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Apollo 1 Malfunction Procedures Manual

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MALFUNCTION

PROCEDURES

APOLLO 1 MALFUNCTION PROCEDURES

INDEX

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PROCEDURES ENTRY SHEET

SECTION 9.1.1.1

GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES

SYMPTOM	SYMPTOM NUMBER	STEP	PAGE
S/C 012 CHECKLIST ERROR CODES	1	1	2
OCDU DRIVE PROBLEM	1	1	8
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OPTICS ZERO ENCODE PROBLEM	3	1	8
ACCELEROMETER FAIL (ISS LOOP)	1	1	9
IMU FAIL	2	1	9
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LARGE IMU ALIGNMENT ERRORS	4	1	9
CDU FAIL LIGHT ON	1	1	10
ABNORMAL FDAI ATT ERROR NEEDLES IN G&N ATT	2	1	10
SUSPECTED AGC PROBLEM	1	1	11
COMP FAIL LIGHT ILLUMINATES (MDC)	1	1	12

SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
S/C 012 Check List Error Code					
00101		Depress error reset. Wait for zero encoder light off. Place Optics Mode switch in Zero Optics position & wait until zero encoder light off again.		Optics Mode switch removed from Zero Optics position before end of 60 second wait.	
00102		Depress Error reset			Computer unable to achieve desired optics mode.
00104		Depress Error Reset on DSKY. Switch Optics Mode to Manual and complete optics drive manually.			The computer has failed to properly control the optics drive. The OCDU's may drive with no desired optics angles.
00105		Depress Error Reset and continue or return to P00 and start over.		Internal marks request with mark system busy.	
00106		Depress Error Reset and continue.		Too many marks	
00107		Depress Error Reset and continue.		Mark reject (V52E) with mark system not in use.	
00110		Depress Error Reset. If rejection of an accepted mark is desired, go back to P00 and start over.		Mark reject with no effect, i.e., no mark between mark rejects or all requested marks have been accepted when V52E entered.	
00112		Depress Error Reset and continue.		Optics mark with none requested.	
PREPARED BY: <i>AM</i>		FLIGHT CREW SUPPORT DIVISION		APOLLO OPERATIONS HANDBOOK	
DATE: <i>8/13/67</i>		Jan 27, 1967		GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES	
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SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
00122		Depress Error Reset. Re-enter program and make 2 marks or select a known landmark.		Only one mark made for unknown landmark.	
00123		Depress Error Reset. Re-enter program and try again.		Mark data unavailable after restart.	
00201		Depress Error Reset. Wait until zero encoder light off. Reselect Zero Encode Mode and wait until zero encode light off again.		IMU Mode changed from Zero Encode before end of 35 sec. delay.	
00202		Depress Error Reset. Check switches.			Computer unable to achieve desired mode.
00203		Depress Error Reset. Check IMU status.		No IMU mode indicated to computer.	
00204		Depress Error Reset. Select switch configuration to avoid this situation.		IMU mode changed with transfer switch at COMPUTER, but computer did not command the change.	
00205		Depress Error Reset. See PIPA failure malfunction procedures. (Entrance to P00 is enabled by the alarm.)			Excessive accelerometer output (≥ 18.5 g's)
00310		Depress Error Reset and continue (cautiously)			Error return from routine.
00401		Depress Error Reset and continue or realign if desired.		Desired gimbal angles yield gimbal lock. (MGA $\geq 60^\circ$)	
PREPARED BY: <i>grn</i>		FLIGHT CREW SUPPORT DIVISION		APOLLO OPERATIONS HANDBOOK	
DATE: Jan 27, 1967		GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES		S/C 012	REV FINAL
				SECTION 9.1.1.1	PAGE 3

SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
00402		Depress Error Reset. Maneuver vehicle to obtain stars. Reselect program.		Star out of FOV.	
00405		Depress Error Reset. Select proper mode. If no SCS monitor desired (wasn't disabled by V33E at the proper time), key V21N01E 730E 77776E.		SCS Mode not in desired state.	
00412		Depress Error Reset. Reselect program and change associated time by 15 min. or more.		Time and longitude too far apart.	
01101		Depress Error Reset. Check with ground.			Rupt 2 (not expected, not wired) Hardware suspect
01102		Record R2 and R3 contents. Relay to ground. Depress Error Reset.			AGC self-test error. Use computer with caution.
01103		Depress Error Reset.	1.0		Forbidden step executed (by computer). Use computer with caution.
01104		Record DSKY display. Depress Error Reset. Relay information to ground.			C-relay failed during test.
01201		Depress Error Reset.	1.0		No VAC areas available. Use computer with caution.
PREPARED BY: <i>gmc</i>		FLIGHT CREW SUPPORT DIVISION		APOLLO OPERATIONS HANDBOOK	
DATE: <i>2013</i>		Jan 27, 1967		S/C 012 REV FINAL	
		GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES		SECTION 9.1.1.1 PAGE 4	

SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
01202		Depress Error Reset.	1.0		No correct areas available. Use computer with caution.
01203		Depress Error Reset.	1.0		Waitlist overflow
01204		Depress Error Reset.	1.0		Task couldn't be fit into the waitlist.
01206		Depress Error Reset.	1.0	Display system routine already in use.	
01207		Depress Error Reset.	1.0		No VAC area available for marks. Use computer with caution.
01210		Depress Error Reset	1.0	Job already waiting in --- STALL	
01301		Depress Error Reset.		Possible erasable memory disturbance.	Arccos or Arcsin argument too large. Use computer with caution.
01302		Depress Error Reset.	1.0	Possible erasable memory disturbance.	Square root argument excessively negative. Use computer with caution.
PREPARED BY: <i>gms</i>		FLIGHT CREW SUPPORT DIVISION		APOLLO OPERATIONS HANDBOOK	
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SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
01401		Depress Error Reset. Select P00 and troubleshoot for poor alignment, control system problem etc.		Thrust misalignment exceeds 90°.	
01405		Depress Error Reset. Return to prethrust program via P00 and try again.		Less than 5 min. to ignition.	
01406		Depress Error Reset. Select P00 and reselect prethrust program.		Error return from maneuver to ignition attitude.	This alarm may indicate transient computer error.
01407		Depress Error Reset. Similar to pattern 00401.		Commanded CDUZ exceeds 60°.	
01410		Depress Error Reset. Reselect P32 through P00. Change input parameters.		Entry conditions not computable.	
01411		Depress Error Reset. Reselect P32 through P00. Change latitude of target. If target beyond max. declination is desired, select latitude in P32 to avoid 01411 alarm. Reselect desired latitude in P62.		Target latitude exceeds declination of orbit.	
01421		Go to SCS entry procedures.		Avg. g not running for entry. (Not likely)	
01426		Depress Error Reset. Avoid roll into gimbal lock.		IMU orientation not satisfactory for entry (Computer waits 5 sec and proceeds)	
PREPARED BY: <i>gm</i>		FLIGHT CREW SUPPORT DIVISION		APOLLO OPERATIONS HANDBOOK	
<i>NBB</i>		DATE: Jan 27, 1967		GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES	
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SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
01427		Depress Error Reset. Add 180° to backup bank angle charts. 0 deg. roll is lift down.		IMU orientation reversed for entry (Computer waits 5 sec and proceeds.)	
01430		Depress Error Reset. Report condition to ground.		CM/SM sep. discrete present with major mode not 11 or 62.	Since spacecraft not wired for this discrete, appearance of this alarm implies computer transient error.
01431		Depress Error Reset. Report condition to ground.		SIVB sep. discrete present with major mode not 11 or 12.	Since spacecraft not wired for this discrete, appearance of this alarm implies computer transient error.
01501		Depress Error Reset	1.0	Internal display system alarm.	
	1.0	Allow program to continue			
		a. POO displayed	1.1		
		b. POO not displayed	1.2		
		c. Repeated aborts	1.3		
	1.1	Reselect program, try again			
	1.2	Program is attempting to start again at an appropriate point			
	1.3	Key V36E (Fresh Start). Reinitialize erasable memory.			

PREPARED BY: <i>JTC</i>	FLIGHT CREW SUPPORT DIVISION	GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES	APOLLO OPERATIONS HANDBOOK	
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SYMPTOMS

TROUBLE SHOOTING PROCEDURES

CONCLUSIONS

CORRECTIVE ACTIONS

PROBLEM SUSPECTED
IN G&N OPTICS
LOOP

1. OCDU DRIVE
PROBLEM
2. OPTICS DRIVE
PROBLEM
3. OPTICS ZERO
ENCODE PROBLEM

FAILURES

1. AGC
2. OCDU
3. AGC OR OCDU
ENCODER
4. TELESCOPE DRIVE
5. SEXTANT DRIVE

1. COMMAND ZERO OPTICS
2. VERIFY ZERO ENCODE
LIGHT COMES ON AND GOES OUT
3. SELECT OPTICS MANUAL
MODE
4. SELECT TELESCOPE STAR
LOS MODE

NO ZERO
ENCODER LIGHT

AGC PROBLEM

①

MANUALLY COMMAND
OCDU REGISTERS
TO ZERO (V24N57EEE)

OCDU'S DRIVING
CONTINUOUSLY?

YES

OCDU FAILURE

②

1. PULL OPTICS CB'S ON
MDC 22 TO STOP CDU
DRIVE
2. USE MECHANICAL
DRIVES

ARE OCDU'S ZERO

NO

OCDU FAILURE

②

USE MECHANICAL
DRIVES

CALL UP DISPLAY ON
DSKY OF OCDU ANGLES
(V16N55E)

ARE DSKY R1 & R2
ZERO?

NO

AGC
PROBLEM

①

MANUALLY COMMAND
OCDU AGC REGISTERS
TO ZERO (V24N57EEE)

V16N55E

DRIVE OPTICS IN SHAFT
AND TRUNNION

DO OCDU'S DRIVE?

NO

CHANGE CONTROLLER MODE
SWITCH OR CONTROLLER
SPEED SWITCH

DO OCDU'S DRIVE?

YES

USE OPERATIONAL MODE

NO

DOES DSKY DISPLAY FOLLOW OCDU'S?

