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Space Shuttle Program

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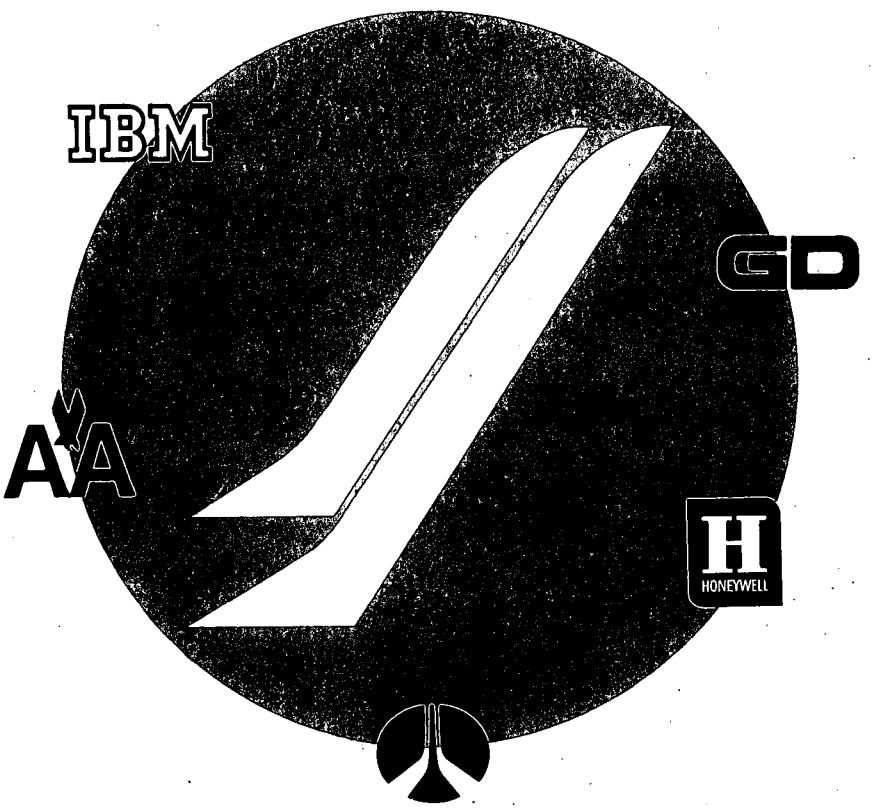

Phase B Final Report
Expendable Second Stage
Reusable Space Shuttle Booster
Volume VII. Preliminary Design Drawings

Contract NAS9-10960, Exhibit B
DRL MSFC-DRL-221, DRL Line Item 6
DRD MA-078-U2
SD 71-140-7
25 June 1971

Space Division • North American Rockwell 12214 Lakewood Boulevard, Downey, California 90241

SD 71-140-7
(MSC-03321)

25 June 1971

PHASE B FINAL REPORT
EXPENDABLE SECOND STAGE
REUSABLE SPACE SHUTTLE BOOSTER

Volume VII
Preliminary Design Drawings

Contract NAS9-10960, Exhibit B
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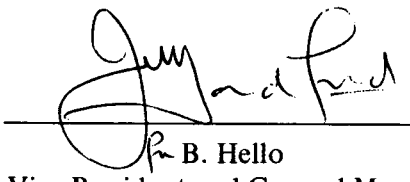
Approved by



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Vice President and General Manager
Space Shuttle Program

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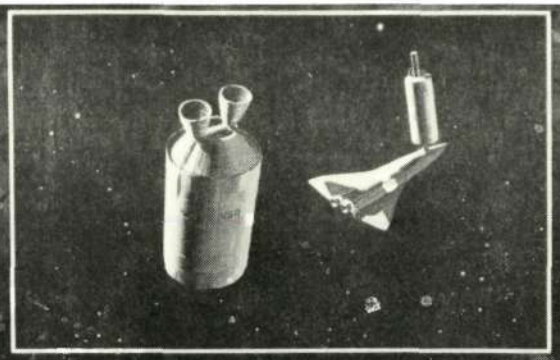

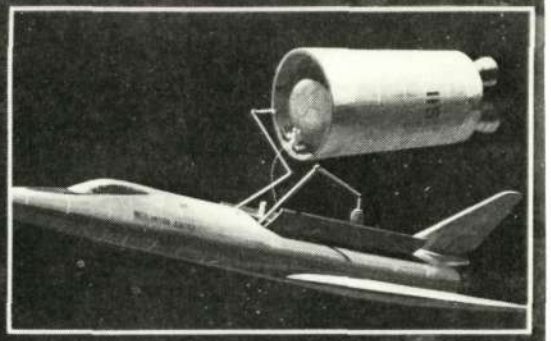

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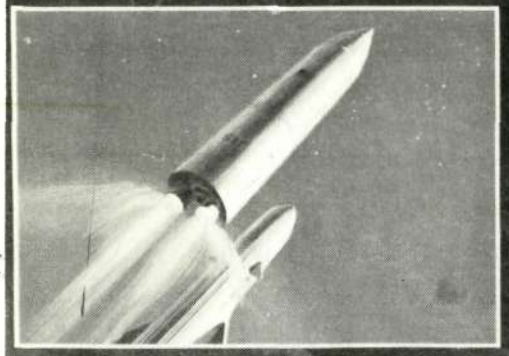
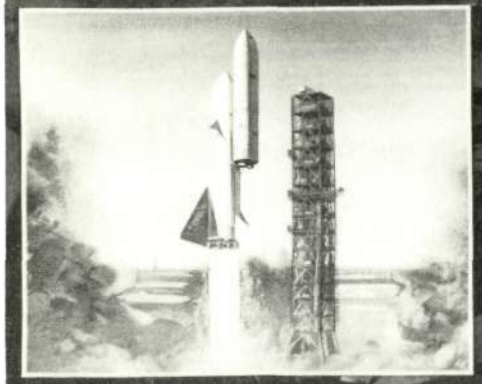
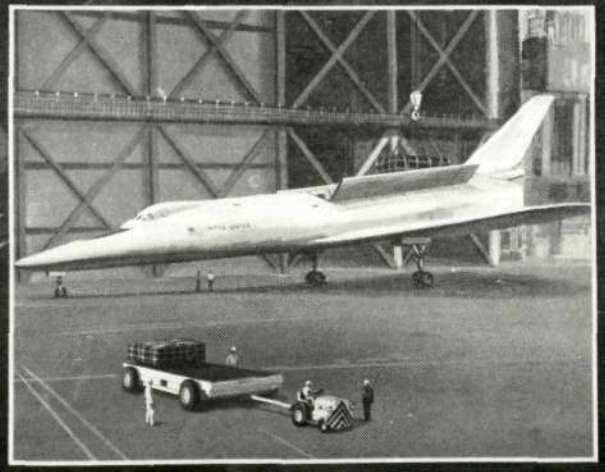
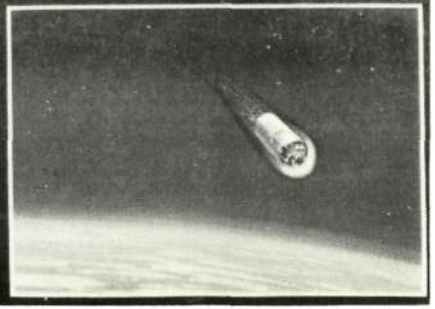








FOREWORD

The Space Shuttle Phase B studies are directed toward the definition of an economical space transportation system. In addition to the missions which can be satisfied with the shuttle payload capability, the National Aeronautics and Space Administration has missions planned that require space vehicles to place payloads in excess of 100,000 pounds in earth orbit. To satisfy this requirement, a cost-effective multimission space shuttle system with large lift capability is needed. Such a system would utilize a reusable shuttle booster and an expendable second stage. The expendable second stage would be complementary to the space shuttle system and impose minimum impact on the reusable booster.

To assist the expendable second stage concept, a two-phase study was authorized by NASA. Phase A efforts, which ended in December 1970, concentrated on performance, configuration, and basic aerodynamic considerations. Basic trade studies were carried out on a relatively large number of configurations. At the conclusion of Phase A, the contractor proposed a single configuration. Phase B commenced on February 1, 1971 (per Technical Directive Number 503) based on the recommended system. Whereas a large number of payload configurations were considered in the initial phase, Phase B was begun with specific emphasis placed on three representative payload configurations. The entire Phase B activity has been directed toward handling the three representative payload configurations in the most acceptable manner. Results of this activity are reported in this 12-volume Phase B final report.

Volume I	Executive Summary	SD 71-140-1
Volume II	Technical Summary	SD 71-140-2
Volume III	Wind Tunnel Test Data	SD 71-140-3
Volume IV	Detail Mass Properties Data	SD 71-140-4
Volume V	Operations and Resources	SD 71-140-5
Volume VI	Interface Control Drawings	SD 71-140-6
Volume VII	Preliminary Design Drawings	SD 71-140-7
Volume VIII	Preliminary CEI Specification - Part 1	SD 71-140-8
Volume IX	Preliminary System Specification	SD 71-140-9
Volume X	Technology Requirements	SD 71-140-10
Volume XI	Cost and Schedule Estimates	SD 71-140-11
Volume XII	Design Data Book	SD 71-140-12

This document is Volume VII, Preliminary Design Drawings.

CONTENTS

ILLUSTRATIONS

1.0 INTRODUCTION

1.0 INTRODUCTION

1.1 SYSTEM CONCEPT

The prime objective of the Expendable Second Stage (ESS) study was to determine the feasibility and cost-effectiveness of and to produce a preliminary design for a system suitable for a wide variety of advanced space missions beginning in the last half of 1979. The overall system is intended to meet evolving NASA/DOD system requirements through the most economical use of shuttle/ESS system elements.

The space shuttle orbiter's cargo bay is 15 feet in diameter and 60 feet in length. Payloads larger than this bay can be accommodated by using the ESS mounted on the reusable booster. In addition to the capability of placing large payloads in orbit, the expendable second stage constitutes an element of a larger shuttle mission. To reduce cost, it has been assumed that a space shuttle orbiter will be available after it has completed its primary up-mission. By performing a rendezvous and docking maneuver with the ESS, the orbiter could remove high-value components from the ESS by means of a manipulator arm arrangement on the orbiter. After the components are placed in the cargo bay of the orbiter, the orbiter would return to the launch site. The recovered components would be refurbished and made available for use in subsequent ESS flights. In this concept, the ESS must have provisions for docking with the orbiter and means to facilitate removal (minimum EVA) of the components. Following the removal of components, the ESS will deorbit to a safe impact area.

ESS preliminary design drawings are provided to illustrate the features of this concept.

1.2 SELECTED VEHICLES

1.2.1 Expendable Second Stage Vehicle

Phase B activity on the expendable second stage has been directed toward selecting a baseline system based on a derivative of the Saturn S-II stage, shown on Drawing V080-0002, Zone 33, in Appendix C. The ESS is equipped with two space shuttle orbiter engines. The hydrogen tank volume is reduced from the basic S-II stage by the deletion of one hydrogen ring (approximately 99 inches). Other features of the selected ESS include the use of shuttle orbiter auxiliary propulsion system elements for the orbit maneuvering system and the attitude control propulsion system. In addition,

the design features the use of orbiter avionics elements. To preclude the need for jettisoning hardware from the reusable booster at staging — to achieve an all-azimuth launch capability — the ESS incorporates a modified S-II aft skirt. The selected ESS vehicle is shown on NR Drawing No. V080-0001, Inboard Profile General Arrangement. The features mentioned here are shown in the various preliminary design drawings included in this volume.

1.2.2 B-9U Booster Vehicle

The Space Shuttle Phase B Study has resulted in the selection of a reusable booster with a mission gross weight of approximately 4.2 million pounds. This booster (designated the GDC B-9U) features 12 engines, each producing 550,000 pounds of thrust at sea level. It is designed to launch an orbiter weighing approximately 859,000 pounds. Although a modified attachment system has been defined to accommodate the ESS, the system can be installed for an ESS flight and removed following the flight with only minimal effect on the booster in terms of accommodating an orbiter launch.

The preliminary design drawings included in this volume emphasize booster modifications that have been defined to permit the booster to launch both the space shuttle orbiter and an expendable second stage with the three specified payloads. Also included are preliminary design drawings that reflect launch operations at KSC.

Complete details of the booster are included in SD 71-114-2(3), Booster Vehicle Definition. In addition to the information referenced above, this volume contains the following basic drawings: B-9U Booster Inboard Profile (General Dynamics Drawing No. 76Z0240), Booster Lines (GD Drawing No. 76Z0241), and Booster 3-View (GD Drawing No. 76Z0243). The B-9U/ESS Booster Basic Configuration is shown on General Dynamics Drawing No. 76Z1140.

1.2.3 Specified Payloads

The Phase B design activity has been oriented to accommodate three NASA-specified payload configurations, which cover the spectrum (weight and size envelope) of anticipated payloads. Payload variables include weight, size, and shape.

1.2.3.1 ESS/Booster/Space Station

The heaviest of the three payloads is the MDAC space station, which weighs 176,960 pounds. The mated configuration is shown on NR Drawing No. S080-0002.

1.2.3.2 ESS/Booster/RNS

The largest aerodynamic shape and the lightest payload are combined in the NR reusable nuclear stage (RNS) without engine. The RNS weighs 83,000 pounds. The mated configuration of the ESS/booster/RNS is shown on NR Drawing S080-0001.

1.2.3.3 ESS/Booster/Space Tug

The smallest aerodynamic shape and medium-weight payload is the NR space tug, with a designated weight of 107,180 pounds. However, since the payload is less than 33 feet in diameter (diameter of ESS vehicle), it requires an adapter between the payload (15-foot diameter) and the ESS. A potential shape is shown on NR Drawing No. VX80-0013. The mated configuration for the ESS/booster/space tug is shown on NR Drawing No. S080-0003.

2.0 DRAWING CONTENT AND DRAWING NUMBER SYSTEM

2.0 DRAWING CONTENT AND DRAWING NUMBER SYSTEM

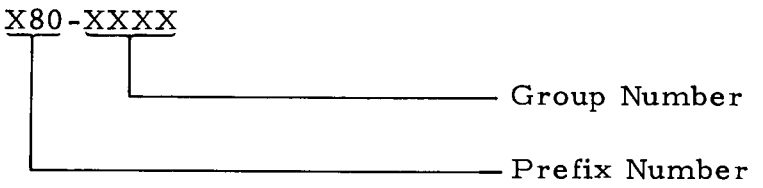
2.1 DRAWING CONTENT

The preliminary design drawings in this volume clearly identify the payloads for each of the combinations shown. Also, the physical properties of the three payloads are indicated in the three mated-configuration preliminary design drawings. The main body of this volume contains preliminary design drawings of the selected system; several alternate configurations are shown in the Appendixes. The selected expendable second stage is shown with the booster selected for the Orbiter External Hydrogen Tank study (the selected ESS is shown with an alternate main engine arrangement). In addition, the selected ESS (with one shuttle orbiter engine) is shown in combination with the baseline B-9U booster.

2.2 DRAWING NUMBER SYSTEM

The following drawing number system was used in the Expendable Second Stage study for all drawings submitted with the final report. For this study, the basic 080 designation was used.

The Phase B drawings, except those of General Dynamics, are submitted for the selected configuration with the drawing prefix and group number, as shown below:



2.2.1 Drawing Prefix Usage

The following prefixes are applicable:

V080 - Expendable Second Stage (ESS) Vehicle Drawings

FS80 - ESS Field-Installed Support Equipment Drawings

G080 - ESS Support Equipment Drawings

M080 - ESS Manufacturing Drawings

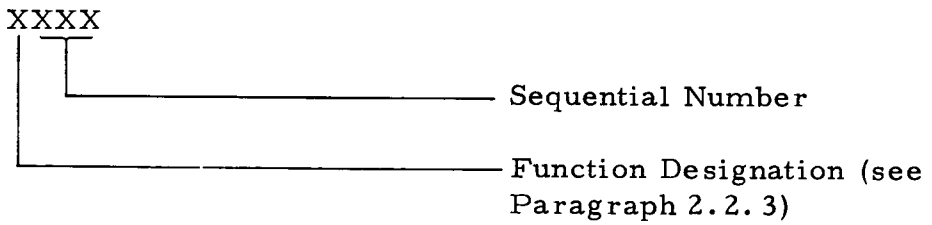
R080 - ESS Model and Mockup Drawings

S080 - ESS Combined-Vehicle Drawings

VX81 - ESS Payload Drawings

2.2.2 Group Number Usage

A four-digit group number is used, with the first digit designating the various functional activities and the remaining digits assigned sequentially.



2.2.3 Function Designation Usage

The functions are designated as follows:

Function No.	Function Name	Examples
0XXX	General	Configuration Control, 3-View
1XXX	Structure	Thrust Structure, Forward Skirt
2XXX	Propulsion	OMS, ACPS
3XXX	Avionics	Avionics General Arrangement
4XXX	Vehicle Support	Electric and Hydraulic Power
5XXX	Mechanical	Separation Mechanism

2.2.4 Drawing Control

Except those for Manufacturing, all drawings were monitored, approved, controlled, and maintained by the Structure and Mechanisms group. These responsibilities included the following:

1. Assignment of all drawing numbers for drawings to be included in the final report.

2. Approval of all drawings before distribution.

3. Preparation and maintenance of a drawing list that identifies all drawings applicable to each prefix (including General Dynamics drawings).

4. Maintenance of a program file of all drawings and revisions (including General Dynamics drawings).

2.2.5 General Dynamics Drawings

General Dynamics drawings applicable only to the ESS program were prepared in accordance with the General Dynamics format, using a specific prefix to indicate the ESS usage — i.e., space shuttle drawings are 76Z0XXX and ESS drawings are 76Z1XXX.

General Dynamics drawings include the ESS separation system, booster, and launch facility modifications. Other related General Dynamics booster drawings are referenced to the NR report SD-71-128-2, Design Evaluation Drawings for a Space Shuttle System, Volume II, Booster.

2.2.6 ESS/WBS Numbers Relationship

Figure 2-1, ESS Study Engineering Drawing Assignment, shows the relationship of the preliminary design drawing numbering system to the WBS numbering system.

2.2.7 ESS Vehicle Drawing Numbers

Following is the list of ESS vehicle drawing numbers for the selected system. A complete list of drawings is presented in the front of this volume under Illustrations.

