

WINGED GEMINI

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COLOR LEGEND

GREEN - QUALIFIED GEMINI EQUIPMENT
YELLOW - QUALIFIED SPACE EQUIPMENT
WHITE - NEW EQUIPMENT

MCDONNELL AIRCRAFT CORPORATION

LANBERT - ST. LOUIS MUNICIPAL AIRPORT, BOX 816, ST. LOUIS, MO. 63166

LIST OF PAGES

This report consists of the following pages:

Title Page

1	1.17
1.1	1.18
1.2	1.19
1.3	1.20
1.3.1	1.21
1.3.2	1.22
1.4	1.23
1.5	1.24
1.6	1.25
1.7	1.26
1.8	1.27
1.9	1.28
1.10	1.29
1.11	1.30
1.12	1.31
1.13	1.32
1.14	
1.15	
1.16	

WINGED GEMINI

OBJECTIVES

- EARLY EXPERIMENTAL DEMONSTRATION OF MANNED FULL SCALE CAPABILITY OF WINGED SPACECRAFT
- PROVIDE LARGE FOOTPRINT RANGE WITH INCREASED TOUCHDOWN CONTROL
- USE OF COMBINED GEMINI AND ASSET EXPERIENCE IN MATERIALS, MANUFACTURING METHODS, TOOLING, AND QUALIFIED COMPONENTS

CONFIGURATION CONCEPTS

- USE OF EXISTING PAD FACILITIES AND MAN-RATED BOOSTER (GLV)
- MAXIMUM USE OF EXISTING GEMINI STRUCTURE
- REDUNDANCY IN RE-ENTRY CAPABILITY
- WING WOULD BE RELEASED PRIOR TO PARACHUTE DEPLOYMENT
- DESIGN SIMPLIFIED BECAUSE OF NO LAND LANDING REQUIREMENTS
- MAJOR SYSTEMS OF GEMINI WOULD BE RETAINED

GENERAL ARRANGEMENT
LAUNCH VEHICLE
AND
WINGED GEMINI

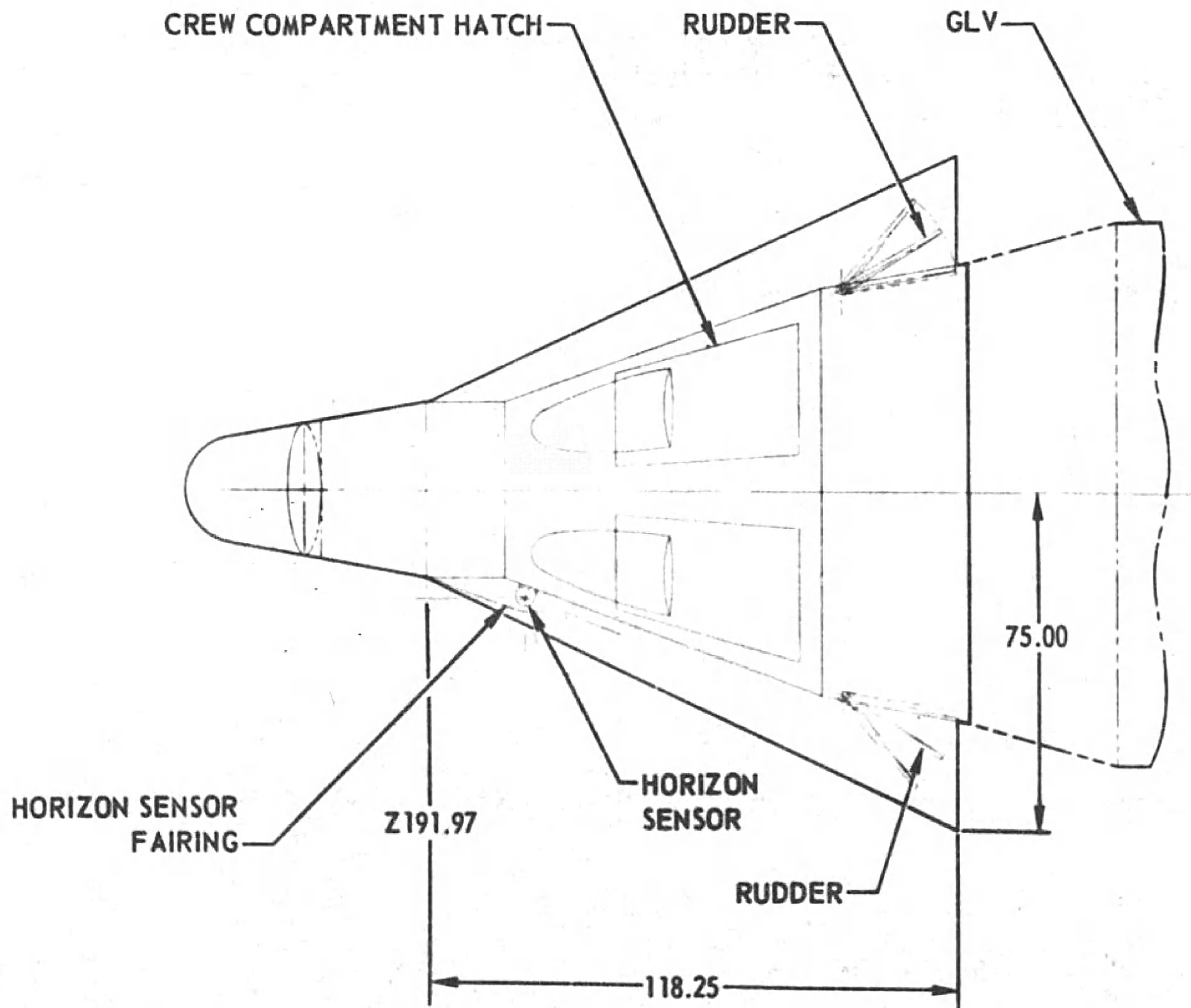
WINGED GEMINI

GLV

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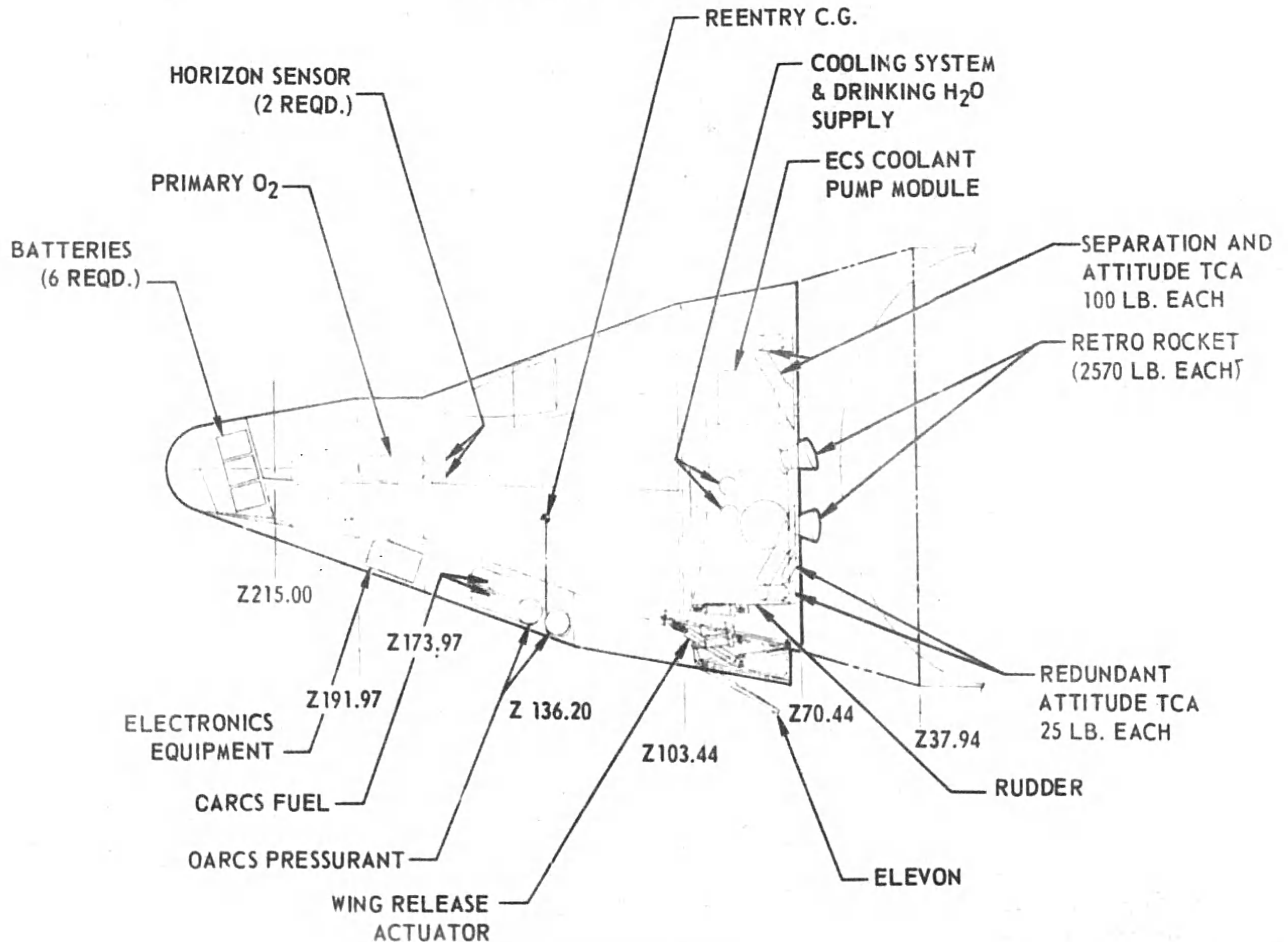