NO

AGC OR OCDU ENCODER
PROBLEM

③

PERFORM BACKUP
ALIGNMENTS ONLY

YES

DOES TELESCOPE FOLLOW

NO

TELESCOPE DRIVE
PROBLEM

④

USE MECHANICAL DRIVES

YES

DOES SEXTANT FOLLOW

NO

SEXTANT DRIVE
PROBLEM

⑤

USE TELESCOPE FOR
SIGHTINGS

YES

SYSTEM LOOKS
GOOD

MISSION
SUPPORT
TM POINTS

- CG 3102 V SIX TRUN MOTOR
DRIVE IN PHASE
- CG 3112 V SIX SHAFT MOTOR
DRIVE IN PHASE
- CG 3133 V SCT. TRUN MOTOR
DRIVE
- CG 3141 V TRUN CDU 16X RES.
ERROR IN PHASE
- CG 3200 V TRUN CDU MOTOR
DRIVE IN PHASE
- CG 3220 V SHAFT CDU MOTOR
DRIVE IN PHASE

G&N Optics Loop Check

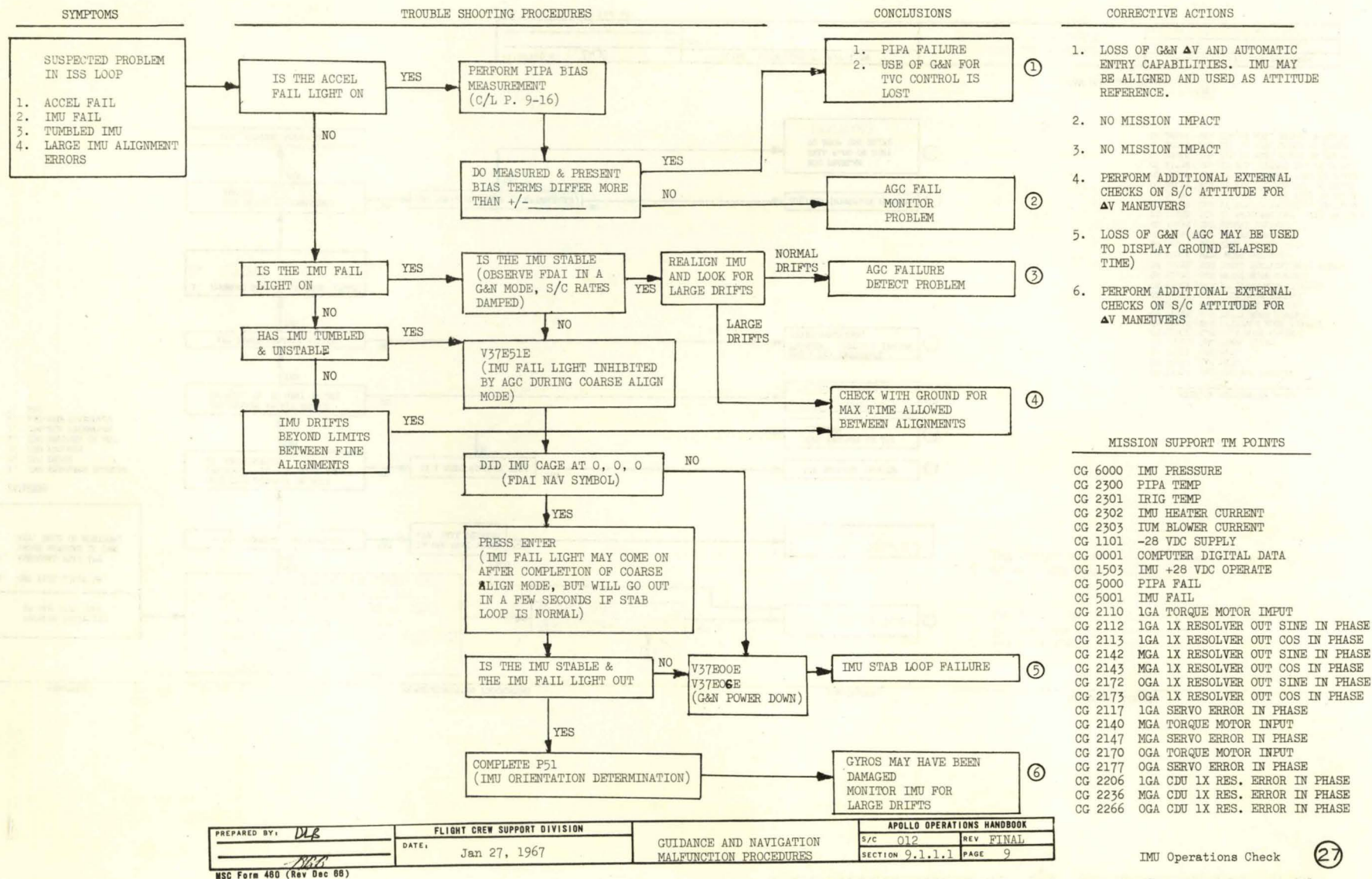
PREPARED BY: DLS

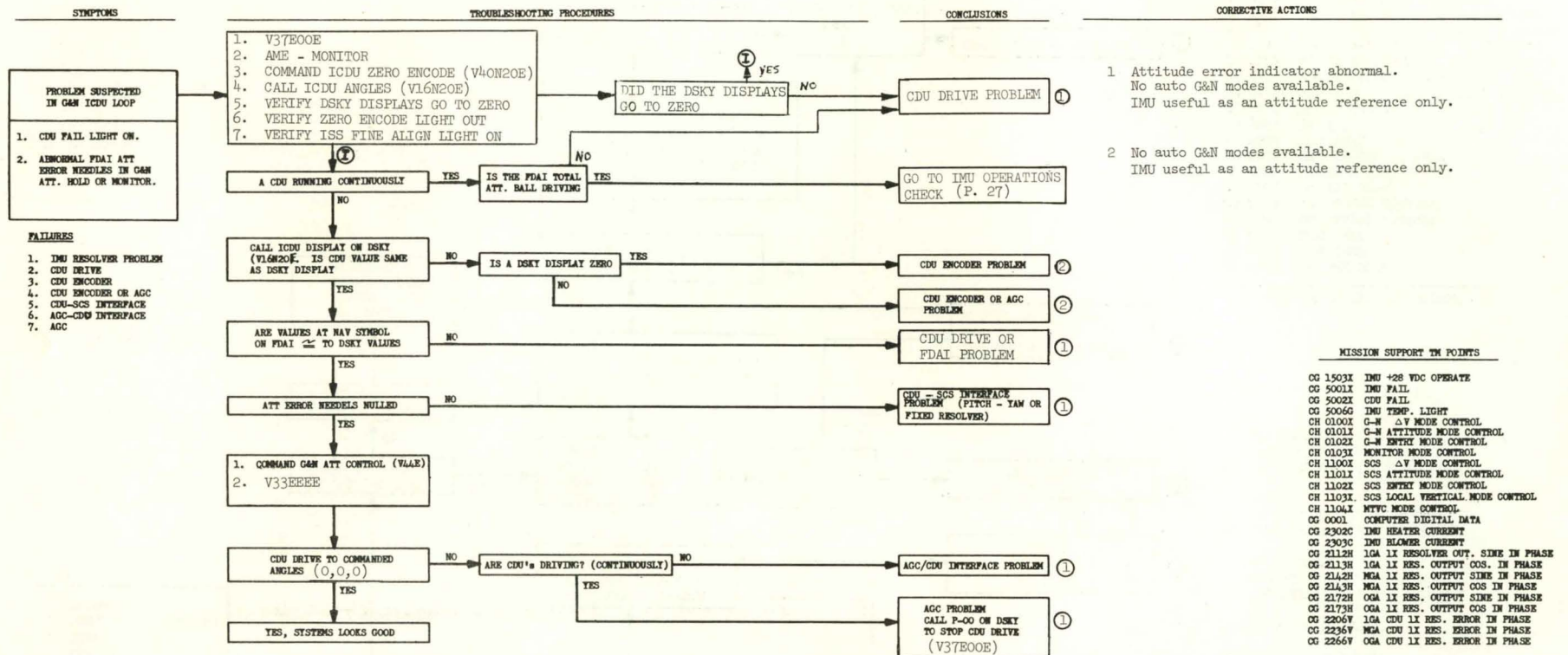
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FLIGHT CREW SUPPORT DIVISION

GUIDANCE AND NAVIGATION
MAINTENANCE PROCEDURES

APOLLO OPERATIONS HANDBOOK
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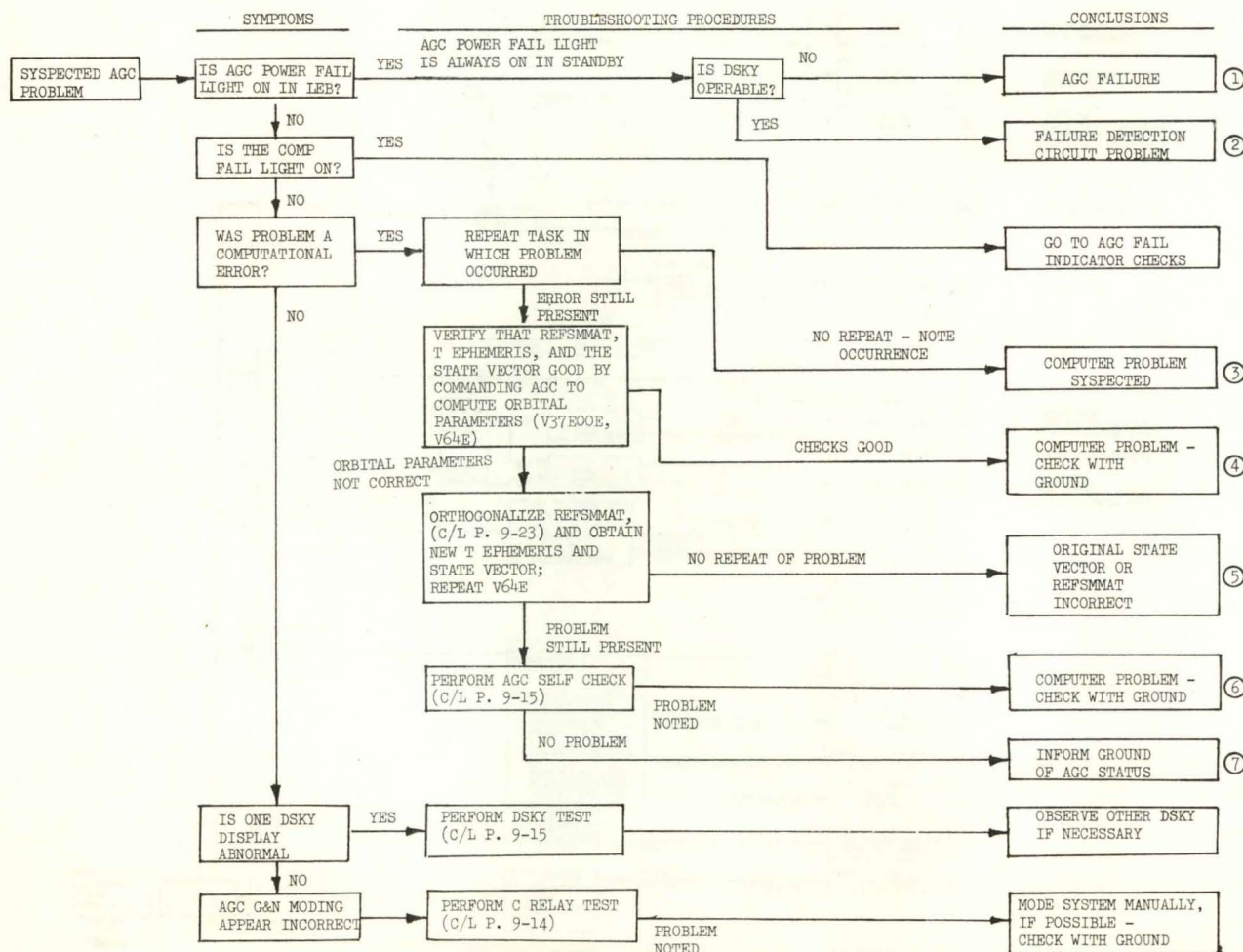