Number	Description
S080-0001	ESS/B-9U/RNS—3-View Mated Configuration

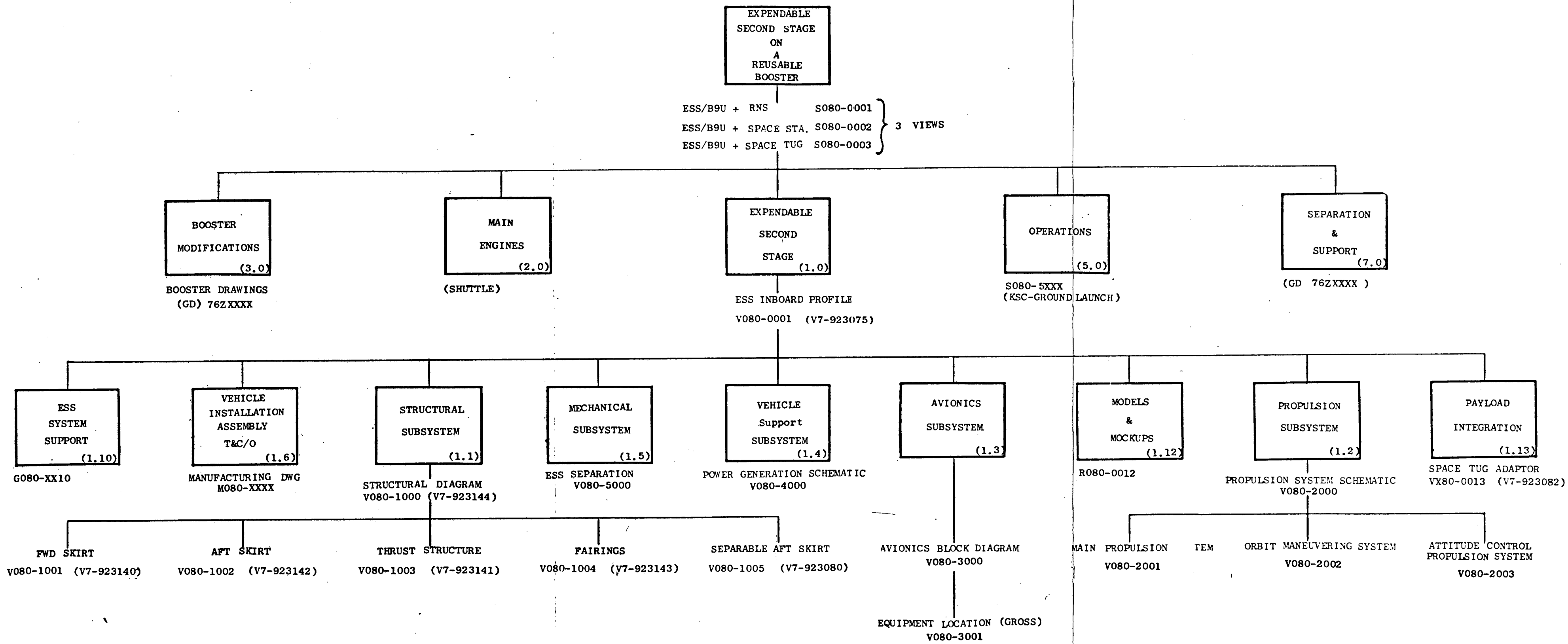


Figure 2-1. ESS Study Engineering Drawing Assignment

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Number	Description
S080-0002	ESS/B-9U/Space Station—3-View Mated Configuration
S080-0003	ESS/B-9U/Space Tug—3-View Mated Configuration
S080-5002	Expendable Second Stage Recoverable Hardware—Horizontal/Vertical Engine Orientation
V080-0001	Expendable Second Stage Inboard Profile, General Arrangement
V080-0001	Expendable Second Stage Inboard Profile, Phase B Baseline
V080-1000	Expendable Second Stage Space Allotment, General Arrangement
V080-1001	Expendable Second Stage Forward Skirt Structure Diagram
V080-1002	Expendable Second Stage Aft Skirt Structure Diagram
V080-1003	Expendable Second Stage Thrust Cone Structure Diagram
V080-1006	Expendable Second Stage Heat Shield Base—Main Engines
V080-1007	Expendable Second Stage Thermal Protection Subsystem—Structure
V080-1008	Expendable Second Stage Docking Provision—ESS/SS Orbiter Configuration
V080-2000	Expendable Second Stage Main Propulsion System Schematic
V080-2001	Expendable Second Stage Propellant Feed Subsystem Layout

Number	Description
V080-2002	Expendable Second Stage Orbit Maneuvering System and APS Tankage Fuel Lines Layout
V080-2003	Expendable Second Stage Installation—Attitude Control Propulsion Subsystem
V080-2004	Expendable Second Stage Engine Servicing Subsystem
V080-2005	Expendable Second Stage Pressurization Subsystem
V080-2006	Expendable Second Stage Engine Compartment Conditioning System
V080-2008	Expendable Second Stage Auxiliary Propulsion Subsystem Schematic
V080-2009	Expendable Second Stage Thrust Vector Control Layout
V080-2010	Expendable Second Stage/Engine Connect Panel—Recoverable Engine
V080-3000	Expendable Second Stage Avionics Subsystem Block Diagram
V080-3001	Expendable Second Stage Avionics Containers Installation
VX80-0013	Expendable Second Stage Payload Adapter—ESS/Space Tug Configuration

2.2.8 S-II Applicable Drawing Numbers

Following is a list of S-II major assembly drawings which may be used for the ESS vehicle without structural or functional revisions. Detail drawing breakouts are not included but may be structured from the major assemblies.

Number	Description
V7-316002	Systems Tunnel
V7-332142	LH_2 Forward Bulkhead
V7-332242	LH_2 Cylinder No. 6
V7-332442	LH_2 Cylinder No. 4
V7-332542	LH_2 Cylinder No. 3
V7-332742	LH_2 Cylinder No. 1
V7-333102	Common Bulkhead
V7-333202	Aft LO_2 Bulkhead
V7-490004	LO_2 Tank Vent
V7-490007	LH_2 Tank Vent
V7-480008	LO_2 and LH_2 Fill and Drain Lines

Drawings for the other major assemblies required are not included because they entail structural or functional revisions to be compatible with the ESS vehicle system.

3.0 MATED CONFIGURATIONS

3.0 MATED CONFIGURATIONS

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4.0 EXPENDABLE SECOND STAGE (ESS—MODIFIED S-II)

4.0 EXPENDABLE SECOND STAGE (ESS–MODIFIED S-II)

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Space Division
North American Rockwell

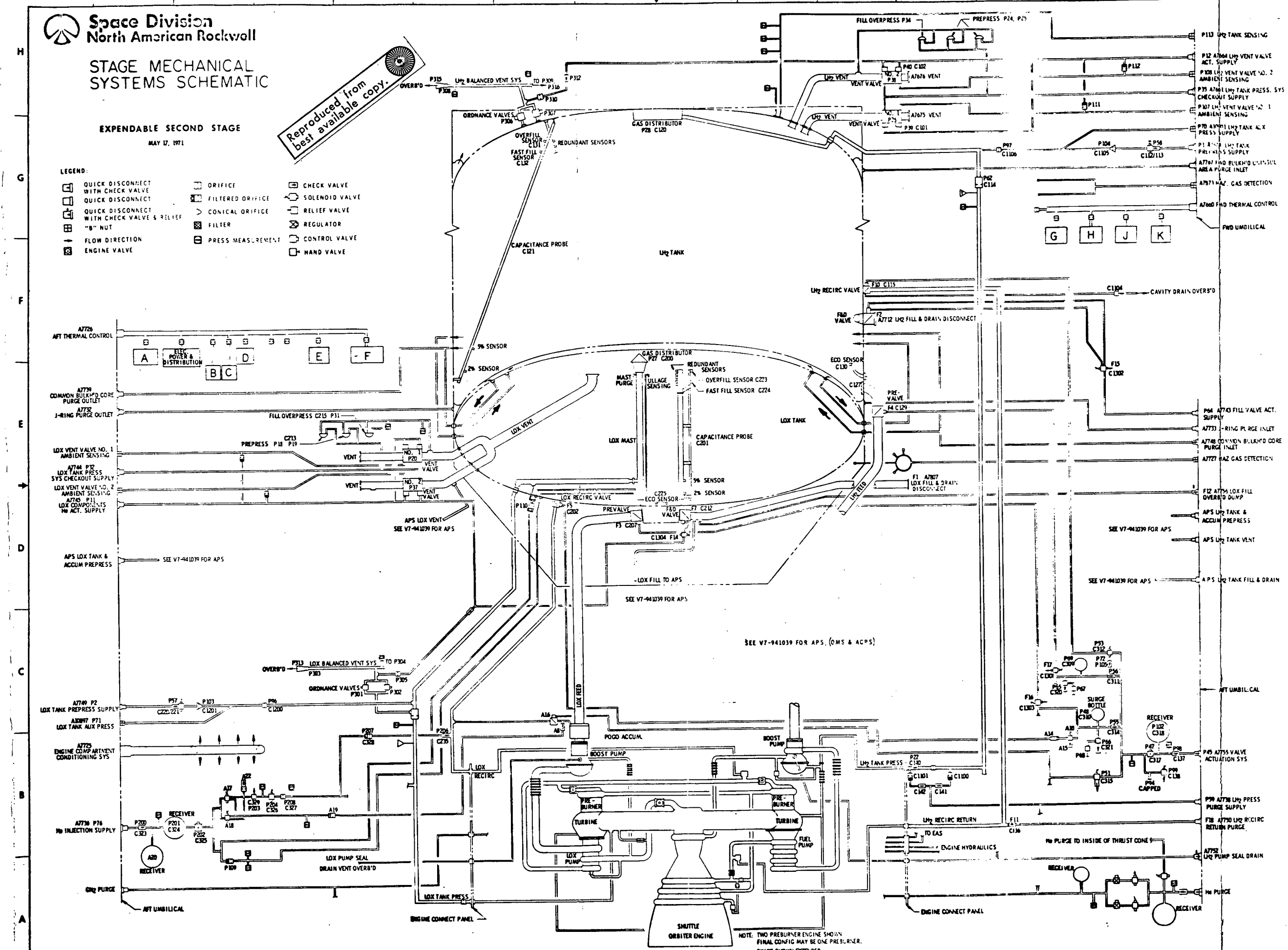
STAGE MECHANICAL SYSTEMS SCHEMATIC

EXPENDABLE SECOND STAGE

MAY 17, 1971

LEGEND:

- QUICK DISCONNECT WITH CHECK VALVE
- QUICK DISCONNECT
- QUICK DISCONNECT WITH CHECK VALVE & RELIEF
- "B" NUT
- FLOW DIRECTION
- ENGINE VALVE
- ORIFICE
- FILTERED ORIFICE
- CONICAL ORIFICE
- FILTER
- PRESS MEASUREMENT
- CHECK VALVE
- SOLENOID VALVE
- RELIEF VALVE
- REGULATOR
- CONTROL VALVE
- HAND VALVE



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SPACE DIVISION
NORTH AMERICAN ROCKWELL CORPORATION
12214 LAKEWOOD BOULEVARD, DOWNEY, CALIFORNIA 90241

EXPENDABLE SECOND STAGE
MAIN PROPULSION SYSTEM
SCHEMATIC

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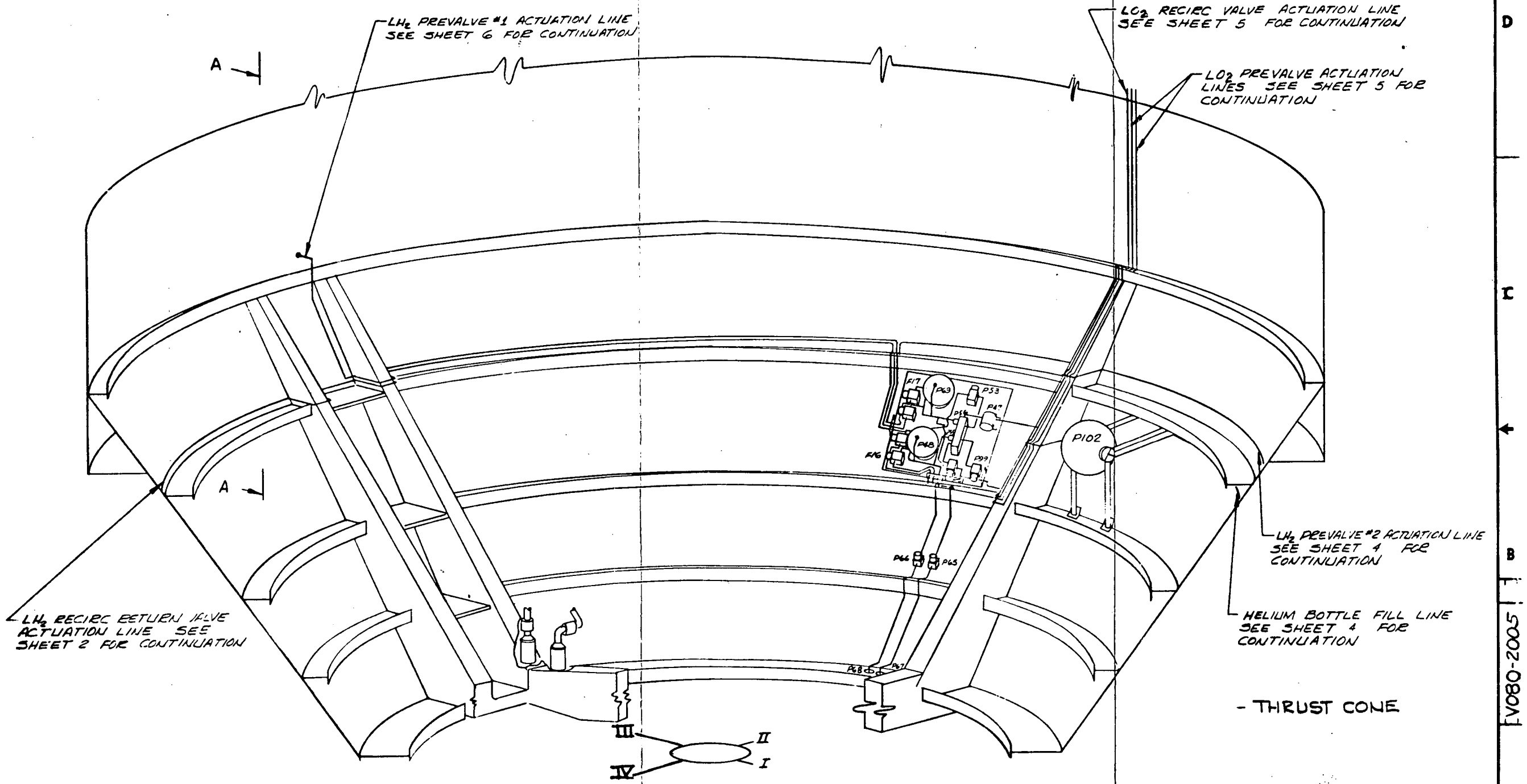

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NORTH AMERICAN ROCKWELL CORPORATION
12214 LAKEWOOD BOULEVARD • DOWNEY, CALIFORNIA 90241

EXPENDABLE SECOND STAGE PRESSURIZATION SUBSYSTEM

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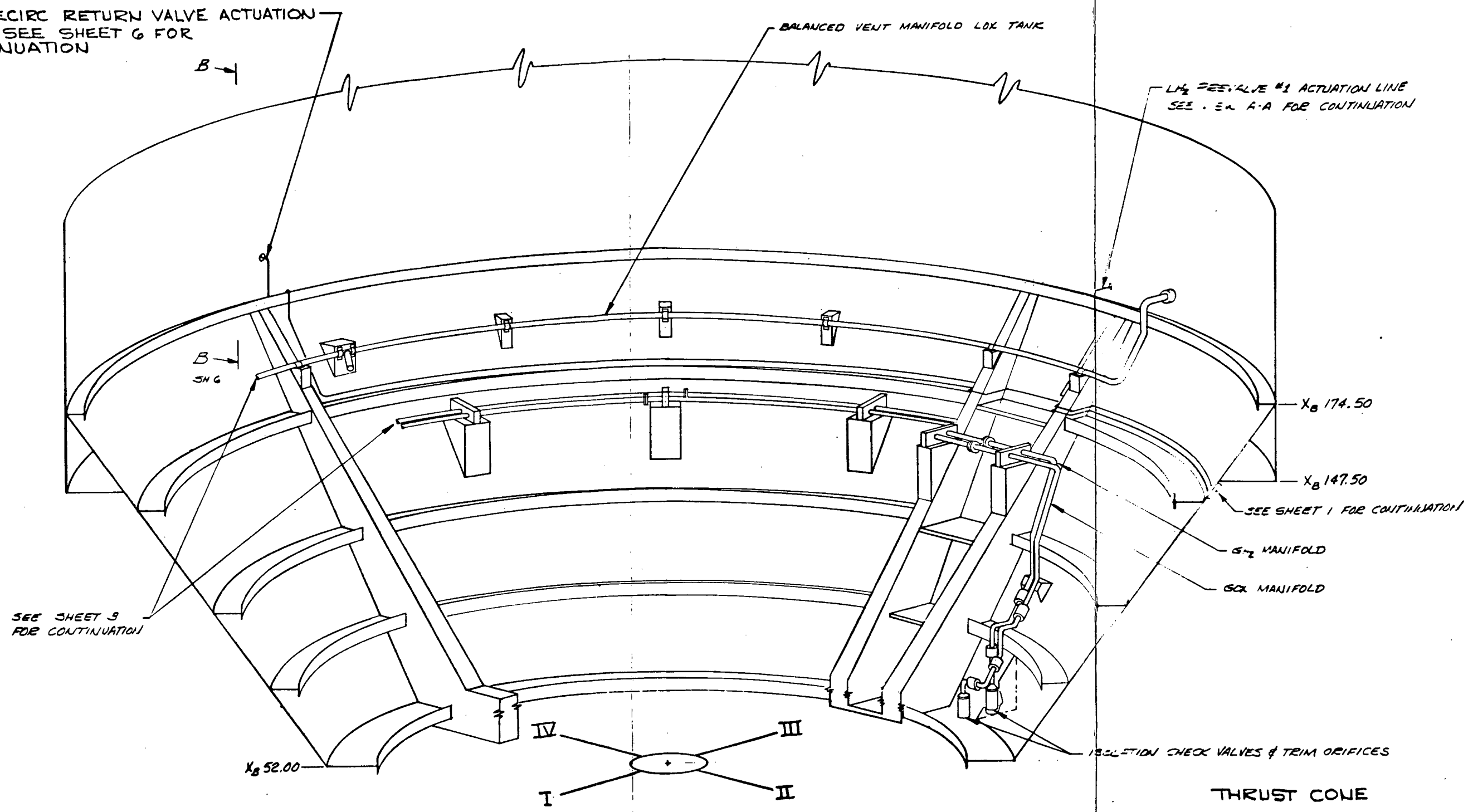

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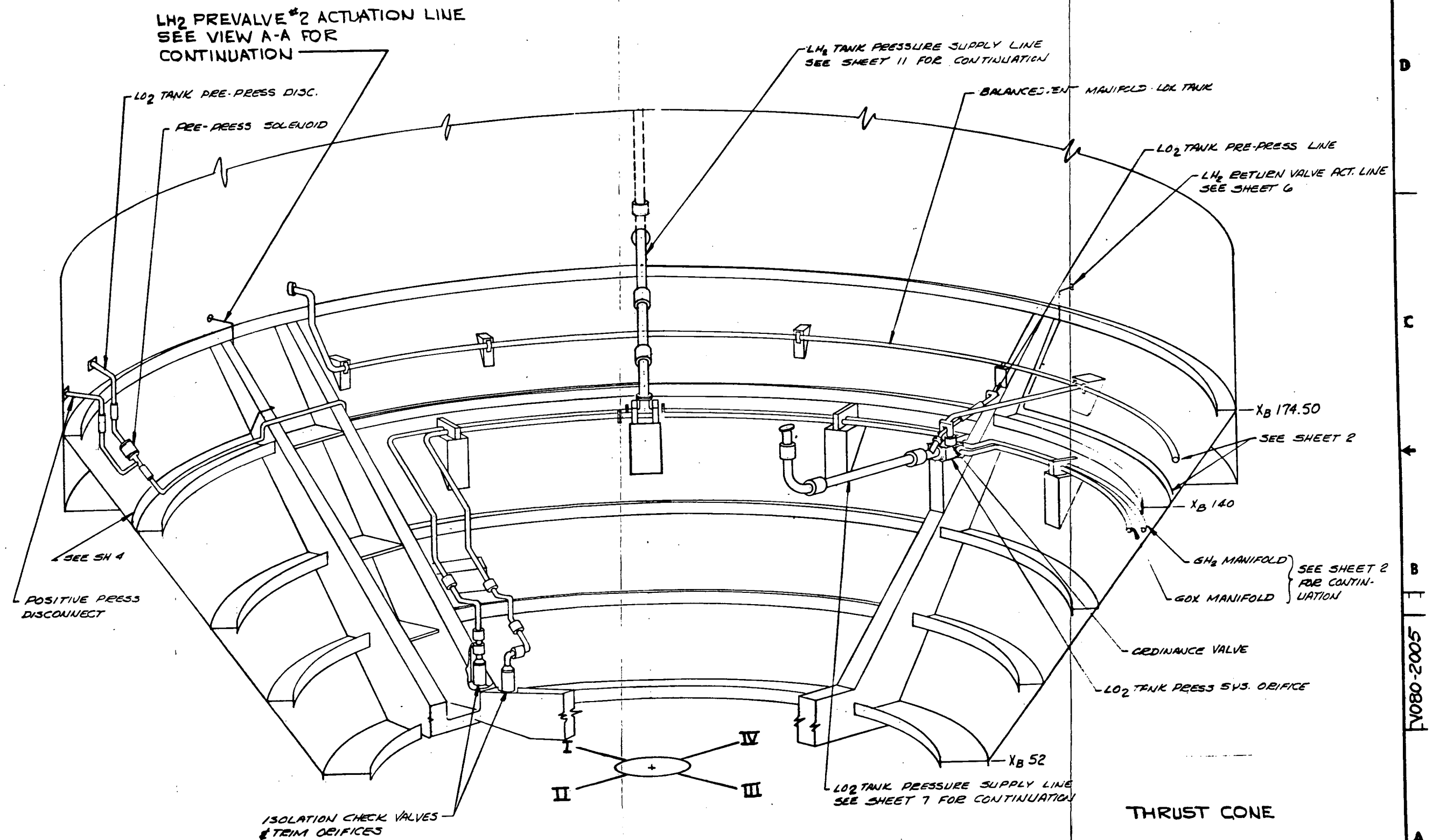

