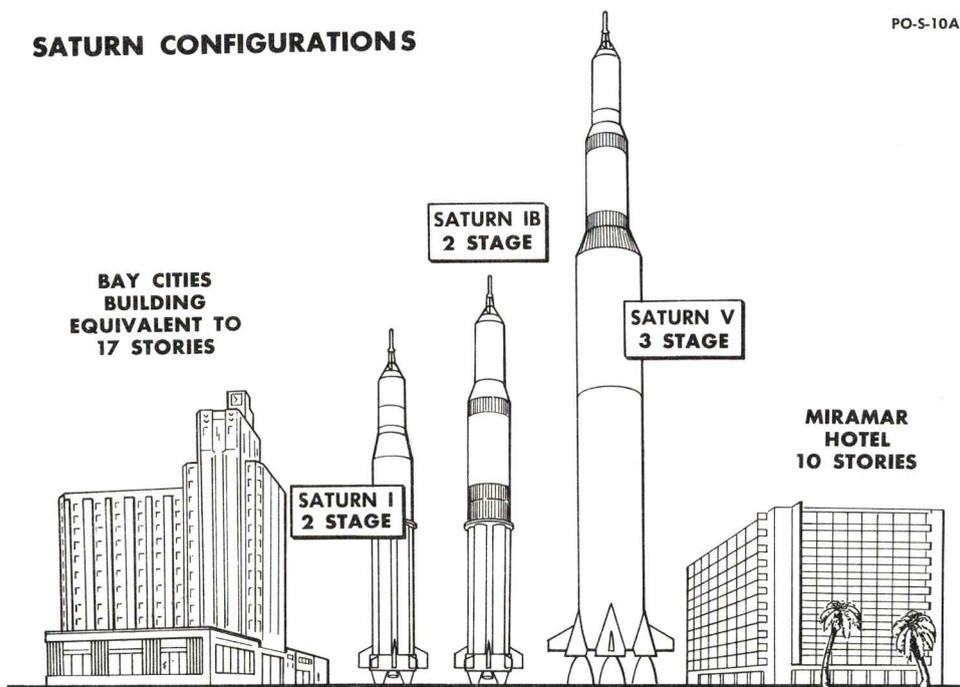






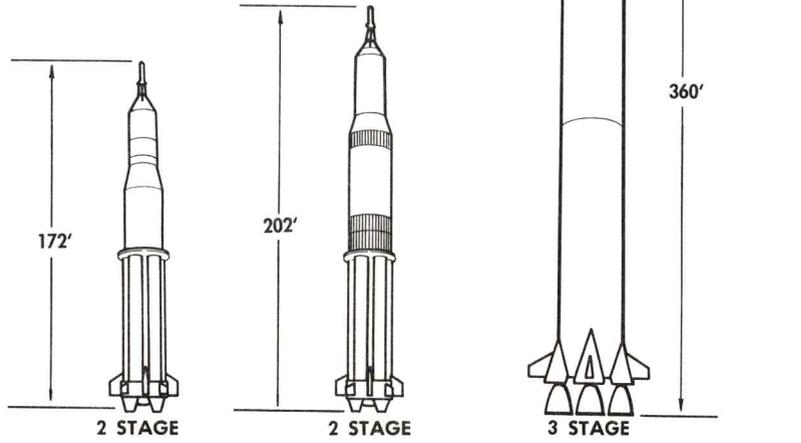
# SATURN CONFIGURATIONS

PO-S-10A



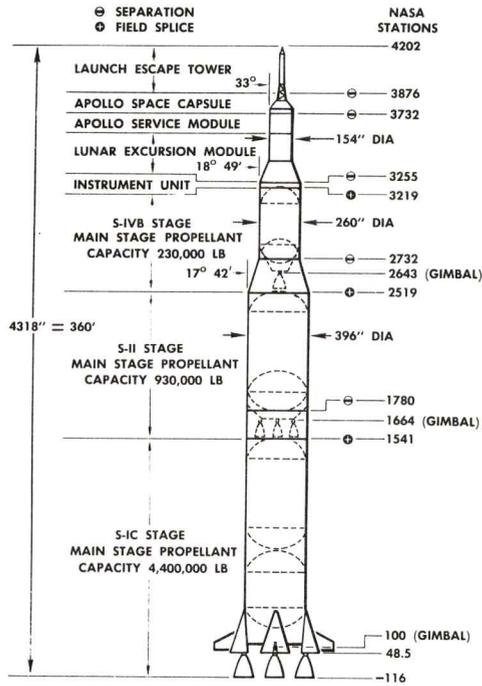
# SATURN CONFIGURATIONS

	SATURN I	SATURN IB	SATURN V
DRY WEIGHT	139,000 LBS	164,000 LBS	560,000 LBS
LIFT OFF WEIGHT	1,151,000 LBS	1,275,000 LBS	6,228,000 LBS



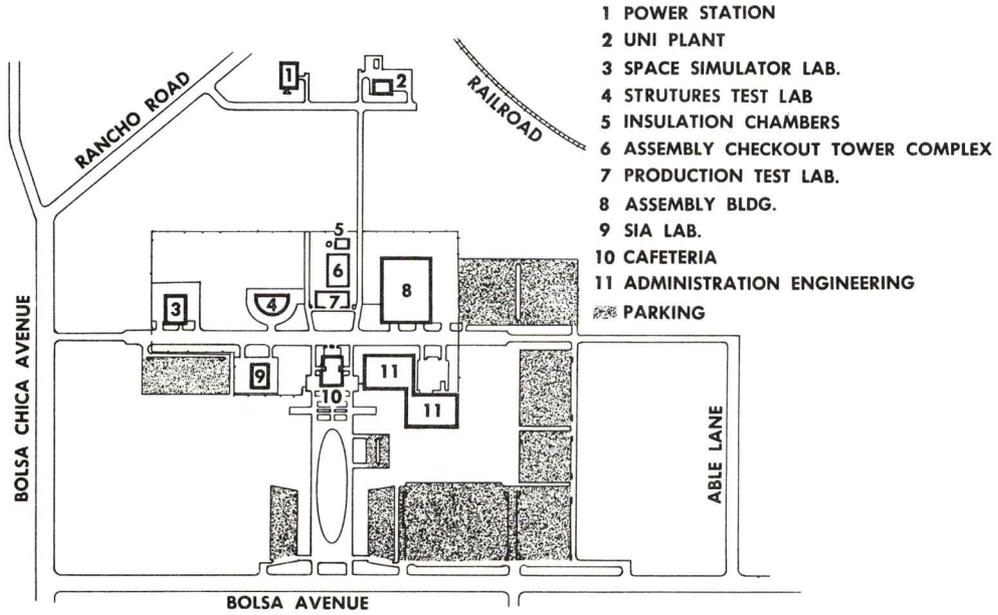
# SATURN V LAUNCH VEHICLE CONFIGURATION

DSV-4B-586



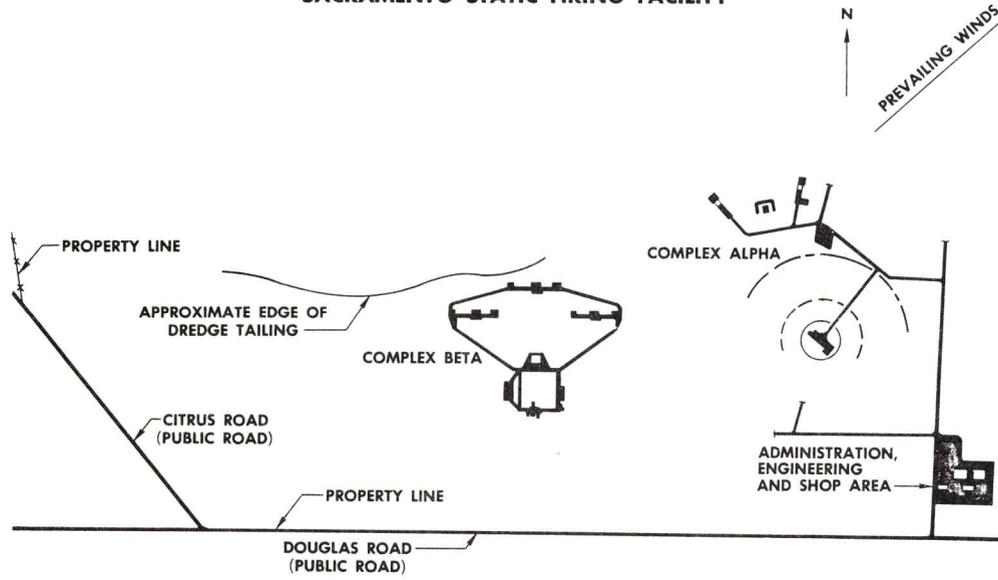
# SPACE SYSTEM CENTER HUNTINGTON BEACH

DSV-4B-588



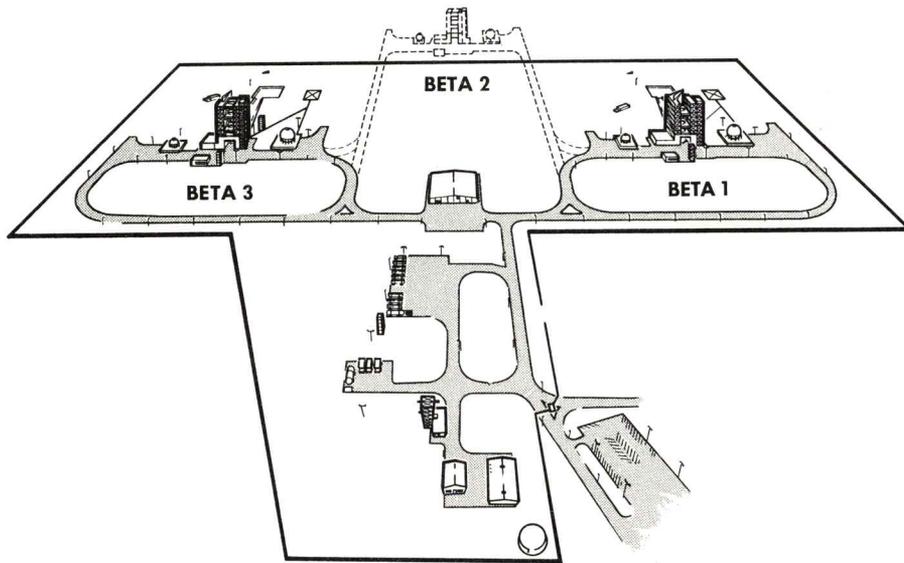
# SACRAMENTO STATIC FIRING FACILITY

DSV-48-49A



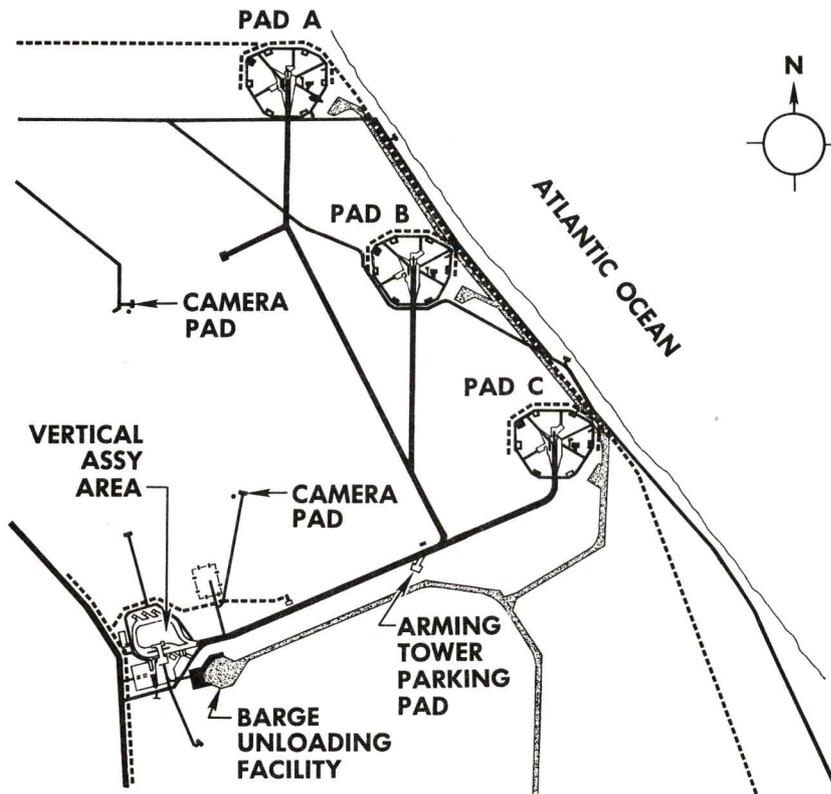
# BETA COMPLEX

DSV-4B-169



# LAUNCH COMPLEX 39

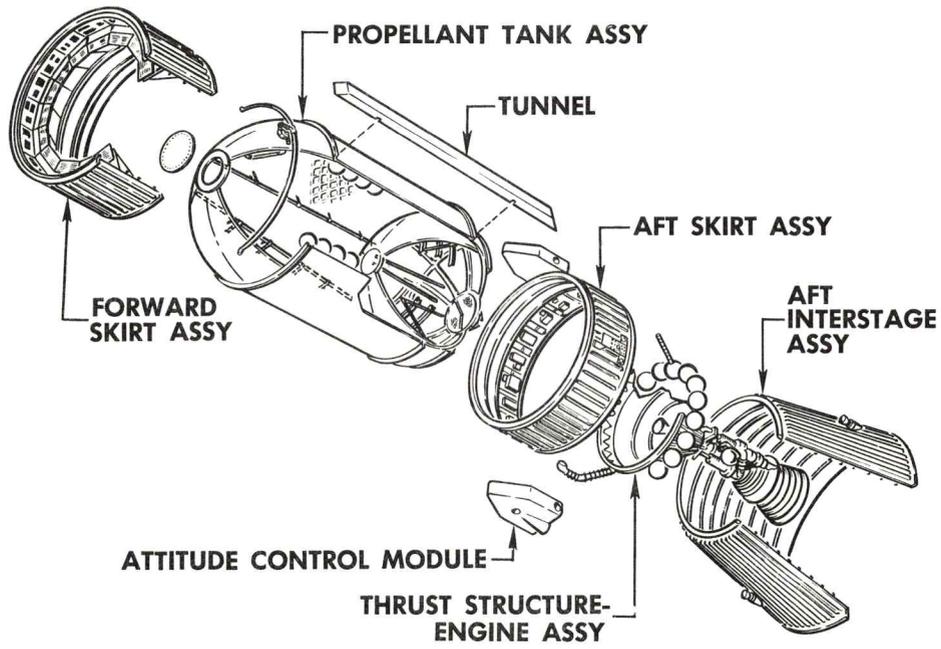
DSV-4B-393





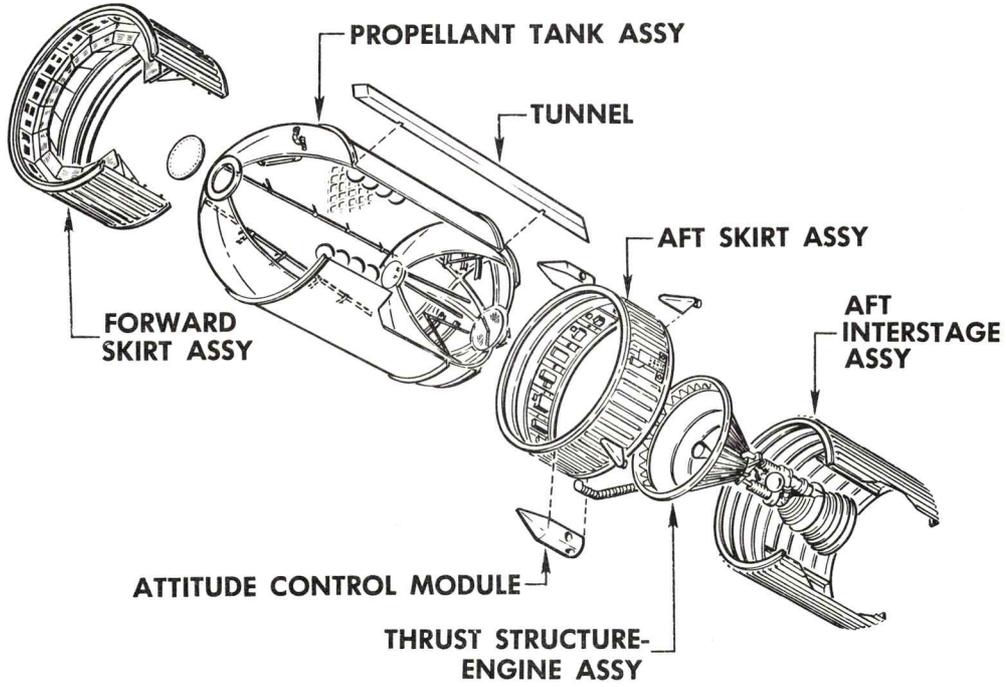
# SATURN V/S-IVB EXPLODED VIEW

DSV-4B-359



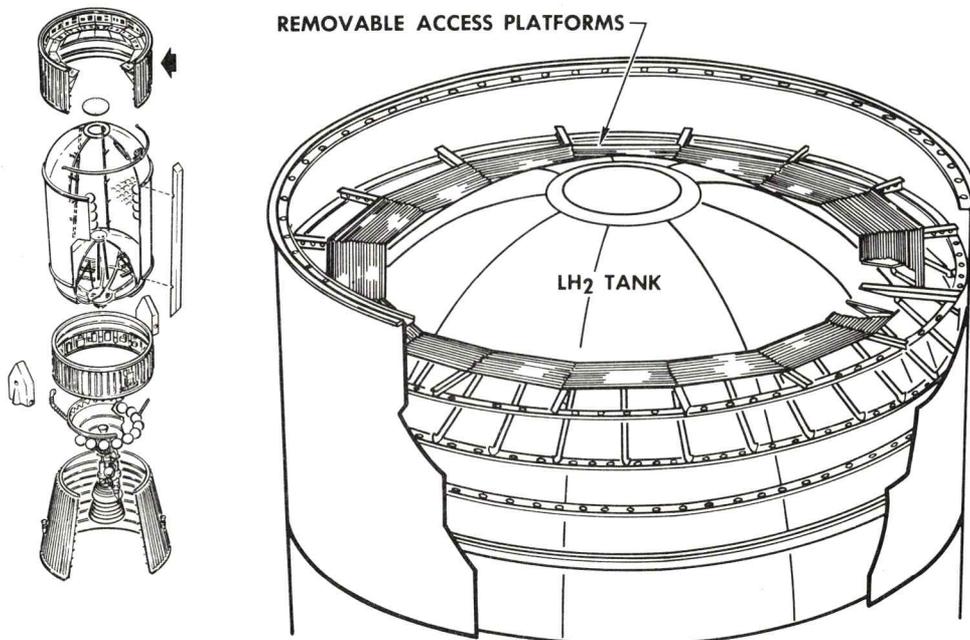
# SATURN IB/S-IVB EXPLODED VIEW

DSV-4B-367



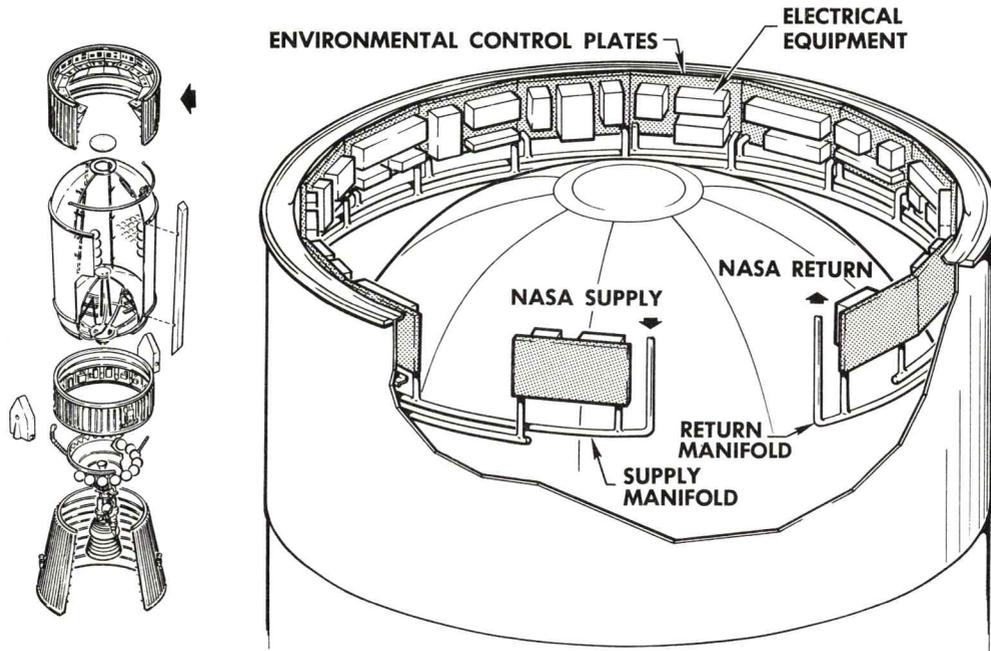
# S-IVB FORWARD SKIRT INSTALLATION

DSV-4B-54A



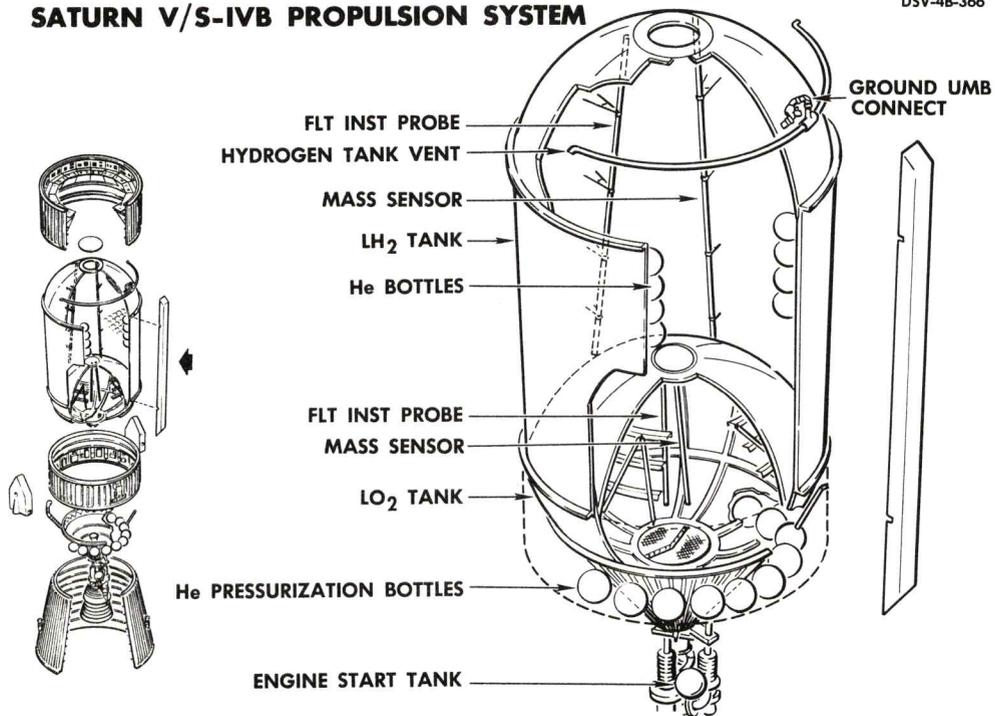
# S-IVB FORWARD SKIRT ENVIRONMENTAL CONTROL SYSTEM

DSV-4B-360



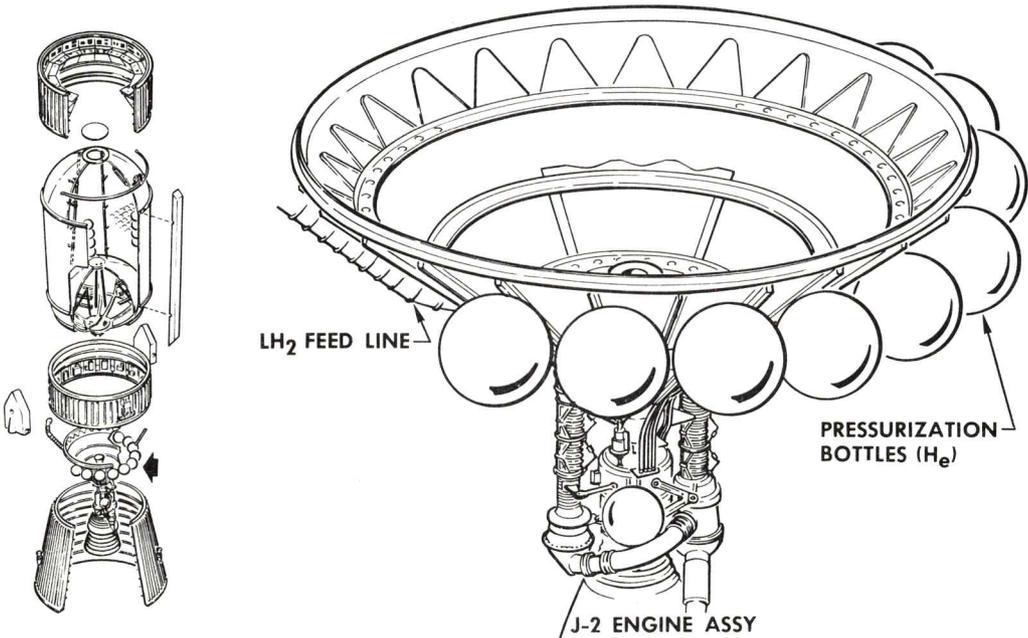
# SATURN V/S-IVB PROPULSION SYSTEM

DSV-4B-366



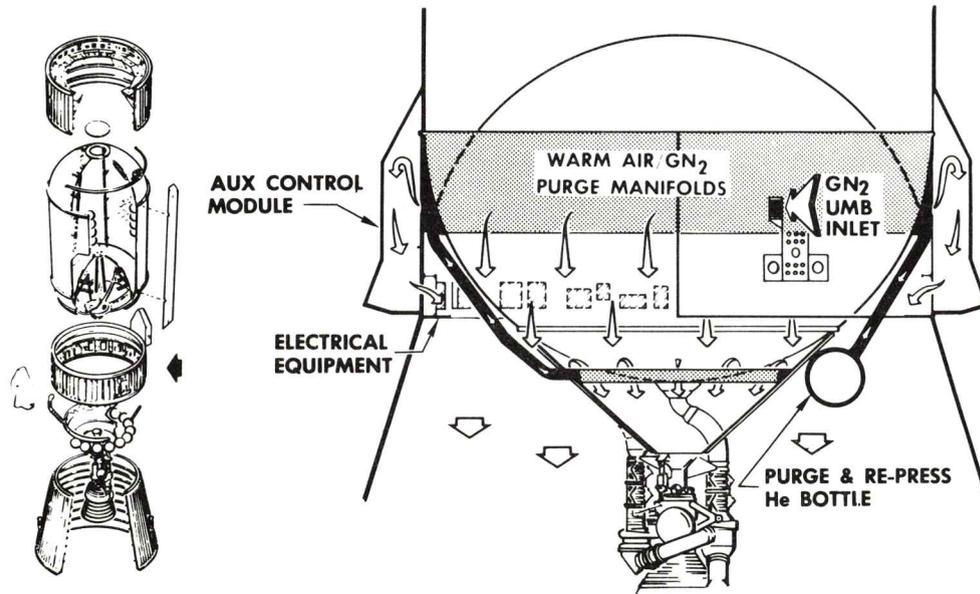
**S-IVB THRUST STRUCTURE/ENGINE ASSEMBLY**

DSV-4B-56 A



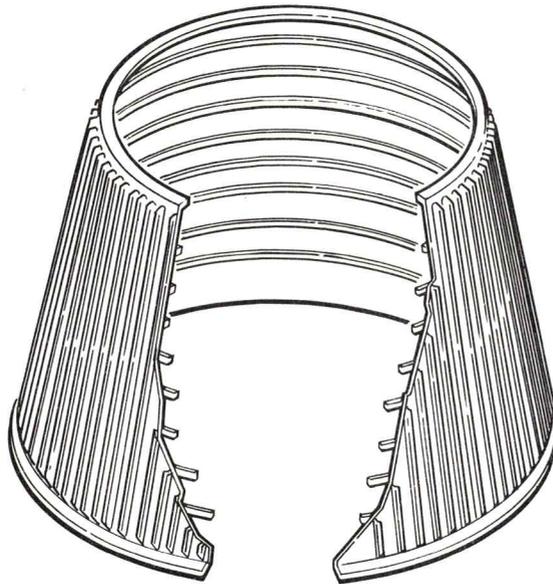
# SATURN V/S-IVB AFT SKIRT ENVIRONMENTAL CONTROL