GAN ICDU Loop Check

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PREPARED BY: <u>DLB</u>	FLIGHT CREW SUPPORT DIVISION	GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES	APOLLO OPERATIONS HANDBOOK	
DATE: <u>Jan 27, 1967</u>			S/C <u>012</u>	REV <u>FINAL</u>
MSC Form 480 (Rev Dec 66)			SECTION <u>9.1.1.1</u> PAGE <u>10</u>	



- | CORRECTIVE ACTIONS |
|--|
| 1 LAUNCH - NO ACTION UNTIL SAFE ORBIT INJECTION
ALL OTHER PHASES - AGC INOPERABLE |
| 2 LAUNCH - NO ACTION UNTIL SAFE ORBIT INJECTION
ALL OTHER PHASES - NO IMPACT |
| 3 COMPUTER APPEARS UNRELIABLE - USE WITH CAUTION |
| 4 COMPUTER APPEARS UNRELIABLE FOR MISSION TASKS |
| 5 AGC OK - NO MISSION IMPACT |
| 6 ALL PHASES - COMPUTER APPEARS UNRELIABLE |
| 7 PERFORM BACKUP MISSION AS DIRECTED BY MCC/MSC |

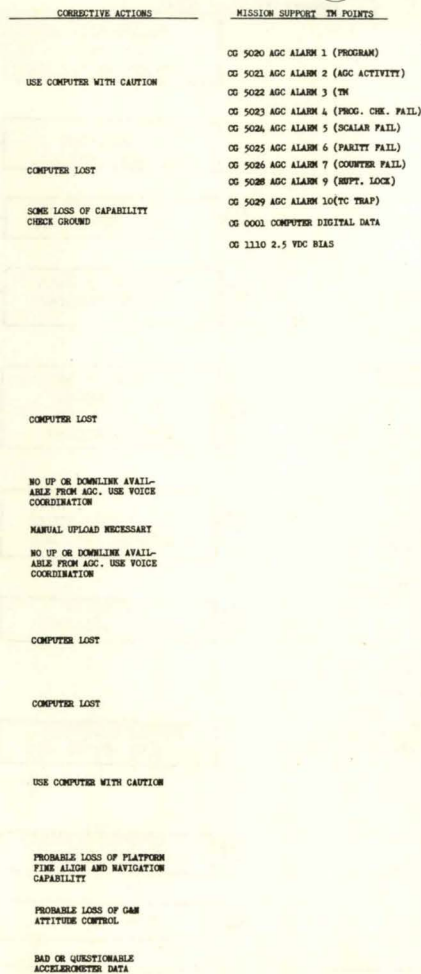
MISSION SUPPORT TM POINTS

- CG 0001 COMPUTER DIGITAL DATA
- CG 5030 COMPUTER FAIL LIGHT

PREPARED BY: <u>DUB</u>	FLIGHT CREW SUPPORT DIVISION	GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES	APOLLO OPERATIONS HANDBOOK
DATE: <u>Jan 27, 1967</u>			S/C <u>012</u> REV <u>FINAL</u>
			SECTION <u>9.1.1.</u> PAGE <u>11</u>

MSC Form 460 (Rev Dec 66)

A G C Operations Check

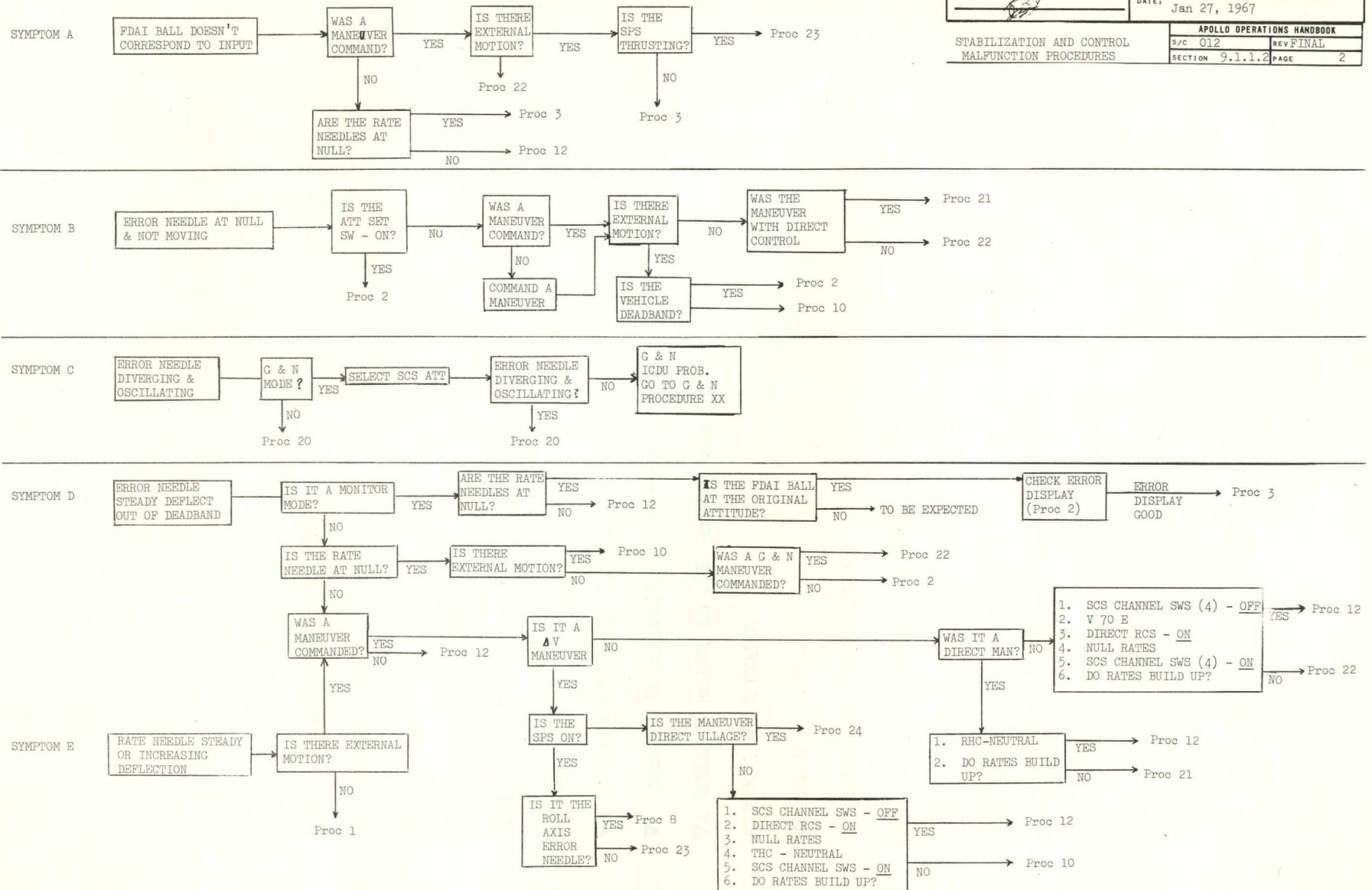


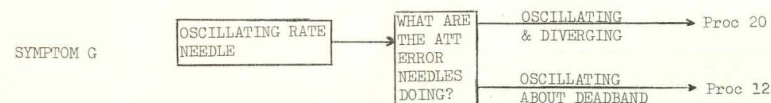
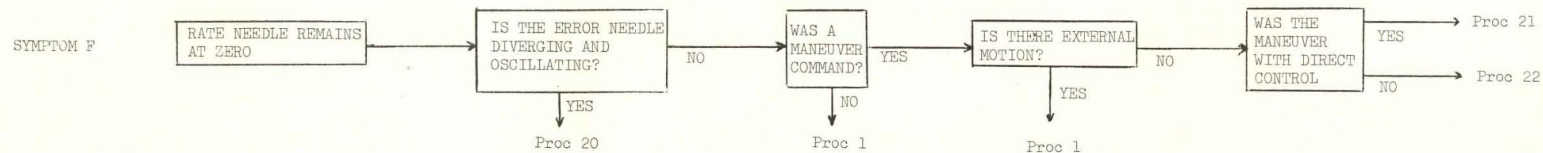
PREPARED BY: <i>WLB</i>	FLIGHT CREW SUPPORT DIVISION	GUIDANCE AND NAVIGATION MALFUNCTION PROCEDURES	APOLLO OPERATIONS HANDBOOK	
<i>WLB</i>	DATE: Jan 27, 1967		S/C 012	REV FINAL
NSC Form 460 (Rev Dec 66)			SECTION 9.1.1.1	PAGE 12

PROCEDURES ENTRY SHEET

SECTION 9.1.1.2 SCS MALFUNCTION PROCEDURES

SYMPTOM	SYMPTOM LETTER	PAGE
FDAI BALL DOESN'T CORRESPOND TO INPUT	A	2
ERROR NEEDLE AT NULL AND NOT MOVING	B	2
ERROR NEEDLE DIVERGING AND OSCILLATING	C	2
ERROR NEEDLE STEADY DEFLECTION OUT OF DEADBAND	D	2
RATE NEEDLE STEADY OR INCREASING DEFLECTION	E	2
RATE NEEDLE REMAINS AT ZERO	F	3
OSCILLATING RATE NEEDLE	G	3
ΔV COUNTER DRIFTS	H	3
RUNAWAY ΔV COUNTER	I	3
ΔV COUNTER MOVES AT ONE SPEED ONLY	J	3
ΔV COUNTER IS ERRATIC OR ONE-WAY ONLY	K	3
ΔV COUNTER FAILS TO START COUNTING	L	3
THRUST FAILS TO CUT-OFF	M	3
THRUST PREMATURELY CUTS-OFF	N	3
THRUST FAILS TO INITIATE	O	3
GPI HARDOVER	P	3
GPI NO RESPONSE	Q	3
FDAI LIGHTING WON'T ADJUST	R	3





