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:

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DOWNEY, CALIFORNIA  
EXTENSION 4325, 6 OR 7
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## NAA APOLLO SUBCONTRACTORS

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<td>2 KMC HI GAIN ANTENNA</td>
<td>DALMO - VICTOR - BELMONT, CALIF.</td>
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FAM-1004G
APOLLO SPACECRAFT
SPACE DIVISION RESPONSIBILITIES

CM  SM  LES  SLA  GSE  SPARES

MAJOR SUBS

TRAI NERS

FACILITIES

TEST SITE
ACTIVATION

(NAA ALSO INTERFACES WITH ASSOCIATE CONTRACTORS FOR GUIDANCE & NAVIGATION, ACCEPTANCE CHECKOUT EQUIPMENT, LUNAR MODULE, ETC.)
### MANNED SPACECRAFT

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<th>MERCURY</th>
<th>GEMINI</th>
<th>APOLLO</th>
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<tr>
<td>PAYLOAD, LBS</td>
<td>3,500</td>
<td>7,000</td>
<td>250,000</td>
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<tr>
<td>EARTH ORBITAL</td>
<td></td>
<td></td>
<td>94,000</td>
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<tr>
<td>TRANSLUNAR</td>
<td></td>
<td></td>
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<tr>
<td>BOOSTER</td>
<td>ATLAS</td>
<td>TITAN II</td>
<td>SATURN V</td>
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<tr>
<td>THRUST, LBS</td>
<td>360,000</td>
<td>430,000</td>
<td>7,500,000</td>
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APOLLO LAUNCH VEHICLES

UPRATED SATURN I

SATURN V

APOLLO SPACECRAFT
LM ADAPTER
INSTRUMENT UNIT
2ND STAGE
1ST STAGE

364'

225'

3RD STAGE
2ND STAGE
1ST STAGE

FAM-1024A
UPRATED SATURN I

- LES
- APOLLO CM
- APOLLO SM
- LM ADAPTER
- S-IVB 2ND STAGE
- S-1 1ST STAGE
- 1 J-2 ENGINE
- 8 H-1 ENGINES

TOTAL WT 1,288,000 LB

225 FT
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

LUNAR
LANDING

ELLiptical ORBIT

EARTH ORBITS WITH LM

EARTH ORBITS

SUBORBIT

SC 002 - TUMBLING ABORT
SC 009 - SUBORBITAL
SC 011 - SUBORBITAL

BOOSTER - S C COMPATIBILITY

ABORT & RECOVERY

FAM-1021A
APOLLO MISSION
LUNAR MISSION

TRANSEARTH COAST

PARKING ORBIT

RECOVERY

ASCENT

TRANSLUNAR INJECTION

TRANSLUNAR COAST

LUNAR ORBIT

LUNAR ORBITAL INSERTION

LUNAR APPROACH TRAJECTORY

LUNAR ASCENT

LUNAR LANDING

LM ASCENT

LM DESCENT

ΔV

ΔV

F-313C
APOLLO SPACECRAFT/3RD STAGE
EARTH ORBITAL CONFIGURATION
TRANSLUNAR INJECTION & COAST

12,800 N MI RADIUS
1HR AFTER TRANSLUNAR INJECTION

TRANSPOSITION & DOCKING

MOON
TRANSPOSITION & DOCKING

ADAPTER SEPARATION

FREE FLY-AROUND

DOCKING & PULLOUT
APOLLO SPACECRAFT
TRANSLUNAR CONFIGURATION

EVA HANDLES
PROPOSED LUNAR LANDING

RANGER IMPACTS
SURVEYOR

FAM-1022
LM DESCENT AND LANDING

LUNAR PARKING ORBIT (80 N MI)

