The MSC design review team visited BxA Monday, 20 May, to review the design of the cask, the fuel capsule, and the integrated cask mount assembly, with particular emphasis being placed on safety.

Prepared By W. Durrant

Approved By M. Katz

The subjects presented by cognizant BxA engineers are noted in the following Meeting Agenda:

- Introduction

  W. Durrant

- Review analyses and tests pertaining to potential vacuum welding problems.

  W. Durrant

- Review of integrated cask testing performed on prototype hardware.

  L. Wagman & J. McNaughton

- Verification of on-pad installation and removal techniques for the cask capsule and associated G. E. furnished hardware.

  C. Ahlstrom

- Review of integrated structural/thermal cask qualification test plans, including cask, capsule and support structure.

  C. Ahlstrom

- Review of verification of crew compatibility with the integrated cask system. This review should include the functional and safety aspects.

  H. Grubbs

The minutes of the meeting are covered in the attached ALSEP 9712-864. These minutes document the subject material covered by each cognizant engineer, along with subsequent questions and answers.

Copies of the "viewgraphs" used to form the basis for presentation are also attached. The figure numbers corresponding to the Agenda subject are listed below:

Introduction	Figures 1 & 2
Analyses and test pertinent to potential vacuum welding problems	Figures 3 thru 7
Prototype hardware integrated cask testing	Figures 8 thru 57
Verification of on-pad installation and removal techniques	(Film)
Integrated structural/thermal cask qualification test plans	Figure 58
Verification of crew compatibility with integrated cask system	Figures 59 thru 63

Fuel Cask Mount
Design Review

Date of Meeting 5/20/68

ATTENDEES

Bendix	NASA/MSC
M. Katz	D. Medlock
L. Wagman	D. Greenshields
E. VanValkenburg	R. Miller
J. Maszatics	R. Ferguson
J. McNaughton	T. Kerr
C. Ahlstrom	D. Lind
H. Grubbs	T. Herrington
R. Redick	J. Grayson
K. Wright	
E. Rutz	
D. Dewhirst	
R. Hostettler	
W. Durrant	

1.0 The meeting was opened and a welcome given to our visitors by E. VanValkenburg.

2.0 W. Durrant reviewed the present mechanical design of the Cask Assembly and discussed in detail the analyses and test pertaining to possible vacuum welding phenomenon.

2.1 Question - Review of materials making up gearbox in particular the bearings.

Answer - All self aligning steel bearings. W. Durrant will check on specific material and respond to T. Herrington and J. Grayson.

2.2 Question - Temp and pressure at which gear box was tested?

Answer - $700^{o}F$ @ 10^{-7} torr

2.3 Question - Have we run lab tests on cold welding of titanium to steel?

Answer - No, our component level tests did not indicate a need for such tests.

2.4 Question - What prevents pin and lever of upper trunnion release from coming loose as occurred at MSC?

Answer - Model at MSC is not representative of final design.

2.5 Question - What materials make up trunnion release pin? Interior Rod?

Answer - Rod should be microsealed. The balls are definitely microsealed.

2.6 Question - On-pad temp. of release pin?

Answer - 250 to 270°F.

2.7 Explanation given of new dome removal mechanism.

2.8 Question - Material from which springs are fabricated?

Answer - Inconel X

2.9 Question - Can direction of pin in dome release mechanism be changed to allow release of nut in one direction and dome removal in opposite direction.

Answer - Have new release in house and will demonstrate it.

2.10 Question - What are effects of radiation on cold welding?

Answer - Are not aware of any but BxA tests have not been made.

3.0 Vibration Test Program

Test item w/electric capsule subjected to sine sweep 1g magnitude

1. at 280°F
2. at 600°F.

Details of accelerometers - see handout.

Details of strain gages - see handout

2 element rosette type - temp compensated.

Band location of strain gages - see handout.

Slides of test shown
High temp accelerometers used - o.k. up to 700°F.
Film of Vibration run - full level.

<u>Discussion of Data From Tests</u>

See Handout Pictures.

Launch & Boost Sine

Max Transmissibility	Y-Axis	7.6 max
Max Transmissibility	Z-Axis	1.6 max
Max Transmissibility	X-Axis	3.8 max

Launch & Boost Random: Z-Axis input
Launch & Boost Random: Cross Axis (Y/Z)

Fuel Cask sine input
Cask & Support Random - X response
Cask & Support Random - Y response
Cask & Support Random - Z response

Sine response X input/output
Sine response Y input/output
Sine response Z input/output

1g sweep launch & boost (X axis) 280°F
" " 600°F

Discussion Grayson/Maszatics on differences in transmissibilities predicted and those actually experienced in test. System is non-linear and transmiss. therefore varies with input level.

J. Grayson asked if information from test has been included in rewritten ICS - answer is not yet.

4.0 J. McNaughton - Discussion of On-pad cooling and Thermal/Vacuum Testing.

Question - Dimensions and Δ P of nozzle.

Answer - The design of the Qual cask cooling nozzle has been completed and copies transmitted to MSFC. The nozzle has a 5 inch diameter inlet, a 2 1/4 inch dia. exit and an overall length of 8 inches. The predicted performance of the nozzle is shown in the enclosed viewgraph for nozzle inlet pressure versus I. U. tapoff flowrate. The data is derived from the engineering tests conducted at MSFC combined with the results from the BxA Prototype cask cooling test program.

The preliminary interface layout for the Bendix/MSC/MSFC cask cooling configuration is described in the viewgraphs. The interface locates the exit plane of the nozzle 2 ft below the cask. For this configuration,nozzle pressures are predicted to range from 0.3 to 0.6 psig with corresponding nozzle flow rates from 15 to 30 lb/min. Maximum cask surface temperatures for these conditions with a 130°F SIVB I. U. inlet temperature range from 230°F to 275°F.

5.0 C. Ahlstrom - On-pad Operations

Film shown on installation of cask assembly on LM.

6.0 C. Ahlstrom - Cask Qual Test

1. Distributed TM-157, Exhibit B - Qual Test Plan and described Qual Plan

2. QTRR will be after Acceptance according to Ahlstrom. Grayson stated that the rest of the ALSEP Program has been run such that the QTRR precedes acceptance. Timing of QTRR will be resolved by BxA - L. Wagman.

3. Qual Test start on 6/14/68 with D-2 Qual on 6/17/68.

Question - When will ICS be completed?

Answer - Will be completed before Qual according to M. Katz. At Grayson's request a date on which spec will be completed for NASA review. Date given by M. Katz is 31 May 1968. The ICD and ICS will be mailed on this date.

4. Concern was expressed over fact that T/V Test does not cover entire mission time. Time allocated according to McNaughton is for nominal mission and was dictated by economics.

5. Question raised on use of live capsules throughout Qual Program. Answer was that the capsule, cask, and BxA cask assembly will all be qualified. Qual is a system level test with no upper dome modification allowable on Qual or Flight hardware.

6. Data was requested on band strain. Copies of the ATM by Dr. D. Dewhirst on this subject will be obtained by C. Ahlstrom.

7.0 H. Grubbs - Mission & Crew Safety Features of Cask

1. Discussion of cask safety features.

2. Film on ALSEP unloading and cask unloading w/RTG fueling.

3. Protective device will withstand at least 30 lbs.

4. Question, D. Lind - Storage provisions for lanyard?

Answer - 2 strips of Velcro tape.

5. BxA will deliver the 2 GFE casks as a part of the E-2 model. Hardware will be representative of the Qual/Ft design and delivered approximately 24 July 1968.

8.0 General

1. The following drawings were transmitted to J. Grayson of NASA/MSC. 2337960, 2338140, 2338141, 2338142, 2338143, 2338218, 2338219, 2338220, 2338221, 2338348, 2338375, 2338138, 2337980, 2337979, 2337981, 2337982, 2337983, 2337984, 2337985, BSX 7658 (Preliminary), Lanyard Hook (Preliminary), Astronaut Guard/Gearbox (Preliminary), and Center Plunger Dome (Preliminary). These drawings relate to the redesign of the cap removal lock and the one-piece lanyard.

2. Differences between Proto and Qual:

   (a) Change in dome release to center plunger.

   (b) Gear box swivel change.

   (c) Adjustment on axial band.

   (d) 1 piece lanyard.

   (e) Increase in axial band thickness, from .017 to .030.

   (f) Cut-off thermal shield - analysis indicates that input to LM is within spec.

   (g) Addition of astronaut guard.

   (h) Increase in surface area of trunnion pads.

3. Question on T/C instrumentation of LM skin. New Grumman blankets were used on Proto T/V. How representative is this blanket? LM Panel is <u>now</u> made of 4 mil? Inconel. Behind this is aluminized Kapton and Mylar.

4. T/C on rear face of shield is not included in final design. Will be mounted upon final approval. According to Grayson T/C is still shown on BxA/GAEC ICD.

Grayson asked for look at ICD location of T/C. Interface problem should be resolved by MSC. Signal conditioning components for this T/C have already been included in the LM.

T/C instrumentation on LM Panel was bonded to Inconel foil and used for steady state conditions only.

Approved by: (original signed by)
T. Herrington, MSC

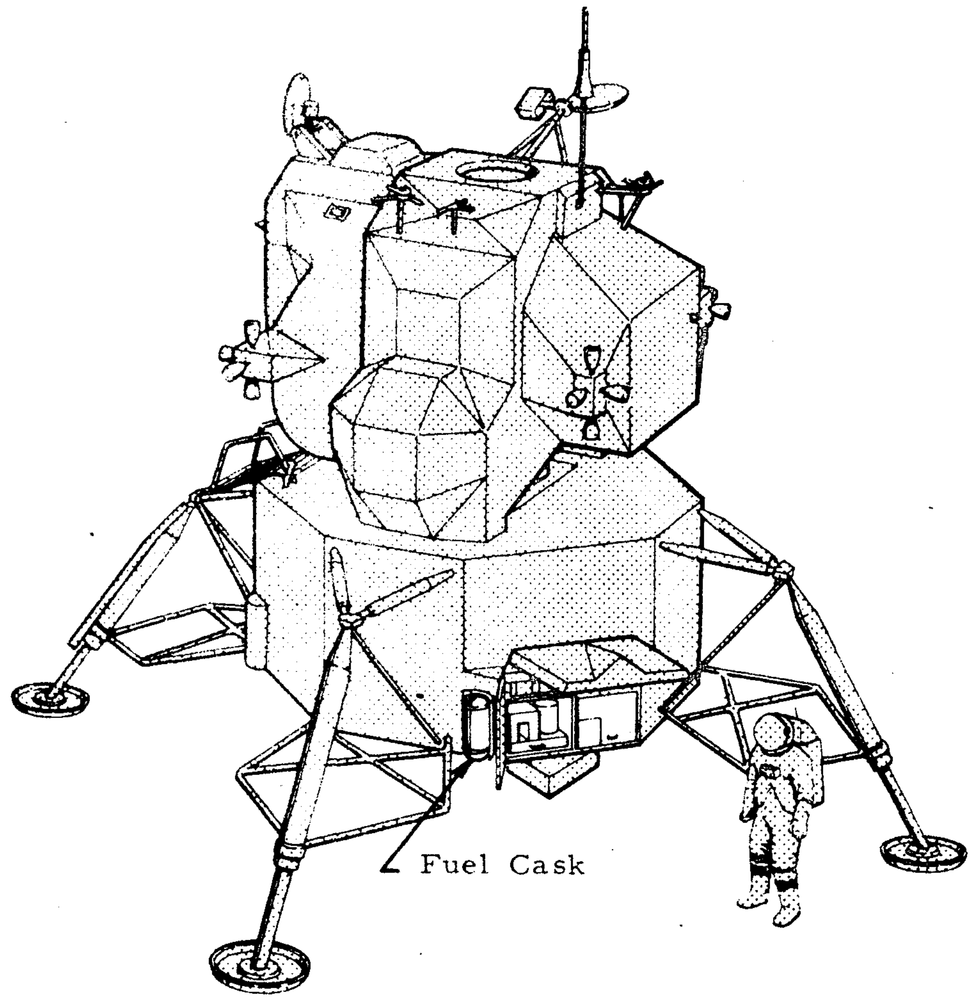
Recorded by: L. Wagman
L. Wagman, BxA

Approved by: ______________________
M. Katz, BxA

Distribution
All Attendees
R. Long
C. Weatherred

Figure 1

INSTALLATION IN LUNAR MODULE



OCT 67 5178.2.2

Figure 2

FUEL CASK SUPPORT ASSEMBLY

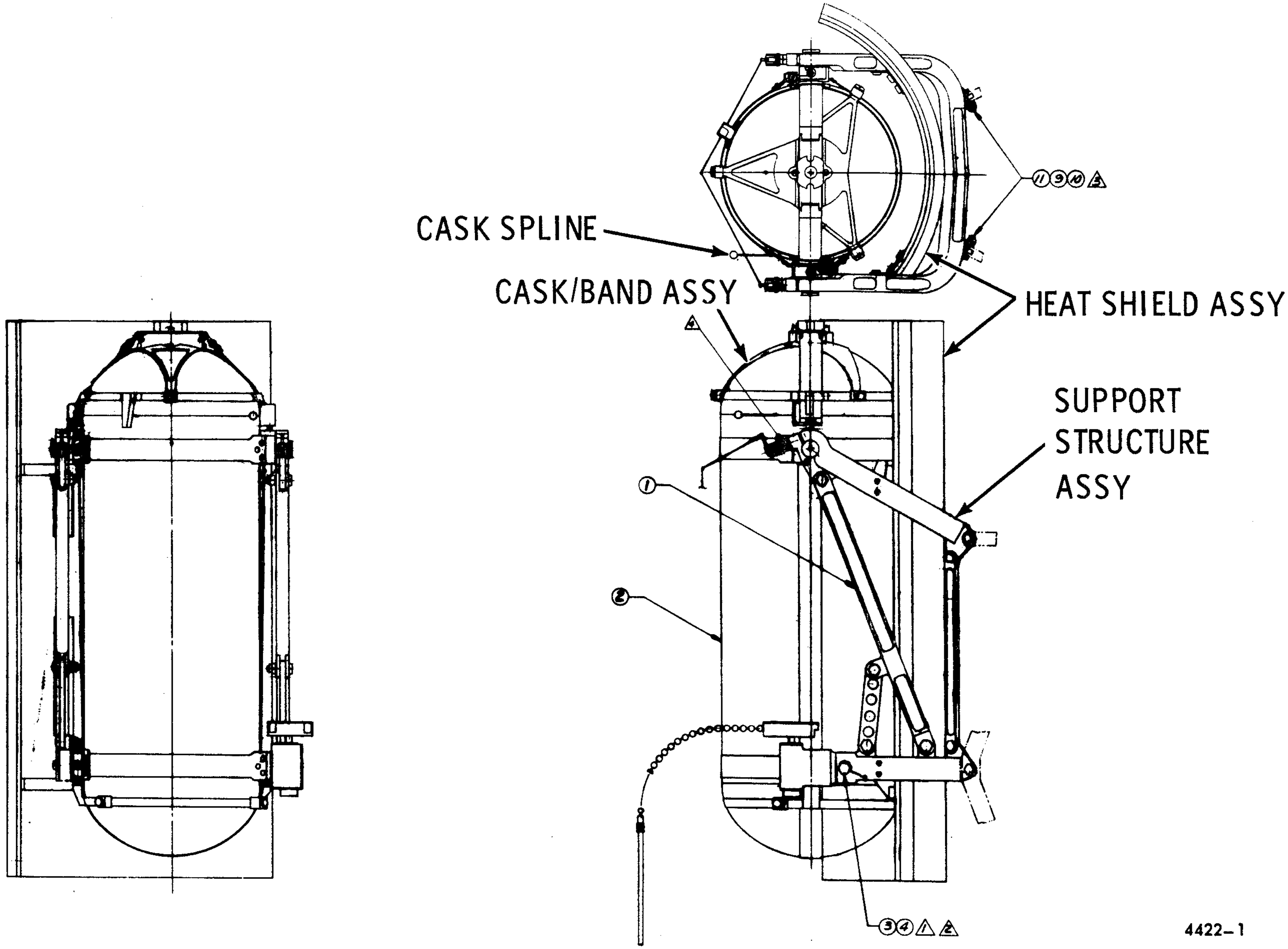
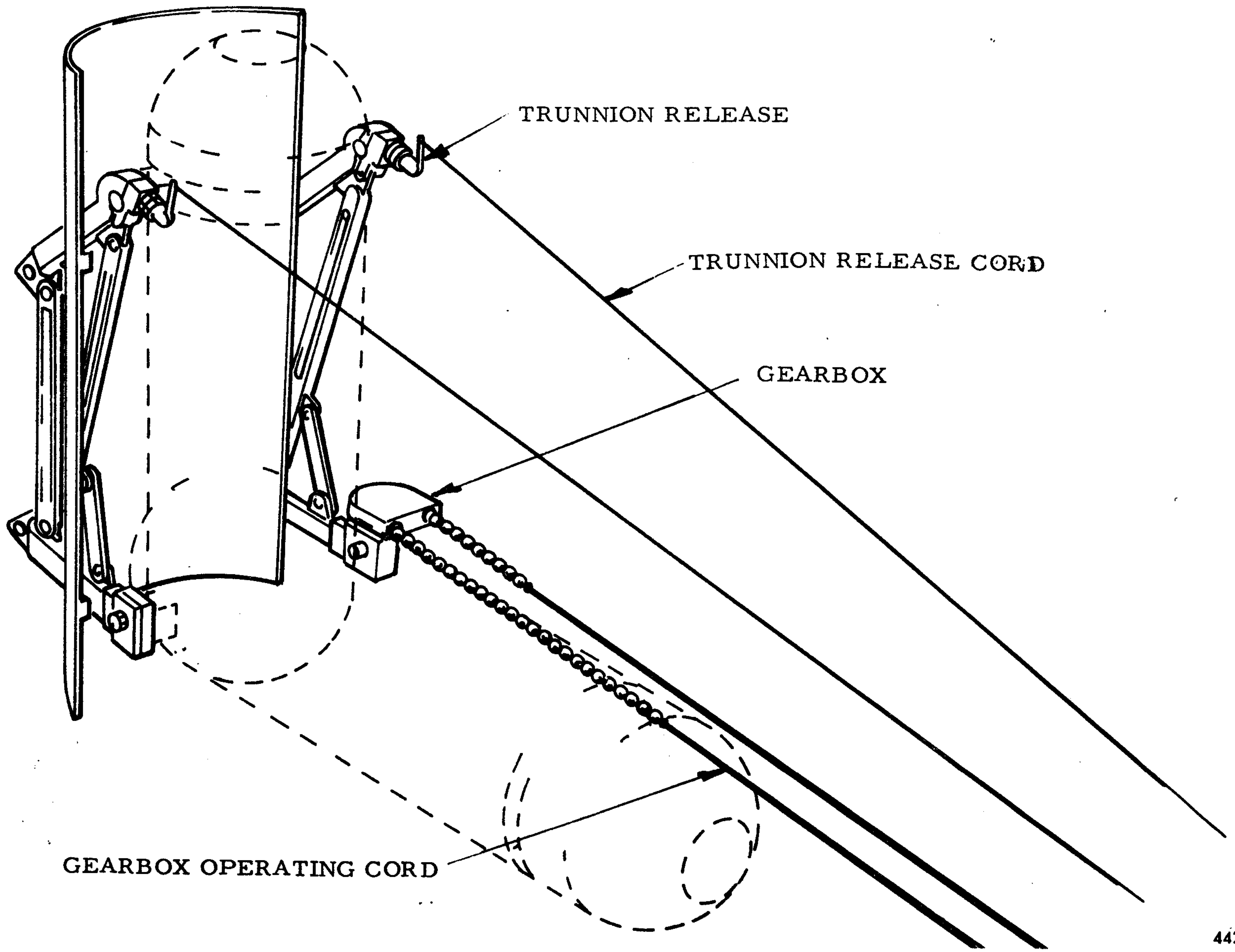


Figure 3

CASK ROTATION DETAILS



4422-4

Figure 4

TILT GEARBOX ASSEMBLY

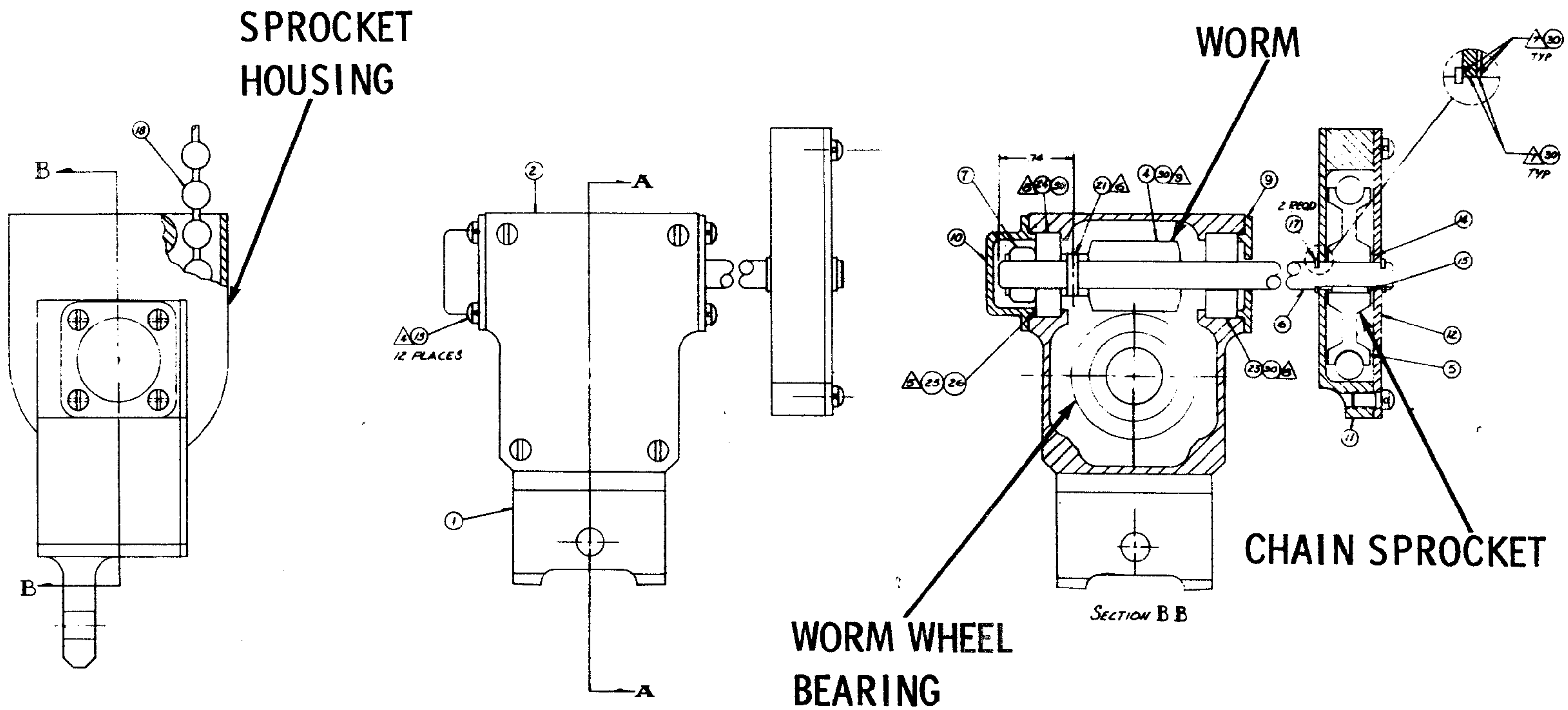
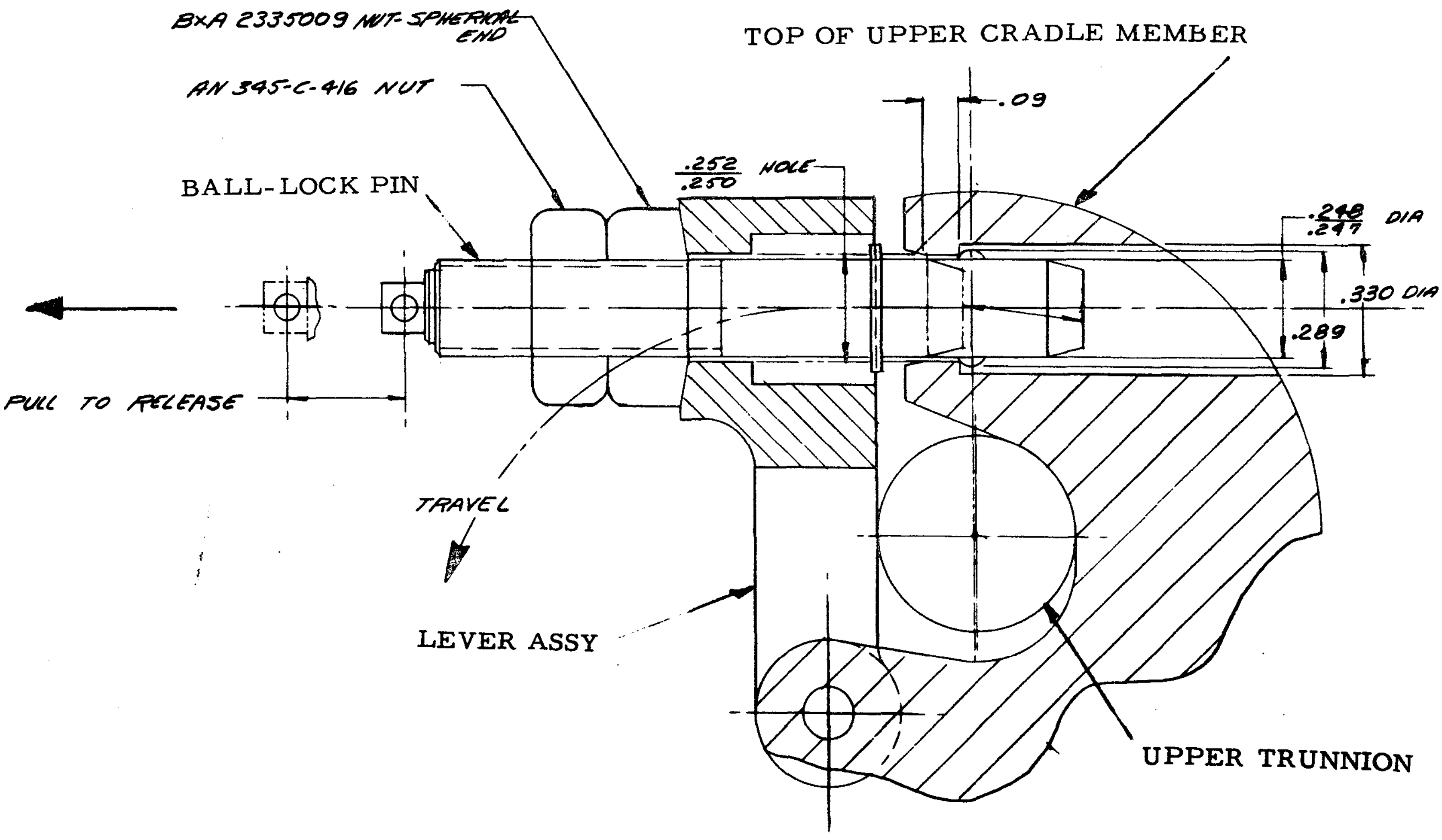