		REMARKS
SYMPTOM H	ΔV COUNTER DRIFTS → Proc 5 - A	1. ALSO CONSIDERS ECO AT IGNITION
SYMPTOM I	RUNAWAY ΔV COUNTER → Proc 5 - B	
SYMPTOM J	ΔV COUNTER MOVES AT ONE SPEED ONLY → Proc 5 - C	
SYMPTOM K	ΔV COUNTER IS ERRATIC OR ONE-WAY ONLY → Proc 5 - D	
SYMPTOM L	ΔV COUNTER FAILS TO START COUNTING → Proc 5 - E	
SYMPTOM M	THRUST FAILS TO CUT-OFF → Proc 6 - A	
SYMPTOM N	THRUST PRE- MATURELY CUTS- OFF ^{1.} → Proc 6 - B	
SYMPTOM O	THRUST FAILS TO INITIATE → Proc 6 - C	
SYMPTOM P	GPI HARDOVER → Proc 23	
SYMPTOM Q	GPI NO RESPONSE → Proc 23	
SYMPTOM R	FDAI LIGHTING WON'T ADJUST → Proc 4	

PREPARED BY: *CFH*

FLIGHT CREW SUPPORT DIVISION

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STABILIZATION AND CONTROL
MALFUNCTION PROCEDURES

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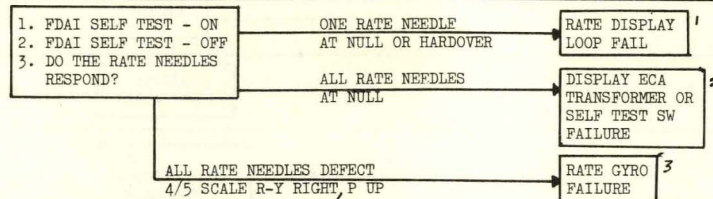
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STABILIZATION AND CONTROL
MALFUNCTION PROCEDURESS/C 012 REV FINAL
SECTION 9.1.1.2 PAGE 4

SCS 1

PROCEDURE

REMARKS



1. LAUNCH: NO ACTION

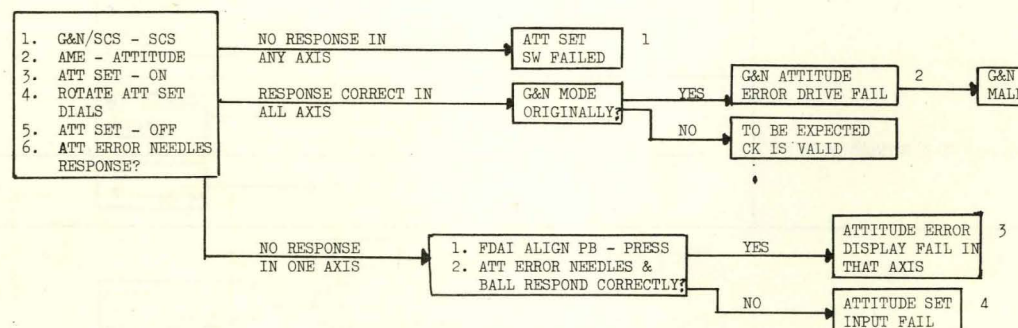
BALL, ATTITUDE ERROR INDICATORS, AND PHYSICAL SENSES ARE AVAILABLE AS BACKUP RATE CUES. USE DISPLAY SELF CHECK AFTER INJECTION.

MIDCOURSE, Δ 'S & ENTRY: BALL OR EXTERNAL REFERENCES, ATTITUDE ERROR INDICATORS, AND/OR PHYSICAL SENSES ARE AVAILABLE AS BACKUP RATE CUES. DISREGARD RATE DISPLAY IN AFFECTED AXIS.

2. ALL PHASES: DISPLAY SELF TEST FUNCTION IS LOST. USE CROSS CHECK OF BALL OR EXTERNAL REFERENCES, ATTITUDE ERROR INDICATORS, AND/OR PHYSICAL SENSES FOR CORRECT RATE CONTROL RESPONSE FOR REMAINDER OF MISSION. IF TRANSFORMER FAILED GPI DISPLAY WILL NOT FUNCTION PROPERLY.

3. TBD

SCS 2



1. ALL PHASES: ATTITUDE SET FUNCTION LOST. FDAI ALIGN STILL FUNCTIONAL.

2. LAUNCH: NO ACTION

BALL, RATE DISPLAYS, AND PHYSICAL SENSES ARE AVAILABLE AS BACKUP CUES. USE ATTITUDE ERROR INDICATOR CHECK AFTER INJECTION.

MIDCOURSE, Δ 'S, AND PRE 0.05G ENTRY: BALL OR EXTERNAL REFERENCES, RATE DISPLAYS, AND/OR PHYSICAL SENSES ARE ALL AVAILABLE AS BACKUP ATTITUDE ERROR CUES. DISREGARD ATTITUDE ERROR INDICATION IN AFFECTED AXIS.

POST 0.05G: ROLL COMMAND ANGLE (θ) WILL BE DISPLAYED IN R1 AS LONG AS THE V16N71 DISPLAY IS PRESENT. PITCH AND YAW ATTITUDE ERRORS NO LONGER ARE REQUIRED.

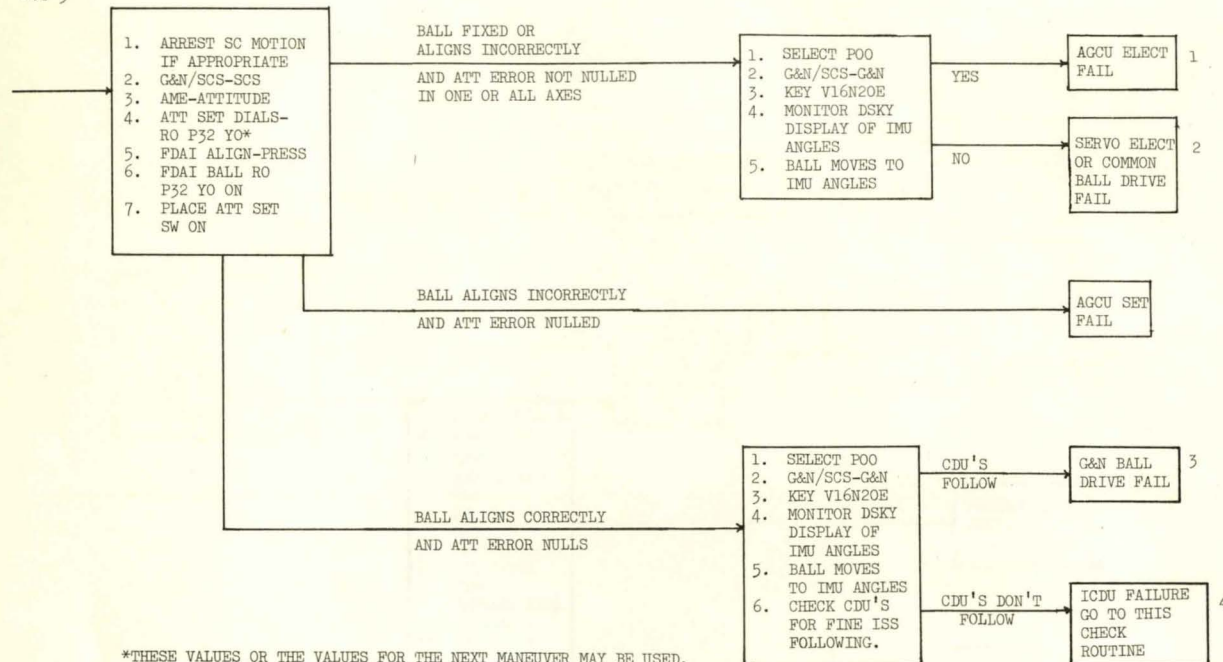
3. ALL PHASES: SAME AS 2 EXCEPT BOTH G&N AND SCS ATTITUDE ERROR DISPLAY ARE LOST.

4. ALL PHASES: ATTITUDE SET FUNCTION LOST. FDAI ALIGN LOST. G&N ATTITUDE ERROR DISPLAY STILL FUNCTIONAL.

PROCEDURE

REMARKS

SCS 3



*THESE VALUES OR THE VALUES FOR THE NEXT MANEUVER MAY BE USED.

GENERAL FOR LAUNCH PHASE: NO ACTION IF BALL DRIVE IS INCONSISTENT. USE OTHER CUES AND PERFORM TROUBLESHOOTING FOLLOWING INJECTION INTO ORBIT.

1 MIDCOURSE & V'S: USE G&N MODES FOR BALL DISPLAY OR DSKY CALLUP (V16N20E) WHEN SCS MODES ARE NEEDED. SCS ATTITUDE DISPLAY IS LOST FOR THE REST OF THE MISSION.

ENTRY: USE G&N ENTRY MODE AND DISPLAY AS PRIMARY PATH. VISUAL "OUT-THE-WINDOW" ORIENTATION IS AVAILABLE UNTIL POST.05G ROLLING ENTRY IS FINAL BACKUP.

2 MIDCOURSE & V'S: USE DSKY DISPLAY (V16N20E) FOR TOTAL ATTITUDE INDICATION OR READ CDU'S AT LEB.

ENTRY: NORMAL ENTRY EXCEPT NO TOTAL ATTITUDE BALL.

3 SAME AS 1 EXCEPT THAT THE AGCU DRIVEN BALL DISPLAY IS AVAILABLE AS A RELATIVE INDICATOR IF THE LOSS OF RESET CAPABILITY DOES NOT MAKE THE MENTAL COORDINATE TRANSFORMATION PROBLEM TOO DIFFICULT.

4 MIDCOURSE: USE SCS MODES FOR BALL DISPLAY OR DSKY CALLUP (V16N20E). G&N TOTAL ATTITUDE DISPLAY IS LOST BUT ALL G&N MODES MAY STILL BE USED WITHOUT TOTAL ATTITUDE FUNCTIONAL.

V'S: EITHER G&N OR SCS V'S MAY BE PERFORMED BUT THE TAKE OVER ATTITUDE REFERENCE MUST BE THE EXTERNAL REFERENCE SUPPLIED BY MSPN.

ENTRY: G&N MANUAL ENTRY IS POSSIBLE BY USING PROCEED (V33E) AT THE G&N ENTRY MODE SELECT POINT. AN SCS BALL WITH DSKY DISPLAY OF PROGRAMS 61-67 WOULD BE USED OR ANY OF THE OTHER BACKUP MODES.