50,000 FT

250 N MI

LANDING CONFIGURATION

ASCENT STAGE

DESCENT STAGE
LUNAR ORBITAL RENDEZVOUS

SUN

THRUST FOR RENDEZVOUS

EARTH

THRUST TO CIRCULARIZE

RENDZEVOUS
APOLLO SPACECRAFT LOR CONFIGURATION

EVA HANDLES
TRANSEARTH & ENTRY

TRANSEARTH INJECTION

MID COURSE CORRECTIONS

ENTRY CORRIDOR

CM / SM SEPARATION

FAM-1018A
HEAT SHIELD JETTISONED BY 24,000 FEET

AFTER TIME DELAY DROGUE CHUTES DEPLOYED REEDED

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

MAIN CHUTES FULLY OPENED AFTER BEING REEDED

MAIN CHUTES RELEASED AFTER SPLASHDOWN
"G" FORCES, LUNAR MISSION, BLOCK II
ASTRONAUT SENSED

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

FAM-1016 ( )
STRUCTURES
COMMAND MODULE EXTERIOR
BLOCK II

- Docking Mechanism
- FWD Heat Shield
- Crew Comp Heat Shield
- Aft Heat Shield
- Optics Penetration
- LES Tower Leg Wells
- CM/SM Umbilical
- Crew Access Hatch
- Side Window (Typ 2 Places)
- Rendezvous Window (Typ 2 Places)
COMMAND MODULE AERODYNAMICS

DRAG

LIFT

LOCATION OF HEAVY EQUIPMENT

DIRECTION OF FLIGHT

X

FAM-1511
COMMAND MODULE HEAT SHIELDS
BLOCK II

FORWARD HEAT SHIELD

AFT HEAT SHIELD

CREW COMPARTMENT HEAT SHIELD

FAM-1504A
COMMAND MODULE
ABLATIVE MATERIAL THICKNESS
BLOCK II

1.0 IN.
2.25 IN.
1.5 IN.

.75 IN.
.75 IN.
.75 IN.
.75 IN.

RELATIVE WIND

ST-530
PROBE INSTALLATION - DOCKING SYSTEM
SM INSULATION TYPICAL FOR SECTOR IV

NOTE: INSULATE OUTER PANEL BETWEEN THESE STATIONS ON INNER SURFACE ONLY

ALUMINIZED MYLAR

X5 305

X5 203

ST-1611
S/M SPS NOZZLE AND HEAT SHIELD

FUEL FILL POINT

BEAM 6

BEAM 5

BEAM 1

HEAT SHIELD

OXIDIZER FILL POINT

FLEXIBLE BOOT

HIGH GAIN ANTENNA

SPS ENGINE

$X_S = 200$

$X_S = 180 \text{ SPS NOZZLE EXT ATTACH POINT}$
SPACECRAFT/LM ADAPTER

PANEL SEPARATION BY EXPLOSIVE CHARGES (MDF)
SLA PANEL DEPLOYMENT

ATTENUATOR
(8 PLACES)

PISTON

CORE

CABLE

NEGATOR SPRING REEL
(4 PLACES)

X

45°
ADAPTER PANEL SEPARATION LINE

$X_A = 838$
$X_S = 200$

SM AFT BULKHEAD

SEP LINE

SEP LINE

SEP LINE

SEP LINE

BLAST SHIELD

EXPLODED VIEW

$X_A = 584.7$
VELOCITY REQUIREMENTS

ESCAPE VELOCITY

36,700 FT/SEC

8,400 FT/SEC

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

6 - RELATIVE GRAVITY - 1
GUIDANCE & NAVIGATION
REFERENCE TRAJECTORIES
EARTH ORBIT POSITION & TRAJECTORY DETERMINATION
MIDCOURSE POSITION & TRAJECTORY DETERMINATION

REFERENCE TRAJECTORY

NEW COMPUTED TRAJECTORY

COMPUTED TRAJECTORY

ΔV

TARGET AREA
# GUIDANCE & CONTROL FUNCTIONS

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<th>SPS</th>
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STABILIZATION AND CONTROL SYSTEM

TRANSITION CONTROL

ROTATION CONTROL

GYRO ASSEMBLIES

ROTATION CONTROL

ELECTRONIC ASSEMBLIES

MANUAL CONTROLS
G&C AND APOLLO SUBSYSTEMS INTERFACE
CSM GUIDANCE & CONTROL
INERTIAL MEASUREMENT UNIT
G&C EQUIPMENT LOCATION
ROTATION CONTROL

PUSH TO TALK SWITCH PARAMETERS

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

ROTATION CONTROL PARAMETERS

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<th>DISPLACEMENT</th>
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<td>≈11.0°</td>
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<tr>
<td>SOFT STOP</td>
<td>10±1°</td>
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<tr>
<td>BREAKOUT SWITCH ACTUATION</td>
<td>1.5± 0.5°</td>
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<tr>
<td>CONTROLLER LOCK TO ARM</td>
<td>50.0°</td>
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TRANSLATION CONTROL

