2 April 1959

SYSTEM DESCRIPTION FOR SATURN VEHIC[LE]

By

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SECTION 1 (S)

MISSION

SECTION 2 (S)

GENERAL DESCRIPTION

SECTION 3 (S)

STRUCTURE

SECTION 4

PERFORMANCE

SECTION 5 (S)

MASS CHARACTERISTICS

SECTION 6 (S)

PROPULSION SYSTEM

SECTION 7

PNEUMATIC SYSTEM

SECTION 8

HYDRAULIC SYSTEM

SECTION 9

ELECTRICAL SYSTEM

SECTION 10

PYROTECHNICS

SECTION 8 (U)
HYDRAULIC SYSTEM

8.1 Electrical Reference Designation System

(1) The system to be used will be MIL-STD-16B, Unit Numbering System.

(2) The booster is divided into units with the first number of any electrical reference designation indicating the location of the item. The designation system for measurements will also show the unit in which the measuring point is located. In requesting measurements, the unit to which the measurement is located will have to be specified.

(3) Figure 8-1 presents in diagram form the unit locations which are listed below:

Unit 1	Engine 1 Compartment
Unit 2	Engine 2 Compartment
Unit 3	Engine 3 Compartment
Unit 4	Engine 4 Compartment
Unit 5	Engine 5 Compartment
Unit 6	Engine 6 Compartment
Unit 7	Engine 7 Compartment
Unit 8	Engine 8 Compartment
Unit 9	Thrust Frame Area
Unit 10	Propellant Tanks
Unit 11	Adapter Area

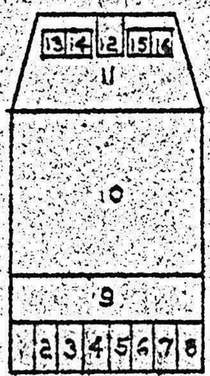

Figure 8-1. Block Diagram of Unit Location

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SECTION 6 (S)

PROPULSION SYSTEM

A typical schematic of the H-1 engine showing start and cutoff sequences is given in Figure 6-1. Table 6-A gives engine data for H-1 engines of three thrust ratings.

TABLE 6-A
H-1 ENGINE DATA
(All data at sea level)

	Thrust Rating of Engine		
	150K	165K	188K
Thrust (lb)	150,000	165,190	188,000
I_{sp} (sec)	248	253.6	256.69
Total Propellant Flow Rate Including Gas Generator (lb-sec)	604.8	652.07	732.39
Mixture Ratio:			
Engine	2.30	2.30	2.30
Thrust Chamber	2.40	2.40	2.40
Chamber Pressure, Injector End (psia)		580.4	651.9
Throat Area (sq.in.)	205	205	205
Expansion Ratio	8:1	8:1	8:1

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SECTION 2 (S)

GENERAL DESCRIPTION

2.1 General Design Parameters

(1) Cluster arrangement of eight Rocketdyne type H-1 engines.

(2) Four engines mounted stationary on inner circle (radius of 32 in.) and canted at an angle of 3° from the missile centerline.

(3) Four engines gimbal-mounted on outer circle (radius of 95 in.) and canted at an angle of 6° with actuators in the null position. The gimbal joint has a maximum capacity of ±7°. This allows for a ±10° engine movement along the radial line of the SATURN vehicle.

2.2 System Parameters

The system parameters for the SATURN vehicle and the manner in which the present design will contribute to their realization are as follows:

(1) Reliability - Use of missile components which have been previously flight-tested.

(2) Safety - Failure of one outboard engine permits accomplishment of limited mission.

(3) Economy - Use of existing manufacturing facilities and tooling and utilization of experienced fabrication personnel.

(4) Growth potential - Improved performance might be developed later by replacing the four inboard H-1 engines by a single more powerful engine such as the type F-1.

(5) Early availability.

2.3 First-Stage Thrust Unit

The booster assembly for the SATURN vehicle (SA-1 through SA-4) with nomenclature for component units is shown in Figure 2-1. Figure 2-2 presents booster configuration data. General descriptive data are given in Table 2-A, and further available information in the subsequent paragraphs.

2.3.1 Structure

(1) The booster structure consists basically of a thrust frame which mounts the eight engines, five lox containers, which are

SECURITY NOTE

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

FOREWORD

The information contained in this document is for the use of personnel concerned with the development of the SATURN vehicle.

This document is preliminary and subject to change and addition; however, the general outline as indicated in the Table of Contents is believed to be applicable to the vehicles during the development stage. It is therefore recommended that these pages be placed in loose-leaf binders in order that additions and changes can be readily made. The information contained herein is for general information only and should not be used as final design criteria.

The contributions of various ABMA personnel to this document are hereby gratefully acknowledged.

TABLE OF CONTENTS*

*No data are included in this preliminary publication for some of the sections indicated. Dividers for these sections have been included to permit additions as the information becomes available. This listing is subject to revision.

LIST OF TABLES AND FIGURES

Tables and figures are designated by section and by sequence in the section. Capital letters are used to designate sequence of tables, and Arabic numerals to designate sequence of figures.

Table 5-C

SATURN 70-INCH DIAMETER FUEL CONTAINER WEIGHT DATA (SA-1 THROUGH SA-4)

	Weight, lb	Center of Gravity Station
Ring Frame, front	34	867
Longerons, top	68	832
Support Blocks, top (2)	40	834
Bulkhead, front	95	814
Manhole Cover	12	835
Ring Frame 1	8	791
Ring Frame 2	8	762
Ring Frame 3	8	733
Ring Frame 4	8	704
Ring Frame 5	8	675
Ring Frame 6	8	646
Ring Frame 7	8	617
Ring Frame 8	8	588
Ring Frame 9	8	559
Ring Frame 10	8	530
Ring Frame 11	8	491
Ring Frame 12	8	462
Ring Frame 13	8	433
Ring Frame 14	8	404
Ring Frame 15	8	375
Ring Frame 16	8	346
Ring Frame 17	8	307
Skin Segment 1 0.090 in. Thick	152	829
Skin Segment 2 0.090 in. Thick Milled to 0.050 in.	76	761
Skin Segment 3 0.090 in. Thick Milled to 0.050 in.	76	703
Skin Segment 4 0.090 in. Thick Milled to 0.050 in.	76	645
Skin Segment 5 0.090 in. Thick Milled to 0.050 in.	76	587
Skin Segment 6 0.090 in. Thick Milled to 0.054 in.	80	529
Skin Segment 7 0.090 in. Thick Milled to 0.056 in.	82	471
Skin Segment 8 0.090 in. Thick Milled to 0.062 in.	84	413
Skin Segment 9 0.090 in. Thick Milled to 0.068 in.	89	355
Skin Segment 10 0.090 in. Thick Milled to 0.071 in.	62	307
Skin Segment 11 0.100 in. Thick	100	263
Rear Skin 0.100 in. Thick	160	221
Rear Bulkhead	95	264
Fuel Elbow	11	235
Bottom Ring Frame 1	21	253
Bottom Ring Frame 2	21	229
Bottom Ring Frame 3	21	207
Bottom Ring Frame 4	21	189
Bottom Plate	80	246
Support Blocks, bottom (2)	40	246
Longerons, bottom	68	221
Stiffeners, rear	40	221
Brackets and Miscellaneous	46	235
TOTAL	1975	485

SECTION 1 (S)

MISSION

1.1 Initial Objective

The initial objective of the SATURN program is indicated in the following excerpt from ARPA Order No. 14-59, dated 15 August 1958:

"Initiate a development program to provide a large space vehicle booster of approximately 1,500,000 lb thrust based on cluster of available rocket engines. The immediate goal of this program is to demonstrate a full-scale captive dynamic firing by the end of CY 1959."

