

— ROBINSON —



APOLLO TRAINING

APOLLO SPACECRAFT & SYSTEMS
FAMILIARIZATION

COURSE NUMBER
APC-118

AUGUST 15, 1967

FOR TRAINING PURPOSES ONLY





APOLLO TRAINING

APOLLO SPACECRAFT & SYSTEMS
FAMILIARIZATION

COURSE NUMBER
APC-118

AUGUST 15, 1967

FOR TRAINING PURPOSES ONLY

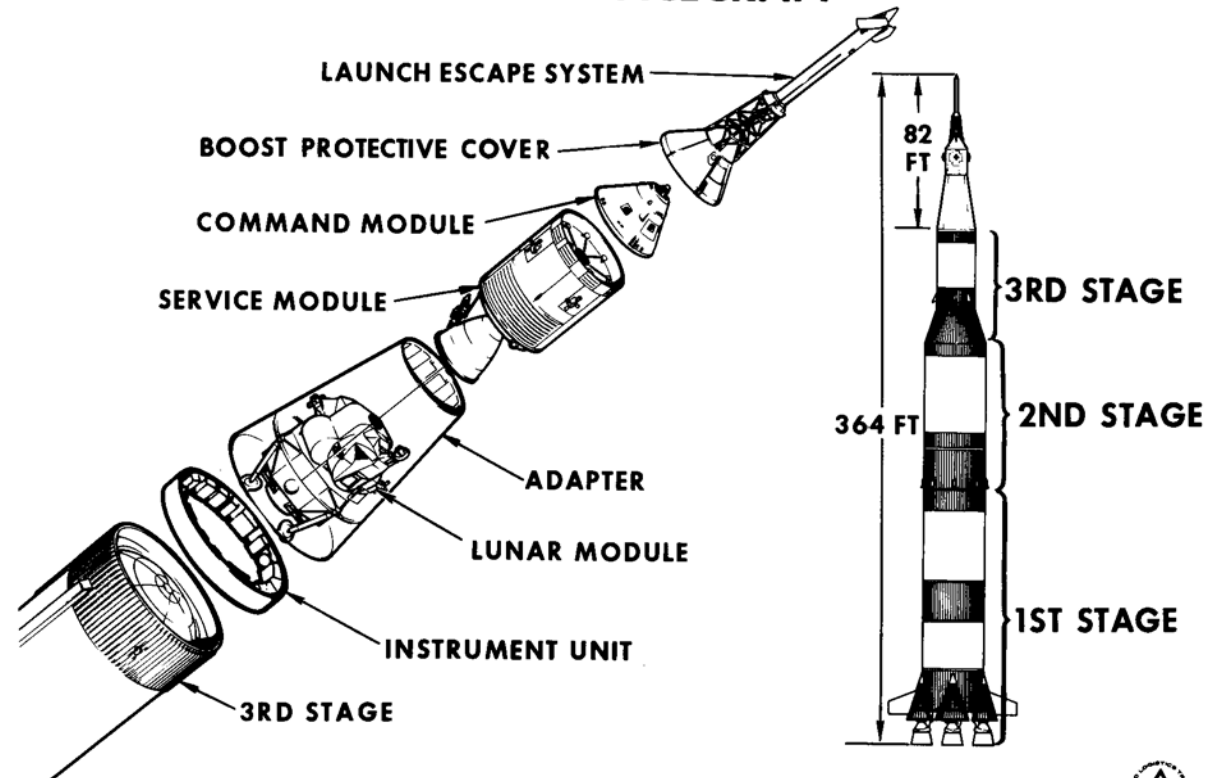


QUESTIONS RELATIVE TO THE CONTENTS OF THIS
DOCUMENT SHOULD BE DIRECTED TO:

S.I. JIMENEZ
B.C. GROVER
NAA, SPACE DIVISION
DOWNEY, CALIFORNIA
EXTENSION 4325,6 OR 7

CONTENTS	SECTION
INTRODUCTION & MISSION	1
STRUCTURES	2
GUIDANCE AND CONTROL	3
PROPULSION	4
COMMUNICATIONS	5
SEQUENCING	6
ELECTRICAL POWER	7
ENVIRONMENTAL CONTROL	8
CREW EQUIPMENT	9
APOLLO ABBREVIATIONS	LAST PAGE

APOLLO SPACECRAFT



NAA APOLLO SUBCONTRACTORS (CONT)

SYSTEM/COMPONENTS

CONTRACTOR

PROPULSION

CM REACTION CONTROL ENGINES.....ROCKETDYNE DIV OF NAA - CANOGA PARK, CALIF.
 SM REACTION CONTROL ENGINES.....MARQUARDT CORP - VAN NUYS, CALIF.
 POSITIVE EXPULSION TANKS (RCS).....BELL AEROSYSTEMS - BUFFALO, N.Y.
 HELIUM TANKS.....AIRITE PRODUCTS - LOS ANGELES, CALIF.
 FUEL & OXIDIZER TANKS (SPS).....ALLISON DIV OF GMC - INDIANAPOLIS, IND.
 PROPELLANT GAGING & MIXTURE RATIO CONTROL.....SIMMONDS PRECISION PROD - TARRYTOWN, N.Y.
 SERVICE PROPULSION ENGINE.....AEROJET GENERAL - SACRAMENTO, CALIF.

COMMUNICATIONS & DATA.....COLLINS RADIO CO.-CEDAR RAPIDS, IOWA

BEACON ANTENNA (R&D).....MELPAR - FALLS CHURCH, VA.
 C-BAND ANTENNA.....RADCOM - COLLEGE PARK, MD.
 CENTRAL TIMING SYSTEM.....GENERAL TIME - ROLLING MEADOWS, ILL.
 HF ANTENNAS (RECOVERY & ORBITAL).....DEHAVILLAND - ONTARIO, CANADA
 DIGITAL UP-DATA LINK.....MOTOROLA, INC. - SCOTTSDALE, ARIZ.
 VHF ANTENNA.....LOS ANGELES DIV OF NAA - INGLEWOOD, CALIF.
 TV CAMERA.....RCA - PRINCETON, N.J.
 2 KMC HI GAIN ANTENNA.....DALMO - VICTOR - BELMONT, CALIF.

MISSION SIMULATOR TRAINER.....GIP-LINK DIV - BINGHAMTON, N.Y.

SYSTEMS INTEGRATED TEST EQUIPMENT.....AUTONETICS DIV OF NAA - ANAHEIM, CALIF.

NAA APOLLO SUBCONTRACTORS

SYSTEM/COMPONENTS	CONTRACTOR
STRUCTURES	
ABLATIVE MATERIAL FOR HEAT SHIELD.....	AVCO CORP-WILMINGTON, MASS.
BOOST COVER, LES TOWER, DOCKING PROBE, CANARDS	
RADIAL BEAMS, FWD HEAT SHIELD & CREW COUCHES	LOS ANGELES DIV OF NAA - INGLEWOOD, CALIF.
STAINLESS STEEL HONEY COMB PANELS	AERONCA MFG CO - MIDDLETOWN, OHIO
ELECTRICAL POWER	
BATTERIES ("A", "B" & "C").....	EAGLE PICHER - JOPLIN, MO.
BATTERY CHARGER.....	ITT - INDUSTRIAL PRODUCTS DIV - SAN FERNANDO, CALIF.
FUEL CELL MODULES.....	PRATT & WHITNEY - EAST HARTFORD, CONN.
STATIC INVERTERS	WESTINGHOUSE ELECTRIC CORP - LIMA, OHIO
CRYOGENIC GAS STORAGE.....	BEECH AIRCRAFT - BOULDER, COLO.
ENVIRONMENTAL CONTROL	AIRESEARCH MFG CO - LOS ANGELES, CALIF.
SEQUENTIAL EVENTS CONTROL	
MASTER EVENT SEQUENCE CONTROLLER.....	AUTONETICS DIV OF NAA - ANAHIEM, CALIF.
LAUNCH ESCAPE & PITCH CONTROL MOTORS	LOCKHEED PROPULSION CO - REDLANDS, CALIF.
TOWER JETTISON MOTOR	THIOKOL CHEMICAL CORP - ELKTON, MD.
EARTH LANDING PARACHUTE SUBSYSTEM	NORTHROP - VENTURA - NEWBERRY PARK, CALIF.
STABILIZATION & CONTROL.....	HONEYWELL CORP - MINNEAPOLIS, MINN.

NAA APOLLO SUBCONTRACTORS (CONT)

SYSTEM/COMPONENTS

CONTRACTOR

PROPULSION

CM REACTION CONTROL ENGINES.....ROCKETDYNE DIV OF NAA - CANOGA PARK, CALIF.
 SM REACTION CONTROL ENGINES.....MARQUARDT CORP - VAN NUYS, CALIF.
 POSITIVE EXPULSION TANKS (RCS).....BELL AEROSYSTEMS - BUFFALO, N.Y.
 HELIUM TANKS.....AIRITE PRODUCTS - LOS ANGELES, CALIF.
 FUEL & OXIDIZER TANKS (SPS).....ALLISON DIV OF GMC - INDIANAPOLIS, IND.
 PROPELLANT GAGING & MIXTURE RATIO CONTROL.....SIMMONDS PRECISION PROD - TARRYTOWN, N.Y.
 SERVICE PROPULSION ENGINE.....AEROJET GENERAL - SACRAMENTO, CALIF.

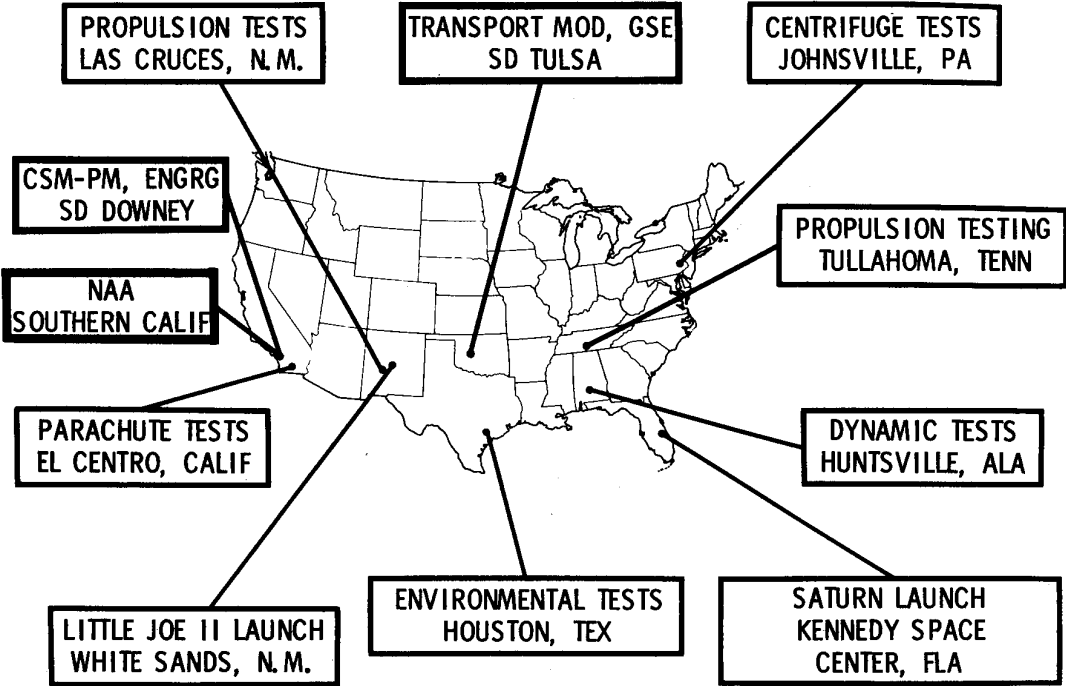
COMMUNICATIONS & DATA.....COLLINS RADIO CO.-CEDAR RAPIDS, IOWA

BEACON ANTENNA (R&D).....MELPAR - FALLS CHURCH, VA.
 C-BAND ANTENNA.....RADCOM - COLLEGE PARK, MD.
 CENTRAL TIMING SYSTEM.....GENERAL TIME - ROLLING MEADOWS, ILL.
 HF ANTENNAS (RECOVERY & ORBITAL).....DEHAVILLAND - ONTARIO, CANADA
 DIGITAL UP-DATA LINK.....MOTOROLA, INC. - SCOTTSDALE, ARIZ.
 VHF ANTENNA.....LOS ANGELES DIV OF NAA - INGLEWOOD, CALIF.
 TV CAMERA.....RCA - PRINCETON, N.J.
 2 KMC HI GAIN ANTENNA.....DALMO - VICTOR - BELMONT, CALIF.

MISSION SIMULATOR TRAINER.....GIP-LINK DIV - BINGHAMTON, N.Y.

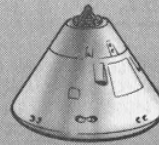
SYSTEMS INTEGRATED TEST EQUIPMENT.....AUTONETICS DIV OF NAA - ANAHEIM, CALIF.

FACILITIES-NATIONWIDE



APOLLO SPACECRAFT SPACE DIVISION RESPONSIBILITIES

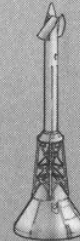
337 AP83067E



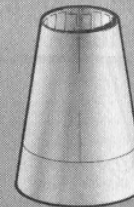
CM



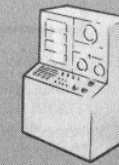
SM



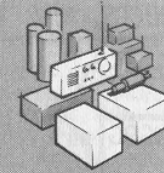
LEM



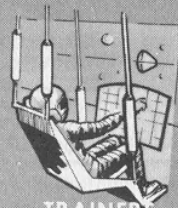
SLA



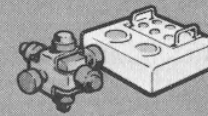
GSE



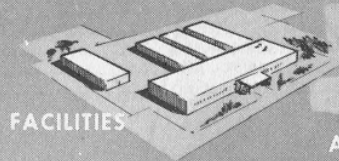
SPARES



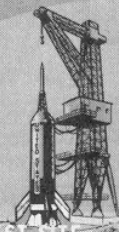
TRAINERS



MAJOR SUBS



FACILITIES



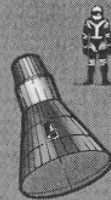
TEST SITE
ACTIVATION

(NAA ALSO INTERFACES WITH ASSOCIATE CONTRACTORS FOR GUID-
ANCE & NAVIGATION, ACCEPTANCE CHECKOUT EQUIPMENT, LUNAR
MODULE, ETC.)

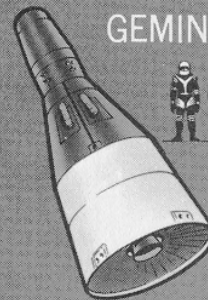
MANNED SPACECRAFT

S47ASD10175D

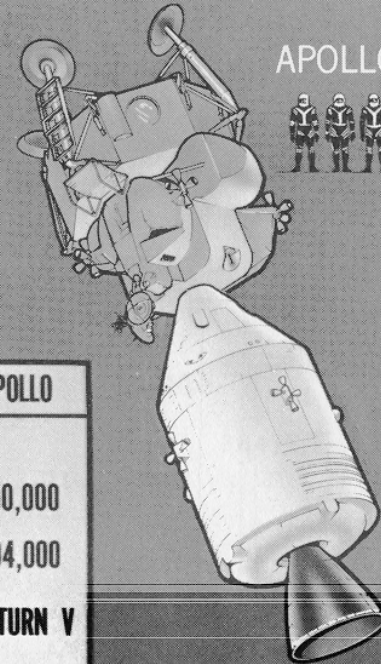
MERCURY



GEMINI

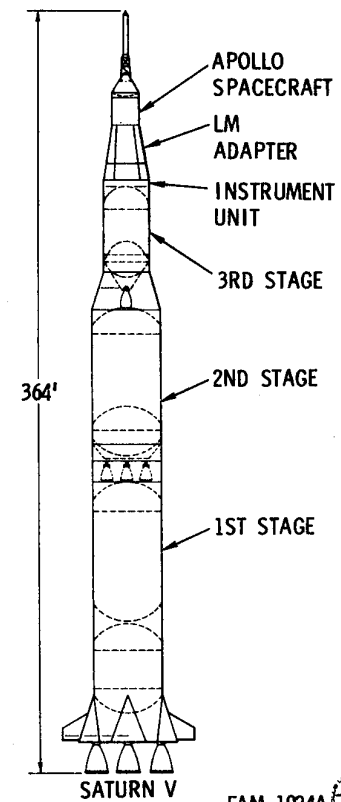
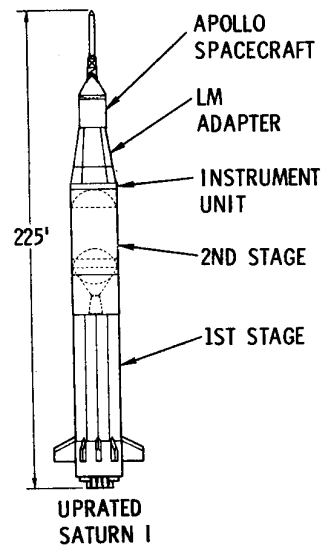


APOLLO



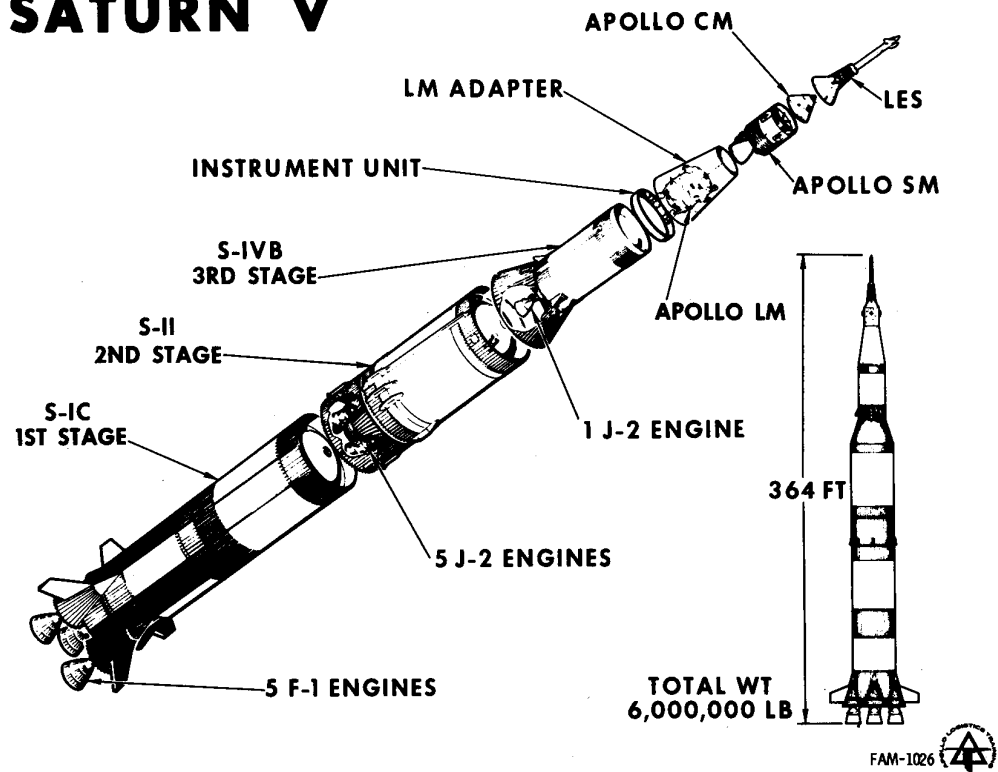
	MERCURY	GEMINI	APOLLO
PAYLOAD, LBS			
EARTH ORBITAL	3,500	7,000	250,000
TRANSLUNAR	—	—	94,000
BOOSTER	ATLAS	TITAN II	SATURN V
THRUST, LBS	360,000	430,000	7,500,000

APOLLO LAUNCH VEHICLES

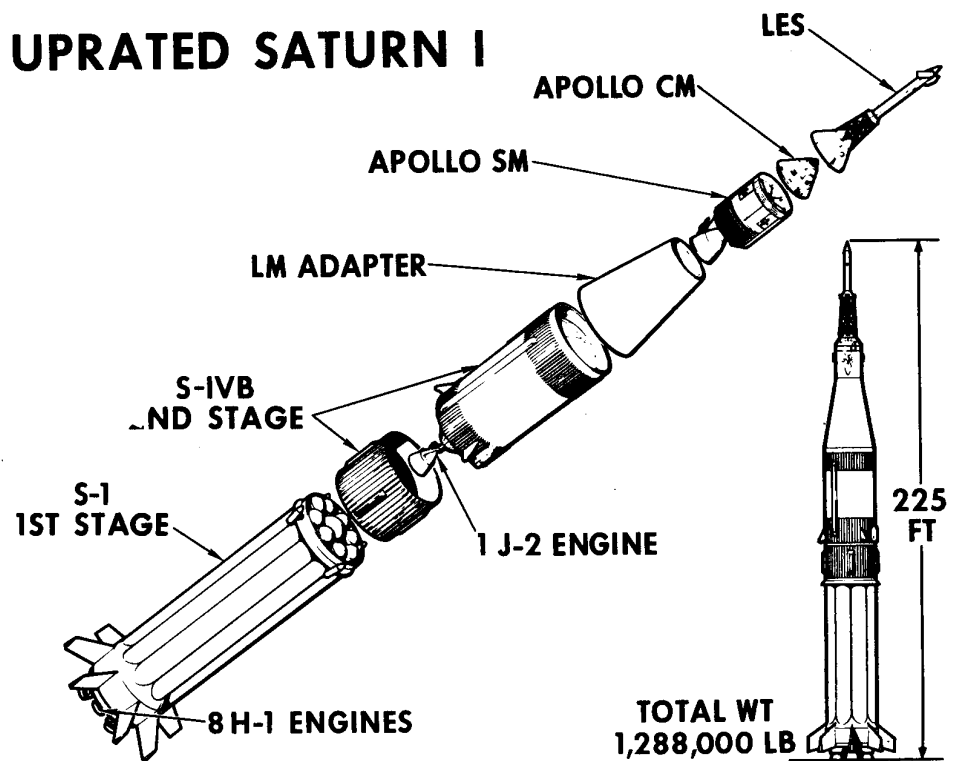


FAM-1024A 

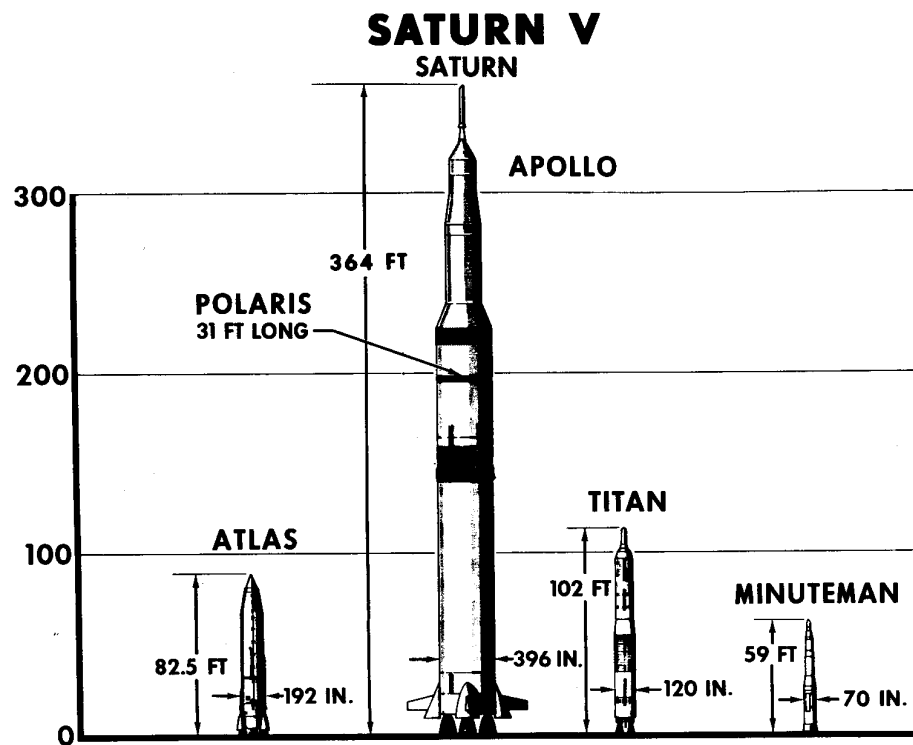
SATURN V



UPDATED SATURN I



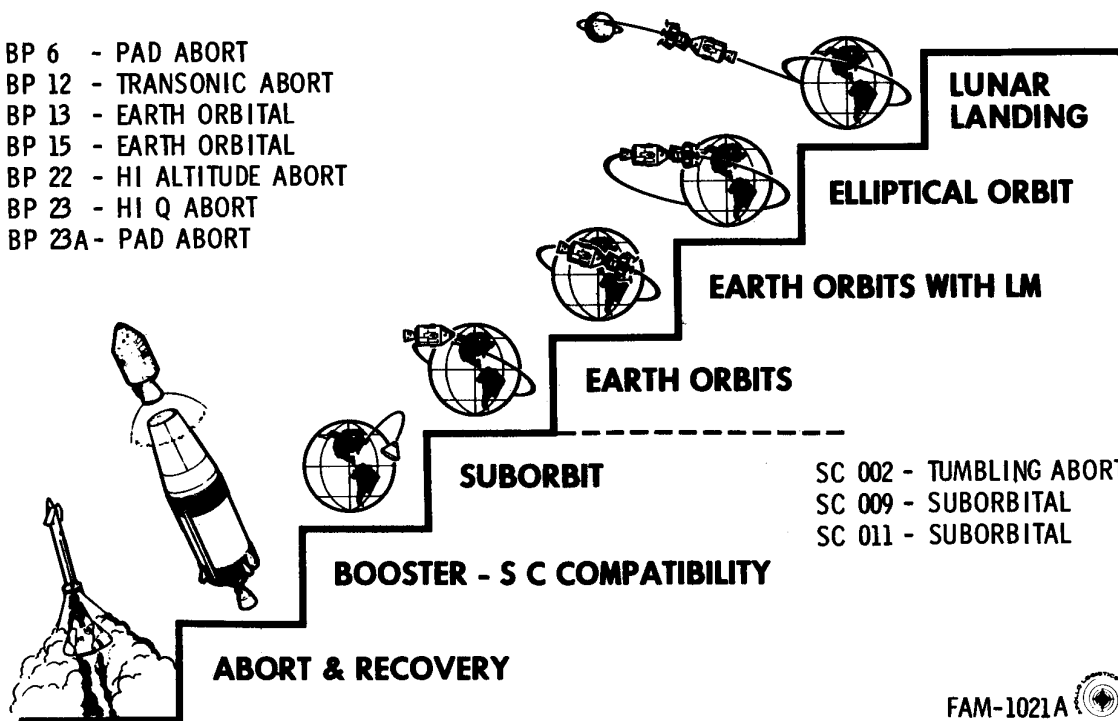
FAM-1025 



SPACECRAFT DEVELOPMENT FLIGHT CATEGORIES

MAJOR STEPS TO ULTIMATE MISSION

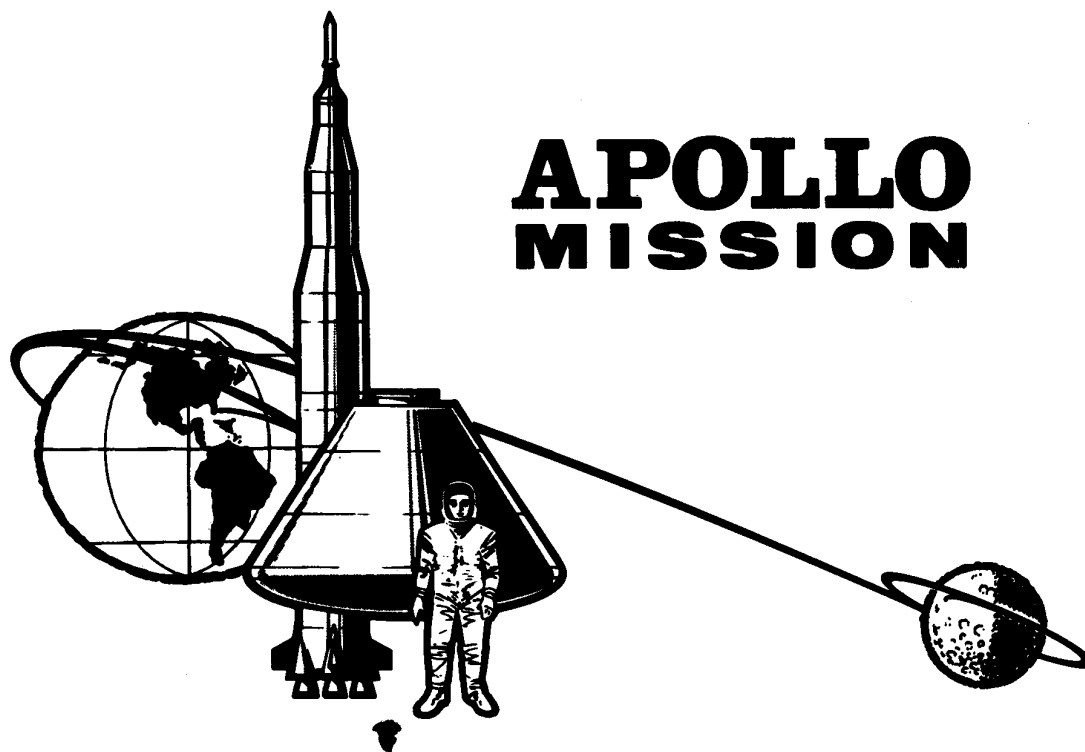
BP 6 - PAD ABORT
 BP 12 - TRANSONIC ABORT
 BP 13 - EARTH ORBITAL
 BP 15 - EARTH ORBITAL
 BP 22 - HI ALTITUDE ABORT
 BP 23 - HI Q ABORT
 BP 23A - PAD ABORT



