

NOV 18, 1966

APOLLO TRAINING

SEQUENTIAL SYSTEMS
(SECS, EDS, LES, ELS)

COURSE NO. A-324

FOR TRAINING PURPOSES ONLY



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION



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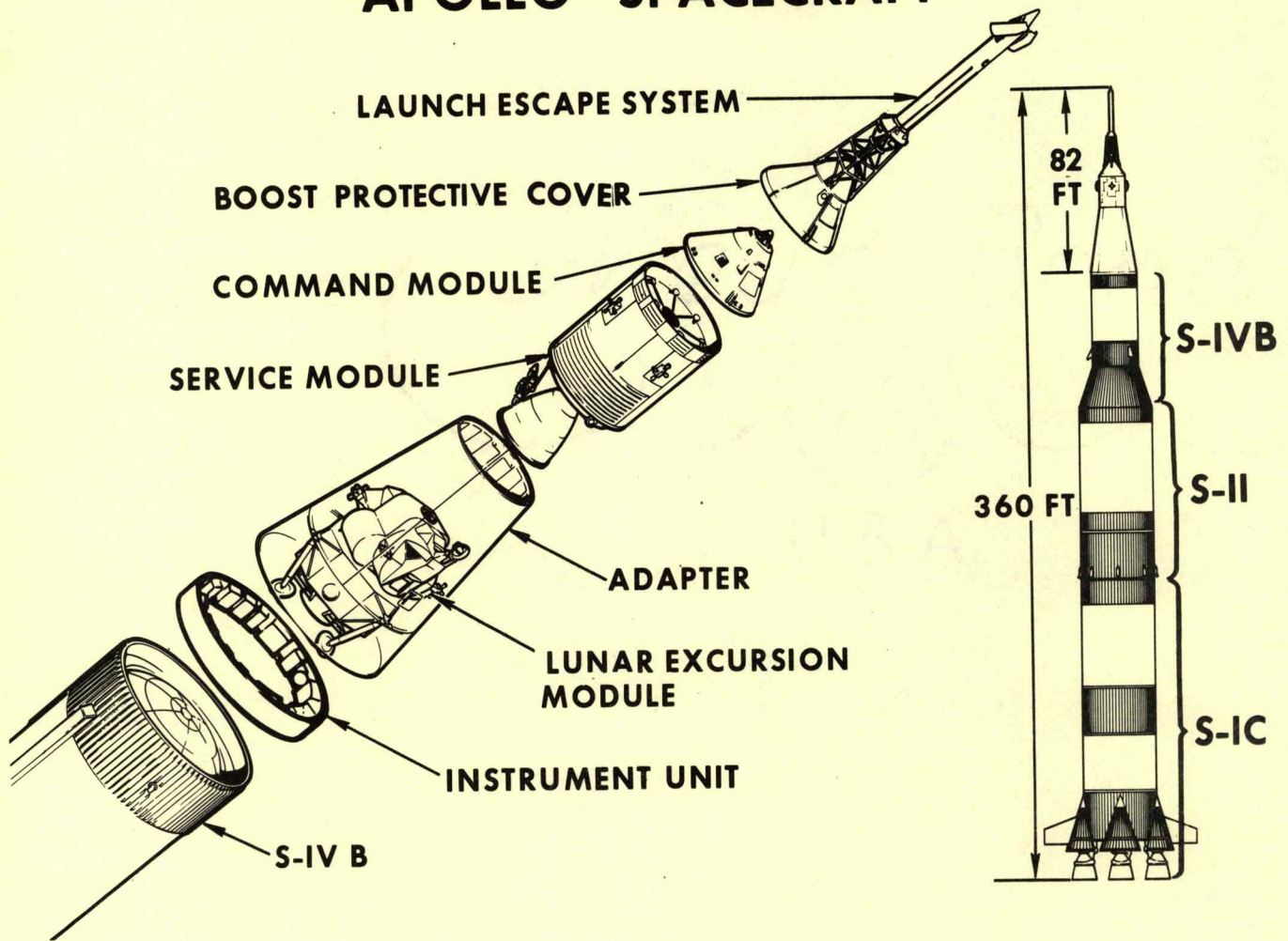
GLOSSARY OF ACRONYMS

ACE	Acceptance Checkout Equipment	SECS	Sequential Events Control Subsystem
AOA	Angle of Attack	SC	Spacecraft
ASI	Apollo Standard Initiator	SCS	Stabilization Control Subsystem
BECO	Booster Engine Cut-off	SLA	Spacecraft LM Adapter
BPC	Boost Protective Cover	SM	Service Module
CDF	Confined Detonating Fuse	SMJC	Service Module Jettison Controller
CM	Command Module	SPS	Service Propulsion Subsystem
COI	Contingency Orbit Insertion	T/C	Telecommunications Subsystem
CSM	Command Service Module	TEI	Transearth Injection
DET	Digital Event Timer	THC	Translation Hand Control
DS	Docking Subsystem	TJM	Tower Jettison Motor
EDS	Emergency Detection System	TLI	Translunar Injection
ELS	Earth Landing Subsystem	TLM	Telemetered or Telemetry
ELSC	Earth Landing Sequence Controller	UDL	Up-Data Link
EPS	Electrical Power Subsystem		
FDAI	Flight Director Attitude Indicator		
FLSC	Flexible Linear Shaped Charge		
G&N	Guidance and Navigation		
GSE	Ground Support Equipment		
IECO	Inboard Engine Cut-Off		
IPB	Illuminated Push Button		
IU	Instrument Unit		
LDEC	Lunar Docking Events Controller		
LEM	Launch Escape Motor		
LM	Lunar Module		
LES	Launch Escape Subsystem		
LET	Launch Escape Tower		
LEV	Launch Escape Vehicle		
LSSC	LM Separation Sequence Controller		
LV	Launch Vehicle		
MDC	Main Display Console		
MDF	Mild Detonating Fuse		
MESC	Master Events Sequence Controller		
MSC	Manned Spacecraft Center		
MCC	Mission Control Center		
MSFC	Marshall Space Flight Center		
MSFN	Manned Space Flight Network		
NAA	North American Aviation		
OECO	Outboard Engine Cut-Off		
PCM	Pitch Control Motor		
PCVB	Pyro Continuity Verification Box		
PSO	Pad Safety Officer		
RCS	Reaction Control Subsystem		
RCSC	Reaction Control System Controller		
RSO	Range Safety Officer		
SECO	S-IVB Engine Cut-Off		



APOLLO SPACECRAFT

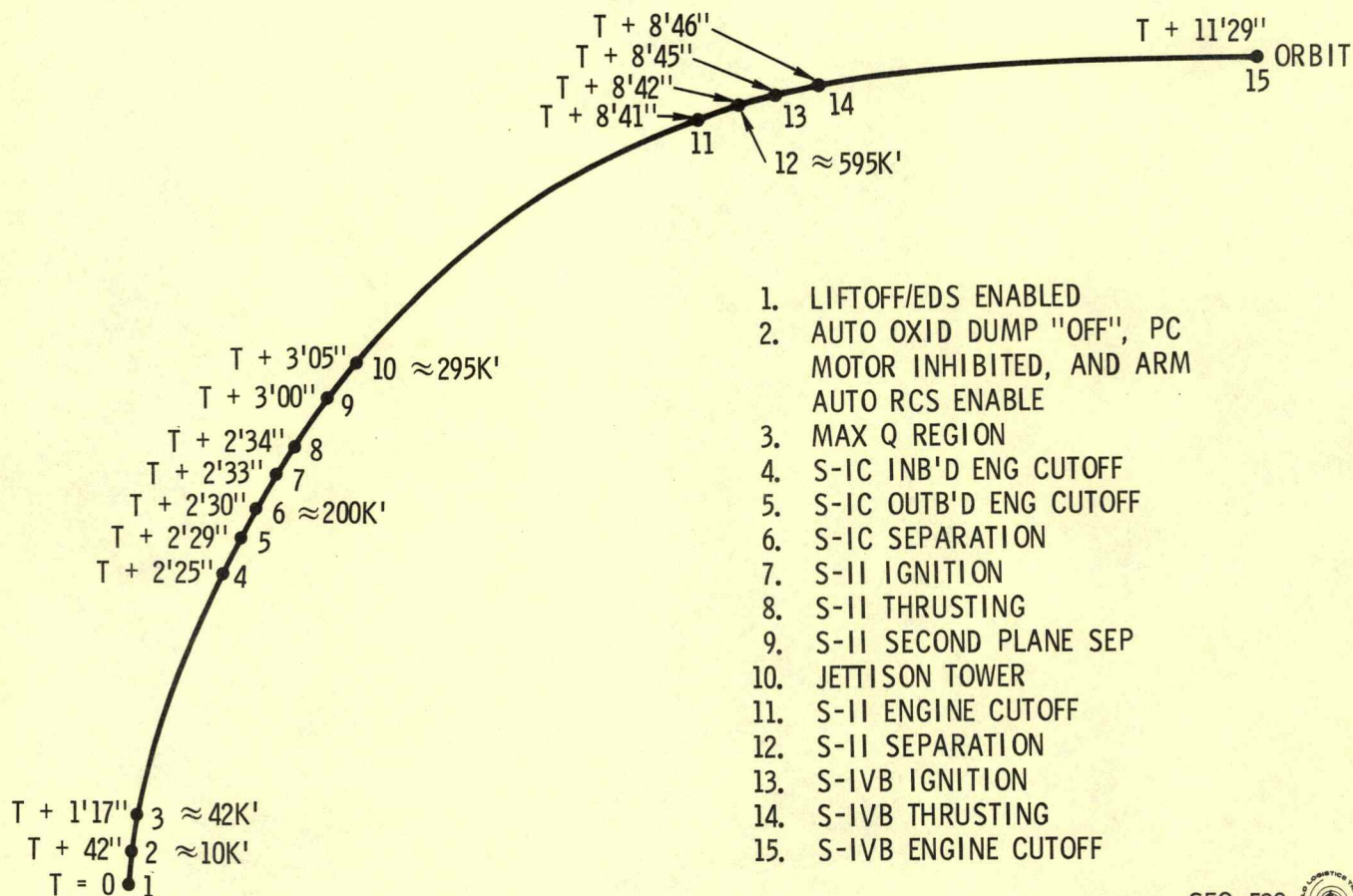
S36AP84509A



EVENT PROFILE

NORMAL ASCENT

SA-V LV CSM-102



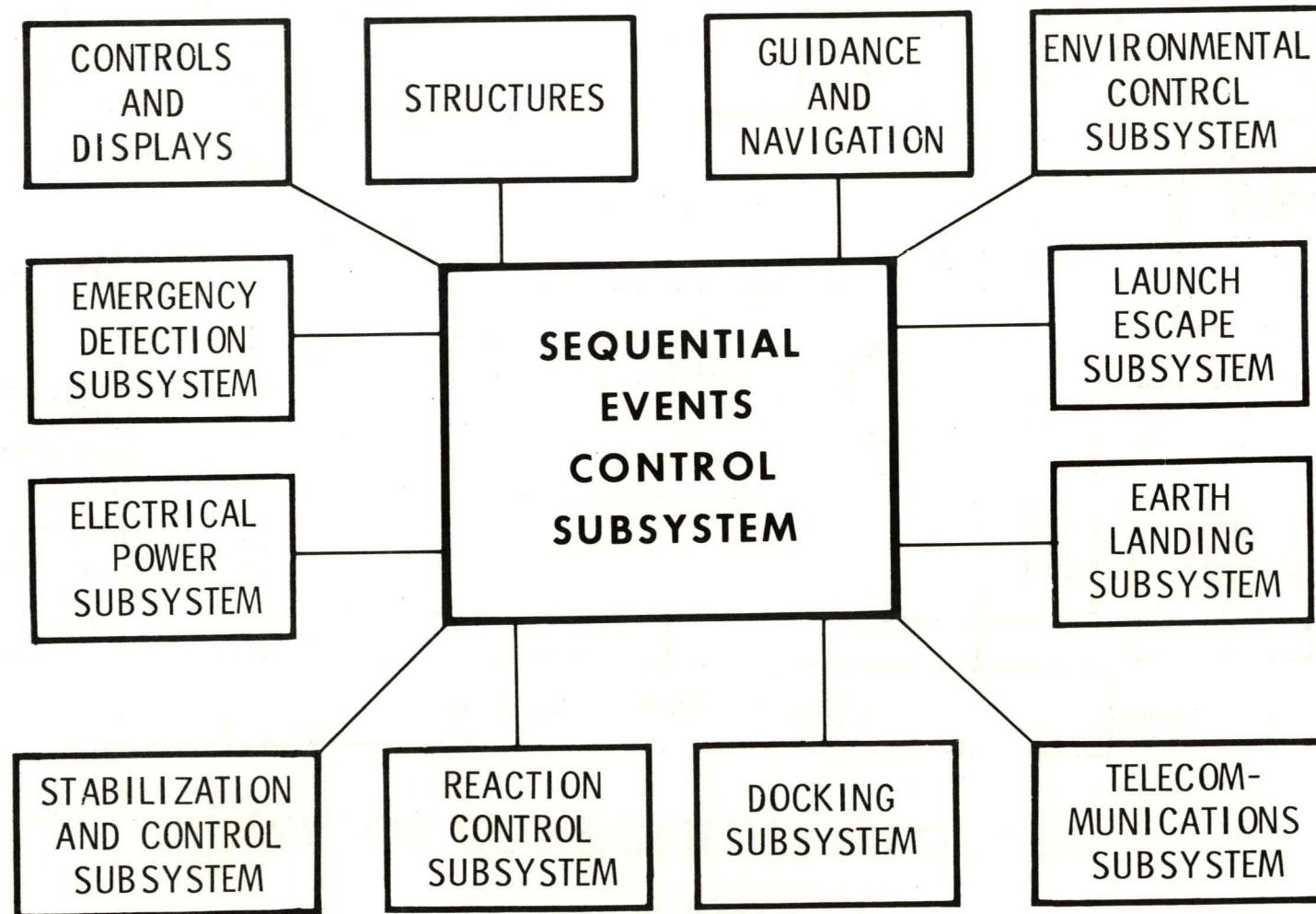
1. LIFTOFF/EDS ENABLED
2. AUTO OXID DUMP "OFF", PC MOTOR INHIBITED, AND ARM AUTO RCS ENABLE
3. MAX Q REGION
4. S-IC INB'D ENG CUTOFF
5. S-IC OUTB'D ENG CUTOFF
6. S-IC SEPARATION
7. S-II IGNITION
8. S-II THRUSTING
9. S-II SECOND PLANE SEP
10. JETTISON TOWER
11. S-II ENGINE CUTOFF
12. S-II SEPARATION
13. S-IVB IGNITION
14. S-IVB THRUSTING
15. S-IVB ENGINE CUTOFF

SEQ-538



SEQUENTIAL SYSTEMS

BLOCK II

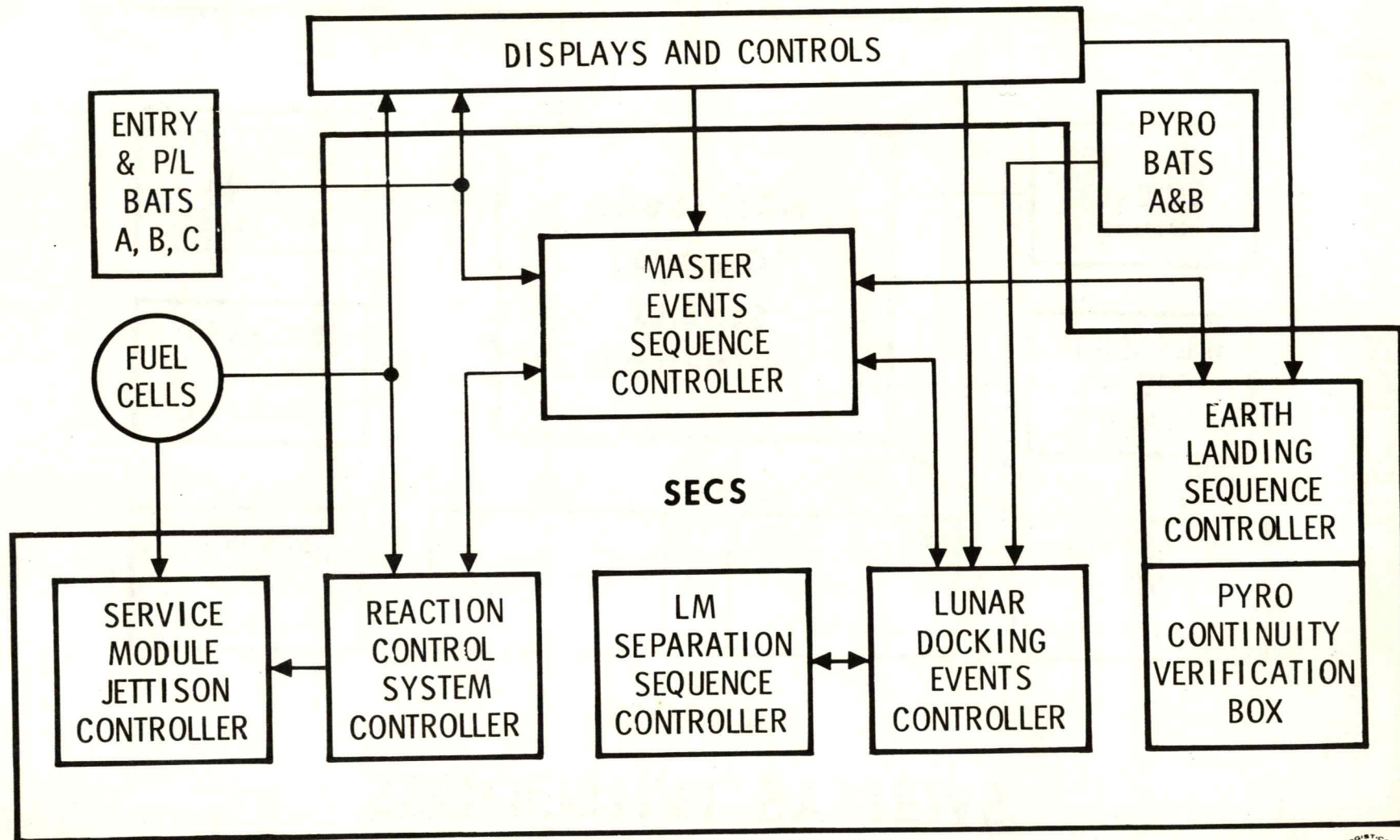


SEQ-500B



SECS

MAJOR COMPONENTS (BLOCK II)



SEQ-501B



MESC, ELSC, LDEC, PCVB LOCATION

BLOCK II

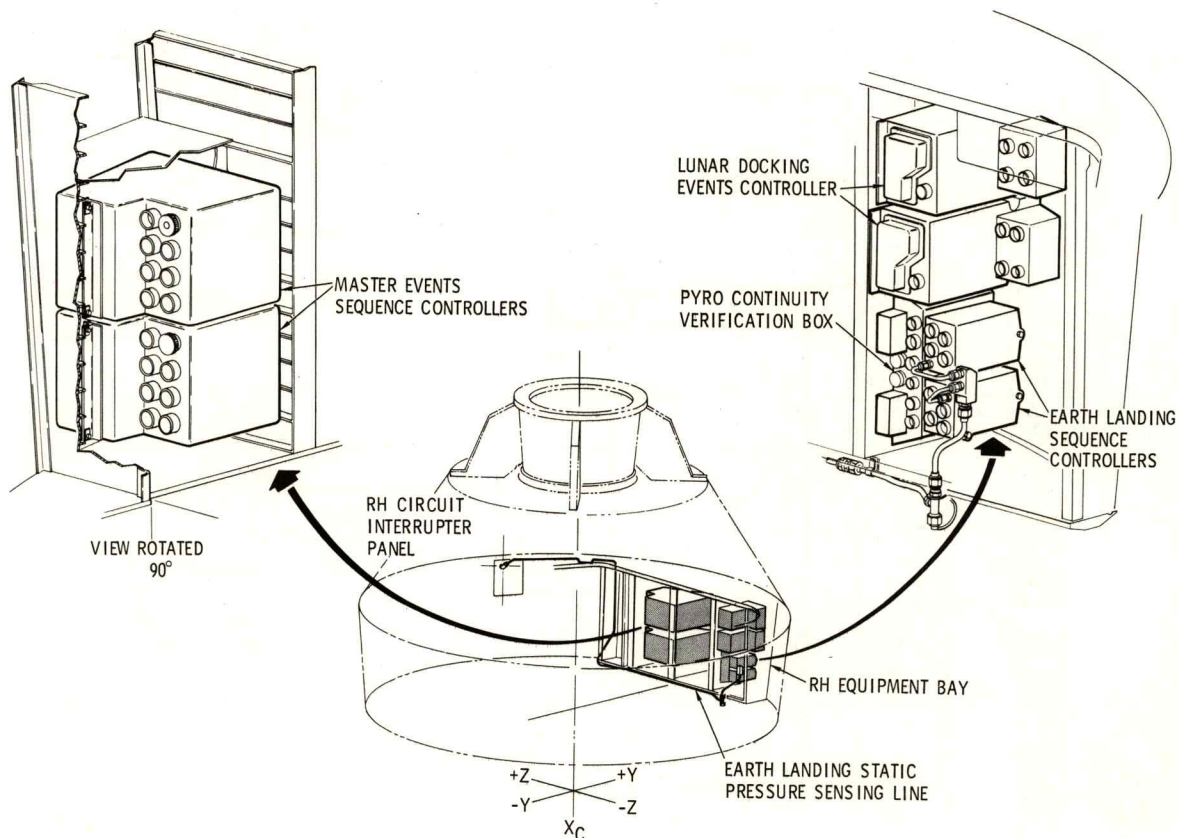
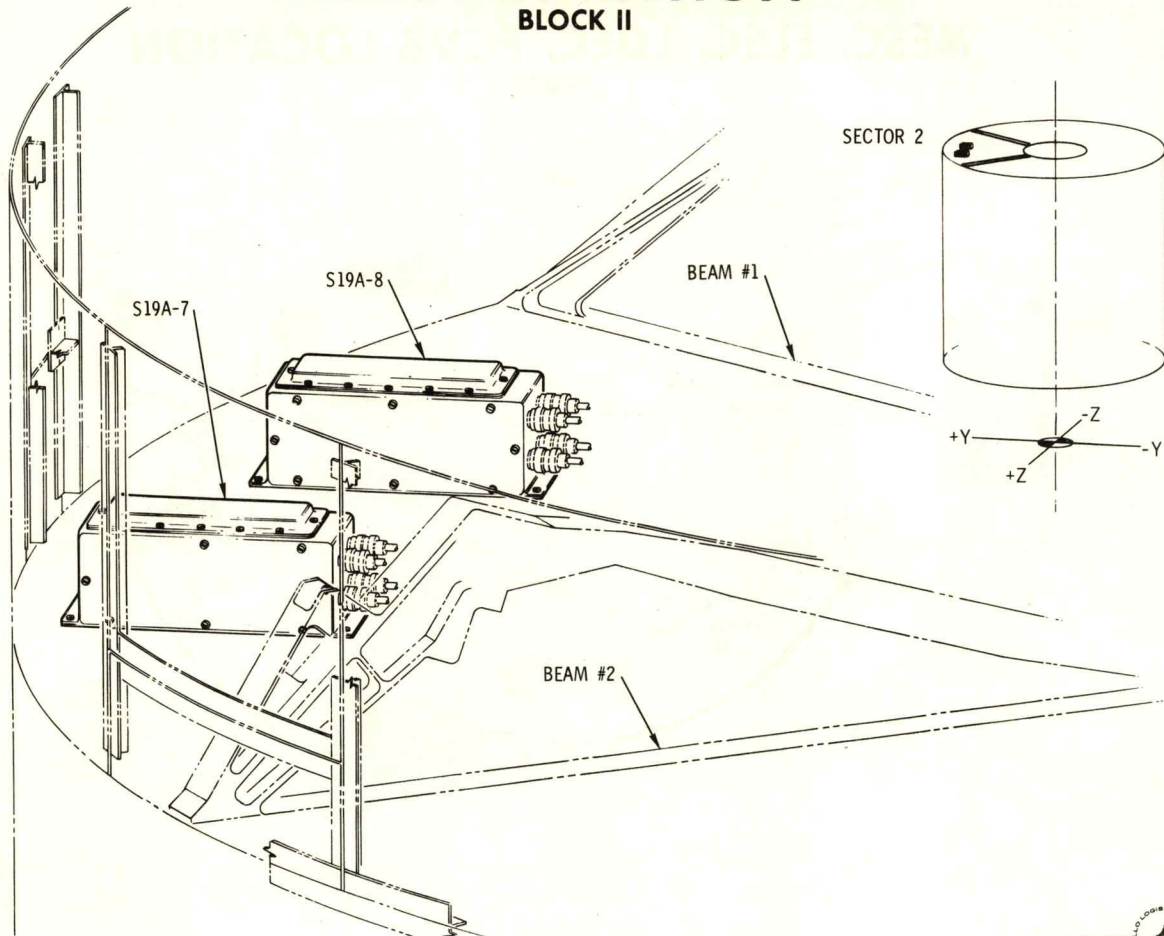


Figure 1

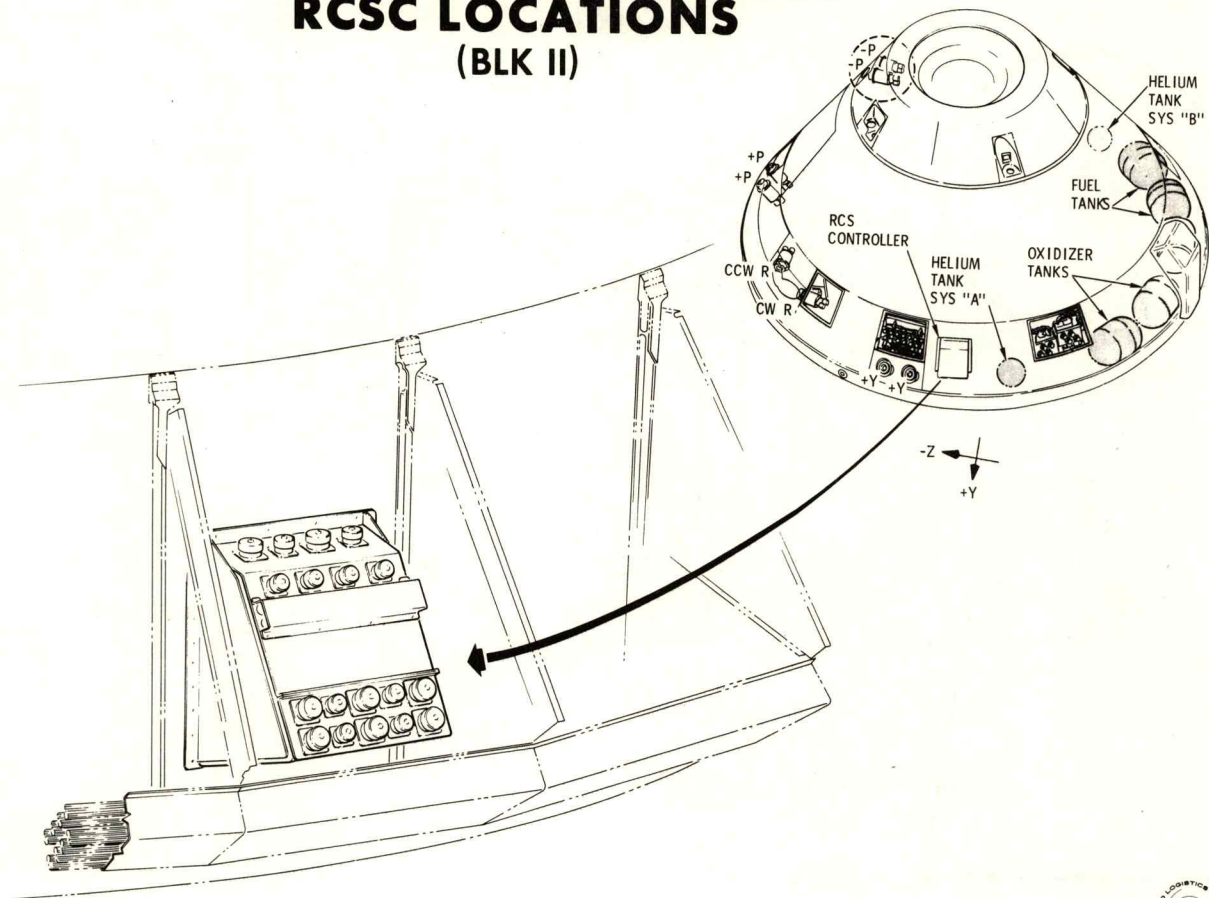
SMJC LOCATION

BLOCK II



SEQ-503 

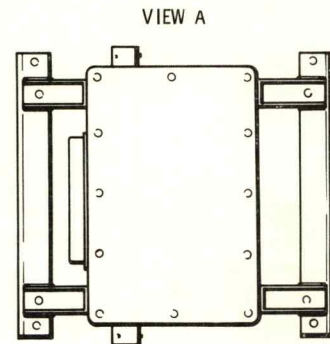
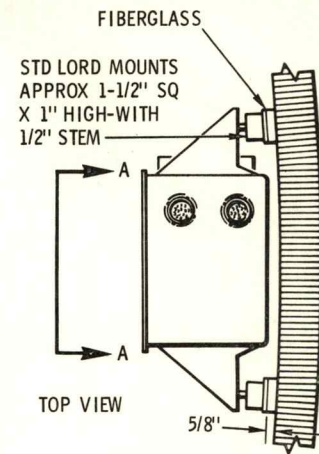
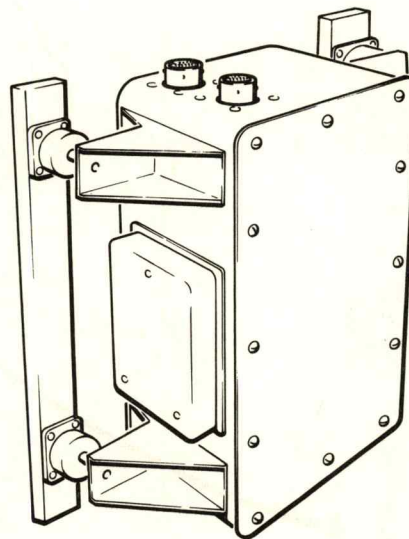
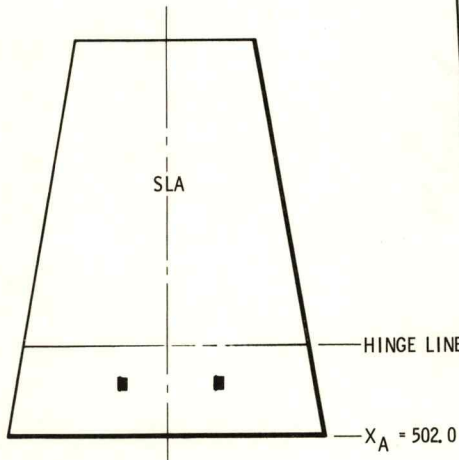
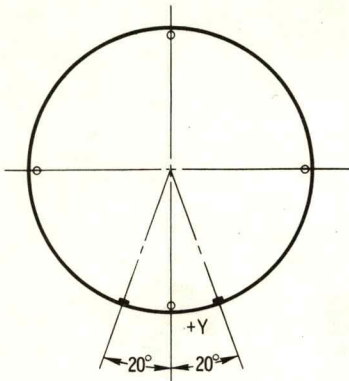
5
RCSC LOCATIONS
(BLK II)