WINGED GEMINI



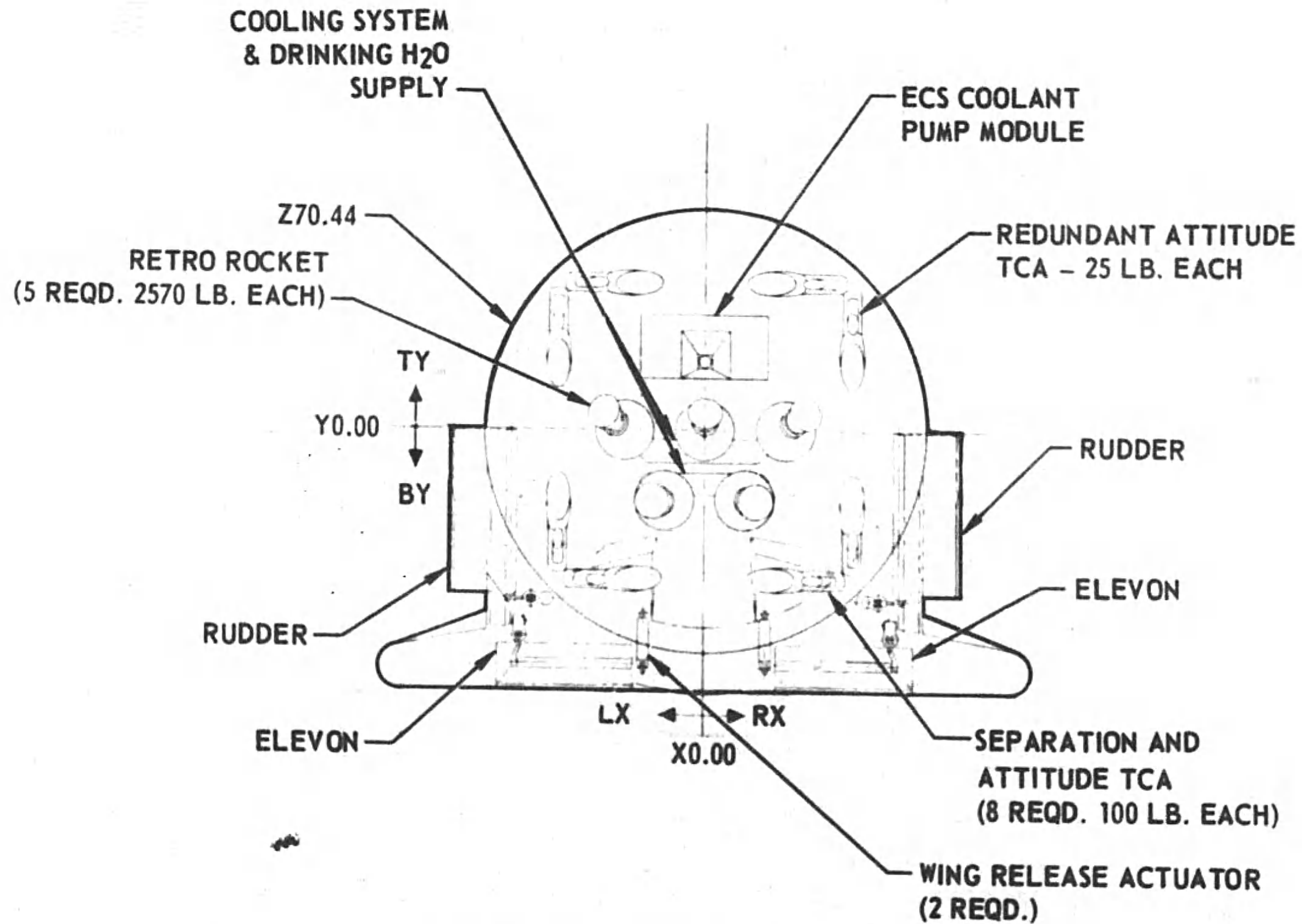
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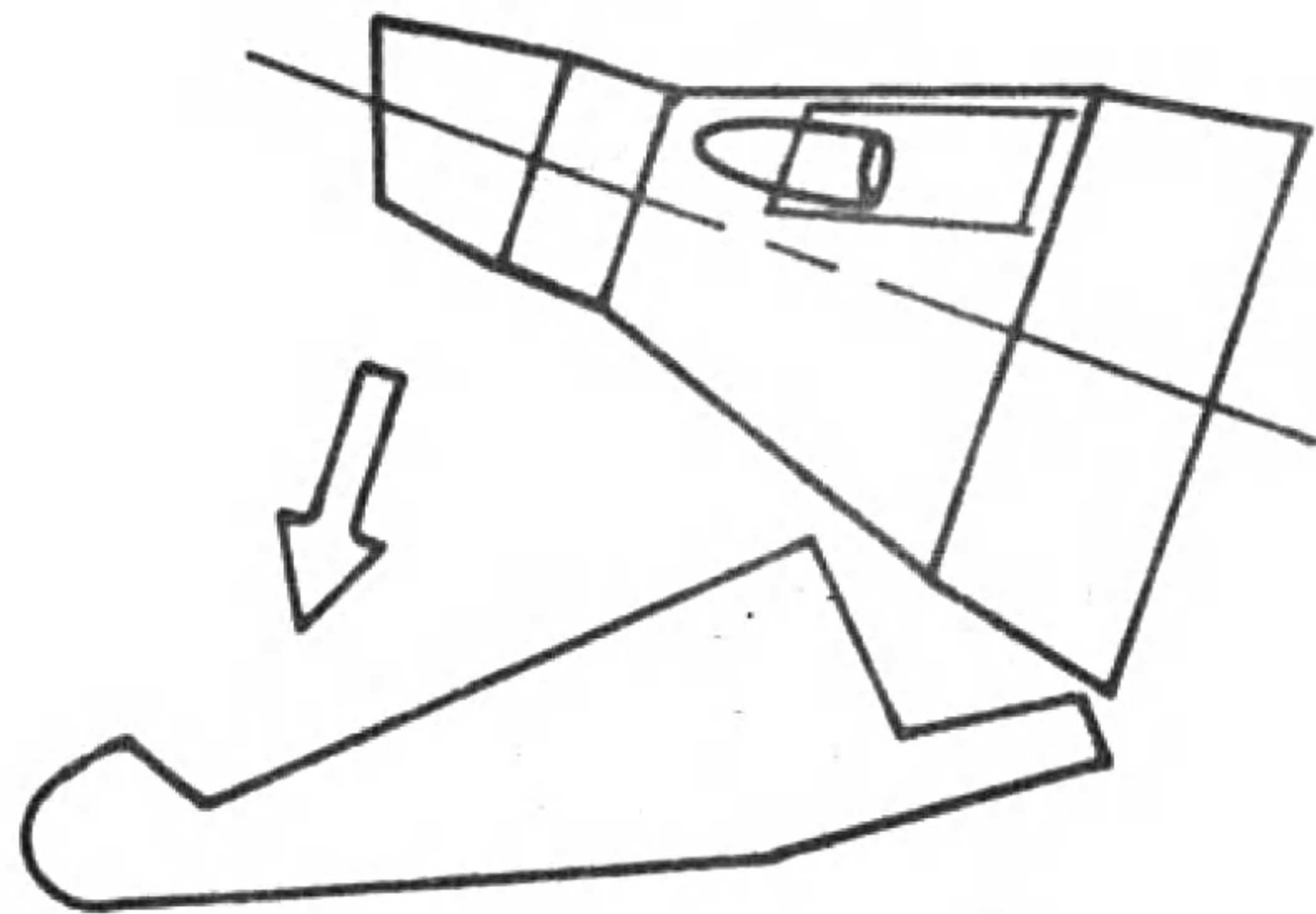
WINGED GEMINI



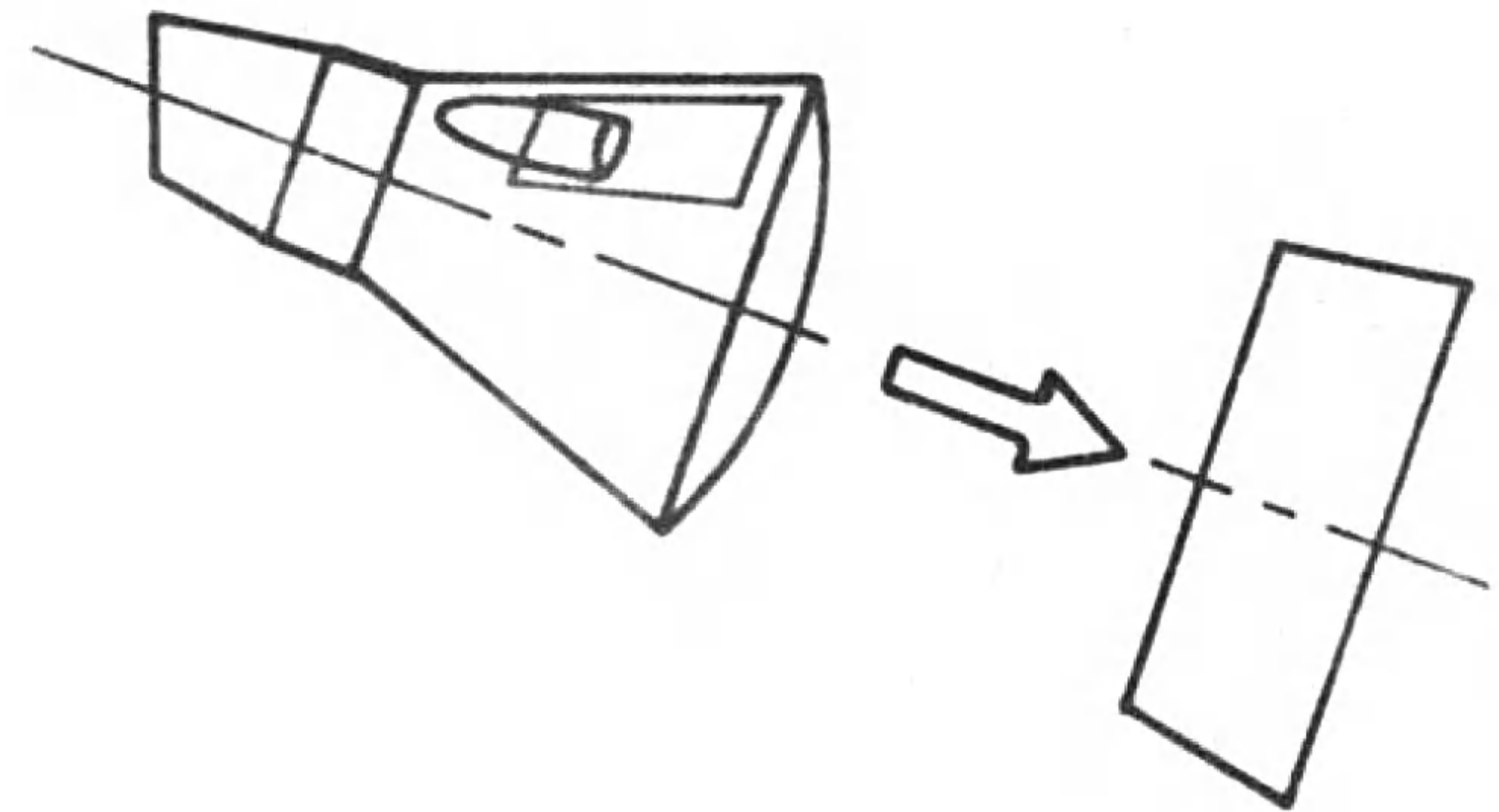
THIS VIEW LOOKING FORWARD

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SEPARATION SEQUENCE PRIOR TO PARACHUTE DEPLOYMENT



● WING SEPARATION FROM
RE-ENTRY MODULE.



● ADAPTER SEPARATION FROM
RE-ENTRY MODULE

ESTIMATED WEIGHT STATEMENT WINGED GEMINI

	WEIGHT (POUNDS)
GLIDER WEIGHT	7646
WING SEPARATION WEIGHT	7390
DROGUE CHUTE DEPLOYMENT WEIGHT	4259
PARACHUTE DEPLOYMENT WEIGHT	4063
TOUCHDOWN WEIGHT - NO PARACHUTE	3952

TABLE OF EXPENDABLES

	LOADED WEIGHT (POUNDS)
RCS PROPELLANT	75
PRIMARY OXYGEN	2
SECONDARY OXYGEN	14
POST LANDING WATER	14
DRINKING AND COOLING WATER	25
OA AND RCS PROPELLANT	187

STRUCTURAL DESIGN PARAMETERS AND CRITERIA

FACTOR OF SAFETY

- ULTIMATE LOAD = 1.36 TIMES LIMIT LOAD.

LAUNCH

- ALL NATURAL AND VEHICLE INDUCED ENVIRONMENT SAME AS GEMINI 'A' (EXCEPT LOCALIZED BUFFETING).
- MAXIMUM LOCAL DYNAMIC ULTIMATE PRESSURES: 12.7 PSI ON NOSE, 3.91 PSI ON WING LOWER SURFACE.

ABORT

- SAME AS GEMINI 'A' (JETTISON WING PRIOR TO PARACHUTE DEPLOYMENT)

RE-ENTRY

- ANGLE OF ATTACK 30-37.8 DEGREES
- MAXIMUM FREE STREAM q OF 200 PSF
- MAXIMUM LOCAL DYNAMIC ULTIMATE PRESSURES: 3.5 PSI ON NOSE, 3.37 PSI ON WING LOWER SURFACE.

