



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

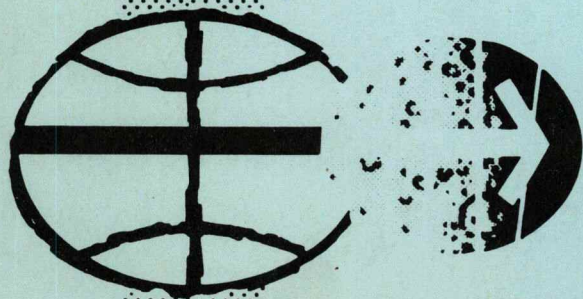
# APOLLO 15

## HEADQUARTERS FLIGHT READINESS REVIEW

### PART I

### MISSION SUMMARY COMMAND AND SERVICE MODULE

JUNE 24, 1971



MANNED SPACECRAFT CENTER HOUSTON, TEXAS

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## MISSION SUMMARY

# APOLLO 15 MISSION SUMMARY

- PROFILE DIFFERENCES
- MISSION RULE CHANGES
- MCC TRAINING



## PROFILE DIFFERENCES

### APOLLO 14

1. 100 N. MI. EPO
2. SPLIT LAUNCH TIME
3. 72 - 96° LAZ
4. CONSTANT SEA (10.3)
5. HYBRID TRAJECTORY
6. 33.5 HR LSST
7. 34 REVS (66.5 HR) 9 DAYS
8. NO SHAPING BURN
9. PLANE CHANGE PHOTOGRAPHY  
(DESCARTES)
10. 2 EVA'S
11. 14° INCLINATION
12. -76.3° AZIMUTH

### APOLLO 15

- 90 N. MI. EPO
- OPT. 1ST OPP.
- 80 - 100° LAZ
- VARIABLE SEA (12.0 - 13.6)
- OPTIMIZED TLI
- 67.0 HR LSST
- 74 (145 HR) 12 DAYS 7 HR
- SHAPING BURN
- TARGETS OF OPPORTUNITY
- 3 EVA'S
- 26° INCLINATION
- 91.0° AZIMUTH

# APOLLO 15 SPS $\Delta V$ BUDGET

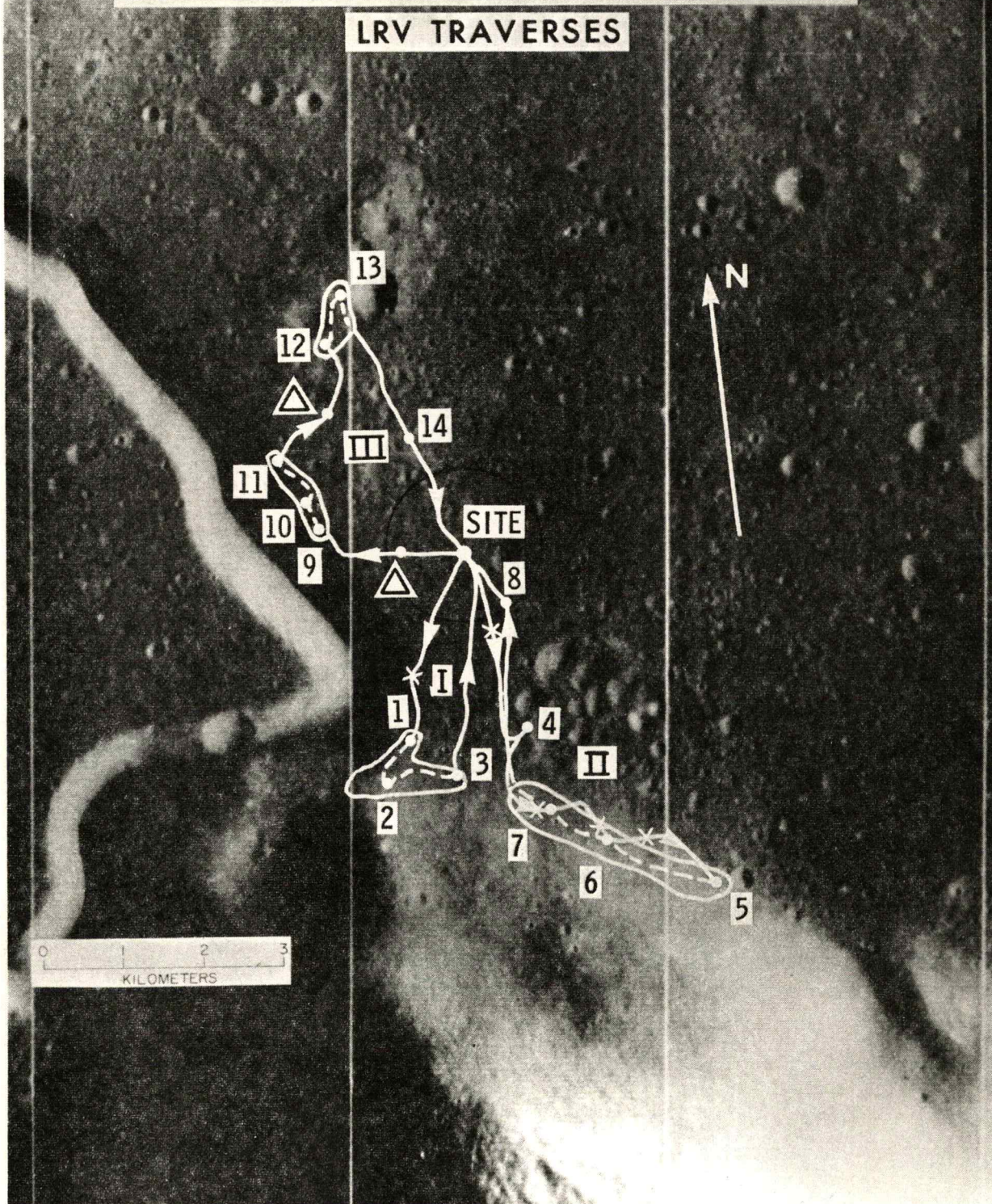
(JULY 26, 1971; 80° LAUNCH AZIMUTH)

● REQUIRED $\Delta V$ FOR MANEUVERS		6699.1
● LOI	2997.9	
● DOI	207.6	
● CIRC	70.8	
● LOPC	308.6	
● SHAPING BURN	64.2	
● TEI	3050.0	
● DISPERSIONS		163.0
● TLMC	23.0	
● -3 $\sigma$ DISPERSION	140.0	
● S-IVB $\Delta V$ DEFICIT	0.0	
● AVAILABLE FOR WEATHER AVOIDANCE		318.0
(240 FPS AVAILABLE FOR 100° LAUNCH AZIMUTH)		



# HADLEY APENNINE

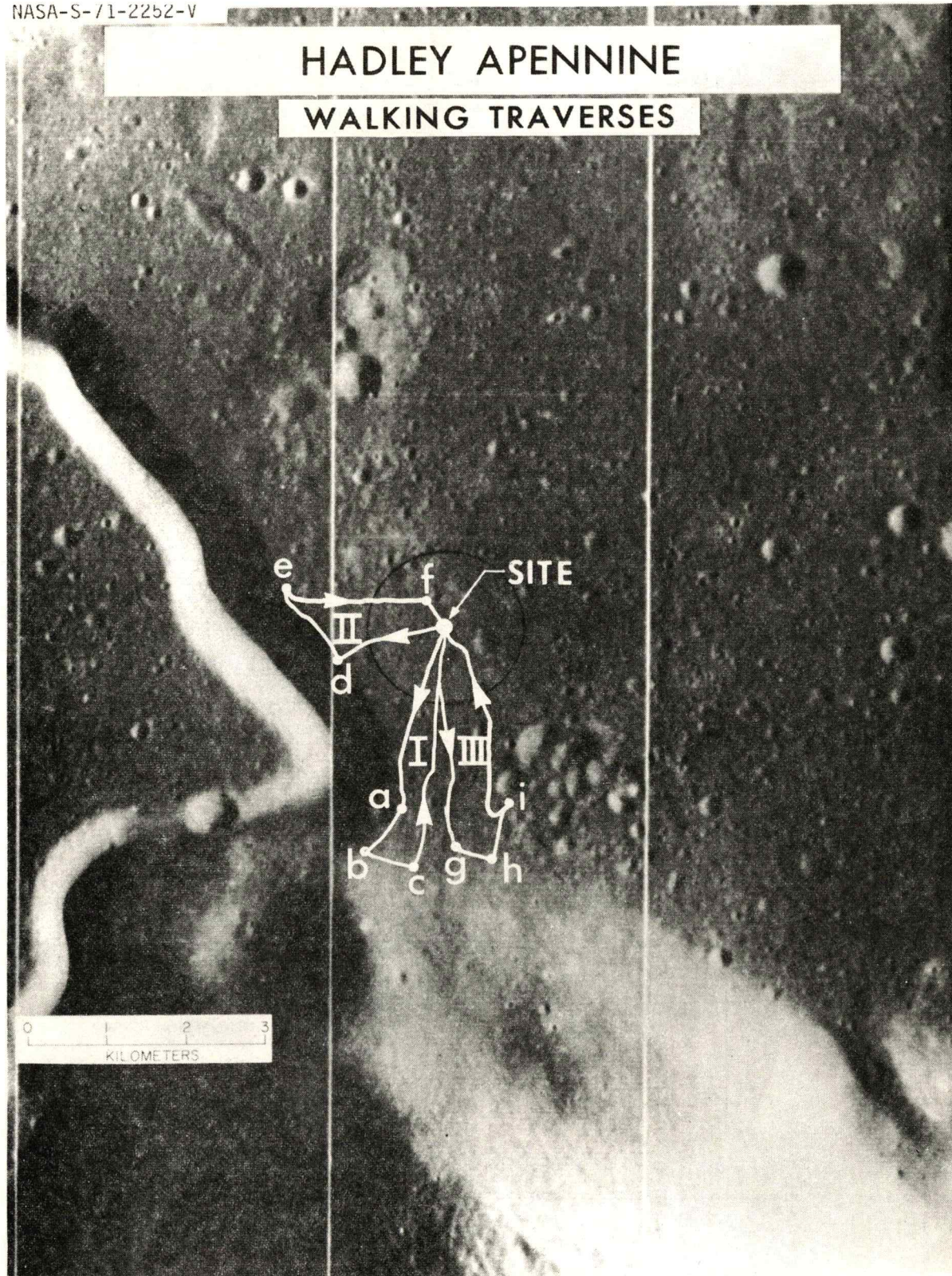
## LRV TRAVERSES





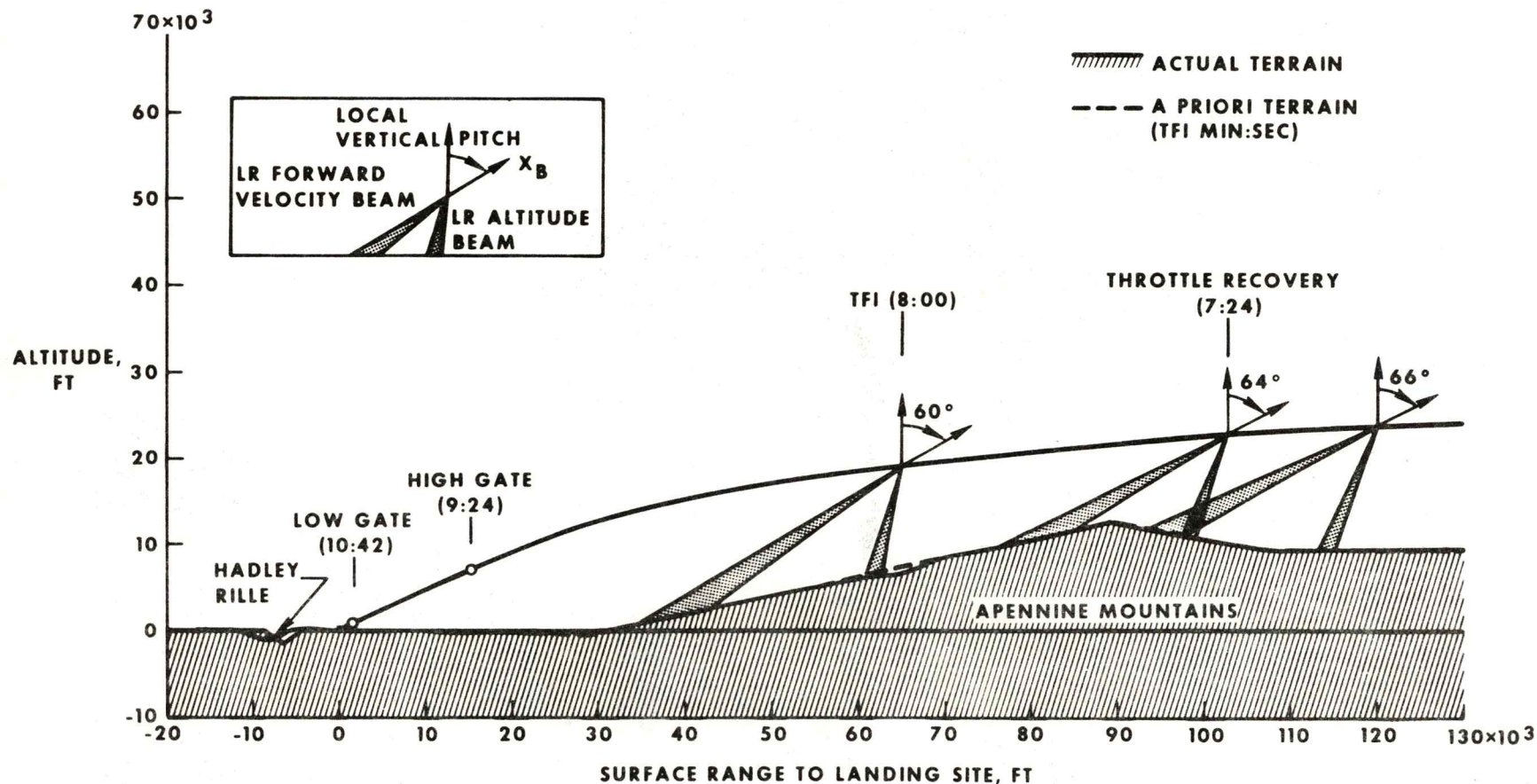
# HADLEY APENNINE

## WALKING TRAVERSES





# APOLLO 15 DESCENT OVER APENNINE FRONT



**SUMMARY OF LM LANDING PHASE FLIGHT TIME**

MISSION	TIME, MIN:SEC	
	TOTAL AVAILABLE	ACTUAL REMAINING
APOLLO 11	3:32 ± 24	1:02
APOLLO 12	3:51 ± 34	1:41
APOLLO 13	4:08 ± 36	—
APOLLO 14	3:45 ± 34	1:06
APOLLO 15	3:39 ± 35	—



## **ALTERNATE MISSIONS**

- **LUNAR ORBIT SCIENCE - WITH OR WITHOUT LUNAR  
MODULE, HIGH INCLINATION, 4 TO 6 DAYS  
DURATION**
- **EARTH ORBIT SCIENCE - 4 TO 6 DAYS DURATION**

## APOLLO 15 SPACECRAFT FLIGHT SOFTWARE

- AS REVIEWED BY THE FLIGHT SOFTWARE READINESS REVIEW (FSRR) HELD AT MSC ON JUNE 16, 1971, FORMAL INTEGRATED TESTING OF ALL THREE PROGRAMS HAS BEEN COMPLETED AND THEY ARE CAPABLE OF FULLY SUPPORTING THE APOLLO 15 MISSION
- MAJOR CHANGES FROM APOLLO 14
  - MINIMUM KEYSTROKE RENDEZVOUS SEQUENCE (MINKEY) - CMC
  - TLI SEQUENCE INITIAL AND BURN CUTOFF PROGRAM (P15) - CMC
  - UNIVERSAL TRACKING (P20) ADDING PTC AND SIM POINTING - CMC
  - BIT FAILURE PROTECTION VIA DSKY INPUT - CMC AND LGC
  - AUTO TRANSFER OF RR DATA TO THE AGS - LGC AND AGS
  - REDESIGN AND ADD CURSOR/SPIRAL MARKING CAPABILITY TO INFLIGHT AS WELL AS LUNAR SURFACE ALIGNMENT PROGRAMS

## MISSION RULE CHANGES

### ● LAUNCH - TLI

- LAUNCH AZIMUTH 80 DEGREES TO 100 DEGREES
- IU UPDATE FOR MCC<sub>1</sub> (AT 9:00 GET) GREATER THAN 23 FPS (1.8  $\sigma$ )
  - APOLLO 14 WAS 55 FPS (3.7  $\sigma$ )
- SIVB CONSUMABLES GO FOR TLI WITH LUNAR ORBIT CAPABILITY (SPS MCC, DPS LOI, SPS TEI)

### ● LOI

- USE LM SYSTEMS AS BACKUP FOR CSM SYSTEMS IN EVALUATING GO FOR LOI
  - DESCENT ENGINE - SPS BALL VALVES
  - COMMUNICATIONS
  - DPS LOI - SPS PROPELLANT
- LOI ABORT TECHNIQUES SAME

## MISSION RULE CHANGES (CONT)

### ● LUNAR ORBIT - GENERAL

- 60 x 8 N.MI. LUNAR ORBIT FOR LUNAR LANDING MISSION ONLY
- CONTINGENCY EVA IS ACCEPTABLE FOR LANDING MISSION
- RADIAL NOUN 69 ALLOWS DESCENT TO 6000 FEET WITHOUT LANDING RADAR ALTITUDE DATA INCORPORATION

### ● LUNAR ORBITAL SCIENCE (SIM BAY)

- TLC OPERATIONS - THERMAL ONLY
  - ALL CREWMEN IN CSM FOR DOOR JETTISON
- NO EVA FOR SYSTEMS MALFUNCTIONS - FILM RETRIEVAL ONLY
- PAN CAMERA FILM RETRIEVAL WILL NOT BE ATTEMPTED WITH 'HOT' SATELLITE
- WILL SHAPE ORBIT FOR SATELLITE JETTISON
- EXPERIMENT OPERATIONS PER MR PRIORITY
- COVERS CLOSED FOR FLUID ACTIVITIES
- AN EXPERIMENT WILL BE OPERATED WITH CORONA IF OTHER EXPERIMENTS ARE NOT AFFECTED
- SPS BURN AND RENDEZVOUS PHASE REQUIRE EITHER POSITIVE CUE OF BOOM RETRACTION OR EXPERIMENT JETTISON



## MISSION RULE CHANGES (CONT)

### ● LUNAR SURFACE

- LUNAR ROVER WILL BE USED AS LONG AS CREW HAS SAFE CONTROL
- LUNAR ROVER WILL BE USED AT DEGRADED SPEEDS IF WALKING EVA CAN BE ACCOMPLISHED OR IF LOAD JUSTIFIES REDUCED SPEED
- VOICE UP AND TELEVISION DOWN IS MINIMUM COMMUNICATIONS MODE
- 'NO COMMUNICATION' EVA WILL BE ACCOMPLISHED TO ACTIVATE LCRU
- LCRU WILL BE USED TO EXTEND COMMUNICATIONS RANGES IF REQUIRED
- EVA TRAVERSE LIMITS WILL ALLOW FOR FAILURE OF EITHER LRV OR PLSS (EFFECT IS TO DIMINISH RADIUS FROM LRV AS DISTANCE FROM LM INCREASES)
- HEAT-FLOW HOLES HAVE PRIORITY OVER DRILL CORE STEMS

## MCC TRAINING SUMMARY

- 7 DAYS LUNAR ORBIT SCIENCE (SIM BAY)
- 7 DAYS LUNAR SURFACE (4 DAYS ON A-14)
  - 1 DAY TELEVISION CONTROL FAMILIARIZATION
  - 2 DAYS CAPE EVA's
  - 1 DAY FLAGSTAFF EVA
  - 1 DAY PLSS MATH MODEL
- 1 DESCENT/SEVA
- OVERALL SIMULATION PERIOD AND OTHER PHASES  
APPROXIMATELY SAME AS A-14

## APOLLO 15 MAJOR MISSION EVENTS

EVENT	LUNAR REV	G.E.T., HR:MIN:SEC	CENTRAL DAYLIGHT TIME, DAY/HR:MIN:SEC	LONGITUDE, DEG	$\Delta V$ , FPS	BURN TIME, SEC	SEA, DEG
EOI		00:11:54.5	JULY 26/08:45:54.5	-52.4*			
TLI		02:49:52.3	11:23:52.3	-168.5*			
TLI CUTOFF		02:55:29.1	11:29:29.1	-142.9*	10,431.2	336.8	
LOI	0	78:31:14.7	29/15:05:14.7	-169.9			
LOI CUTOFF	1	78:37:46.8	15:11:46.8	163.2	2,997.9	392.0	
DOI	2	82:39:32.6	19:13:32.6	-148.7			
DOI CUTOFF	2	82:39:55.4	19:13:55.4	-150.0	207.6	22.9	
UNDOCK AND SEPARATION	12	100:13:56.1	30/12:47:56.1	110.5			
CIRCULARIZATION	12	101:34:55.1	14:08:55.1	-146.0	70.8	3.9	
LM LANDING (APPROXIMATELY)	14	104:41:00.0	17:15:00.0	3.7			12.04
1ST PASS OVER LLS	14	104:41:33.2	17:15:33.2	3.7			12.04
PLANE CHANGE 1	45	165:12:50.6	AUG 2/05:46:50.6	93.0	308.6	16.5	
2ND PASS OVER LLS (ASCENT)	48	171:38:28.2	12:12:28.2	3.7			41.5
CSM SEPARATION AFTER JETTISON	51	177:25:45.0	17:59:45.0	25.9			
SHAPING BURN	73	221:25:51.6	4/13:59:51.6	-111.8	64.2	3.4	
SUBSATELLITE JETTISON	74	222:36:12.7	18:10:12.7	41.4			
TEI	74	223:46:06.1	4/16:20:06.1	-167.8			
TEI CUTOFF	74	223:48:23.9	16:22:23.9	-175.8	3,049.7	137.8	
ENTRY		294:58:20.0	7/15:32:20.0	-175.0*			
LANDING		295:11:42.0	15:45:42.0	-158.0*			

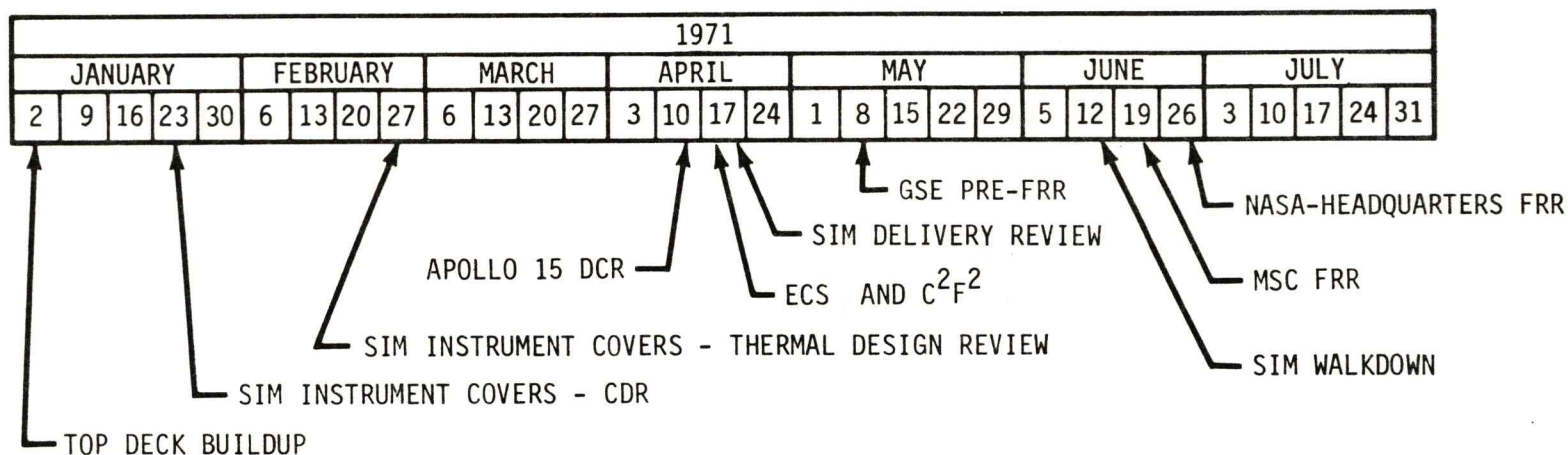
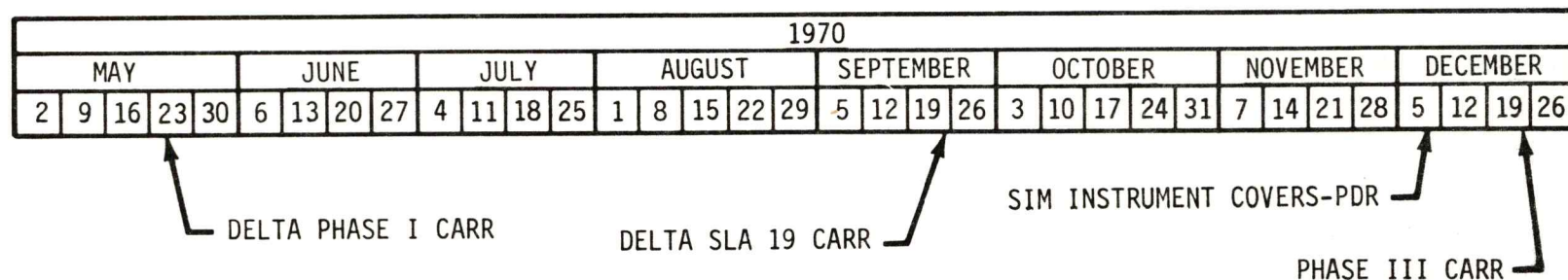
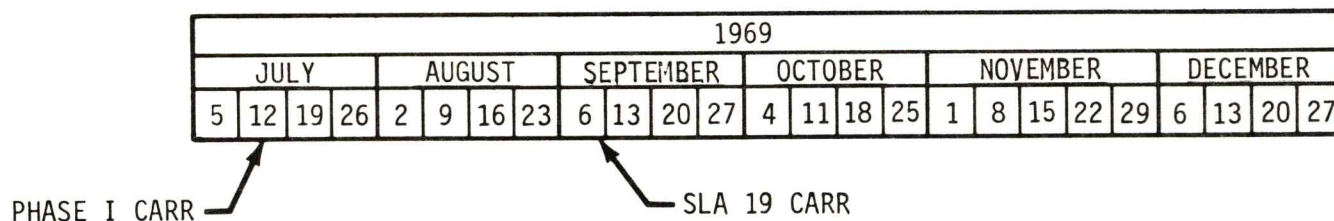
\*GEODETIC LONGITUDE, ALL OTHERS ARE SELENOGRAPHIC

**CSM**  
**INTRODUCTION**  
**AND**  
**REVIEWS SUMMARY**



# SIGNIFICANT MILESTONES

CSM 112/SLA 19



## DESIGN REVIEWS SUMMARY

<u>REVIEW</u>	<u>DATE</u>	<u>RID's/ACTIONS</u>	
		<u>OPEN</u>	<u>CLOSED</u>
SIM INSTRUMENT COVERS - PDR	DECEMBER 8, 1970	0	21
SIM INSTRUMENT COVERS - CDR	JANUARY 20, 21, 1971	0	17
SIM INSTRUMENT COVERS - THERMAL DESIGN REVIEW	FEBRUARY 24, 25, 26, 1971	<sup>Δ</sup> 7	61
DCR (APOLLO 15)	APRIL 5, 6, 1971	0	1*

\* BRIEF SUMMARY WILL BE PRESENTED.