PREPARED BY: *CEH*

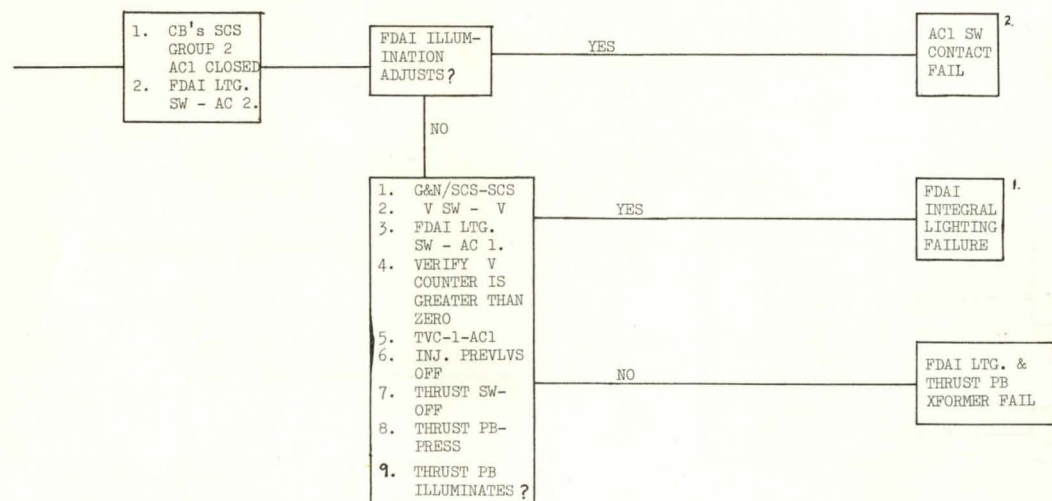
FLIGHT CREW SUPPORT DIVISION

DATE: Jan 27, 1967

STABILIZATION AND CONTROL
MALFUNCTION PROCEDURES

APOLLO OPERATIONS HANDBOOK

S/C012 REV FINAL
SECTION 9.1.1.2 PAGE 5



1 ALL PHASES: ADJUST FLOODLIGHTING FOR BEST ILLUMINATION AND CONTINUE WITH MISSION.

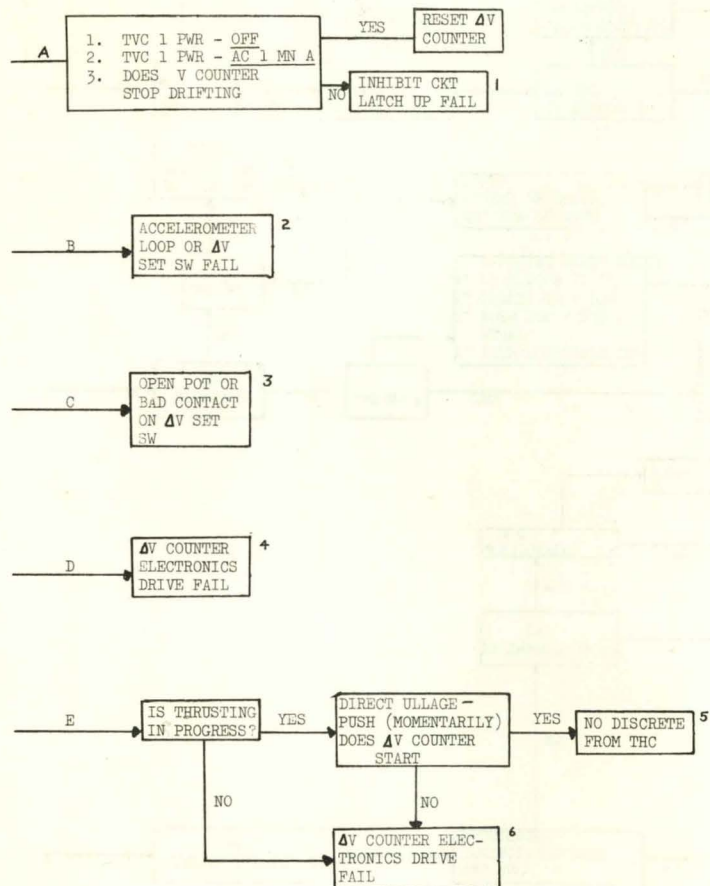
2 ALL PHASES: USE AC-2 SWITCH POSITION FOR FDAI LIGHTING SWITCH. REVERSE THE TVC SWITCHING CONVENTION FOR V'S, i.e.,

SCS POWER - AC2
RATE GYROS - AC2
TVC-1 - AC2
BMAG's - AC1
ROTATION CONTROL - AC1
TVC-2 - AC1
G&N LIGHTING - AC2
SPS GUAGING - AC2

3 ALL PHASES: ADJUST FLOODLIGHTING FOR BEST ILLUMINATION. THRUST ON LIGHT CHECKS NO LONGER POSSIBLE. CONTINUE WITH MISSION.

PREPARED BY: <i>W.C.</i>	FLIGHT CREW SUPPORT DIVISION	APOLLO OPERATIONS HANDBOOK	
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SCS 5



1. USE G&N FOR THRUST MAGNITUDE CONTROL
2. USE G&N CONTROLLED BURNS
3. USE OTHER THREE DRIVE SPEEDS TO GET PROPER COUNTER SETTING
4. USE G&N CONTROLLED BURNS
5. NEXT BURN ULLAGE WITH OTHER THC
6. USE G&N CONTROLLED BURNS

PREPARED BY: *CTD*

FLIGHT CREW SUPPORT DIVISION

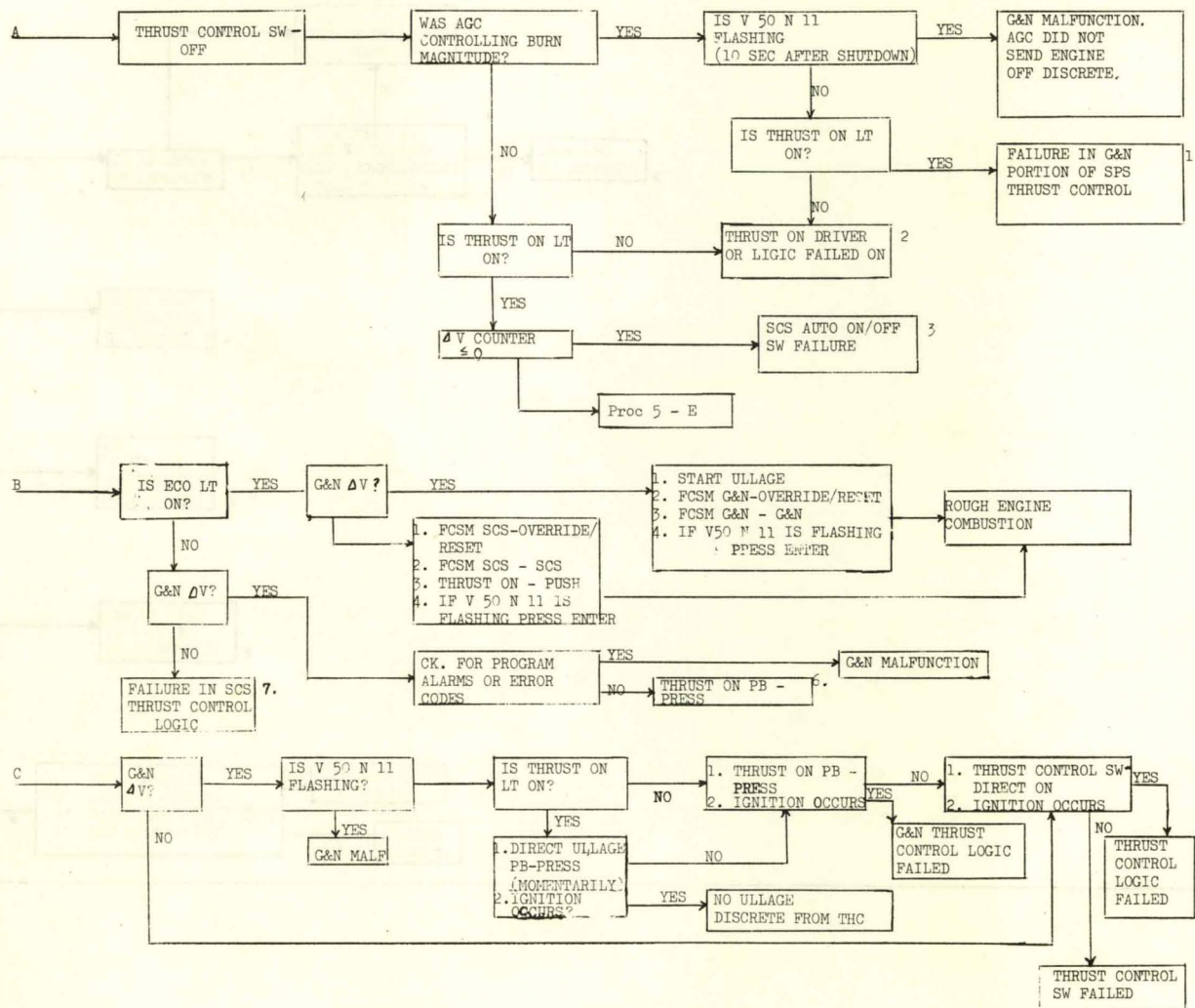
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STABILIZATION AND CONTROL
MALFUNCTION PROCEDURES

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SCS 6



1. USE SCS THRUST CONTROL
2. USE DIRECT ON/OFF OF THRUST CONTROL SW FOR SUBSEQUENT BURNS.
3. USE G&N TO CONTROL BURN OR DIRECT ON/OFF OF THRUST CONTROL SW FOR SUBSEQUENT BURNS.
4. USE DIRECT ON/OFF OF THRUST CONTROL SW FOR SUBSEQUENT BURNS
5. SPS NON-OPERATIONAL
6. G&N THRUST CONTROL LOGIC FAILURE, USE SCS FOR SUBSEQUENT BURNS.
7. USE G&N FOR ALL SUBSEQUENT BURNS.