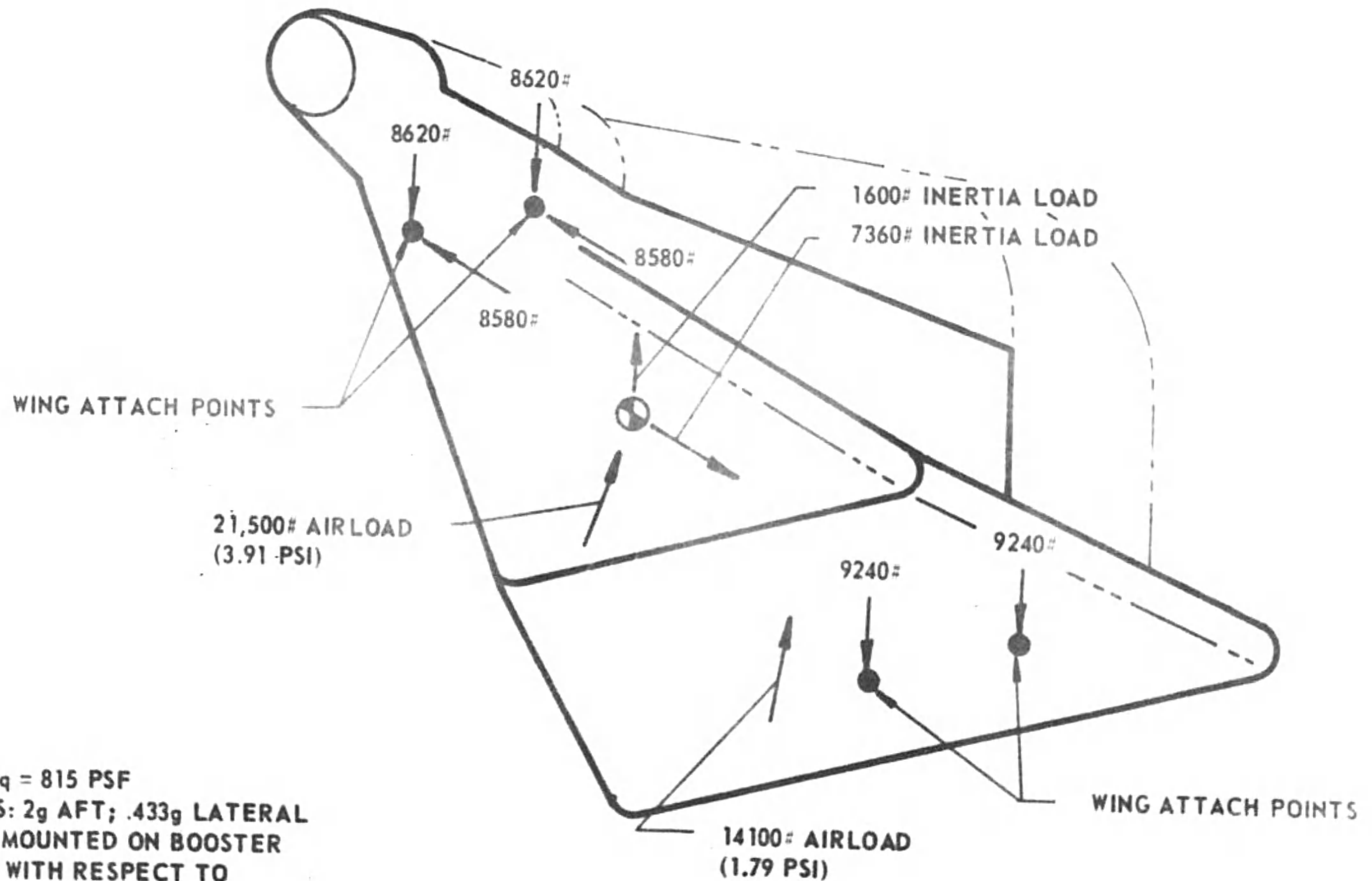
WING JETTISON

- JETTISON WING AT 100,000 FT. ALTITUDE MACH NO. 2.36 TO 3.76.
- ROTATE WING 8.5 DEGREES WITH RESPECT TO GEMINI WITHIN .40 SEC.

LANDING

- SAME AS GEMINI 'A'

ULTIMATE DESIGN LOADS WING ATTACH POINTS



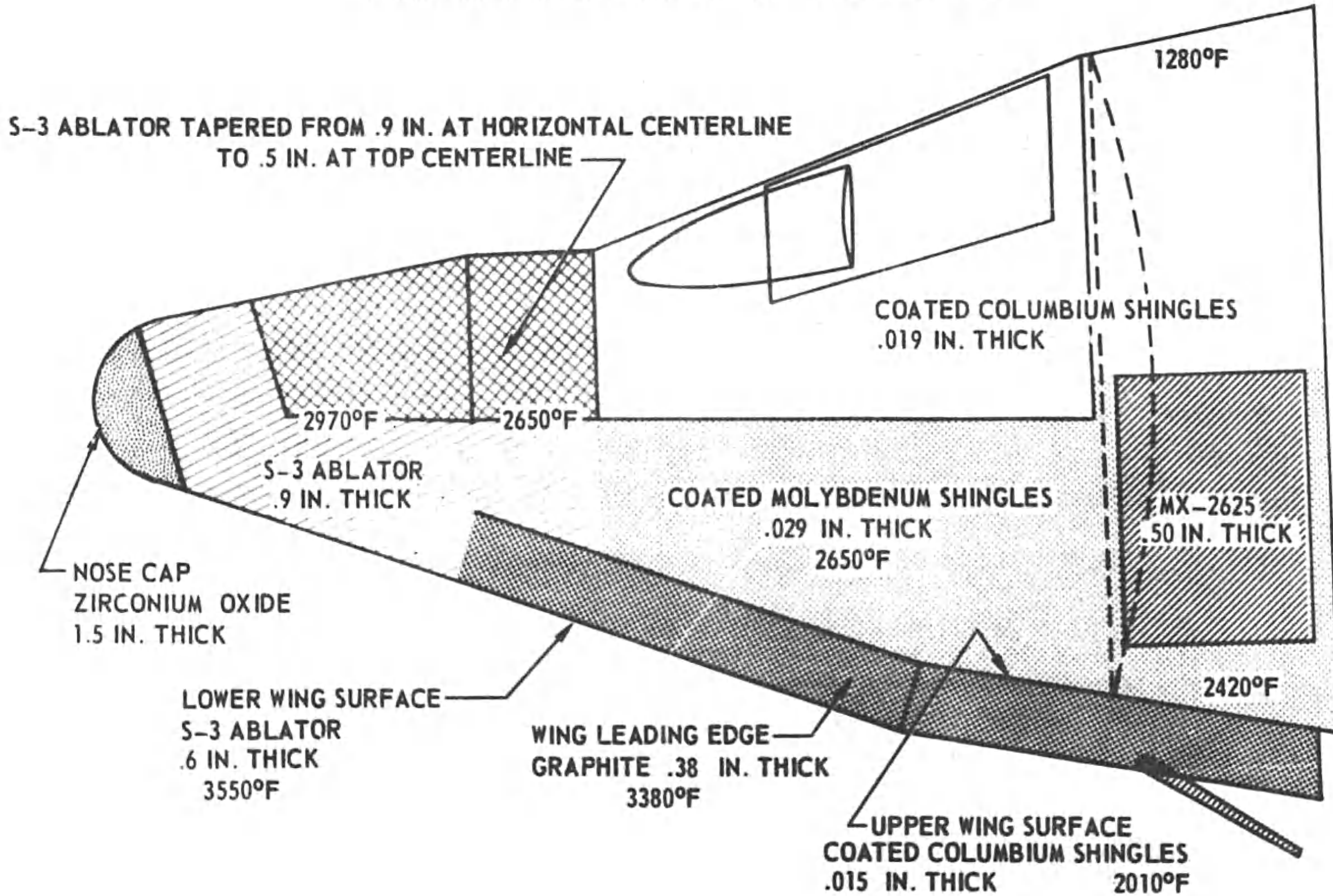
CONDITION

- LAUNCH
- T = 75 SEC.
- M = 1.72
- FREE STREAM $q = 815$ PSF
- INERTIA LOADS: 2g AFT; .433g LATERAL
- LIFTING BODY MOUNTED ON BOOSTER WITH 8° CANT WITH RESPECT TO BOOSTER CENTER LINE

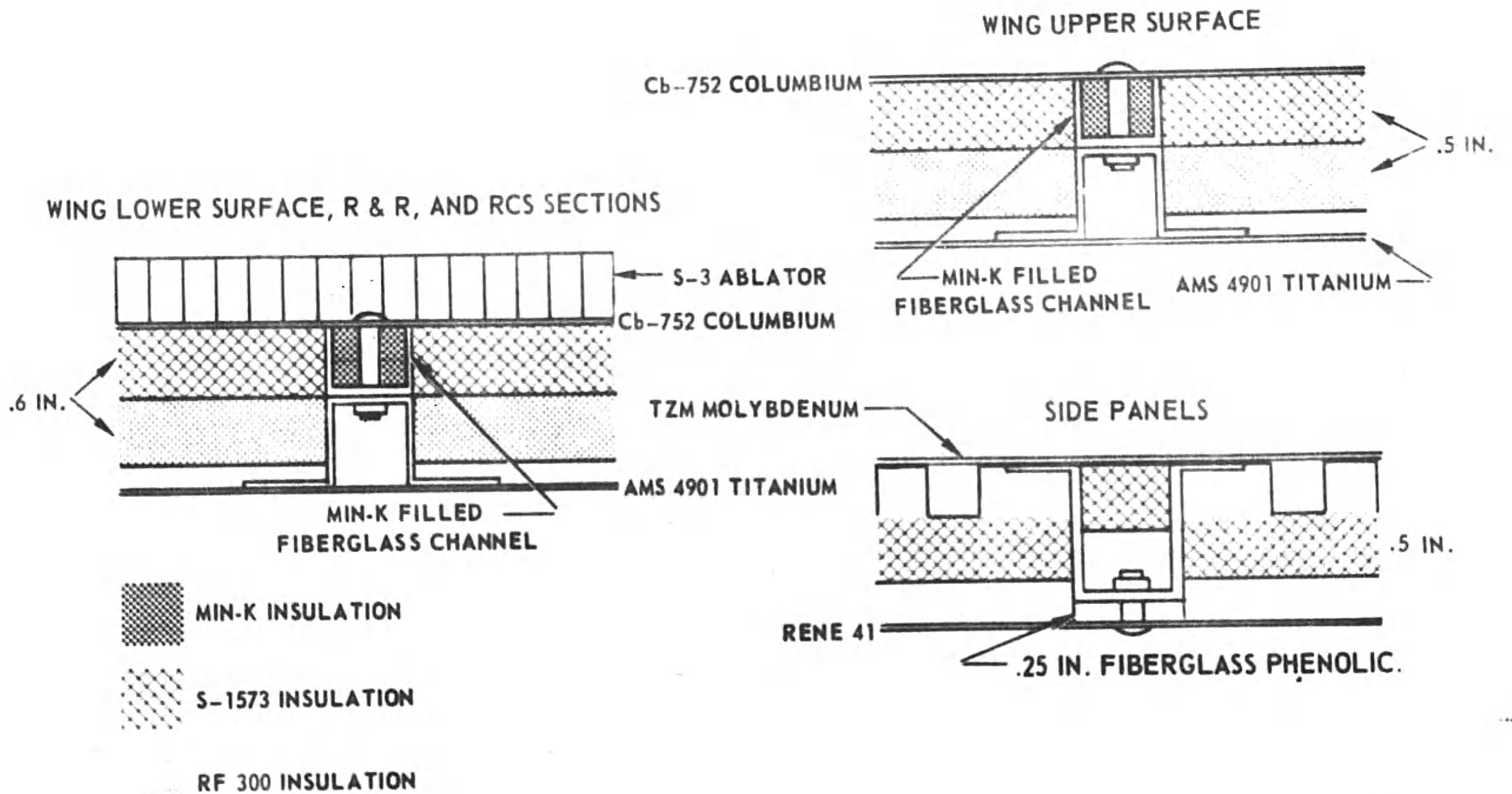
WINGED GEMINI HEAT PROTECTION

- HEAT PROTECTION SYSTEM IS REDUNDANT
 - RE-ENTRY FROM ORBIT - WINGED GEMINI OR NORMAL GEMINI CONFIGURATION
 - ABORT - NORMAL GEMINI CONFIGURATION
- MATERIALS ARE FLIGHT QUALIFIED FROM GEMINI OR ASSET PROGRAMS
- AERODYNAMIC HEATING DESIGN HEATING DATA FROM GEMINI AND ASSET FLIGHTS SUPPLEMENTED BY WINGED GEMINI MODEL WIND TUNNEL TESTS
- HEAT PROTECTION IS DESIGNED FOR RE-ENTRY FROM 87 TO 100 N.M. ORBITS
- ANGLE OF ATTACK LIMITED TO A MINIMUM OF 30° TO REDUCE HEATING ON WINDOWS TO ACCEPTABLE DESIGN VALUES