DSV-48-362

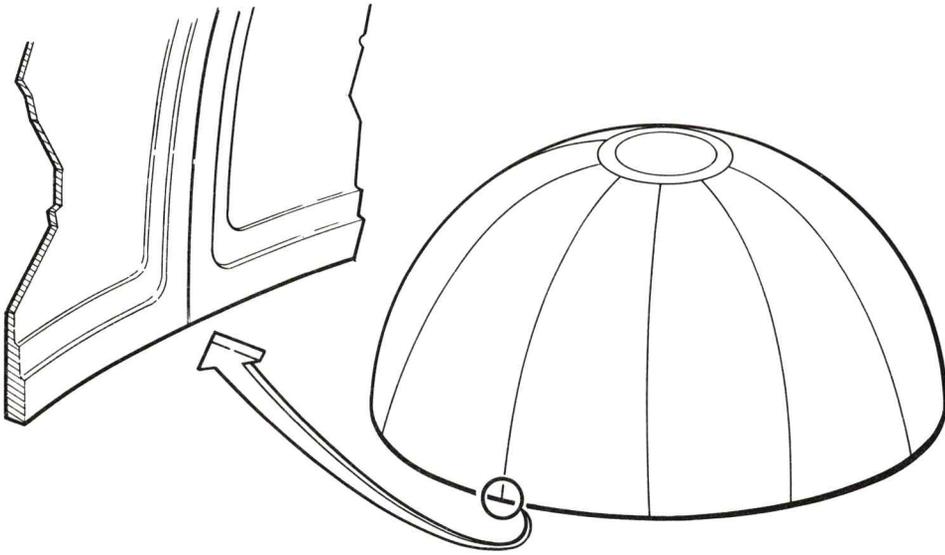


# SATURN V/S-IVB AFT INTERSTAGE

DSV-4B-384

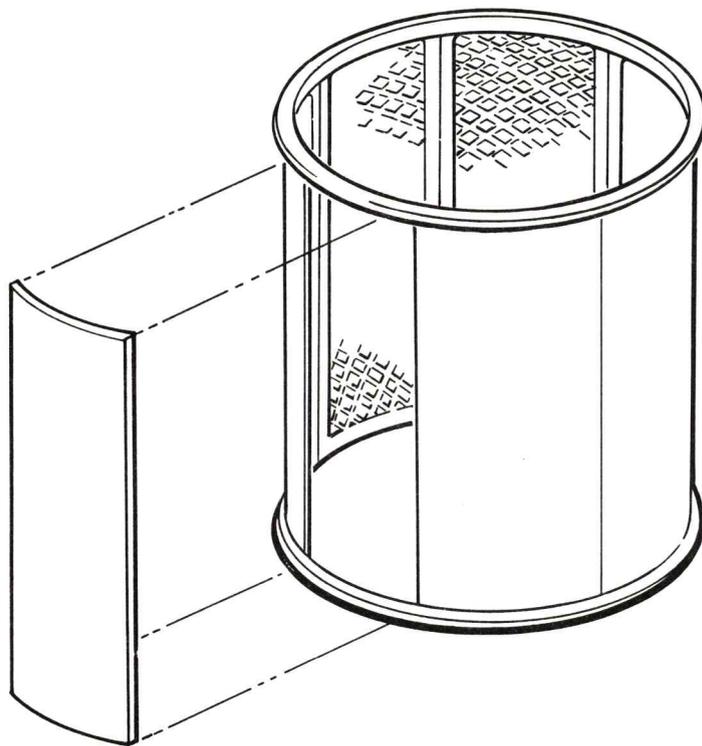


# SATURN S-IVB FORWARD DOME



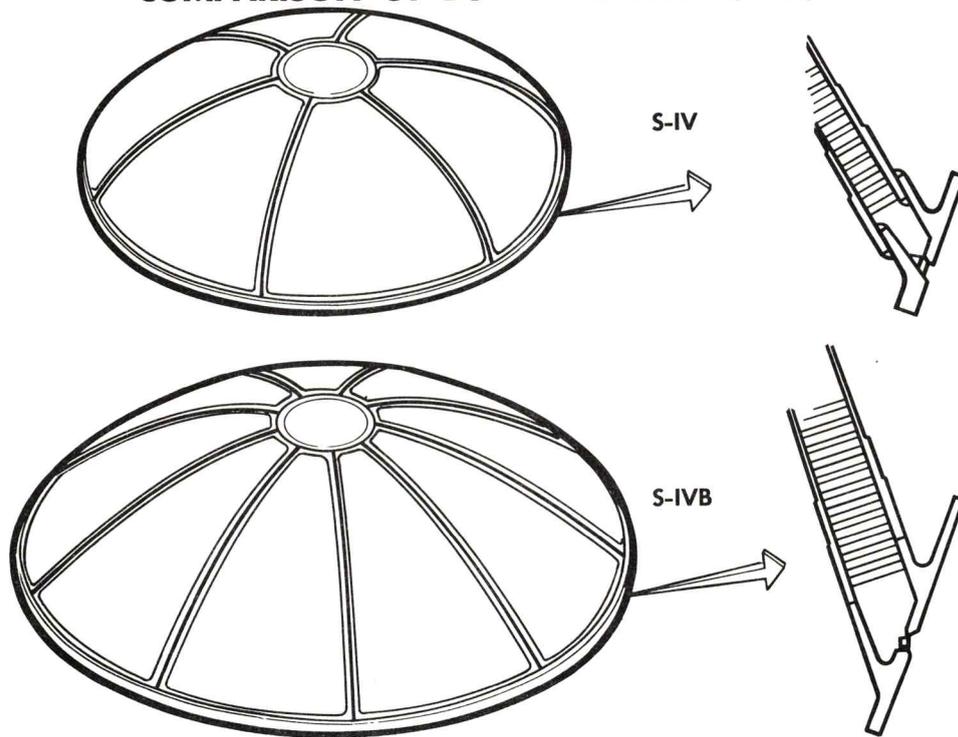
# SATURN S-IVB TANK SHELL

DSV-4B-426 A



# COMPARISON OF BULKHEAD FABRICATION

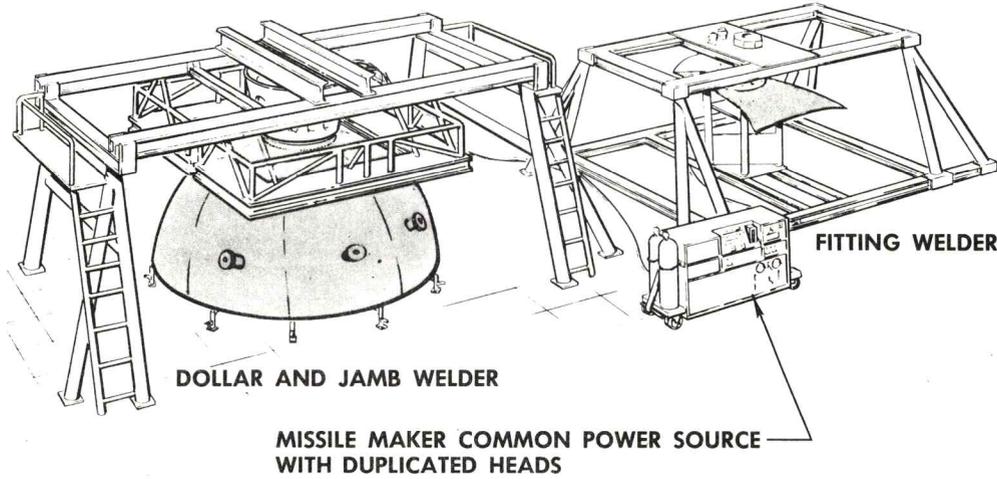
DSV-4B-172



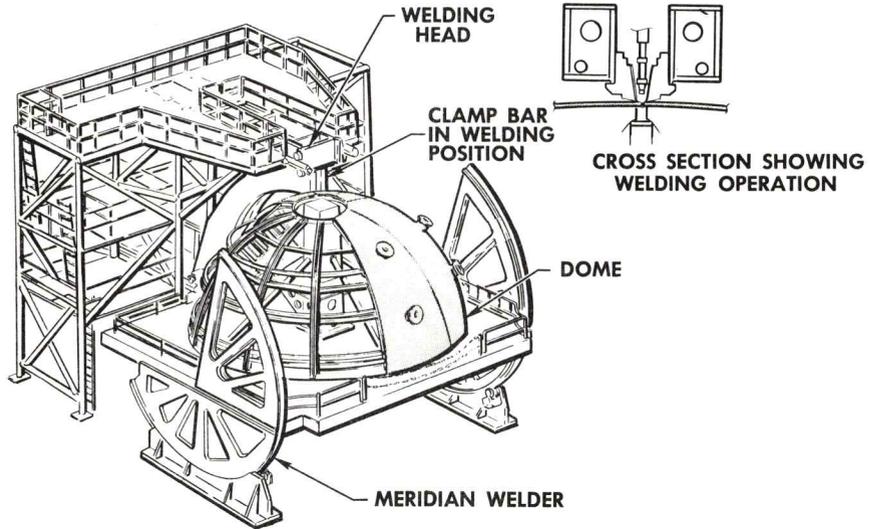
MANUFACTURING

**SATURN S-IVB WELD COMPONENTS—  
FORWARD AND AFT DOMES**

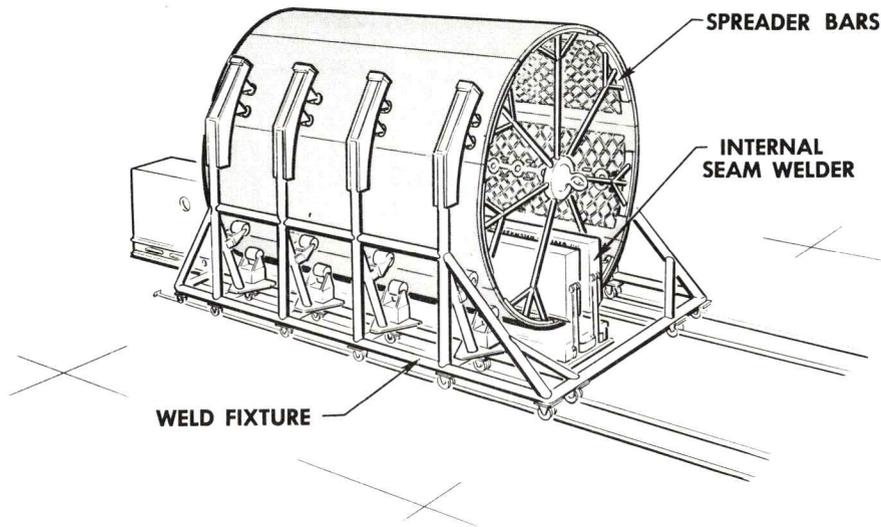
DSV-4B-382



### SATURN S-IV SEAM WELDING GORE SEGMENTS—FORWARD AND AFT DOMES

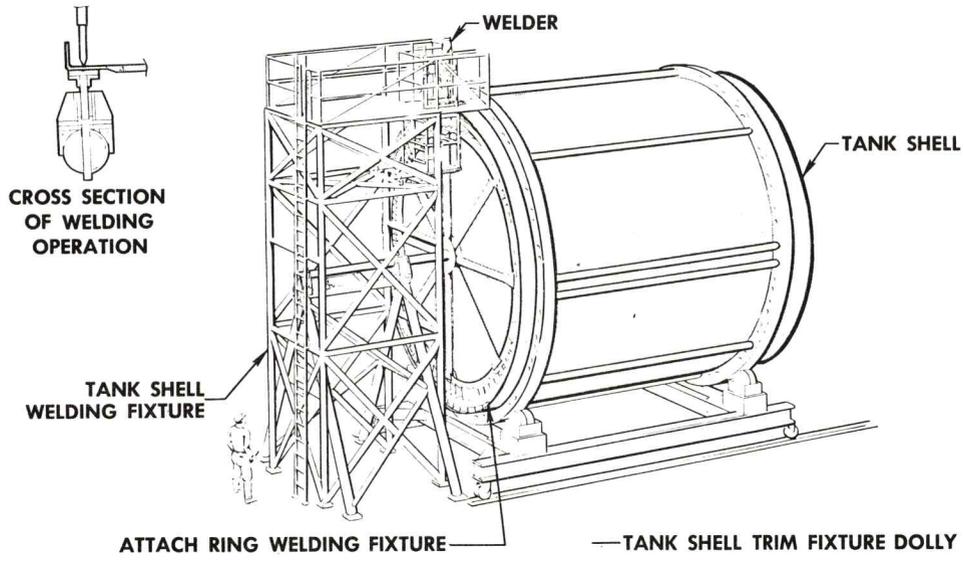


# SATURN S-IVB TANK SHELL LONGITUDINAL WELDING



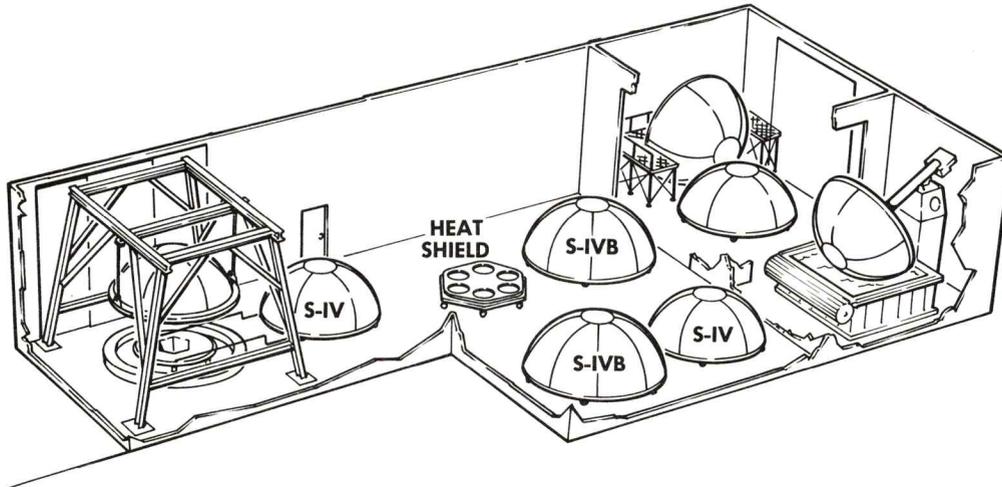
# SATURN S-IVB WELDING ATTACH ANGLES TO ENDS OF TANK SHELL

DSV-48-383

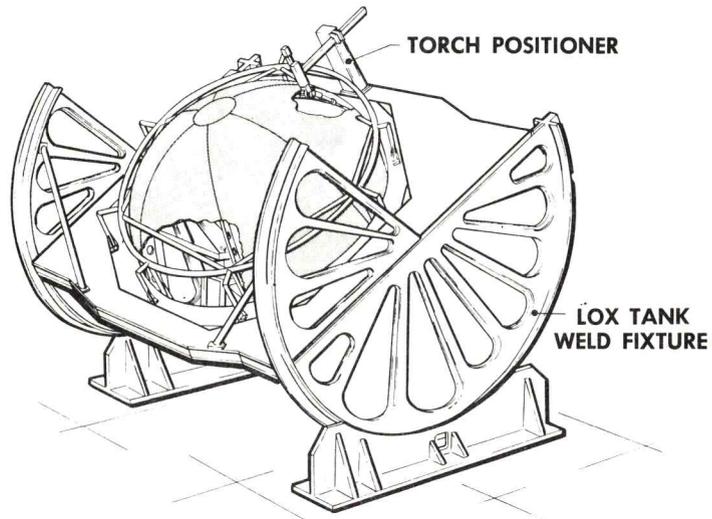


# S-IV & S-IVB COMMON BULKHEAD BONDING FACILITY

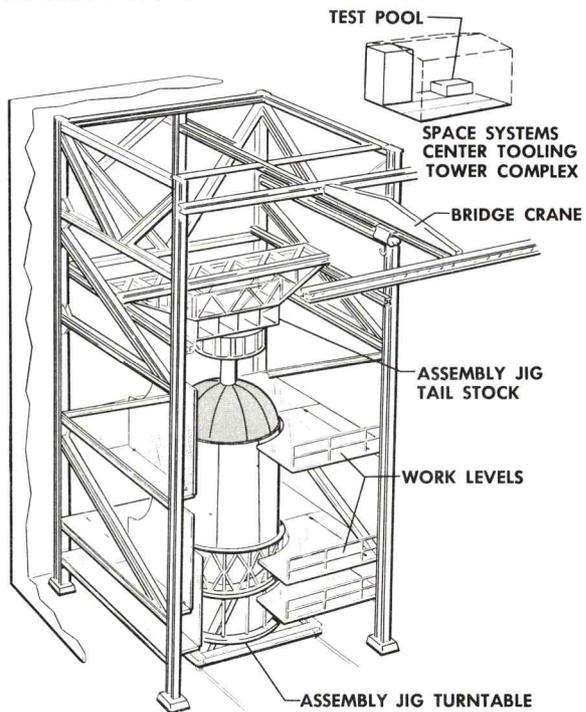
DSV-4B-176



# SATURN S-IVB LOX TANK—JOINING COMMON BULKHEAD AND AFT DOME

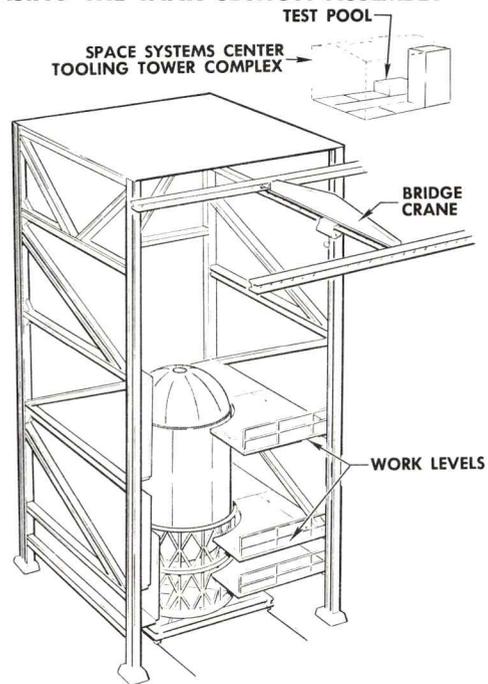


### SATURN S-IVB TANK SECTION ASSEMBLY



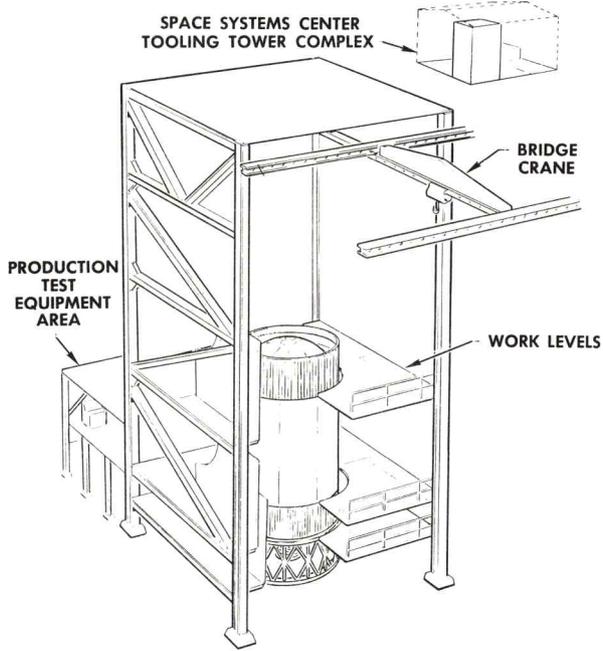
**SATURN S-IVB CLEANING AND VAPOR  
DEGREASING THE TANK SECTION ASSEMBLY**

DSV-4B-425



**SATURN S-IVB FINAL ASSEMBLY.  
INSTALLATIONS AND COMPLETE VEHICLE  
CHECKOUT**

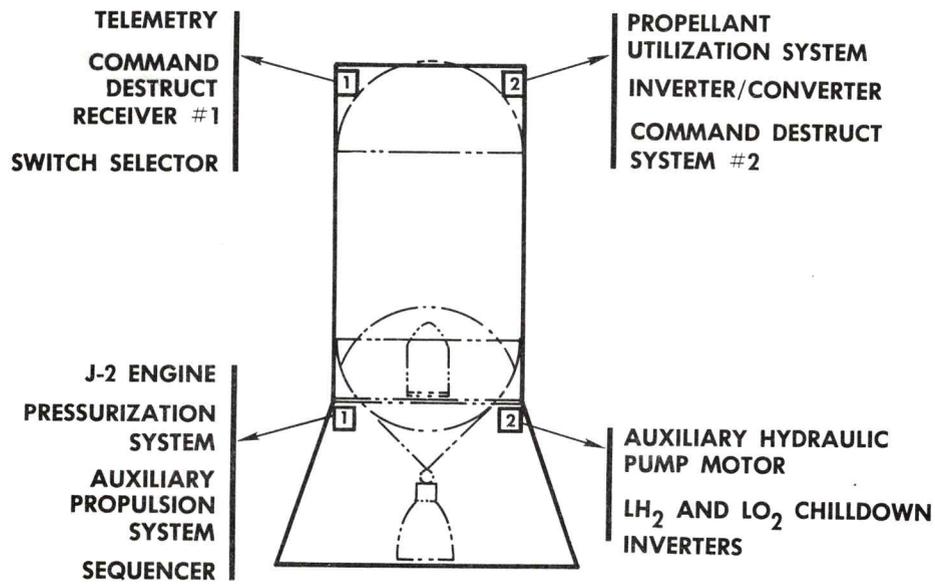
DSV-48-424



ELECTRICAL

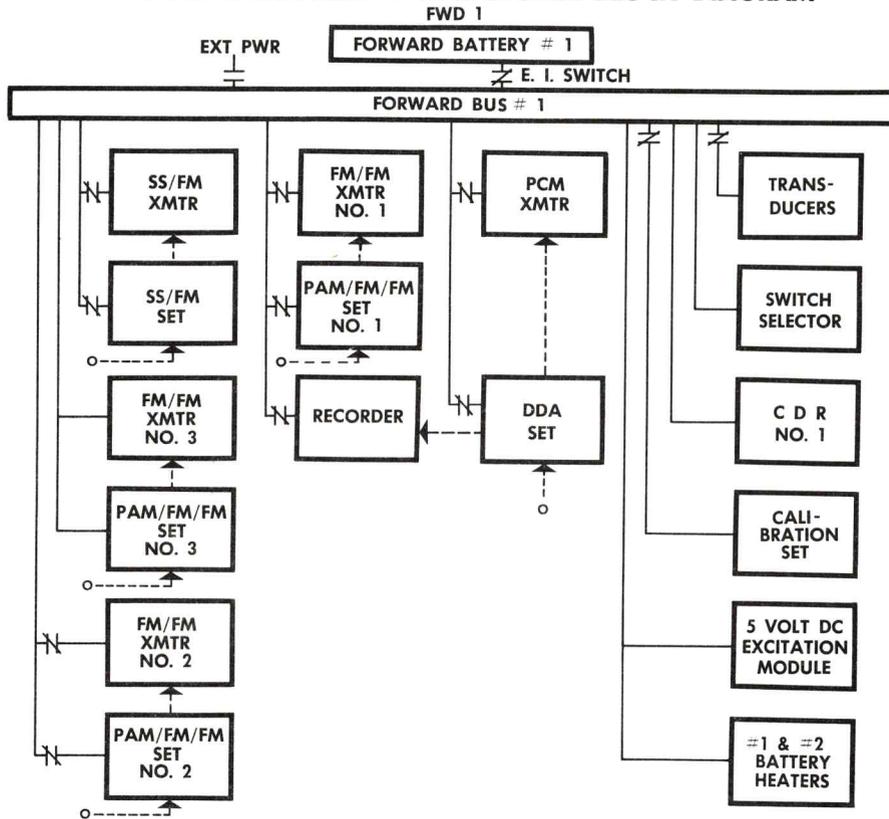
# S-IVB BASIC ELECTRICAL POWER SYSTEM

DSV-4B-395 A



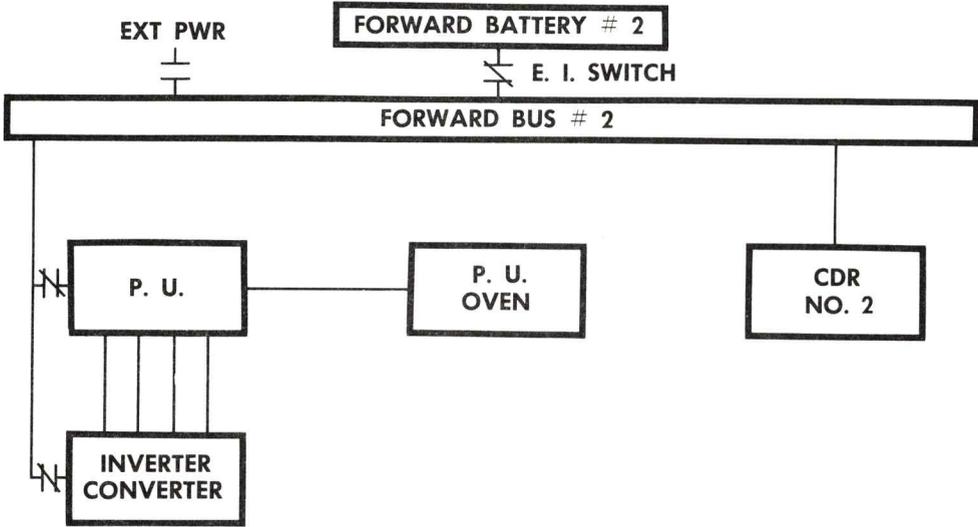
# S-IVB ELECTRICAL POWER SYSTEM BLOCK DIAGRAM

DSV-4B-417A

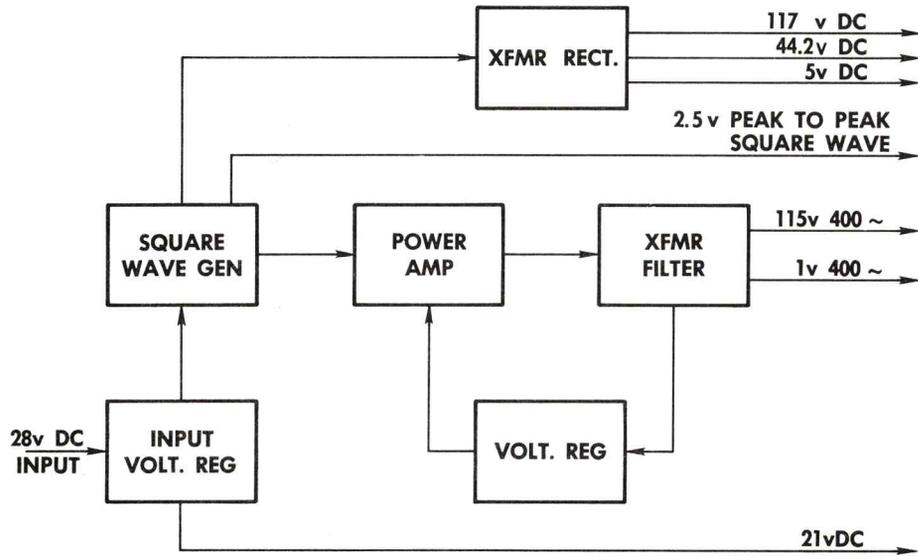


# S-IVB ELECTRICAL POWER SYSTEM BLOCK DIAGRAM

FWD 2

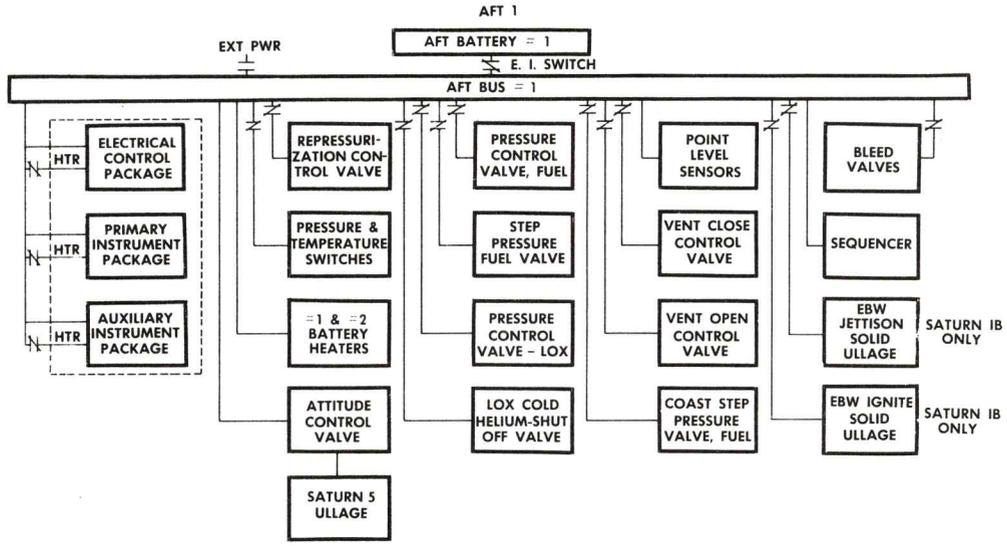


### S-IVB INVERTER/CONVERTER BLOCK DIAGRAM



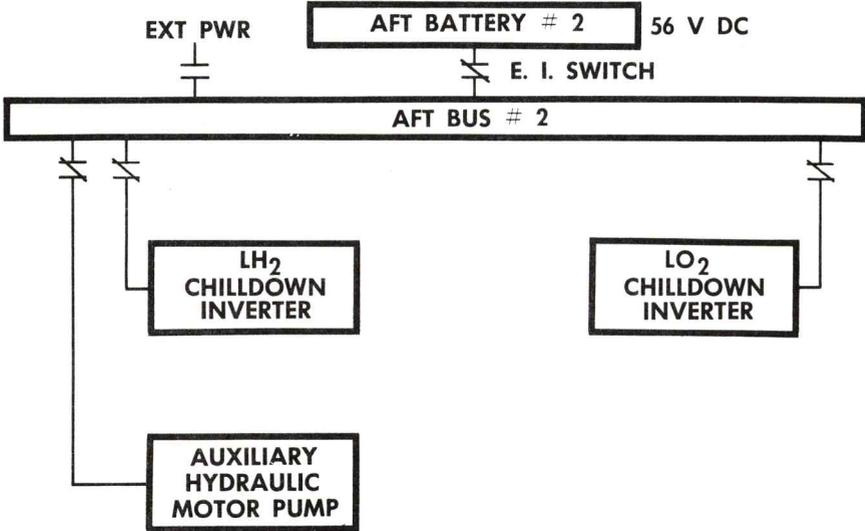
# S-IVB ELECTRICAL POWER SYSTEM BLOCK DIAGRAM

DSV-4B-416



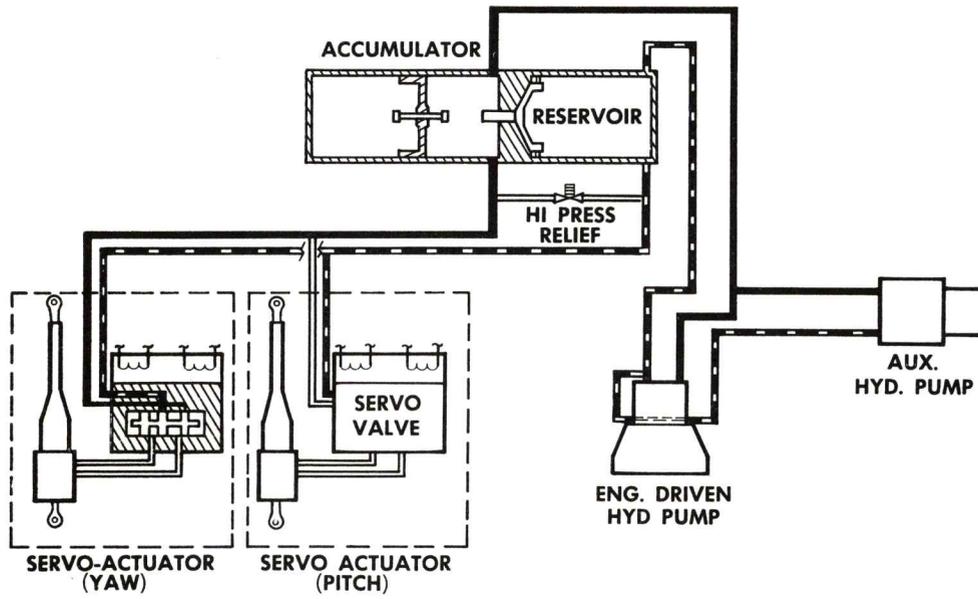
# S-IVB ELECTRICAL POWER SYSTEM BLOCK DIAGRAM