Figure 5

UPPERTRUNNION RELEASE MECHANISM



4422–5

Figure 6

DOME RELEASE DETAILS

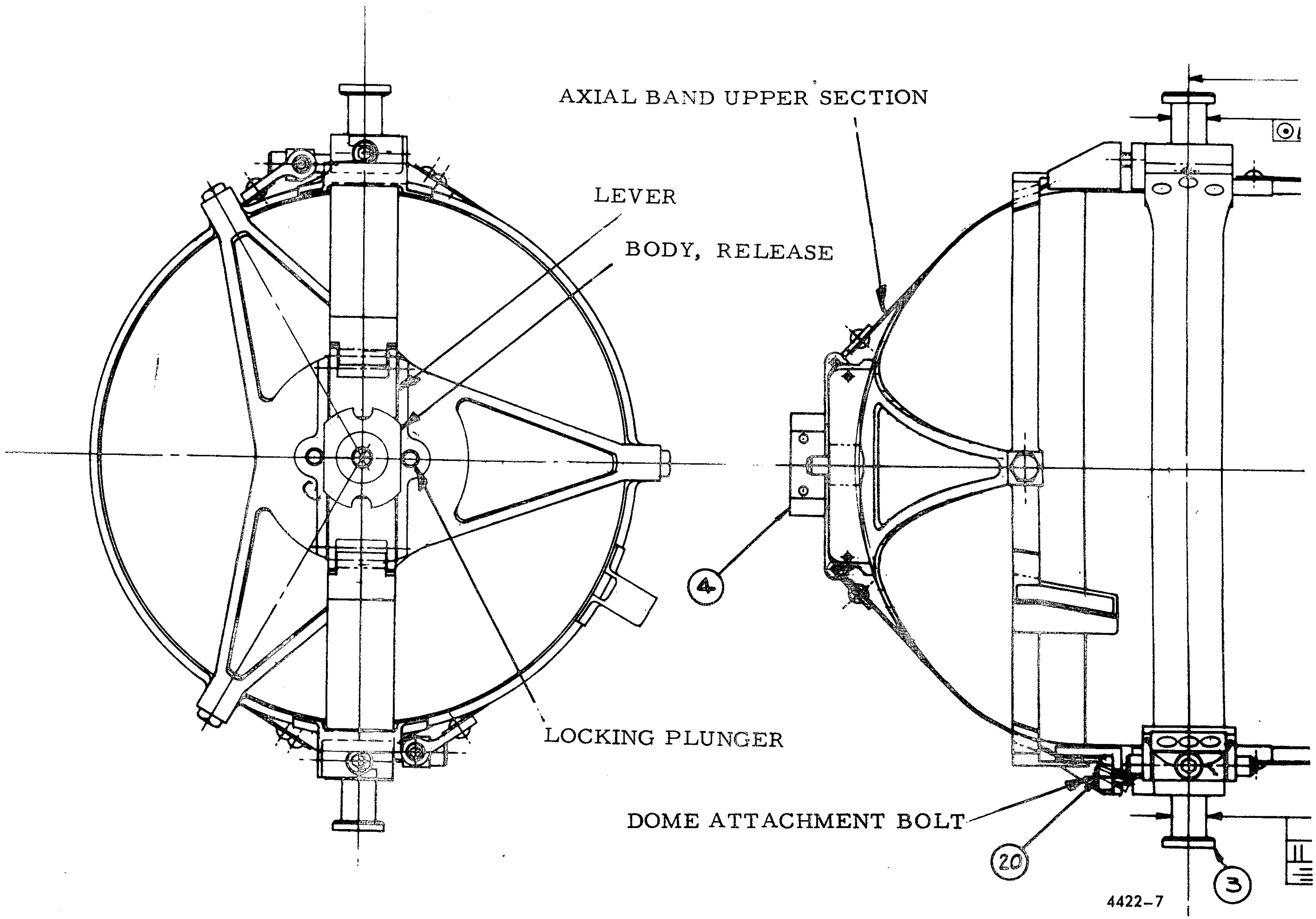


Figure 7

DOME REMOVAL TOOL

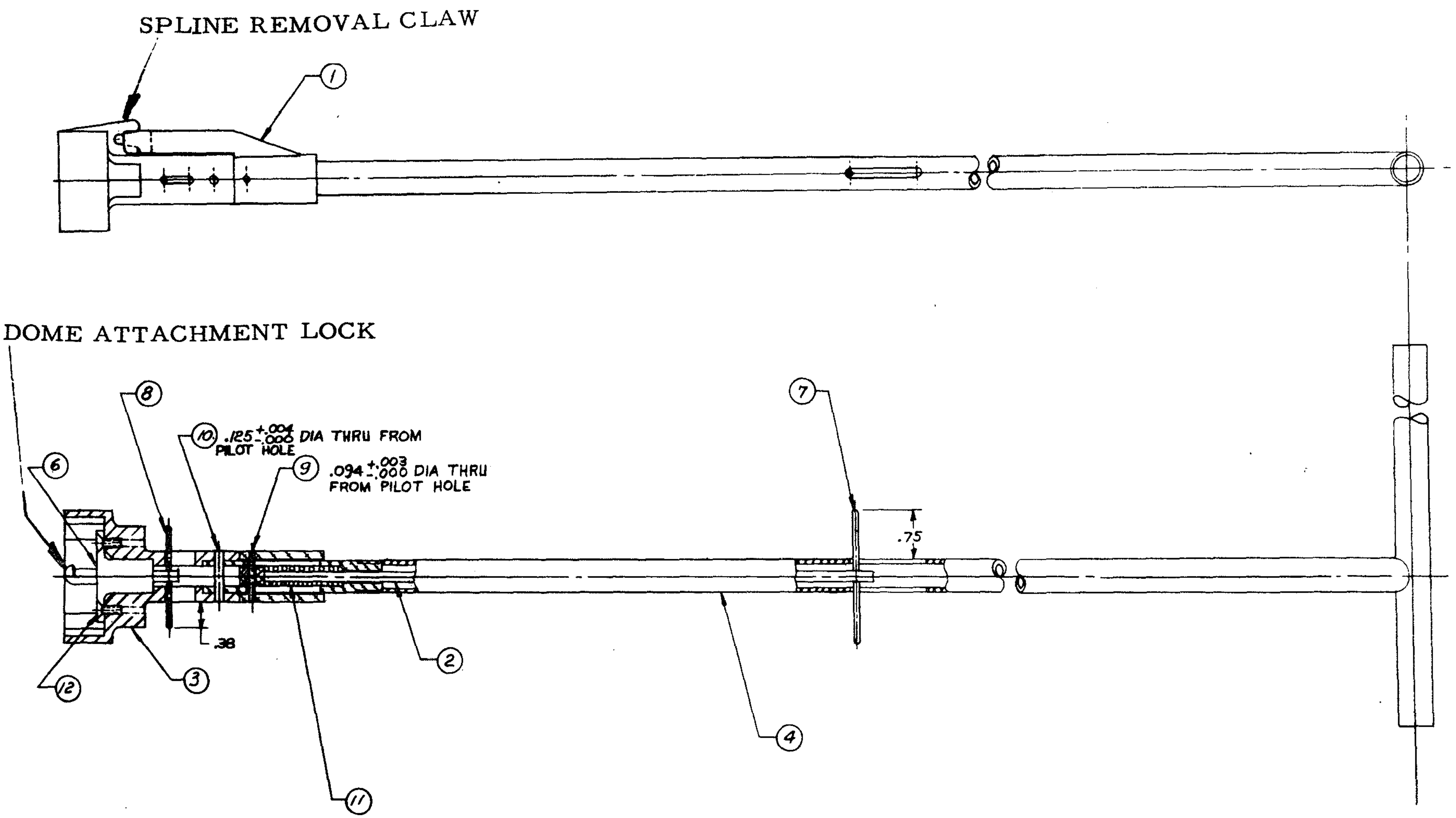


Figure 8

PROTOTYPE FUEL CASK VIBRATION TEST

1 g SINUSOIDAL SURVEY – 280° F (LAUNCH AND BOOST)

– 600° F (LUNAR DESCENT)

3 g SINUSOIDAL – 280° F (LAUNCH AND BOOST)

FULL LEVEL RANDOM – 280° F (LAUNCH AND BOOST)

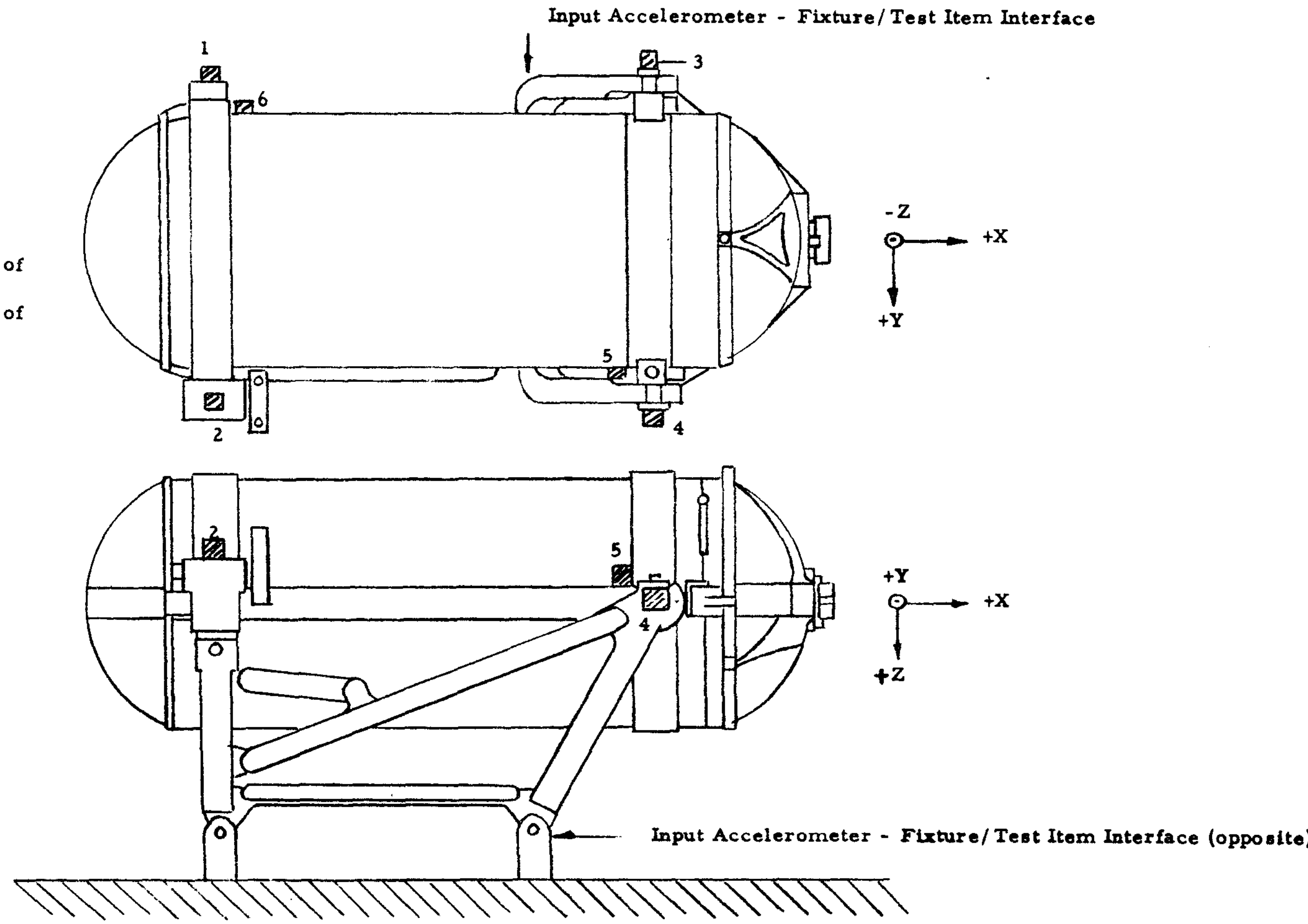
5607–1

Figure 9

ACCELEROMETER LOCATIONS

1 Response Accelerometer in direction of vibration
4 Response Accelerometer in direction of vibration
5 Triaxial Response Accelerometer
6 Triaxial Response Accelerometer

NOTE: Location 2 and 3 will be used if the accelerometer blocks at locations 5 and 6 come off during vibration.



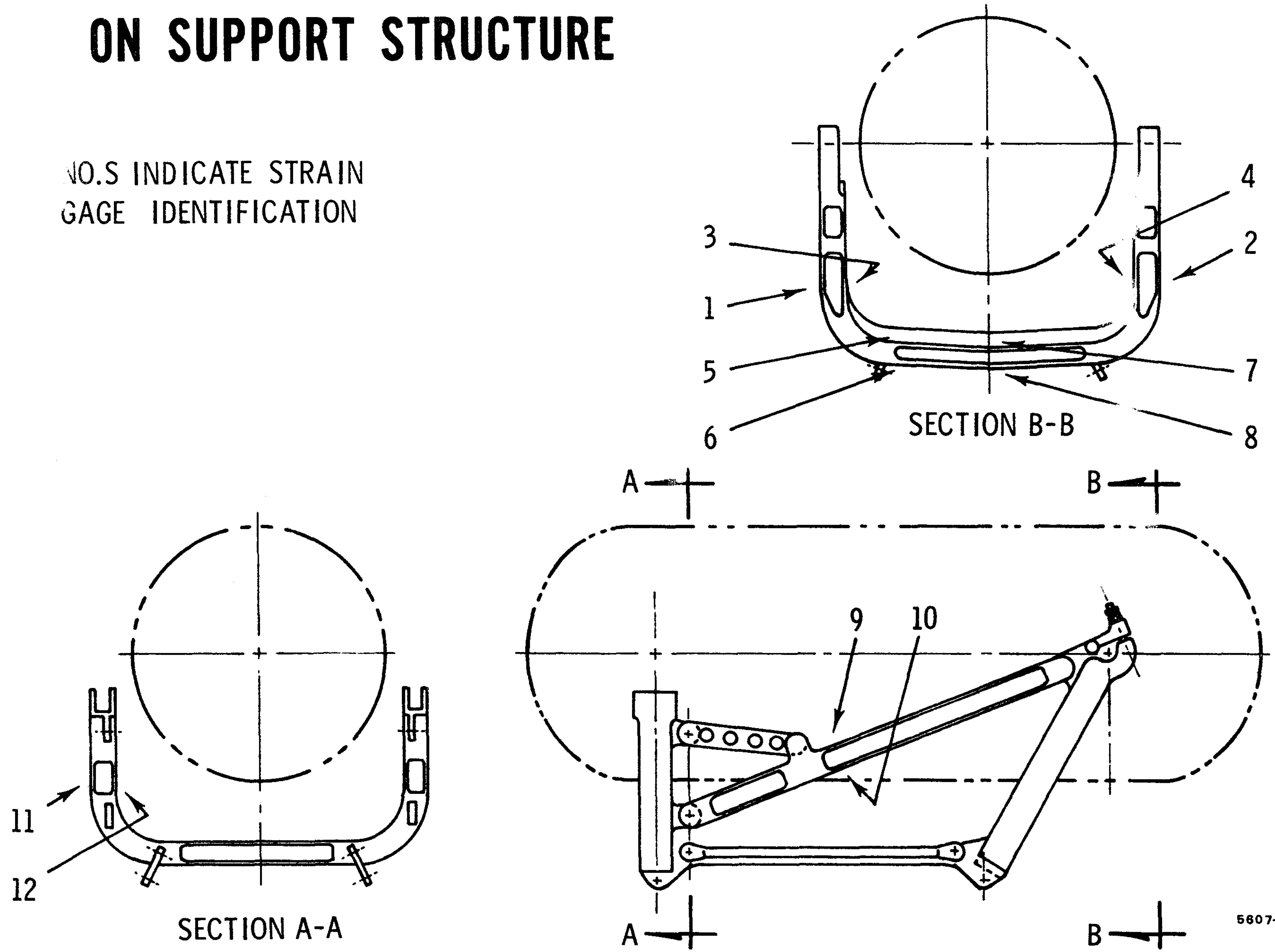
VIBRATION TEST SETUP

5607—21

Figure 10

STRAIN GAGE LOCATIONS ON SUPPORT STRUCTURE

NO.S INDICATE STRAIN GAGE IDENTIFICATION



5607-23

Figure 11

STRAIN GAGE LOCATIONS ON BAND ASSEMBLY

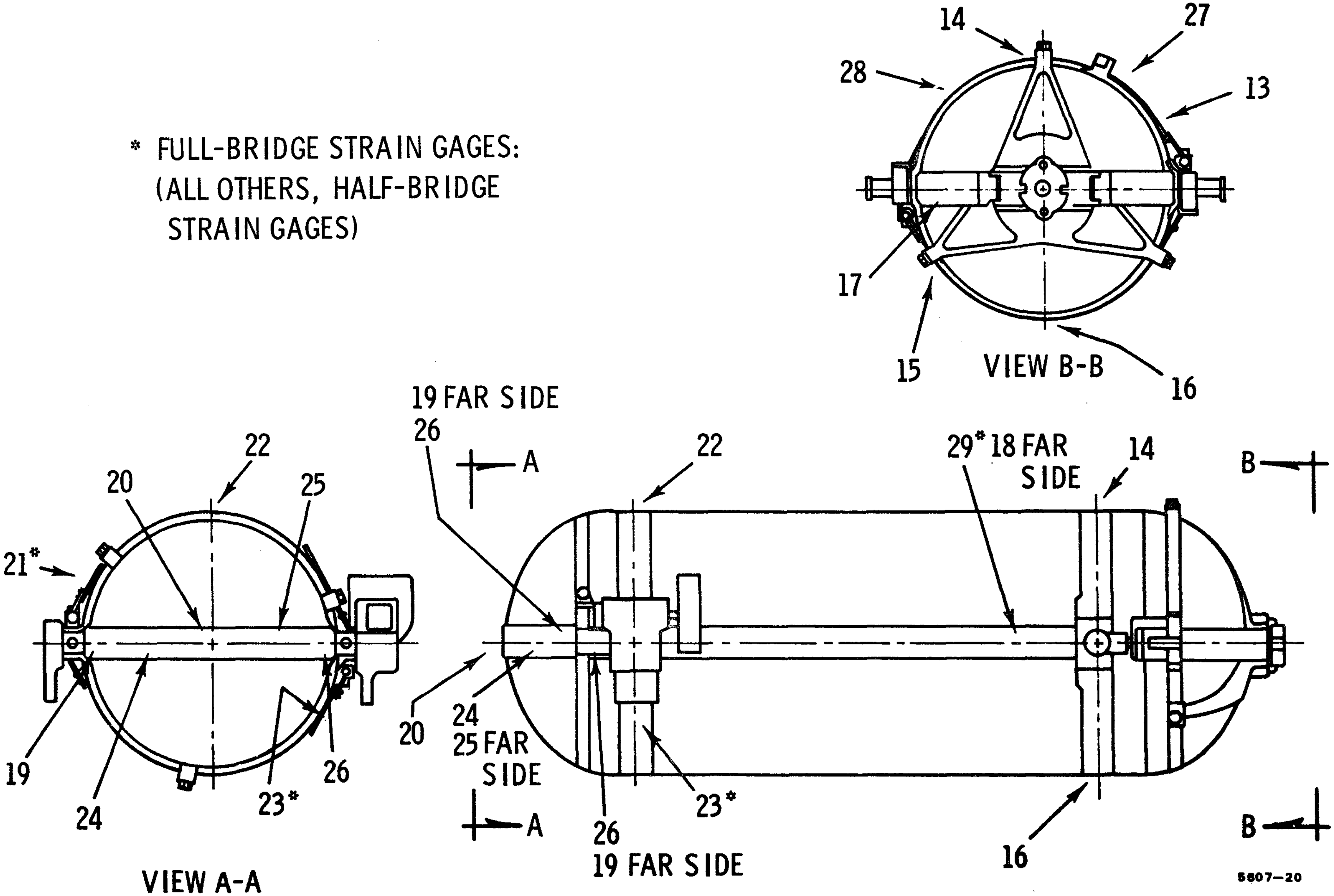
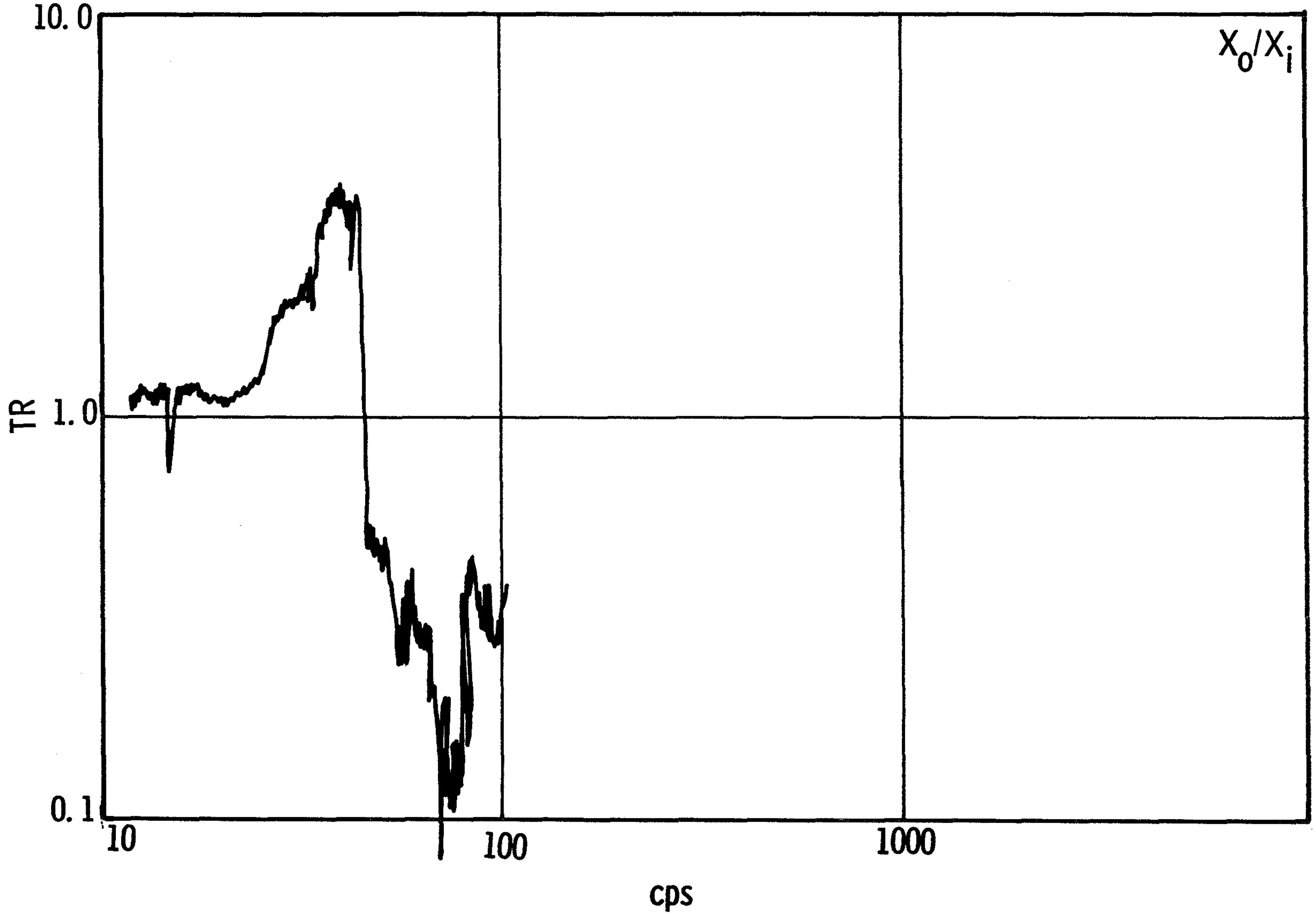