WINGED GEMINI MAXIMUM DESIGN TEMPERATURES AND HEAT PROTECTION MATERIALS

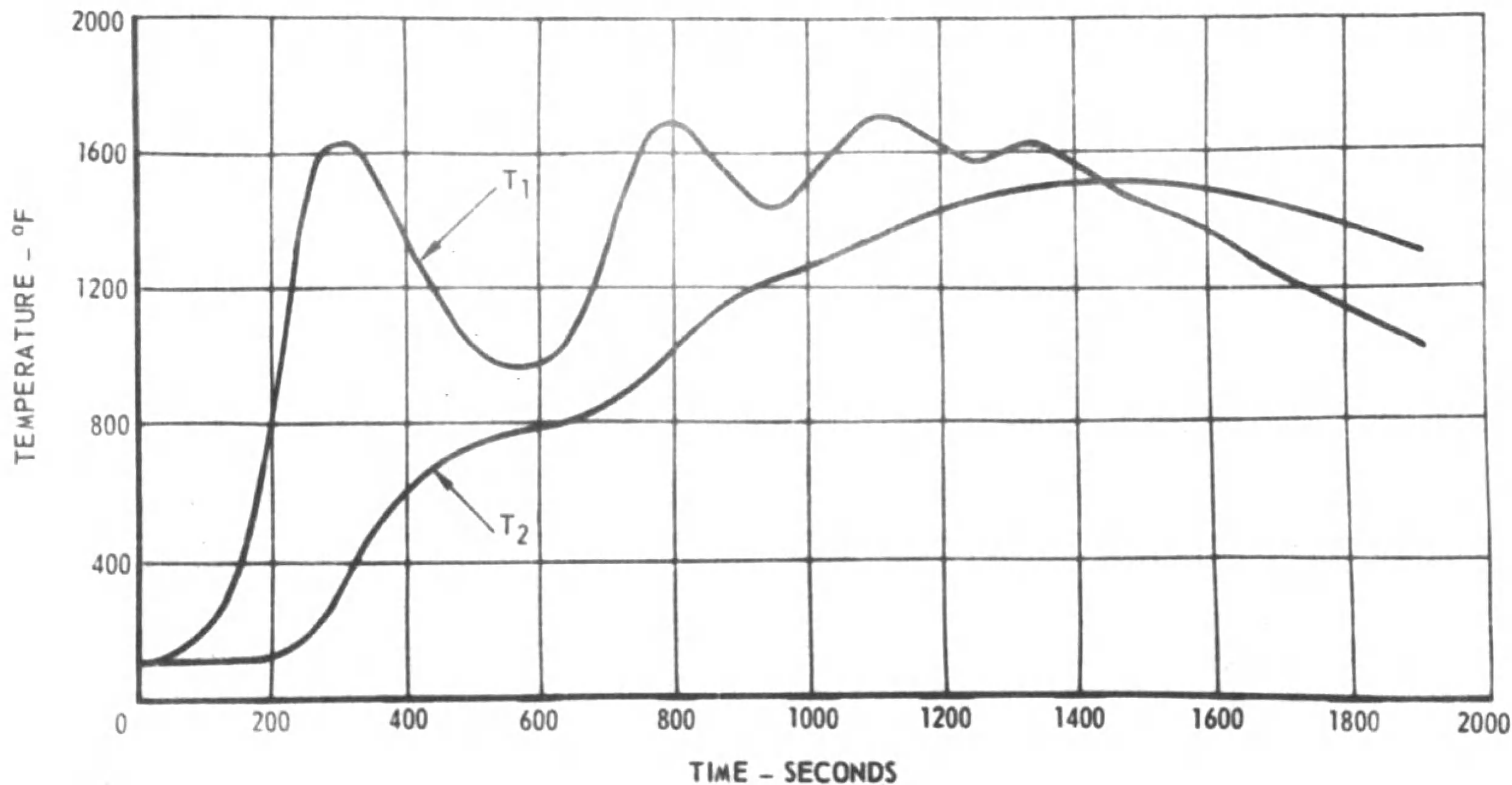
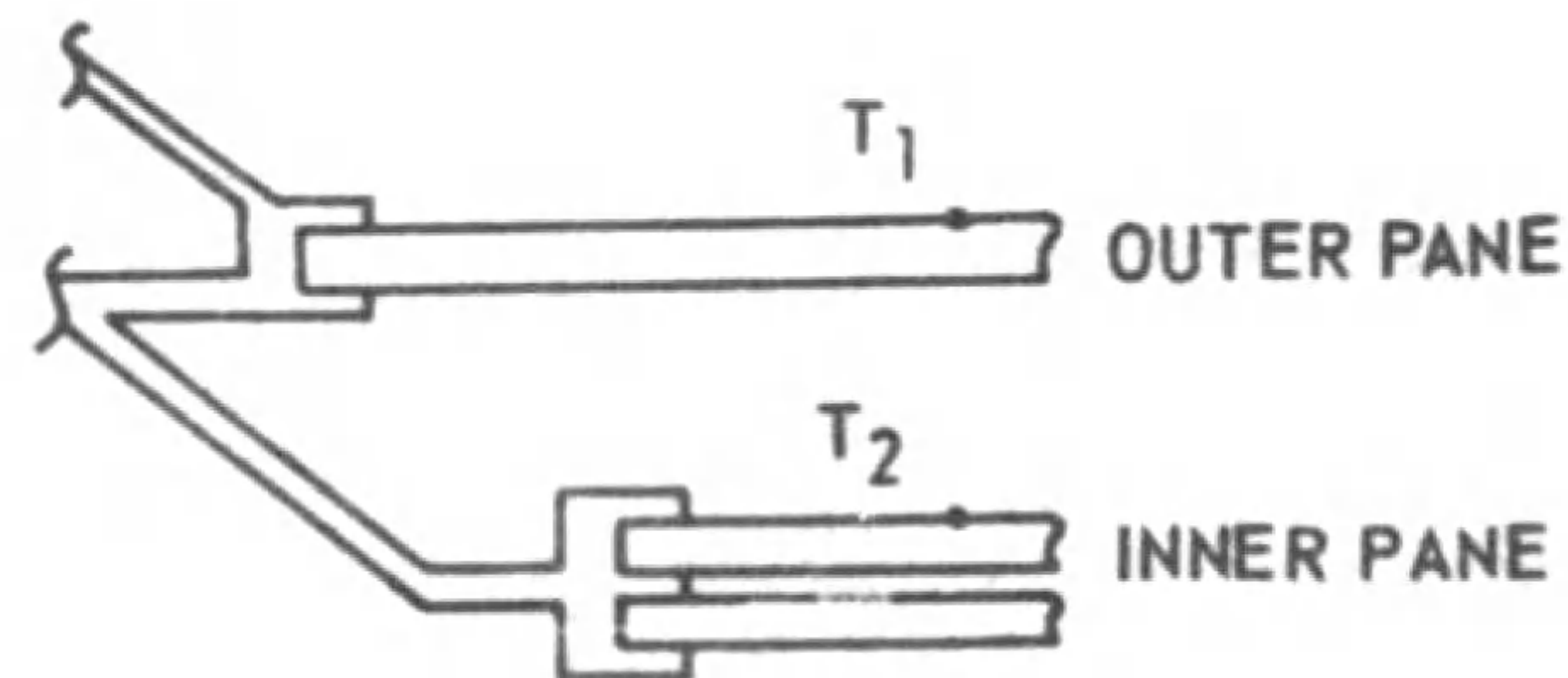


WINGED GEMINI HEAT PROTECTION CROSS SECTIONS



WINGED GEMINI-WINDOW TEMPERATURES DURING RE-ENTRY

RE-ENTRY $\gamma = -1.75^\circ$

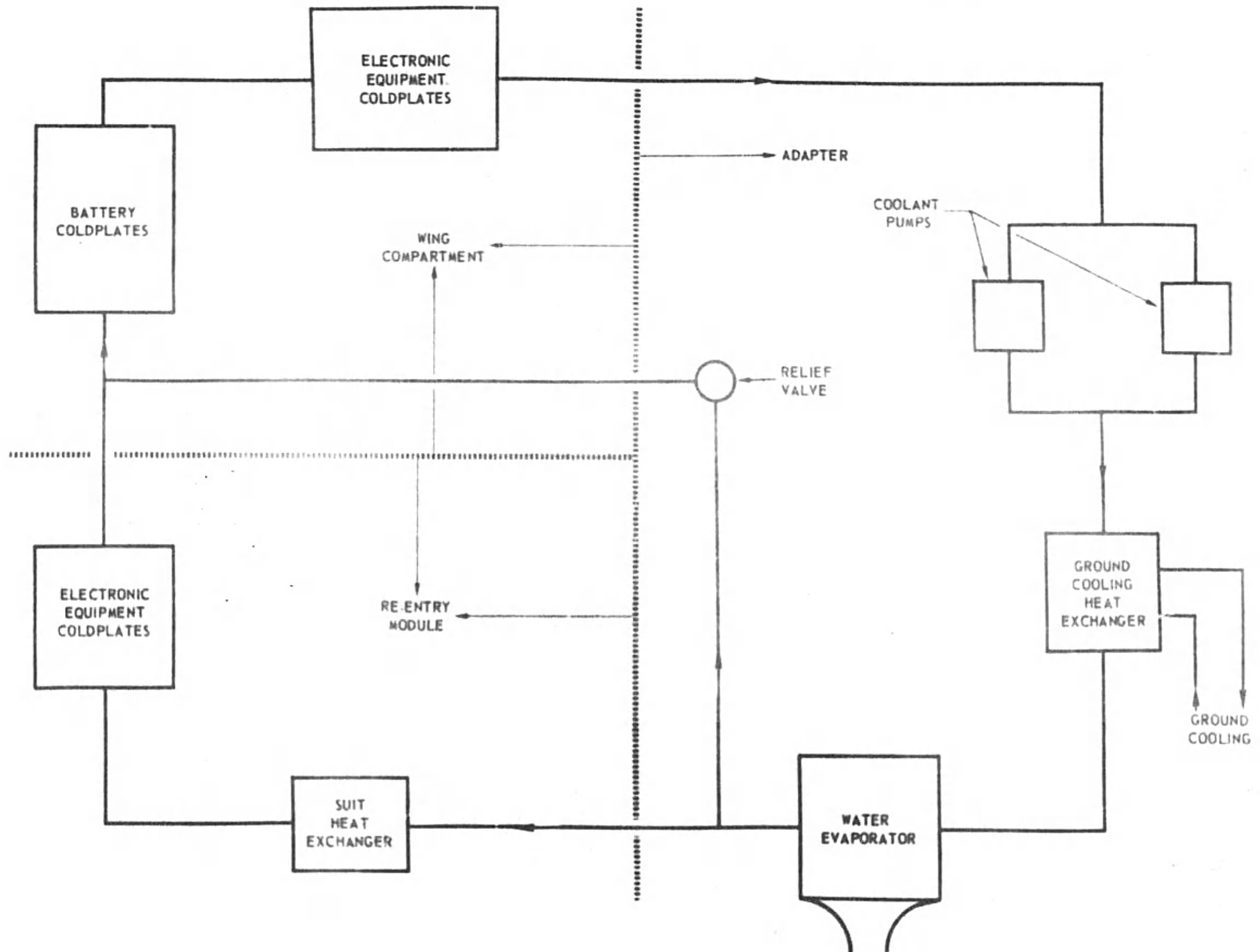


WINGED GEMINI ECS AND COOLING SYSTEM DESIGN CRITERIA

- SUPPORT TWO MEN
- EARTH ORBITAL MISSION
- PRIMARY OXYGEN SUPPLY FOR METABOLIC PURPOSES AND CABIN LEAKAGE
 - (1) 3.5 HOURS PRE-LAUNCH
 - (2) THREE ORBIT MISSION
 - (3) TWO POUNDS O₂ REQUIRED – STORED AS A GAS IN PRESENT SECONDARY OXYGEN BOTTLES.
- SIXTEEN POUNDS OF WATER ARE CARRIED FOR METABOLIC PURPOSES – THREE POUNDS FOR FLIGHT – THIRTEEN POUNDS FOR POST LANDING.
- ONE COOLANT LOOP WITH REDUNDANT PUMPS
- MAXIMUM HEAT LOAD IS 4800 BTU/HR.
 - (1) HEAT IS DISSIPATED BY EVAPORATING WATER.
 - (2) 21.5 POUNDS OF WATER REQUIRED FOR COOLING.