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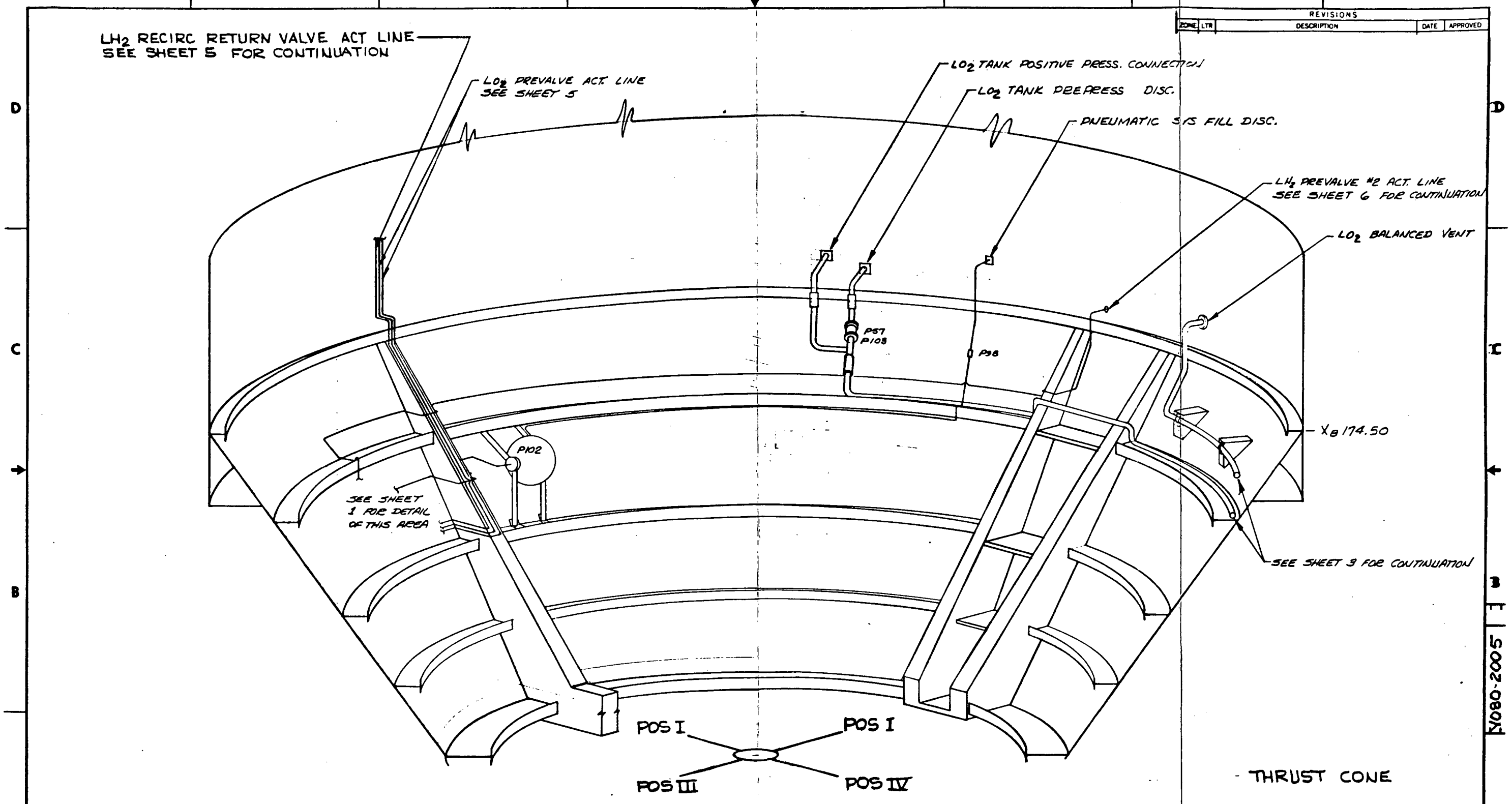

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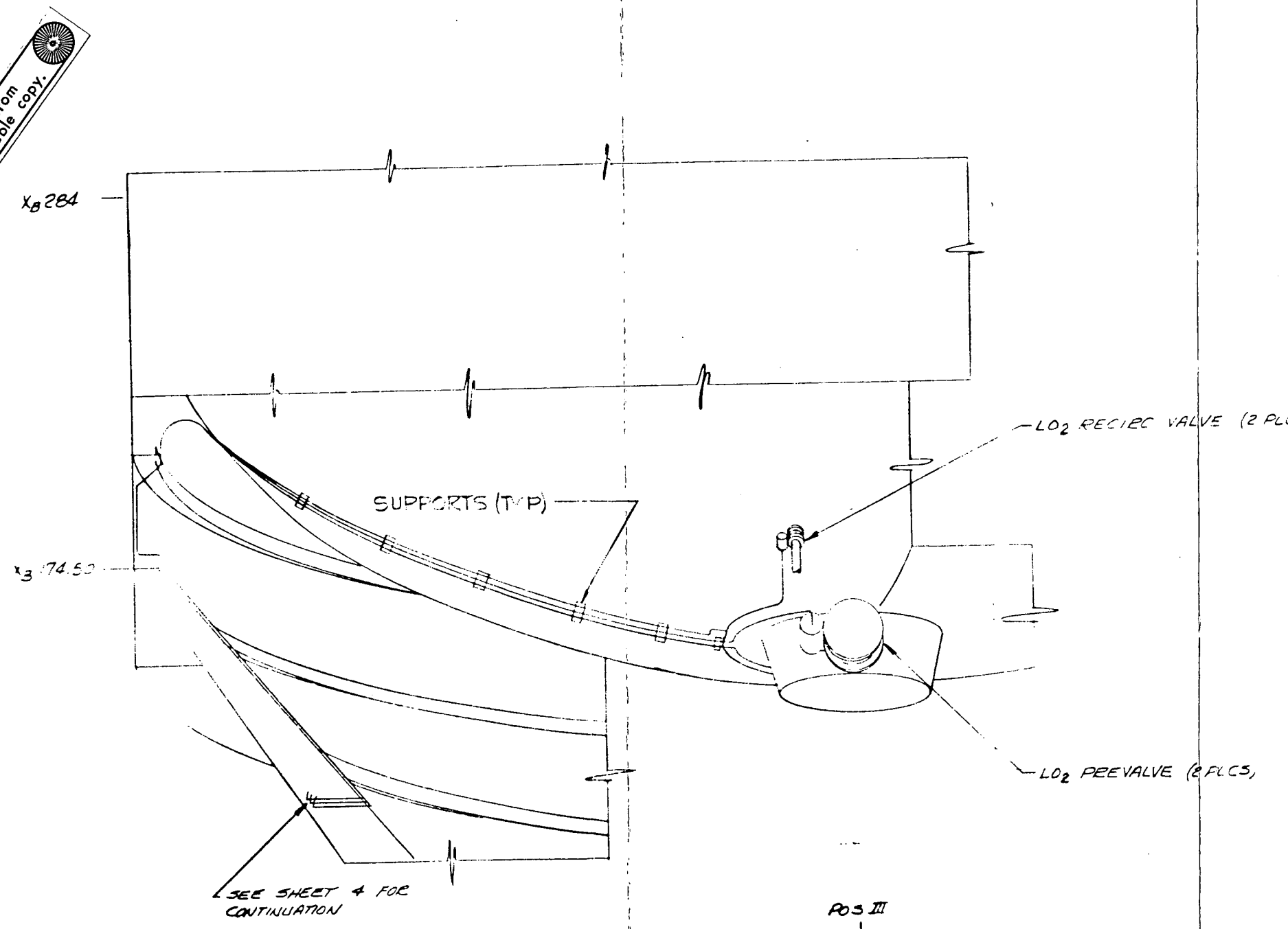

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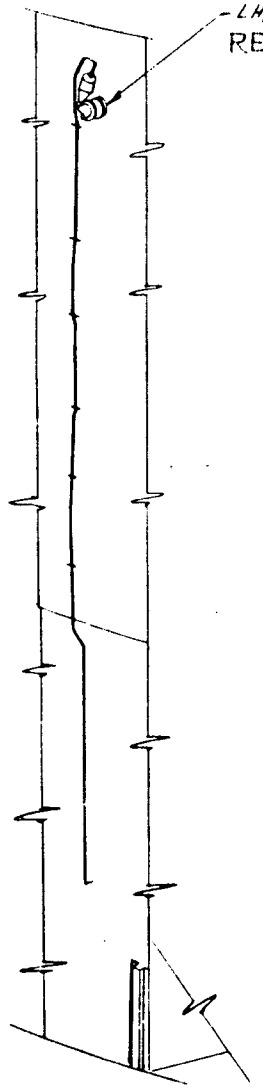

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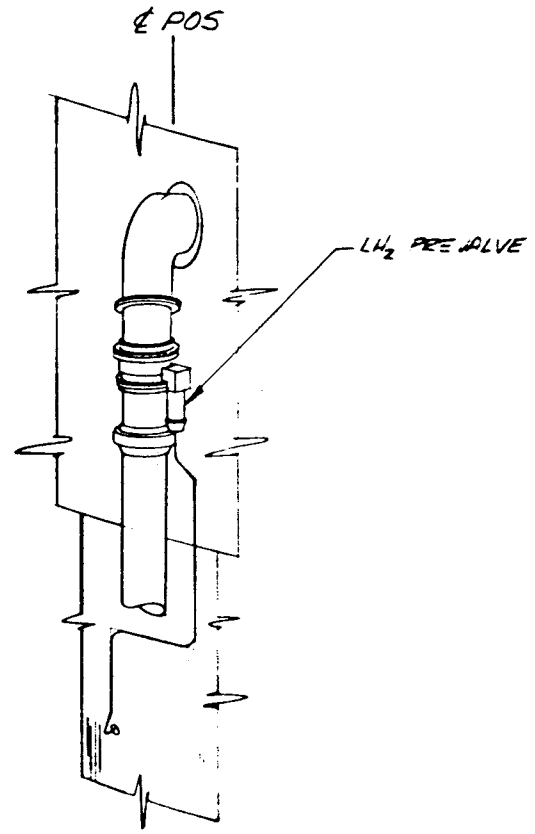

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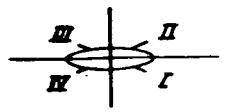

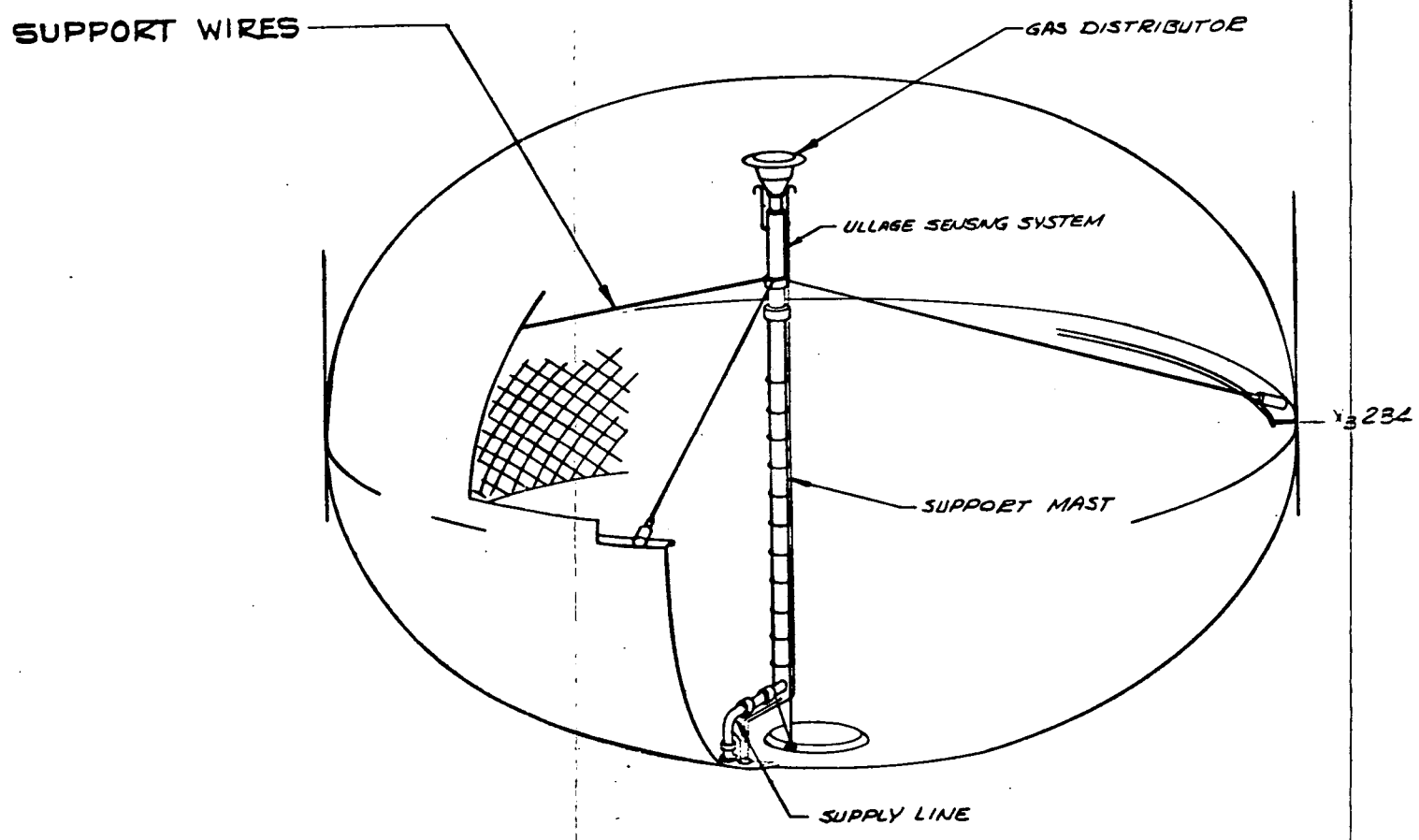

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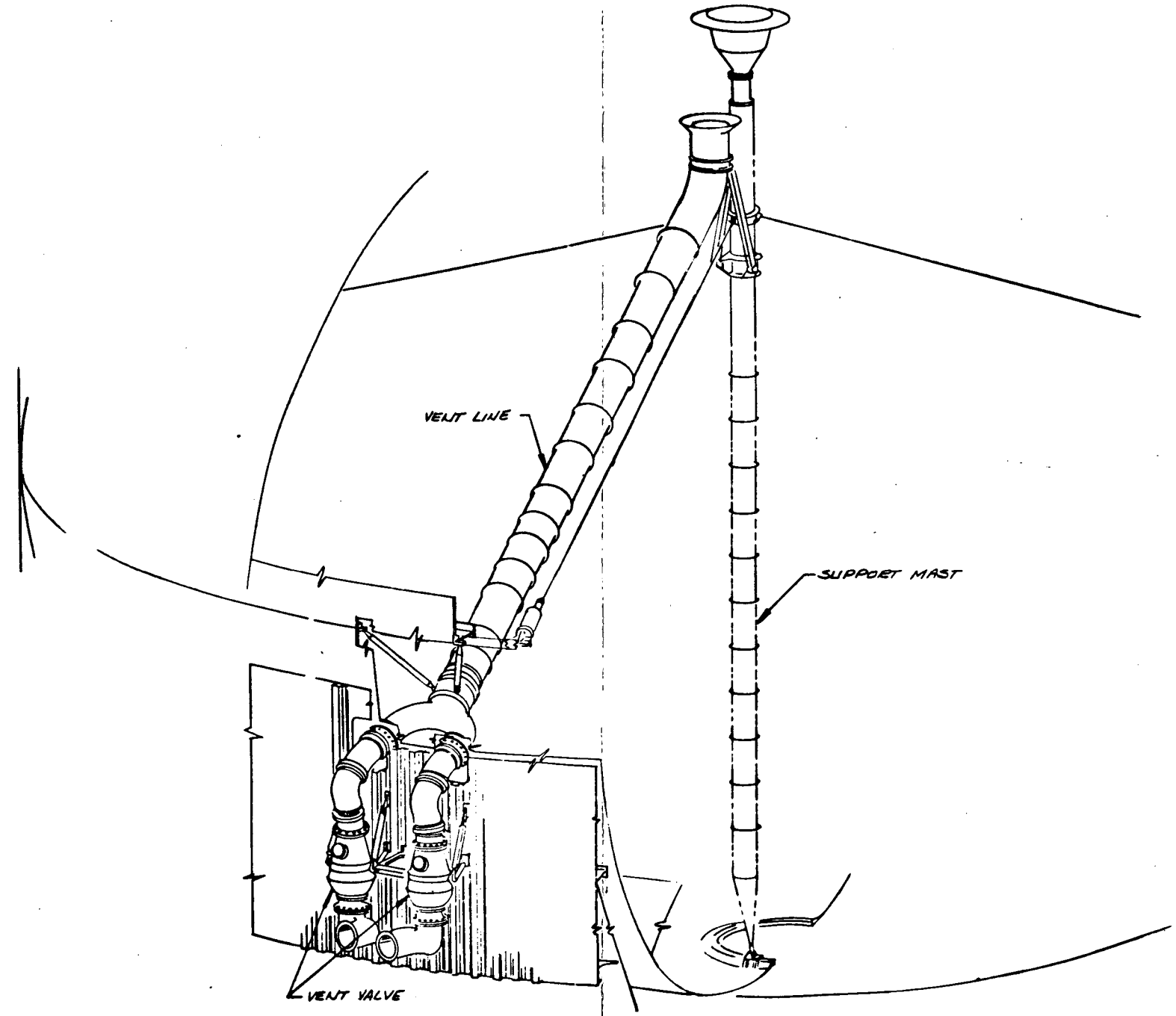