SEQ-504 A

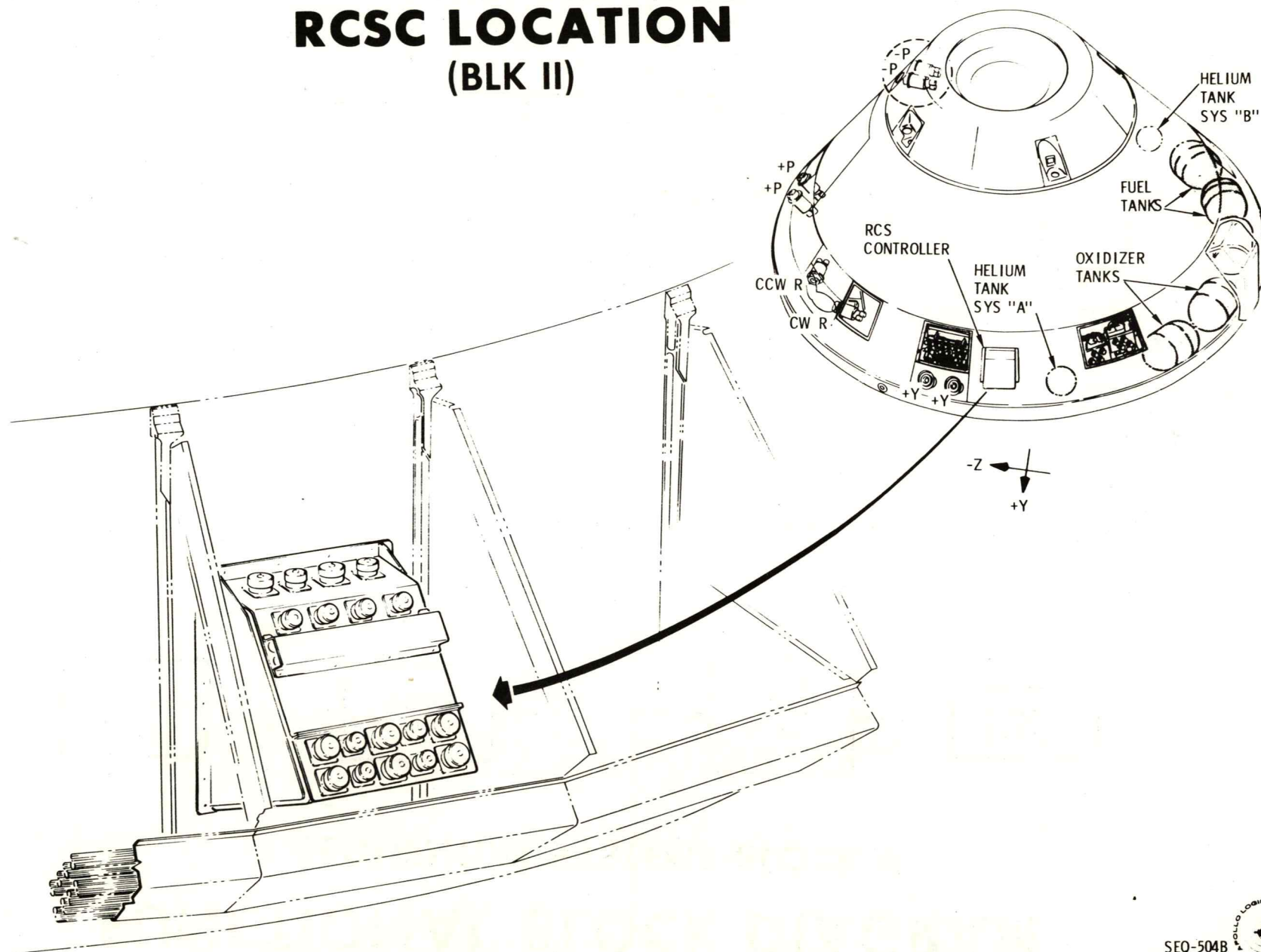


6 LSSC LOCATION BLK II



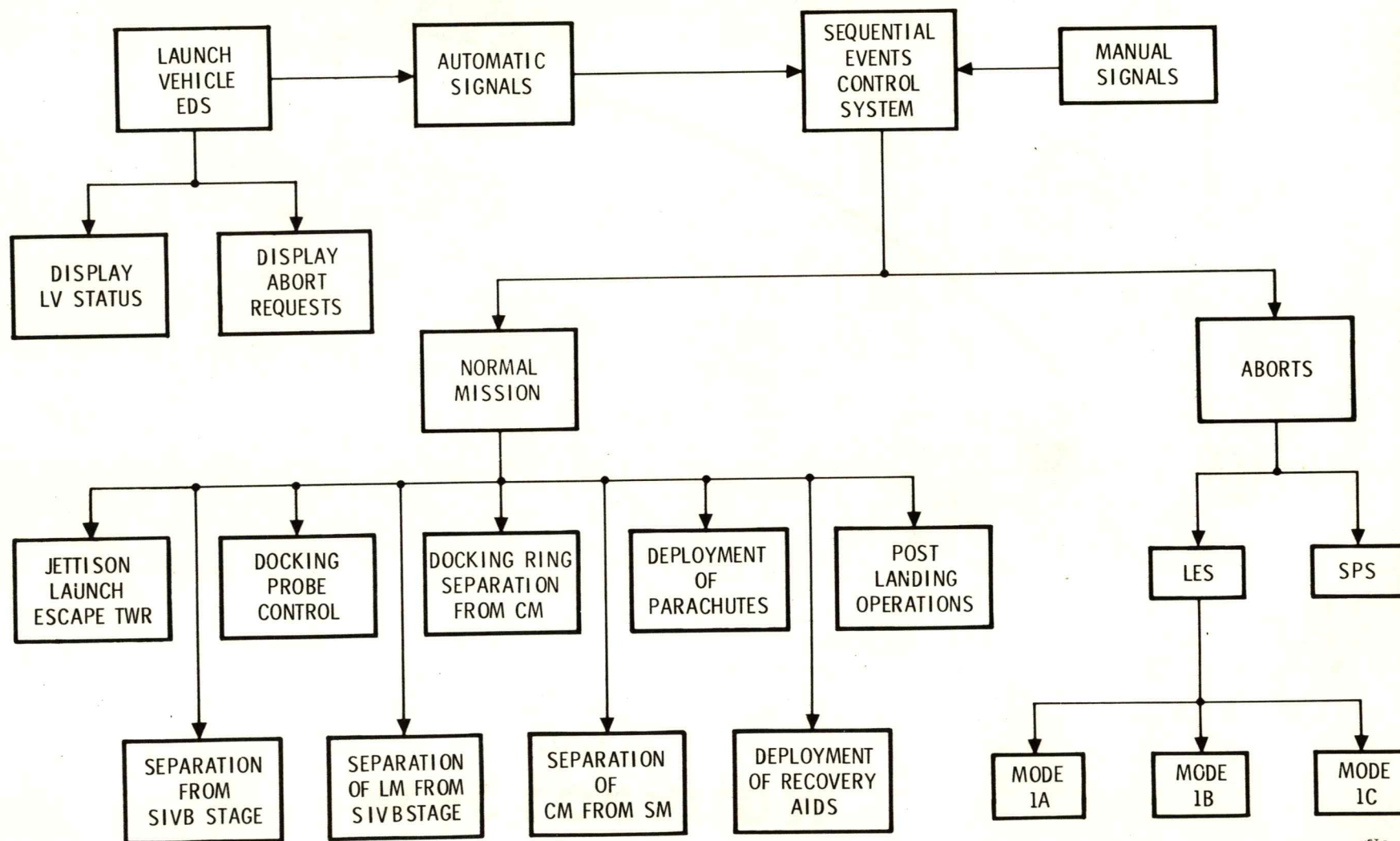
SEQ-505 

RCSC LOCATION (BLK II)



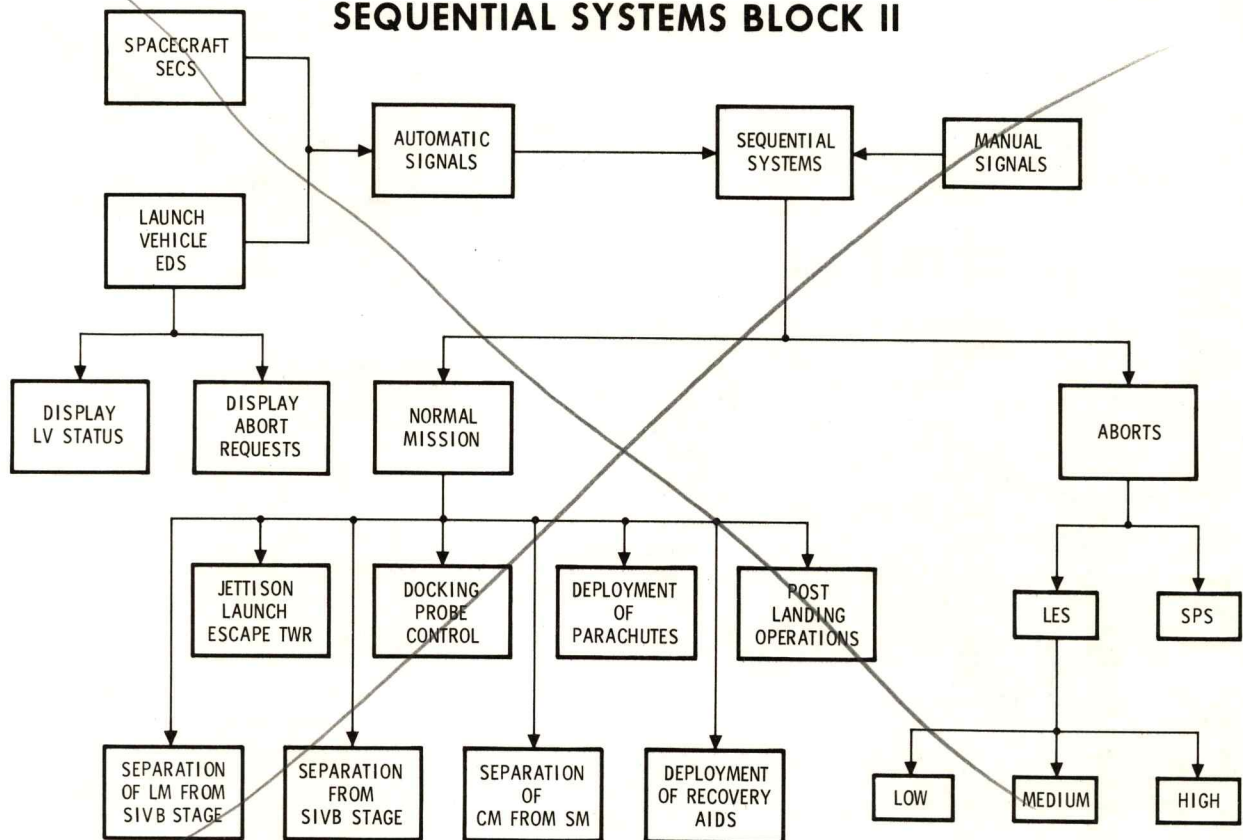
FUNCTIONAL BLOCK DIAGRAM

SEQUENTIAL SYSTEMS BLOCK II

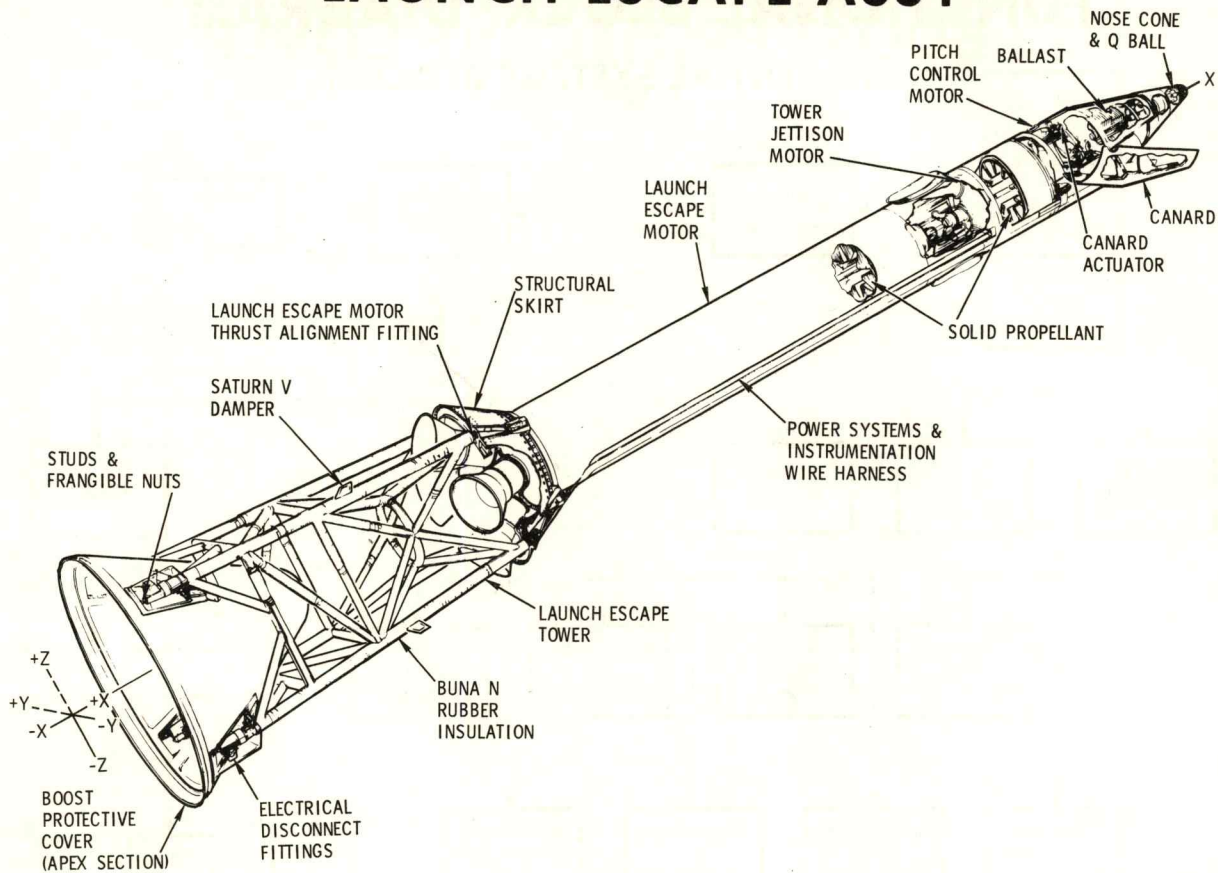


FUNCTIONAL BLOCK DIAGRAM

SEQUENTIAL SYSTEMS BLOCK II



LAUNCH ESCAPE ASSY

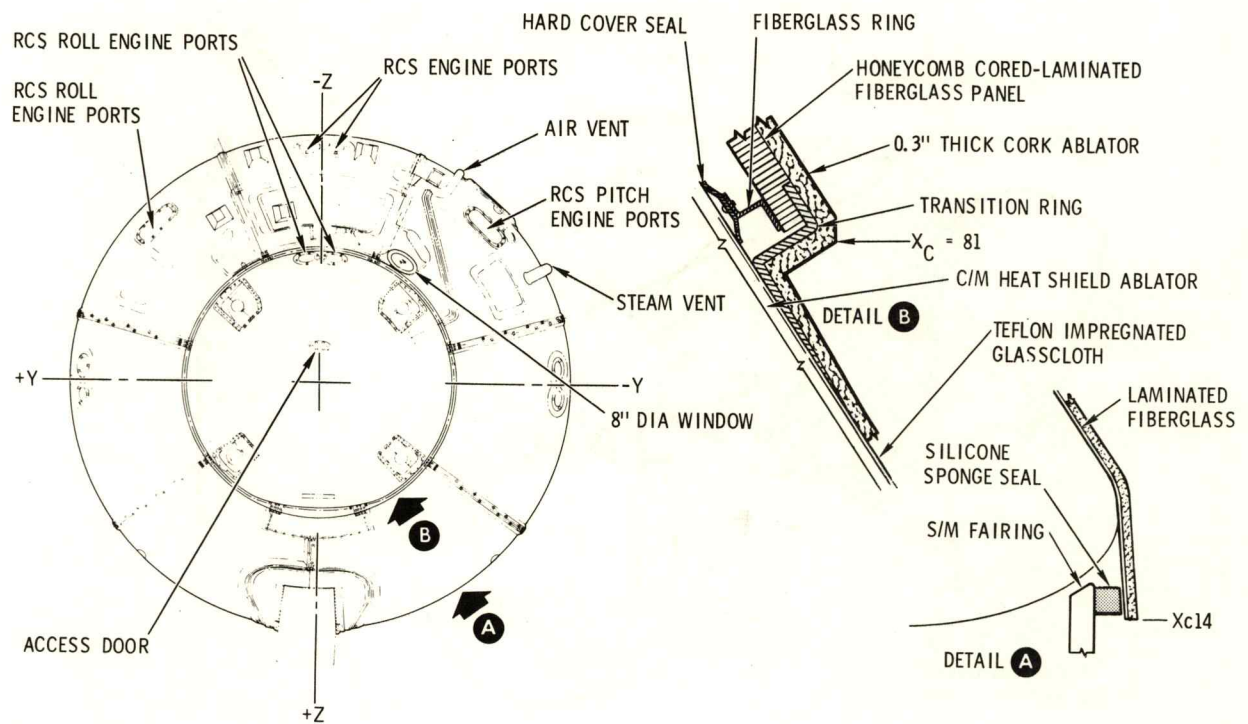


SEQ-65C

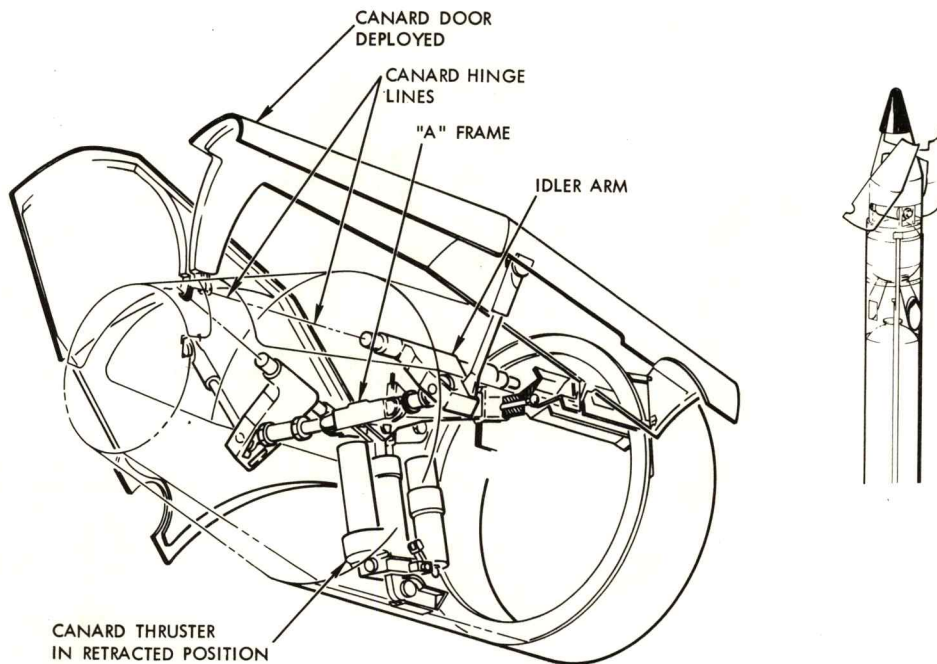


BOOST PROTECTIVE COVER

BLOCK II CSM

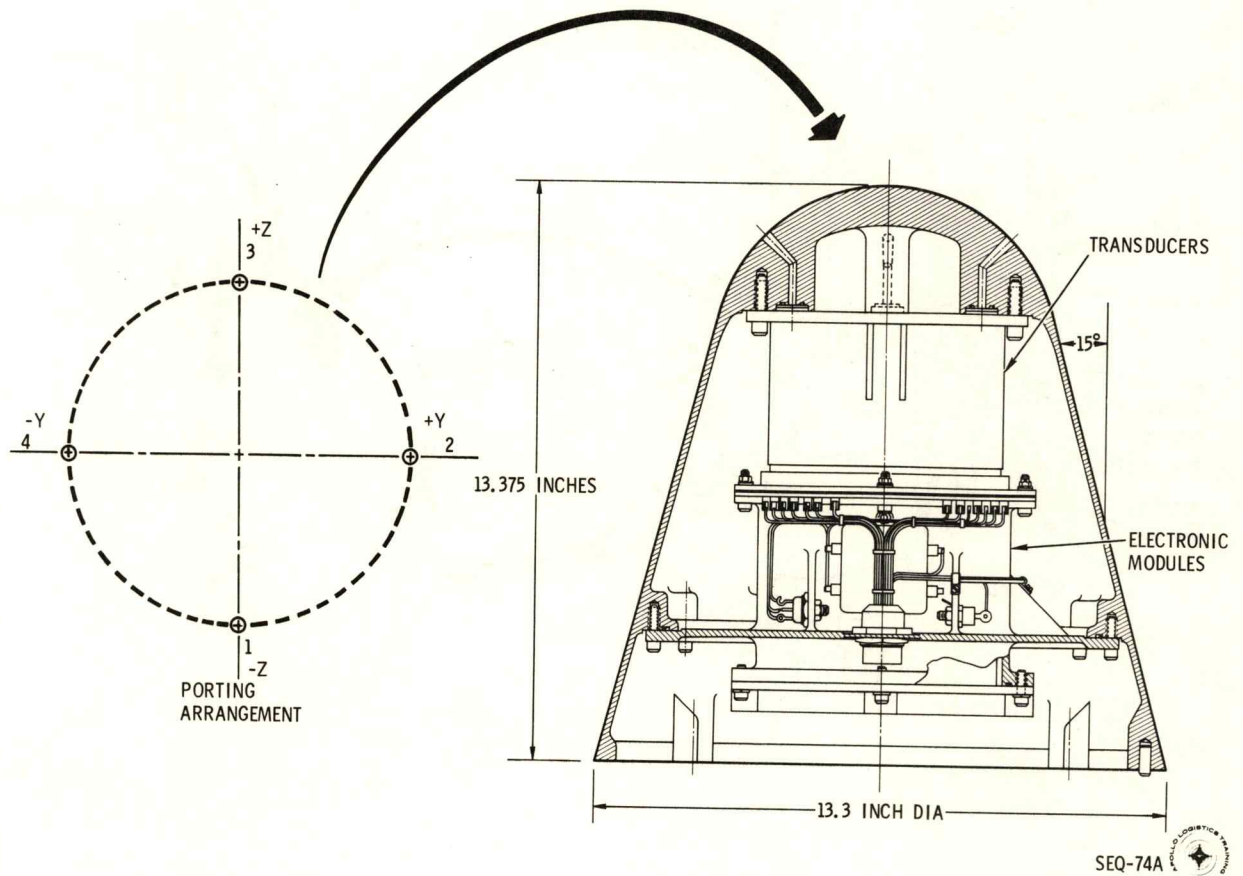


CANARD THRUST & LINKAGE ASSEMBLIES

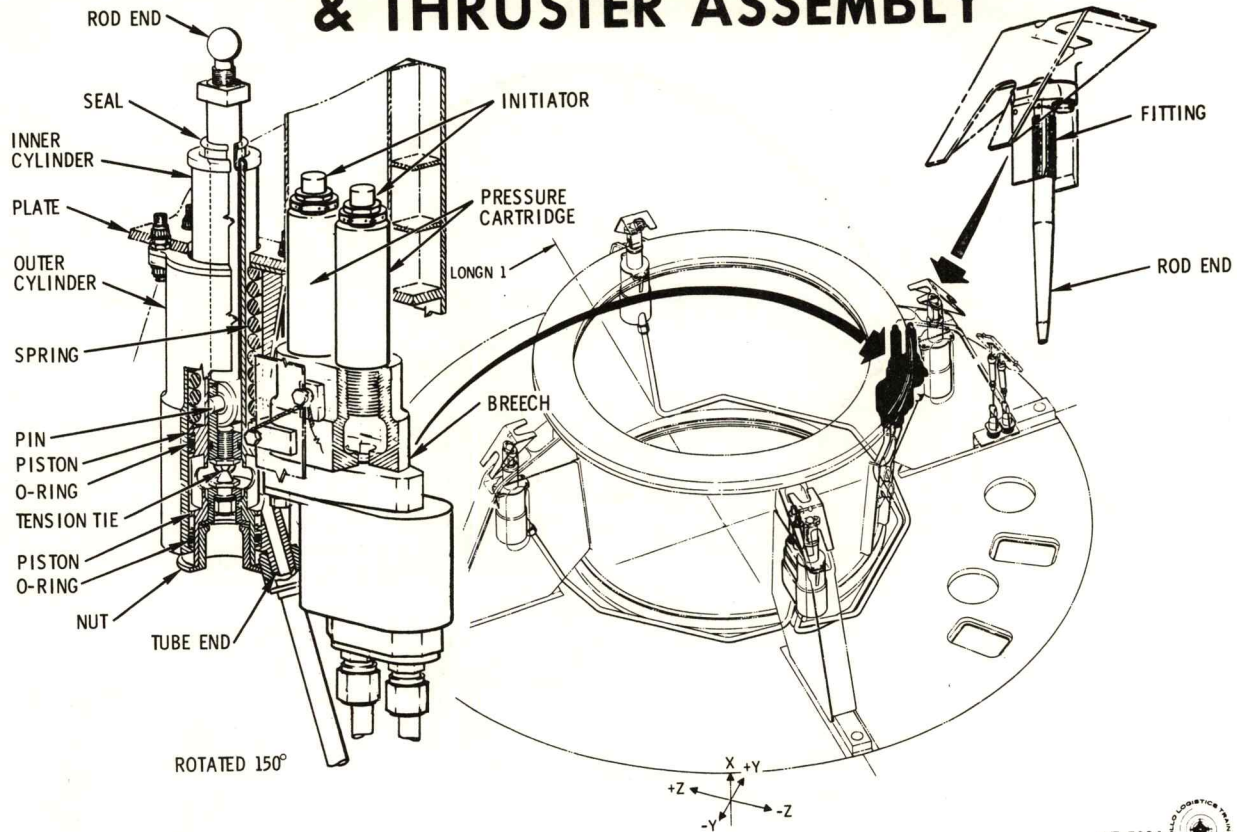


ST-162B 

11
EDS Q-BALL



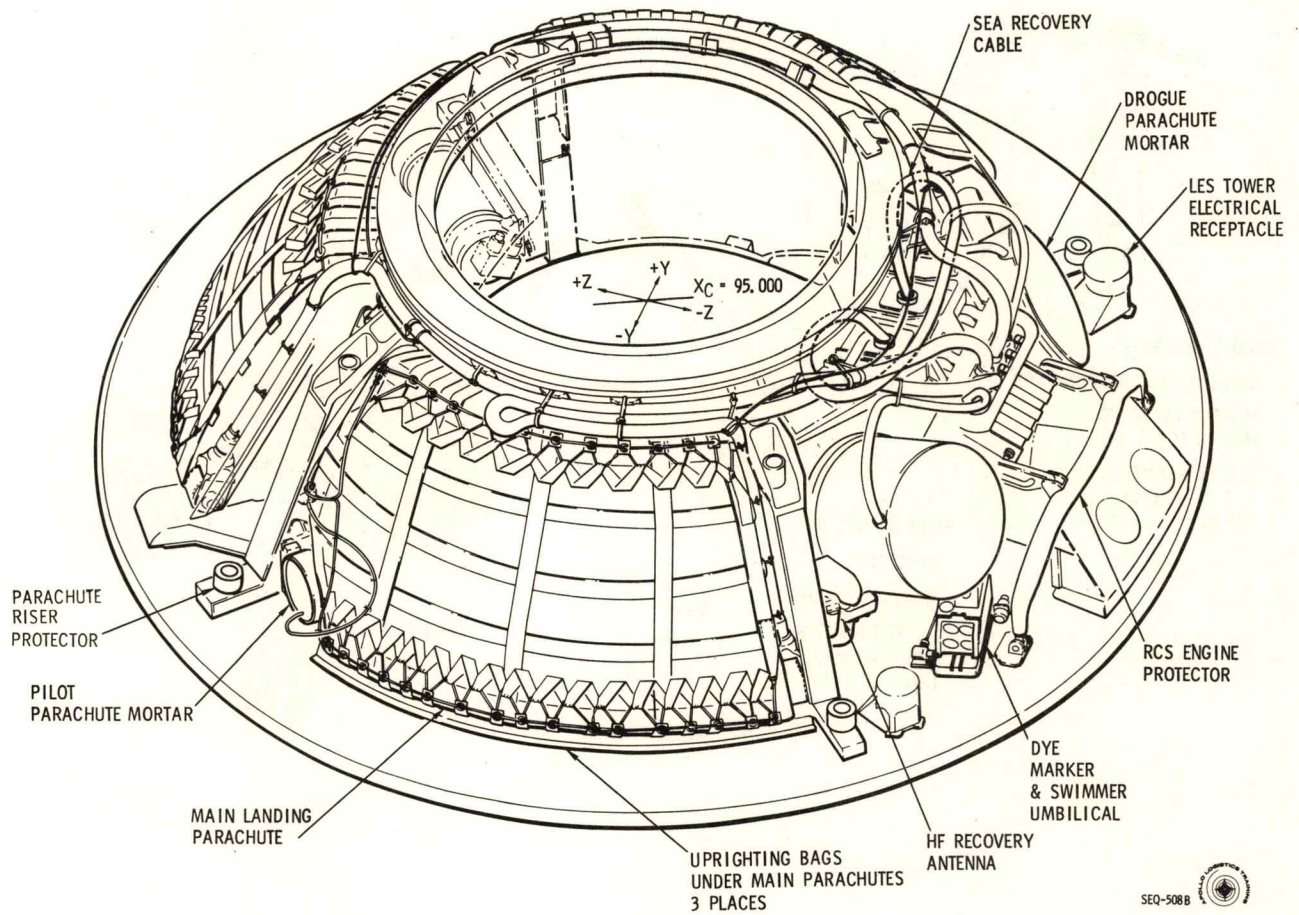
FORWARD HEATSHIELD ATTACHMENT & THRUSTER ASSEMBLY