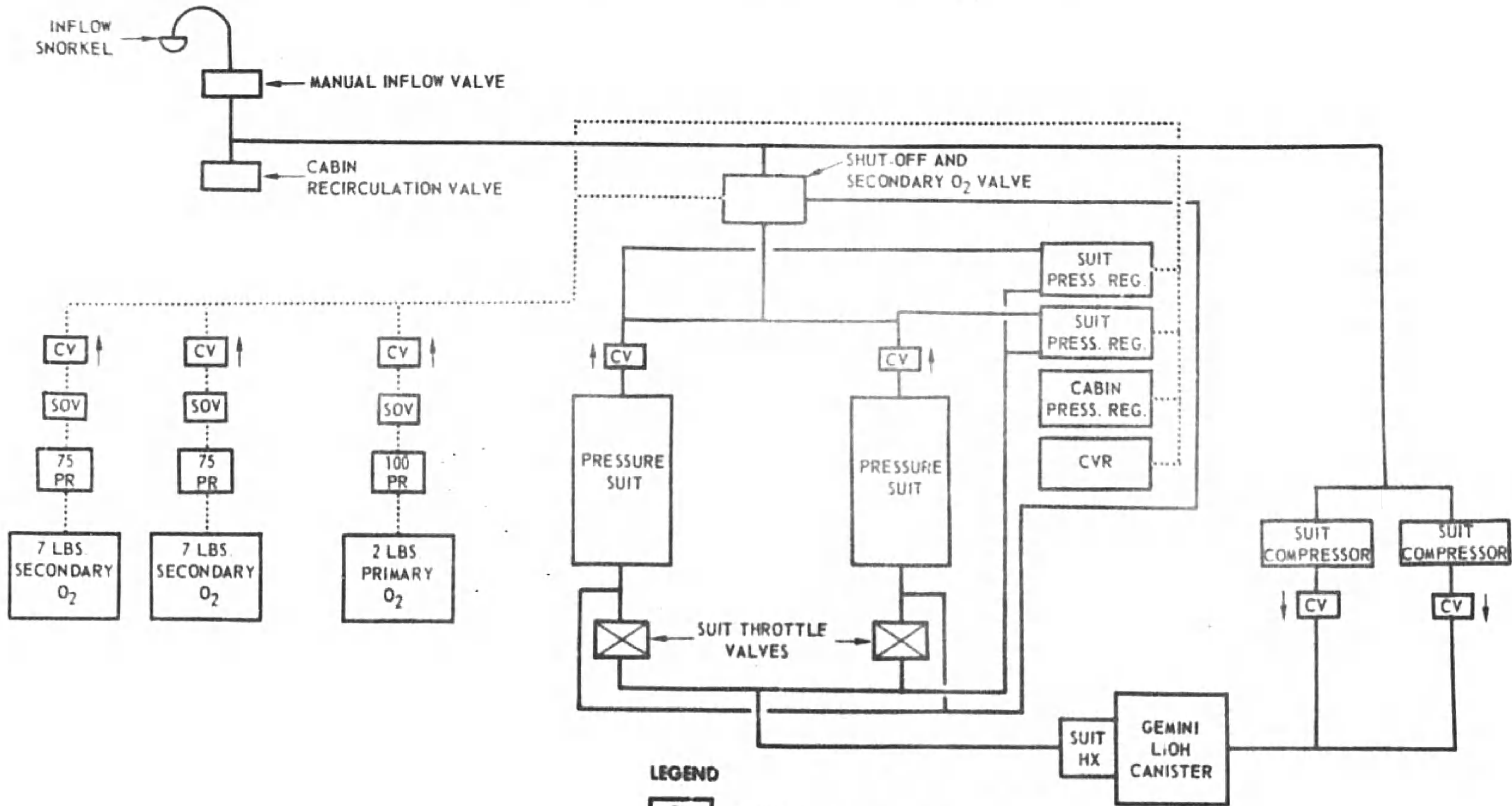
COOLANT SYSTEM FOR WINGED GEMINI

REPORT NO. E045
10 SEPTEMBER 1965



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ENVIRONMENTAL CONTROL SYSTEM FOR WINGED GEMINI



LEGEND

- CV** CHECK VALVE
- SOV** SHUT-OFF VALVE
- 75 PR** 75 PSI PRESSURE REGULATOR
- 100 PR** 100 PSI PRESSURE REGULATOR
- CRV** CABIN REPRESS VALVE
- HIGH PRESSURE O₂ SUPPLY