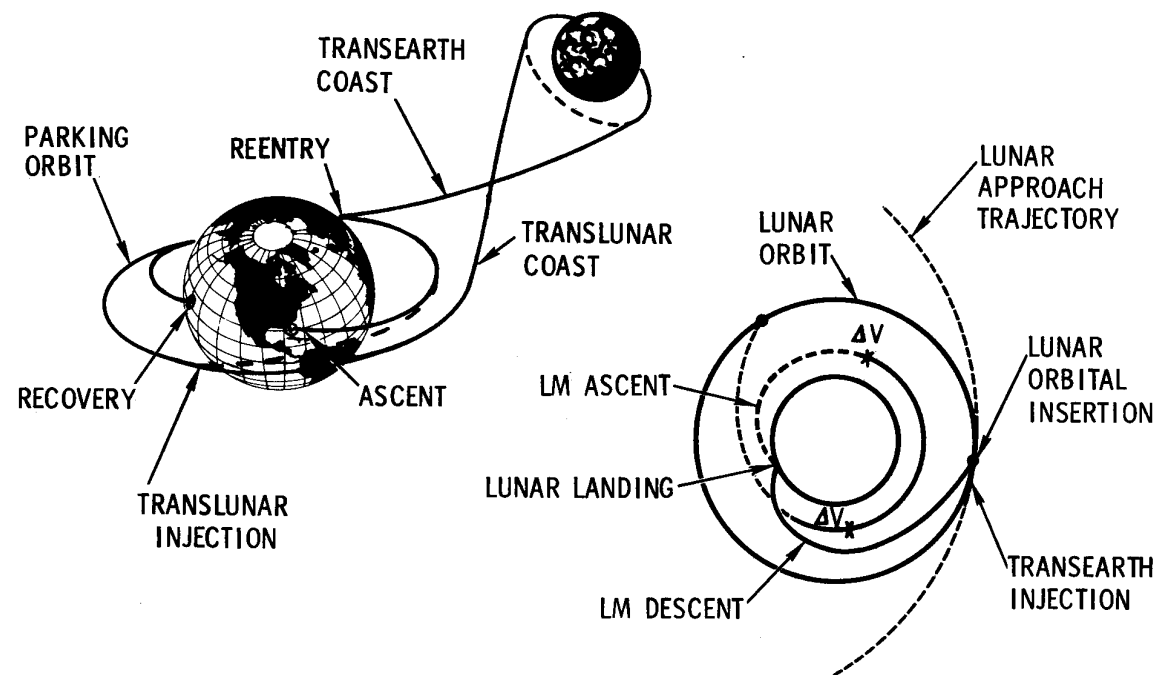
S95AP83838

1

APOLLO MISSION



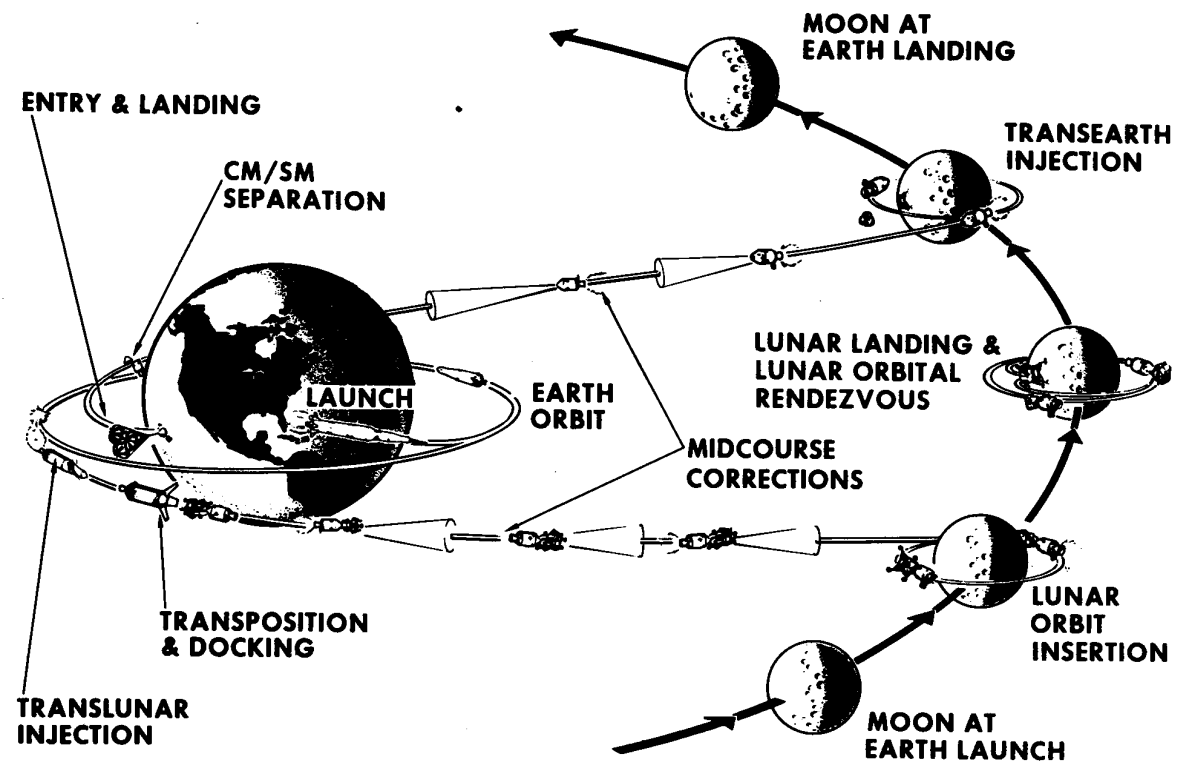
LUNAR MISSION

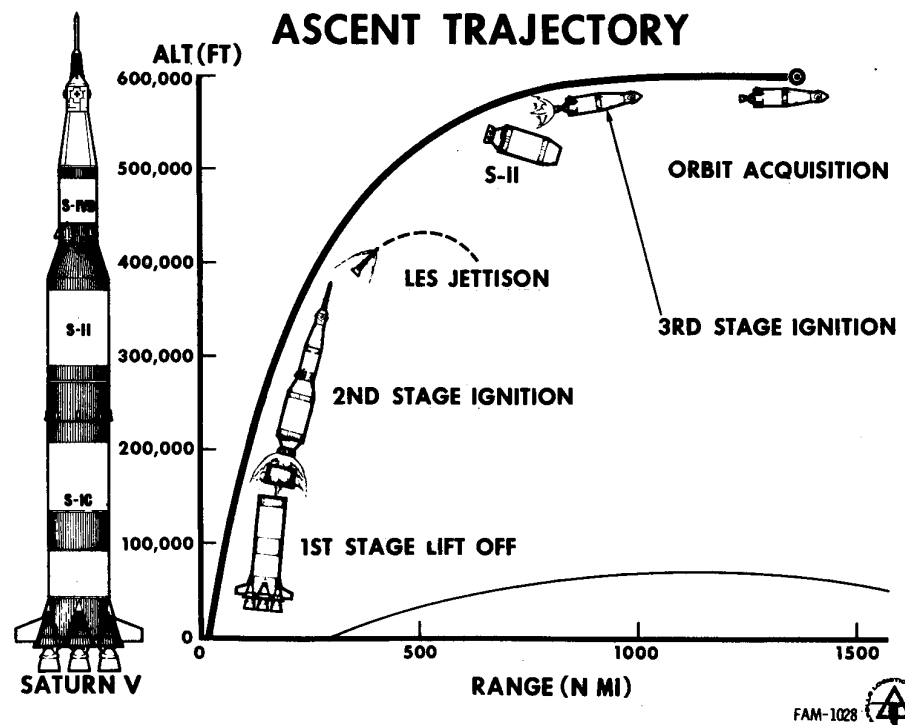


APOLLO MISSION PLAN

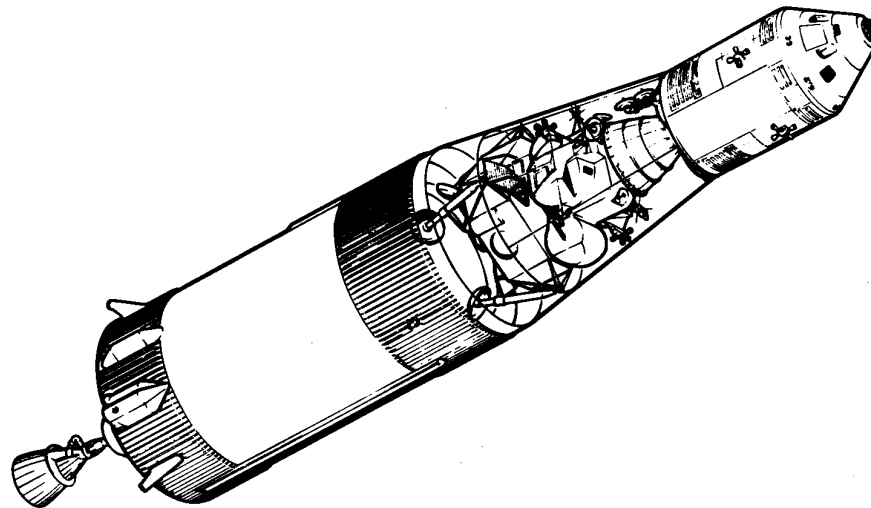
S115AP04500

1

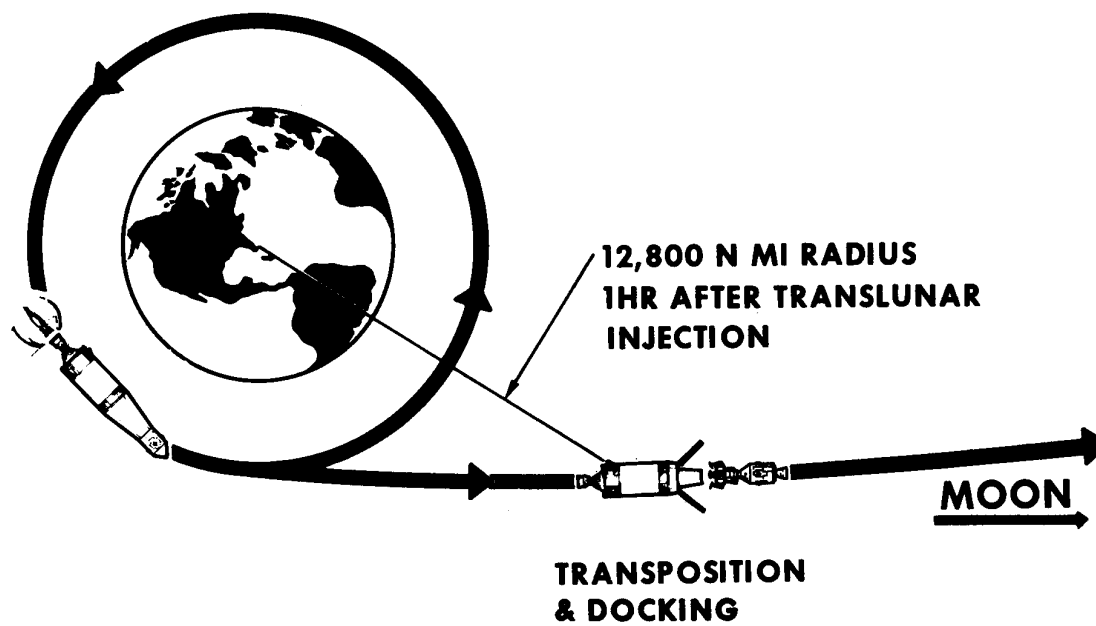




APOLLO SPACECRAFT/3RD STAGE EARTH ORBITAL CONFIGURATION

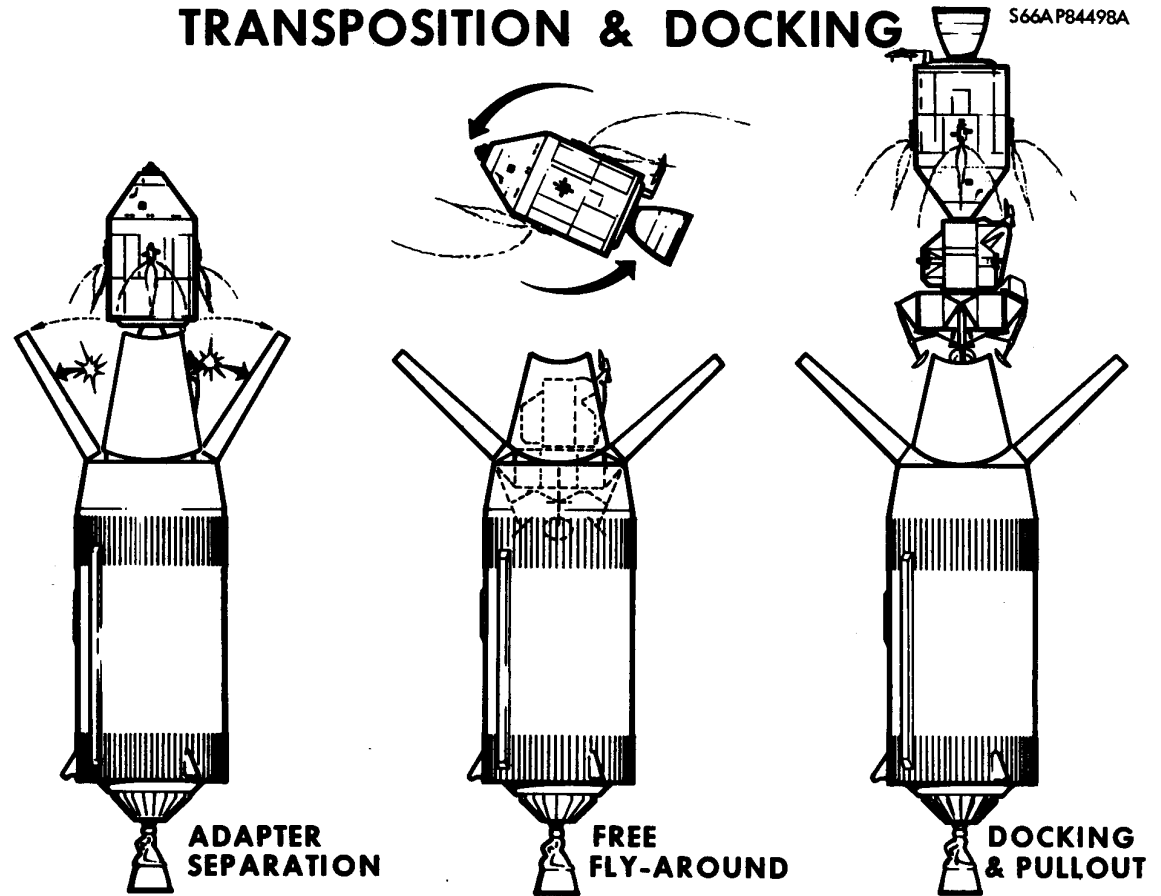


TRANSLUNAR INJECTION & COAST



TRANSPOSITION & DOCKING

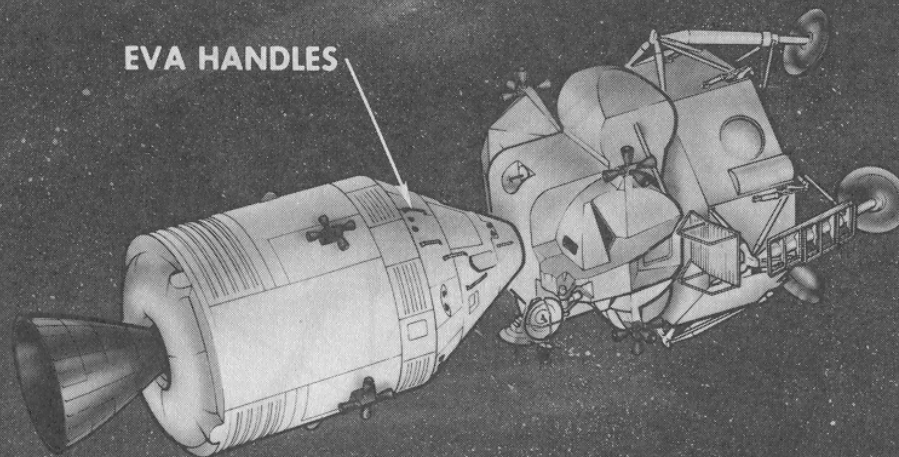
S66AP84498A



APOLLO SPACECRAFT TRANSLUNAR CONFIGURATION

S47AP84497B

EVA HANDLES





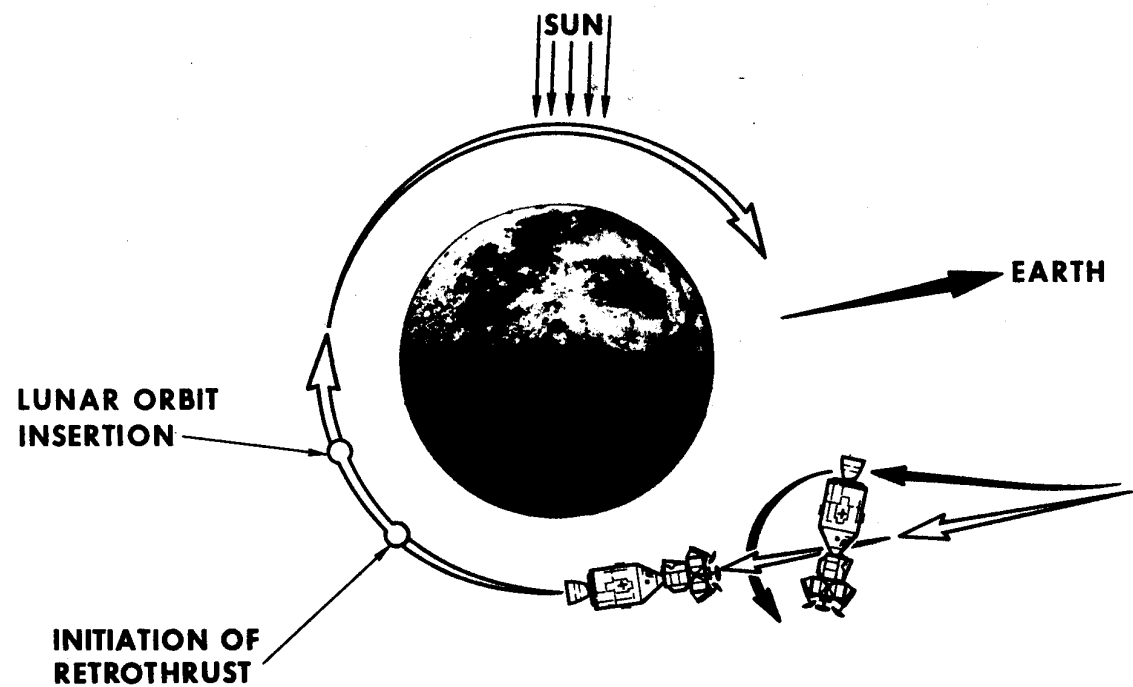
PROPOSED LUNAR LANDING

 RANGER
IMPACTS
 SURVEYOR

FAM-1022 

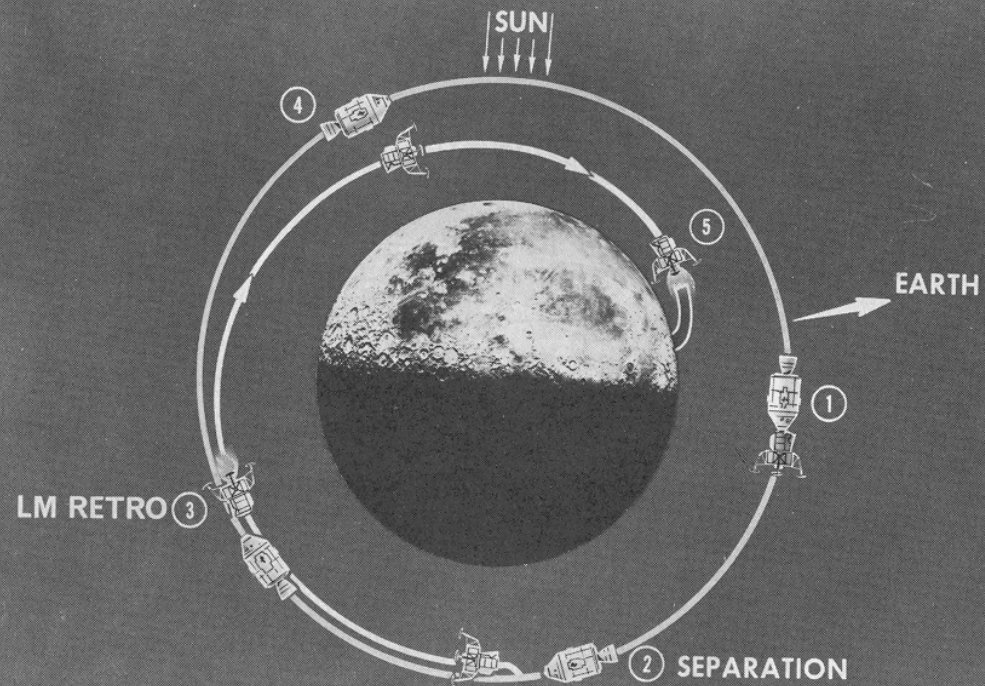
LUNAR ORBIT INSERTION

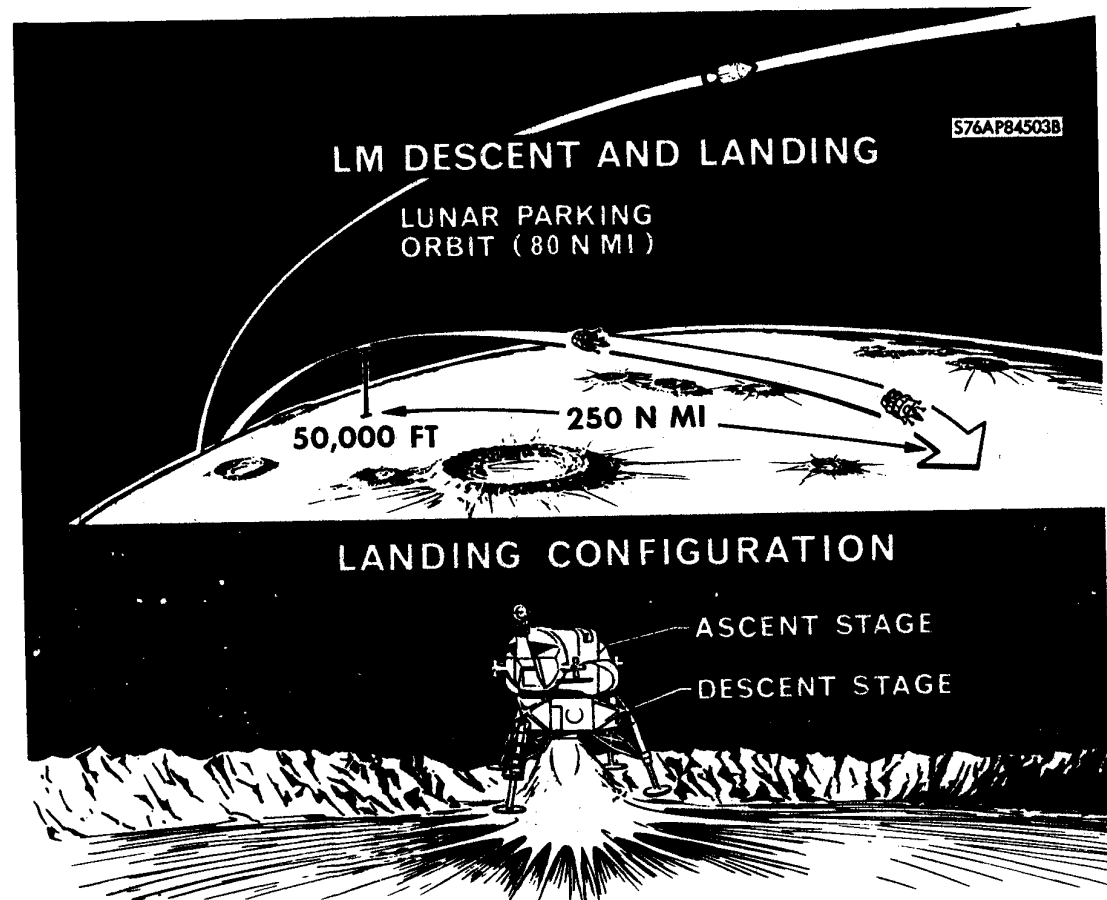
S56AP85005C



LM SEPARATION & DESCENT

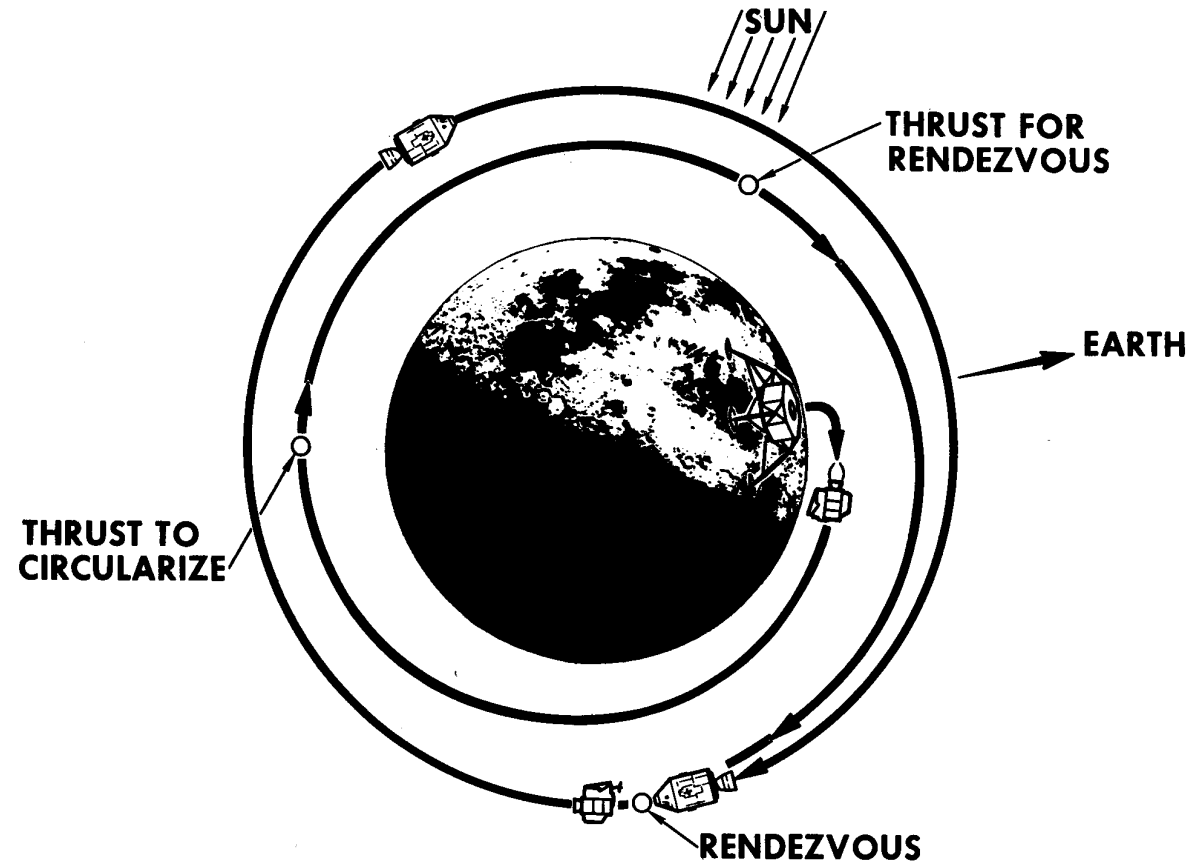
S47AP84866D

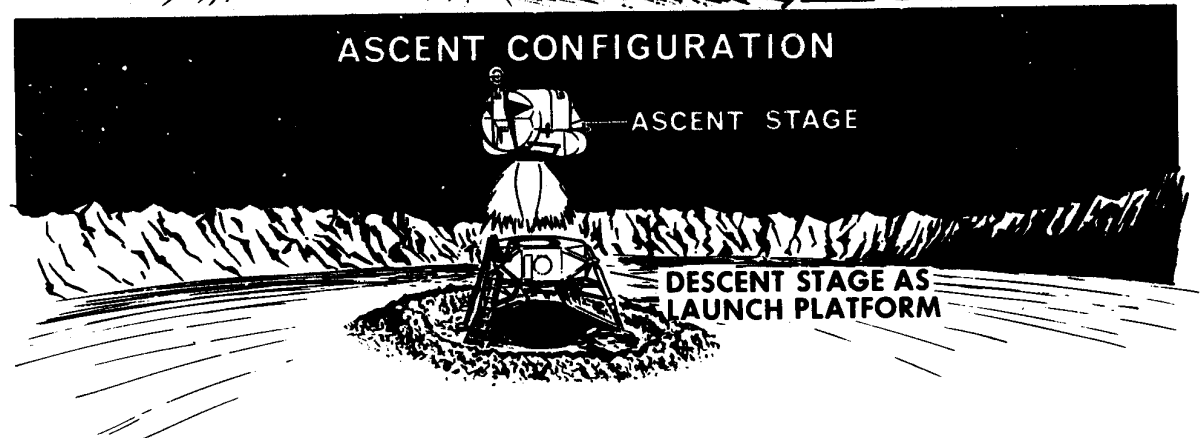
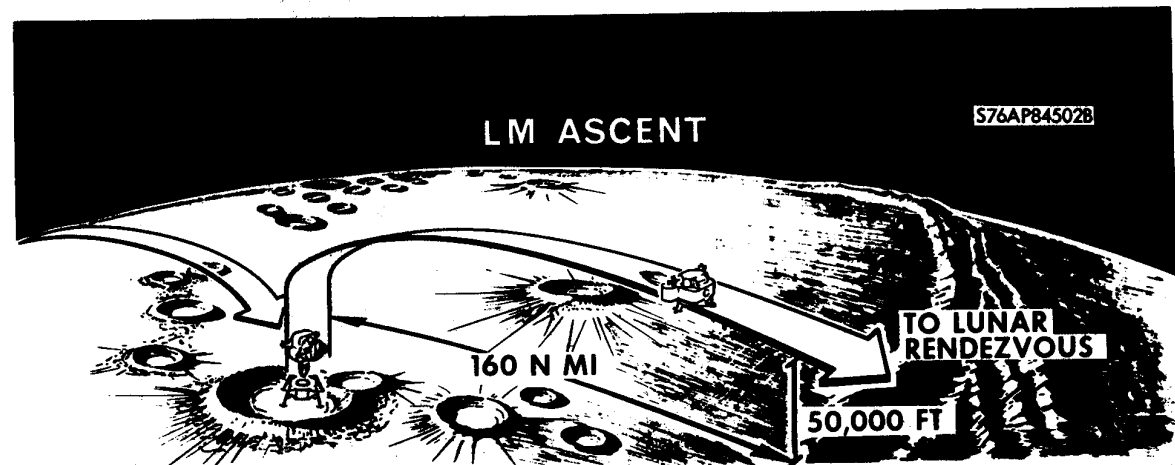




LUNAR ORBITAL RENDEZVOUS

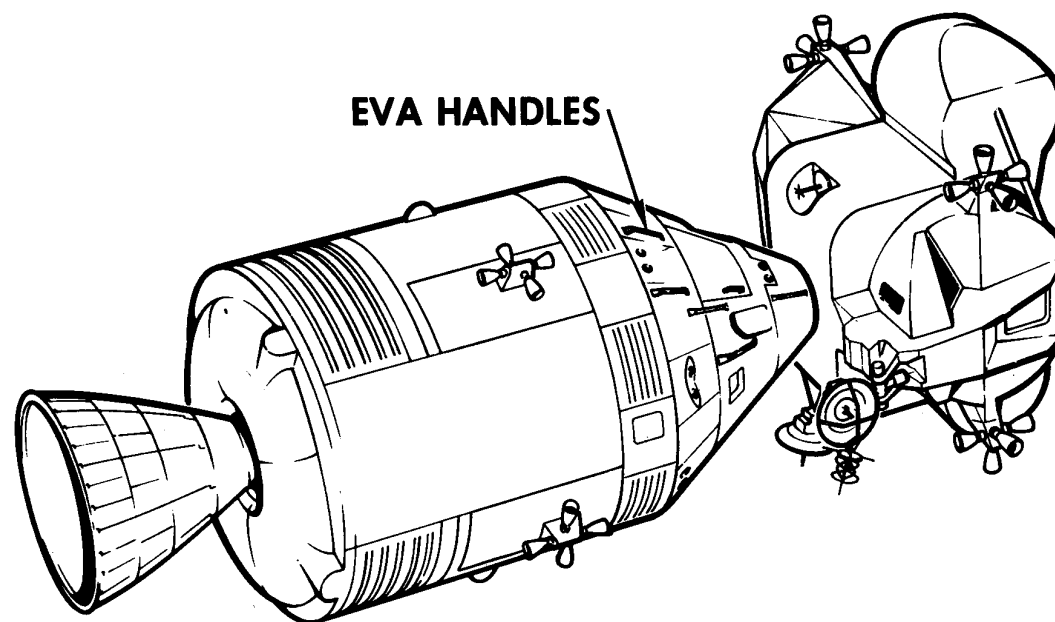
556ASD10292C





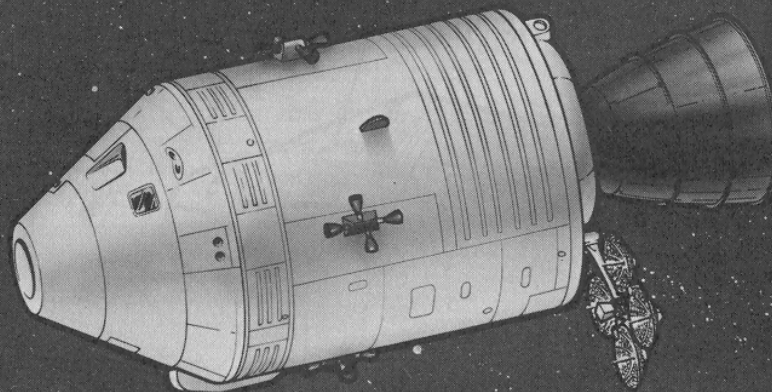
S47AP84507B

APOLLO SPACECRAFT LOR CONFIGURATION

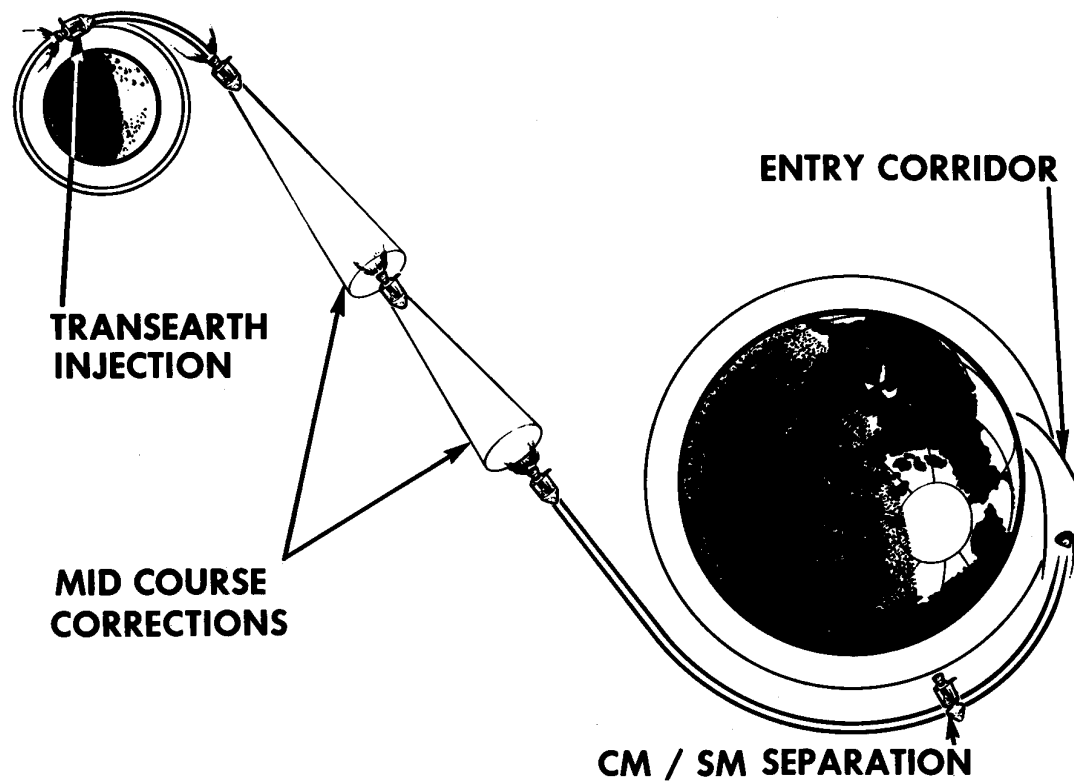


S47AP83078B

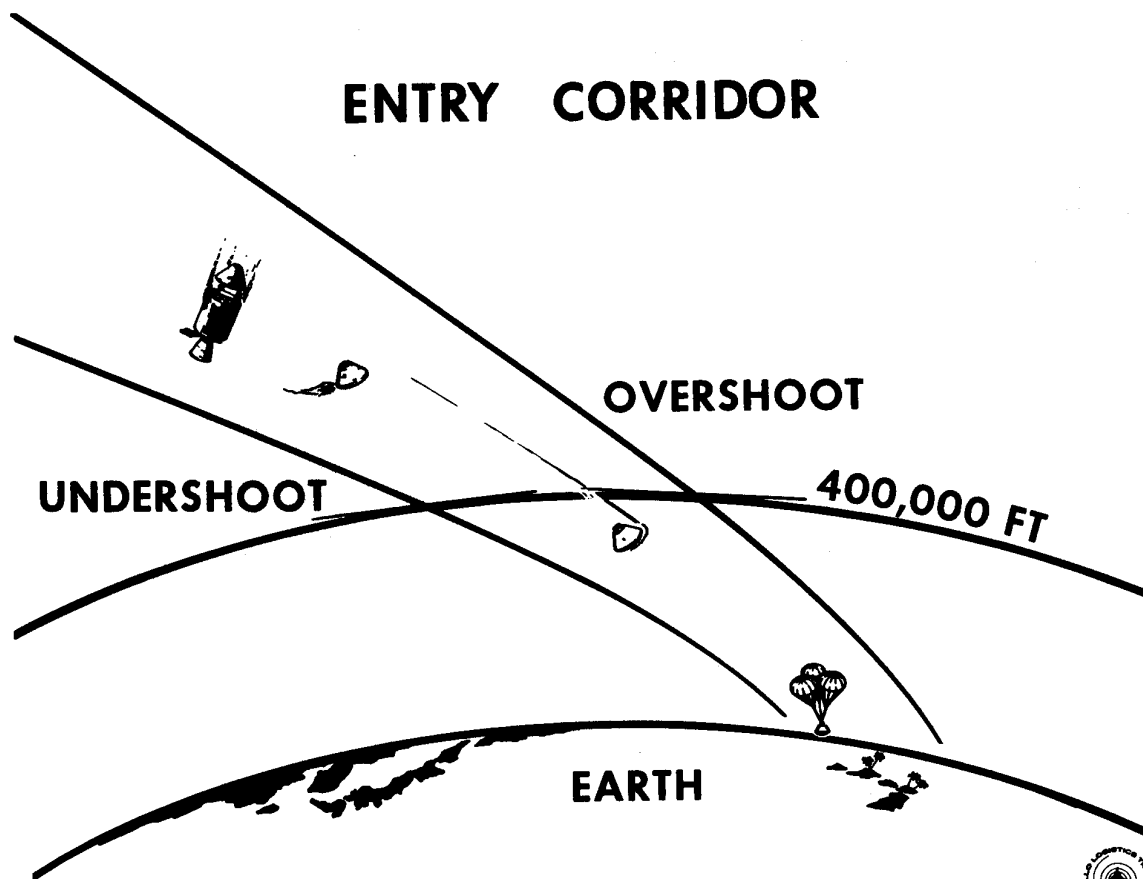
APOLLO TRANSEARTH CONFIGURATION



TRANSEARTH & ENTRY



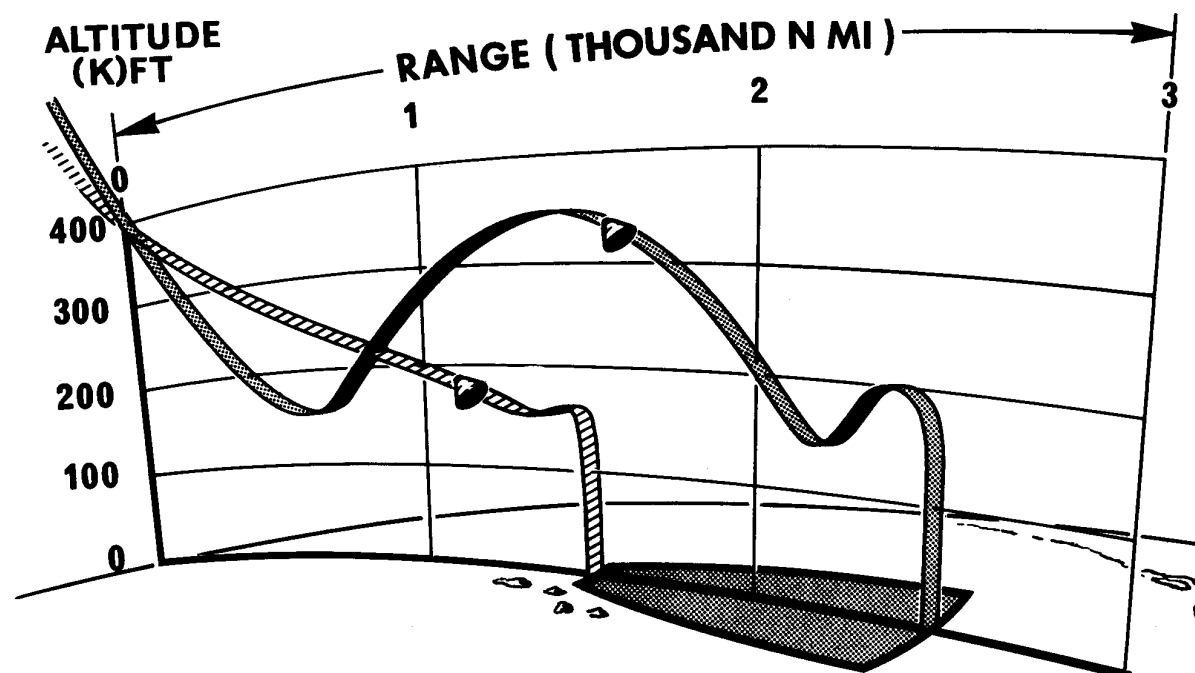
ENTRY CORRIDOR



FAM-1017A



TYPICAL RE-ENTRY RANGES



RECOVERY

HEAT SHIELD
JETTISONED
BY 24,000 FEET

AFTER
TIME DELAY
DROGUE CHUTES
DEPLOYED-REEFED

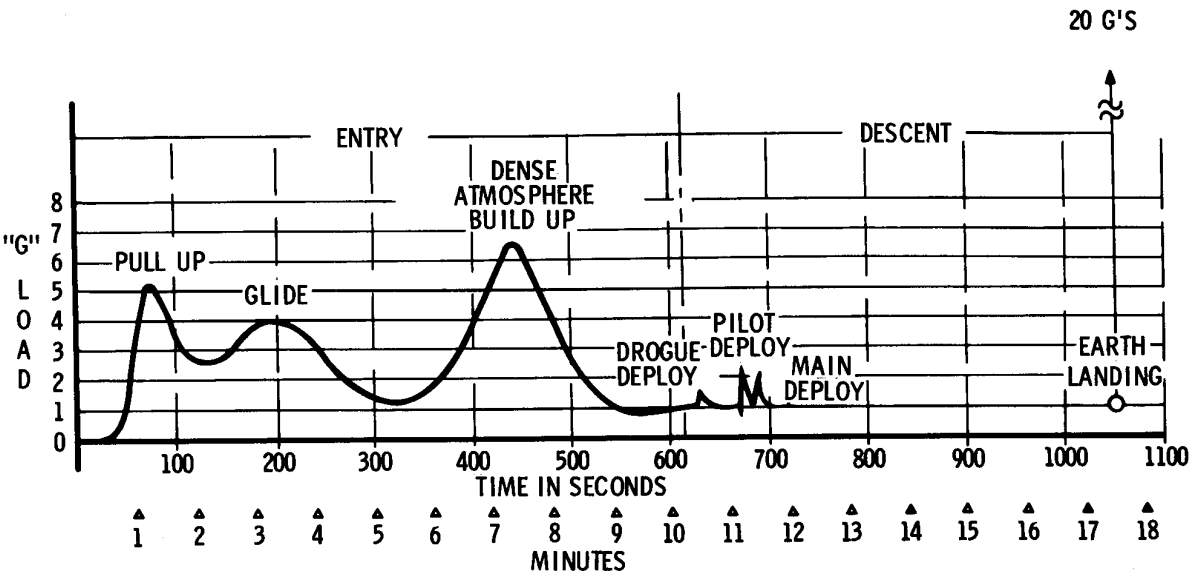
DROGUE CHUTES RELEASED
AND MAIN CHUTES DEPLOYED
REEFED BY 10,000 FT

MAIN CHUTES FULLY
OPENED AFTER BEING
REEFED



"G" FORCES, LUNAR MISSION, BLOCK II

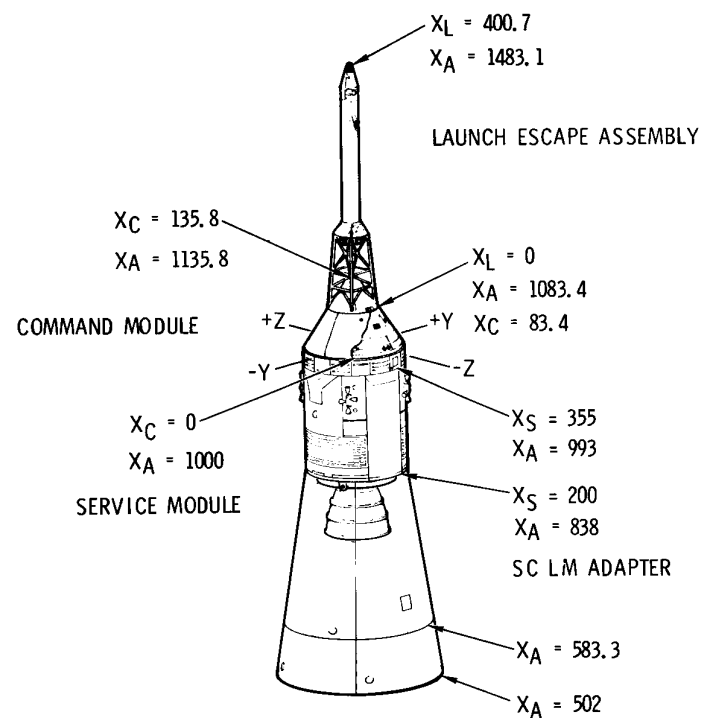
ASTRONAUT SENSED



REF DESIGN REFERENCE MISSION, LED-540-12 dtd OCT 64

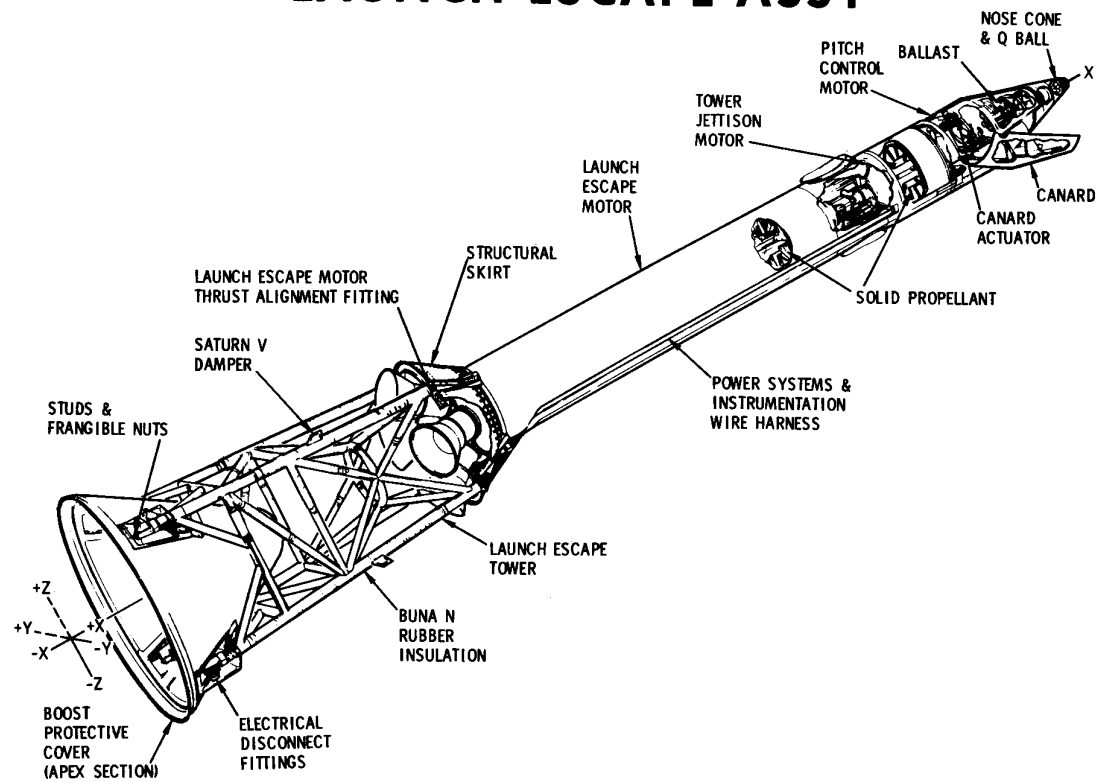
STRUCTURES

APOLLO INTEGRATED STATION & CSM AXIS BLOCK II



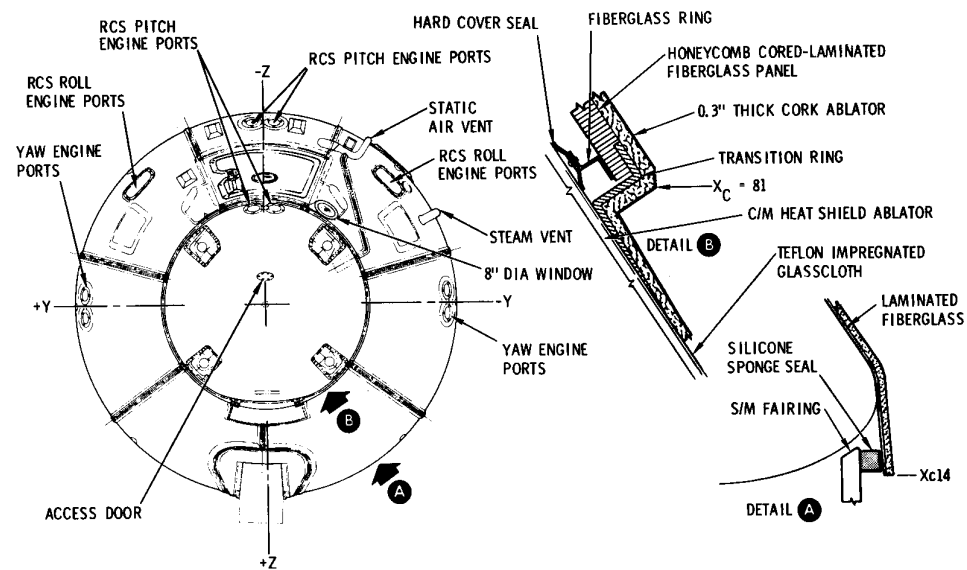
ST-107A 

LAUNCH ESCAPE ASSY



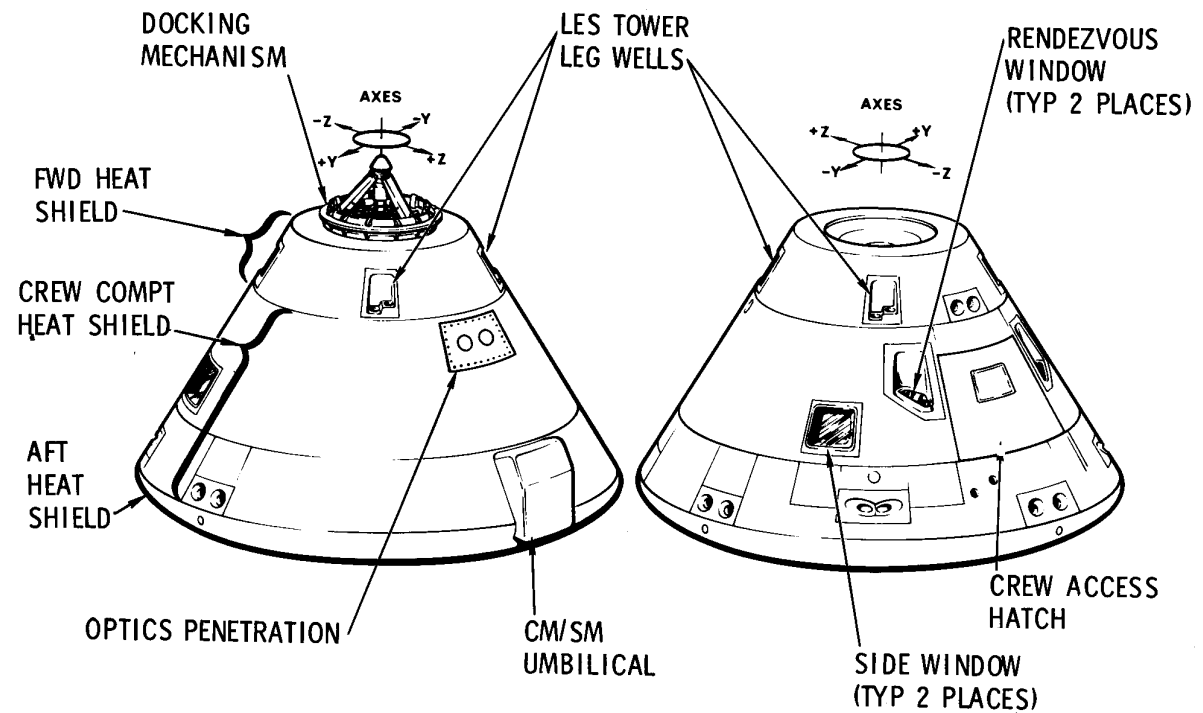
BOOST PROTECTIVE COVER

BLOCK II CSM



COMMAND MODULE EXTERIOR

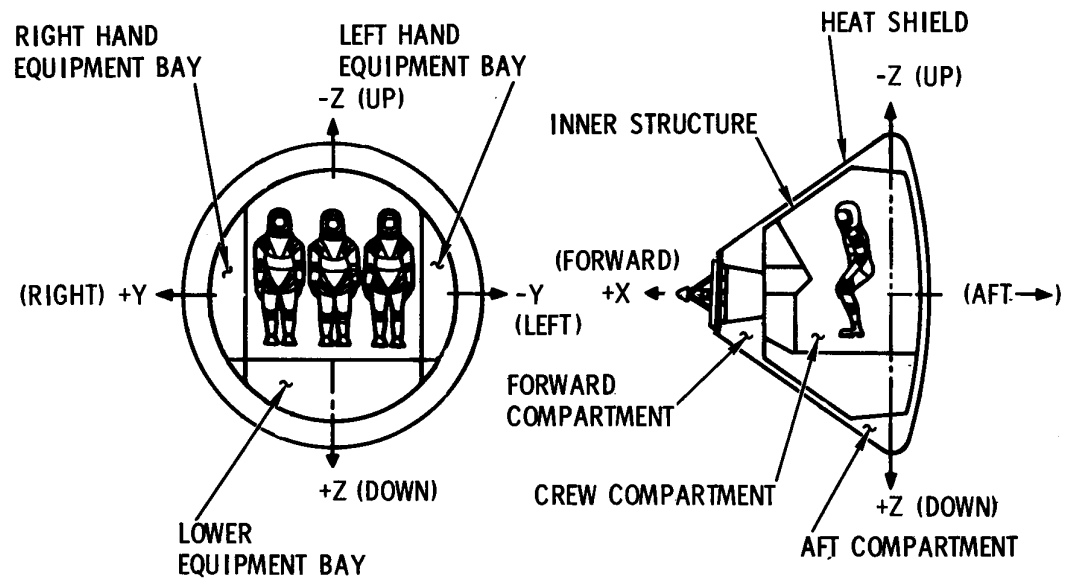
BLOCK II



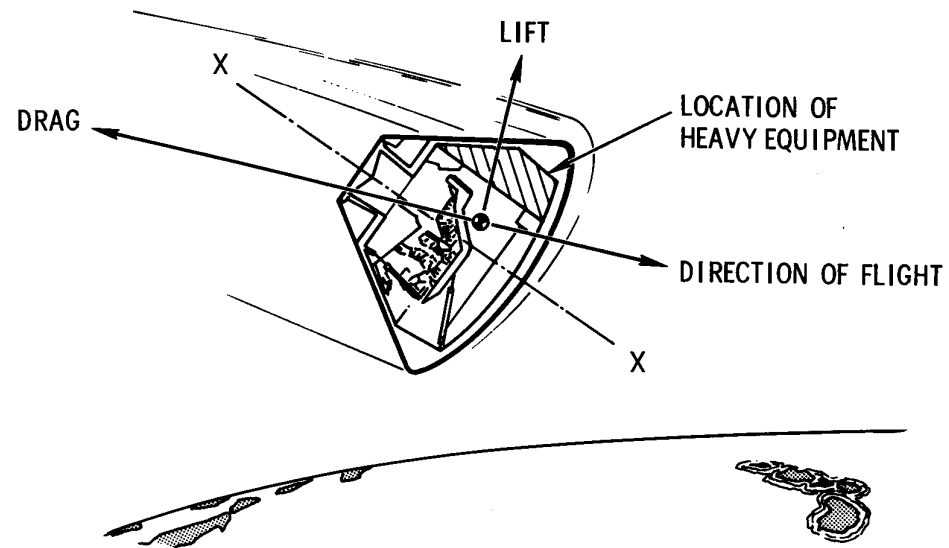
ST-260B



COMMAND MODULE COMPARTMENT ORIENTATION BLOCK II



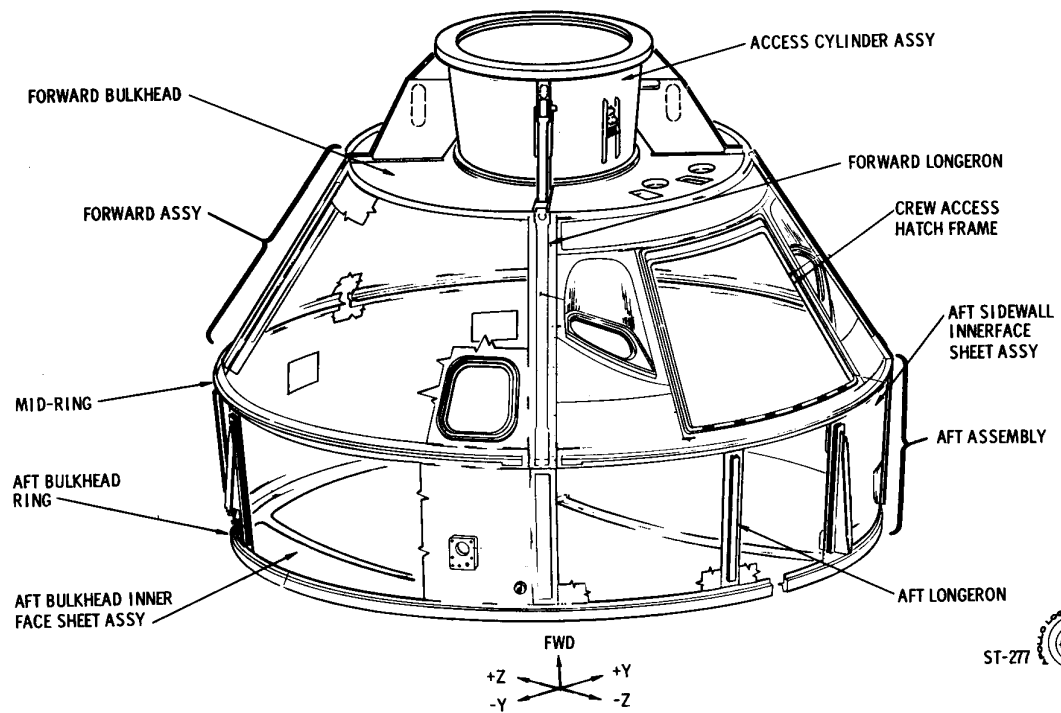
COMMAND MODULE AERODYNAMICS



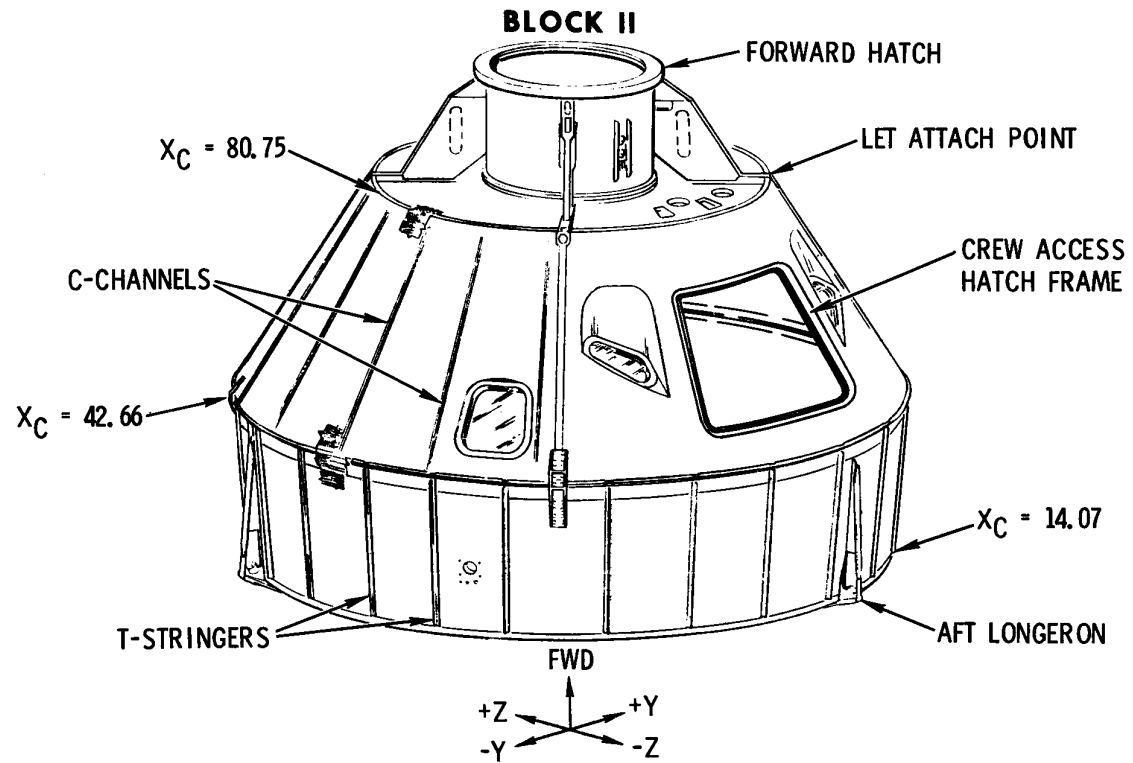
FAM-1511 

INNER STRUCTURE

INNER SHELL (BLOCK II)