Δ ACTION CLOSEOUT STILL IN PROCESS.

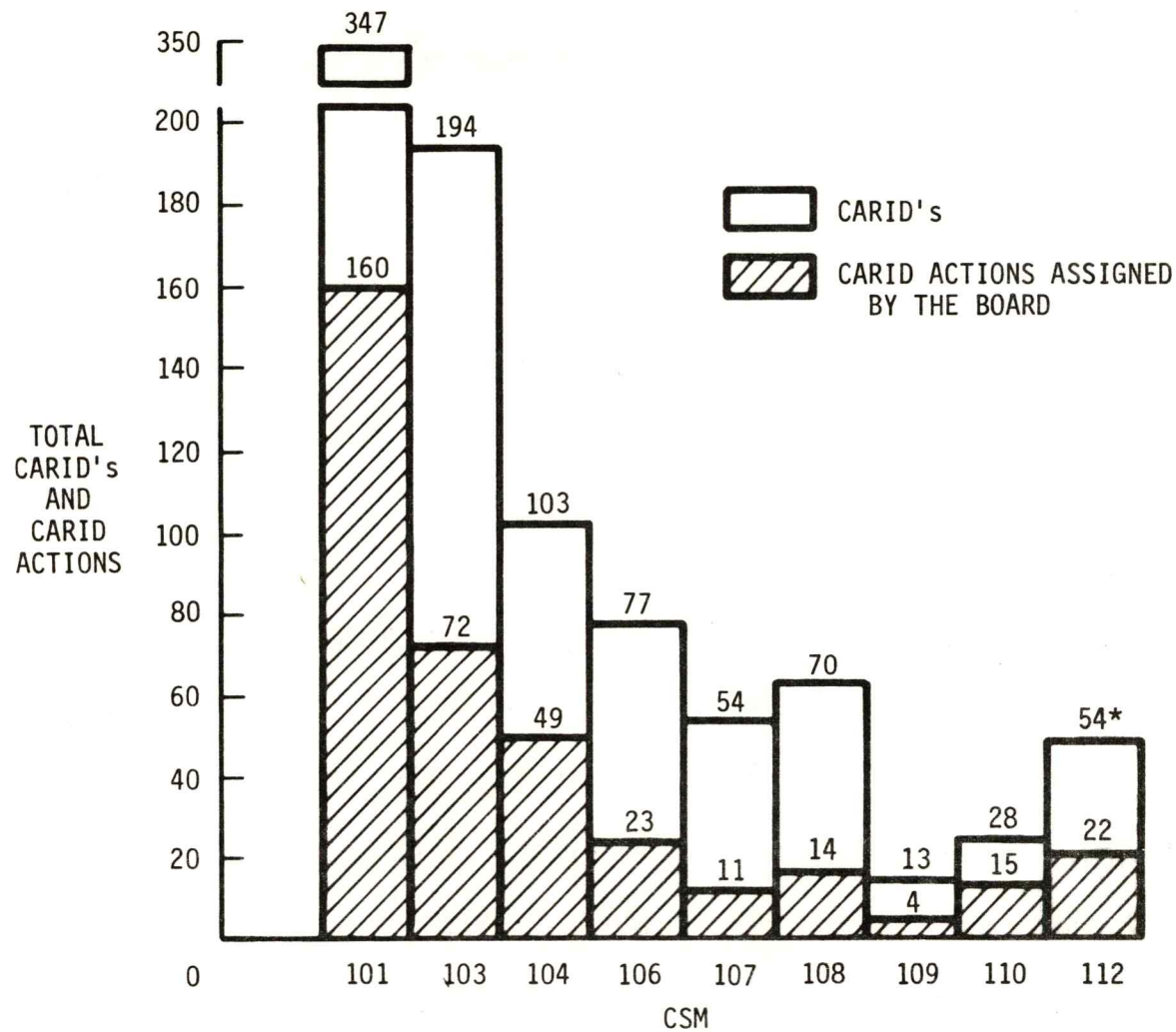
# HARDWARE REVIEW SUMMARY

## CSM 112/SLA 19

<u>REVIEW</u>	<u>DATE</u>	<u>ACTIONS</u> <u>CARID/FRRID</u>	
		<u>OPEN</u>	<u>CLOSED</u>
PHASE I CARR	JULY 15, 1969	0	1
SLA 19 CARR	SEPTEMBER 11, 1969	0	0
DELTA PHASE I CARR	MAY 21, 1970	0	11
DELTA SLA 19 CARR	SEPTEMBER 16, 1970	0	0
PHASE III CARR	DECEMBER 18, 1970	0	41
TOP DECK BUILDUP	JANUARY 4, 1971	0	0
ECS AND C <sup>2</sup> F <sup>2</sup>	APRIL 15, 1971	0	5
SIM DELIVERY REVIEW	APRIL 15, 1971	0	1
GSE PRE-FRR	MAY 7, 1971	0	18
SIM WALKDOWN	JUNE 12, 1971	10*	0

\* 6 ACTIONS CSM 112 EFFECTIVITY - RESOLUTION IN PROCESS.

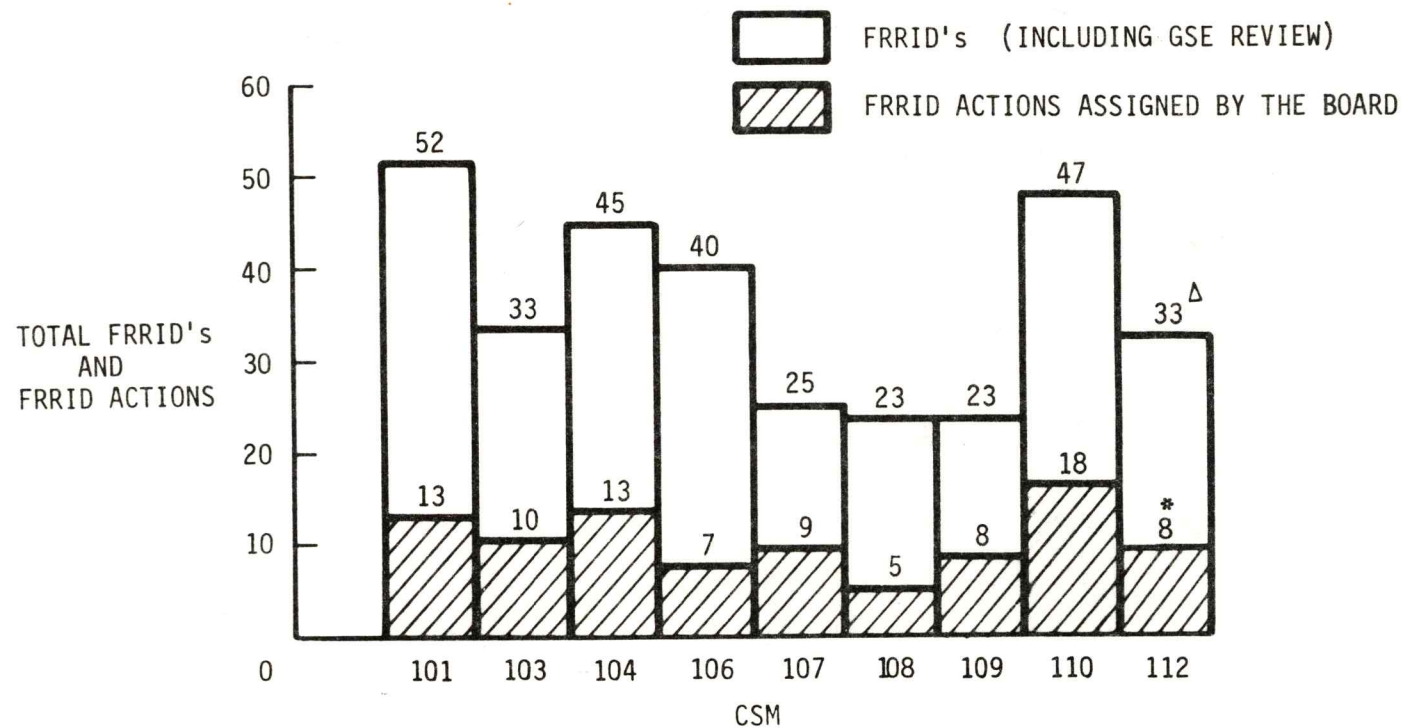
# CARR'S



\*INCLUDES SIM DELIVERY REVIEW - 1 CARID



# FRR'S



\*ACTIONS ASSIGNED AT MSC BOARD.

Δ INCLUDES ECS AND C<sup>2</sup>F<sup>2</sup>

## CSM 112 FRR DATA REVIEW SUMMARY

- 33 FRRID's WRITTEN
- 23 WORKED AND CLOSED PRIOR TO MSC PREBOARD
- 6 CLOSED AT MSC PREBOARD, JUNE 17
- 4 ACTIONS ASSIGNED BY MSC PREBOARD
- 1 FRRID's TO MSC BOARD, JUNE 18  
(UNEXPLAINED ANOMALY FC NO. 2 FUSE)  
FRRID 3.20.2



## SUMMARY OF OPEN ACTIONS ASSIGNED BY THE MSC PREBOARD/BOARD

- NR WILL REVISE THE SPECIFICATION REGARDING DRR TAPE LIFE LIMITATION  
DUE: PRIOR TO APOLLO 15 FRR (JUNE 24, 1971)
- NR WILL PROVIDE A PARALLEL FUSE ANALYSIS REGARDING THE INSTALLATION  
IN THE FUEL CELL NO. 2 HYDROGEN FLOWMETER  
DUE: PRIOR TO THE APOLLO 15 FRR
- NR WILL PROVIDE THE EXTENSION RATIONALE FOR THOSE COMPONENTS NOT  
MEETING THE 110-DAY SCRUB AND RECYCLE REQUIREMENTS  
DUE: PRIOR TO THE APOLLO 15 FRR
- MSC/PE WILL PROVIDE A FAILURE ANALYSIS STATUS AND KSC WITH PROVIDE  
A PLAN REGARDING THE EXTERNAL LEAKAGE OF  $\text{GH}_2$  IN THE  $\text{LH}_2$  DEWAR  
DUE: PRIOR TO THE APOLLO 15 FRR
- 4 PROGRAM ACTIONS ASSIGNED, DO NOT CONSTRAIN APOLLO 15

## UNEXPLAINED ANOMALIES

### CARID

- 2.8.2 FUSE F-7 OPEN IN C28A5
- 2.12.1 SECS RESISTANCE READING
- 2.14.2 DIGITAL EVENT TIMER ON PANEL 306 STOPPED
- 2.14.3 DIGITAL EVENT TIMER ON PANEL 1 DID NOT STOP
- 2.14.5 DIGITAL EVENT TIMER ON PANEL 1 DID NOT START
- 3.20.1 FUEL CELL NO. 2 C&W INDICATOR LIGHTED

### FRRID

- 3.4.6 X-RAY SPECTROMETER EXIBITED HIGH BIT RATE
- 3.20.2 FUEL CELL NO. 2 HYDROGEN FLOWMETER BLOWN FUSE

ALL UNEXPLAINED ANOMALIES HAVE BEEN REVIEWED AND CLOSED BY THE  
PHASE III CARR AND MSC FRR BOARDS

**SIGNIFICANT  
CONFIGURATION DIFFERENCES  
CSM 110 VS CSM 112**



# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS CSM 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
STRUCT	DOCKING PROBE			
	● CAPTURE LATCH CAM CHAMFER MOD		X	DESENSITIZES CAPTURE LATCH MECHANISM TO SIDE LOADS
	● CAPTURE LATCH ROLLER CHAMFER MOD		X	
	● CAPTURE LATCH EXTERNAL SHAFT BUSHING (NEW)		X	
	● CAPTURE LATCH ROLLER PIN MOD		X	
	● CAPTURE LATCH SHAFT BALL END DIAMETER REDUCED		X	

# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
STRUCT (CONT)	PASSIVE TENSION TIE ● SHEAR PINS RETAINED		X	REDUCES POSSIBILITY OF SHEAR PIN REMNANTS INTERFERRING WITH PROBE OR RING LATCHES AFTER SEPARATION
	CREW COUCH ● Y-Y STRUT ADJUSTMENT		X	PROVIDES FINER ADJUST- MENT FOR STRUT EXTENSION
	CM RH SIDE WINDOW SYSTEM ● OUTER WINDOW COATING REMOVAL		X	SUPPORT ULTRA VIOLET PHOTOGRAPHY (EXP S-177)

# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
STRUCT (CONT)	CM RH SIDE WINDOW SYSTEM (CONT)			SUPPORT ULTRA VIOLET PHOTOGRAPHY (EXP S-177)
	• INNER WINDOW			
	• ALUMINO SILICATE	X		
	• QUARTZ (WITHOUT COATING)		X	
	• LEXAN WINDOW SHADE		X	
	CREW HATCH TV / DAC POLE MOD		X	SUPPORT SIM EVA PHOTO- GRAPHY

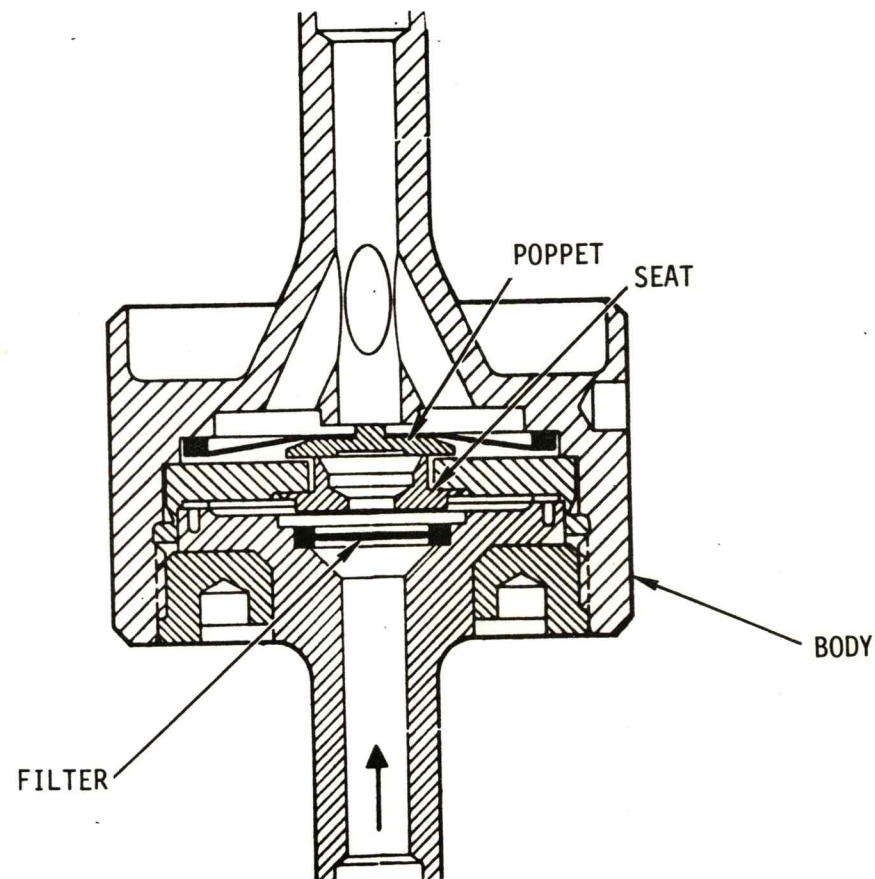
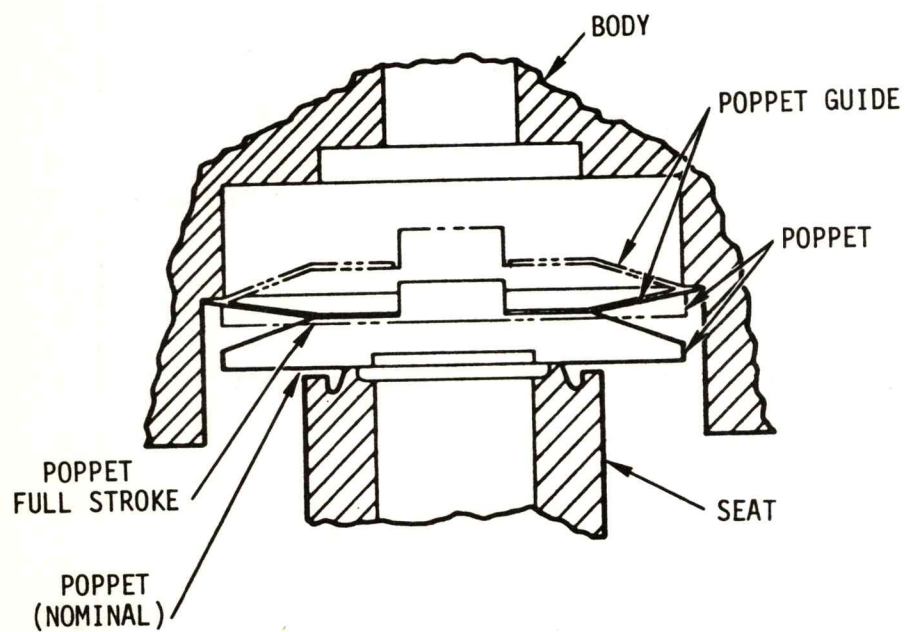


## SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

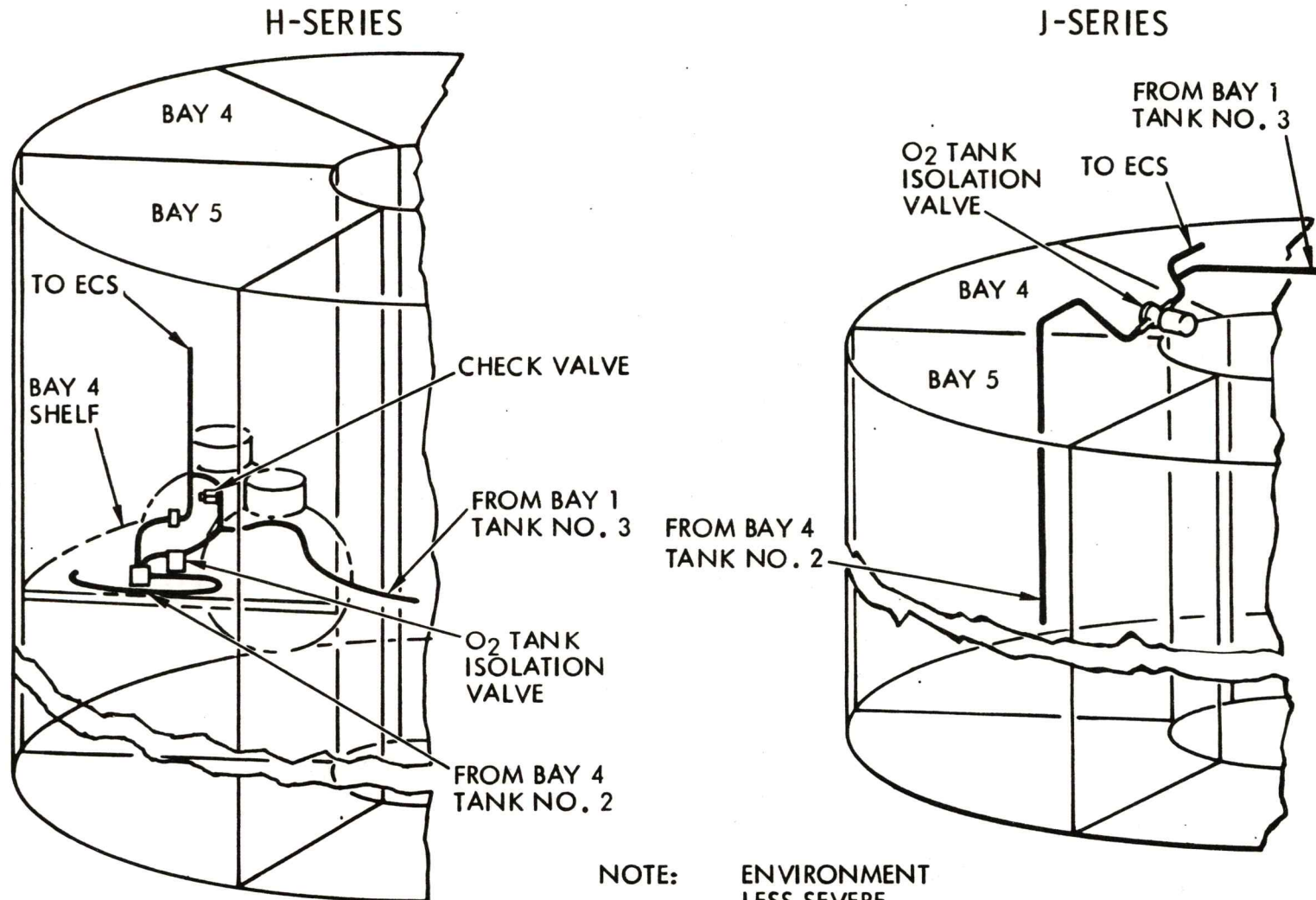
### CSM 110 VS CSM 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
SPS	SPS ENGINE • 1.396 IN. DIA FUEL ORIFICE • 1.337 IN. DIA FUEL ORIFICE	X	X	IMPROVE OXIDIZER / FUEL RATIO TO PROVIDE MAXIMUM PROPELLANT MARGIN
CRYO	H <sub>2</sub> TANK QUANTITY INCREASE • 2 H <sub>2</sub> TANKS • 3 H <sub>2</sub> TANKS  CHECK VALVE CONFIG • SINGLE SEAT • DOUBLE SEAT	X	X	EXTEND MISSION CAPABILITY
		X	X	DECREASE SUSCEPTIBILITY TO DAMAGE