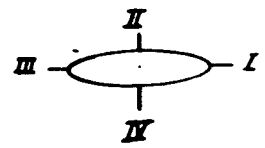

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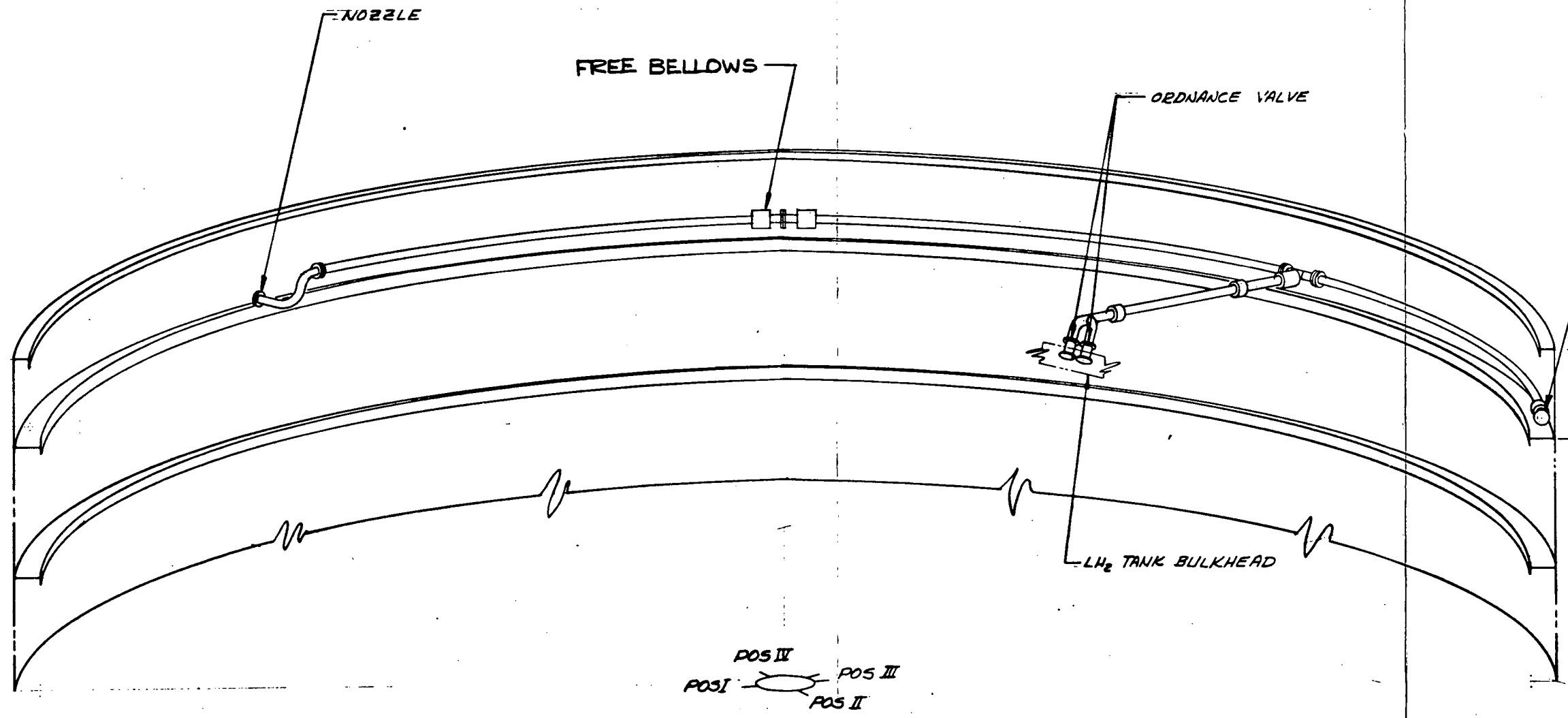
ZONE	LTR	DESCRIPTION	DATE	APPROVED



LH2 BALANCED VENT SUBSYSTEM

THIS PRINT REDUCED 55%

CHANGED FROM V7-949062

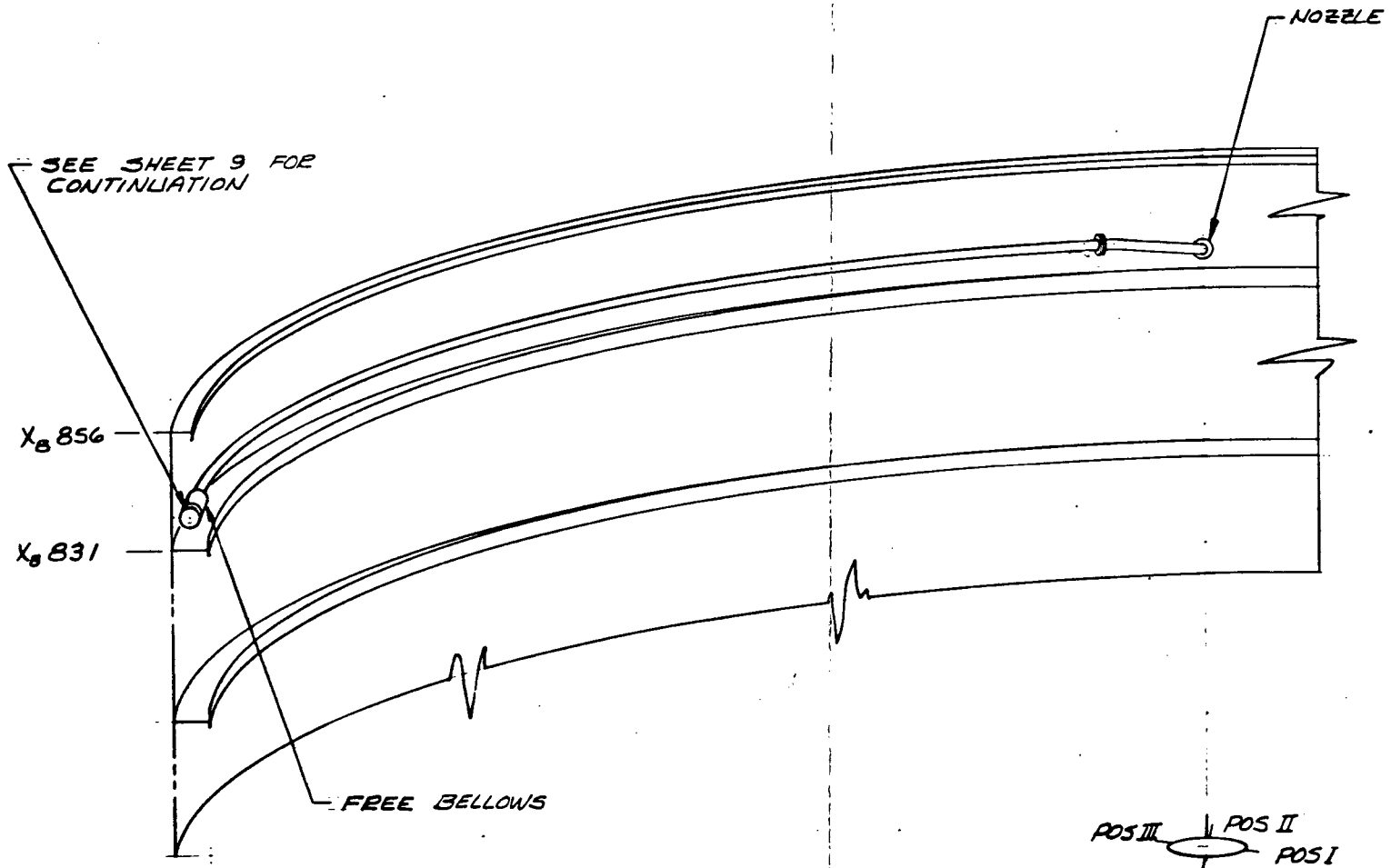
SIZE	CODE IDENT NO	V080-2005
D	03953	
SCALE		SHEET 9 OF 13

V080-2005

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



LH_2 BALANCED VENT SUBSYSTEM

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CHANGED FROM V7-949062

SIZE	CODE IDENT NO	V080-2005
D	03953	

SCALE | REVISED 5/3/71 | SHEET 10 OF 13

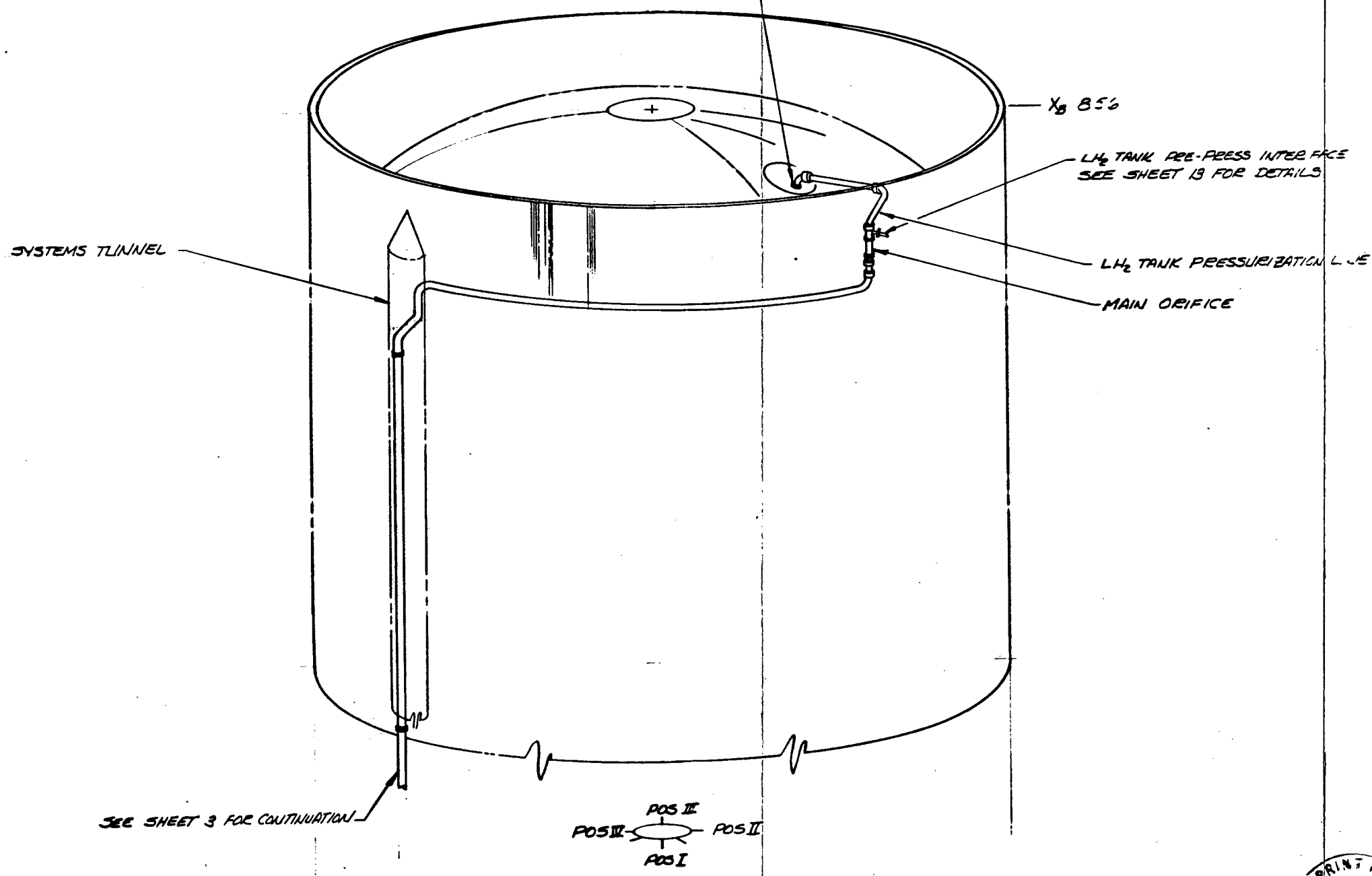
5002-080V

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REVISIONS			
ZONE LTR	DESCRIPTION	DATE	APPROVED

SYSTEM ATTACH PLATE SEE SHEET 12 FOR CONTINUATION



LH2 TANK PRESSURIZATION SUBSYSTEM

THIS PRINT REDUCED

CHANGED FROM V7-849062

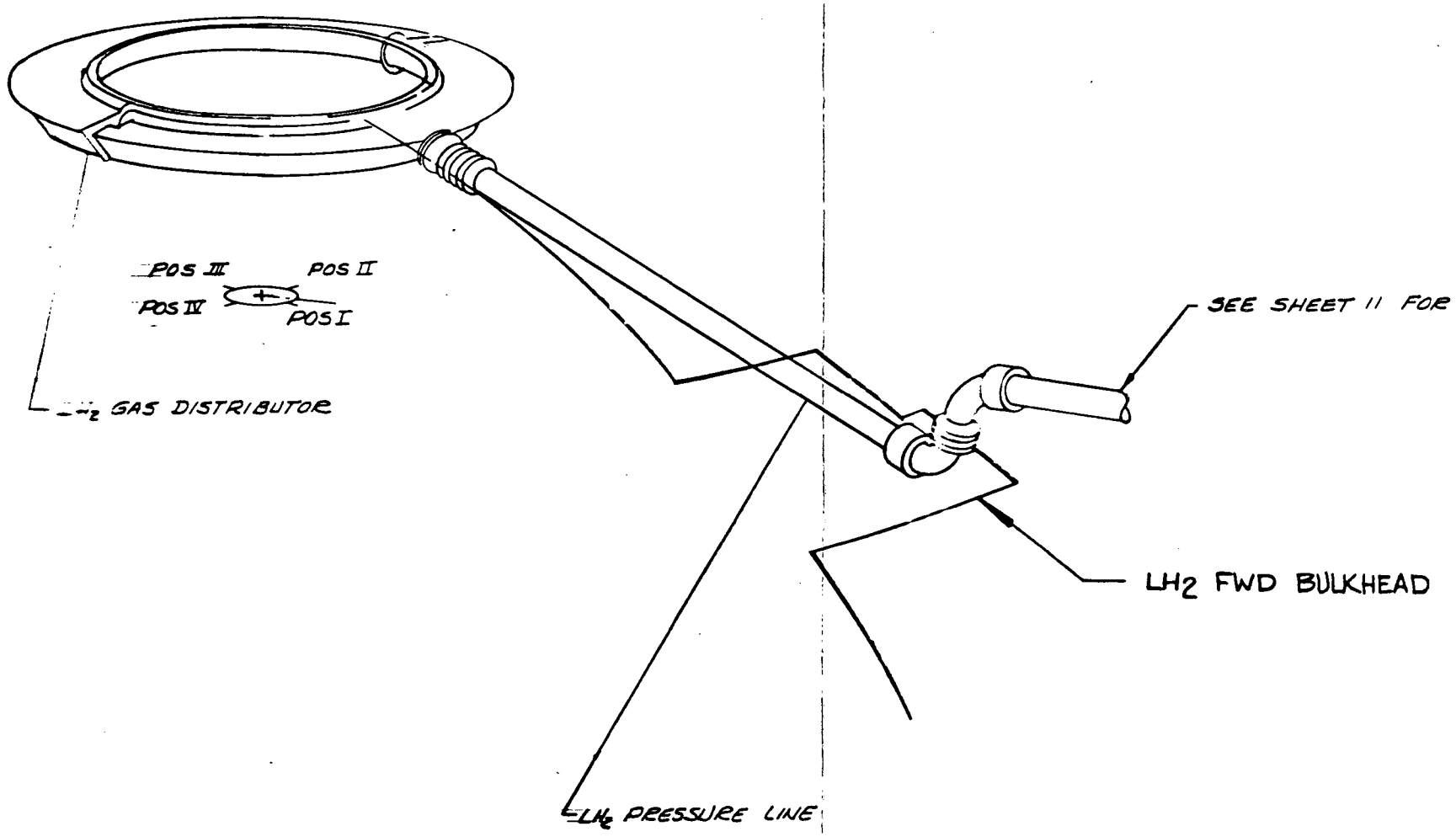
SIZE	CODE IDENT NO.	V080-2005
D	03953	
SCALE		SHEET 11 OF 13

V080-2005

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



LH2 TANK
PRESSURIZATION
SUBSYSTEM

THIS PRINT REDUCED 55%

CHANGED FROM V7-949062

SIZE	CODE IDENT NO.	
D	03953	V080-2005

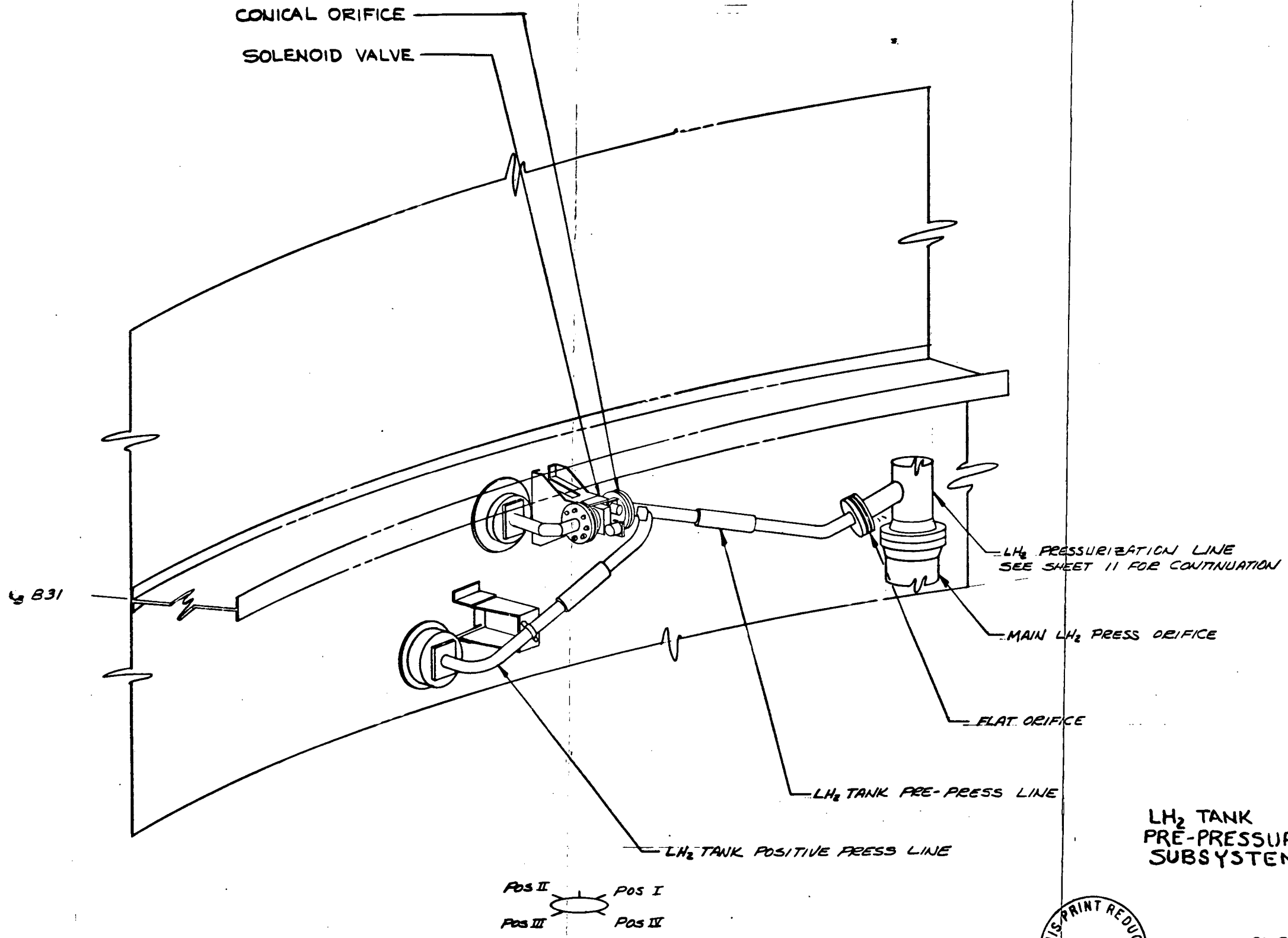
SCALE | DRAWN L.R. Mull 5-3-71 | SHEET 12 OF 13