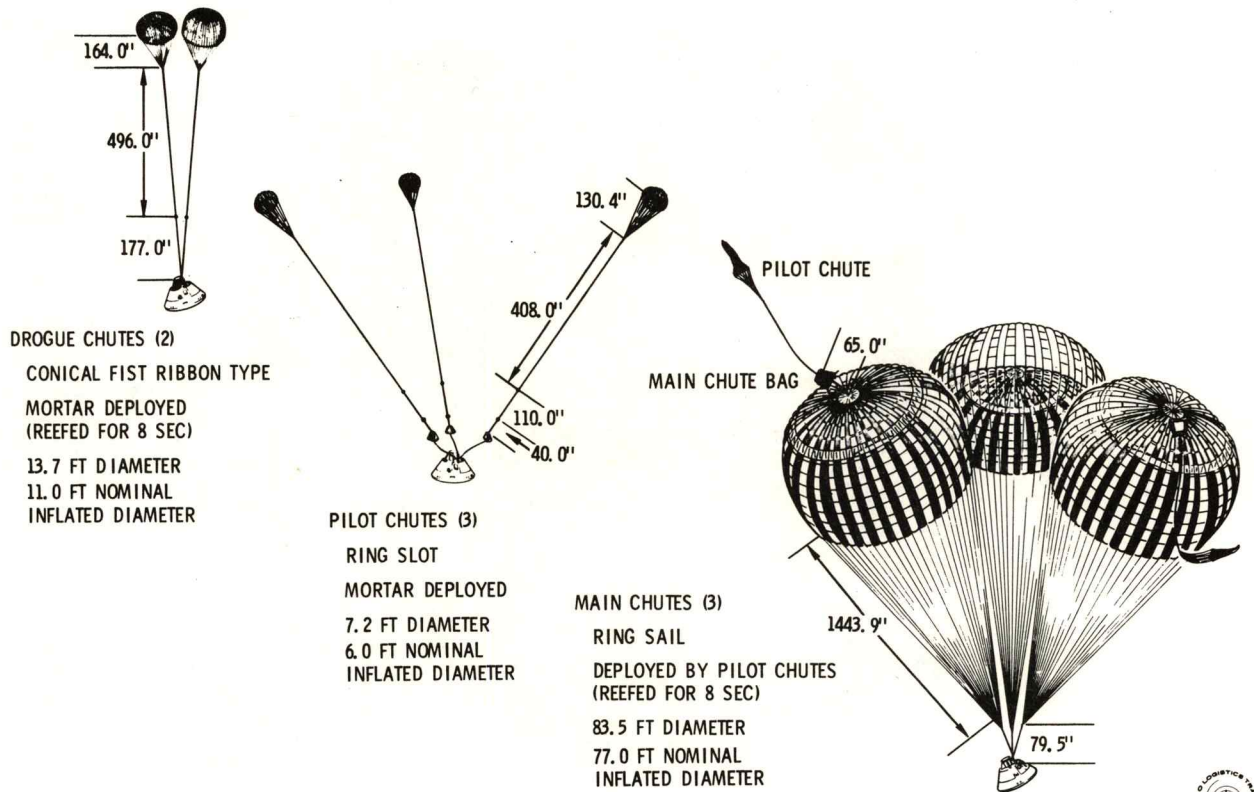
ST-590A



13
ELS EQUIPMENT
 (BLOCK II)



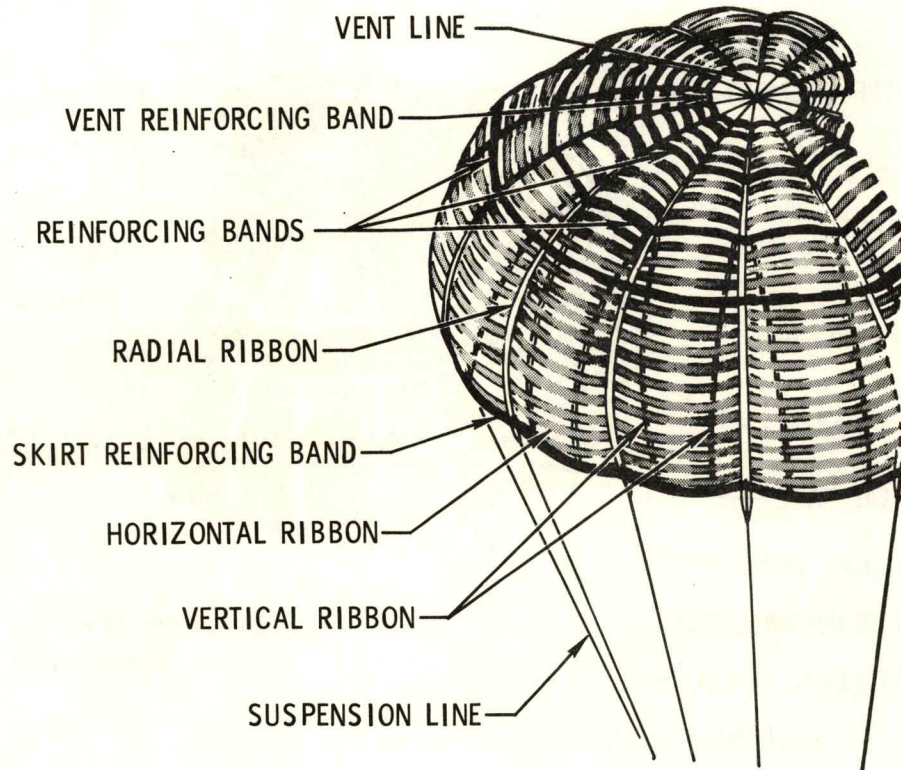
EARTH LANDING SYSTEM PARACHUTES



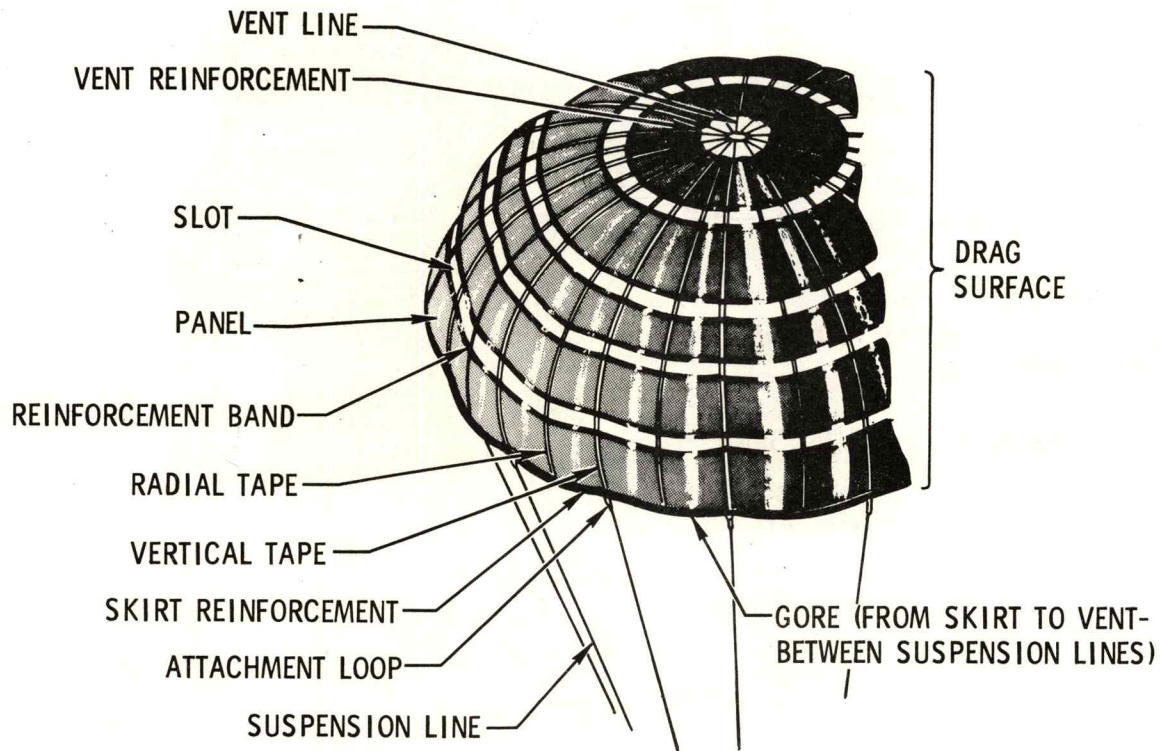
SEQ-520



FIST RIBBON PARACHUTE



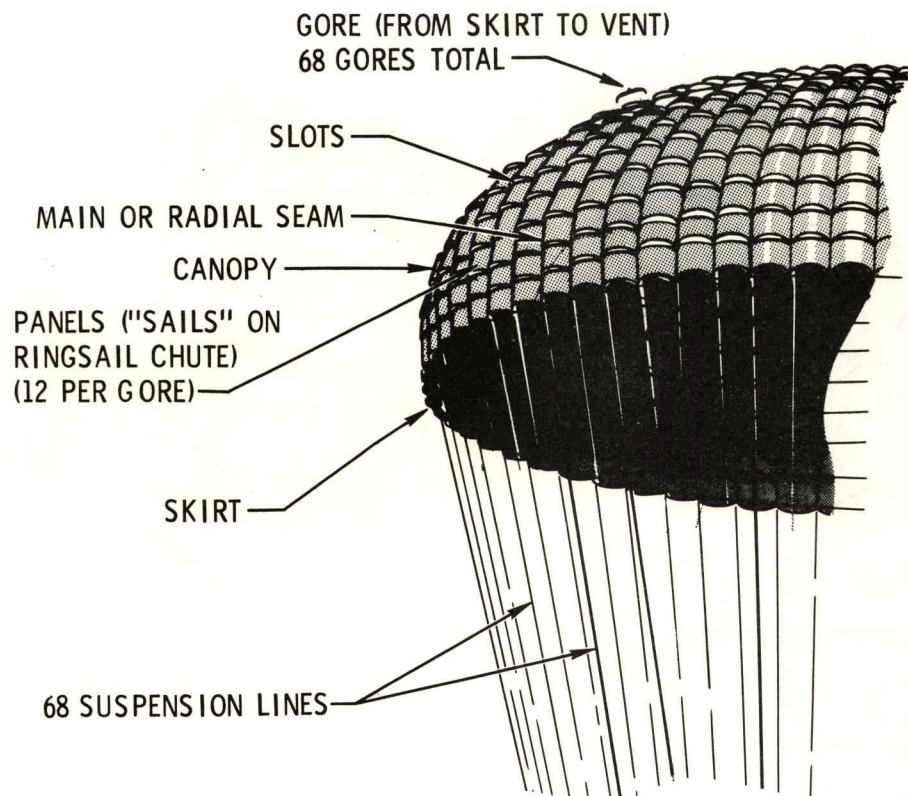
RING SLOT PARACHUTE



SEQ-37

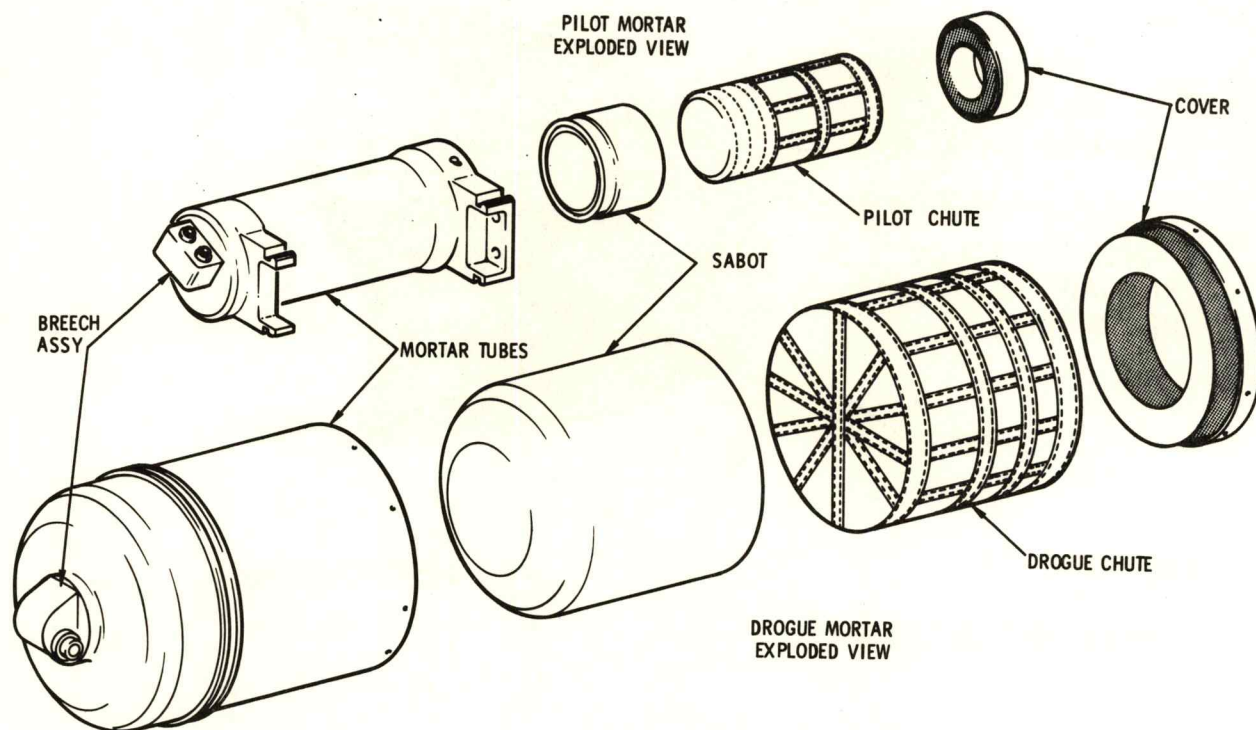


RING SAIL PARACHUTE



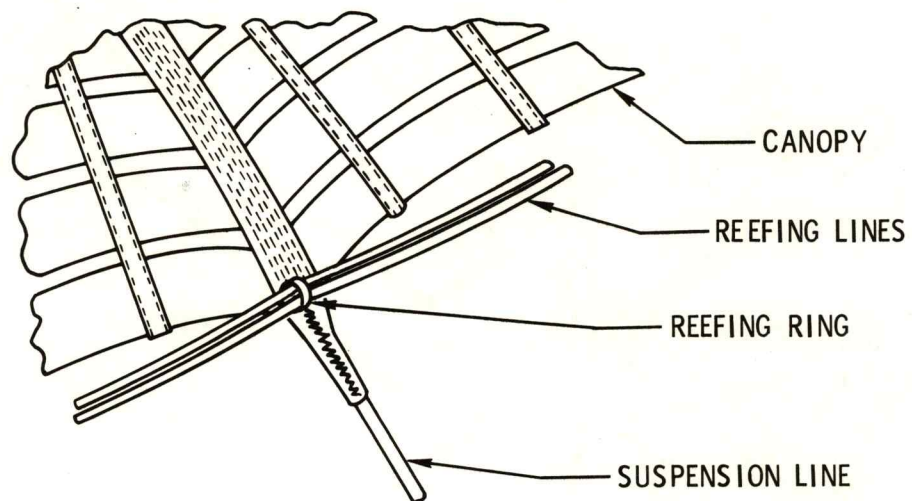
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18
MORTAR ASSEMBLIES
(BLK II)

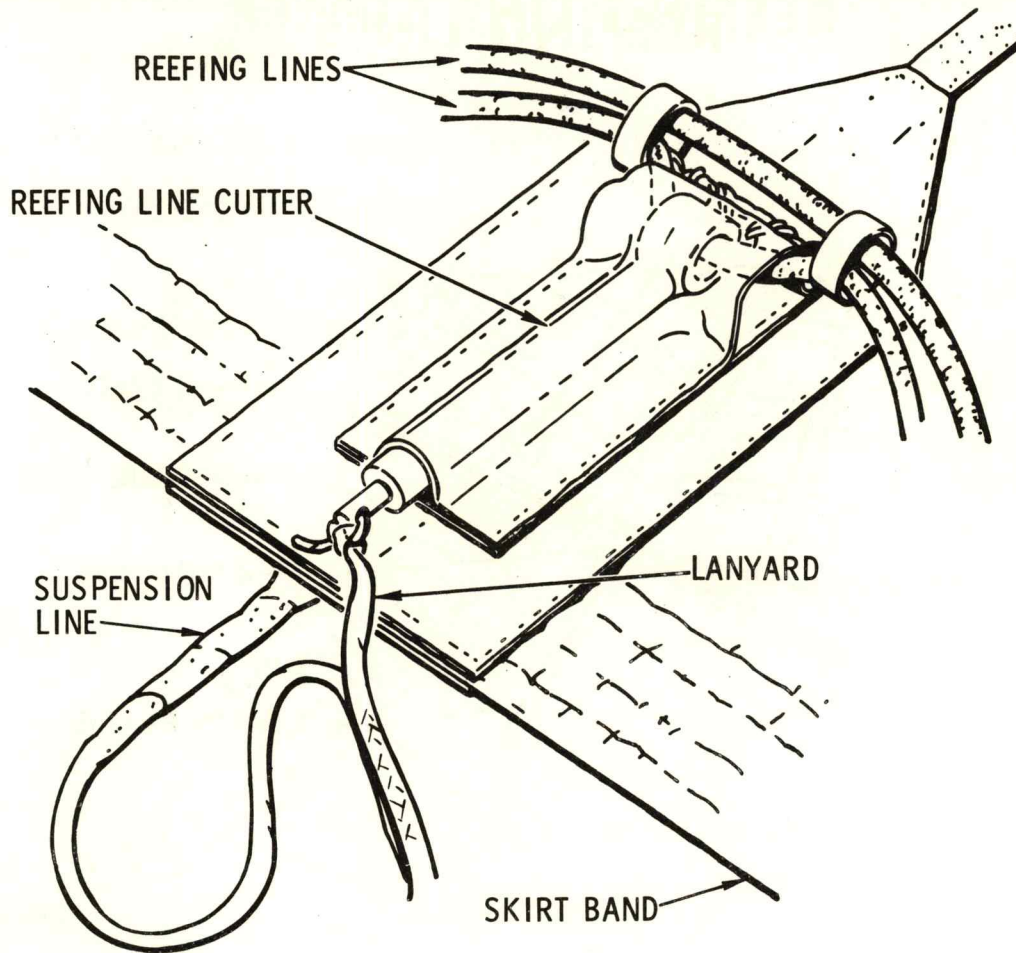


SEQ-509 

19
REEFING LINES



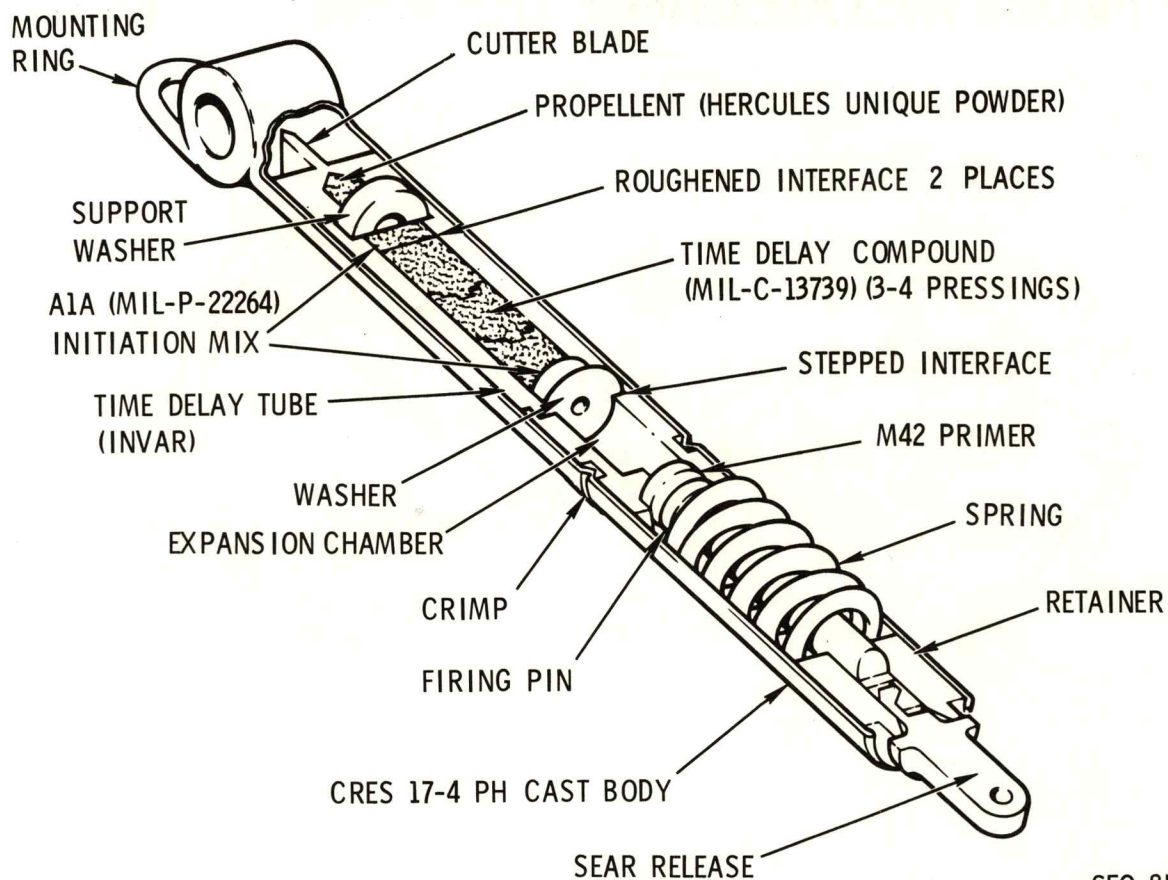
REEFING LINE CUTTER INSTALLATION



SEQ-75



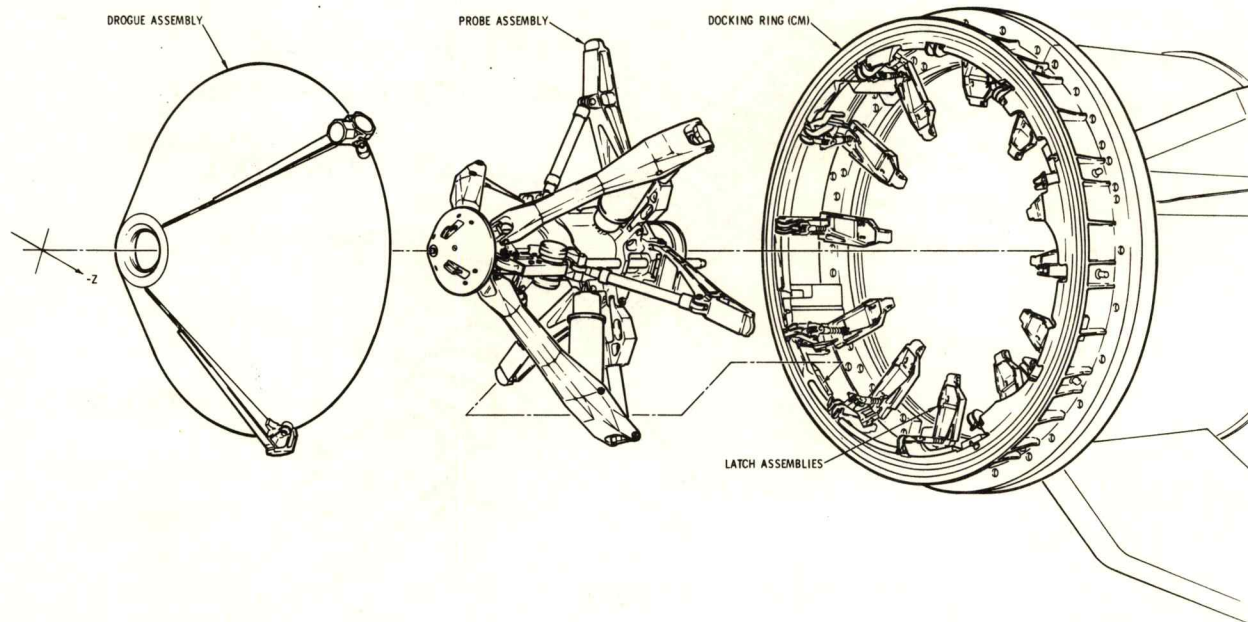
21
REEFING LINE CUTTER



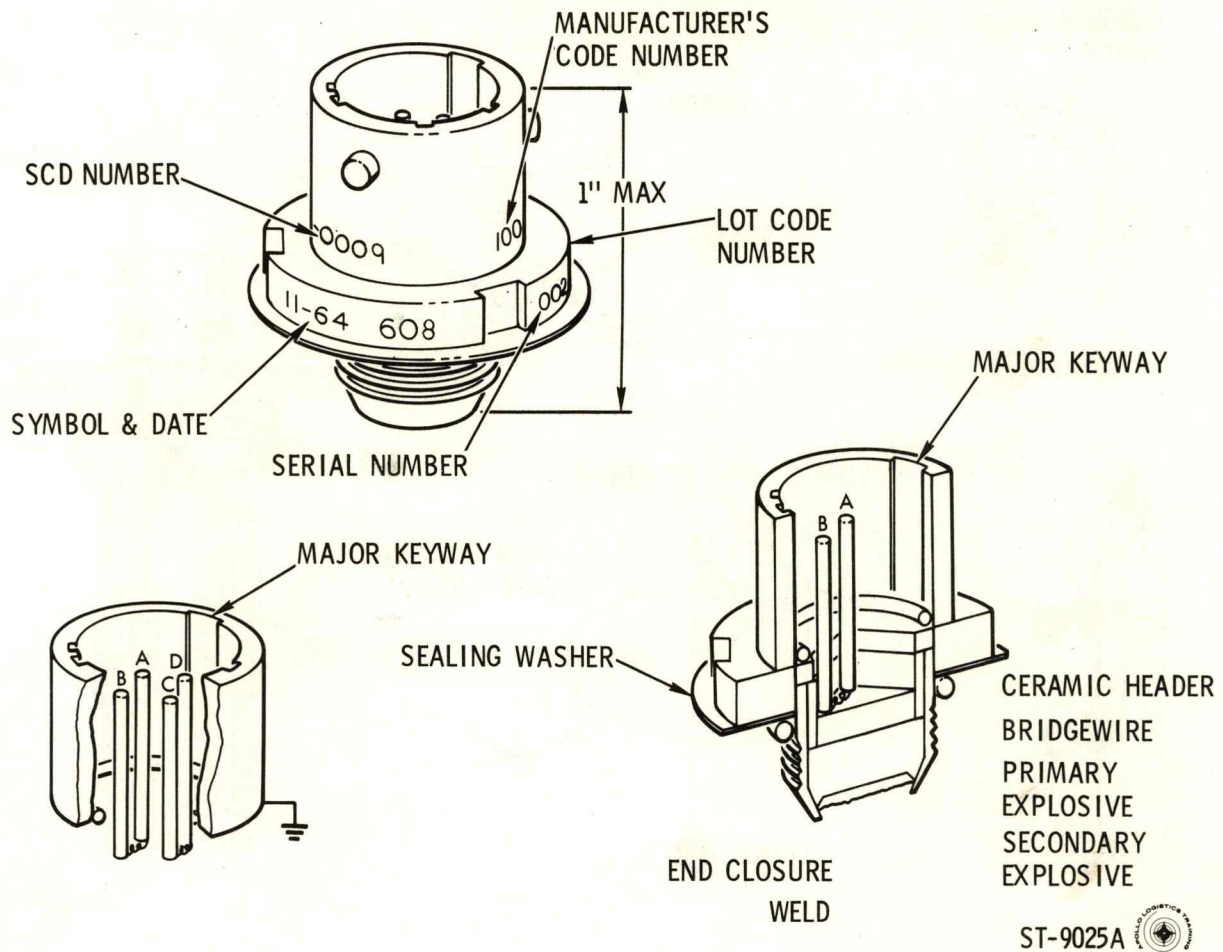
SEQ-8D



PROBE INSTALLATION-DOCKING SYSTEM



ELECTRICAL HOTWIRE INITIATOR



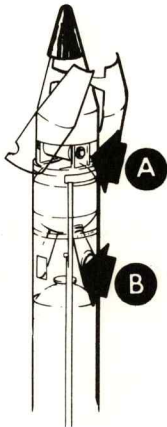
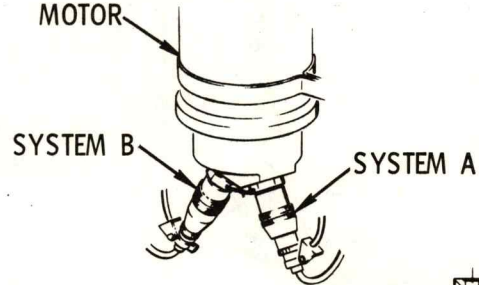
LES IGNITERS

PITCH
CONTROL
MOTOR



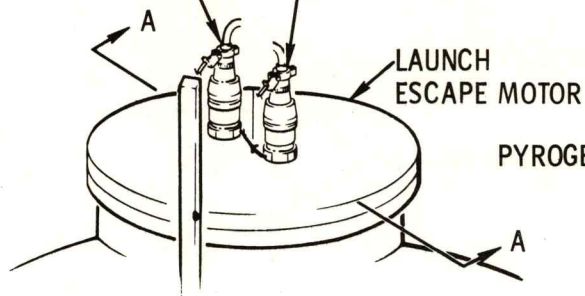
DETAIL A

JETTISON
MOTOR



SYSTEM B

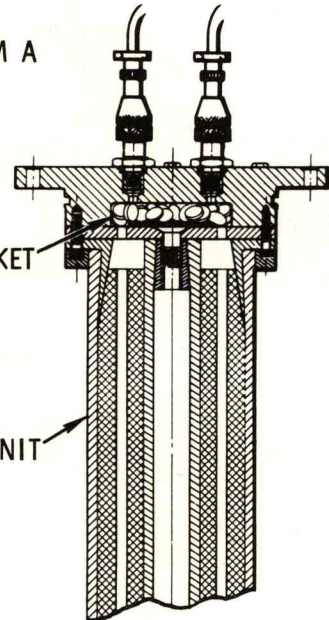
SYSTEM A



DETAIL B

PELLET BASKET

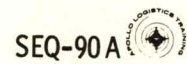
PYROGEN UNIT



SECTION A-A

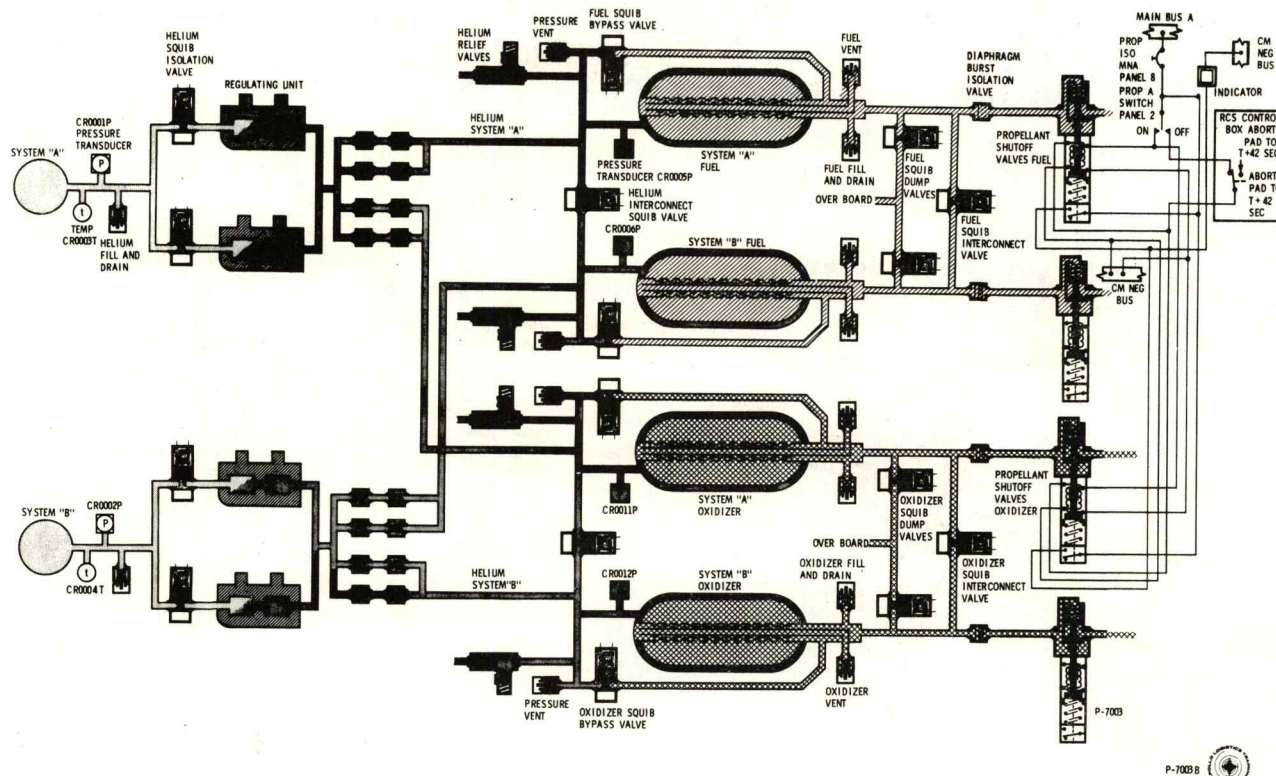
SEQ-79

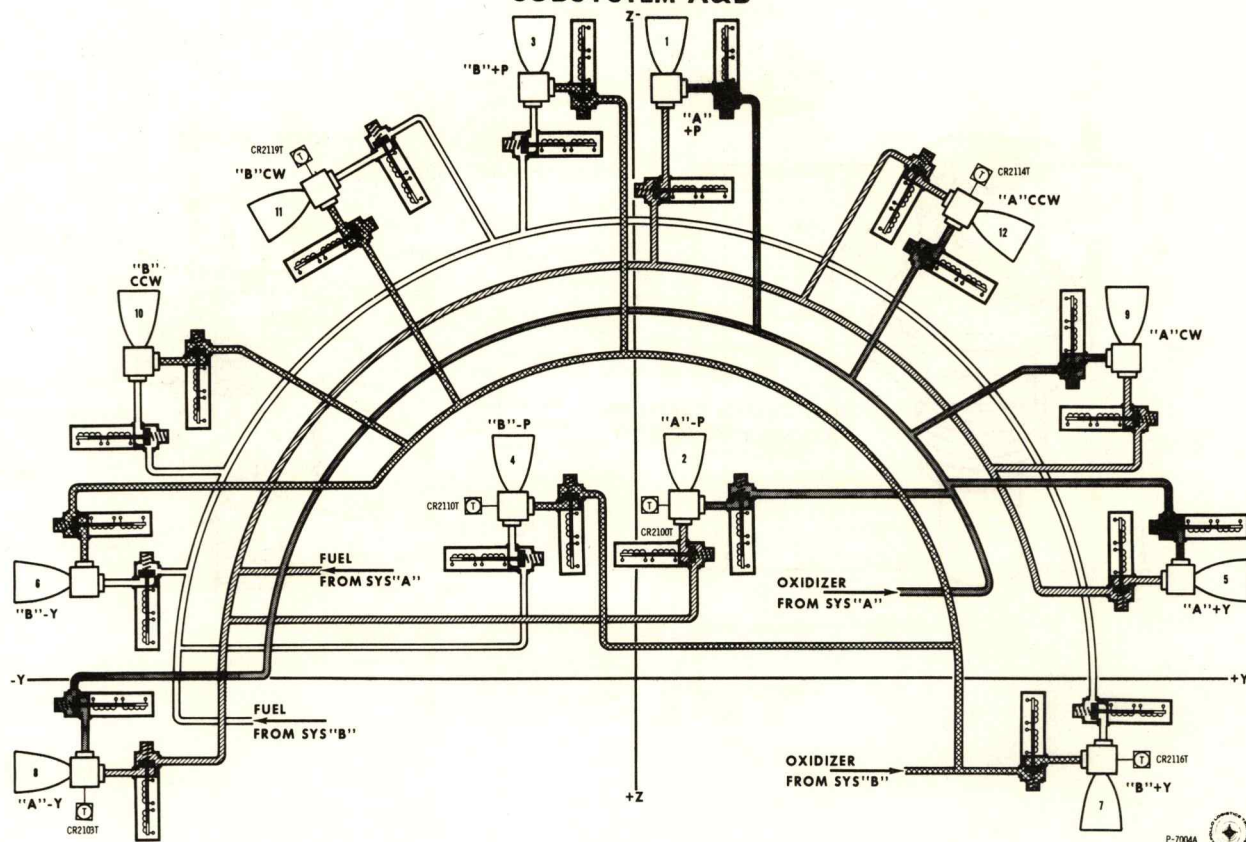




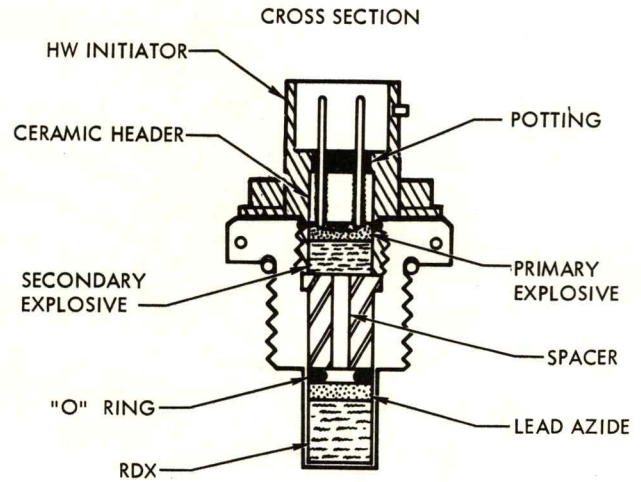
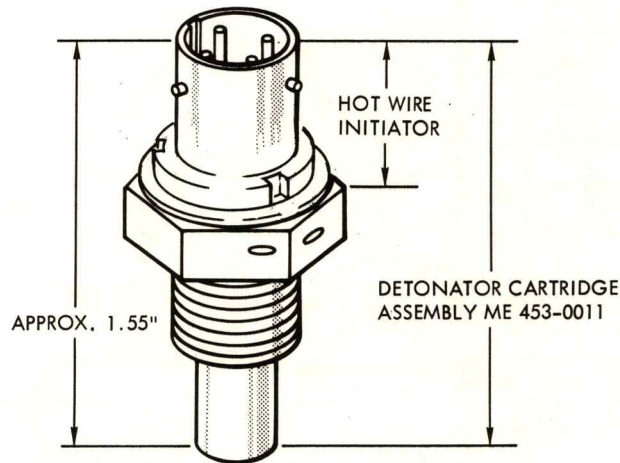
CM REACTION CONTROL SUBSYSTEM