# SINGLE SEAT VS DOUBLE SEAT CRYO CHECK VALVE

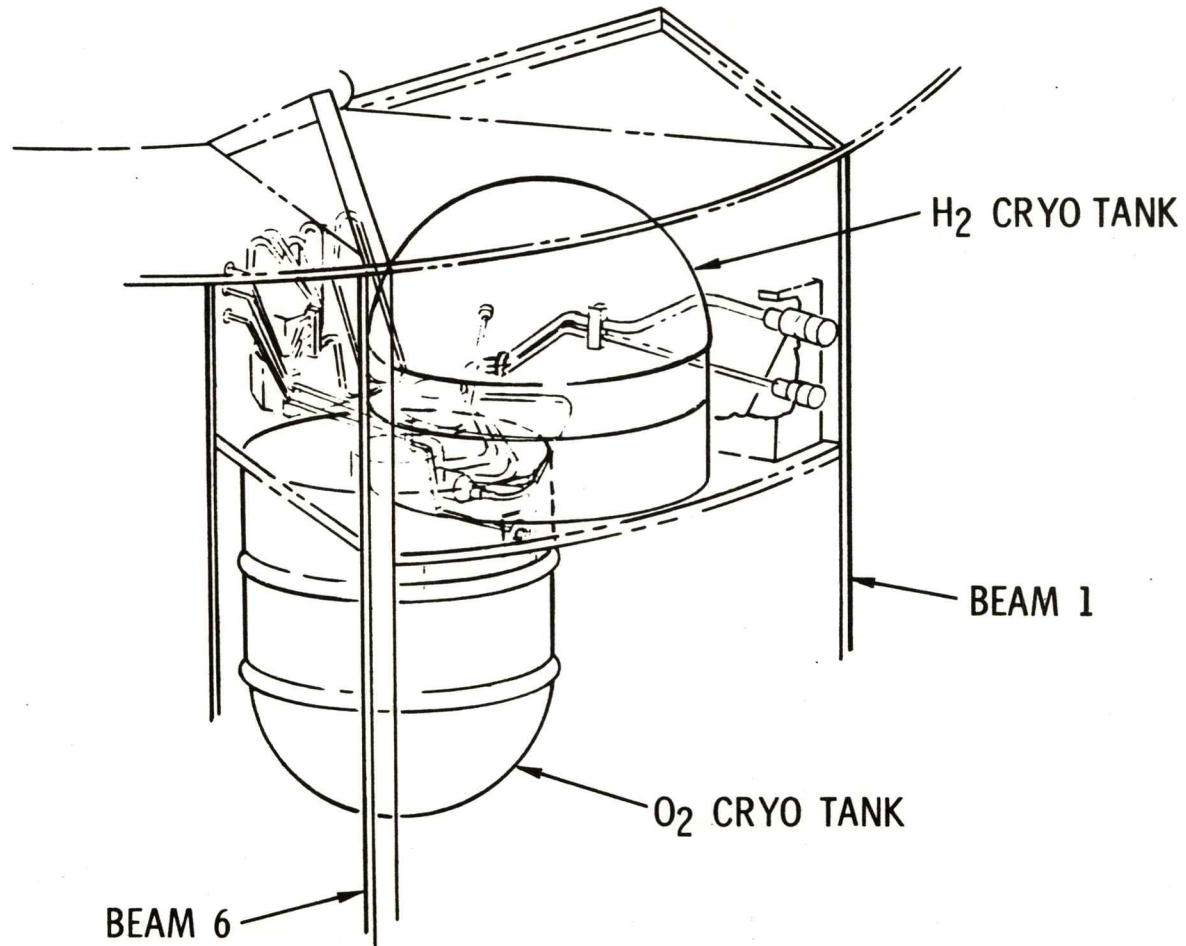


# CSM RETURN ENHANCEMENT PROVISIONS





## CRYO ADDITION SECTOR I



# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
D&C	MDC PANEL 1  ● CONTROLS FOR ADDITIONAL TANKS		X	

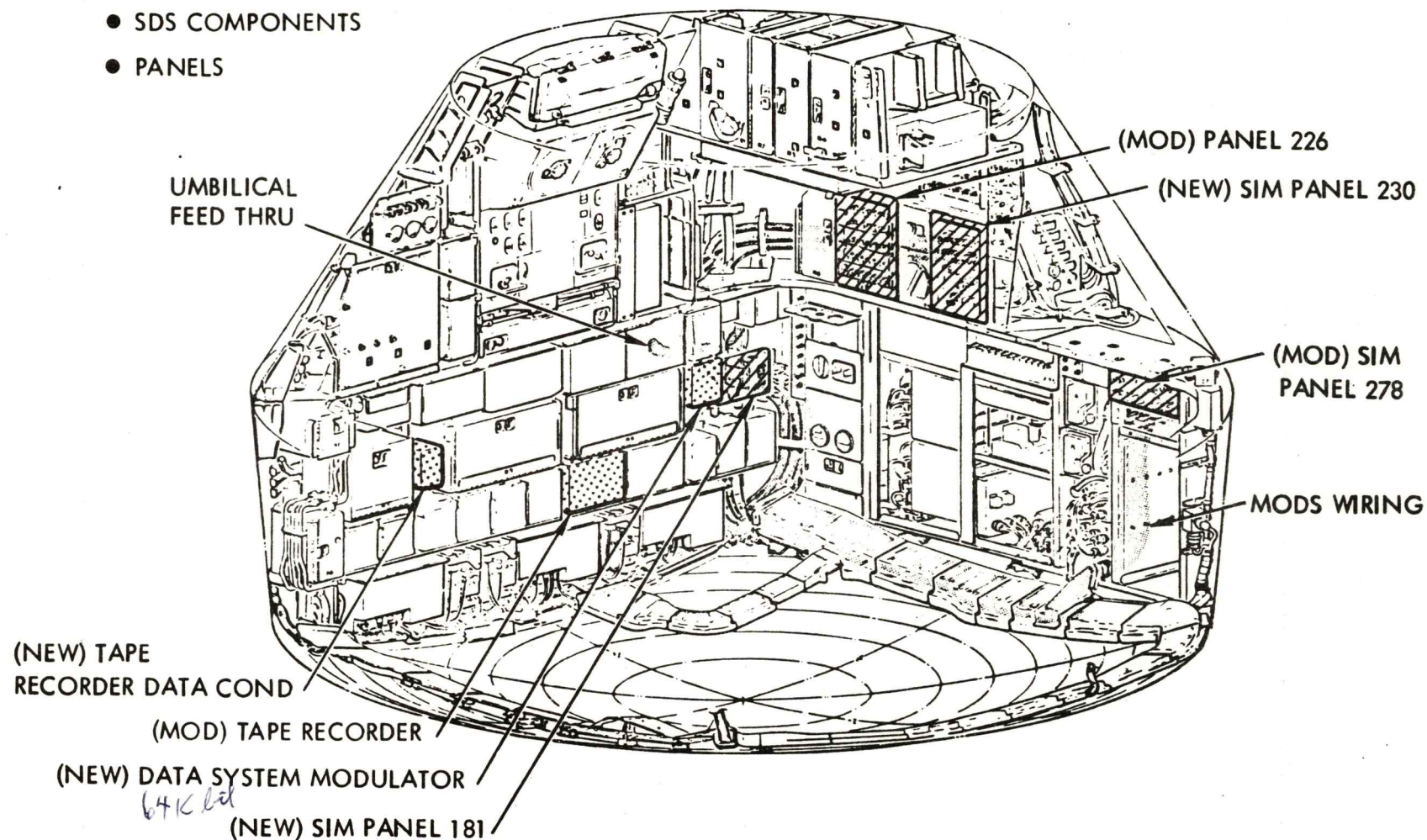
# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
D&C (CONT)	SM / SIM POWER CONTROL - PANEL 181		X	ADD PROVISIONS FOR J-MISSION EXPERIMENTS
	SCI EXPERIMENTS CONTROL - PANEL 230 & DISPLAY		X	SIM EXPERIMENT CONTROLS
	EXPERIMENTS COVER CONTROL - PANEL 278 MODIFICATION		X	ADD PROVISIONS FOR J-MISSION EXPERIMENTS
	SIM POWER DISTRIBUTION - PANEL 226 MODIFICATION		X	POWER FOR SIM & CRYO CONTROL

# CSM J - SERIES MODIFICATIONS COMMAND MODULE

- WIRING
- SDS COMPONENTS
- PANELS



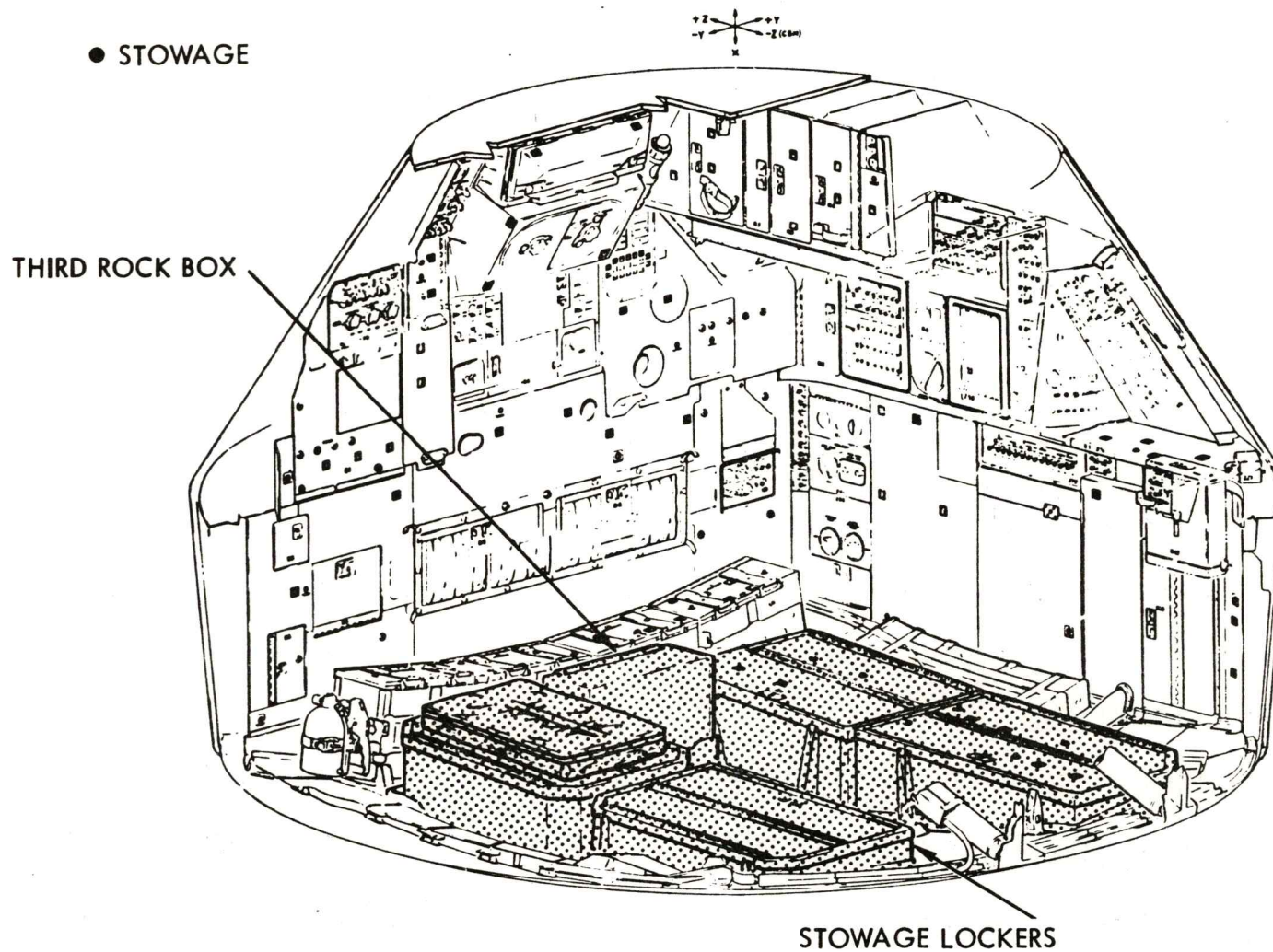


# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
CREW	AFT STOWAGE LOCKERS ● J-MISSION AFT BULKHEAD STOWAGE		X	

# CSM J - SERIES MODIFICATIONS COMMAND MODULE



# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
CREW (CONT)	IV CREWMAN TETHER		X	EVA REQUIREMENTS
	HIGH CAPACITY URINE FILTER		X	MISSION REQUIREMENTS
	URINE CONTAINER		X	MISSION REQUIREMENTS
	PENETROMETER RECORDING DEMONSTRATION		X	MISSION REQUIREMENTS
	ELECTROPHORESIS DEMONSTRATION	X		MISSION REQUIREMENTS
	HEATFLOW & CONVECTION DEMONSTRATION	X		MISSION REQUIREMENTS
	LIQUID TRANSFER DEMONSTRATION	X		MISSION REQUIREMENTS
	PANORAMIC CAMERA CASSETTE		X	MISSION REQUIREMENTS
	MAPPING CAMERA CASSETTE		X	MISSION REQUIREMENTS



# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
CREW (CONT)	CMP PGA (A7LB)		X	CM EVA
	PGA (A7LB)		X	LUNAR SURFACE EVA
	PGA (A7L)	X		
	500 MM LENS	X		MISSION REQMTS
	HYCON CAMERA	X		MISSION REQMTS
	35 MM CAMERA		X	MISSION REQMTS
	80 MM LENS	X		MISSION REQMTS
	EVA PANEL GUARDS		X	PROTECT MDC PANELS DURING EVA
	16 MM MAGS	20	22	MISSION REQMTS
	70 MM MAGS	14	13	MISSION REQMTS
	ROCK BAGS	3	5	ADDITIONAL LUNAR ROCK REQUIREMENTS



# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

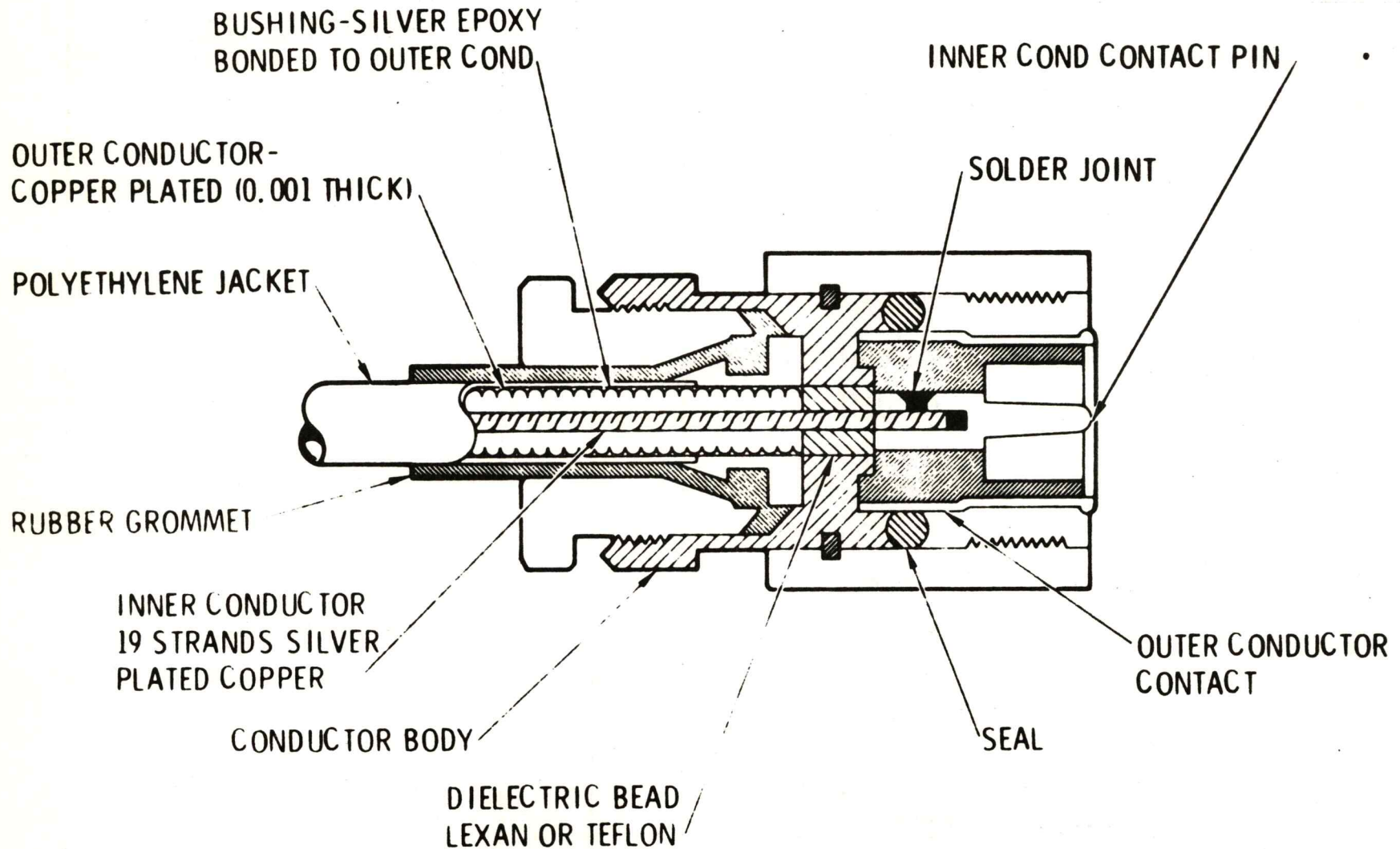
SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
CREW (CONT)	OXYGEN PURGE SYSTEM (OPS)		X	BACKUP OXYGEN SYSTEM FOR EVA

# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
EPS	CSM/LM UMBILICAL, BEEPER, DAC TIMING & HEC TIMING CABLES			
	● TEFLON BRAID COVER	X		ENHANCE CREW BAY FLAMMABILITY REQUIREMENT
	● BETA CLOTH COVER		X	
COMM	TAPE RECORDER DATA COND (TRDC)		X	IMPROVE DATA PLAYBACK
	TRDC BY-PASS CIRCUITRY		X	
	DRR - 51.2 & 64K BITS / SEC SYSTEM - 1 HR RECORD TIME		X	INCREASED CAPABILITY FOR EXPERIMENT DATA
	DSE - 51.2K BITS / SEC SYSTEM - 1/2 HR RECORD TIME	X		
	HIGH GAIN ANTENNA THERMAL ACCEPTANCE TESTING		X	SCREEN POTENTIAL DEFECTS FROM FLIGHT HARDWARE
	HGA COAX SCREENING		X	
SECS	LDEC - SIM PYRO INITIATOR (4) CIRCUITRY ADDED		X	J-MISSION SUPPORT EXPERIMENTS

# PLAXIAL CABLE AND TNC CONNECTOR



## SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

### CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
ECS	CO <sub>2</sub> ABSORBER ELEMENT QUANTITY			EXTEND MISSION CAPABILITY
	• 20 ELEMENTS TOTAL	X		
	• 30 ELEMENTS TOTAL		X	
	CHLORINE & BUFFER AMPULES			EXTEND MISSION CAPABILITY
	• 10 EACH	X		
	• 16 EACH		X	
	SUIT DEMAND PRESSURE REGULATOR CYCLIC TESTING		X	ASSURE STABILIZED SET CONTROL ADJUSTMENTS
	EMERGENCY CABIN PRESSURE REGULATOR CYCLIC TESTING		X	ASSURE NO INTERNAL CONTAMINATION
	CM SIDE HATCH AUXILIARY DUMP NOZZLE			
	• MODIFIED ASSEMBLY FOR TEST	X		O <sub>2</sub> FLOW TEST IN CSM 110
	• STANDARD UNIT		X	



# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
ECS (CONT)	EVA PROVISIONS <ul style="list-style-type: none"> <li>● PANEL 603 WITH GUARD</li> <li>● PANEL 604</li> <li>● 1 ADDITIONAL O<sub>2</sub> RESTRICTOR</li> <li>● EVA PANEL PRESS. GAGE</li> <li>● EVA UMBILICAL ASSEMBLY</li> </ul>		X  X  X  X  X	ADDITIONAL MISSION ACTIVITIES
INST	J-MISSION DELTA MEASUREMENTS: <ul style="list-style-type: none"> <li>● SIM-EXPERIMENTS 79</li> <li>    THERMAL 11</li> <li>    PYROTECHNIC 2</li> <li>● CRYOGENIC TANK 3</li> <li>● THERMAL CONTROL 13</li> <li>● VHF AGC MONITOR. 2</li> </ul>		X	

## SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

### CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
SIM	SCIENTIFIC INSTRUMENT MODULE (SIM) SECTOR I STRUCTURE		X	SUPPORT J-MISSION EXPERIMENTS REQUIREMENTS
	MAPPING CAMERA (SIM)		X	INTEGRATED TO SUPPORT J-MISSION REQUIREMENTS
	LASER ALTIMETER (SIM)		X	
	PANORAMIC CAMERA (SIM)		X	
	SUB-SATELLITE (SIM)		X	
	<ul style="list-style-type: none"> <li>● PARTICLES &amp; FIELDS</li> <li>● MAGNETOMETER</li> <li>● S-BAND</li> </ul>			
	GAMMA RAY SPECTROMETER (SIM)		X	
	ALPHA/X-RAY SPECTROMETER (SIM)		X	
	X-RAY SOLAR MONITOR (SM SECTOR IV)		X	

# SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

## CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
SIM (CONT)	MASS SPECTROMETER		X	INTEGRATED TO SUPPORT
	SIM EXPERIMENTS GN <sub>2</sub> SYSTEM		X	J-MISSION REQUIREMENTS
	DEPLOYMENT MECHANISM		X	SUPPORT J-MISSION EXPERIMENTS REQUIRE- MENTS
	SIM EXPERIMENTS COVERS		X	PROTECT EXPERIMENTS FROM RCS PLUME HEATING AND CONTAINMENT

## SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

### CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
SIM (CONT)	SIM PLUME HEATING THERMAL BLANKETS			PROTECT FROM RCS PLUME HEATING
	MAPPING CAMERA		X	
	PANORAMIC CAMERA		X	
	FOOT RESTRAINT		X	EVA SIM DATA RETRIEVAL
	SIM DOOR SEPARATION SYSTEM SECTOR I		X	EXPOSE SIM EXPERIMENTS TO LUNAR SURFACE
	SCIENTIFIC DATA SYSTEM (SDS)		X	PROVIDE INCREASED DATA CAPABILITY FOR EXPER-
	DATA PROCESSOR, - MASTER & SLAVE		X	IMENT DATA ACQUISITION