1.2 Extension of Program

Further studies for the extension of the big booster program past the feasibility demonstration resulted in a memorandum of agreement between Mr. R. W. Johnson, Director of ARPA, and Major General J. B. Medaris, Commanding General of AOMC, on 23 September 1958. This memorandum provides for the extension of the program to include four booster test flights. The first two flights will be booster propulsion test flights, and the latter two flights will be with a second stage which will provide limited orbital capability.

1.3 Program and Vehicle Designation

The program is identified as SATURN. The vehicle booster to be used in the full-scale captive dynamic firing is designated SA-T; the two booster vehicles to be used in the booster propulsion test flights are designated SA-1 and SA-2, respectively; and the vehicles for the latter flights, as defined in paragraph 1.2, will be designated SA-3 and SA-4.

Table 5-B
SATURN 70-INCH DIAMETER LOX CONTAINER WEIGHT DATA (SA-1 THROUGH SA-4)

	Weight, lb	Center of Gravity Station
Ring Frame, front	34	867
Longerons, top	68	837
Support Blocks, top	40	842
Stiffeners, front	24	837
Bulkhead, front	95	824
Manhole Cover	12	842
Ring Frame 1	8	795
Ring Frame 2	8	766
Ring Frame 3	8	737
Ring Frame 4	8	708
Ring Frame 5	8	679
Ring Frame 6	8	650
Ring Frame 7	8	621
Ring Frame 8	8	592
Ring Frame 9	8	563
Ring Frame 10	8	534
Ring Frame 11	8	505
Ring Frame 12	8	476
Ring Frame 13	8	447
Ring Frame 14	8	418
Ring Frame 15	8	389
Ring Frame 16	8	360
Ring Frame 17	8	321
Ring Frame 18	8	292
Skin Segment 1 0.125 in. Thick	131	834
Skin Segment 2 0.125 in. Thick Milled to 0.100 in.	135	770
Skin Segment 3 0.125 in. Thick Milled to 0.100 in.	135	712
Skin Segment 4 0.125 in. Thick Milled to 0.100 in.	135	654
Skin Segment 5 0.125 in. Thick Milled to 0.100 in.	136	596
Skin Segment 6 0.125 in. Thick Milled to 0.100 in.	141	538
Skin Segment 7 0.125 in. Thick Milled to 0.100 in.	180	480
Skin Segment 8 0.160 in. Thick Milled to 0.132 in.	182	422
Skin Segment 9 0.190 in. Thick Milled to 0.139 in.	196	364
Skin Segment 10 0.190 in. Thick	202	306
Skin Segment 11 0.190 in. Thick	212	252
Rear Skin 0.100 in. Thick	160	221
Rear Bulkhead	95	253
Lox Elbow	26	235
Bottom Ring Frame 1	21	253
Bottom Ring Frame 2	21	229
Bottom Ring Frame 3	21	207
Bottom Ring Frame 4	34	189
Bottom Plate	80	235
Support Blocks, bottom (2)	40	235
Longerons, bottom	68	203
Stiffeners, rear	36	200
Brackets and Miscellaneous	46	235
TOTAL	2850	479

Table 5-D
SATURN 105-INCH DIAMETER LOX CONTAINER WEIGHT DATA (SA-1 THROUGH SA-4)

	Weight, lb	Center of Gravity Station
Ring Frame, front	70	867
Sump, front	135	850
Bulkhead, front	207	821
Manhole Cover	12	842
Skin Segment 1 0.375 in. Thick	931	829
Skin Segment 2 0.250 in. Thick Milled to 0.188 in.	360	763
Skin Segment 3 0.250 in. Thick Milled to 0.188 in.	360	705
Skin Segment 4 0.250 in. Thick Milled to 0.188 in.	360	647
Skin Segment 5 0.250 in. Thick Milled to 0.188 in.	360	589
Skin Segment 6 0.250 in. Thick Milled to 0.188 in.	360	531
Skin Segment 7 0.250 in. Thick Milled to 0.194 in.	371	473
Skin Segment 8 0.250 in. Thick	478	415
Skin Segment 9 0.250 in. Thick	478	357
Skin Segment 10 0.250 in. Thick	478	306
Skin Segment 11 0.375 in. Thick	483	267
Rear Bulkhead	295	256
Sump	150	230
Ring Frames, bottom (2)	70	253
Support Blocks, top (8)	240	840
Stiffeners, top	10	840
Longerons, top (32)	208	840
Anti-Slosh Devices	200	525
Brackets and Miscellaneous	34	500
TOTAL	6650	563

Table 5-E
SATURN TAIL SECTION WEIGHT DATA (SA-1 THROUGH SA-4)

	Weight, lb	Center of Gravity Station
Thrust Ring, bottom	1200	110
Ring Frame 1	13	130
Ring Frame 2	13	148
Ring Frame 3	13	167
Thrust Ring, upper	1100	187
Ring Frame 4	13	205
Ring Frame 5	13	225
Top Frame	150	245
Corrugated Skin	720	146
Shear Panels	1500	142
Shear Panels	500	142
Outriggers, lox	2000	147
Outriggers, fuel	1500	144
Cutout Reinforcements	300	146
Miscellaneous	15	100
TOTAL	9050	147

Table 5-F
SATURN WEIGHT BREAKDOWN DATA (SA-1 THROUGH SA-4)

	Weight, lb	Total Weight, lb
Valves and Couplings		500
Lox Fill and Drain Valve	18	
Fuel Fill and Drain Valve	8	
Lox Replenishing Valve	7	
Lox Vent Valve	21	
Fuel Vent Valve (2)	12	
Lox Relief Valve (2)	36	
Lox Pre-Valve (8)	168	
Fuel Pre-Valve (8)	168	
Fuel Pressure Valve (4)	7	
Fuel Container Pressure Switch	1	
Lox Pressure Switch (3)	3	
Lox Fill Flange	10	
Fuel Fill and Flange Arrester	10	
Filter Check Valve Assembly (3)	6	
High Pressure O. K. Switches (3)	3	
Heat Exchanger Check Valve (4)	12	
Lox Heat Exchanger by Pass Valve (4)	8	
Sphere Fill and Vent Valve (2)	4	
Control Valves (15)	15	
Pressure Checkout Valve (7)	4	
Multiple Couplings	15	
Miscellaneous	14	
Vent Lines and Tubing		1000
Fuel Fill and Drain Line		
Lox Replenishing Line		
Fuel Container Pressurizing Line		
High Pressure Fill Line		
Fuel Duct Purge Line		
Fuel Sensing Line		
Top Lox Sensing Line		
Bottom Lox Sensing Line		
Ground Lox Container Pressurizing Line		

designed as thrust-load carrying members, four fuel containers which are flexible-mounted to allow for shrinkage differences, and a transitional structure at the top of the containers which extends to the base of the second stage.

Table 2-A
GENERAL DESCRIPTIVE DATA FOR FIRST-STAGE THRUST UNIT

Components	Descriptive Data
Four Inboard Engines	Fixed mount; 32-in. radius; 3° cant
Four Outboard Engines	Gimbal-mounted; 95-in. radius; 6° cant (null position); gimbal mount provides for ±7° action
Outrigger Actuator (For Outboard Engines Only)	Mounting dimension from gimbal plane - 40.0 in.; from centerline of engine - 27.5 in.
One Lox Container at Center	105-in. diameter; 607.054-in. length
Four Lox Containers at Outboard	93.5-in. mounting radius; 70-in. diameter; 607.054-in. length
Four Fuel Containers at Outboard	70-in. diameter; 588.500-in. length
Suction Line Height From Pump Inlet to Container*	
Lox, Inboard Engine	Approximately 148 in. at 3° cant
Lox, Outboard Engine	Approximately 153 in. at 6° cant
Fuel, Inboard Engine	Approximately 159 in. at 3° cant
Fuel, Outboard Engine	Approximately 164 in. at 6° cant
Booster Length (with aspirators)	Approximately 984 in.
Booster Width (across containers)	257 in. (21.5 ft)
Hemispherical Bulkheads	Used on both ends of all containers

*Dimensions with all outboard engines parallel to the vehicle axis and inboard engines with normal 3° cant.