Figure 12

LAUNCH AND BOOST SINE MAXIMUM TRANSMISSIBILITY - X AXIS

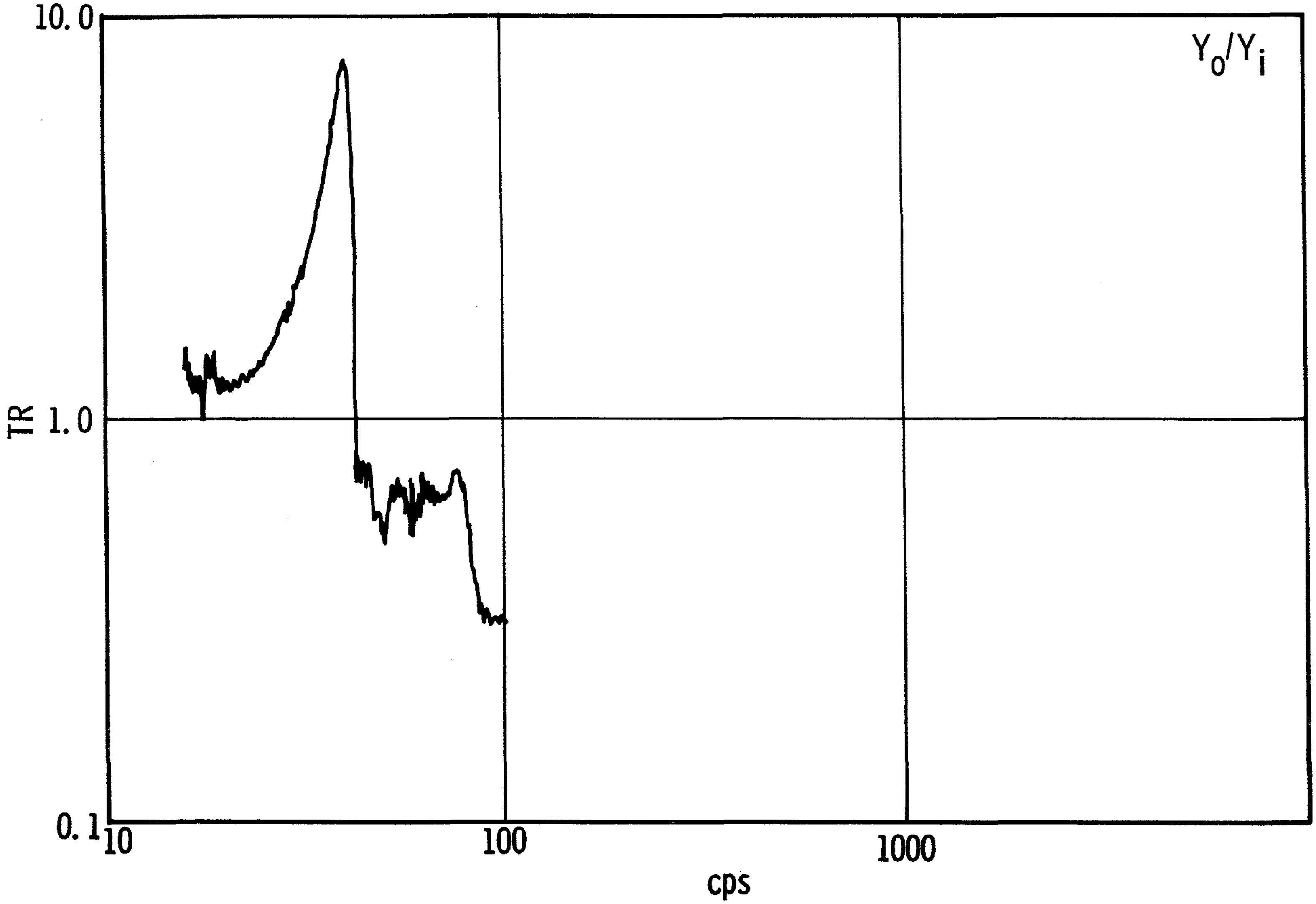


5607-13

Figure 13

MAXIMUM TRANSMISSIBILITY - Y AXIS

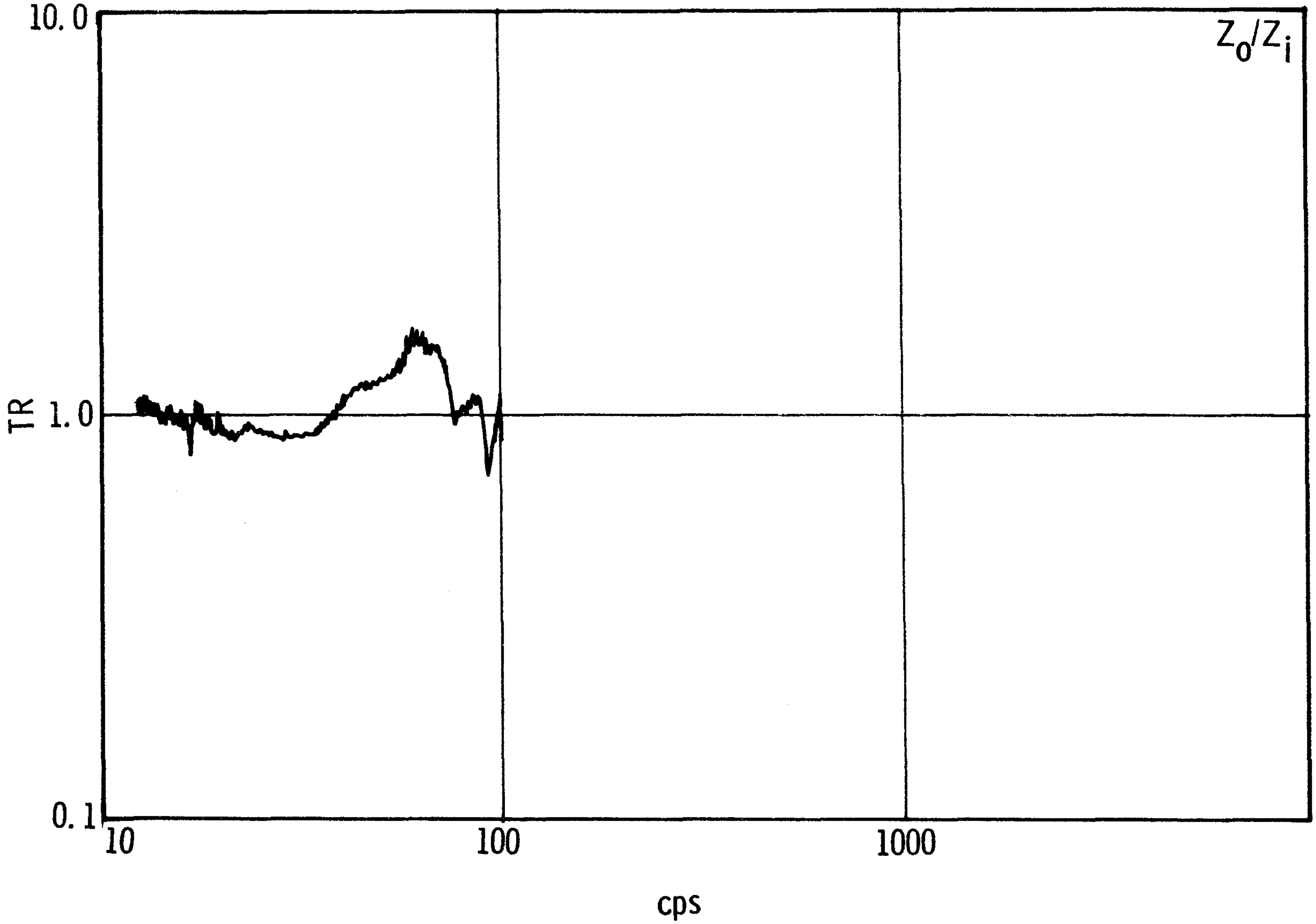
LAUNCH AND BOOST SINE



5607-14

Figure 14

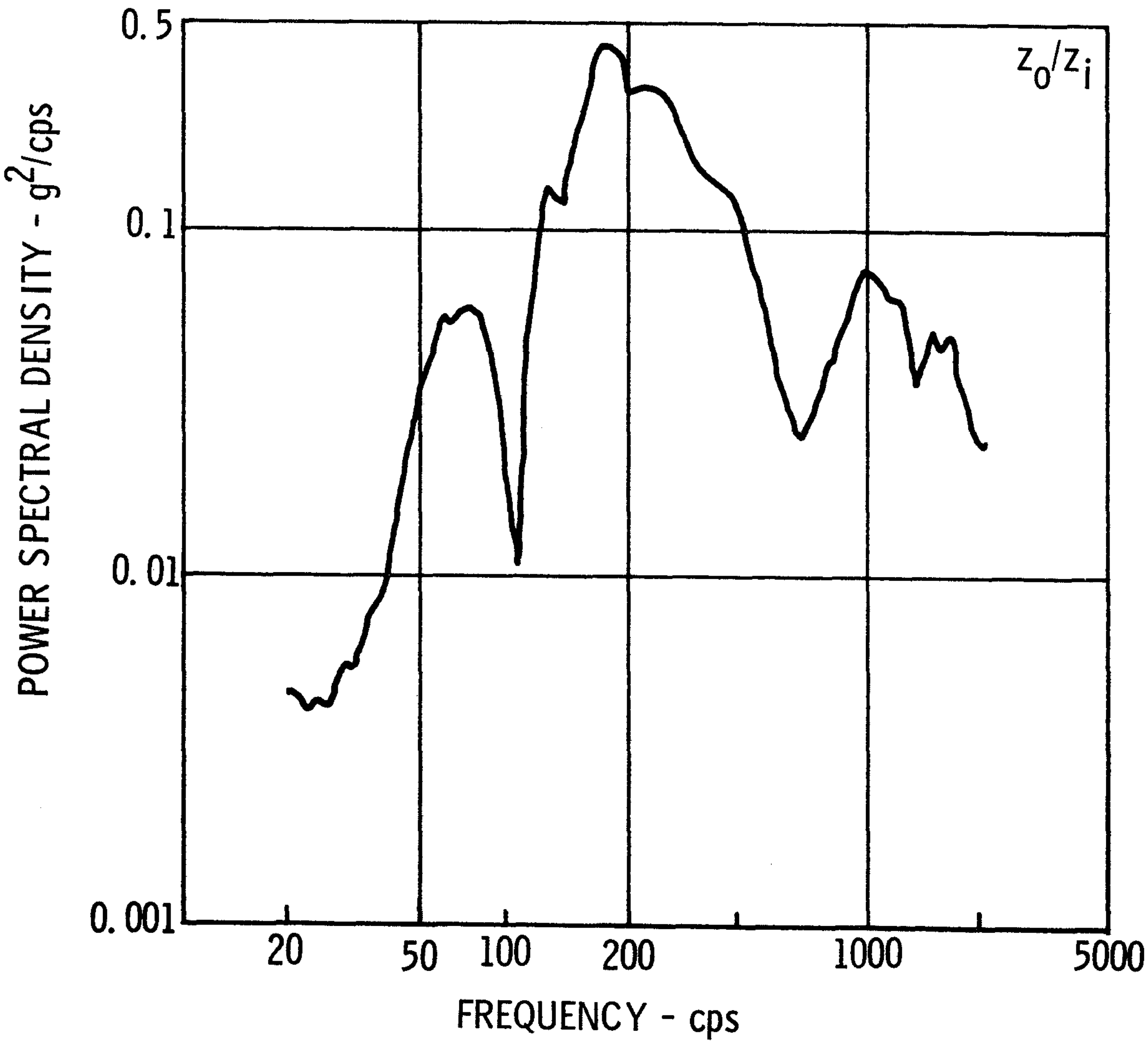
LAUNCH AND BOOST SINE
MAXIMUM TRANSMISSIBILITY - Z AXIS



5607-15

Figure 15

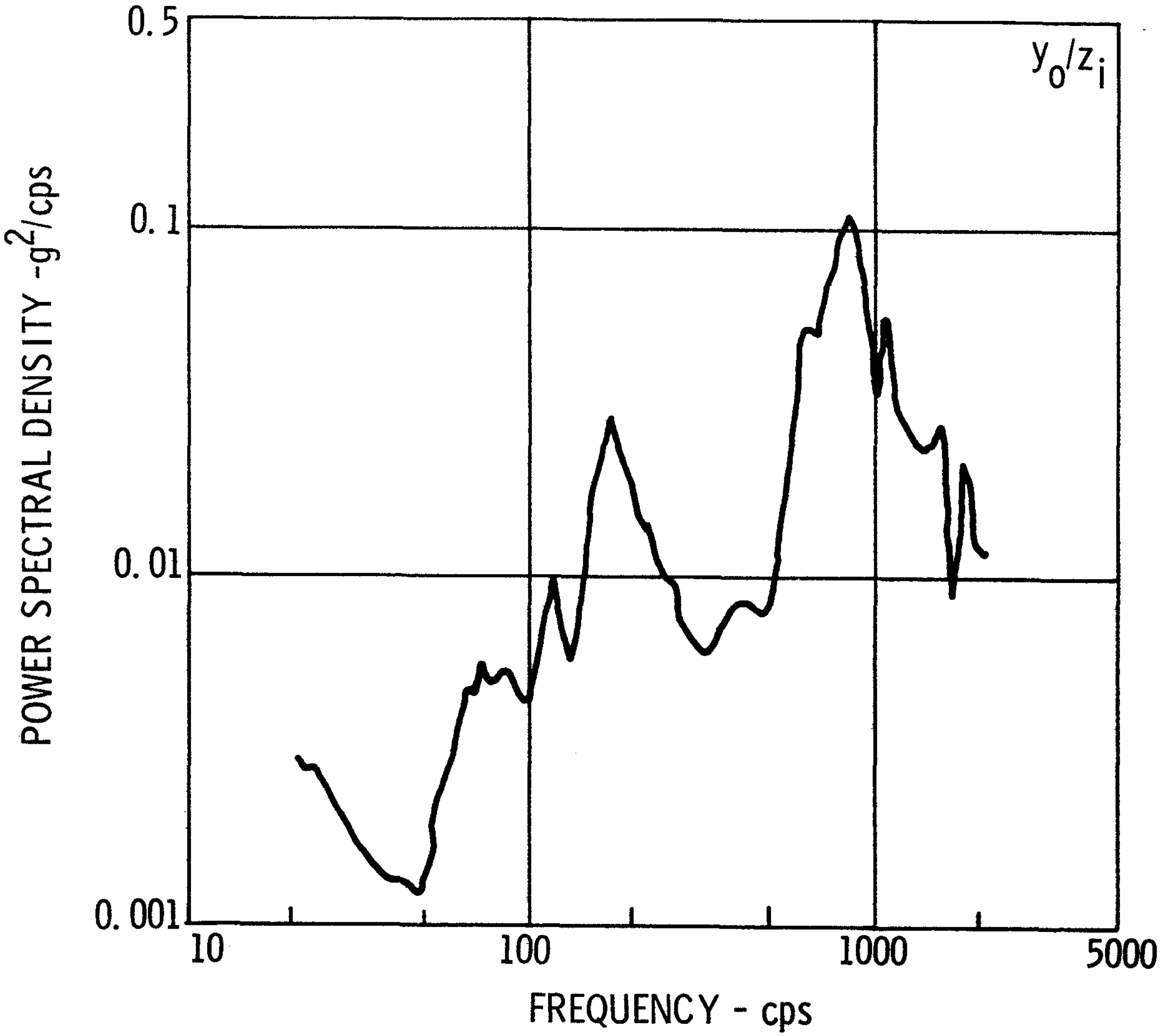
LAUNCH AND BOOST RANDOM VIBRATION SPECTRUM-Z AXIS INPUT



5607-7

Figure 16

LAUNCH AND BOOST RANDOM VIBRATION SPECTRUM-CROSS AXIS RESPONSE



5607-6

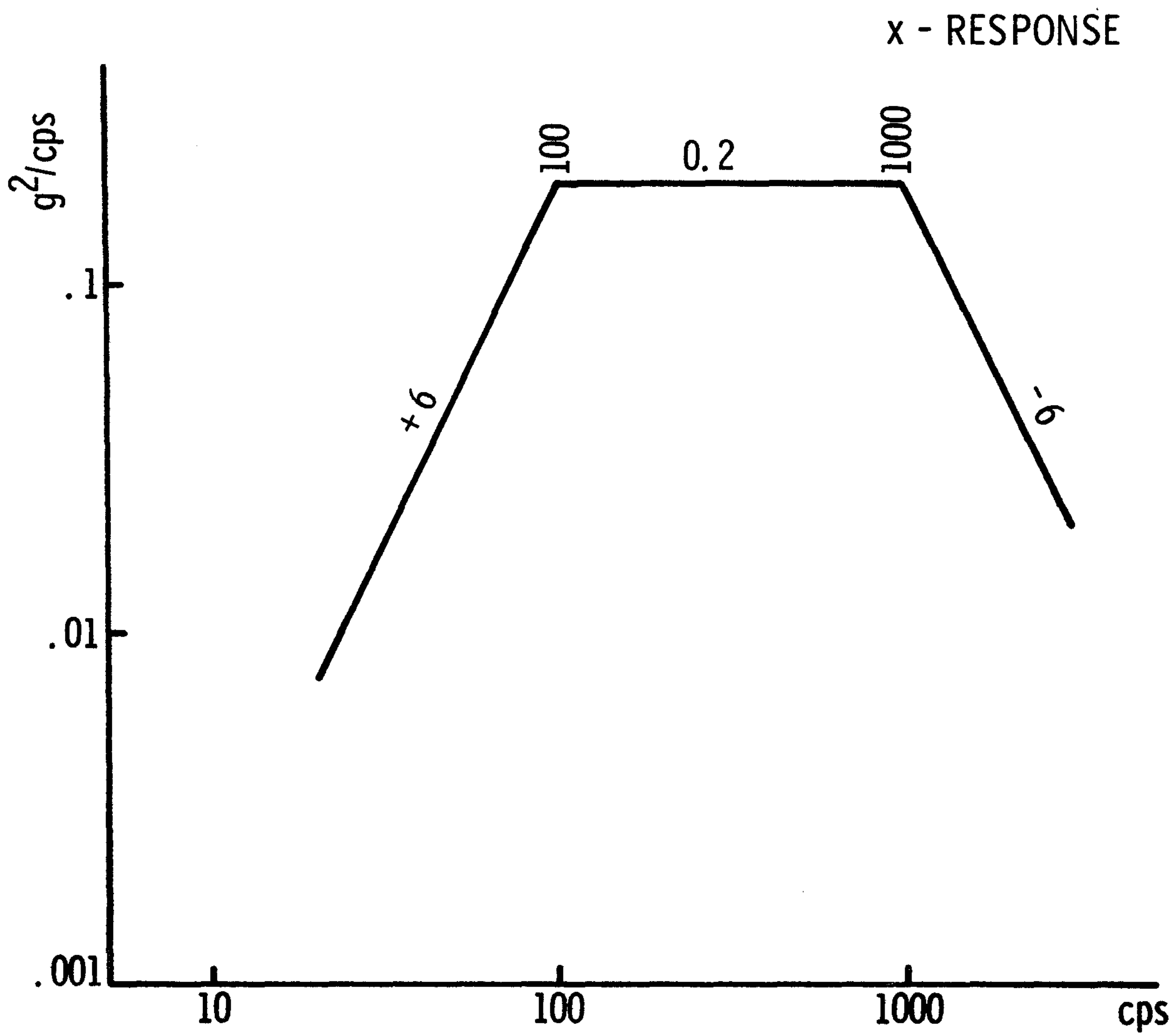
Figure 17

FUEL CASK SINUSOIDAL LAUNCH AND BOOST INPUT SPECIFICATION

x-axis :	5-23 cps	0.5 in. d.a.
	23-100 cps	13 g - peak
y-axis :	5-30 cps	0.5 in. d.a.
	30-100 cps	23 g - peak
z-axis :	5-18 cps	0.3 in. d.a.
	18-100 cps	5.0 g - peak