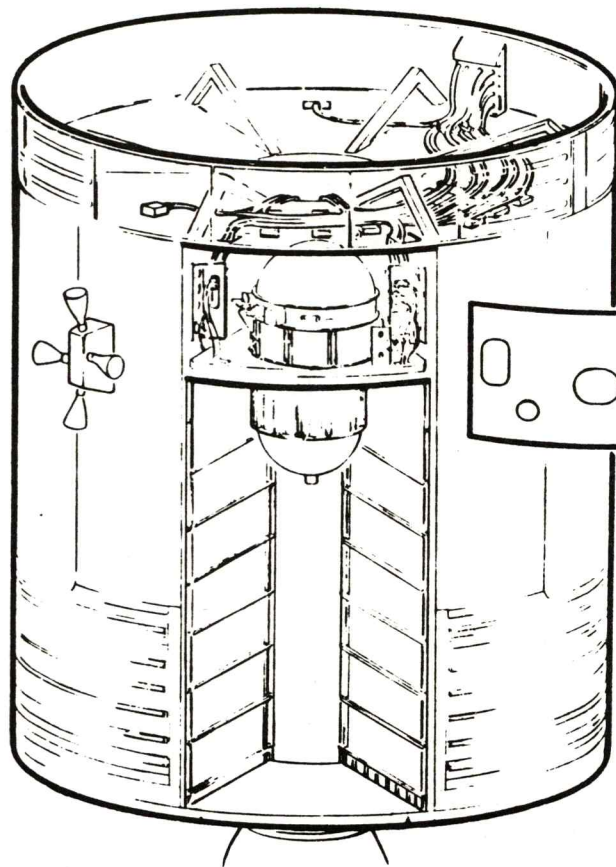


## SIGNIFICANT CONFIGURATION DIFFERENCES (CONT)

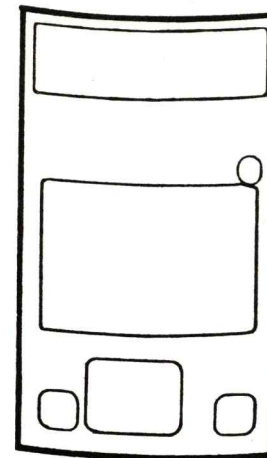
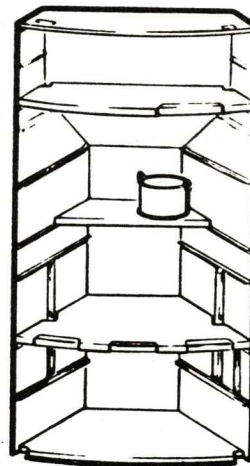
### CSM 110 VS 112

SYS	DESCRIPTION OF CHANGE	110	112	REMARKS / RATIONALE
SIM (CONT)	SCIENTIFIC DATA SYSTEM (SDS) (CONT)			PROVIDE INCREASED DATA CAPABILITY FOR EXPER- IMENT DATA ACQUISITION
	• BUFFER AMPLIFIER		X	
	• DATA MODULATOR - 3 BI PHASE SCD'S - 4 FM VCO'S		X	
	M.O.M. BOX: CONTROL CIRCUITY FOR FUSIBLE LINK INITIATORS (8) & SIM PYRO INITIATORS (4)		X	J-MISSION REQUIREMENT

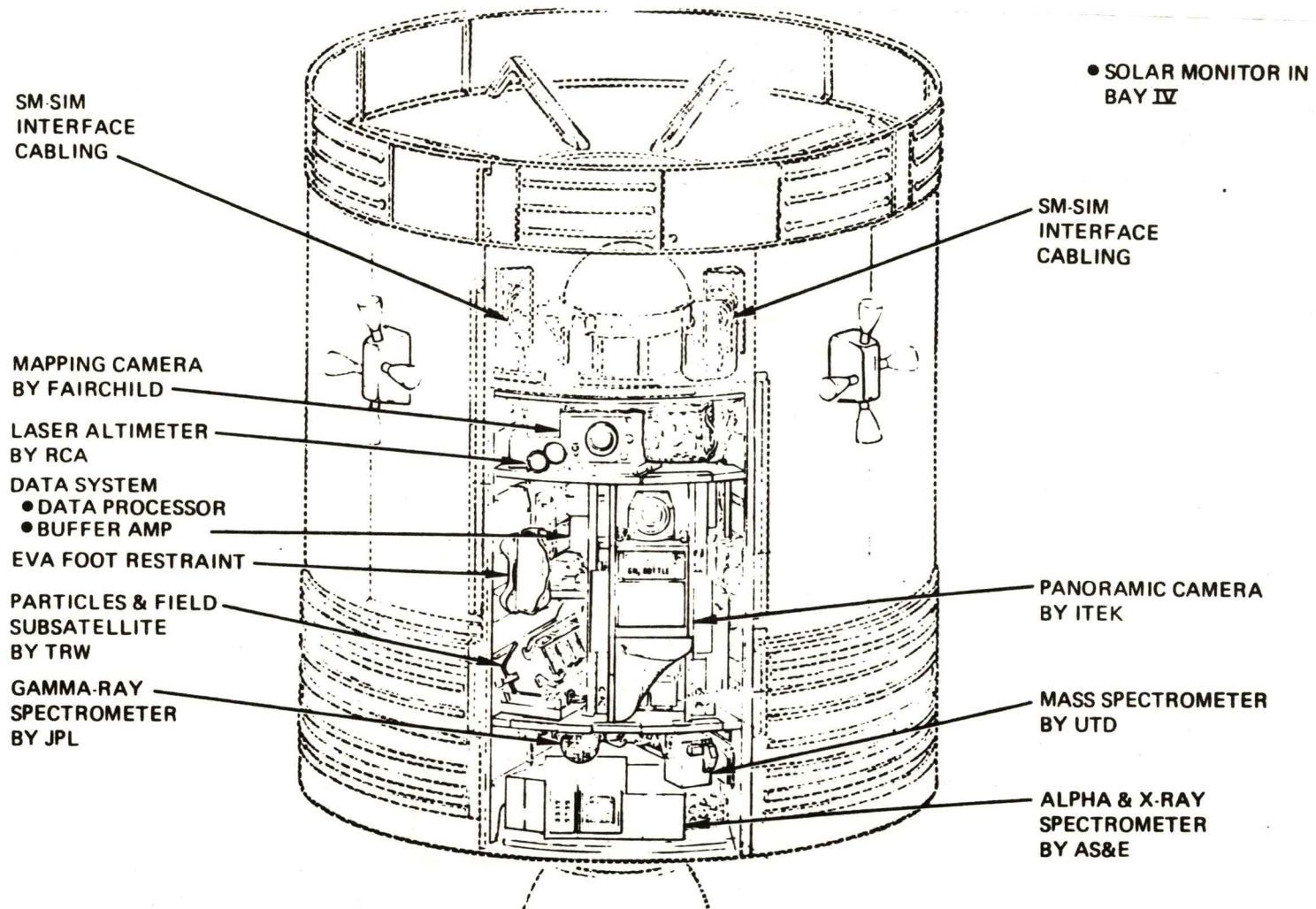
## CSM J - SERIES MODIFICATIONS SERVICE MODULE



- SM WIRING
- SECTOR I CYRO SHELF / DOOR
- SCIENTIFIC INSTRUMENT MODULE (SIM)
- SIM DOOR



# CSM J - SERIES MODIFICATIONS EXPERIMENTS



## WAIVERS AND DEVIATIONS



## WAIVERS AND DEVIATIONS SUMMARY

CSM	106	107	108	109	110	112
DOWNEY WAIVERS/DEVIATIONS	17	14	6	10	2	6
KSC WAIVERS/DEVIATIONS	13*	15*	12*	22*	12*	15
TOTAL	30	29	18	32	14*	21

\*NOTE: DIFFERENCES BETWEEN DATA ABOVE AND DATA FROM PREVIOUS FRR PRESENTATIONS ARE DUE TO WAIVERS RELEASED BETWEEN FRR AND LAUNCH

## CSM 112 SPECIFICATION WAIVER/DEVIATION SUMMARY

### DEVIATIONS

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
192	WAIVE HORIZONTAL & VERTICAL WEIGHT & BALANCE OF SLA	HISTORY OF PRIOR SLA WEIGHT & BALANCE DETERMINATION INDICATED EXCELLENT REPEATABILITY WITHIN SPECIFICATION FOR $\pm 0.2$ INCHES ON THE CENTERS OF GRAVITY
0211	NON-AVAILABILITY OF EVA UMBILICAL CABLE TO MEET SPECIFIED CONTRACT SPECIFICATION	EVA UMBILICAL NOT AVAILABLE TO SUPPORT DOWNEY CHECKOUT DUE TO CONFIGURATION CHANGE. UNIT TO BE TESTED AT KSC
0212	EEE PARTS IN O <sub>2</sub> TANK HEATER TEMP SIGNAL CONDITIONER NOT TO SELECTION CRITERIA	EEE PARTS IN ROSEMOUNT ENGINEERING COMPANY SIGNAL CONDITIONER NOT SUBJECTED TO BURN-IN & SCREENING PER REQUIREMENTS OF RELIABILITY PLAN PLAN SID 62-203B. COMPONENTS ARE CRITICALITY III, ALL PARTS ARE PROPERLY DERATED & THERE IS NO OVERSTRESS POTENTIAL. ALL PARTS ARE SUBJECTED TO ELECTRICAL PERFORMANCE CHECK & THERMAL-CYCLE TEST PRIOR TO SHIPMENT TO BEECH

## CSM 112 SPECIFICATION WAIVER/DEVIATION SUMMARY (CONT)

### WAIVERS

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
189	CM RCS PROOF PRESSURE ON SYS 1 & SYS 2 LOW PRESSURE HELIUM SYS LOWER THAN MINIMUM ALLOWABLE	SYSTEM PROOF PRESSURE TEST WAS 430 PSIG; S/B 450 $\pm$ 10 PSIG. PROPELLANT TANKS WERE PROOF PRESSURE TESTED TO 455 PSIG. SYS NOT SUBJECTED TO REPROOF DUE TO FRACTURE MECHANICS LIMITATION ON TANK PRESSURE CYCLES
197	WAIVE PYRO GROUND LOOP RESISTANCE REQUIREMENT FOR ADAPTER SEPARATION INITIATOR CIRCUITS	PYRO GROUND LOOP READS 2.54 OHMS FOR SYS A & 2.57 OHMS FOR SYS B; S/B 2.5 OHMS MAX. ENGINEERING ANALYSIS INDICATES WORST CASE RESISTANCE SHOULD BE 2.5 TO 3.75 OHMS. REQUIREMENT FOR A MINIMUM OF 5 AMPS THROUGH INITIATOR SIMULATOR IS UNAFFECTED

# CSM 112 SPECIFICATION WAIVER/DEVIATION SUMMARY

## (CONT)

### WAIVERS (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
0210	DEVIATION FROM REQUIRE- MENT CF0034 PRIMARY STEAM DUCT PRESSURE TRANSDUCER	CF0034 INDICATED 0.22 PSIA ON CRT; SHOULD BE 0.20 PSIA MAXIMUM. CF0073 INDICATED 0.18 PSIA. USEABLE DATA FROM CF0034 OBTAINED BY ESTABLISHING A NEW CALIBRATION CURVE DURING ALTITUDE RUNS AT KSC



## CSM 112 TRSD WAIVER/DEVIATION SUMMARY - KSC

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-001	70mm CAMERA MOUNT INSTALLATION TO BE PARALLEL TO SC X-X AXIS, DEVIATED $10 \pm 2$ IN -Z DIRECTION & FIELD OF VIEW THROUGH RIGHT RENDEZVOUS WINDOW TO BE UNOBSTRUCTED	OPTICS CENTERLINE OF THE 70mm CAMERA WITH 80mm LENS INSTALLED IS PARALLEL TO SC X-X AXIS & DEVIATED 13.5 IN -Z DIRECTION. DEVIATION REQUIRED TO OBTAIN UNOBSTRUCTED FIELD OF VIEW
112-PO-002	RADIATOR HEATER CONTROLLER SHALL TURN OFF BETWEEN 17,028 & 17,532 OHMS INPUT CSM 112 WAS 17,650 OHMS & 17,600 OHMS	THE CSM 112 VALVES ARE EQUIVALENT TO 10.72°F & 10.64°F INCLUDING A 0.72, FACTOR FOR TEMP. SENSOR SELF HEAT. THE ALLOWABLE UPPER LIMIT IS 10.5°F (INCLUDING THE 0.72 FACTOR). THE 0.22°F OUT OF TOLERANCE CONDITION HAS NO ADVERSE EFFECT ON HEATER OPERATION SINCE SUFFICIENT DEAD BAND EXISTS TO PREVENT HEATER FLUCTUATIONS

## CSM 112 TRSD WAIVER/DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-003	OVERVOLTAGE ON BUS "A" & "B" SPEC VALUE IS $29 \pm 2V$ DC	MAIN A REACHED PEAK OF 40.5V DC (ABOVE 31V DC FOR 250 MILLISECONDS) & MAIN B REACHED 33.6V DC (ABOVE 31V DC FOR 334 MILLISECONDS). DATA REVIEW INDICATED NO DETRIMENTAL EFFECT ON SYSTEMS POWERED AT TIME OF OCCURRENCE

## CSM 112 TRSD WAIVER/DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-004	GO <sub>2</sub> NON-CONFORMANCE TO MSFC GRADE A SPEC ALLOWABLE OF 30 PPM MAXIMUM INERTS	GO <sub>2</sub> SAMPLES IN S14-088 WERE 31.6 PPM INERTS (PRIMARY) & 36.0 PPM INERTS (SECONDARY). TEST REQUIRED GO <sub>2</sub> FOR ECS ONLY & GRADE B GO <sub>2</sub> WAS ACCEPTABLE BE- CAUSE FUEL CELL REACTANT VALVES ARE MAINTAINED CLOSED. ABOVE SAMPLES MEET GRADE B REQUIRE- MENTS
112-PO-005	CABIN PRESSURE REGULATOR SHALL "CRACK" ON INCREASING PRESSURE AT 3.5 TO 4.7 PSIA. CSM 112 WAS 3.48 PSIA	DATA FROM TCP K-0034 INDICATES CABIN PRESSURE REGULATOR "CRACKED" AT 3.48 PSIA, WHICH COMPARES TO GSE READINGS OF 3.45 & 3.5 PSIA. WORST CASE DIFFERENCE OF 0.05 PSIA IS NOT DETRIMENTAL TO OPERATION IN FLIGHT

## CSM 112 TRSD WAIVER DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-006	WASTE WATER DUMP NOZZLE HEATER "B" INOPERATIVE	SYSTEM "B" HEATER INOPERATIVE & HAS BEEN ELECTRICALLY ISOLATED. REPLACEMENT ON NOZZLE REQUIRES MAJOR REWORK & SYSTEM A HEATER IS FUNCTIONING PROPERLY. NOZZLE HAS 2 BACKUP METHODS FOR DUMP- ING WASTE WATER
112-PO-007	GO <sub>2</sub> NON-CONFORMANCE TO MSFC GRADE A ALLOWABLE OF 30 PPM MAX- IMUM INERTS	GO <sub>2</sub> SAMPLES AT S14-088 WERE 30.6 PPM INERTS. TEST REQUIRED GO <sub>2</sub> FOR ECS ONLY & GRADE B GO <sub>2</sub> WAS ACCEPTABLE BECAUSE FUEL CELL REACTANT VALVES ARE MAIN- TAINED CLOSED. SAMPLES MET GRADE B REQUIREMENTS
112-PO-008	ELS BAROSWITCH CLOSURE TOLER- ANCE IS 10.67 TO 11.57 IN. hg - CSM 112 SYSTEM A WAS 11.66 AND SYSTEM B WAS 11.92 IN. hg	COMPARISON OF DNY & KSC TEST DATA INDICATES A SHIFT ON ALL BAROSWITCH CLOSURES (10K & 25K) OF APPROX 0.15 IN. hg



## CSM 112 TRSD WAIVER/DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-008 (CONT)		(0.15 IN. hg FOR 25K A1, A2, & B1 & 0.24 IN. hg FOR B2). THIS IS EQUIVALENT TO 500 FT ALTITUDE ERROR & IS NOT DERIMENTAL SYSTEM PERFORMANCE.
112-PO-009	HELIUM IN LH <sub>2</sub> SAMPLE. SPEC ALLOWABLE NITROGEN & HELIUM IS 170 PPM	DURING TCP K-0005, LH <sub>2</sub> TANK SAMPLE INDICATED 531 PPM HELIUM. PRATT & WHITNEY (F/C SUPPLIER) LIMITS INERT GAS IN HYDROGEN TO 600 PPM. NO DETRIMENTAL EFFECTS TO FUEL CELL OPERATION AND PERFORMANCE

## CSM 112 TRSD WAIVER/DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-010	SPS CONTROL BOX - GIMBAL DRIVE FAIL CIRCUITS NOT REVERIFIED AFTER INSTALLATION	GIMBAL DRIVE FAIL CIRCUITS IN THE BOX WERE FUNCTIONAL CHECKED PRIOR TO SHIPMENT FROM DOWNEY. AFTER INSTALLATION, CAPABILITY DOES NOT EXIST TO FUNCTION & VERIFY CIRCUITRY WITHOUT DIS- CONNECTING SPS ENGINE CONNECTORS
112-PO-012	DC VOLTAGE - MAIN BUS A WAS - 34.65V DC SHOULD BE $29 \pm 2V$ DC	MAIN A BUS VOLTAGE PEAKED AT 34.65V DC WHEN CONNECTING F/C I TO MAIN BUS A. VOLTAGE DECAYED EXPONENTIALLY TO 31V DC IN LESS THAN 2 SECONDS. DATA REVIEW INDICATES NO DETRIMENTAL EFFECT ON SYSTEMS POWERED AT TIME OF OCCURRENCE

## CSM 112 TRSD WAIVER DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-013	CM RCS SYSTEM B PLUS PITCH ENGINE FUEL VALVE LEAK RATE EXCEEDS ALLOWABLE RATE	SP-T-0017, PARA 3.7.1 G SPECIFIES VALVE LEAK RATE OF 20 SCC/HR. MAX ACTUAL LEAK RATE WAS 36 TO 44 SCC/HR. THIS LEAK RATE OF HELIUM WILL NOT ALLOW LIQUID LEAKAGE. SYSTEM IS NOT PRESSUR- IZED UNTIL CSM SEPARATION. ACCEPTABLE FOR FLIGHT
112-PO-014	SM RCS QUAD A SYSTEM 1 PRESSURE REGULATION WAS 173 PSIG VS SPEC REQUIREMENT OF $181 \pm 4$ PSIG	THE ACTUAL PRESSURE IS ESSENTIALLY THE SAME AS OBTAINED DURING CHECK- OUT AT DOWNEY. THE SYSTEM 2 REG- ULATOR IS WITHIN SPECIFICATION LIMITS AND EACH CONTROLS THE PRESSURE. TEST INDICATED NO REGULATOR DEGRADATION AND PERFORMANCE IS ACCEPTABLE

## CSM TRSD WAIVER/DEVIATION SUMMARY - KSC (CONT)

<u>NUMBER</u>	<u>SUBJECT</u>	<u>RATIONALE</u>
112-PO-015	CM He TANK TEMP OUT OF SPEC	DURING TANK BLEED DOWN GSE CONFIGURATION CAUSED TEMPERATURE OVERSHOOT TO 32°F. HUMIDITY LEVEL DURING THIS TIME WAS LOW ENOUGH TO PRECLUDE CONDENSATION WHICH IS LIMITING CRITERIA FOR SPEC TEMP
112-PO-016	SEC WATER/GLYCOL SYSTEM FLUID ANALYSIS NOT PERFORMED AT EIGHT WEEK INTERVAL AS REQUIRED	SAMPLE TAKEN JUNE 14, 1971, PREVIOUS SAMPLE MARCH 30, 1971. DUE TO SCHEDULE WORKLOAD, SYSTEM NOT ACCESSIBLE. SAMPLES TAKEN WERE ACCEPTABLE. SYSTEM OPERATION IS NOT AFFECTED



## APOLLO 14 ANOMALIES

# CSM 110 ANOMALIES

## SUMMARY LIST AND STATUS

<u>SUBJECT</u>	<u>STATUS</u>
1. COMMANDER ELECTROCARDIOGRAM	CLOSED
*2. FAILURE TO ACHIEVE CAPTURE LATCH ENGAGEMENT	OPEN
3. QUAD B OXIDIZER MANIFOLD PRESSURE TRANSDUCER	CLOSED
*4. HIGH-GAIN ANTENNA TRACKING PROBLEMS	CLOSED
5. UNEXPLAINED VENTING AND HIGH OXYGEN FLOW	CLOSED
6. FROZEN URINE DUMP NOZZLE	CLOSED
7. IN-LINE CHECK VALVE ON OXYGEN TANKS LEAKED	CLOSED
8. INTERMITTENT VOICE COMMUNICATIONS FROM COMMANDER	CLOSED
9. ERRONEOUS RANGE READOUTS FROM VHF	CLOSED
10. ENTRY MONITOR SYSTEM DID NOT AUTOMATICALLY INITIALIZE	CLOSED
*11. MAIN BUSES DID NOT DISCONNECT WHEN SWITCHES SET TO OFF (MOTOR SWITCHES)	OPEN
12. VHF VOICE COMMUNICATIONS INADEQUATE	CLOSED
13. BUFFER AMPULES HARD TO INSERT	CLOSED
14. HOT WATER VALVE LEAKED	CLOSED
15. REPRESS PACKAGE LEAKED	CLOSED
*16. INTERMITTENT BATTERY C TO MAIN BUS B CIRCUIT BREAKER	CLOSED

\*SEPARATE BRIEFINGS

## **DOCKING PROBE**

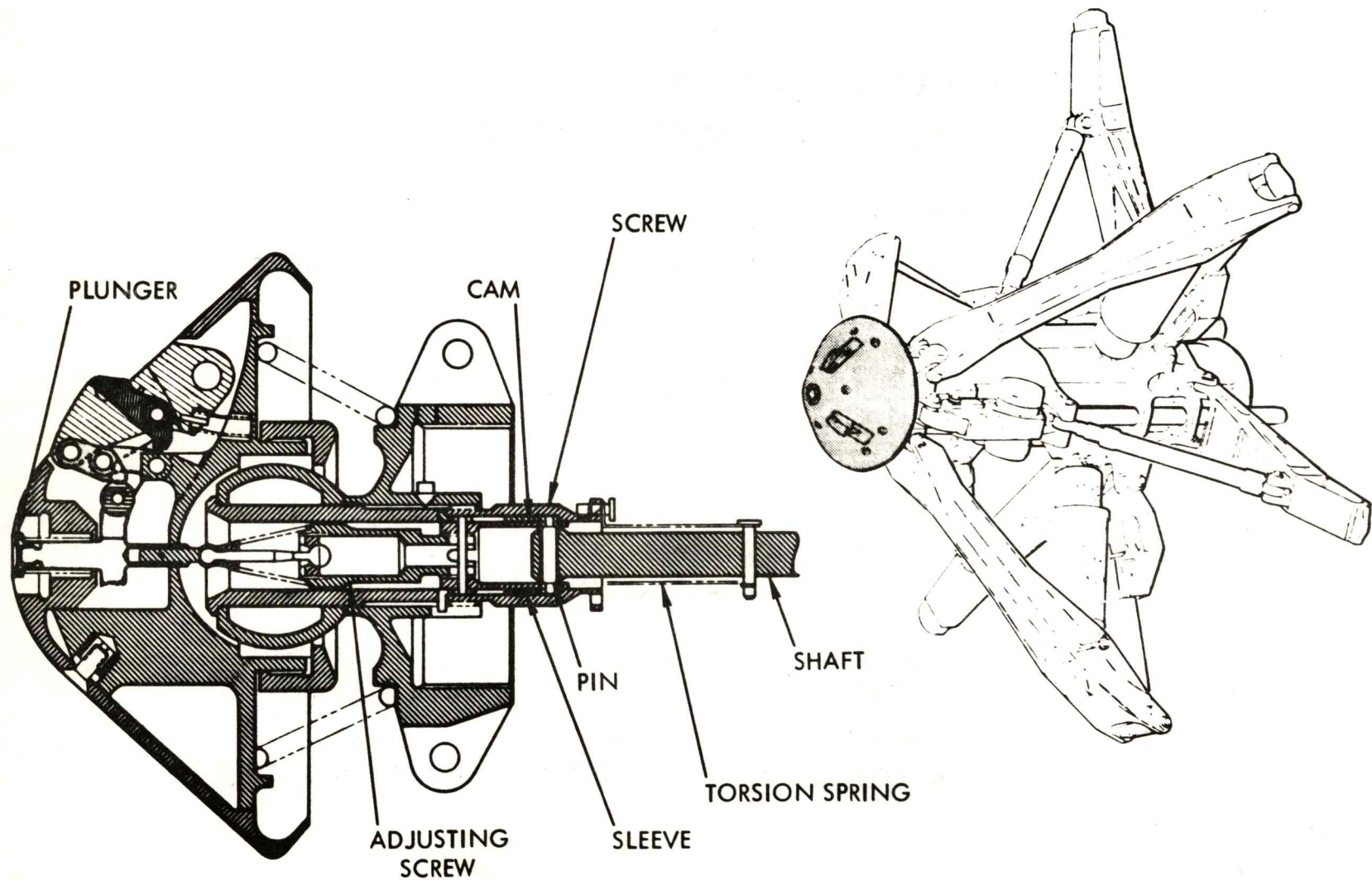
- ISSUE:** CSM 110 INFLIGHT FAILURE TO CAPTURE UNTIL 6TH ATTEMPT
- ANALYSIS:** POST FLIGHT TESTING & ANALYSIS COMPLETED
- CONCLUSION:** CAUSE OF PROBLEM COULD HAVE BEEN
- SHAFT BALL ENTERING CAM SLOT
  - FOREIGN MATERIALS
- CORRECTIVE ACTION:**
- DESIGN CHANGE INCORPORATED TO ELIMINATE EXCESS FRICTION IN CAM AREA
  - ADDED CLEANLINESS REQUIREMENTS IMPOSED