SCS 7

TVC #2 CHECK

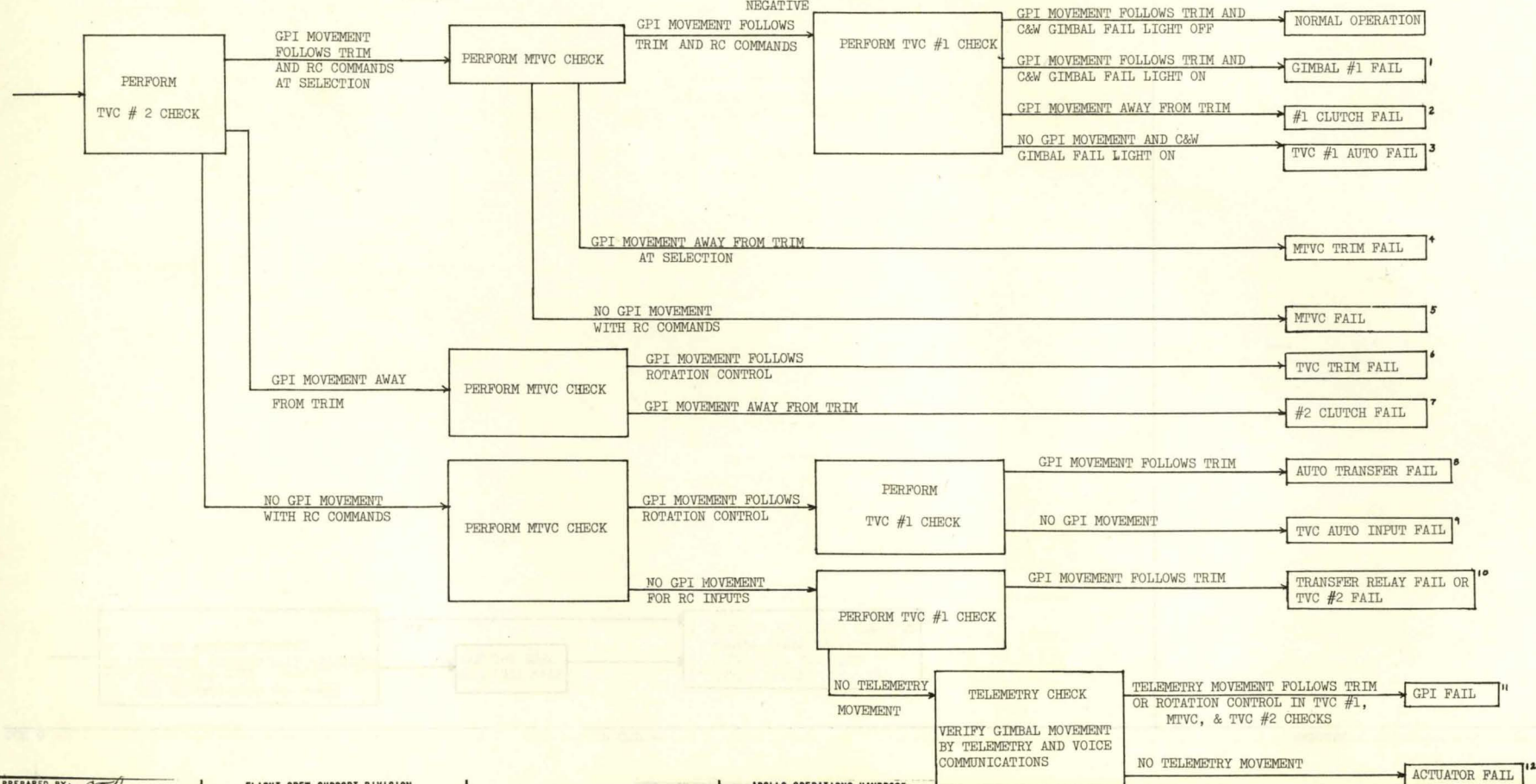
1. TVC #1 SWITCH - AC #1
2. TVC #2 SWITCH - AC #2
3. START PITCH #2 GIMBAL MOTOR
4. START YAW #2 GIMBAL MOTOR
5. CHANGE PITCH TRIM POSITIVE THEN NEGATIVE
6. CHANGE YAW TRIM POSITIVE THEN NEGATIVE

MTVC CHECK

1. V SWITCH - ON
2. ROTATE TRANSLATION CONTROL CE
3. ROTATE ROTATION CONTROL POSITIVE THEN NEG. IN PITCH
4. ROTATE ROTATION CONTROL POSITIVE THEN NEG. IN YAW
5. ΔV SWITCH - OFF
6. RETURN TRANSLATION CONTROL TO CENTER

TVC #1 CHECK

1. GIMBAL MOTORS PITCH #2 & YAW #2 - OFF
2. GIMBAL MOTORS PITCH #1 - START/ON
3. GIMBAL MOTORS YAW #1 - START/ON
4. ΔV sw - ON
5. Verify C&W GIMBAL FAIL LT OFF
6. CHANGE PITCH TRIM POSITIVE THEN NEGATIVE
7. CHANGE YAW TRIM POSITIVE THEN NEGATIVE



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FLIGHT CREW SUPPORT DIVISION
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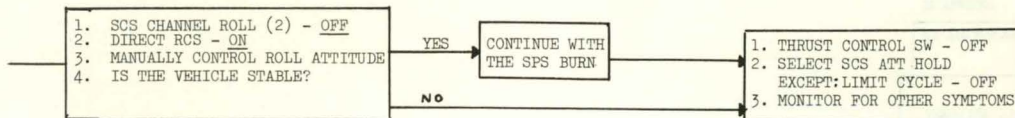
STABILIZATION AND CONTROL
MALFUNCTION PROCEDURES

APOLLO OPERATIONS HANDBOOK
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SECTION 9.1.1.2 PAGE 10

SCS 8

PROCEDURE

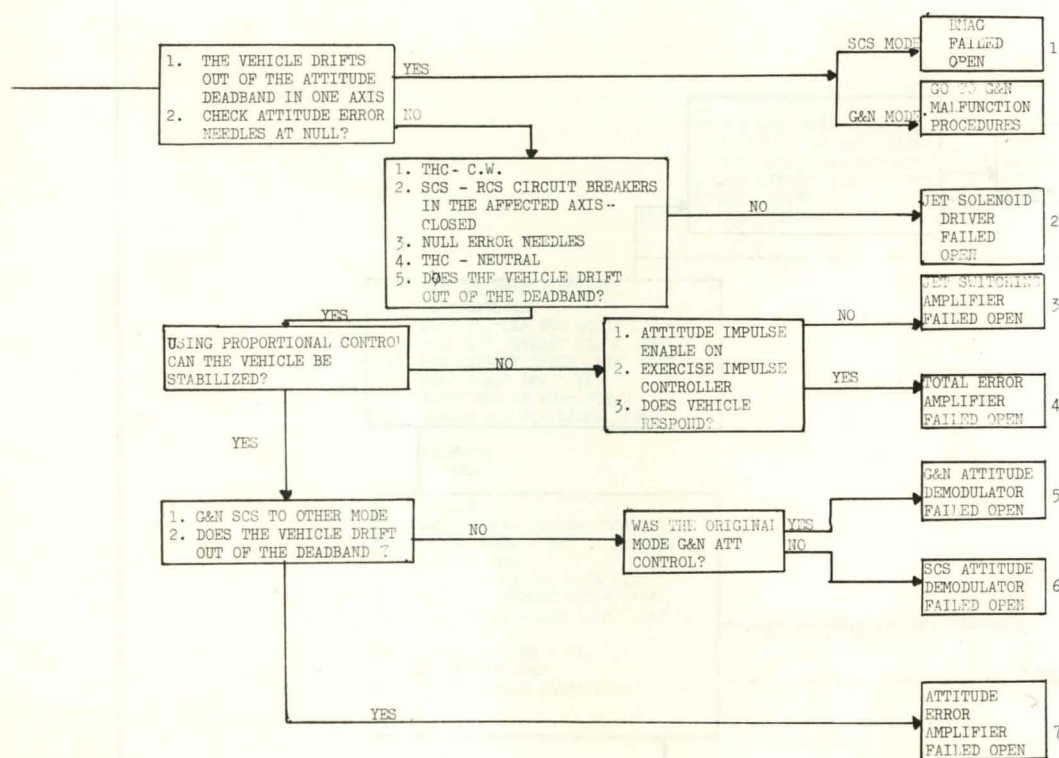
REMARKS



PROCEDURE

REMARKS

SCS TO



1. BMAG OPEN.

LAUNCH - NOT DETECTABLE
ALL OTHER PHASES - SCS AUTO. CONTROL LOST IN ONE AXIS. G&N, DIRECT & PROPORTIONAL CONTROL ALL REMAIN. SCS V, MTVC (IF FAILURE IN PITCH OR YAW) & SCS ATTITUDE ARE LOST.

2. DRIVER OPEN:

LAUNCH - NOT DETECTABLE
MIDCOURSE & V'S - USE OPPOSITE JET PAIR FOR SINGLE JET ATTITUDE CONTROL AND/OR TRANSLATIONS (ROLL FAILURES FAIL 1/2 OR Y OR Z ± OR - CONTROL)
ENTRY - SET UP FOR EITHER AN "A" OR "B" AUTO ENTRY DEPENDENT ON WHETHER OR NOT THE FAILED DRIVER IS IN "B" OR "A" (IGNORE IF IT WAS AN A&C ROLL DRIVER)

3. SWITCHING AMPLIFIER OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER PHASES - AUTO ATTITUDE, RATE, AND PROPORTIONAL RATE CONTROL IS LOST IN THIS AXIS. DIRECT CONTROL IS THE ONLY REMAINING RCS CONTROL PATH.

4. TOTAL ERROR AMPLIFIER OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER PHASES - AUTO ATTITUDE, RATE, AND PROPORTIONAL RATE CONTROL IS LOST IN THIS AXIS. DIRECT CONTROL IS THE ONLY REMAINING RCS CONTROL PATH OTHER THAN MINIMUM IMPULSE CONTROL.

5. G&N ATTITUDE DEMODULATOR OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER PHASES - G&N AUTO CONTROL LOST IN ONE AXIS. DIRECT OR PROPORTIONAL CONTROL OF RCS REMAINS. SCS V OR MTVC FOR BURNS AND MANUAL G&N FOR ENTRY. SCS ATTITUDE FOR ATTITUDE HOLD.

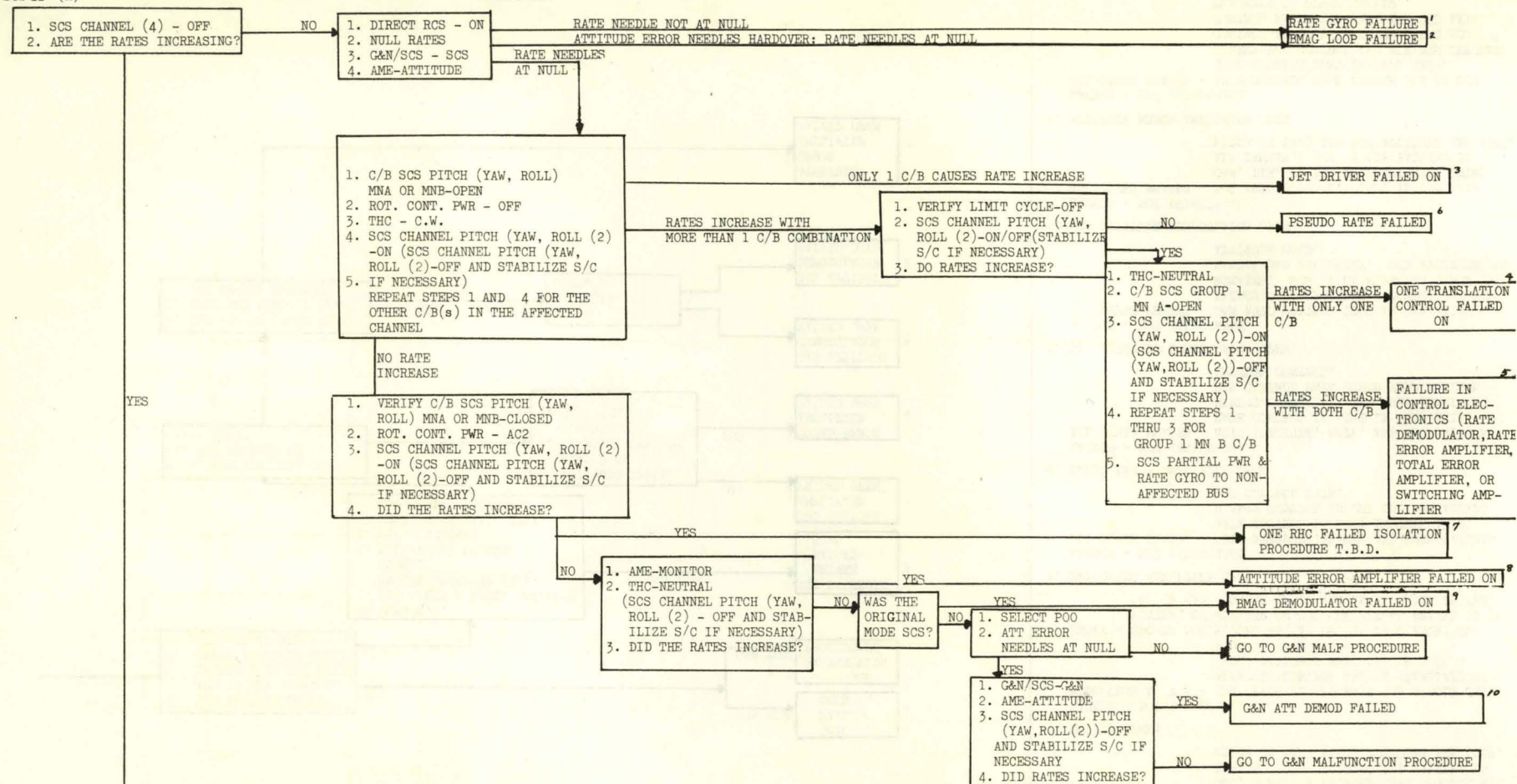
6. SCS ATTITUDE DEMODULATOR OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER PHASES - SCS AUTO CONTROL. LOST IN ONE AXIS G&N, DIRECT, AND PROPORTIONAL CONTROL ALL REMAIN. SCS V (IF FAILURE IS PITCH OR YAW) AND SCS ATTITUDE ARE LOST.