2.3.2 Cluster Engine Assembly

(1) The four inner engines are stationary-mounted on a 32-in. radius and are canted from the missile centerline at an angle of 3°. The engine suction lines are a wrap-around configuration with expansion bellows in the lines. The turbine exhaust of each of the four inner engines is ducted individually to the free air stream at the outer periphery of the booster. In each of these ducts is a heat exchanger.

(2) The four outer engines are gimbal-mounted at a 95-in. radius with a cant angle of 6° when actuators are in null position. The gimbal joint has a ±7° capacity. The suction lines are designed to a wrap-around configuration. Two gimbal pipe joints provide for maximum gimbaling. The turbine exhaust of each of the four outer engines is ducted through a heat exchanger mounted on the engine. After passing through the heat exchanger, the gases are passed into an aspirator which in turn directs the gases into the main jet around the periphery of the nozzle exit. Figure 2-2 can be referenced for booster configuration.

Table 2-B shows container volume data.

(3) Figure 2-3 gives the cluster engine schematic.

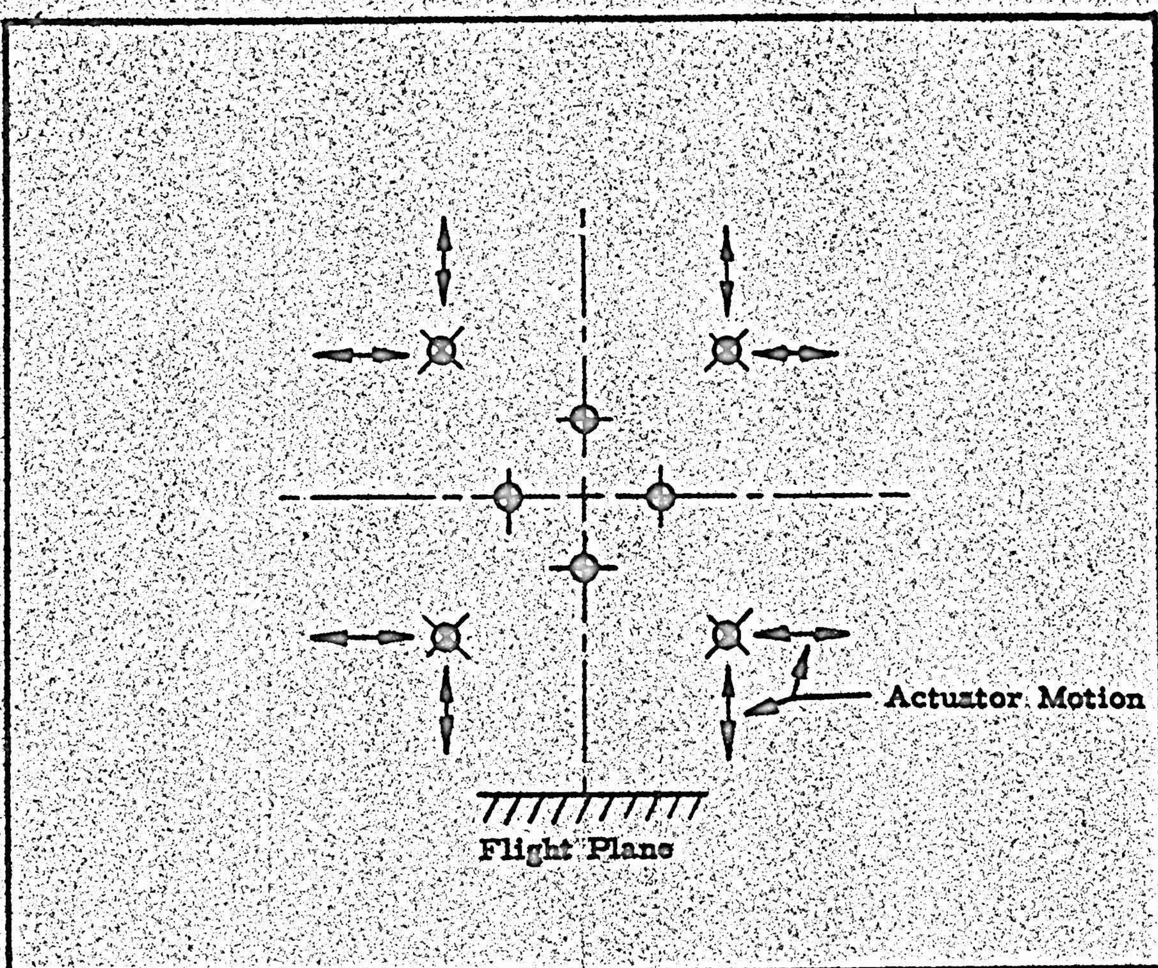


Figure 2-3. Cluster Engine Schematic

Table 2-B

BOOSTER CONTAINER VOLUME DATA (FOR SA-1 THROUGH SA-4)

(SA-3 and SA-4 will carry live upper stages; SA-1 and SA-2 will carry dummy upper stages of equivalent weight. Data below are for ATLAS or TITAN upper stages or their equivalent in weight)

Eight engines with thrust of 165K each (sea level); total thrust 1, 320, 000 lb (sea level)

	ATLAS*		TITAN*	
	Lift-Off, lb	End-of-Thrust-Decay, lb	Lift-Off, lb	End-of-Thrust Decay, lb
Main Stage - Lox**	453, 030		501, 818	
Main Stage - Fuel**	196, 970		218, 182	
Thrust Decay - Lox	998		998	
Thrust Decay - Fuel	1, 517		1, 517	
1% Reserve for Mixture Ratio Shift - Lox	4, 530	4, 530	5, 018	5, 018
1% Reserve for Mixture Ratio Shift - Fuel	1, 970	1, 970	2, 182	2, 182
Fuel Lubrication	503		558	
Trapped Propellants	12, 450	12, 450	12, 450	12, 450

*Data from Report No. DSL-TN-14-59, dated 25 February 1959.

**ATLAS burning time 124.6 sec; TITAN burning time 138 sec.

Container volumes (assuming 1.4% shrinkage in lox containers; 2, 312 gal ullage in lox containers and 1, 145 gal ullage in fuel containers)

One Lox Container, 105 in. diameter	21, 549 gal
Four Lox Containers, 70 in. diameter	9, 712 gal each
Four Fuel Containers, 70 in. diameter	9, 403 gal each
Total Volume Lox	60, 397 gal
Total Volume Fuel	37, 612 gal

2.3.3 Interconnecting Lines

(1) The outer lox containers are connected to the center container at the base.

(2) The fuel containers are interconnected with a fuel manifold at the base of the container assembly. This manifold is coupled to each of the fuel containers.

(3) Fuel and lox interconnect lines are shown in Figure 2-2.

2.3.4 Venting Arrangement

(1) The lox containers are vented from a manifold located at the top of the center container.

(2) The center lox container has three vent lines which terminate with valves at the outside of the outer containers. Each of the outer lox containers is interconnected to the center container at the top of the booster.