# CSM 110 PROBE ANALYSIS

1. INFLIGHT EXAMINATION
  - MECHANISM FUNCTIONED PROPERLY
2. LRL EXAMINATION & TEST
  - NO SIGNIFICANT FOREIGN MATERIAL OR VISUAL PROBLEM AREAS
  - TIMING TESTS SHOW TIME TO LOCK FASTER THAN PREFLIGHT. TIME TO INDICATE SLOWER BUT NOT SIGNIFICANT
3. NR EXAMINATION & TEST
  - VERIFIED LRL TIMING
  - ELECTRICAL CHECKS OK
  - MECHANISMS FUNCTIONED REPEATEDLY. FAIL TO CAPTURE SIMULATED WITH SIDE LOAD ON SHAFT
  - TIMING TESTS RUN AT +50, AMBIENT, & 145°F, RESPONSE FASTER WITH INCREASING TEMPERATURE



# PROBE CAPTURE LATCH ASSEMBLY



## **CSM 110 DOCKING PROBE (CONT) CONCLUSIONS**

- 1. PROBLEM COULD HAVE BEEN CAUSED BY FOREIGN MATERIAL  
THAT WAS DISLODGED BY REPEATED DOCKING ATTEMPTS**
- 2. ALTHOUGH NOT READILY REPEATABLE IN POST-FLIGHT TESTING,  
PROBLEM COULD HAVE BEEN CAUSED BY SHAFT BALL ENTERING  
CAM SLOT**

## CSM 110 DOCKING PROBE (CONT) CHANGES EFFECTIVE ON APOLLO 15

1. REMOVABLE COVER FOR PROBE HEAD AND ADDED CLEANLINESS REQUIREMENTS FOR GSE. LIMITATION OF FLUIDS, ETC. IN AREA OF PROBE
2. LOCK WIRE SHEAR REMNANTS IN PASSIVE TENSION TIE
3. PROVIDE BALL CENTERING TO DESENSITIZE MECHANISM AND REDUCE FRICTION IN CAM AREA

EXTERNAL BUSHING

ROLLERS

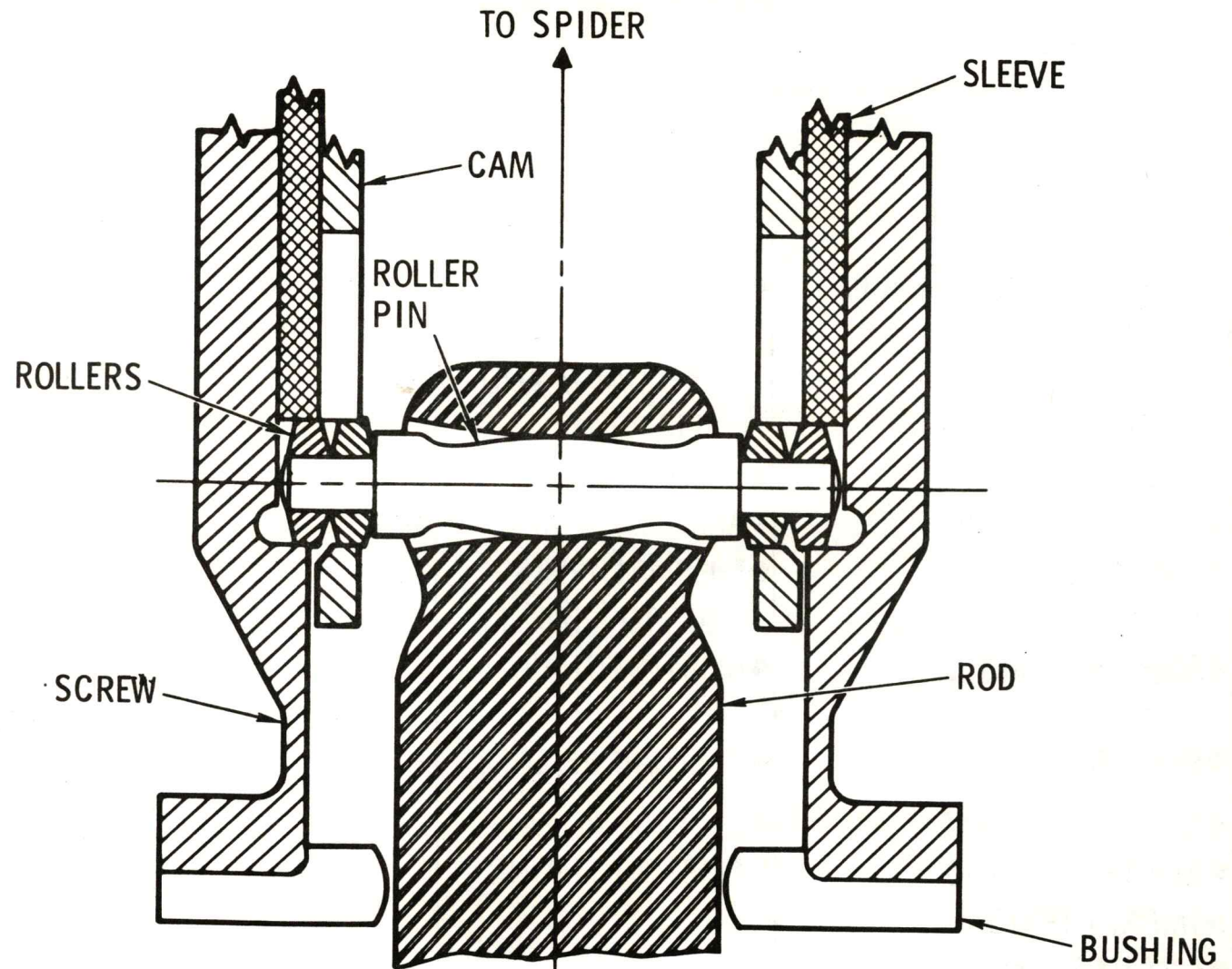
ROLLER PIN

CAM

SHAFT BALL END

4. HORIZONTAL TIMING TESTS ON CAPTURE RESPONSE

## CSM 110 DOCKING PROBE (CONT)



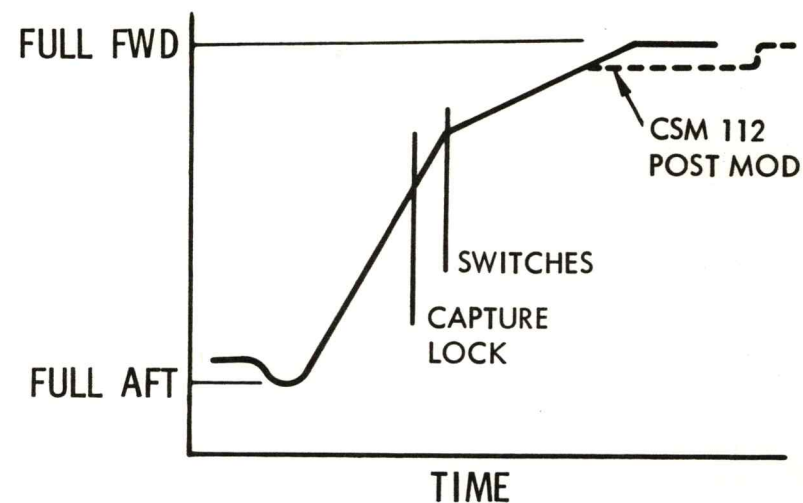


## CSM 110 DOCKING PROBE (CONT) VERIFICATION LOGIC

X-QUAL AND PROBE (CTR TESTS)	CSM 110 PROBE (CTR TESTS)	CSM 112 PROBE	CSM 113 PROBE
<ul style="list-style-type: none"> <li>● INCORPORATE CHANGES</li>   <li>● AMBIENT TIMING TESTS</li> <li>● THERMAL TESTS (-20° TO +180° F)</li> <li>● AMBIENT TIMING</li>   <li>● PRELOAD RELEASE</li> <li>● LM SIDE RELEASE</li> <li>● AMBIENT TIMING</li> <li>● IMPACT TESTS</li> <li>● AMBIENT TIMING</li> </ul>	<ul style="list-style-type: none"> <li>● INCORPORATE CHANGES FROM X-QUAL 3 AND 112</li> <li>● VIBRATION</li> <li>● AMBIENT TIMING</li> <li>● THERMAL TESTS (-20° TO +180° F)</li> <li>● AMBIENT TIMING</li>   <li>● PRELOAD RELEASE</li> <li>● LM SIDE RELEASE</li> <li>● AMBIENT TIMING</li> </ul>	<ul style="list-style-type: none"> <li>● INCORPORATE CHANGES</li>   <li>● DELTA ATP</li> <li>● C/O IN SC 114</li>   <li>● INSTALL IN CSM 112</li> </ul>	<ul style="list-style-type: none"> <li>● INCORPORATE CHANGES</li>   <li>● ATP</li> <li>● TEST AND SHIP WITH CSM 113</li> </ul>

## CSM 112 POST MOD TIMING PROBLEM

- IN PROBE LEVEL TIMING TESTS, PLUNGER TRAVEL STALLED APPROXIMATELY 0.030 FROM FULL TRAVEL
- CAPTURE RESPONSE GOOD, TIME TO INDICATE DELAYED

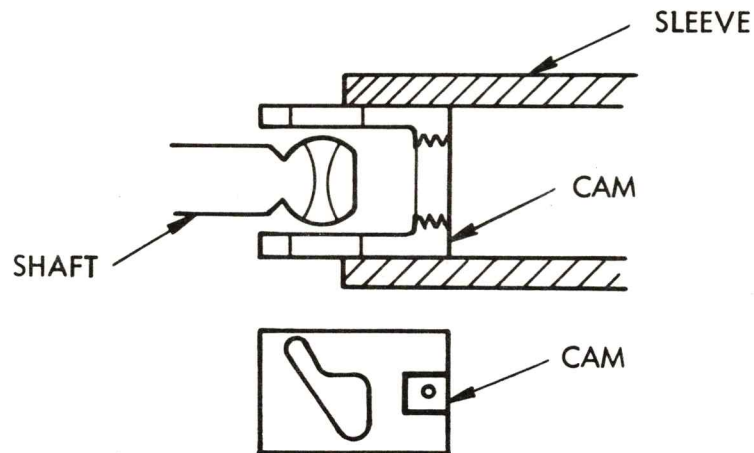


TYPICAL TIMING TRACE

## CSM 112 POST MOD TIMING PROBLEM (CONT)

### ANALYSIS

- CAM IN CSM 112 PROBE FOUND TO BE DRAGGING ON CORNER OF SLEEVE



- SPIDER & CAPTURE MECHANISM FREE
- EXTERNAL BUSHING PERFORMING PROPERLY

## PROBE ASSEMBLY MOTOR SWITCHES

### ● PROBLEM

- DURING ELECTRICAL ATP 'A' CIRCUIT SHOWED TWO SWITCH MALFUNCTIONS
- ONE OR TWO SWITCHES IN THE CAPTURE INDICATING CIRCUIT SHOWED A MALFUNCTION LIGHT ON THE TEST CONSOLE AND ONE SOLENOID POWER SWITCH SHOWED NO CONTINUITY

### ● PROBABLE CAUSE

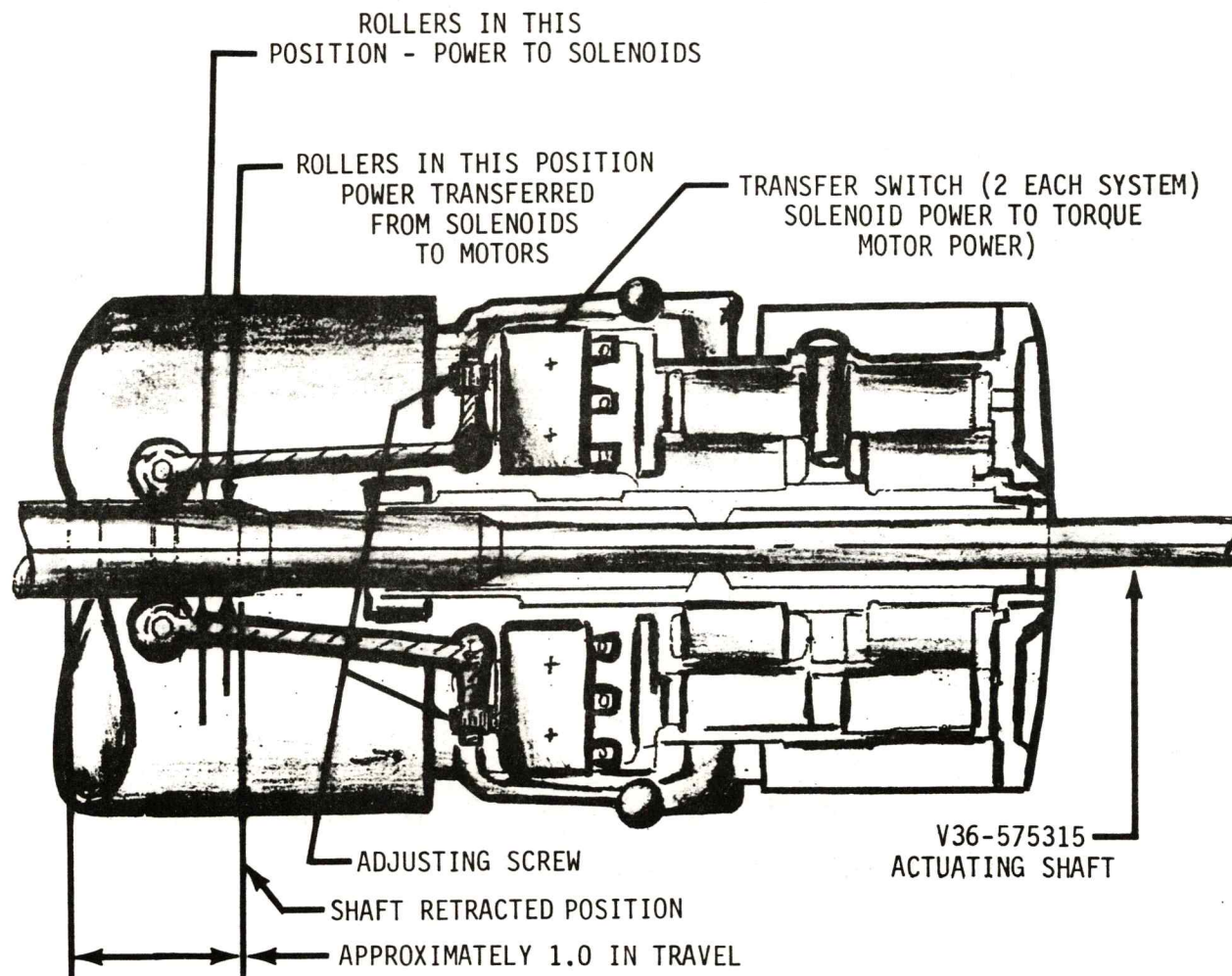
- SWITCH MISADJUSTMENT
- SWITCH DAMAGE
  - DIAPHRAM SEPARATION
  - CONTACT DAMAGE

### ● RESOLUTION

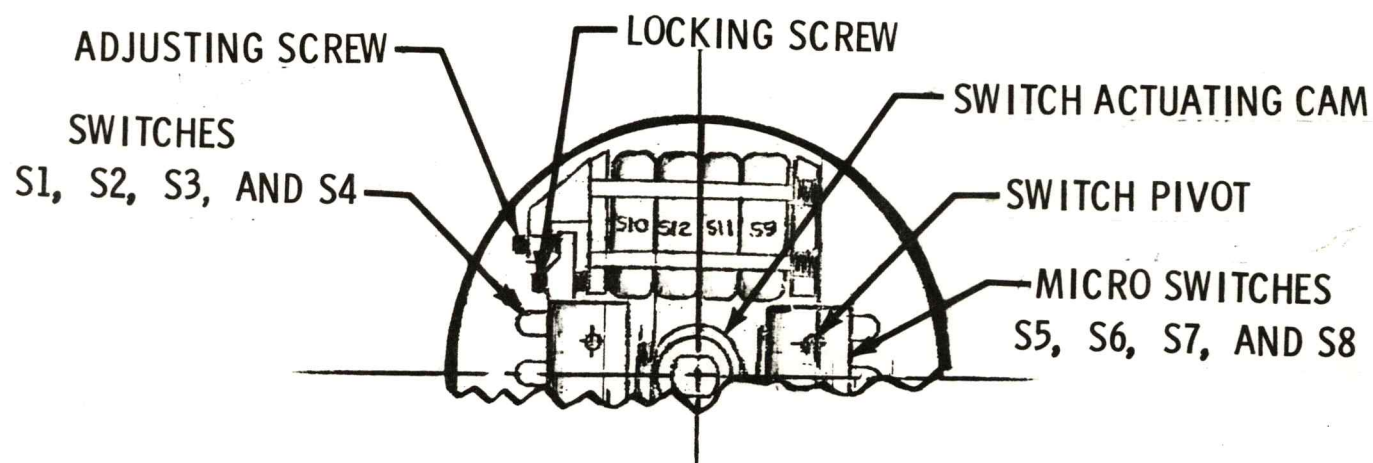
- REPLACE MOTOR ASSEMBLY WITH 113 UNIT AND TROUBLESHOOT 112 ACTUATOR TO DETERMINE PROBLEM CAUSE



# SOLENOID POWER TRANSFER SWITCHES



## CAPTURE LATCH INDICATING SWITCH



### ADJUSTING PROCEDURE:

1. BACK-OFF LOCKING SCREW AND RUN IN ADJUSTING SCREW TOGETHER UNTIL SWITCH JUST ACTUATES.
2. WITH LOCK SCREW BACKED OFF TURN ADJUSTING SCREW AN ADDITIONAL  $\frac{3}{4}$  TURN FOR O/T. RE-CHECK  $\frac{3}{4}$  TURN AFTER ALL SWITCHES ADJUSTED AND TORQUED.

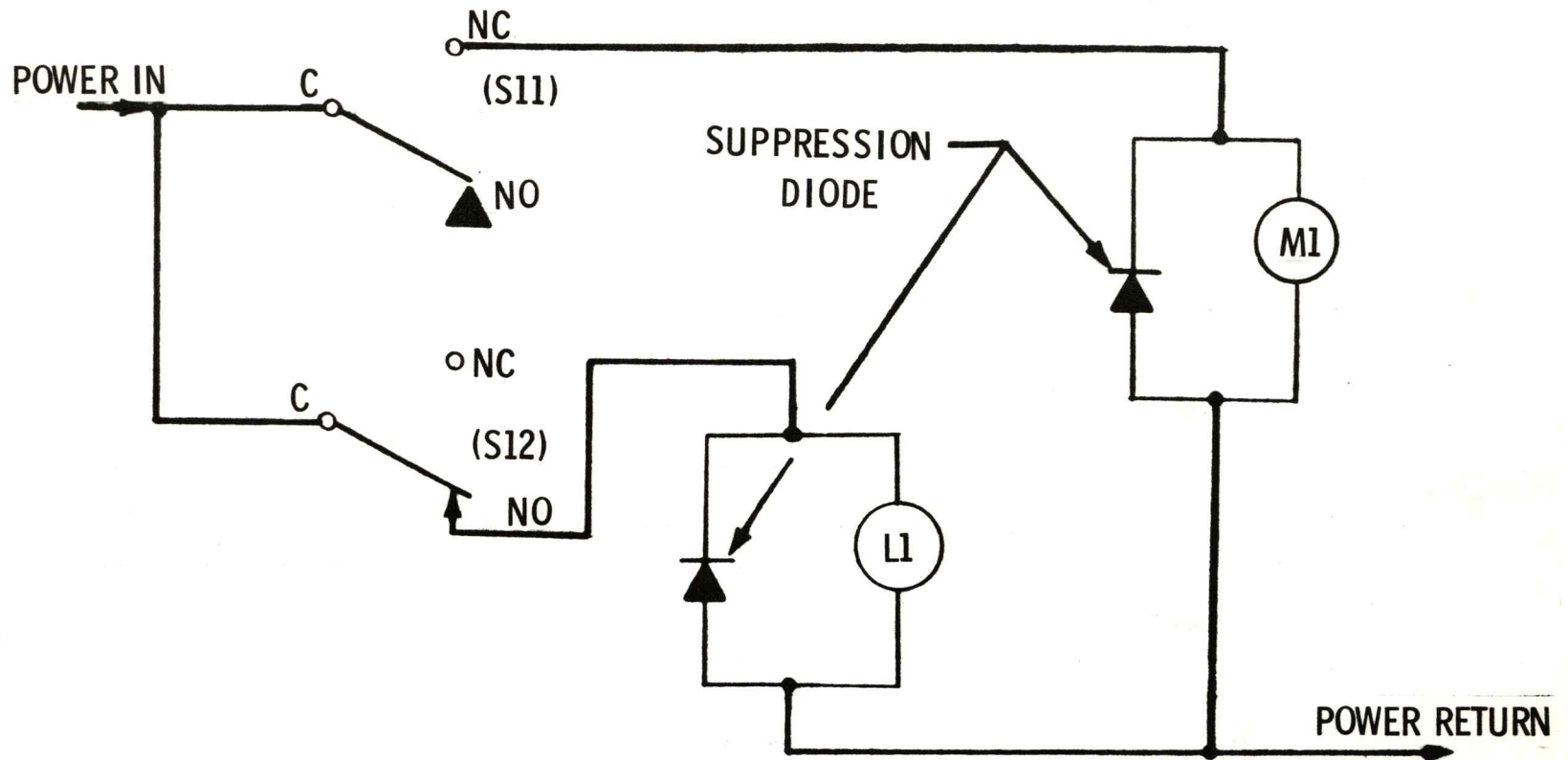
## -401 (112) AND -501 (113) ACTUATOR DIFFERENCES