7. ATTITUDE ERROR AMPLIFIER OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER PHASES - AUTO CONTROL FROM EITHER G&N OR SCS HOLD SIGNALS LOST IN THIS AXIS. DIRECT RCS CONTROL AND MINIMUM IMPULSE CONTROL ARE THE ONLY REMAINING RCS CONTROL PATHS FOR THE AFFECTED AXIS. USE MTVC IF PITCH OR YAW.

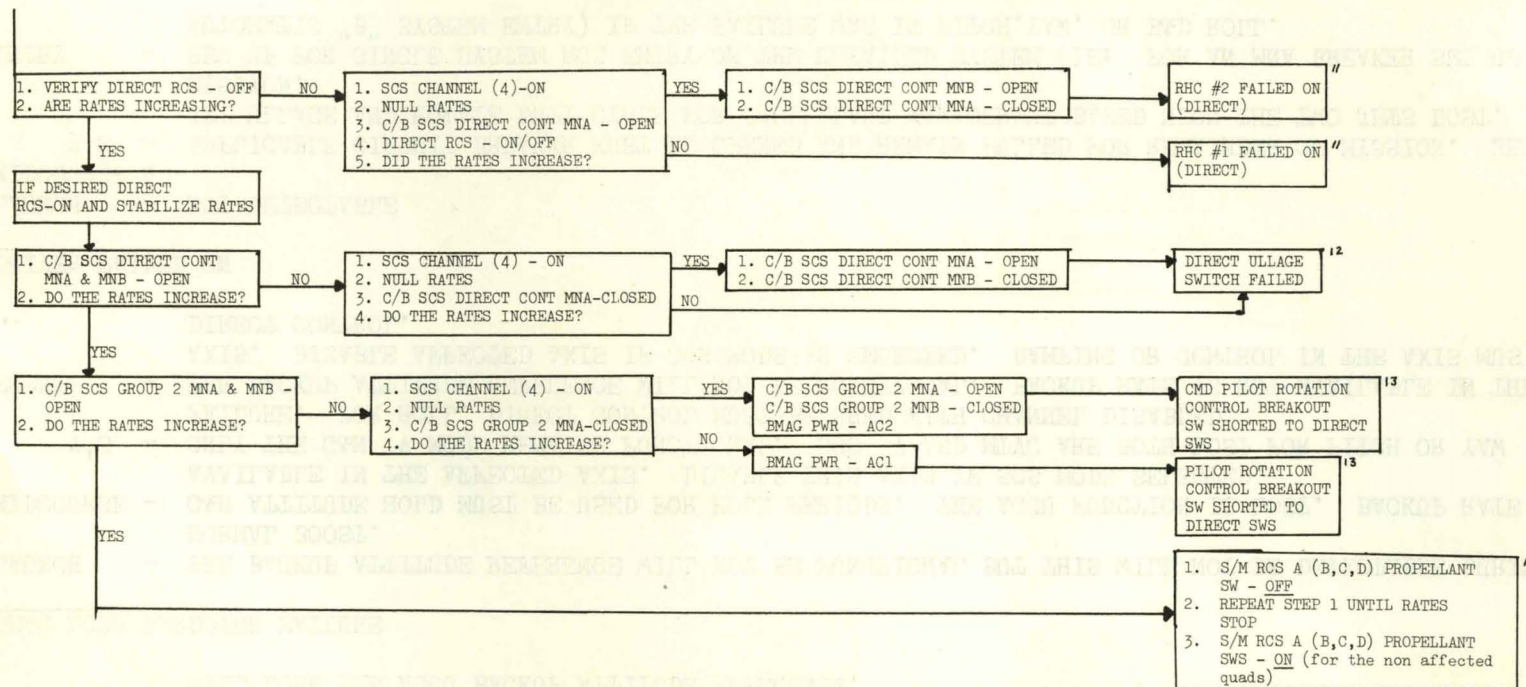
PROCEDURE



(CONTINUED ON
SCS - 12 B)

PREPARED BY: <u>CFM</u>	FLIGHT CREW SUPPORT DIVISION	APOLLO OPERATIONS HANDBOOK	
DATE: <u>Jan 27, 1967</u>	STABILIZATION AND CONTROL MALFUNCTION PROCEDURES	S/C <u>012</u>	REV <u>FINAL</u>
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SCS 12 (B)



PREPARED BY: CEP
FLC

FLIGHT CREW SUPPORT DIVISION
DATE: Jan 27, 1967

STABILIZATION AND CONTROL
MALFUNCTION PROCEDURES

APOLLO OPERATIONS HANDBOOK
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1 RATE GYRO HARDOVER FAILURE

- LAUNCH - RATE DISPLAY WILL NOT AGREE WITH ATTITUDE, ATTITUDE ERROR (IF STILL ACTIVE), AND PHYSICAL SENSES. THIS CAN BE CORRECTED BY SELECTING BACKUP RATE IN THE AFFECTED AXIS.
- MIDCOURSE - LEAVE THE RATE GYRO SWITCH OFF MOST OF THE TIME. ATTITUDE HOLD CAN BE HANDLED BY THE G&N AND LIMIT CYCLE SWITCH OR THE BMAG'S AND LIMIT CYCLE SWITCH. FOR MANEUVERS, PLACE THE BMAG'S TO BACKUP RATE OR USE DIRECT AUTO CONTROL IN ALL THREE AXES. IN THE FORMER CASE THE AGCU CAN NO LONGER UPDATE.
- V'S - SCS V MODE IS NO LONGER FUNCTIONAL FOR A PITCH OR YAW AXIS PROBLEM. G&N V WITH A BMAG IN BACKUP RATE AND MTVC ARE STILL OPERATIONAL. IN THESE MODES THE RATE GYROS WOULD BE ON WITH BACKUP RATE SELECTED IN THE AXIS AFFECTED.
- ENTRY - IN THESE MODES, THE RATE GYROS WOULD BE ON WITH BACKUP RATE SELECTED IN THE AXIS AFFECTED. THIS WILL LOSE THE AGCU BACKUP ATTITUDE REFERENCE.

2 BMAG LOOP HARDOVER FAILURE

- LAUNCH - THE BACKUP ATTITUDE REFERENCE WILL NOT BE FUNCTIONAL BUT THIS WILL NOT BE DETECTABLE DURING A NORMAL BOOST.
- MIDCOURSE - G&N ATTITUDE HOLD MUST BE USED FOR HOLD PERIODS. THE AGCU FUNCTION IS LOST. BACKUP RATE IS NOT AVAILABLE IN THE AFFECTED AXIS. DISABLE THIS AXIS IF SCS MODE SELECTED.
- V'S - ONLY THE G&N V MODE REMAINS FUNCTIONAL. SCS V AND MTVC ARE BOTH LOST FOR PITCH OR YAW FAILURE. FOR ROLL, DIRECT CONTROL MUST BE USED WITH CHANNEL DISABLED.
- ENTRY - THR BACKUP ATTITUDE REFERENCE WILL NOT BE FUNCTIONAL. BACKUP RATE IS NOT AVAILABLE IN THE AFFECTED AXIS. DISABLE AFFECTED AXIS IF SCS MODE IS SELECTED. DAMPING OR CONTROL IN THE AXIS MUST BE WITH DIRECT CONTROL.

3 DRIVER FAILED ON

- LAUNCH - NOT DETECTABLE
- MIDCOURSE & V'S - APPLICABLE CIRCUIT BREAKER MUST BE OPENED AND REMAIN PULLED FOR REMAINDER OF MISSION. SELECT TWO JET ULLAGE AND ROTATE DUTY CYCLE FOR PROPELLANT MANAGEMENT BASED UPON THE TWO JETS LOST. CONTINUE MISSION.
- ENTRY - SET UP FOR SINGLE SYSTEM RCS ENTRY ON THE UNFAILED SYSTEM (1E: FOR AN MNA BREAKER SET UP FOR AN AUTOMATIC "B" SYSTEM ENTRY) IF THE FAILURE WAS IN PITCH,YAW, OR B&D ROLL.

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4 ONE TRANSLATION CONTROL BAD

- LAUNCH - NOT APPLICABLE
MIDCOURSE &
V'S - PULL EITHER THE MNA OR MNB BREAKER FOR SCS GROUP 1 POWER. SET SCS POWER AND TVC #1 POWER TO OPPOSITE POSITIONS. USE OTHER TRANSLATION CONTROL. HALF OF THE POWER FOR THE SCS CONTROL PANEL IS NOW OFF.
ENTRY - THE CIRCUIT BREAKER CAN BE RE-CLOSED AS BOTH THE POWER PATHS ARE OPENED BY CM-SM SEPARATION.

5 FAILURE IN CONTROL ELECTRONICS

- LAUNCH - NOT DETECTABLE
MIDCOURSE - AFFECTED AXIS MUST BE DISABLED. DIRECT RCS CONTROL AND DIRECT ULLAGE ARE THE ONLY REMAINING MEANS OF FIRING THE JETS IN THIS AXIS.
V'S - THIS FAILURE GROUP MUST BE FURTHER ISOLATED TO DETERMINE IF THE TVC CONTROL CAPABILITY HAS BEEN AFFECTED, WHEN THERE IS A PITCH OR YAW FAILURE. FOR A ROLL FAILURE, DIRECT ROLL CONTROL MUST BE USED.