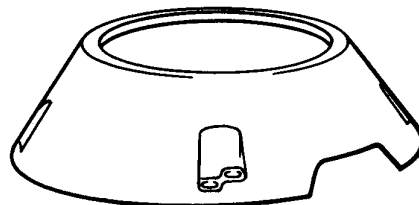
CM INNER STRUCTURE



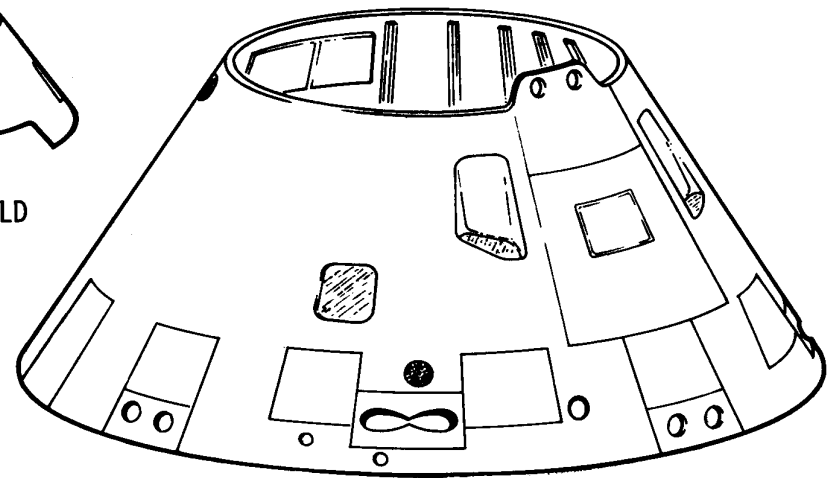
ST-278A 

COMMAND MODULE HEAT SHIELDS

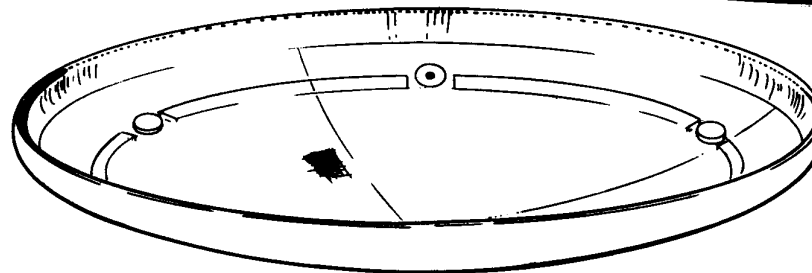
BLOCK II



FORWARD HEAT SHIELD



CREW COMPARTMENT
HEAT SHIELD

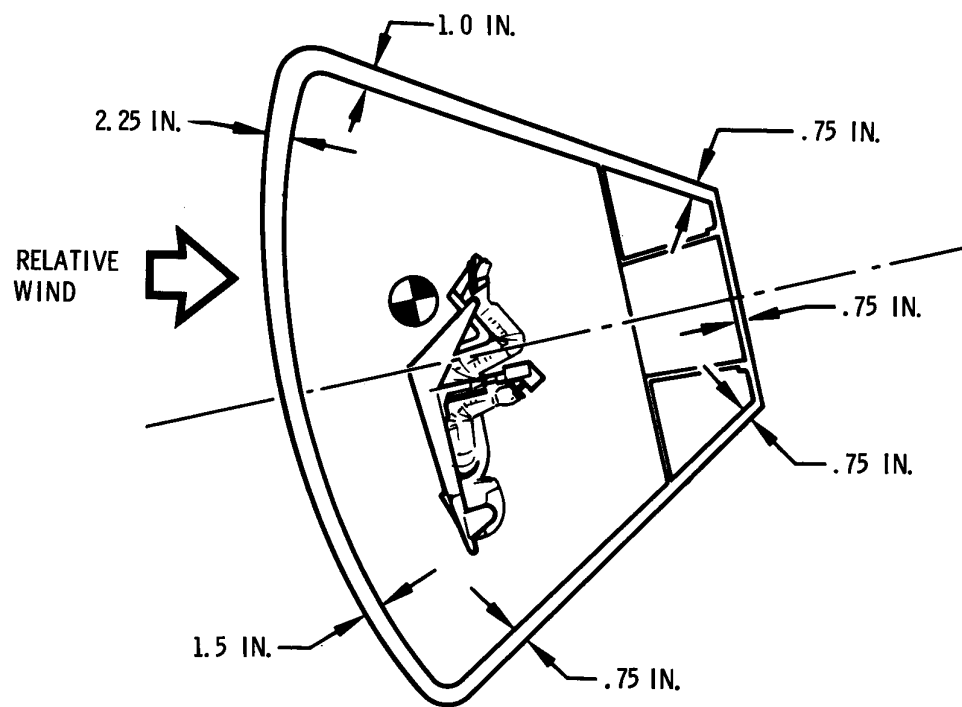


AFT HEAT SHIELD

FAM-1504A

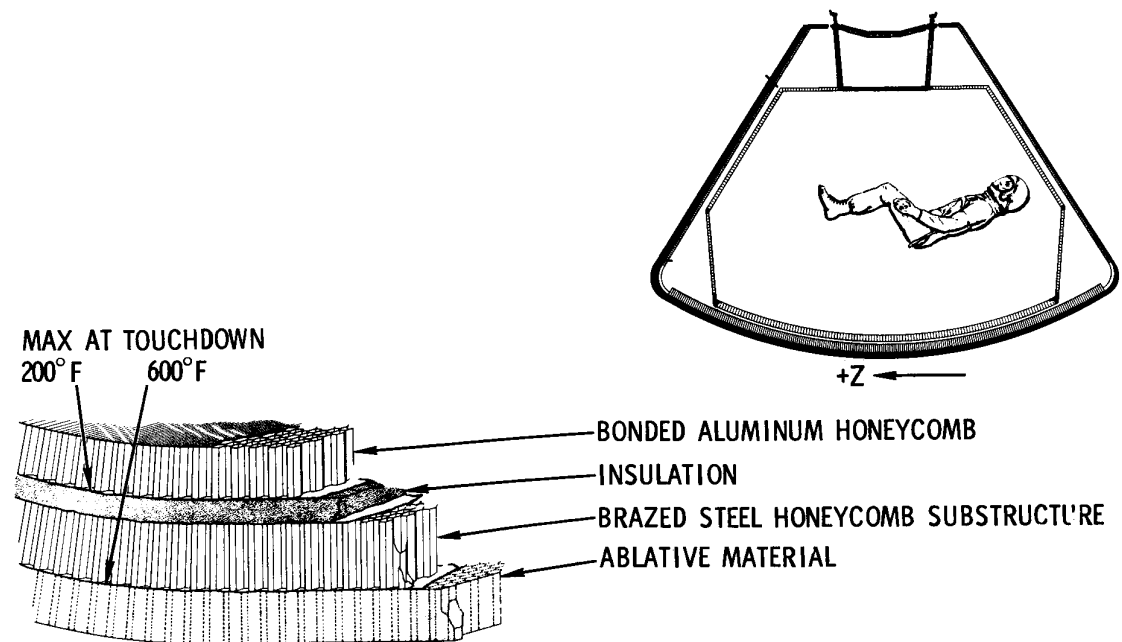


COMMAND MODULE ABLATIVE MATERIAL THICKNESS BLOCK II



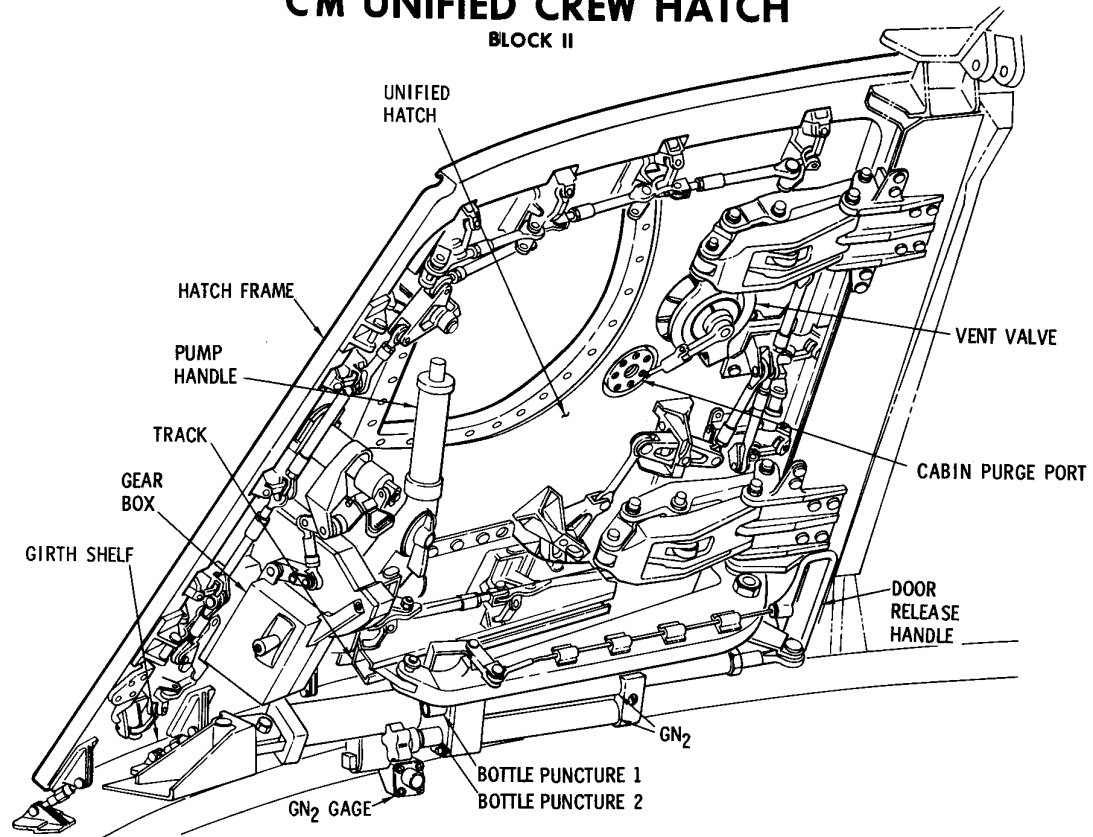
ST-530 

COMMAND MODULE SKIN CONFIGURATION



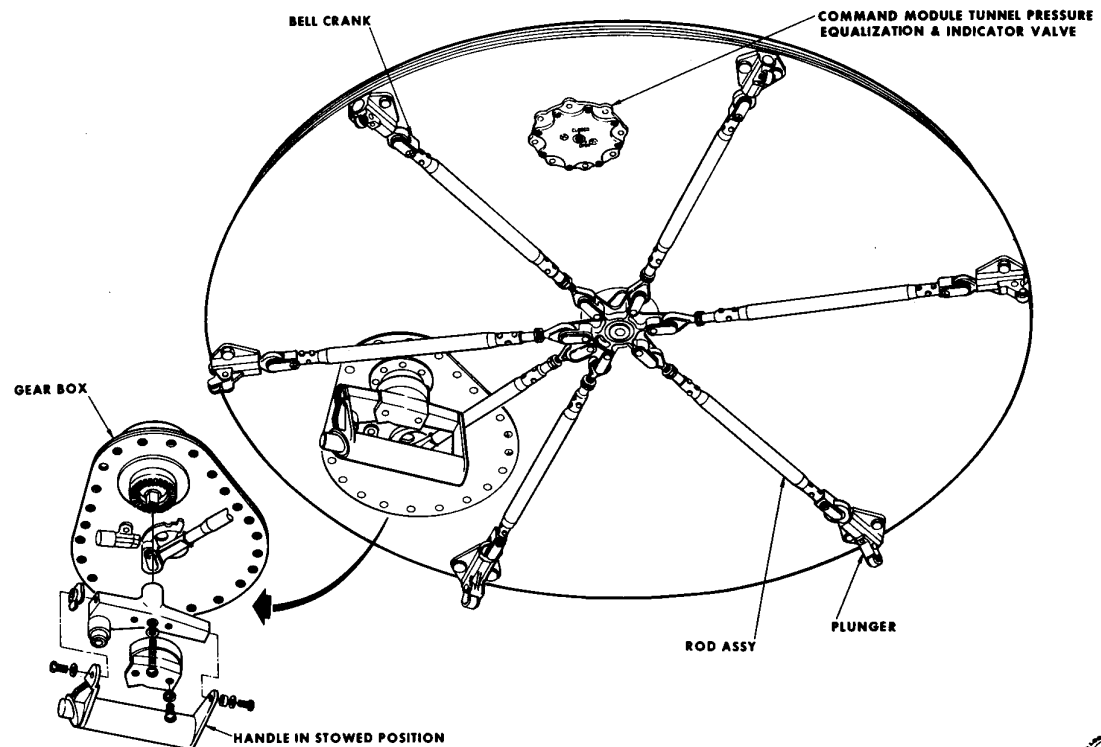
CM UNIFIED CREW HATCH

BLOCK II

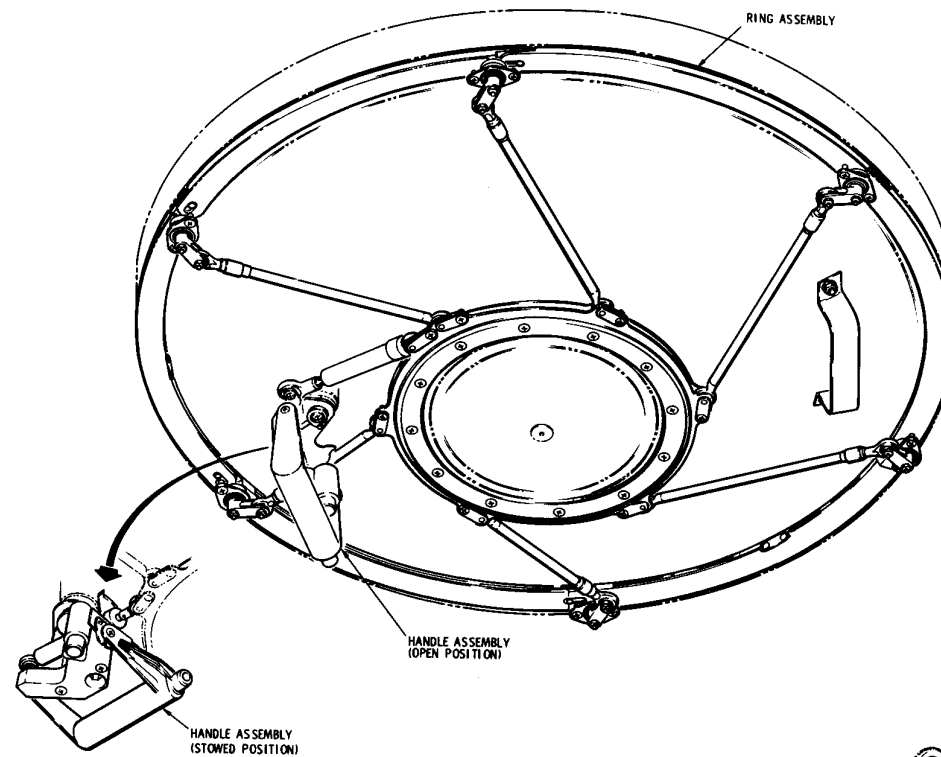


FORWARD PRESSURE HATCH

BLOCK II

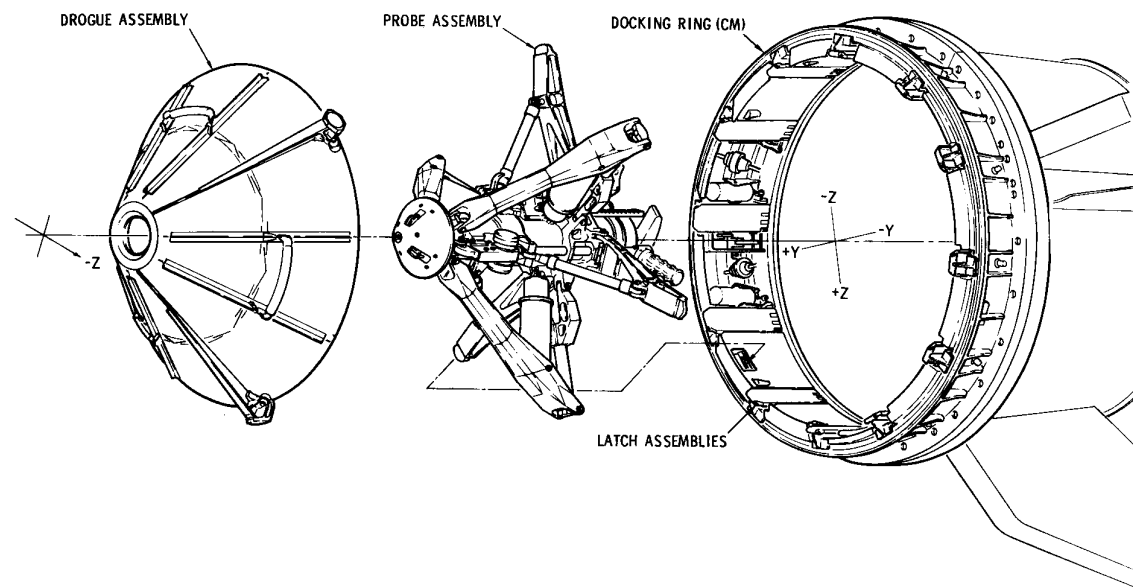


ABLATIVE HATCH

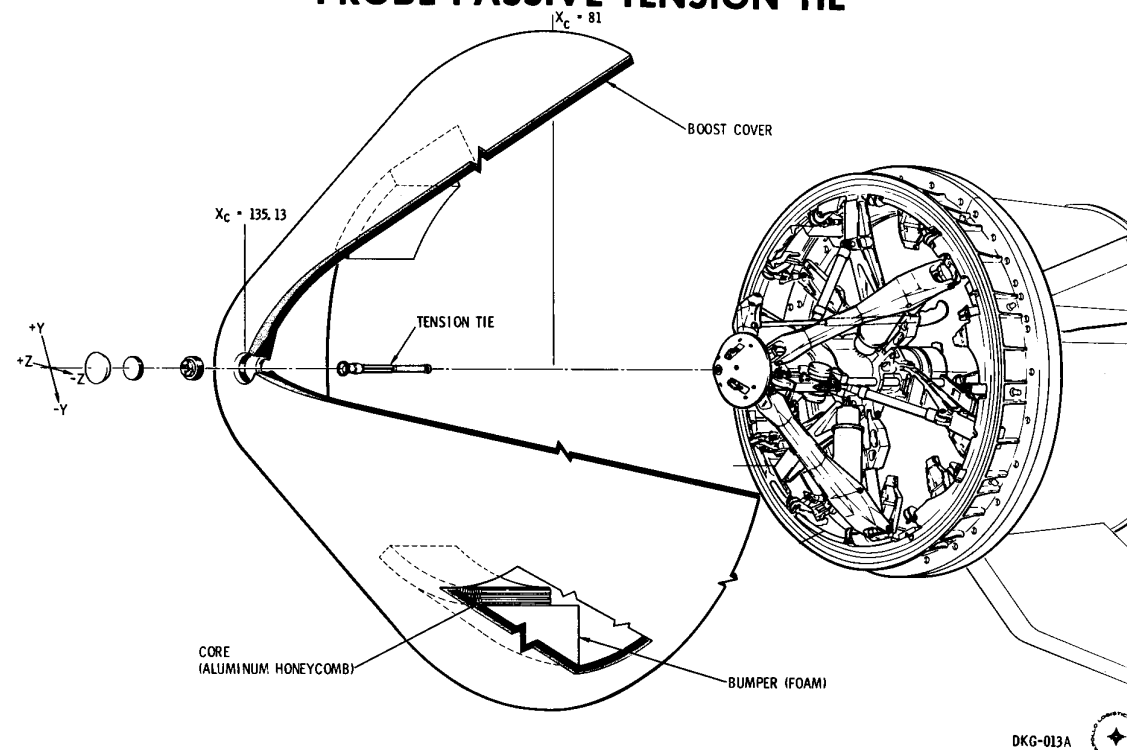


ST-501

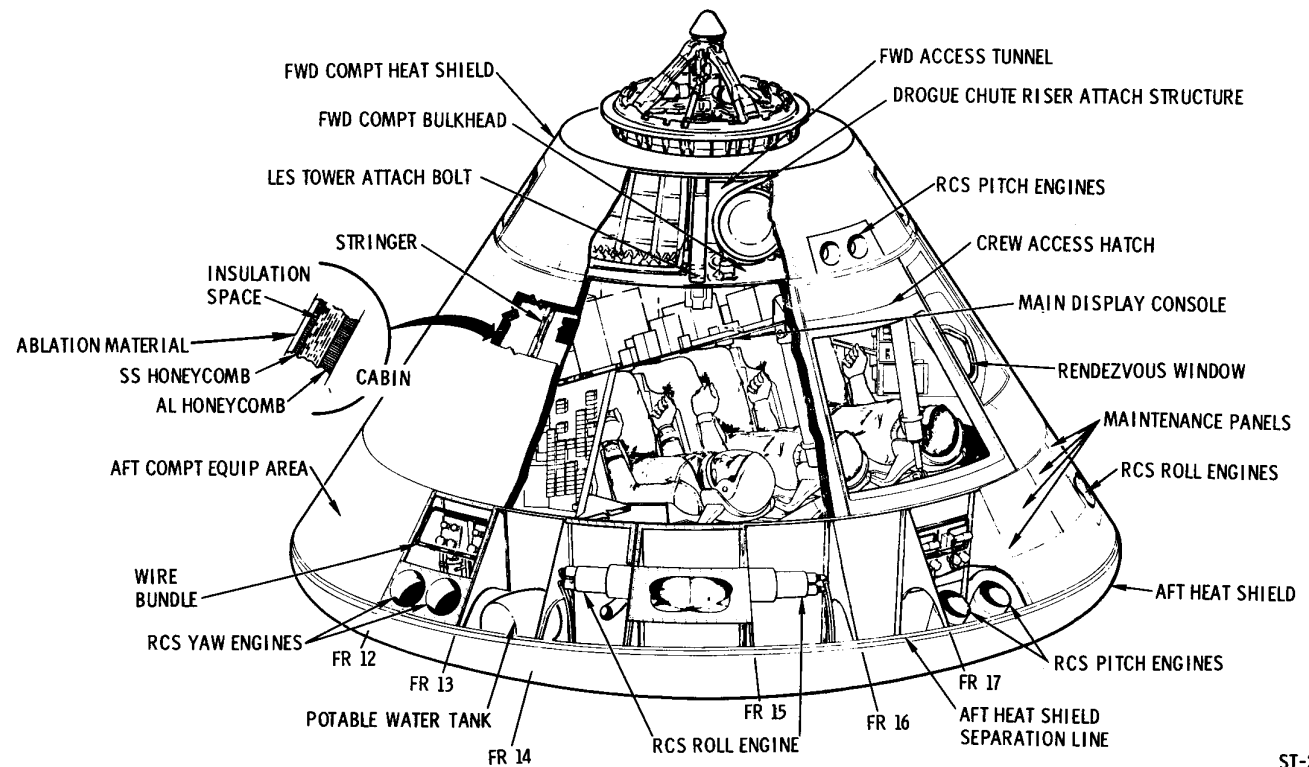
PROBE INSTALLATION-DOCKING SYSTEM



PROBE PASSIVE TENSION TIE

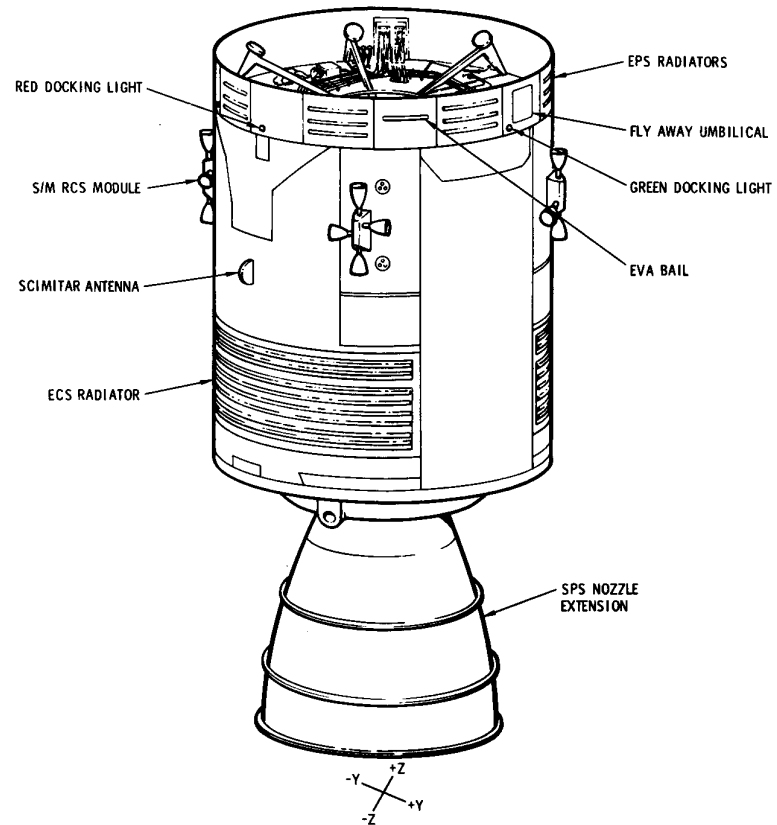


GENERAL ARRANGEMENT COMMAND MODULE (BLOCK II)



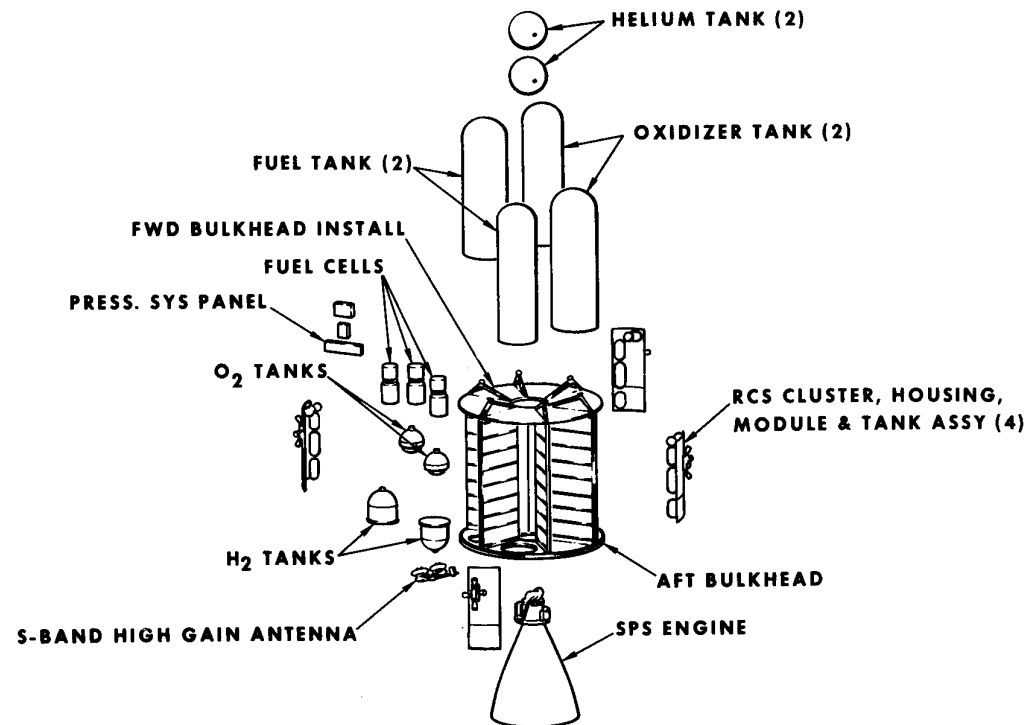
SERVICE MODULE

BLOCK II

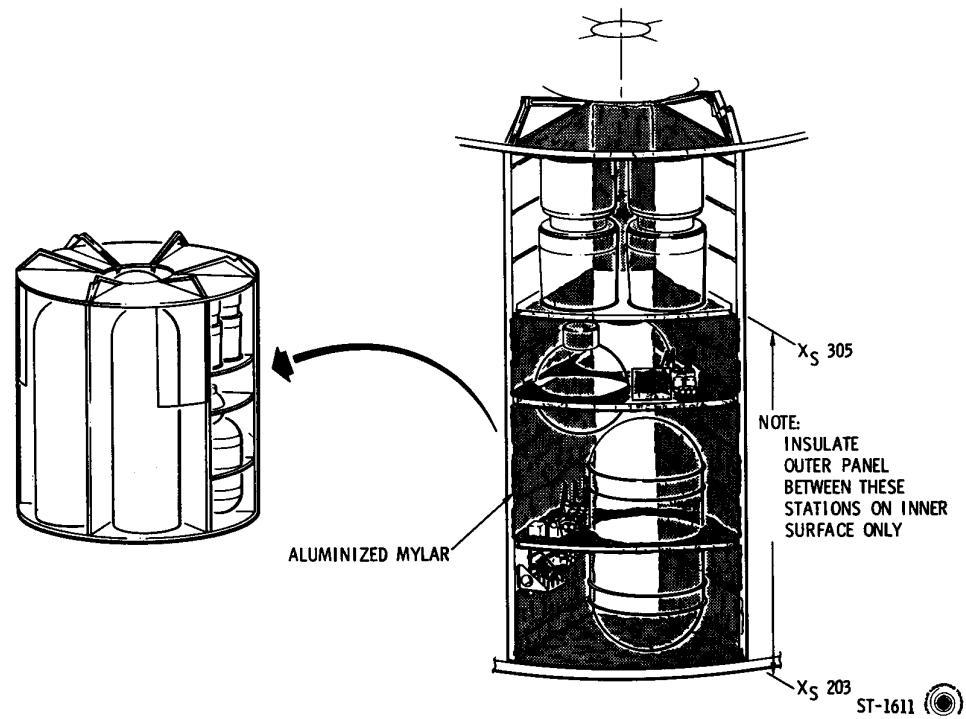


APOLLO SM SYSTEMS EQUIPMENT

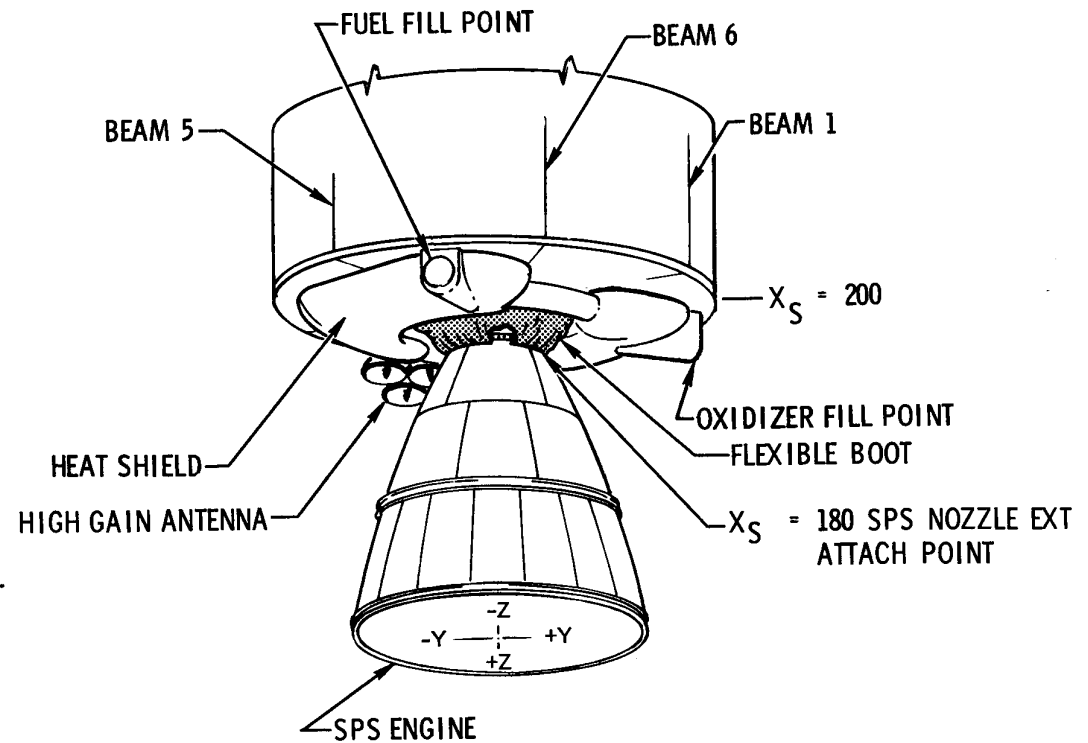
BLOCK II



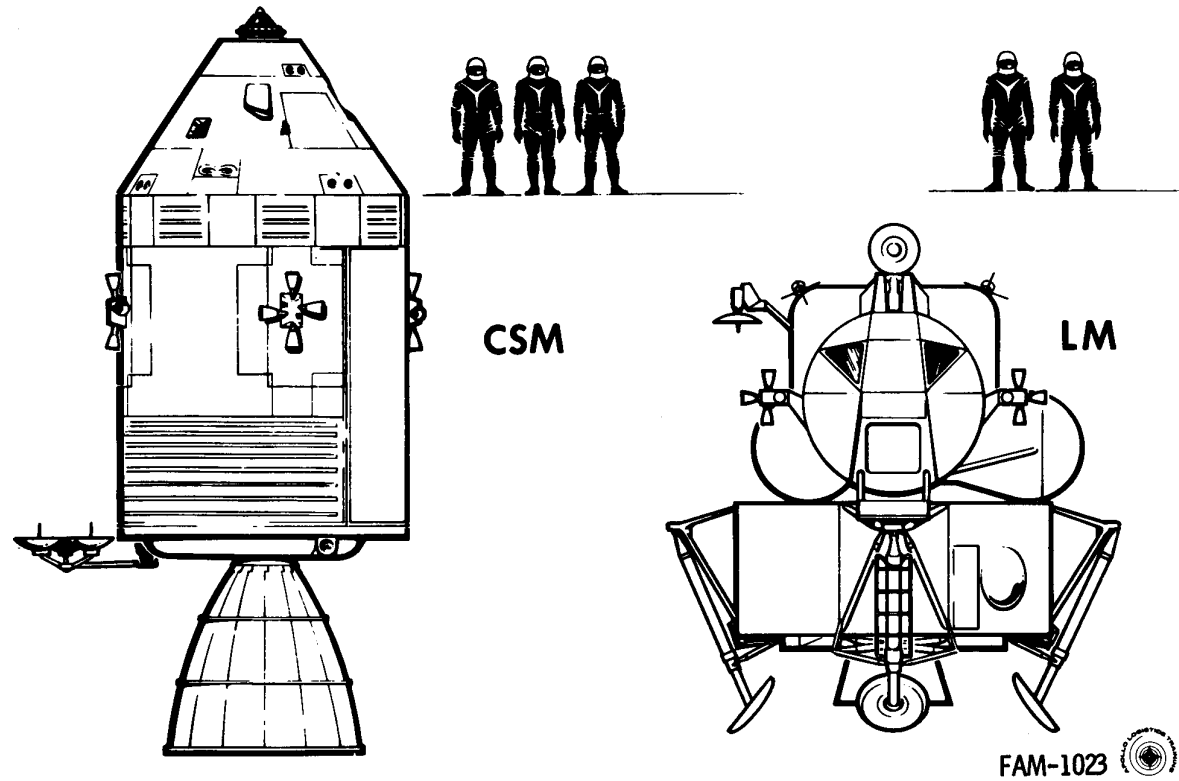
SM INSULATION TYPICAL FOR SECTOR IV



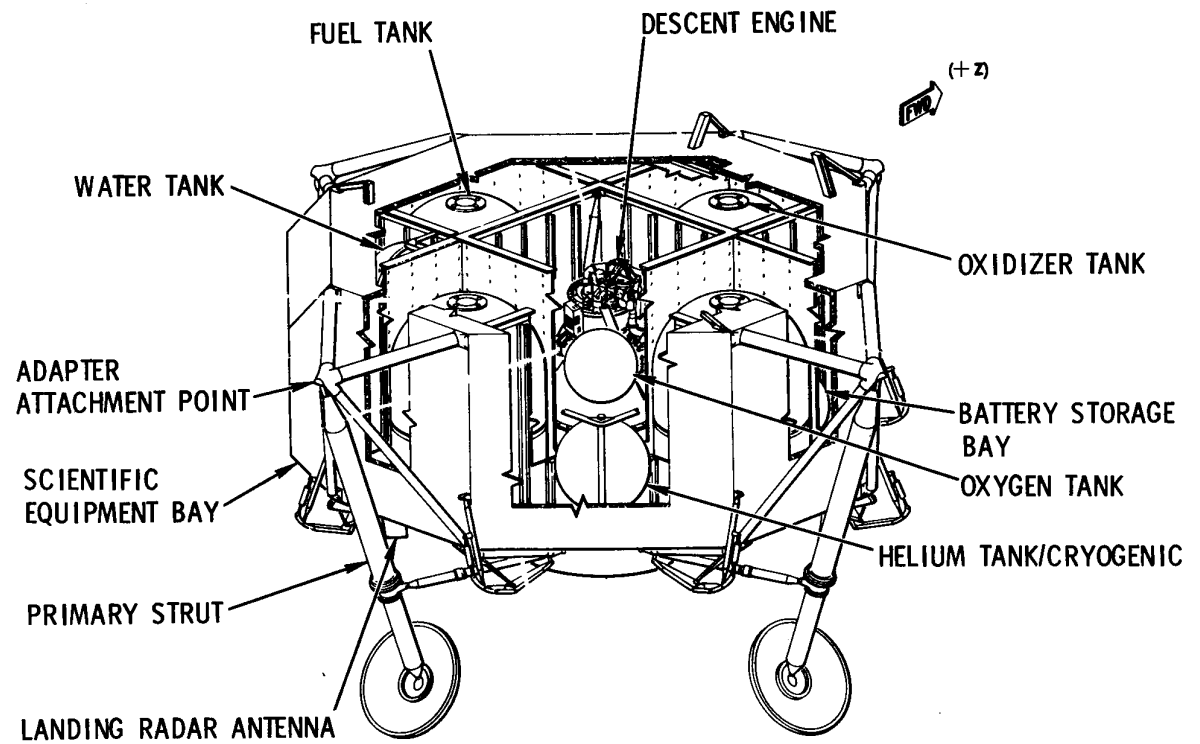
S/M SPS NOZZLE AND HEAT SHIELD



CSM & LM COMPARISON



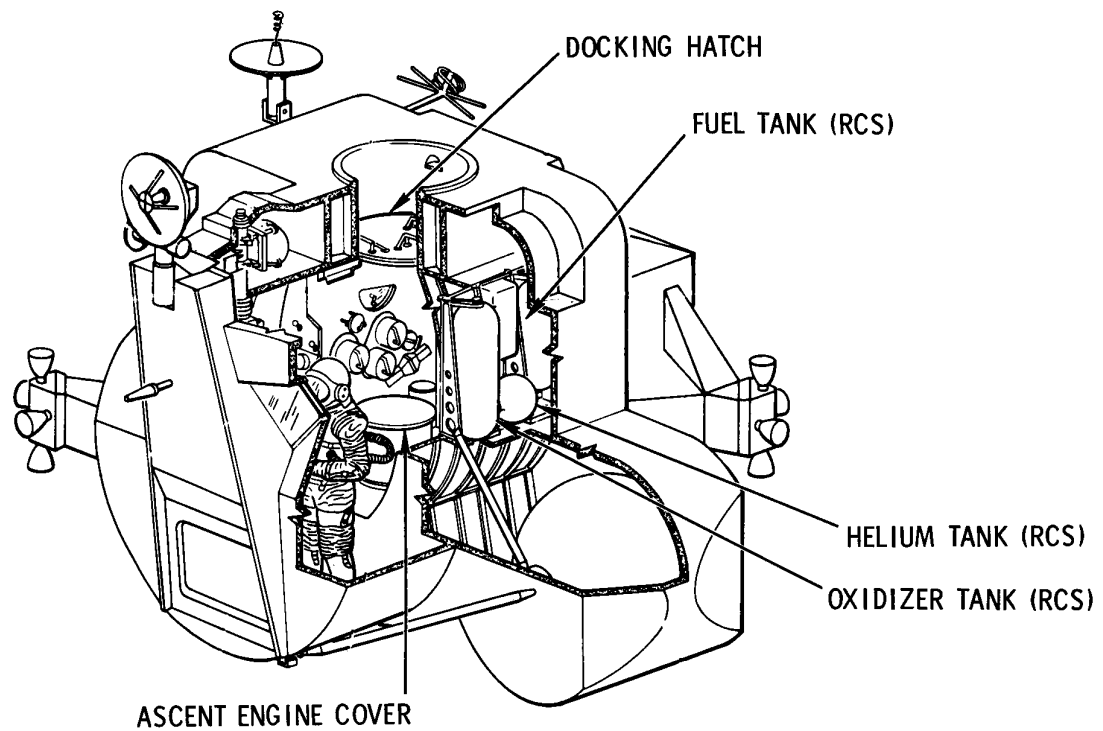
LM DESCENT STAGE



FAM-1512 A 

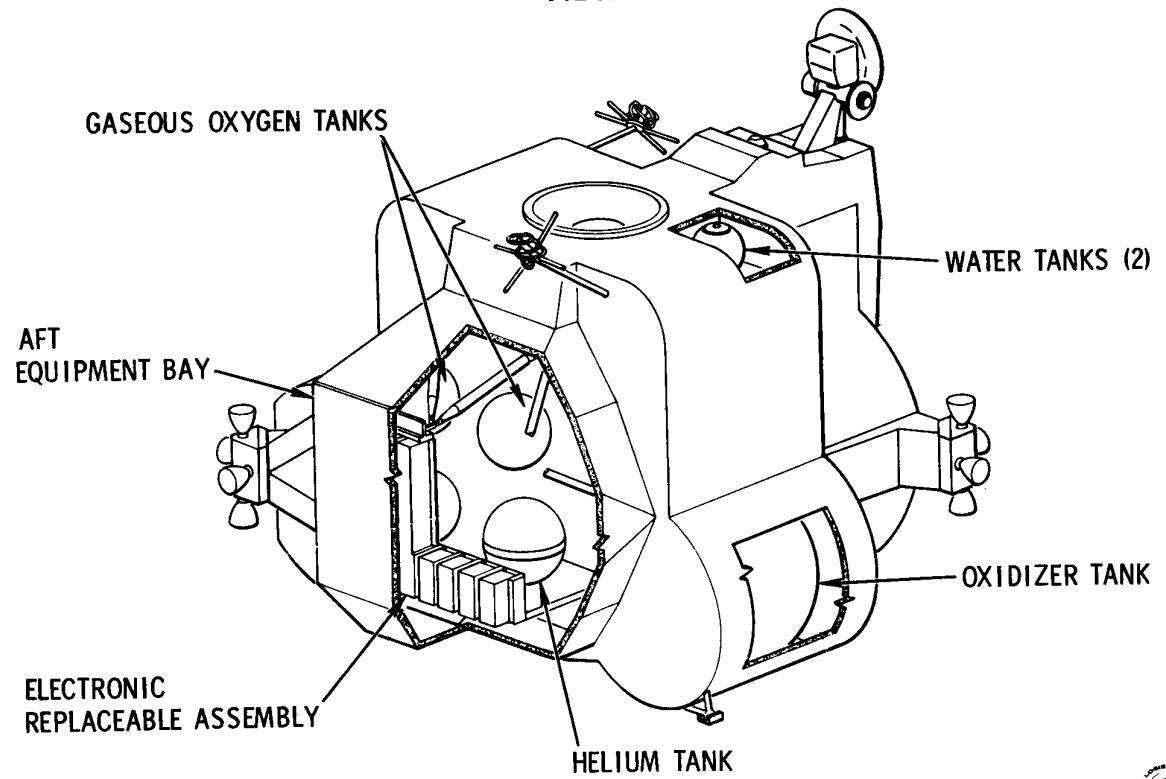
LM ASCENT STAGE

VIEW A



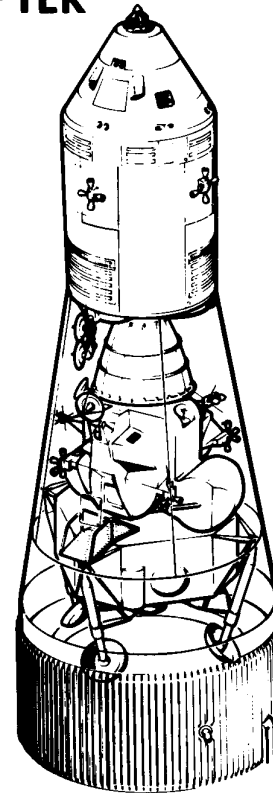
LM ASCENT STAGE

VIEW B



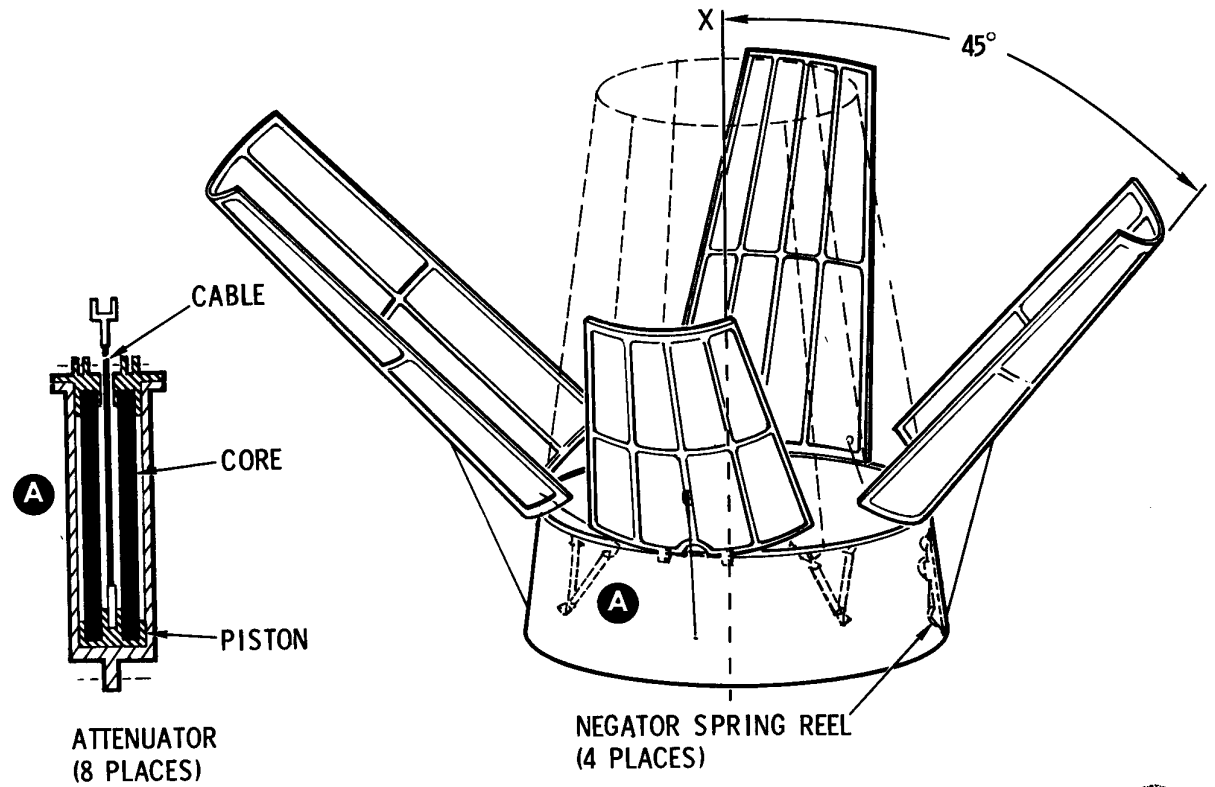
SPACECRAFT/LM ADAPTER

PANEL SEPARATION BY
EXPLOSIVE CHARGES
(MDF)