ELECTRICAL POWER SYSTEM

● GEMINI

FOUR 45 A-H RE-ENTRY MAIN BUS BATTERIES

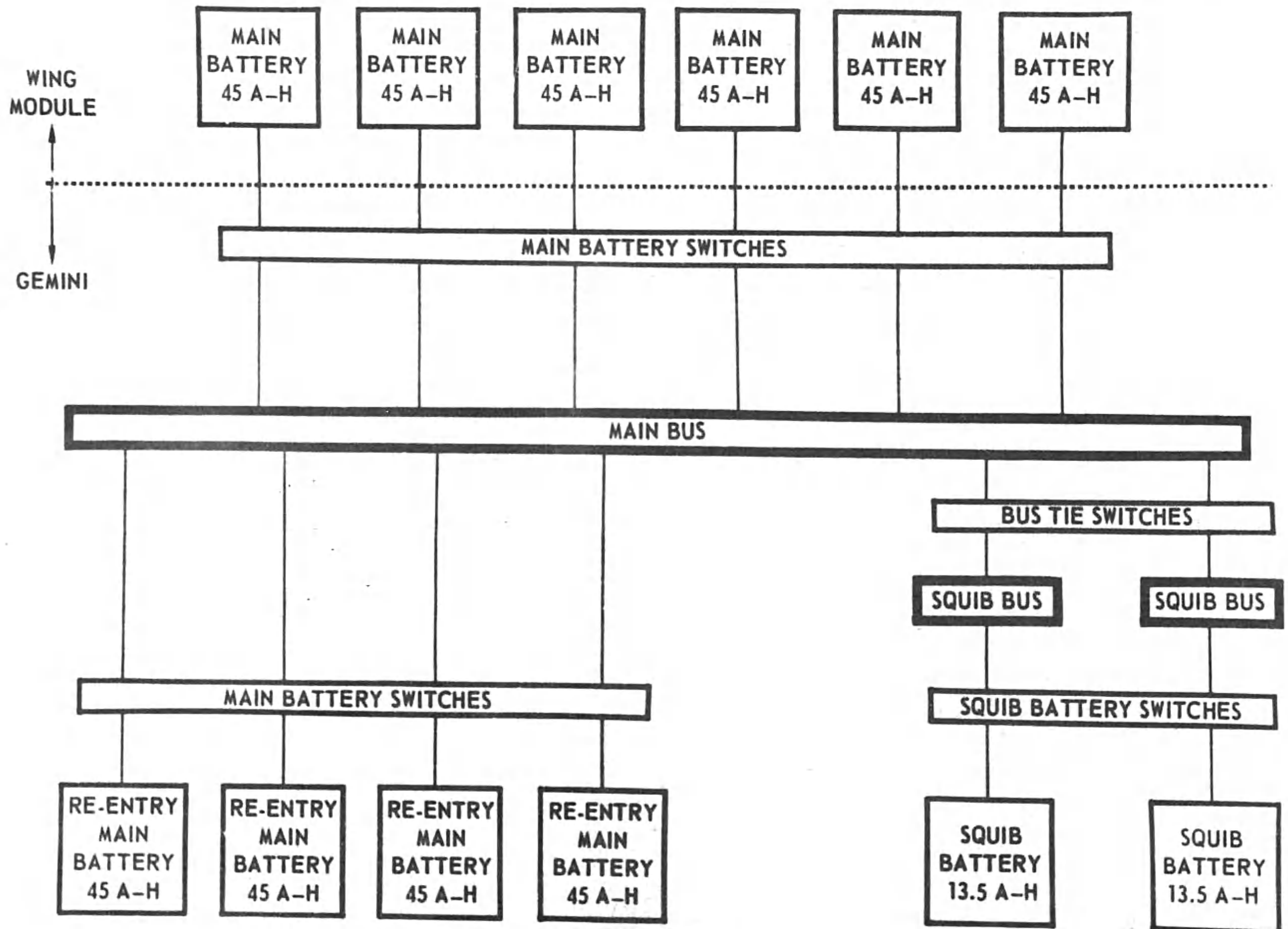
TWO 13.5 A-H SQUIB BUS BATTERIES

● WING MODULE

SIX 45 A-H MAIN BUS BATTERIES

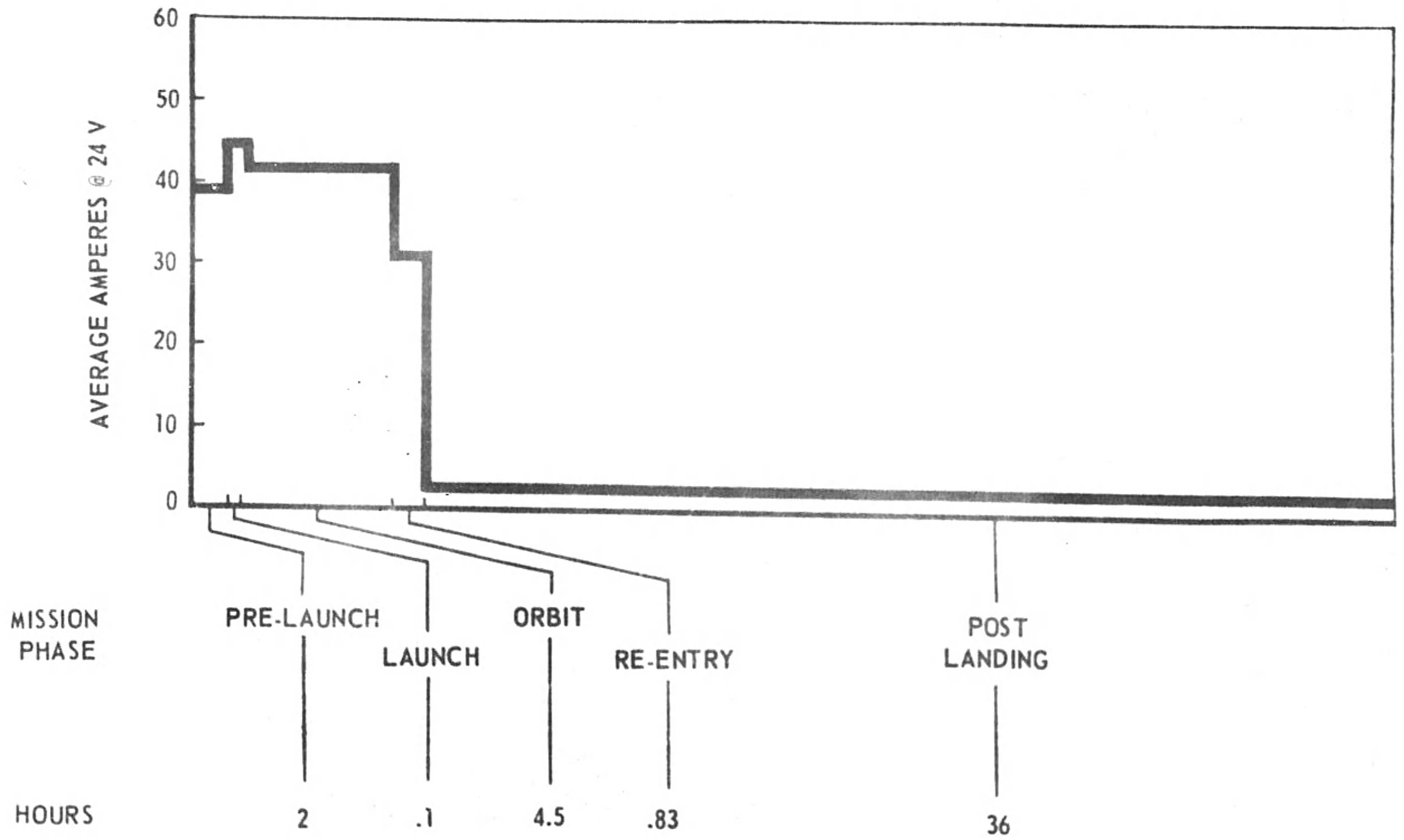
BLOCK DIAGRAM-ELECTRICAL POWER SYSTEM

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ELECTRICAL LOAD PROFILE



ELECTRICAL LOAD SUMMARY

	SYSTEM TOTAL	PRE-LAUNCH	LAUNCH	ORBIT	RE-ENTRY	POST LANDING
EQUIPMENT	AMP.-HRS.	AMPS.	AMPS.	AMPS.	AMPS.	AMPS.
COMMUNICATIONS	49.93	1.41	3.20	2.49	2.64	.97
ENVIRONMENTAL	84.30	8.28	9.40	9.56	1.76	.85
GUIDANCE & CONTROL	145.47	22.96	25.10	22.96	20.08	
INSTRUMENTATION	13.41	2.18	2.30	2.36	.44	
LIGHTING	23.52	3.68	3.80	3.46	4.69	.02
MISCELLANEOUS	5.21	.82	.90	.59	.98	
TOTAL	321.84	39.33	44.70	41.42	30.59	1.84

GUIDANCE AND CONTROL BASIC FUNCTIONS

BACKUP LAUNCH VEHICLE ASCENT GUIDANCE

SAME AS PRESENT GEMINI

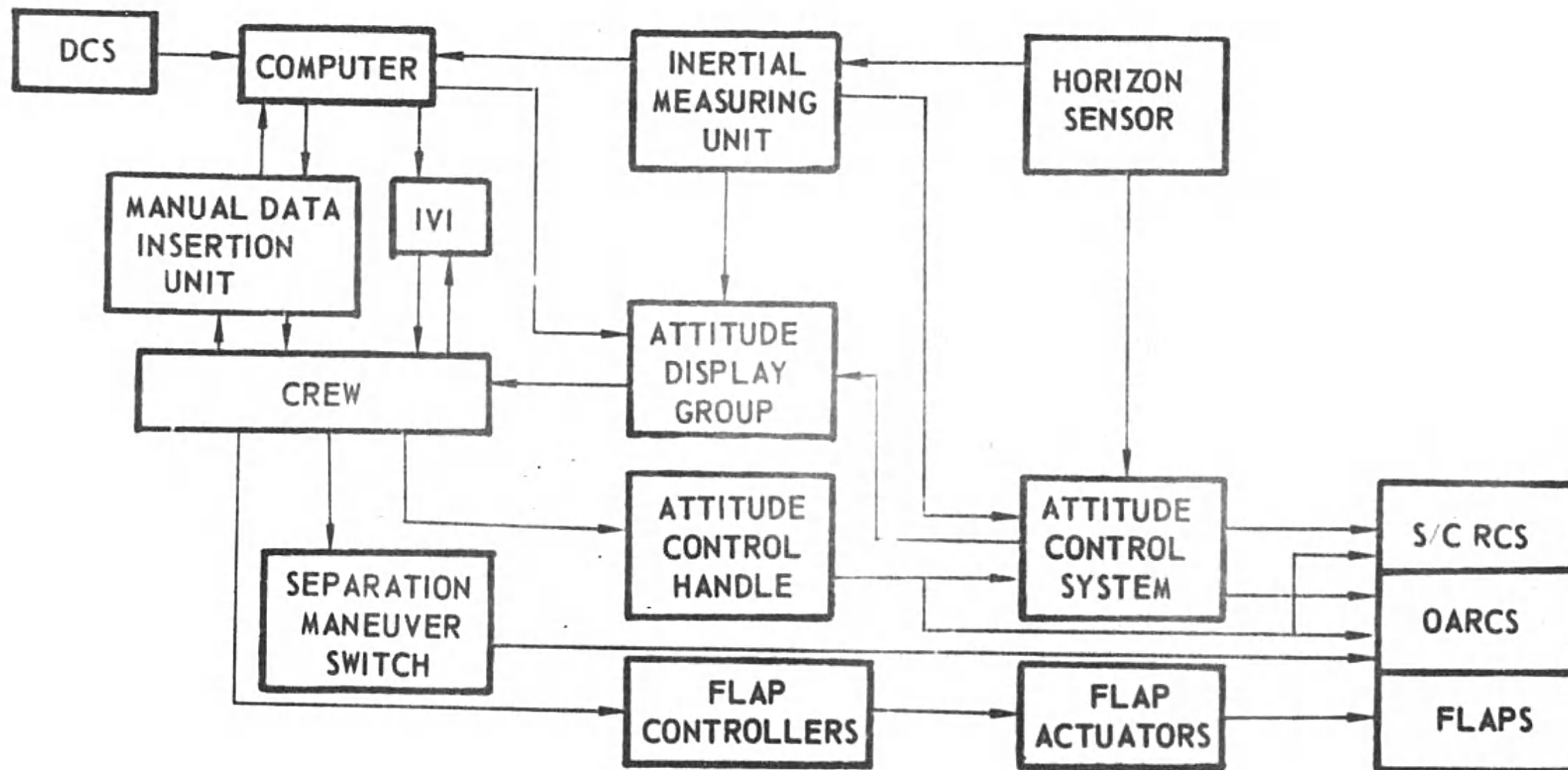
RE-ENTRY GUIDANCE AND CONTROL

MANUAL CONTROL OF FLAP POSITION

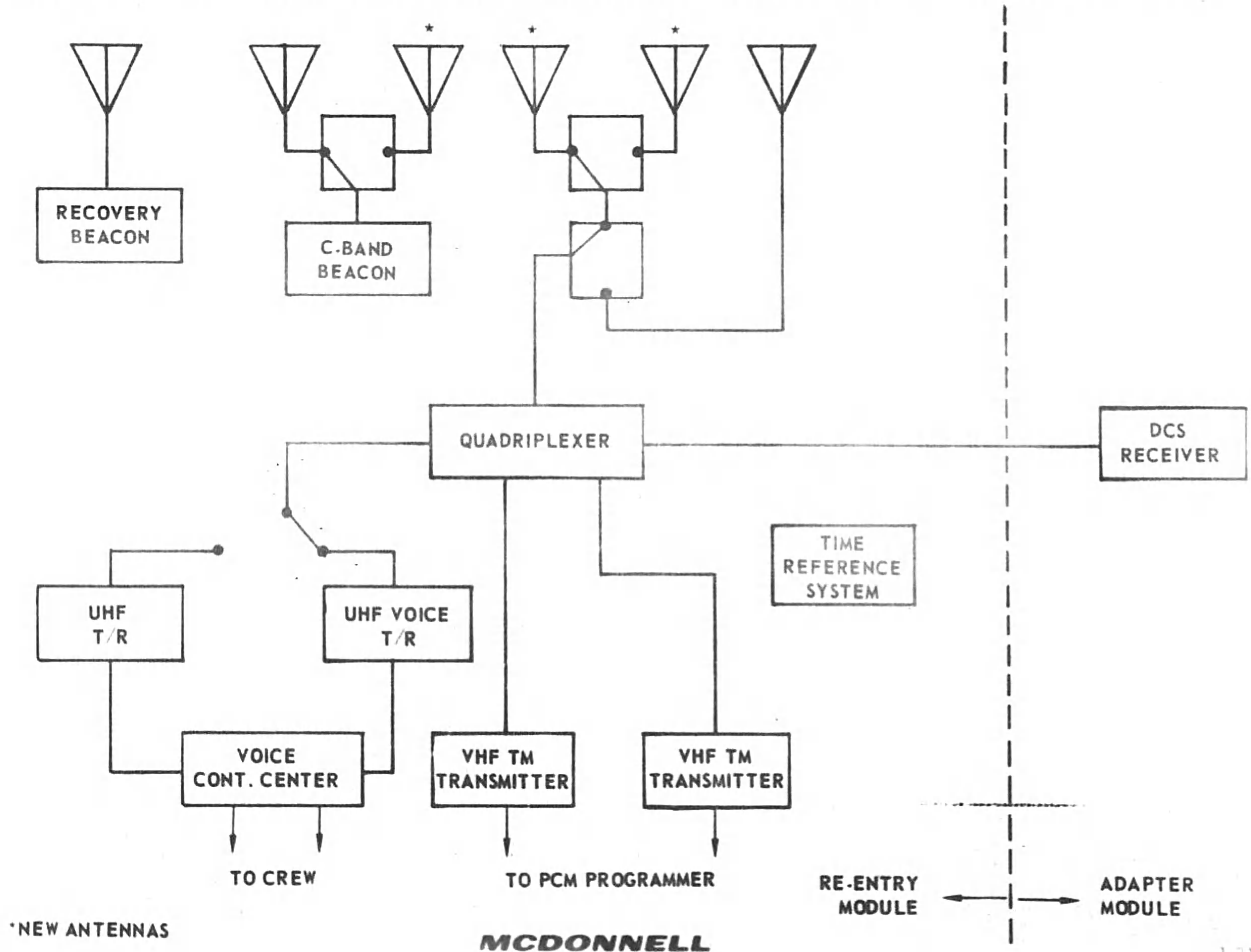
SHORT TERM OSCILLATIONS CONTROLLED BY OARCS

ON-BOARD COMPUTER GENERATION OF GUIDANCE COMMANDS

GUIDANCE AND CONTROL BLOCK DIAGRAM



WINGED GEMINI COMMUNICATION SYSTEM BLOCK DIAGRAM



PROPULSION SYSTEMS

- **RE-ENTRY CONTROL SYSTEM**

PROVIDES THE IMPULSE FOR PITCH AND YAW RATE DAMPING AND ROLL CONTROL OF THE GEMINI SPACECRAFT FROM WING JETTISONING (APPROX. 100,000 FT.) TO MAIN PARACHUTE DEPLOYMENT.

- **ORBIT ATTITUDE & RE-ENTRY CONTROL SYSTEM**

PROVIDES THE IMPULSE FOR SEPARATION OF THE SPACECRAFT FROM THE LAUNCH VEHICLE AT INSERTION, ATTITUDE CONTROL WHILE ON-ORBIT, ORIENTATION TO RETROGRADE ATTITUDE, ATTITUDE HOLD DURING RETROGRADE FIRING, TURN-AROUND, AND PITCH AND YAW RATE DAMPING AND ROLL CONTROL DURING RE-ENTRY UNTIL WING JETTISONING.

- **RETROGRADE SYSTEM**

PROVIDES THE IMPULSE TO DECELERATE THE SPACECRAFT FOR RE-ENTRY.