Figure 18

CASK AND SUPPORT LAUNCH AND BOOST

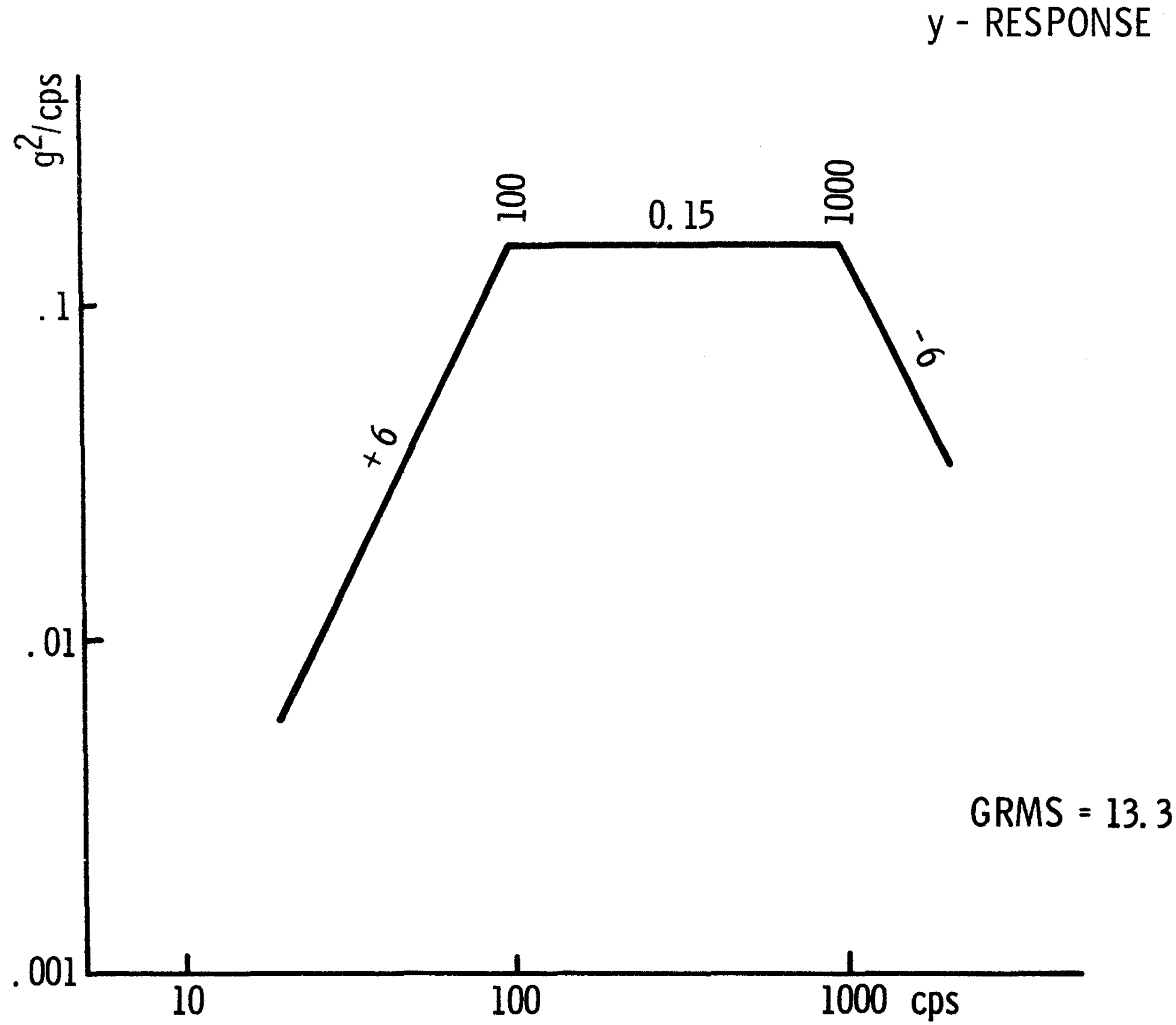


FROM MIL-STD-810 : GRMS = 16.9

5607-17

Figure 19

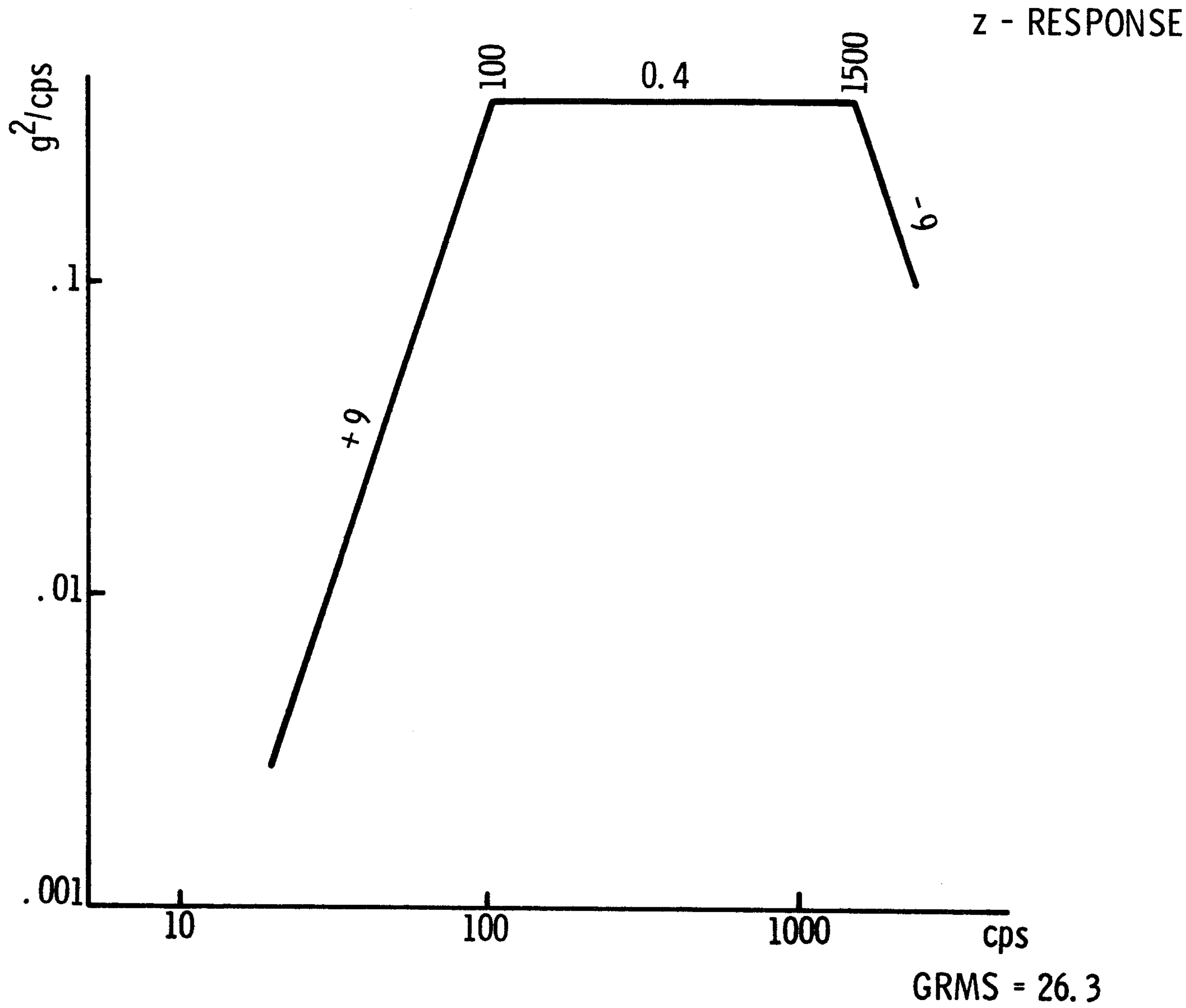
CASK AND SUPPORT LAUNCH AND BOOST



5607-18

Figure 20

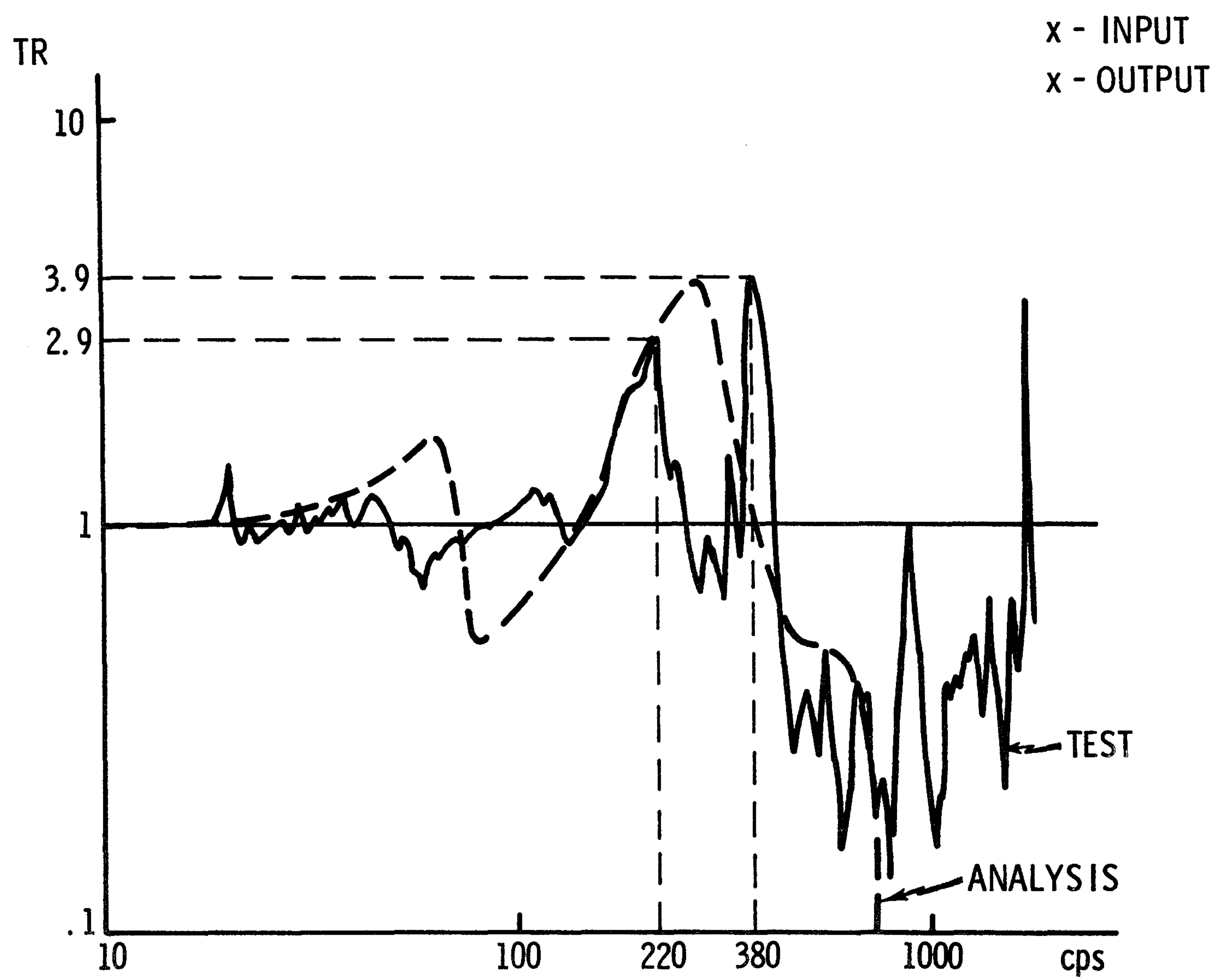
CASK AND SUPPORT LAUNCH AND BOOST



5607—19

Figure 21

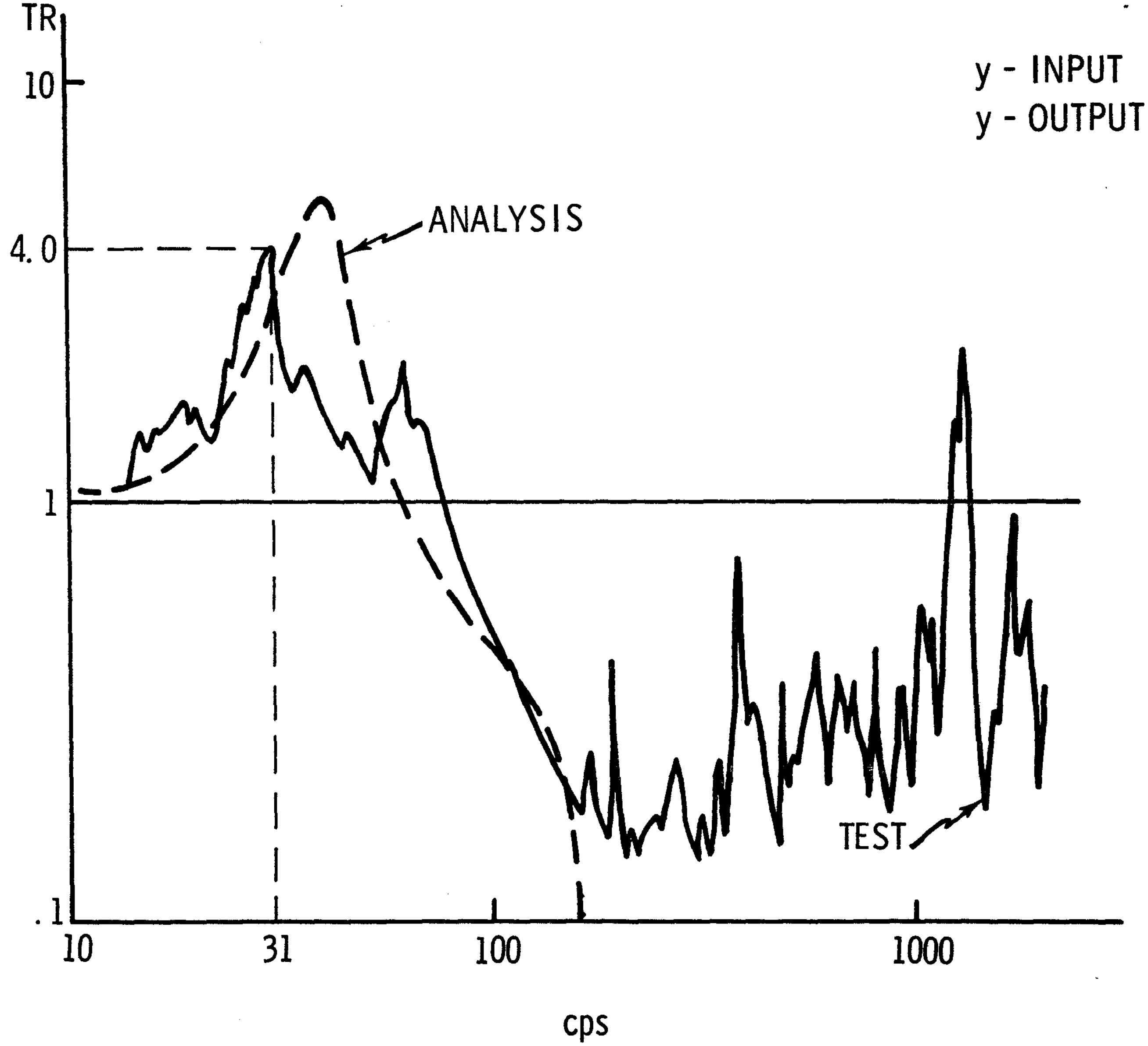
ANALYSIS VS. TEST DATA



5607-3

Figure 22

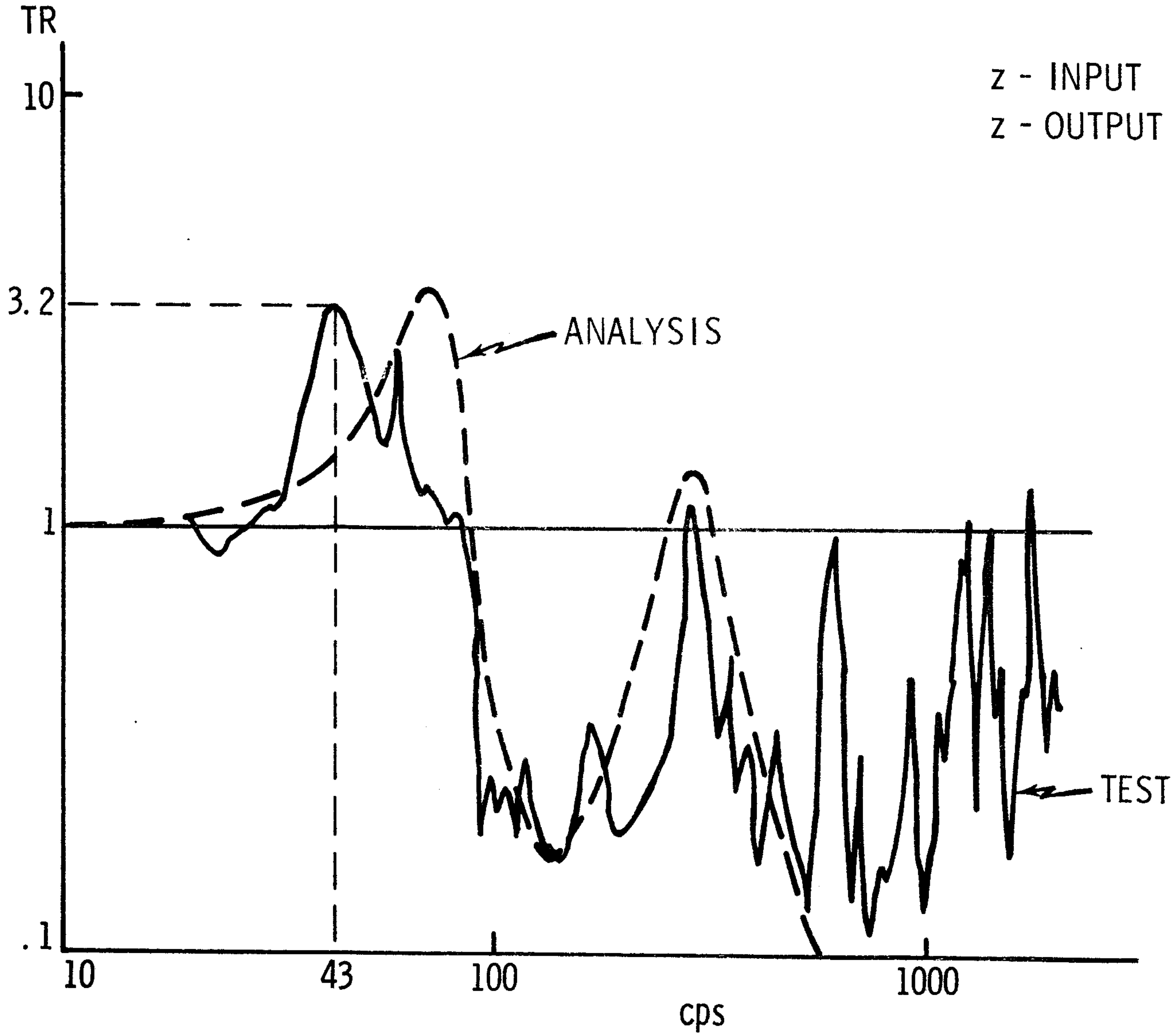
ANALYSIS VS. TEST DATA



5607-4

Figure 23

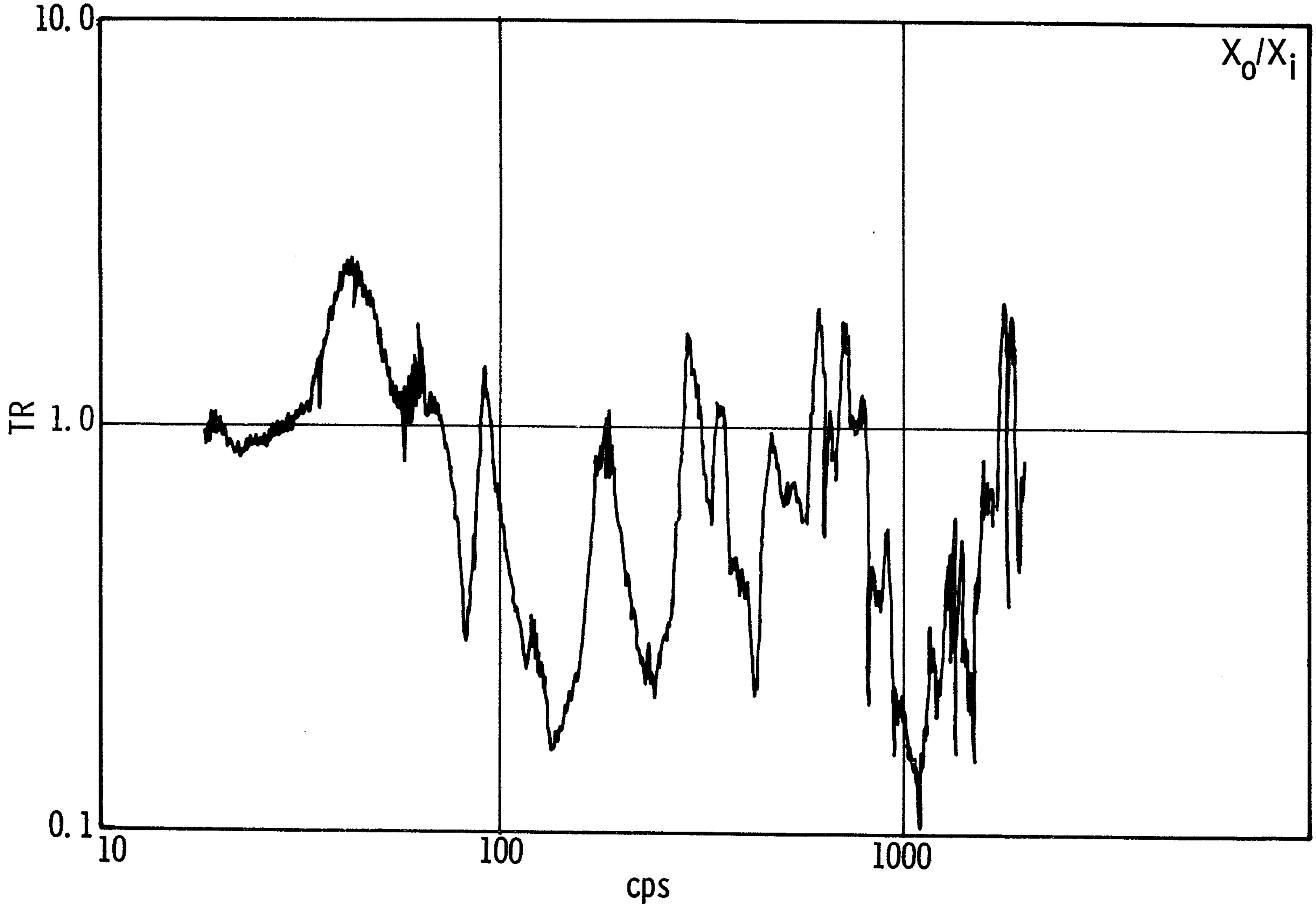
ANALYSIS VS. TEST DATA



5607-5

Figure 24

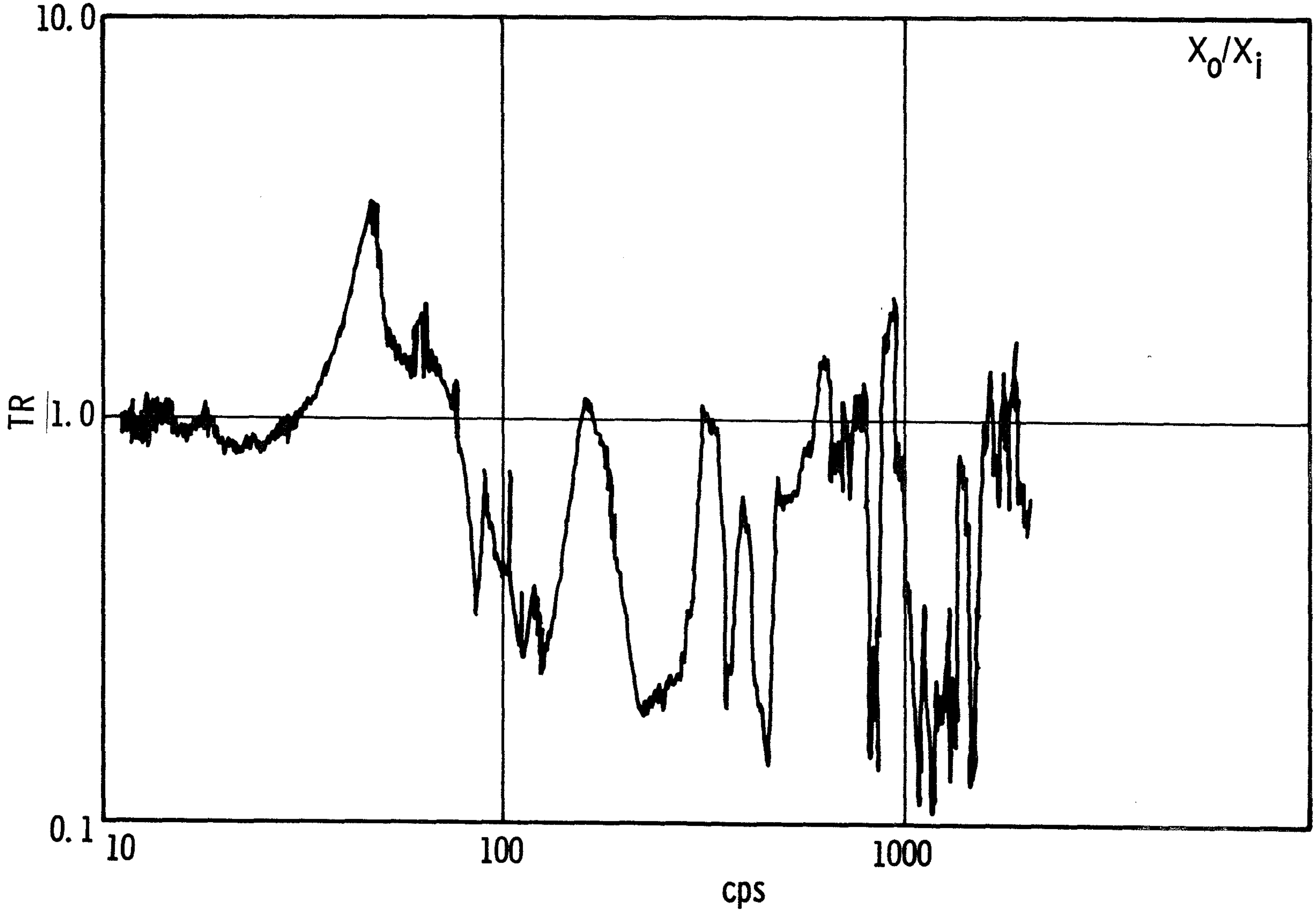
1G SWEEP LAUNCH AND BOOST



5607-8

Figure 25

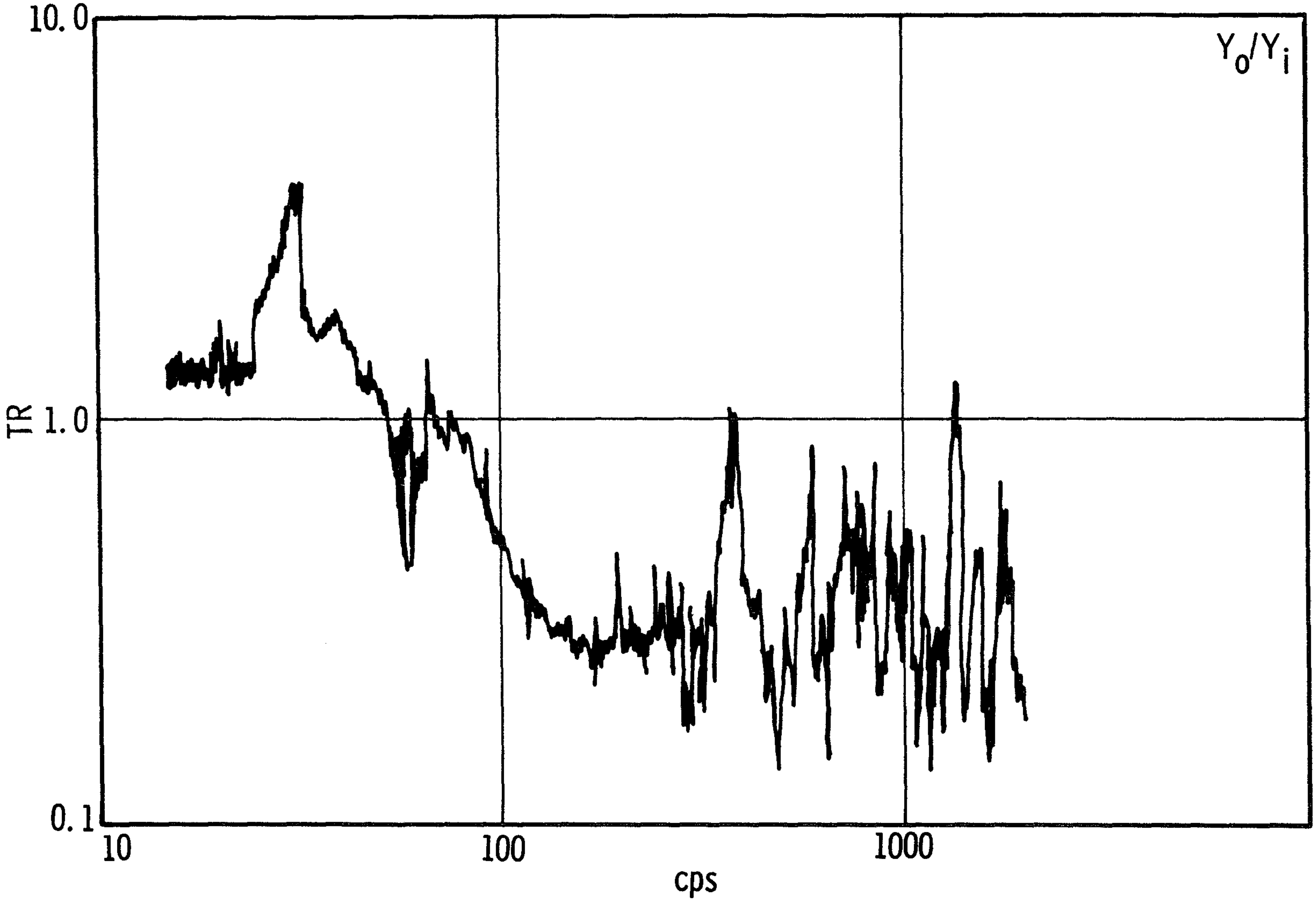
1G SWEEP LUNAR DESCENT



5607-9

Figure 26

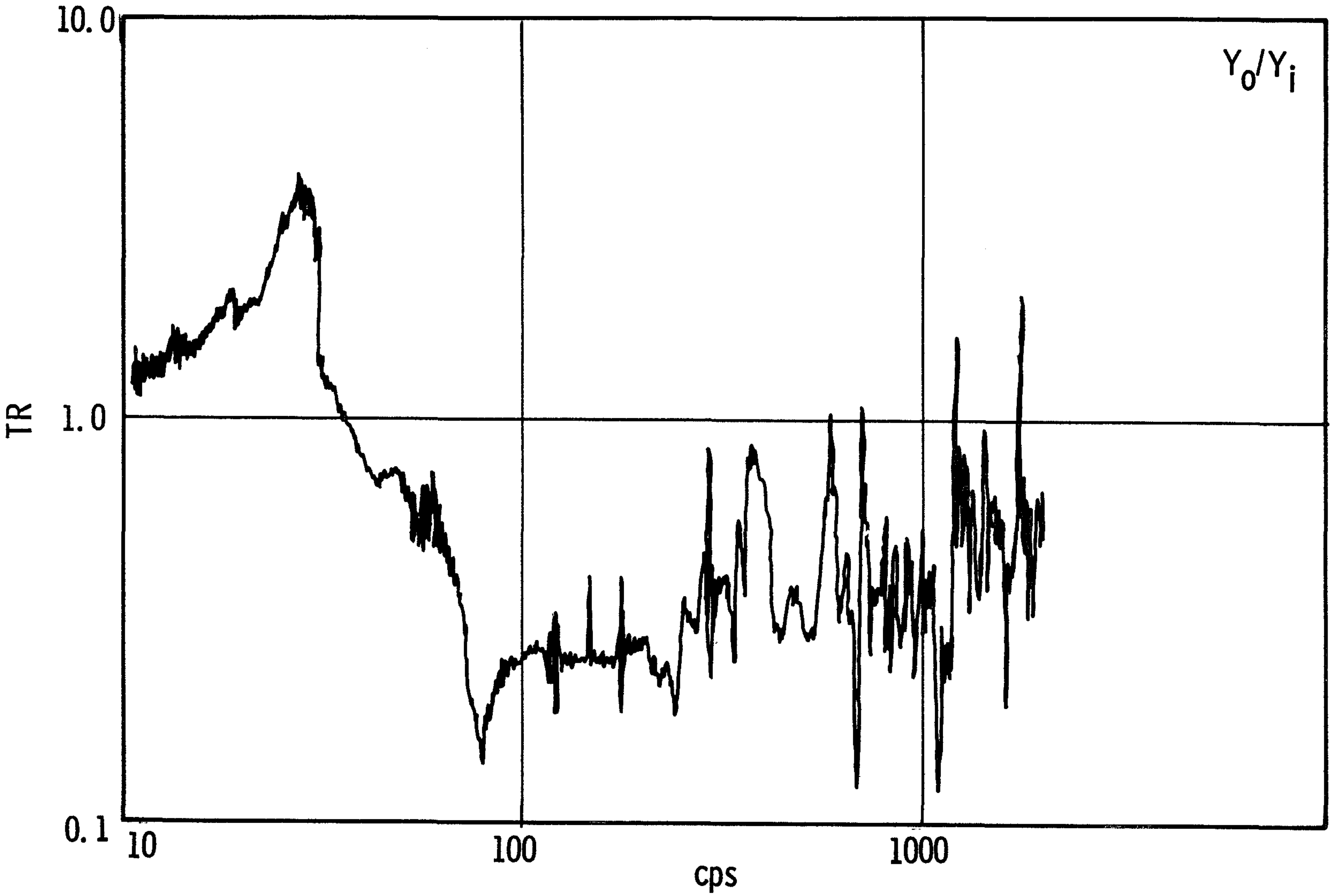
1G SWEEP LAUNCH AND BOOST



5607—10

Figure 27

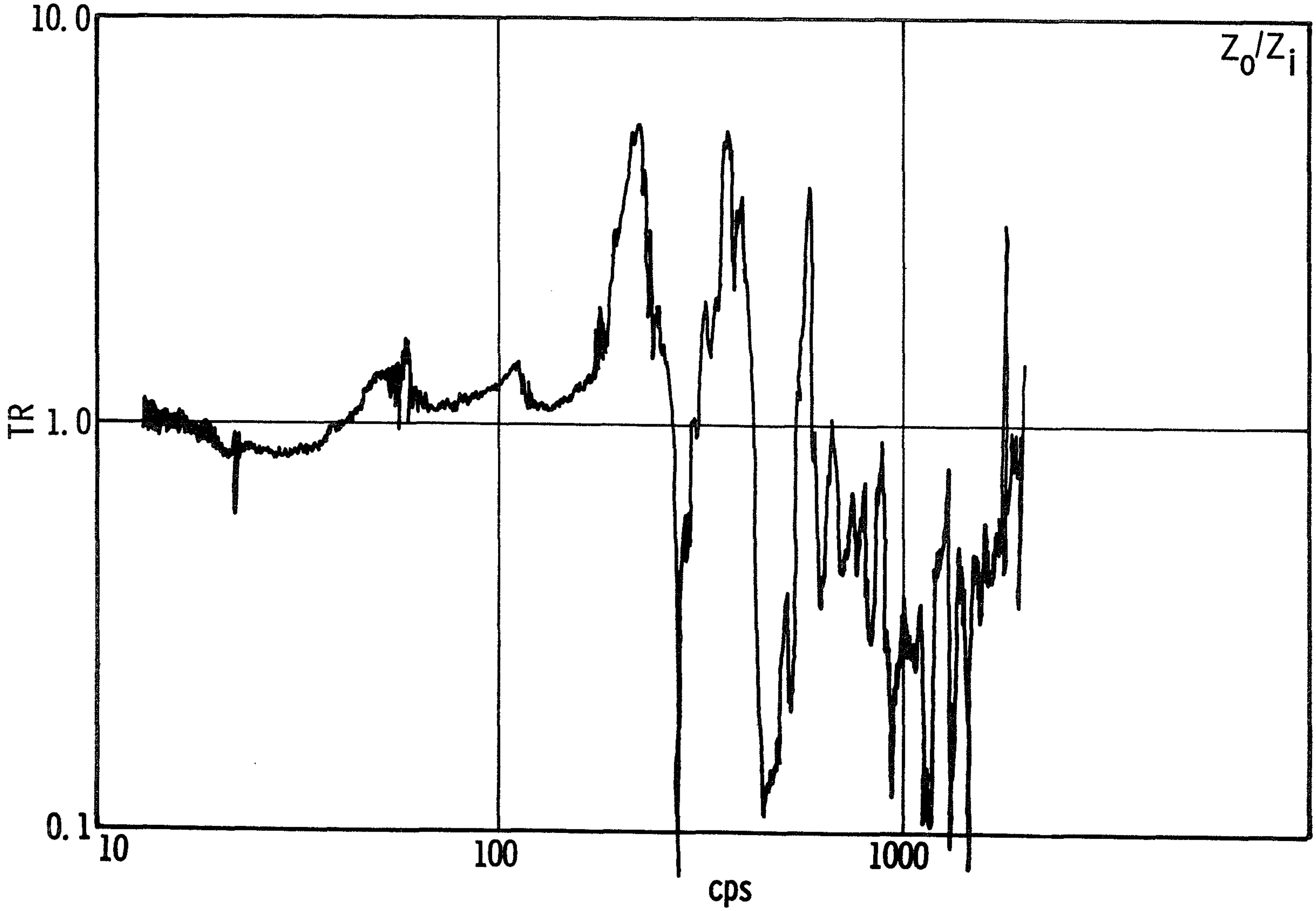
1G SWEEP LUNAR DESCENT



5607-11

Figure 28

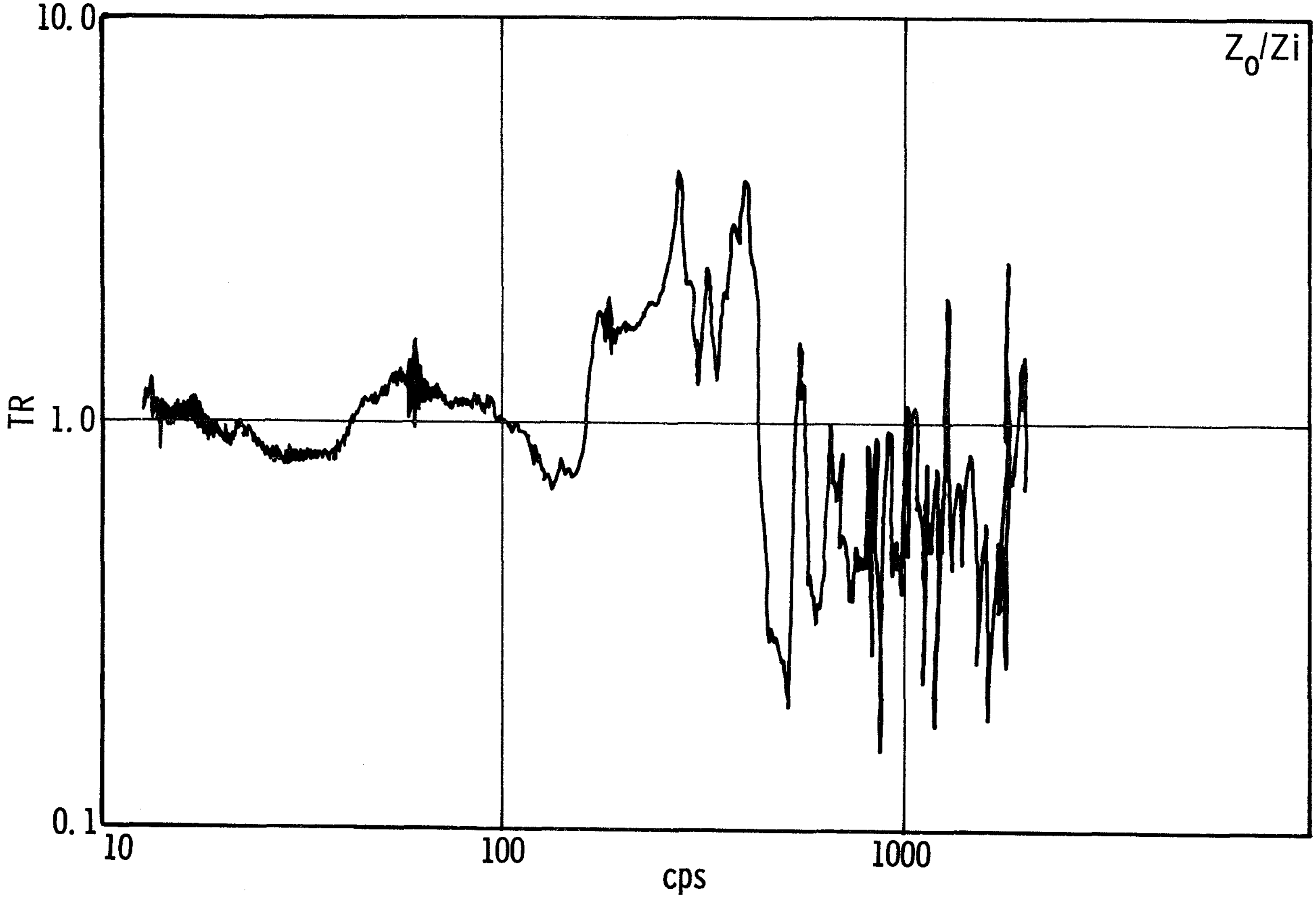
1G SWEEP LAUNCH AND BOOST



5607-12

Figure 29

1G SWEEP LUNAR DESCENT



5607—16

Figure 30

PURPOSE: VERIFY THE THERMAL INTEGRATION OF THE ALSEP/GLFC/LM CONFIGURATION FOR THE PRELAUNCH AND FLIGHT ENVIRONMENT

TESTS: TEST SERIES INCLUDED THE FOLLOWING SIMULATED FLIGHT ENVIRONMENTS:

1. PRELAUNCH AMBIENT ENVIRONMENT(FREE CONVECTION CASE)
2. PRELAUNCH CASK COOLING WITH FORCED CONVECTION(35 RUNS)
3. LAUNCH AND BOOST TRANSIENT TESTS
4. EARTH ORBIT WITH AND WITHOUT SOLAR HEATING
5. TRANSLUNAR WITH AND WITHOUT SOLAR HEATING

Figure 31

INTERFACE AND DESIGN REQUIREMENTS USED FOR INPUT CRITERIA FOR BxA THERMAL MODEL OF ALSEP/CASK/LM INTERFACE CONFIGURATION

- Bendix

  1) Prototype structural design configuration
  2) Prototype thermal shield design

     A. Circumferencial angle of shield with cask is 135°
     B. Total hemispherical emittance $\leq$ .10

  3) 800°F maximum temperature with 150°F circumferencial gradient around cask

- G.E.