-401

-501

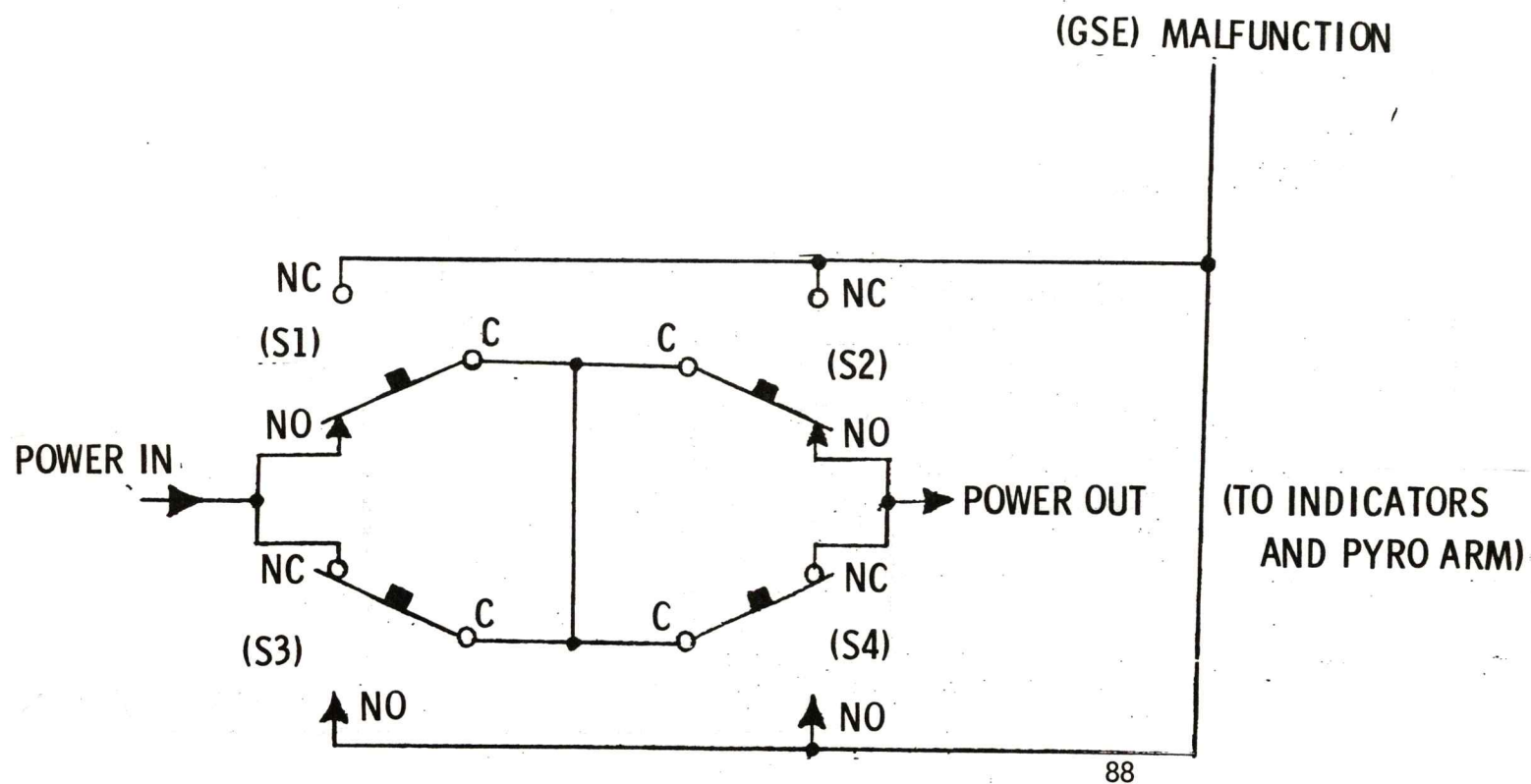
● SWITCH ADJUSTMENT	O/T NOT VERIFIED AFTER SETTING	O/T RECHECKED AFTER INITIAL SETTING. SET SCREWS CHECKED TO FLATTEN CONTACT SURF
● SWITCH	NOT LEAK CHECKED AFTER MACHINING	SWITCHES LEAK CHECKED TO VERIFY NO DIAPHRAM DAMAGE
● CAM SHAFT	TOLERANCES ON CAM LOBE CAN PREVENT ADJUSTING	TOLERANCES CONTROLLED

# SOLENOID POWER/ TRANSFER CIRCUIT 'A' SYST.





## CAPTURE INDICATING CIRCUIT 'A' SYSTEM



## APOLLO 14 HGA ANOMALY

- PROBLEM

- WIDE-BEAM SKEW PREVENTED SWITCHING TO NARROW BEAM

- CAUSE

- BROKEN PLAXIAL CABLE DUE TO POOR WORKMANSHIP PROBLEM
- TESTS VERIFIED OPEN RF-SIGNAL PATH TO ONE WIDE-BEAM HORN GIVES COMPARABLE BEAM SKEW

- CORRECTIVE ACTION

- ALL PLAXIAL CABLES REWORKED AND REINSPECTED XDV-9, XDV-15, AND SUBS
- HGA ATP EXPANDED TO INCLUDE ATT
- HGA SHOCK DESIGN INTEGRITY TO BE VERIFIED BY PYRO SHOCK TEST - XDV-13

## APOLLO 14 HGA ANOMALY

- WIDE-BEAM SKEW PREVENTED SWITCHING TO N/B
- CAUSE OF BEAM SKEW
  - OPEN RF-PATH TO ONE WIDE-BEAM HORN
- COMPONENTS INVOLVED
  - STRIPLINE
  - SEMI-RIGID COAX LINE
  - FLEXIBLE COAX LINE (PLAXIAL)
  - WIDE-BEAM HYBRIDS
  - HORN
- PLAXIAL LINE POOR WORKMANSHIP PROBLEM MAKE FLEXIBLE COAX LINE PRIME SUSPECT

## APOLLO 14 HGA ANOMALY

- WIDE-BEAM COMPONENT

ASSESSMENT

- STRIPLINE
- SEMI-RIGID COAX
- WIDE-BEAM HYBRIDS
- HORN
- FLEXIBLE COAX (PLAXIAL)

DESIGN AND TEST HISTORY

DESIGN AND HISTORY

TEST HISTORY

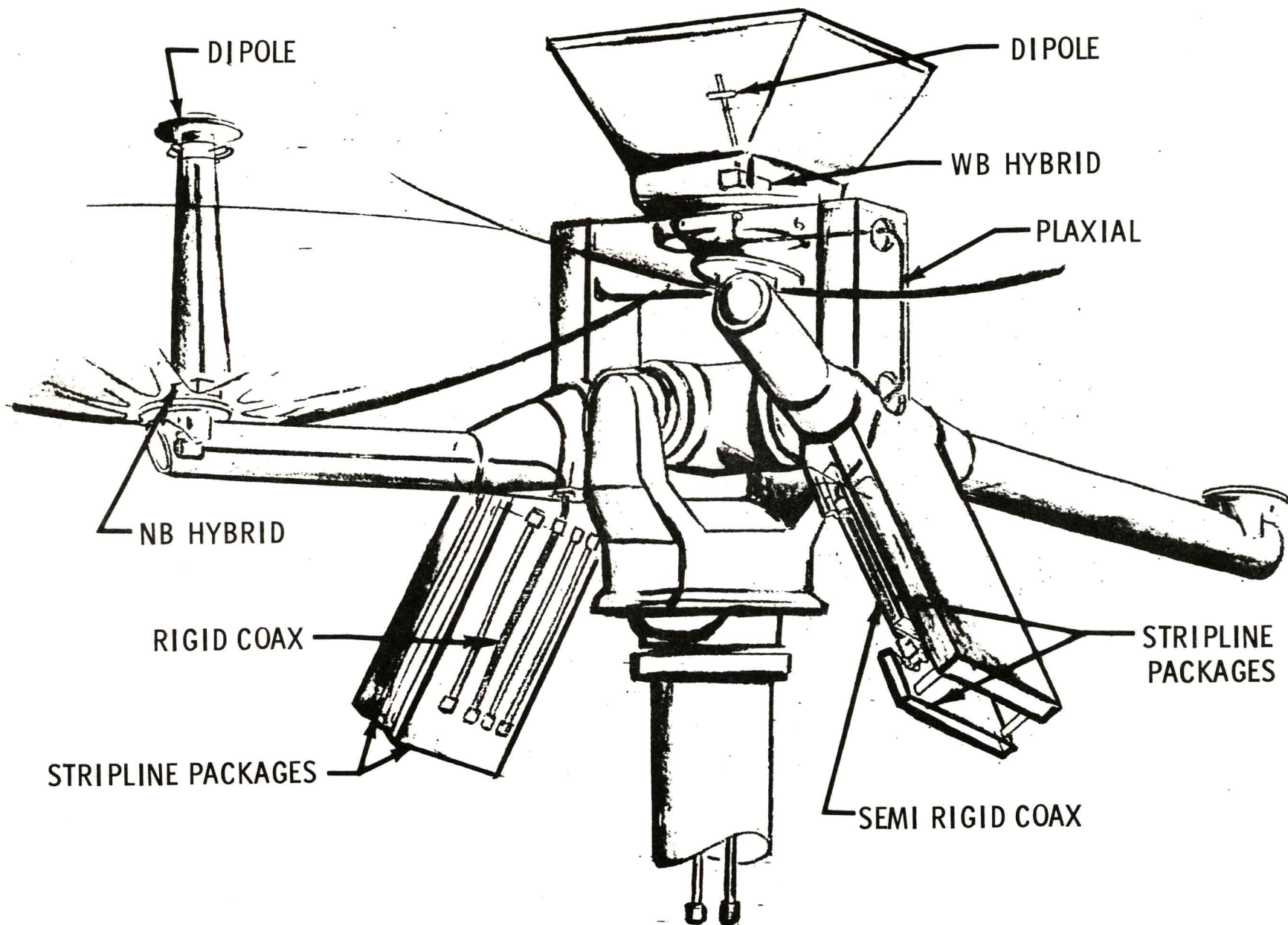
DESIGN AND TEST HISTORY

DESIGN, FABRICATION HISTORY,  
HARDWARE INSPECTION

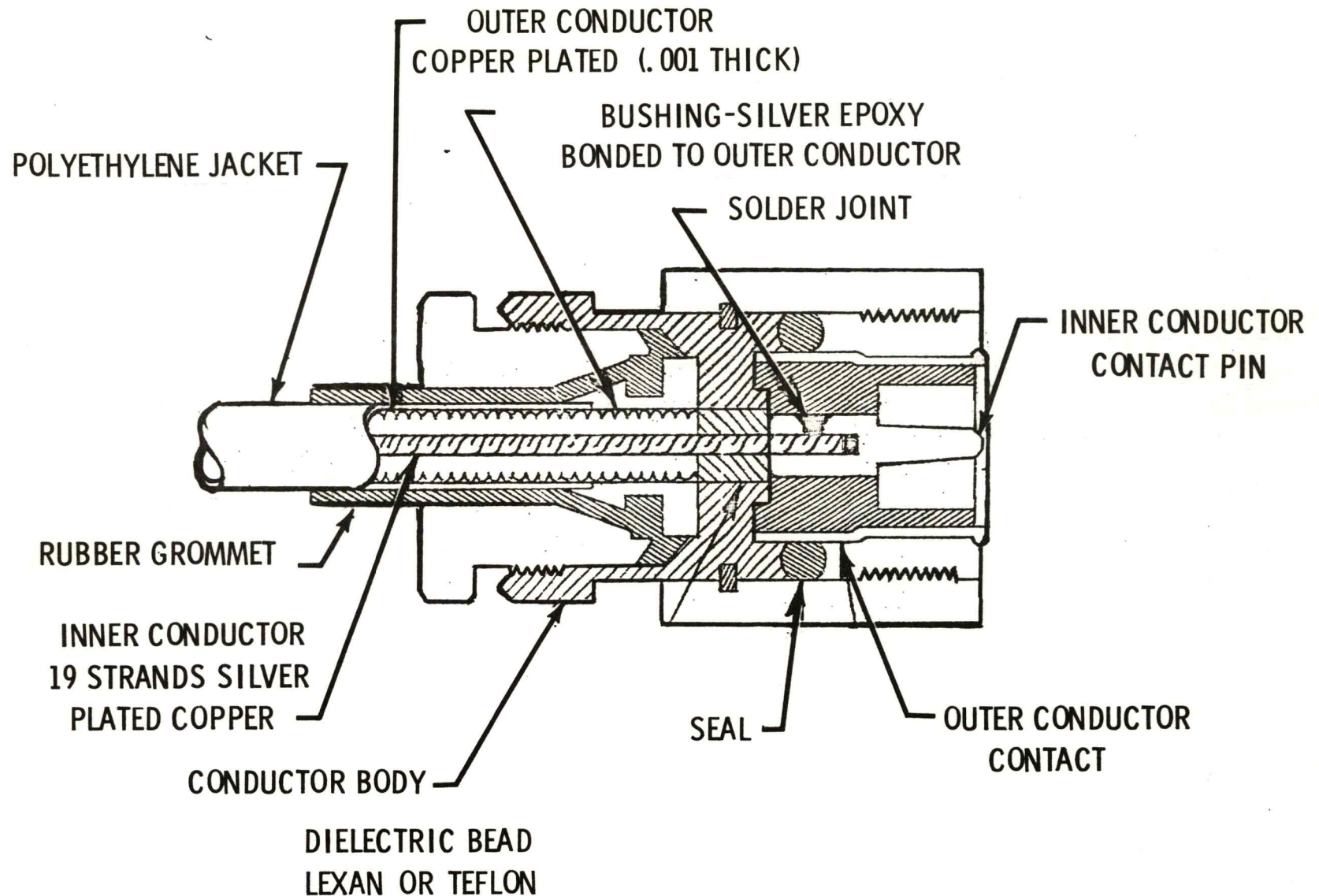
- ASSESSMENT PROVIDED GOOD CONFIDENCE FOR COMPONENTS EXCEPT FLEXIBLE COAX



# HGA WB AND NB ELEMENTS



# PLAXIAL CABLE AND TNC CONNECTOR



## APOLLO 14 HGA ANOMALY

- PROBLEM RESOLUTION

- REWORK ALL PLAXIAL CABLES
- PERFORM OFF-LINE TEST ON CABLES AND HYBRID
- PERFORM ATT ON HGA WHILE RADIATING
- PERFORM PYRO-SHOCK TEST ON HGA AND RETURN TO  
D/V FOR COMPLETE FUNCTIONAL TEST INCLUDING ATT

# MOTOR SWITCHES

- ISSUE - MOTOR SWITCH DC POWER CONTROL BOX FAILED TO TRANSFER
- ANALYSIS - DISASSEMBLY DISCLOSED EXCESSIVE OVERHEATING DUE TO STALL IN MIDCYCLE
- ANALYSIS AND CYCLING TESTS HAVE DISCLOSED THREE PROBLEMS:

## PROBLEM INDICATION

## ANALYSIS

LONG TIME OUT

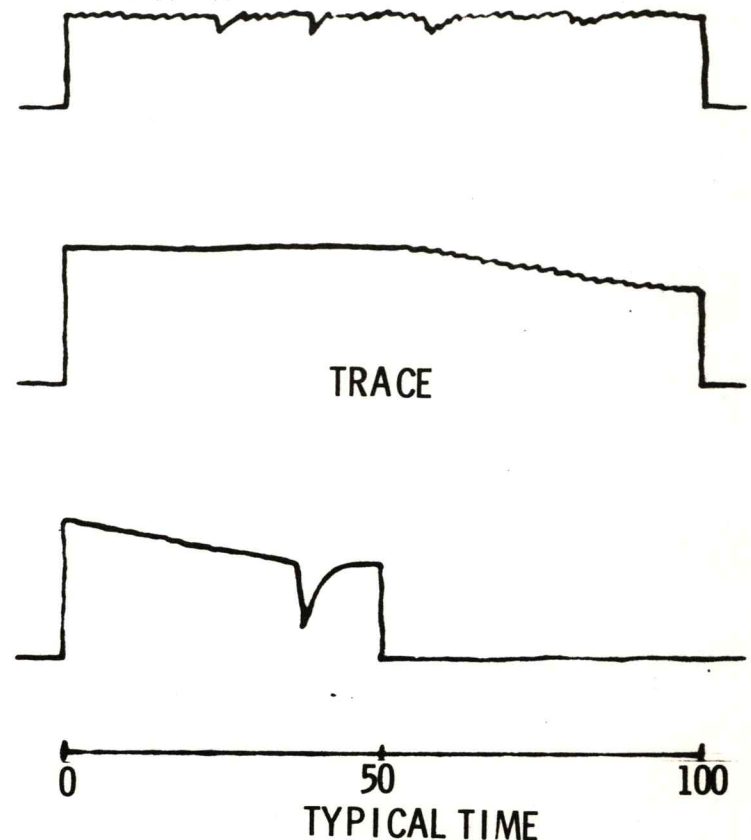
BUILD UP OF MATERIAL  
ON COMMUTATOR  
SEGMENTS

BRAKE HANG UP

EARLY BRAKE MATERIAL  
SUSCEPTIBLE TO  
ATTACHING TO BRAKE  
DISC (NOT DEGRADING)

BRUSH BOUNCE

NORMAL CHARACTERISTIC  
OF -0044 SWITCH  
(RCS CONTROL BOX)





## MOTOR SWITCHES (CONT)

- CONCLUSION - CONDITION OF SWITCH CAN BE DETERMINED BY  
MOTOR SWITCH TRACE
- CORRECTIVE ACTION - TRACES RUN ON CSM 112 SWITCHES RESULTS  
AC CONTROL BOX REPLACED  
SPS CONTROL BOX REPLACED

# APOLLO 14 CIRCUIT BREAKER FAILURE

## ● ISSUE

CB 12 (ME454-0014-0035) ON PANEL 275 FAILED TO MAKE 'BATTERY C TO BUS B' CIRCUIT IN LATCHED POSITION

## ● ANALYSIS

- OPEN CIRCUIT CONDITION REPEATED ON BENCH
- ADDITIONAL FORCE ON ACTUATOR BUTTON IN 'SET' POSITION RESULTED IN 'MAKE' CIRCUIT CONDITION
- X-RAY REVEALED ONE CONTACT PAIR HELD OPEN (0.003-INCH GAP)
- DISASSEMBLY DISCLOSED PRESENCE OF UNKNOWN CRYSTALLINE-LIKE MATERIAL IN ARC AREA OF THE OPEN CONTACT
- MATERIAL SUBSEQUENTLY LOST DURING PHOTOGRAPHIC
- HAVE NOT BEEN ABLE TO DUPLICATE MATERIAL
- NORMAL OPERATION AT DOWNEY AND KSC

## **APOLLO 14 CIRCUIT BREAKER FAILURE (CONT)**

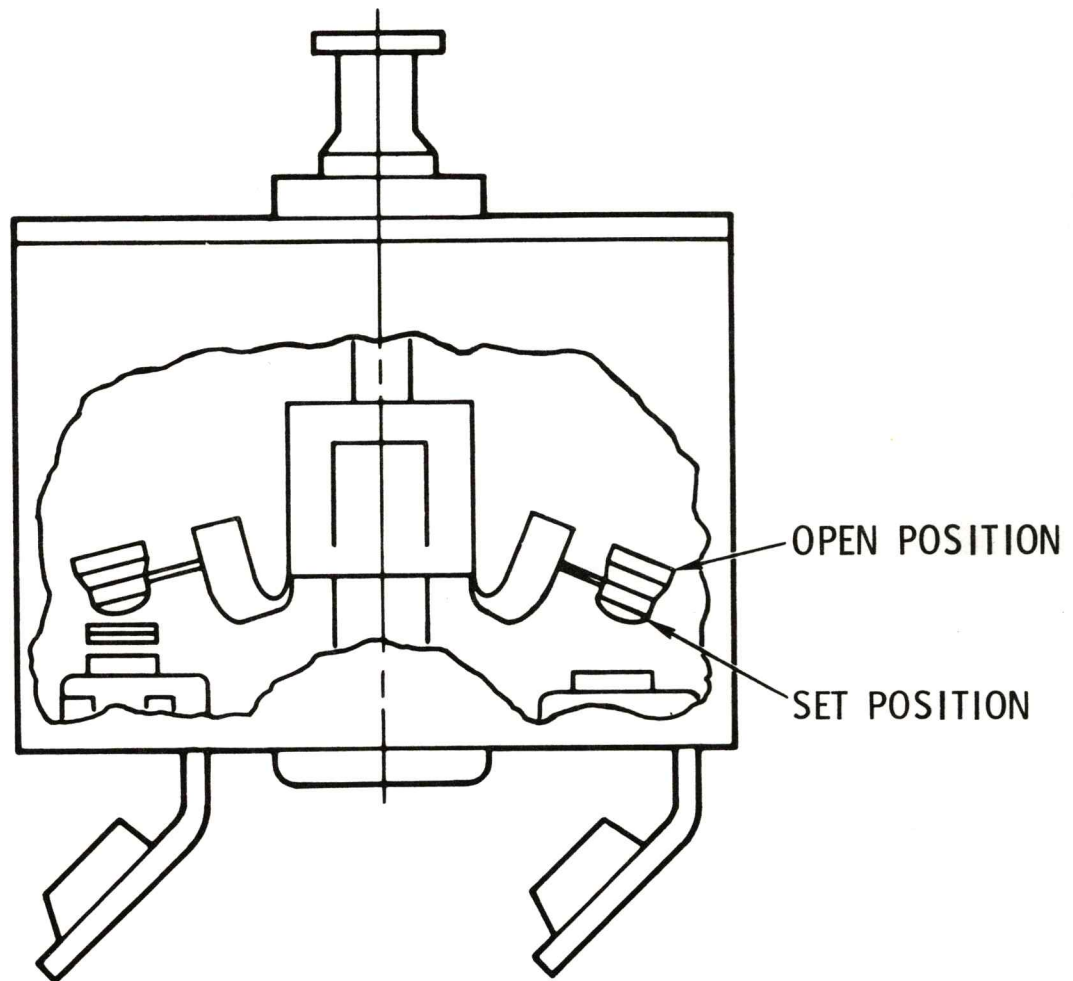
### **● ANALYSIS (CONT)**

- EXPERIENCE HISTORY OF THE ME454-0014 BREAKERS
  - 4665 UNITS MANUFACTURED FOR APOLLO SINCE 1965
  - THERE HAVE BEEN NO FLIGHT ANOMALIES EXCEPT CSM 110
  - THERE HAVE BEEN 106 FAILURES (CSM AND LM) DURING TEST AND CHECKOUT
  - NONE OF THESE FAILURES WERE OF THE UNIQUE NATURE OF THE CSM 110 FAILURE

### **● CONCLUSION**

- CSM 112 ACCEPTABLE BASED ON SATISFACTORY CHECKOUT

## APOLLO 14 CIRCUIT BREAKER FAILURE (CONT)





## SPACECRAFT ISSUES

## SPACECRAFT ISSUES

- PYRO SHOCK TESTS
- LEAD AZIDE STUDY
- INTEGRATED CIRCUIT CONTAMINATION
- H<sub>2</sub> TANKS PRESSURE FLUCTUATION
- ECDU FAILURE
- MAIN BUS A UNDERVOLTAGE SENSOR

# PYRO SHOCK TESTS

- SM 105 SIM DOOR SEP PYRO SHOCK TEST
  - AVAILABLE COMPONENTS ADDED TO SIM DOOR JETTISON TEST
- 2TV-2 SM/SLA SEP PYRO SHOCK TEST
  - HIGH GAIN ANTENNA
- 2TV-2 SM/SLA SEP & SIM DOOR SEP PYRO SHOCK TEST
  - REMAINING COMPONENTS
- COMPONENTS TESTED
  - J-MISSION UNIQUE (INCLUDING EXPERIMENTS)
  - SM COMMON EXPOSED TO HIGHER SHOCK
  - HIGH GAIN ANTENNA

## PYRO SHOCK TEST (CONT)

- ALL COMPONENTS PASSED TEST WITHOUT DEGRADATION  
DUE TO PYRO SHOCK BASED ON PRE- AND POST-TEST  
FUNCTIONALS
- SMJC AND MOM BOX RELAYS MONITORED DURING  
PYRO EVENT AND DID NOT CHATTER
- CM/LM INTERFACE NOT AFFECTED SIM DOOR SEPARATION  
SHOCK IS LESS THAN 2 G's