PROPELLANT FEED SUBSYSTEM A&B





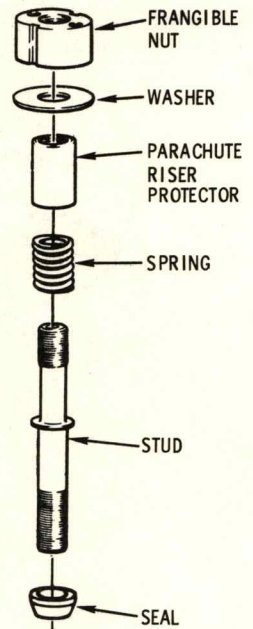
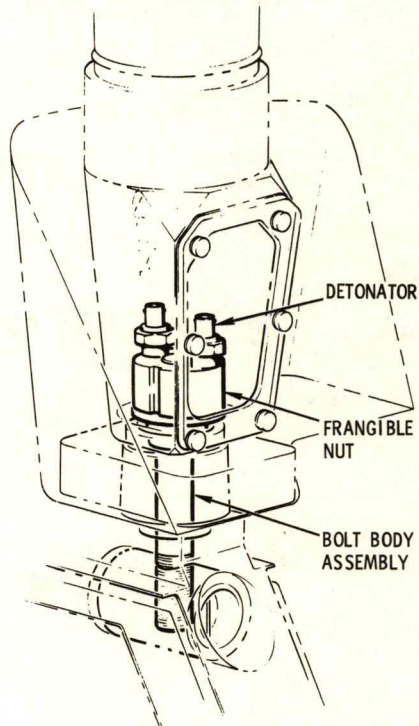
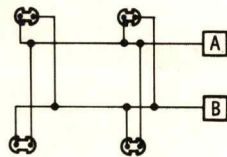
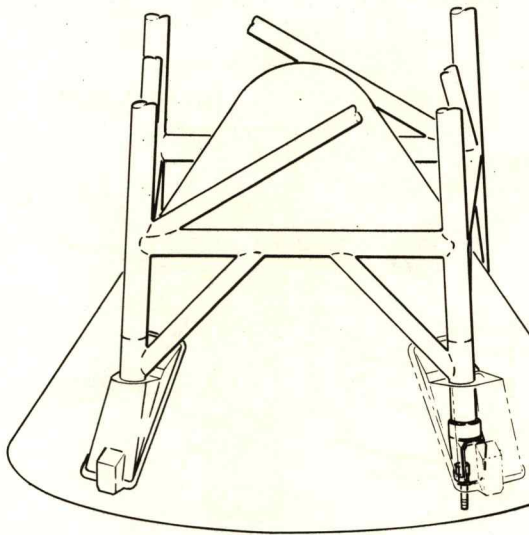
DETONATOR CARTRIDGE ASSEMBLY



ST-9050A

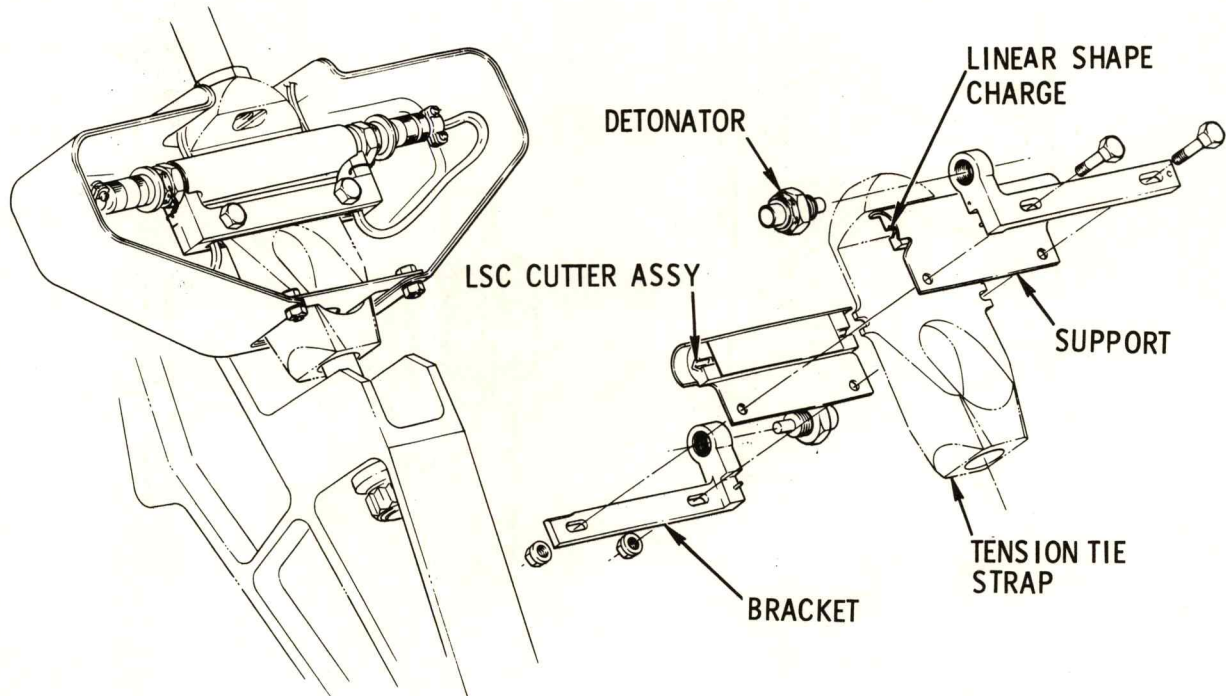


TOWER SEPARATION SYSTEM



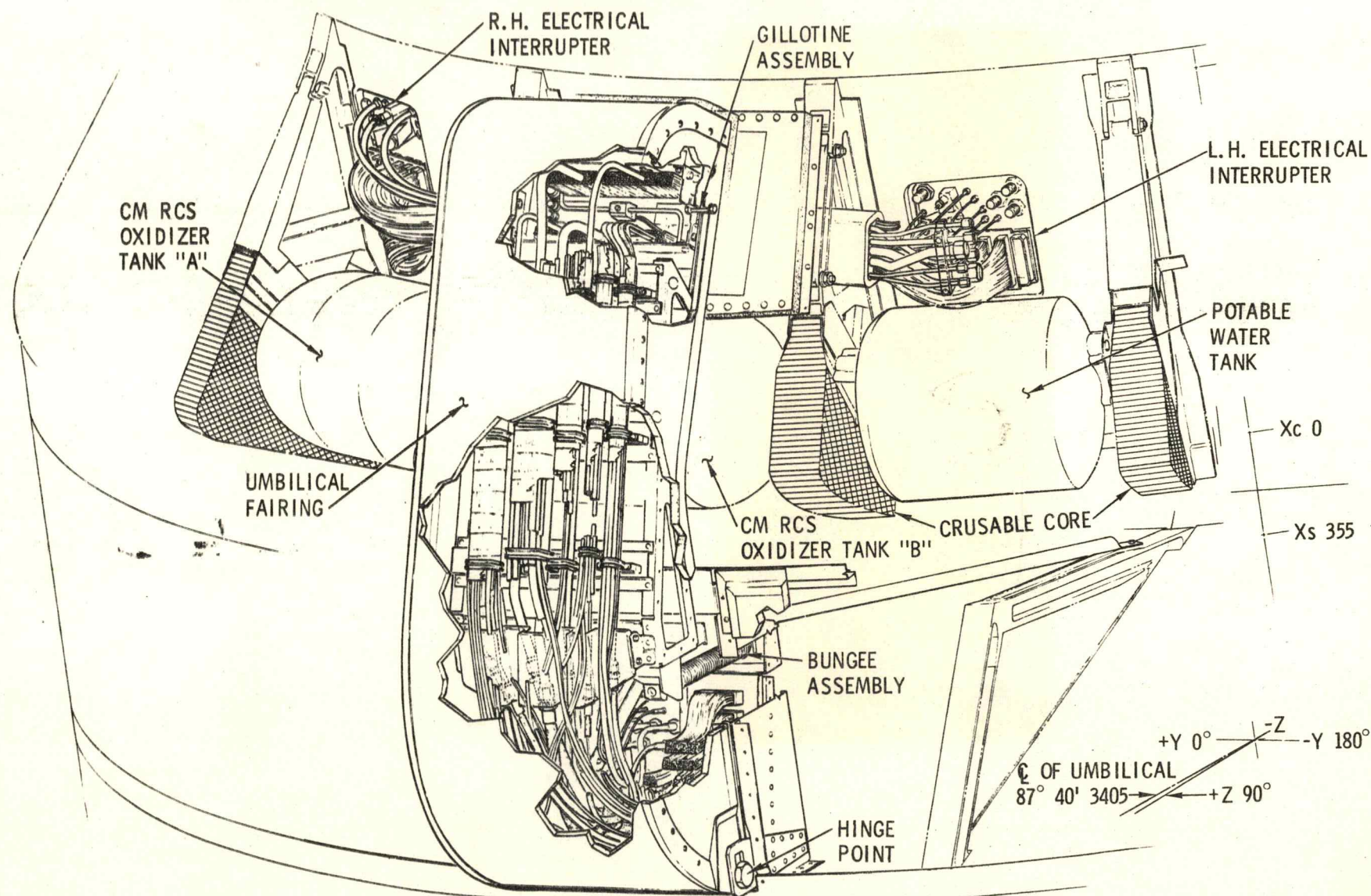
C/M-S/M SEPARATION SYSTEM

ORDNANCE INSTALLATION

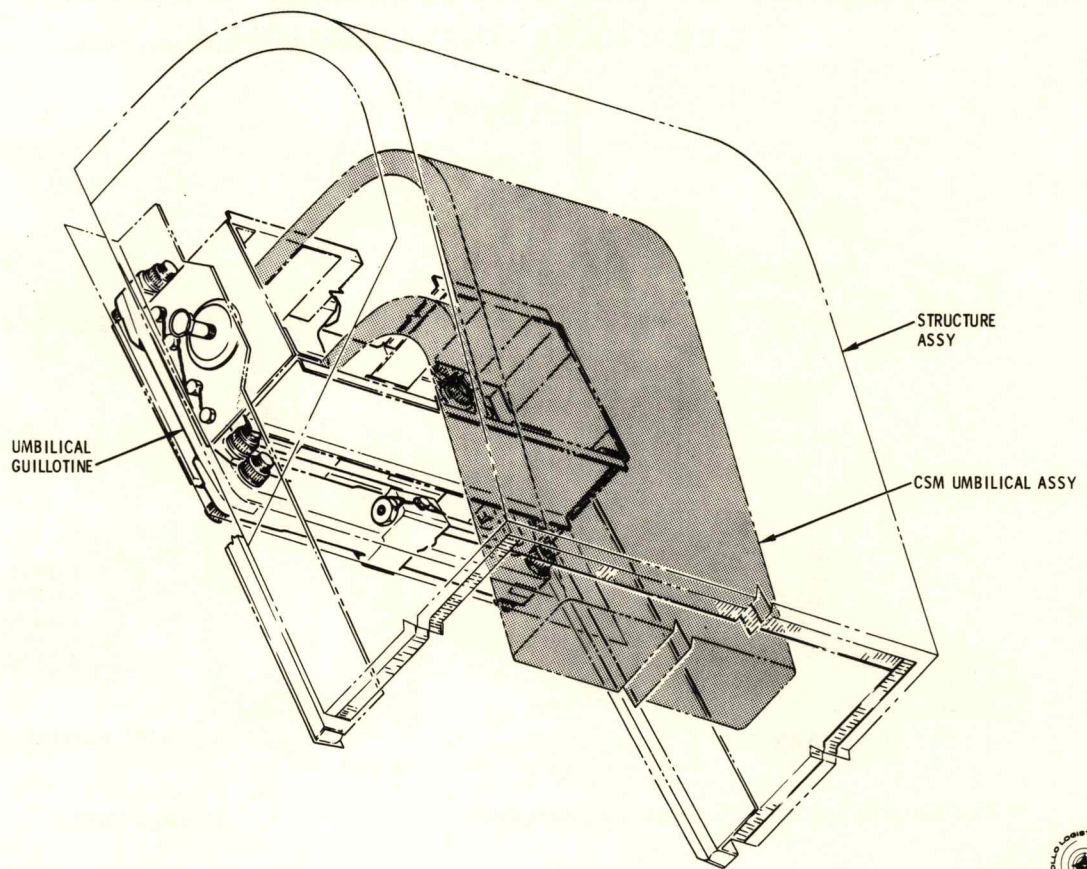


ST-602B 

COMMAND MODULE TO SERVICE MODULE UMBILICAL ASSEMBLY



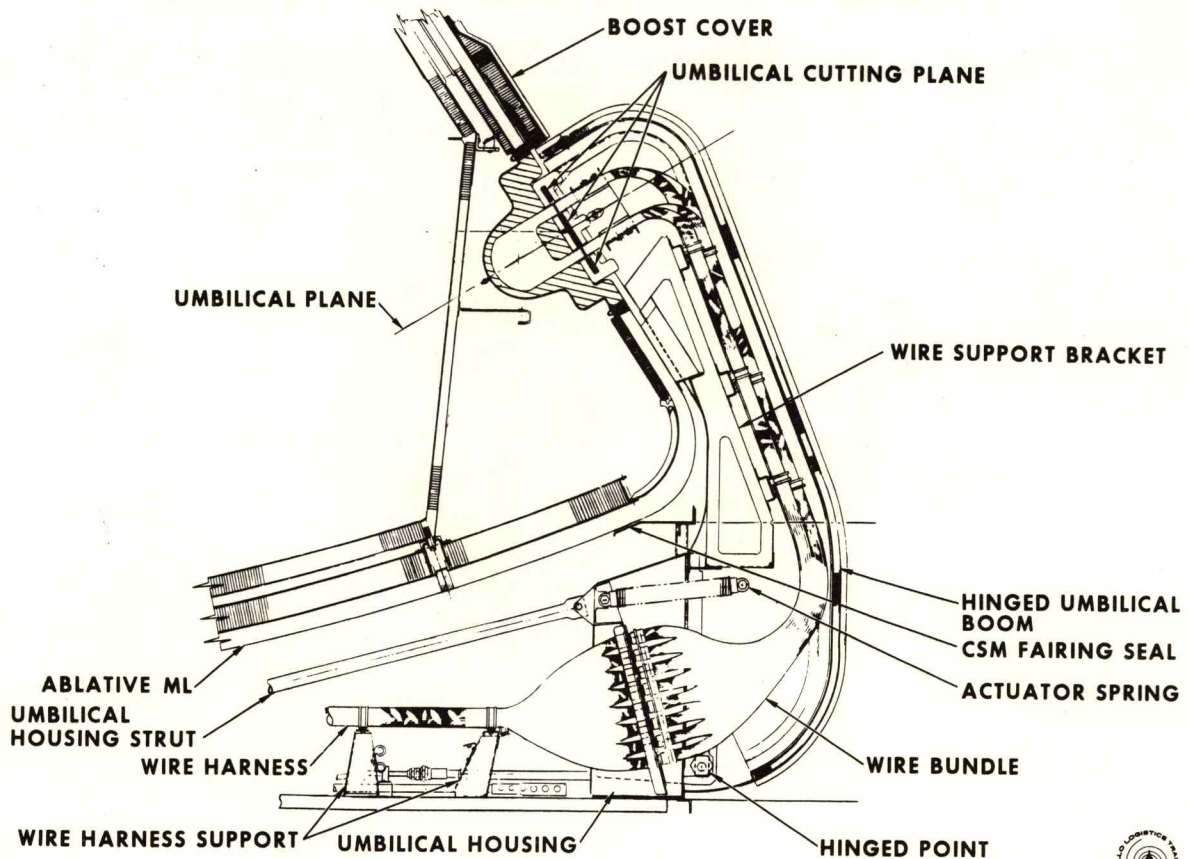
UMBILICAL SEPARATION SYSTEM



ST-1004

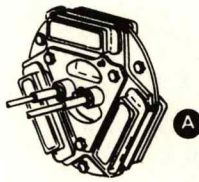


CM TO SM ELECTRICAL CABLE AND HARD LINE ASSY BLK II

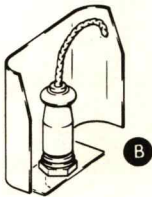


ADAPTER SEPARATION SYSTEM

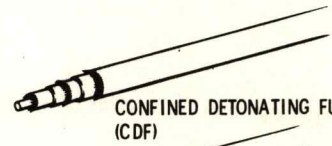
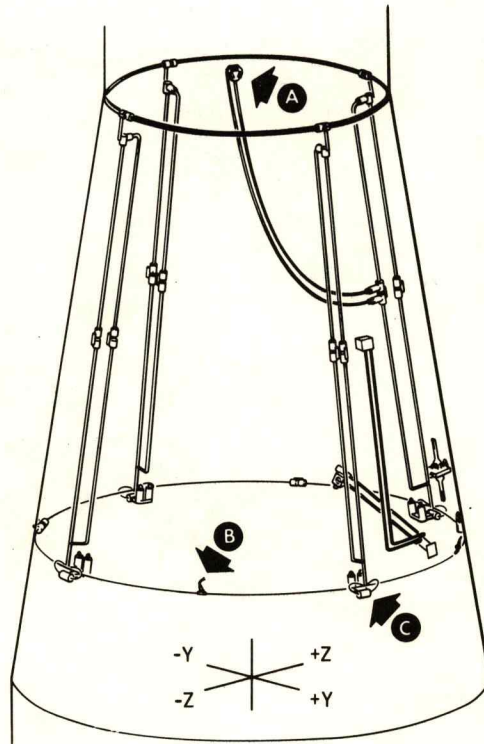
BLOCK II



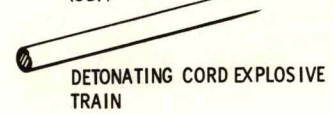
UMBILICAL
SEPARATION



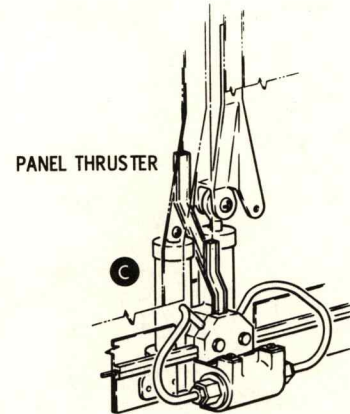
INITIATOR &
SHIELD



CONFINED DETONATING FUSE
(CDF)



DETONATING CORD EXPLOSIVE
TRAIN

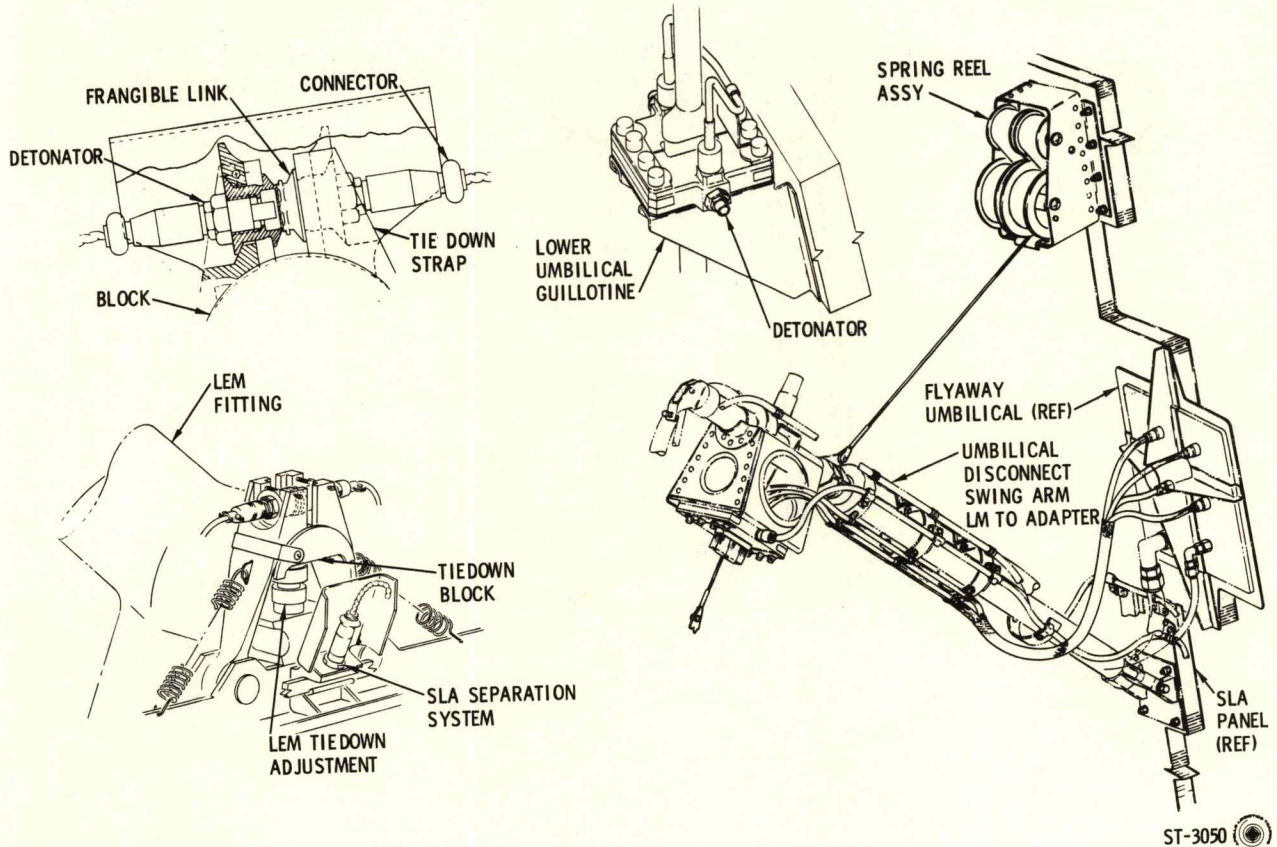


PANEL THRUSTER

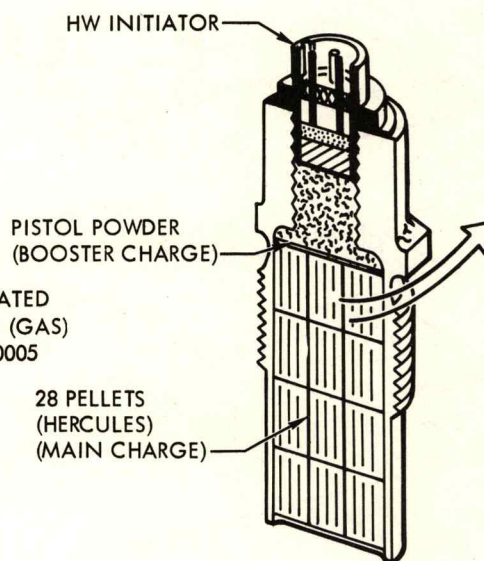
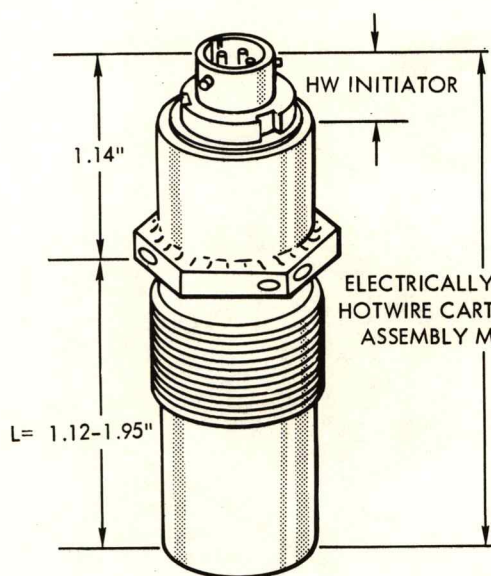
ST-3029



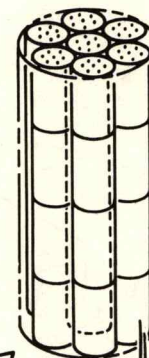
LEM SEPARATION SYSTEM BLOCK II



HOTWIRE PRESSURE CARTRIDGE ASSEMBLY ELECTRICALLY INITIATED



MAIN CHARGE

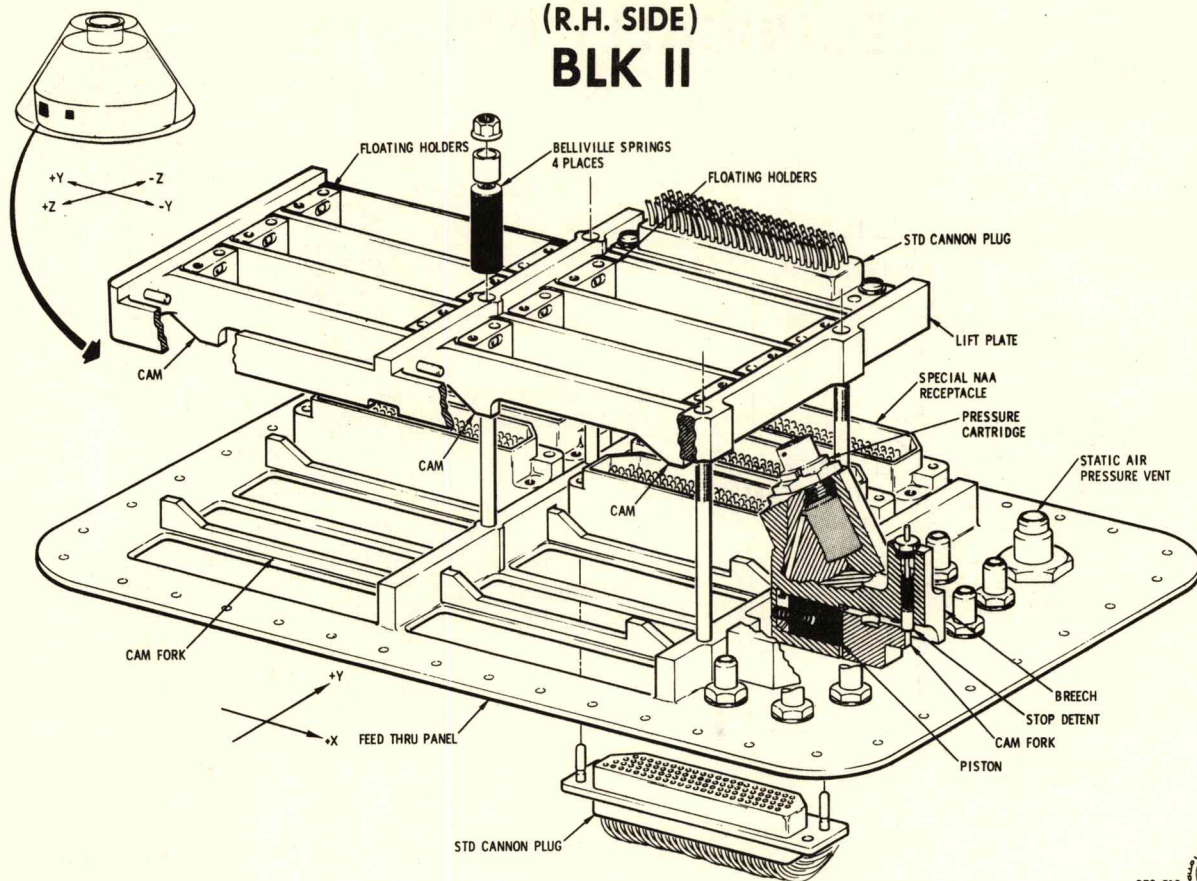


PELLET

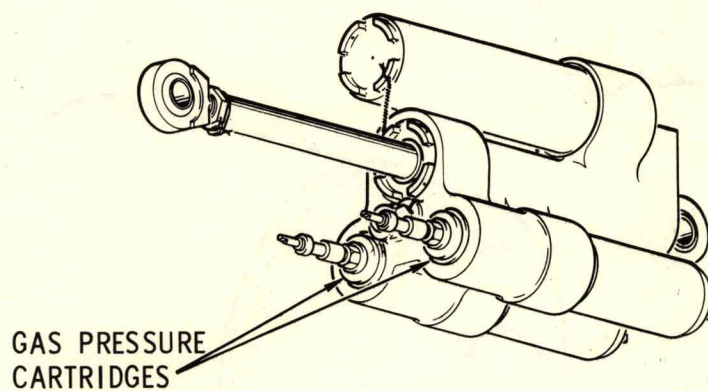
ST-9075A



36
CIRCUIT INTERRUPTER
 (R.H. SIDE)
BLK II

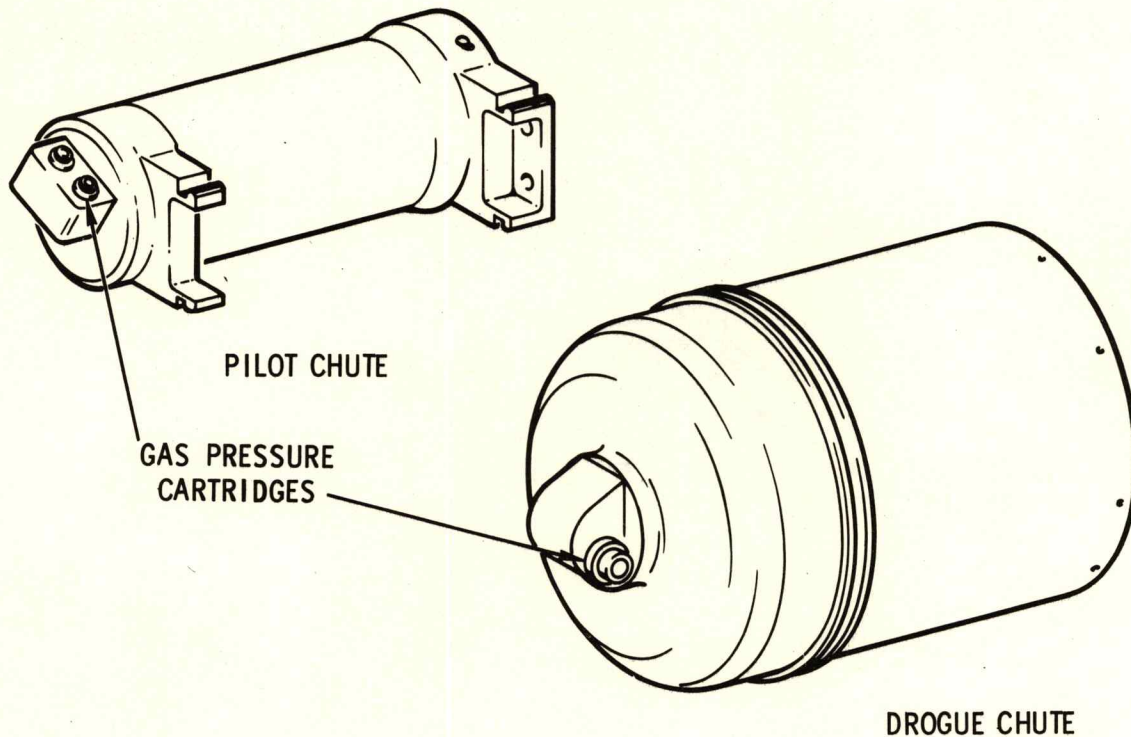


CANARD ACTUATOR



SEQ-70 

PARACHUTE DEPLOYMENT MORTARS (BLK II)

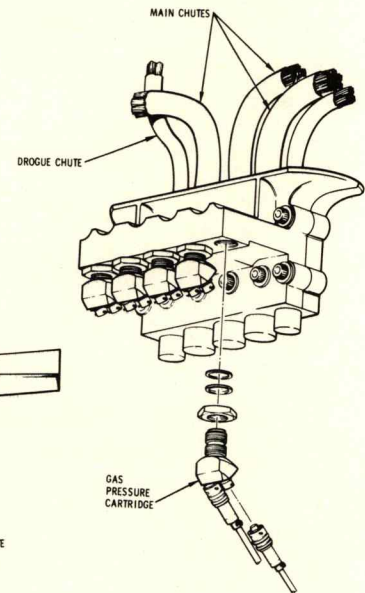
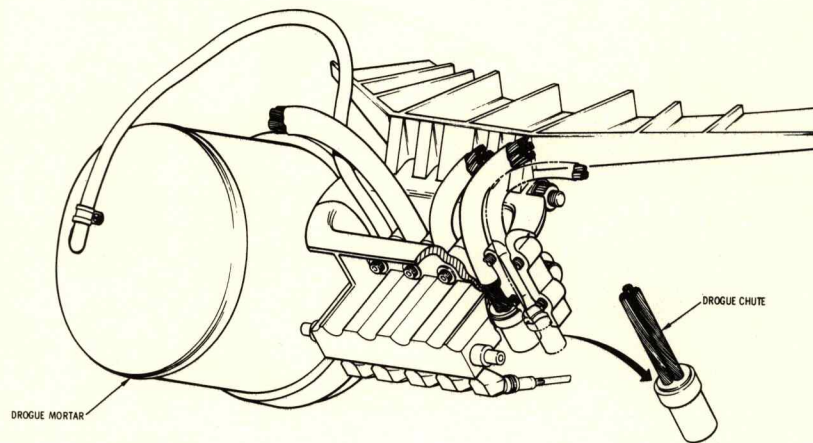
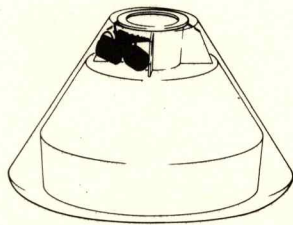