  1) -19D cask design configuration
  2) Material properties per CCP #29
  3) Graphite coatings for total emittance $\geq$ 0.80 per -19D and CCP #29
  4) 1530 watts maximum power
  5) Fuel Capsule design per ICS 314119

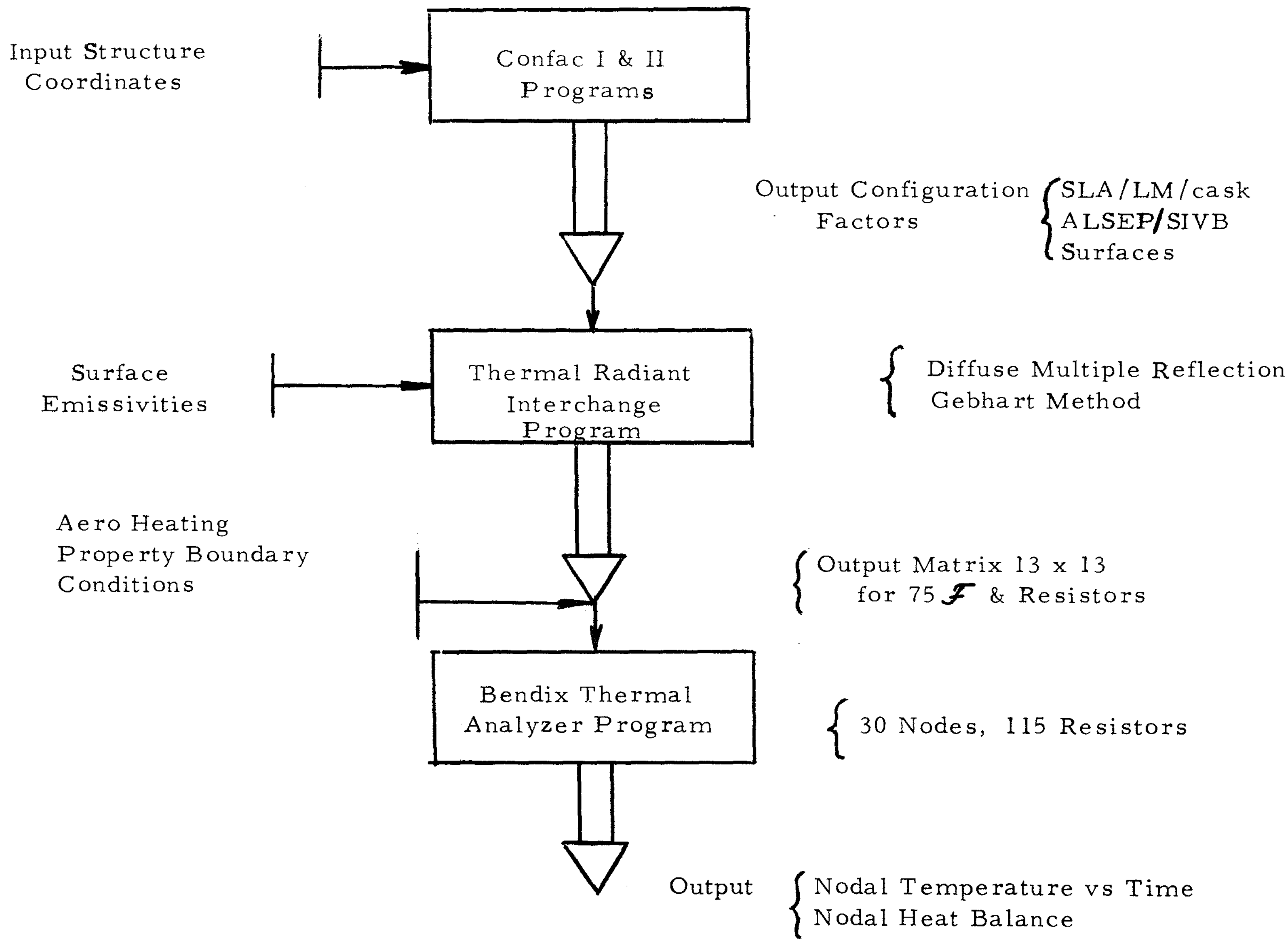
- GAEC

  1) 100 Btu/hr maximum heat leak into LM due to direct cask radiation and conduction
  2) 270°F maximum temperature on LM (not including new astronaut thermal door)
  3) Mechanical interface per LID 360-22809
  4) Environmental interface per ICS LIS 360-22402 and LED 520-1F

- MSC

  1) NAA SLA internal and external thermal coatings per MSC transmittal dated June 1966
  2) LM vehicle thermal coatings per LM-3 and on report by J. Smith, of MSC, dated January 1967
  3) LM vehicle mission profile per MSC June 1966 transmittal and LD-520-F
  4) Apollo Program environment specification per M-DE 8020.008B dated April 1965
  5) BxA/MSC Contract 9-5829, Exhibit B

Figure 32



<u>Computer Programs Used in Thermal Model of ALSEP/Cask/LM Interface</u>

Figure 33

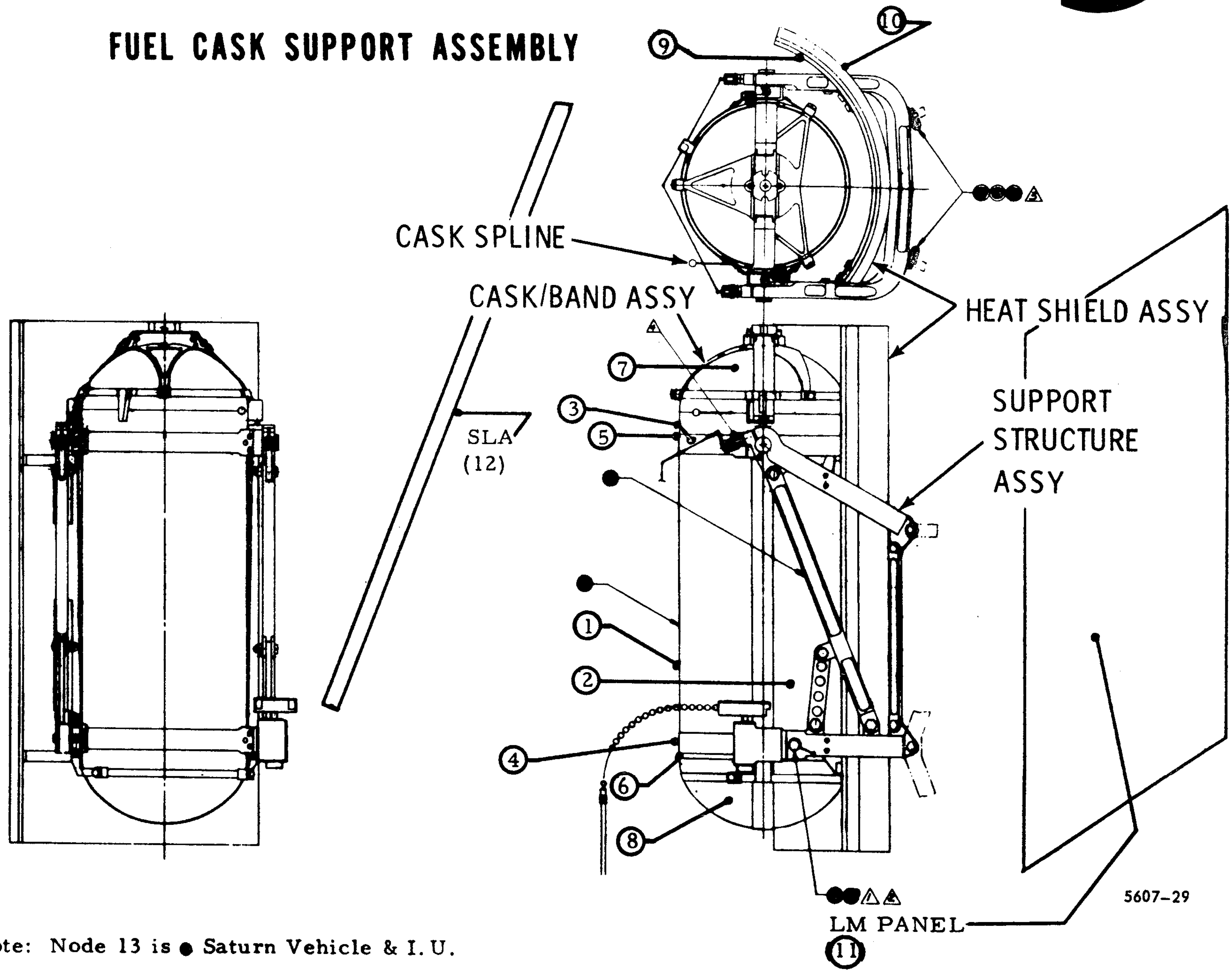
DESCRIPTION OF BxA DIGITAL COMPUTER PROGRAMS UTILIZED FOR THERMAL ANALYSIS OF ALSEP/CASK/LM INTERFACE

- 15 node, 3 dimensional thermal model for ALSEP/cask/LM configuration defined by CCP #29, reference Figure 1
- 25 node, 3 dimensional thermal model of ALSEP/LM vehicle interface to evaluated GAEC temperatures on thermal door and landing gear, reference Figure 2
- 22 node, 3 dimensional thermal model of BxA/GAEC support structure interface for conduction heat leak evaluation
- 20 node, 3 dimensional thermal model of ALSEP/cask interface to evaluate axial and circumferencial gradients for on pad cooling temperature and thermal stresses
- 35 node, 2 dimensional model of Saturn SIVB Instrumentation Unit (I.U.) manifold to determine flow distribution and pressure gradients in I.U. manifold for on pad cooling requirements

Figure 34

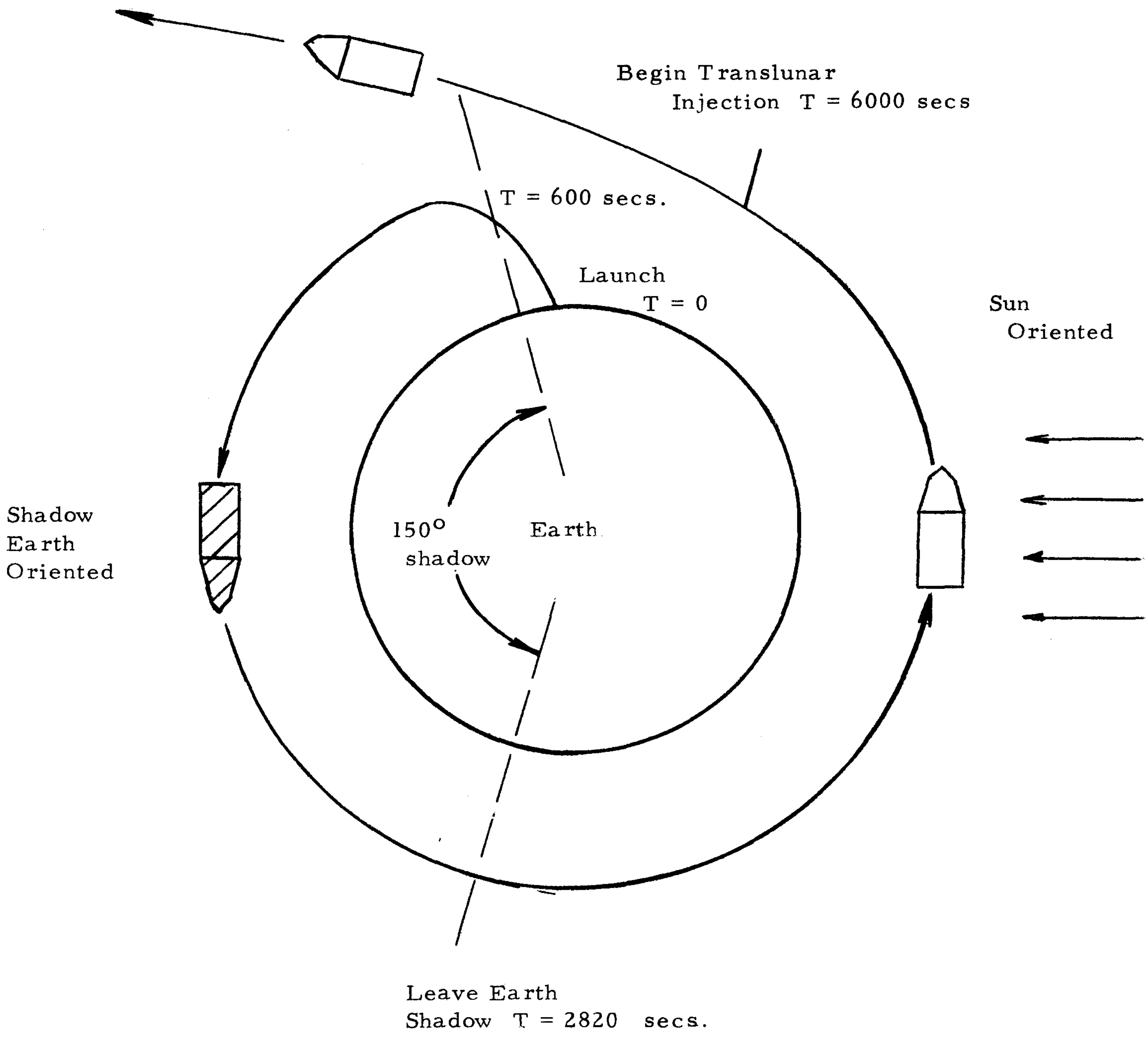
BENDIX THERMAL MODEL NODES

FUEL CASK SUPPORT ASSEMBLY



Note: Node 13 is ● Saturn Vehicle & I.U.

Figure 35



ALSEP/cask/LM/SLA Earth Orbit Case
With and Without Solar Heating

Figure 36

TABLE 3-1

ALSEP/CASK/LM INTERFACE SPECIFICATION REQUIREMENTS VERSUS PROTOTYPE TEST RESULTS AND PRETEST PREDICTED VALUES

	Interface Specification	Specification Requirement	Test Results	Pretest Predicted Values
. MAXIMUM FUEL CASK SURFACE TEMPERATURE	BxA/GE	800°F	615°-798°F	672°-785°F
. MAXIMUM FUEL CASK CIRCUMFERENTIAL TEMP GRADIENT	BxA/GE	150°F	130°F	140°F
. MAXIMUM FUEL CAPSULE SURFACE TEMPERATURE	BxA/GE	1400°F	1210°-1320°F	1220°-1302°F
. MAXIMUM HEAT LEAK TO LM	BxA/GAEC	100 BTU/HR	50 BTU/HR	75 BTU/HR
. MAXIMUM LM SKIN SURFACE TEMPERATURE (EXCEPT ASTRONAUT THERMAL DOOR)	BxA/GAEC	270°F	238°F	240°F
. ASTRONAUT THERMAL DOOR	BxA/GAEC	400°F	388°F*	400°F
.. MAXIMUM CASK THERMAL SHIELD TEMPERATURE	BxA	600°F	588°F	558°F

Figure 37

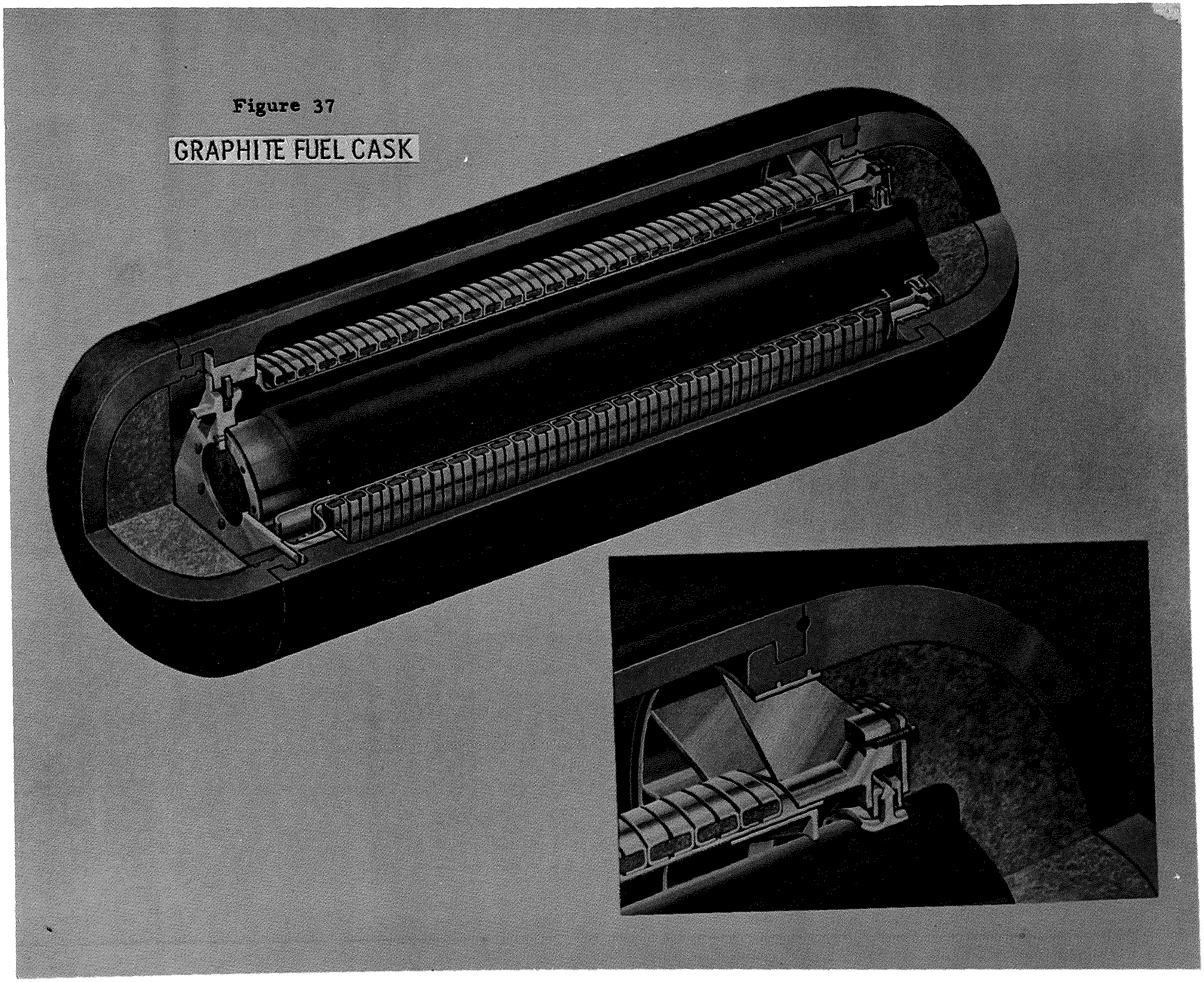
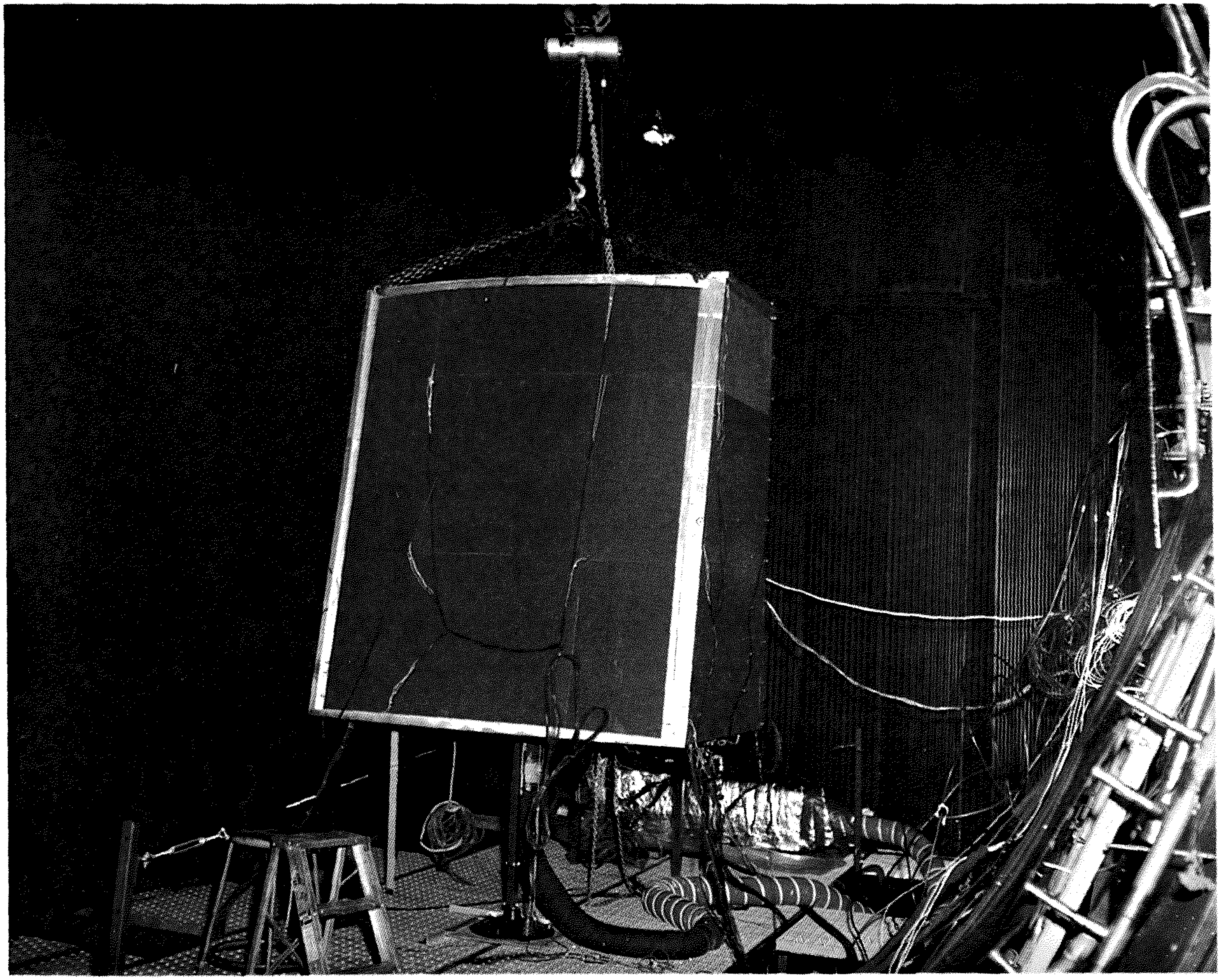
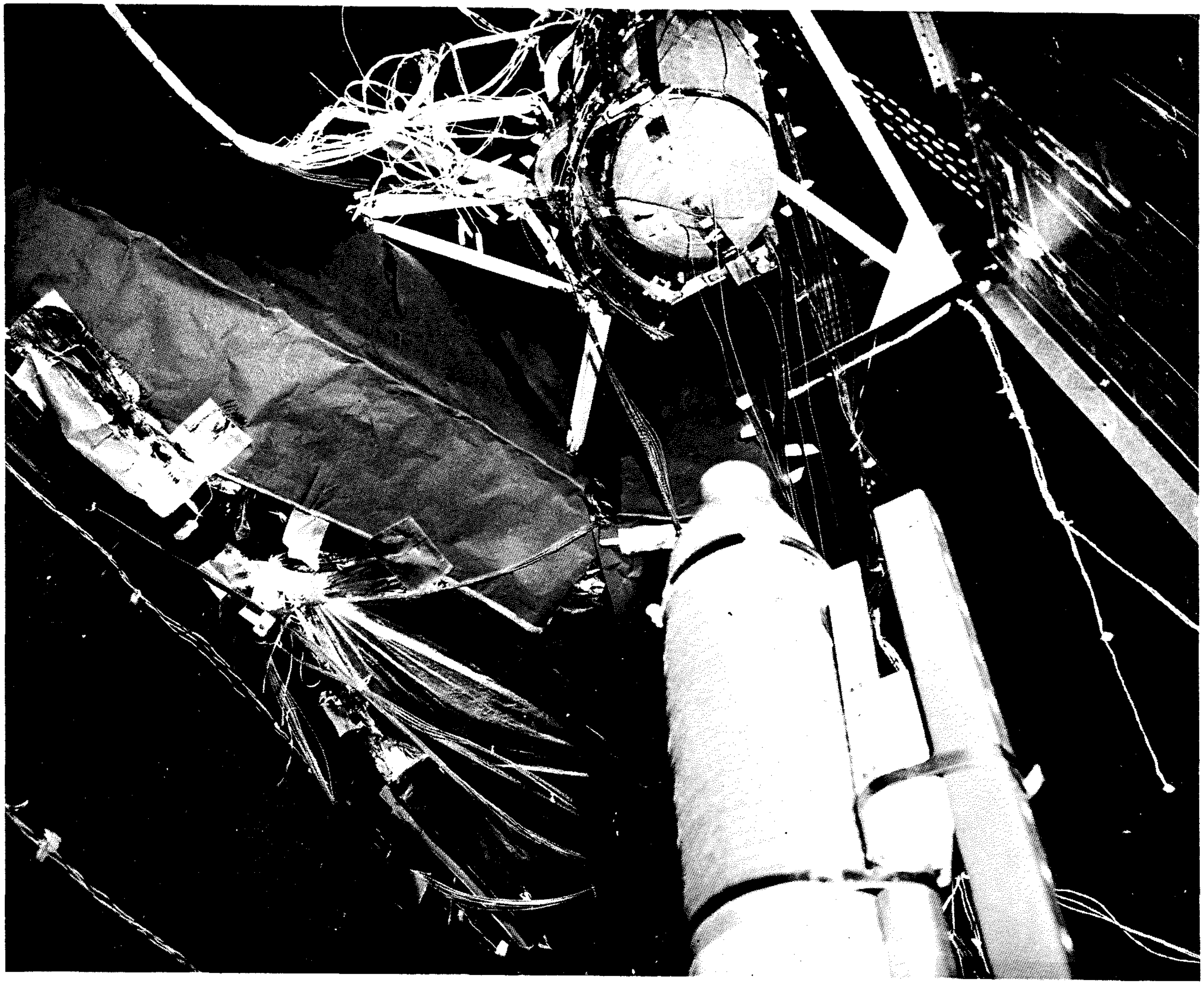