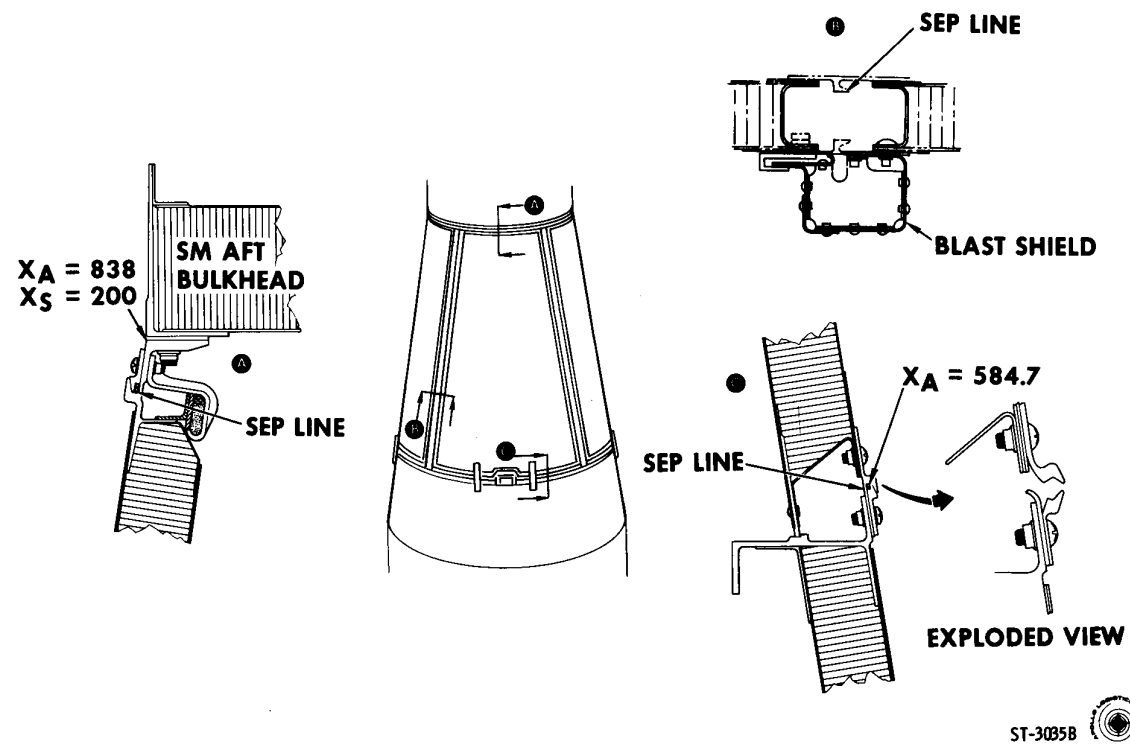


FAM-1503D 

SLA PANEL DEPLOYMENT

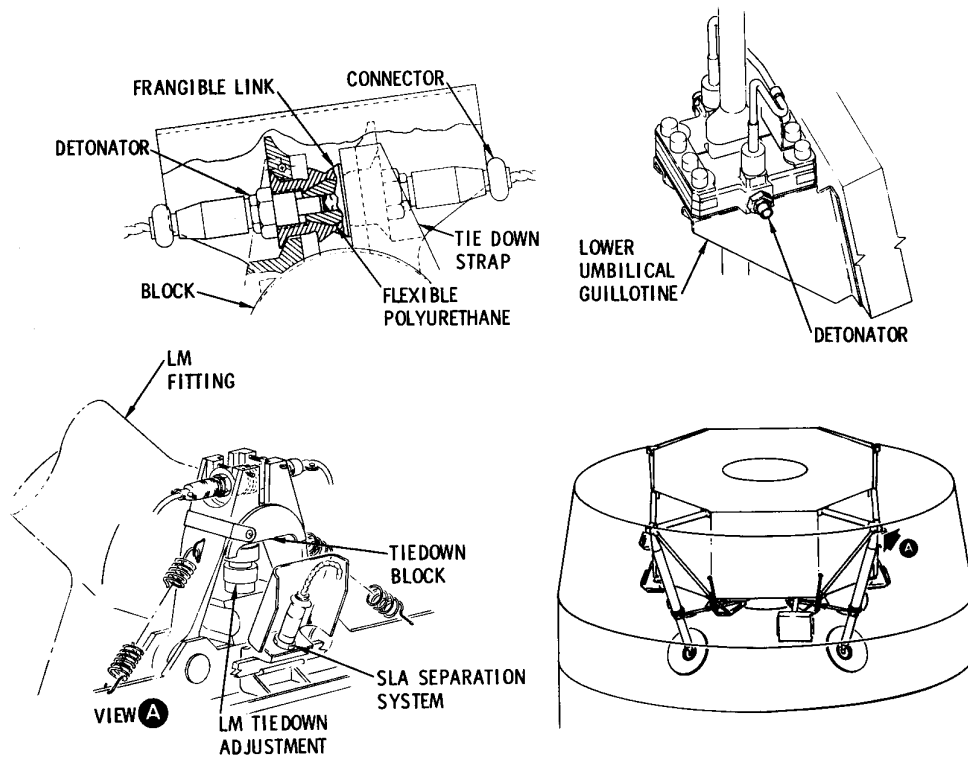


ADAPTER PANEL SEPARATION LINE



LM SEPARATION SYSTEM

BLOCK II

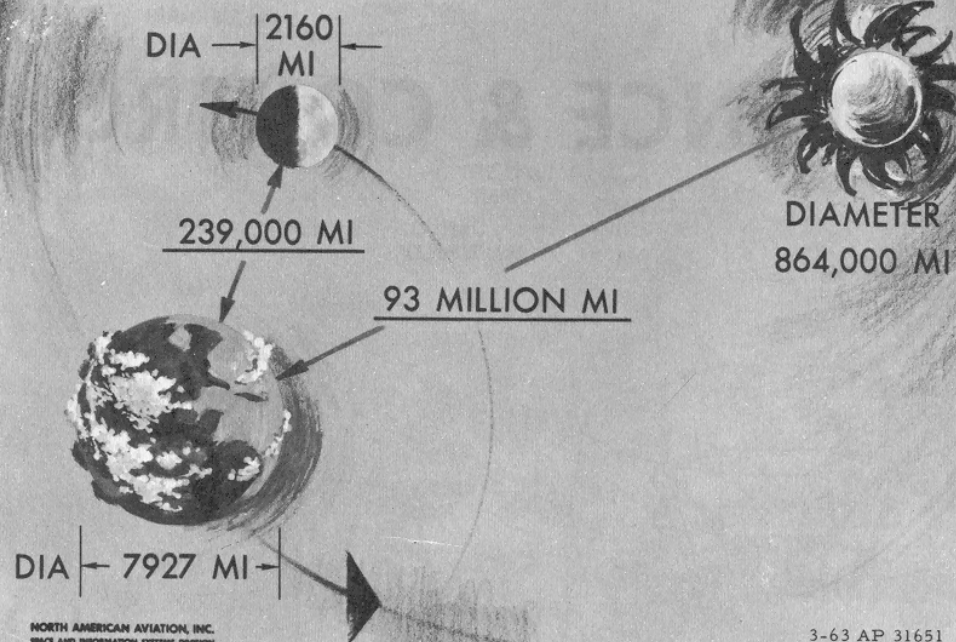


GUIDANCE & CONTROL

3

FAM-3505 

BASIC CONSIDERATIONS



NORTH AMERICAN AVIATION, INC.
SPACE AND INFORMATION SYSTEMS DIVISION

3-63 AP 31651

VELOCITY REQUIREMENTS

ESCAPE VELOCITY

36,700 FT/SEC



8,400 FT/SEC

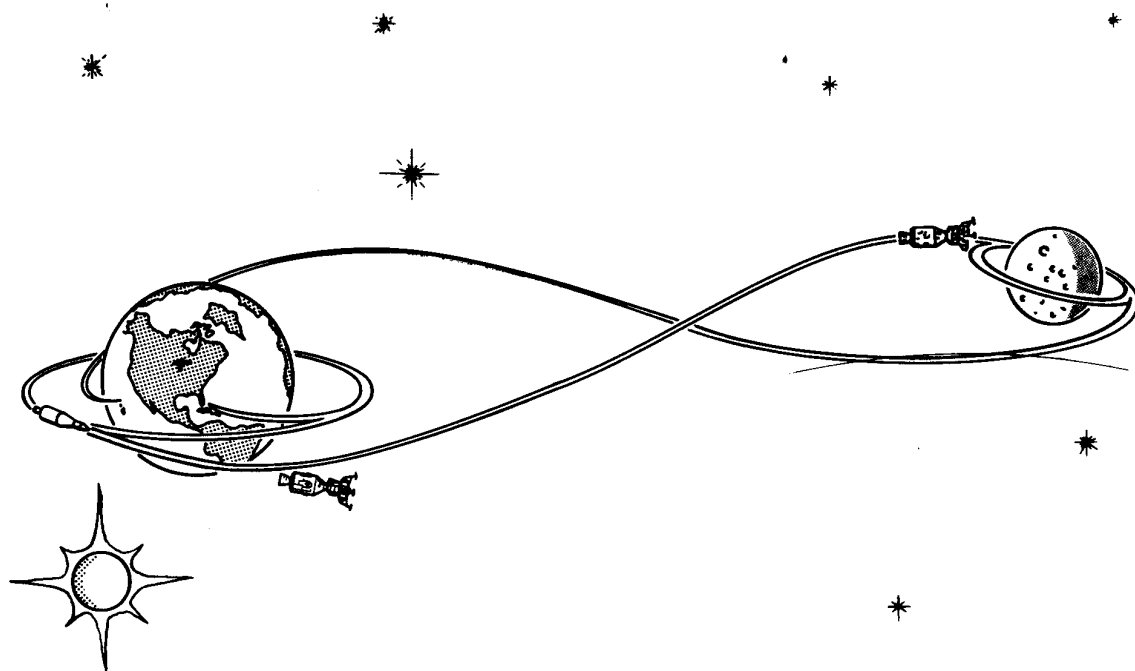
25,000 FT/SEC - ORBIT - 5280 FT/SEC

6 - RELATIVE GRAVITY - 1

NORTH AMERICAN AVIATION, INC.
SPACE AND INFORMATION SYSTEMS DIVISION

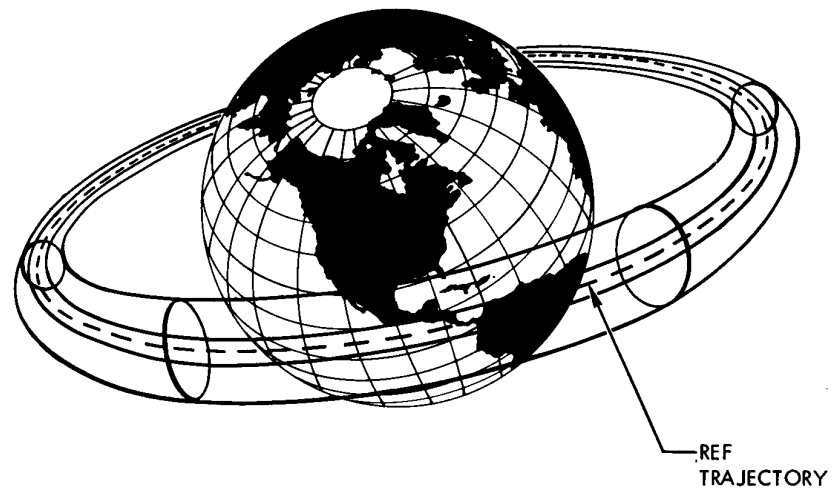
3-63 AP 31653

GUIDANCE & NAVIGATION REFERENCE TRAJECTORIES

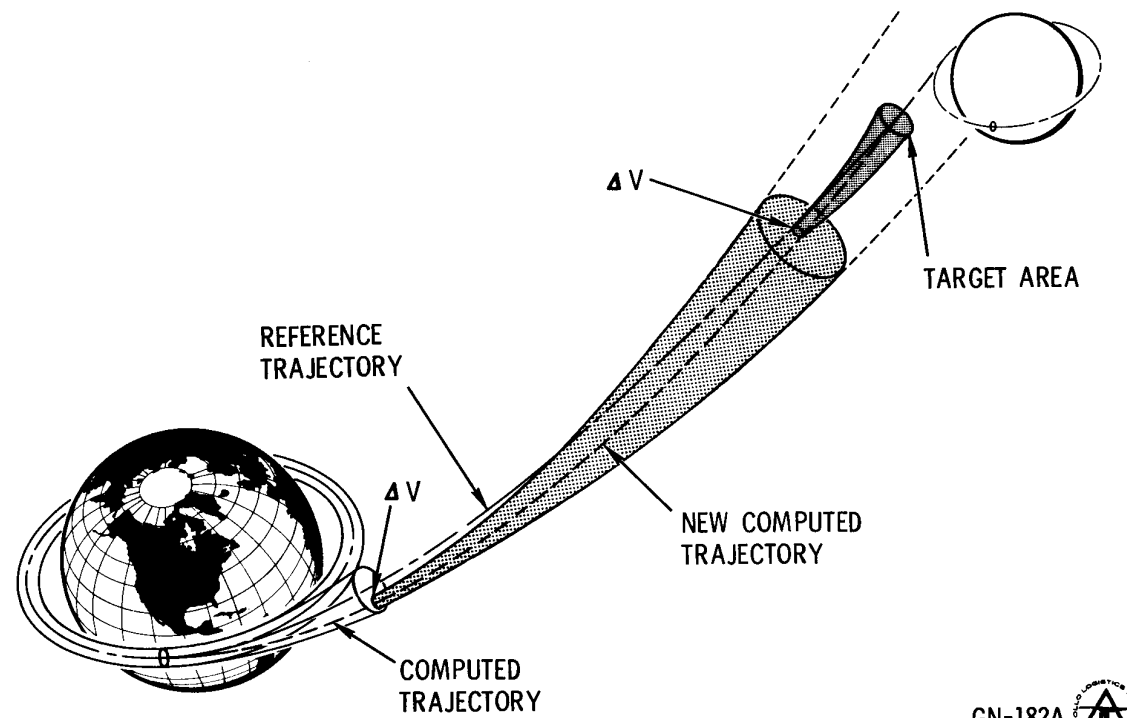


FAM-3501C 

EARTH ORBIT POSITION & TRAJECTORY DETERMINATION



MIDCOURSE POSITION & TRAJECTORY DETERMINATION



GUIDANCE & CONTROL FUNCTIONS

GNCS

- POSITION
- TRAJECTORY
- VELOCITY
- ATTITUDE

SCS

- RATE CONTROL
- ATTITUDE CONTROL
- DISPLAY
- MANUAL CONTROLS

RCS

- ROTATION
ROLL
PITCH
YAW
- TRANSLATION
X, Y, Z
ACCELERATIONS

SPS

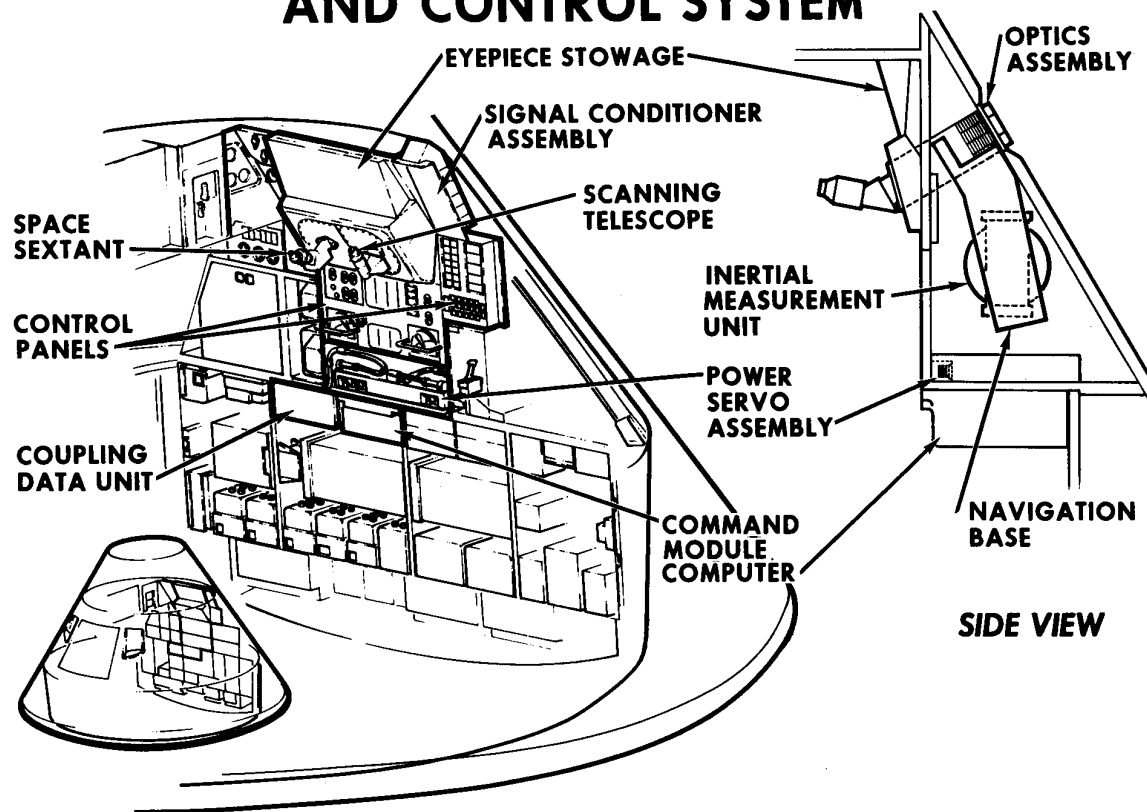
- MID-COURSE
CORRECTIONS
- PLANE
CHANGES
- LUNAR ORBIT
INSERTION
- TRANS-EARTH
INJECTION

FAM-3500B

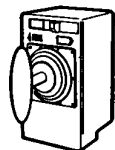
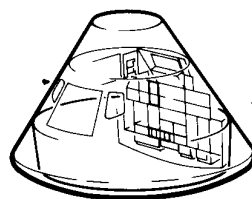


GUIDANCE, NAVIGATION, AND CONTROL SYSTEM

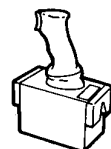
S865D10793B



STABILIZATION AND CONTROL SYSTEM

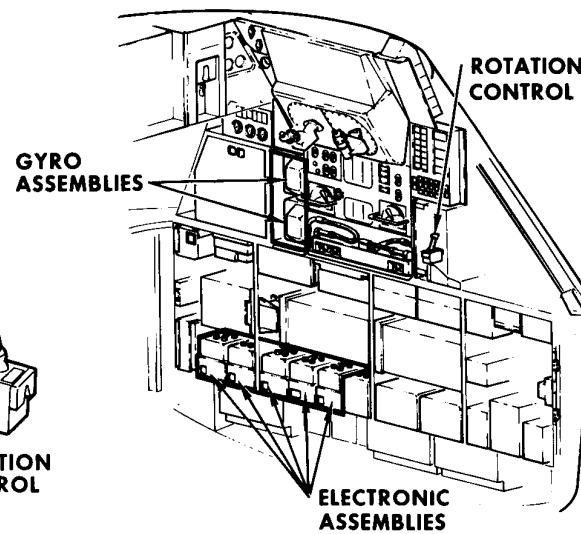


TRANSLATION
CONTROL

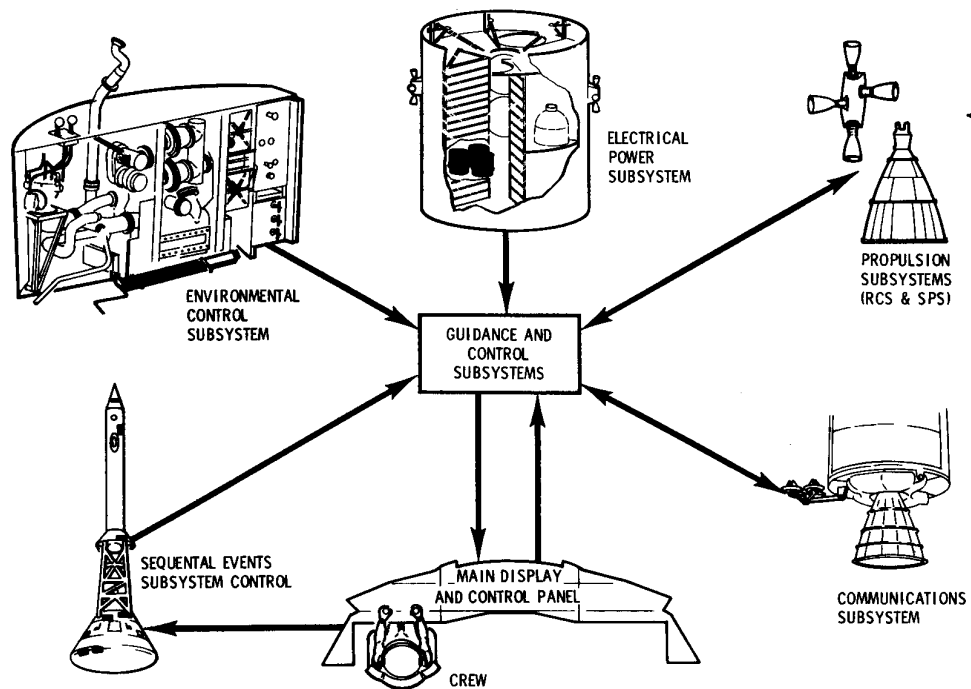


ROTATION
CONTROL

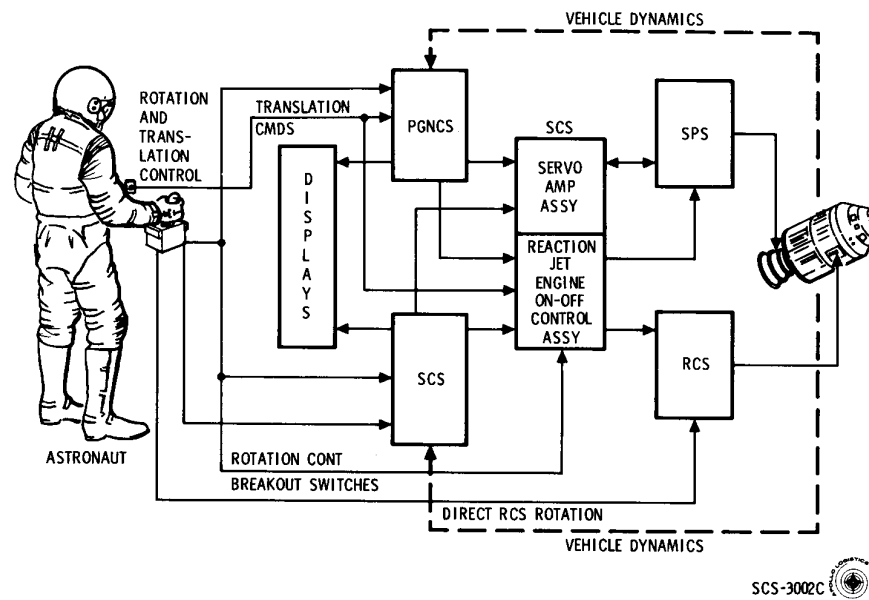
MANUAL CONTROLS



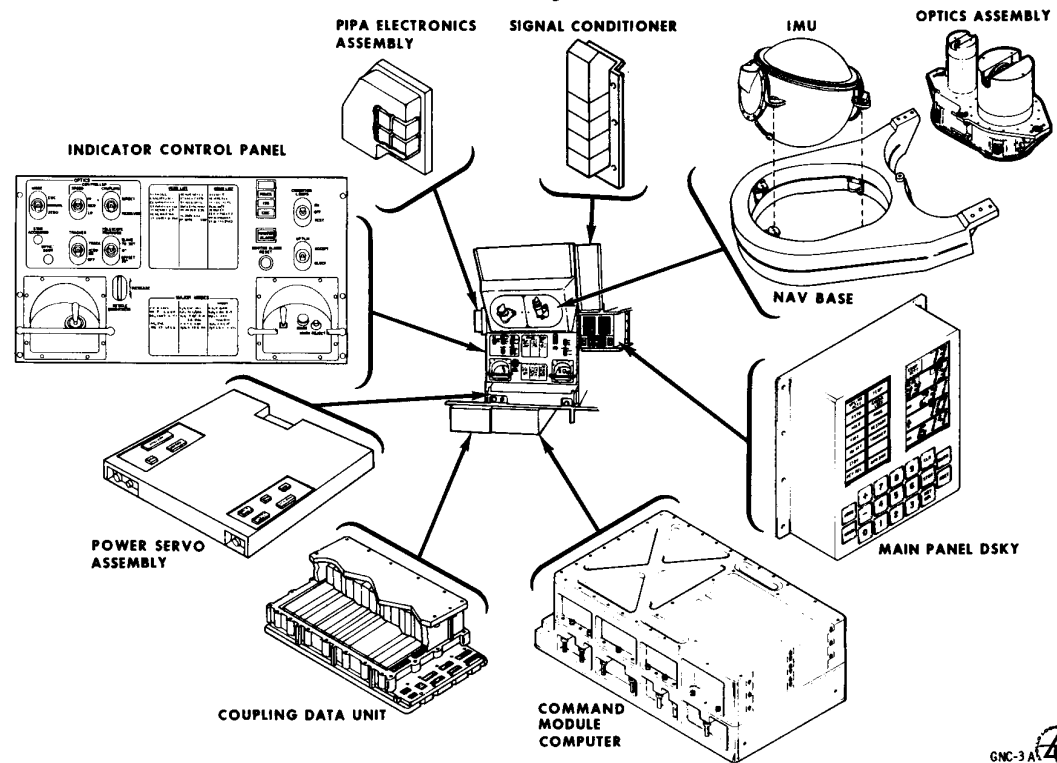
G&C AND APOLLO SUBSYSTEMS INTERFACE



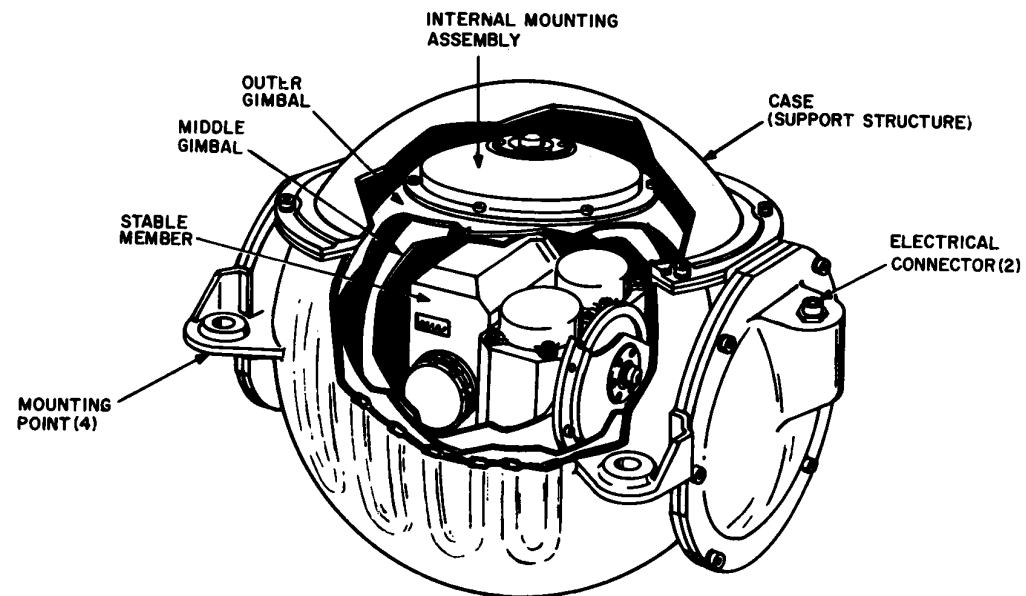
CSM GUIDANCE & CONTROL



PGNCS EQUIPMENT

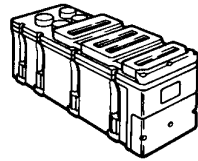


INERTIAL MEASUREMENT UNIT

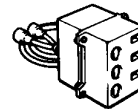


SCS FLIGHT HARDWARE

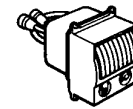
BLOCK II



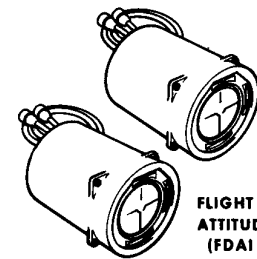
**ELECTRONIC CONTROL ASSEMBLY
(ECA)**



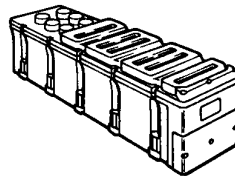
**ATTITUDE SET CONTROL PANEL
(ASCP)**



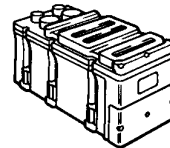
**GIMBAL POSITION/
FUEL PRESSURE INDICATOR
(GP/FPI)**



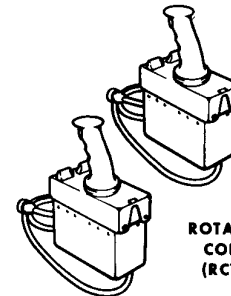
**FLIGHT DIRECTOR
ATTITUDE INDICATOR
(FDAI 1, FDAI 2)**



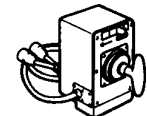
**REACTION JET AND ENGINE
ON-OFF CONTROL
(RJ/EC)**



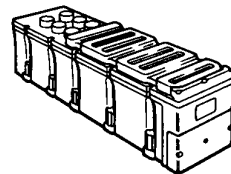
**THRUST VECTOR POSITION
SERVO AMPLIFIER
(TVSA)**



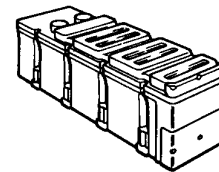
**ROTATION
CONTROL
(RC1, RC2)**



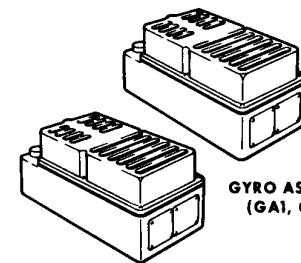
**TRANSLATION CONTROL
(TC)**



**ELECTRONIC DISPLAY ASSEMBLY
(EDA)**



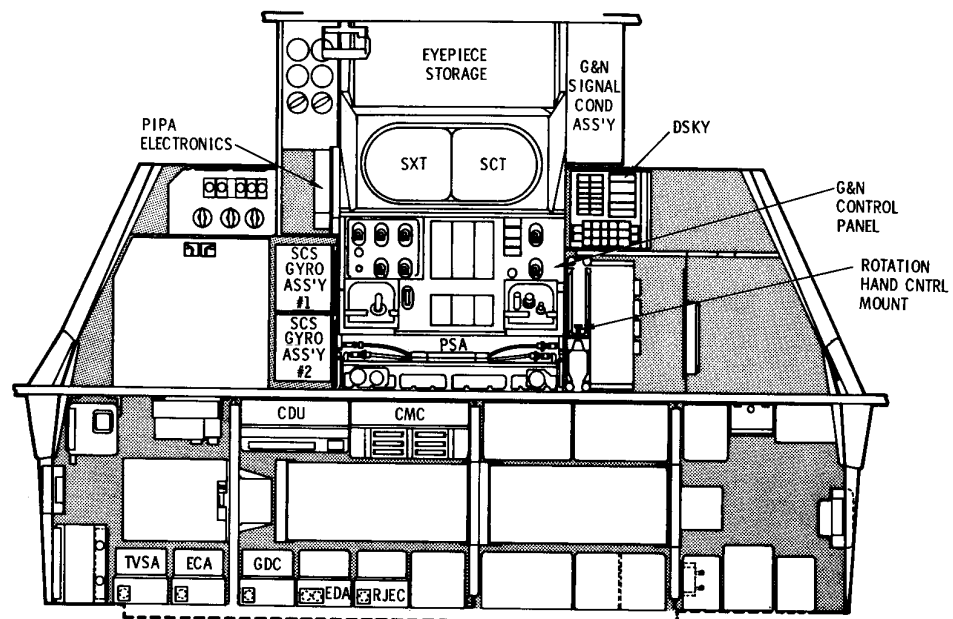
**GYRO DISPLAY COUPLER
(GDC)**



**GYRO ASSEMBLY
(GA1, GA2)**

SCS-2010C 

G&C EQUIPMENT LOCATION



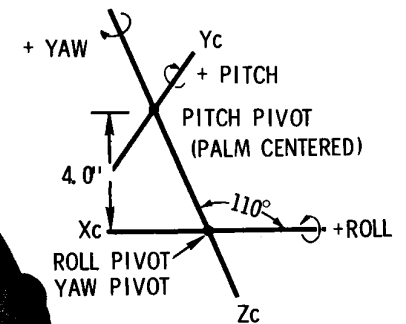
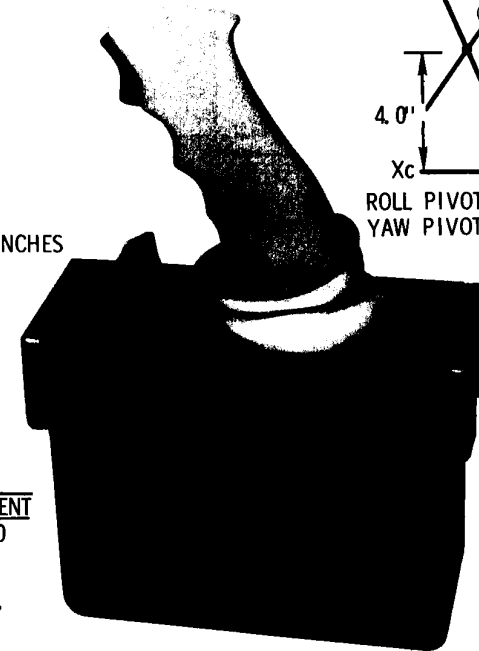
ROTATION CONTROL

PUSH TO TALK SWITCH PARAMETERS

TRAVEL PRIOR TO SWITCH ACTUATION	8.0° MIN
TRAVEL TO HARDSTOP	25.0° MAX
MAXIMUM TORQUE	1.0 POUND INCHES

ROTATION CONTROL PARAMETERS

	<u>DISPLACEMENT</u>
HARD STOP	11.5±0.50
DIRECT SWITCH ACTUATION	≈11.0°
SOFT STOP	10±1°
BREAKOUT SWITCH ACTUATION	1.5± 0.5°
CONTROLLER LOCK TO ARM	50.0°



SCS-2002B



TRANSLATION CONTROL

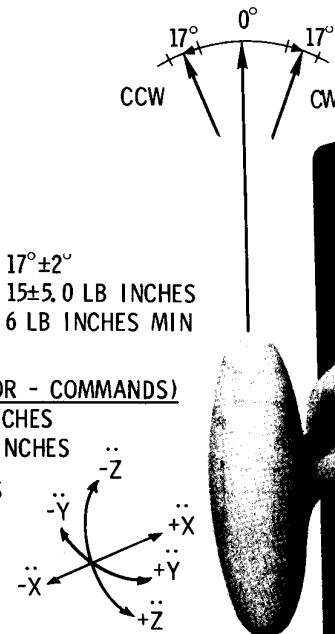
CW & CCW CONTROL MOTION LIMITS

HARD STOP, DETENT & SWITCH CLOSURE
FORCE INTO DETENT
OUT OF DETENT

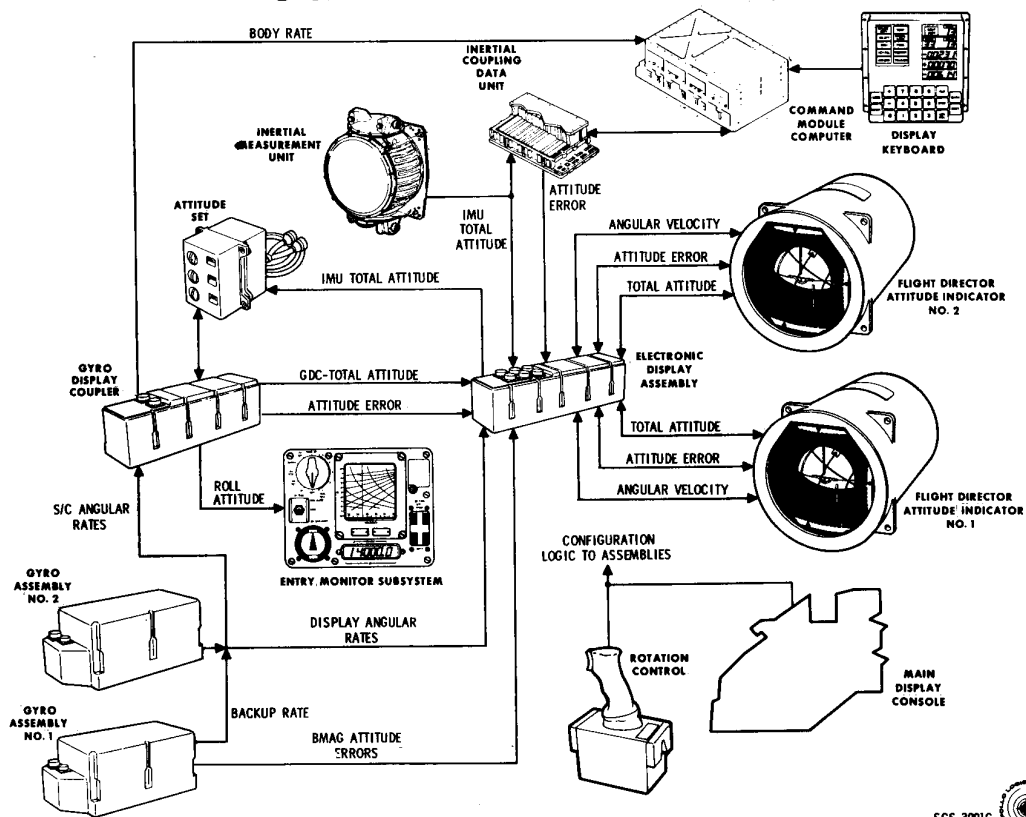
$17^{\circ} \pm 2^{\circ}$
 15 ± 5.0 LB INCHES
6 LB INCHES MIN

TRANSLATION CONTROL MOTION LIMITS (+ OR - COMMANDS)

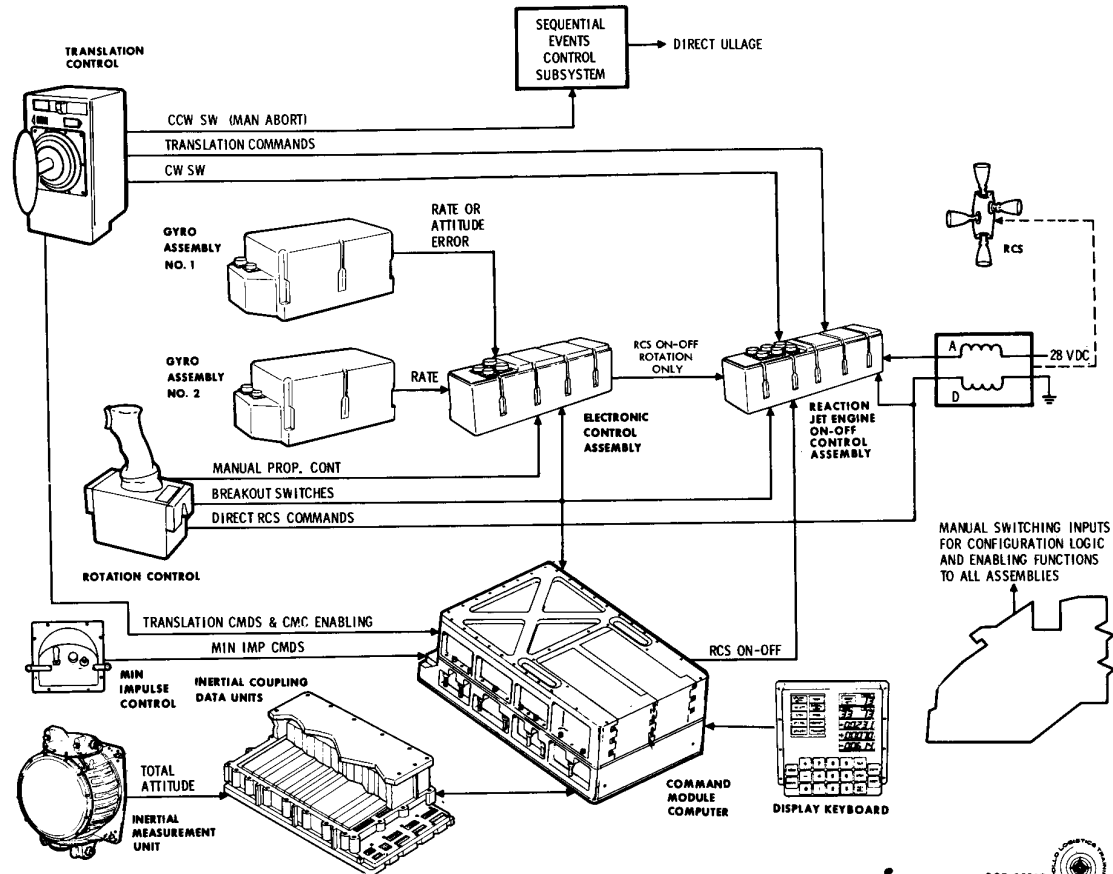
MECHANICAL STOP - 0.5 ± 0.075 ARC INCHES
SWITCH CLOSURE - $0.375 \begin{smallmatrix} +0.025 \\ -0.075 \end{smallmatrix}$ ARC INCHES
FORCE - 1.5 ± 0.33 POUNDS



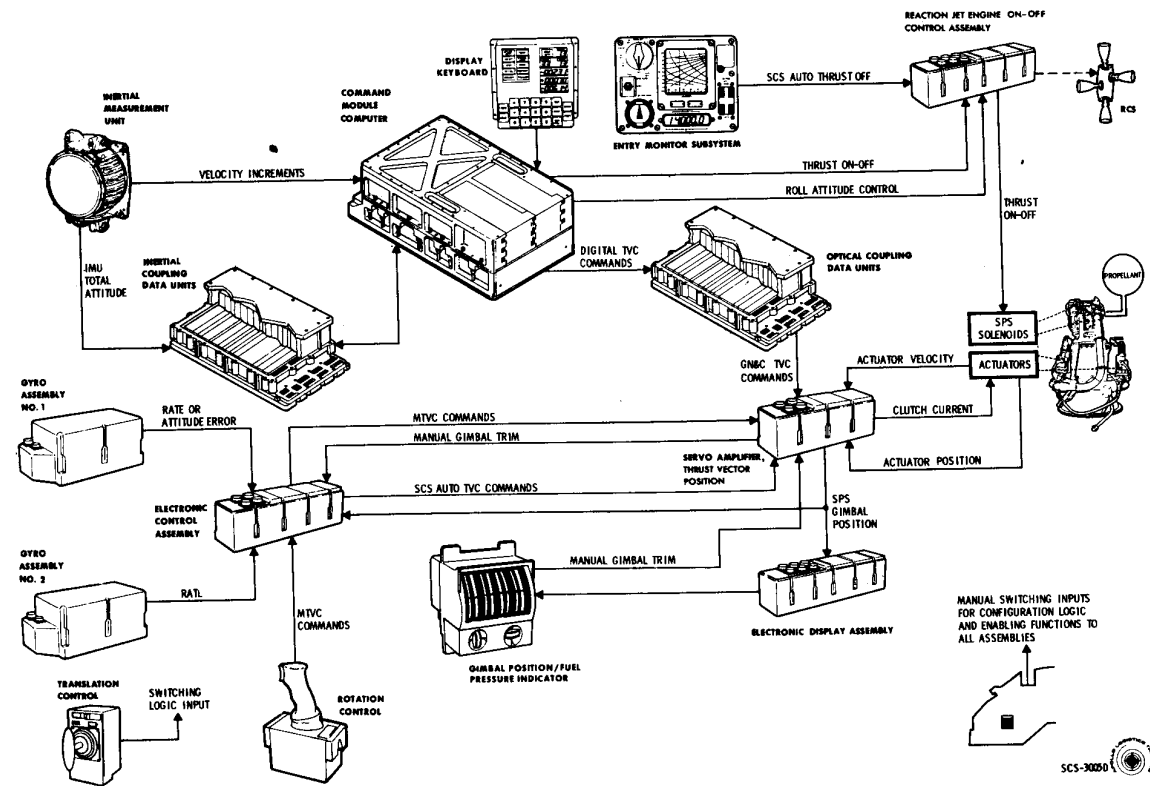
G & C ATTITUDE REFERENCE



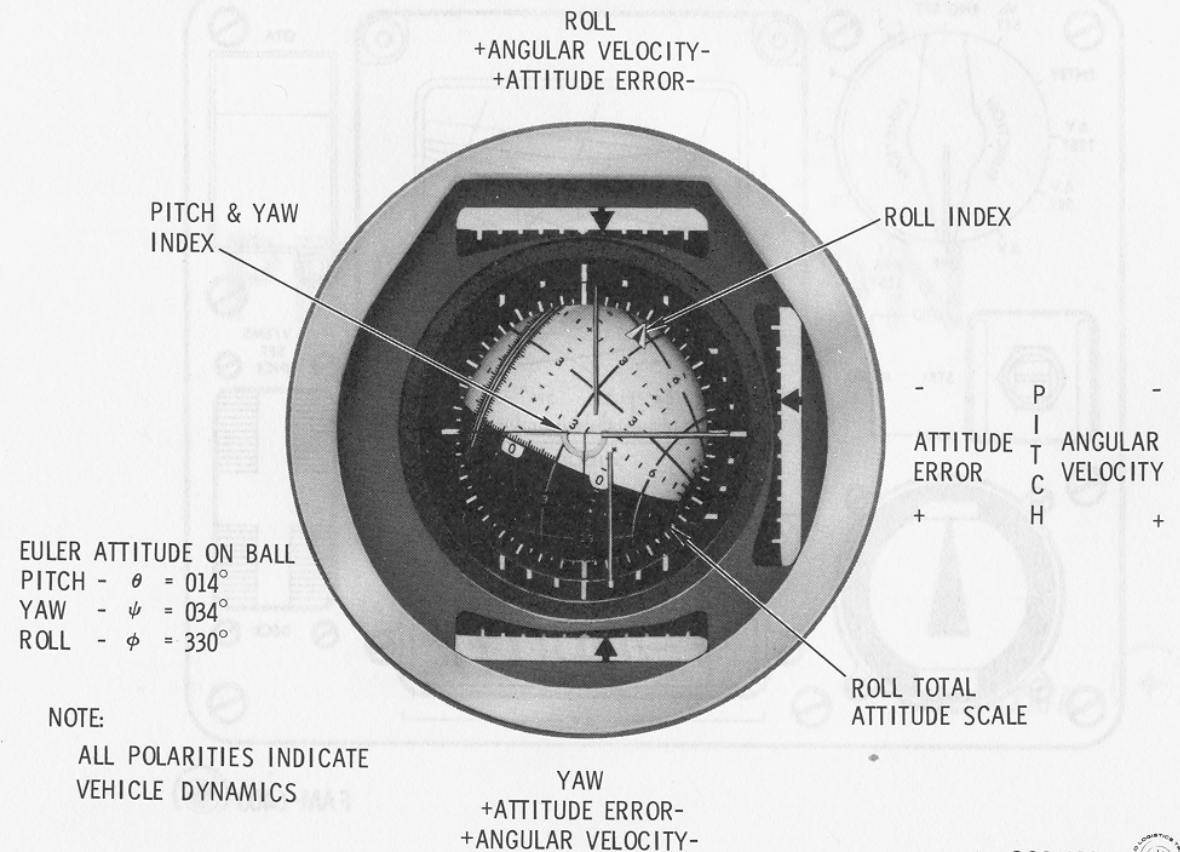
G&C ATTITUDE CONTROL

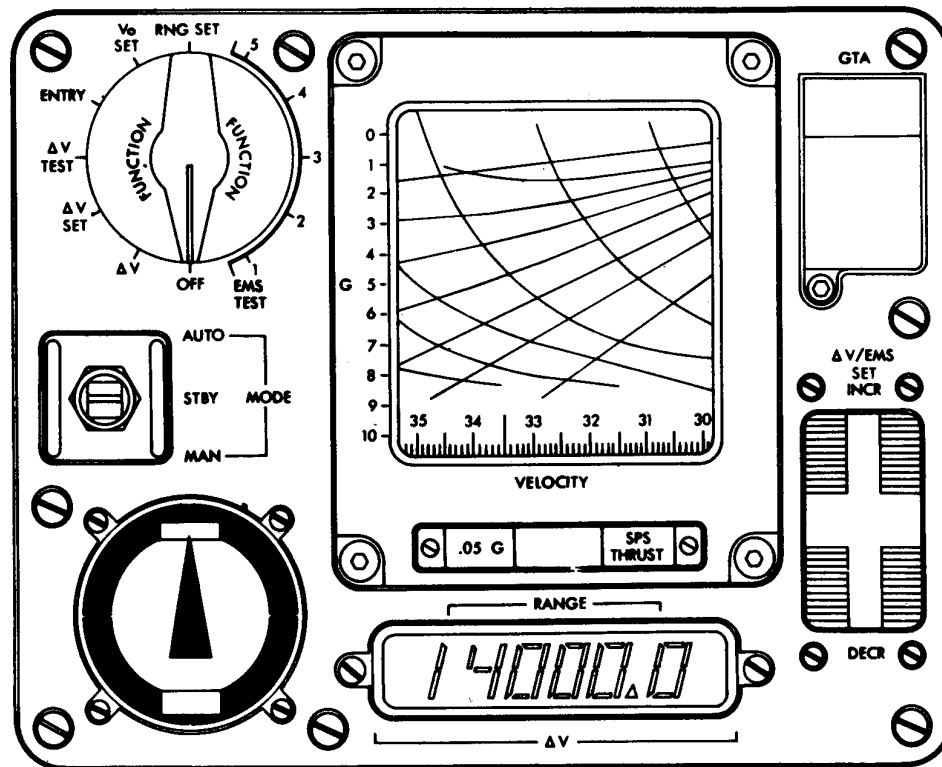


G & C THRUST VECTOR CONTROL



FLIGHT DIRECTOR ATTITUDE INDICATOR





FAM-6400

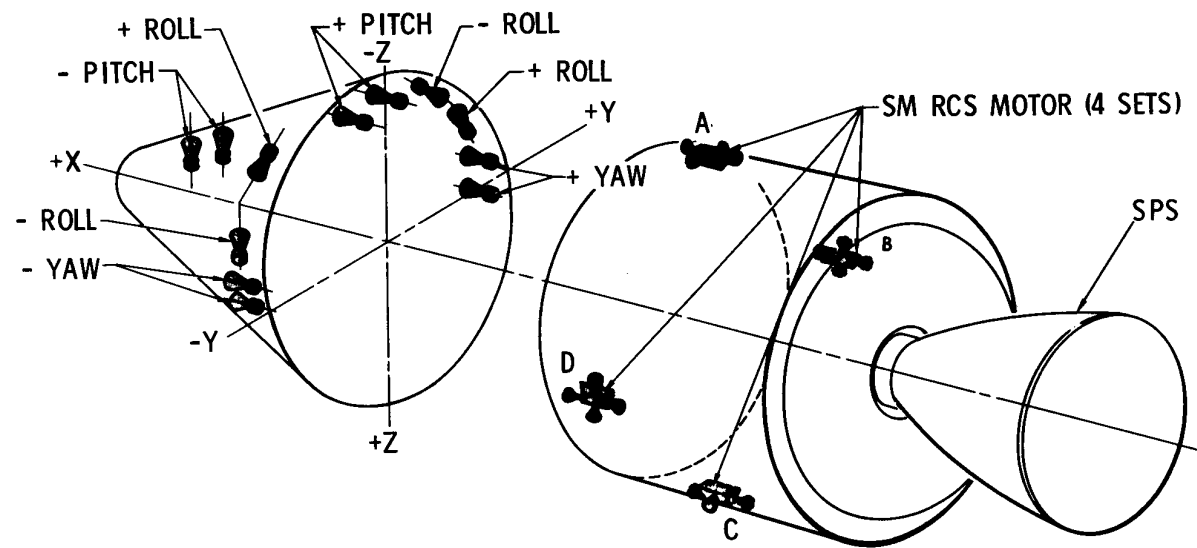
PROPULSION

4

FAM-4000A



ENGINE LOCATION



S/M REACTION CONTROL SYSTEM

PURPOSE: PROVIDE POWER FOR ATTITUDE AND/OR TRANSLATION

CONTROL AFTER BOOSTER SEPARATION UNTIL C/M AND S/M SEPARATION

TYPE OF SYSTEM: NON THROTTLEABLE, PRESSURE FEED SYSTEM, HYPERGOLIC PROPELLANTS AND RADIANT COOLED THRUST CHAMBERS.