V080-2005

FOLDOUT FRAME 1

FOLDOUT FRAME 2

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



LH2 TANK
PRE-PRESSURIZATION
SUBSYSTEM

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CHANGED FROM V7-949062

SIZE	CODE IDENT NO	
D	03953	V080-2005
SCALE		SHEET 13 OF 13

V080-2005

FOLDOUT FRAME 1

FOLDOUT FRAME 2

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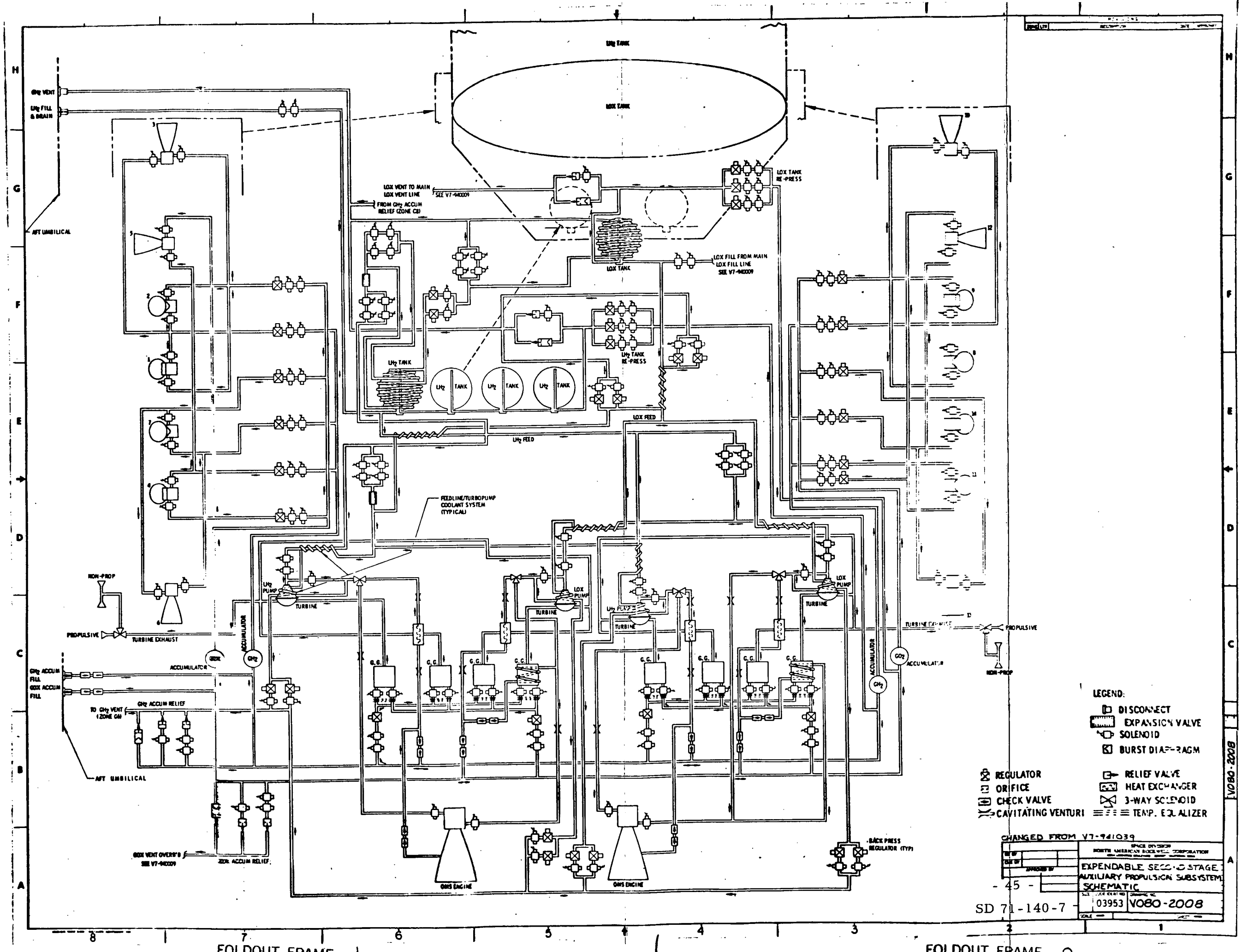

EOLDOUT FRAME

EOLDOUT FRAME 2

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REVISIONS				
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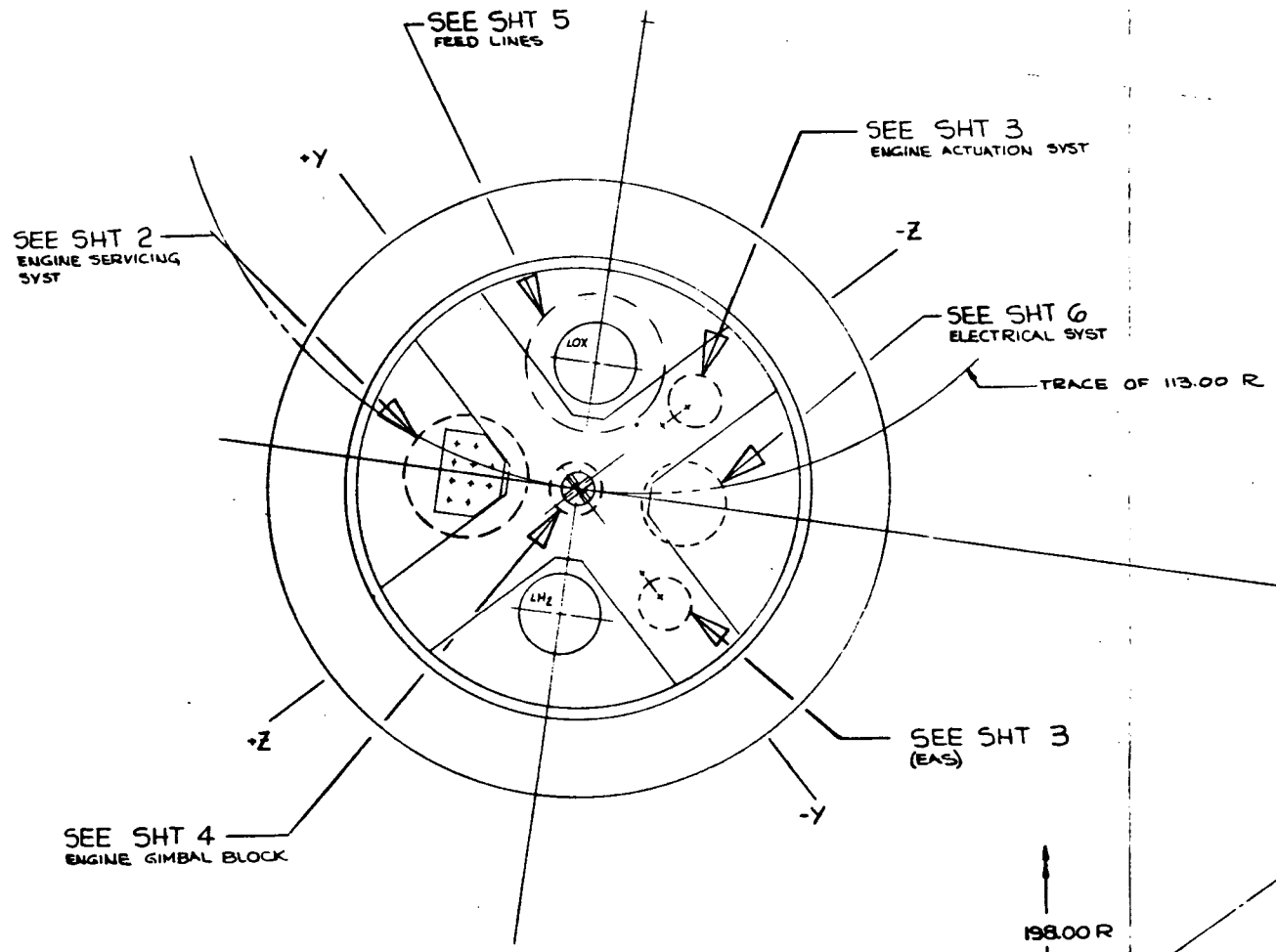

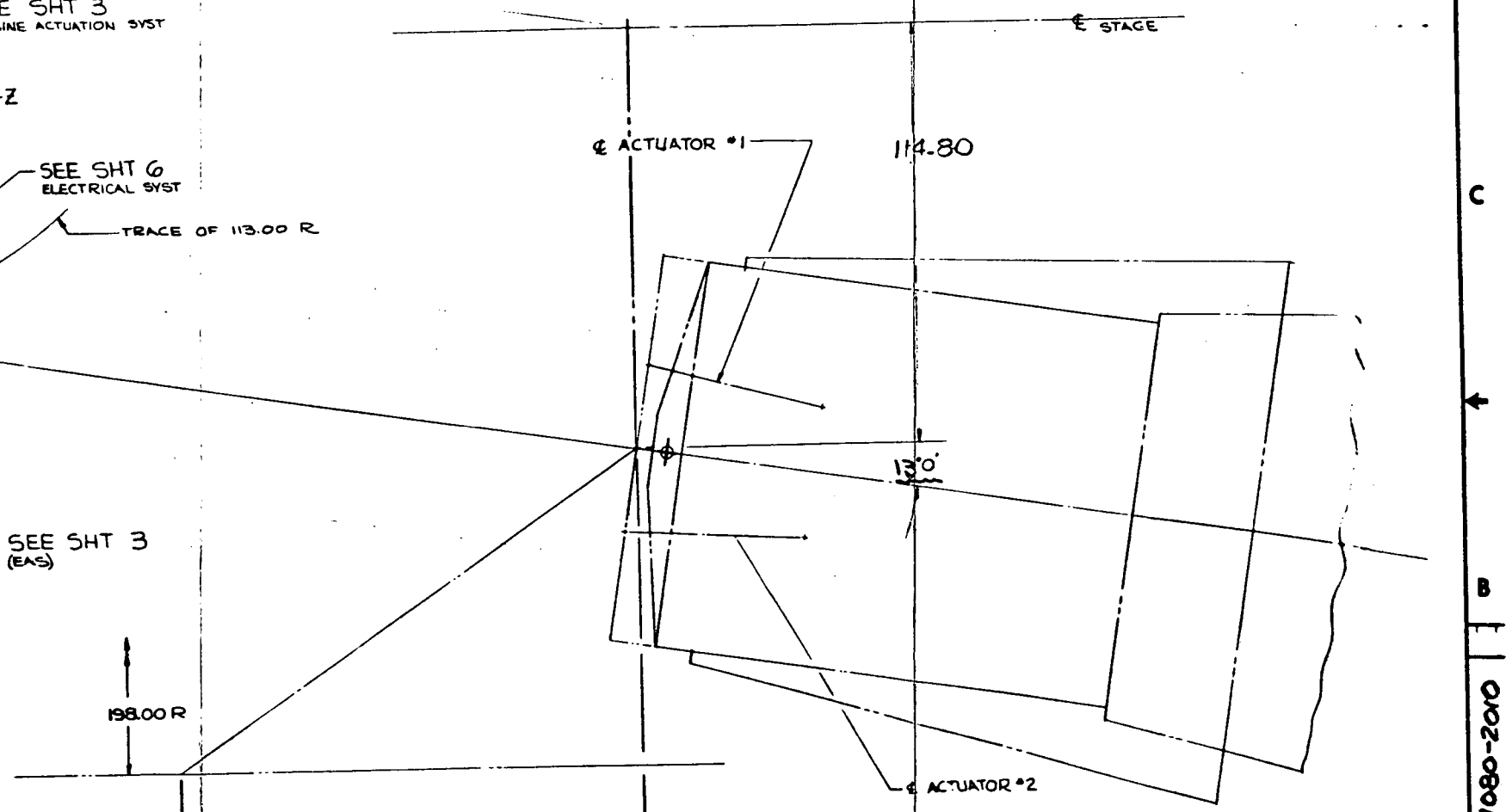

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DR BY	P S TOTAH	3-24-71
CHK BY		
APPROVED BY		

SPACE DIVISION
NORTH AMERICAN ROCKWELL CORPORATION
12214 LAKEWOOD BOULEVARD · DOWNEY, CALIFORNIA 90241

LAYOUT-STAGE/ENGINE CONNECT PANEL, RECOVERABLE ENGINE - ESS

SIZE	CODE IDENT NO.	
D	03953	V080-2010

SCALE 1/12 SHEET 1 OF 2

V080-2010

ENGINE ← → STAGE

A

TBD TO ℄ ENGINE

CONNECT PANEL STAGE MOUNTED

SELF SEALING DISCONNECT

¼" STUD (TYP)

SEPARATION NUT (14) SIMILAR TO SN7323-2 (HI-SHEAR CORP)

9.00 (8.00 ON ICD)

4.50 (4.00 ON ICD)

13.50 (12.50 ON ICD)

9.00 (8.50 ON ICD)

6.75 (TBD ON ICD)

4.50 (4.00 ON ICD)

ENGINE HYDRAULIC SUPPLY

ENGINE HYDRAULIC RETURN

LH_2 RECIRC

LH_2 TANK PRESS

LH_2 PUMP SEAL DRAIN

GH_2

LOX PUMP SEAL DRAIN

LOX RECIRC

LOX TANK PRESS

SECT A-A

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

ACT ATTACH POINT -Y

FUEL PUMP INLET +Z

ELECT CONNECT PANEL

MECH ELEC/STG INTERFACES

-Z

OXIDIZER PUMP INLET +Y

ACT ATTACH POINT

ORBITER ENGINE LOOKING AFT NO SCALE

ENGINE SERVICING SYSTEMS

THIS PRINT IS 55%

V080-2010

CHANGED FROM V7-941622

DR BY	R.B.TOTAN	3-12-71
CHK BY		
APPROVED BY		

SPACE DIVISION
NORTH AMERICAN ROCKWELL CORPORATION
12214 LAKEWOOD BOULEVARD · DOWNEY, CALIFORNIA 90241

LAYOUT - STAGE/ENGINE CONNECT PANEL, RECOVERABLE ENGINE - ESS

SIZE	CODE IDENT NO.	
D	03953	V080-2010

SCALE 1/1 SHEET 2 OF 6

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE

ENGINE ← → STAGE

ACTUATOR #1 (OR #2) STAGE ATTACH POINT

ACT #1 HYD SUPPLY

EAS MAIN PUMP HYD SUPPLY

ACT #1 HYD RETURN

EAS MAIN PUMP HYD RETURN

SEPERATION NUT (¼) SIMILAR TO SN7323-2 (HI-SHEAR CORP)

½ SEPERATION NUT SIMILAR TO SN7323-4 (HI-SHEAR CORP)

4.75

ACTUATOR #2 (OR #1) STAGE ATTACH POINT

ACT #2 HYD SUPPLY

ACT #2 HYD RETURN

4.75 (TYP)

2.38 (TYP)

4.88 (TYP)

A SH2 SAME AS ENGINE HYD. SUPPLY (TYP)

SECT C-C

SECT B-B

ENGINE ACTUATION SYSTEM

CHANGED FROM V7-941622

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CHK BY		
APPROVED BY		

SPACE DIVISION
NORTH AMERICAN ROCKWELL CORPORATION
12214 LAKEWOOD BOULEVARD · DOWNEY, CALIFORNIA 90241

LAYOUT - STAGE/ENGINE CONNECT PANEL, RECOVERABLE ENGINE - ESS

SIZE	CODE IDENT NO.	
D	03953	V080-2010

SCALE 1/1 SHEET 3 OF 5

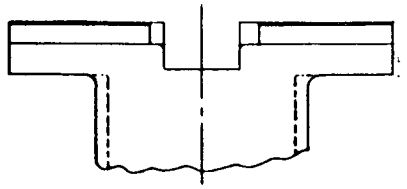
V080-2010

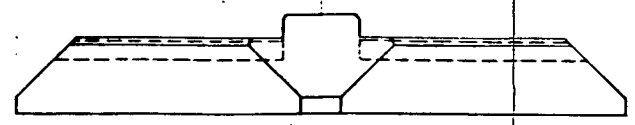
FOLDOUT FRAME 1

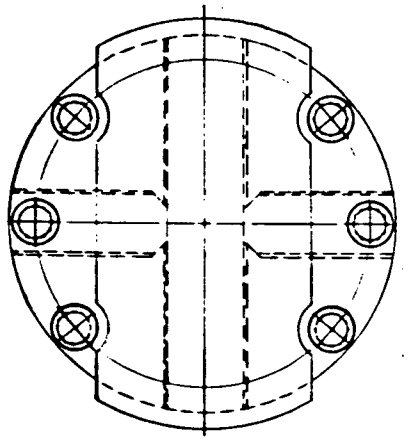
FOLDOUT FRAME 2

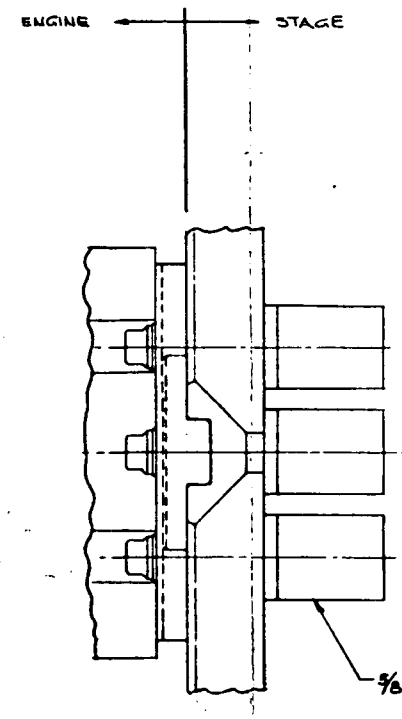
REVISIONS

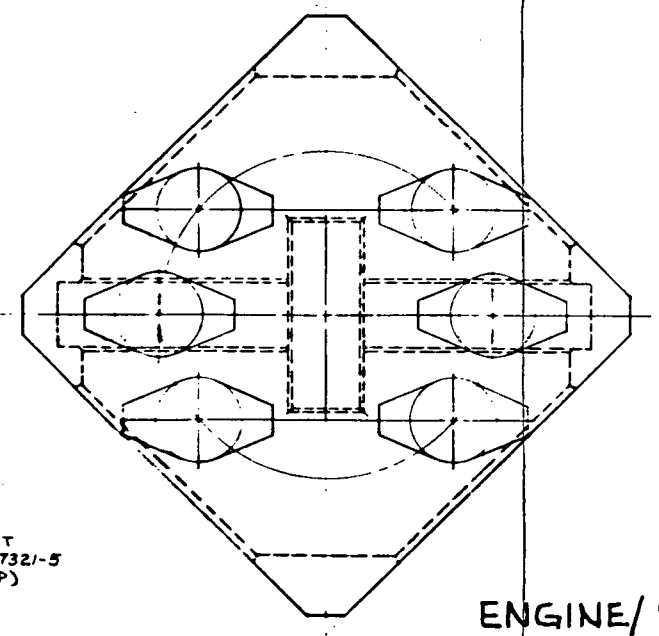
ZONE	LTR	DESCRIPTION	DATE	APPROVED











ENGINE/ STAGE GIMBAL BLOCK

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CHANGED FROM V7-941622
P.S. 7-1-