Figure 38



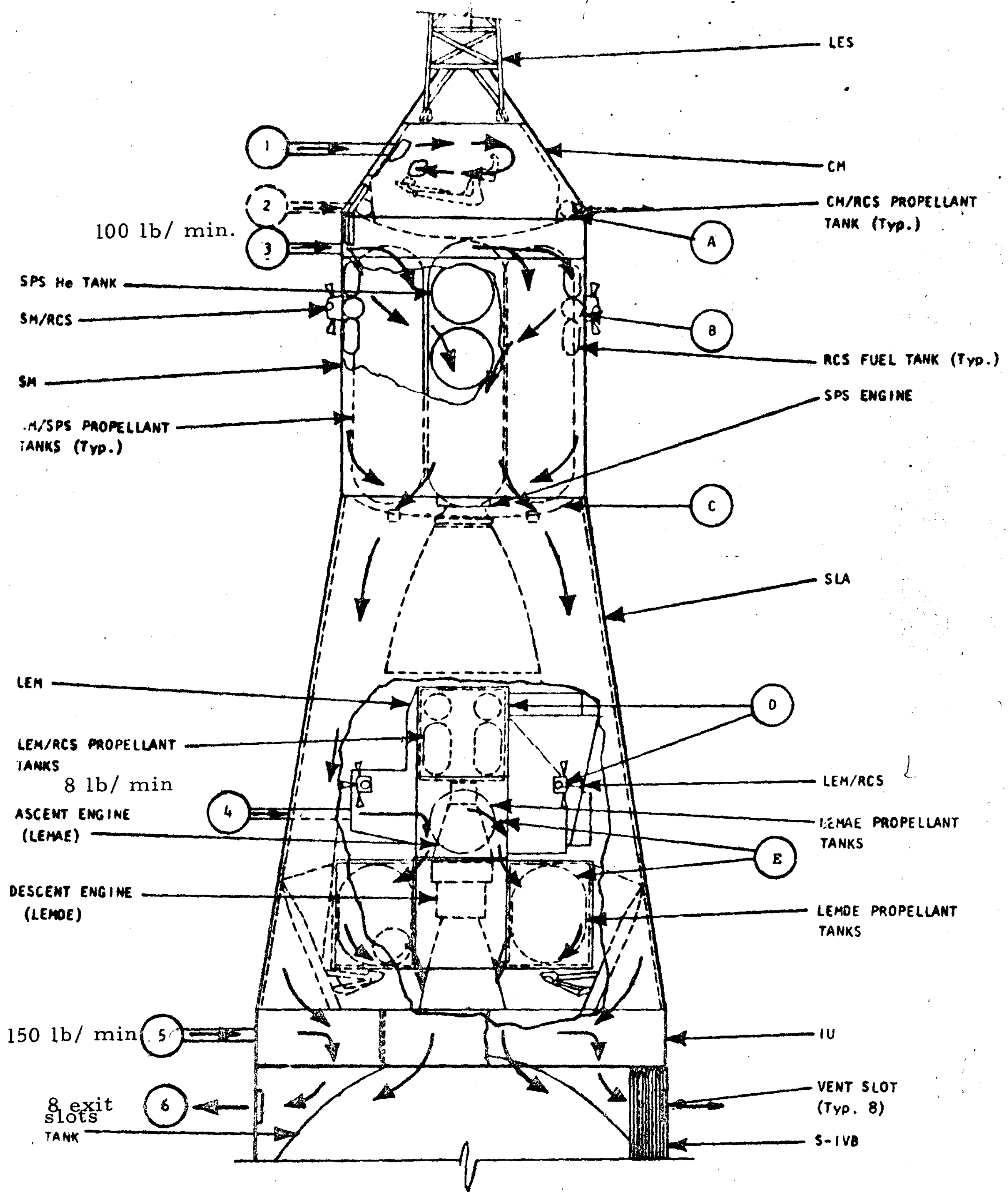
SLA/ LM Canister Used for Proto Cask Cooling and T/ V Test

Figure 39



Prototype Conical Nozzle Configuration Inside SLA/LM Canister

Figure 40



PHYSICAL CONFIGURATION OF

CSM/LEM/SLA - BLOCK II

RTG COOLING DUCT ASSY

Figure 41

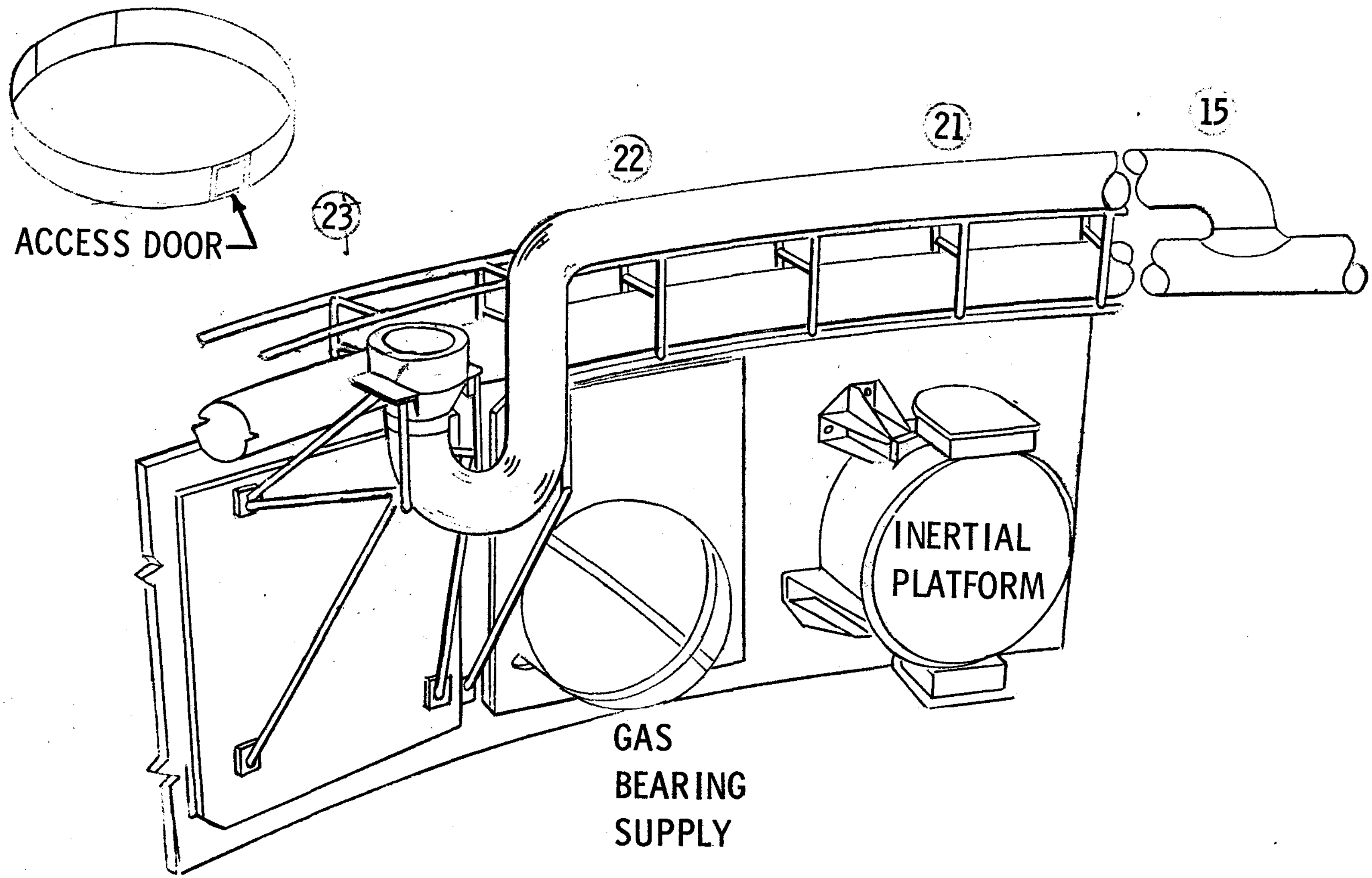
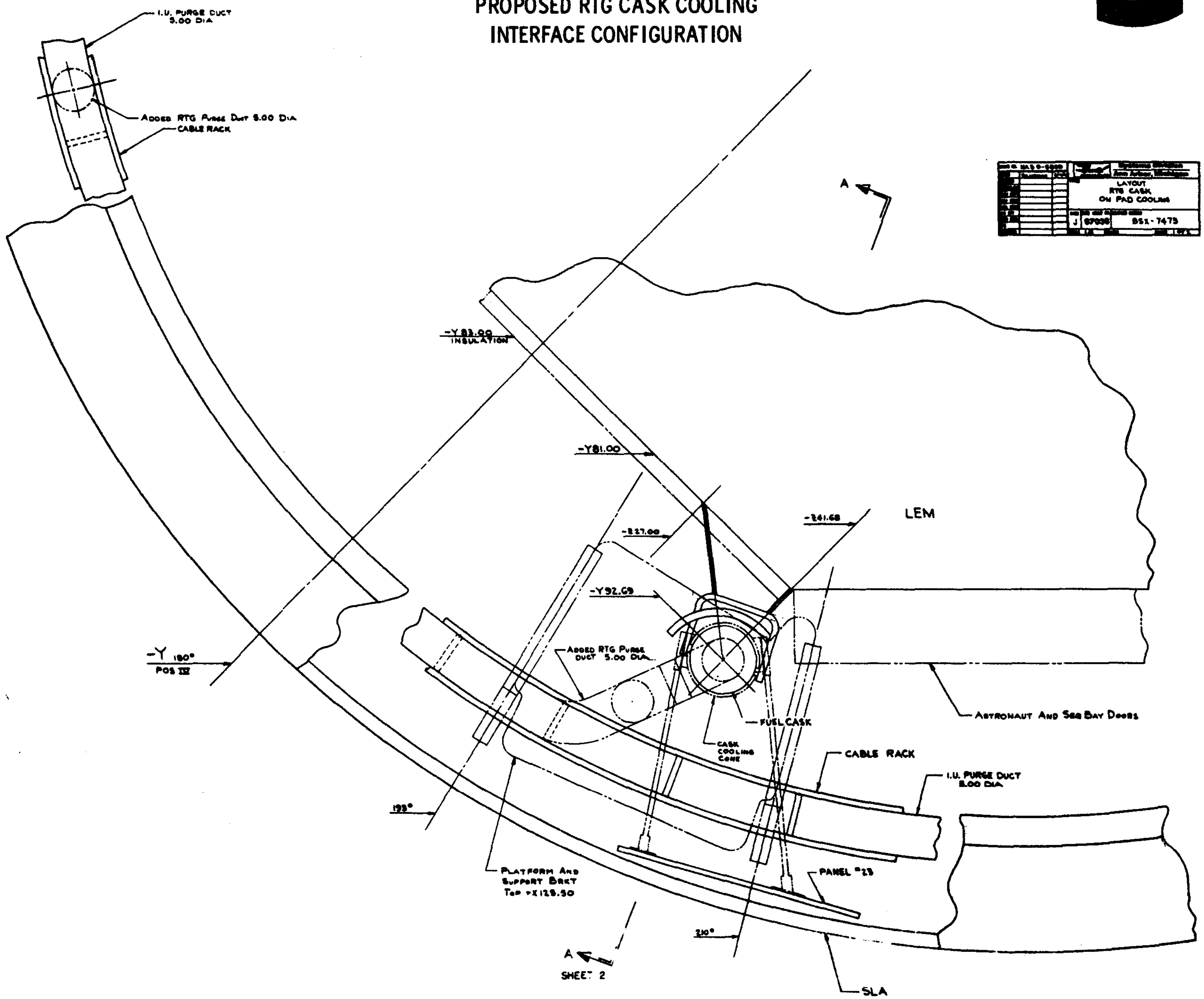


Figure 42

PROPOSED RTG CASK COOLING INTERFACE CONFIGURATION



5607-43

Figure 43

RTG CASK COOLING NOZZLE LOCATIONS FOR
BxA PROTOTYPE TEST PROGRAM

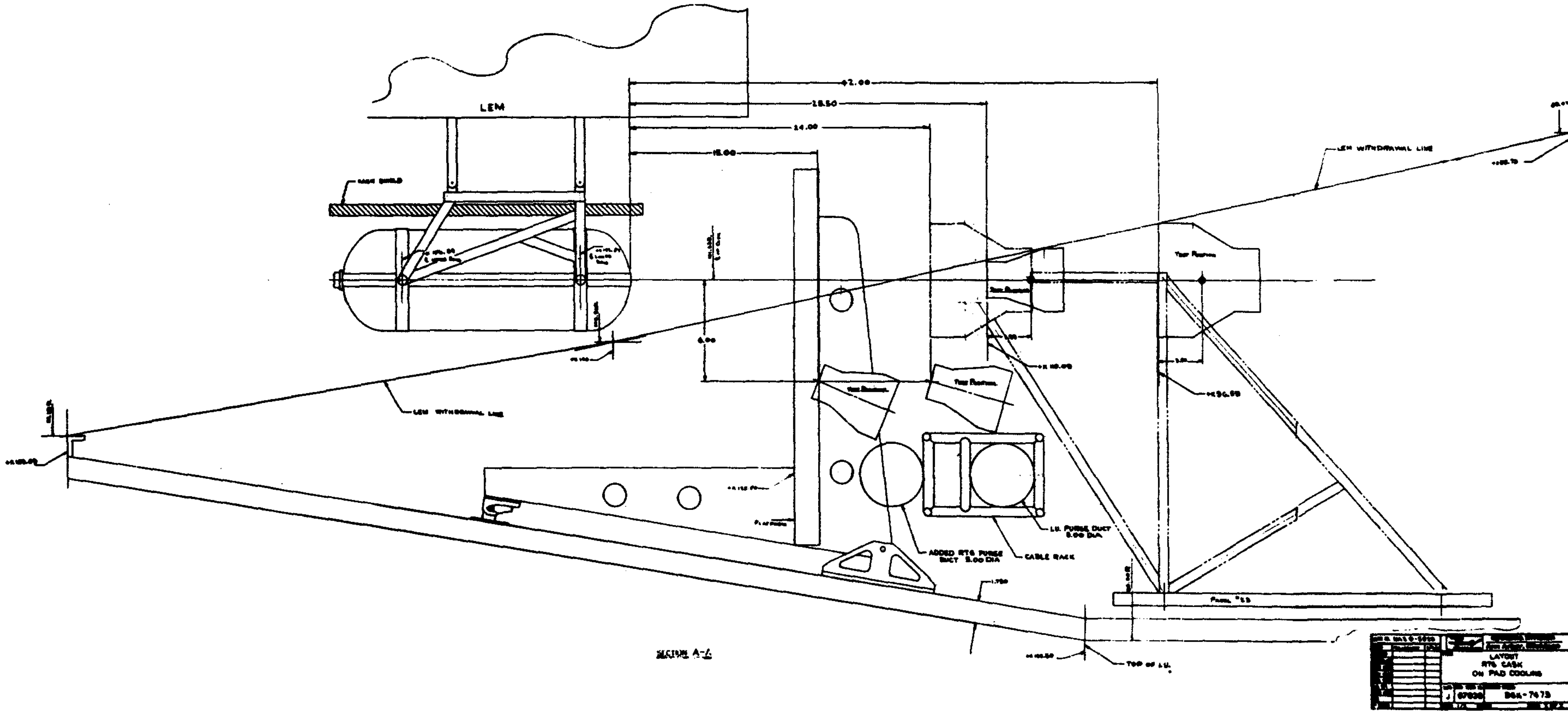
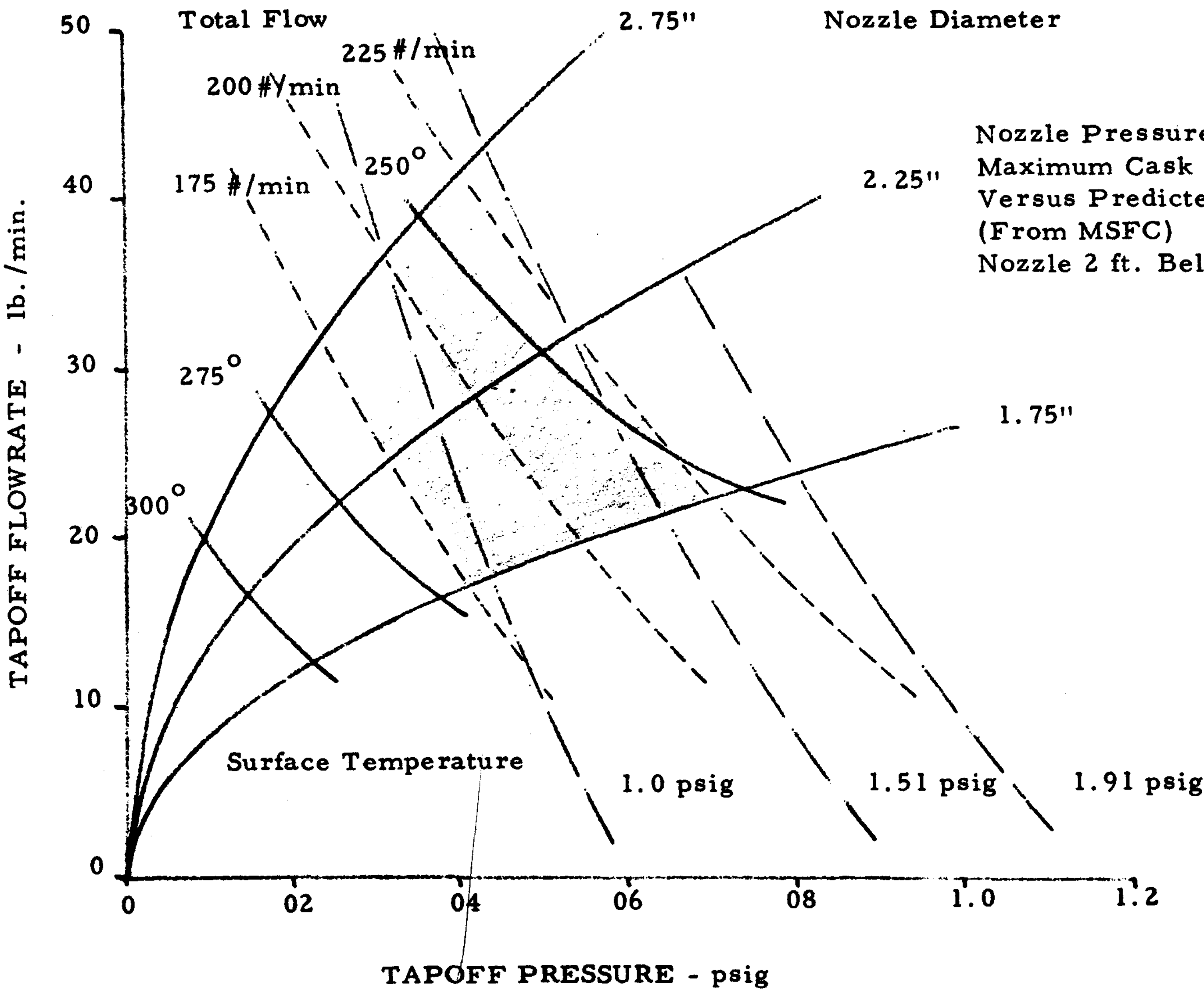


Figure 44

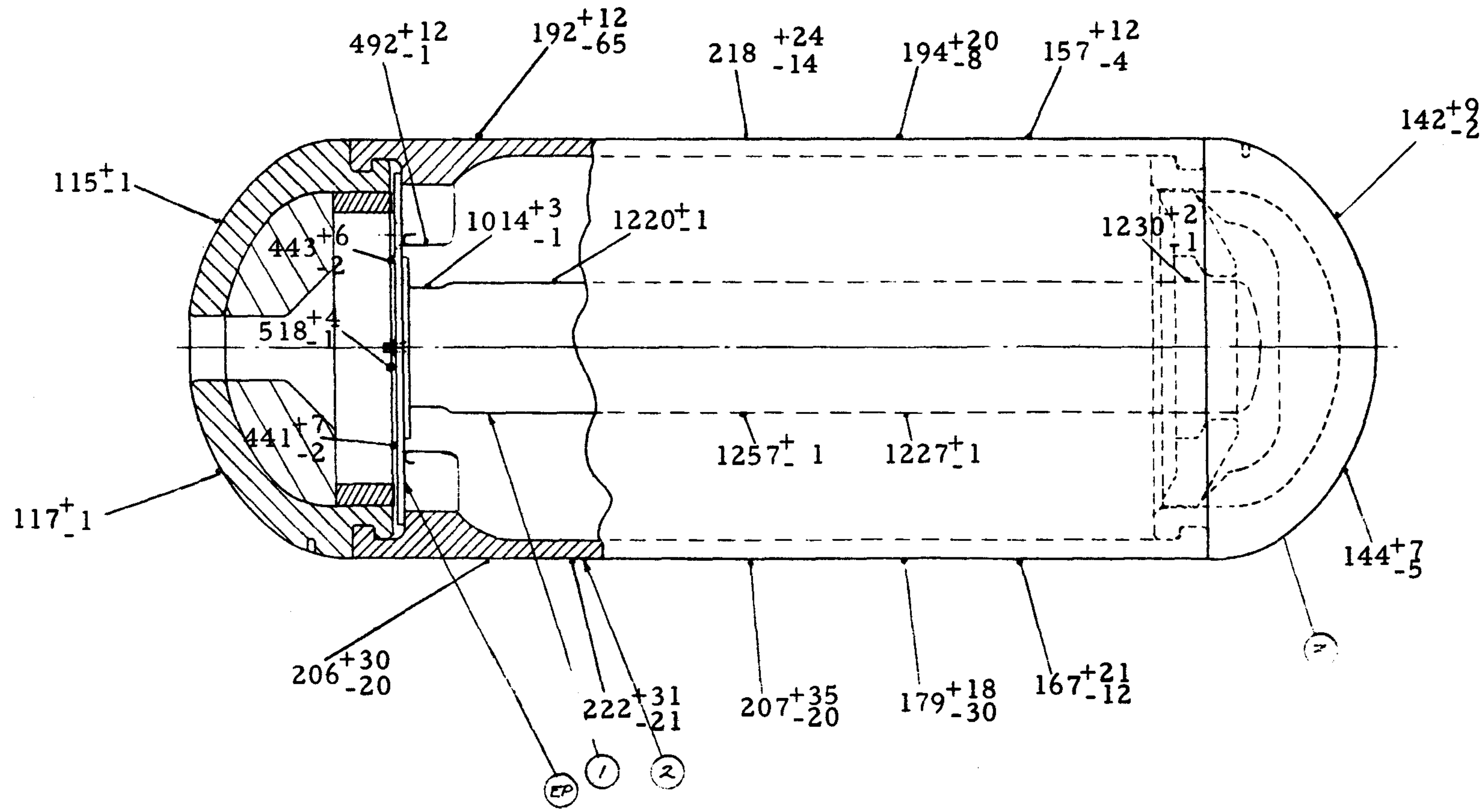


Nozzle Pressure and Flow Rate for Maximum Cask Surface Temperature Versus Predicted I.U. Flow Conditions (From MSFC)
Nozzle 2 ft. Below Cask

5607-32

Figure 45

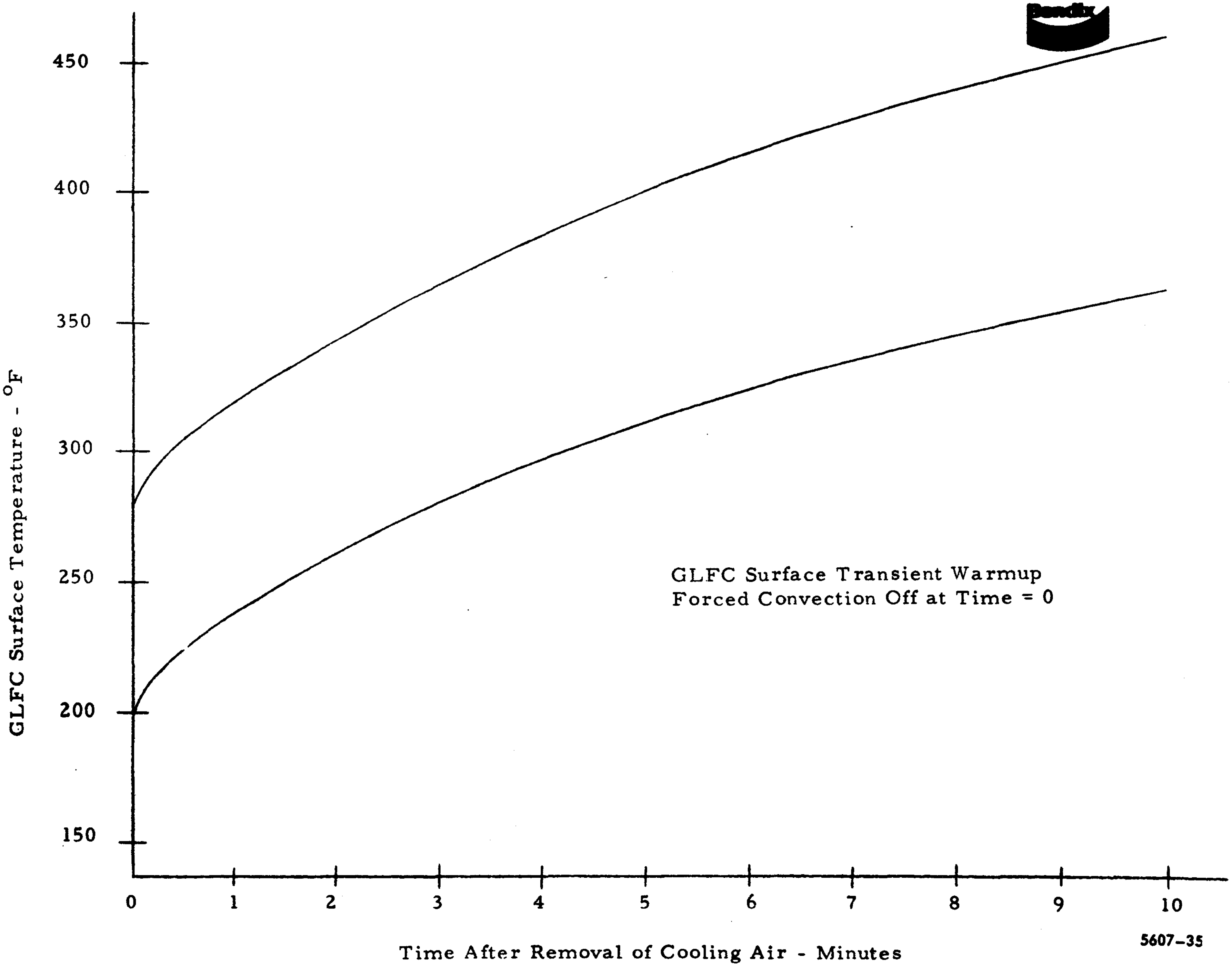
FUEL CAPSULE AND CASK SURFACE TEMPERATURE RESULTS ON PAD FORCED COOLING WITH 17.5 LB/MIN OF AMBIENT AIR TEMPERATURES FOR IN-LINE NOZZLE VARIATIONS SHOWN FOR NOZZLE OFFSET 2 INCHES



Surface Description	Test Results, °F	Pre-Test Predictions, °F
1. Capsule Surface	1094-1257	1110-1245
2. Cask Exterior Surface		
a. Center	179-222	175-230
b. Ends	157-206	153-194
3. Cask Domes	115-144	121-166
4. Thermal Shield	75-92	70-85
5. LM Panel	72-109	70-100
6. SLA	70	70