CW & CCW CONTROL MOTION LIMITS
HARD STOP, DETENT & SWITCH CLOSURE 17° ± 2°
FORCE INTO DETENT 15±5.0 LB INCHES
OUT OF DETENT 6 LB INCHES MIN

TRANSLATION CONTROL MOTION LIMITS (+ OR - COMMANDS)
MECHANICAL STOP - 0.5 ± 0.075 ARC INCHES
SWITCH CLOSURE - 0.375 ± 0.075 ARC INCHES
FORCE - 1.5 ± 0.33 POUNDS
G & C ATTITUDE REFERENCE
FLIGHT DIRECTOR ATTITUDE INDICATOR

ROLL
+ANGULAR VELOCITY-
+ATTITUDE ERROR-

PITCH & YAW INDEX

ROLL INDEX

EULER ATTITUDE ON BALL
PITCH - $\theta = 0.14^\circ$
YAW - $\psi = 0.04^\circ$
ROLL - $\phi = 330^\circ$

NOTE:
ALL POLARITIES INDICATE
VEHICLE DYNAMICS

YAW
+ATTITUDE ERROR-
+ANGULAR VELOCITY-

SCS-2100D (+)
PROPULSION
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
CM REACTION CONTROL ENGINES
CM RCS ENGINE

- Fuel Valve
- Cres Steel Shell
- JTA Refractory Throat Insert
- One Piece Trimming Orifice
- Filter
- Ablative Sleeve
- Glass Wrap
- TR69 Cushion
- Ablative Material
- Asbestos Wrap

P-7005
**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 (90% UDMH & 10% Hydrazine).

**SYSTEM CONTROLLED BY:** OMC or SCS with a manual back-up capability.

**PURPOSE:** Provide thrust for major velocity changes after booster separation until CIM/SM separation. In addition supports SSM abort after the launch escape tower has been jettisoned.

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*Diagram of the service propulsion system showing various components labeled with coordinates.*
SERVICE MODULE SECTORS

VIEW LOOKING FORWARD FROM AFT BULKHEAD
SPS ROCKET ENGINE

AJ10-137

152.82"

111.82"

94.4"

P-10000 (C)
SPS RING, STRUT & THRUST CHAMBER ASSEMBLY

ACTUATOR BRACKET

STRUT

GIMBAL RING

THRUST CHAMBER

THRUST MOUNT
COMMUNICATIONS SYSTEM
MISSION REQUIREMENTS

- DATA COLLECTION
  CREW STATUS
  SYSTEM STATUS

- VOICE
- TV
- TRACKING
- RECOVERY BEACON
- UP DATA
- TAPE RECORDER
COMMUNICATIONS SYSTEM
BLOCK II

PLSS ANTENNA

2-KMC HIGH GAIN ANTENNAS

RECOVERY ANTENNAS (NOT SHOWN)

RENDZVOUS RADAR ANTENNA (NOT SHOWN)

2-KMC OMNI ANTENNAS

VHF OMNI ANTENNAS (2) 180° APART

FAM-4507A
TV CAMERA LOCATIONS
CSM COMMUNICATIONS RANGES

BLOCK II

VHF OMNI VOICE
2OMC OMNI DOWN VOICE
UP-DATA BACKUP VOICE & EMERGENCY KEY
TM (LOW BIT RATE)
TM (HIGH BIT RATE)
2OMC HIGH GAIN
UP-DATA, UP-VOICE
DN VOICE, DN TM PWR
TV NEAR EARTH & DEEP SPACE

~2,500 NM
~3,800 NM
~22,000 NM

220 KNM
200 KNM

WIDE BEAM
MEDIUM BEAM
NARROW BEAM
DEEP SPACE BLIND AREA FOR BS' ANT.
HIGH GAIN ANTENNA OPERATIONAL (~200K)
LUNAR OPERATIONS: VHF, VOICE, CM-LM, Rendezvous Radar/
Transponder, CM-LM