AFT 2



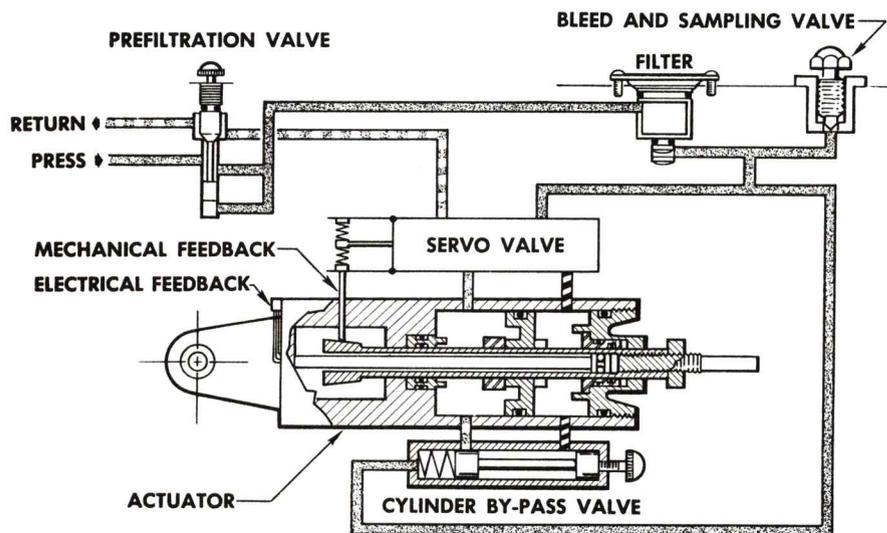
HYDRAULICS

### S-IVB HYDRAULIC SYSTEM (SIMPLIFIED)



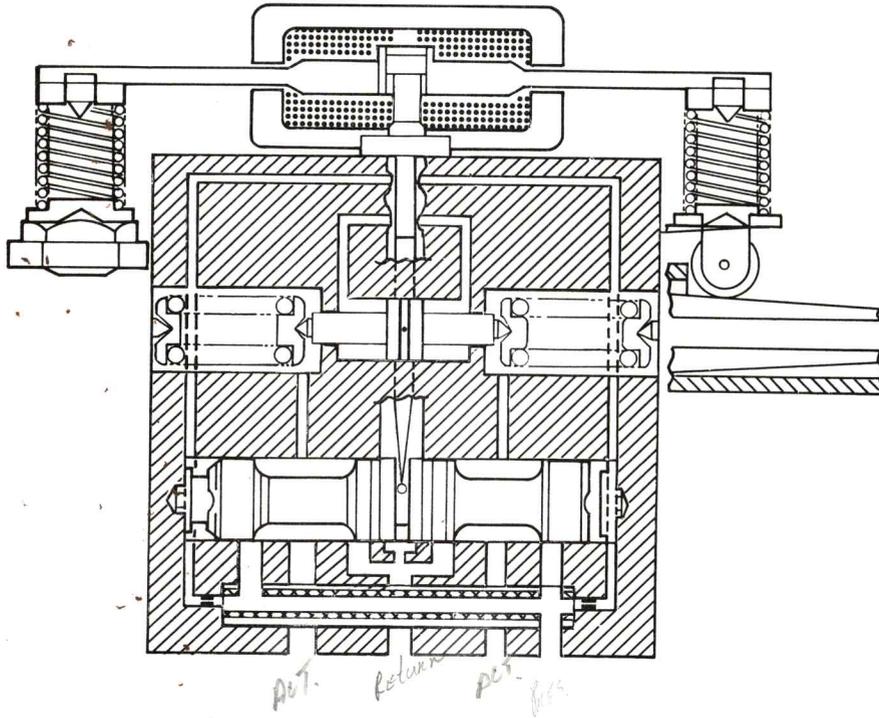
# ACTUATING ASSEMBLY SCHEMATIC

DSV-4B-402



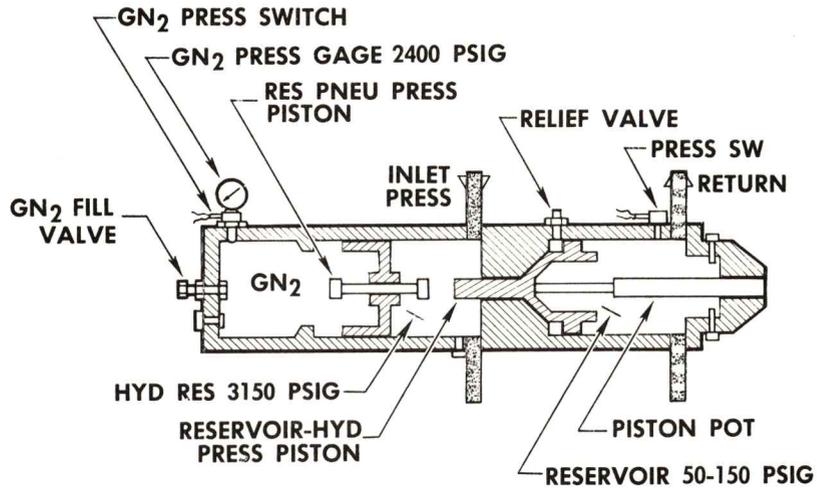
# DPF SERVOVALVE SCHEMATIC

DSV-4B-589



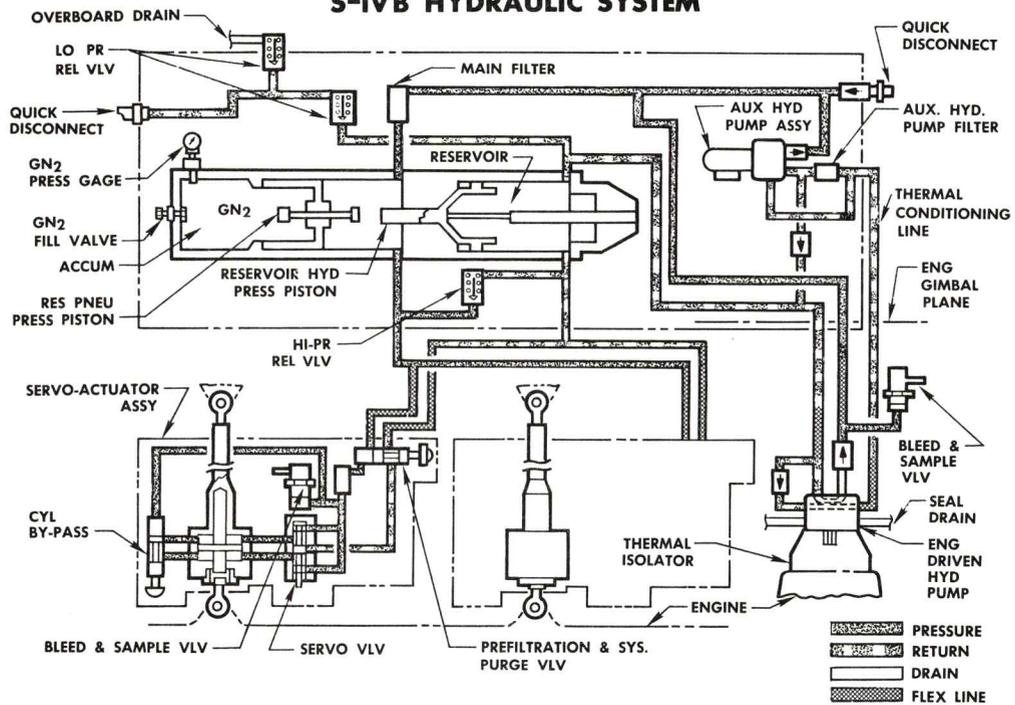
# ACCUMULATOR - RESERVOIR

DSV-4B-292 A



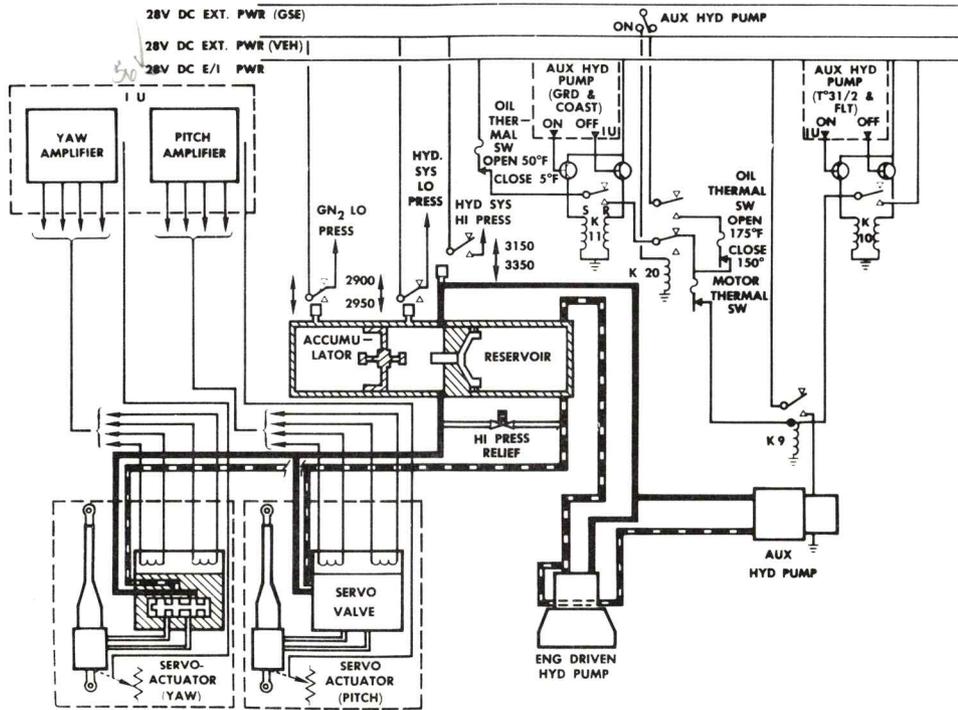
# S-IVB HYDRAULIC SYSTEM

DSV-4B-403 4



# S-IVB HYDRAULIC SYSTEM (ELECTRICAL CONTROL)

DSV-48-412





Under Separate Cover

J-2 PROPULSION SECTION CLASSIFIED CONFIDENTIAL



LIQUID HYDROGEN CHARACTERISTICS

Common Name: Liquid Hydrogen (LH<sub>2</sub>)

Chemical Formula: H<sub>2</sub>

Use at Douglas: Fuel in Bi-Propellant Engine Systems

Physical Properties:

Freezing Point.....	-435°F
Boiling Point.....	-423°F
Odor.....	None
Critical Temperature.....	-400.3°F
Liquid Specific Gravity.....	.070 at -423°F
Gas Density Relative to Air....	.0056
Appearance.....	Clear Liquid
Liquid to Gas Ratio.....	1:780
Vapor Pressure.....	12.8 Atmos- pheres
Flammability Limits.....	4% to 74.5% By Volume in Air

Chemical Properties: Stable against mechanical shock in pure form.

Impact sensitive if contaminated with liquid air or oxygen ice.

Highly flammable when mixed with air, low ignition temperature, 1061 - 1065°F, creates extreme fire hazard.

Helium only material that will not turn to a solid when immersed in LH<sub>2</sub>.

Storage: Storage tanks are stainless steel, double wall, vacuum, insulation and radiation protected against heat transfer.

Storage: (Cont'd)

Tanks are pressurized to 2 PSI, vented and provided with both burst diaphragms and relief valves.

Storage area must be kept clear of all fire hazards, ignition sources, etc.

Vented gases must be directed away from personnel, combustible material and ignition sources. In most installations vented gases are burned to prevent an explosive accumulation.

Systems:

Metallic materials effected by extreme cold. Stainless steel, aluminum and copper are acceptable.

Non-metallic materials must be screened for low temperature brittleness for use with  $LH_2$ .

Gaskets and seals, most common materials in use include:

1. Kel - F
2. Teflon
3. Mylar

Lubricants:

1. Oxylube 701
2. Oxylube 702
3. Oxylube 703

For a more detailed listing of materials refer to Memo #A270-EPT-EEH-60M4517 and DPS 4.930 Section D.2.

Availability:

Source.....76% of the weight of all the matter in the universe is hydrogen.

Produced by a number of chemical processes, most common today is the conversion of crude oil.

Some experimentation in conversion of sea water.

Personnel Hazard  
Characteristics:

Temperature... Extreme cold destroys living tissues on contact with  $LH_2$  or exposed uninsulated pipes or lines. Effect is as a burn.

Toxicity..... No hazard. However, it does present a danger of suffocation in confined area.

Fire..... Evaporates to a highly flammable gas when mixed with air. Will saturate clothing, combustible trash, etc.

Corrosion:

None

Safety Clothing  
Required:

Face Shield  
Asbestos Gloves, Long Gauntlet  
Flame Resistant Coveralls  
Leather Shoes, High Top

First Aid:

Water deluge to wash off  $LH_2$  and warm effected area. Medical treatment required.

$LH_2$  saturated clothing to be removed and aired.

Fire:

In confined areas, if the source of  $GH_2$  can't be turned off, it is better to allow burning and keep adjacent areas cool with water.

After source has been turned off, fire can be best extinguished with  $CO_2$ .

Less hazard to personnel than with hydrocarbon fires due to lower flame temperature.

LIQUID OXYGEN

CHARACTERISTICS

Common Name: LOX, Liquid Oxygen (LO<sub>2</sub>)

Chemical Formula: O<sub>2</sub>

Use at Douglas: Oxidizer in Bi-Propellant Engine System

Physical Properties:

Freezing Point.....	-362°F
Boiling Point.....	-297.4°F
Odor.....	None
Critical Temperature.....	-183°F
Liquid Specific Gravity.....	1.138
Gas Density Relative to Air..	1.103
Appearance.....	Pale Blue, Clear Liquid
Liquid to Gas Ratio.....	1:862
Vapor Pressure.....	Extremely High (49.7 Atmos- pheres at Critical Tem- perature)

Chemical Properties: Stable against mechanical shock in pure form.

Impact sensitive to unpredictable degree if contaminated, especially with organic materials.

Mixed with grease, oils, petroleum derivative fuels, alcohol, etc., it forms a highly impact sensitive gel which may be detonated by spark or flame as well as mechanical shock. The explosive potential of this gel has been shown to be approximately equivalent to Nitroglycerine.

Storage:

Storage tanks are stainless steel, double wall, vacuum and insulation protected against heat transfer.

Tanks are vented and provided with both burst diaphragms and relief valves.

Storage area must be kept clear of fire hazards.

Vented gases must be directed away from personnel and combustible material.

Systems:

Metallic materials effected primarily by extreme colds. Iron and carbon steel become dangerously brittle at this low temperature. Stainless steel, aluminum alloys, copper and brass are acceptable.

Non-metallic materials must be screened for both impact sensitivity and low-temperature brittleness for use with LOX.

Gaskets and seals - Most common materials in use include:

1. Kel-F, restricted to non-impact, non-friction applications.
2. Arualon PDX 7700 (B).
3. Fluorobestos A, B
4. Teflon
5. Teflon Tape P - 412, used as directed by material and processing only.

Lubricants:

1. Fluorolube FS-5
2. Fluorolube HG
3. Fluorolube GR 362
4. Kel-F #90 Grease

Systems: (Cont'd)

5. Oxylube 701
6. Oxylube 702
7. Oxylube 703

For a more detailed listing of materials refer to Drawing No. 7696938, Materials, Compatible, Liquid Oxygen Service.

Availability:

Source....Made from air, universally available.

Manufacturing

Method... Air compressed and cooled regeneratively to liquid air. Nitrogen is boiled off, leaving LOX (Hampson - Linde Process). Process is adaptable to field use.

Personnel Hazard  
Characteristics:

Temperature .. Extreme cold destroys living tissue on contact with either LOX or exposed uninsulated pipes or lines. Effect is as a burn.

Toxicity..... No hazard. Inhalation has exhilarating effect.

Fire..... Evaporates to pure gaseous oxygen which supports combustion in very intense manner. Clothing, combustible trash, etc., give no indication of gaseous oxygen saturation until violent combustion takes place. Extreme fire hazard in combustion with any combustible material.

Personnel Hazard  
Characteristics: (Cont'd)

Explosion.....LOX forms highly explosive gel in combination with oils, fuels, greases. Gel has appearance of dirty, white slush; and is highly unpredictable in nature. May detonate from mechanical shock, heat, flame, mechanical or electrical spark.

Corrosion: None

Safety Clothing  
Required:

Face Shield  
Fire Resistant Coveralls  
Asbestos Gloves, Long Gauntlet  
Lift Line and Supplied Air Mask, for  
Work Inside Tank

First Aid:

Water deluge to wash off LOX and warm effected area. Medical treatment required.

GO<sub>2</sub> saturated clothing to be aired for two hours minimum.

Fire:

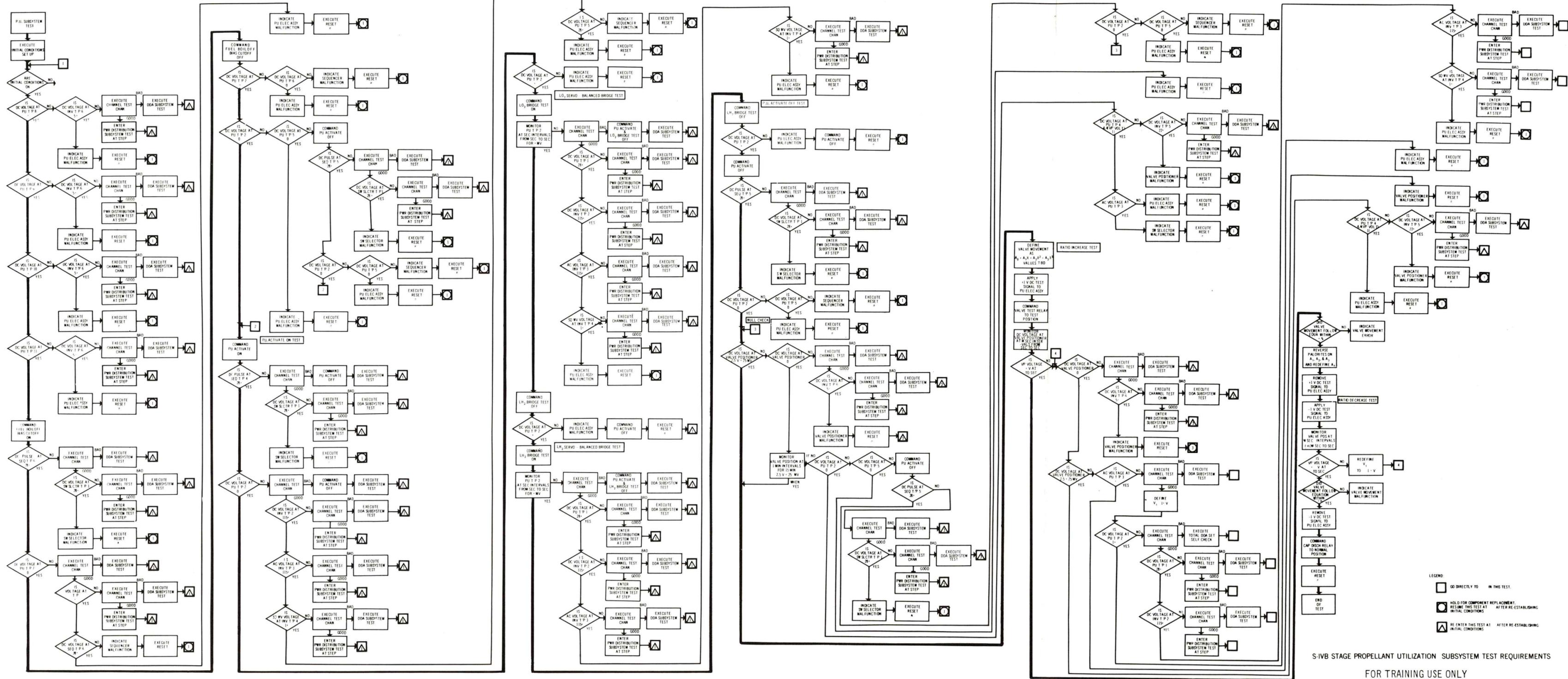
Permissible fire fighting agents include the following:

Water - Solid stream or for. Either high or low velocity.

Sand

Carbon Dioxide (CO<sub>2</sub>) -  
Not as effective as water.

Dry Chemical - Not as effective as water.



S-IVB STAGE PROPELLANT UTILIZATION SUBSYSTEM TEST REQUIREMENTS  
FOR TRAINING USE ONLY

## S-IVB CRYOGENIC CHARACTERISTICS

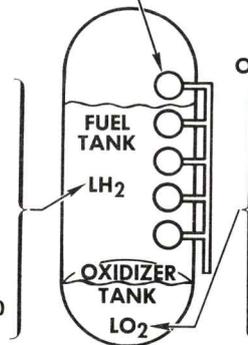
DSV-4B-282

### HELIUM He

1. PRESSURIZING AGENT
2. COLORLESS
3. ODOR, NONE
4. FREEZING POINT  $-453.5^{\circ}\text{F}$
5. BOILING POINT  $-452.1^{\circ}\text{F}$
6. LIQUID DENSITY LB/GAL 1.04
7. LIQUID DENSITY LB/FT<sup>3</sup> 7.80
8. LIQUID TO GAS RATIO 1:753

### HYDROGEN H<sub>2</sub>/LH<sub>2</sub>

1. BI-PROPELLANT FUEL
2. CLEAR LIQUID
3. ODOR, NONE
4. FREEZING POINT  $-435^{\circ}\text{F}$
5. BOILING POINT  $-423^{\circ}\text{F}$
6. LIQUID DENSITY LB/GAL .59
7. LIQUID DENSITY LB/FT<sup>3</sup> 4.43
8. LIQUID TO GAS RATIO 1:780

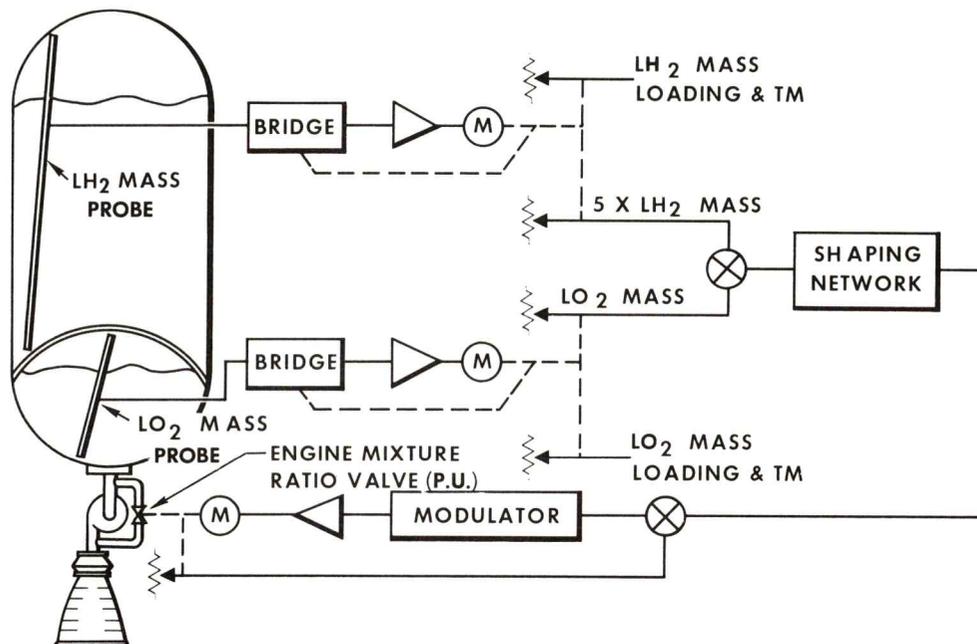


### OXYGEN O<sub>2</sub>/LO<sub>2</sub>

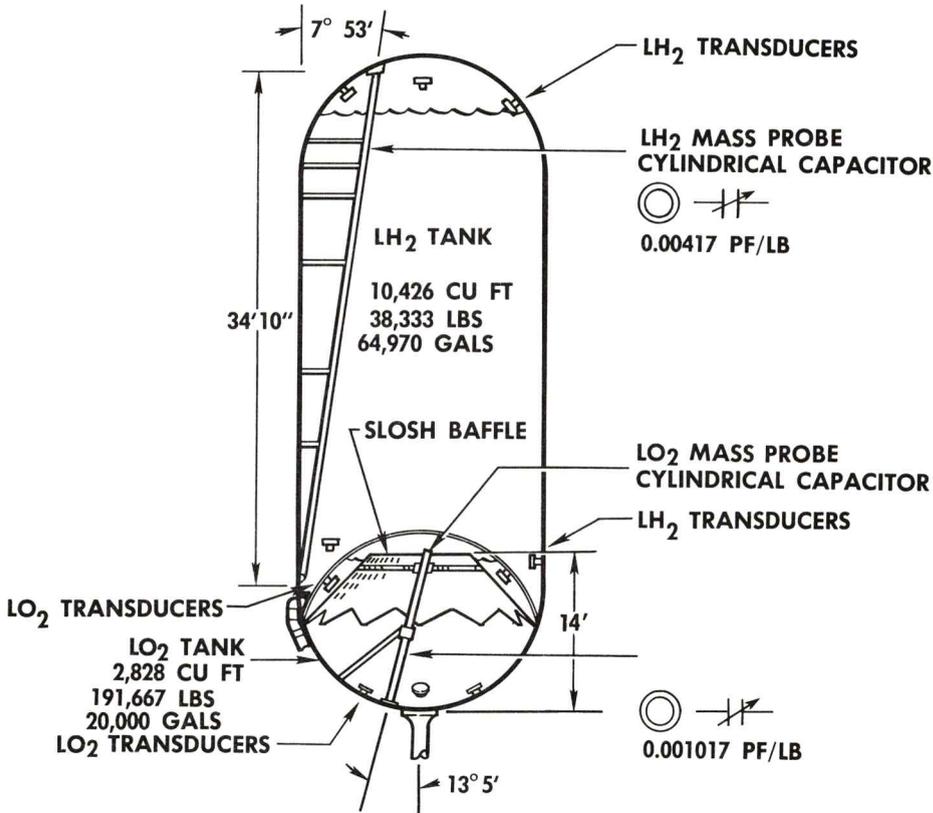
1. BI-PROPELLANT OXIDIZER
2. CLEAR LIQUID, PALE BLUE
3. ODOR, NONE
4. FREEZING POINT  $-363^{\circ}\text{F}$
5. BOILING POINT  $-297^{\circ}\text{F}$
6. LIQUID DENSITY LB/GAL 9.54
7. LIQUID DENSITY LB/FT<sup>3</sup> 71.5
8. LIQUID TO GAS RATIO 1:862

# S-IVB PROPELLANT UTILIZATION

DSV-4E 166A



### S-IVB P U SYSTEM MASS PROBE LOCATIONS

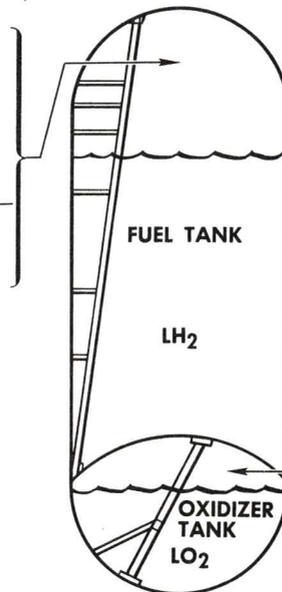




## S-IVB PROPELLANT TANK PRESSURIZATION SEQUENCE

### LH<sub>2</sub> PRESS. SEQUENCE (SATURN V)

1. PRE-PRESS-He 28/31 P.S.I.A
2. LIFT-OFF/BOOST
3. S-IVB FIRST BURN —  
H<sub>2</sub> 28/31 P.S.I.A.
4. COAST ORBIT VENT TO  
24.5/38 P.S.I.A.
5. RE-PRESS (2 SEC. PRIOR IGN.)—  
He 35/36.5 P.S.I.A.
6. S-IVB SECOND BURN-H<sub>2</sub>  
35/38 P.S.I.A.

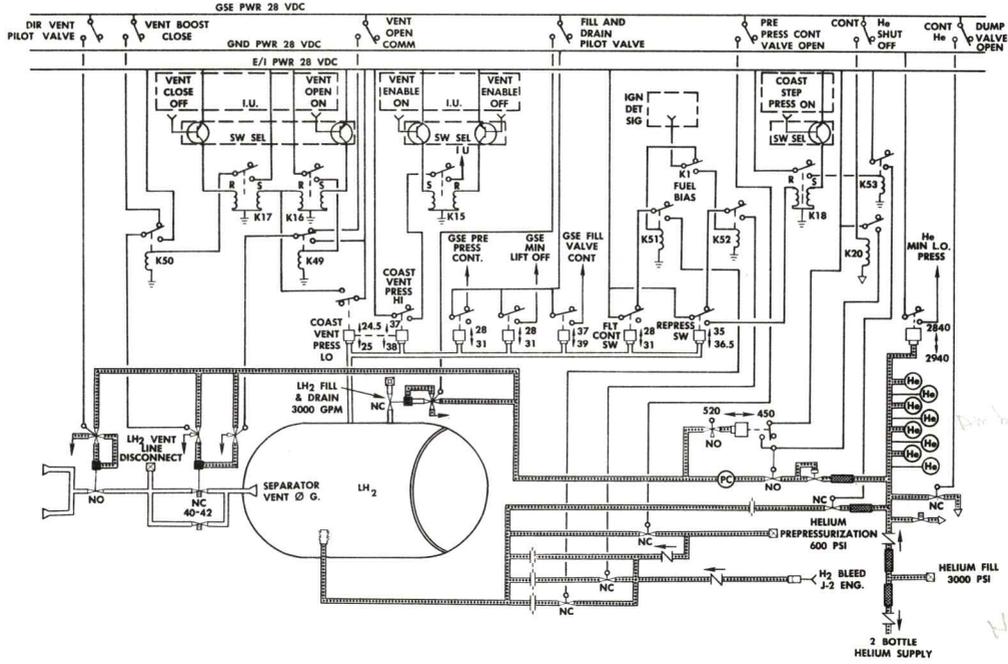


### LO<sub>2</sub> PRESS. SEQUENCE

1. PRE-PRESS-He 39/40 P.S.I.A.
2. LIFT-OFF/BOOST
3. S-IVB FIRST BURN-He  
37/40 P.S.I.A.
4. COAST ORBIT "NO VENT"
5. RE-PRESS-He 39/40 P.S.I.A.
6. S-IVB SECOND BURN-  
37/40 P.S.I.A.

# S-IVB FUEL TANK PRESSURIZATION-LH<sub>2</sub>

DSV-4B-405B







HYDRAZINE

Common Name: Hydrazine - Hypergolic Fuel

Chemical Formula: Hydrazine =  $N_2H_4$

Use at Douglas: Fuel in Bi-Propellant Hypergolic Engine Systems.