(3) The fuel containers are interconnected at the top by a manifold tube which is coupled to each container. Two vent valves are provided for the four containers.

2.3.5 Pressurization System

(1) The lox containers are pressurized by passing a portion of the lox through heat exchangers in the turbine exhaust of the engines and passing the gox (gaseous oxygen) into the lox container.

(2) The fuel containers are pressurized by passing GN_2 into the top of the fuel containers. The GN_2 is stored in spheres at 3000 psi. There are 51 spheres of 1 cu ft capacity located on the structure at the top of the container assembly. Three other 1 cu ft spheres are located at the tail end for engine purging. Similarly located is a 1½ cu ft sphere for the pneumatic control system.

2.3.6 Tail Shrouds, Base Plate, and Compartments

The tail shrouds consist of a shroud over the area between the base of the outer containers and the lower end of the thrust frame and shrouds over the outer engines to prevent aerodynamic hinge moments on the thrust chamber. The inner engine cluster is enclosed by the lower portion of the outer shrouds. A base plate covers the entire base of the eight-engine cluster. The small area around the inner engines will be filled with flexible heat resistant material. A comparatively large area around the outer engines will be protected with a flexible heat-resistant material to provide for the gimbaling of the engines.

2.3.7 Instrumentation

The instrumentation necessary for the booster has not been finalized. For SA-1 and SA-2 the guidance, measuring, and tracking equipment will be located on the structure above the propellant containers. SA-3 and SA-4 will have some upper stage guidance equipment as well as instrumentation located in the first-stage booster. Some missile network (distribution) will be located in the tail area.

2.3.8 Servicing Points

(1) Servicing points are shown in diagram form in Figure 2-4.

(2) Four fuel fill connections are provided for use on the test stand (one for each container). This provision is for the emergency dumping of fuel in case of fire. Three will be blocked, and one will be used on the launching site.

(3) Two lox fill connections are provided for emergency test stand use. One will be blocked and the other used on the launching site.

(4) Multiple couplings are provided on the thrust frame outriggers at the stationary hold-down positions.

(5) A lox replenishing line is routed to one of the thrust frame outriggers and a disconnect coupling is again provided in that area.

(6) A short cable mast (similar to JUPITER) will be located in the tail area to provide a disconnect for the electrical cables in the area.

(7) Another cable quick disconnect (similar to the JUPITER long cable mast disconnect) will be installed in the area above the propellant containers. This will provide for the disconnection of cables, liquid nitrogen fill, gaseous nitrogen high-pressure fill, and pre-flight cooling lines.

2.3.9 Fire Prevention Considerations

(1) Elimination of leaks in suction lines, valves, turbine, gas generator, turbine exhaust, etc. by fewer flange connections, better gaskets and seals, and improved method of suction line gimbaling.

At time of printing, this drawing was unavailable. Figure 2-2 on pages 3, 4, and 5 can be used for interim reference. Figure 2-4 is intended for distribution at a later date.

Figure 2-4. Main Service Points - SATURN Booster

(2) Flame shielding completely around the nozzle exit of the inner engines and as much as possible around the outer engines.

2.3.10 Booster Recovery Equipment

The recovery equipment consists of parachutes and retro-rockets. The parachutes are packaged in the structure at the top of the booster. Retro-rockets are attached to the thrust frame outriggers at the base of the booster. Recovery is intended for the boosters for SA-1 and SA-2.

SECTION 5 (S)
MASS CHARACTERISTICS (SA-1 THROUGH SA-4)

TABLE 5-A
SATURN BOOSTER PRELIMINARY WEIGHT BREAKDOWN*

(These weights are for hardware only and are exclusive of possible recovery gear)**

	Component Weight	Total Weight, lb
Structure		48,500
105-in. Diameter Lox Tank	6,650	
70-in. Diameter Lox Tanks (4)	11,400	
70-in. Diameter Fuel Tanks (4)	7,900	
Tail Section	9,050	
Top Frame (20-in. I Beam)	2,500	
Upper Stage Support	4,000	
Adapter Shroud and Flame Deflector	2,000	
Fire Wall	1,000	
Tail Shroud and Ducting	2,000	
Flame Shield	1,000	
Pressurized Instrument Compartment	500	
Paint and Corrosion Protection	500	
Propulsion System		22,725
H-1 Engines (8)	11,200	
Exhausterators (8)	400	
Hydraulic Actuators (4)	400	
Heat Exchangers (8)	525	
High Pressure Supply System (1)	3,000	
Suction Lines	4,200	
Tank Interconnecting Lines	450	
Valves and Couplings	550	
Vent Lines and Tubing	1,000	
Firefighting System	1,000	
Guidance and Control Equipment		2,100
Electrical Network	500	
Distributors	175	
Power Supply	100	
Measuring Network (400 measurements)	500	
Flowmeters	320	
Telemeter System (4 transmitters)	330	
Range Safety and Tracking	150	
Preflight Cooling	25	
Miscellaneous		1,675
TOTAL		75,000

*Data from Report No. DSL-TN-14-59, dated 25 February 1959.
**Recovery gear estimated at 6000 lb.

Table 6-B
WEIGHT, CENTER OF GRAVITY, AND MOMENT OF INERTIA FOR THE GIMBALED MASS OF ONE H-1 ENGINE*
(The actuator weight is not included in the total weight of the engine.)

GIMBALED MASS - DRY CONDITION			
Weight	1,467 lb		
Center of Gravity**	$\bar{X}$ = 23.3 in.	$\bar{Y}$ = 4.1 in.	$\bar{Z}$ = 10.5 in.
Moment of Inertia for the Gimbaled Mass About the Center of Gravity			
Ix = 18.80 $KgMSec^2$		Radius of Gyration	20.7 in.
Iy = 36.36 $KgMSec^2$		Radius of Gyration	28.8 in.
Iz = 28.20 $KgMSec^2$		Radius of Gyration	25.4 in.
Moment of Inertia for the Gimbaled Mass About the Gimbal Point			
Ix = 24.33 $KgMSec^2$			
Iy = 64.97 $KgMSec^2$			
Iz = 52.67 $KgMSec^2$			
GIMBALED MASS - WET CONDITION			
Weight	1,743 lb		
Center of Gravity**	$\bar{X}$ = 24.3 in.	$\bar{Y}$ = 3.6 in.	$\bar{Z}$ = 10.2 in.
Moment of Inertia for the Gimbaled Mass About the Center of Gravity			
Ix = 21.98 $KgMSec^2$		Radius of Gyration	20.5 in.
Iy = 44.38 $KgMSec^2$		Radius of Gyration	29.2 in.
Iz = 37.32 $KgMSec^2$		Radius of Gyration	26.8 in.
Moment of Inertia for the Gimbaled Mass About the Gimbal Point			
Ix = 28.06 $KgMSec^2$			
Iy = 80.46 $KgMSec^2$			
Iz = 68.71 $KgMSec^2$			

*Data from Rocketdyne 26 September 1958 with moment of inertia converted from slug ft^2 and Y axis made the X axis.