RANGE FROM EARTH'S SURFACE IN NAUTICAL MILES (THOUSANDS)
NEAR EARTH COMMUNICATION MODES
LEM-CSM VHF/AM DATA REC

1. RECORDING LM PCM THROUGH VHF/AM
2. EMISSION PCM THROUGH "S" BAND/FM

L-6 KBP PCM

EARTH
S-BAND GROUND STATION GEOMETRY
S-BAND GROUND STATION REQ

100 MILE ORBIT

4000 MILES

EARTH

4100 MILES

\[ \cos \theta = \frac{4000}{4100} \]

\[ \theta \approx 12^\circ \]

\[ 2 \theta \approx 24^\circ \]

\[ \frac{360^\circ}{24^\circ} = 15 \text{ STATIONS} \]

\~ 4000 MILES

100 MILES

CD-71
BLOCK I & II MSFN S-BAND STATION LOCATIONS

- 85 FOOT STATION (DUAL)
- 30 FOOT STATION (DUAL)
- 30 FOOT STATION (SINGLE)
- 12 FOOT STATION (SINGLE)

KEY:

NOTE: SINGLE CAPABILITY STATIONS CAN SUPPORT ONE SPACE VEHICLE IN TRACKING MODE AND RECEIVE AND PROCESS TWO PCM TELEMETRY BIT STREAMS. DUAL CAPABILITY STATIONS CAN SUPPORT CONCURRENTLY TWO SPACE VEHICLES IN TRACKING MODE AND RECEIVE THREE PCM TELEMETRY BIT STREAMS (PROCESSING TWO).
# MSFN S-BAND IMPLEMENTATION SCHEDULE

<table>
<thead>
<tr>
<th>STATION</th>
<th>Single C, Single Capability</th>
<th>Antenna Size (ft)</th>
<th>1966</th>
<th>1967</th>
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<tbody>
<tr>
<td>CARNARVON</td>
<td>D</td>
<td>30</td>
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<tr>
<td>BERMUDA</td>
<td>S</td>
<td>30</td>
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<tr>
<td>HAWAII</td>
<td>D</td>
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<td>KENNEDY</td>
<td>D</td>
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<tr>
<td>TEXAS</td>
<td>S</td>
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<td>GUAYMAS</td>
<td>S</td>
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<tr>
<td>GUAM</td>
<td>D</td>
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<tr>
<td>ASCENSION</td>
<td>D</td>
<td>30</td>
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<tr>
<td>ANTIGUA</td>
<td>S</td>
<td>30</td>
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<tr>
<td>CANARY</td>
<td>S</td>
<td>30</td>
<td></td>
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<tr>
<td>GRAND BAHAMA</td>
<td>S</td>
<td>30</td>
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<tr>
<td>GOLDSTONE</td>
<td>D</td>
<td>15</td>
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<tr>
<td>CANBERRA</td>
<td>D</td>
<td>15</td>
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<tr>
<td>MADRID</td>
<td>D</td>
<td>15</td>
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<tr>
<td>INJECTION SHIP</td>
<td>S</td>
<td>30</td>
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<tr>
<td>INJECTION SHIP</td>
<td>D</td>
<td>30</td>
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<tr>
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<td>D</td>
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<tr>
<td>REENTRY SHIP</td>
<td>S</td>
<td>12</td>
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<tr>
<td>B INSTRUMENTATION AIRCRAFT</td>
<td></td>
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</table>

- **Complete Installation and Checkout** — ▲
- **Complete System Simulation** — ■
- **Fully Operational-Manned Missions** — ●

CD-2018
<table>
<thead>
<tr>
<th></th>
<th>PRE-LAUNCH</th>
<th>LAUNCH EARTH ORBIT</th>
<th>TRANS-LUNAR INJECT</th>
<th>TRANS-LUNAR FLIGHT 4000 M1</th>
<th>LUNAR ORBIT</th>
<th>LUNAR DESCENT</th>
<th>LUNAR EXPLORE</th>
<th>LUNAR ASCENT</th>
<th>TRANS-EARTH INJECT</th>
<th>TRANS-EARTH FLIGHT</th>
<th>DESCENT LANDING RECOVERY</th>
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<tr>
<td><strong>VOICE</strong></td>
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<tr>
<td><strong>BEACON</strong></td>
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</table>