Physical Properties: Freezing Point..... 35°F  
Boiling Point.....236°F  
Odor.....Similar to Ammonia  
Critical Temperature.....716°F  
Liquid Density at 68°F.....8.4 lb/gal  
Appearance.....Clear - Oily- Water  
White Liquid  
Max. Allowable Concentration... .05 PPM

Chemical Properties: Stable under extreme heat or cold. Stable to shock, but vapor propagates detonation within flammable limits.

Will react with carbon dioxide and oxygen in air.

Exposure to air on a large surface (such as on rags) may result in spontaneous combustion.

A film of Hydrazine in contact with metallic oxides or other oxidizing agents may ignite.

Very caustic.

Extremely miscible in water (req's copious amount of water).

Iron, copper, molybdenum, and their alloys and oxides cause Hydrazine to decompose.

**Chemical Properties:**  
(Cont'd)

Freezing has no effect on the chemical properties of Hydrazine.

**Storage:**

Can be stored and shipped in tanks or containers - short time storage requirements differ from long time requirements. Evaluate requirements according to storage time.

Stainless steel 304 recommended for storage facilities.

Keep storage area clear of combustible materials.

Vents and pressure relief extended to atmosphere above working level.

**Systems:**

All pipes and fittings of approved material.

**Approved Metals:**

1. Mild Steel
2. 303, 304, 316, 321, and 347
3. Nickel
4. 25 and 35 Aluminum

**Gaskets, seals and packing, non-metals:**

1. Braided asbestos impregnated with Teflon
2. Teflon and high density Polyethylene
3. Garlock 735
4. Mylar film
5. Unplasticized Kel-F

**Lubricants:**

1. To date no completely satisfactory lubricant has been developed. "Q-Seal", Quigley Co. has been used with fair results.

Personnel Hazard  
Characteristics:

Toxicity..... Precaution taken to  
prevent spills.

If spilled onto skin or  
in eyes can cause severe  
local damage or burns.

Prolonged contact can  
cause dermatitis.

If inhaled, the vapor  
causes local effects.  
(Eye and respiratory  
irritation.)

Fire..... Flammable in all con-  
centrations in air above  
4.7%. Hypergolic with  
some oxidants such as;  
Hydrogen Peroxide and fuming  
Nitric Acid. Ignition  
can occur when a Hydra-  
zine film comes in con-  
tact with some metallic  
oxides such as; Iron  
Oxide, Copper Oxide, Lead  
Oxide, and Molybdenum  
Oxide.

Explosion.....Vapors of Hydrazine can be  
exploded by an electric  
spark or an open flame.  
Not sensitive to shock  
or friction.

Safety Clothing  
Required:

Acid Hood or full Face Mask  
Fuel Resistant Gloves  
Wrist and Arm Protectors  
Rubber Apron  
Rubber Safety Shoes or Overboots  
Airline Respirator or Cannister  
Mask as Required

First Aid:

If spilled on skin, flush with large  
amounts of water.

First Aid: (Cont'd)

If spilled into eyes - flush with large amounts of water for several minutes then seek medical help. If it's necessary to choose between flushing or medical help, flush for several minutes before seeking help.

Remove casualties from the area, keep them quiet, apply artificial respiration if breathing has stopped. Call for immediate medical help.

Fire:

Air Supported Type: Water is most effective combatant.

Small Spill Fires: Water fog and soda base are effective combatants.

Oxidizer Supported Type: Where acceptable for the oxidizer, water is the most effective combatant.

NITROGEN TETROXIDE

Common Name: Nitrogen Tetroxide, Nitrogen Peroxide  
or Liquid Nitrogen Dioxide.

Chemical Formula:  $N_2O_4$      $2NO_2$

Use at Douglas: Oxidizer in Bi-Propellant Hypergolic  
Engine Systems.

Physical Properties: Freezing Point.....11.84°F  
Boiling Point.....70.1°F  
Odor. ... ..Characteristic  
  Pungent Odor  
Critical Temperature.....316.8°F  
Appearance.....At room temper-  
  ature a heavy  
  brown liquid.  
  As temperature  
  decreases, color  
  becomes lighter.  
  Fumes are yellow-  
  ish to reddish  
  brown.  
Maximum Allowable Concentration..2.5 PPM

Chemical Properties: A corrosive oxidizing agent. Hypergolic  
with UDMH, Hydrazine, Aniline, Furfuryl  
Alcohol and some other fuels.

Not sensitive to heat, mechanical shock  
or detonation.

Is nonflammable with air, however, it  
can support combustion with combustible  
materials. Very stable at room tempera-  
ture.

Storage: Liquid Nitrogen Tetroxide may be safely  
stored in moderate-pressure vessels  
with adequate pressure relief.

Storage: (Cont'd)

Can be stored in tank cars or cylinders up to one ton capacity.

Vent and relief into a fume scrubbing system.

Systems:

All pipes and fittings of approved materials.

Approved metals when moisture is 0.1% or less:

1. Carbon Steels
2. Aluminum
3. Stainless Steels
4. Nickel
5. Inconel

For service under wet conditions:

1. Stainless Steel  
(300 series)

Non-Metals:

1. Ceramic
2. Pyrex Glass
3. Teflon
4. Kel-F
5. Asbestos (cotton free)
6. Polyethylene (limited use)

Lubricants:

1. Fluorolube Series
2. Nordo Seal - 147 and DC 234S
3. Water Glass and Graphite

Personnel Hazard Characteristics:

Liquid Nitrogen Tetroxide is corrosive to body tissues.

Toxicity..... Severe burns of skin and eyes can result from momentary contact.

Personnel Hazard  
Characteristics: (Cont'd)

Inhalation of toxic vapors is the most serious hazard. Color of the fumes is not indicative of concentration.

Fire..... Liquid Nitrogen Tetroxide, by itself, will not burn, but will support combustion.

Hypergolic with UDMH and other fuels.

Explosion..... Stable at normal temperatures.

Hypergolic with UDMH and other fuels.

Vapor can form explosives mixtures with fuel vapors in a confined space.

Safety Clothing  
Required:

Face Shield  
Vinyl Coated Gloves  
Rubber Safety Shoes or Overboots  
Protective Clothing  
Airline Respirator or Cannister Mask,  
as Required

First Aid:

If spilled on skin, flush with large amounts of water.

If spilled into eyes, flush with water for several minutes then seek medical help. If it is necessary to choose between flushing or medical help, flush for several minutes before seeking help.

Remove casualties from the area, keep them quiet, apply artificial respiration if breathing has stopped. Call for immediate medical help.

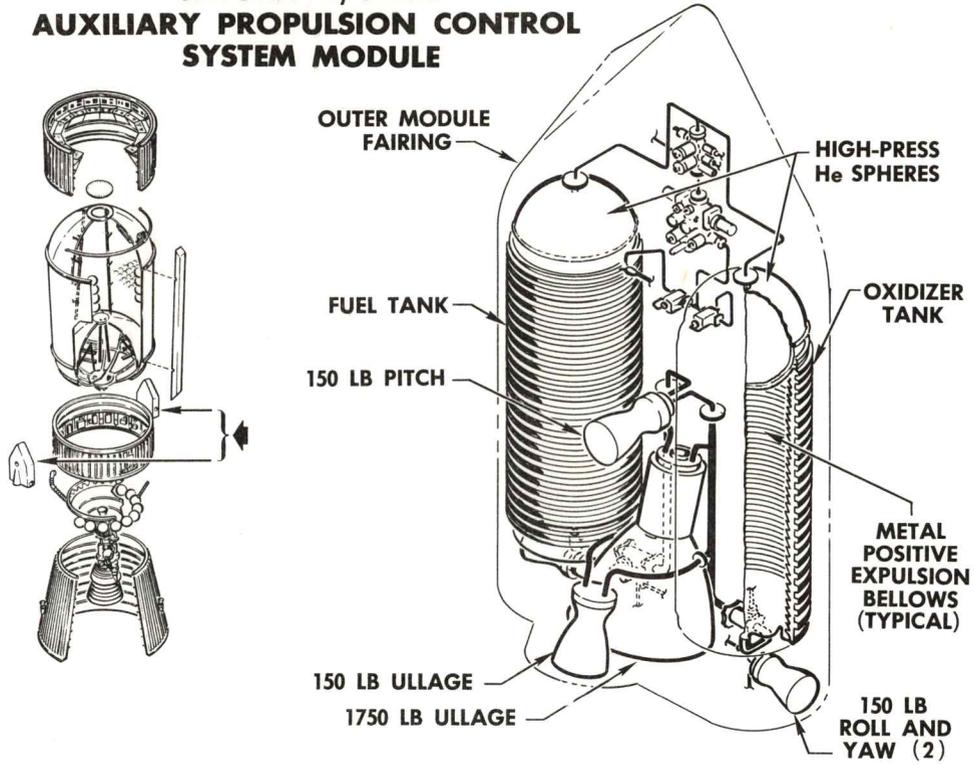
Fire:

Attempt to shut off source of Nitrogen Tetroxide. Large quantities of water will eventually dilute concentration so that combustion is no longer supported.

The remaining air-supported fuel fire is then extinguished with techniques applicable to the fuel involved.

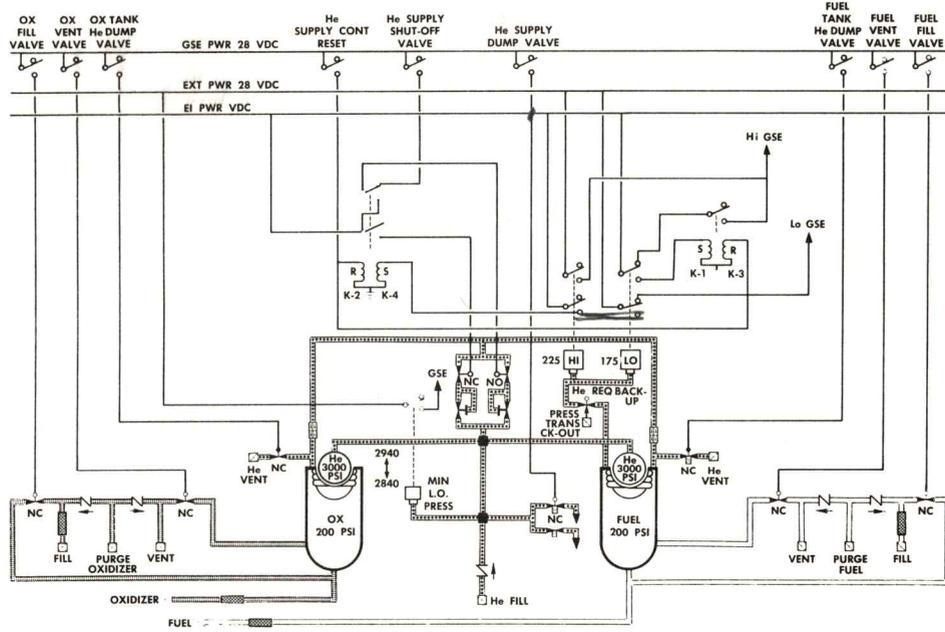
# SATURN V/S-IVB AUXILIARY PROPULSION CONTROL SYSTEM MODULE

DSV-4B-361



# SATURN V/S-IVB ATTITUDE & ULLAGE CONTROL SYSTEM PRESSURIZATION

DSV-48-4074



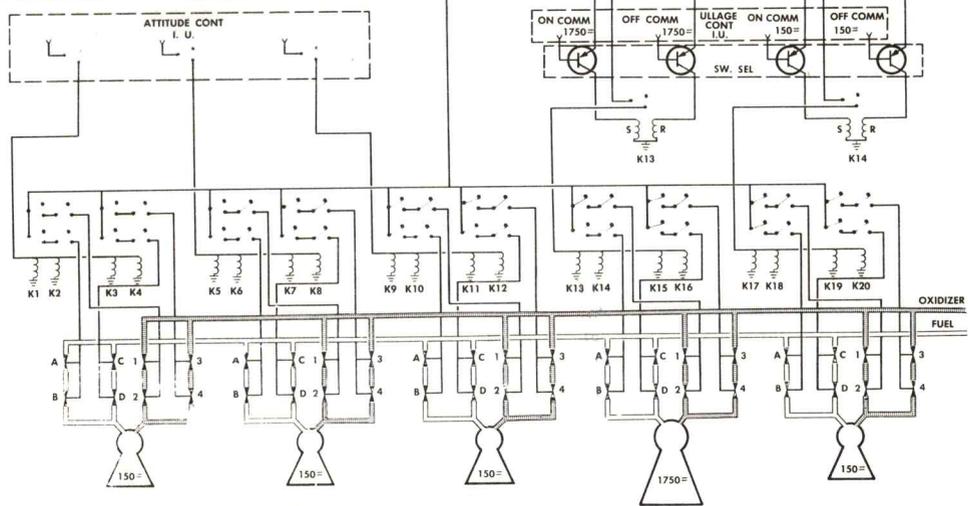
SATURN V/S-IVB  
ATTITUDE & ULLAGE ENGINE CONTROL SYSTEM

DSV-4B-4084

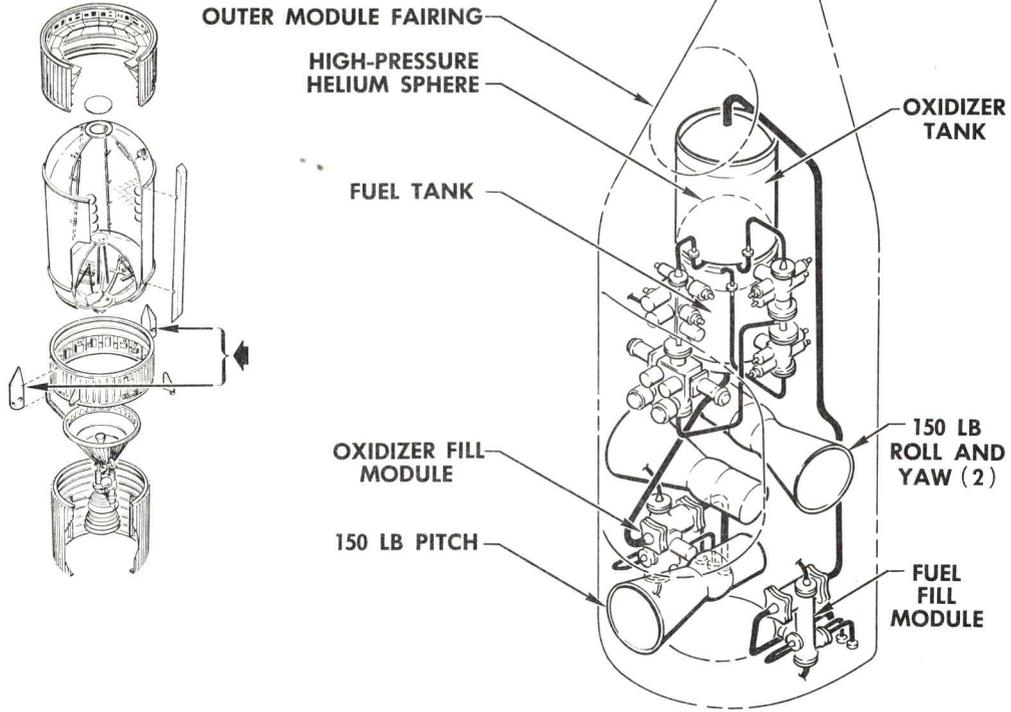
GSE PWR 28 VDC

EXT PWR 28 VDC

E/I PWR 28 VDC

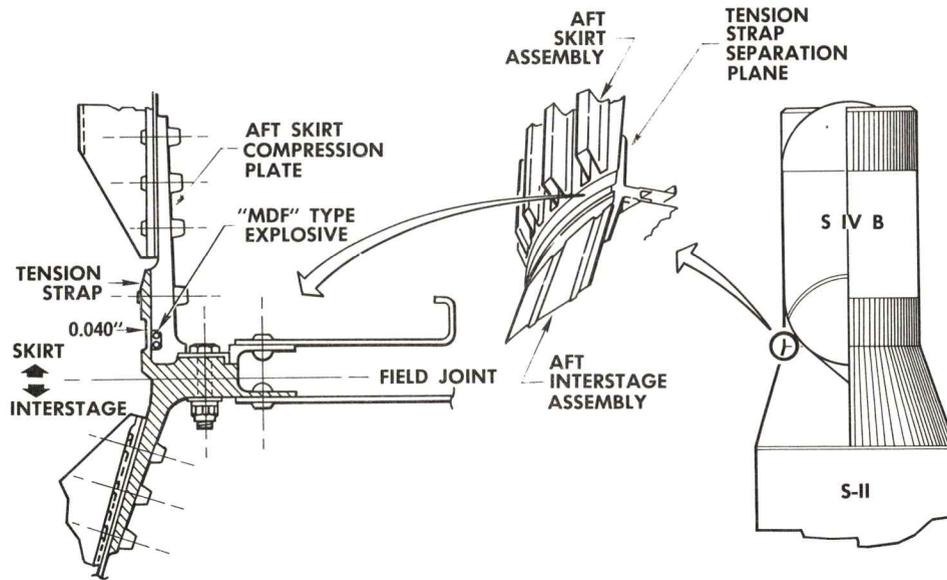


### SATURN IB/S-IVB AUXILIARY PROPULSION CONTROL SYSTEM MODULE



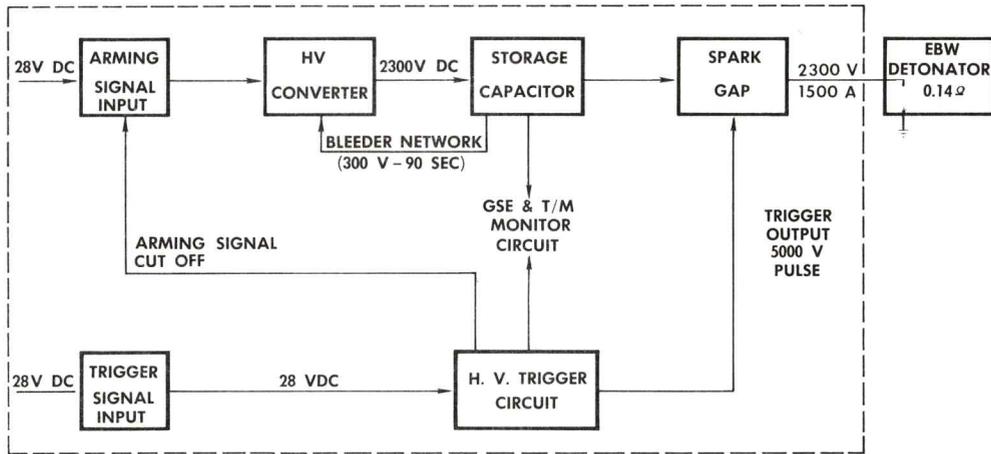
ORDNANCE

S-II/SIVB SATURN V EXPLOSIVE SEPARATION PLANE DSV-4B-584



# EBW FIRING UNIT DATA FLOW

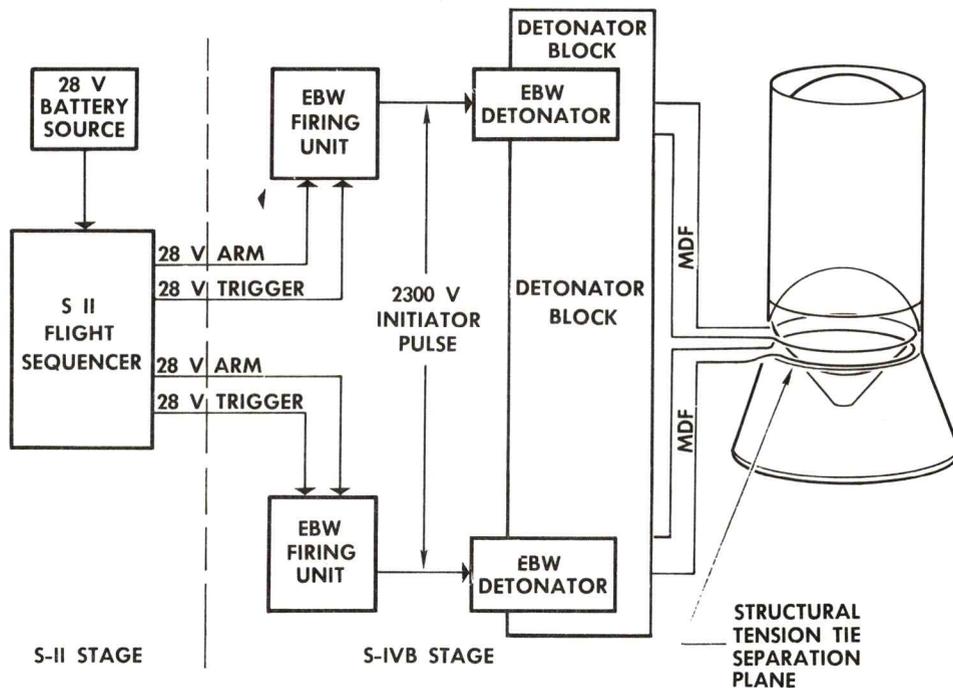
DSV-4B-585



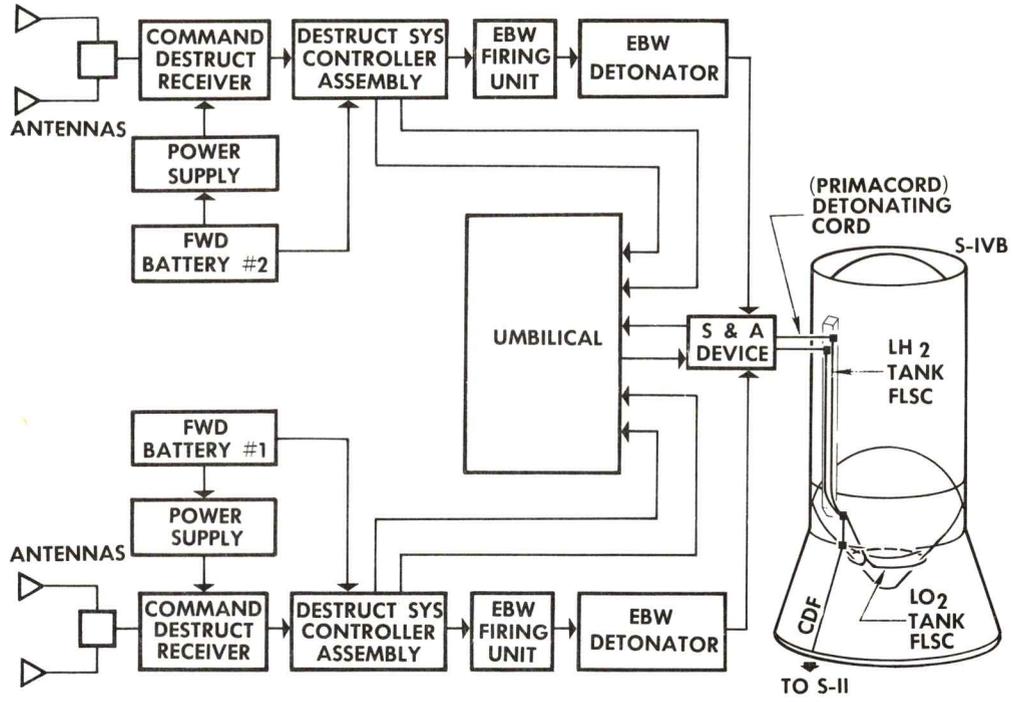
LENGTH 5"  
WIDTH 2.5"  
DEPTH 3.5"  
WEIGHT 3.6 LB

# S-II/S-IVB SATURN V SEPARATION SYSTEM FUNCTIONAL DIAGRAM

DSV-4B-429 A



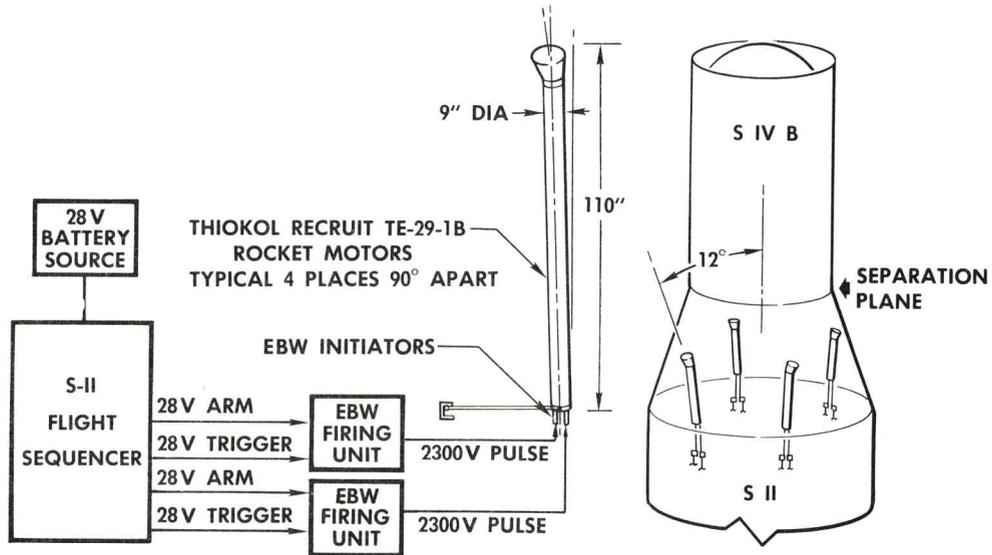
### S-IVB COMMAND DESTROY SYSTEM





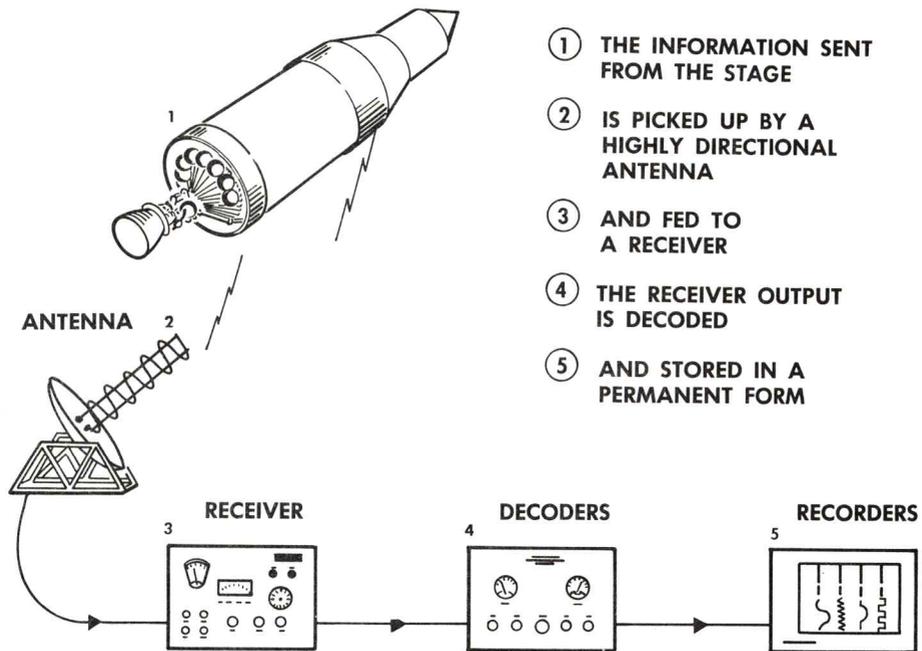
# S-II/S-IVB SATURN V RETRO-ROCKET SYSTEM (EBW)

DSV-4B-587



INSTR. &  
TELEMETRY

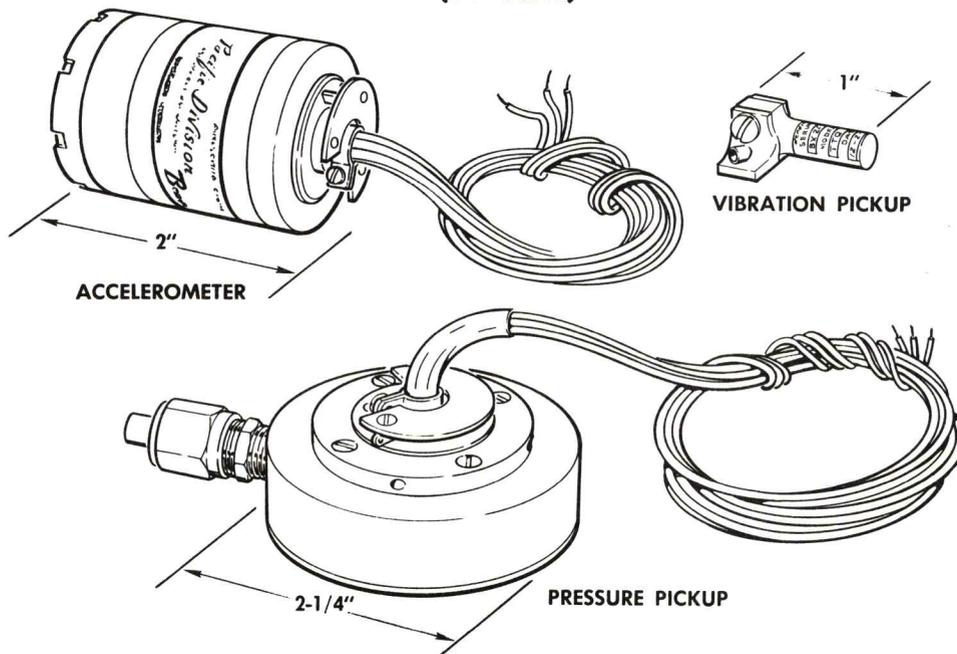
## BASIC RADIO-TELEMETRY SYSTEM



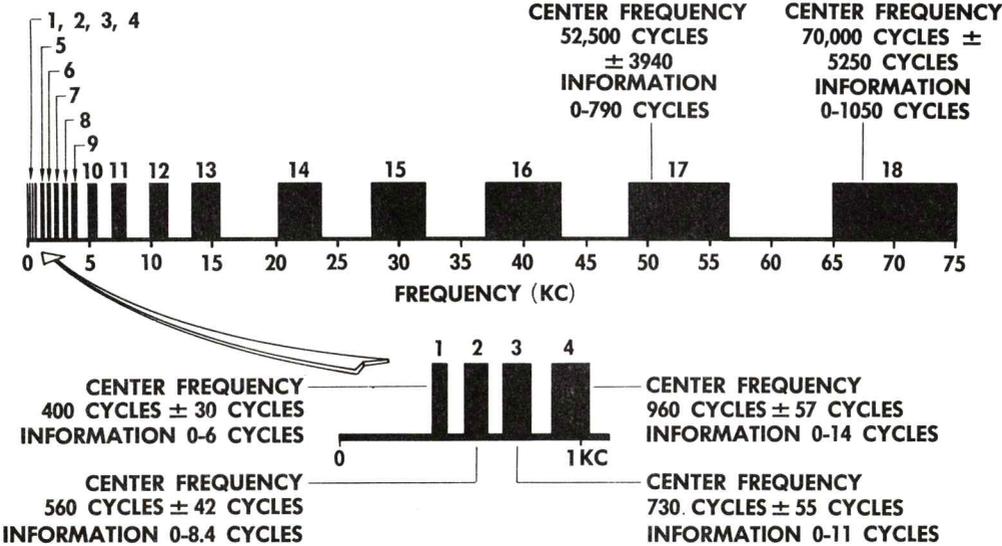
- ① THE INFORMATION SENT FROM THE STAGE
- ② IS PICKED UP BY A HIGHLY DIRECTIONAL ANTENNA
- ③ AND FED TO A RECEIVER
- ④ THE RECEIVER OUTPUT IS DECODED
- ⑤ AND STORED IN A PERMANENT FORM