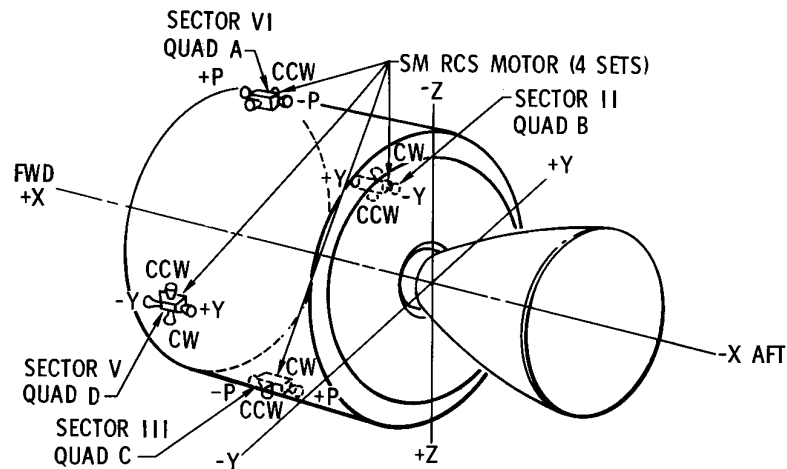
SYSTEM DESCRIPTION: FOUR INDIVIDUAL SUB-SYSTEMS

EACH SUBSYSTEM CONSISTS OF A SEPARATE PROPELLANT

FEED SYSTEM AND FOUR THRUST CHAMBERS

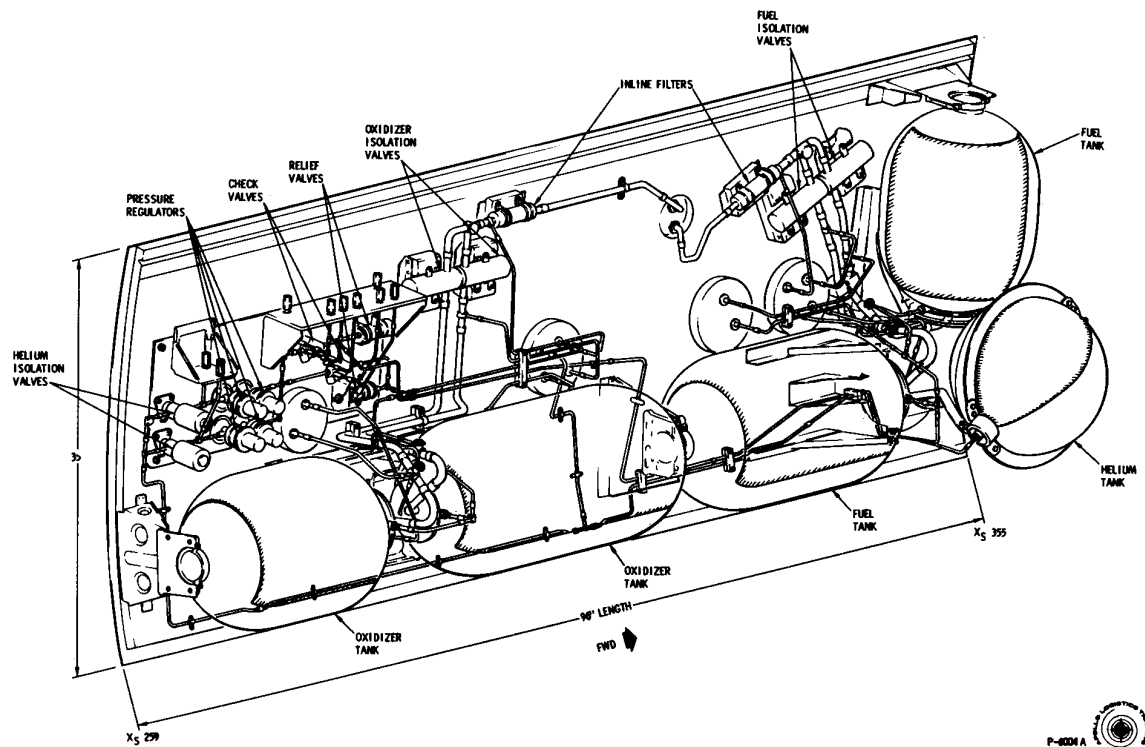
PROPELLANTS - INHIBITED NITROGEN TETROXIDE AND MONOMETHYL HYDRAZINE

SYSTEM CONTROLLED BY CMC OR SCS WITH A MANUAL BACK-UP CAPABILITY

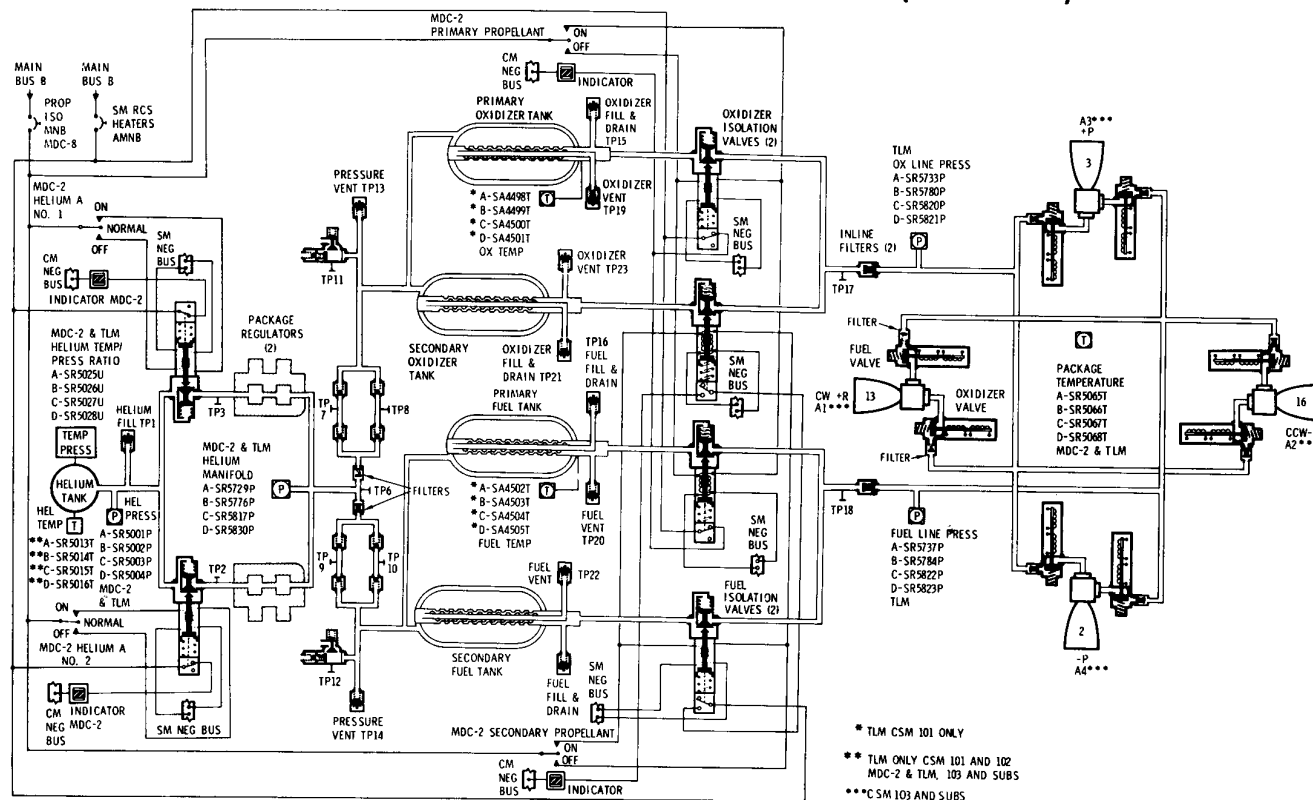


P-6000A 

SM RCS PANEL ASSEMBLY QUAD B & D

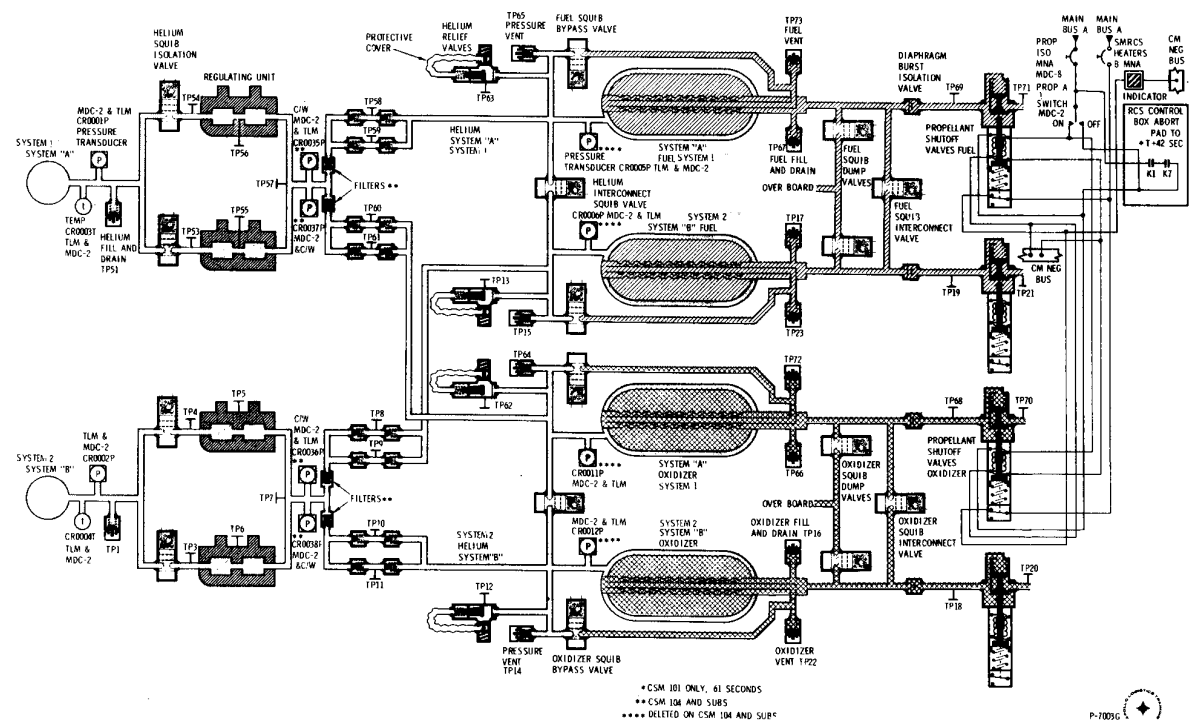


SM REACTION CONTROL SUBSYSTEM (QUAD A)

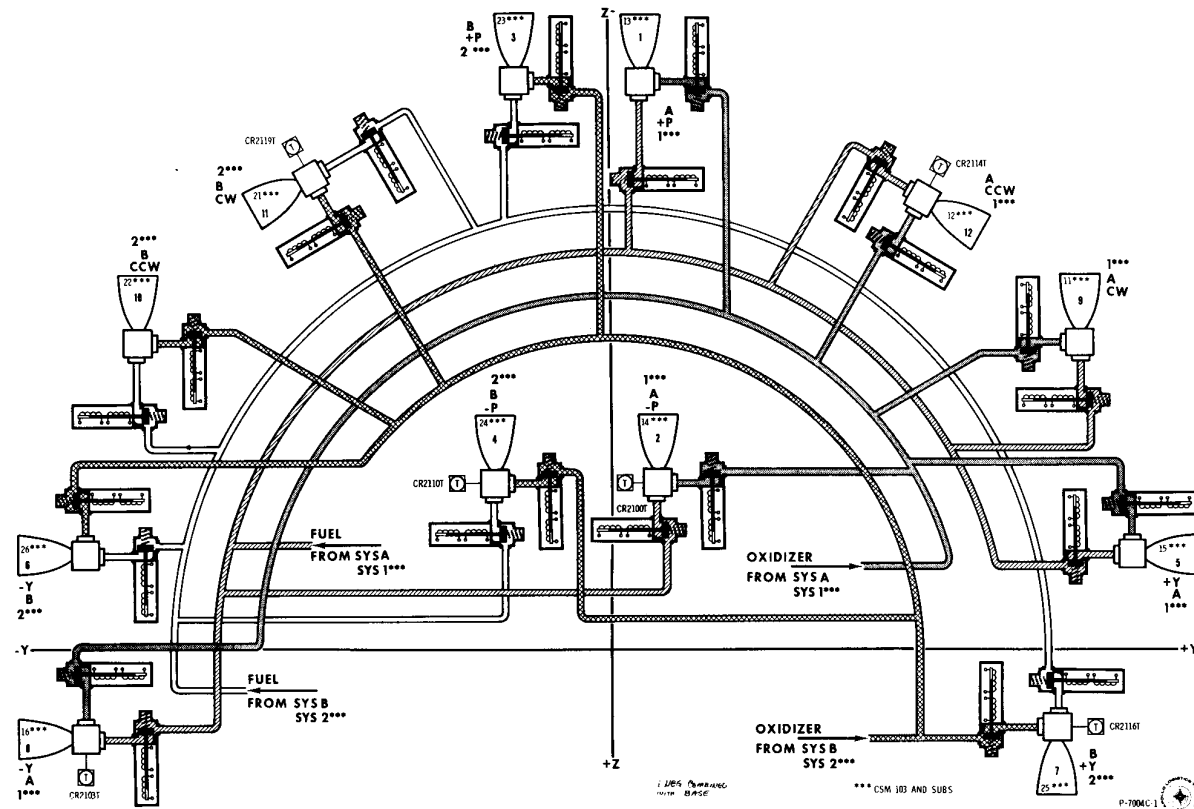


CM REACTION CONTROL SUBSYSTEM

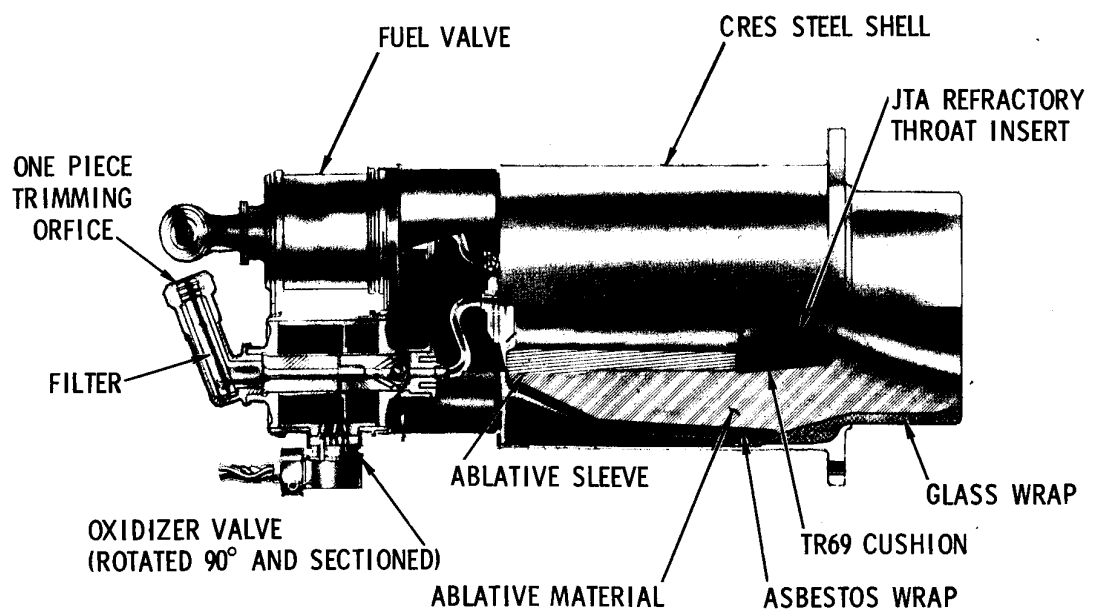
PROPELLANT FEED SUBSYSTEM A&B



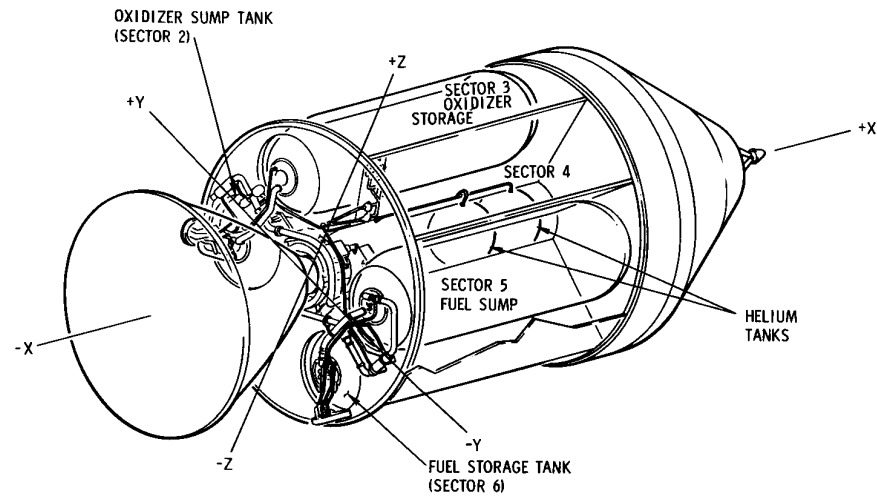
CM REACTION CONTROL ENGINES



CM RCS ENGINE



SERVICE PROPULSION SYSTEM



TYPE OF SYSTEM: NON-THROTTLEABLE, PRESSURE FEED SYSTEM, HYPERGOLIC PROPELLANTS AND ABLATIVE CHAMBER WITH RADIANT COOLED NOZZLE EXTENSION.

SYSTEM DESCRIPTION: ONE SYSTEM CONSISTING OF A PROPELLANT FEED SYSTEM AND ONE ENGINE

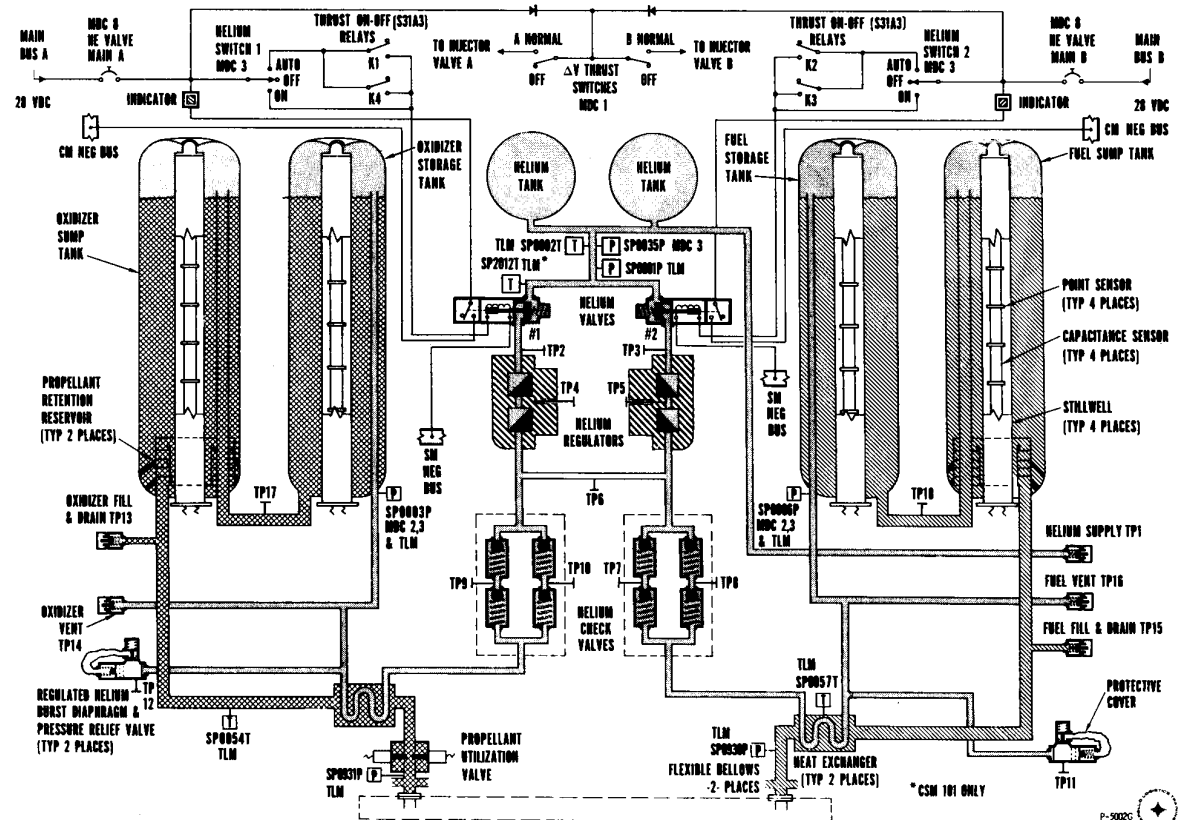
PROPELLANTS - INHIBITED NITROGEN TETROXIDE AND BLENDED HYDRAZINE (50% UDMH & 50% HYDRAZINE)

SYSTEM CONTROLLED BY CMC OR SCS WITH A MANUAL BACK-UP CAPABILITY

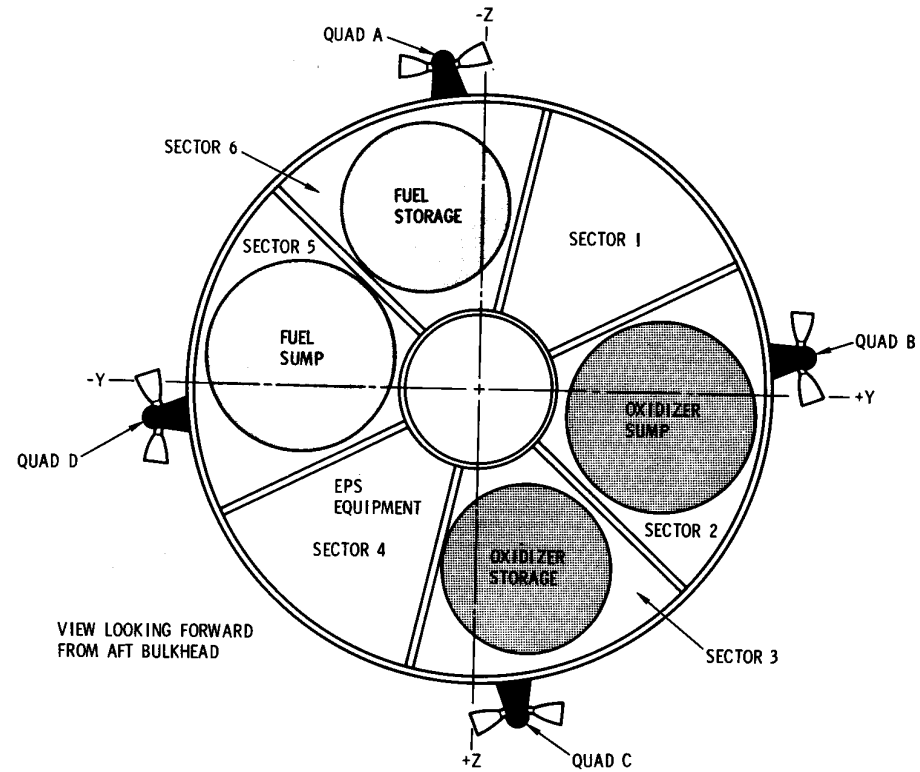
PURPOSE: PROVIDE THRUST FOR MAJOR VELOCITY CHANGES AFTER BOOSTER SEPARATION UNTIL C/M S/M SEPARATION. IN ADDITION SUPPORTS S/M ABORT AFTER THE LAUNCH ESCAPE TOWER HAS BEEN JETTISONED.

P-5078A 

SERVICE PROPULSION SYSTEM PROPELLANT FEED



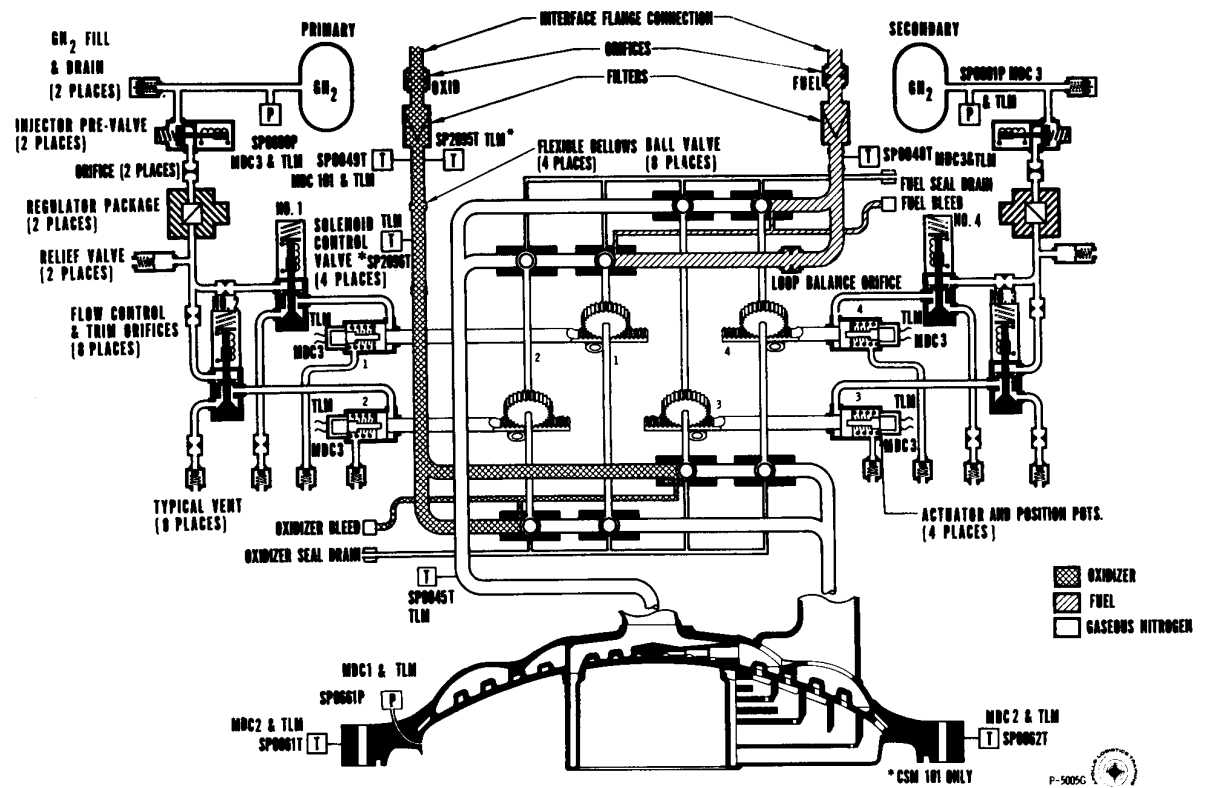
SERVICE MODULE SECTORS



P-5038

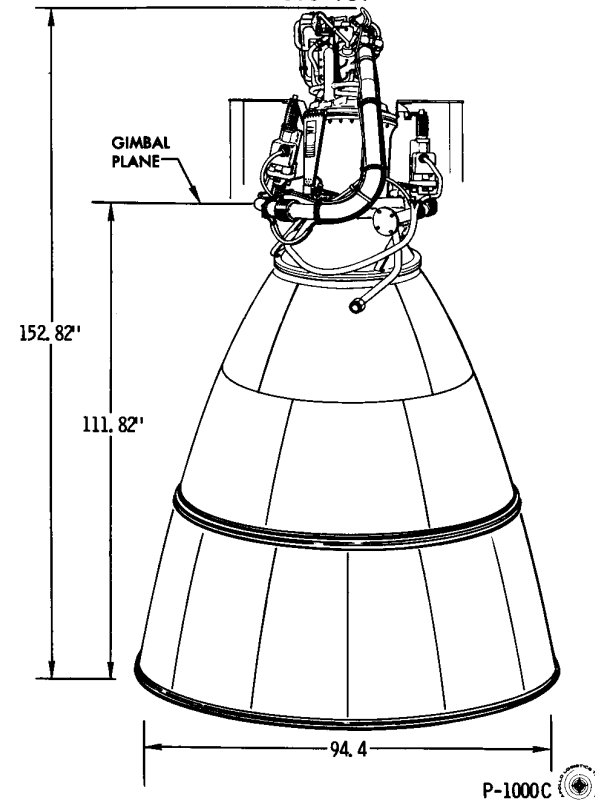


SPS ENGINE PROPELLANT FEED

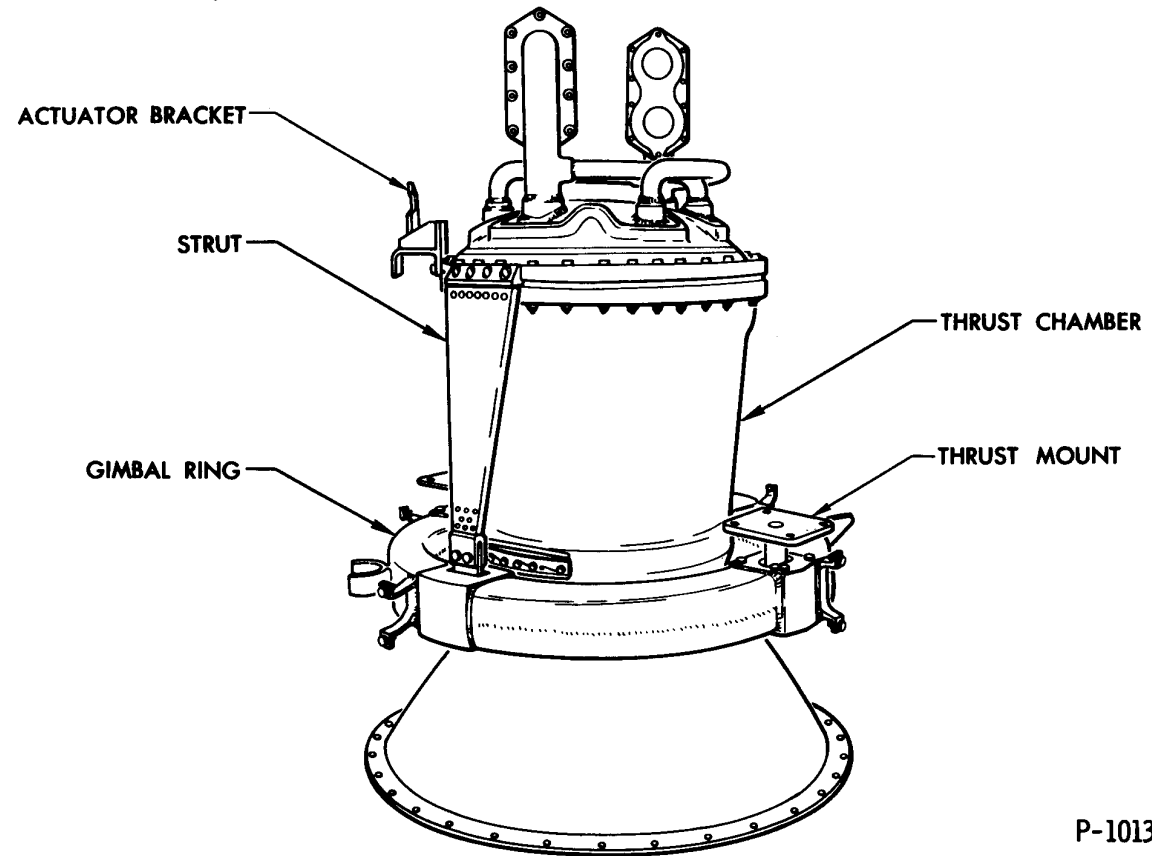


SPS ROCKET ENGINE

AJ10-137



SPS RING, STRUT & THRUST CHAMBER ASSEMBLY



TELECOMMUNICATIONS

COMMUNICATIONS SYSTEM

MISSION REQUIREMENTS

- DATA COLLECTION

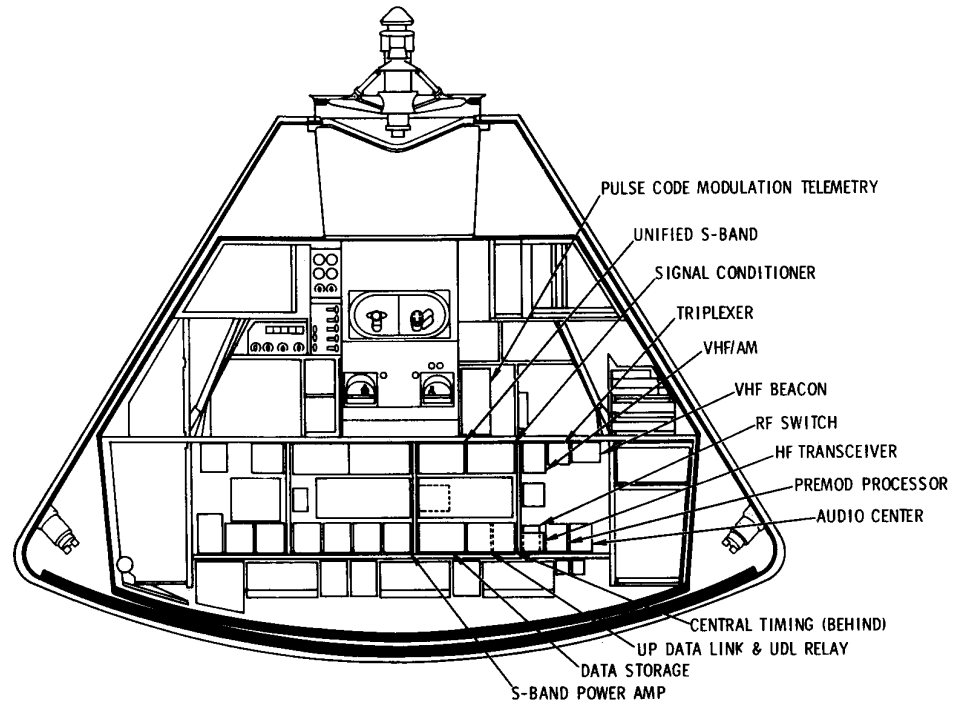
CREW STATUS

SYSTEM STATUS

- VOICE
- TV
- TRACKING
- RECOVERY BEACON
- UP DATA
- TAPE RECORDER

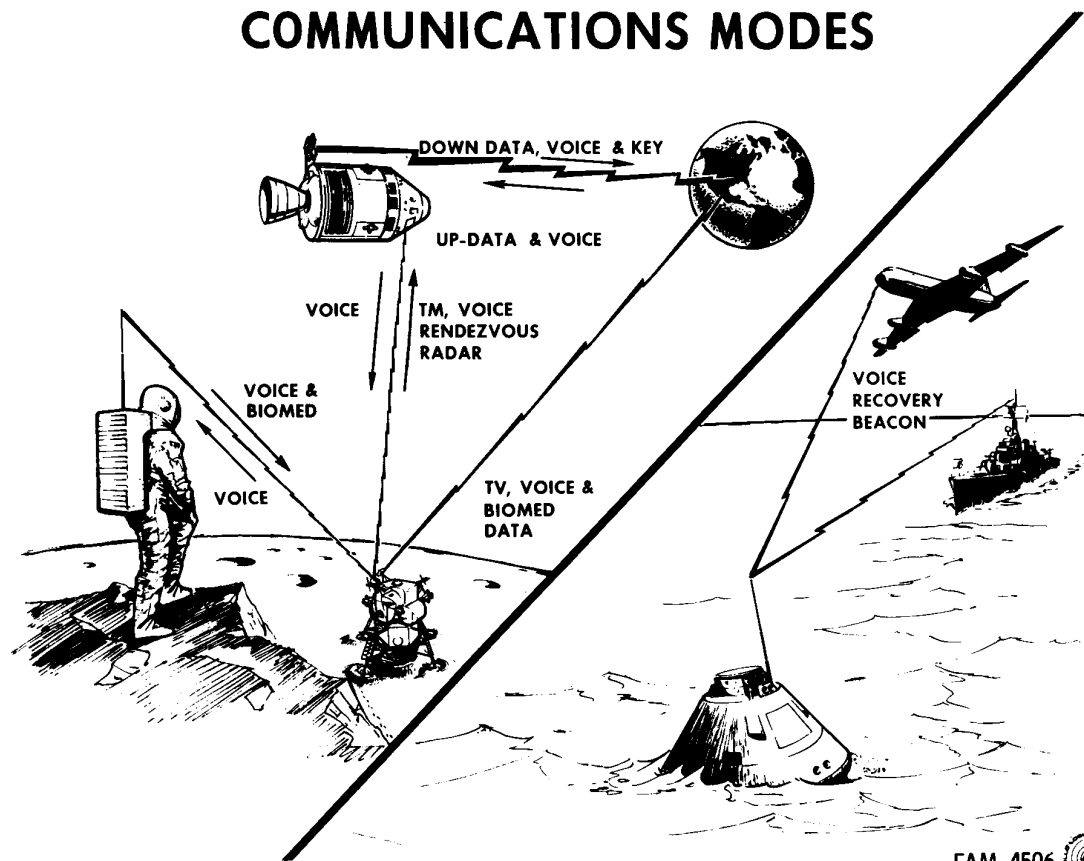
TELECOMMUNICATIONS EQUIPMENT

LOWER EQUIPMENT BAY BLOCK II

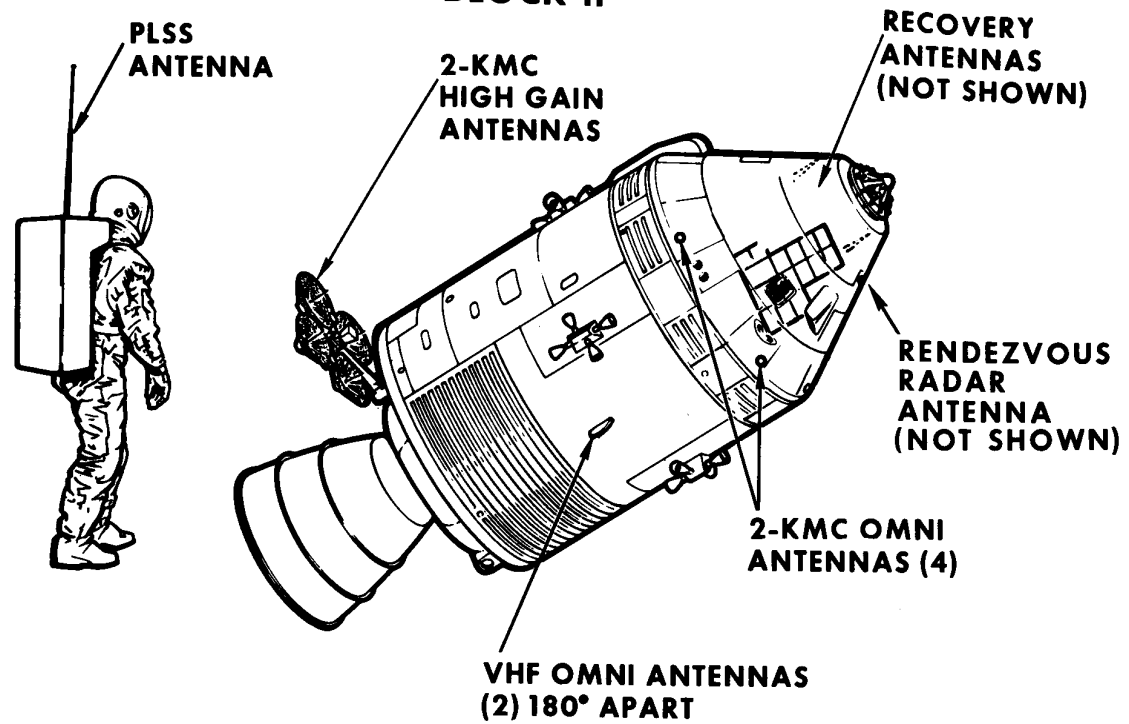


CD-2006 

COMMUNICATIONS MODES

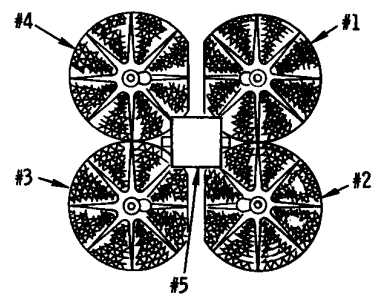


COMMUNICATIONS SYSTEM BLOCK II



FAM-4507A 

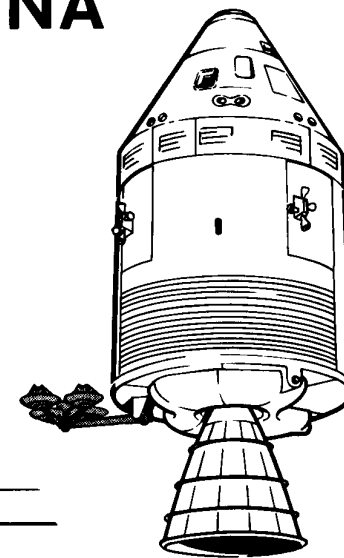
BLOCK II S-BAND HI GAIN ANTENNA



SOLAR RIB
REFLECTORS
≈31" DIA

FEEDHORNS
10° OFFSET

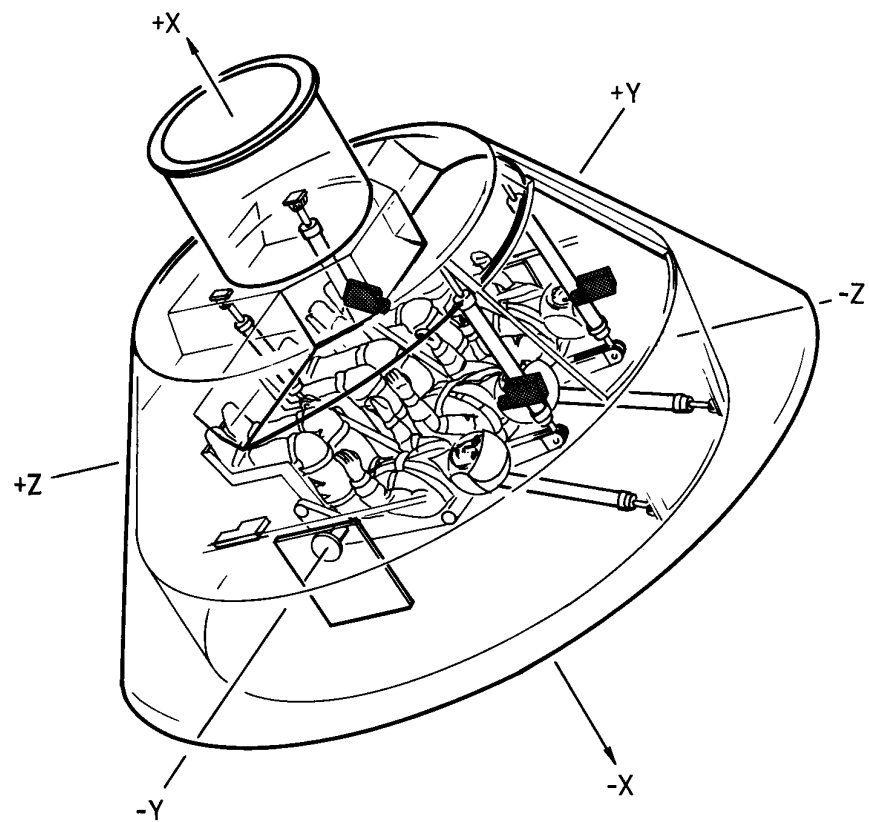
FRONTVIEW



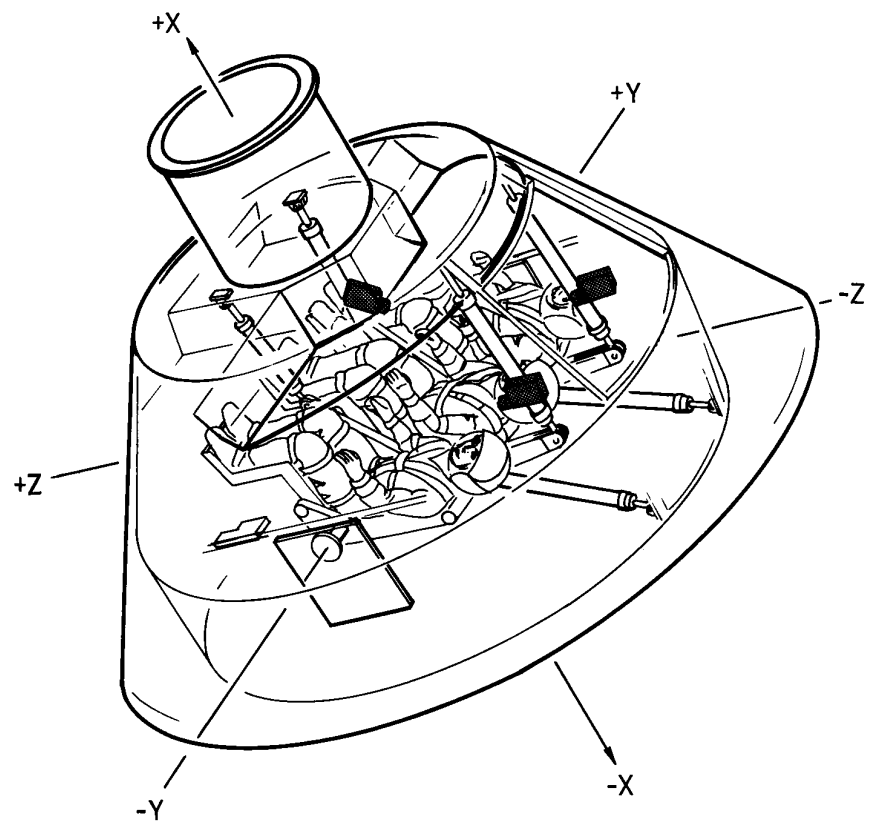
CD-2001C



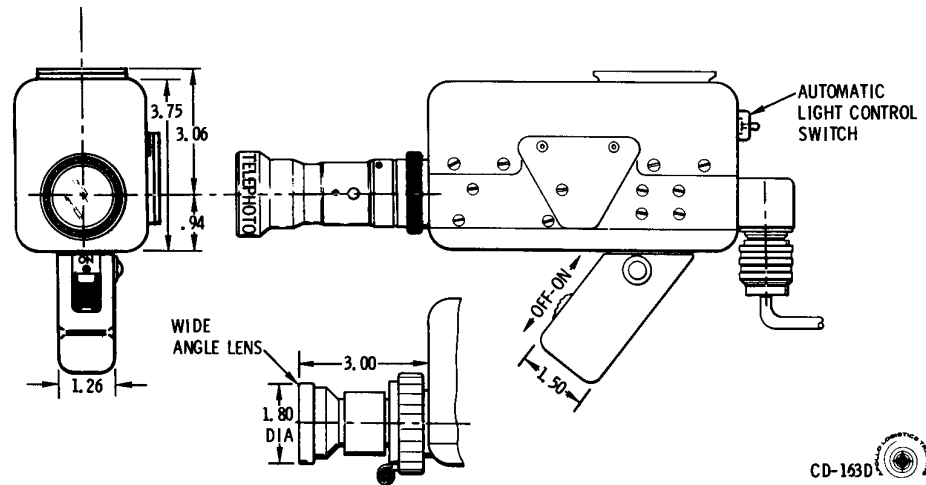
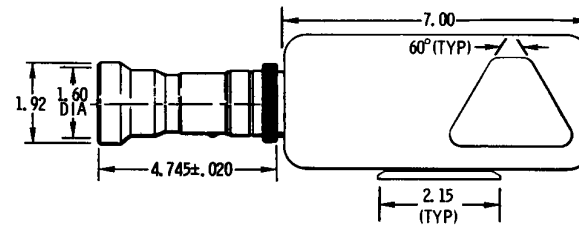
TV CAMERA LOCATIONS