* BACKUP MODE
+ LM-E.V.A. COMMUNICATIONS
ELECTRICAL UMBILICAL (COMM CABLE)

BLOCK II

PERSONAL COMMUNICATIONS ASSEMBLY

CWG ELECTRICAL ADAPTER

CONSTANT WEAR GARMENT

LEFT HAND FORWARD EQUIPMENT BAY

ELECTRICAL UMBILICAL ASSY (COBRA CABLE)
UP-DATA LINK
(BLOCK II)

S-BAND RCVR

70 KC DISCRIMINATOR

PMP DATA VOICE BU

DECODER

RELAY ASSEMBLY (32 RELAYS)

INTERFACE & BUFFER STORAGE

POWER SUPPLY

VALIDITY DATA RATE

UP DATA ACCEPT

MCU DATA

COMMAND MODULE COMPUTER

RESET & TIMING PULSE TRAINS

VOICE BU S-36

AUDIO CENTER

SUB-BIT DETECTOR

EXTERNAL RTC'S (NOT IMPLEMENTED)

RESET

UDL FLIGHT BUS
28 VDC C300 5A

FLIGHT BUS

CO-20FRB
SEQUENCING
SECS
MAJOR COMPONENTS (BLOCK II)

ENTRY & P/L BATS A, B, C

FUEL CELLS

DISPLAYS AND CONTROLS

MASTER EVENTS SEQUENCE CONTROLLER

SECS

SERVICE MODULE JETTISON CONTROLLER

REACTION CONTROL SYSTEM CONTROLLER

LM SEPARATION SEQUENCE CONTROLLER

LUNAR DOCKING EVENTS CONTROLLER

PYRO BATS A&B

EARTH LANDING SEQUENCE CONTROLLER

PYRO CONTINUITY VERIFICATION BOX

SEQ-501B
LAUNCH ESCAPE SYSTEM &
BOOST PROTECTIVE COVER

PITCH CONTROL MOTOR

BOOST PROTECTIVE
COVER

TOWER
JETTISON
MOTOR

LAUNCH ESCAPE
MOTOR
TOWER SEPARATION SYSTEM
ABORT VEHICLE MECHANICS

DIRECTION OF ABORT

CG OF ABORT VEHICLE AT LAUNCH

CG OF ABORT VEHICLE AT BURNOUT

CG OF COMMAND MODULE ONLY

CG OF LET ONLY

(MOVES OUT ~ 1")

2.75°

+Z > -Z

FAM-3009A (©)
FORWARD HEATSHIELD ATTACHMENT & THRUSTER ASSEMBLY

- ROD END
- SEAL
- INNER CYLINDER
- PLATE
- OUTER CYLINDER
- SPRING
- PIN
- PISTON
- O-RING
- TENSION TIE
- PISTON O-RING
- NUT
- TUBE END
- ROTATED 150°

FITTING
- ROD END

LONCH 1

BREECH
EARTH LANDING SYSTEM PARACHUTES

DROGUE CHUTES (2)
CONICAL FIST RIBBON TYPE
MORTAR DEPLOYED (REELED FOR 8 SEC)
13.7 FT DIAMETER
11.0 FT NOMINAL INFLATED DIAMETER

PILOT CHUTES (3)
RING SLOT
MORTAR DEPLOYED
7.2 FT DIAMETER
6.0 FT NOMINAL INFLATED DIAMETER

MAIN CHUTES (3)
RING SAIL
DEPLOYED BY PILOT CHUTES (REELED FOR 8 SEC)
83.5 FT DIAMETER
77.0 FT NOMINAL INFLATED DIAMETER
REEFING LINE CUTTER INSTALLATION

REEFING LINES

REEFING LINE CUTTER

SUSPENSION LINE

LANYARD

SKIRT BAND
EARTH LANDING SYSTEM
NORMAL SEQUENCE

1. APEX COVER JETTISONED AT 24,000 FT + 0.8 SEC
2. DROOGE CHUTES DEPLOYED AT 24,000 FT  + 2 SEC REQUIRED FOR 8 SEC
3. DROOGE CHUTES DISSTRED
4. PILOT CHUTES DEPLOYED & DROOGE CHUTES RELEASED AT 10,000 FT
5. MAIN CHUTES DEPLOYED AT 10,000 FT  + 8 SEC
6. MAIN CHUTES DISSTRED, VHF RECOVERY ANTENNAS & FLASHING BEACON DEPLOYED
7. MAIN CHUTES RELEASED & LM PRESSURE, PYRO VALVE CLOSED AFTER TOUCHDOWN
8. HF ANTENNA DEPLOYED