# TELEMETRY PICKUPS (TYPICAL)

DSV-4B-398



### SUBCARRIER BAND SPECTRUM



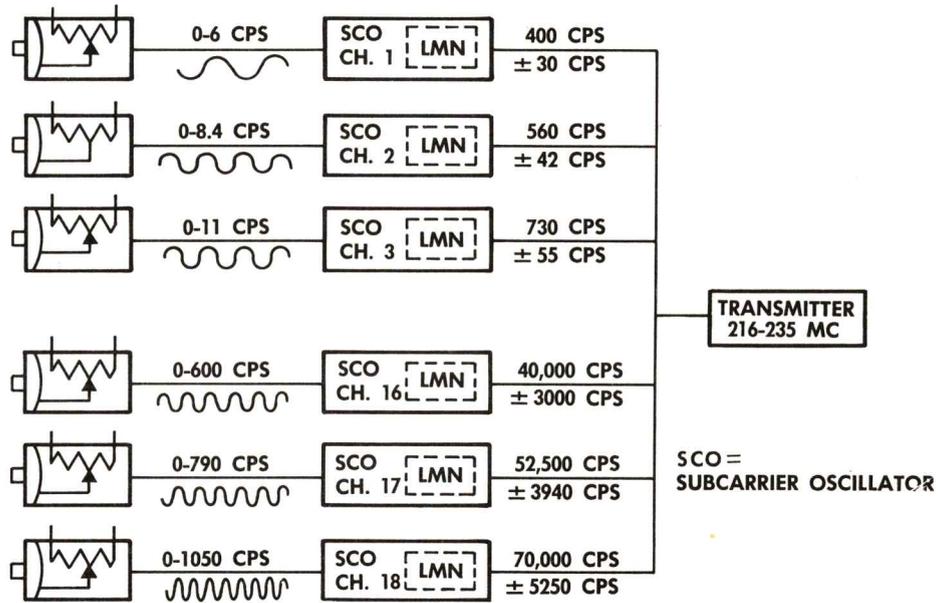
I.R.I.G. TELEMETRY BAND STANDARDS

Band	Subcarrier Band			Subcarrier	Nominal	Maximum
	Lower Limit (cps)	Center Freq. (cps)	Upper Limit (cps)	Deviation %	Intell. Freq. (cps)	Intell. Freq. (cps)
1	370	400	430	± 7.5	6	30
2	518	560	602	± 7.5	8	40
3	675	730	785	± 7.5	11	55
4	888	960	1032	± 7.5	14	70
*5	1202	1300	1398	± 7.5	20	100
*6	1575	1700	1828	± 7.5	25	125
*7	2127	2300	2473	± 7.5	35	175
*8	2775	3000	2473	± 7.5	45	255
*9	3607	3900	4193	± 7.5	60	300
*10	4995	5400	5805	± 7.5	80	400
*11	6799	7350	7901	± 7.5	110	550
*12	9712	10,500	11,288	± 7.5	160	800
*13	13,412	14,500	15,588	± 7.5	220	1100
14	20,350	22,000	23,650	± 7.5	330	1650
15	27,750	30,000	32,250	± 7.5	450	2250
16	37,000	40,000	43,000	± 7.5	600	3000
17	48,560	52,500	56,440	± 7.5	790	3950
18	64,750	70,000	75,250	± 7.5	1,050	5250
Optional Bands						
*A.	18,700	22,000	25,300	± 15	660	3300
B.	25,500	30,000	34,500	± 15	900	4500
*C.	34,000	40,000	46,000	± 15	1,200	6000
D.	44,620	52,500	60,000	± 15	1,600	8000
*E.	59,500	70,000	80,500	± 15	2,100	10,500

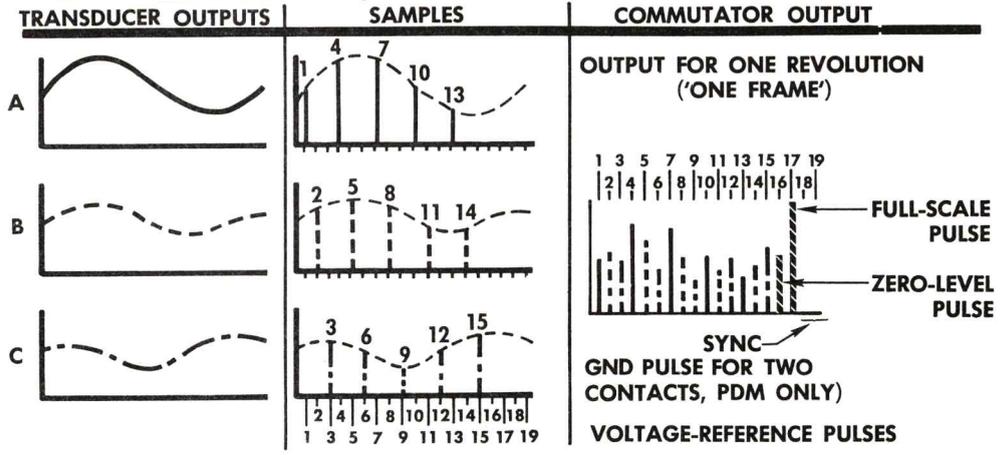
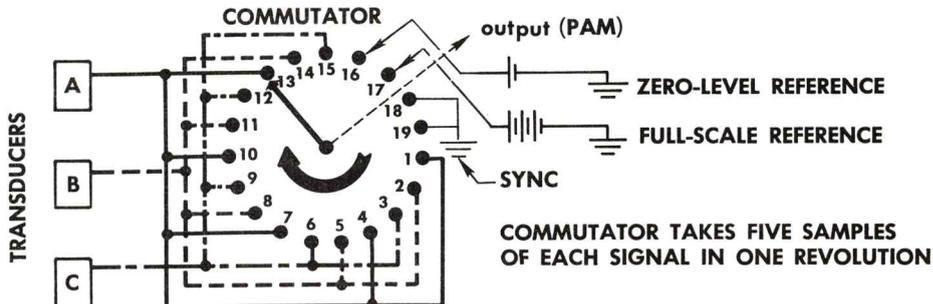
\* - Preferred Bands

- A. This band may be employed by omitting the 30 kc band.
- B. This band may be employed by omitting the 22 and 40 kc bands.
- C. This band may be employed by omitting the 30 and 52.5 kc bands.
- D. This band may be employed by omitting the 40 and 70 kc bands.
- E. This band may be employed by omitting the 52.5 kc band.

## FREQUENCY-DIVISION MULTIPLEXING (FM-FM)

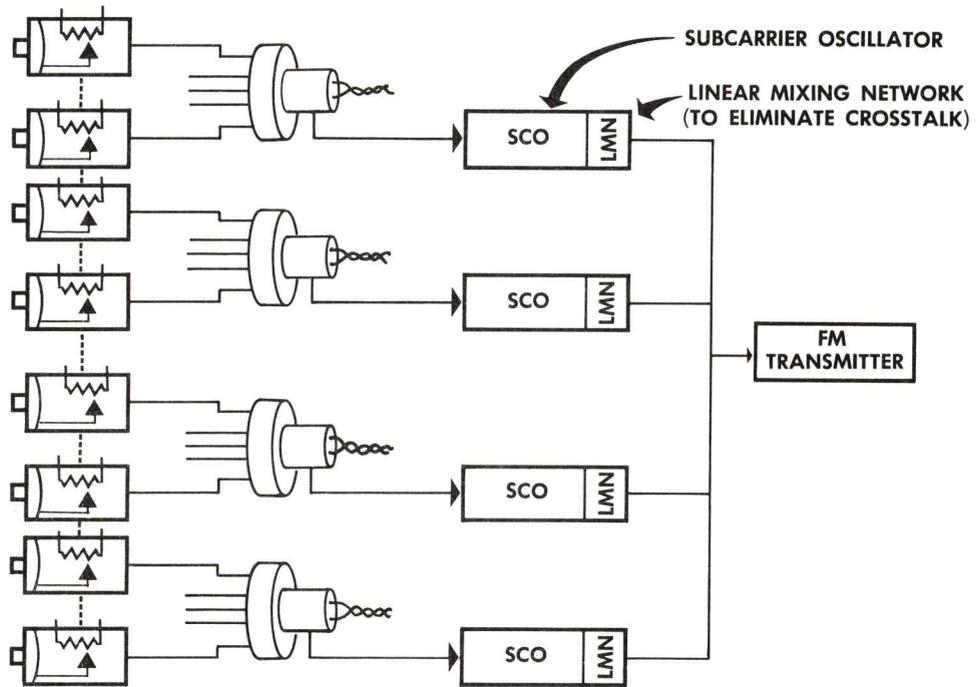


### TIME-DIVISION MULTIPLEXING OF THREE SIGNALS



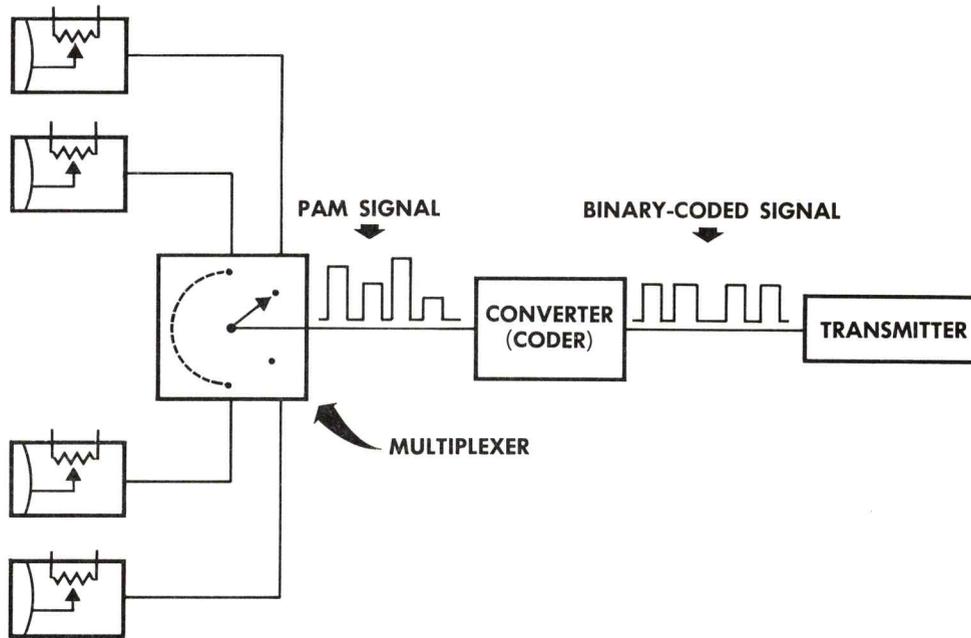
# A PAM-FM-FM SYSTEM

DSV-4B-396



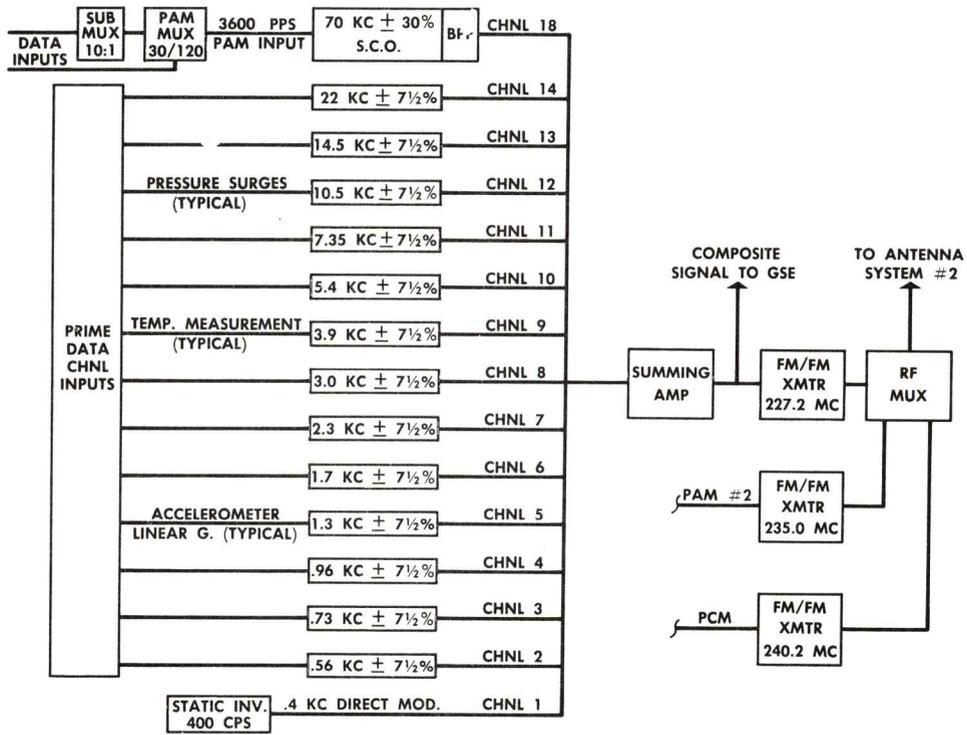
# A BASIC PCM SYSTEM

DSV-4B-397



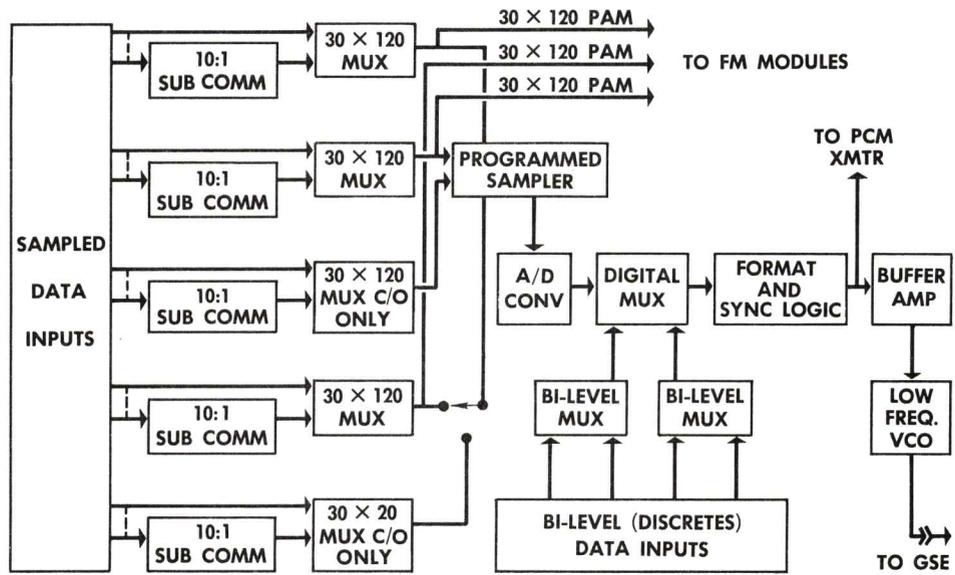
# S-IVB PAM/FM/FM SUB-SYSTEM #1

DSV-4B-399

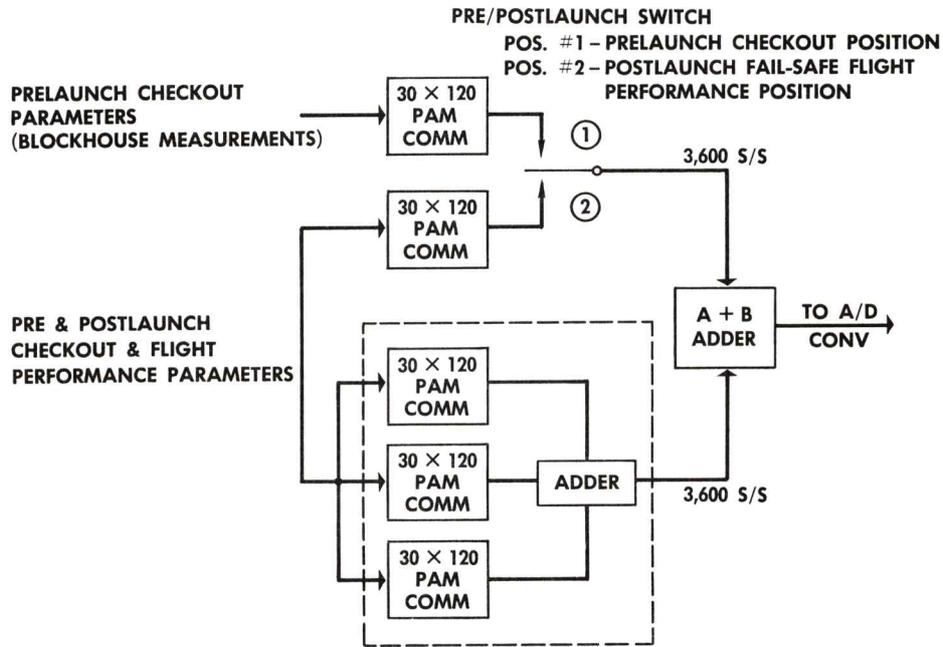


# S-IVB-PCM (DDAS) DATA SYSTEM

DSV-4B-406

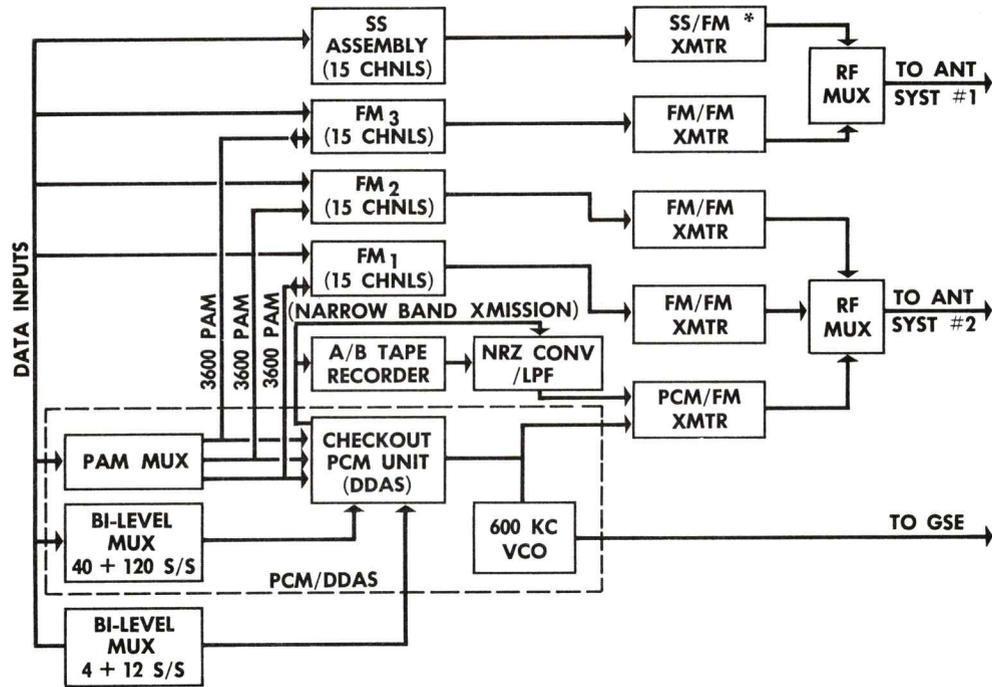


### S-IVB PCM PROGRAMMED SAMPLER



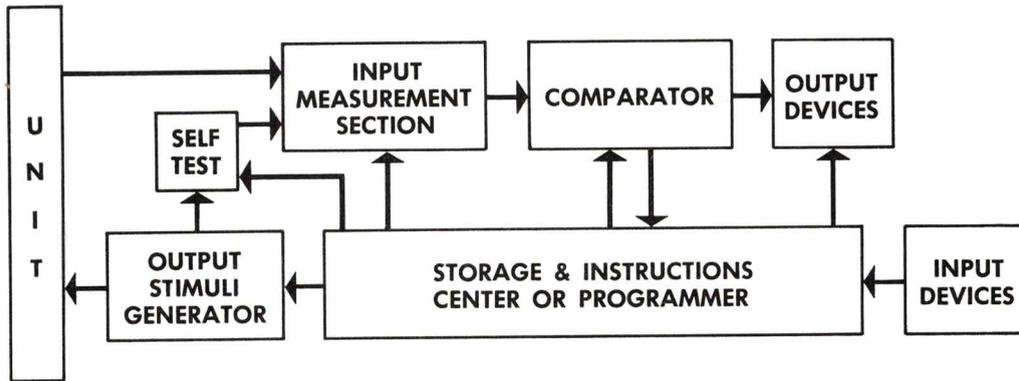
# DATA ACQUISITION SYSTEM SATURN V/S-IVB VEHICLE

DSV-48-401



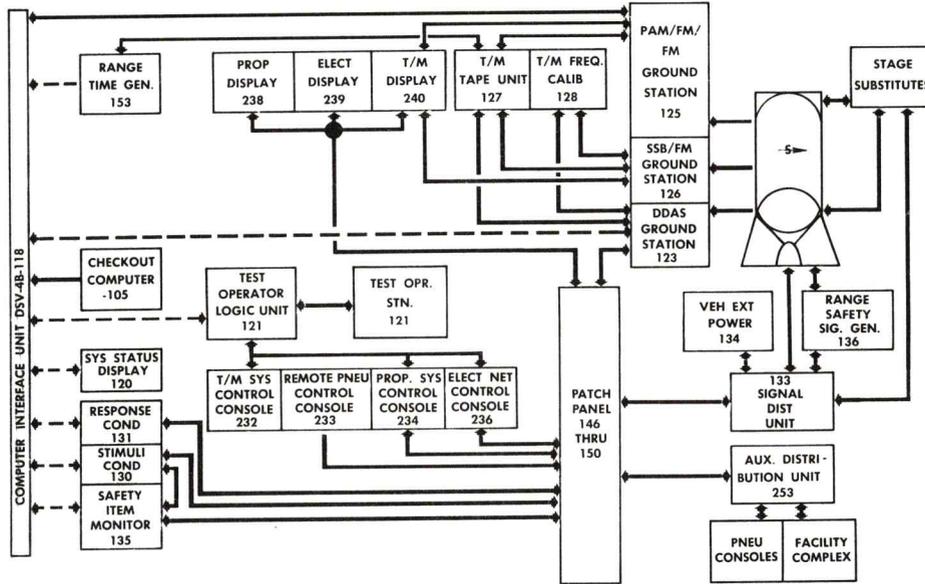
AUTOMATIC GSE

# AUTOMATIC TEST SET



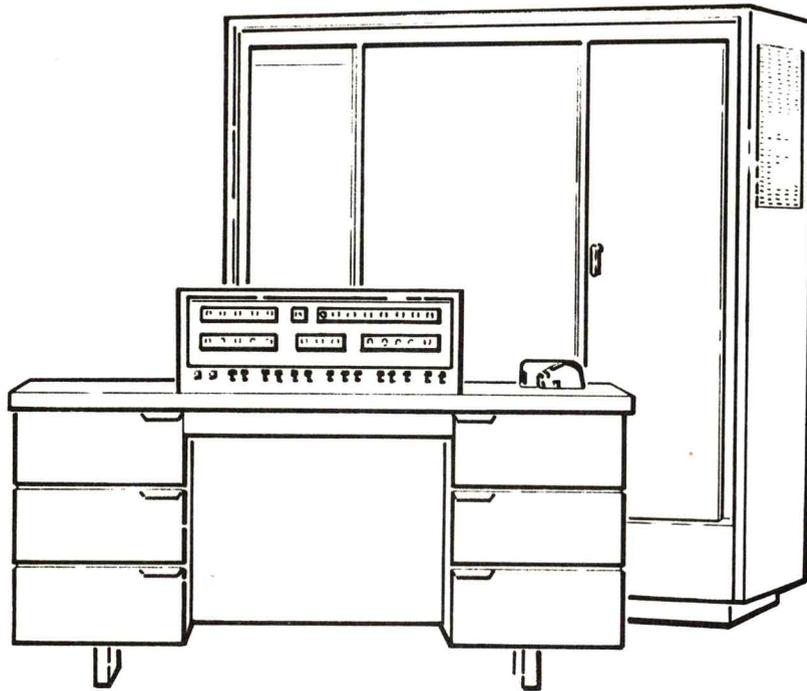
# S-IVB CHECKOUT EQUIPMENT

DSV-4B-413 A



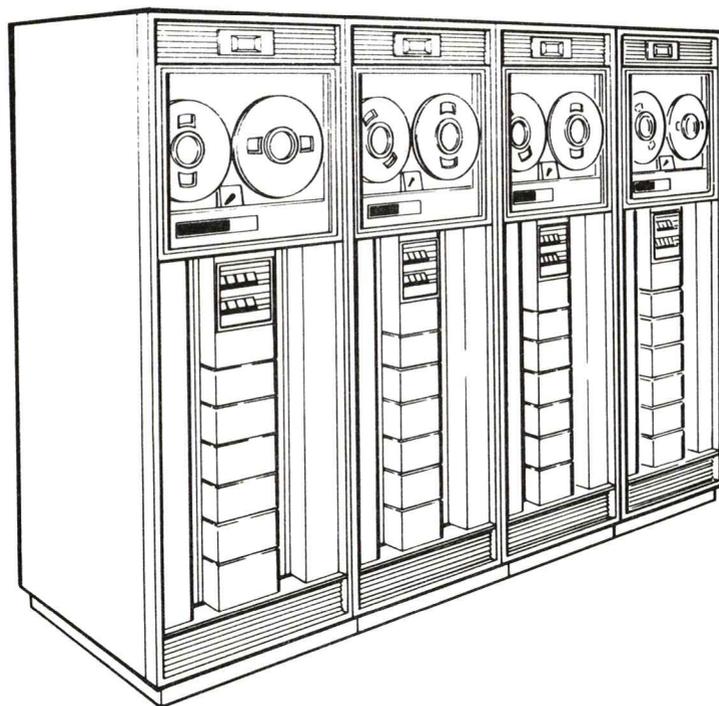
# CDC-924 A CHECKOUT COMPUTER

DSV-4B-390A



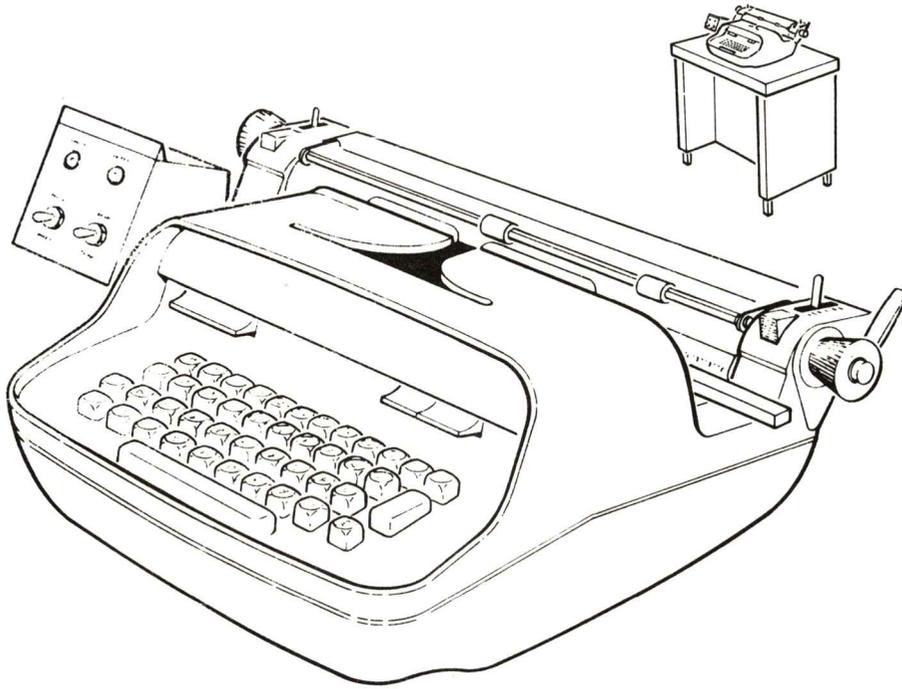
# 603 MAGNETIC TAPE TRANSPORT

DSV-4B-386



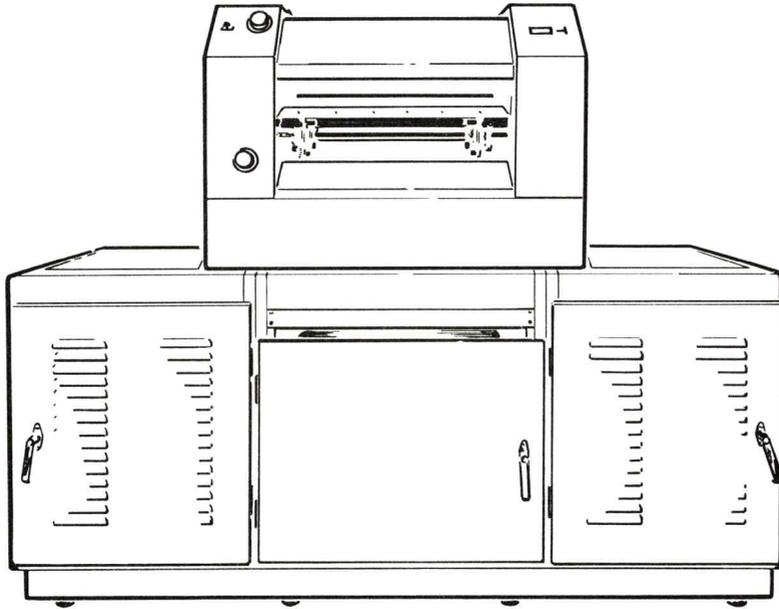
# 161 TYPEWRITER

DSV-48-387



# 612 LINE PRINTER

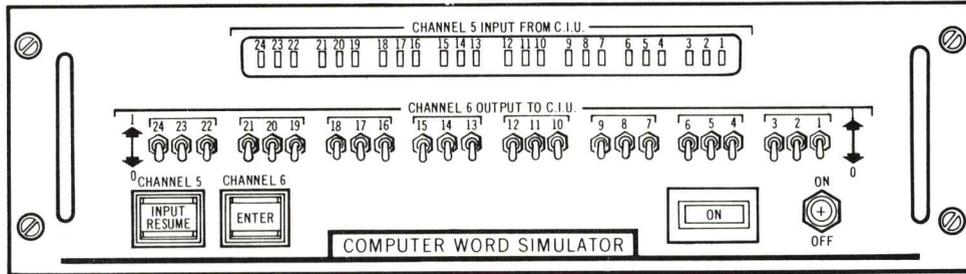
DSV-4B-388



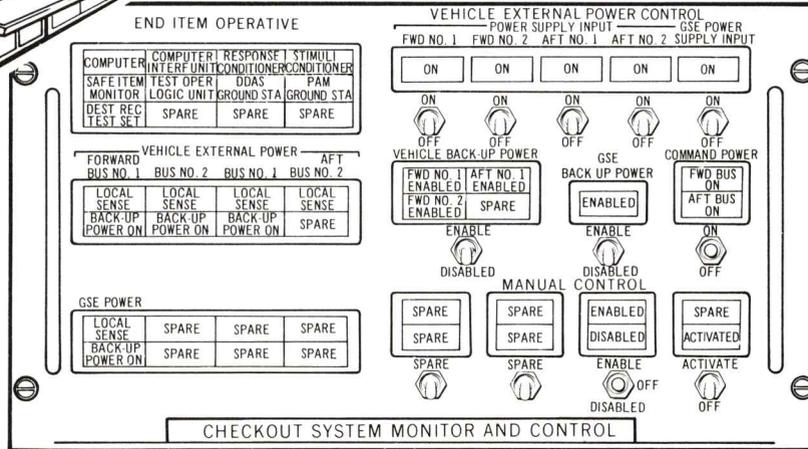


**TEST OPERATOR STATION**  
**MODEL DSV-4B-121**

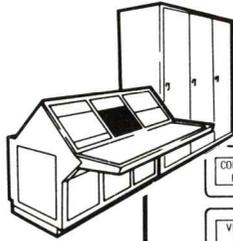
DSV-4B-521



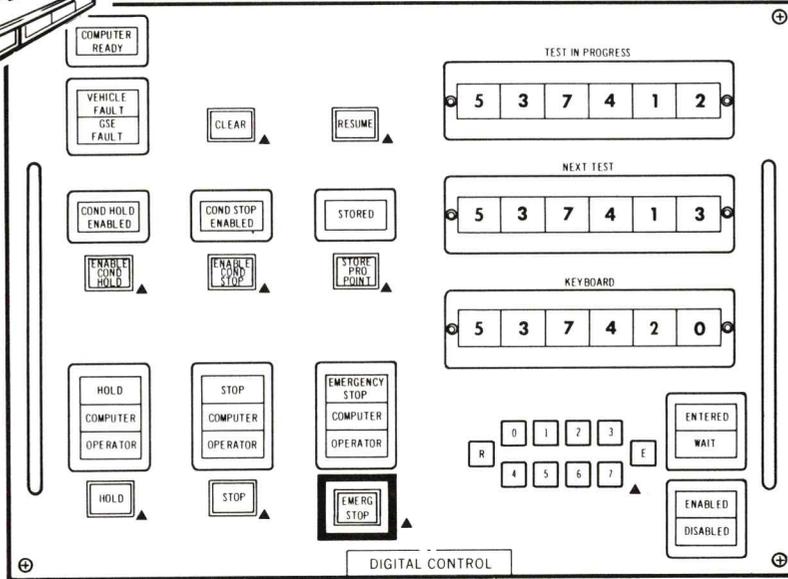
## TEST OPERATOR STATION MODEL DSV-4B-121