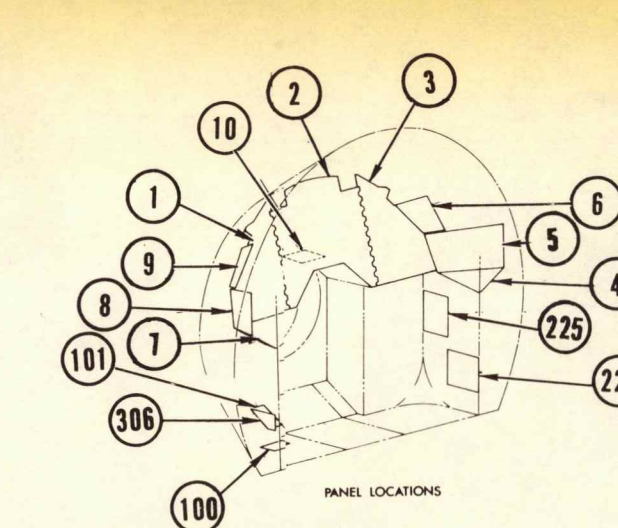
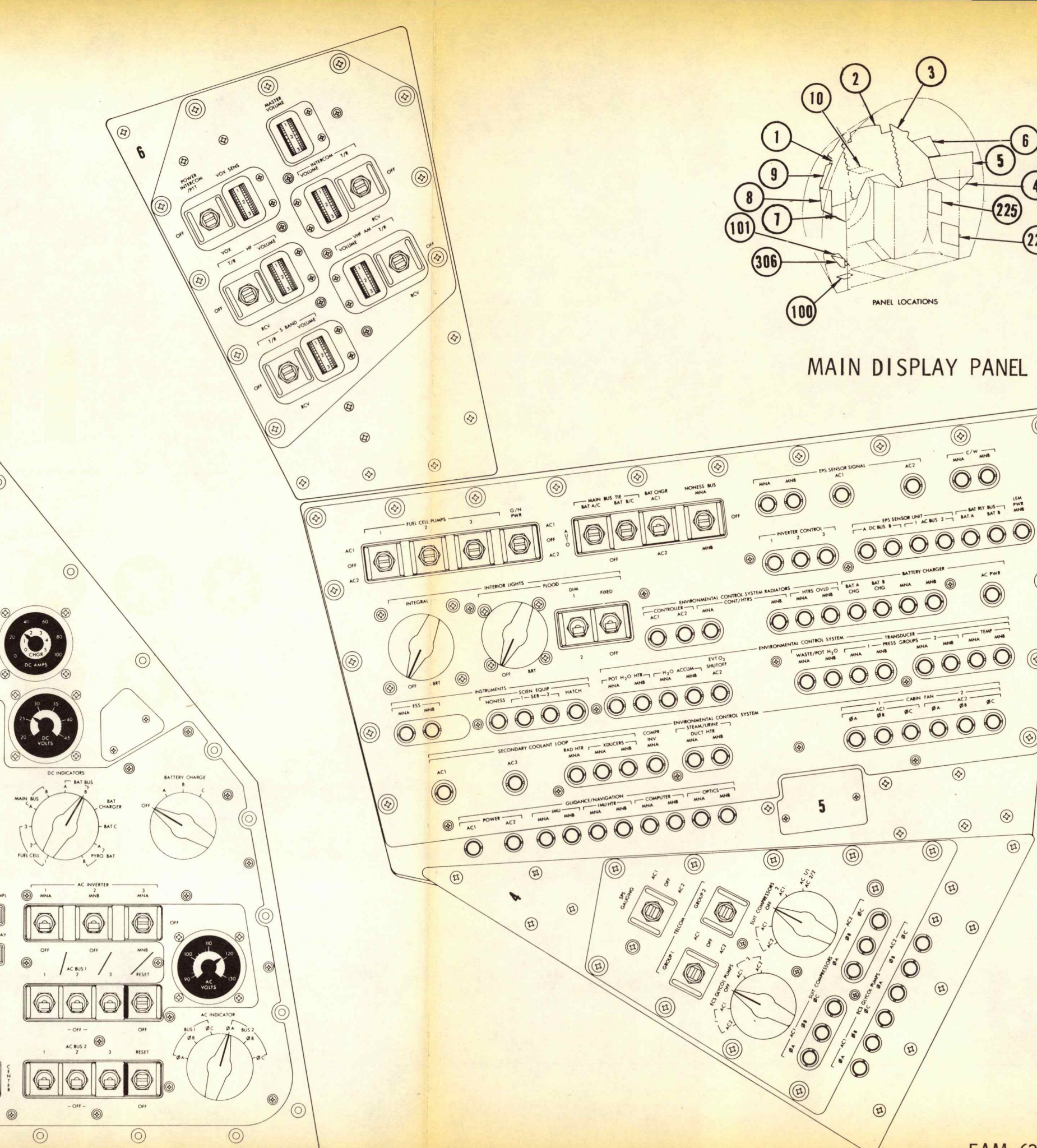
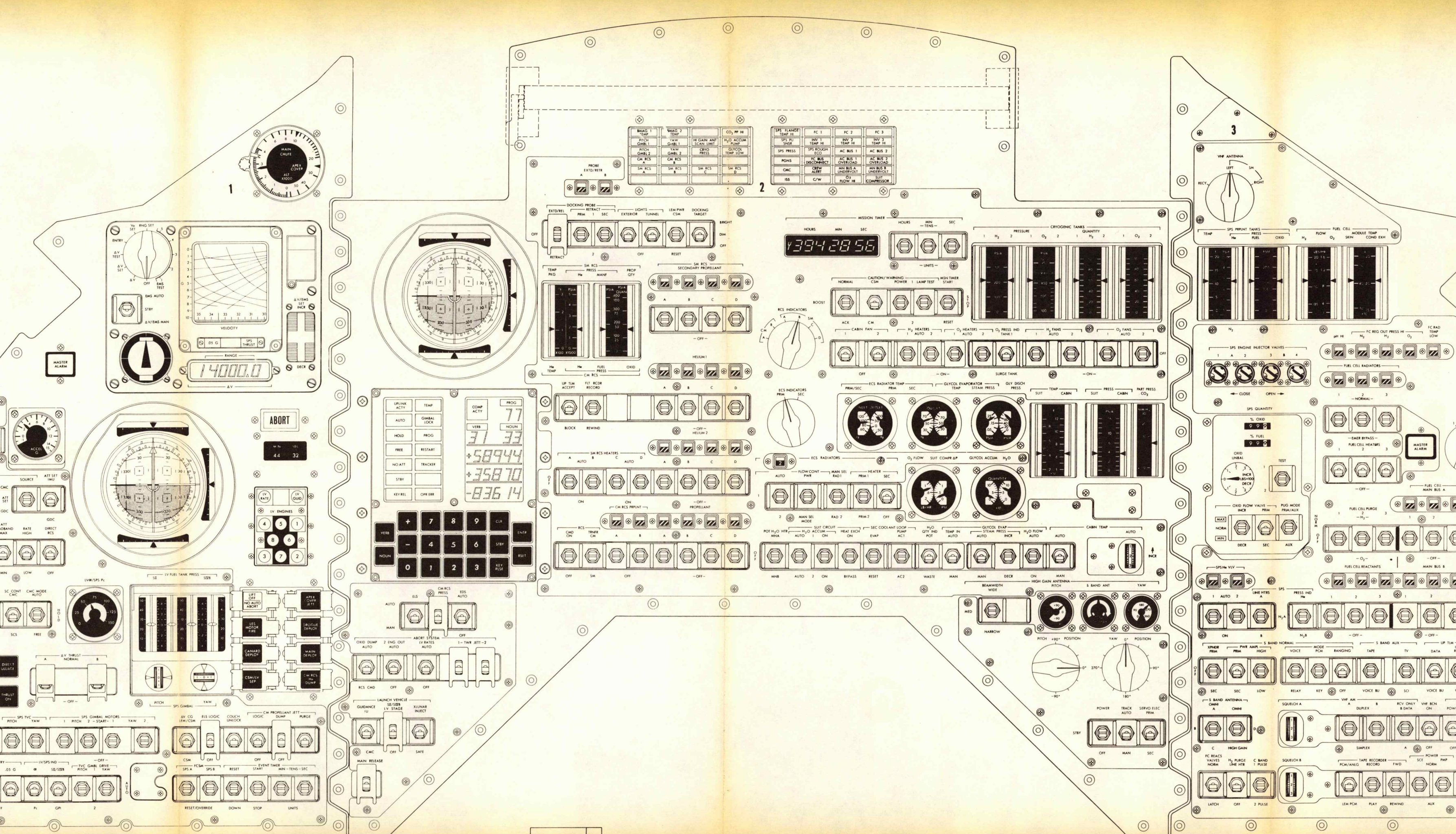
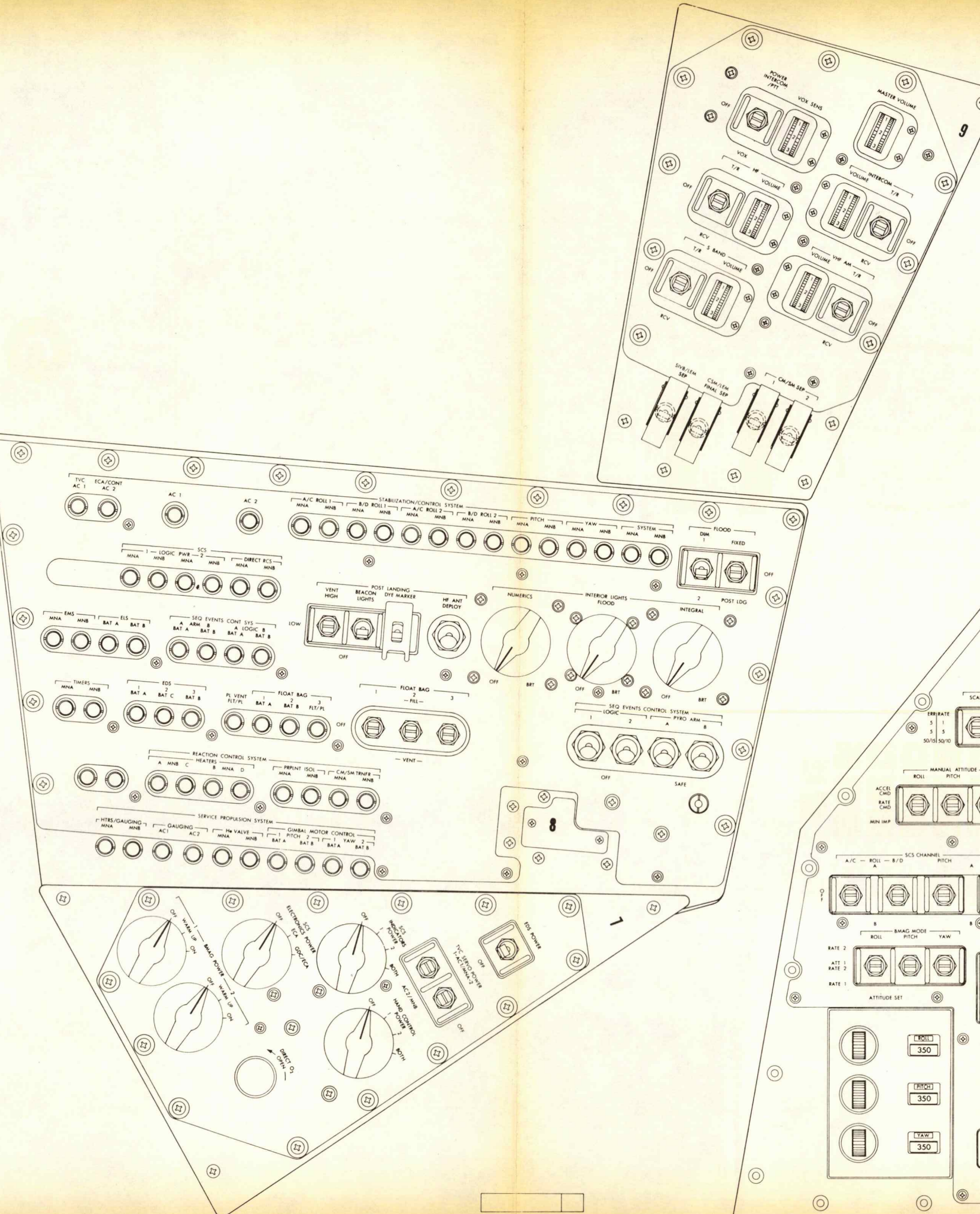
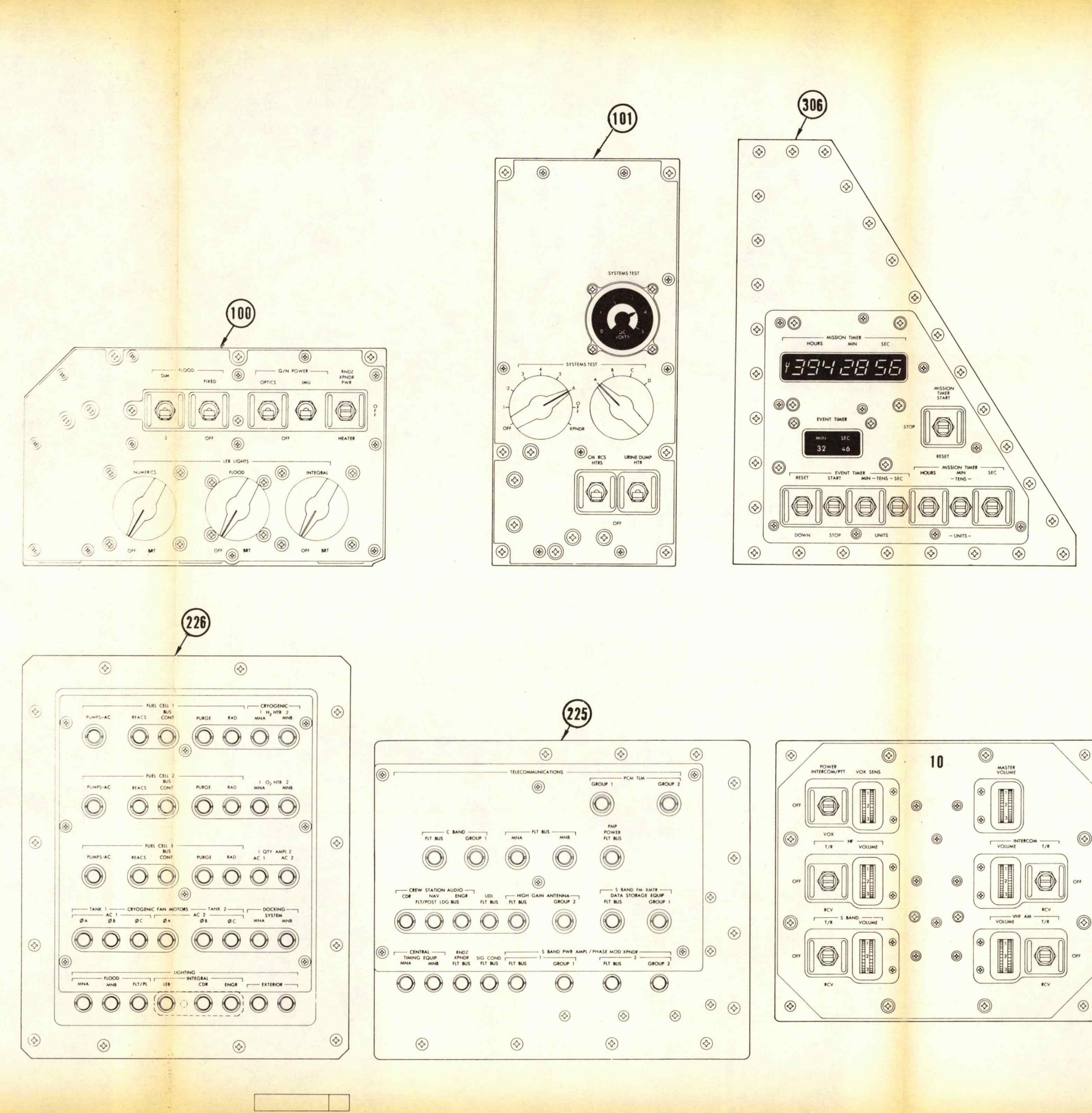
SEQ-510



39

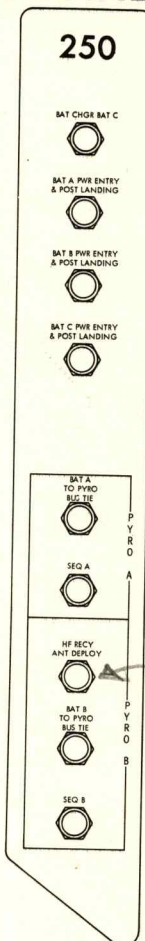
PARACHUTE DISCONNECT (FLOWER POT) BLK II





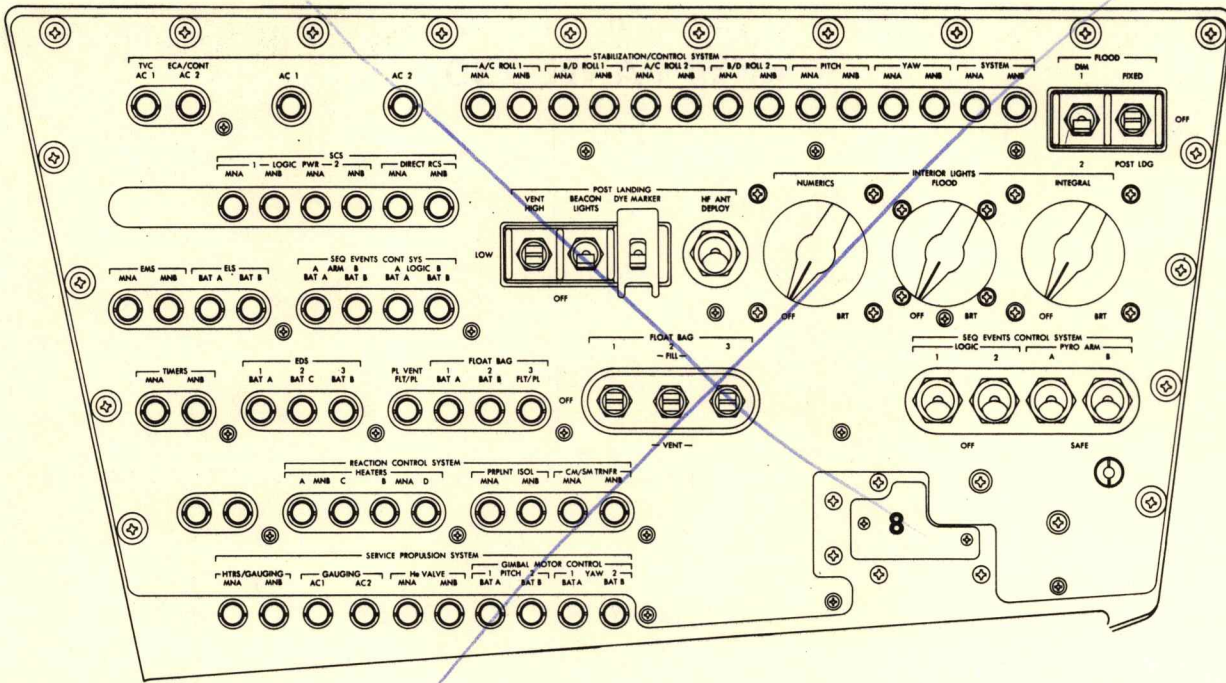
MAIN DISPLAY PANEL

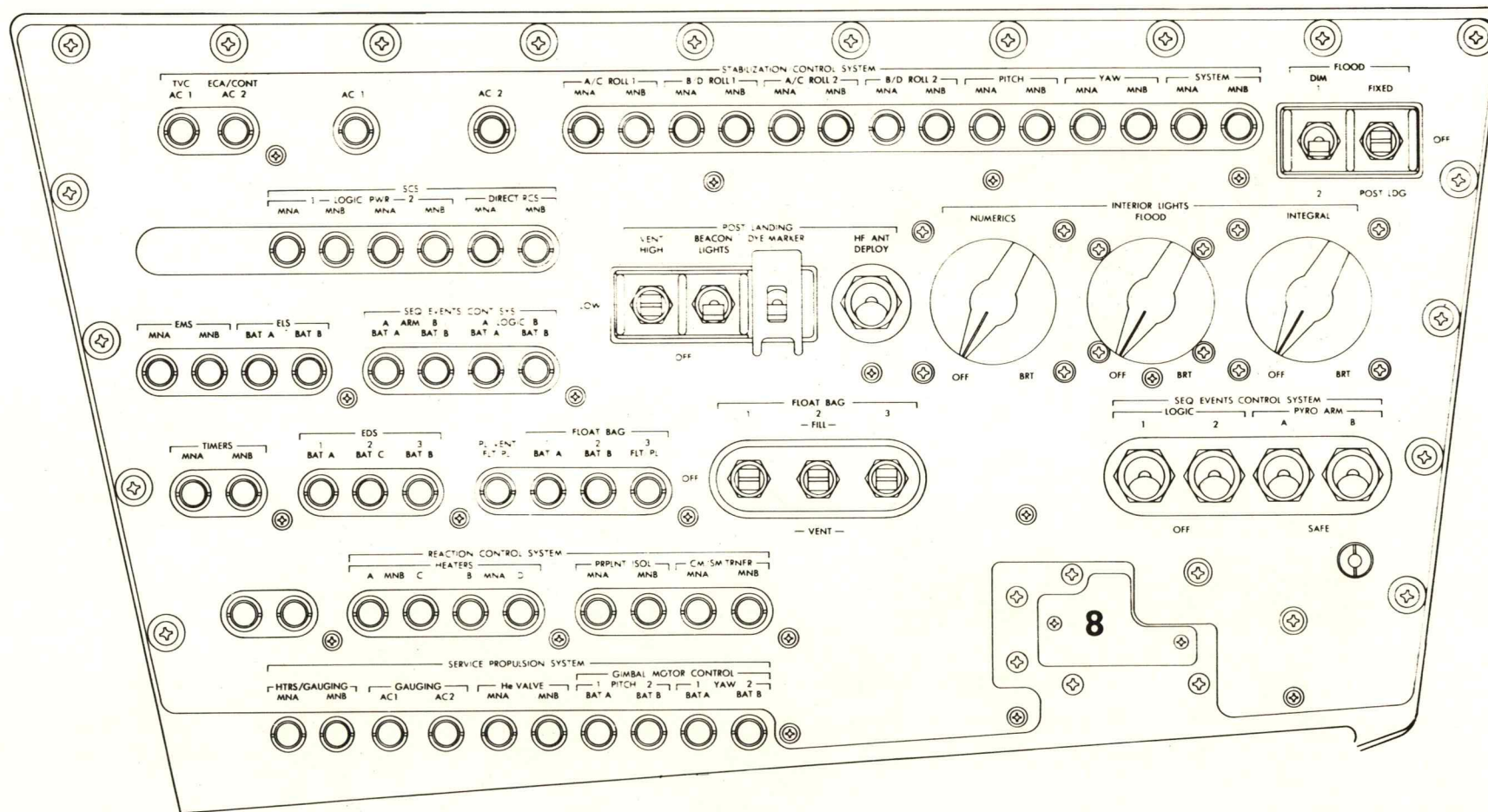
RHEB PANEL 250



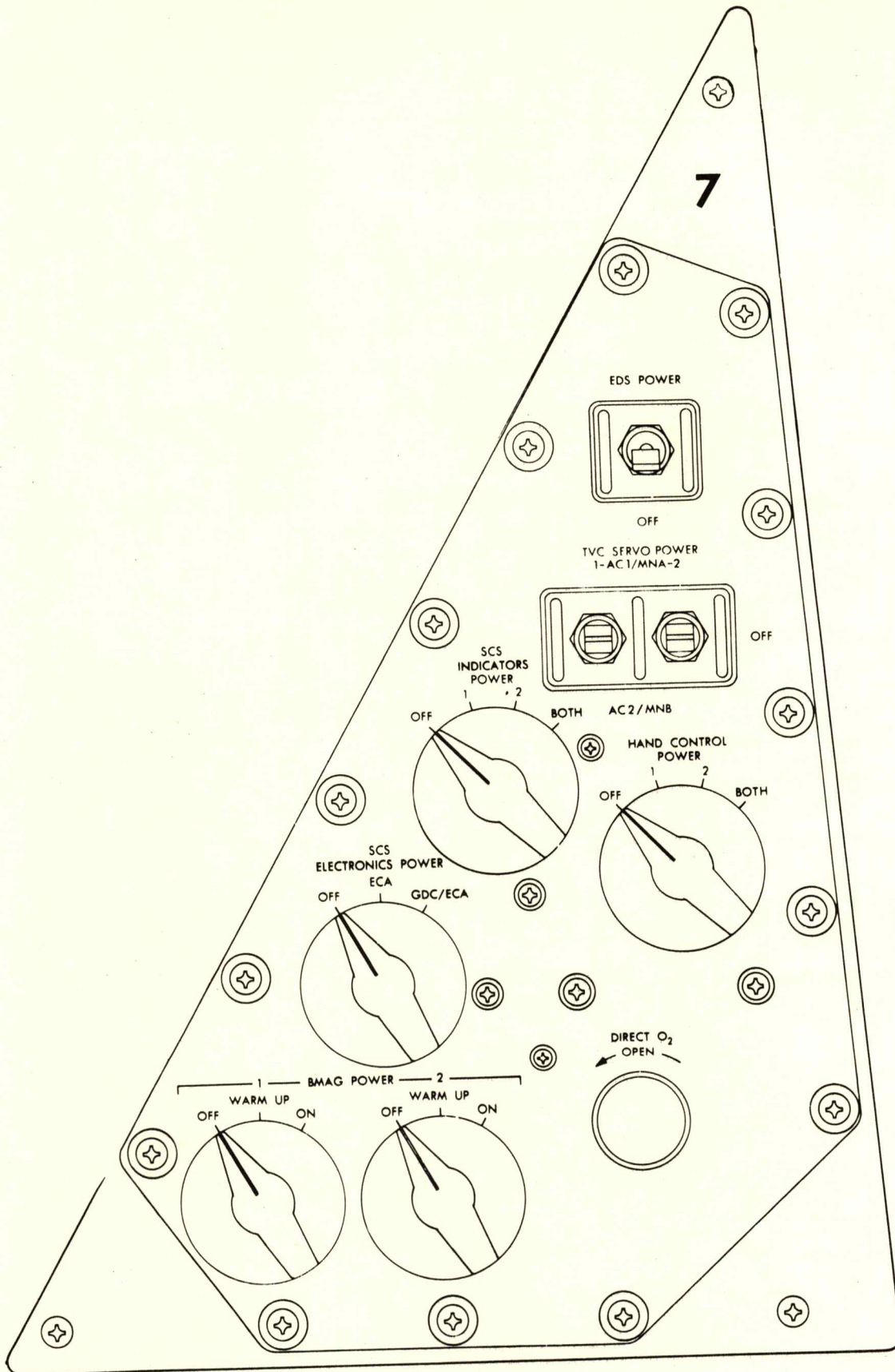
SEQ-521

*Not used*



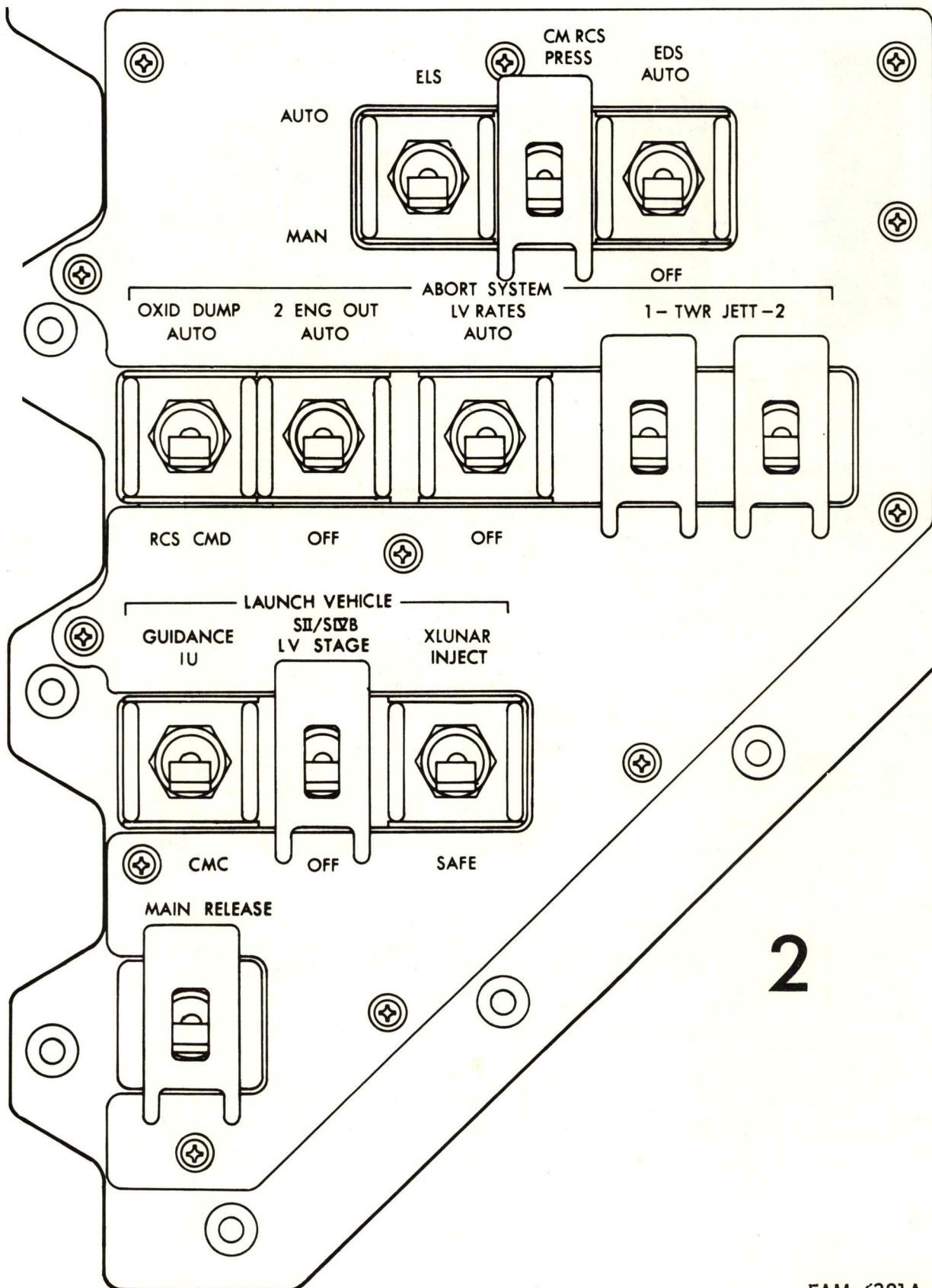


7

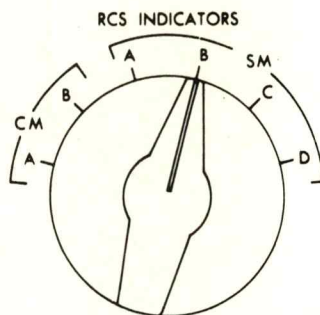
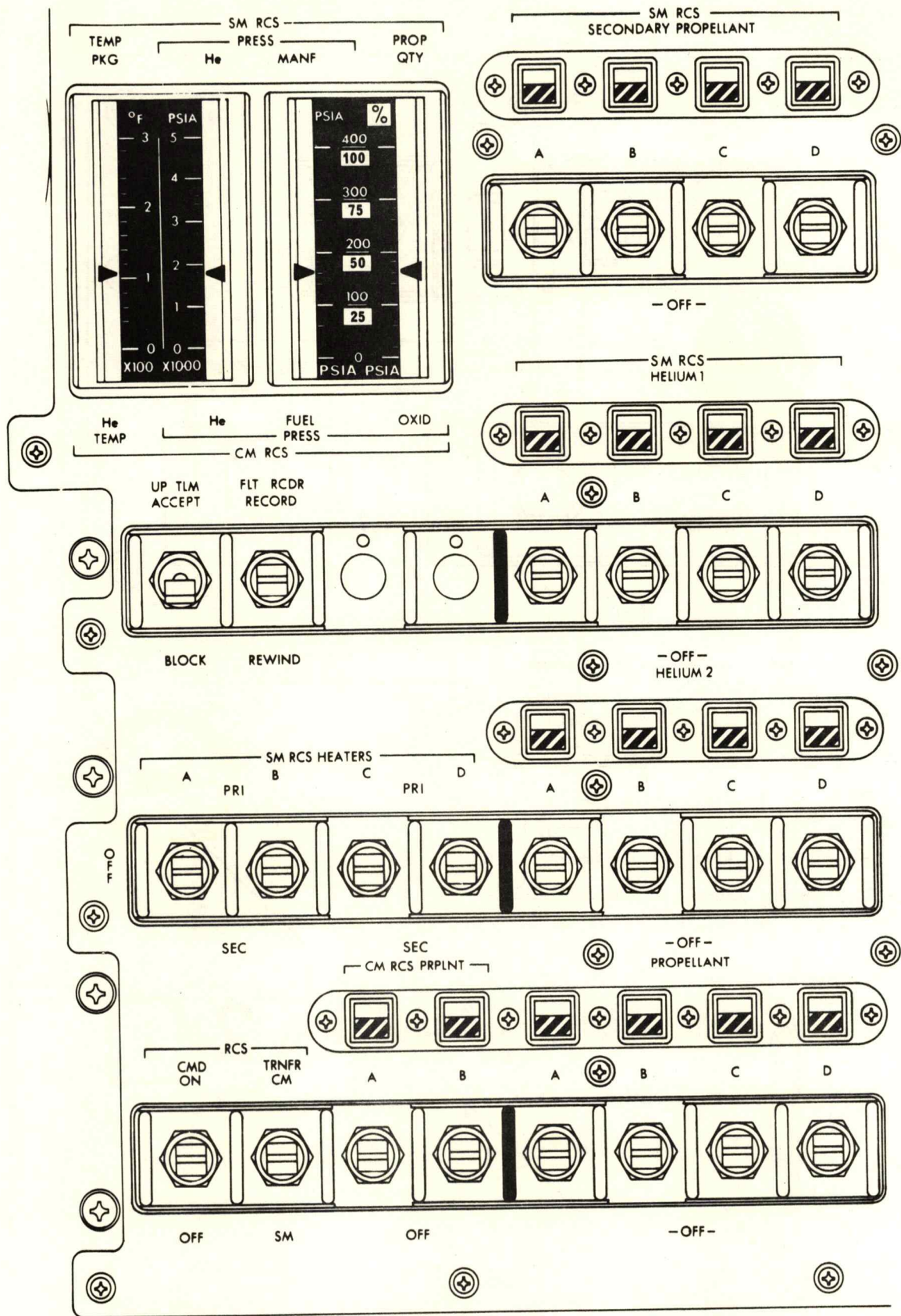