TOUCHDOWN VELOCITIES:
3 CHUTES - 30.5 FT/SEC
ABORT DESIGNATIONS
BLOCK II - MODE 1

- 295 K'
- MODE 1C
- 100 K'
- MODE 1B
- T+42 SEC
- MODE 1A

PAD

TOWER JETTISON

SPS OR SM ABORT AREA (MODES 2, 3 & 4 - AFTER TWR. JETT. TO NORMAL CSM/LV SEP.)

* MANUAL INTERVENTION

LES ABORT AREA

* CREW INDUCES A + PITCH RATE OF 5°/SEC (MIN)
PAD TO ≈ 30,000 FT LES ABORT

- PC MOTOR IGNITED TO 42 SEC AFTER LIFT-OFF
- CANARDS DEPLOYED (11 SEC)
- APEX COVER JETTISONED (14.4 SEC)
- DROGUE CHUTES DEPLOYED (16 SEC)
- MAIN CHUTES DEPLOYED

SEQ-5448
≤ 30,000 FT TO TWR JETT LES ABORT

- ELS ARMED (14 SEC)
- CANARDS EFFECT & DAMP TURN-AROUND MANEUVER BELOW MACH 3.8
- TOWER, BPC, AND DOCKING RING JETTISONED AT 24,000 FT
- APEX COVER JETTISONED AT 24,000 FT + .4 SEC

LE MOTOR IGNITED

- CANARDS DEPLOYED (11 SEC)
ELECTRICAL POWER
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. BUSSES
- A.C. BUSSES

SPECIAL CIRCUITS
- BATTERY CHARGER
- PYROTECHNIC BATTERIES (2)
- S/M JETTISON CONTROL
# Cryogenic Storage System

<table>
<thead>
<tr>
<th>GAS</th>
<th>CONTAINER</th>
<th>USEABLE</th>
<th>TOTAL USEABLE</th>
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<tr>
<td>O₂</td>
<td>INCONEL (2)</td>
<td>320 LBS (EA)</td>
<td>640 LBS</td>
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<tr>
<td>H₂</td>
<td>TITANIUM (2)</td>
<td>28 LBS (EA)</td>
<td>56 LBS</td>
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<table>
<thead>
<tr>
<th>GAS</th>
<th>INPUT TEMP.</th>
<th>SETTLED TEMP.</th>
<th>STORED PRESSURE</th>
<th>SYSTEM ALLOCATION</th>
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<tbody>
<tr>
<td>O₂</td>
<td>-297° F</td>
<td>-284° F</td>
<td>900 ± 35 PSIA</td>
<td>EPS - 410 #</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ECS - 290 #</td>
</tr>
<tr>
<td>H₂</td>
<td>-423° F</td>
<td>-417° F</td>
<td>245 ± 15 PSIA</td>
<td>FUEL CELLS ONLY</td>
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</table>
CRYOGENIC STORAGE SYSTEM

TANK #1

TO F/C
FLOW SENSOR
REACTANT ISOLATION VALVE
TO F/C

TANK #2

RELIEF VALVE
PURGE
TO F/C

QUANTITY SENSOR
QUANTITY INDICATOR

TANK HEATER
PRESSURE SENSOR
PRESS. INDICATOR

MANUAL
28 VDC
AUTO

FAN HEATER

MANUAL
115 VAC
AUTO

EP-008B
AC POWER DISTRIBUTION
SIMPLIFIED SCHEMATIC DIAGRAM

MAIN BUS A

400～INVERTER NO. 1

AC CONTROL BOX (6 MOTOR SWITCHES)