**Reference point for center of gravity is hinge point.

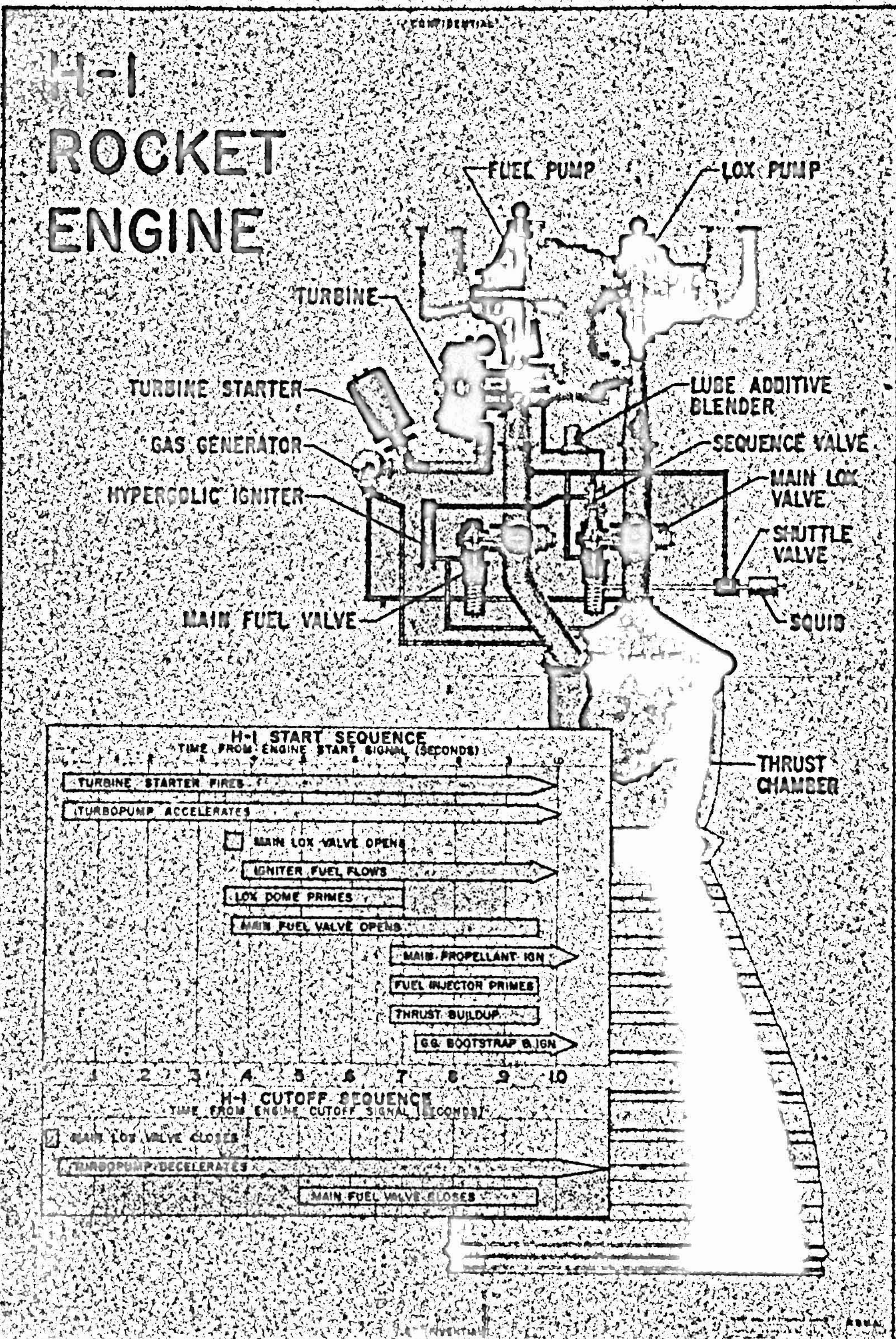


Figure 6-1. H-1 Rocket Engine

[redacted]

NOTE: The nomenclature data presented in the original "System Description for JUNO V (SATURN) Vehicle," Report DSL-TM-2-59, dated 22 January 1959, is under revision and was not available for this printing.

Figure 2-1. Nomenclature for SATURN First-Stage Thrust Unit

Unit 12	Recovery Equipment
Unit 13	Instrument Canister 1
Unit 14	Instrument Canister 2
Unit 15	Instrument Canister 3
Unit 16	Instrument Canister 4

(4) Figure 8-2 (View A) indicates the engines in relation to the fin positions.

(5) Figure 8-2 (View B) indicates the location of the instrument canister in relation to the fin position.

(NOTE: The information in this section was taken from DF, dated 23 March 1959, ORDAB-DGE, "Division of SATURN Booster for Electrical Designation Purposes.")

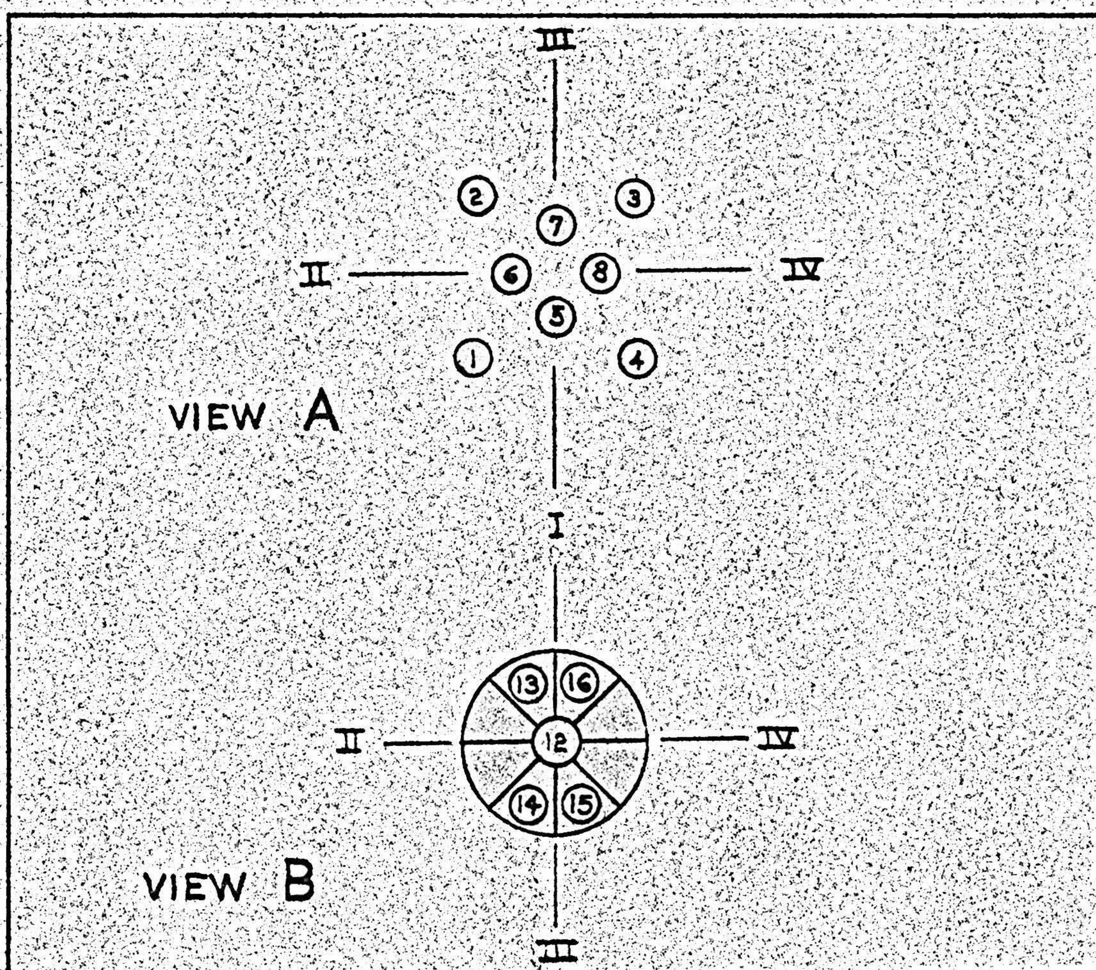


Figure 8-2. Location of Engines (View A) and Canisters (View B) in Relation to Fin Position