# TEST OPERATOR STATION MODEL DSV-4B-121

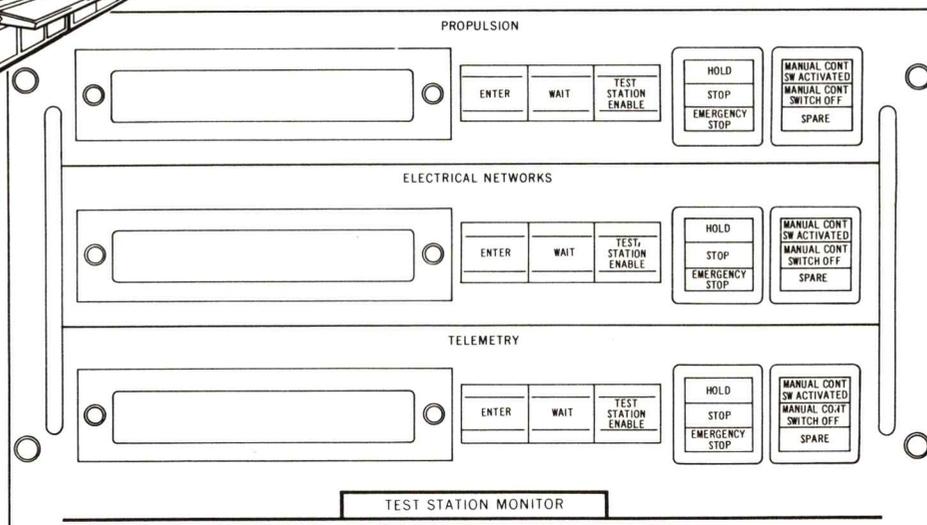


○ MAINTAINED  
▲ MOMENTARY



**TEST OPERATOR STATION**  
MODEL DSV-4B-121

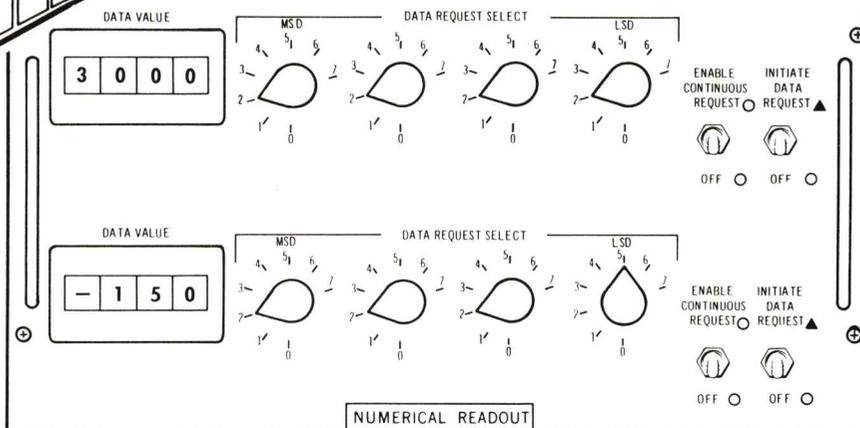
DSV-4B-517



# TEST OPERATOR STATION

MODEL DSV-4B-121

- MAINTAINED
- ▲ MOMENTARY

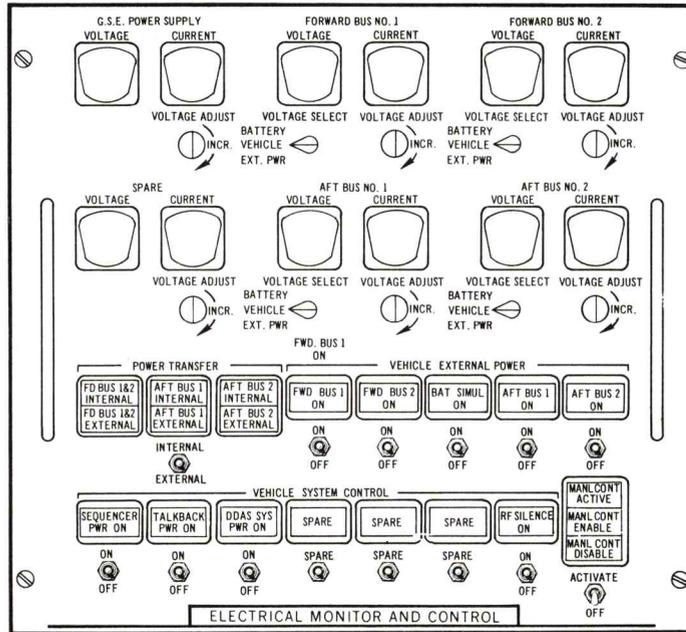




MODEL DSV-4B-236

**ELECTRICAL NETWORKS CONTROL CONSOLE**

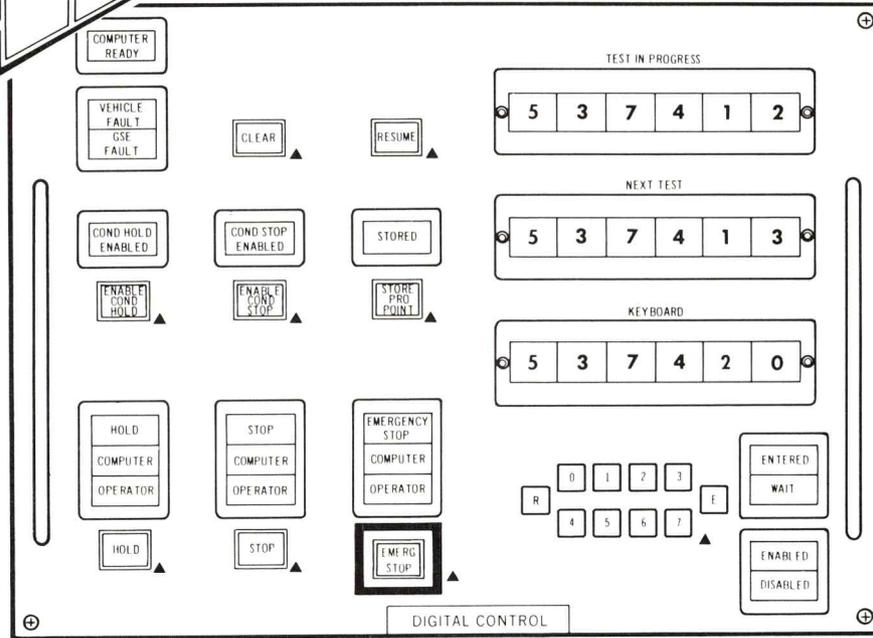
DSV-4B-525

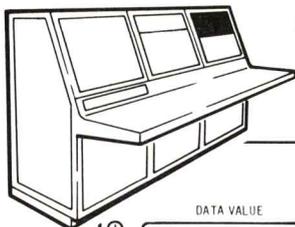


# ELECTRICAL NETWORKS CONTROL CONSOLE MODEL DSV-4B-236



○ MAINTAINED  
▲ MOMENTARY

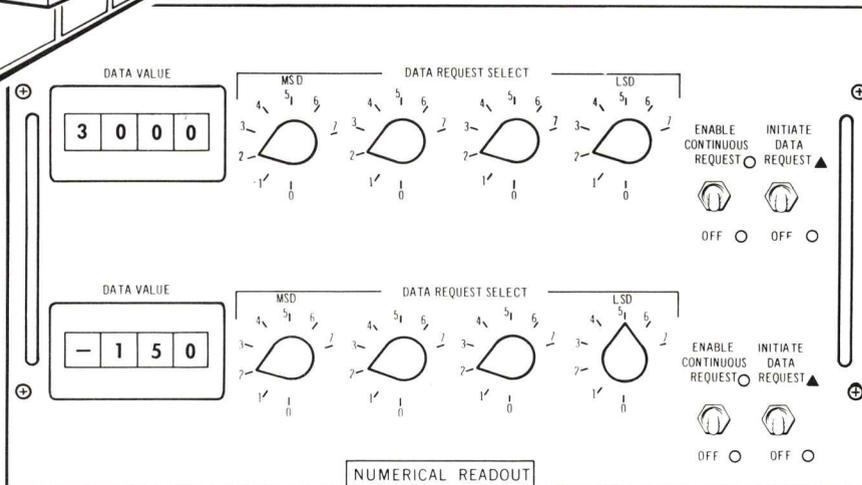


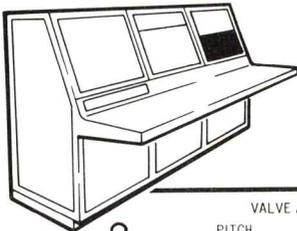


# ELECTRICAL NETWORKS CONTROL CONSOLE

MODEL DSV-4B-236

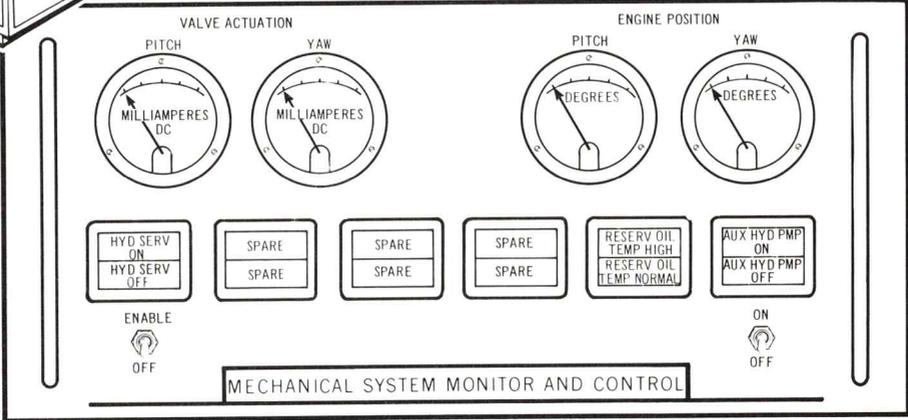
- MAINTAINED
- ▲ MOMENTARY

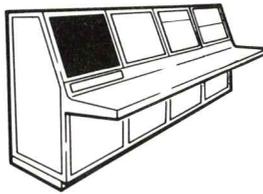




# ELECTRICAL NETWORKS CONTROL CONSOLE

MODEL DSV-4B-236

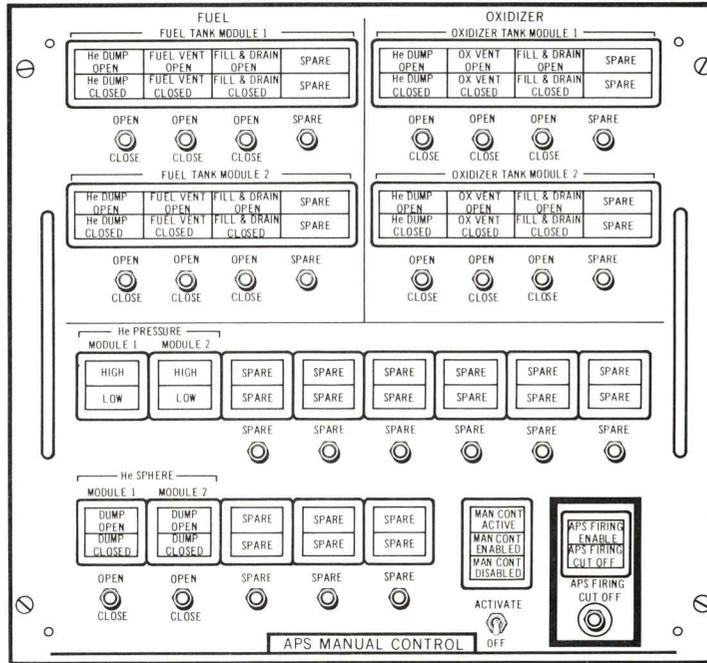




MODEL DSV-4B-234

### PROPULSION SYSTEM CONTROL CONSOLE

DSV-4B-516

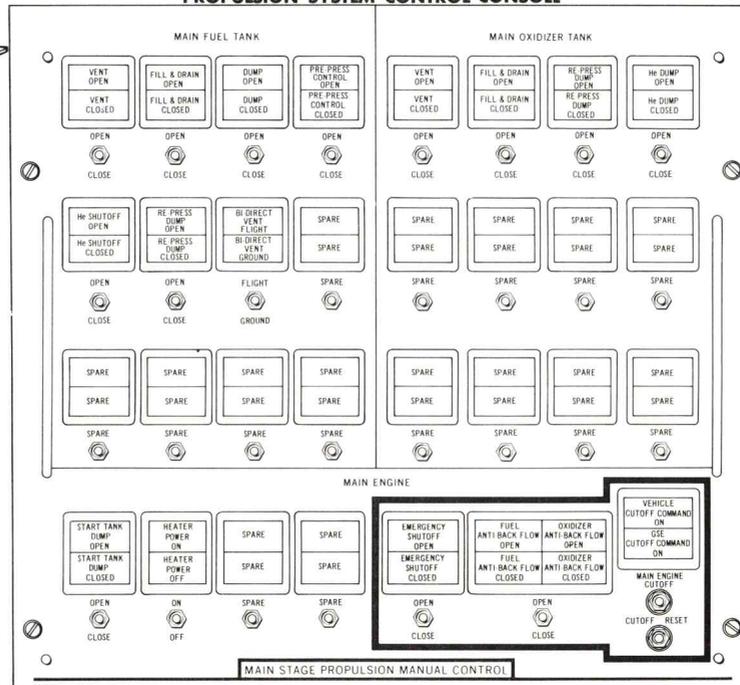


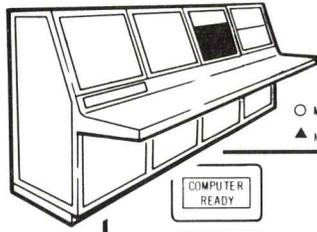


MODEL DSV-4B-234

**PROPULSION SYSTEM CONTROL CONSOLE**

DSV-4B-526

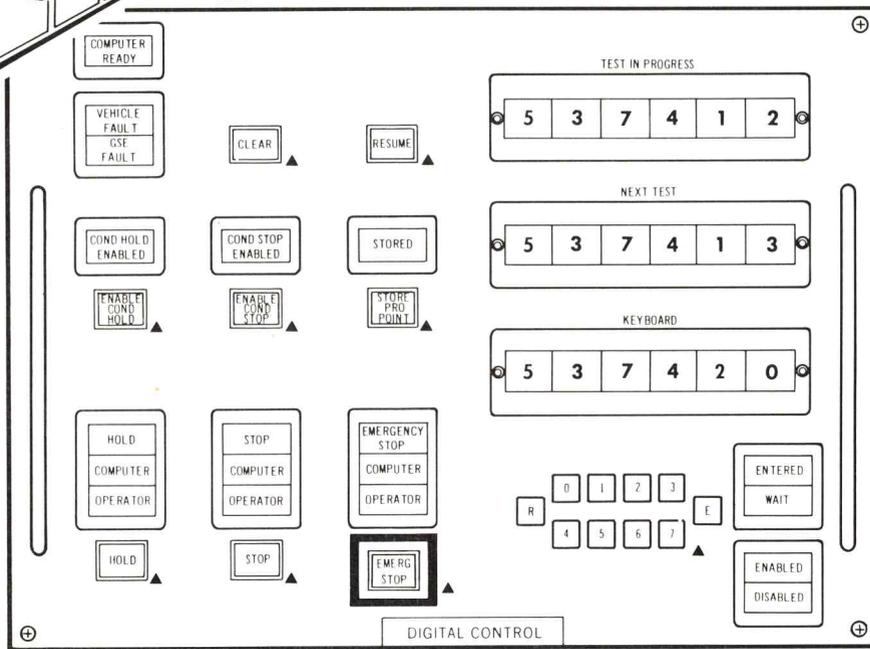


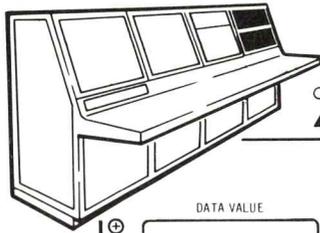


# PROPULSION SYSTEM CONTROL CONSOLE

MODEL DSV-4B-234

○ MAINTAINED  
▲ MOMENTARY

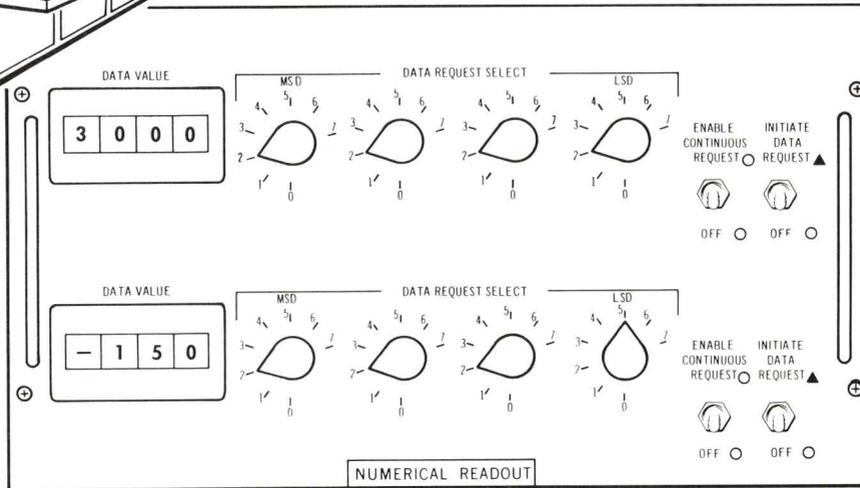




# PROPULSION SYSTEM CONTROL CONSOLE

MODEL DSV-4B-234

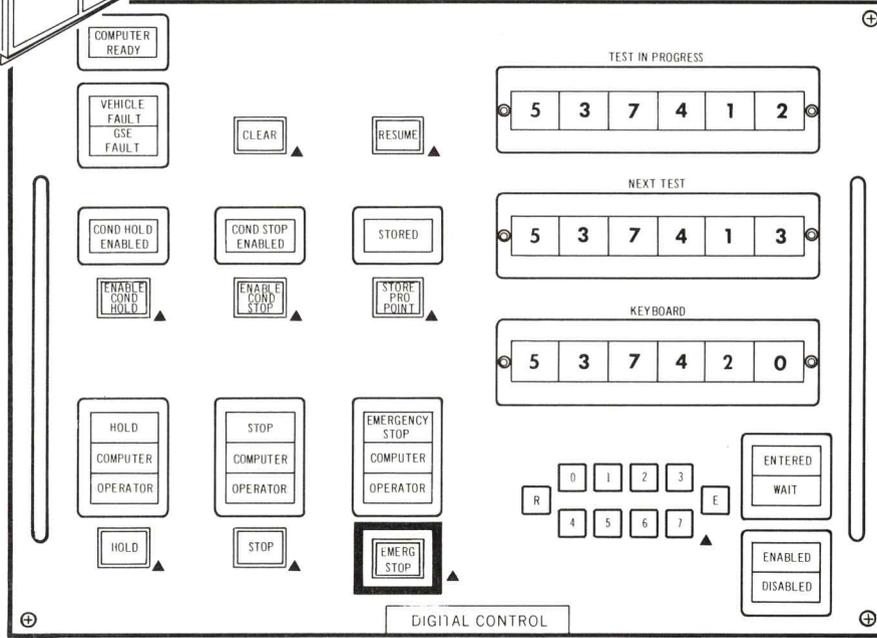
- MAINTAINED
- ▲ MOMENTARY

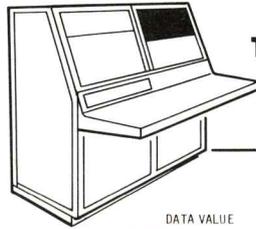


# TELEMETRY SYSTEMS CONTROL CONSOLE MODEL DSV-4B-232



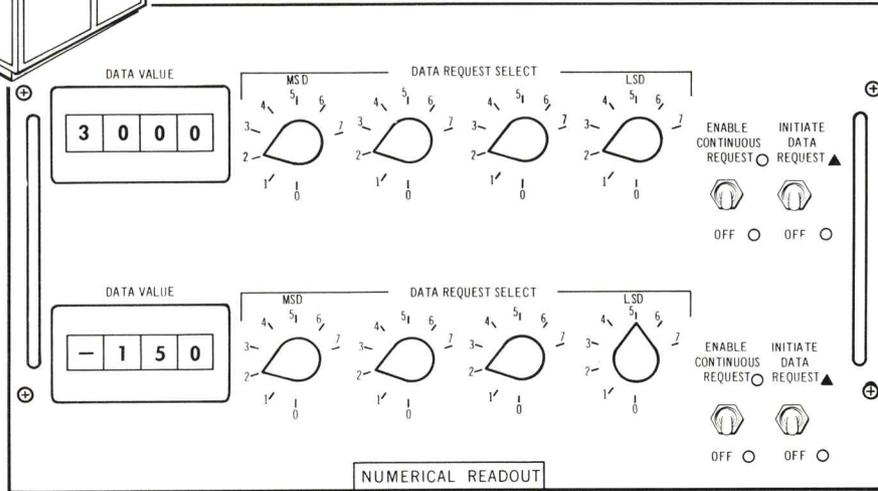
○ MAINTAINED  
▲ MOMENTARY



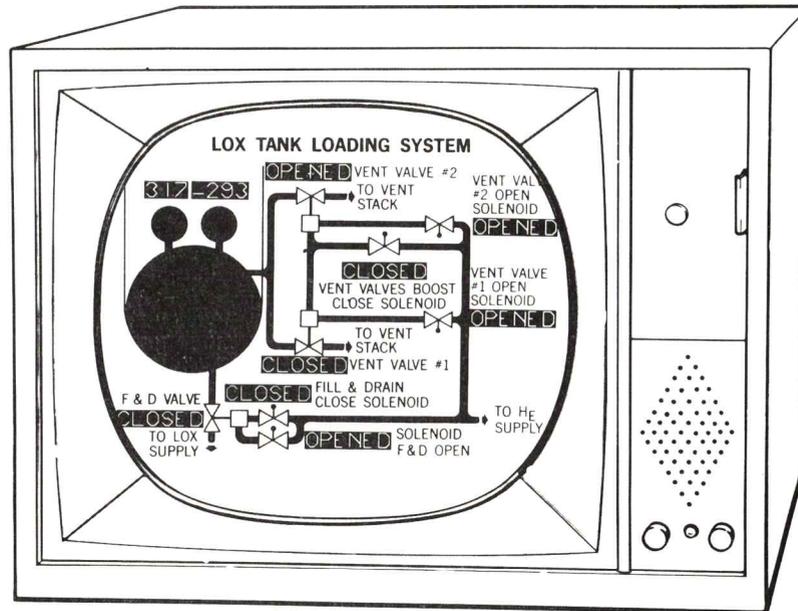


# TELEMETRY SYSTEMS CONTROL CONSOLE MODEL DSV-4B-232

- MAINTAINED
- ▲ MOMENTARY

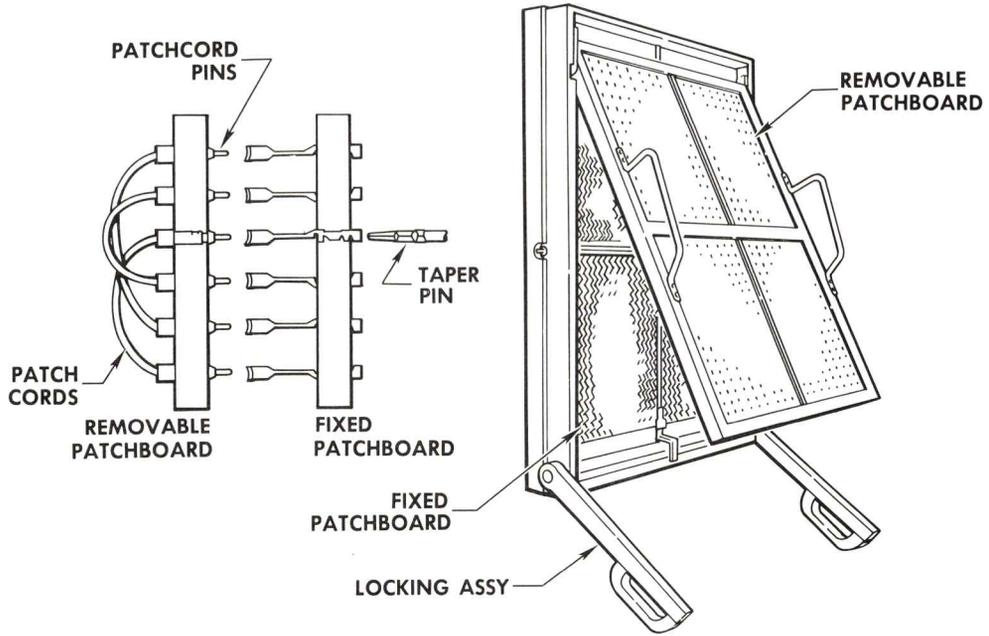


# SYSTEMS STATUS DISPLAY MONITOR STATION



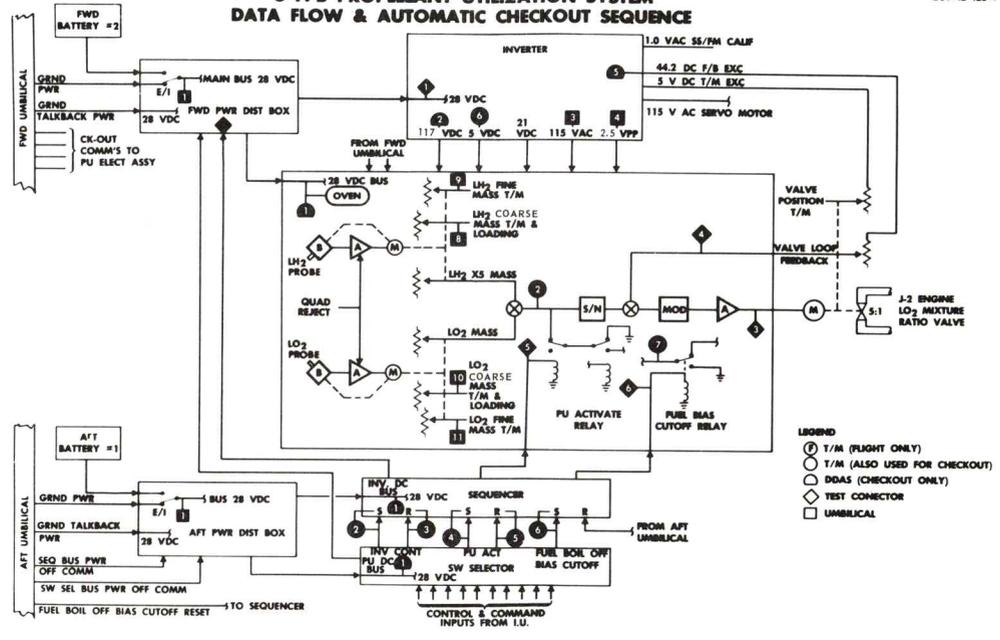
# PATCHBOARD PROGRAMMING CONCEPT S-IVB AUTOMATIC CHECKOUT SYSTEM

DSV-4B-513



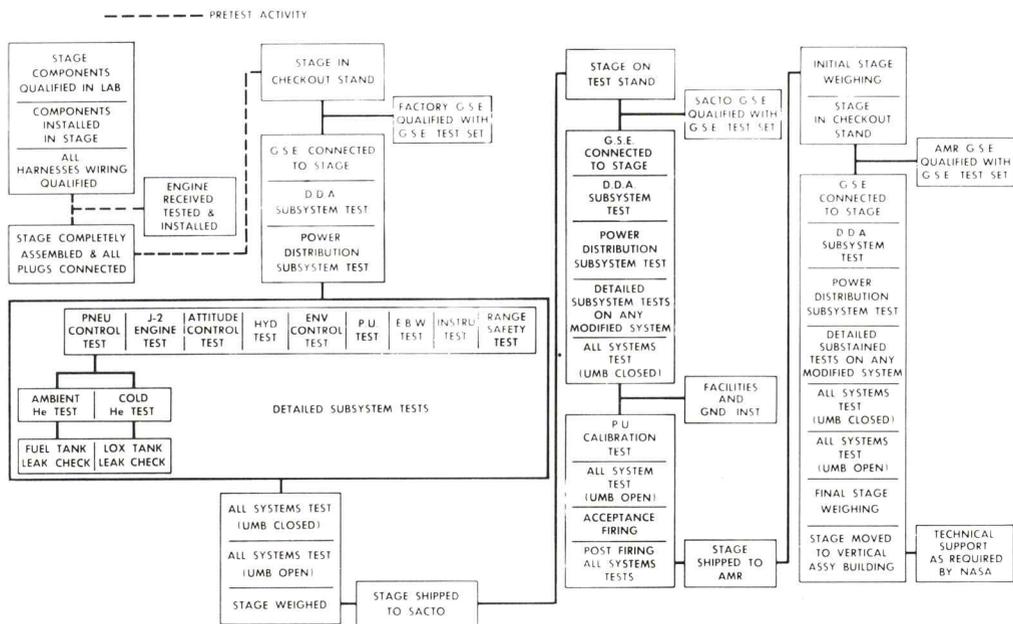
### S-IVB PROPELLANT UTILIZATION SYSTEM DATA FLOW & AUTOMATIC CHECKOUT SEQUENCE

DSV-48-423 A



# S-IVB CHECKOUT PLAN

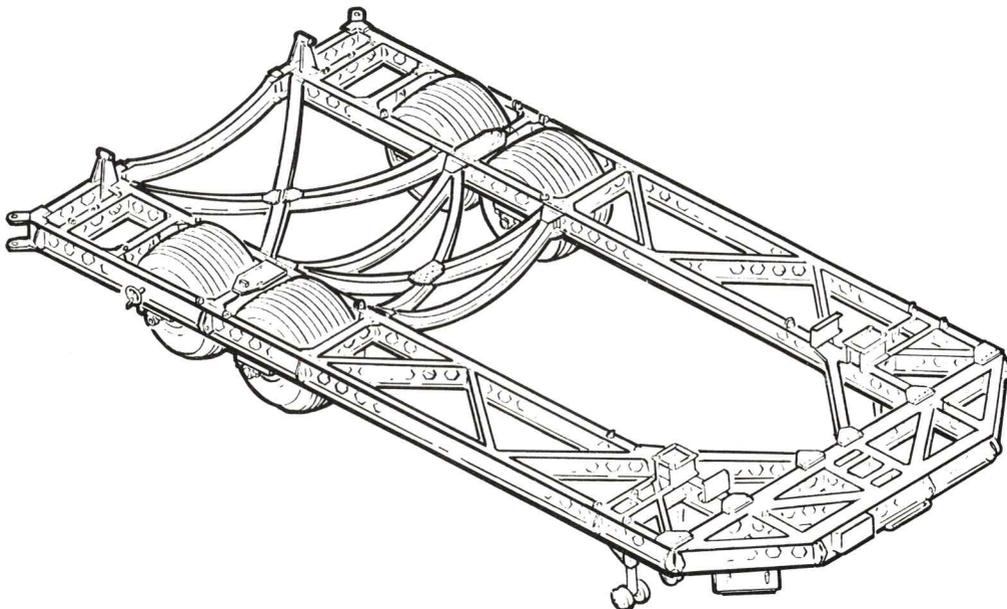
DSV-48-355





## S-IVB TRANSPORTER

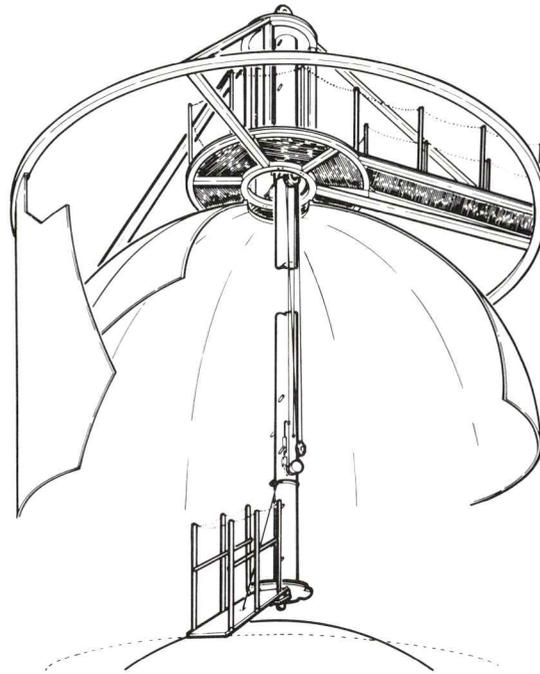
DSV-4B-323



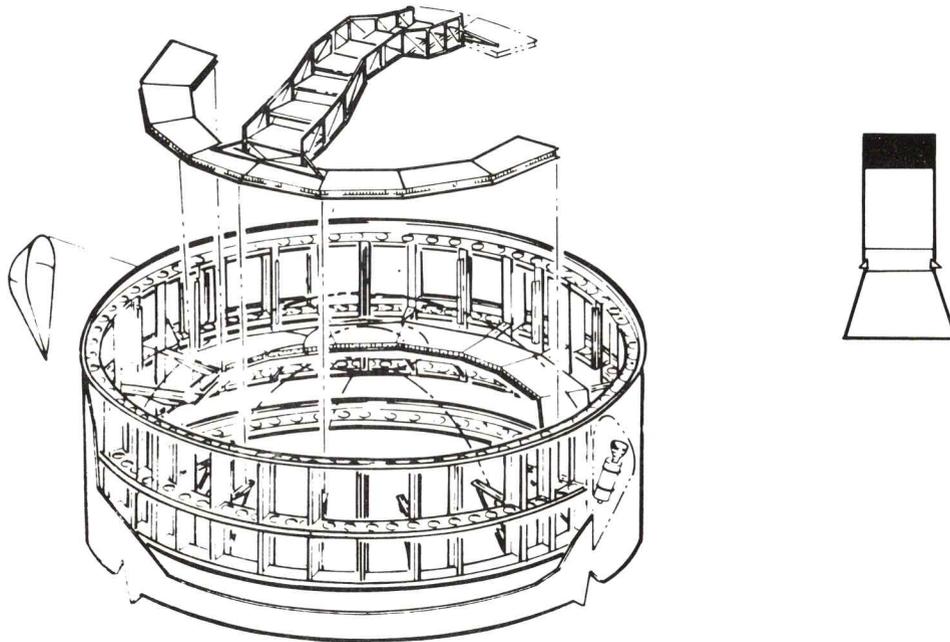
S-IVB Transporter (DSV-4B-300) – is a modified S-IV Transporter, with three point suspension. It will provide shock isolation to the stage during normal land travel, and can be dismantled for shipment.

## FUEL TANK INTERIOR ACCESS KIT

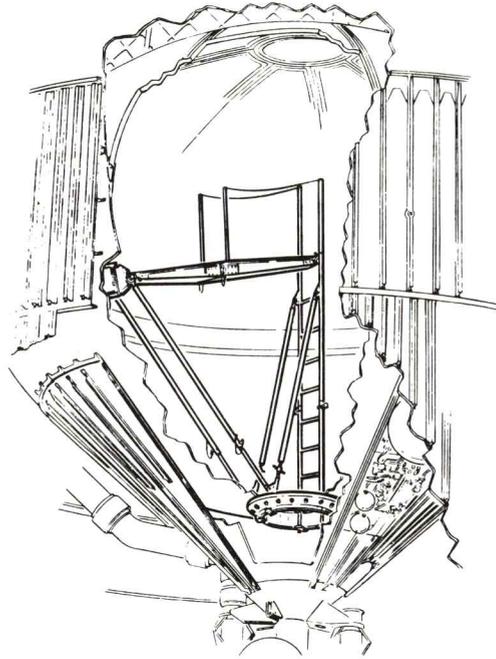
DSV-4B-326



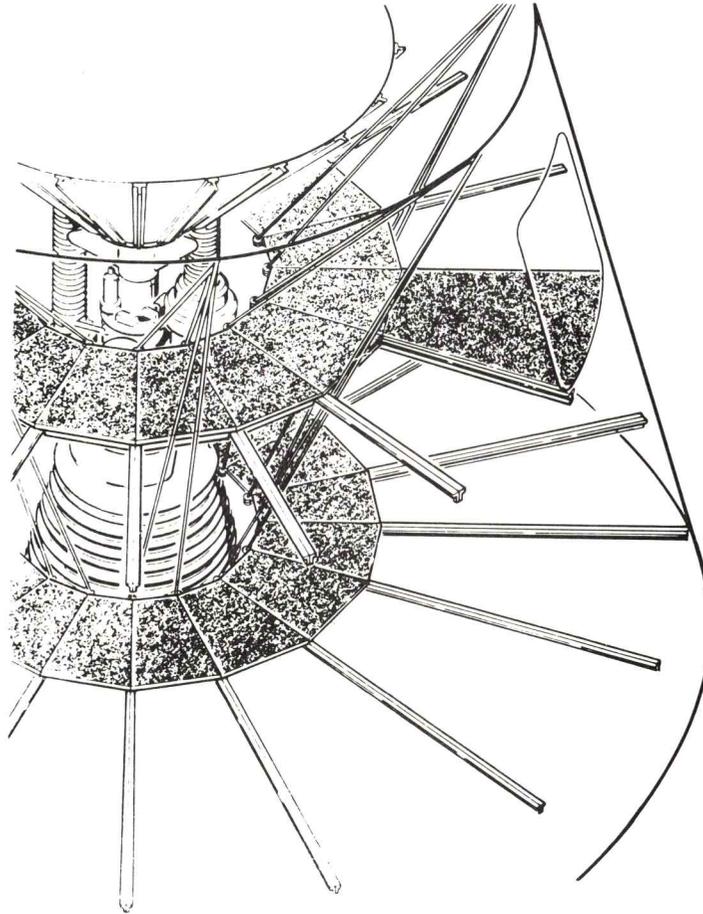
Fuel Tank Interior Access Kit (DSV-4B-308) – provides personnel access to tank interior when stage is in a vertical position. The kit consists of a fold up cantilevered work platform, rotational drive mechanism, support mast, access ladder, tank lighting and an electrical work platform hoist.

**VERTICAL ACCESS KIT FORWARD SECTION**

Vertical Access Kit, Forward Section (DSV-4B-319) – provides access to the forward section of the S-IVB when in a vertical position. The kit will consist of a walkway of removable sections attached to bracket in the forward skirt.

**LOX TANK INTERIOR ACCESS KIT**

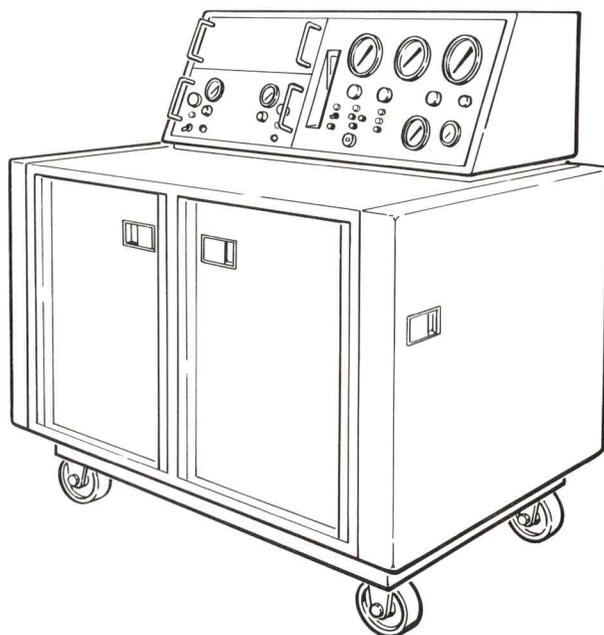
Lox Tank Access Kit (DSV-4B-348) – is a hinged ladder assembly that provides personnel access to the interior of the S-IVB Liquid Oxygen Tank when stage is in a vertical or horizontal position.