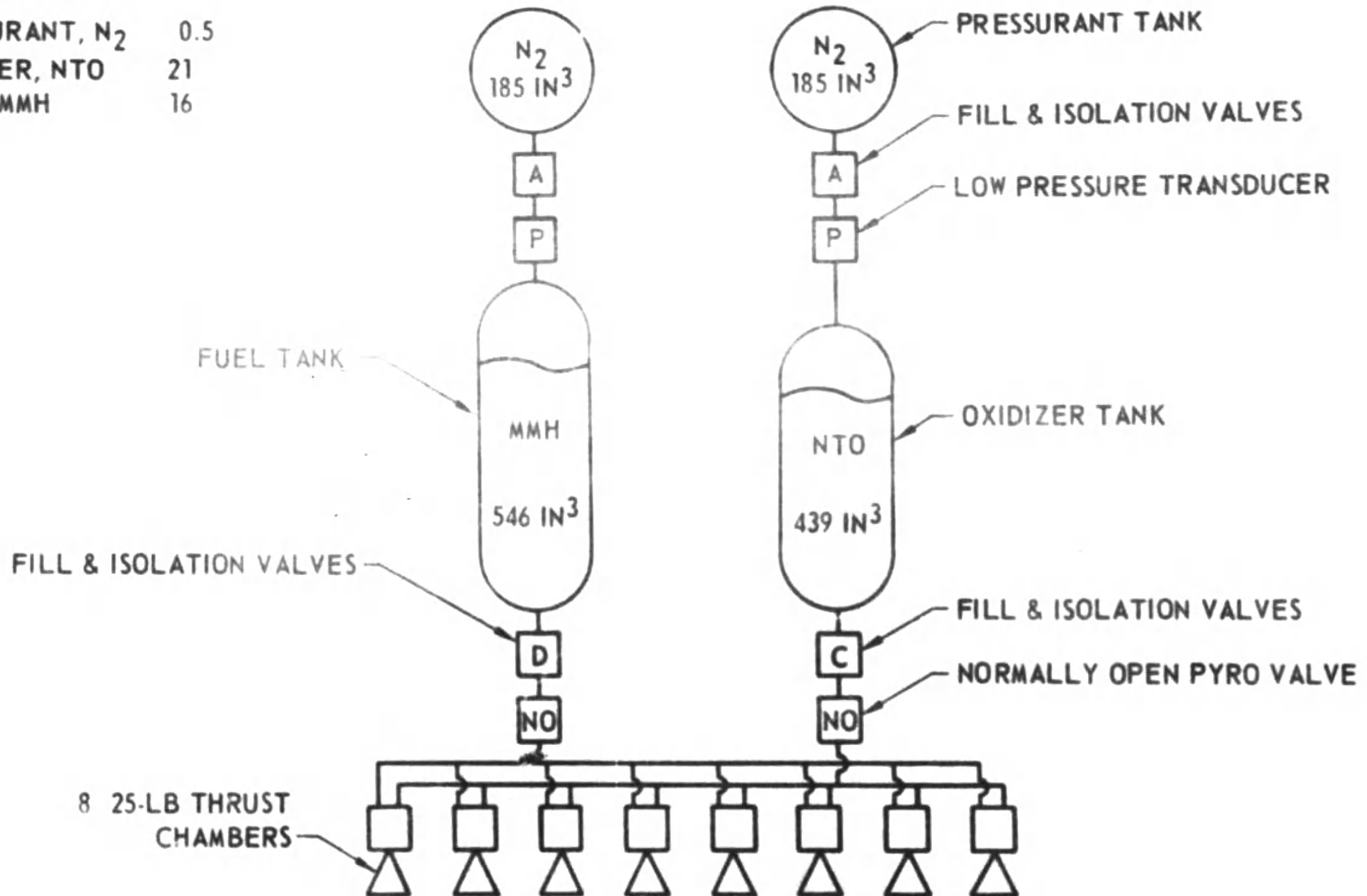
RE-ENTRY CONTROL SYSTEM

- SYSTEM COMPONENTS SAME AS GEMINI.
- TWO REDUNDANT RINGS
- EACH RING CONTAINS 37 LB OF PROPELLANT
- EACH RING HAS 8 25-LB TCA's
- BLOW DOWN DESIGN
- PROPELLANTS
 - OXIDIZER - NTO
 - FUEL -- MMH
- PRESSURANT GAS
 - NITROGEN

SCHEMATIC OF RE-ENTRY CONTROL SYSTEM

ONE OF TWO REDUNDANT SYSTEMS

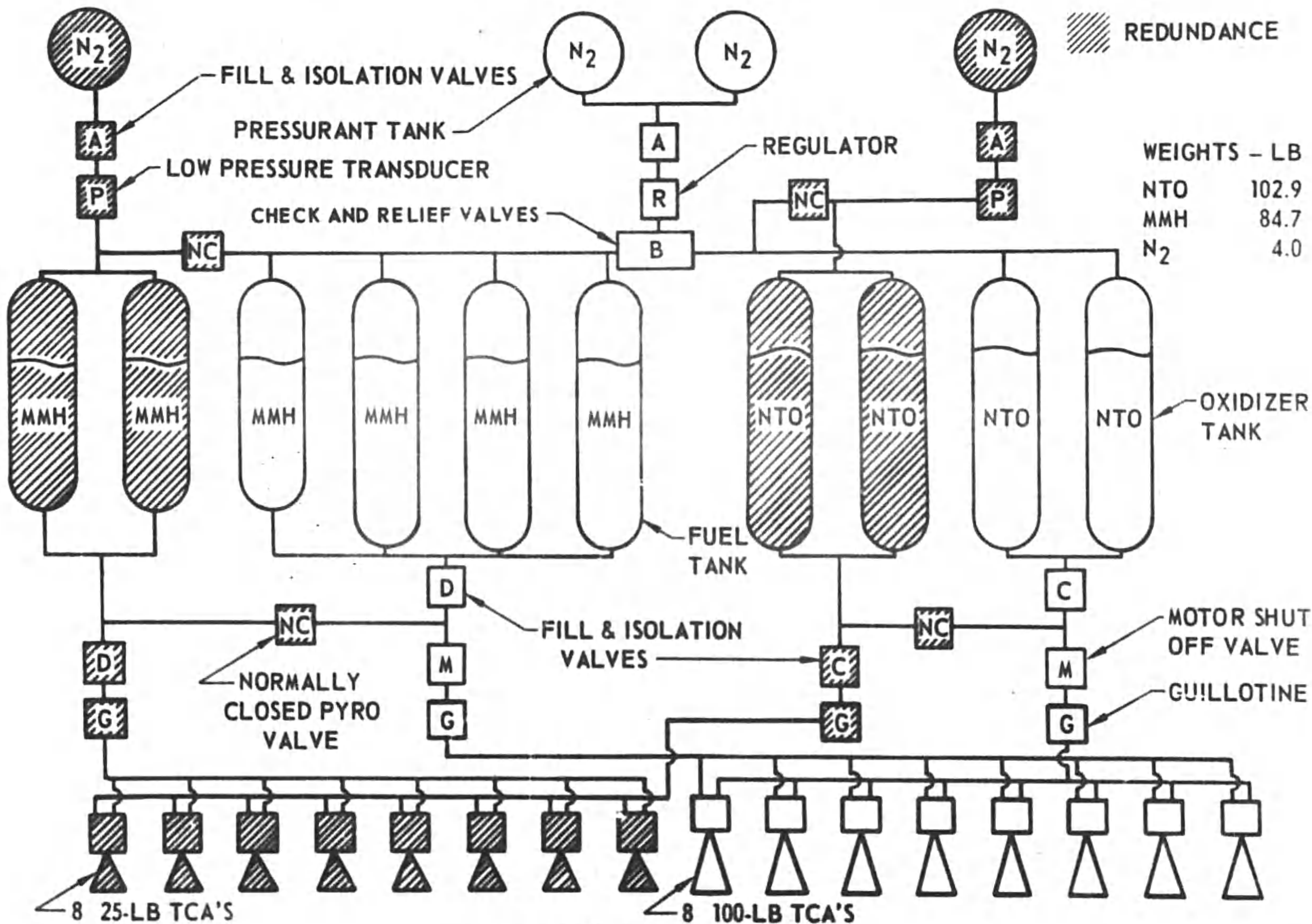
WEIGHTS - LB	
PRESSURANT, N ₂	0.5
OXIDIZER, NTO	21
FUEL, MMH	16



ORBIT ATTITUDE AND RE-ENTRY CONTROL SYSTEM

- **ALL GEMINI COMPONENTS**
- **188 LBS OF PROPELLANT LOCATED IN WINGS**
- **8 100-LB AND 8 25-LB TCA'S LOCATED IN ADAPTER**
- **REDUNDANCY PROVIDED BY ISOLATING SUFFICIENT PROPELLANT TO PERFORM ALL FUNCTIONS THROUGH RETROGRADE**
- **COMBINATION PRESSURE REGULATED AND BLOWDOWN DESIGN**
- **PROPELLANTS**
 - OXIDIZER - NTO**
 - FUEL - MMH**
- **PRESSURANT GAS**
 - NITROGEN**

SCHEMATIC OF ORBIT ATTITUDE & RE-ENTRY CONTROL SYSTEM

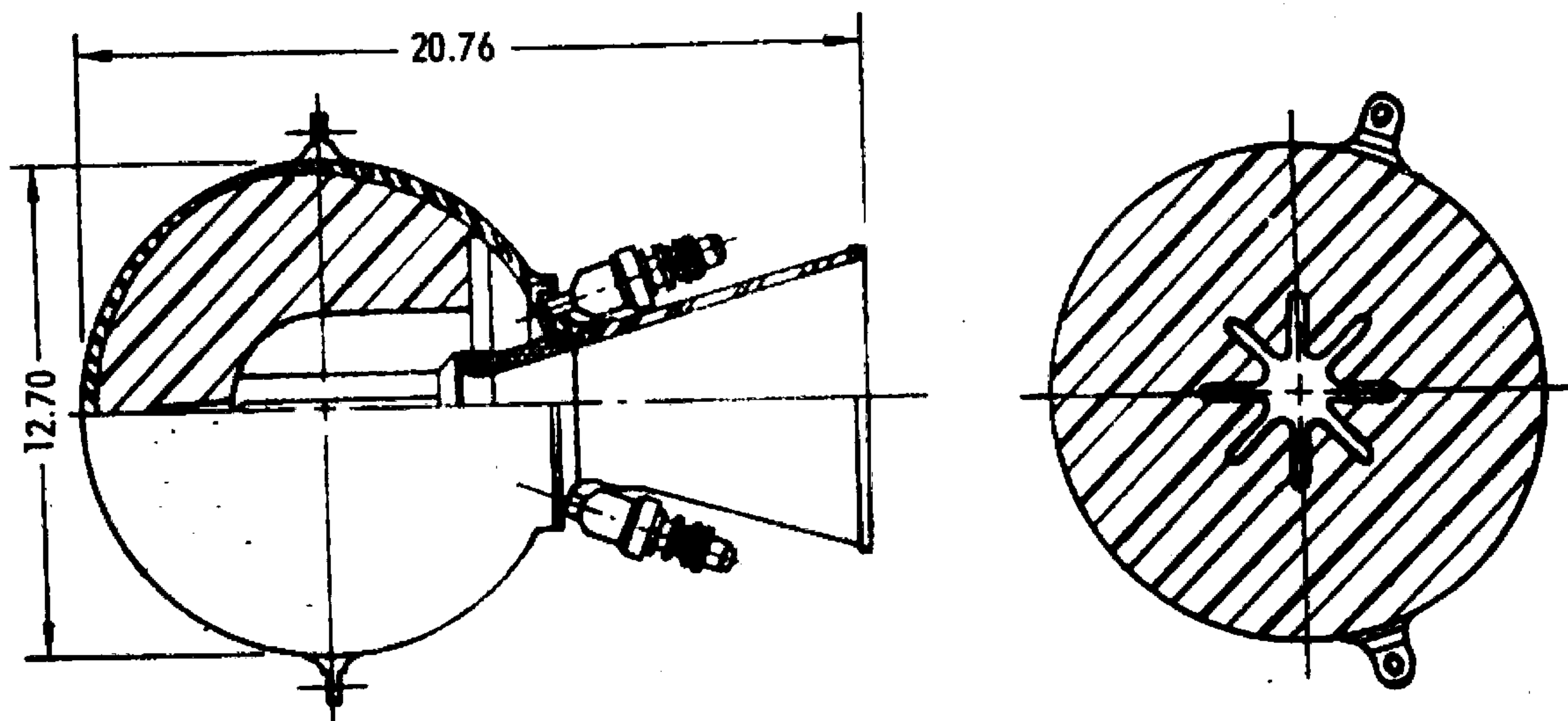


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RETROGRADE SYSTEM

- GEMINI TE-M-385 SOLID PROPELLANT MOTORS
- FIVE MOTORS INSTALLED IN THE ADAPTER
- MINIMUM RETROGRADE ΔV 272 FPS
- MOTORS ARE RIPPLE FIRED
- NO MODIFICATION TO MOTORS REQUIRED
- WEIGHT OF EACH MOTOR IS 67.4 LB.
- MOTORS MANUFACTURED BY THIOKOL