TV CAMERA LOCATIONS



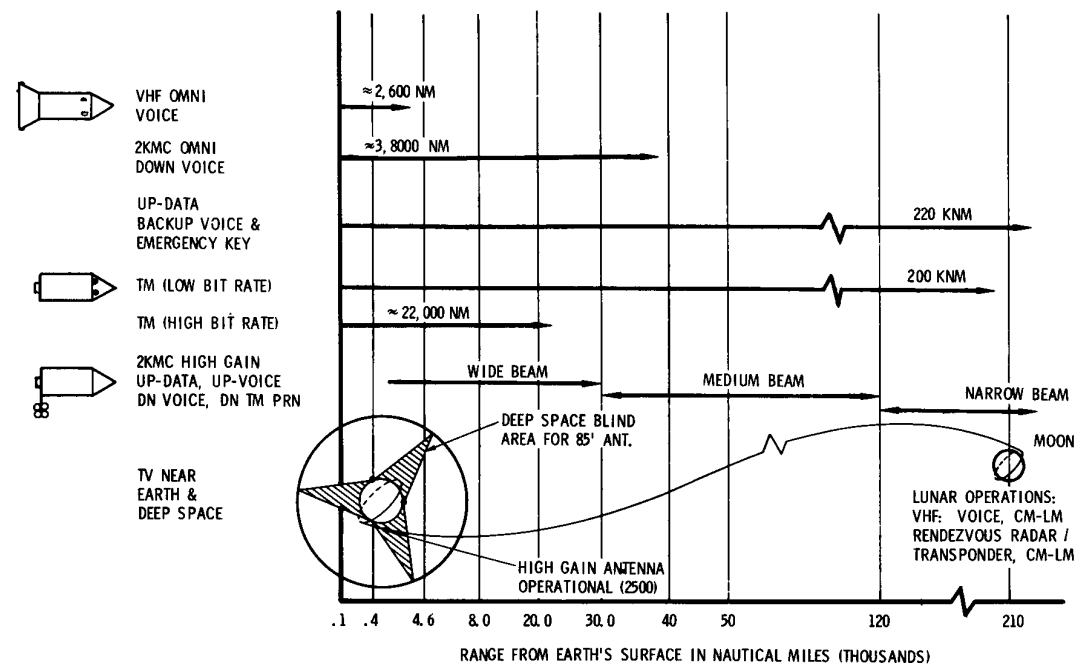
APOLLO TV CAMERA



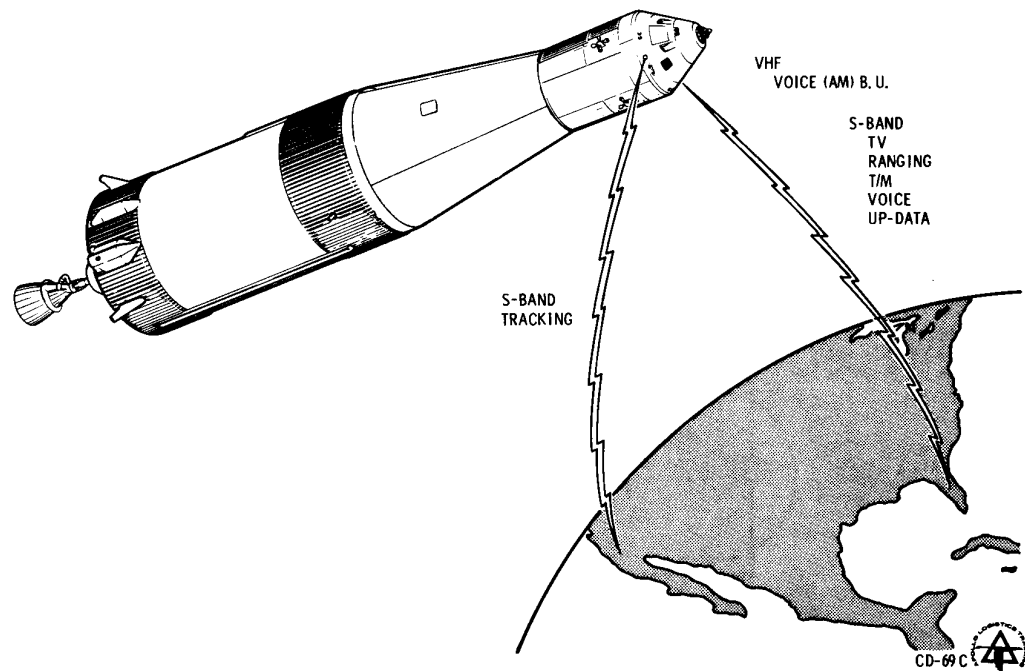
CD-163D



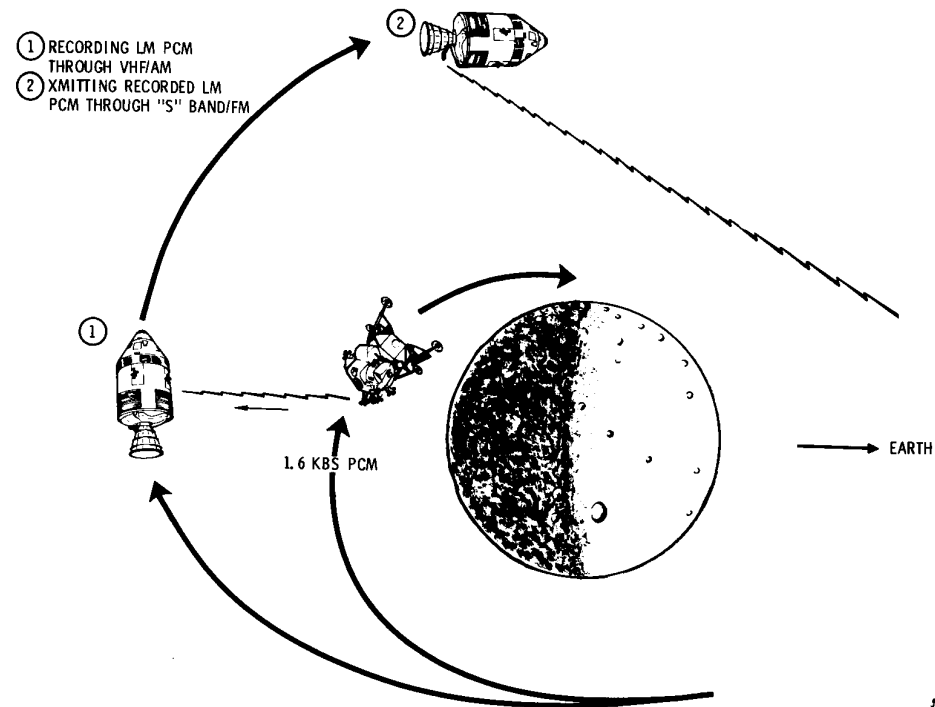
CSM COMMUNICATIONS RANGES BLOCK II



NEAR EARTH COMMUNICATION MODES



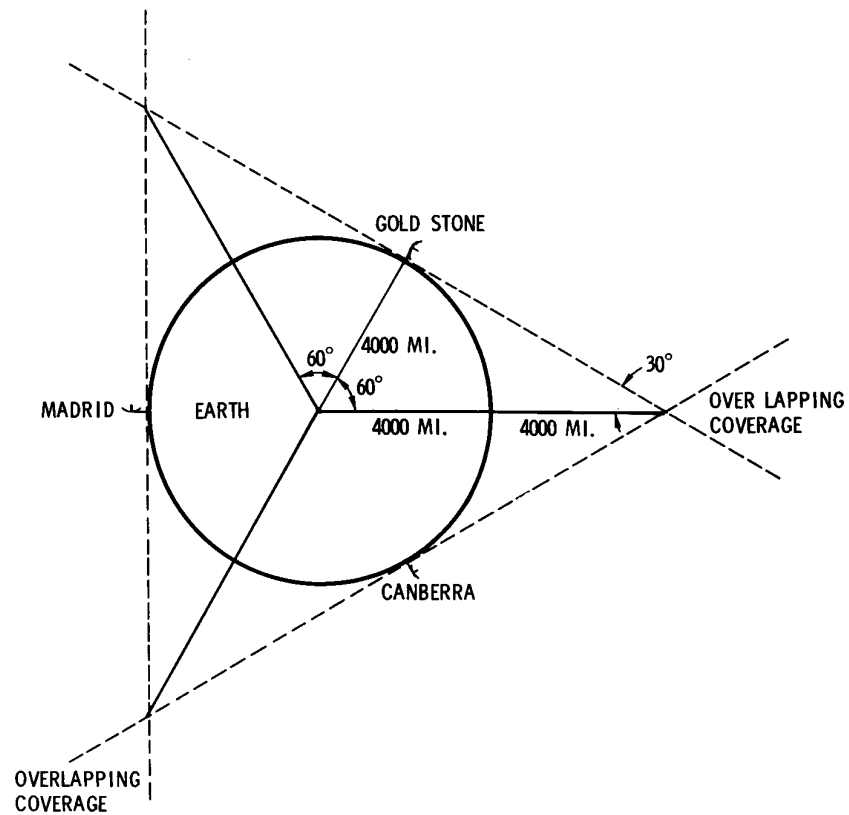
LEM-CSM VHF/AM DATA REC



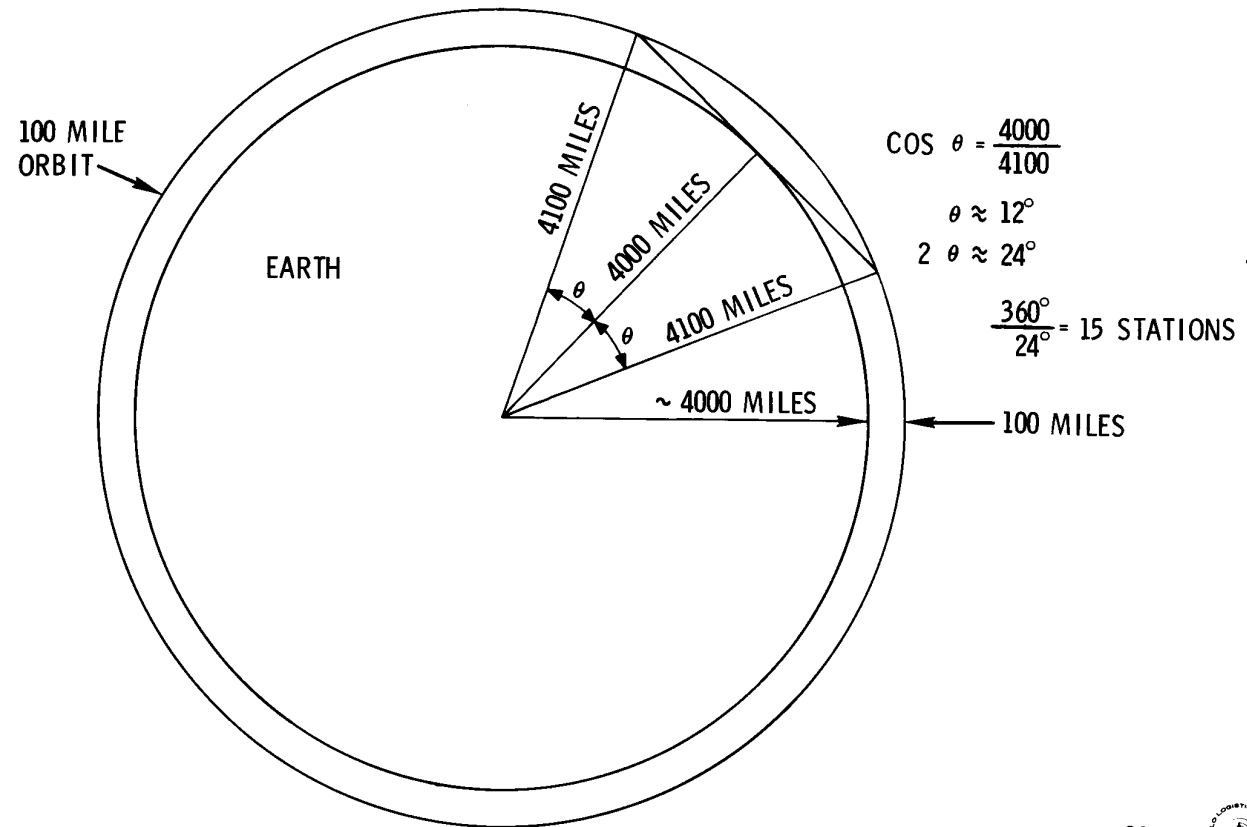
CD-2089B



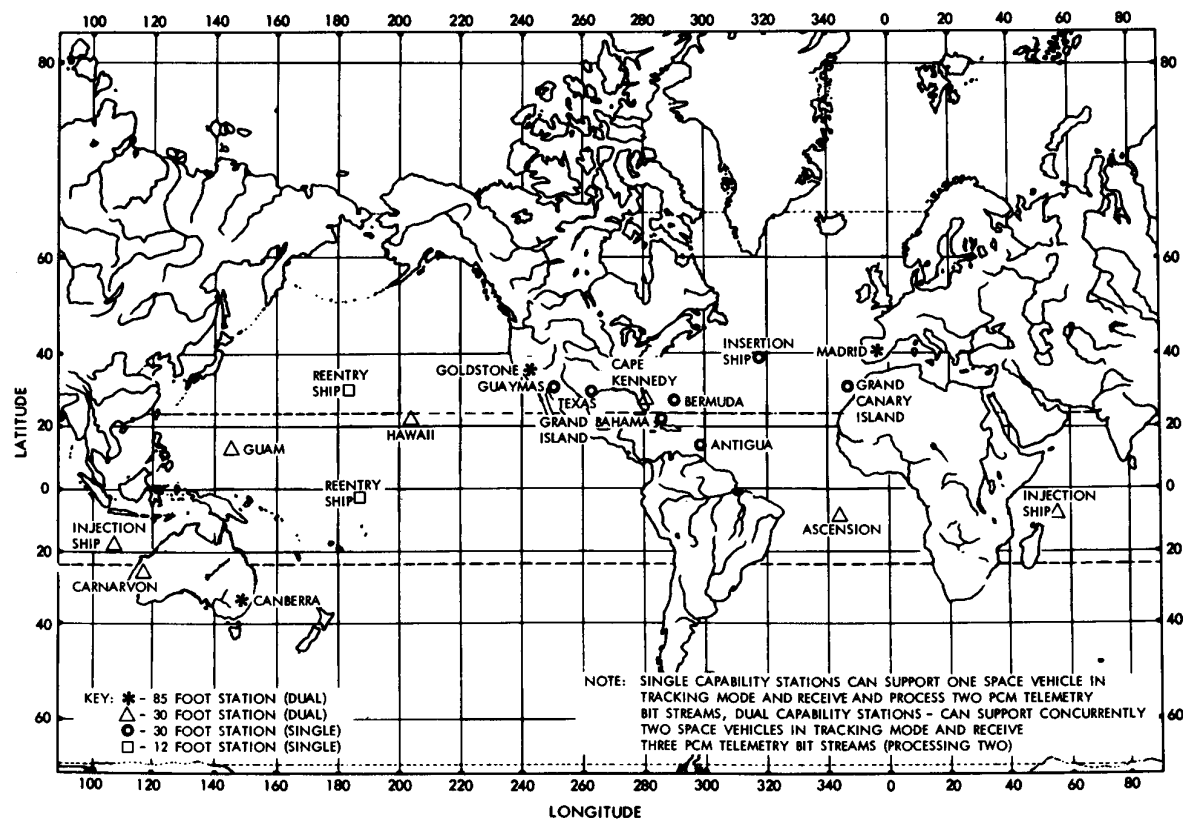
S-BAND GROUND STATION GEOMETRY



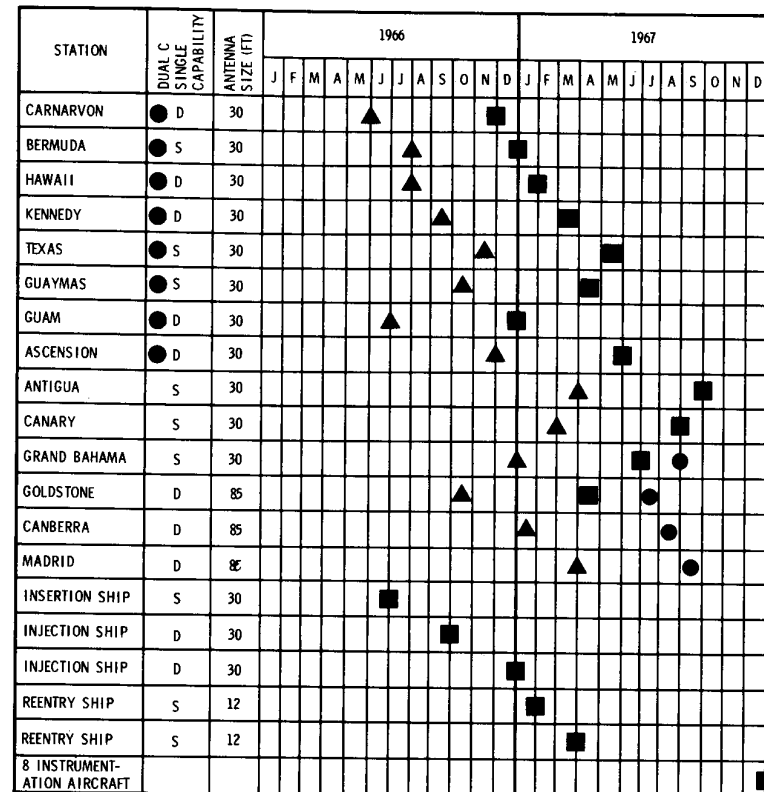
S-BAND GROUND STATION REQ



BLOCK I & II MSFN S-BAND STATION LOCATIONS



MSFN S-BAND IMPLEMENTATION SCHEDULE



COMPLETE INSTALLATION AND CHECKOUT _____ ▲
FULLY OPERATIONAL-MANNED MISSIONS _____ ●

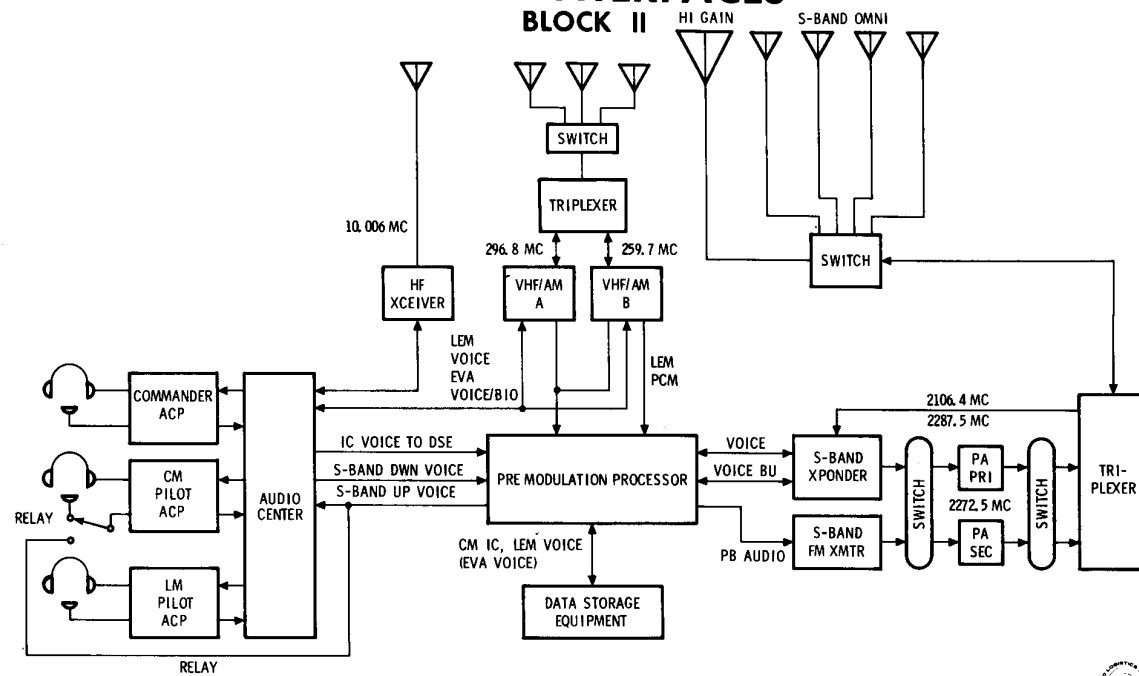
COMPLETE SYSTEM SIMULATION _____ ■

COMM EQUIPMENT/MISSION PHASE

	PRE-LAUNCH	LAUNCH EARTH ORBIT TRANS- LUNAR INJECT.	TRANS- LUNAR FLIGHT 4000 MI	LUNAR ORBIT	LEM DESCENT LUNAR EXPLORE LEM ASCENT	TRANS- EARTH INJECT TRANS EARTH FLIGHT	DESCENT LANDING RECOVERY
VOICE	HARDLINE S-BAND	S-BAND VHF/AM*	S-BAND	S-BAND	S-BAND VHF/AM+	S-BAND	S-BAND VHF/AM
TV	HARDLINE	S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
BIO MED	HARDLINE S-BAND*	S-BAND	S-BAND VHF/AM+	S-BAND	S-BAND VHF/AM+	S-BAND	
UP-DATA	HARDLINE S-BAND*	S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
DWN- DATA	HARDLINE S-BAND*	S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
RANGING		S-BAND	S-BAND	S-BAND	S-BAND	S-BAND	
BEACON							VHF-BCN

* BACKUP MODE
+ LM-E. V. A. COMMUNICATIONS

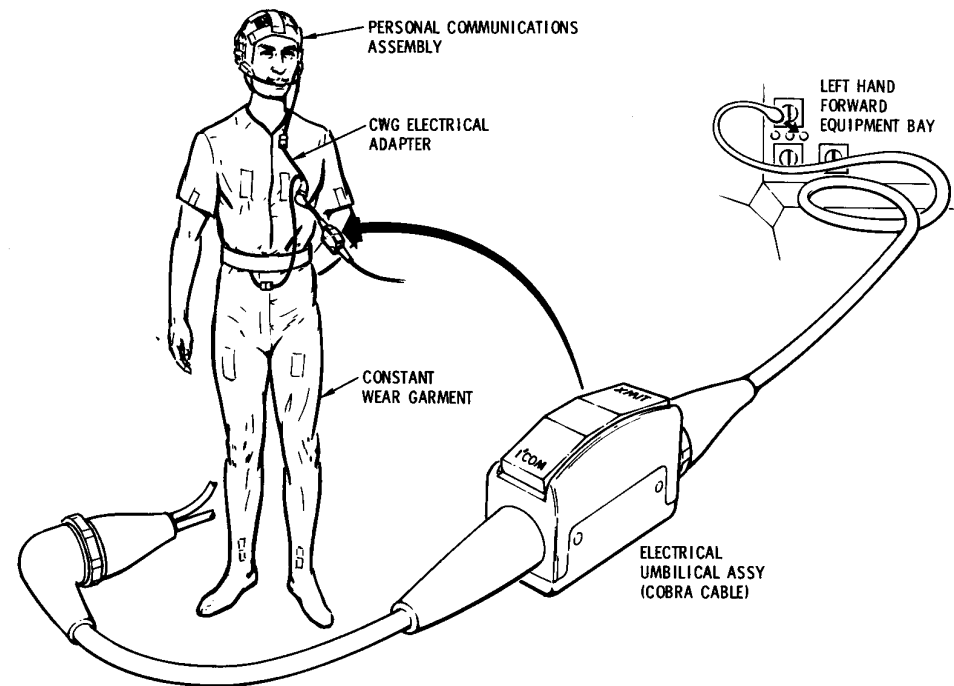
AUDIO INTERFACES



CD-2040-1B 

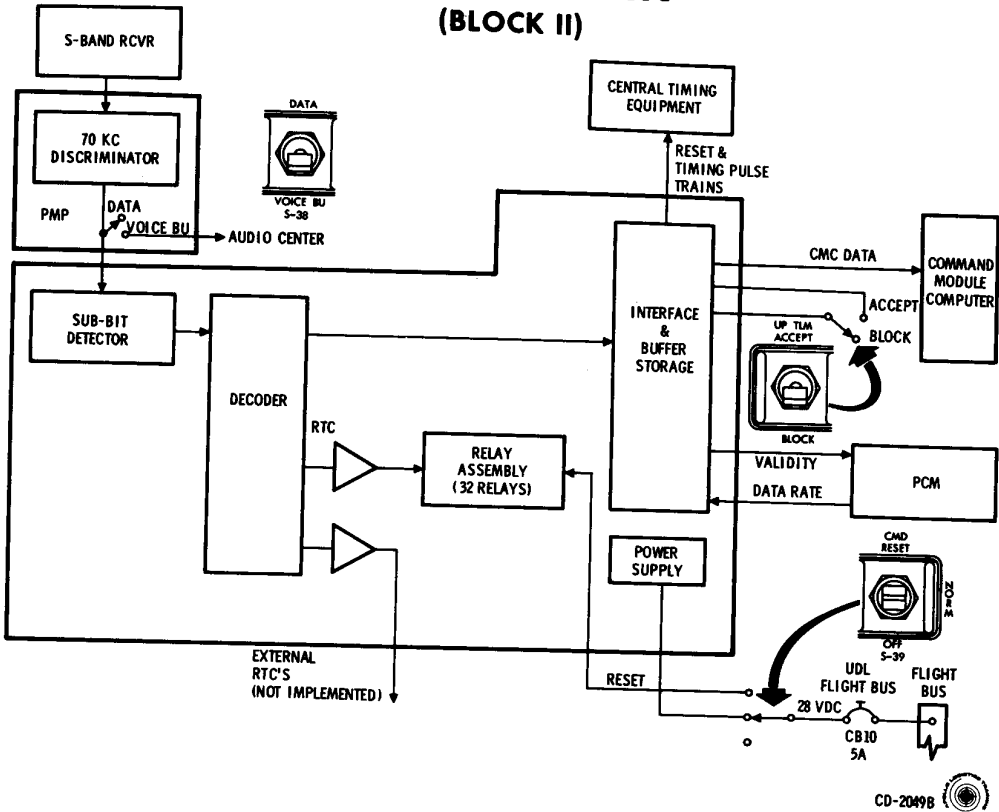
ELECTRICAL UMBILICAL (COMM CABLE)

BLOCK II



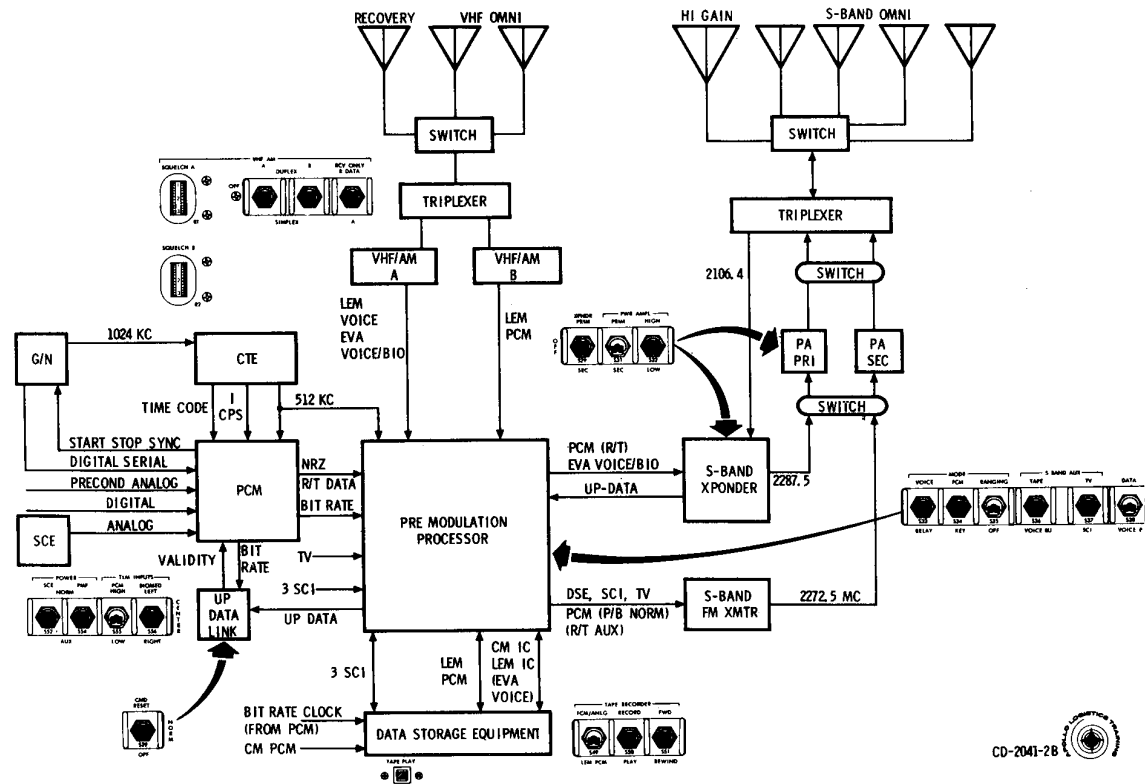
UP-DATA LINK

(BLOCK II)

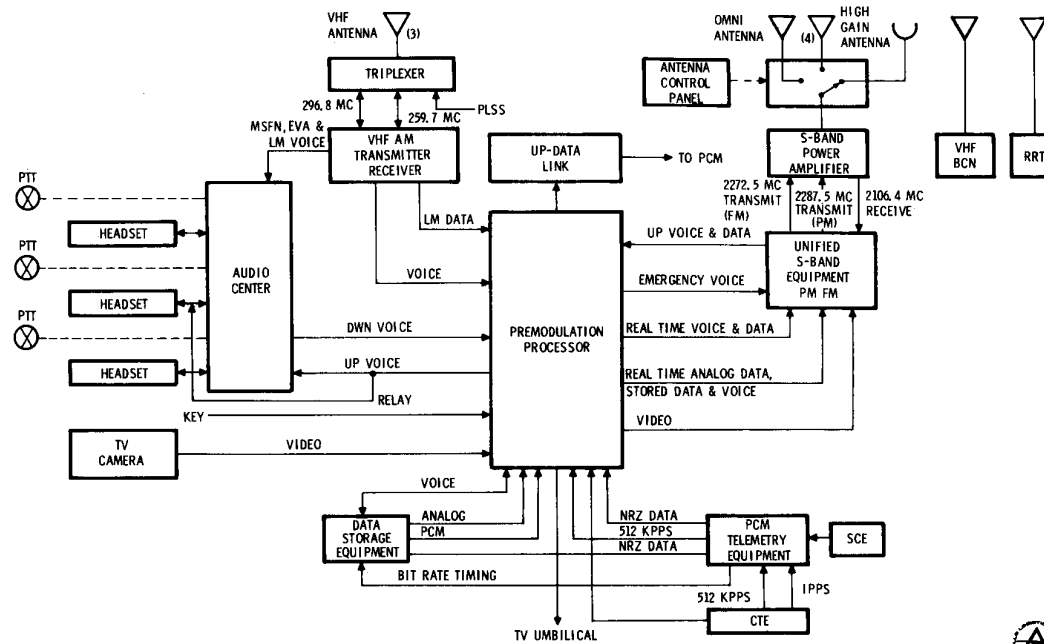


DATA INTERFACES

BLOCK II



TELECOMMUNICATIONS SYSTEM BLOCK II



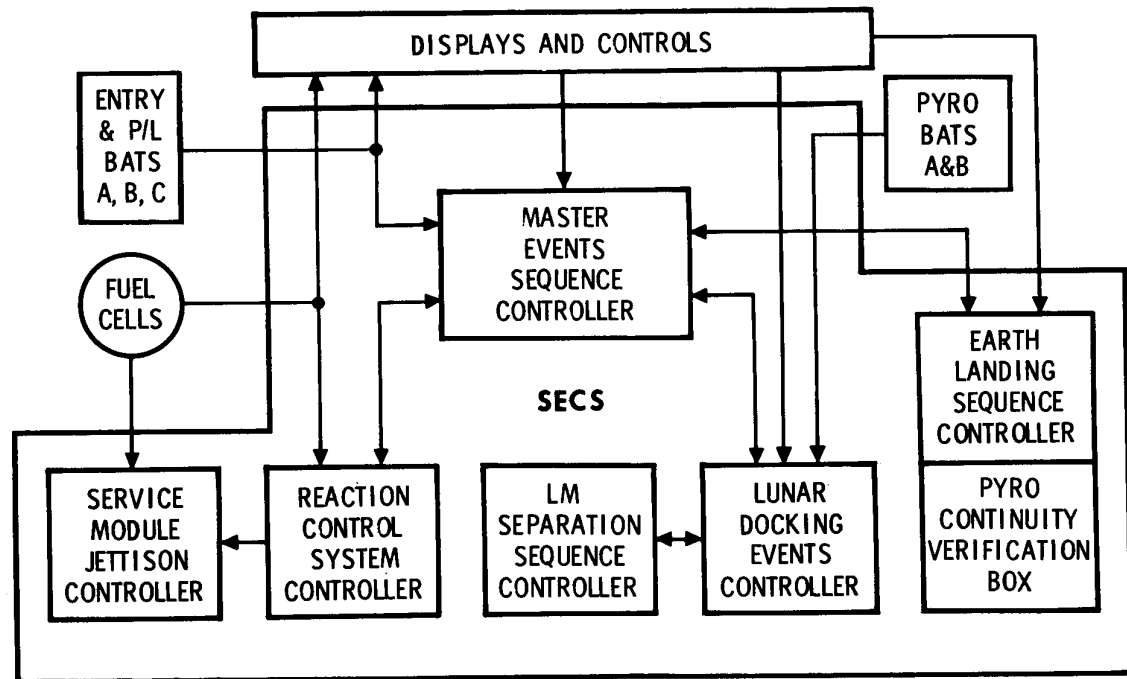
SEQUENCING

FAM-3005B



SECS

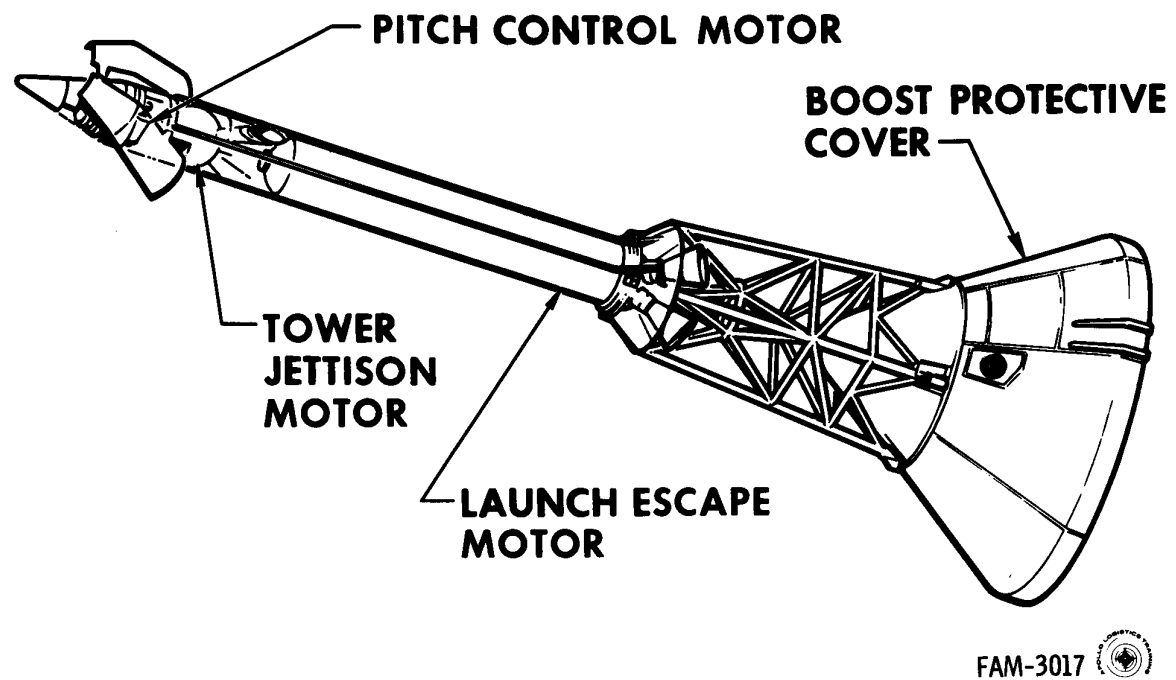
MAJOR COMPONENTS (BLOCK II)



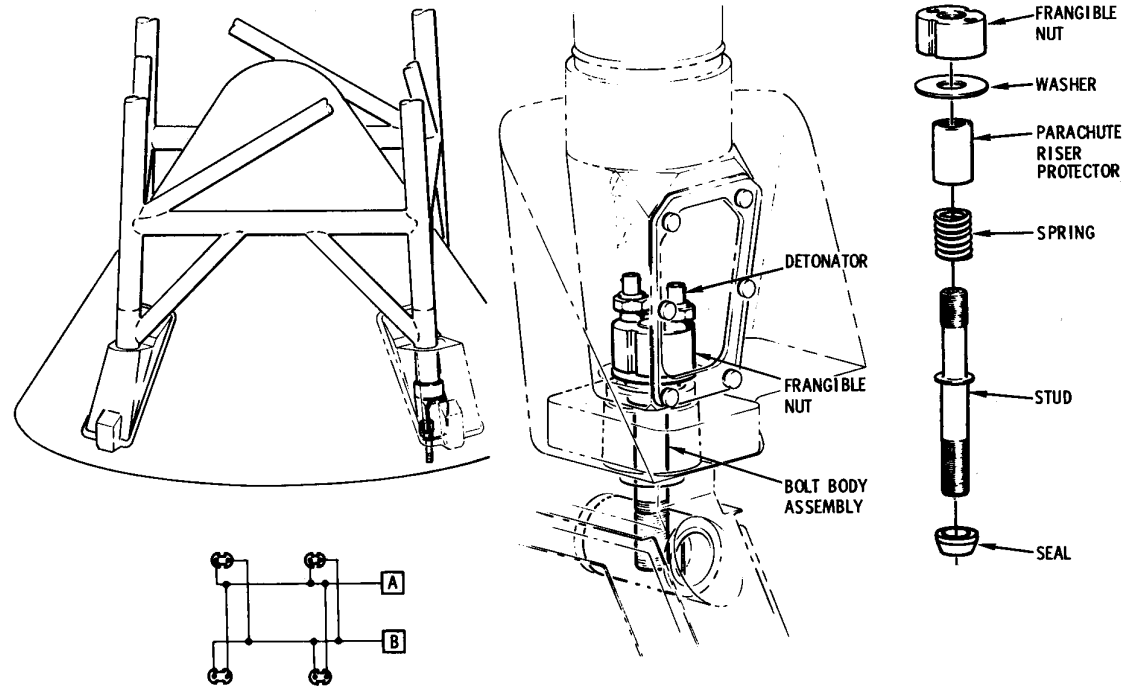
SEQ-501B



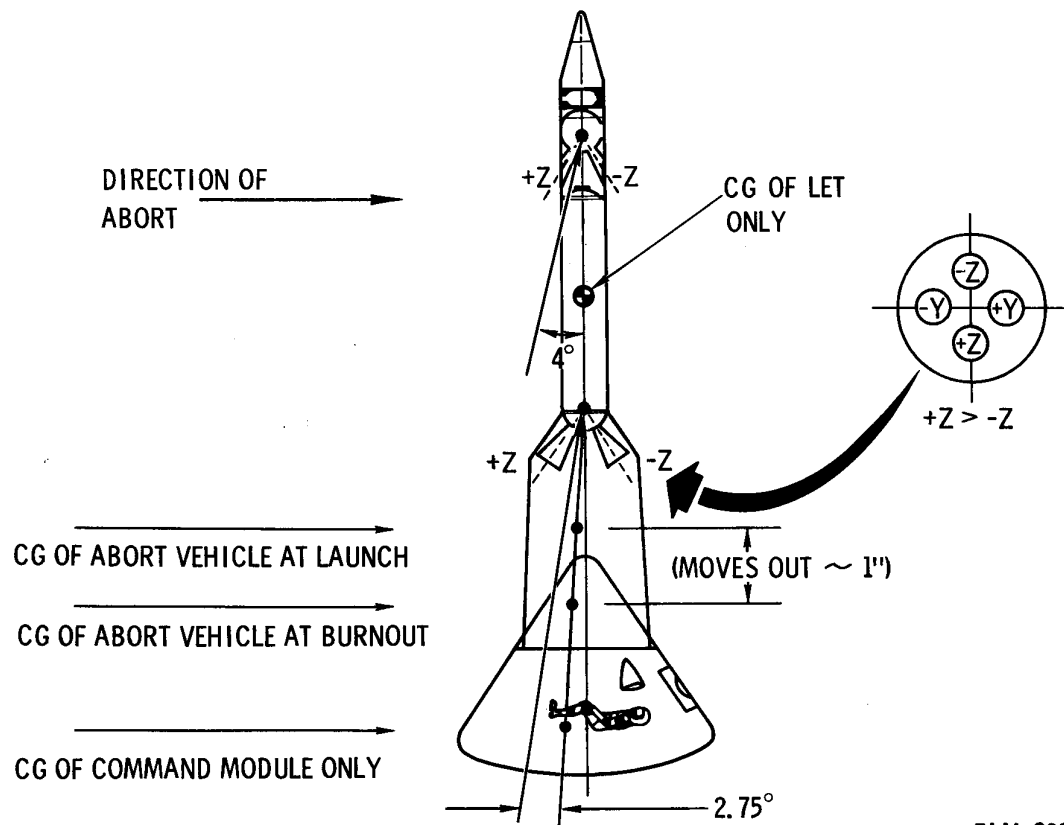
LAUNCH ESCAPE SYSTEM & BOOST PROTECTIVE COVER



TOWER SEPARATION SYSTEM



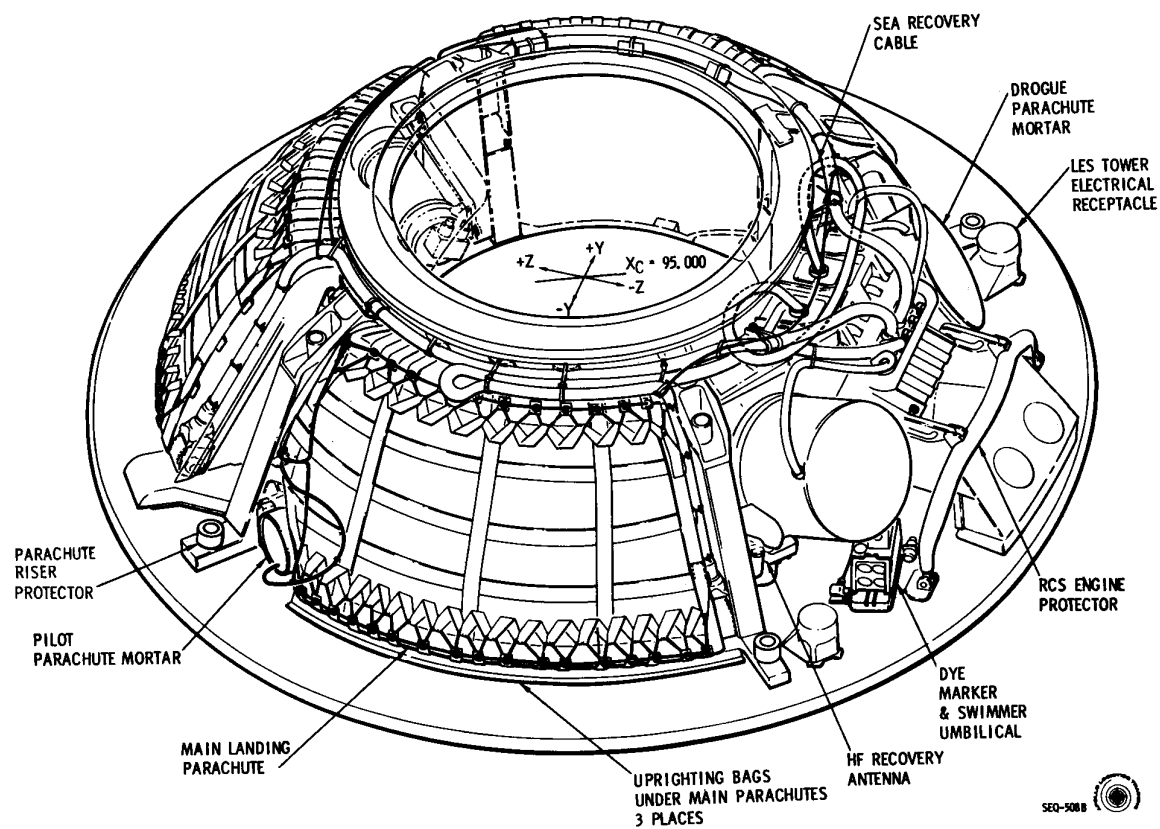
ABORT VEHICLE MECHANICS



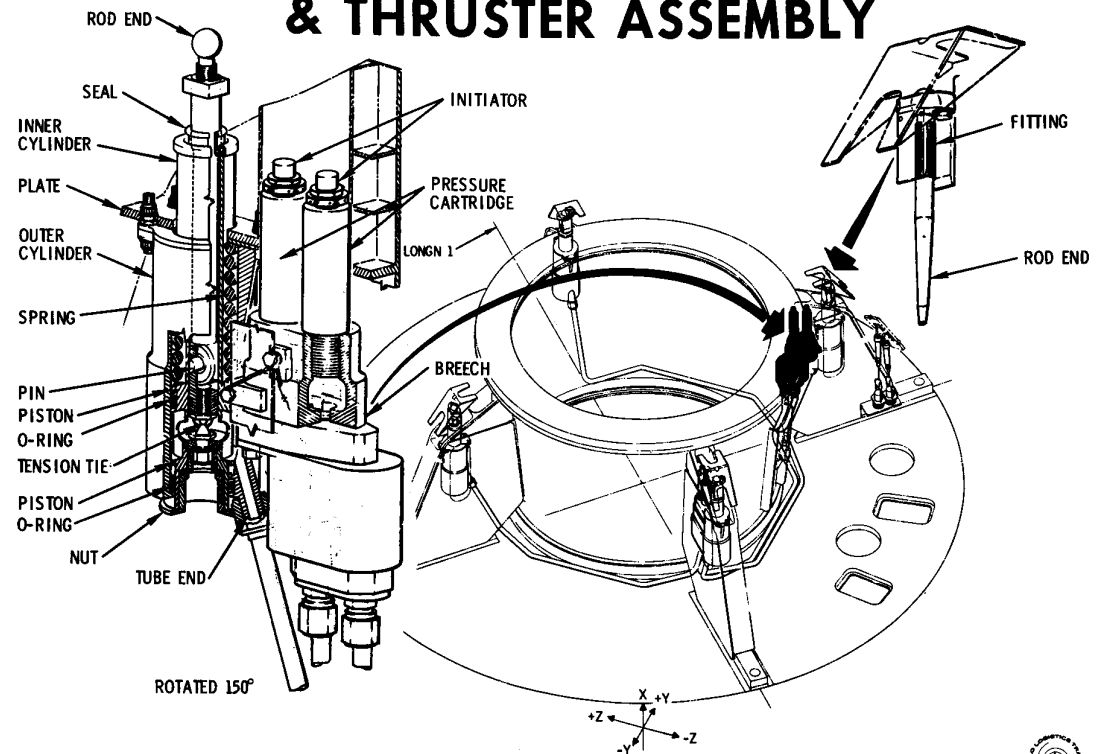
FAM-3009A



ELS EQUIPMENT (BLOCK II)

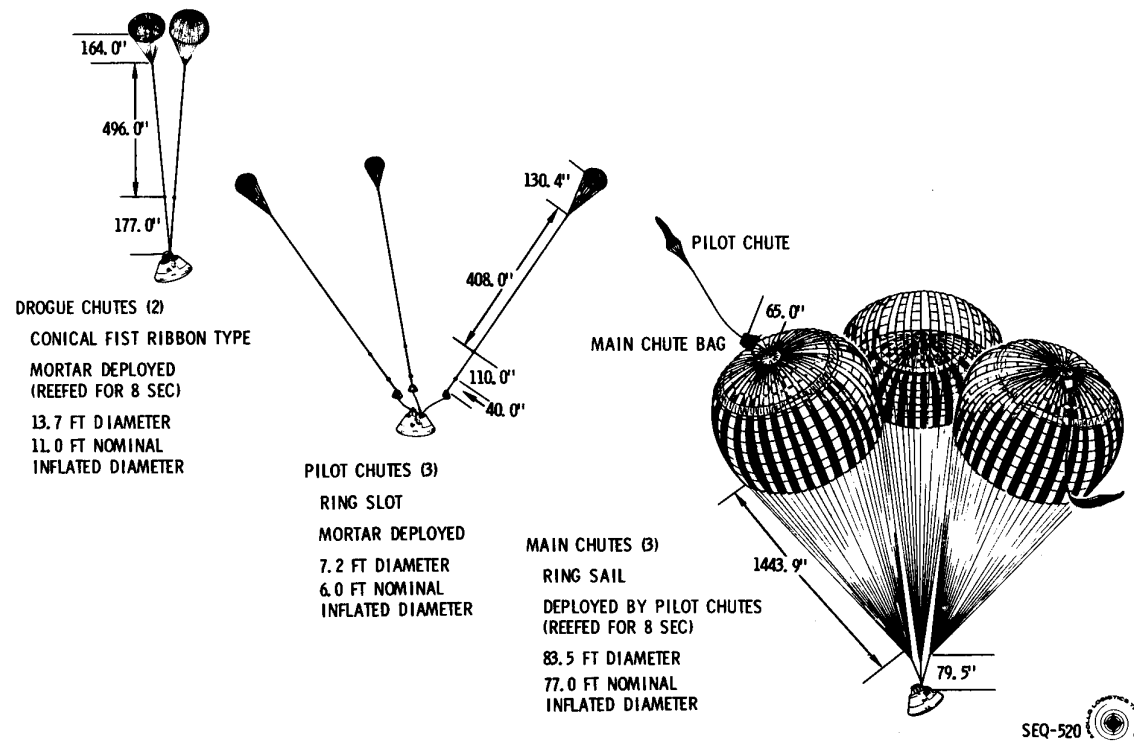


FORWARD HEATSHIELD ATTACHMENT & THRUSTER ASSEMBLY

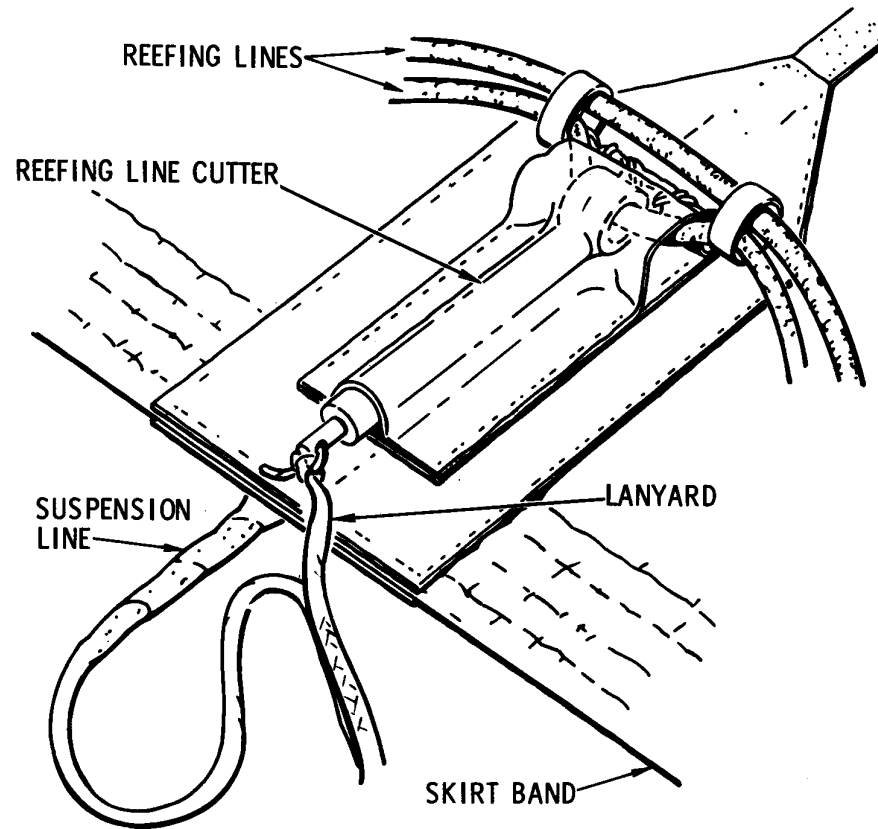


ST-590A

EARTH LANDING SYSTEM PARACHUTES



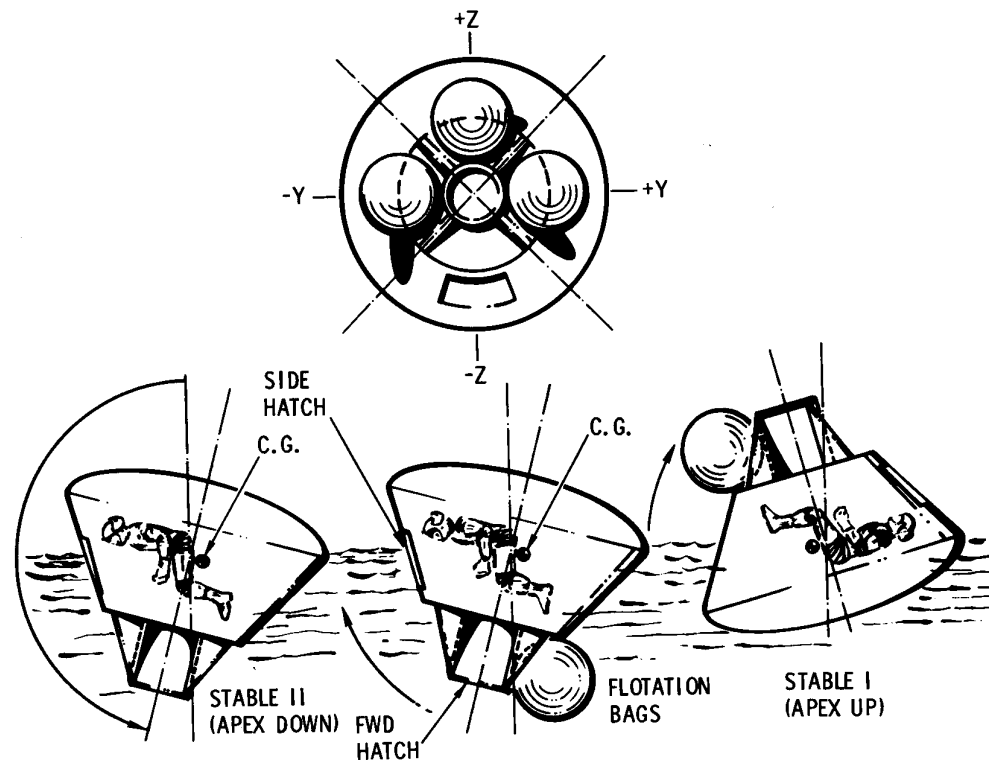
REEFING LINE CUTTER INSTALLATION



SEQ-75 

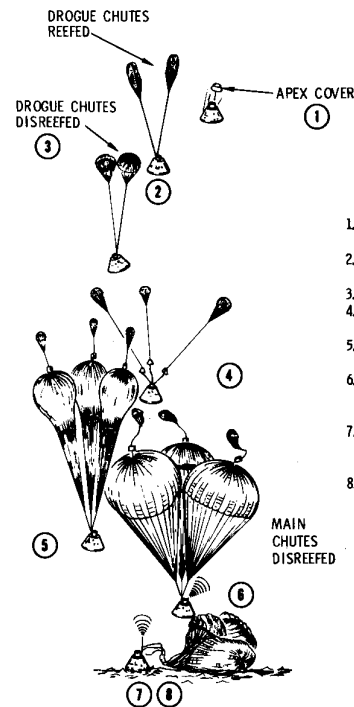
UPRIGHTING SYSTEM

3 BAG SYSTEM



ST-650C 

EARTH LANDING SYSTEM NORMAL SEQUENCE



1. APEX COVER JETTISONED AT 24,000 FT
+ .4 SEC (TLM)
2. DROGUE CHUTES DEPLOYED AT 24,000 FT
+ 2 SEC (REEFED FOR 8 SEC) (TLM)
3. DROGUE CHUTES DISREEFED
4. PILOT CHUTES DEPLOYED & DROGUE
CHUTES RELEASED AT 10,000 FT (TLM)
5. MAIN CHUTES DEPLOYED AT 10,000 FT
(REEFED FOR 8 SEC)
6. MAIN CHUTES DISREEFED, VHF
RECOVERY ANTENNAS, & FLASHING
BEACON DEPLOYED
7. MAIN CHUTES RELEASED & LM PRESS.
PYRO VALVE CLOSED AFTER TOUCH-
DOWN (TLM)
8. HF ANTENNA DEPLOYED (TLM)

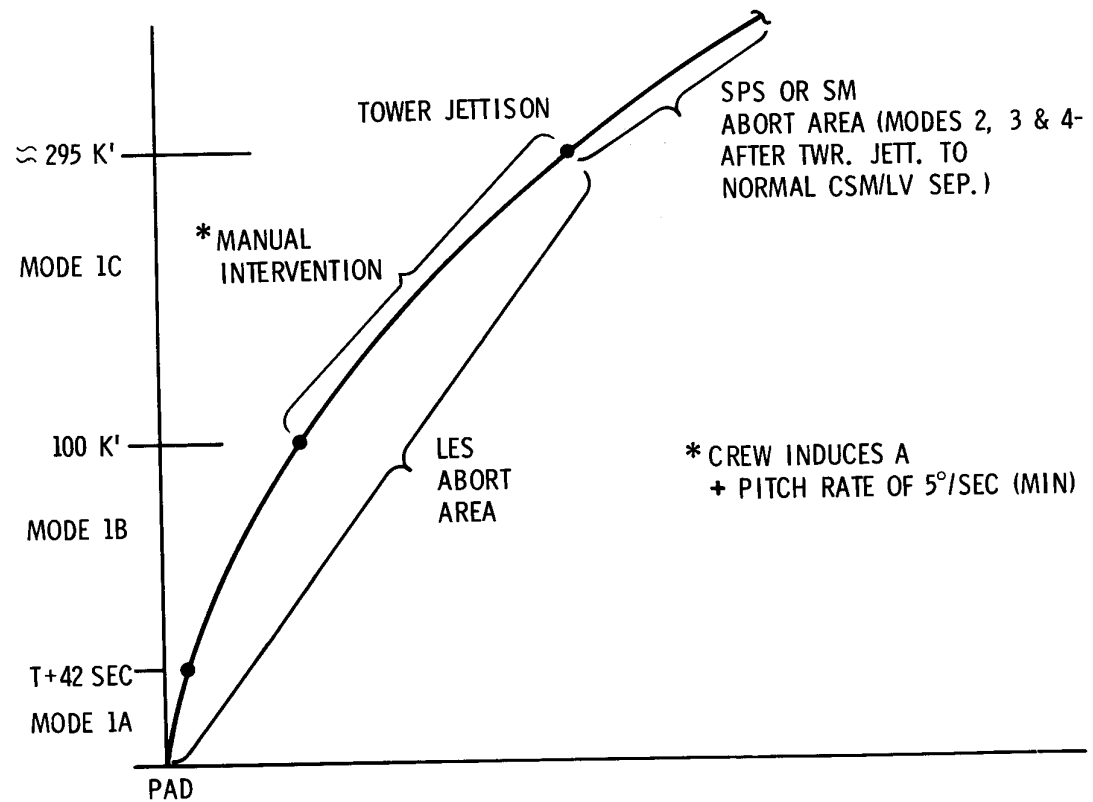
TOUCHDOWN VELOCITIES:
3 CHUTES - 30.5 FT/SEC