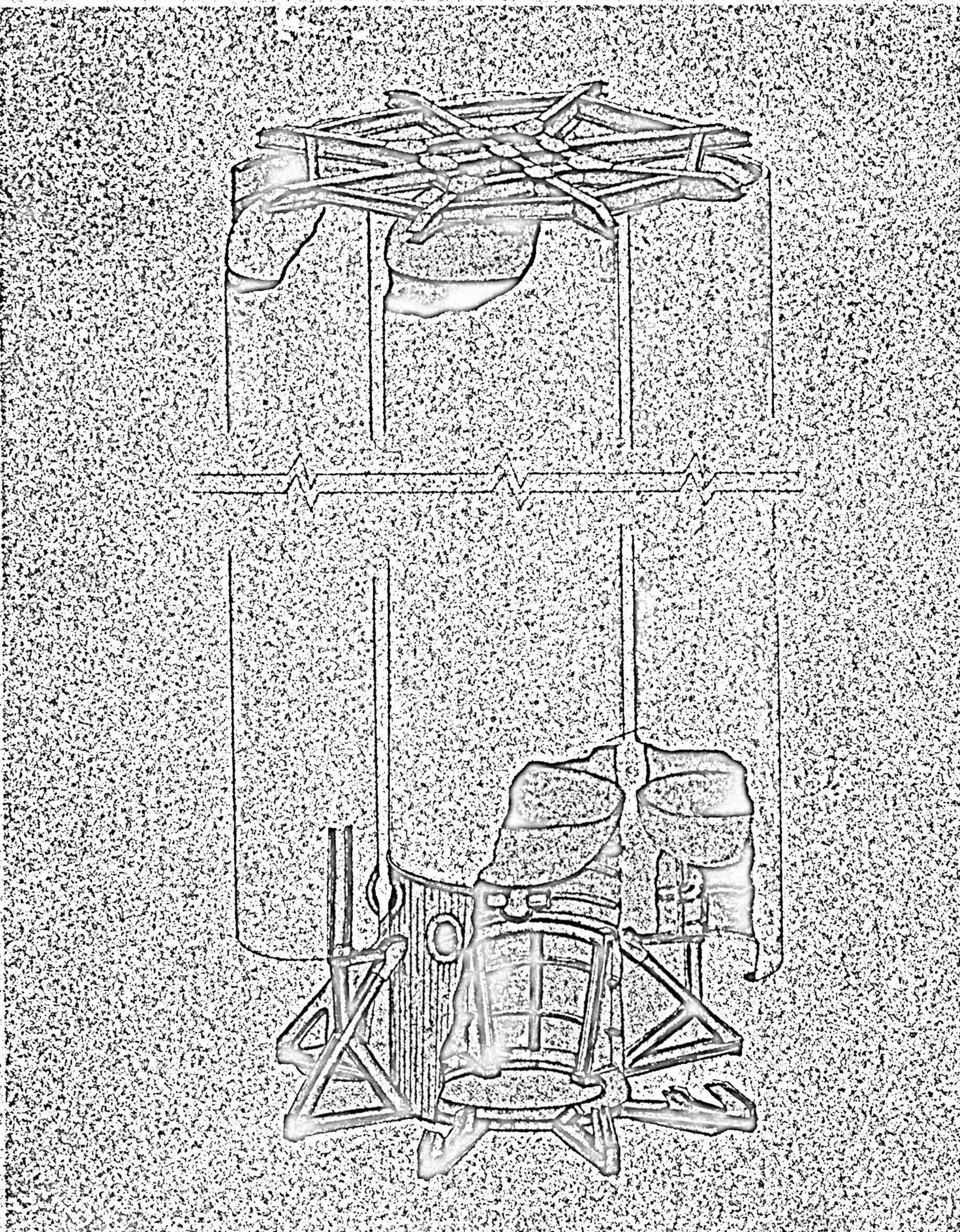
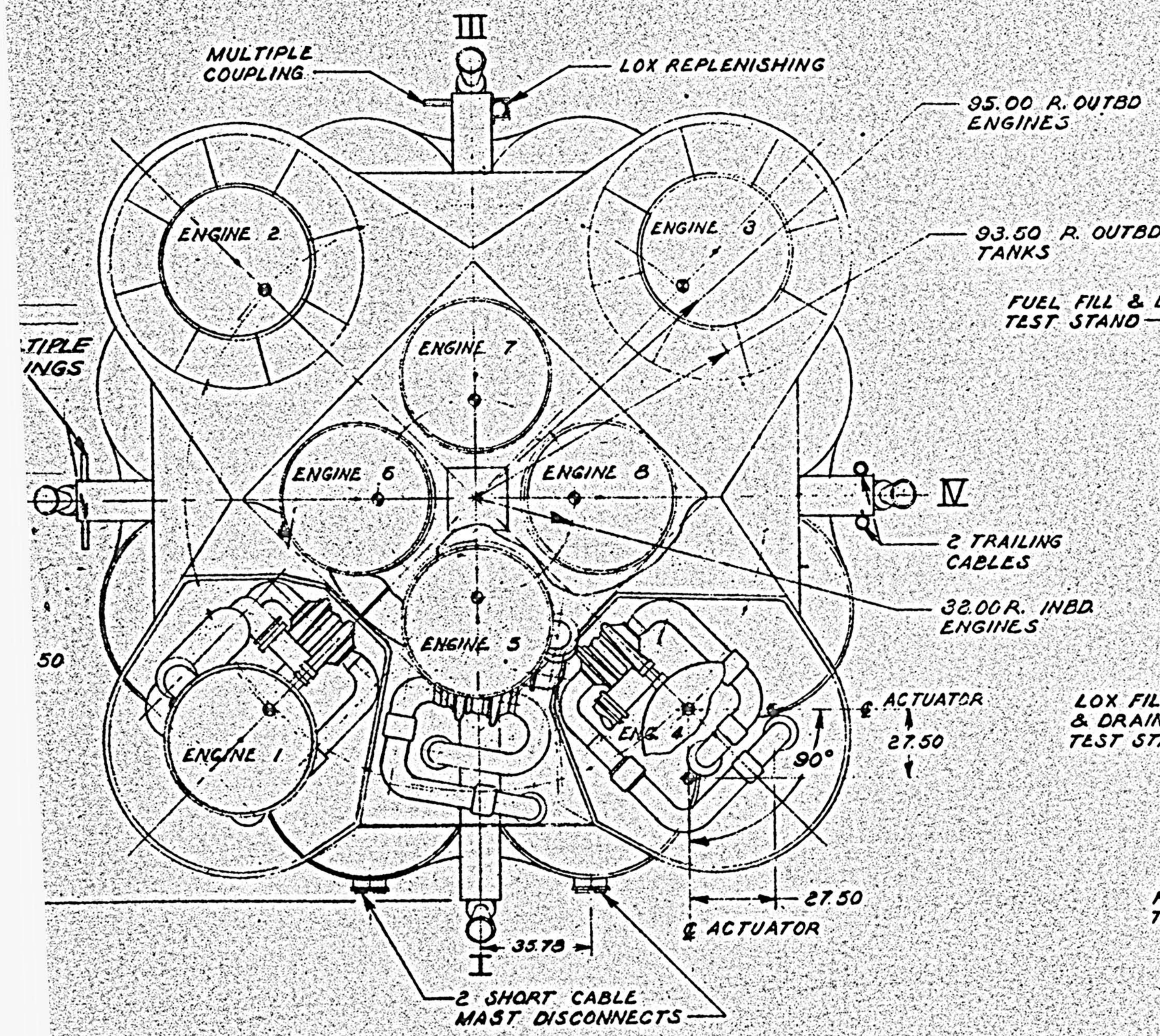