SKETCH OF RETROGRADE MOTOR



THRUST, LB*	2,570
TOTAL IMPULSE, LB-SEC*	14,200
WEIGHT, LB (EACH)	67.4

*VACUUM

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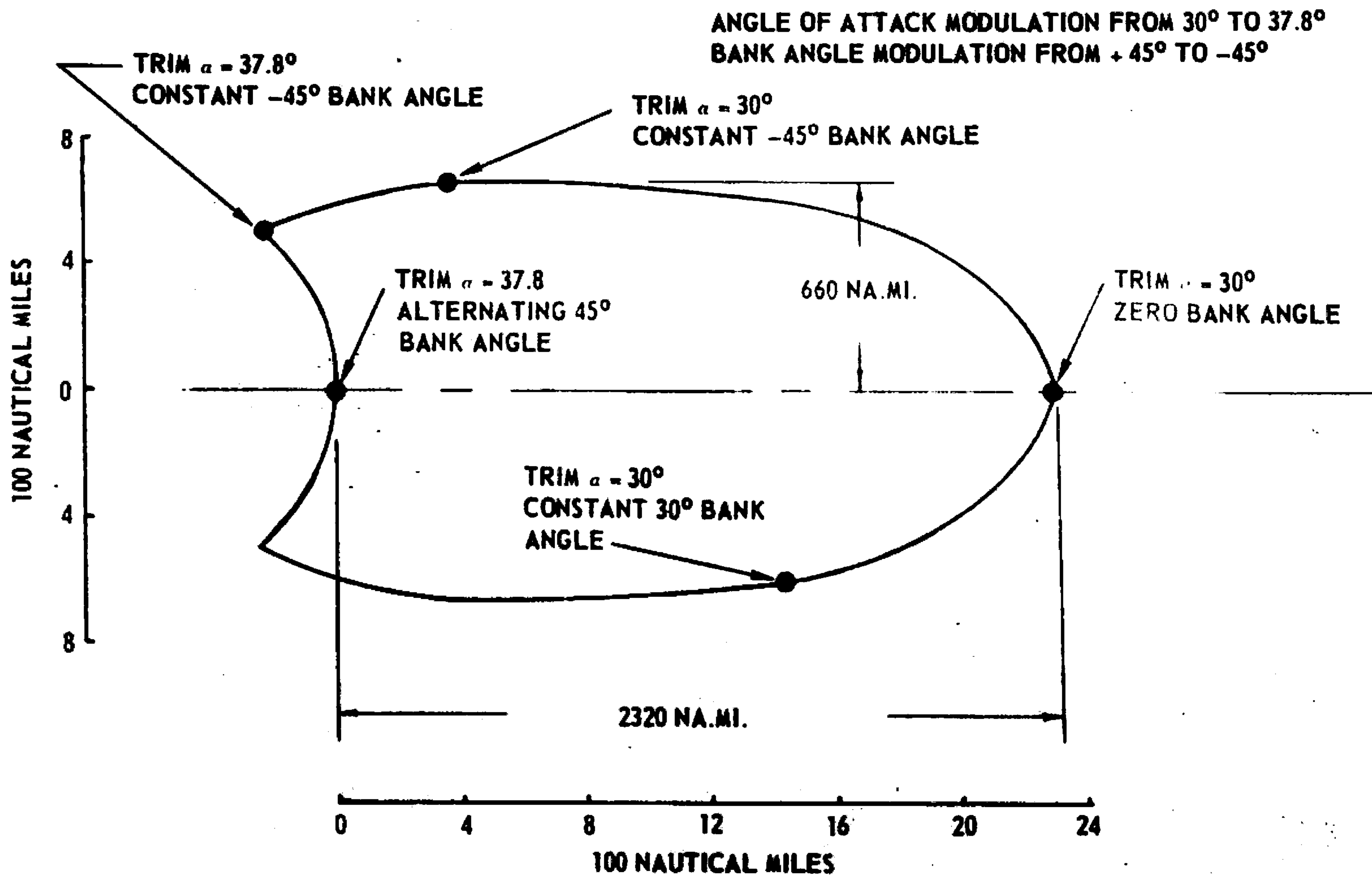
RE-ENTRY AERODYNAMIC CHARACTERISTICS

- VEHICLE STATICALLY STABLE ABOUT ALL AXES.
- AERODYNAMIC TRIM CONTROLS PROVIDE ATTITUDE TRIM ABOUT ALL AXES.
- HYPERSONIC TRIM ANGLE OF ATTACK MAY BE MODULATED BETWEEN 30 AND 37.8 DEG. — MAX. $L/D = 1.07$.
- DESIGN CRITERIA PERMITS UNRESTRICTED BANK ANGLE ATTITUDES UP TO 45 DEG.
- NOMINAL FOOTPRINT LENGTH APPROXIMATELY 2300 NA.MI. WITH 660 NA.MI. LATERAL RANGE CAPABILITY.
- TOTAL RE-ENTRY FLIGHT TIME DOES NOT EXCEED 2500 SEC. FOR RETROGRADE ANY PLACE IN A 87-100 NA.MI. ORBIT.
- DYNAMIC PRESSURE DOES NOT EXCEED 200 LBS. SQ.FT. DURING RE-ENTRY.
- WING SECTION, ADAPTER, AND NOSE FAIRING JETTISONED AT APPROXIMATELY 100,000 FT. CANTED SMALL END INSURES TURNAROUND TO BLUNT END FORWARD ATTITUDE.
- NORMAL GEMINI PARACHUTE RECOVERY SEQUENCE INITIATED AT 50,000 FT.
- WATER LANDING.

WINGED GEMINI

TOUCHDOWN FOOTPRINT CAPABILITY

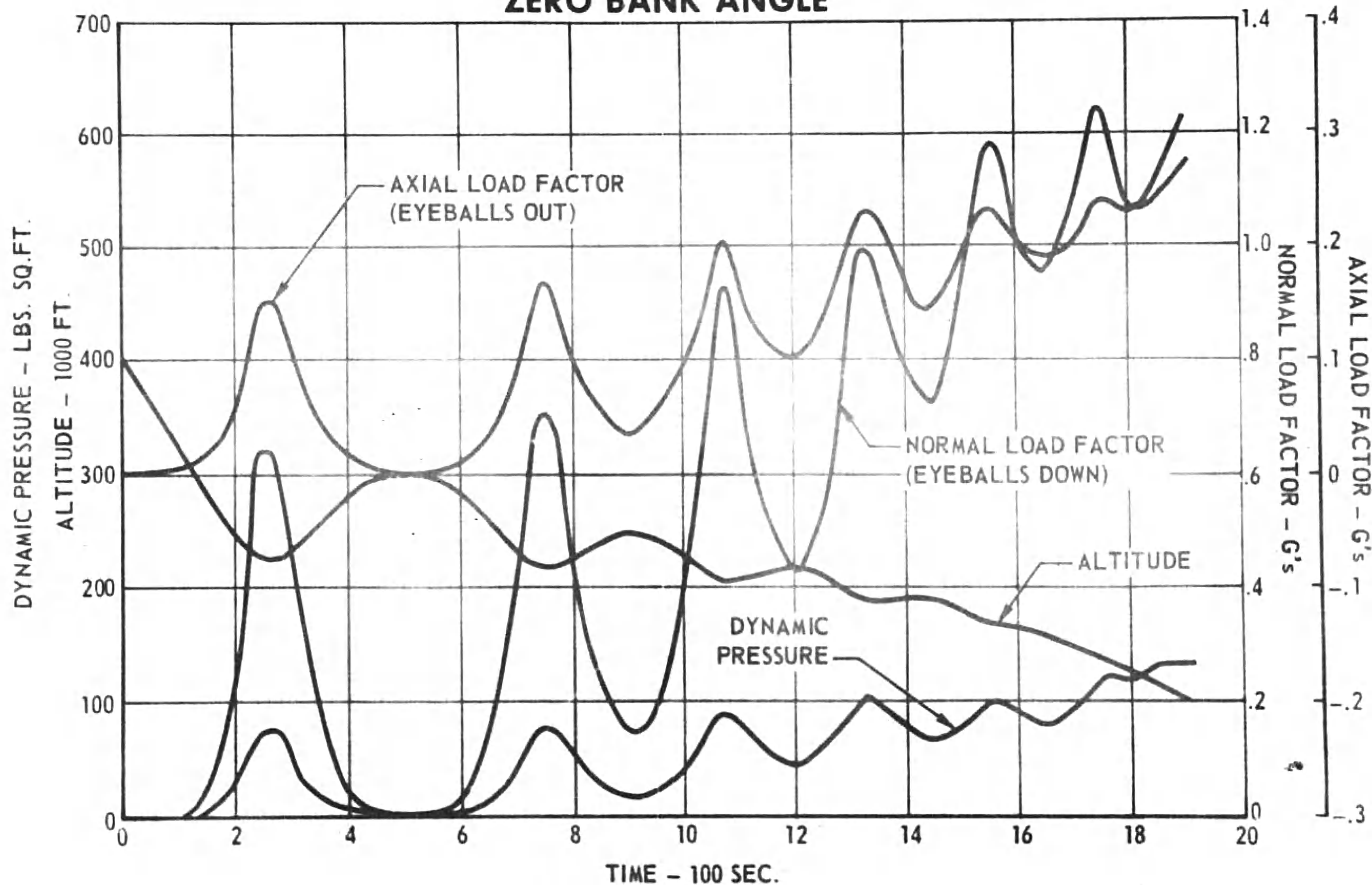
RE-ENTRY $\gamma = -1.05^\circ$



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WINGED GEMINI REPRESENTATIVE RE-ENTRY TRAJECTORY

HYPERSONIC TRIM $\alpha = 30^\circ$
ZERO BANK ANGLE



ABORT CONSIDERATION SUMMARY

METHOD OF ESCAPE	NOMINAL ALTITUDE AND TIME RANGE	COMMENTS
EJECTION SEAT	0 TO 15,000 FT. 0 TO 50 SEC.	SAME SYSTEM NOW USED IN GEMINI PROGRAM. DESIGN PROVIDES EJECTION CAPABILITY UP TO 70,000 FT. 15,000 FT. MAXIMUM ALTITUDE REFLECTS CURRENT UTILIZATION OF EJECTION SEAT IN GEMINI PROGRAM.
	15,000 FT. TO 300,000 FT. 50 TO 187 SEC.	LAUNCH VEHICLE RELIABILITY PERMITS THE CONSIDERATION OF A RIDE IT OUT PHILOSOPHY.
SPACECRAFT OARCS	300,000 FT. TO END OF LAUNCH PHASE 187 TO 340 SEC.	DYNAMIC PRESSURE NEGLIGIBLE. OARCS THRUST SUFFICIENT TO SEPARATE SPACECRAFT FOLLOWING LAUNCH VEHICLE THRUST TERMINATION. SPACECRAFT TURNAROUND AND RETROGRADE NECESSARY FOLLOWING ABORT DURING LATTER PART OF LAUNCH PHASE.

FOR LAUNCH ABORTS OTHER THAN EJECTION, THE WING SECTION, ADAPTER, AND NOSE FAIRING OF THE WINGED GEMINI WILL BE JETTISONED SHORTLY AFTER THE ABORT AND THE SPACECRAFT WILL RE-ENTER IN THE CONVENTIONAL GEMINI BLUNT END FORWARD ATTITUDE.