SEQ-547A

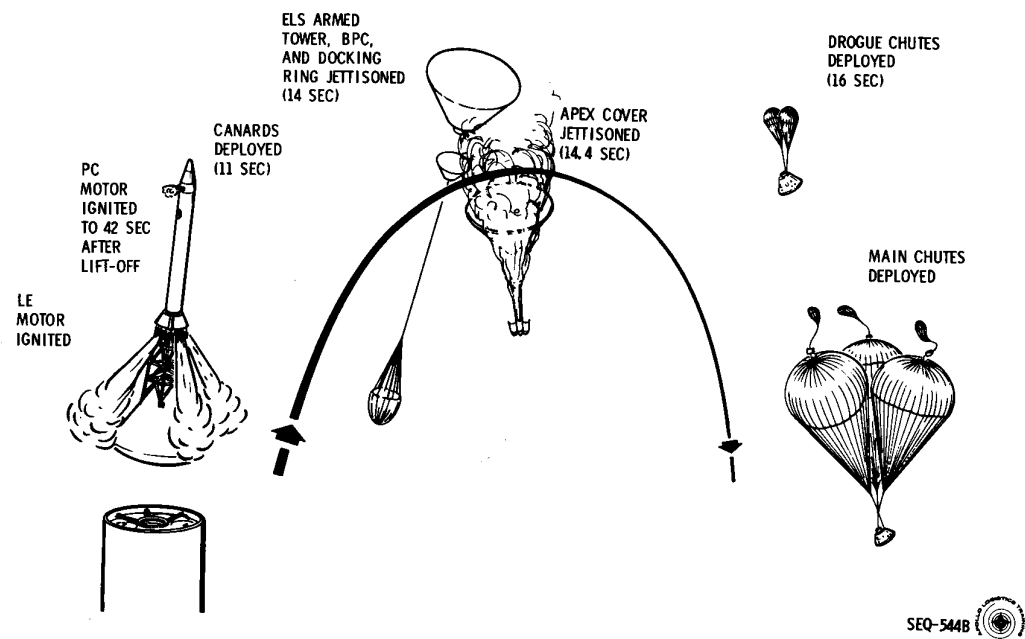


ABORT DESIGNATIONS

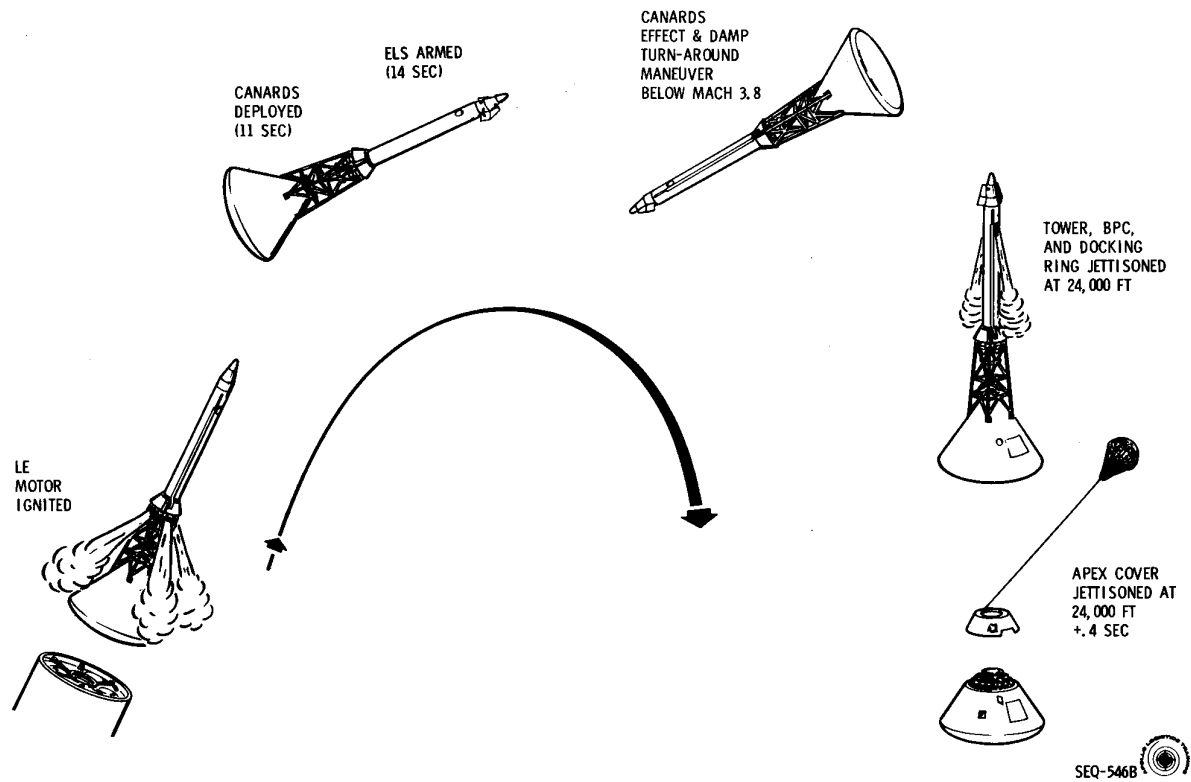
BLOCK II - MODE 1



PAD TO $\approx$ 30,000 FT LES ABORT



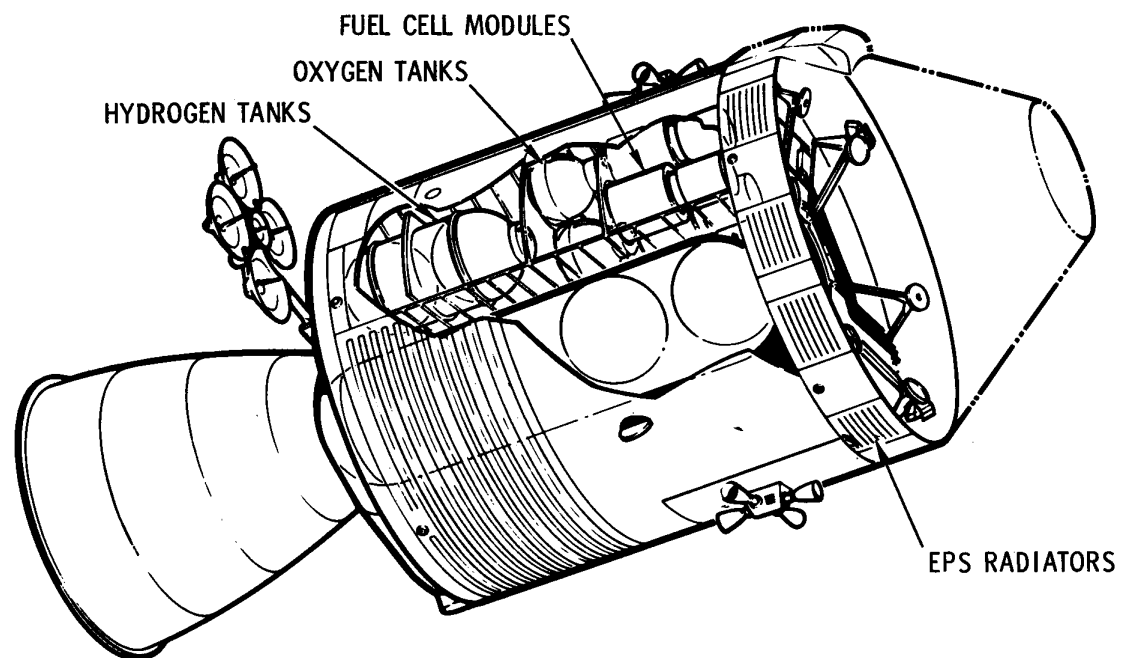
≈ 30,000 FT TO TWR JETT LES ABORT



ELECTRICAL POWER

FAM-2008 

ELECTRICAL POWER SYSTEM BLOCK II



ELECTRICAL POWER SYSTEM

FUNCTIONAL DIVISION

POWER SOURCES

- **D.C. SYSTEM**
 - FUEL CELL MODULES (3)**
 - BATTERIES (3)**
- **A.C. SYSTEM**
 - INVERTERS (3)**

POWER DISTRIBUTION

- **D.C. BUSES**
- **A.C. BUSES**

SPECIAL CIRCUITS

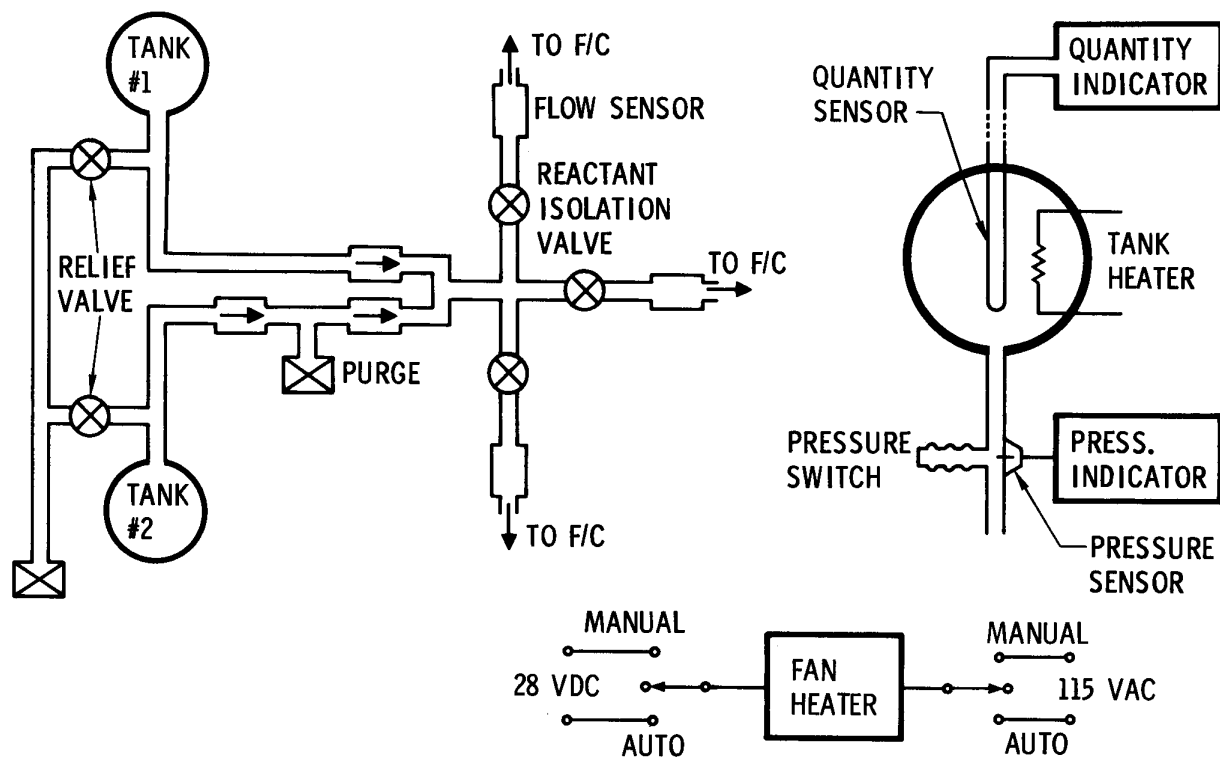
- **BATTERY CHARGER**
- **PYROTECHNIC BATTERIES (2)**
- **S/M JETTISON CONTROL**

CRYOGENIC STORAGE SYSTEM

GAS	CONTAINER	USEABLE	TOTAL USEABLE
O ₂	INCONEL (2)	320 LBS (EA)	640 LBS
H ₂	TITANIUM (2)	28 LBS (EA)	56 LBS

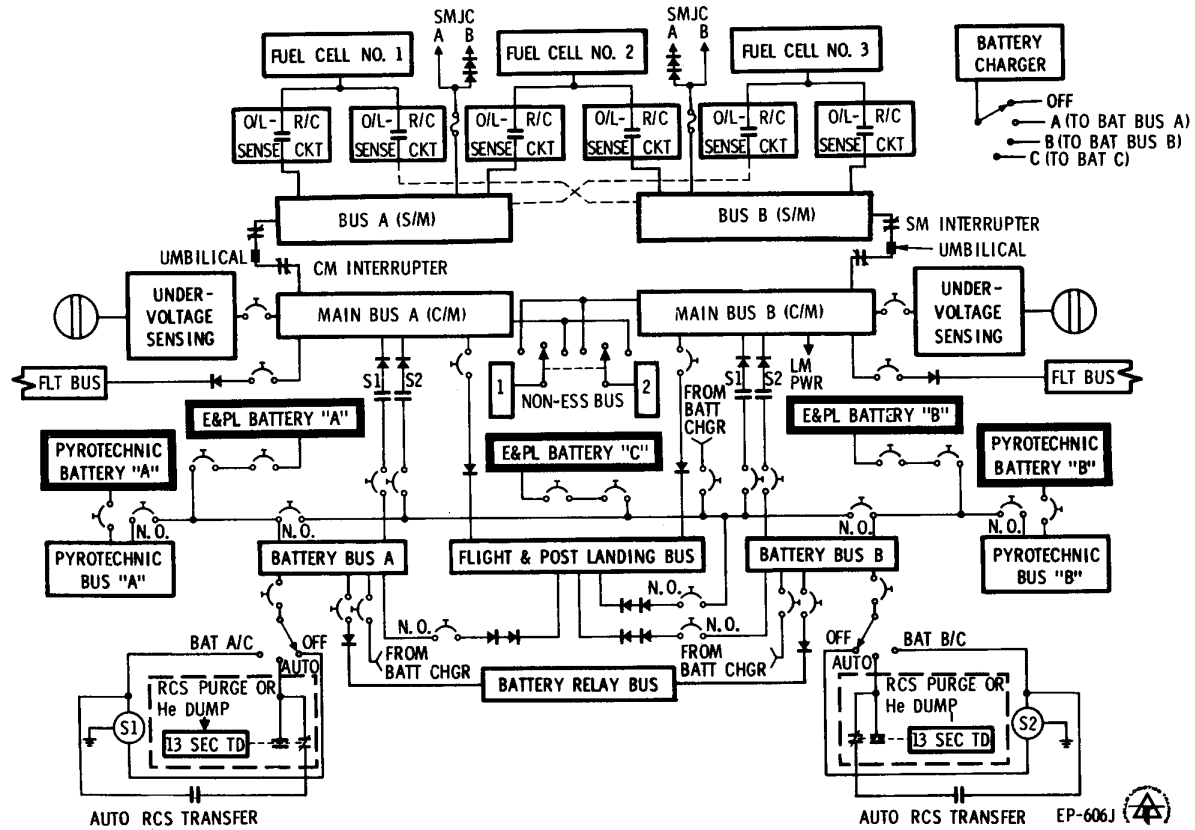
GAS	INPUT TEMP.	SETTLED TEMP.	STORED PRESSURE	SYSTEM ALLOCATION
O ₂	-297° F	-284° F	900 ± 35 PSIA	EPS - 410 #
				ECS - 230 #
H ₂	-423° F	-417° F	245 ± 15 PSIA	FUEL CELLS ONLY

CRYOGENIC STORAGE SYSTEM



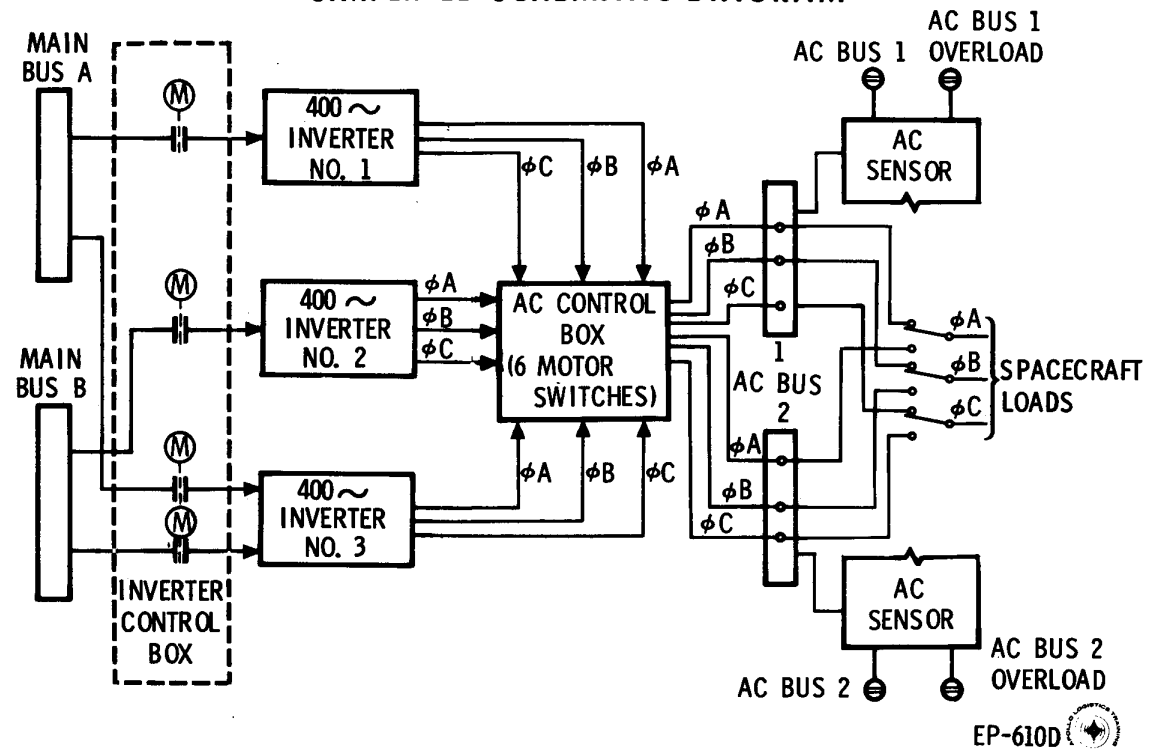
DC POWER DISTRIBUTION

SIMPLIFIED SCHEMATIC DIAGRAM

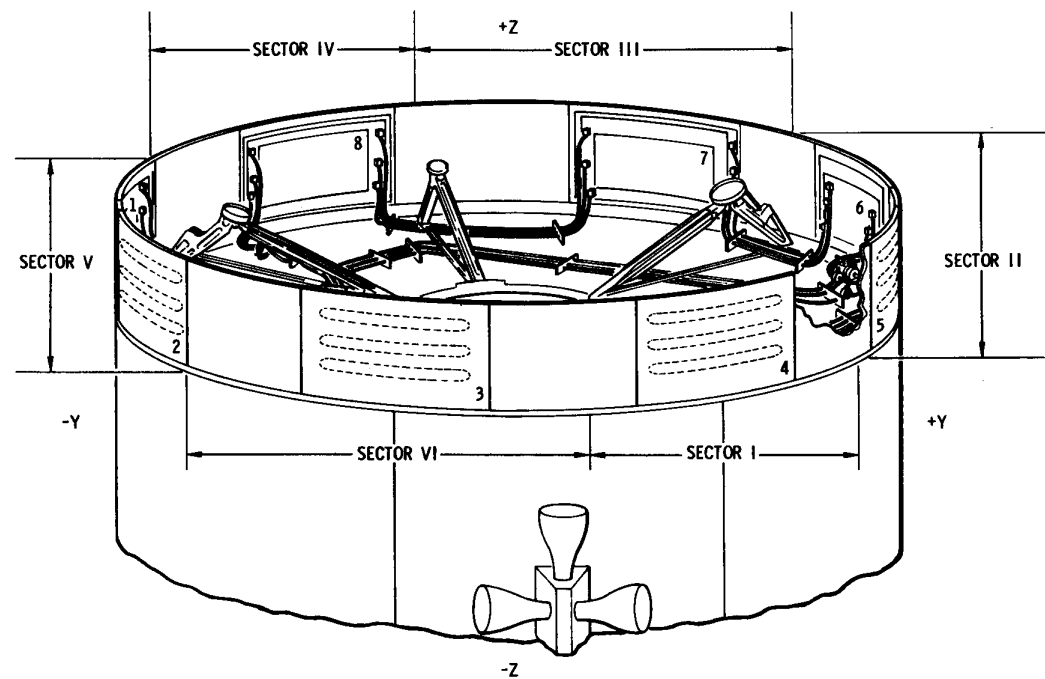


AC POWER DISTRIBUTION

SIMPLIFIED SCHEMATIC DIAGRAM

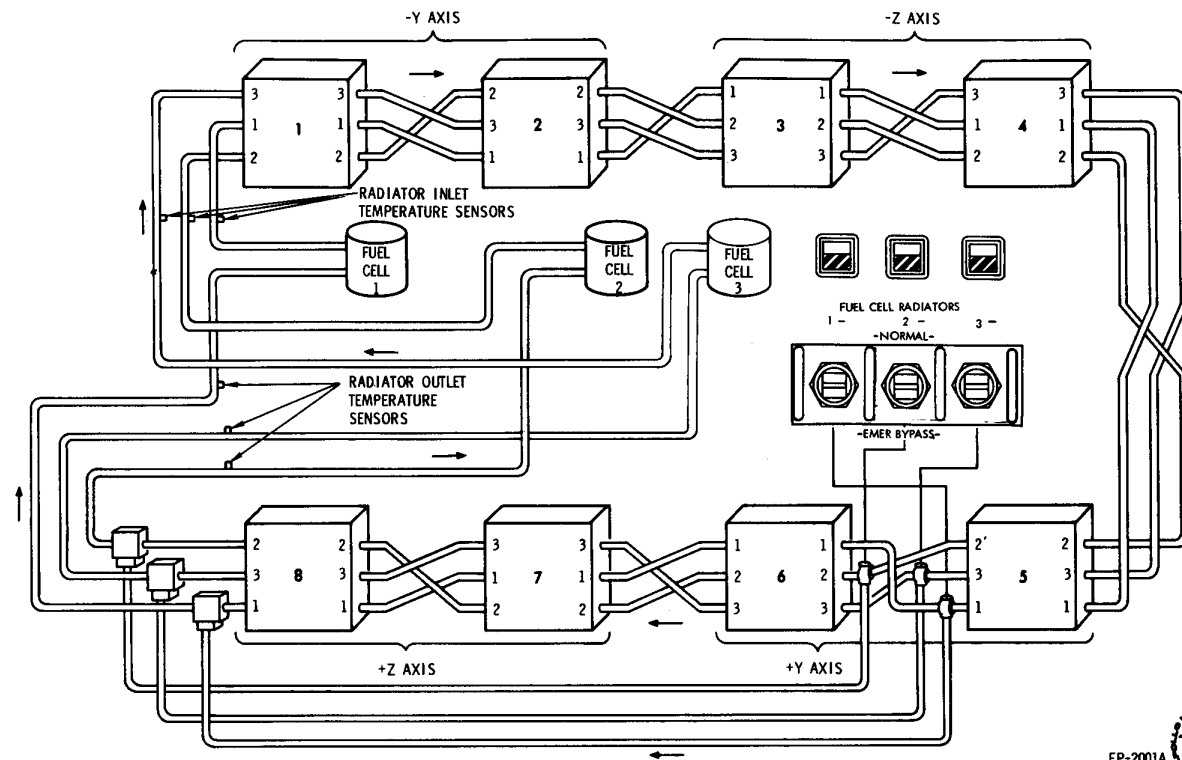


EPS RADIATOR LOCATION BLOCK II



EPS RADIATOR CONTROL

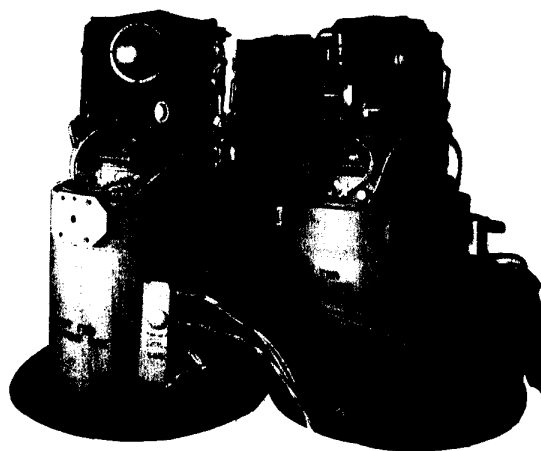
BLOCK II



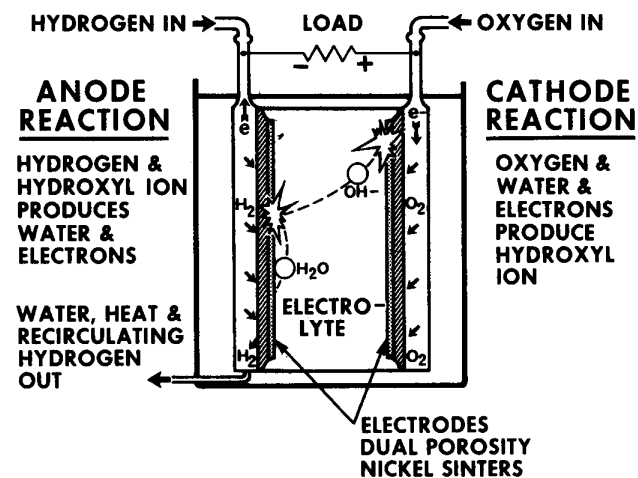
EP-2001A



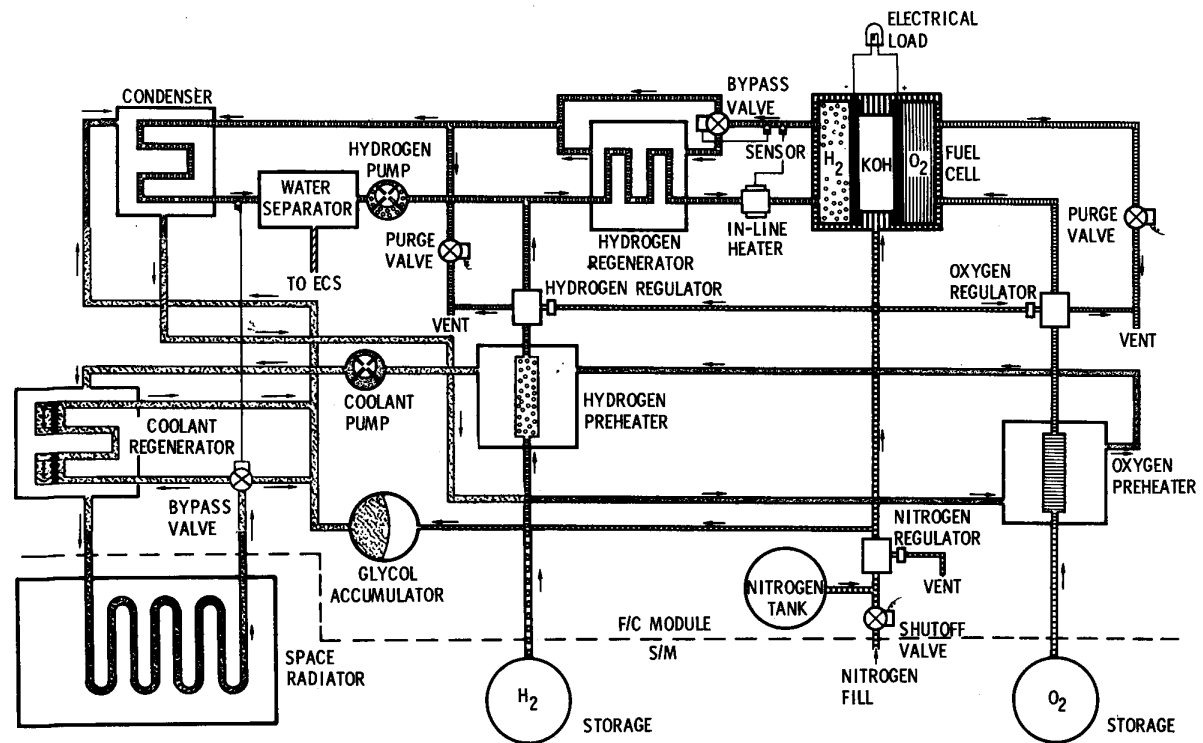
APOLLO FUEL CELL POWERPLANT



HEIGHT = 44 IN.
DIAM = 22 IN.
WEIGHT = 245 LB EACH

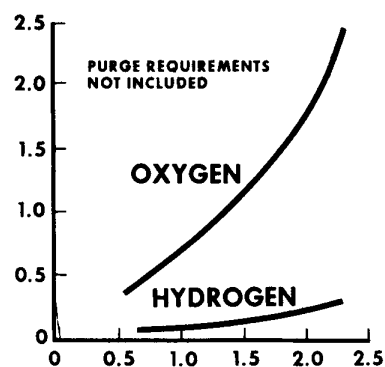


EPS FUEL CELL DIAGRAM

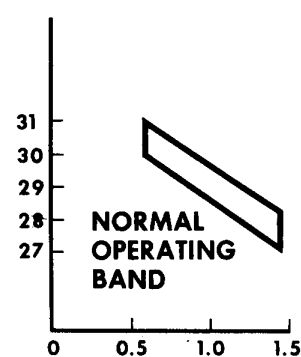


FUEL CELL REACTION

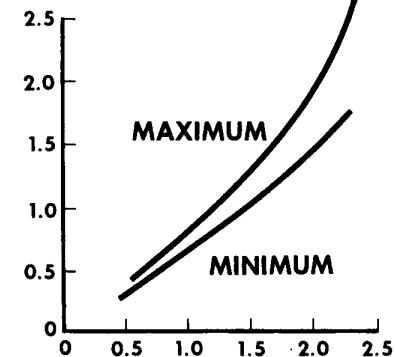
MAXIMUM REACTANT
CONSUMPTION-
POUNDS PER HOUR



VOLTAGE

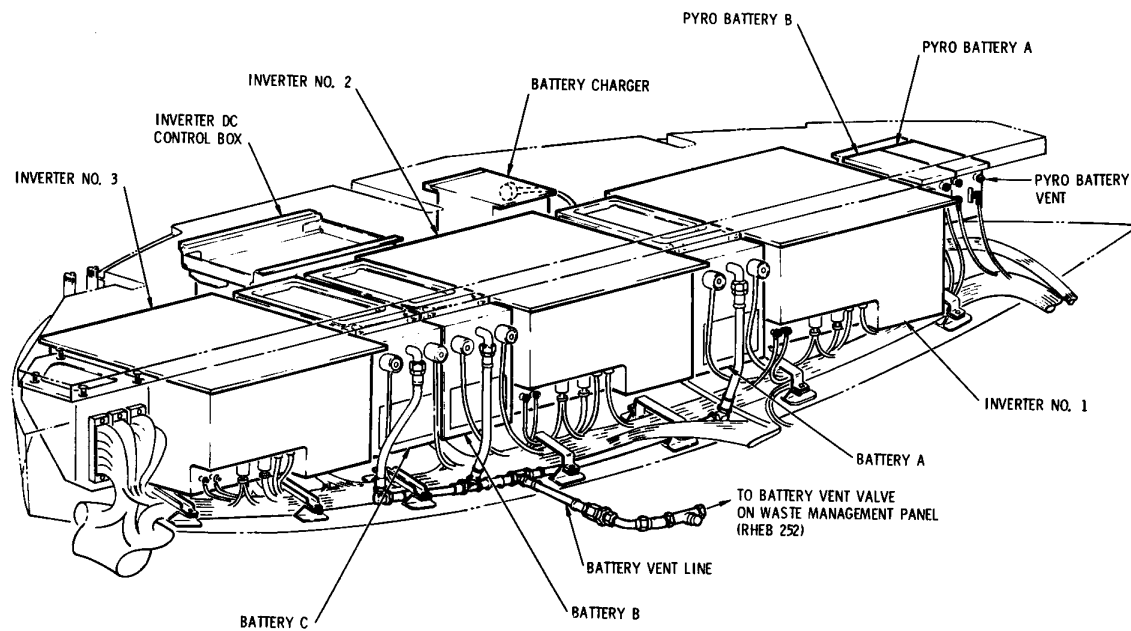


WATER GENERATION RATE-
POUNDS PER HOUR-
PURGING NOT INCLUDED



GROSS POWER PER POWERPLANT - KILOWATTS

EPS COMPONENTS LOWER EQUIPMENT BAY (BLOCK II)



ENVIRONMENTAL CONTROL

FAM-2505A 

ECS FUNCTIONAL REQUIREMENTS

CONTROL SPACECRAFT ATMOSPHERE

- PRESSURE-TEMPERATURE-HUMIDITY-CONTAMINATION

PROVIDE COOLING FOR SPACECRAFT EQUIPMENT

- GUIDANCE & NAVIGATION-STABILIZATION & CONTROL
- COMMUNICATIONS-AC POWER SUPPLY-OTHER

CONTROL COLLECTION, STORAGE & DISTRIBUTION OF WATER

- POTABLE WATER FOR CREW USE
- WASTE WATER FOR SUPPLEMENTAL COOLING

ENVIRONMENTAL CONTROL

SUBSYSTEM FUNCTIONS

OXYGEN SUPPLY SUBSYSTEM

- NORMAL OXYGEN SUPPLY
- ENTRY OXYGEN SUPPLY
- CABIN PRESSURE CONTROL
- FLUID TANK PRESSURIZATION

PRESSURE SUIT SUBSYSTEM

- WATER & CONTAMINANT REMOVAL FROM SUIT & CABIN
- SUIT PRESSURE & TEMPERATURE CONTROL

WATER SUBSYSTEM

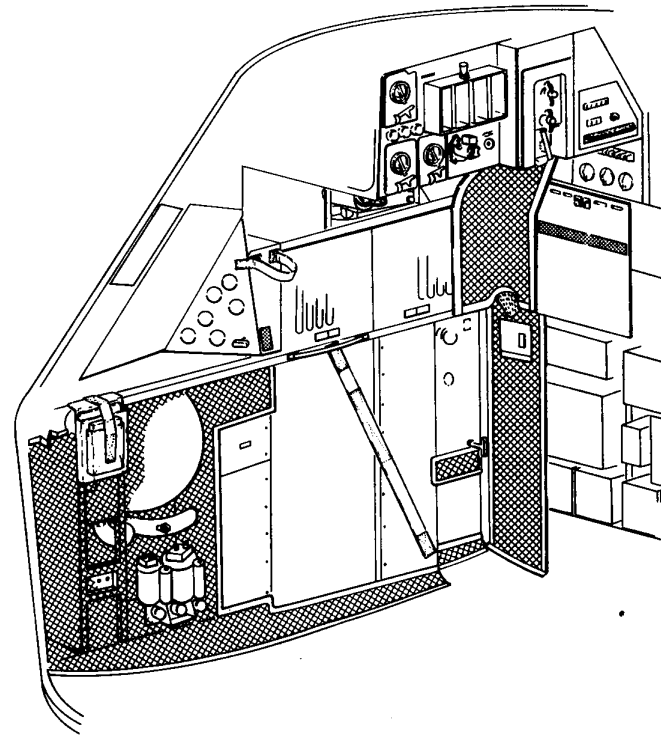
- STORES & DISTRIBUTES
 - POTABLE WATER (DRINKING & FOOD RECONSTITUTION)
 - WASTE WATER (SUPPLEMENTAL COOLING)

WATER GLYCOL SUBSYSTEM

- PRIMARY HEAT TRANSFER
- COOLING FOR SUIT & ELECTRONICS
- HEATING OR COOLING FOR CABIN
- REJECTS EXCESS HEAT TO SPACE

APOLLO CM INTERIOR LHEB & LHFE

BLOCK II



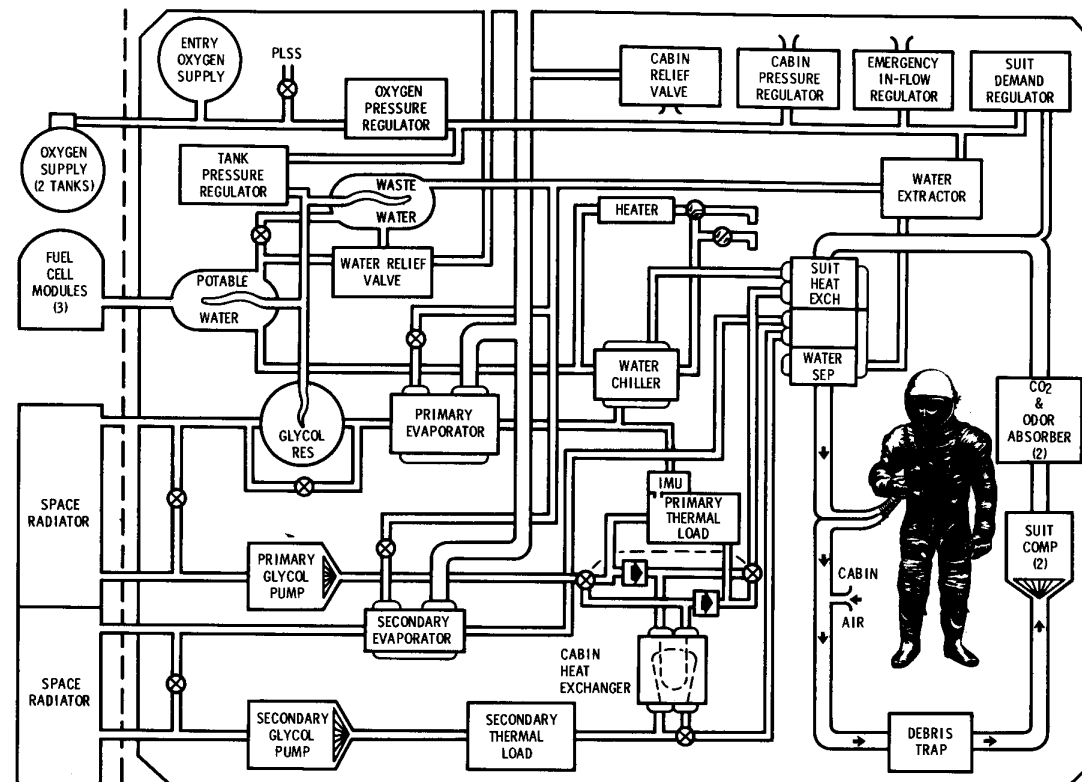
■ VELCRO

FEB 67

CS-0014 

ENVIRONMENTAL CONTROL

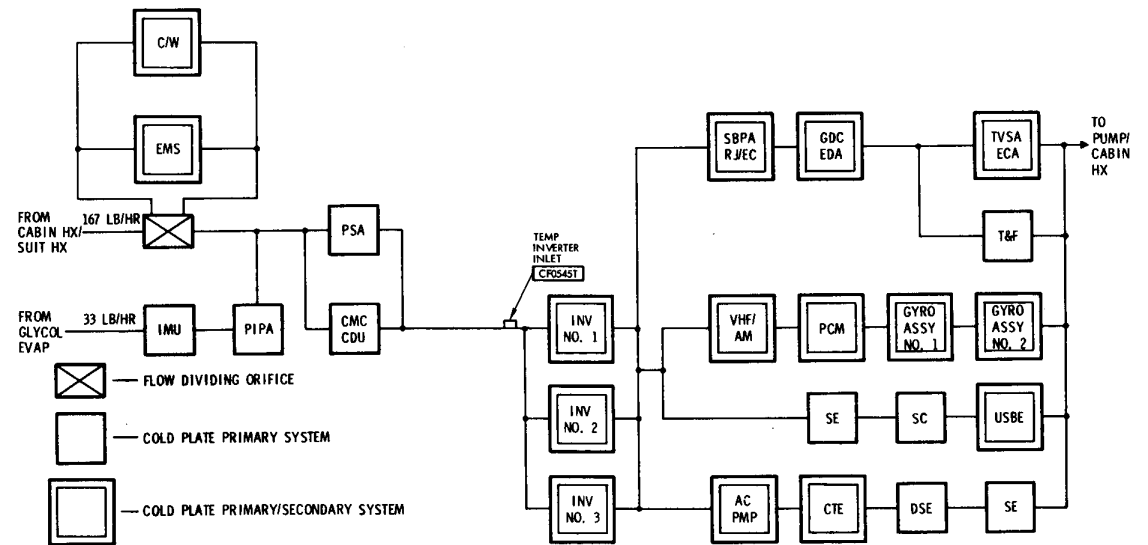
BLOCK II



FAM-2507D

COLD PLATE NETWORK

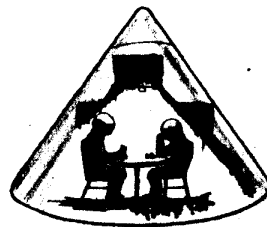
PRIMARY SYSTEM - BLOCK II



CREW EQUIPMENT

9

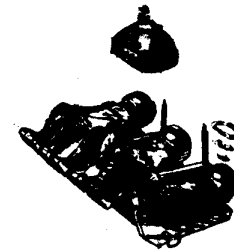
FAM-5015 



LIGHT AND SIGHT



SPACE SUIT ASSY



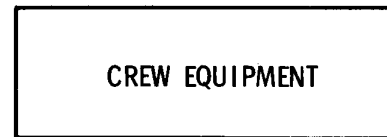
CREW COUCHES



RESTRAINTS



SURVIVAL



CREW EQUIPMENT



INFLIGHT TOOLSET



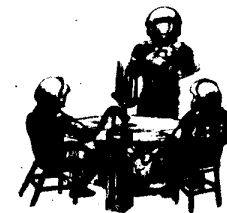
MISSION EXPERIMENTS



MEDICAL



WASTE CONTROL



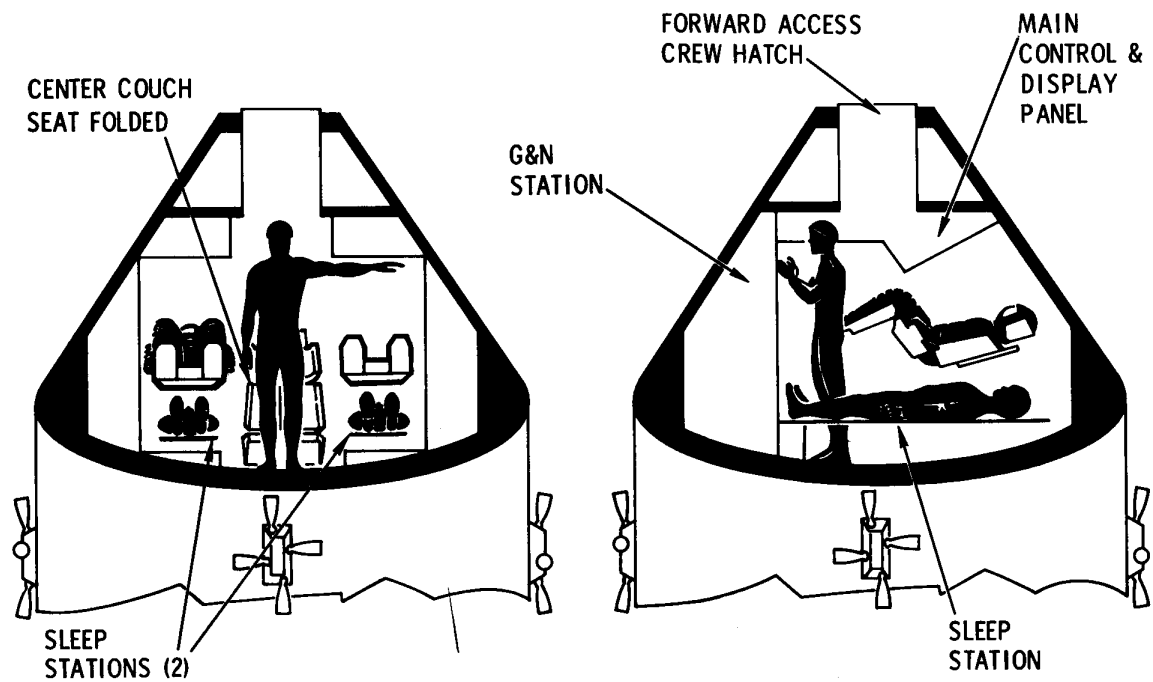
WATER AND FOOD

MAR 66

FAM-5402 A

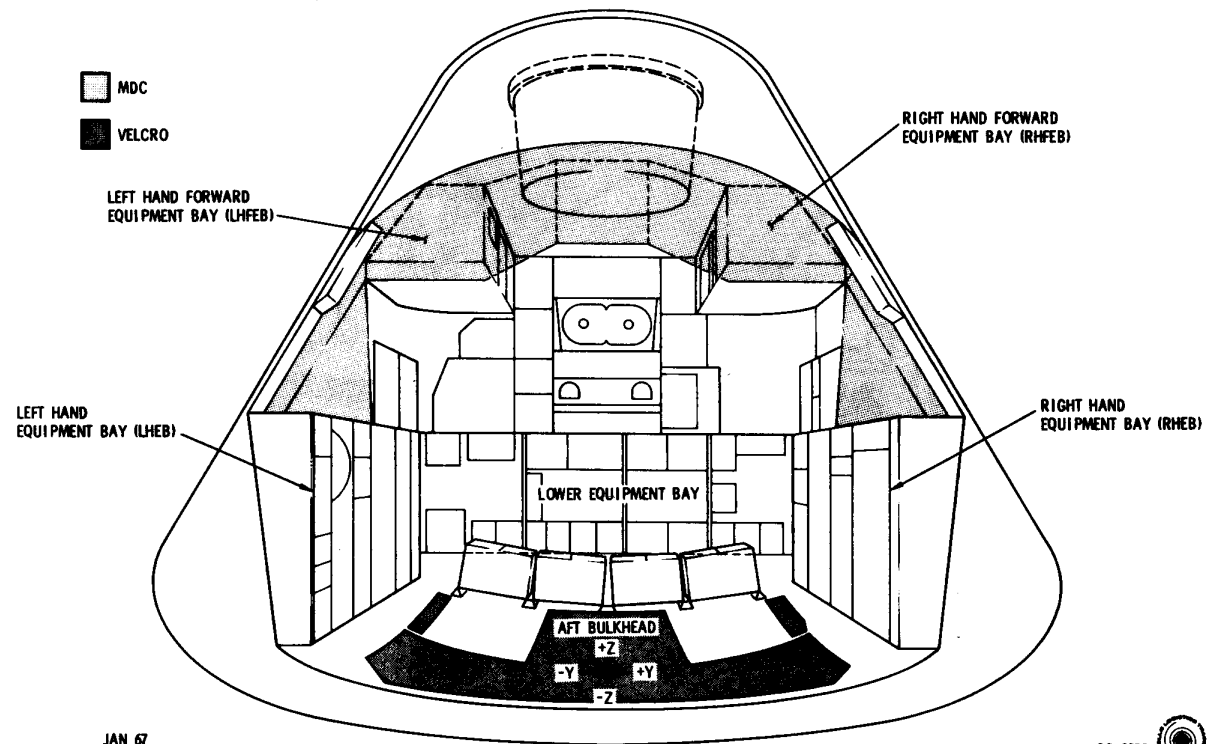


APOLLO CREW STATIONS



APOLLO CREW COMPARTMENT

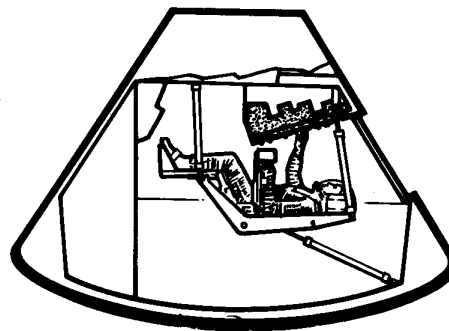
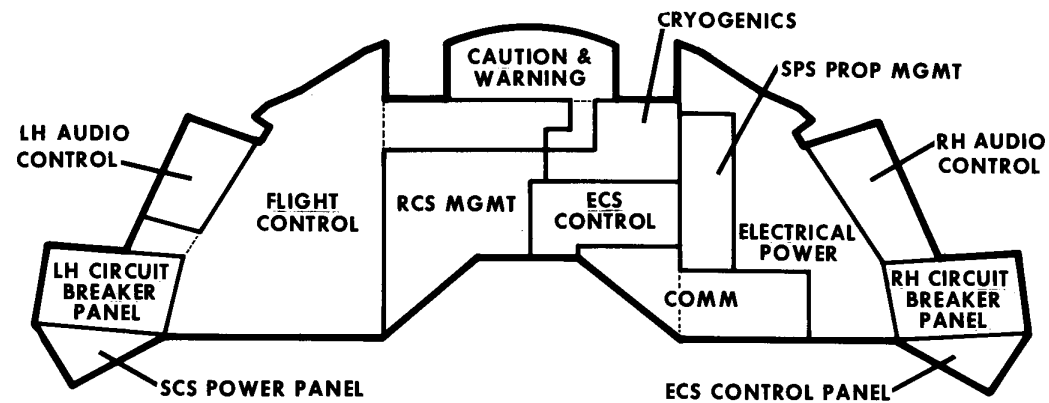
BLOCK II



JAN 67

CS-0012

COMMAND MODULE MAIN PANEL

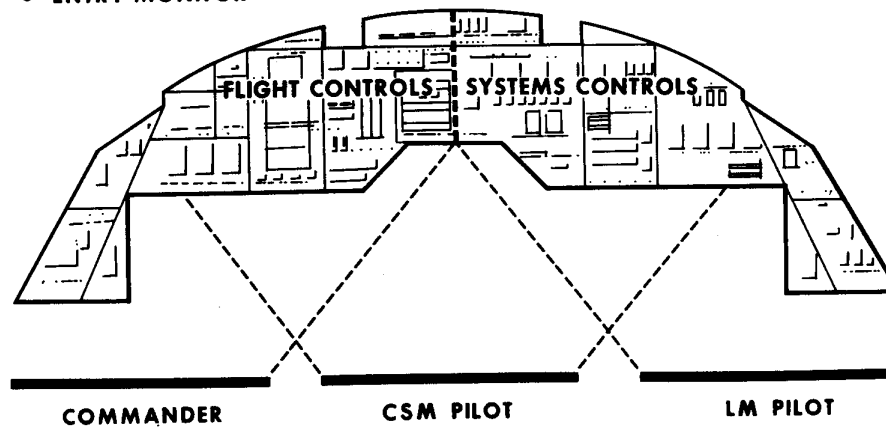


S66SD10818-1B

MAIN PANEL FUNCTIONS

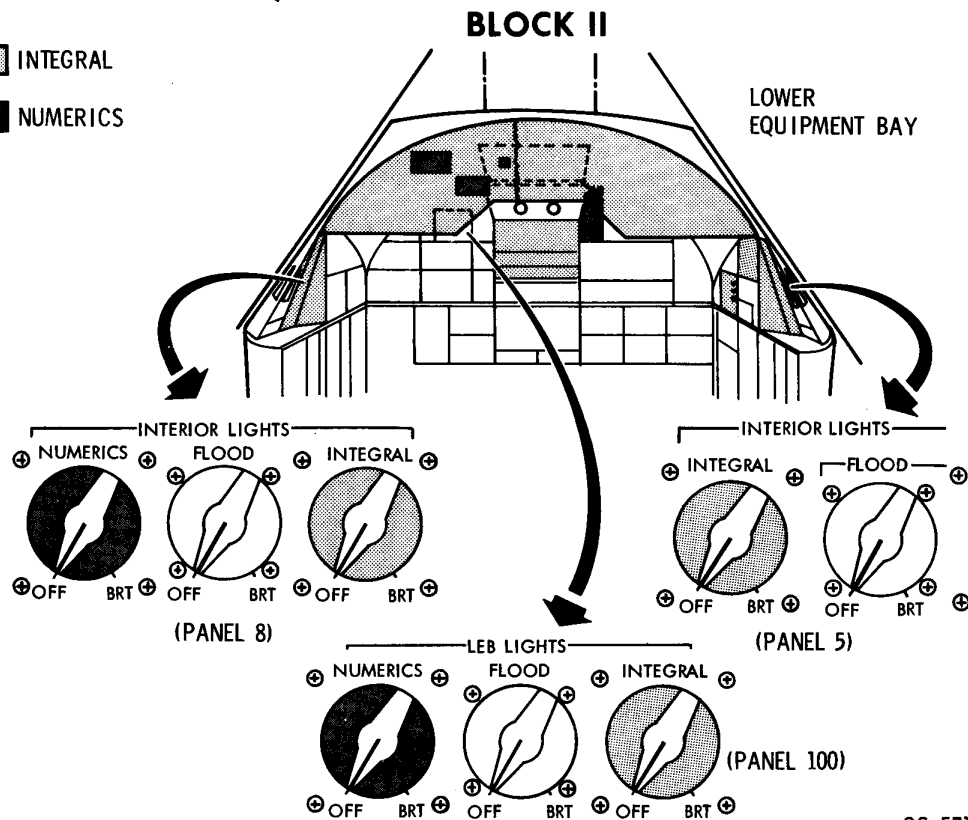
- LV EMERGENCY DETECTION
- FLIGHT ATTITUDE
- MISSION SEQUENCE
- ΔV MONITOR
- ENTRY MONITOR