SIZE	CODE IDENT NO	V080-2010
D	03953	

SCALE 1/2 SHEET 4 OF 7

V080-2010

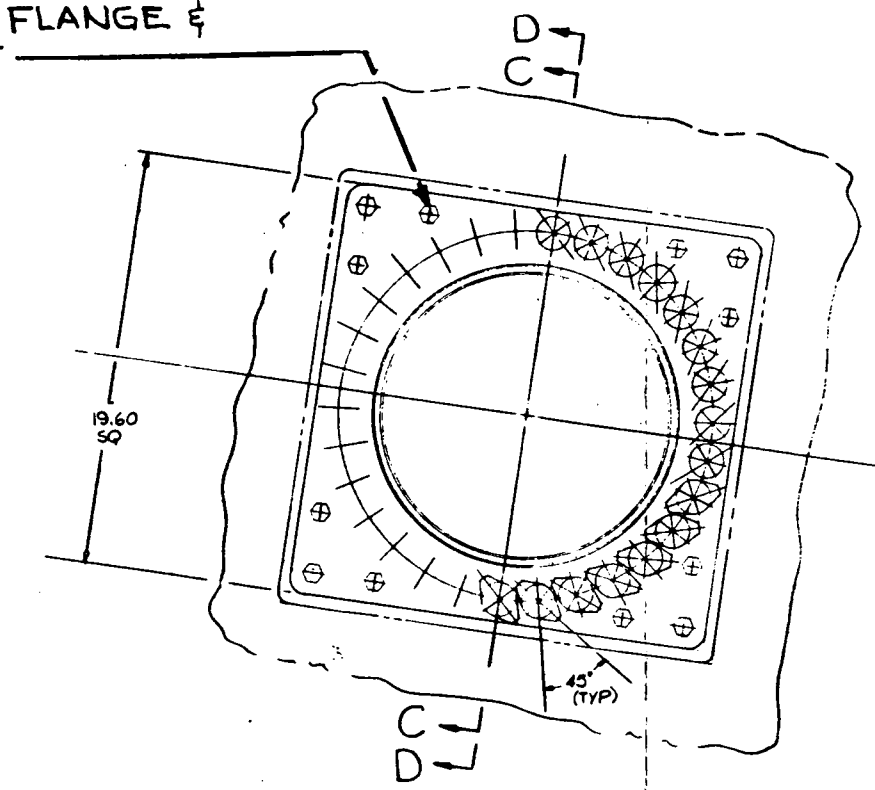
FOLDOUT FRAME 1

FOLDOUT FRAME 2

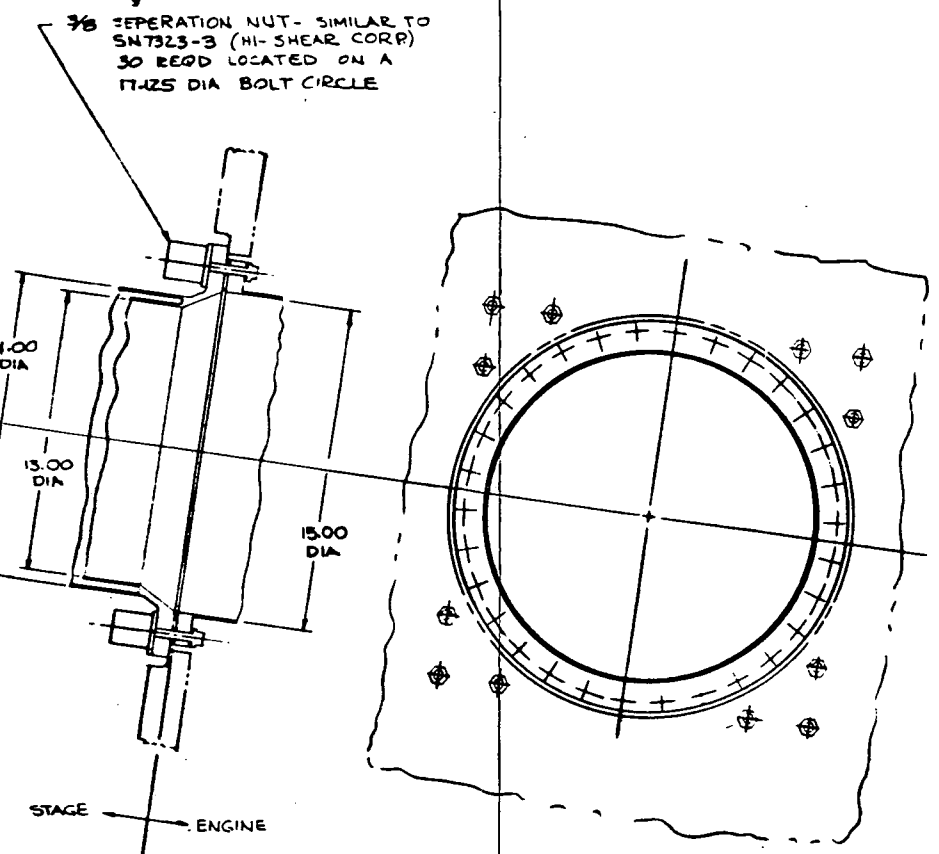
SD 71-140-7

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

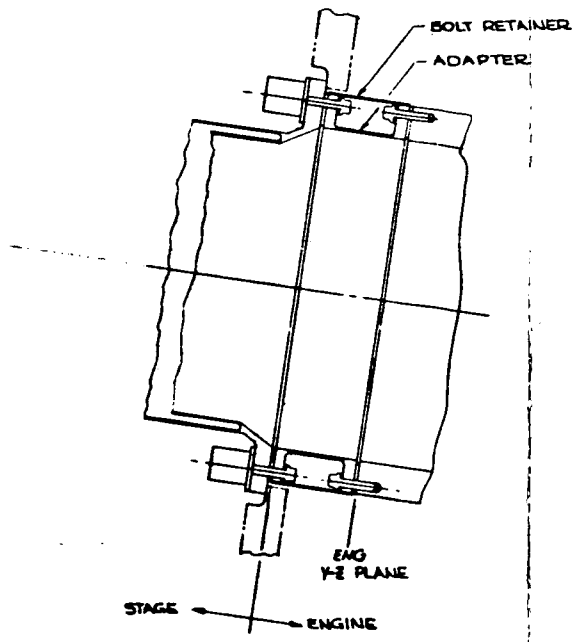
NAS 1008 BOLT THRU STAGE DUCT FLANGE & SPT STRUCT



TYP FEED SYST (LOX & LH_2)
STAGE/ENGINE INTERFACE



SECT C-C



SECT D-D
ALTERNATE CONFIG.

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E.S. TOTAH 3-25-71

CHANGED FROM V7-941622

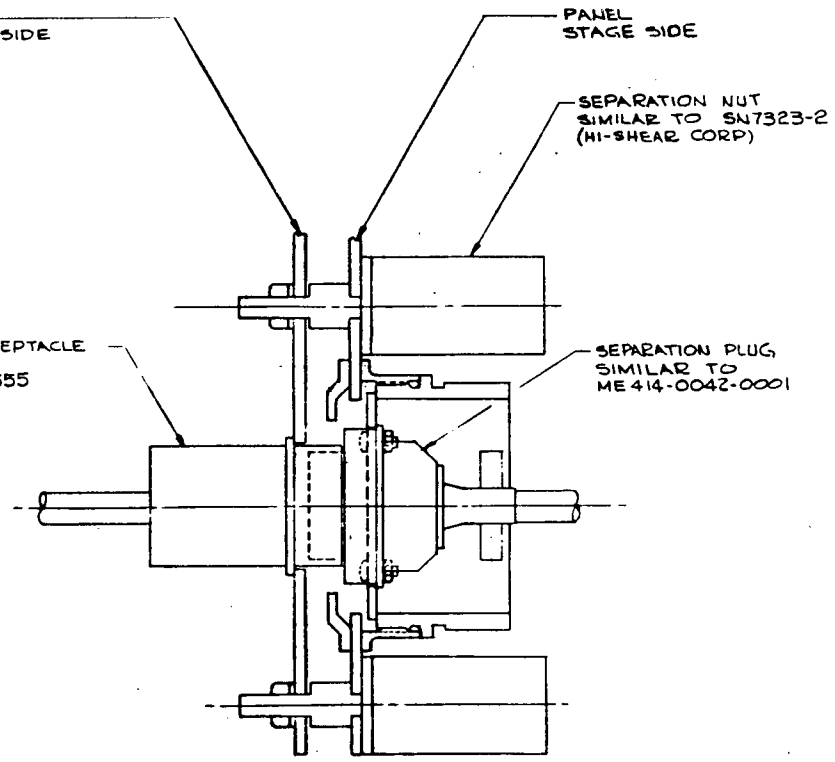
SIZE	CODE IDENT NO.	
D	03953	V080-2010
SCALE 1/4		SHEET 5 OF 6

V080-2010

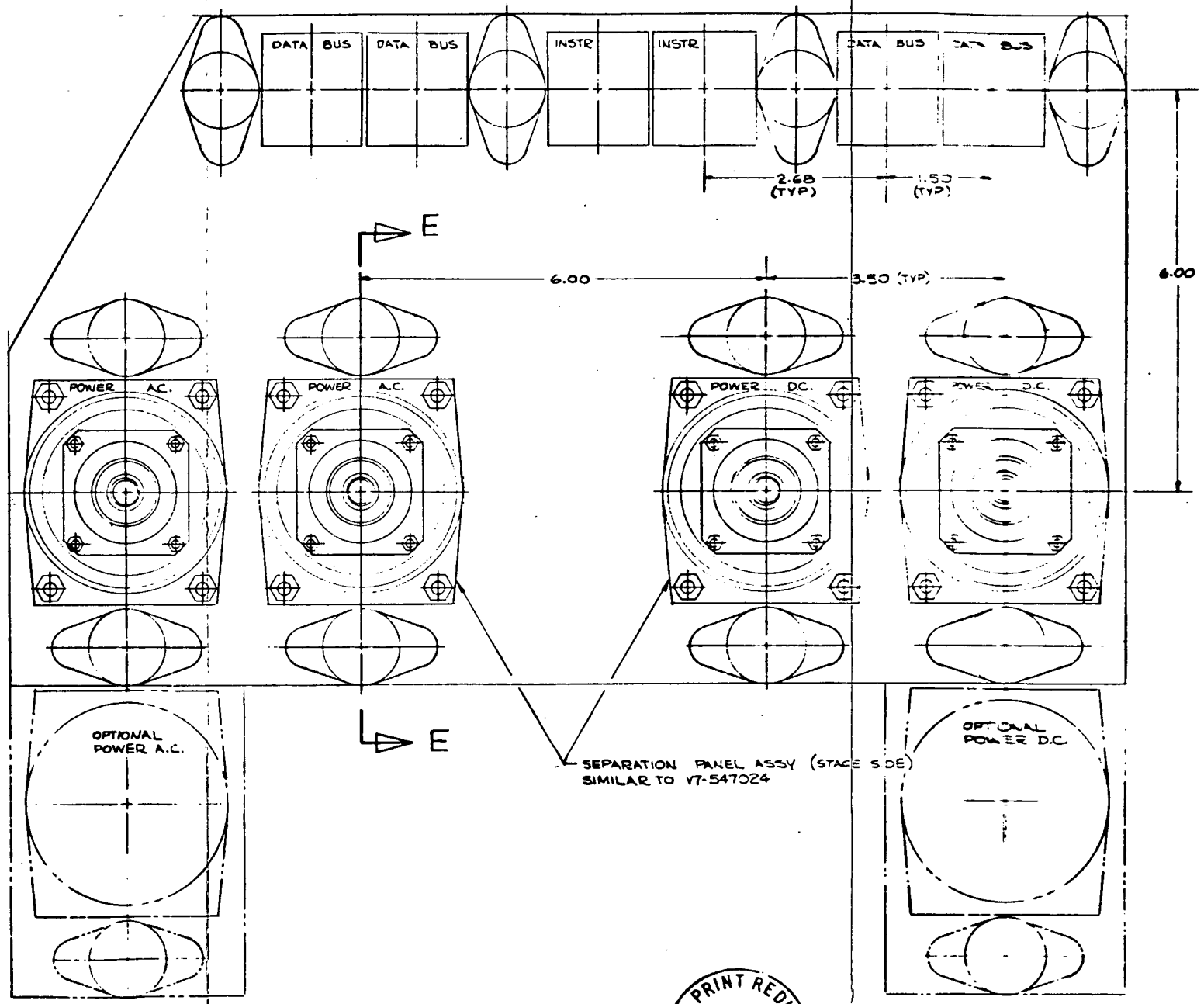
FOLDOUT FRAME

FOLDOUT FRAME

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



SECT E-E



ELECTRICAL SYSTEMS

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E.S. TOTAH 3-30-71

SIZE	CODE IDENT NO	
D	03953	V080-2010
SCALE 1/1		SHEET 6 OF 6

V080-2010

FOLDOUT FRAME 1 FOLDOUT FRAME 1 FOLDOUT FRAME 2

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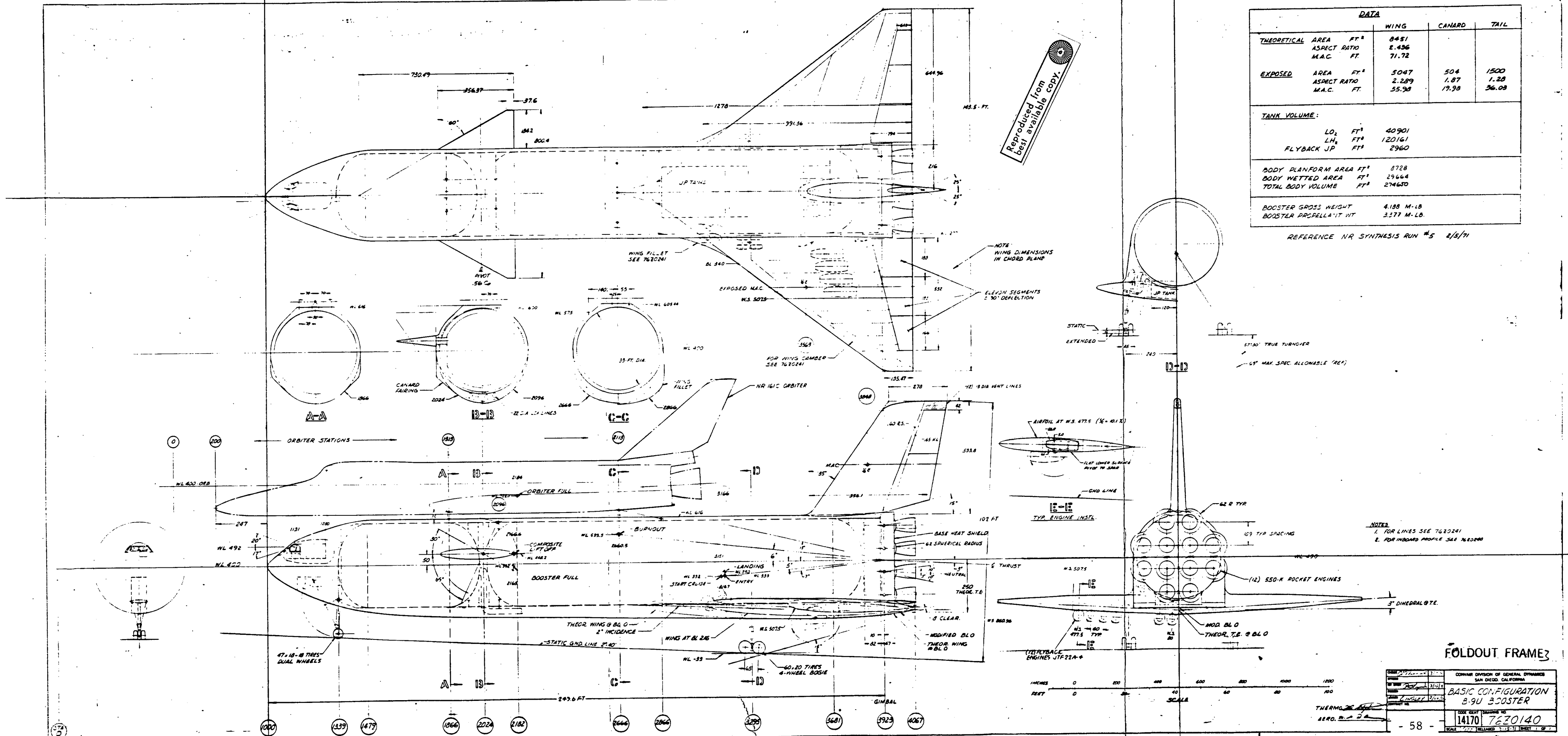
5.0 BOOSTER

5.0 BOOSTER


DATA
WING
CANARD
TAIL
THEORETICAL AREA FT² 8451
ASPECT RATIO 2.436
M.A.C. FT. 71.72
EXPOSED AREA FT² 5047 504 1500
ASPECT RATIO 2.289 1.87 1.28
M.A.C. FT. 55.98 19.98 36.08
TANK VOLUME:
LO₂ FT³ 40901
LH₂ FT³ 120161
FLYBACK JP FT³ 2960
BODY PLANFORM AREA FT² 8728
BODY WETTED AREA FT² 29464
TOTAL BODY VOLUME FT³ 274630
BOOSTER GROSS WEIGHT 4.188 M-LB
BOOSTER PROPELLANT WT 3.377 M-LB.
REFERENCE NR SYNTHESIS RUN #5 2/5/71
Reproduced from best available copy.
NOTE: WING DIMENSIONS IN CHORD PLANE
ELEVON SEGMENTS ± 30° DEFLECTION
ORBITER STATIONS
NR 161C ORBITER
BOOSTER FULL
ORBITER FULL
BURNOUT
LANDING
ENTRY
BASE HEAT SHIELD
68 SPHERICAL RADIUS
(12) 550-K ROCKET ENGINES
3° DIHEDRAL @ T.E.
MOD. BL 0
THEOR. T.E. @ BL 0
(2) FLYBACK ENGINES JTF22A-4
47 x 18-18 TIRES DUAL WHEELS
60 x 20 TIRES 4-WHEEL BOGIE
GIMBAL
STATIC GND LINE @ 40°
THEOR. WING @ BL 0 2° INCIDENCE
WING AT BL 216
MODIFIED BLO
THEOR. WING @ BL 0
JP TANK
STATIC EXTENDED
ET 30° TRUE TURNOVER
65° MAX. SPEC. ALLOWABLE (REF.)
AIRFOIL AT W.S. 477.5 (36 + 10.1 X)
FLAT LOWER SURFACE PIVOT TO SHAPE
GND LINE
TYP. ENGINE INSTL.
62 R TYP
169 TYP SPACING
NOTES
1. FOR LINES SEE 7620241
2. FOR INBOARD PROFILE SEE 7620240
INCHES 0 200 400 600 800 1000 1200
FEET 0 20 40 60 80 100
SCALE
THERMO
AERO
FOLDOUT FRAME 1
FOLDOUT FRAME 2
FOLDOUT FRAME 3
CONVAIR DIVISION OF GENERAL DYNAMICS
SAN DIEGO, CALIFORNIA
BASIC CONFIGURATION
B-9U BOOSTER
CODE IDENT 14170
DRAWING NO. 7620140
SCALE 1/100
RELEASED 3-15-71
SHEET 1 OF 1
- 58 -
SD 71-140-7