5607-39

Figure 46

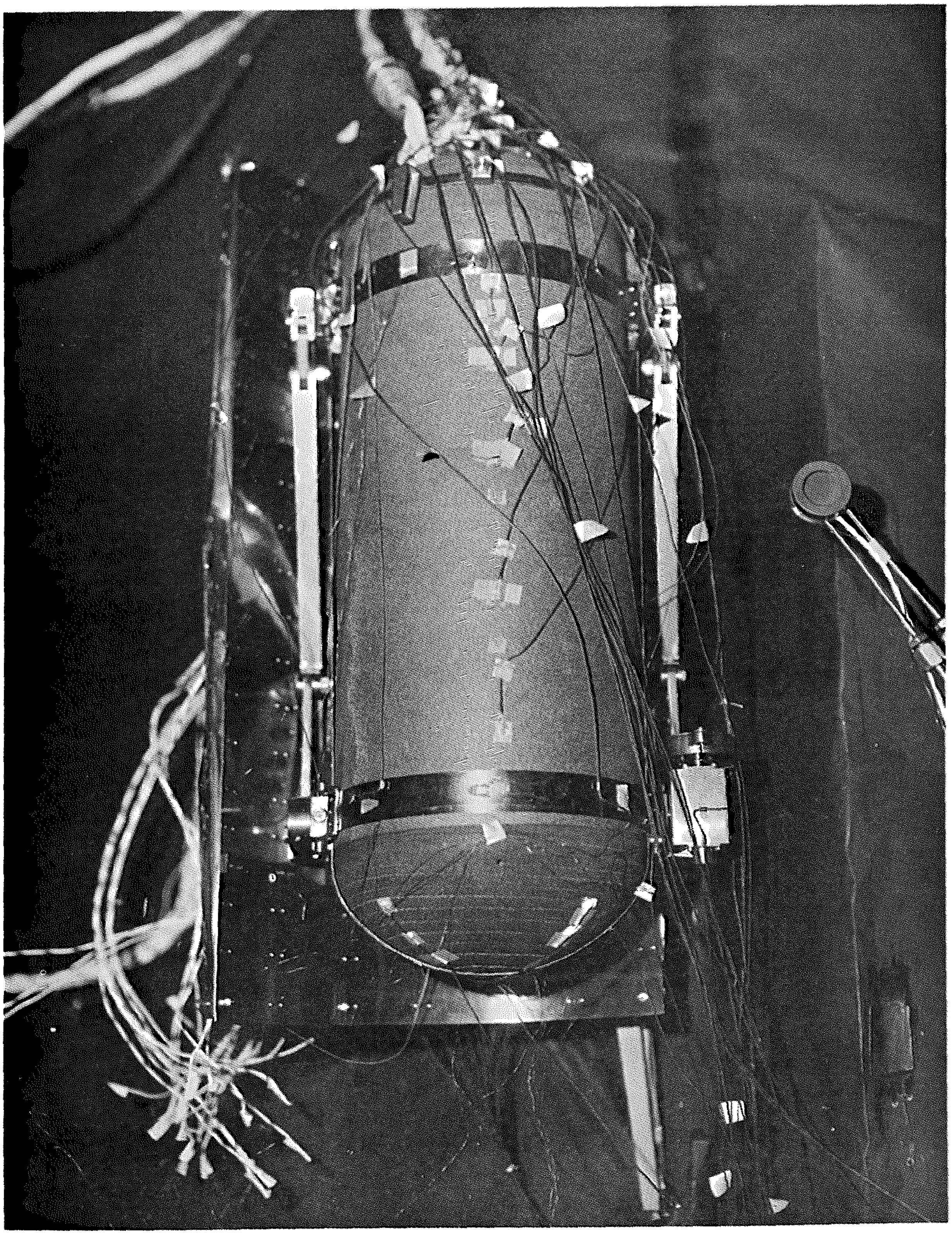


450
400
350
300
250
200
150
GLFC Surface Temperature - °F
0
1
2
3
4
5
6
7
8
9
10
Time After Removal of Cooling Air - Minutes
GLFC Surface Transient Warmup
Forced Convection Off at Time = 0
5607-35

Figure 47

Prototype Cask and Support Structure
Attached to Simulated LM

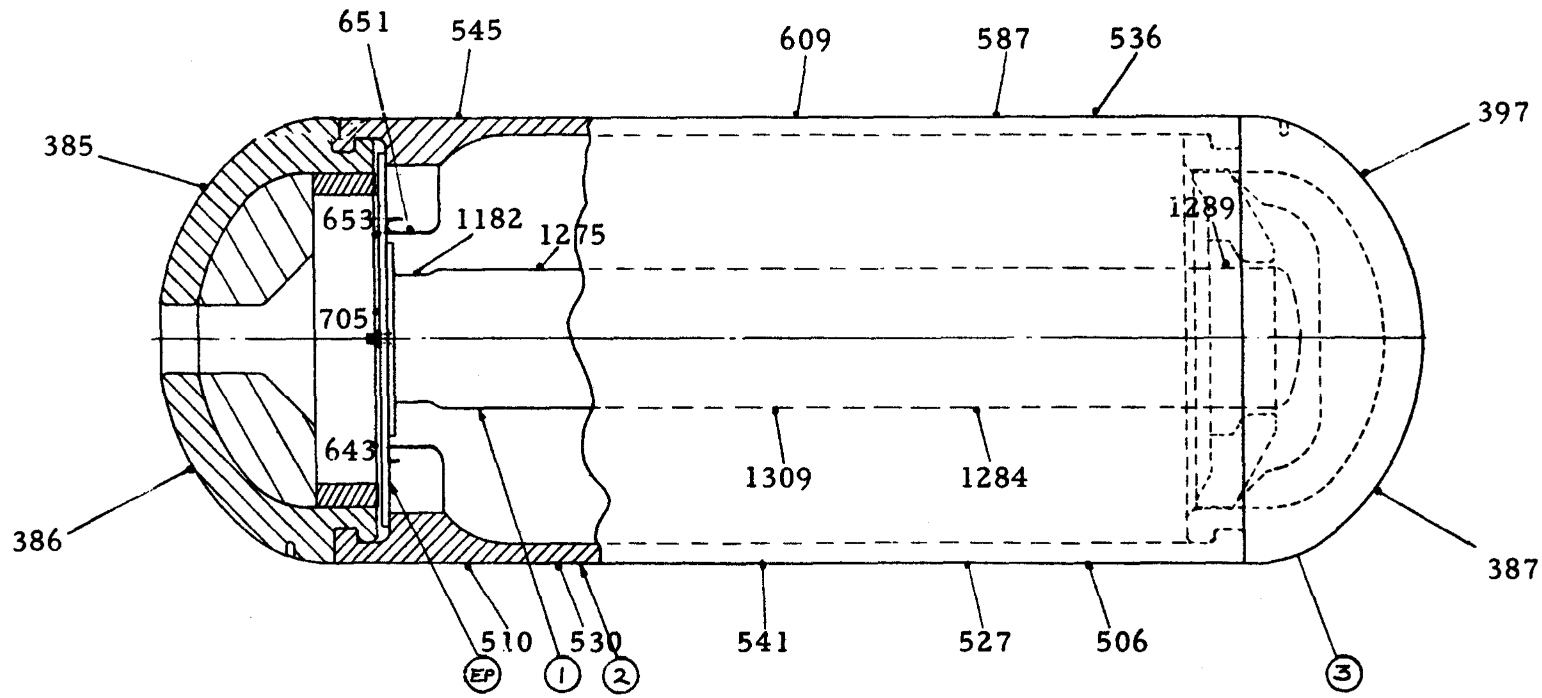
Figure 48



Fuel Cask and Support Assembly for Prototype Thermal Tests

Figure 49

FUEL CAPSULE AND CASK SURFACE TEMPERATURE RESULTS ON PAD WITH FREE CONVECTION

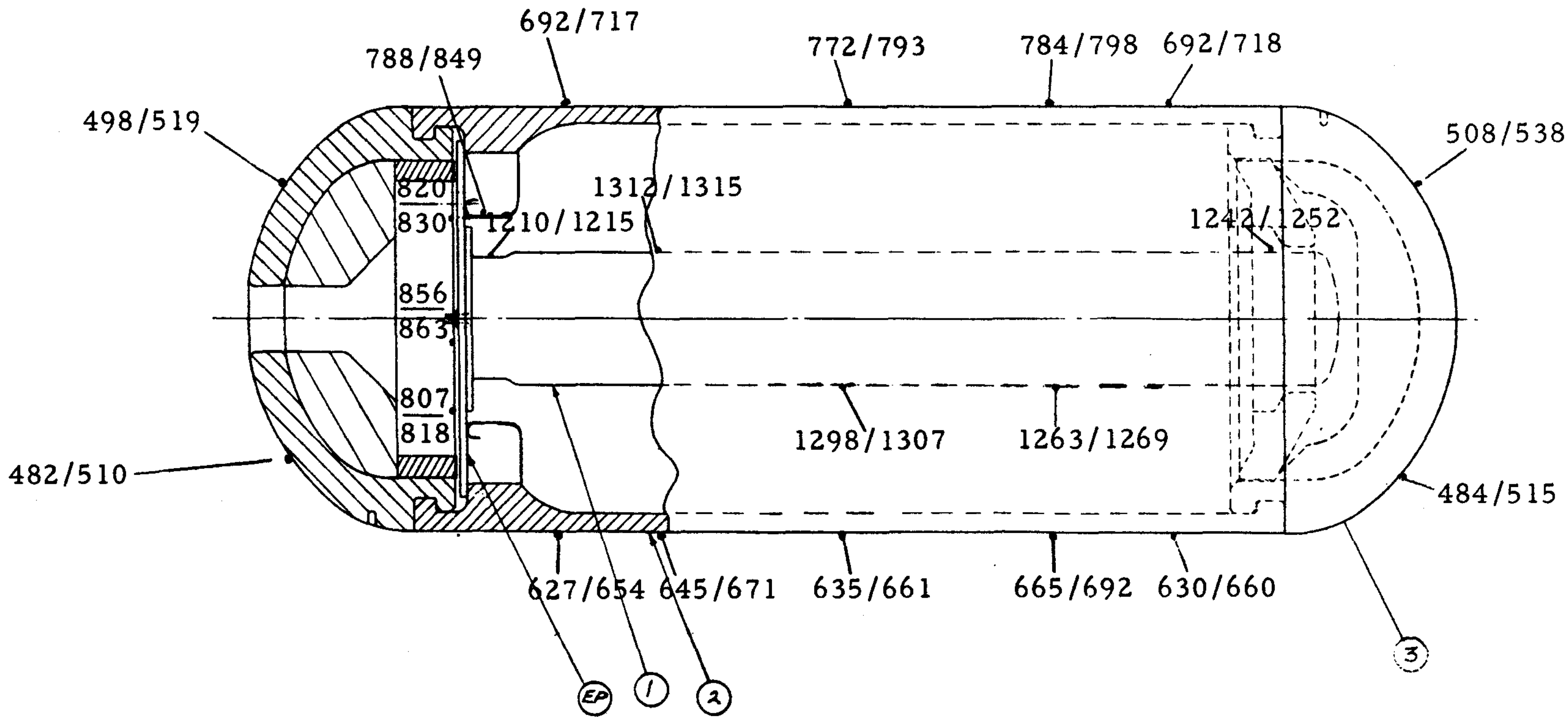


Surface Description	Test Results, °F	Pre-Test Predictions, °F
1. Capsule Surface	1182-1309	1146-1232
2. Cask External Surface		
a. Center	527-609	548-580
b. Ends	506-545	461-519
3. Cask Domes	385-397	364-437
4. Thermal Shield	93-135	90-121
5. LM Panel	75-91	77-85
6. Astronaut Door	91-154	85-170
7. SLA	71-77	70

5607-34

Figure 50

FUEL CAPSULE AND CASK SURFACE TEMPERATURE RESULTS EARTH ORBIT WITH SLA ON - MAXIMUM AND MINIMUM SOLAR HEATING

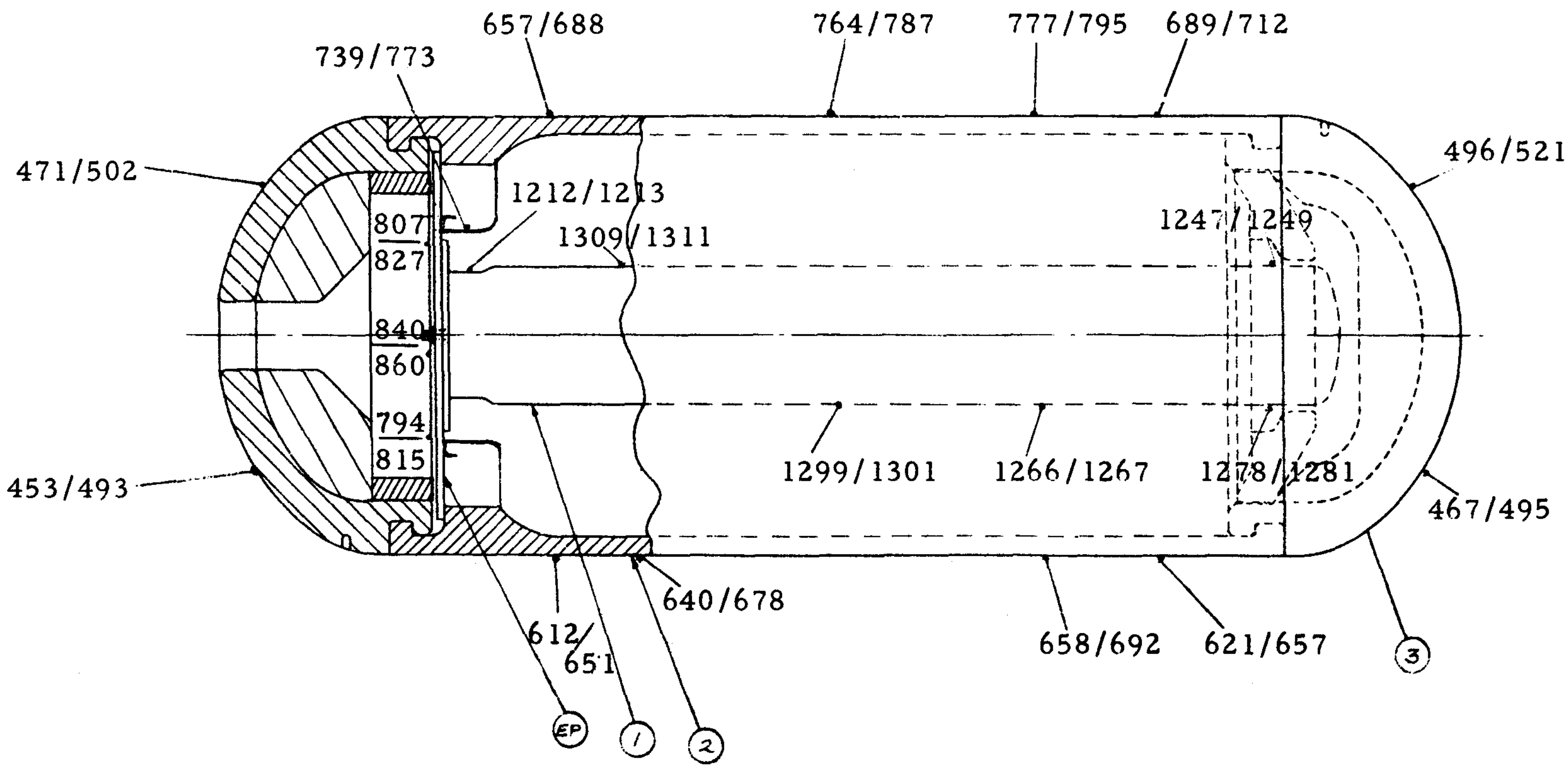


Surface Description	Test Results, °F	Pre-Test Predictions, °F
1. Capsule Surface	1210-1315	1293-1302
2. Cask External Surface		
a. Center	635-798	643-775
b. Ends	627-718	617-687
3. Cask Domes	482-519	447-559
4. Thermal Shield	310-588	350-550
5. LM Panel	0-240	28-215
6. Astronaut Door	118-383	219-400
7. SLA	210-261	250

5607-38

Figure 51

FUEL CAPSULE AND CASK SURFACE TEMPERATURE RESULTS TRANSLUNAR (SLA OFF) - MAXIMUM AND MINIMUM SOLAR HEATING



Surface Description	Test Results, °F	Pre-Test Predictions, °F
1. Capsule Surface	1212-1311	1281-1290
2. Cask External Surface		
a. Center	640-795	634-770
b. Ends	612-712	590-690
3. Cask Domes	453-521	435-541
4. Thermal Shield	283-604	270-494
5. LM Panel	-214-+217	-131-+273
6. Astronaut Door	-12-+337	1-380
7. SLA	-300	-300

5607-33

Figure 52

DOME RELEASE LUNAR SURFACE TEMPERATURES

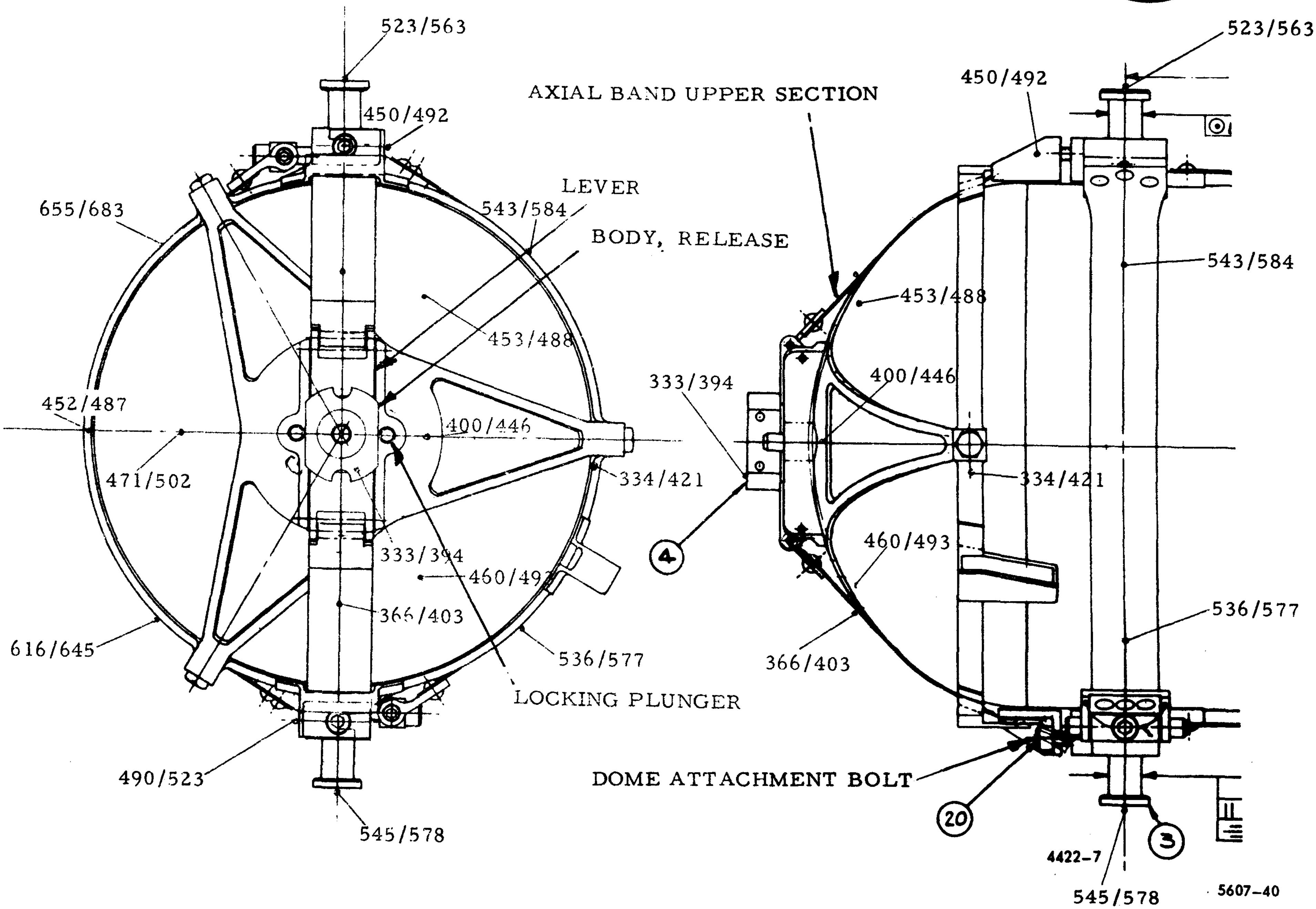
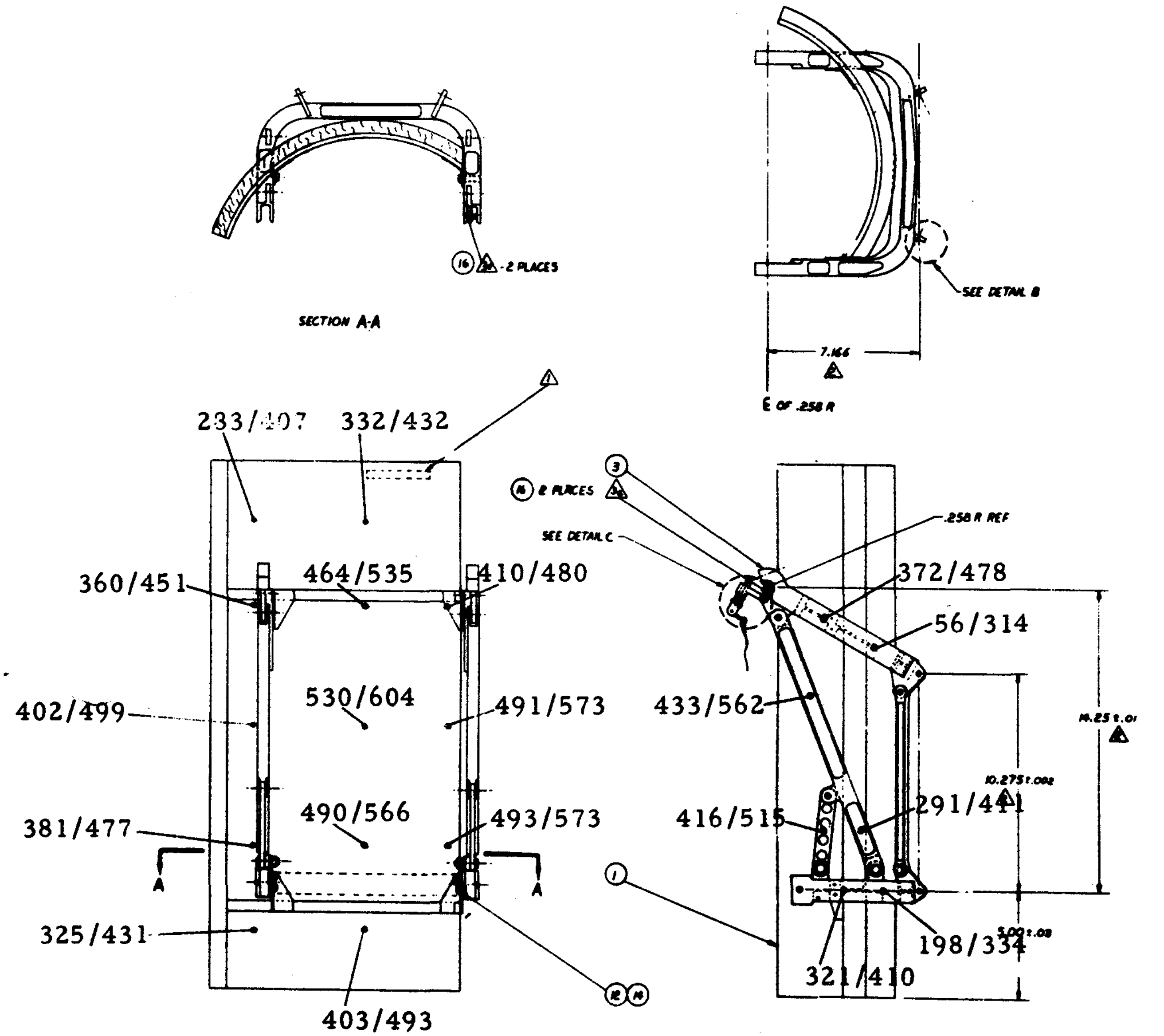


Figure 53

STRUCTURE ASSY. FUEL CASK

MAXIMUM AND MINIMUM THERMAL VACUUM TEMPERATURES



5607-31

Figure 54

PREDICTED CASK STRUCTURE AND ASTRONAUT THERMAL GUARD TEMPERATURES DURING LUNAR SURFACE DEPLOYMENT

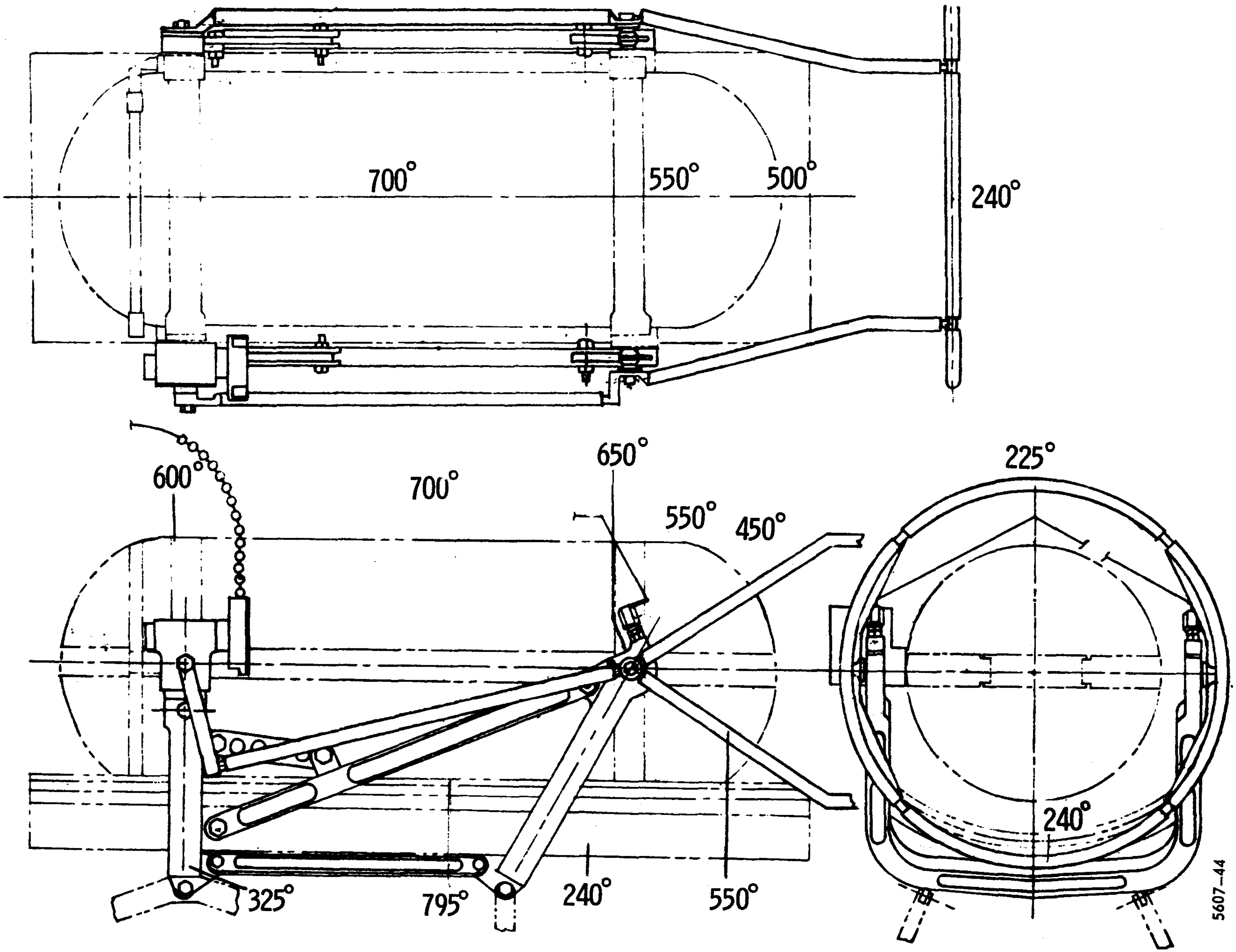
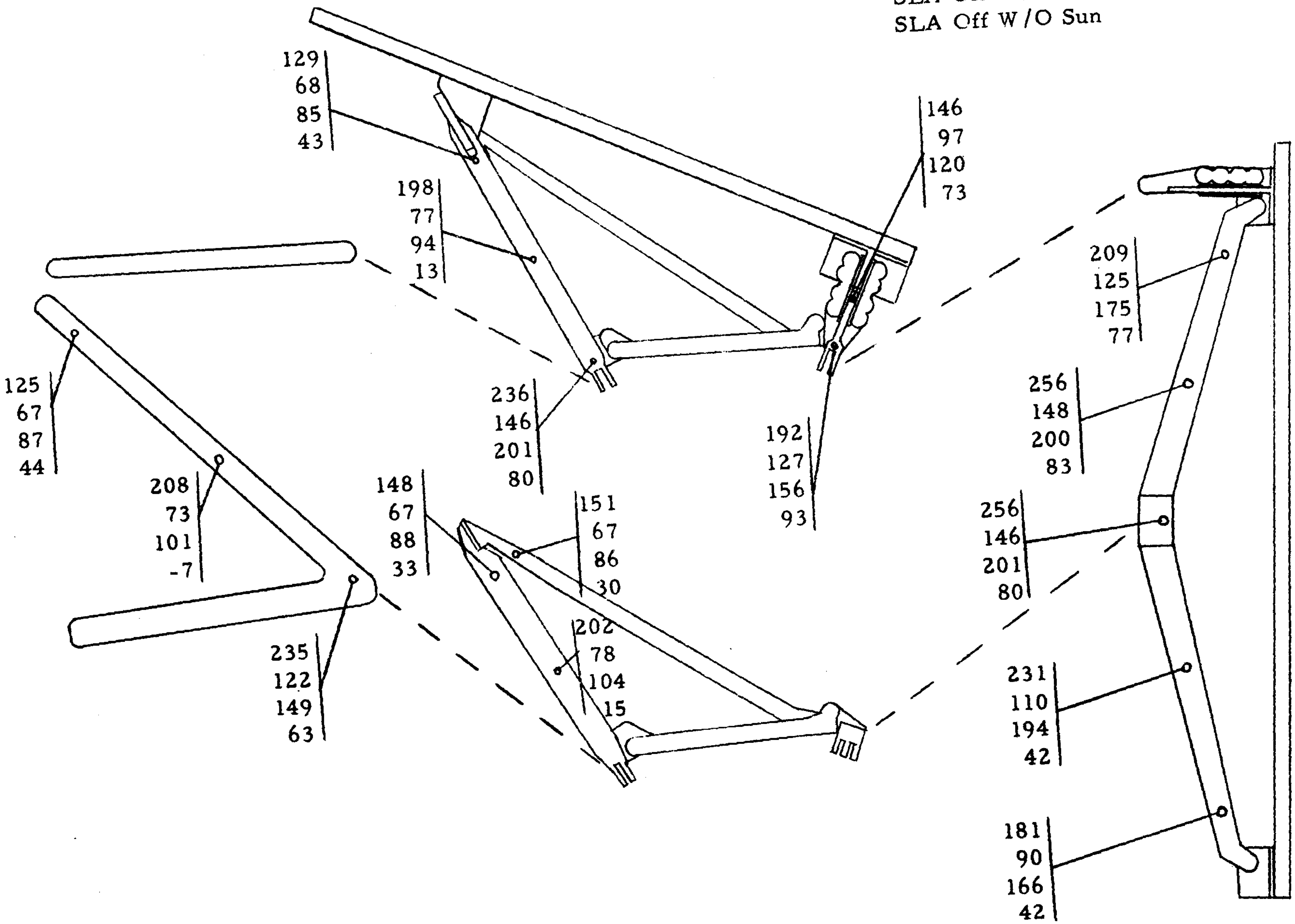