**VERTICAL ACCESS KIT AFT SECTION**

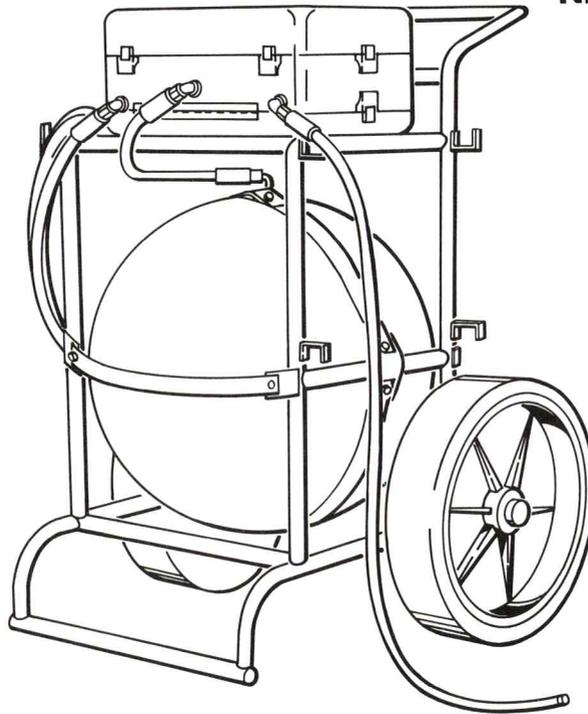
Vertical Access Kit, Aft Section (DSV-4B-311) – provides access to aft section of the S-IVB when in a vertical position. The kit will consist of a series of removable platforms work which connect to the interstage stiffeners. Access is through a door in the aft interstage adjacent to umbilical arm.

## HYDRAULIC PUMPING UNIT

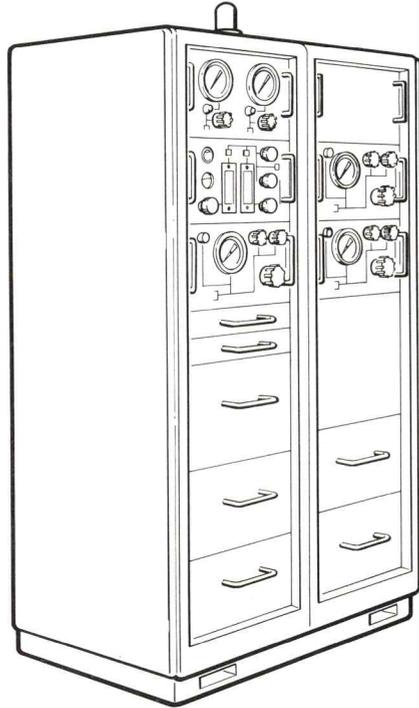
DSV-4B-352



Hydraulic Servicer (DSV-4B-358) – supplies hydraulic fluid to the S-IVB Hydraulic System for checkout and operation of sub-system components.

**NITROGEN FILL TRUCK**

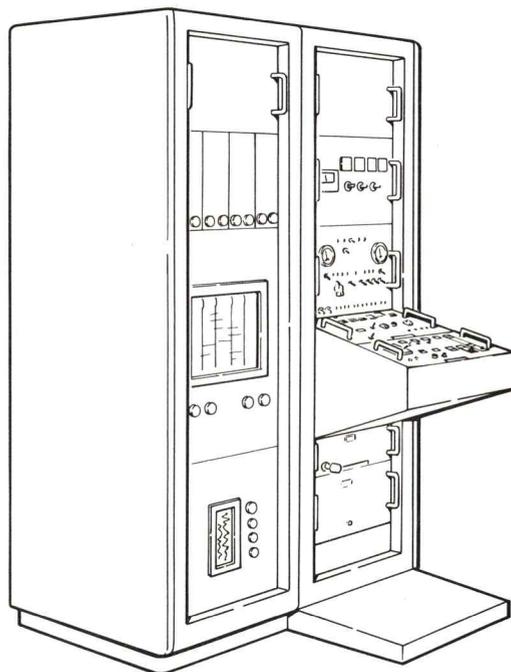
Nitrogen Fill Truck (DSV-4B-186) – used to pressurize the pneumatic side of the Hydraulic Accumulator, to purge the Airborne Electronic Equipment, and is capable of filling the Hydraulic Servicer Bottle.

**PNEUMATIC CHECKOUT CONSOLE G-3106**

Pneumatic Console G3106 – is used to supply and monitor pneumatic pressure to engine systems and components and to measure leakage rate during leak and functional tests of the engine.

**ELECTRICAL CHECKOUT CONSOLE & G 1037 FLIGHT  
INSTRUMENTATION RECORDER CONSOLE & G 3121**

DSV-4B-293A

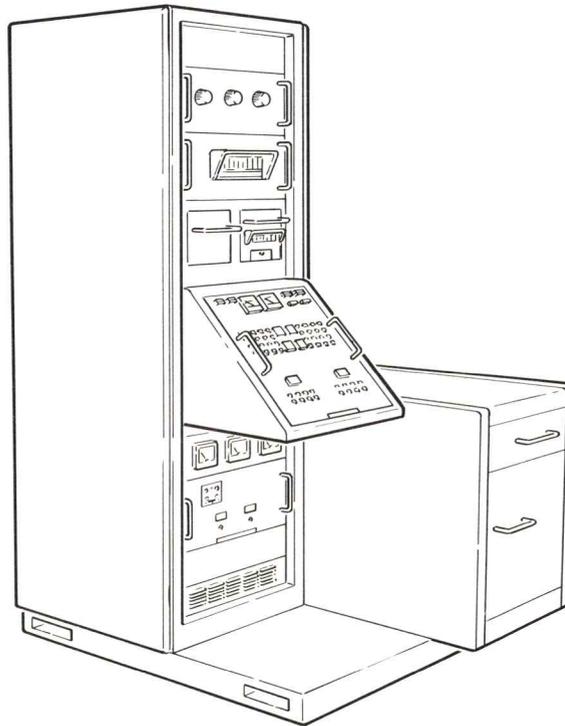


Flight Instrumentation Recorder Console G3121 – is used in conjunction with the Flight Instrumentation Checkout Console G1035 to ensure circuit continuity and hardware integrity prior to calibration checkout of the engine.

Electrical Checkout Console G1037 – The purposes of the console units are to provide, receive, transmit, and monitor the necessary electrical signals required during engine tests.

## FLIGHT INSTRUMENTATION CHECKOUT CONSOLE G-1035

DSV-4B-294

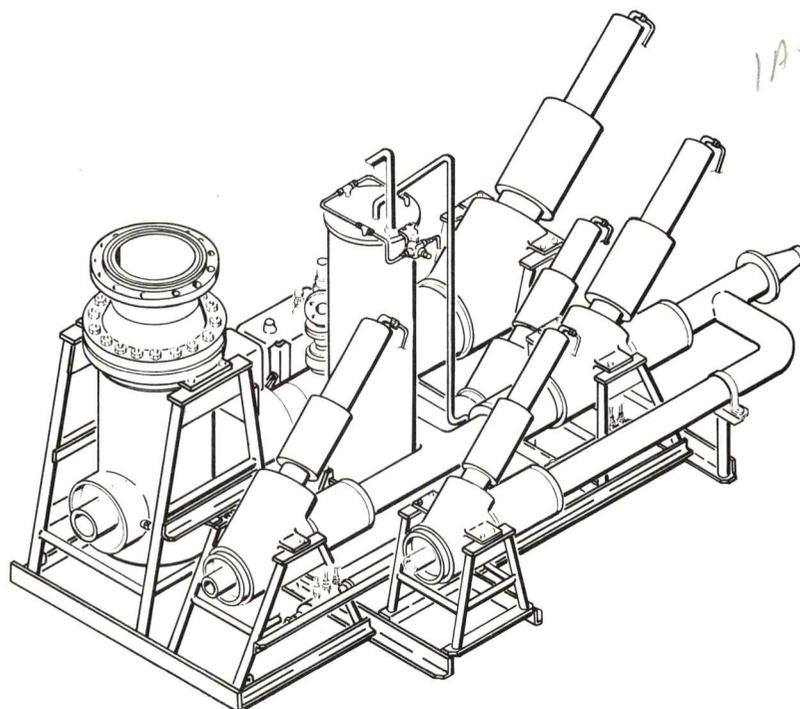


Flight Instrumentation Console G1035 – is designed to perform functional calibration checks of the flight instrumentation system to verify engine instrumentation acceptability.

# LIQUID HYDROGEN VALVE CONTROL COMPLEX

DSV-4B-311

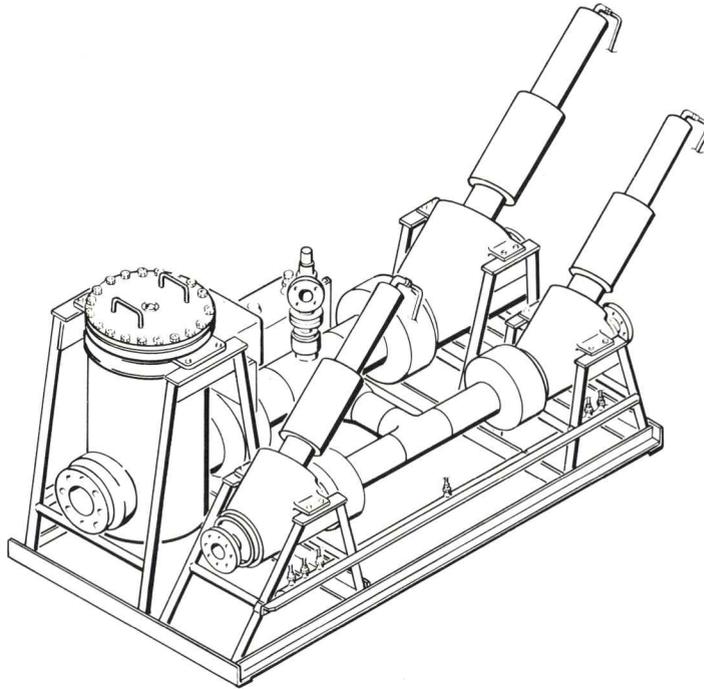
*1A38180  
Beta Design Draw.  
1A78966*



Liquid Hydrogen Valve Complex (DSV-4B-332) – controls the transfer of  $LH_2$  from ground storage facilities to the S-IVB and the Heat Exchanger.

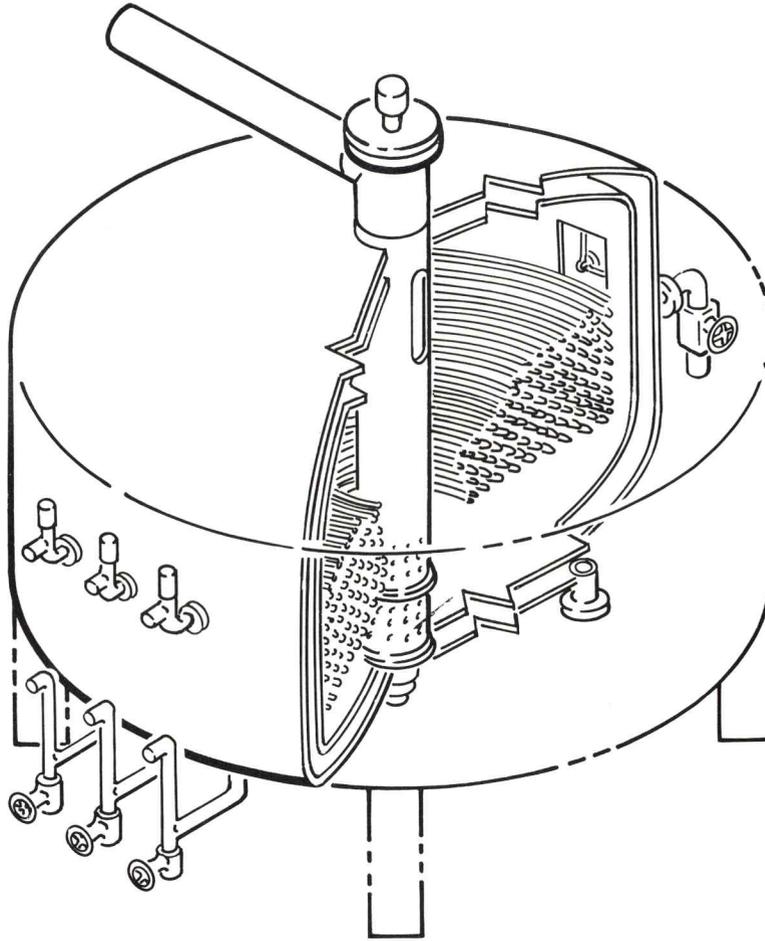
## LIQUID OXYGEN VALVE CONTROL COMPLEX

DSV-4B-312

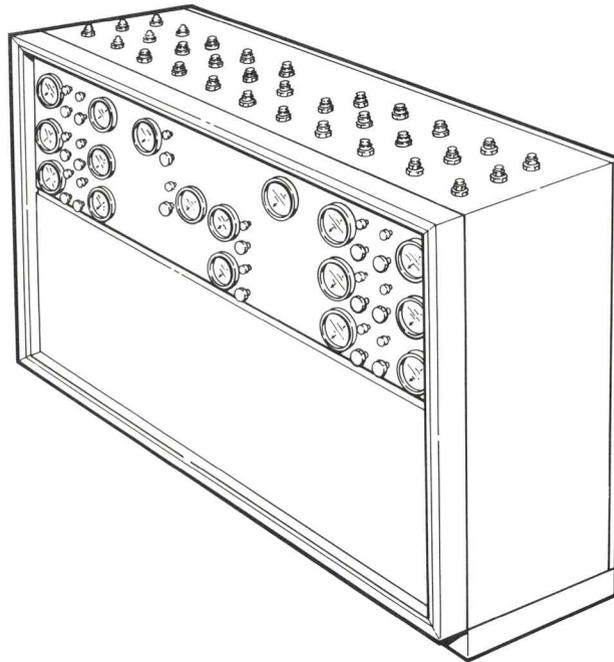


Liquid Oxygen Valve Control Complex (DSV-4B-331) – controls the transfer of  $\text{LO}_2$  from ground facilities to the S-IVB.

# GAS HEAT EXCHANGER

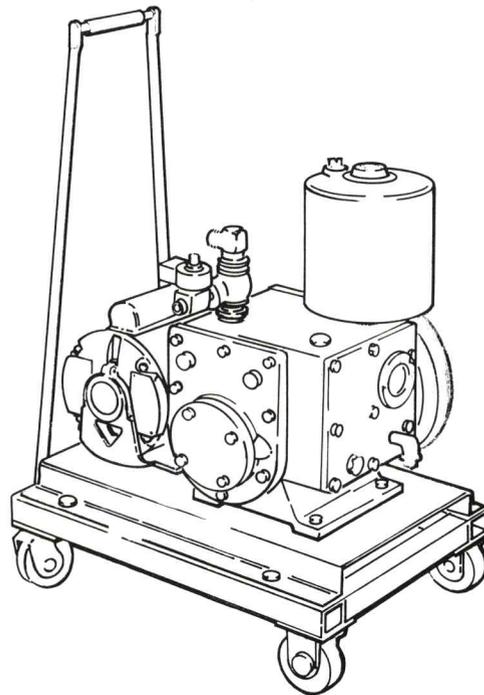


Gas Heat Exchanger (DSV-4B-318) – is a flood type heat exchanger used to fulfill the cold helium and hydrogen gas pre-launch requirements for S-IVB.

**AUTOMATIC STAGE SERVICING PNEUMATIC CONSOLE**

Automatic Stage Servicing Pneumatic Console (DSV-4B-319) – will receive, regulate and control distribution of gaseous hydrogen, nitrogen, and helium to meet the requirements of the S-IVB propulsion system during checkout and operation.

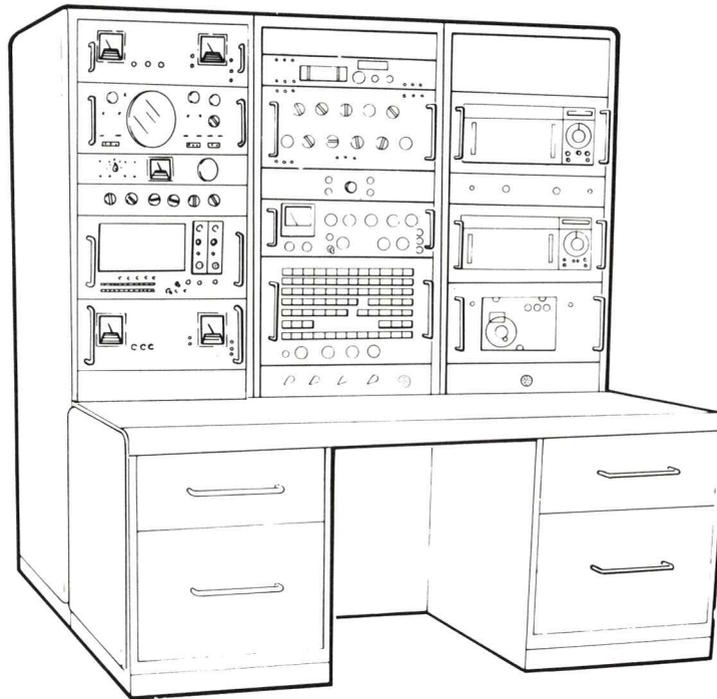
Stage Checkout Pneumatic Console (DSV-4B-321) – receives, regulates, and controls the distribution of helium gas to meet the S-IVB Propulsion System requirements for leak and functional checkout.

**VACUUM PUMPING UNIT**

Vacuum Pumping Unit (DSV4-187) – provides a means of periodically evacuating, to required values, the vacuum jackets of various S-IVB stage and GSE components.