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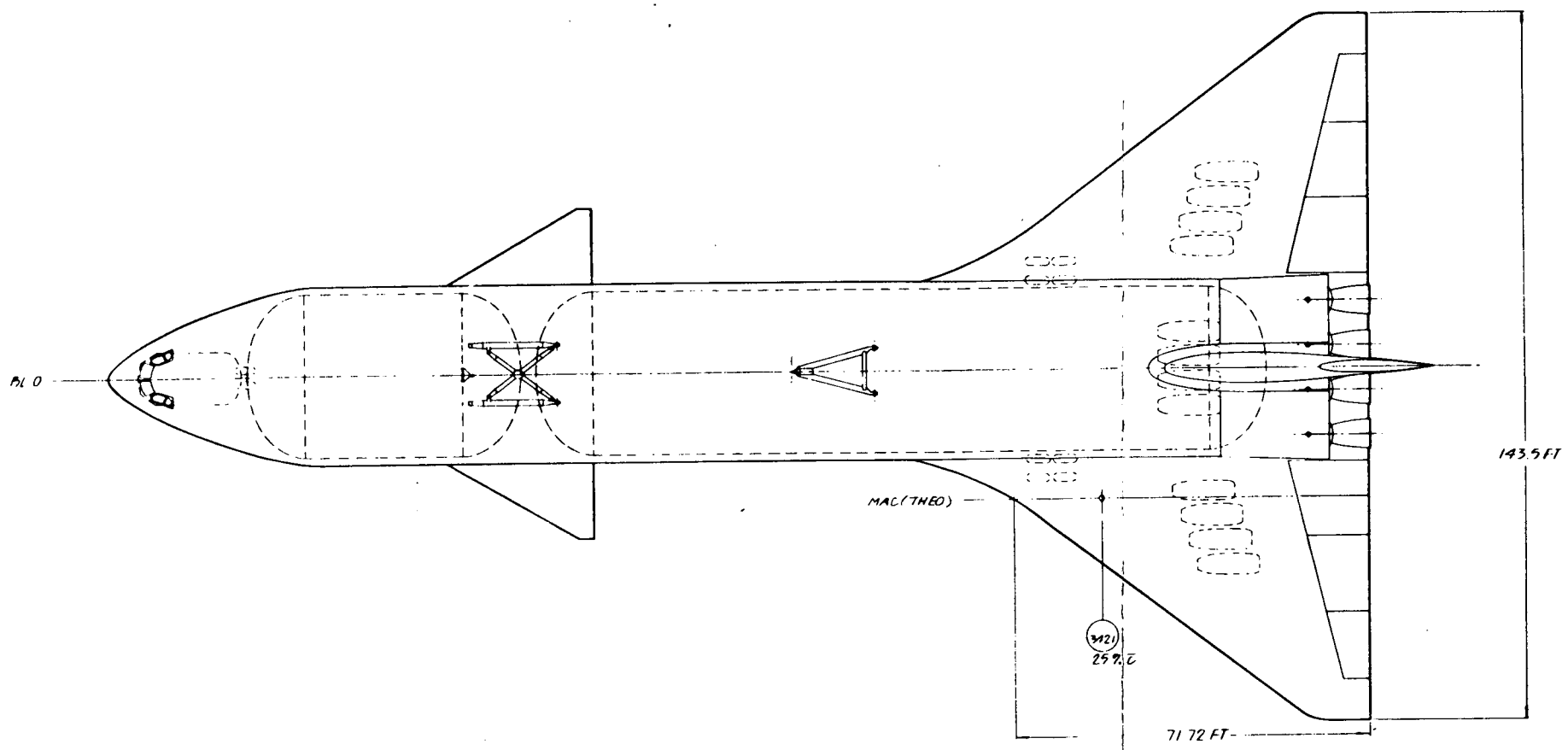

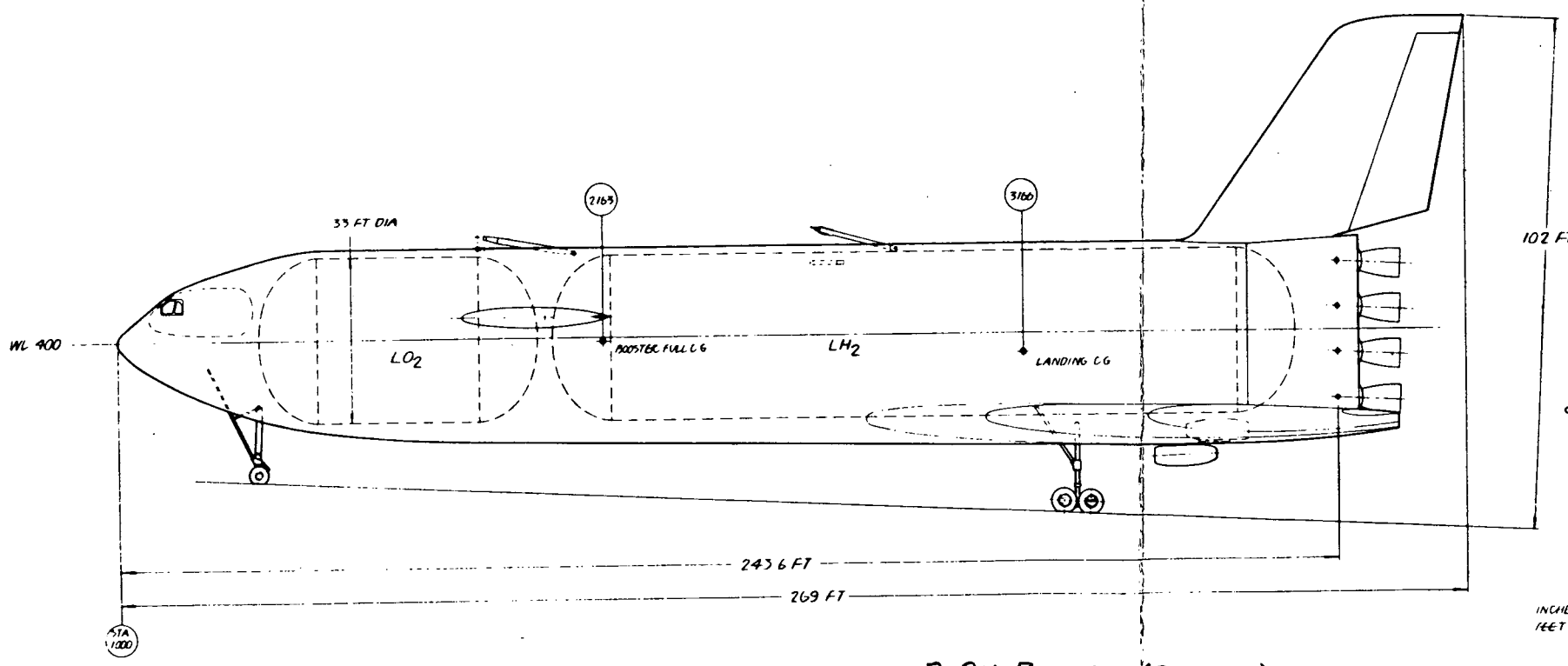

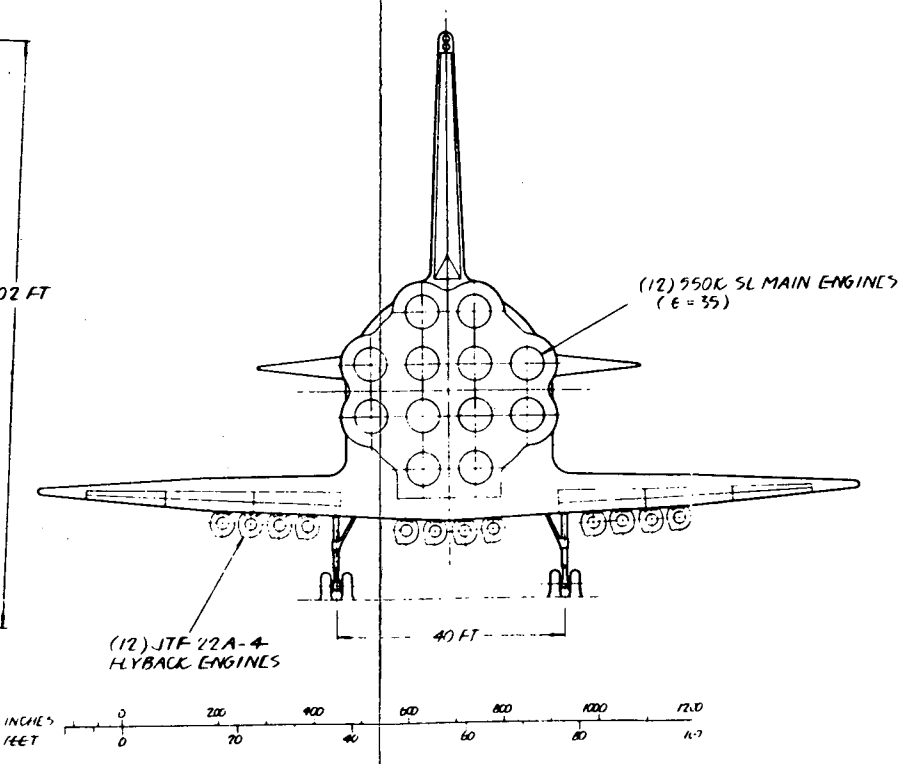

WEIGHTS

BOOSTER LIFTOFF	=	4 188 M LB
ASCENT PROPELLANT	=	3 377 M LB
CRUISE PROPELLANT	=	144 K LB
LANDING (NOMINAL RESIDUALS)	=	639 K LB

AREAS

THEO WING	=	8451 FT^2
EXPOSED CANARD	=	504 FT^2
VERTICAL TAIL	=	1900 FT^2
BODY PLANFORM	=	8728 FT^2
BODY WETTED AREA	=	29664 FT^2

REFERENCE

BOOSTER BASIC CONFIG DWG	76Z0140
BOOSTER INBOARD PROFILE DWG	76Z0240
BOOSTER LINES DWG	76Z0241

B-9U BOOSTER (3-VIEW)

DRAWING NO. 76Z0243

FOLDOUT FRAME 1

FOLDOUT FRAME 2

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6.0 OPERATIONS

6.0 OPERATIONS

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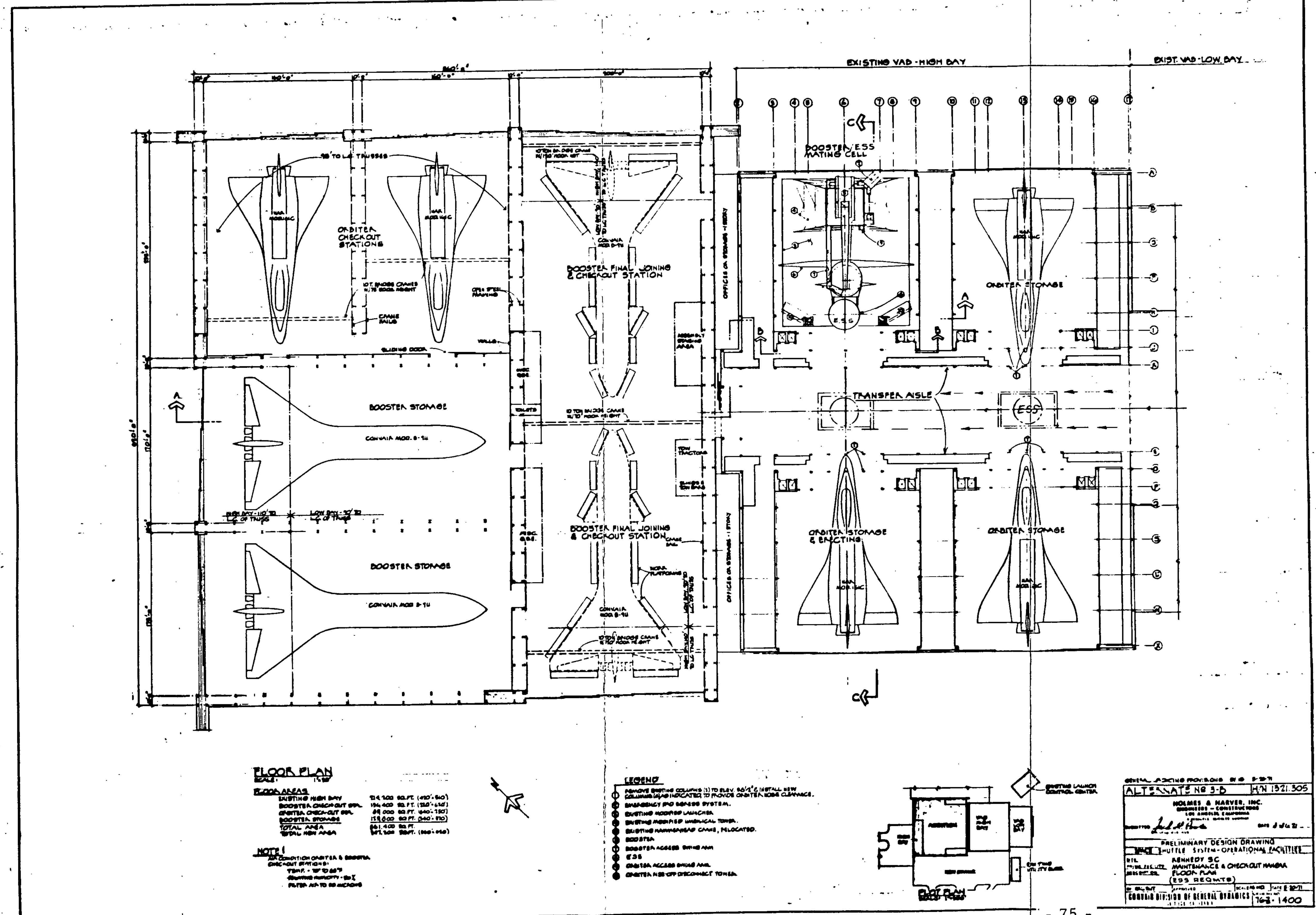
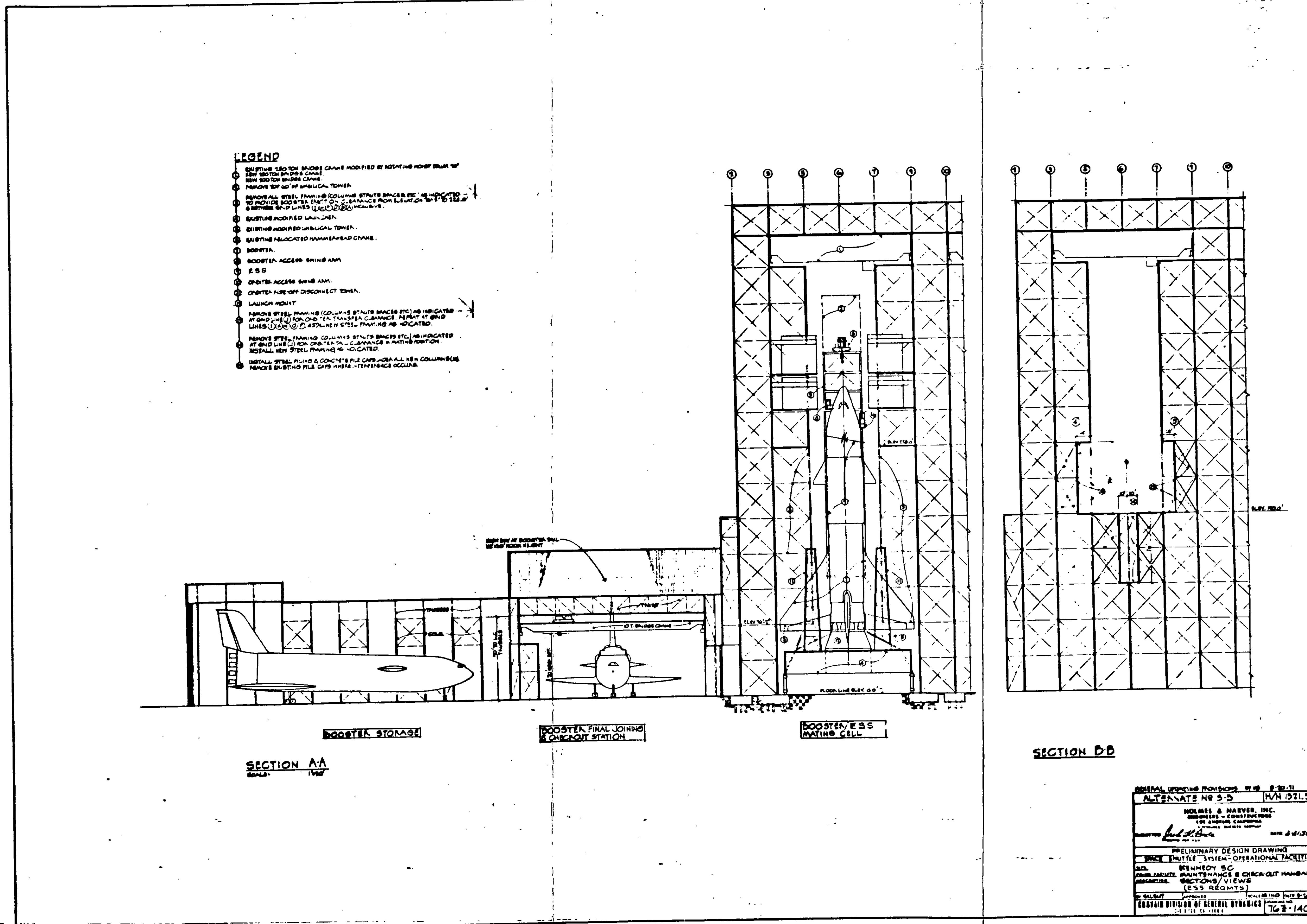