MAIN BUS B

INVERTER CONTROL BOX

400～INVERTER NO. 2

400～INVERTER NO. 3

AC BUS 1

AC BUS 1 OVERLOAD

AC SENSOR

AC BUS 2

SPACECRAFT LOADS

AC BUS 2 OVERLOAD

AC SENSOR

EP-610D
APOLLO FUEL CELL POWERPLANT

HEIGHT = 44 IN.
DIAM = 22 IN.
WEIGHT = 245 LB EACH
FUEL CELL REACTION

MAXIMUM REACTANT CONSUMPTION-
POUNDS PER HOUR

VOLTAGE

WATER GENERATION RATE-
POUNDS PER HOUR-
PURGING NOT INCLUDED

PURGE REQUIREMENTS
NOT INCLUDED

OXYGEN

HYDROGEN

GROSS POWER PER POWERPLANT - KILOWATTS

MAXIMUM

MINIMUM
EPS COMPONENTS LOWER EQUIPMENT BAY
(BLOCK II)
ENVIRONMENTAL CONTROL
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
COLD PLATE NETWORK
PRIMARY SYSTEM - BLOCK II

FLOW DIVIDING ORIFICE
COLD PLATE PRIMARY SYSTEM
COLD PLATE PRIMARY/SECONDARY SYSTEM

FROM CABIN SUIT RX
FROM GUESS EVAP
FROM 33 LB/HR
FROM 56 LB/HR

PFA
EMU
EMS

PSA
CMC CDU
INV NO. 1
INV NO. 2
INV NO. 3

SBPA R/JHC
GDC LDA
TVSA EGA

VHF AM
POW
GYRO ASSY NO. 1
GYRO ASSY NO. 2

SE
SC
USBK
AC PMP
CTRL
DSD
SE

TO PUMP CABIN HK
CREW EQUIPMENT
APOLLO CREW STATIONS

- Center Couch Seat Folded
- Forward Access Crew Hatch
- G&N Station
- Sleep Stations (2)
- Sleep Station
- Main Control & Display Panel
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

BLOCK II

LOWER EQUIPMENT BAY

INTERIOR LIGHTS

NUMERICS  FLOOD  INTEGRAL

OFF  BRT  OFF  BRT

(PANEL 8)

INTERIOR LIGHTS

INTEGRAL  FLOOD

OFF  BRT  OFF  BRT

(PANEL 5)

LEB LIGHTS

NUMERICS  FLOOD  INTEGRAL

OFF  BRT  OFF  BRT

(PANEL 100)

JAN 67

CS-571A
SPACESUIT ASSEMBLY
(BLOCK II INTRAVEHICULAR)

BIOLOGICAL SENSORS (REF)

PASSIVE DOSIMETER POCKETS

COMM SOFT HAT

COMM CABLE (REF)

CGW ADAPTER (REF)

JACKET

BIOMEDICAL HARNESS (REF)

WEIGHTLESS SANDALS (REF)

CONSTANT WEAR GARMENT (SHIRTSLEEVE ENVIRONMENT)

FLIGHT COVERALLS (SHIRTSLEEVE ENVIRONMENT)

PRESSURE GARMENT ASSEMBLY (VENTED OR PRESSURIZED)

(LHFE8)

(OXYGEN HOSE ASSY (REF))

MAY 67

(REF) NOT PART OF SPACESUIT ASSEMBLY

CS-1001B
MISSION PHASES WITH COUCH POSITIONS & SEAT ANGLE
SC 2TV-1 & 101

LAUNCH, ORBIT MIDCOURSE, ENTRY & LANDING (ALL COUCHES)

STOWAGE ACCESS

COUCH EGRESS & G&N SIGHTING

DOCKING (ALL COUCHES)

CENTER COUCH

LEB

JUN 67

CS-2025C (†)
SLEEPING POSITION
RESTRAINT CONFIGURATION
BLOCK II

FEATURES
IN CWG, ASTRO SLEEPS IN BAG
IN POA, ASTRO SLEEPS ON BAG
AND USES STRAPS FOR RESTRAINT

IN USE POSITION
STOWED POSITIONS
AFT RING TIE

VMA-401211
(SLEEPING BAG)

MAR 67
WATER METERING DISPENSER ASSEMBLY
PERSONAL HYGIENE ITEMS

- Wet Cleansing Cloth
- Dry Cleansing Cloth
- 12" x 12" Towels
- Toothbrush (1 each Astronaut)
- Ingestable Gum Pack (2 sticks per pack)