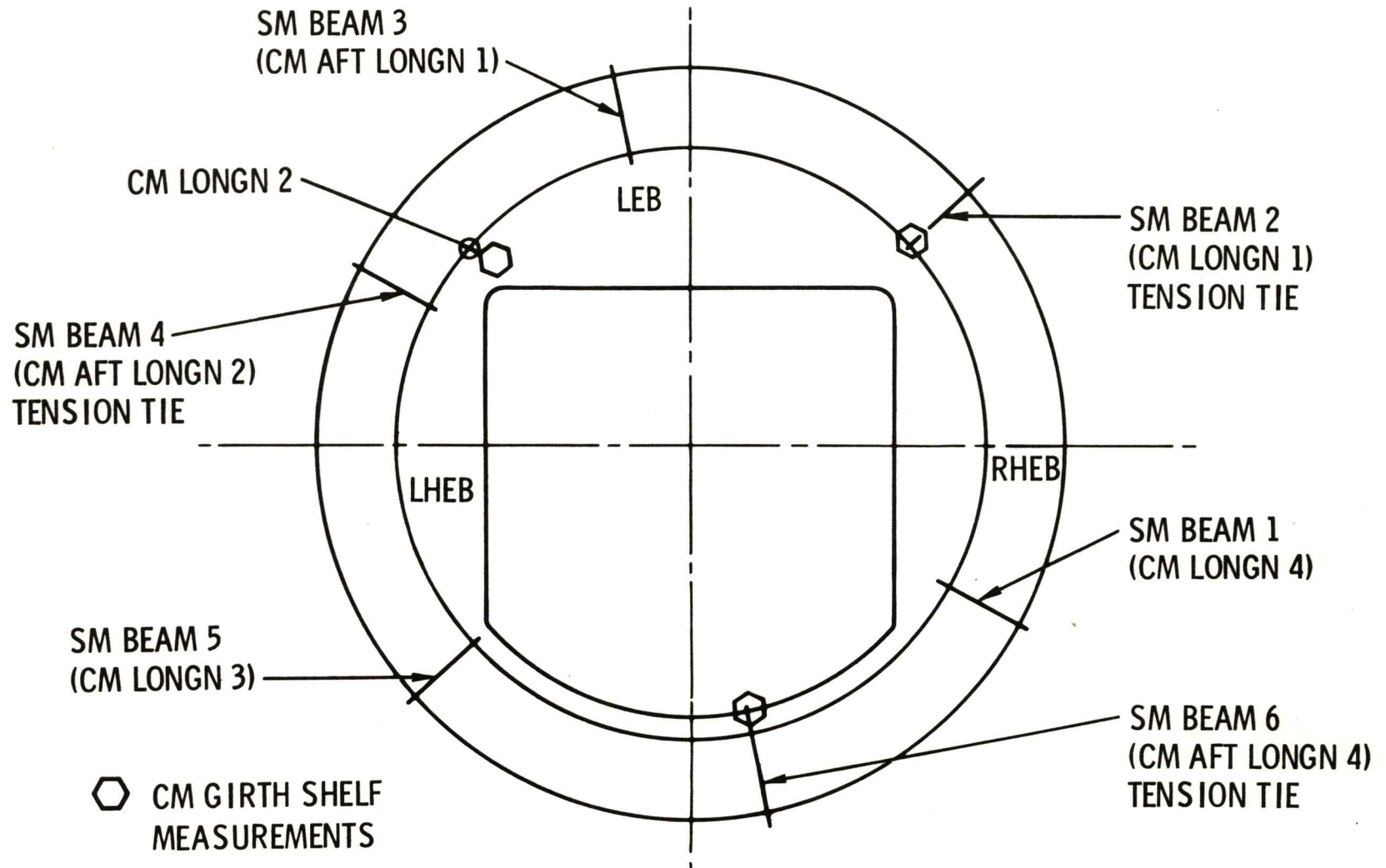


## 2TV - 2 PYRO SHOCK TEST RESULTS CM RESPONSE

LOCATION	g PEAK		
	SLA	SIM	TT
GIRTH RING CM LONGN 4 (SM BEAM 6)	20	65	80
GIRTH RING CM LONGN 1 (SM BEAM 2)	25	25	80
GIRTH RING LH LEB SAME AS CM 101 LOC	25	8	*80
DOCKING RING	5	> 2	

\* CM 101 FLIGHT MEASUREMENT - ASSUMED RELATIVELY UNIFORM AROUND  
GIRTH SHELF

# CM PYRO SHOCK DATA POINTS



## LEAD AZIDE STUDY

ISSUE: USE OF LEAD AZIDE ON APOLLO  
RE: SENSITIVITY, GROUND & FLIGHT  
SAFETY

ANALYSIS: JOINT NASA /NR STUDY CONDUCTED  
TO EVALUATE SAFETY ASPECTS

CONCLUSION: ACCEPTABLE FOR USE ON APOLLO BASED  
ON QUALIFICATION, OFF-LIMIT TESTING,  
& FINDINGS OF STUDY

# LEAD AZIDE STUDY (CONT)

LEAD AZIDE USED IN THE FOLLOWING:

## EXPLOSIVE TRAINS

- SLA SEPARATION
- CSM GUILLOTINE
- UPPER LM GUILLOTINE
- LM DOCKING RING SEP
- SIM DOOR SEPARATION

## BLSC

## DETONATORS

- STANDARD DETONATOR
- LONG REACH DETONATOR



# LEAD AZIDE STUDY (CONT)

## BASIS FOR CONFIDENCE

1. OFF LIMIT TESTING DURING QUALIFICATION
  - SHOCK - 8 FT DROP
  - TEMP - 300 TO 350 DEG F FOR 1 HOUR
  - VIBRATION - UP TO 225% LIMIT
2. SPECIAL HANDLING AND STORAGE
  - HANDLED BY TRAINED PERSONNEL ONLY
  - ALL EXCEPT BLSC CLASSIFIED AS CLASS "C" FOR TRANSPORTATION AND PACKAGING
3. SUCCESSFUL HISTORY ON APOLLO AND OTHER AEROSPACE APPLICATIONS
4. NO HISTORY OF INADVERTENT FIRINGS IN MILITARY OR AEROSPACE DUE TO SHOCK SENSITIVITY OR HANDLING QUALITIES

# INTEGRATED CIRCUIT CONTAMINATION

ISSUE: MOTOROLA (TRDC) T.I. 54L FAILURES

- 2 UNITS QUAL TEST
- 2 UNITS MANUAL SCREENING
- ANALYSIS INDICATES:
  - 2 STAINLESS STEEL PARTICLES
  - 2 PARENT MATERIAL PARTICLES

ANALYSIS: FAILURE INVESTIGATION

- FAILURE DATE CODES 70-17, 70-20 - 70-30
- DATA MODULATION & DATA REPRO REC - OTHER DATE CODES
- NASA AGENCY & APOLLO USERS 116,000 UNIT
- 6 FAILURES REPORTED IN 116 K UNITS
- 5492 APOLLO UNITS AVT TESTED
- 248 UNITS FROM FAILED DATE CODE AVT TESTED
- 356 UNITS FLOWN SATISFACTORILY ON LM

# INTEGRATED CIRCUIT CONTAMINATION (CONT)

## FAILURE EFFECT

### DATA MODULATOR - 18 I/C'S

- 2 - CALIBRATE MODE - NO DATA LOSS
- 16 - PHASE MODULATED SUB-CARRIERS (3)
- I/C FAILURE-LOSS OF RELATED SUB-CARRIER & DATA CHANNEL

### DATA RECORDER REPRODUCER - 14 I/C'S

- I/C FAILURE-LOSS OF EITHER OF TWO RECORDED DATA CHANNELS

### TRDC - 152 I/C'S

- 51 I/C'S - AUTOMATIC SWITCH TO BYPASS
- 101 I/C'S - REQUIRE GROUND COMMAND TO BYPASS TRDC (CAPABILITY ADDED BY E0796690)

## INTEGRATED CIRCUIT CONTAMINATION (CONT)

### CONCLUSIONS:

- FAILURE INCIDENCE LOW
- BYPASS CAPABILITY ADDED. TRDC
- FAILURE DOES NOT JEOPARDIZE VEHICLE OR CREW

### CORRECTIVE ACTION:

- NO FURTHER ACTION CSM 112



# H<sub>2</sub> TANKS PRESSURE FLUCTUATIONS - CSM 112

ISSUE: DURING 0005 C/O PRESSURE IN ALL THREE H<sub>2</sub> TANKS FLUCTUATED

## SEQUENCE OF EVENTS:

- HIGH H<sub>2</sub> FLOW (100 AMP LOAD ON FUEL CELLS)
- FUEL CELL PURGE FLOW (APPROX 3 MINUTES)
- FUEL CELLS ON OPEN CIRCUIT
- PRESSURE FLUCTUATIONS STARTED 1 MINUTE AFTER F/C ON OPEN CIRCUIT

## ANALYSIS:

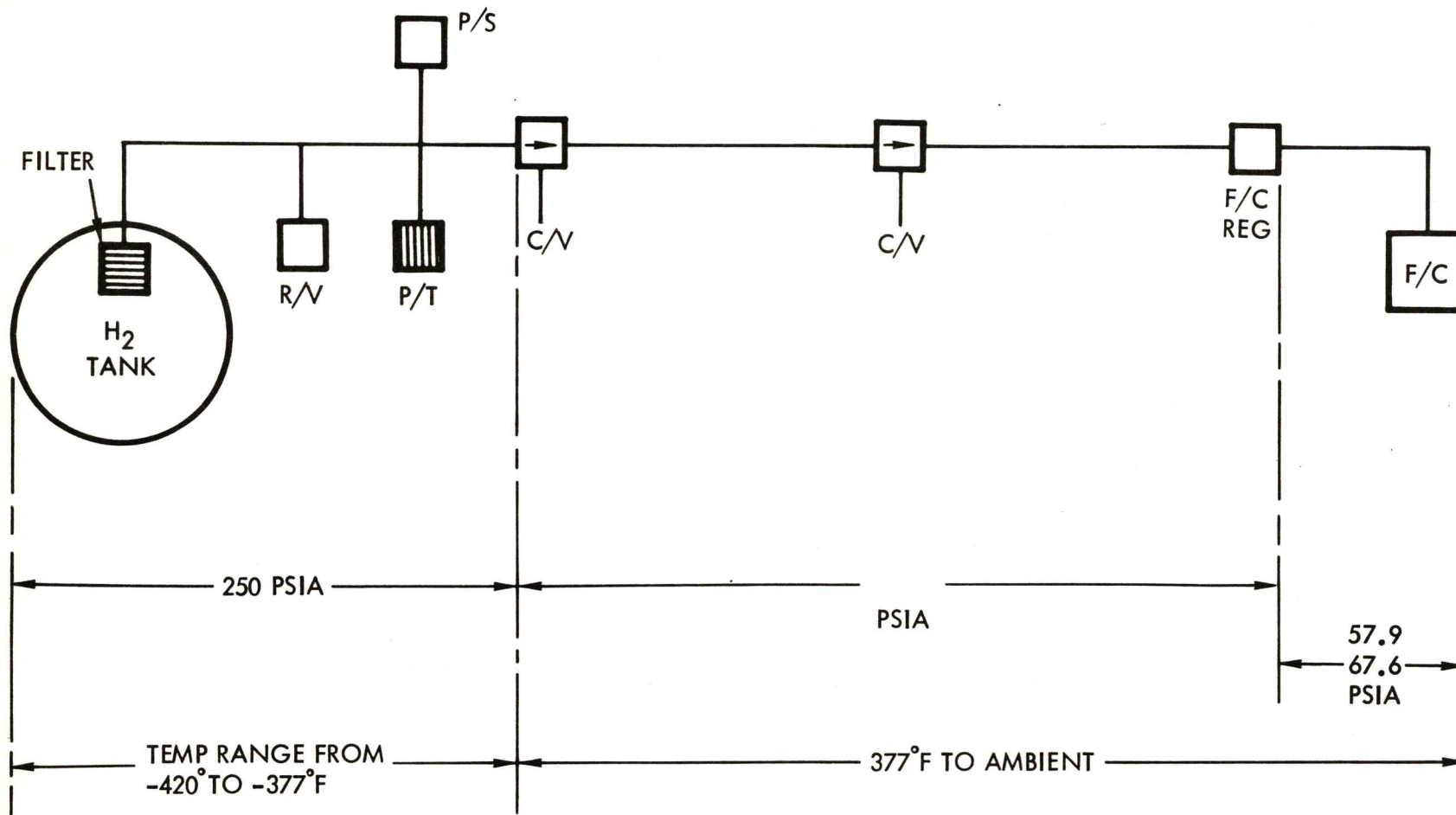
- H<sub>2</sub> TANK NO. 3 PRESSURE FLUCTUATED  $\pm 7$  PSI AT 2 CPS
- H<sub>2</sub> TANKS NO. 1 & 2 PRESSURE FLUCTUATED AT  $< 1$  CPS
- CSM 110 TANKS NO. 1 & 2 SHOWED SIMILAR FLUCTUATIONS DURING COUNTDOWN (DURATION 2 MIN - 40 SEC LOW FLOW CONDITIONS)

## H<sub>2</sub> TANKS PRESSURE FLUCTUATIONS - CSM 112 (CONT)

### ANALYSIS:

- BULK FLUID TEMP WAS -420°F, FLUID OUTLET TEMP WAS -377°F
- WITH F/C ON OPEN CIRCUIT - SYSTEM WAS DEAD ENDED BETWEEN TANK & F/C REGULATOR
- REVIEW OF INSTRUMENTATION DATA REVEALED NO ANOMALIES
- FUEL CELL REGULATED PRESSURE WAS STEADY
- PRESSURE FLUCTUATIONS WERE BELOW NATURAL LINE FREQUENCIES (6.6 CPS)
- NO HISTORY OF PRESSURE FLUCTUATIONS DURING GASEOUS CHECKOUT AT DOWNEY & KSC
- NO HISTORY OF PRESSURE FLUCTUATIONS DURING MISSION

# SIMPLIFIED SYSTEM SCHEMATIC



## H<sub>2</sub> TANKS PRESSURE FLUCTUATIONS - CSM 112 (CONT)

### ANALYSIS:

- ASSUME 1.0 SCCH LEAKAGE THROUGH CHECK VALVE. STARTING AT 250 PSI & RAISING THE TEMPERATURE FROM -377° F TO +70° F THE PRESSURE IN THE LINE WILL REACH 2275 PSIA

### CONCLUSION:

- PRESSURE CYCLES ARE MOST PROBABLY CAUSED BY RAPID EXPANSION & CONTRACTION OF "BUBBLES" (WARM GAS) WITHIN THE FLUID
- "BUBBLES" ARE CAUSED BY THE INCREASED HEAT TRANSPORT PROPERTIES OF THE FLUID NEAR THE CRITICAL TEMPERATURE REGIME
- AT A FLUID DENSITY OF 2.5 LB/FT<sup>3</sup> AT 250 PSIA, A 5° TEMP INCREASE WILL RESULT IN A DENSITY CHANGE OF 1.0 LB/FT<sup>3</sup>



## H2 TANKS PRESSURE FLUCTUATIONS - CSM 112 (CONT)

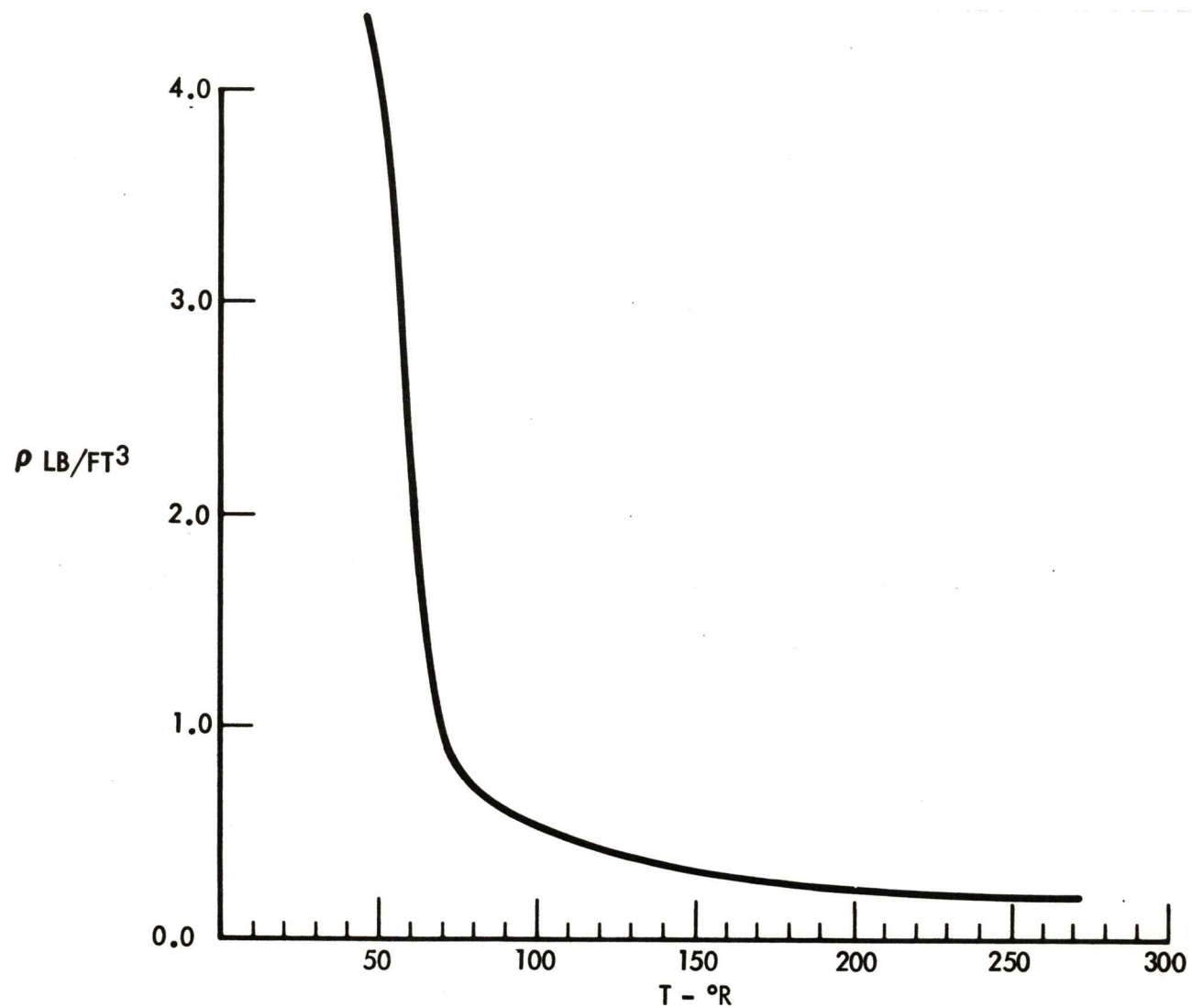
### CONCLUSION:

- CONDITION IS INFLUENCED BY DENSITY, TEMPERATURE, PRESSURE, FLOW OR NO-FLOW
- SYSTEM OPERATION WAS NOT REPRESENTATIVE OF NORMAL FLIGHT OPERATION (DEAD ENDED SYSTEM)
- PRESSURE CYCLES ARE NOT EXPECTED TO OCCUR DURING NORMAL SYSTEM OPERATION

### CORRECTIVE ACTION:

- IF PRESSURE CYCLES OCCUR, MANAGEMENT OF SYSTEM, i.e. ONE, TWO OR THREE TANK OPERATION, PLUS PURGING, CAN BE USED TO CORRECT THE CONDITION

# DENSITY OF H2 VS TEMPERATURE AT 250 PSIA



## **APOLLO 15 ECDU - 44 FAILURE**

- OPTICS TRUNNION SERVO TESTED GOOD ON JUNE 10, 1971
- LIGHTNING STRUCK VEHICLE 1730 HOURS MONDAY, JUNE 14, 1971
- SUBSEQUENT CM G&N INDICATIONS
  - ECDU FAIL ALARM 'ON'
  - TRUNNION FINE ERROR SIGNAL SATURATED ON TM
- REMOVED ECDU-44 AND RETURNED TO FACTORY FOR MALFUNCTION ISOLATION

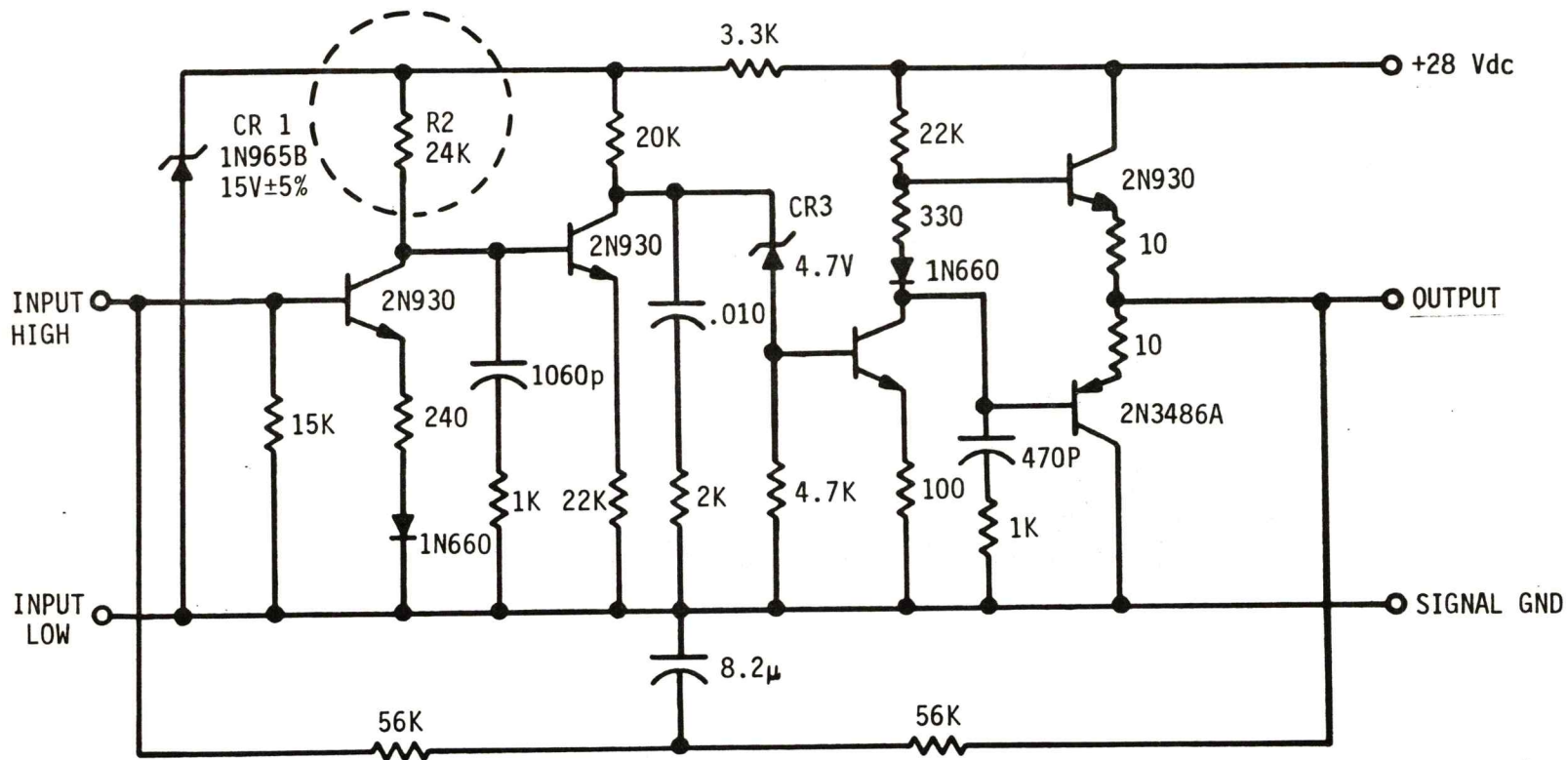
## **ECDU FAILURE (CONT)**

### **FAILURE VERIFICATION AND DIAGNOSTIC ANALYSIS**

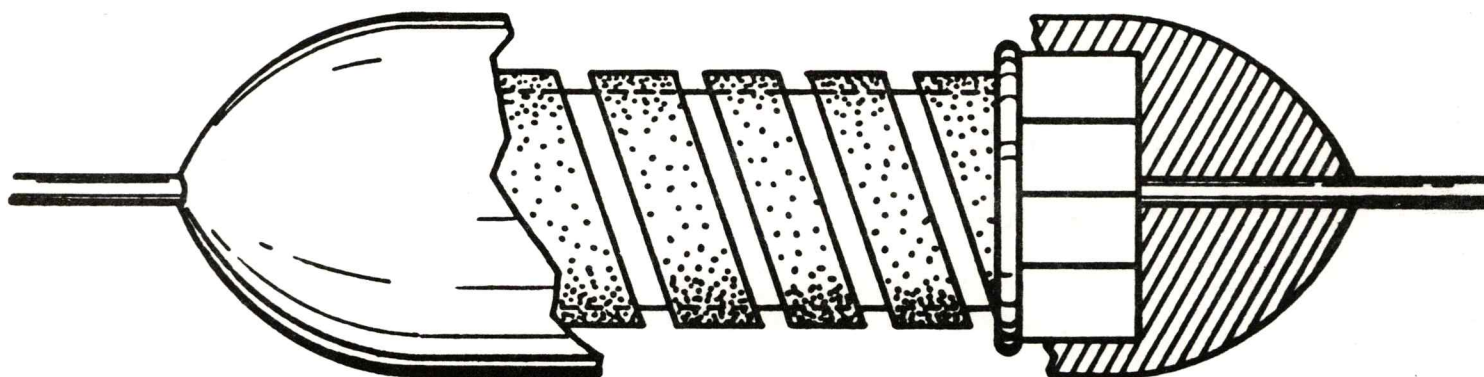
- **FAILURE VERIFIED AT THE BLACK BOX LEVEL**
- **FAILURE ISOLATED TO AN OPEN RESISTOR**
- **COULD BE MADE INTERMITTENT BY APPLYING PRESSURE TO COMPONENT BEFORE REMOVAL FROM MODULE**
- **NO EVIDENCE OF HEAT DAMAGE**
- **OTHER COMPONENTS WOULD HAVE BEEN DAMAGED IF CAUSE WAS VOLTAGE TRANSIENT**