- PROPELLANT GAGING
- ENVIRONMENT CONTROL
- COMMUNICATIONS CONTROL
- POWER DISTRIBUTION
- CAUTION & WARNING



CM INTEGRAL/NUMERICS ILLUMINATION SYSTEM

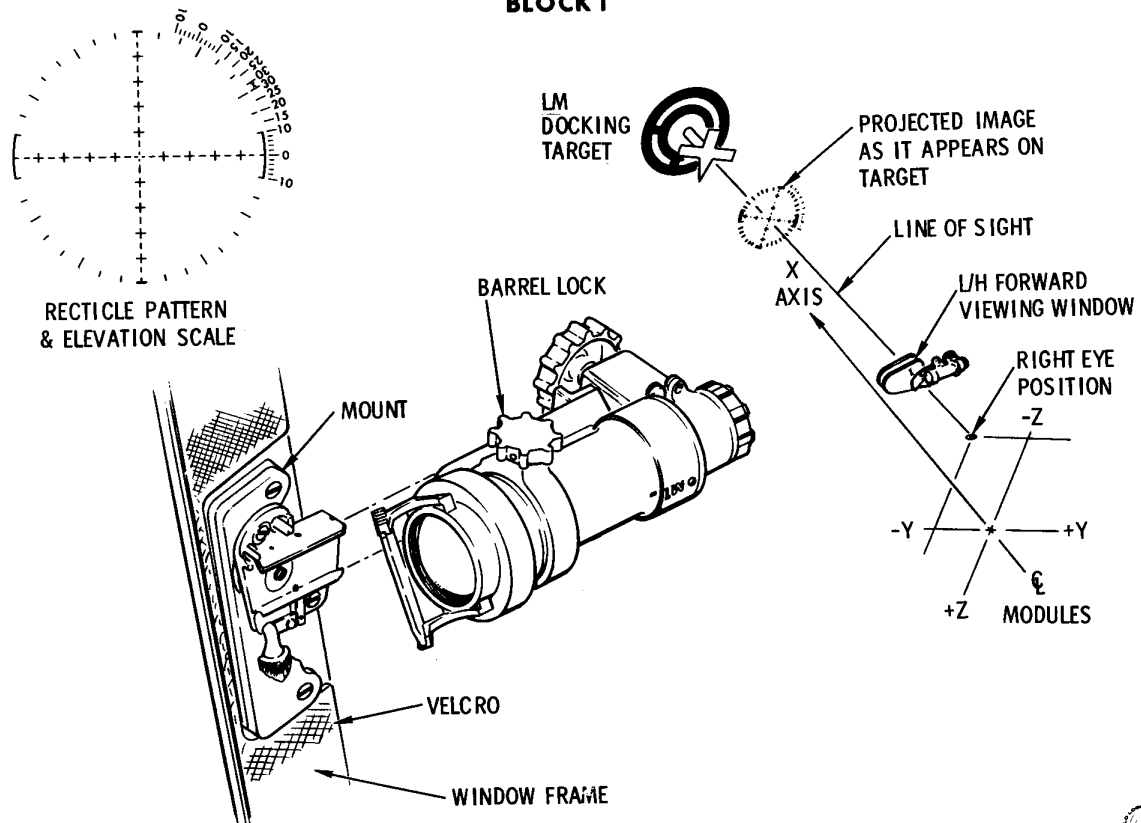
 INTEGRAL
 NUMERICS



JAN 67

CS-571A 

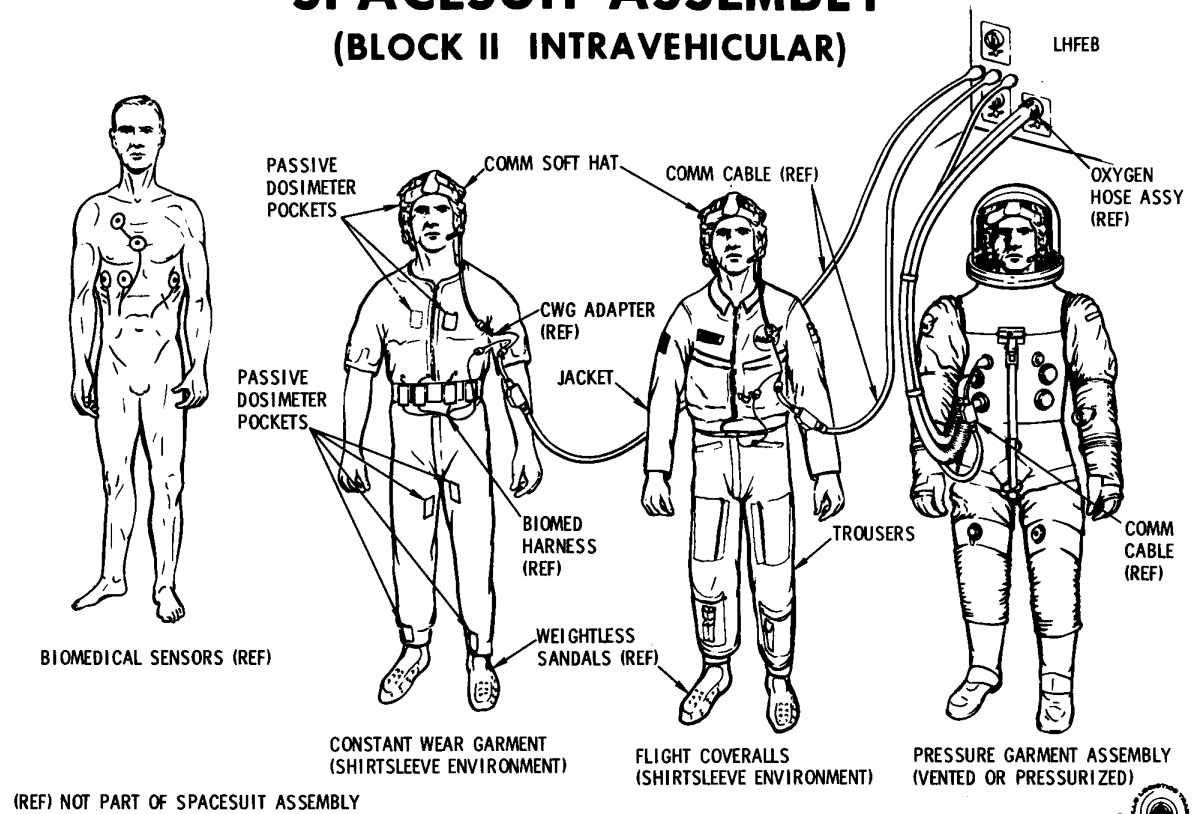
APOLLO CREWMAN ALIGNMENT SIGHT SYSTEM CONFIGURATION BLOCK I



FEB 67

CS-531C

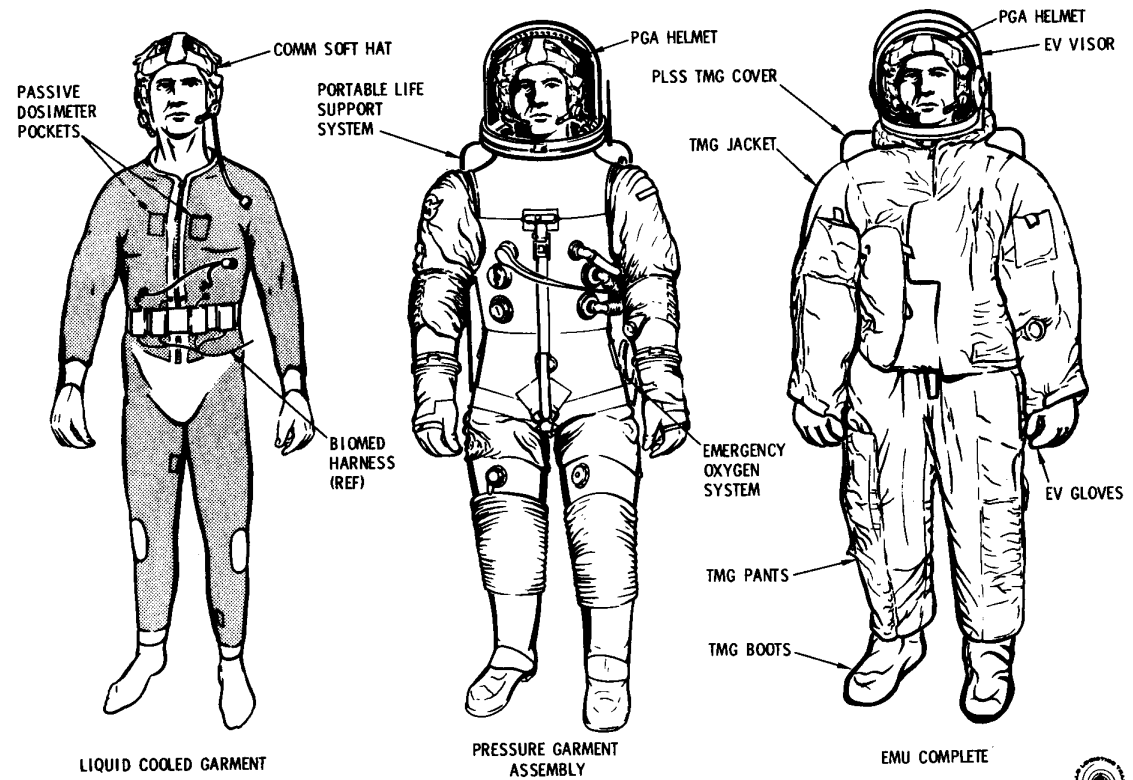
SPACESUIT ASSEMBLY (BLOCK II INTRAVEHICULAR)



MAY 67

CS-1001 B 

EXTRAVEHICULAR MOBILITY UNIT (EMU)

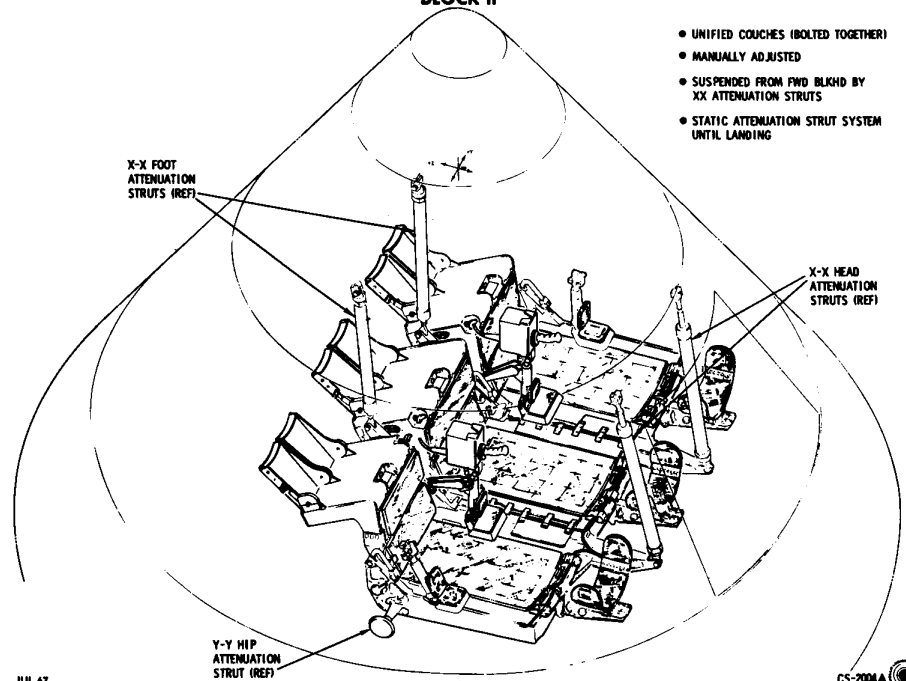


JAN 67

CS-1002A

CREW COUCH STRUCTURE BLOCK II

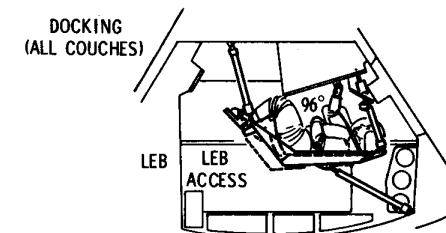
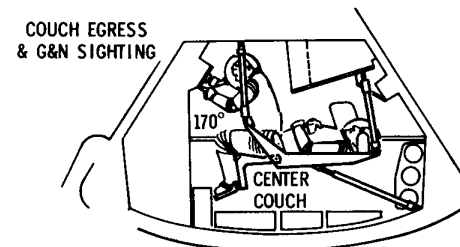
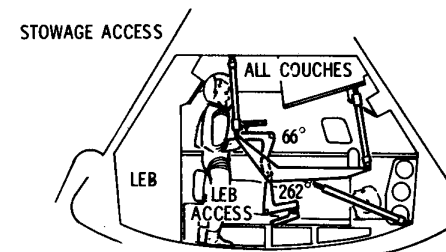
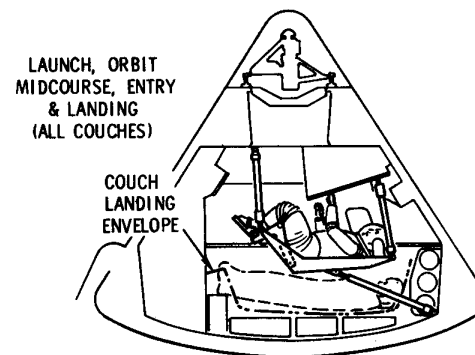
- UNIFIED COUCHES (BOLTED TOGETHER)
- MANUALLY ADJUSTED
- SUSPENDED FROM FWD BULKHEAD BY XX ATTENUATION STRUTS
- STATIC ATTENUATION STRUT SYSTEM UNTIL LANDING



JUL 67

CS-2004A

MISSION PHASES WITH COUCH POSITIONS & SEAT ANGLE SC 2TV-1 & 101

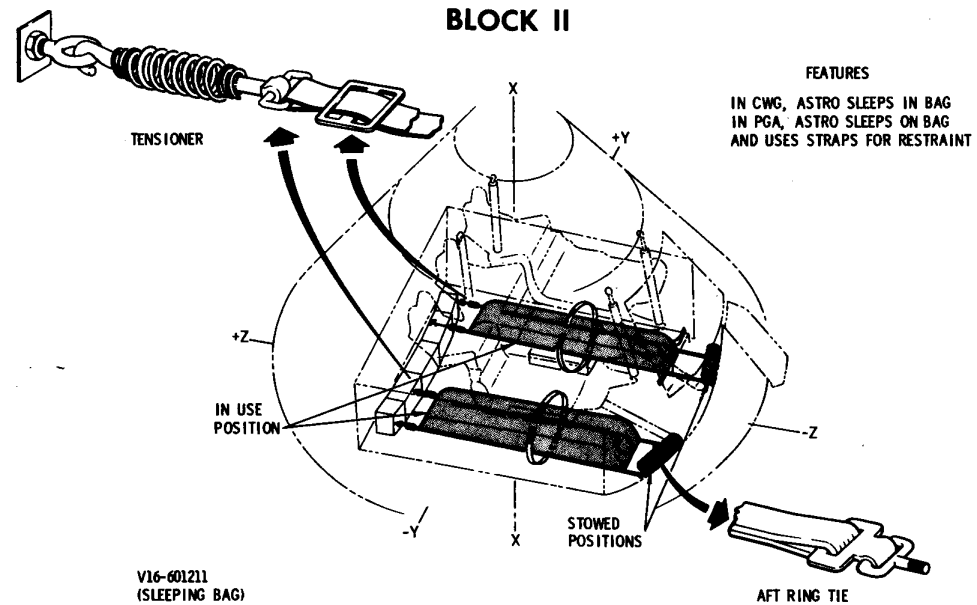


JUN 67

CS-2025C (4)

SLEEPING POSITION RESTRAINT CONFIGURATION

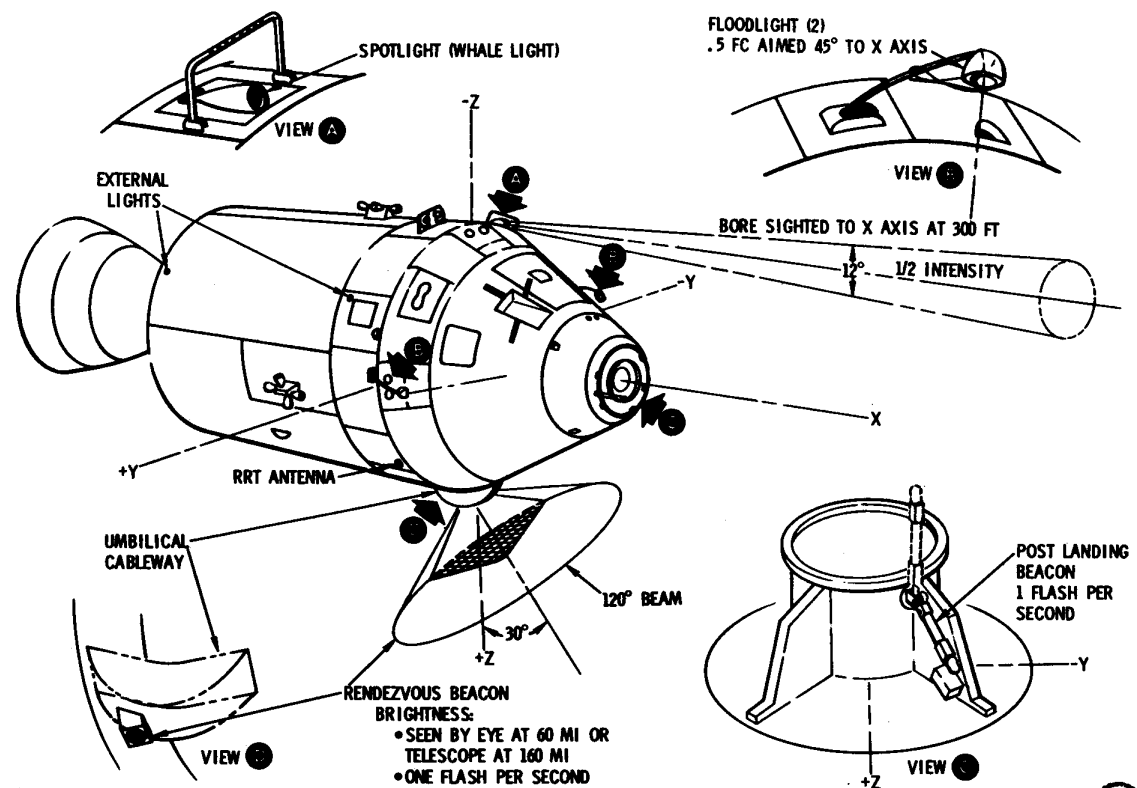
BLOCK II



MAR 67

CS-2331

CSM DOCKING, EVA, & EXTERNAL LIGHTS

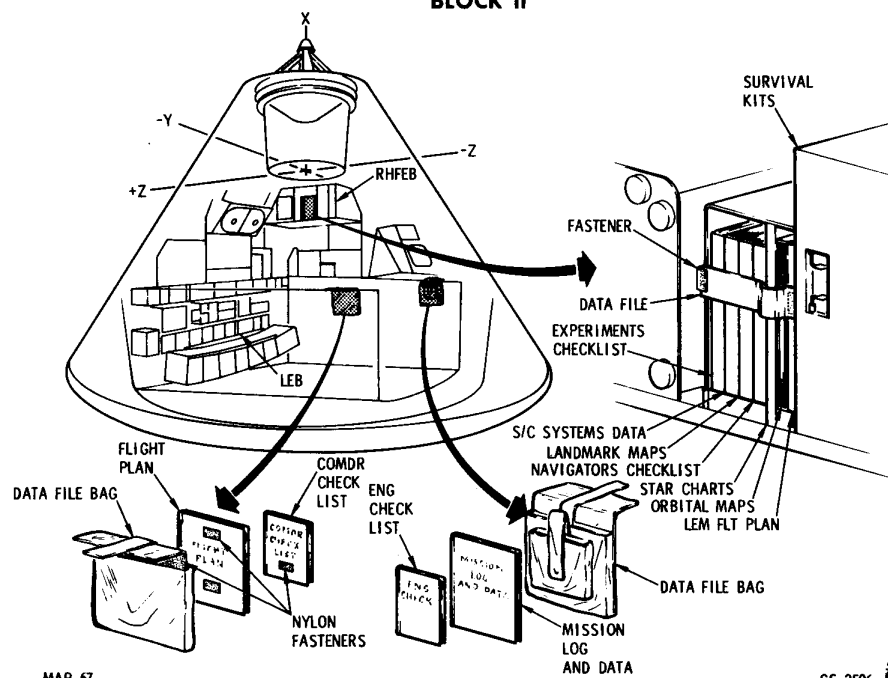


MAY 67

CS-755

FLIGHT DATA FILE

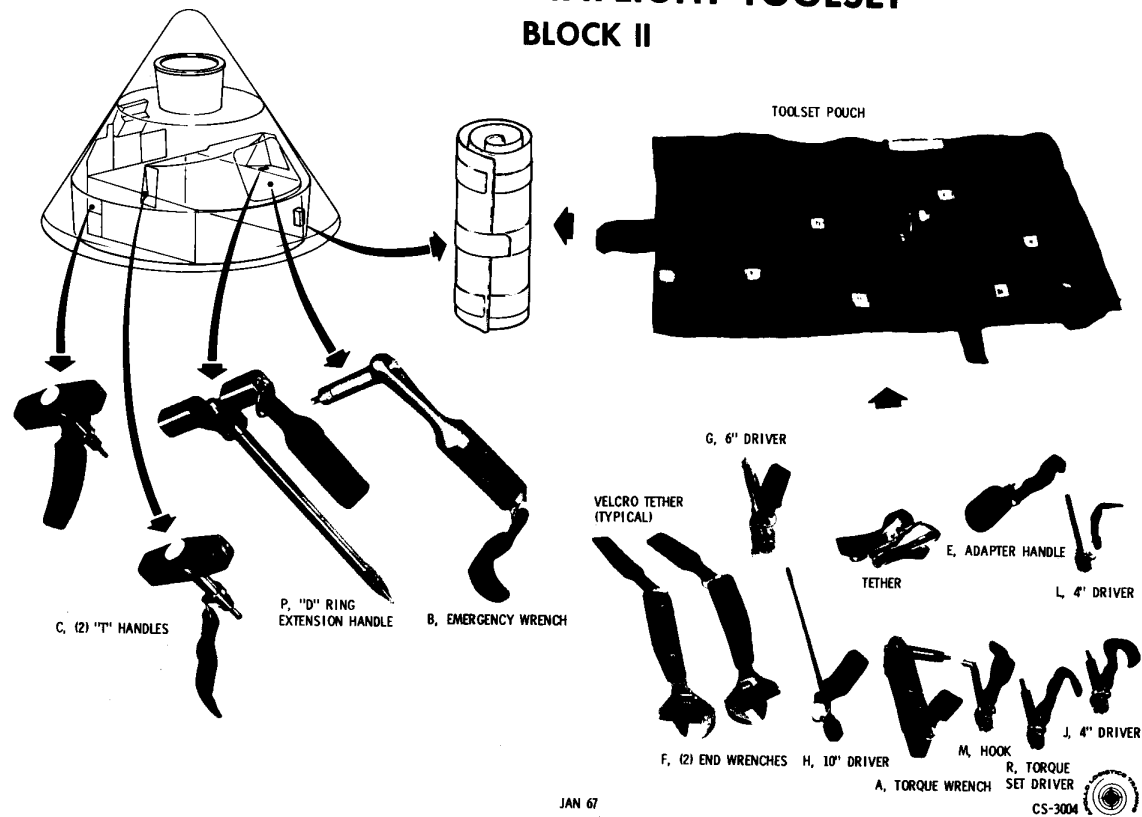
BLOCK II



MAR 67

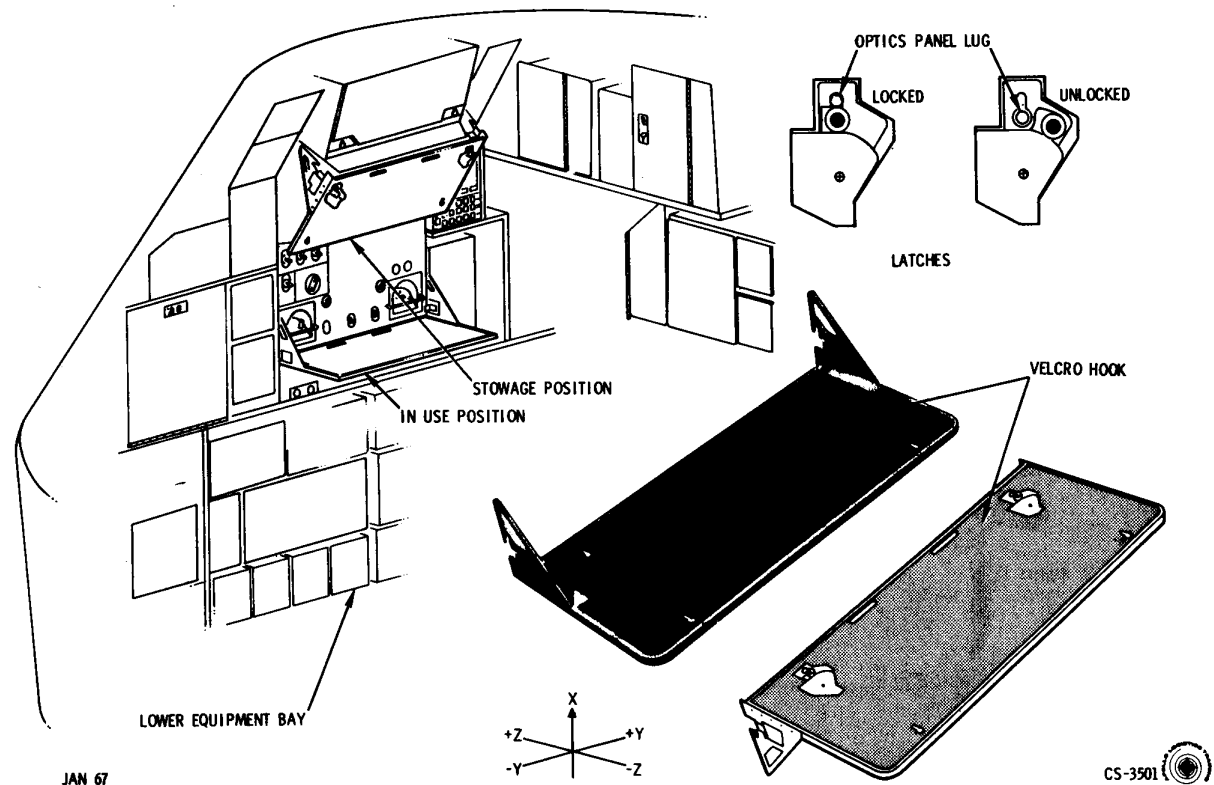
CS-2506

CM CREWMAN INFLIGHT TOOLSET BLOCK II

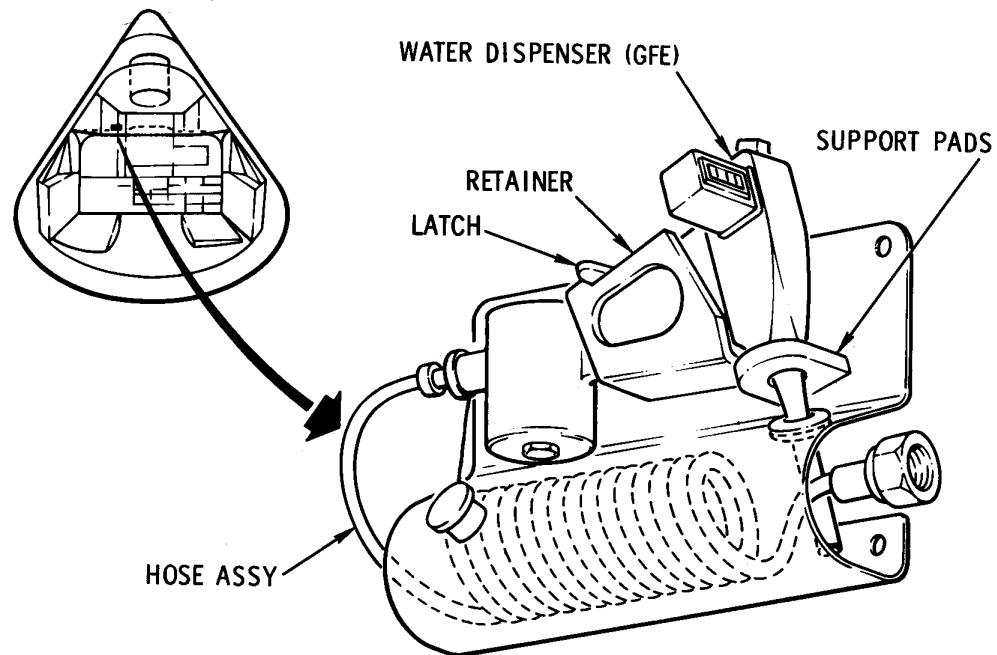


JAN 67

WORK SHELF/OPTICS PANEL COVER BLOCK II



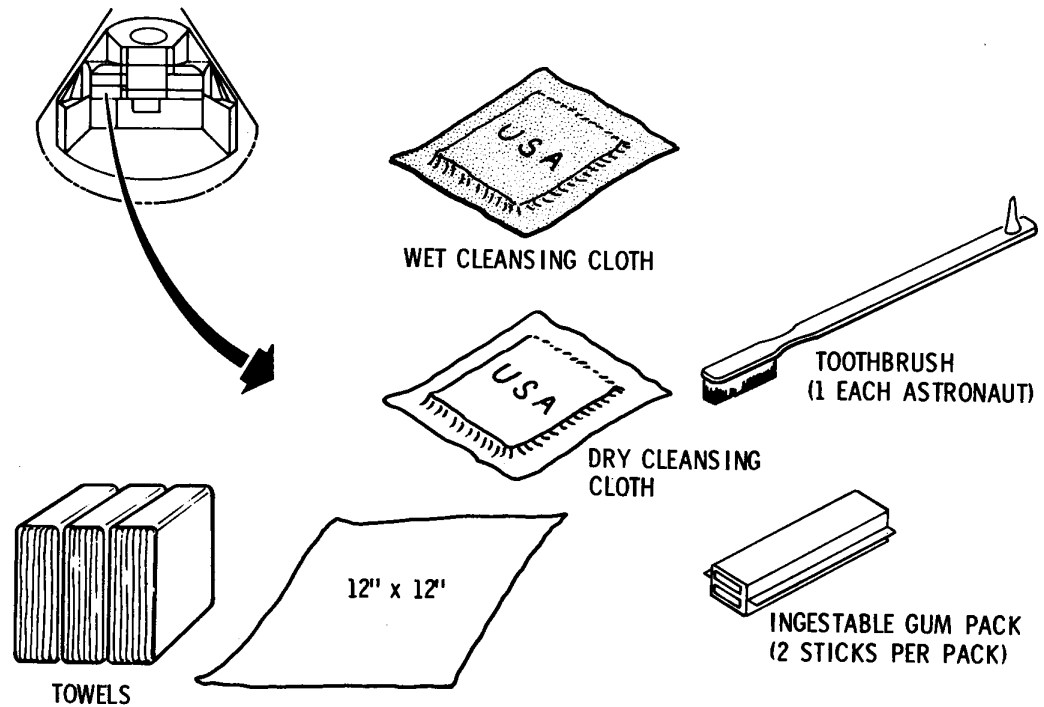
WATER METERING DISPENSER ASSEMBLY



JAN 67

CS-4101D 

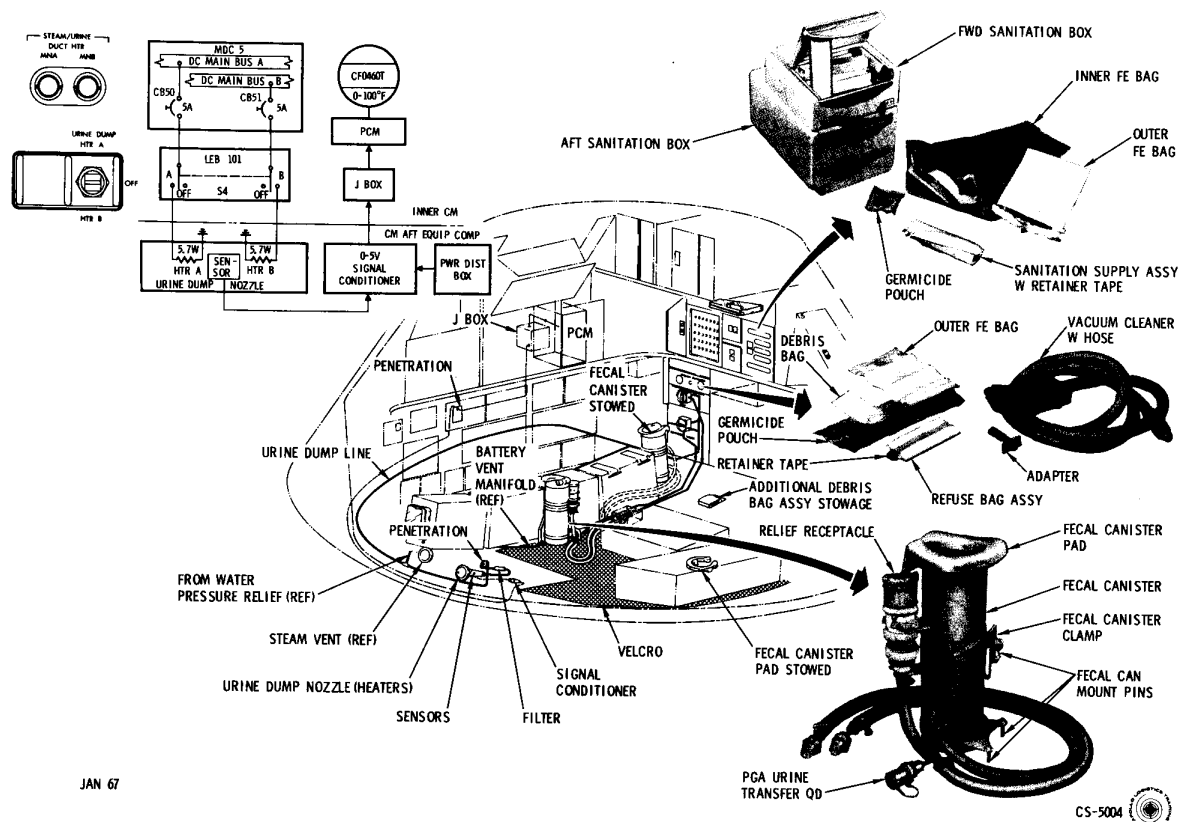
PERSONAL HYGIENE ITEMS



CS-5501D (◆)

WASTE MANAGEMENT SYSTEM

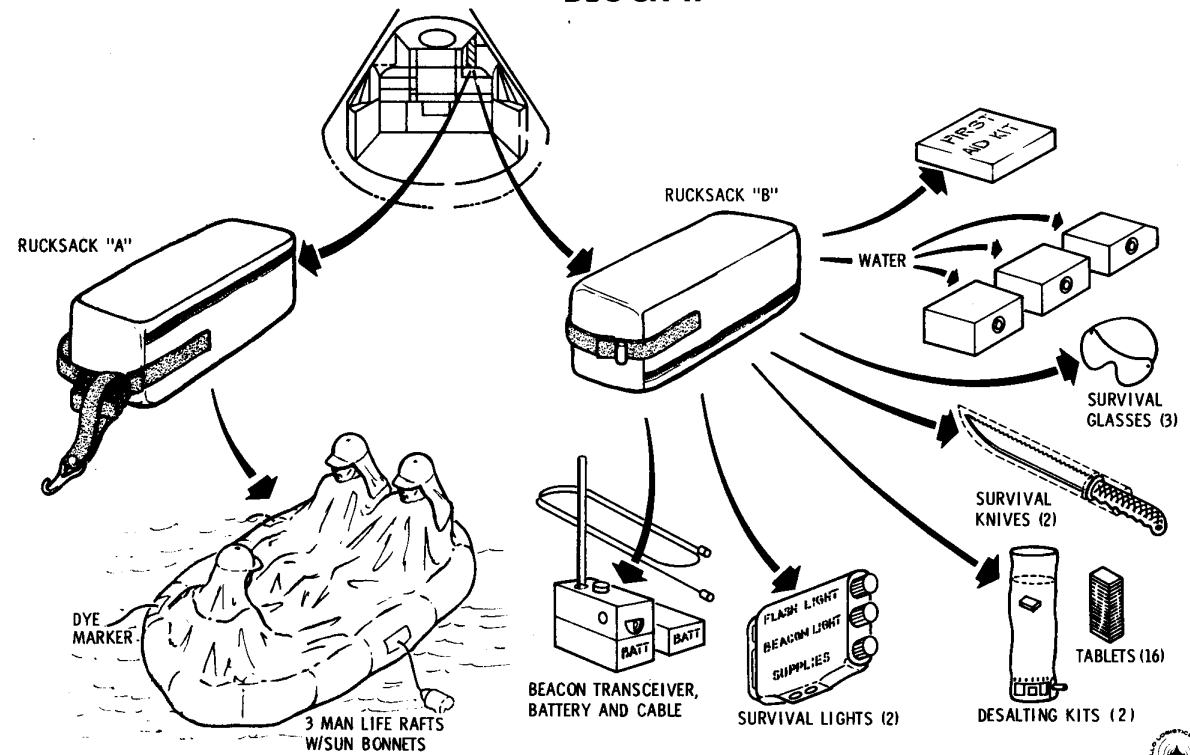
BLOCK II



JAN 67

APOLLO SURVIVAL KIT AND COMPONENTS

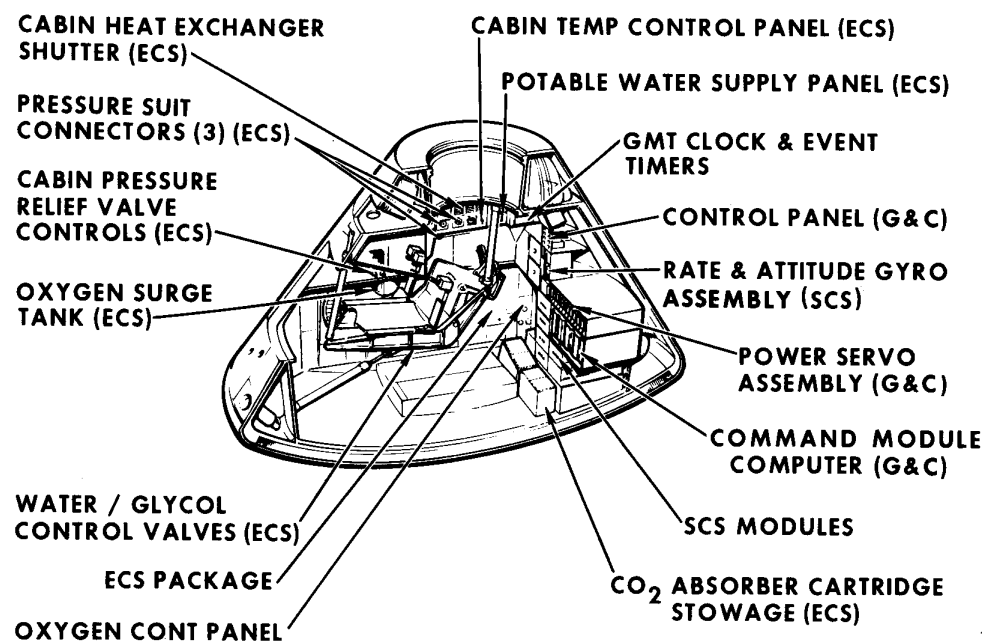
BLOCK II



JAN 67

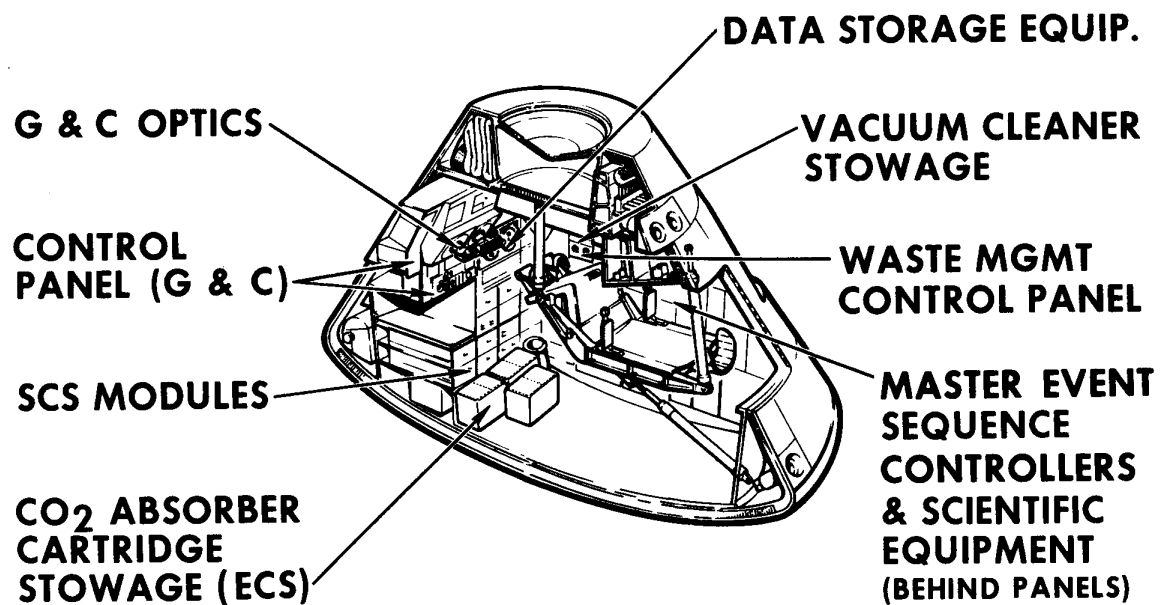
CS-7000D

COMMAND MODULE INTERIOR (LEFT SIDE)



FAM-1007D 

COMMAND MODULE INTERIOR (RIGHT SIDE)



COMMUNICATIONS MODULES

FAM-1008C



APOLLO ABBREVIATIONS

A/C	AUDIO CENTER (COMM)	L/O	LIFT-OFF
ACE	ACCEPTANCE CHECKOUT EQUIP.	LOI	LUNAR ORBIT INSERTION (G&C)
ACS	ATTITUDE CONTROL SUBSYSTEM (SCS)	LOR	LUNAR ORBITAL RENDEZVOUS
A/D	ANALOG TO DIGITAL (COMM)	LOS	LINE OF SIGHT (G&N)
AGAA	ATTITUDE GYRO ACCELEROMETER ASSEMBLY (SCS)	LSC	LINEAR SHAPE CHARGE (SECS)
ARS	ATTITUDE REFERENCE SUBSYSTEM (SCS)	LV	LAUNCH VEHICLE
BMAG	BODY MOUNTED ATTITUDE GYRO (SCS)	MAX Q	MAXIMUM DYNAMIC PRESSURE
BPC	BOOST PROTECTIVE COVER (SECS)	MC	MEGACYCLES
B/P	BOILERPLATE	MDC	MAIN DISPLAY CONSOLE
CDU	COUPLING DATA UNIT (G&C)	MDF	MILD DETONATING FUSE (STRUCT)
CM	COMMAND MODULE	MESC	MASTER EVENTS SEQUENCE CONTROLLER (SECS)
CMC	COMMAND MODULE COMPUTER	MNA	MAIN BUS A (EPS)
COAS	CREWMAN OPTICAL ALIGNMENT SIGHT (CREW)	MNB	MAIN BUS B (EPS)
COMM	COMMUNICATIONS SUBSYSTEM	MSFN	MANNED SPACE FLIGHT NETWORK (COMM)
CSM	COMMAND SERVICE MODULE	MTVC	MANUAL THRUST VECTOR CONTROL (SCS)
CTE	CENTRAL TIMING EQUIP. (COMM)	PCM	PULSE CODE MODULATION (COMM)
C/W	CAUTION & WARNING	PGA	PRESSURE GARMENT ASSEMBLY (CREW)
CWG	CONSTANT WEAR GARMENT (CREW)	PONCS	PRIMARY GUIDANCE, NAVIGATION & CONTROL SYS
D/A	DIGITAL TO ANALOG (COMM)	PIPA	PULSED INTEGRATING PENDULOUS ACCELEROMETER (G&C)
D/S	DOCKING SYSTEM	PLSS	PORTABLE LIFE SUPPORT SYSTEM (CREW)
DSE	DATA STORAGE EQUIP. (COMM)	PM	PHASE MODULATION (COMM)
DSIF	DEEP SPACE INSTRUMENTATION FACILITY (COMM)	PMP	PREMODULATION PROCESSOR (COMM)
DSKY	DISPLAY & KEYBOARD (G&C)	PRN	PSEUDO-RANDOM NOISE (COMM)
ΔV	DIFFERENTIAL VELOCITY (G&C)	PROP	PROPULSION
ECA	ELECTRONIC CONTROL ASSEMBLY (SCS)	PSA	POWER SERVO ASSEMBLY (G&C)
ECS	ENVIRONMENTAL CONTROL SUBSYSTEM	PTT	PUSH TO TALK (COMM)
ECU	ENVIRONMENTAL CONTROL UNIT (ECS)	RCS	REACTION CONTROL SUBSYSTEM
EDA	ELECTRONIC DISPLAY ASSEMBLY (G&C)	RGA	RATE GYRO ASSEMBLY (SCS)
EDS	EMERGENCY DETECTION SUBSYSTEM (SECS)	RJEC	REACTION JET AND ENGINE ON-OFF CONTROL (G&C)
ELS	EARTH LANDING SUBSYSTEM (SECS)	RRT	RENDEZVOUS RADAR TRANSPONDER (COMM)
EHS	ENTRY MONITOR SYSTEM	RTC	REAL TIME COMMAND (COMM)
EMU	EXTRA-VEHICULAR MOBILITY UNIT (CREW)	SBPA	S-BAND POWER AMPLIFIER (COMM)
EOI	EARTH ORBIT INSERTION (G&C)	SC	SPACECRAFT
EPS	ELECTRICAL POWER SUBSYSTEM	SCE	SIGNAL CONDITIONING EQUIPMENT (TLM)
EVA	EXTRA-VEHICULAR ACTIVITY (CREW)	SCS	STABILIZATION & CONTROL SUBSYSTEM
FC	FUEL CELL (EPS)	SCT	SCANNING TELESCOPE (G&N)
FDAI	FLIGHT DIRECTOR ATTITUDE INDICATOR (SCS)	SECS	SEQUENTIAL EVENTS CONTROL SUBSYSTEM
FHS	FORWARD HEAT SHIELD	SLA	SPACECRAFT LM ADAPTER
G&C	GUIDANCE & CONTROL	SM	SERVICE MODULE
GDC	GYRO DISPLAY COUPLER (SCS)	SPS	SERVICE PROPULSION SUBSYSTEM
GHZ	GI GAHERTZ (COMM)	SSA	SPACE SUIT ASSEMBLY (CREW)
G&N	GUIDANCE & NAVIGATION	SXT	SEXTANT (G&N)
GNC/S	GUIDANCE NAVIGATION & CONTROL SYSTEM	TCA	THRUST CHAMBER ASSEMBLY (PROP)
GSE	GROUND SUPPORT EQUIP.	TEI	TRANSEARTH INJECTION (G&C)
HF	HIGH FREQUENCY (3-30MC)	TLI	TRANSLUNAR INJECTION (G&C)
IMU	INERTIAL MEASUREMENT UNIT (G&N)	TLM	TELEMETRY (COMM)
INV	INVERTER (EPS)	TMG	THERMAL METEOROID GARMENT (CREW)
IU	INSTRUMENT UNIT (LV)	TVC	THRUST VECTOR CONTROL (SPS)
KMC	KILOMEGA CYCLES	TVSA	THRUST VECTOR POSITION SERVO AMPLIFIER (G&C)
KOH	POTASSIUM HYDROXIDE (EPS)	UDL	UP DATA LINK (COMM)
LCO	LIQUID COOLED GARMENT (CREW)	UDMH	UNSYMMETRICAL DIMETHYL HYDRAZINE (PROP)
LDEC	LUNAR DOCKING EVENTS CONTROLLER (DS)	UMF	ULTRA HIGH FREQUENCY (300-3000 MC)
LEB	LOWER EQUIPMENT BAY	USBE	UNIFIED S-BAND EQUIP. (COMM)
LES	LAUNCH ESCAPE SUBSYSTEM (SECS)	VHF	VERY HIGH FREQUENCY (30-300 MC)
LET	LAUNCH ESCAPE TOWER (SECS)	WMS	WASTE MANAGEMENT SUBSYSTEM (CREW)
LM	LUNAR MODULE		