## PROPELLANT UTILIZATION COMPONENT TEST SET

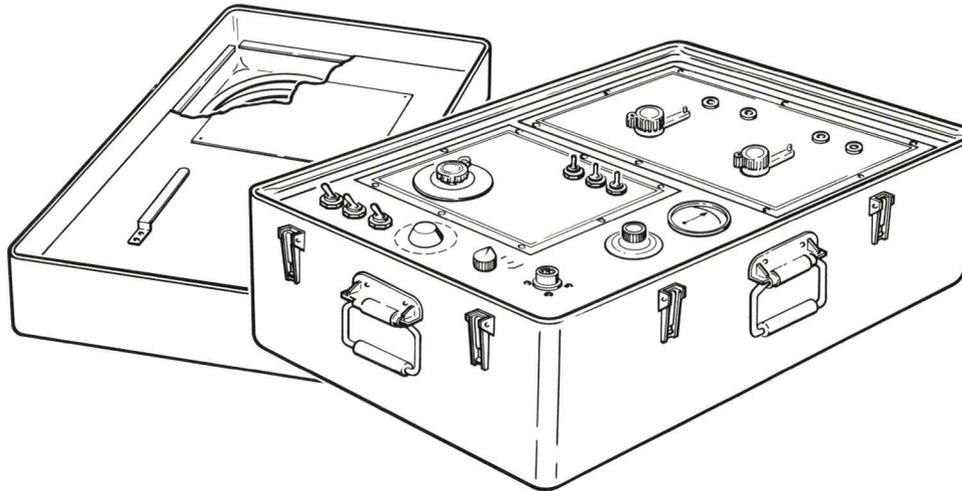
DSV-4B-485



Propellant Utilization System Test Set (DSV-4B-112) – will provide the capability of testing and calibrating the P.U. Electronic Assembly prior to installation in the S-IVB.

## PROPELLANT UTILIZATION CALIBRATION UNIT

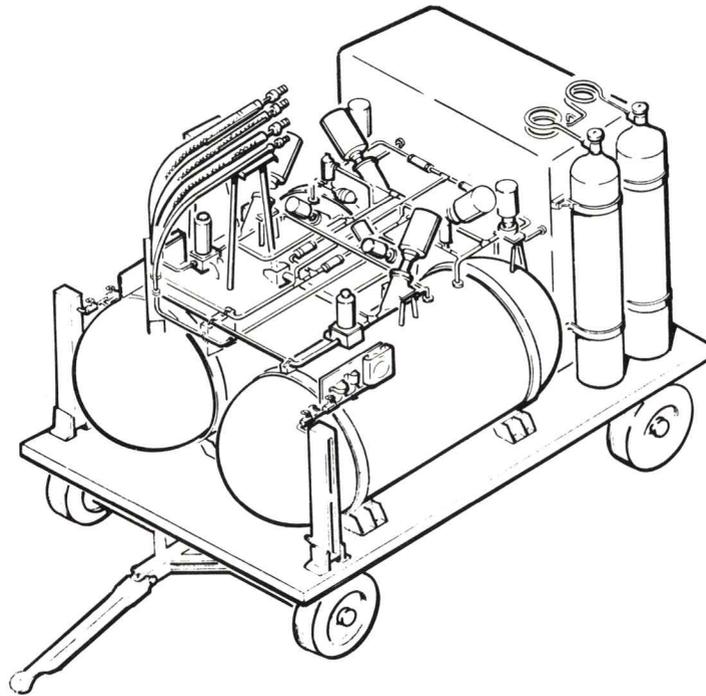
DSV-4B-484A



Propellant Utilization System Calibration Unit (DSV-4B-248) – will provide the capability of calibrating the P.U. Electronics Assembly after installation.

## AUXILIARY PROPULSION SYSTEM OXIDIZER MOBILE SERVICER

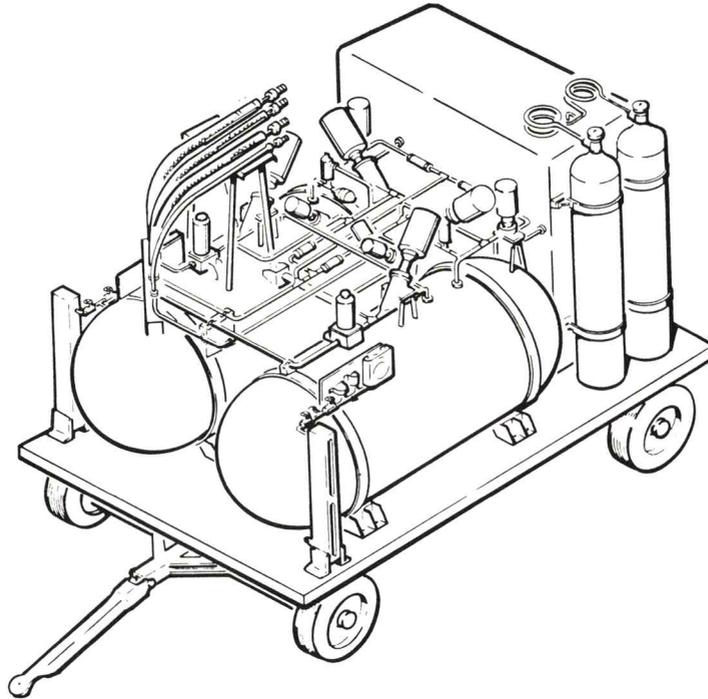
DSV-4B-313 A-1



Auxiliary Propulsion System Oxidizer Mobile Servicer (DSV-4B-322) – is an oxidizer storage and transfer system capable of transporting Nitrogen Tetroxide from the facility storage area and transferring it to the S-IVB Auxiliary Propulsion Modules.

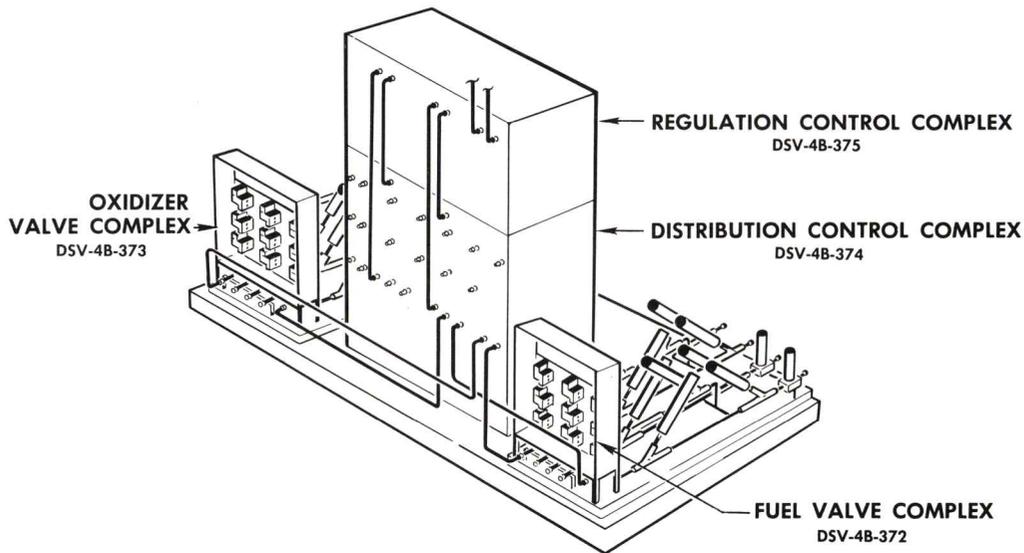
## AUXILIARY PROPULSION SYSTEM FUEL MOBILE SERVICER

DSV-4B-313 A-2



Auxiliary Propulsion System Fuel Mobile Servicer (DSV-4B-323) – is a propellant storage and transfer system, capable of transporting the A.P.S. fuel from facility storage area and transferring it to the S-IVB Auxiliary Propulsion Modules.

## AUXILIARY PROPULSION SYSTEM MODULE CHECKOUT & PROPELLANT LOADING CONTROL ASSEMBLY



Auxiliary Propulsion System Module Checkout and Propellant Loading Control Assembly (DSV-4B-TBD) – is utilized for checkout of the auxiliary propulsion modules prior to and during propellant loading.

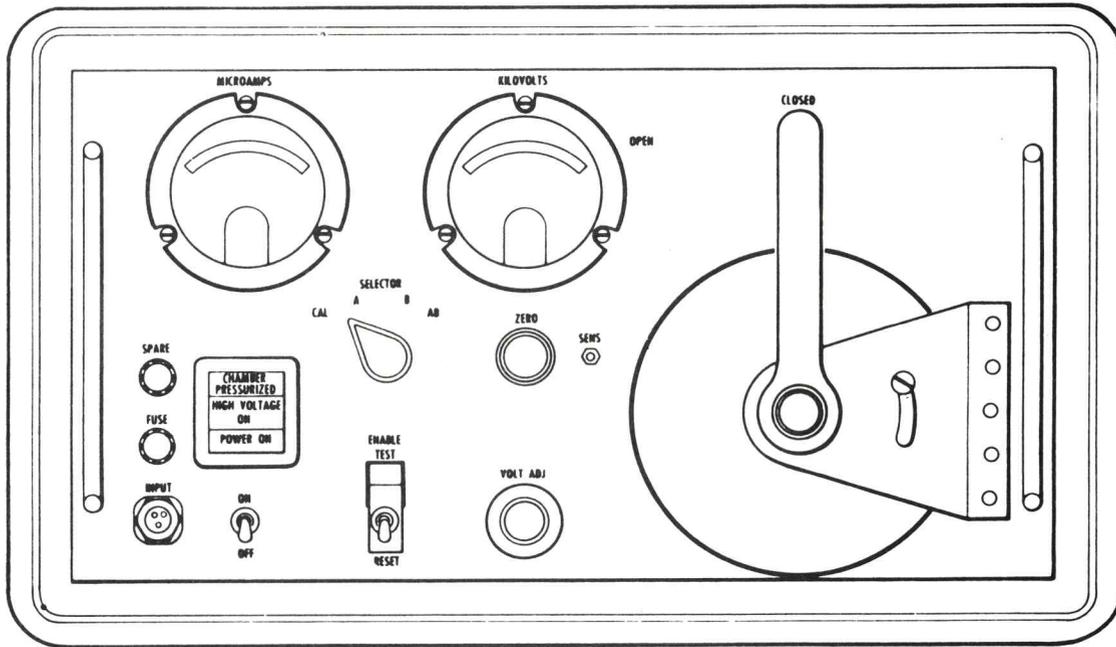
Auxiliary Propulsion System Oxidizer Valve Complex Control Assembly (DSV-4B-373) – will control the transfer of nitrogen tetroxide to auxiliary propulsion modules.

Auxiliary Propulsion System Fuel Valve Complex Control Assembly (DSV-4B-372) – will control the transfer of aerazine 50 to auxiliary propulsion modules.

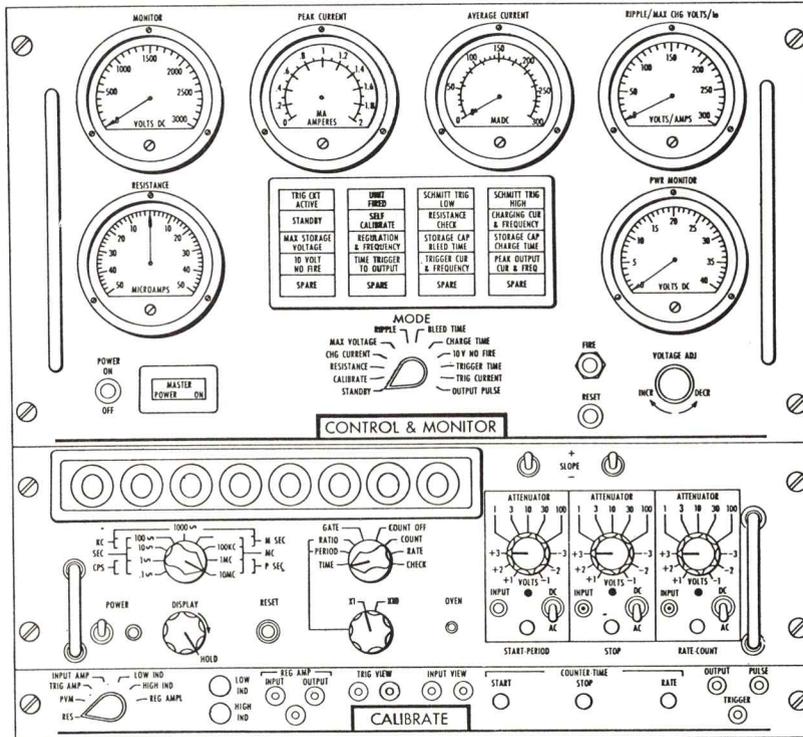
Auxiliary Propulsion System Pneumatic Regulation Control Assembly (DSV-4B-375) – receives gaseous nitrogen and helium from facility sources and regulates them to the required pressures for system operation.

Auxiliary Propulsion System Pneumatic Distribution Complex Control Assembly (DSV-4B-374) – receives nitrogen and helium gases from Auxiliary Regulation Control Assembly (DSV-4B-375) and distributes them to the Auxiliary Propulsion System.

# EBW INITIATOR COMPONENT TEST SET



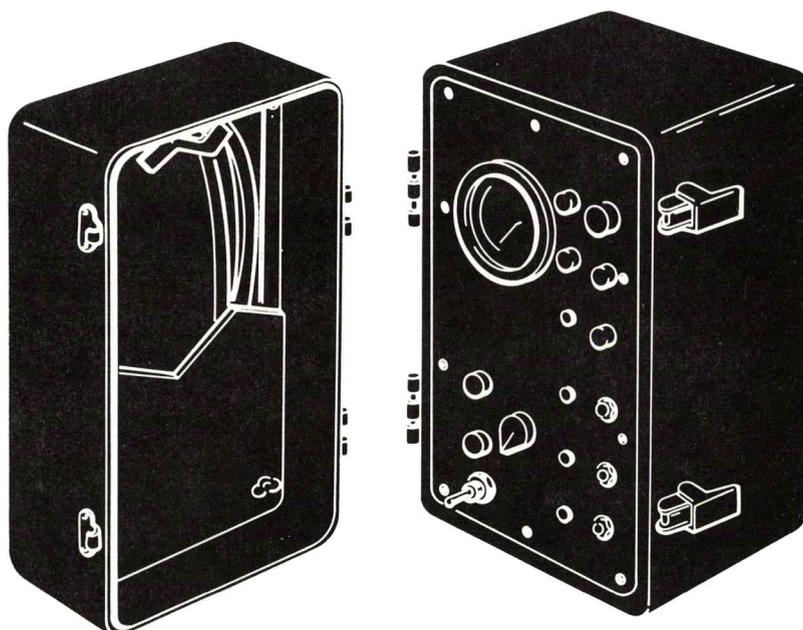
EBW Initiator Test Set (DSV4-196) – will perform qualitative checks of the initiators prior to installation in the S-IVB. Its basic function is to determine whether the electrical characteristics of the initiators are within tolerance.



EBW Firing Unit Component Test Set (DSV-4B-114) – will test the EBW Firing Unit as a component. It is manually operated, and requires no additional equipment for operation.

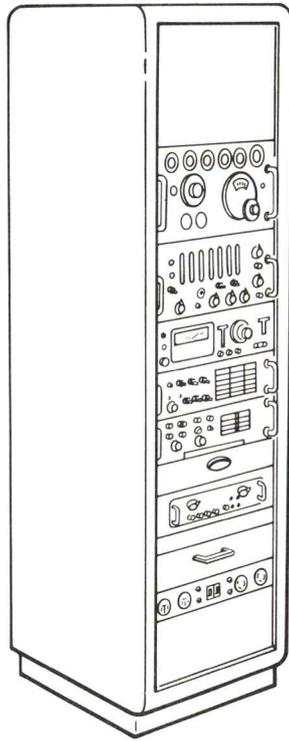
## EBW SYSTEM PULSE TEST SET

DSV-4-766



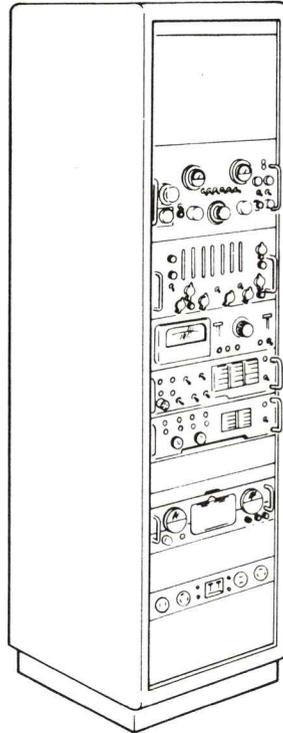
EBW Pulse Checker (DSV-4B-137) – will measure the current pulse generated by an EBW Firing Unit through an initiator simulator to determine that it meets design parameters.

## DESTRUCT SYSTEM TEST SET



Destruct System Test Set (DSV-4B-136) – will provide RF stimulation to the stage destruct system to test system receivers and controllers. System will be capable of remote control by the automatic system.

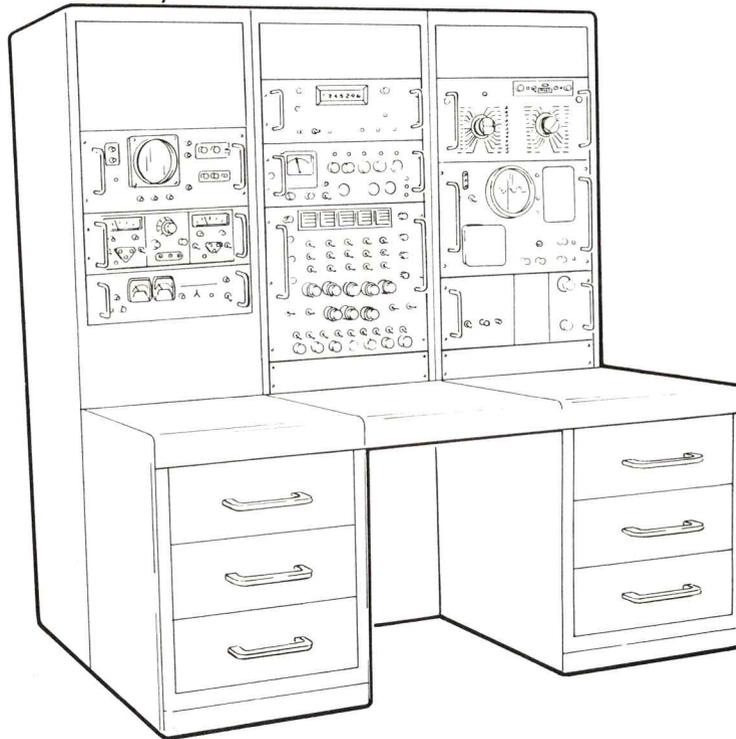
## DESTRUCT SYSTEM COMPONENT TEST SET



Destruct System Component Test Set (DSV-4B-113) – will be used to test the Command Destruct System components prior to installation in the stage.

## PAM-FM/FM TELEMETRY COMPONENT TEST

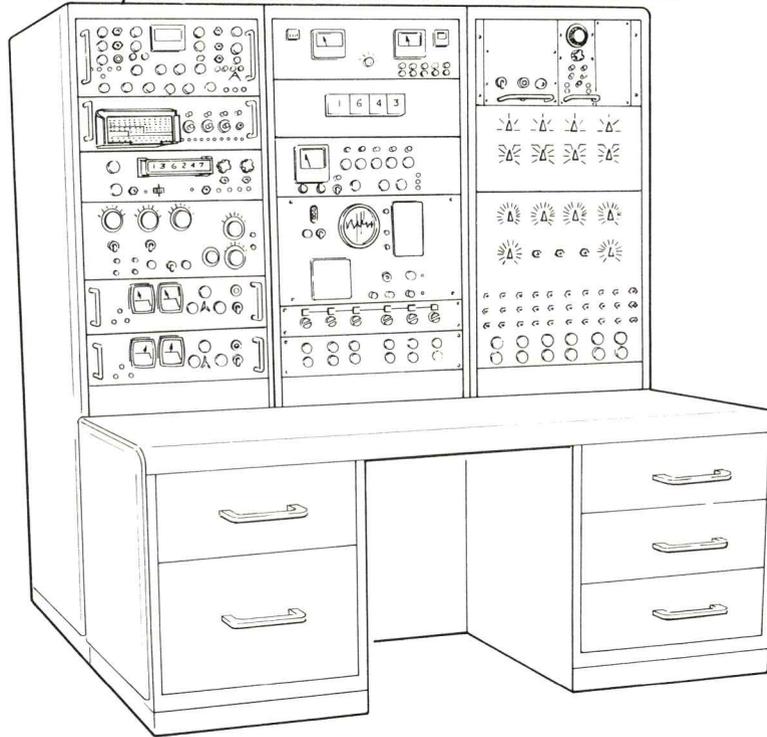
DSV-4B-581



PAM/FM/FM Component Test Set (DSV-4B-102) – is manually operated and will provide necessary power, input signal stimuli, clock pulse, decommutation, and readout equipment for component and system checkout.

## PCM F/M TELEMETRY COMPONENT TEST SET

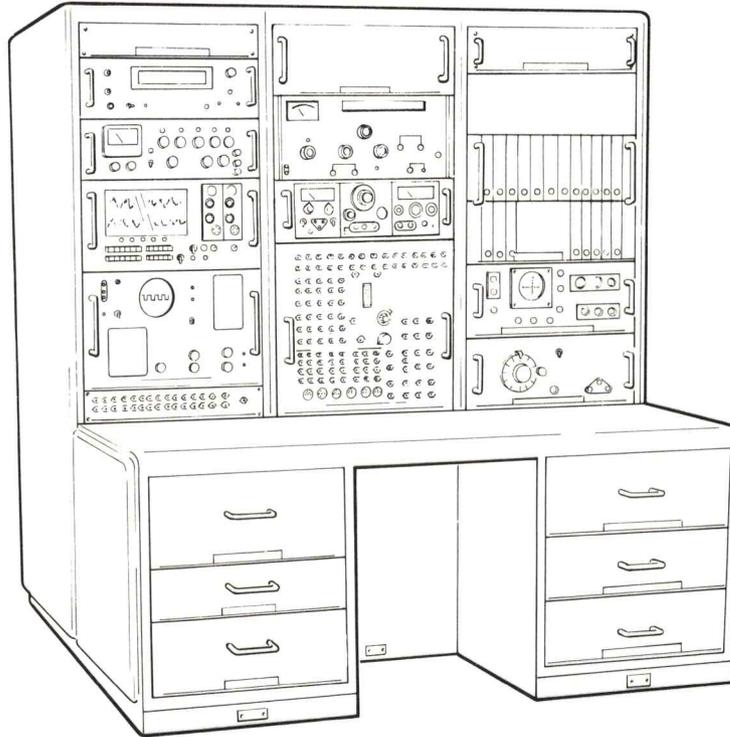
DSV-4B-582



PCM/FM Telemetry Component Test Set ((DSV-4B-115) – will be capable of performing all of the tests required for complete evaluation, adjustment, and fault isolation of the Digital Data Acquisition Assembly.

## SSB/FM TELEMETRY COMPONENT TEST SET

DSV-4B-583

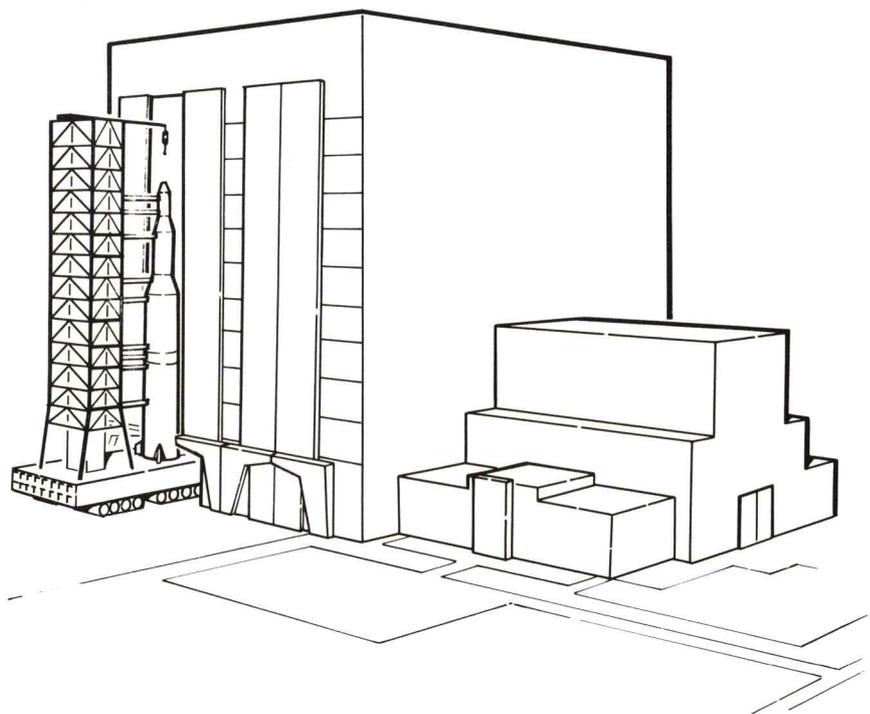


SSB/FM Telemetry Component Test Set (DSV-4B-103) – will provide the stimuli and monitoring equipment necessary to adequately calibrate and troubleshoot the Single Sideband Translator Assembly.



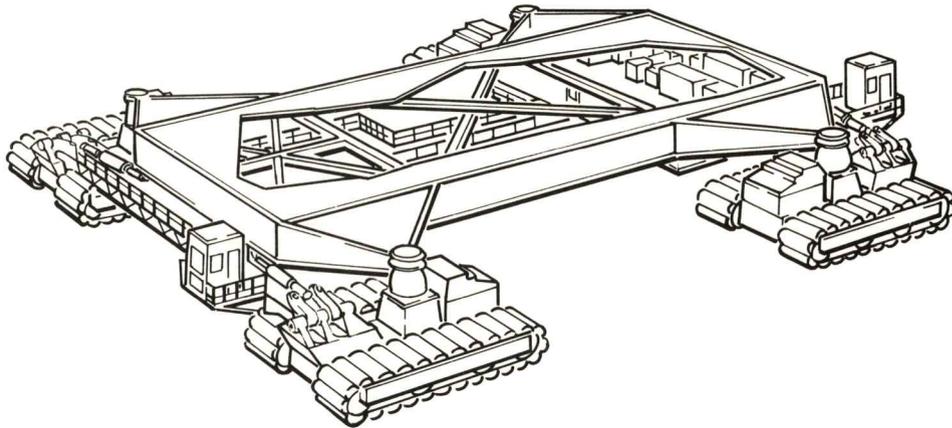
# VERTICAL ASSEMBLY BUILDING

DSV-4B-457

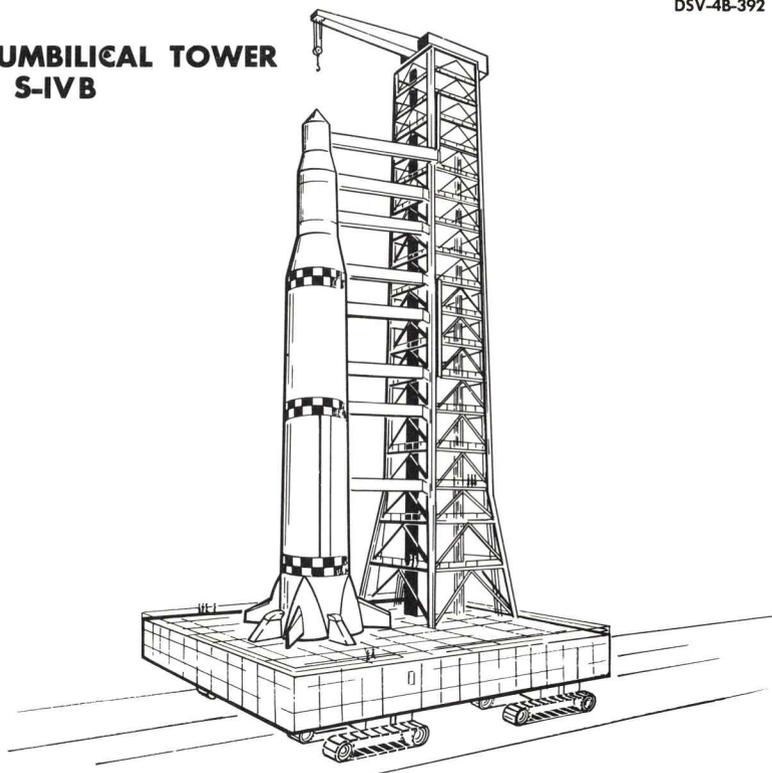


# SATURN V CRAWLER—TRANSPORTER

DSV-4B-391

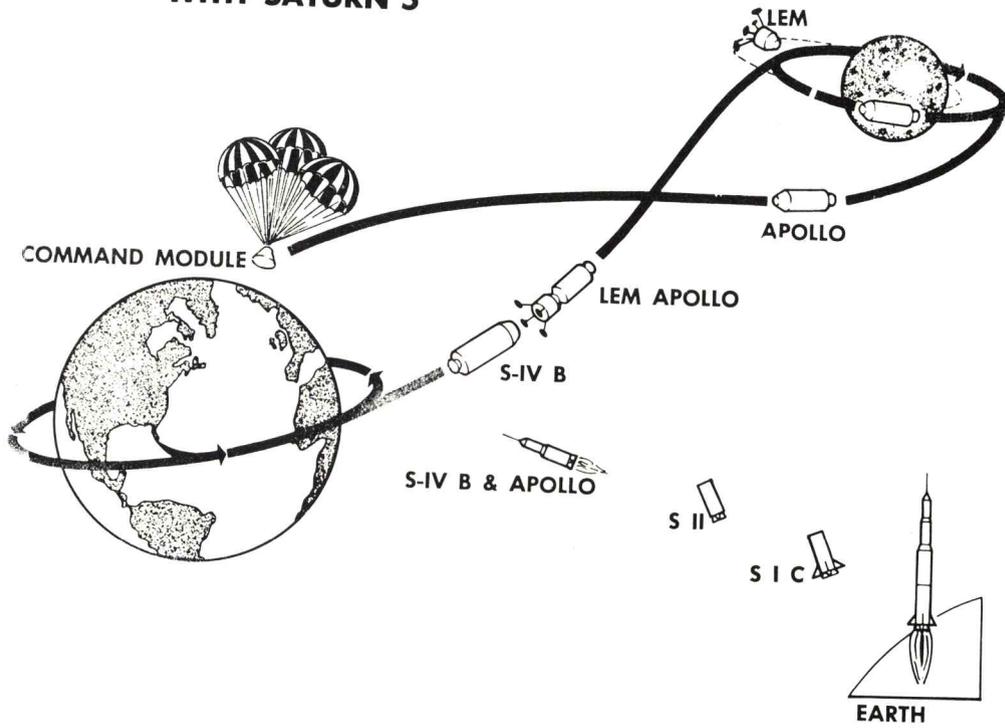


**LAUNCH UMBILICAL TOWER  
S-IVB**



# SATURN S-IVB LUNAR MISSION WITH SATURN 5

DSV-48-164 B





MISSILE & SPACE SYSTEMS DIVISION  
DOUGLAS AIRCRAFT COMPANY, INC.  
SANTA MONICA, CALIFORNIA