FAM-6370A

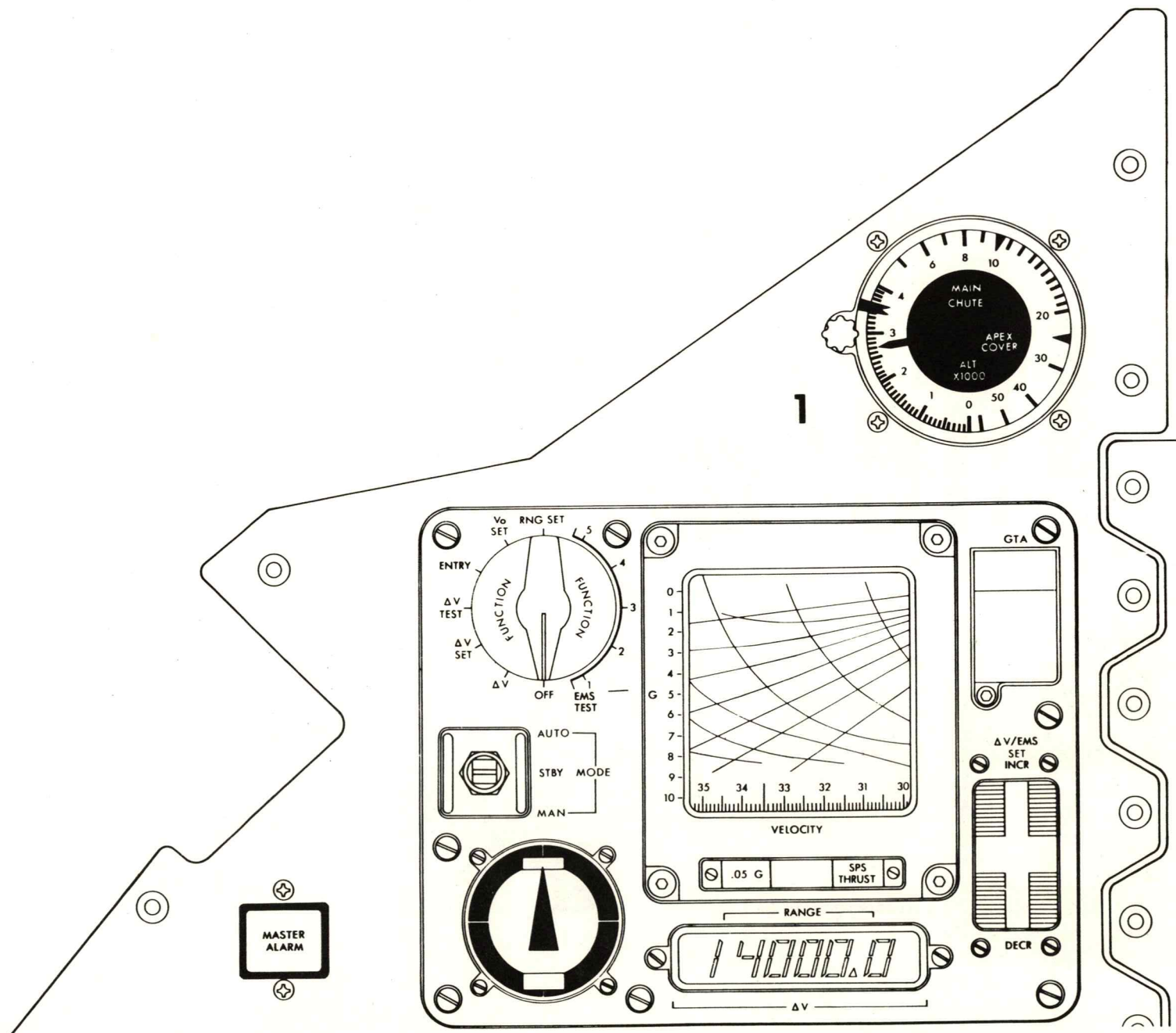




2

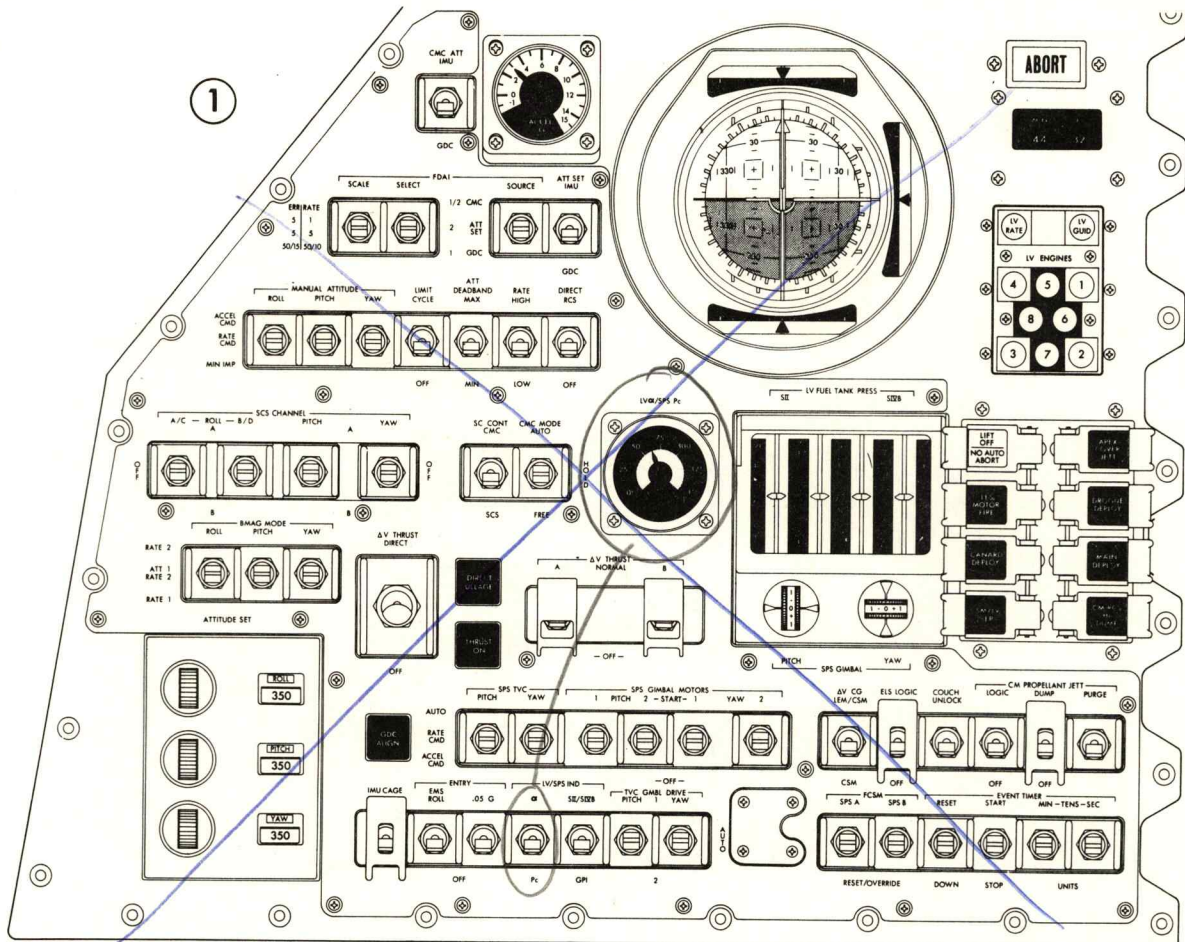


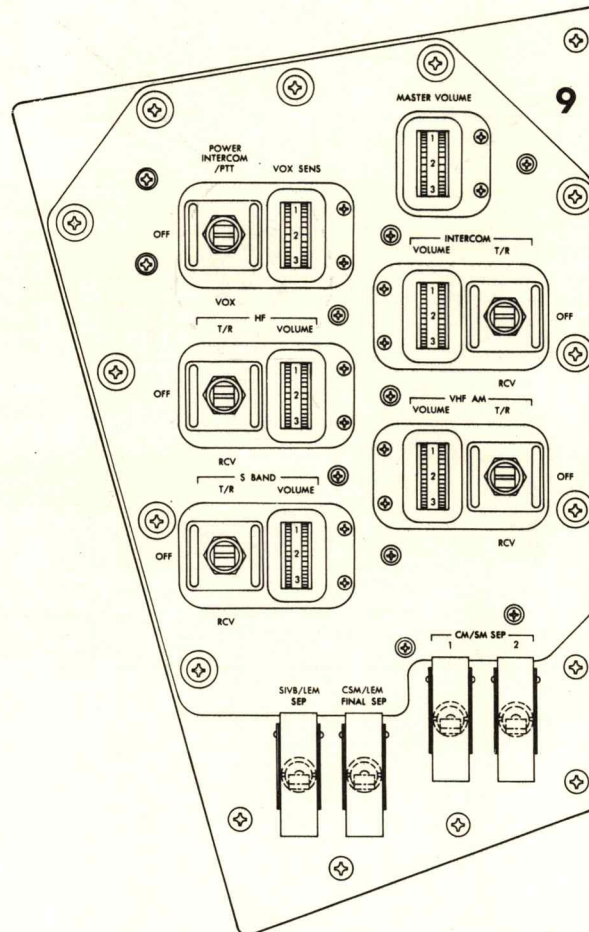
2

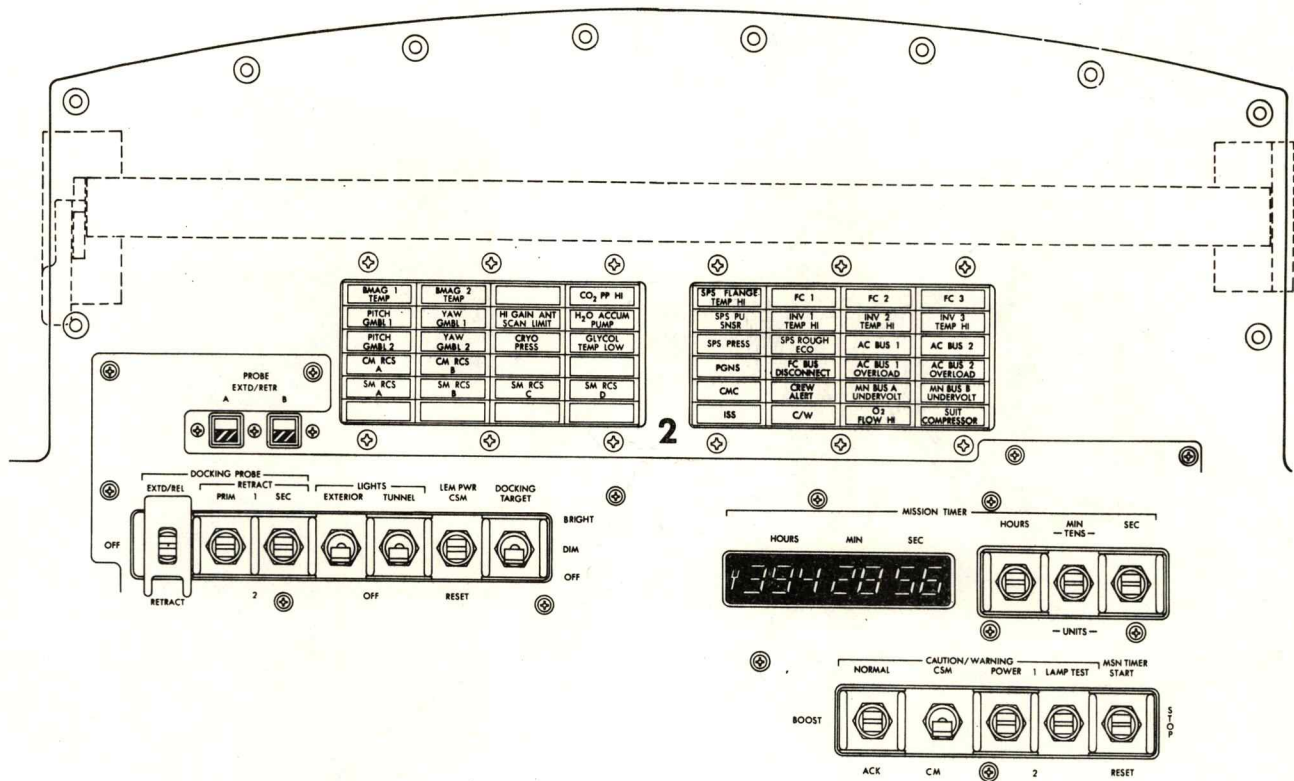


FAM-6311C

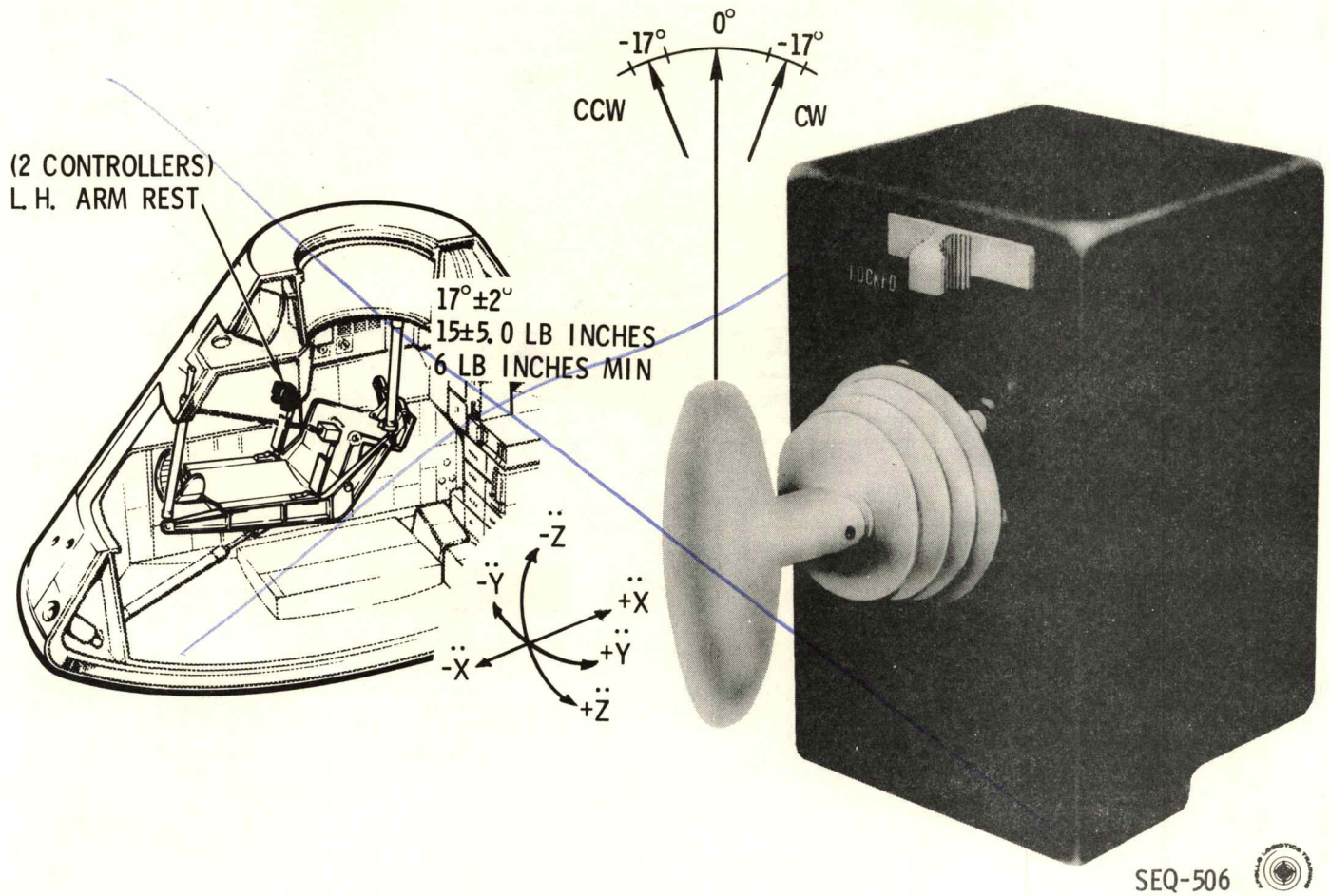






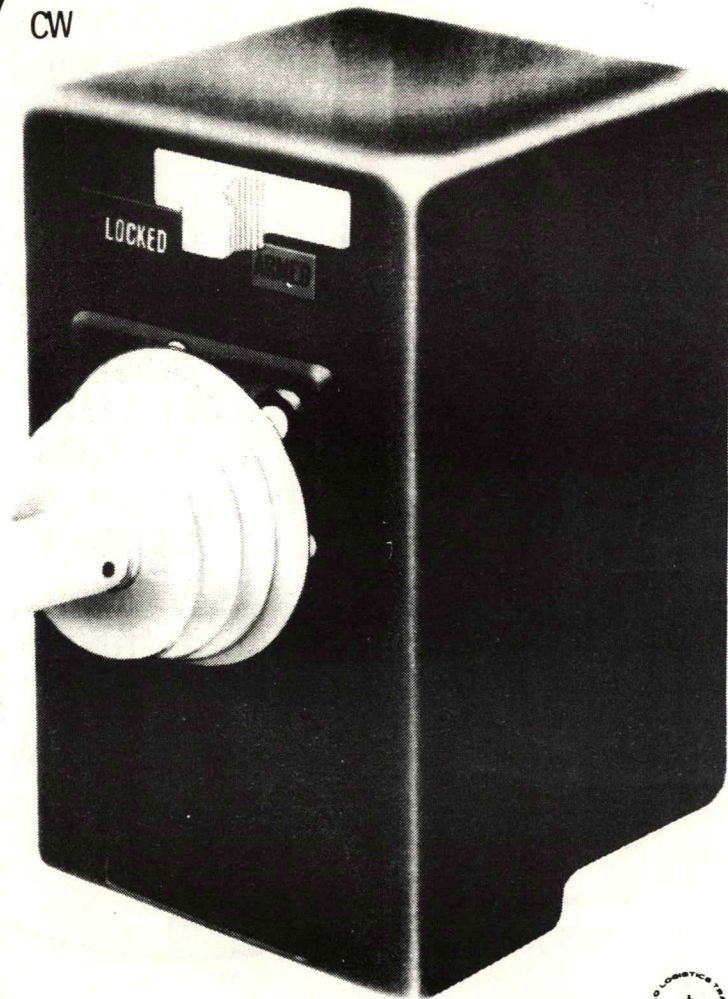
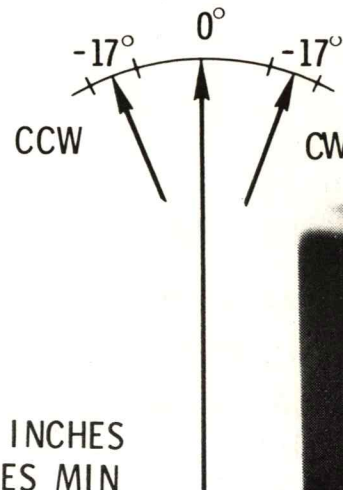
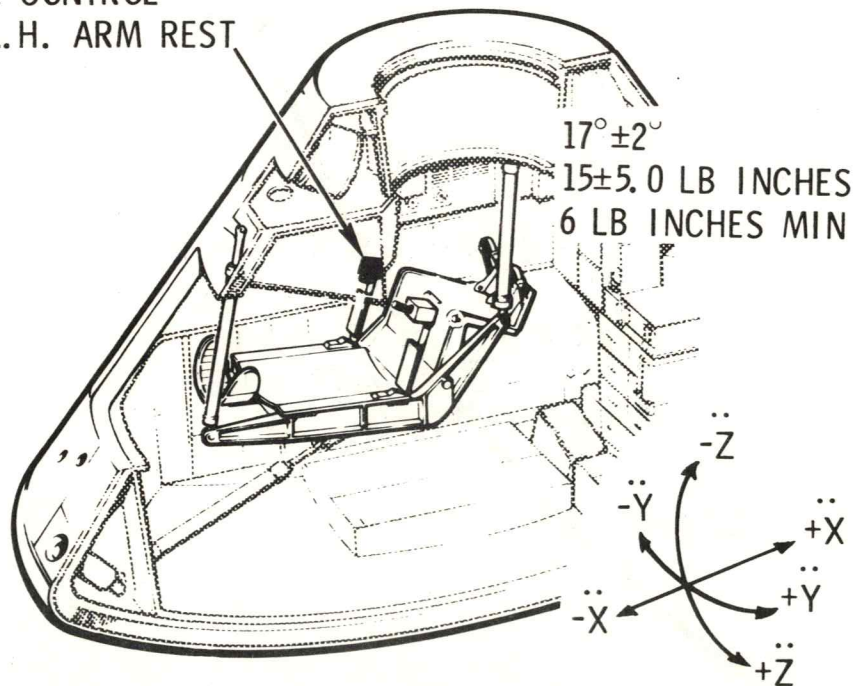


TRANSLATION CONTROL



TRANSLATION CONTROL

1 CONTROL
L.H. ARM REST



SEQ-506A

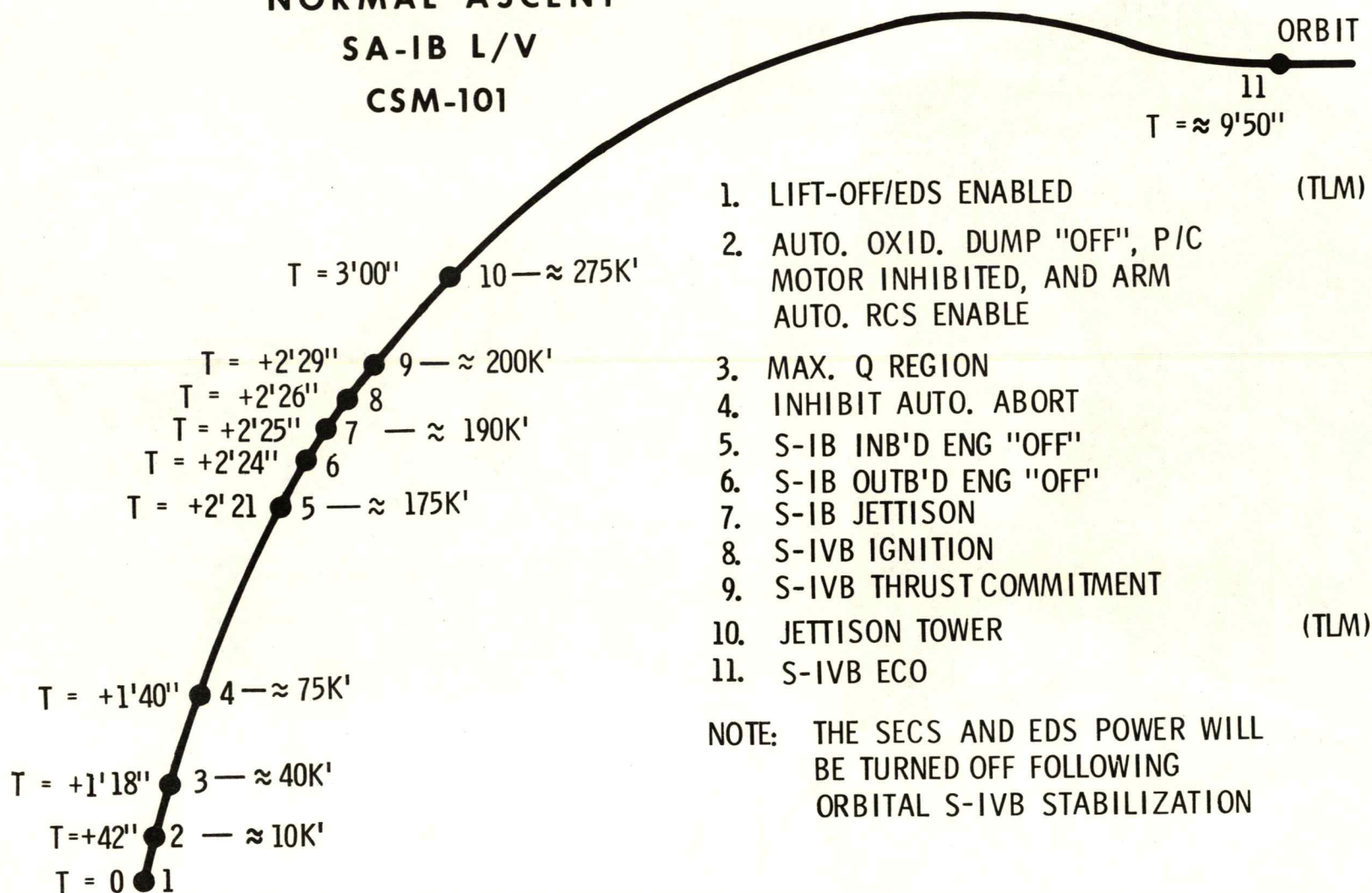


EVENT PROFILE

NORMAL ASCENT

SA-IB L/V

CSM-101



1. LIFT-OFF/EDS ENABLED (TLM)
2. AUTO. OXID. DUMP "OFF", P/C MOTOR INHIBITED, AND ARM AUTO. RCS ENABLE
3. MAX. Q REGION
4. INHIBIT AUTO. ABORT
5. S-IB INB'D ENG "OFF"
6. S-IB OUTB'D ENG "OFF"
7. S-IB JETTISON
8. S-IVB IGNITION
9. S-IVB THRUST COMMITMENT
10. JETTISON TOWER (TLM)
11. S-IVB ECO

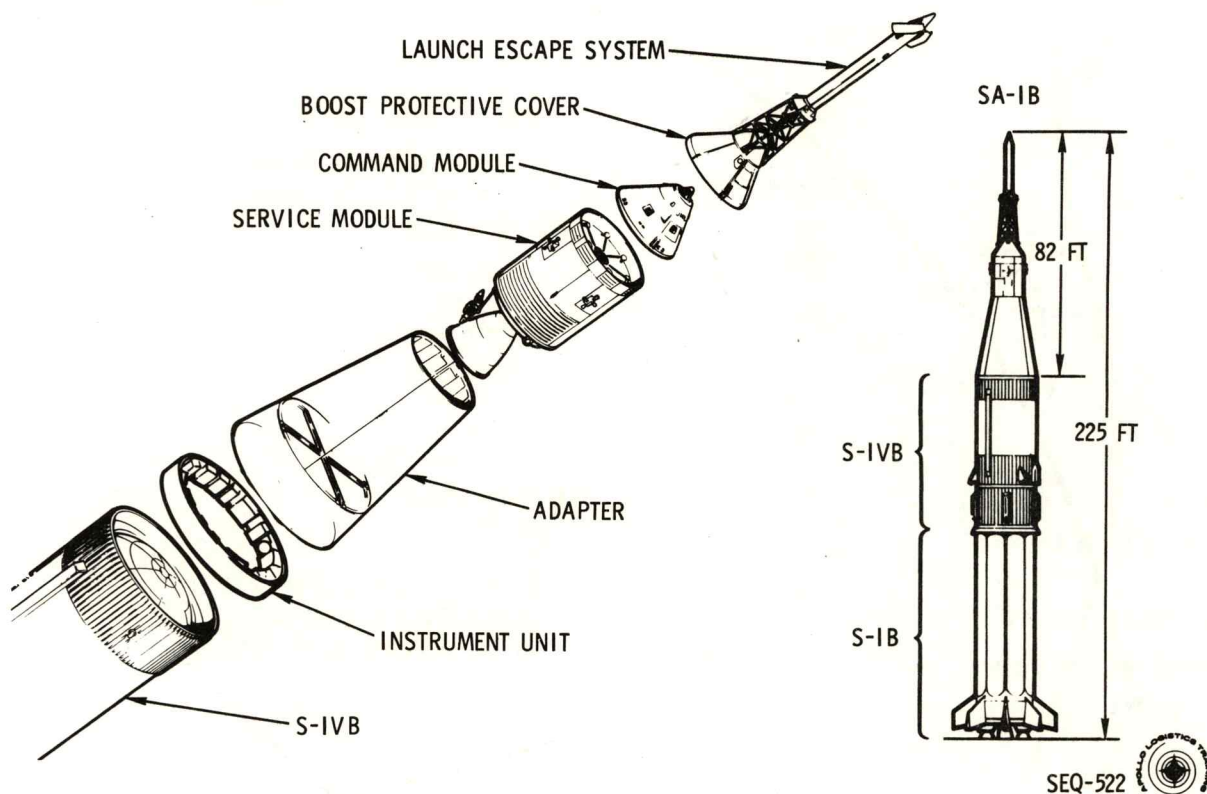
NOTE: THE SECS AND EDS POWER WILL BE TURNED OFF FOLLOWING ORBITAL S-IVB STABILIZATION

SEQ-531A



APOLLO SPACECRAFT

CSM-101

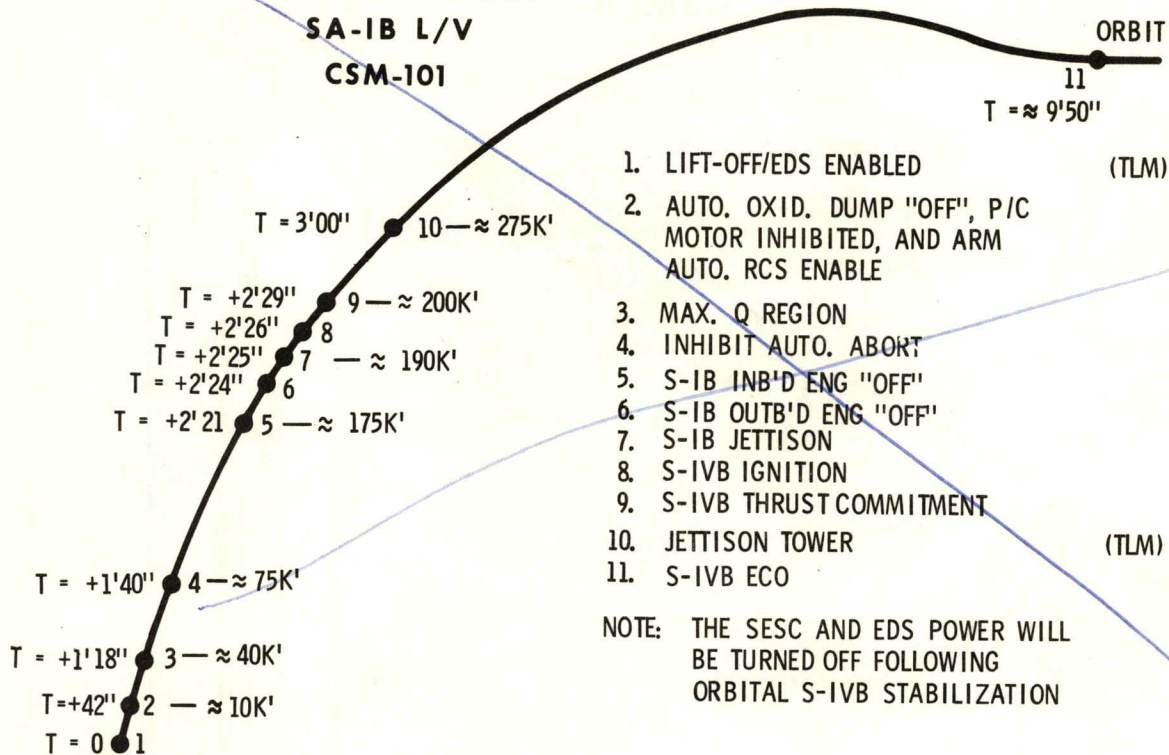


EVENT PROFILE

NORMAL ASCENT

SA-IB L/V

CSM-101



1. LIFT-OFF/EDS ENABLE (TLM)
2. AUTO. OXID. DUMP "OFF", P/C MOTOR INHIBITED, AND ARM AUTO. RCS ENABLE
3. MAX. Q REGION
4. INHIBIT AUTO. ABORT
5. S-IB INB'D ENG "OFF"
6. S-IB OUTB'D ENG "OFF"
7. S-IB JETTISON
8. S-IVB IGNITION
9. S-IVB THRUST COMMITMENT (TLM)
10. JETTISON TOWER
11. S-IVB ECO