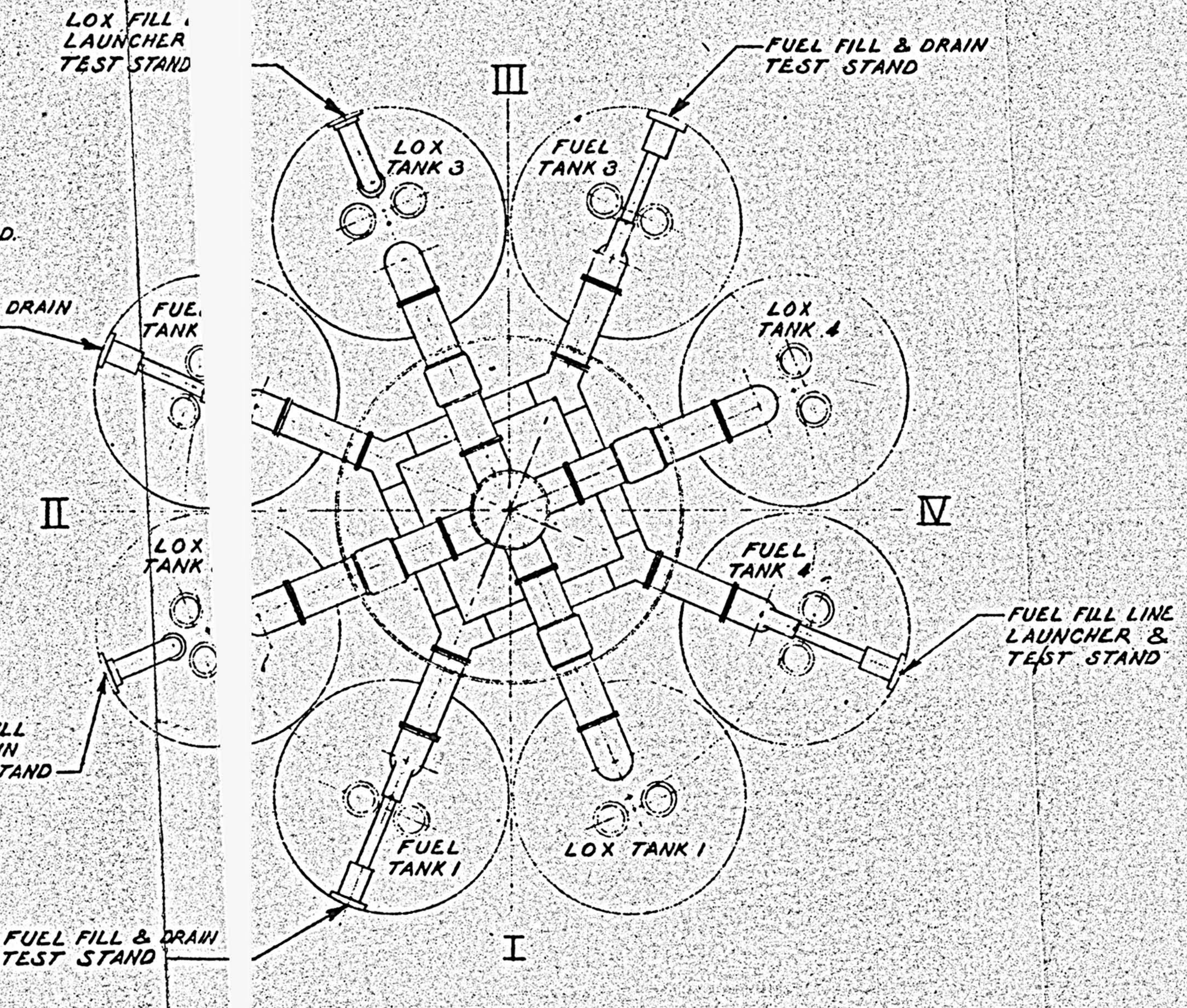