Figure 55

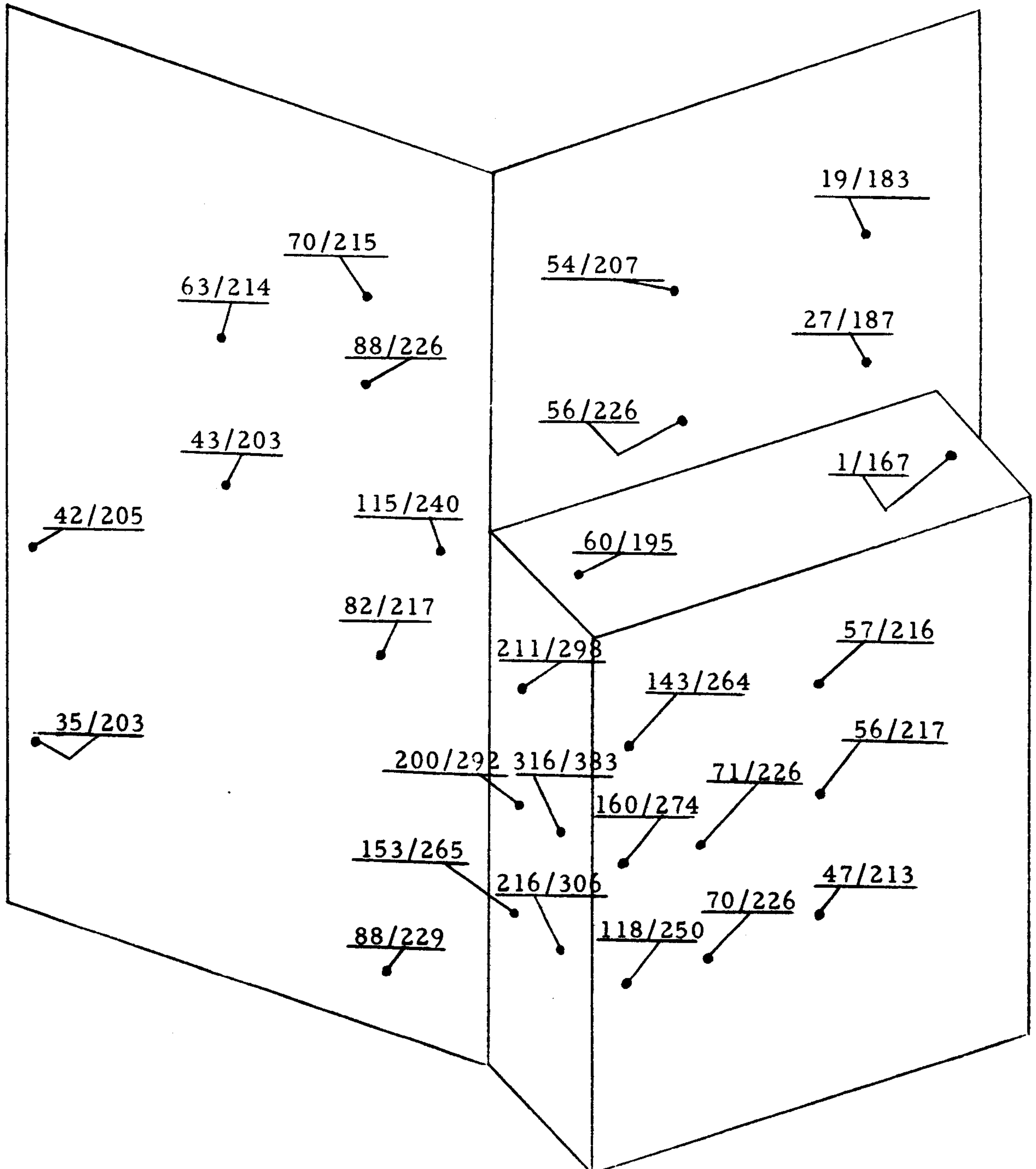
GAEC STRUT TEMPERATURE RESULTS
TEMPERATURES SHOWN IN FOLLOWING ORDER:

SLA On W/Sun
SLA On W/O Sun
SLA Off W/Sun
SLA Off W/O Sun



5607-25

Figure 56

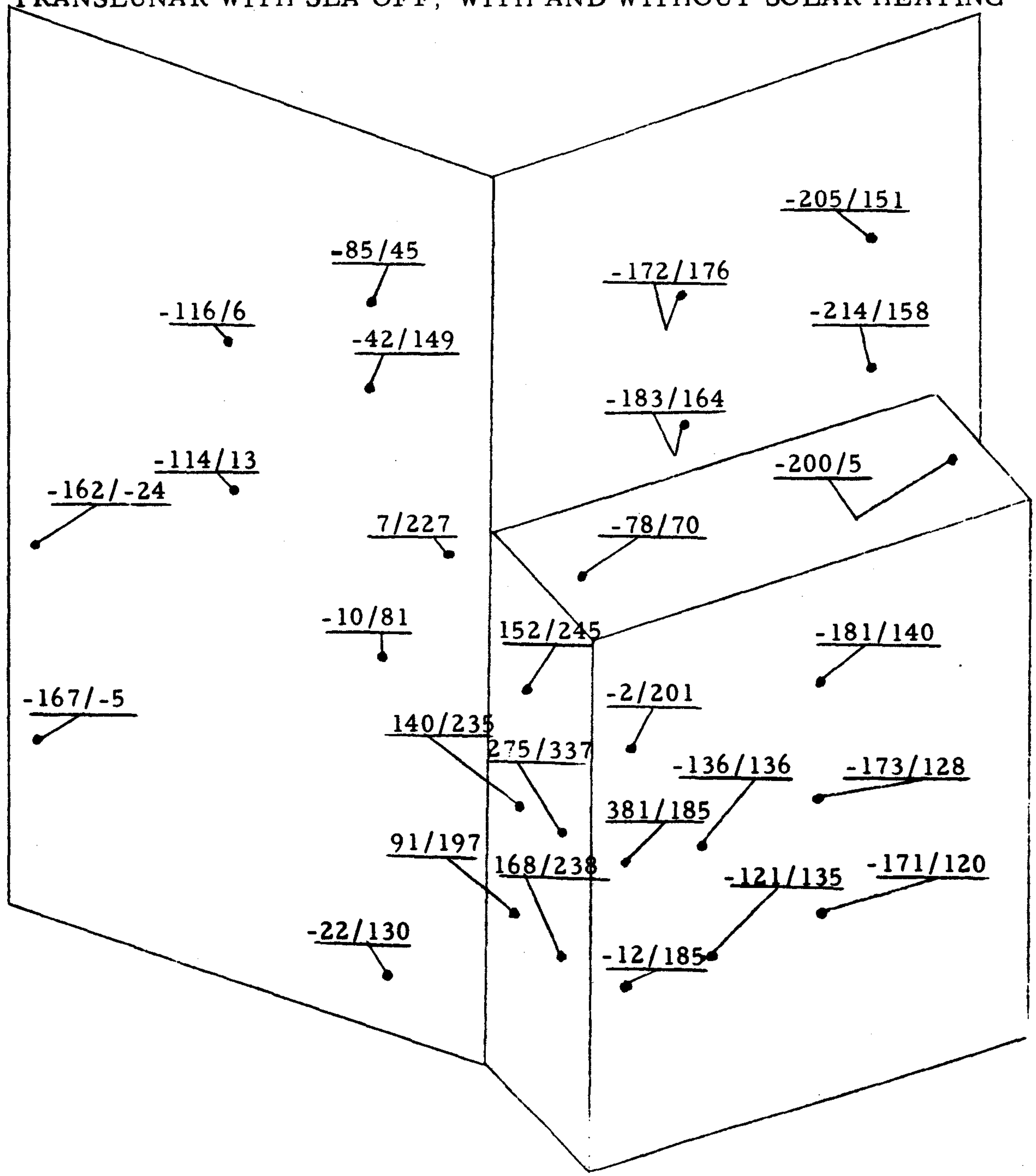


LEM THERMAL BLANKET TEMPERATURE RESULTS
EARTH ORBIT WITH SLA ON, WITH AND WITHOUT SOLAR HEATING

5607-36

Figure 57

LEM THERMAL BLANKET TEMPERATURE RESULTS
TRANSLUNAR WITH SLA OFF, WITH AND WITHOUT SOLAR HEATING



5607-37

Figure 58

ACCEPTANCE AND QUALIFICATION TEST PROGRAM OUTLINE AND TASK NUMBERS

		PRIME QUALIFICATION	FLIGHT 1	FLIGHT 1 BACK-UP	FLIGHT 2	FLIGHT 3	FLIGHT 4	D-2/M-5 QUALIFICATION	D-2/M-5 FLIGHT
	ACCEPTANCE								
0	ASSEMBLY & INSTRUMENTATION	AO	CO	DO	EO	FO	GO	HO	KO
1	WEIGHT AND CG MEASUREMENT	A1	C1	D1	E1	F1	G1	H1	K1
2	LAUNCH VIBRATION	A2	C2	D2	E2	F2	G2	H2	K2
3	FUNCTIONAL TILT TEST	A3	C3	D3	E3	F3	G3		
4	INSPECTION	A4	C4	D4	E4	F4	G4	H4	K4
	QUALIFICATION								
0	INSTRUMENTATION INSTALLATION	B0							
1	AIR SOAK	B1							
2	THERMAL VACUUM	B2							
3	INSPECTION	B3							
4	LAUNCH VIBRATION SHOCK LUNAR DESCENT VIBRATION	B4						H5*	
7	FUNCTIONAL TILT TEST	B7							
8	INSPECTION	B8						H8	
9	TEST REPORTS	B9						H9	

* TASK H-5 INCLUDES ONLY LAUNCH VIBRATION

5607-22

Figure 59

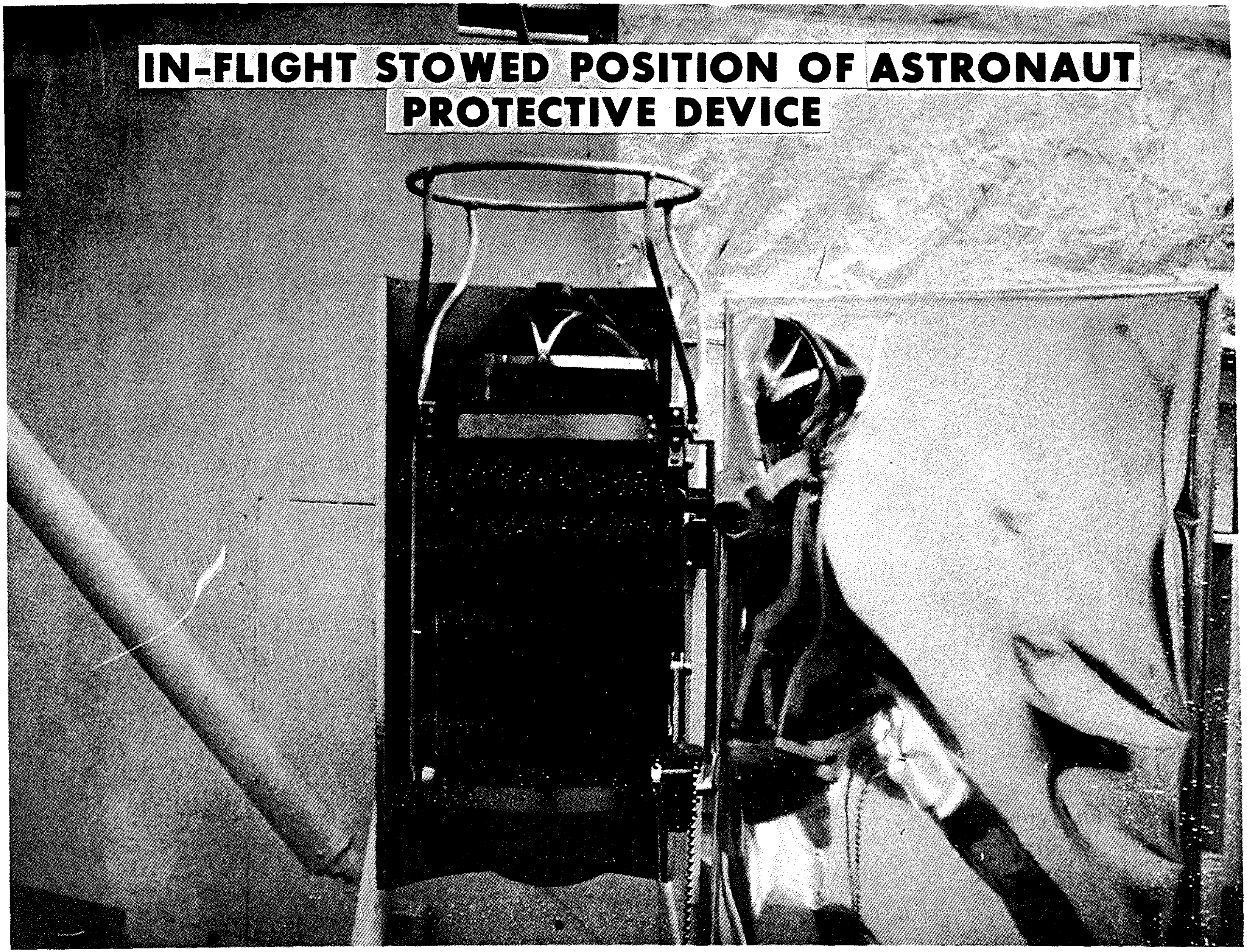


Figure 60

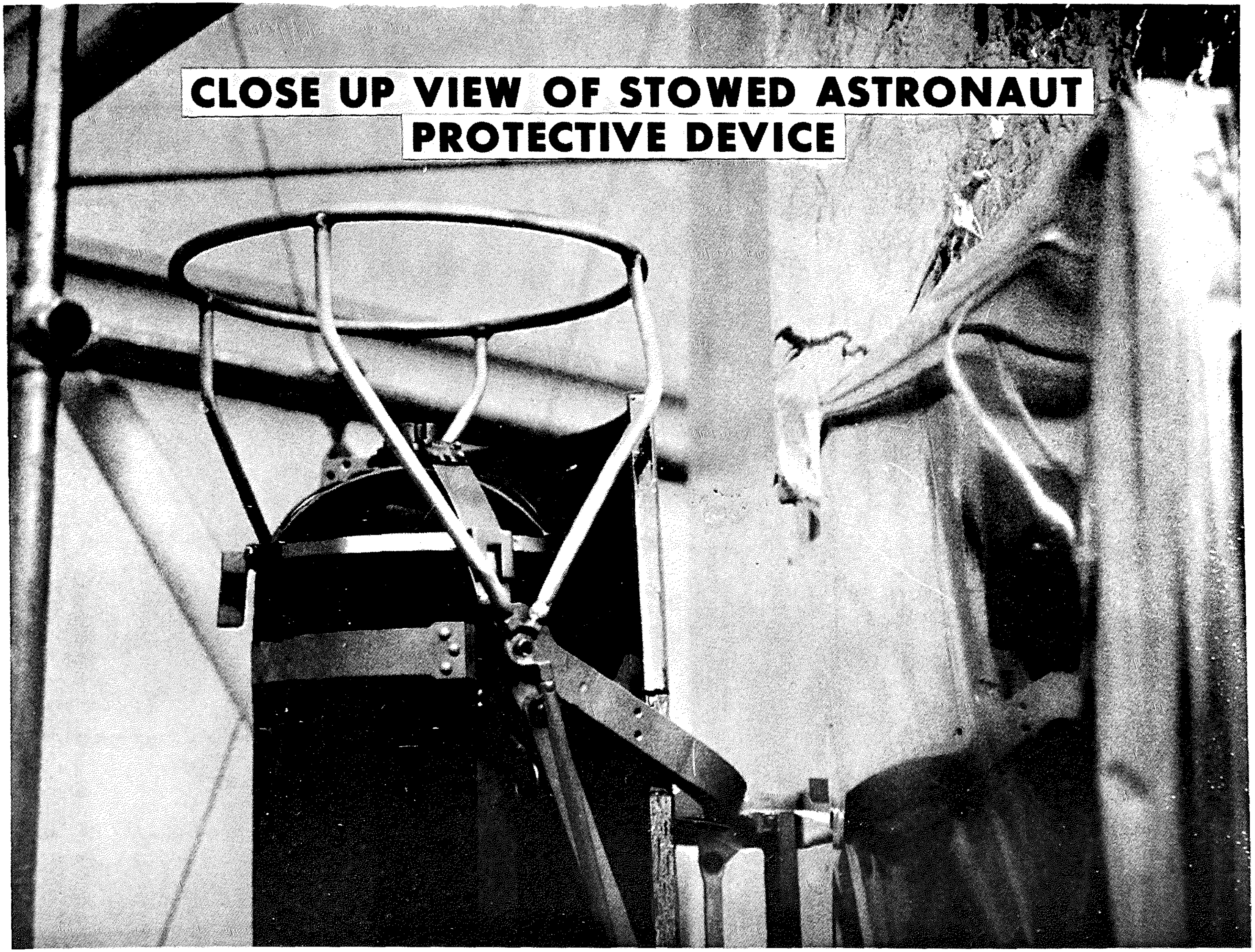


Figure 61

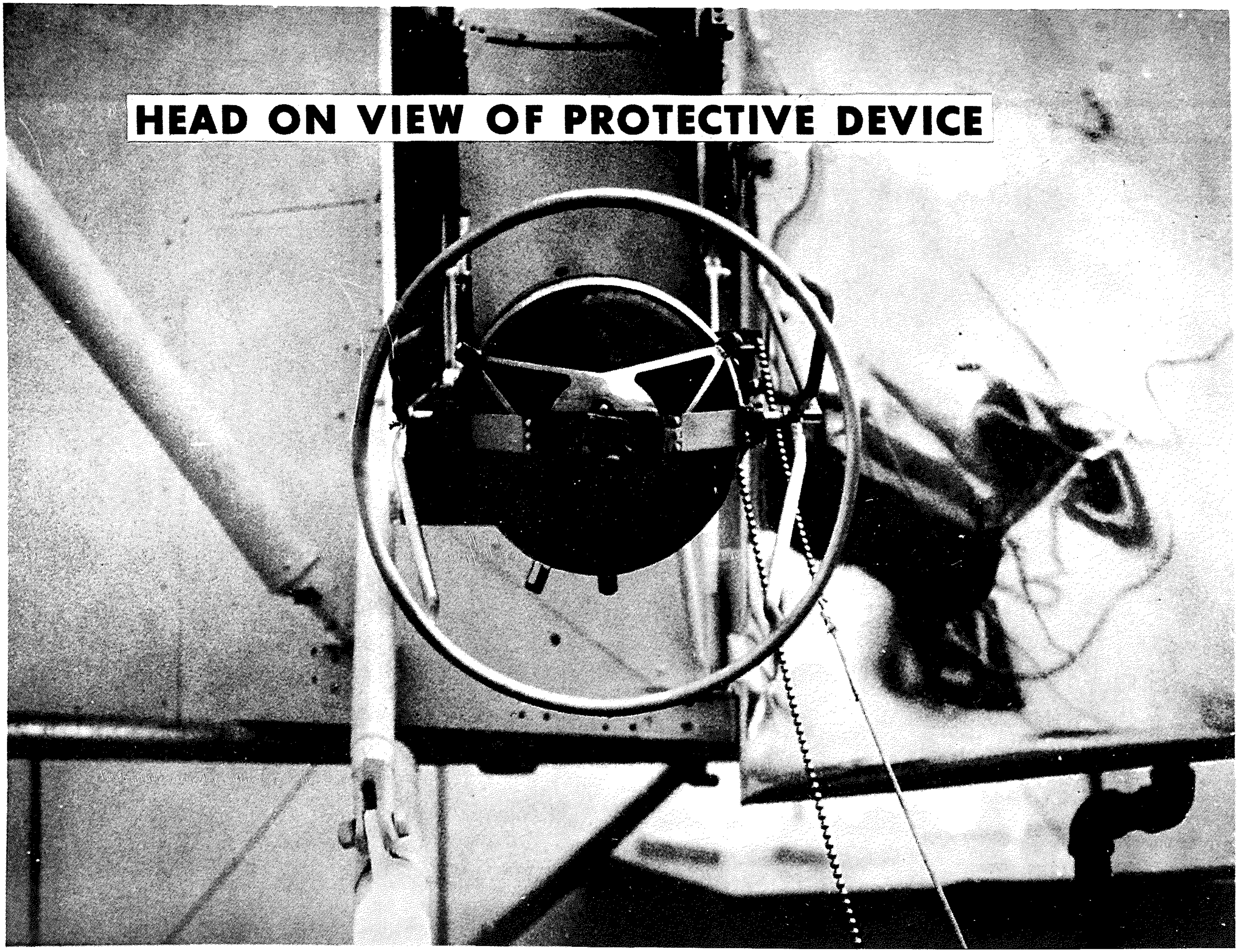


Figure 62

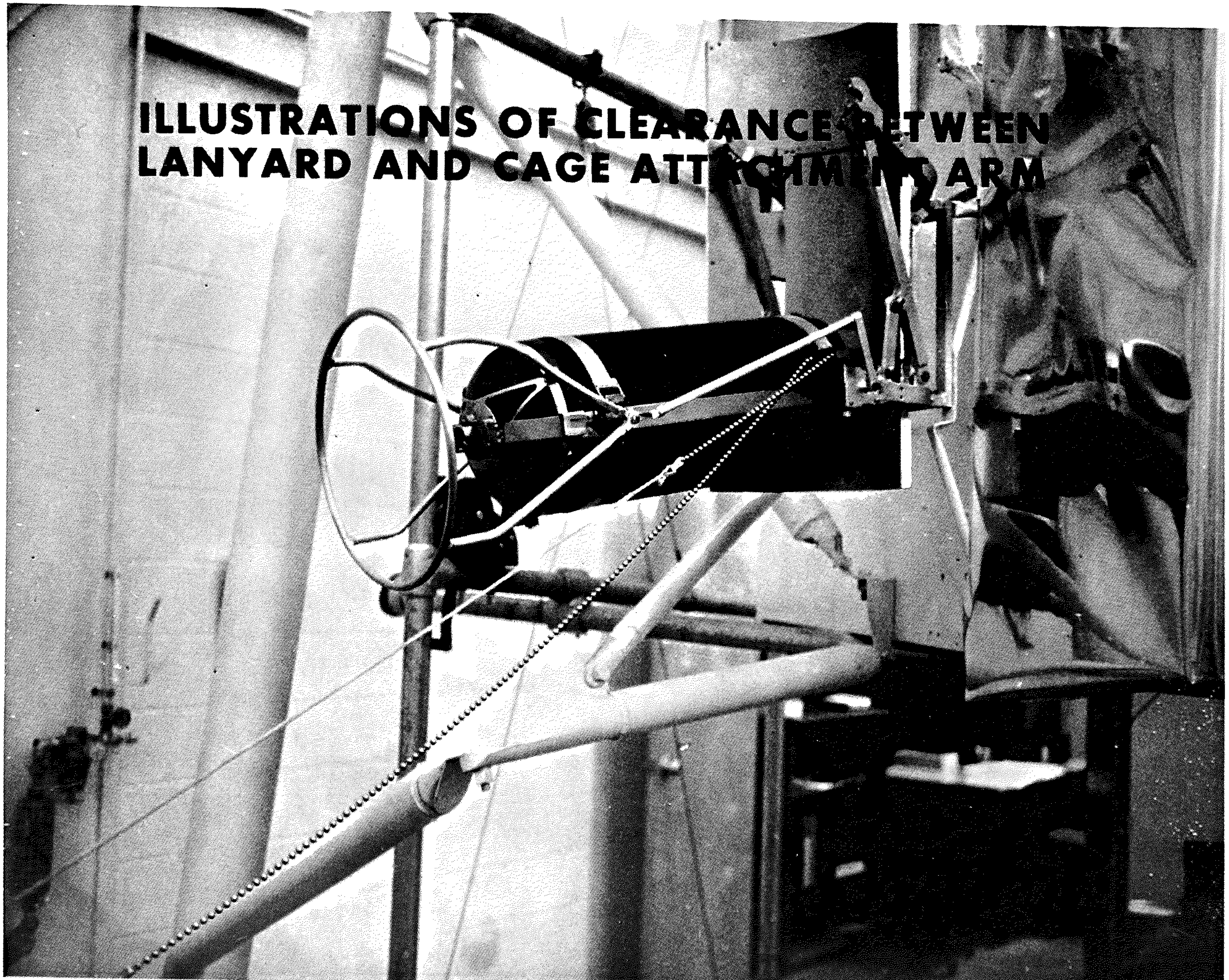

ILLUSTRATIONS OF CLEARANCE BETWEEN
LANYARD AND CAGE ATTACHMENT ARM

Figure 63