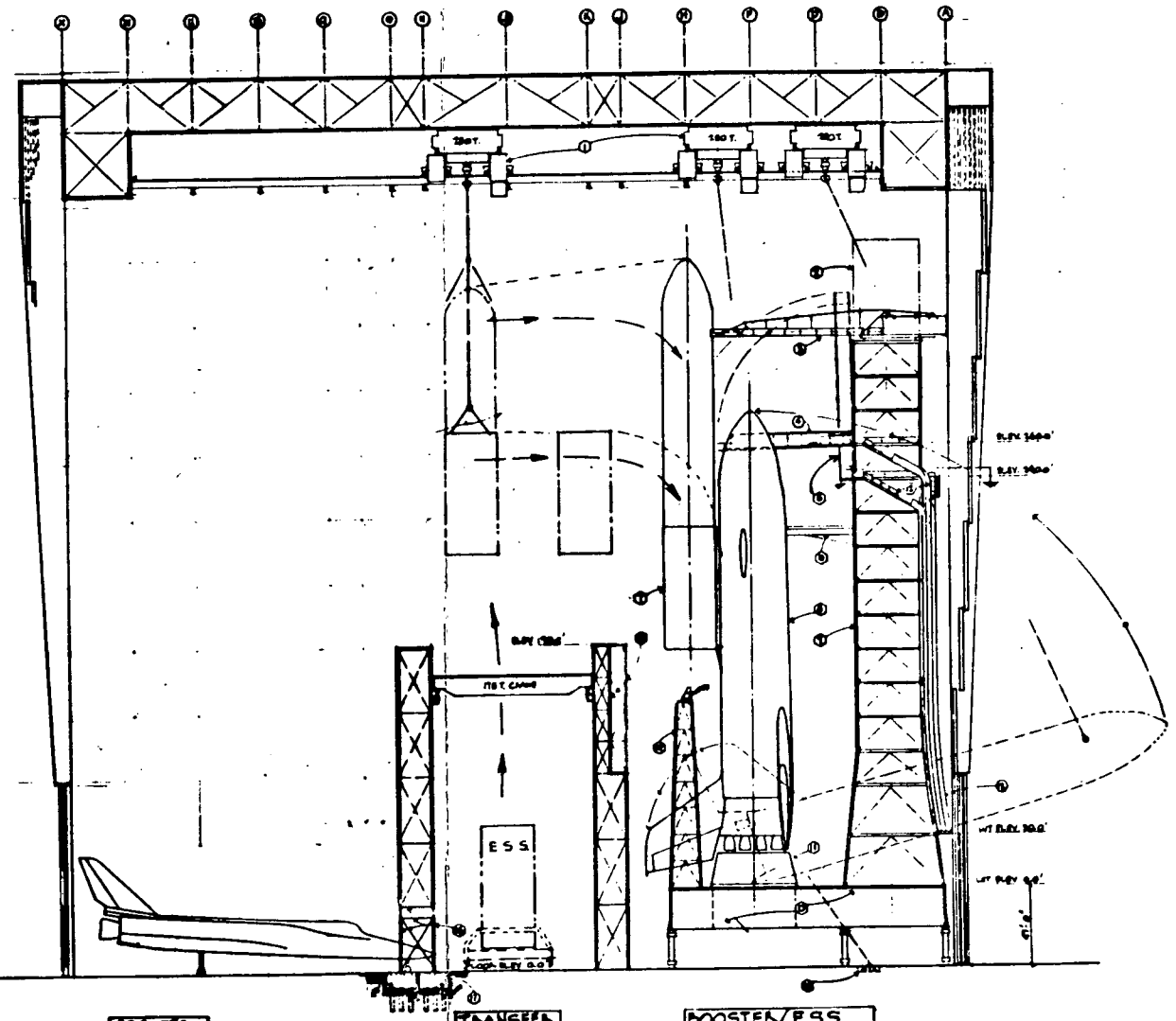
FOLDOUT FRAME 2

FOLDOUT FRAME 1



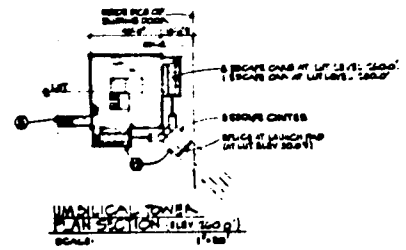
FOLDOUT FRAME 1

FOLDOUT FRAME 2



SECTION CC
SCALE: 1"=50'

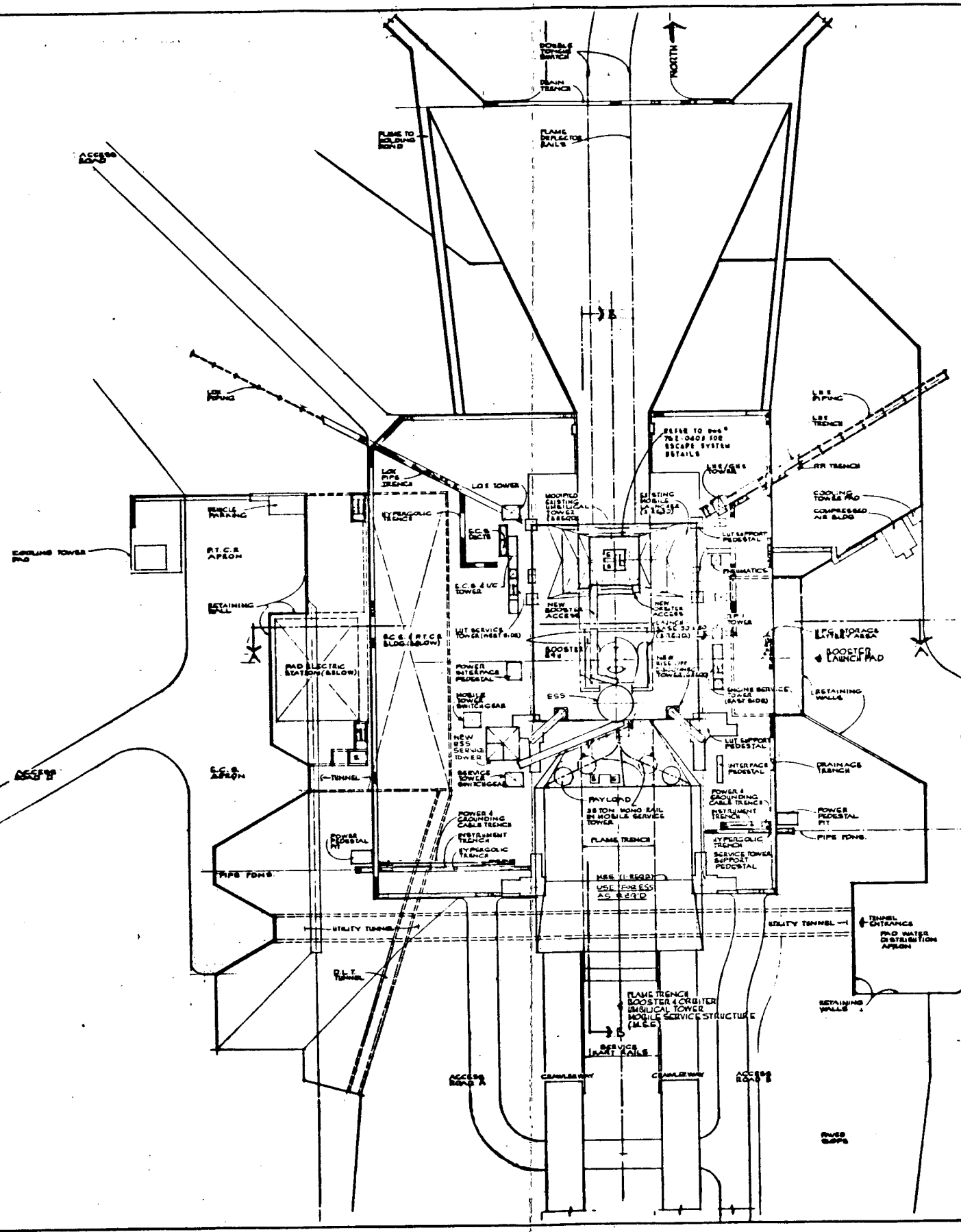
LEGEND



ALTERNATE NO 3-D	MM 371.308
HOLMES & NARVER, INC. ENGINEERS — CONSTRUCTORS LOS ANGELES, CALIFORNIA	
PRELIMINARY DESIGN DRAWING	
SPACE SHUTTLE SYSTEM - OPERATIONAL FACILITIES	
KENNEDY SC MAINTENANCE & CHECK-OUT HANGAR SECTION THRU VAB MATING BAY (ESS REQMTS)	
CONVAIR DIVISION OF GENERAL DYNAMICS	76-1403

FOLDOUT FRAME 1

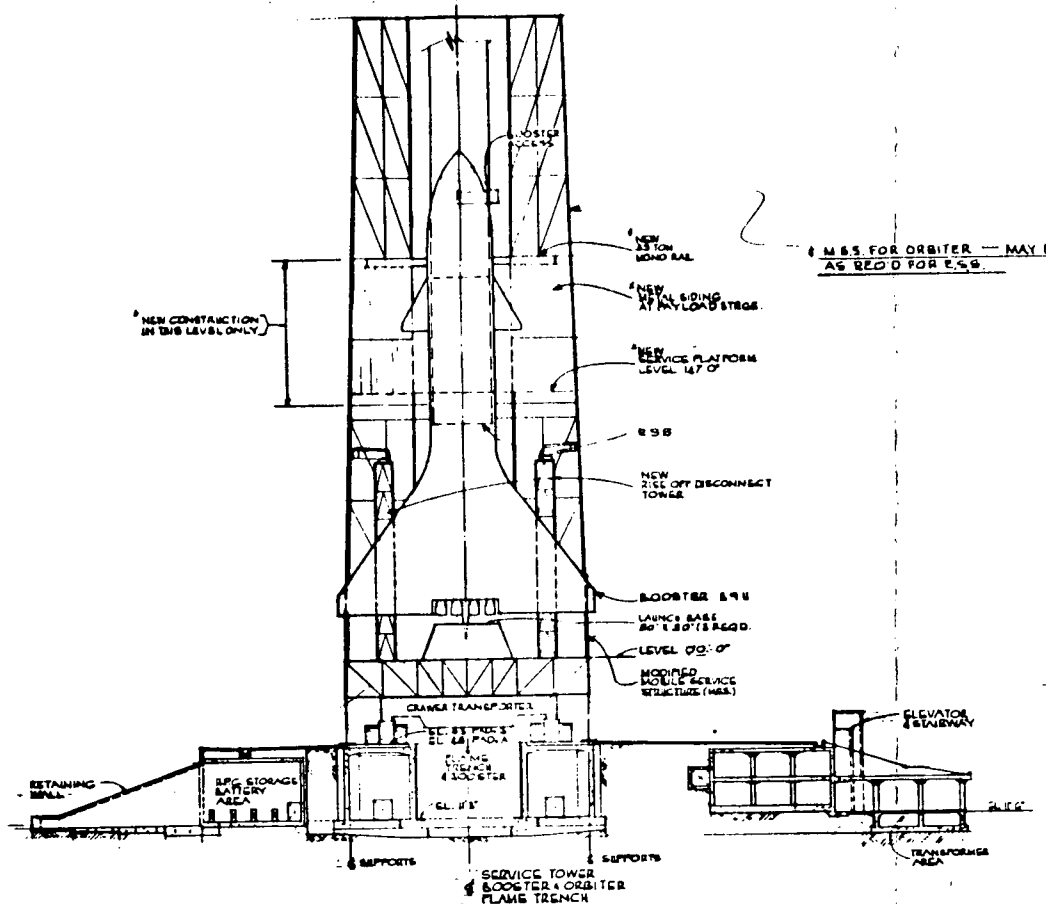
FOLDOUT FRAME 2



FOLDOUT FRAME 1

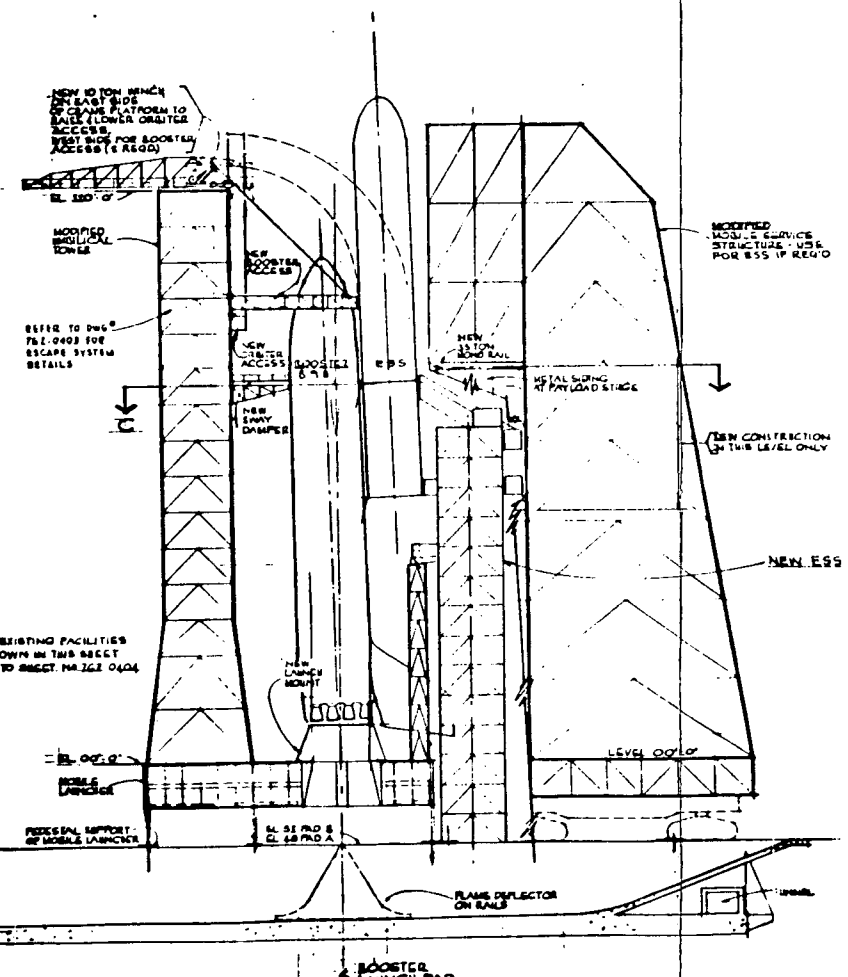
FOLDOUT FRAME 2

SD 71-140-7



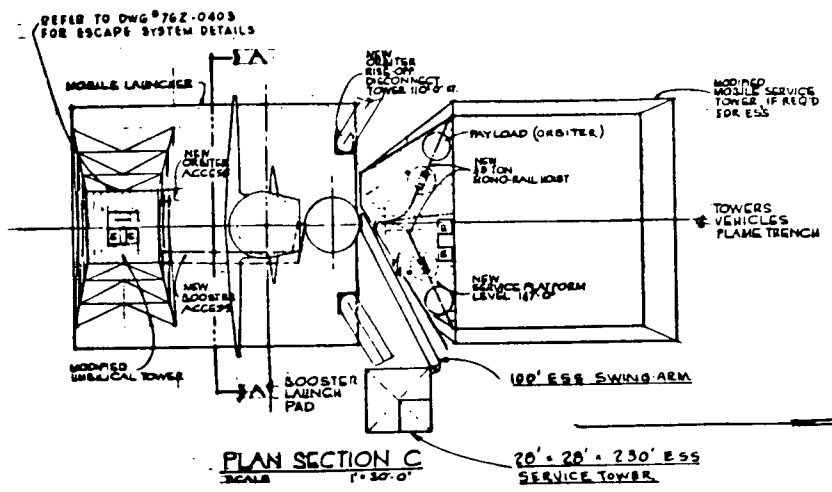
SECTION A-A
SCALE 1"=50'

* MSS FOR ORBITER — MAY BE USED AS REQ'D FOR ESS



NOTE.. OTHER EXISTING FACILITIES NOT SHOWN IN THIS SECT. REFER TO SECT. NO 76E 0404

SECTION B-B
SCALE 1"=50'



PLAN SECTION C
SCALE 1"=50'-0"

1	GENERAL UPDATING REVISION	

ALTERNATE NO 3-B | M/N 1321.505

HOLMES & NARVER, INC.
ENGINEERS — CONSTRUCTORS
LOS ANGELES, CALIFORNIA

PRELIMINARY DESIGN DRAWING
SPACE SHUTTLE SYSTEM-OPERATIONAL FACILITIES
KENNEDY SPACE CENTER
LAUNCH FACILITY LAUNCH PAD 39A & 39B
DESCRIPTION PLAN & SECTION VIEWS (ESS REQMTS)
CONVAIR DIVISION OF GENERAL DYNAMICS | 76E-1405

SD 71-140-7

FOLDOUT FRAME 1

FOLDOUT FRAME 2

7.0 APPENDIX A. ALTERNATE ESS/BOOSTER CONFIGURATION (EXTERNAL HYDROGEN TANK STUDY)

7.0 APPENDIX A. ALTERNATE ESS/BOOSTER CONFIGURATION (EXTERNAL HYDROGEN TANK STUDY)

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8.0 APPENDIX B. ALTERNATE ESS CONFIGURATION

8.0 APPENDIX B. ALTERNATE ESS CONFIGURATION

8.0 APPENDIX B. ALTERNATE ESS CONFIGURATION

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9.0 APPENDIX C. TRADE STUDY REFERENCE DRAWINGS

9.0 APPENDIX C. TRADE STUDY REFERENCE DRAWINGS

9.0 APPENDIX C. TRADE STUDY REFERENCE DRAWINGS

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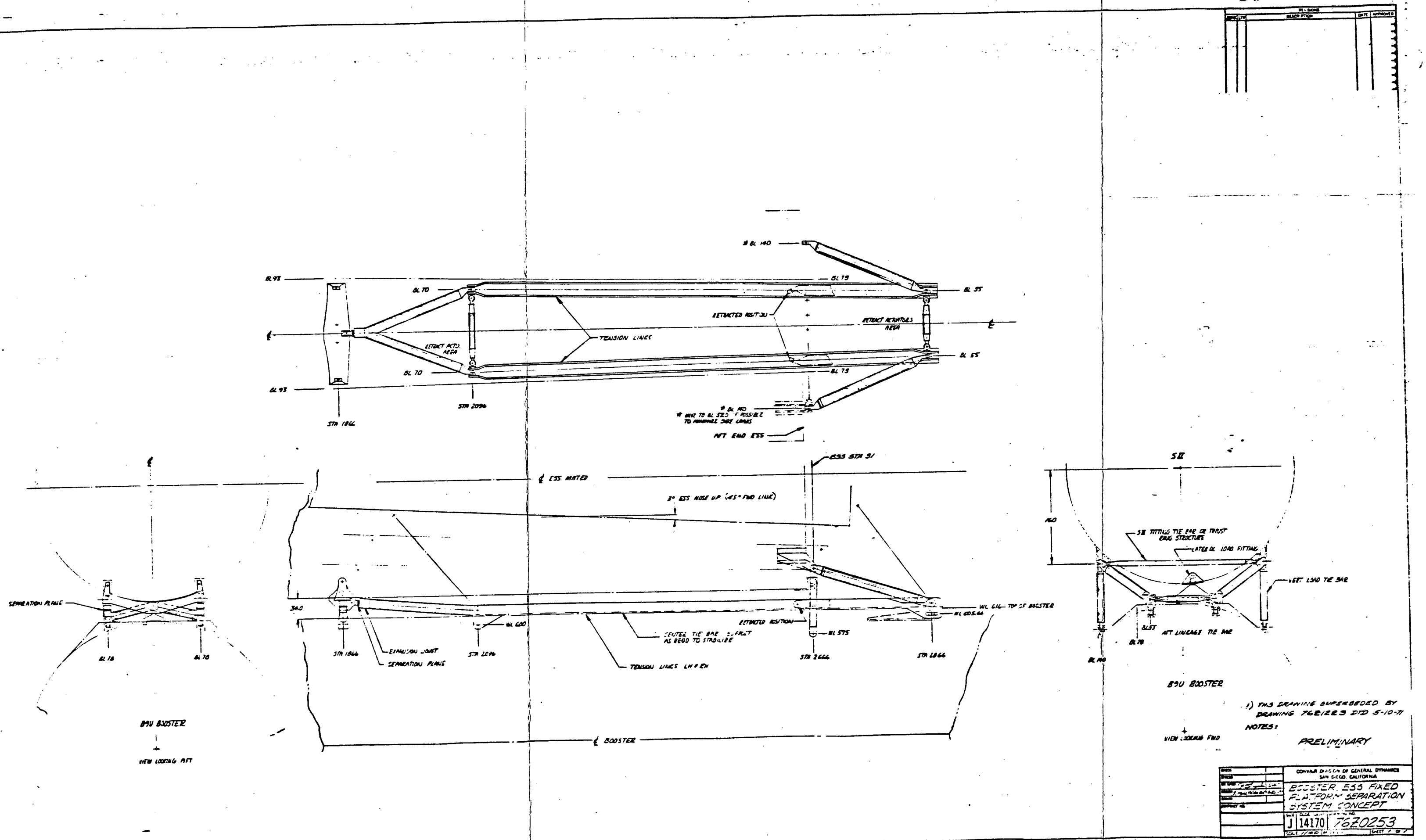

FOLDOUT FRAME 1

FOLDOUT FRAME 2

SD 71-140-7

FOLDOUT FRAME 3

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