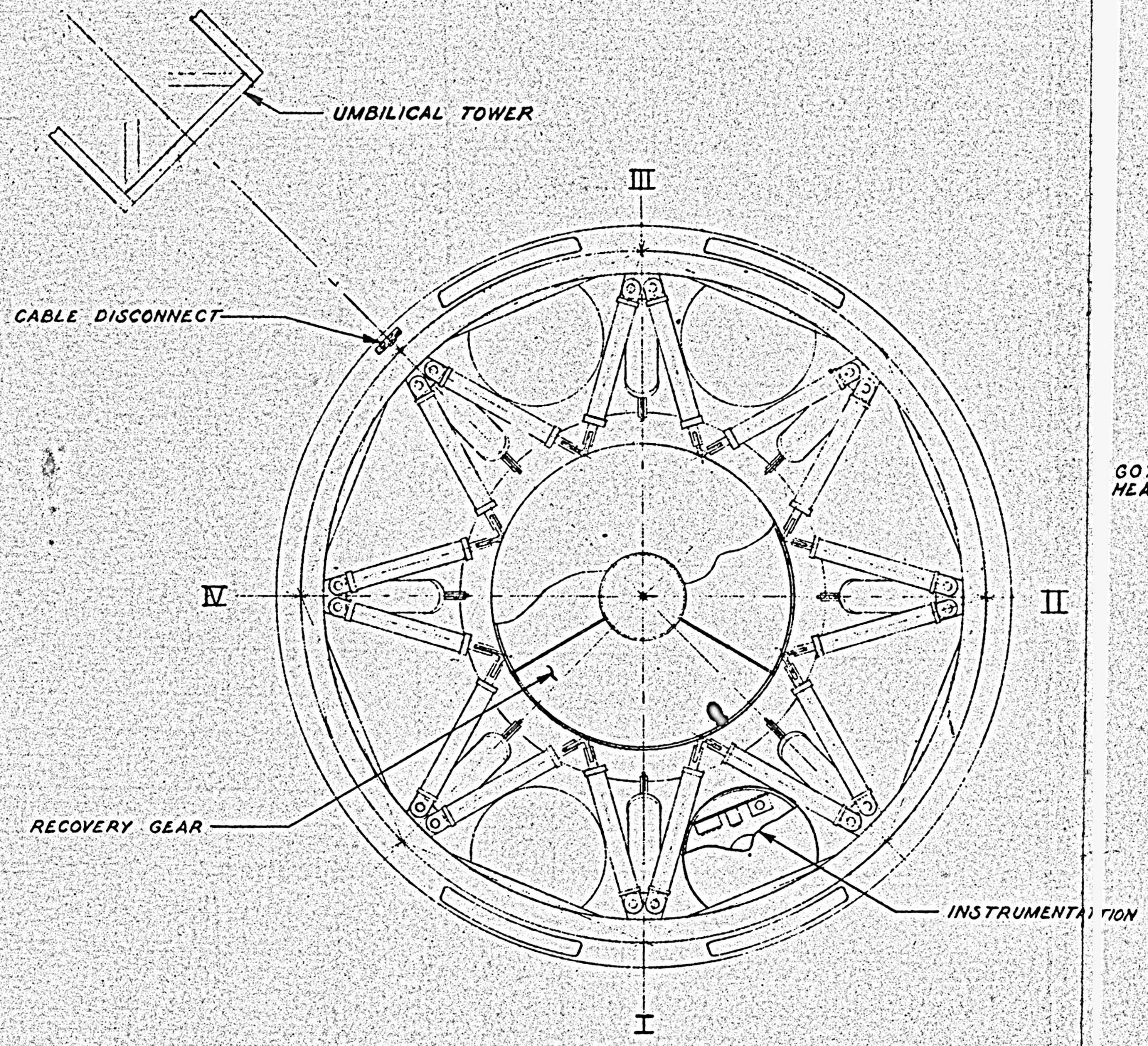
Figure 3-1. Frame Structure Schematic



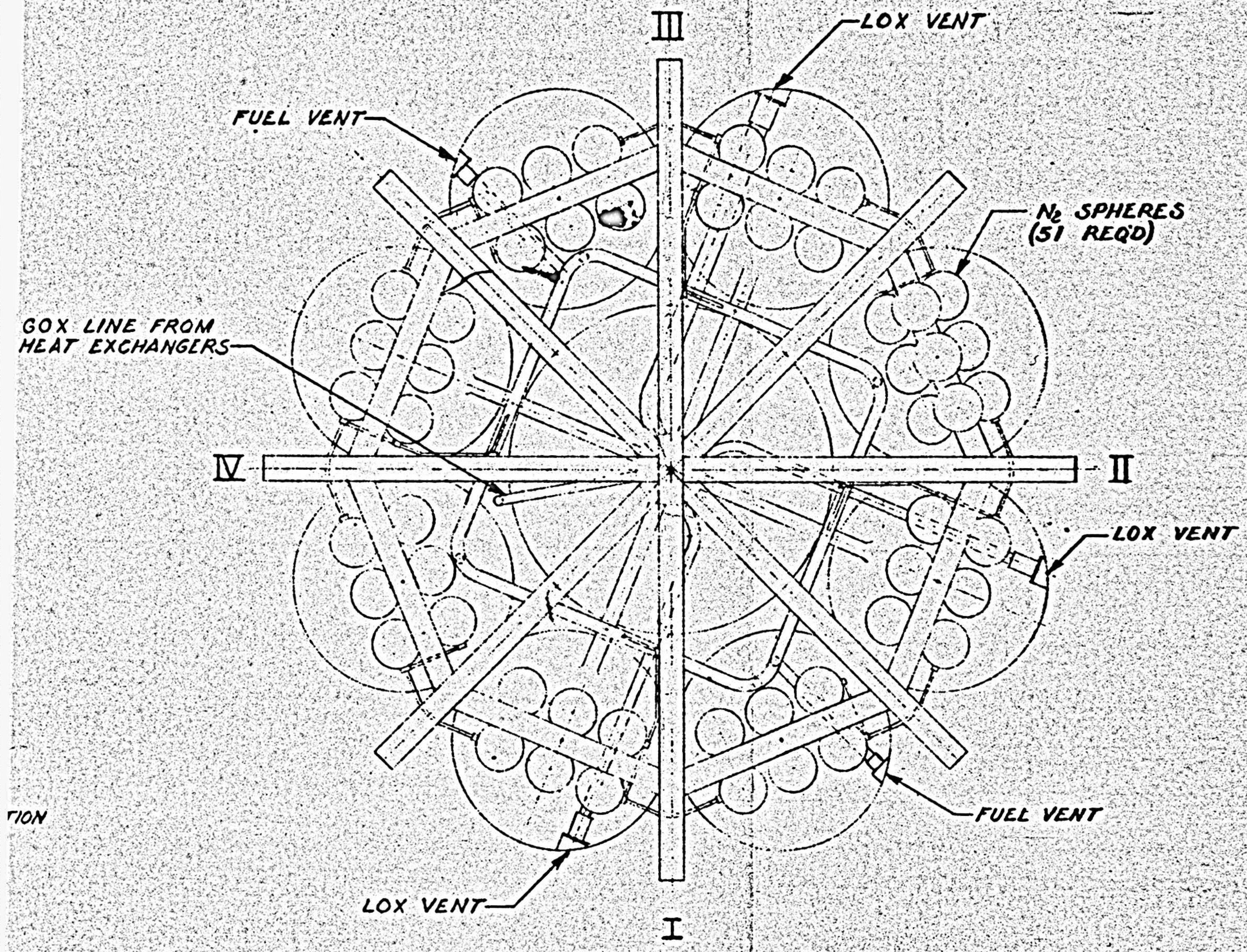


SECTION C-C

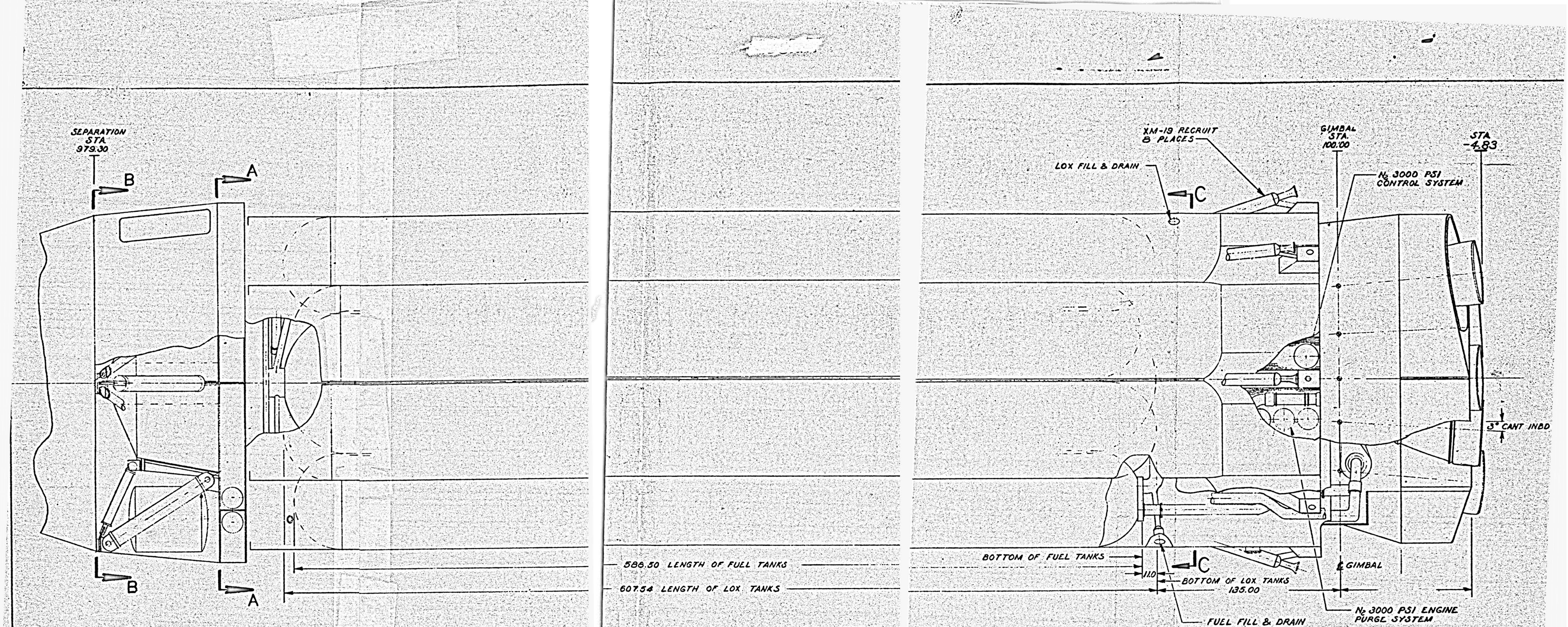
NOTE : Aspirators shown on the inner engines will not be utilized according to a determination made shortly



SECTION B-B



SECTION A-A



NOTE: Aspirators shown on the inner engines will not be utilized according to a determination made shortly before publication.