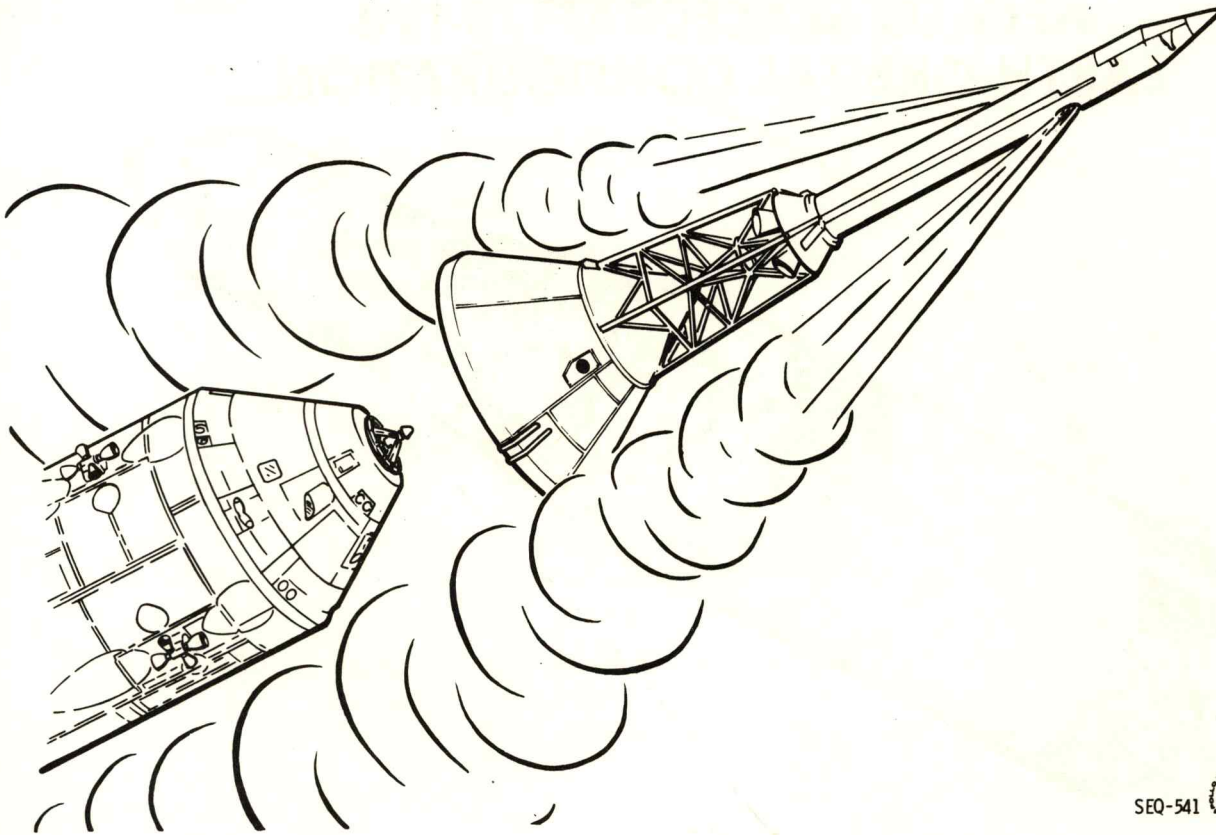
NOTE: THE SESC AND EDS POWER WILL BE TURNED OFF FOLLOWING ORBITAL S-IVB STABILIZATION

SEQ-531



NORMAL TOWER JETTISON

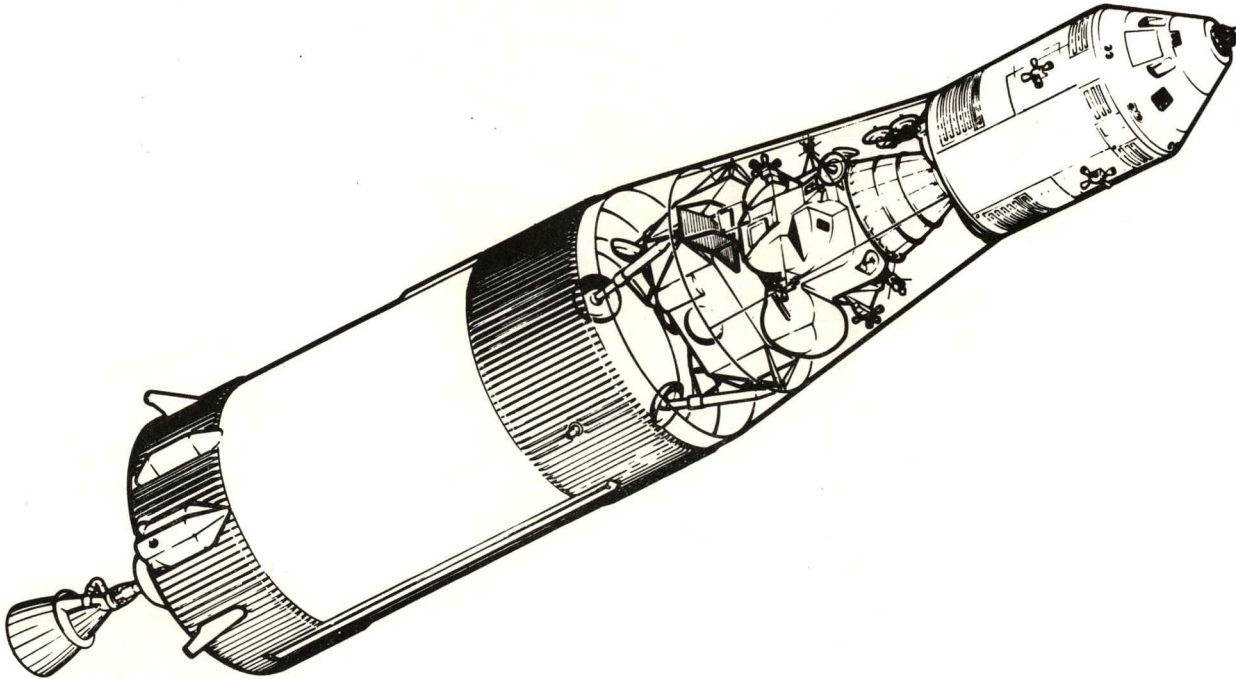
BLOCK II



SEQ-541 

APOLLO SPACECRAFT/S-IVB EARTH ORBITAL CONFIGURATION

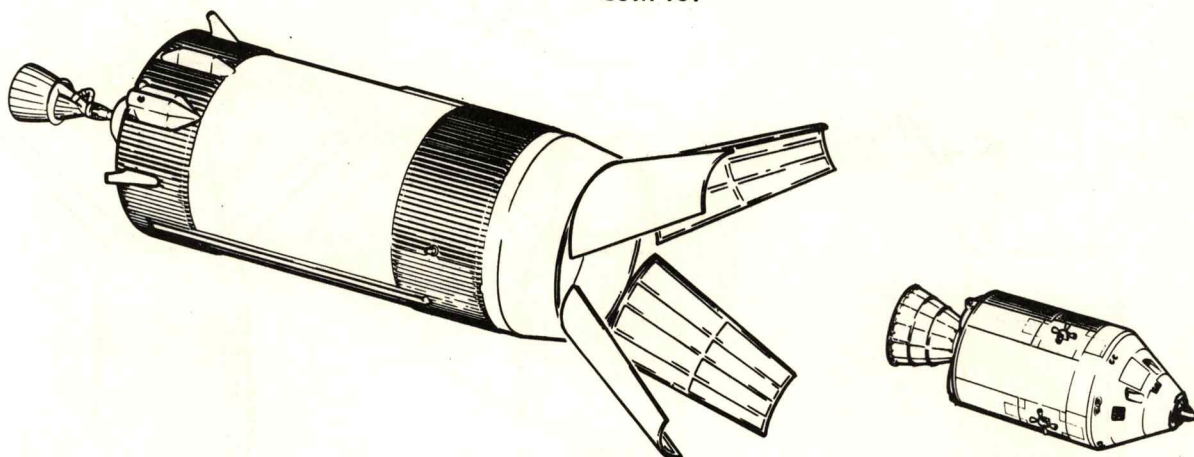
S125AP84510



55

NORMAL ADAPTER SEPARATION

BLOCK II
CSM 101

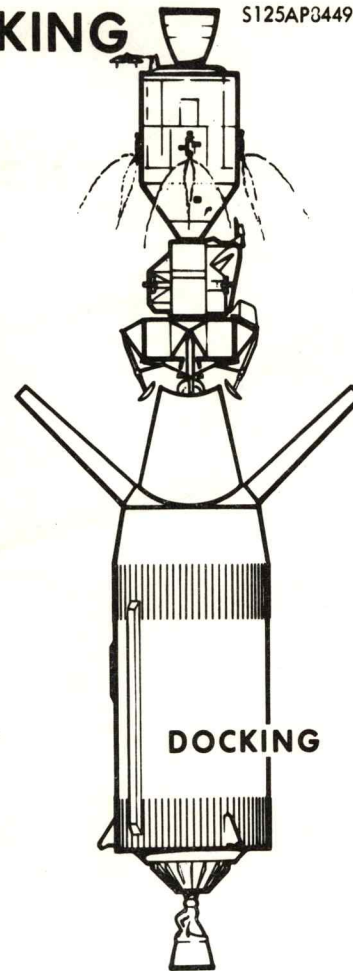
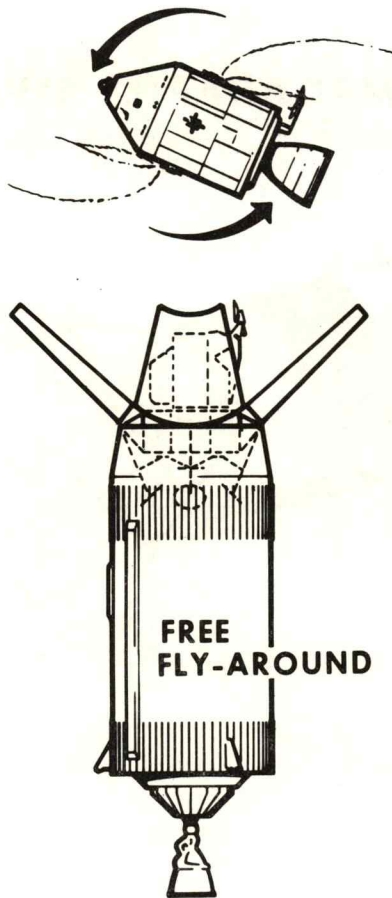
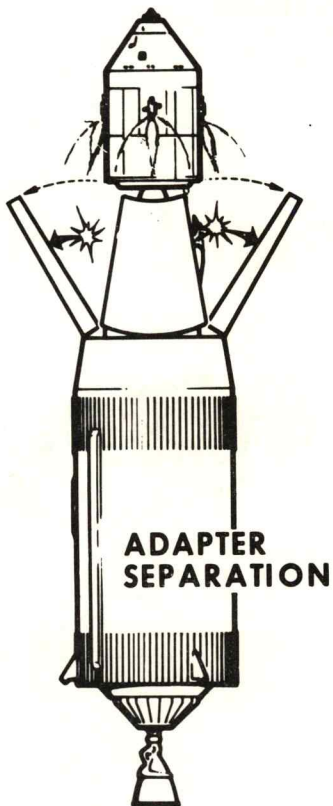


SEQ-542

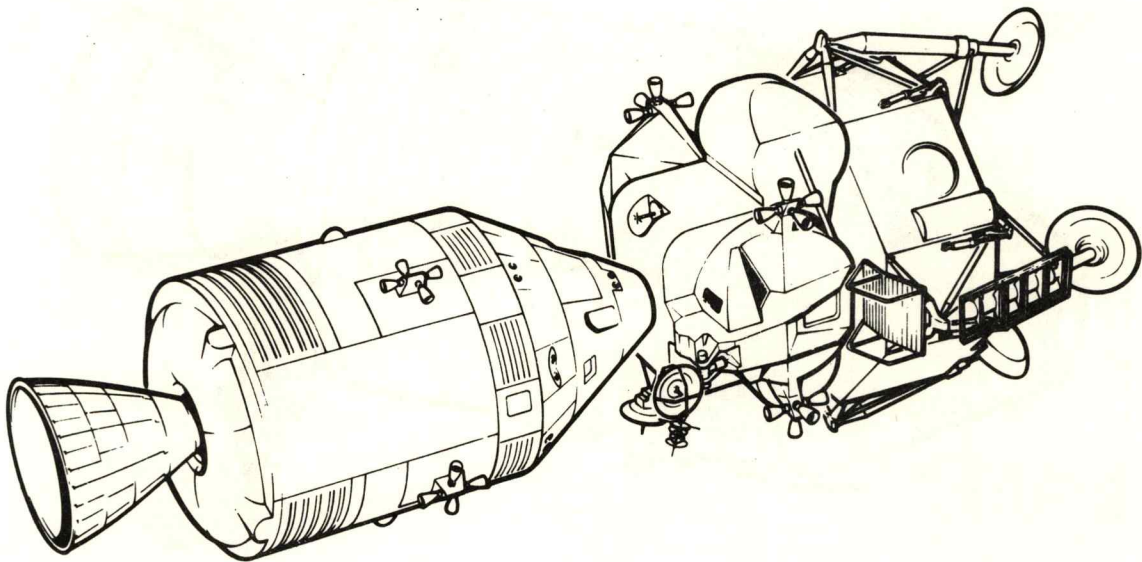


TRANSPOSITION & DOCKING

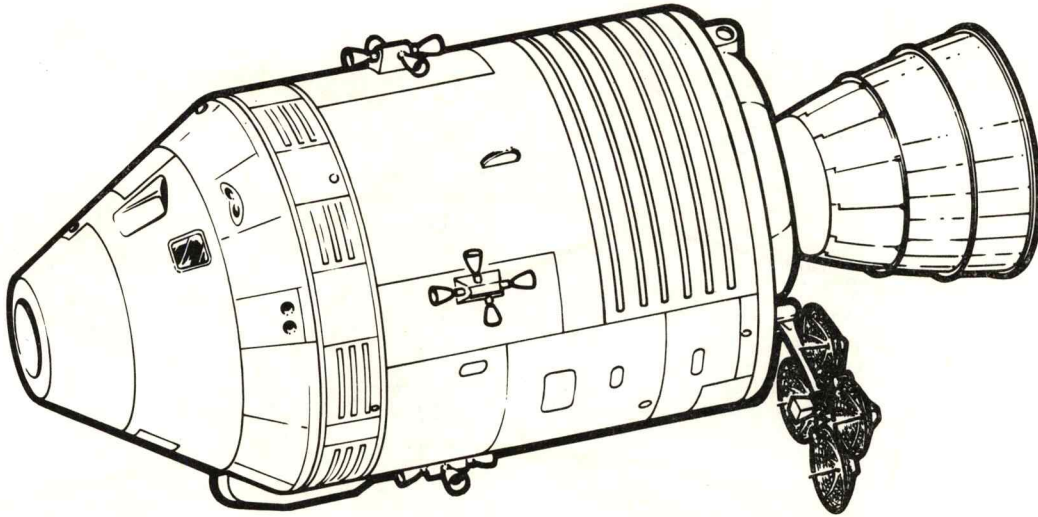
S125AP04493



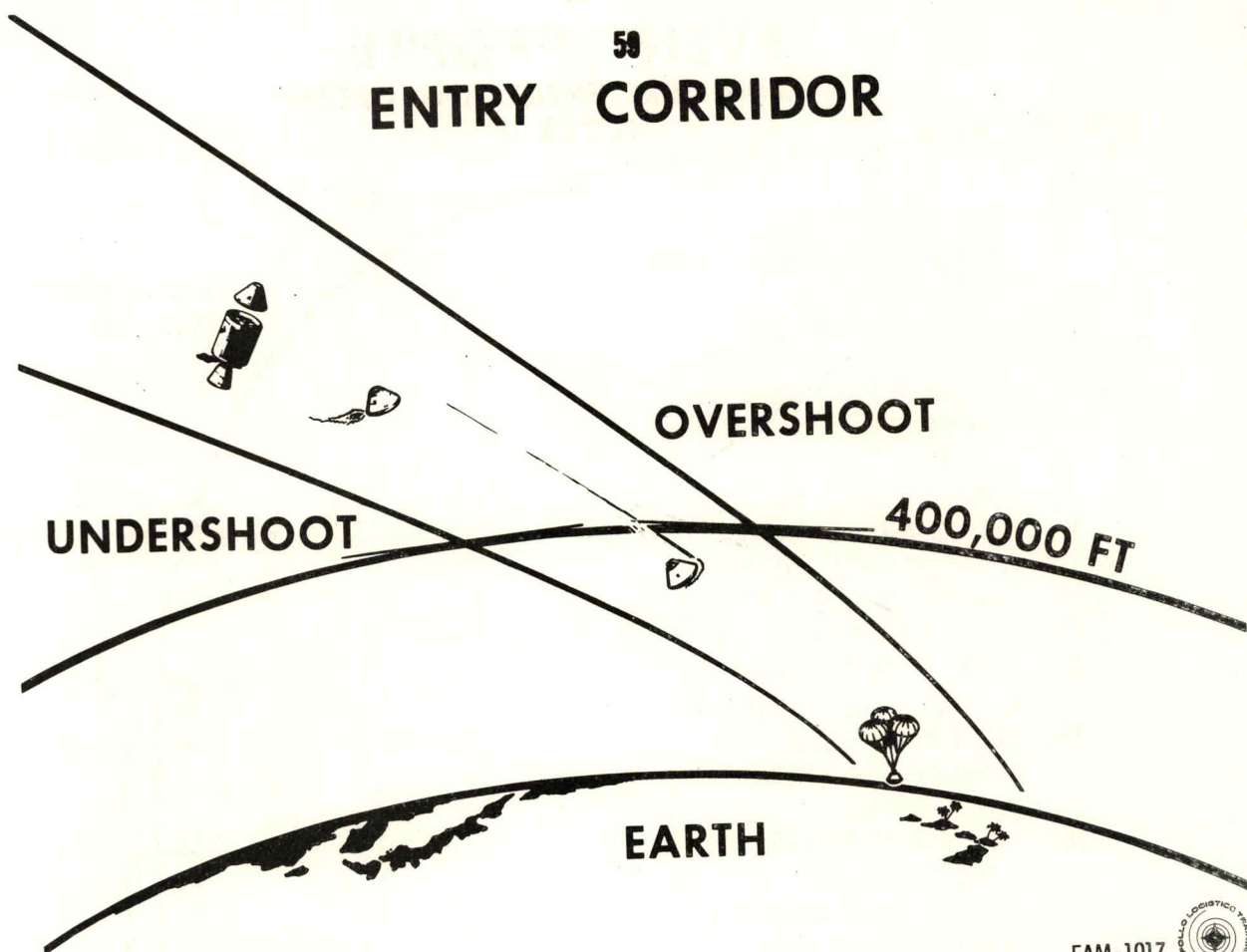
APOLLO SPACECRAFT TRANSLUNAR CONFIGURATION



APOLLO TRANSEARTH CONFIGURATION



ENTRY CORRIDOR



FAM-1017



EVENT PROFILE

NORMAL PRE-ENTRY AND DECENT BLOCK II

FINAL ΔV
CORRECTION

1. ARM SECS (TLM)
2. TRANS RCS CONTROL TO CM
3. PRESS. CM RCS
4. INITIATE CM-SM SEP
- +1.1" { 5. CM-SM UMB DEADFACED
- +1.7" { 6. CM-SM SEPARATED
7. CM-SM SEP PYRO CUTOFF
8. ARM ELS
9. BARO SW LOCK-IN
10. CM RCS/SCS DISABLED
11. APEX COVER JETTISONED
12. DROGUE CHUTES DEPLOYED
13. DROGUE CHUTES DISREEFED
14. DROGUE CHUTES RELEASED
& PILOT CHUTES DEPLOYED
15. BURN RCS PROPELLANTS
16. MAIN CHUTES DISREEFED
17. PURGE CM RCS
18. POWER REMOVED FROM
MAIN DC BUSSES
19. RELEASE MAIN CHUTES &
DEPLOY HF ANTENNA

$\approx 400K'$

NORMAL ENTRY
MANEUVERS

$\approx 50K'$

24K' 9, 10

1.4" 11

1.6" 12

2.9" 13

10K' 14

$\approx 10"$ 15

13" 16

17

18

SPLASHDOWN 19

SEQ-532



EVENT PROFILE

NORMAL PRE-ENTRY AND DESCENT BLOCK II

FINAL ΔV
CORRECTION

1 2 3 4 5,6,7 8

$\approx 400K'$

NORMAL ENTRY
MANEUVERS

1. ARM SECS (TLM)
2. PRESS. CM RCS
3. TRANS RCS CONTROL TO CM
4. TRANS RCS CONTROL TO SM
5. INITIATE CM-SM SEP
6. CM-SM UMB DEADFACED
7. CM-SM SEPARATED
8. CM-SM SEP PYRO CUTOFF
9. ARM ELS
10. BARO SW LOCK-IN
11. CM RCS/SCS DISABLED
12. APEX COVER JETTISONED
13. DROGUE CHUTES DEPLOYED
14. DROGUE CHUTES DISREEFED
15. DROGUE CHUTES RELEASED
& PILOT CHUTES DEPLOYED
16. BURN RCS PROPELLANTS
17. MAIN CHUTES DISREEFED
18. PURGE CM RCS
POWER REMOVED FROM
19. MAIN DC BUSSES
20. RELEASE MAIN CHUTES &
DEPLOY HF ANTENNA

$+1.1''$
 $+1.7''$

$\approx 50K'$

24K' 10, 11

1.6" 12

$\approx 9''$ 13

10K' 14

$\approx 10''$ 15

13" 16

13" 17

13" 18

13" 19

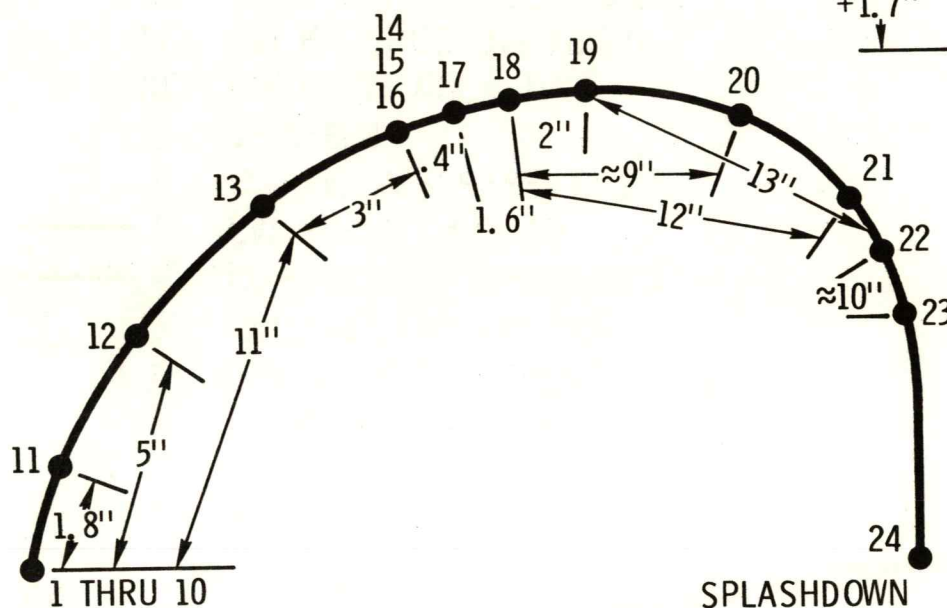
SPLASHDOWN 20

SEQ-532A



EVENT PROFILE

PAD TO T+42" LES ABORT BLOCK II



1. INITIATE ABORT
2. BECO (AFTER T + 40" ONLY)
3. EVENT TIMER RESET
4. CM-SM UMB DEADFACED
5. CM RCS PRESS.
6. RCS CONTROL TRANS
7. CM RCS OXID DUMPED
8. CM-SM SEPARATED
9. LE MOTOR IGNITED
10. PC MOTOR IGNITED
11. CM-SM SEP PYRO CUTOFF
12. CM RCS FUEL DUMPED
13. CANARDS DEPLOYED
14. ELS ARMED
15. BARO SW LOCK-IN
16. TOWER JETTISONED
17. APEX COVER JETTISONED
18. DROGUE CHUTES DEPLOYED
19. CM RCS HELIUM DUMPED
20. DROGUE CHUTES DISREEFED
21. DROGUE CHUTES RELEASED
& PILOT CHUTES DEPLOYED
22. POWER REMOVED FROM
MAIN DC BUSES
23. MAIN CHUTES DISREEFED
24. RELEASE MAIN CHUTES &
DEPLOY HF ANTENNA

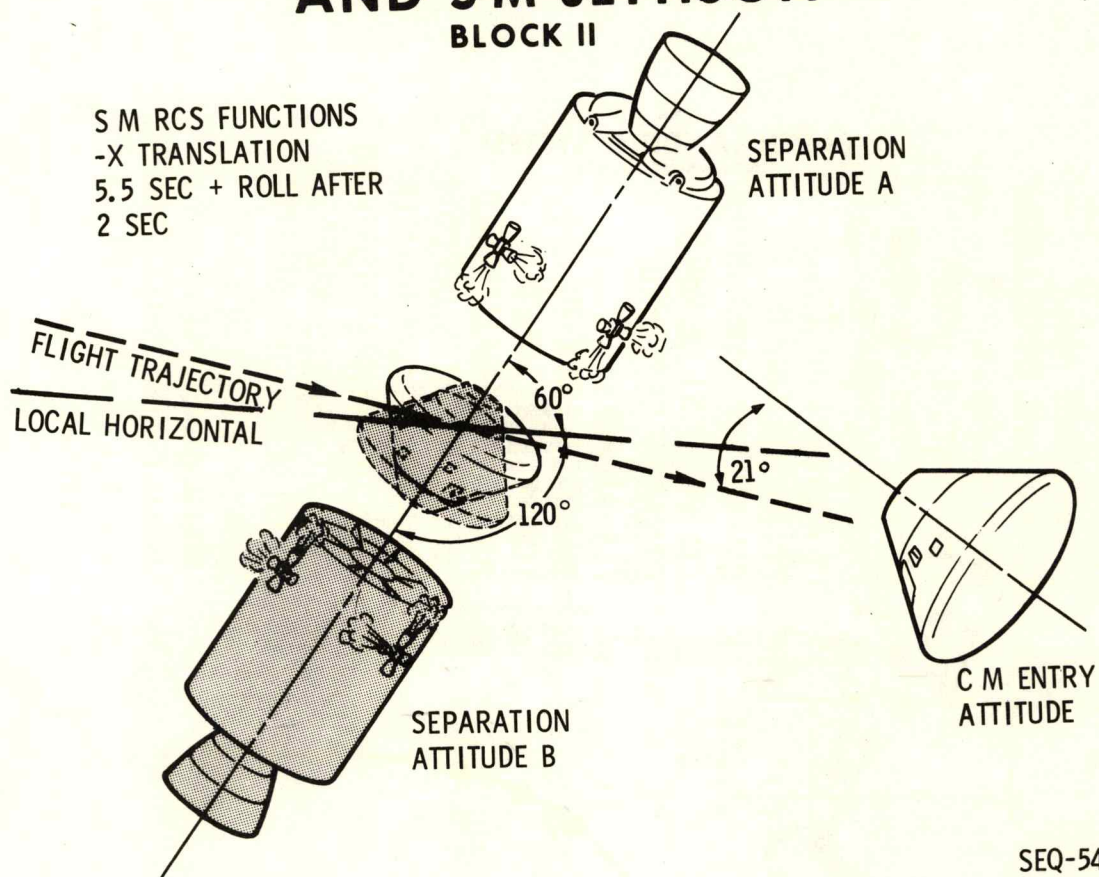
(TLM)

SEQ-533A



NORMAL CM-SM SEPARATION AND SM JETTISON

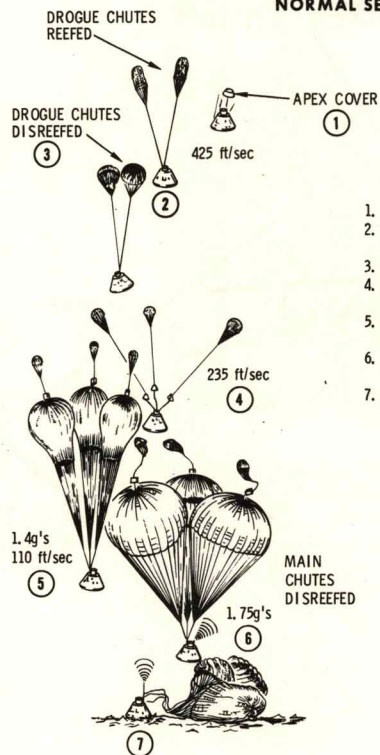
BLOCK II



SEQ-543



EARTH LANDING SYSTEM NORMAL SEQUENCE



1. APEX COVER JETTISONED AT 24,000 FT + .4 SEC
2. DROGUE CHUTES DEPLOYED AT 24,000 FT + 2 SEC (REEFED FOR 8 SEC)
3. DROGUE CHUTES DISREEFED
4. PILOT CHUTES DEPLOYED & DROGUE CHUTES RELEASED AT 10,000 FT
5. MAIN CHUTES DEPLOYED AT 10,000 FT (REEFED FOR 8 SEC)
6. MAIN CHUTES DISREEFED, VHF RECOVERY ANTENNA, & FLASHING BEACON DEPLOYED
7. MAIN CHUTES RELEASED AFTER TOUCHDOWN AND HF ANTENNA DEPLOYED

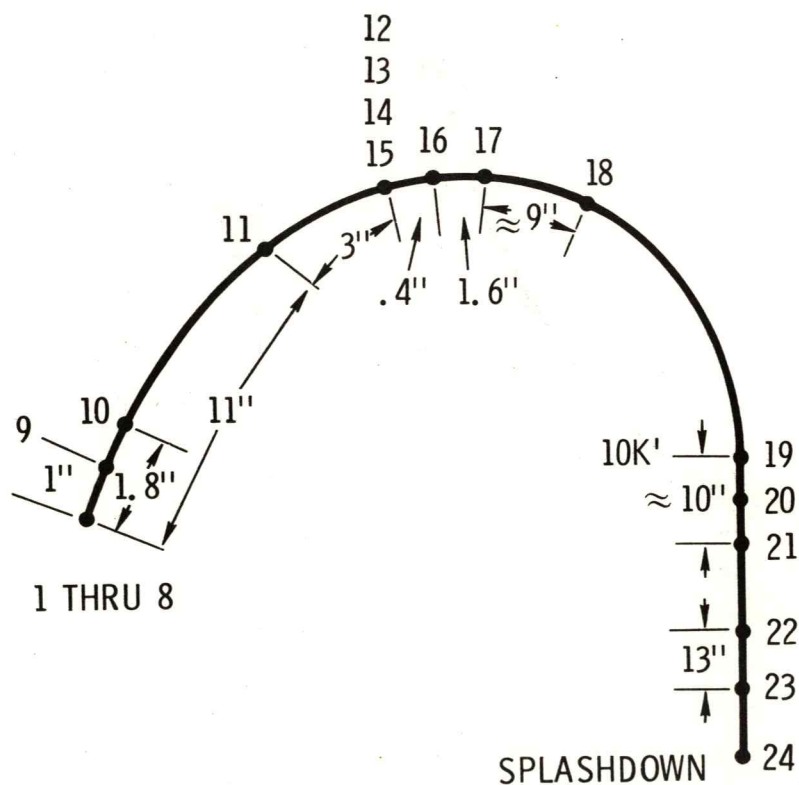
TOUCHDOWN VELOCITIES:
 3 CHUTES - 28 FT/SEC
 2 CHUTES - 33.5 FT/SEC



EVENT PROFILE

T+42" TO $\approx 30,000$ FT LES ABORT

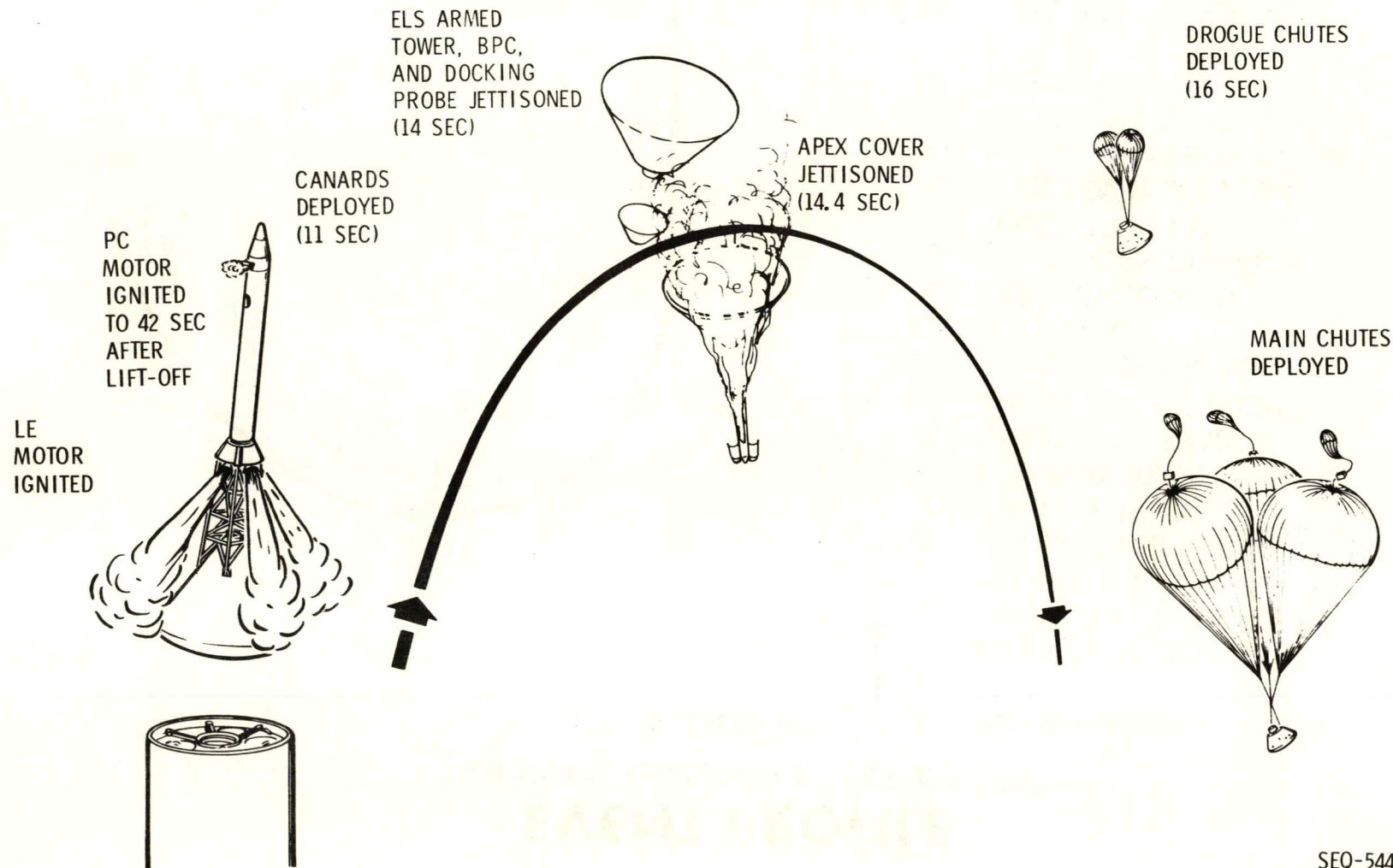
BLOCK II



- | | |
|--|--|
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 1. INITIATE ABORT (TLM) |
| | 2. BECO |
| | 3. EVENT TIMER RESET |
| | 4. CM-SM UMB DEADFACED |
| | 5. CM RCS PRESS. |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 6. RCS CONTROL TRANS |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 7. CM-SM SEPARATED |
| | 8. LE MOTOR IGNITED |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 9. CM RCS/SCS ENABLED |
| | 10. CM-SM SEP PYRO CUTOFF |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 11. CANARDS DEPLOYED |
| | 12. ELS ARMED |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 13. BARO SW LOCK-IN |
| | 14. CM RCS/SCS DISABLED |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 15. TOWER JETTISONED |
| | 16. APEX COVER JETTISONED |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 17. DROGUE CHUTES DEPLOYED |
| | 18. DROGUE CHUTES DISREEFED |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 19. DROGUE CHUTES RELEASED & PILOT CHUTES DEPLOYED |
| | 20. BURN RCS PROPELLANTS |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 21. MAIN CHUTES DISREEFED |
| | 22. PURGE CM RCS |
| <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> <div style="margin-right: 5px;">↑</div> </div> | 23. POWER REMOVED FROM MAIN DC BUSES |
| | 24. RELEASE MAIN CHUTES & DEPLOY HF ANTENNA |