CS-5501D (△)
APOLLO SURVIVAL KIT AND COMPONENTS

BLOCK II

RUCKSACK "A"

RUCKSACK "B"

WATER

SURVIVAL GLASSES (3)

SURVIVAL KNIVES (2)

TABLETS (16)

DESALTING KITS (2)

DYE MARKER

3 MAN LIFE RAFTS

BEACON TRANSEIVER, BATTERY AND CABLE

SURVIVAL LIGHTS (2)

JAN 67

CS-7000D
COMMAND MODULE INTERIOR
(LEFT SIDE)

- Cabin Heat Exchanger Shutter (ECS)
- Pressure Suit Connectors (3) (ECS)
- Cabin Pressure Relief Valve Controls (ECS)
- Oxygen Surge Tank (ECS)
- Cabin Temp Control Panel (ECS)
- Potable Water Supply Panel (ECS)
- GMT Clock & Event Timers
- Control Panel (G&C)
- Rate & Attitude Gyro Assembly (SCS)
- Power Servo Assembly (G&C)
- Command Module Computer (G&C)
- SCS Modules
- CO₂ Absorber Cartridge Stowage (ECS)

FAM-1007D
COMMAND MODULE INTERIOR
(RIGHT SIDE)

DATA STORAGE EQUIP.

G & C OPTICS

VACUUM CLEANER
STOWAGE

CONTROL PANEL (G & C)

WASTE MGMT
CONTROL PANEL

SCS MODULES

MASTER EVENT
SEQUENCE
CONTROLLERS
& SCIENTIFIC
EQUIPMENT
(BEHIND PANELS)

CO₂ ABSORBER
CARTRIDGE
STOWAGE (ECS)

COMMUNICATIONS MODULES
# Apollo Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>AC</td>
<td>Audio Center (COM)</td>
</tr>
<tr>
<td>ADC</td>
<td>Acceptance Checkout Equipment (G)</td>
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<tr>
<td>ACS</td>
<td>Attitude Control Subsystem (G)</td>
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<tr>
<td>AD</td>
<td>Analog to Digital (COM)</td>
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<tr>
<td>ADA</td>
<td>Attitude Gyro Accelerometer Assembly (G)</td>
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<tr>
<td>ARS</td>
<td>Attitude Reference Subsystem (G)</td>
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<td>BMG</td>
<td>Body Mounted Gyro (G)</td>
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<td>BPC</td>
<td>Boost Protective Cover (G)</td>
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<tr>
<td>B/F</td>
<td>Bowler Plate</td>
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<tr>
<td>CDU</td>
<td>Coupling Data Unit (G)</td>
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<td>CM</td>
<td>Command Module</td>
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<td>CNAC</td>
<td>Command Interface Computer</td>
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<td>COS</td>
<td>Crewman Optical Alignment Sight (COM)</td>
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<td>Communications Subsystem</td>
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<td>Command Service Module</td>
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<td>Constant Velocity Gyro (COM)</td>
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<td>Data Flow Control Unit (COM)</td>
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<td>Deep Space Instrumentation Facility (COM)</td>
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<td>Display &amp; Switch Unit (G)</td>
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<td>Differential Velocity Gyro (G)</td>
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<td>Environmental Control System (COM)</td>
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<td>Environmental Control Unit (G)</td>
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<tr>
<td>EDA</td>
<td>Electronic Display Assembly (G)</td>
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<td>DSS</td>
<td>Emergency Site Support System (G)</td>
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<td>Earth Landing Subsystem (G)</td>
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<td>ENS</td>
<td>Energy Management System</td>
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<td>Extravehicular Mobility Unit (COM)</td>
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<td>EMI</td>
<td>Earth Orbit Insertion Gyro (G)</td>
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<td>EPS</td>
<td>Electronic Interface Processor (G)</td>
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<td>ESA</td>
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<td>Flight Director Attitude Indicator (G)</td>
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<td>Forward Stabilization System</td>
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<td>GAC</td>
<td>Guidance &amp; Control</td>
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<td>Gyro Display Coupler (G)</td>
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<td>GNS</td>
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**Notes:**
- **COM:** Command Module
- **G:** Ground System
- **P:** Primary System
- **S:** Secondary System
- **Q:** Quaternary System

*Source:* FAM-1985