AMPLIFIER  
SCH 2010019 REV. 'E'



ECDU FAILURE (CONT)  
GLASS SUBSTRATE RESISTOR



100-PERCENT OVERSTRESS SCREEN x 1-1/2 RATED WATTAGE FOR 24 HOURS

## **ECDU FAILURE (CONT )**

### **P/N 1006750 GLASS SUBSTRATE RESISTOR**

- **USAGE      CM    6261 PER G&N**  
                 LM    6103 PER PGNCs
- **TOTAL PART OPERATING HOURS   204,371,518**
- **30 FAILURES DURING MANUFACTURING PROCESS**  
    **PRIOR TO ACCEPTANCE**
  - **INDUCED AND SCREENED**
- **2 INDUCED FAILURES IN FIELD**
- **THIS IS THE ONLY POST ACCEPTANCE FAILURE**  
    **EXPERIENCED**

## **MAIN BUS A UNDERVOLTAGE SENSOR**

- DID NOT FUNCTION AT 26-VOLT LEVEL DURING RETEST
- DATA REVIEW INDICATED SENSOR WAS NOT WORKING PROPERLY AS EARLY AS JUNE 11
- SENSOR TO BE REMOVED ON JUNE 23 AND FAILURE ANALYSIS PERFORMED

## GENERAL STATUS



## GENERAL STATUS

- \* ● MATERIAL TESTING
- \* ● LIMITED LIFE SUMMARY
- \* ● AGE-LIFE SUMMARY
- \* ● OPEN FAILURES SUMMARY
- \* ● OPEN PROBLEM TRENDS
- \* ● CERTIFICATION SUMMARY
- \* ● REUSED HARDWARE SUMMARY
- \* ● SINGLE FAILURE POINT SUMMARY
  - ICD STATUS SUMMARY
  - AVT/ATT SUMMARY
- \* ● NONMETALLIC MATERIAL SUMMARY
  - PREOPERATIONAL SAFETY REVIEW
  - SNEAK CIRCUIT SUMMARY
- \* ● RETEST OF INVALIDATED SYSTEMS
- \* ● LAUNCH CRITICAL SPARES
  - SAFETY ASSESSMENT
- \* ITEMS FOR PRESENTATION

## MATERIAL TESTING

### SIM - OUTGASSING (VCM)

TOTAL PARTS IDENTIFIED & EVALUATED	282
------------------------------------	-----

MATERIALS TESTED BY NR FOR WT LOSS & VCM	115
--	-----

DEVIATIONS REQUIRED (VCMA'S)	6
------------------------------	---

# MATERIAL TESTING CAT. 'D' SC - 112 DELTA

TOTAL TESTED TO DATE = 150

OPEN ITEMS	EXPOSURE	MATERIALS TO BE TESTED	CONF ANAL OR TEST	MATERIAL TEST COMPLETION
BOURNS $\Delta$ P SWITCH	SBF	THREE	C/A-018	6-25-71
SEATON WILSON Q/D	DIRECT	ONE	-	6-25-71
AIRESEARCH $\Delta$ P TRANSDUCER	SBF	ONE	C/A-007	7-2-71

# MATERIAL TESTING

## CAT. 'J' (SBF) SC - 112 DELTA

TOTAL TESTED TO DATE = 77

OPEN ITEMS	MATERIALS TO BE TESTED	CONF ANAL	MATERIAL TEST COMPLETION
NATIONAL WATER LIFT VALVE	2	C/A-020	7-2-71
SPS ENGINE	1	-	7-2-71
SPS PROBE	1	C/A-021	7-2-71
RCS ENGINE	2	C/A-023	7-2-71
PUGS POTENTIOMETER	12*	C/A-022	7-2-71
PUGS	8	C/A-022	7-2-71

\* 8 SHIPPED - REMAINING 4 TO BE SHIPPED JUNE 23, 1971.

## LIMITED LIFE SUMMARY

### OPERATING TIME / CYCLE - MA0201-0077

SSAD SYSTEM	NOMENCLATURE	PART / SERIAL NUMBER	QUANTITY	REMARKS
RCS (2.6)	RCS ENGINE	ME901-0067-0011 063600950213	1	EXCEEDED 3000 WET CYCLE REQUIREMENT DURING VALVE FLUSHING CYCLE. PROCESS SPEC OPERATIONAL LIFE REQUIREMENT IS 9000 CYCLES. DISPOSITIONED OK TO USE PER MR A134138-1



## LIMITED LIFE SUMMARY (CONT)

AGE LIFE - MA0201-5695

SSAD SYSTEM	NOMENCLATURE	PART/SERIAL NUMBER	QUANTITY	REMARKS
CRYO (3.20)	FUEL CELL NO. 2	ME464-0007-1002 06763P650776	1	AGE LIFE EXPIRES 5-18-71- DISPOSITIONED OK TO USE PER MR A184272-1
CRYO (3.20)	FUEL CELL NO. 3	ME464-0007-1002 06763P650782	1	AGE LIFE EXPIRES 7-29-71- DISPOSITIONED OK TO USE PER MR A184273-1

## CSM 112 AGE LIFE

- ALL CSM 112 COMPONENTS APPROVED FOR FLIGHT
- 3420 DATA PACKAGES REVIEWED TO DETERMINE WHICH PARTS OVER 3 YEARS OLD AS OF SEPTEMBER 1, 1971
- 386 PN's (1145 SN's) WERE OVER 3 YEARS OLD
- RESULTED IN ANALYSIS AND APPROVAL OF 171 ALAS PACKAGES
  - 119 CRITICALITY I, II, AND III\*
  - 52 OTHER CRITICALITY III

\*SIGNIFICANT CRITICALITY III PARTS ASSIGNED CRITICALITY III DUE TO REDUNDANCY.

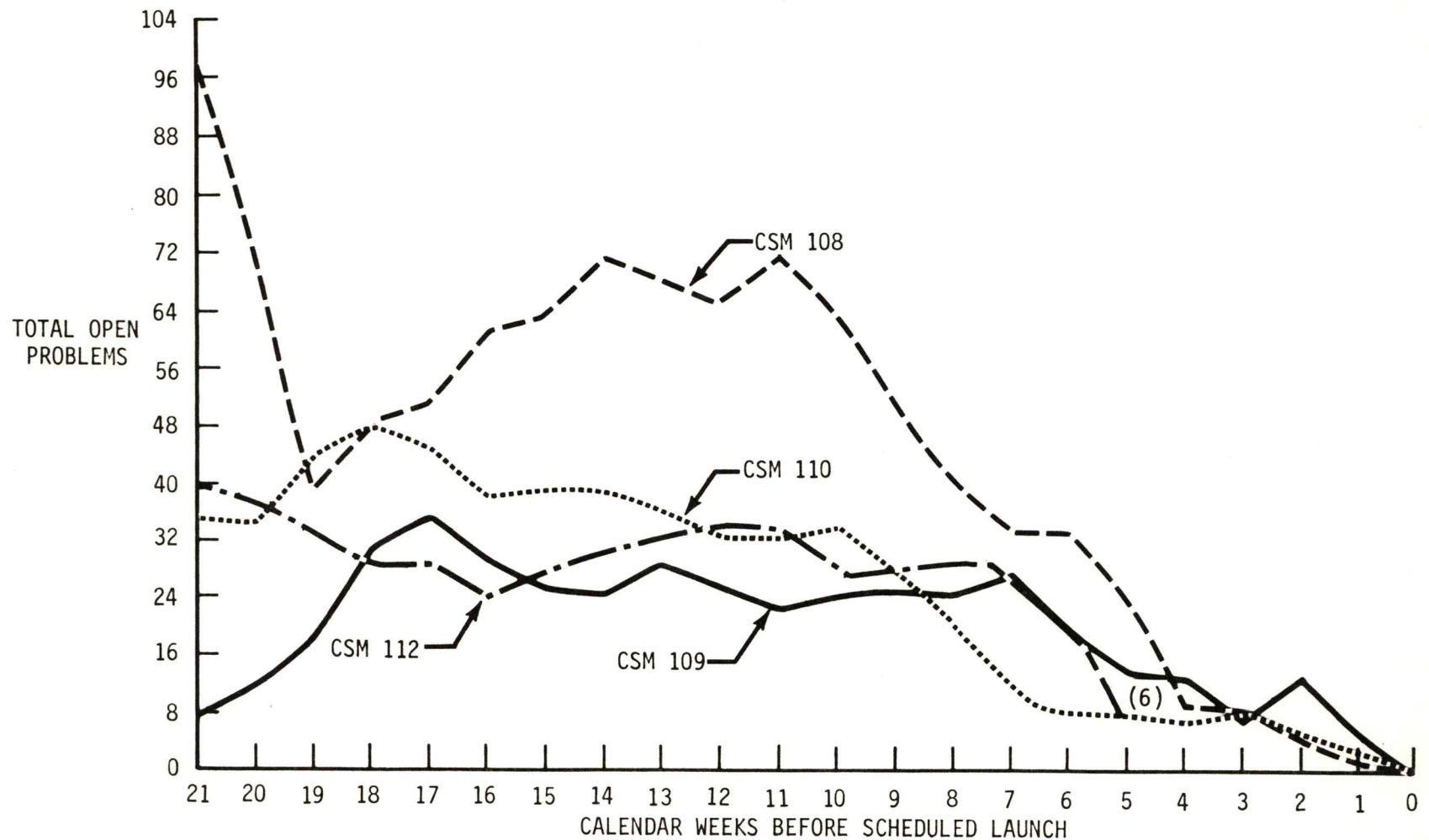
# OPEN CSM 112 FAILURES AND SIGNIFICANT UNSATISFACTORY CONDITIONS

<u>SUBSYSTEM AND COMPONENT NAME</u>	<u>PROBLEM NUMBER AND FAILURE REPORT NUMBER</u>	<u>PROBLEM</u>	<u>STATUS</u>
INSTRUMENTATION SIGNAL CONDITIONER ME901-0291-9034	5-296 063475	DURING CSM 112 SYSTEM CHECKOUT TEST THE TEMPERATURE MEASUREMENT SYSTEMS SIGNAL CONDITIONER WAS FOUND TO BE RADIATING A FREQUENCY BAND WITH A MODULATED FREQUENCY OF 3.3 KC. THIS WAS INTERFERING WITH THE VHF RECEIVER 'A' (296.8 MC). PERFORMING SCREENING TEST USING SPECTRUM ANALYZER IN THE VHF RANGE. 250-400 MHZ	NEW PROBLEM
STRUCTURE BOOM ACTUATING MECHANISM ME190-0005-0004	12-191 185418	DEPLOYMENT BOOM BUCKLED APPROXIMATELY 3 FEET FROM HOUSING DURING APPLICATION OF INCREMENTAL LOAD TO TIP. BOOM WAS FULLY EXTENDED TO 27-FOOT LENGTH. TIP LOAD WAS BEING INCREASED FROM ONE- HALF POUND TO ONE POUND	NEW PROBLEM
<u>DOCKING PROBE</u>	12-192	DURING ATP ON THE CSM 112 PROBE. A SWITCH IN THE CAPTURE-LATCH MOTOR FAILED. THE MOTOR FROM THE CSM 113 PROBE WAS INSTALLED IN THE 112 PROBE	NEW PROBLEM

# OPEN CSM 112 FAILURES AND SIGNIFICANT UNSATISFACTORY CONDITIONS (CONT)

SUBSYS SUBSYSTEM AND COMPONENT NAME	PROBLEM NUMBER AND FAILURE REPORT NUMBER	PROBLEM	STATUS
DOCKING PROBE ASSEMBLY	12-188 158757	CSM 112 PROBE PRELOAD MECHANISM FAILED TO DEVELOP REQUIRED PRELOAD AT BREAK-OUT TORQUE OF RATCHET HANDLE. MEASURED PRELOAD AT RATCHET RELEASE WAS 5022 LB. REQUIRE REQUIRED PRELOAD IS 5900 $\pm$ 200 LB	PROBLEM WAS ATTRIBUTED TO A DAMAGED STUD SET. STUD SET HAS BEEN REPLACED AND FIX WILL BE VERIFIED DURING ATP
DOCKING PROBE ASSEMBLY	12-189 158760	CSM 112 DOCKING PROBE PLUNGER (SPIDER) DID NOT REACH FULL FORWARD POSITION WITHIN THE REQUIRED 500 MILLISECONDS INDICATING THE PROBE LATCHES HAD NOT LOCKED PROPERLY WITHIN THE REQUIRED TIME	PROBLEM WAS ATTRIBUTED TO FRICTION BETWEEN THE CAM CYLINDER AND THE SLEEVE. CAM EDGES HAVE BEEN BEVELED TO ELIMINATE THIS FRICTION. PROBE REASSEMBLY AND RETEST IS IN PROGRESS

# SPACECRAFT OPEN PROBLEM TRENDS





## CSM 112 CERTIFICATION STATUS

TOTAL TESTS REQUIRED	32
TESTS COMPLETE	28
TESTS TO GO	5

TOTAL ANALYSIS REQUIRED	37
ANALYSIS COMPLETE	31
ANALYSIS TO GO	6

# CSM 112 CERTIFICATION STATUS

## OPEN CERTIFICATION TESTS

	<u>TEST COMPLETION</u>	<u>MSC APPROVED</u>
GAMMA RAY DEPLOYMENT MECHANISM	COMPLETE	6/22/71
MASS SPECTROMETER PROTECTIVE COVER	6/28/71	7/6/71
ALPHA X-RAY SPECTROMETER PROTECTIVE COVER	7/2/71	7/9/71
MAPPING CAMERA LASER ALTIMETER PROTECTIVE COVER	7/2/71	7/5/71
DOCKING PROBE	6/26/71	6/27/71
SUBSATELLITE DEPLOYMENT MECHANISM	COMPLETE	6/22/71
TAPE RECORDER DATA CONDITIONER	7/15/71	7/16/71

# CSM 112 CERTIFICATION STATUS (CONT)

## ANALYSIS

	<u>ANALYSIS COMPLETED</u>	<u>MSC APPROVED</u>
GAMMA RAY SPECTROMETER PROTECTIVE COVER	6-25-71	6-30-71
MASS SPECTROMETER PROTECTIVE COVER	6-25-71	6-30-71
ALPHA X-RAY SPECTROMETER PROTECTIVE COVER	6-25-71	6-30-71
MAPPING CAMERA/LASER ALTIMETER PROTECTIVE COVER	6-25-71	6-30-71
SUBSATELLITE COVER	6-25-71	6-30-71
STELLAR LENS PROTECTIVE COVER	6-25-71	6-30-71

# REUSED FLIGHT HARDWARE

SSAD SYSTEM	PREVIOUSLY FLOWN ON CSM	ASHUR HRE	NOMENCLATURE PART NUMBER SERIAL NUMBER	QTY	REMARKS
ECS	101 104 106 108	<u>101080 R-1</u> NOT SUBMITTED	CHLORINE AMPULE P/N F01-610347-21	16	UNITS ARE IN WORK REFURBISHMENT HAS NOT BEEN COMPLETED. ECD 7-19-71
ECS	101 104 106 108	<u>101080 R-1</u> NOT SUBMITTED	BUFFER AMPULE P/N F01-601347-31	16	UNITS ARE IN WORK REFURBISHMENT HAS NOT BEEN COMPLETED. ECD 7-19-71
SCS	2TV-1	<u>2TV1003</u> PC5045	ROTATIONAL HAND CONTROLLER P/N ME901-0704-0702 S/N 10028CAK1036	1	SHIPPED TO KSC AS LOOSE EQUIPMENT
SCS	109	<u>109520</u> NR1056	ORDEAL SUPPORT ASSY P/N V36-311224 S/N 06362YCB9583	1	COMPLETED REFURBISHMENT & SHIPPED TO KSC ON 5-11-71
SCS	109	<u>109520</u> NR1059	ORDEAL FITTING P/N V36-311231 S/N 06362YCB9582	1	SHIPPED TO KSC ON 5-13-71
CREW	108	<u>108070 R-1</u> NR1032	CAMERA MOUNT ASSEMBLY P/N V36-752063-3 S/N 06362YCB8778	1	SHIPPED TO KSC AS LOOSE EQUIPMENT FOR 70MM HASSELBLAD CAMERA
CREW	106	<u>106530 R-1</u> TO NASA ON 5-20-71	SUIT COMPRESSOR P/N 825000-2-2 S/N 004000107169	1	INSTALLED IN VACUUM CLEANER P/N V36-612570 S/N 06362AAJ8349

## CRITICAL SINGLE FAILURE POINT SUMMARY

- ALL SINGLE FAILURE POINT ISSUES ARE RESOLVED



## ICD STATUS SUMMARY

### ICD's

### STATUS

● INTRACENTER

NO OUTSTANDING HARDWARE INTERFACES CHANGE  
CONSTRAINTS (FINAL DOCUMENTATION CHANGES  
IN PROCESS)

● INTERCENTER

NO OUTSTANDING HARDWARE INTERFACES CHANGE  
CONSTRAINTS (FINAL DOCUMENTATION CHANGES  
IN PROCESS)

## ACCEPTANCE VIBRATION TEST/ACCEPTANCE THERMAL TEST PROGRAM

ITEM DESCRIPTION	CSM 106	CSM 107	CSM 108	CSM 109	CSM 110	CSM 112
NUMBER OF COMPONENTS REQUIRING AVT/ATT	63/1	63/1	65/1	65/5	72/40	80/60
NUMBER OF COMPONENTS INSTALLED ON CSM WHICH RECEIVED AVT/ATT	71/17	71/18	72/19	72/24	72/40	80/60

## SUMMARY OF NONMETALLIC MATERIALS (NMM) DEVIATIONS

● DEVIATIONS APPROVED BY MSC CONFIGURATION CONTROL BOARD

	CM 106	CM 107	CM 108	CM 109	CSM 110	CSM 112
CFE	17	17	14	13	13	15
GFE	20	20	20	20	20	20
TOTAL	37	37	34	33	33	35

● TOTAL WEIGHT OF DEVIATED NMM

	CM 106	CM 107	CM 108	CM 109	CSM 110	CSM 112
WEIGHT, POUNDS	64.70	64.06	63.75	49.5	49.5	50.86

## **PRE-OPERATIONAL SAFETY REVIEW**

- **PRE-OPERATIONAL ENGINEERING AND SAFETY REVIEW WAS CONDUCTED ON ALL CSM 112 TEST AND CHECKOUT PROCEDURES TO BE USED AT THE KENNEDY SPACE CENTER. THE TEST AND CHECKOUT PROCEDURES FOR CSM 112 ARE CONSIDERED WELL PREPARED AND ACCEPTABLE FOR THE CHECKOUT AND LAUNCH OF CSM 112**

## SNEAK CIRCUIT ANALYSIS

- OBJECTIVE

- SNEAK CIRCUIT ANALYSIS OF CSM 112 DESIGNED CONFIGURATION

- SCOPE

- MAIN EMPHASIS ON POWER AND CONTROL PATH ANALYSIS, GOVERNMENT FURNISHED EQUIPMENT, AND ALL ELECTRICAL CIRCUIT CHANGES (PARTICULARLY THE SIM MOD)
- TREATED PRELAUNCH, FLIGHT, AND LANDING PHASES
- TREATED CM TO SM, CSM TO IU, LM, AND GSE INTERFACES; EMPHASIS ON CSM 110/112 DIFFERENCES

- RESULTS

- 4 NEW SNEAK CIRCUIT BULLETINS RELEASED - ALL NECESSARY CHANGES ARE BEING IMPLEMENTED



## RETEST OF INVALIDATED SYSTEMS

- ALL CSM SYSTEMS INVALIDATED BY CHANGES AND MODIFICATIONS HAVE BEEN RETESTED AND VERIFIED BY NASA AND CONTRACTOR ENGINEERING PERSONNEL EXCEPT AS SPECIFIED BY WAIVER

## CSM 112 GSE LAUNCH CRITICAL SPARES

- ALL GSE LAUNCH CRITICAL SPARES (CFE) ARE AVAILABLE AT KSC EXCEPT THE FOLLOWING, AS OF JUNE 22, 1971

<u>SUBSYSTEM</u>	<u>PART NAME</u>	<u>PART NUMBER</u>	<u>DUE DATE</u>
S14-132 (MSS, FDS)	VALVE	451A4A-C-3013	JUNE 25, 1971
S14-132 (MSS, FDS)	HOSE ASSEMBLY	D5479	JUNE 25, 1971
S14-132 (MSS, FDS)	VALVE	AD-916-4-3427	JUNE 25, 1971

## CSM 112 SPACECRAFT LAUNCH CRITICAL SPARES

- ALL CSM LAUNCH CRITICAL SPARES (CFE) ARE AVAILABLE AT KSC EXCEPT THE FOLLOWING, AS OF JUNE 22, 1971

<u>SUBSYSTEM</u>	<u>PART NAME</u>	<u>PART NUMBER</u>	<u>DUE DATE</u>
INSTRUMENTATION	MODULE ASSEMBLY	V36-759525-71	JUNE 23, 1971

## CSM 112 SAFETY ASSESSMENT

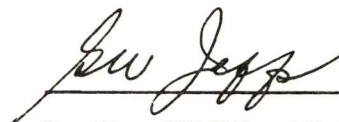
- ALL ACCIDENTS / INCIDENTS INVESTIGATED & CLOSED
- SAFETY REVIEW OF TEST DOCUMENTS
  - DCS'S
  - SAFETY CRITICAL TPS'S
- ALL WAIVERS APPROVED
- SCREEN ALL ENGINEERING CHANGES
  - DETAILED REVIEW OF SAFETY SIGNIFICANT ENGINEERING CHANGES
  - REVISED SPECIFICATIONS APPROVED
- ALL FMEA'S APPROVED
- FLIGHT CREW EMERGENCY EGRESS TRAINING COMPLETED 6-10-71
- HYPERGOLICS, CRYOGENICS, & HI-PRESSURE GROUND CREW CERTIFICATION PROGRAM UP TO DATE

# FLIGHT READINESS STATEMENT

CONTINGENT UPON THE RESOLUTION OF OPEN ITEMS  
IDENTIFIED IN THIS REPORT, OPEN WORK DEFINED IN SPACECRAFT  
RECORDS AND SATISFACTORY RESOLUTION OF "LIGHTNING ISSUES",  
CSM 112 & SLA 19 ARE HEREBY CERTIFIED AS CAPABLE OF SUPPORTING  
THE AS 510 APOLLO 15 FLIGHT MISSION.



A. COHEN  
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