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



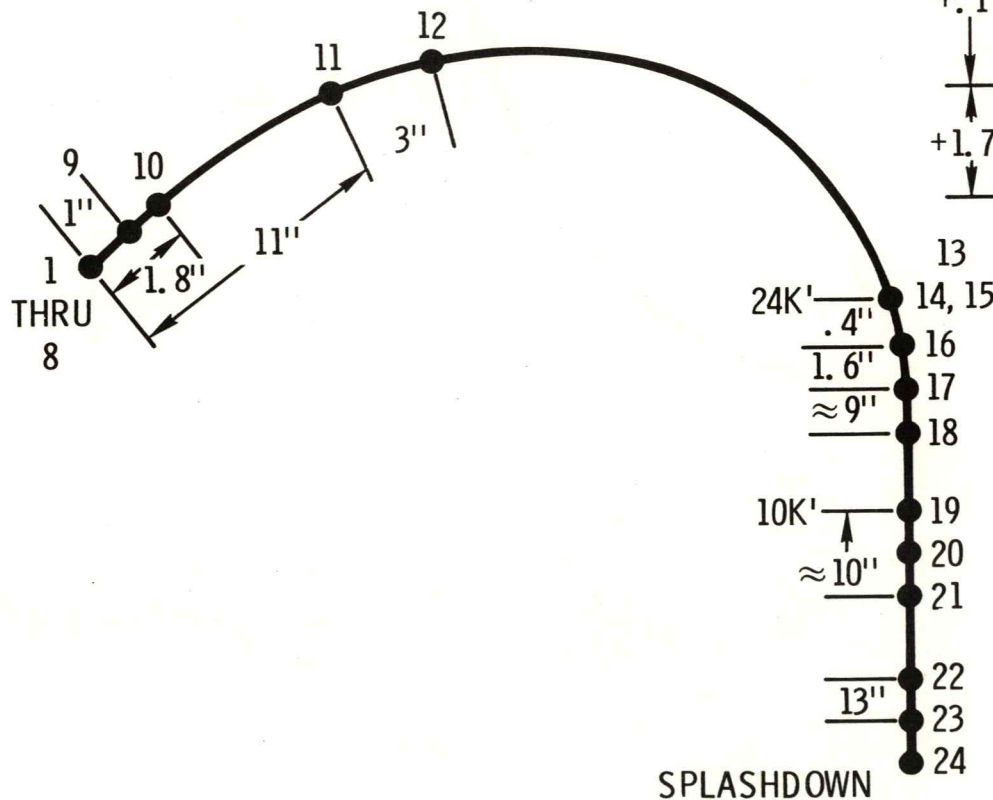
SEQ-544A



EVENT PROFILE

≈ 30,000 FT TO ≈ 100,000 FT LES ABORT

BLOCK II

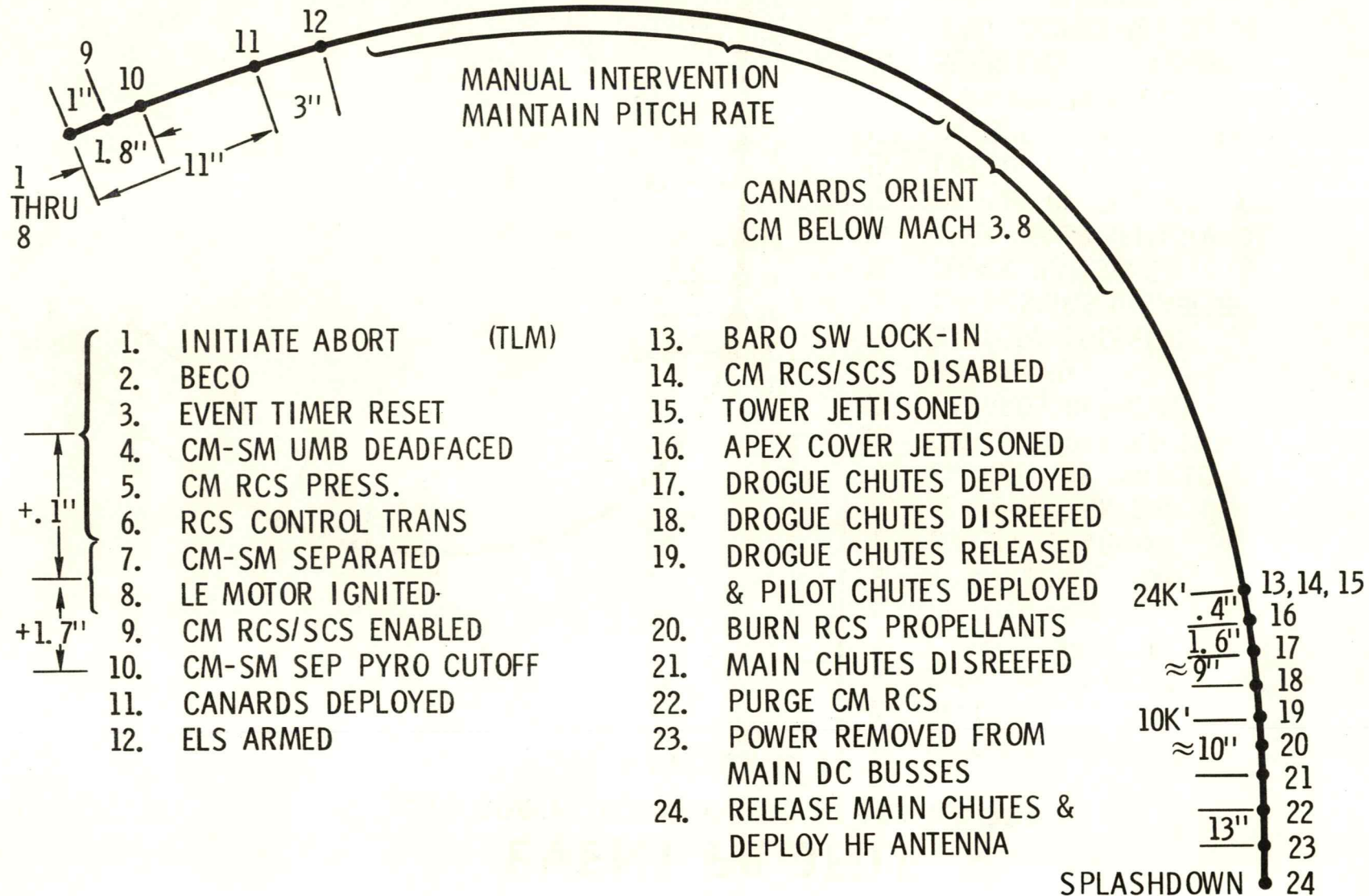


1. INITIATE ABORT (TLM)
2. BECO
3. EVENT TIMER RESET
4. CM-SM UMB DEADFACED
5. CM RCS PRESS.
6. RCS CONTROL TRANS
7. CM-SM SEPARATED
8. LE MOTOR IGNITED
9. CM RCS/SCS ENABLED
10. CM-SM SEP PYRO CUTOFF
11. CANARDS DEPLOYED
12. ELS ARMED
13. BARO SW LOCK-IN
14. CM RCS/SCS DISABLED
15. TOWER JETTISONED
16. APEX COVER JETTISONED
17. DROGUE CHUTES DEPLOYED
18. DROGUE CHUTES DISREEFED
19. DROGUE CHUTES RELEASED & PILOT CHUTES DEPLOYED
20. BURN RCS PROPELLANTS
21. MAIN CHUTES DISREEFED
22. PURGE CM RCS
23. POWER REMOVED FROM MAIN DC BUSSES
24. RELEASE MAIN CHUTES & DEPLOY HF ANTENNA



EVENT PROFILE

≈ 100,000 FT TO TWR. JETT. LES ABORT
BLOCK II

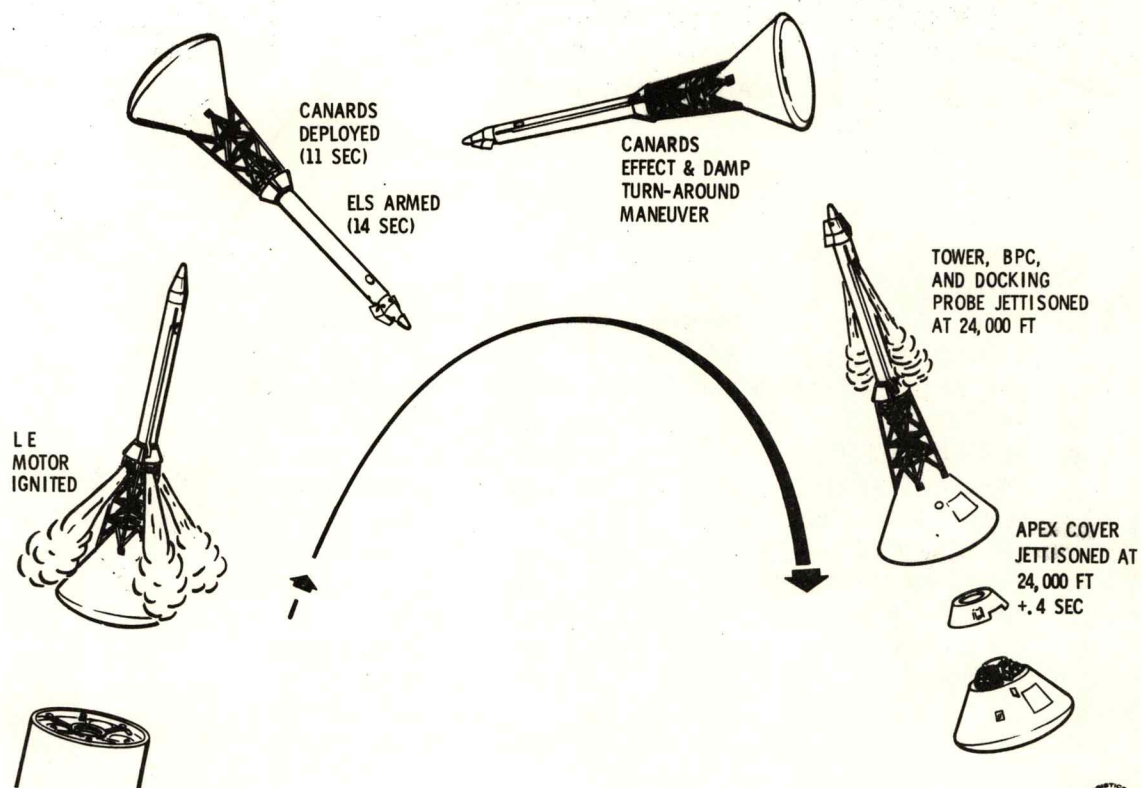


SEQ-536 A



MEDIUM ALTITUDE LES ABORT

(30,000 TO 100,000 FT.)

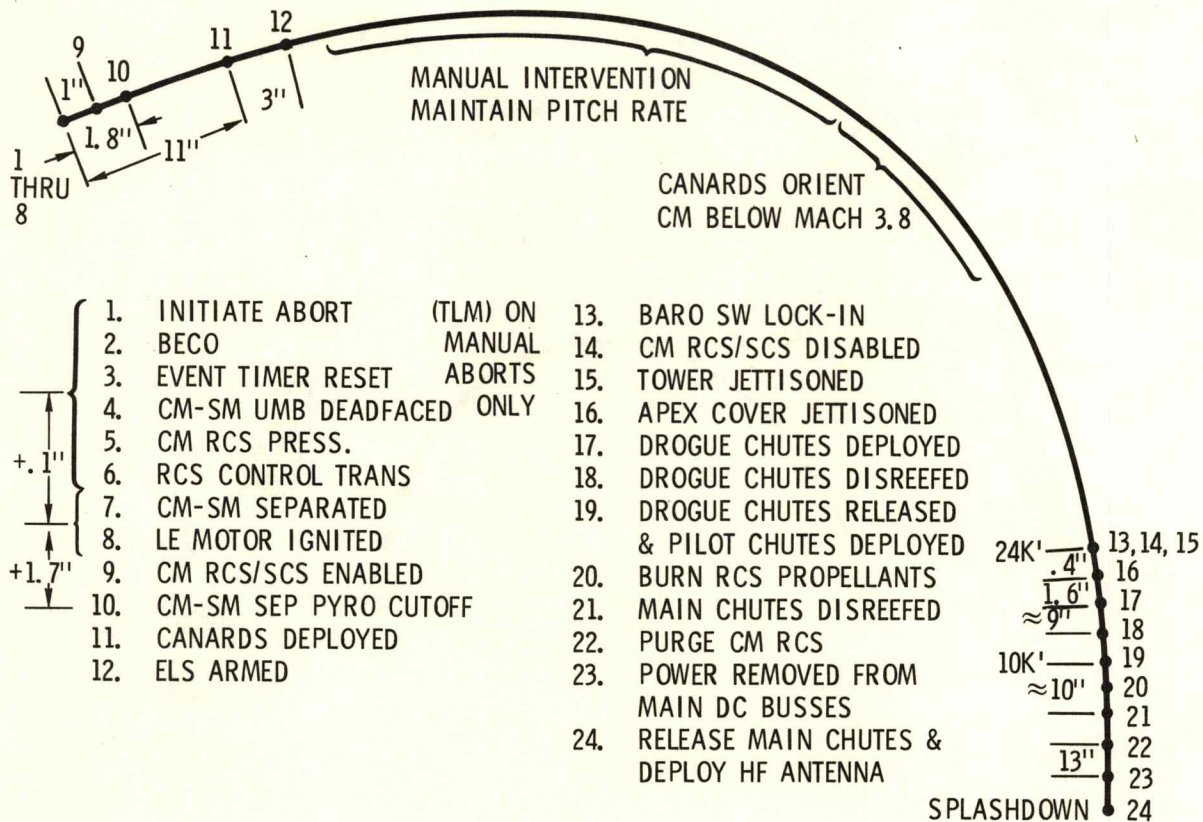


SEQ-545

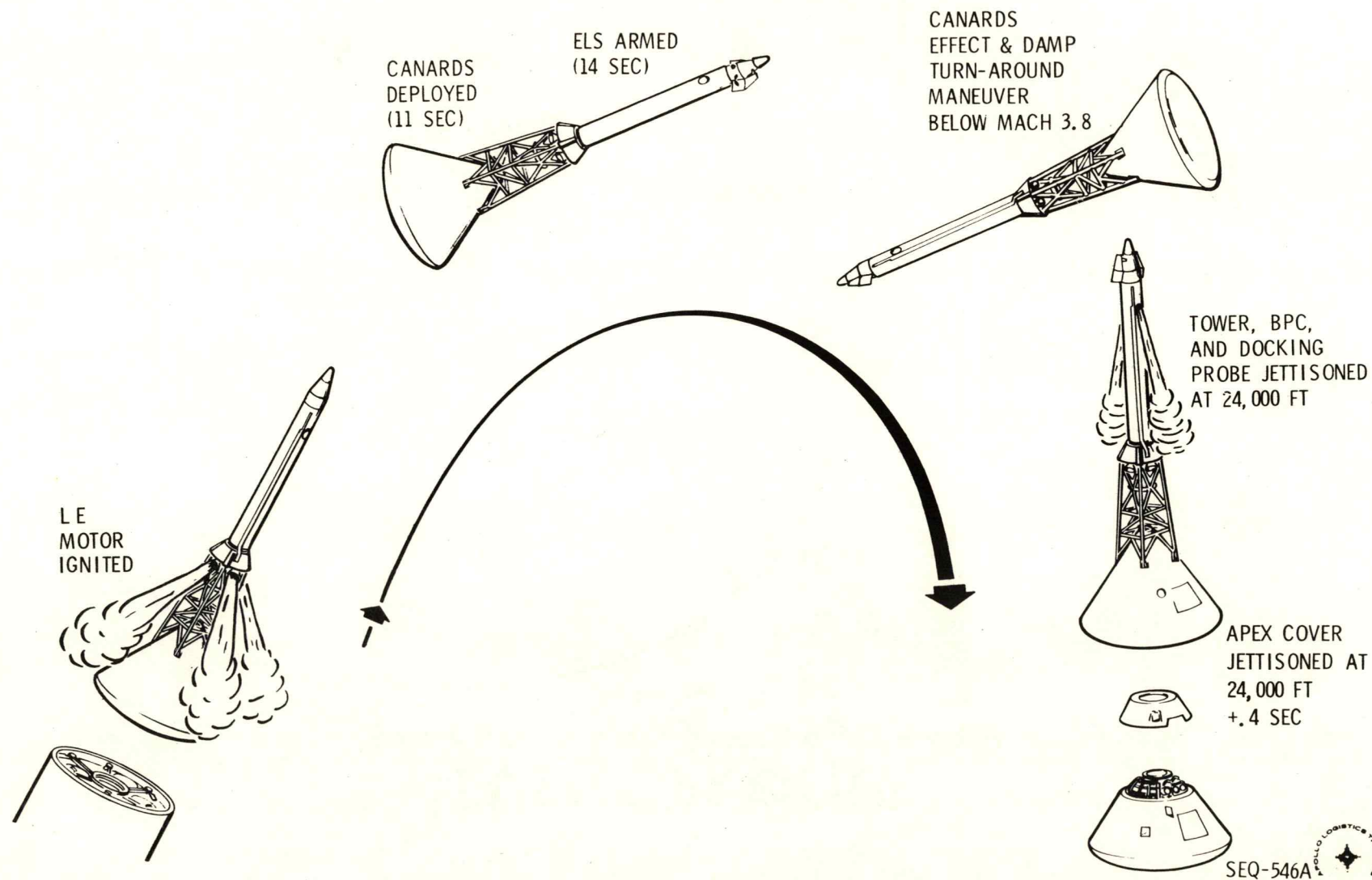


EVENT PROFILE

≈ 100,000 FT TO TWR. JETT. LES ABORT
BLOCK II

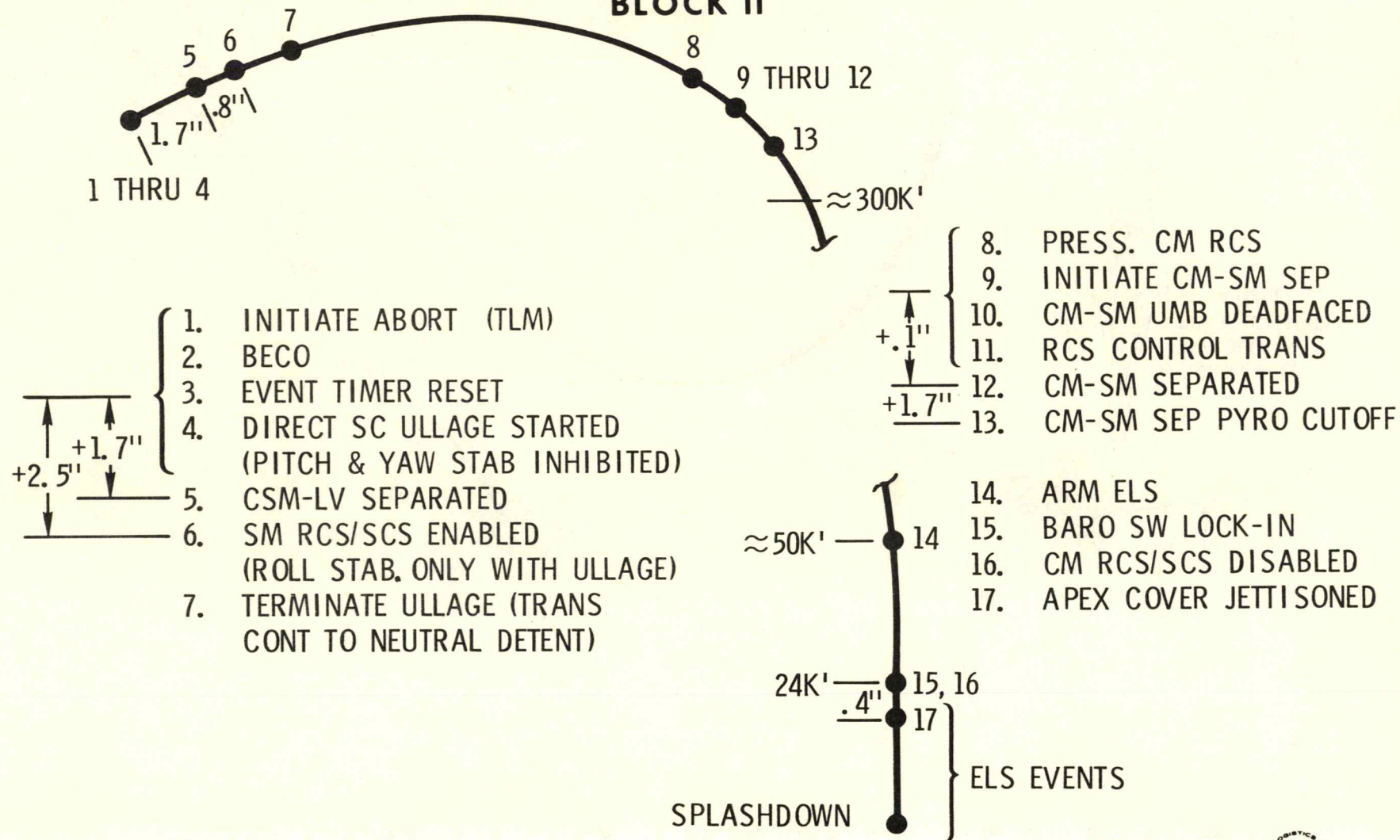


≈ 30,000 FT TO TWR JETT LES ABORT



EVENT PROFILE

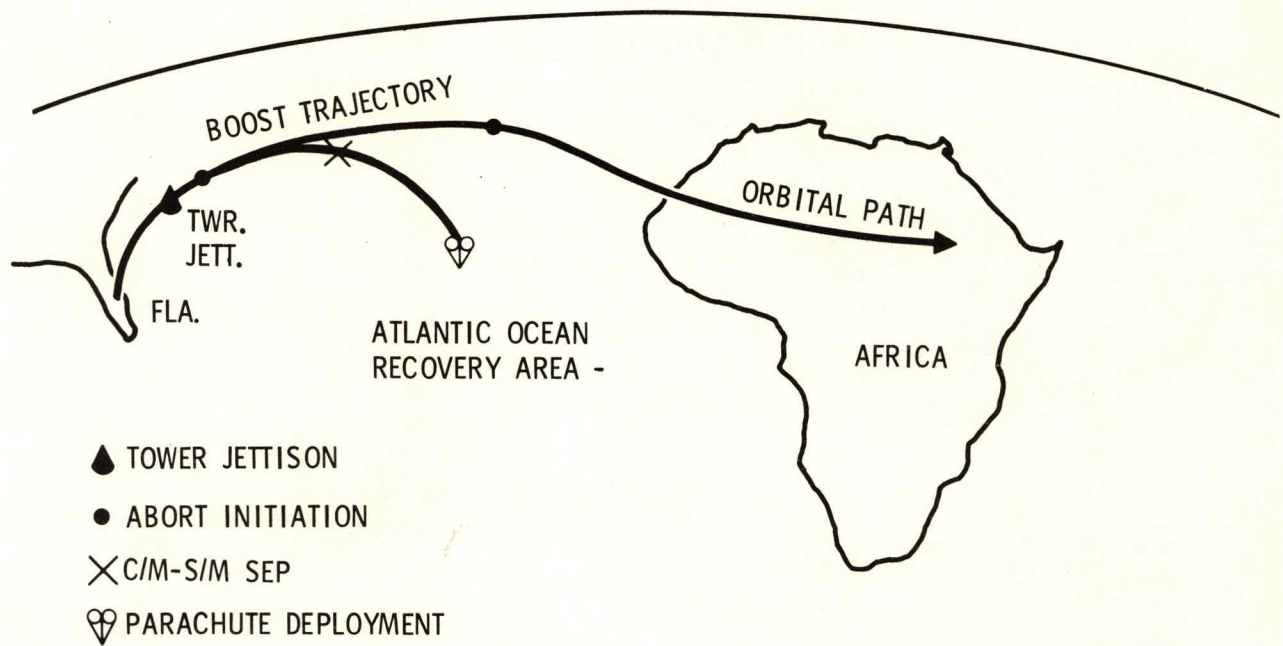
SPS ABORT AND RETURN TO EARTH BLOCK II



SEQ-537A



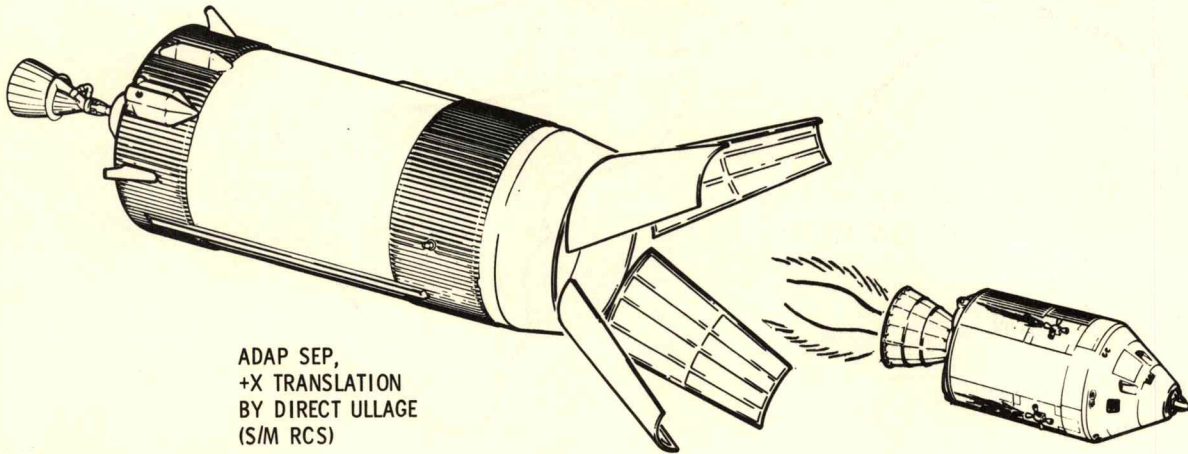
71
SPS ABORTS
FROM LAUNCH PHASE



SEQ-99 A

72

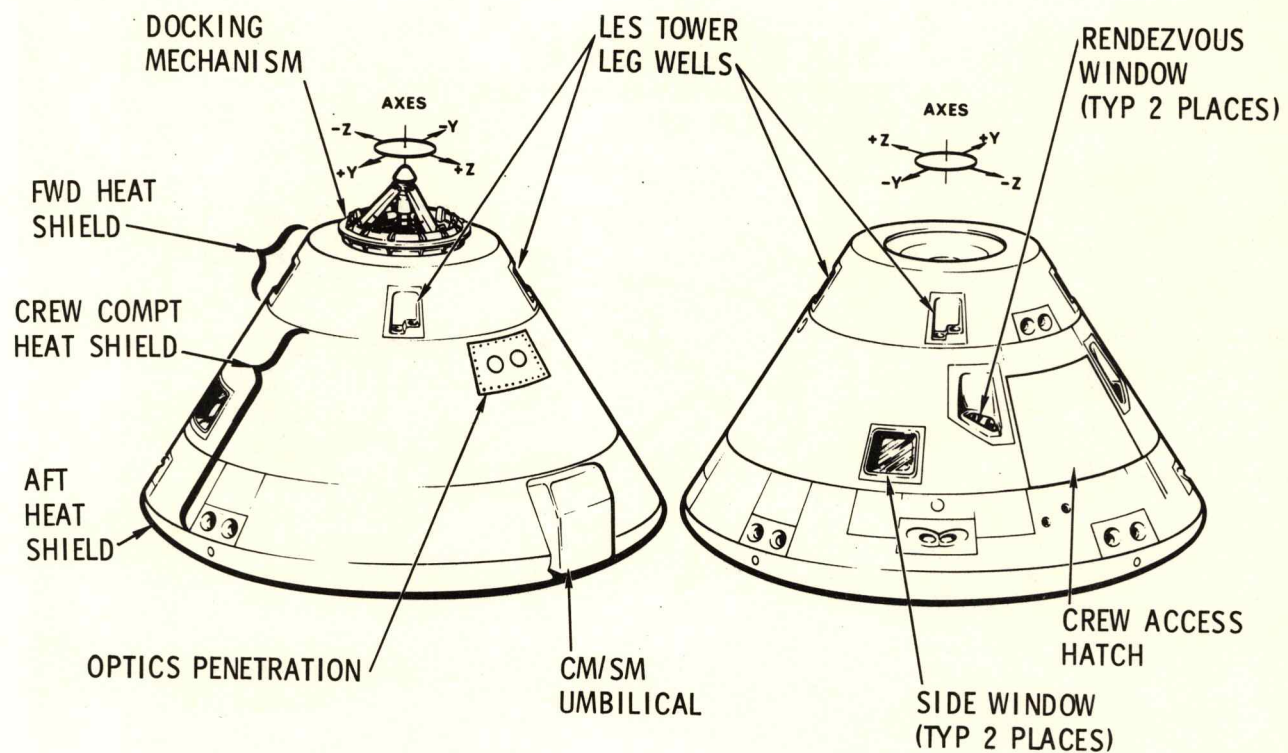
BLK II SPS ABORT
(TWR JETT TO NORMAL ADPT SEP)
CSM 101



SEQ-542-1

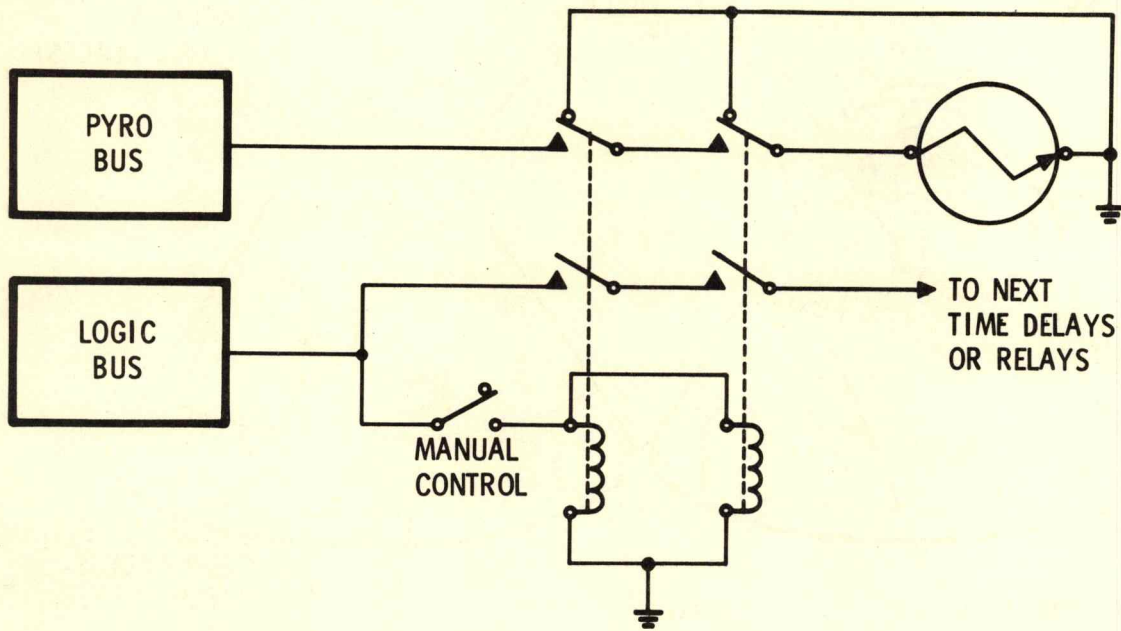


73
COMMAND MODULE EXTERIOR
(BLOCK II)



ST-260 A 

CIRCUIT CONCEPT



SEQ-63C