THE ISOLATION SHOULD BE ACCOMPLISHED AS FOLLOWS:

1. SELECT SCS V MODE
2. RECONFIRM THRUST CONTROL SWITCH - OFF
3. RECONFIRM PREVALVE SWITCHES (2) - OFF
4. GIMBAL MOTORS IN AFFECTED AXIS (2) - START - ON
5. CONFIRM RESPONSE TO GIMBAL TRIM THEN STABILIZATION AT TRIM POINT
6. THRUST ON PUSHBUTTON - PRESS
7. CONFIRM THRUST ON LIGHT - ON
8. OBSERVE GPI IN AFFECTED AXIS. DOES IT REMAIN STABLE?
(CONFIRM WITH TM IF COVERAGE IS AVAILABLE)

STABILITY ISOLATES THE FAILURE TO THE TOTAL ERROR AMPLIFIER OR THE SWITCHING AMPLIFIER SO THAT ANY OF THE THREE TVC CONTROL METHODS MAY BE USED. DIRECT ULLAGE AND DIRECT ROTATION MUST BE USED THOUGH FOR RCS CONTROL.

LACK OF STABILITY MEANS NO TVC. RCS DEORBIT MUST BE USED.

- ENTRY - SAME AS MIDCOURSE EXCEPT THAT THE DIRECT ULLAGE DOES NOT APPLY

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6 PSEUDO RATE FAILED

LAUNCH &

ENTRY - NOT DETECTABLE (IN ENTRY THE LIMIT CYCLE SWITCH MUST BE OFF)

MIDCOURSE &

V'S - LIMIT CYCLE SWITCH MUST BE OFF. HIGHER RCS PROPELLANT CONSUMPTION AND LIMIT CYCLE RATES WILL BE OCCURRING.

7 ROTATION CONTROL BAD (PROPORTIONAL)

ALL PHASES - T.B.D.

8 ATTITUDE ERROR AMPLIFIER FAILED

LAUNCH - NOT DETECTABLE

ALL OTHER

PHASES - THE AFFECTED AXIS MUST REMAIN DISABLED. ALL CONTROL METHODS USING THE AUTOMATIC RCS COILS IN THIS AXIS ARE LOST. PITCH OR YAW FAILURES ALSO LOSE BOTH AUTOMATIC TVC CONTROL PATHS BUT MTVC IS STILL FUNCTIONAL.

9 BMAG DEMODULATOR FAILURE

LAUNCH - NOT DETECTABLE

ALL OTHER

PHASES - SCS AUTOMATIC RCS CONTROL AND SCS V MODES (FOR PITCH AND YAW FAILURES) ARE LOST. IF AN SCS MODE IS SELECTED THE AXIS MUST BE DISABLED FOR AUTO CONTROL AND DIRECT RCS OR DIRECT ULLAGE SUBSTITUTED.

10 G&N ATTITUDE DEMODULATOR FAILURE

LAUNCH - NOT DETECATBLE

ALL OTHER

PHASES - G&N AUTOMATIC CONTROL IS LOST BUT, USING THE TRANSLATION CONTROL LOCKOUT (HANDLE CW), THE COMMANDS CAN BE FLOWN OUT FROM G&N DISPLAY WITH THE PROPORTIONAL CONTROL OR MTVC AS APPROPRIATE.

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11 ROTATION CONTROL BAD (DIRECT)

ALL PHASES - THE DIRECT CONTROL CIRCUIT BREAKER FOR THE SHORTED SWITCH CONTACT MUST BE OPENED. ONLY ONE ROTATION CONTROL WILL BE EFFECTIVE FOR DIRECT CONTROL. ONLY ONE SIDE OF THE THRUST CONTROL SWITCH WILL BE ACTIVE. FULL DIRECT ULLAGE CAN BE OBTAINED USING THE ABORT POSITION OF THE TRANSLATION CONTROL THROUGH THE MESC.

12 DIRECT ULLAGE SWITCH FAILED

ALL PHASES - THE DIRECT CONTROL CIRCUIT BREAKER FOR THE SHORTED SWITCH CONTACT MUST BE OPENED. ONLY ONE ROTATION CONTROL WILL BE EFFECTIVE FOR DIRECT CONTROL. ONLY ONE SIDE OF THE THRUST CONTROL SWITCH WILL BE ACTIVE. FULL DIRECT ULLAGE CAN BE OBTAINED USING THE ABORT POSITION OF THE TRANSLATION CONTROL THROUGH THE MESC.

13 BREAKOUT SWITCH POWER SHORTED TO DIRECT CONTROL

ALL PHASES - THE GROUP 2 MNA OR MNB CIRCUIT BREAKER INVOLVED MUST BE OPEN FOR THE REST OF THE MISSION. THE BMAG POWER SWITCH SHOULD BE PLACED TO THE OPPOSITE POWER SETTING. ONE ROTATION CONTROL WILL NO LONGER HAVE BREAKOUT SWITCH POWER AND SHOULD NO LONGER BE USED. THE CONTROL CAN BE DETERMINED BY:

1. DISABLING THE RCS CHANNELS
2. SELECTING THE SCS ΔV MODE
3. WAITING FOR AN ATTITUDE ERROR INDICATION FROM THE BMAGS
4. DISPLACING ONE ROTATION CONTROL PAST BREAKOUT
5. IF THE BMAG'S CAGE ATTITUDE ERROR WILL GO TO ZERO AND THE BALL DRIVE WILL START. THIS IS THE GOOD ROTATION CONTROL.

14 RCS QUAD PROBLEM

ALL PHASES - QUAD USE IS LOST FOR REST OF MISSION.

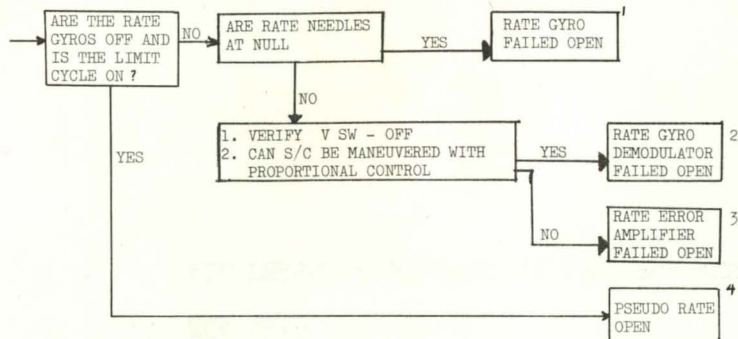
PREPARED BY: <i>C. H. H.</i>	FLIGHT CREW SUPPORT DIVISION	STABILIZATION AND CONTROL MALFUNCTION PROCEDURES	APOLLO OPERATIONS HANDBOOK	
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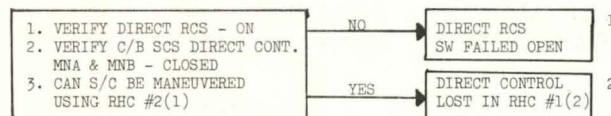
PROCEDURE

REMARKS



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SCS 21



1. DIRECT RCS SWITCH FAILED OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER - DIRECT ROTATION CONTROL IS LOST. AUTOMATIC PROPORTIONAL CONTROL, MANUAL PROPORTIONAL CONTROL, AND DIRECT AUTO CONTROL ALL REMAIN FOR RCS CONTROL.

2. DIRECT CONTROL LOST IN ONE ROTATION CONTROL

LAUNCH - NOT DETECTABLE
ALL OTHER - KEEP OPERABLE ROTATION CONTROL AT CMD PILOTS' STATION

1. RATE GYRO FAILED OPEN

- LAUNCH - DETECTABLE FROM LACK OF DISPLAY MOTION DURING LAUNCH. CAN BE CORRECTED BY SELECTION OF BACKUP RATE RESTORING RATE DISPLAY.
- MIDCOURSE & - SELECTION OF BACKUP RATE PROVIDES AN ALTERNATE RATE SOURCE BY CHANNEL FOR MANEUVERS OR TVC. ATTITUDE CONTROL DURING LOW RATE CONDITIONS CAN BE HANDLED BY PSEUDO RATE SO THAT THE BMAG CAN STILL BE USED FOR ATTITUDE HOLD. THE SCS DELTA V MODE IS LOST THOUGH AND THE BMAG IS COMMON TO BOTH G&N DELTA V AND MTVC FOR PITCH OR YAW FAILURES.
- ENTRY - BMAG IS AFFECTED AXIS CAN BE PLACED TO BACKUP RATE FOR G&N OR SCS MODES. UPDATING OF THE AGCU WILL BE LOST. ATTITUDE HOLD IN SCS ENTRY MODE MUST BE MANUAL. VISUAL BACKUP ATTITUDE REFERENCE IS AVAILABLE.

2. RATE GYRO DEMOD OPEN

- ALL PHASES - RATE DISPLAYS REMAIN FUNCTIONAL
- LAUNCH - NOT DETECTABLE
- MIDCOURSE & - ONLY DIRECT CONTROL - DIRECT AUTO CONTROL AND MTVC (FOR PITCH OR YAW CHANNEL PROBLEMS) REMAIN IN THE AXIS.
- DELTA V'S - ONLY DIRECT CONTROL OR DIRECT AUTO CONTROL REMAIN IN THE AXIS AFFECTED.
- PRE 0.05G - AUTOMATIC RATE DAMPING LOST IN AXIS. DIRECT AUTO OR DIRECT CONTROL CAN BE USED WITH THE ACTIVE RATE DISPLAY OR IN ROLL TO CONTROL ATTITUDE.

3. RATE ERROR AMP OPEN

- ALL PHASES - RATE DISPLAYS REMAIN FUNCTIONAL
- LAUNCH - NOT DETECTABLE
- MIDCOURSE & - ONLY DIRECT CONTROL AND MTVC (FOR PITCH OR YAW CHANNEL PROBLEMS) REMAIN IN THE AXIS.
- PRE 0.05G - ONLY DIRECT CONTROL REMAIN IN THE AXIS AFFECTED.
- POST 0.05G - AUTOMATIC RATE DAMPING LOST IN AXIS. DIRECT CONTROL CAN BE USED WITH THE ACTIVE RATE DISPLAY OR IN ROLL TO CONTROL ATTITUDE.

4. PSEUDO RATE OPEN

- LAUNCH & - NOT DETECTABLE
- ENTRY
- MIDCOURSE & - RATE OR BACKUP RATE MUST REMAIN ON IN AXIS AFFECTED FOR ATTITUDE HOLD. HIGHER RCS
- PRE DELTA V'S PROPELLANT CONSUMPTION WILL EXIST IN THAT AXIS.

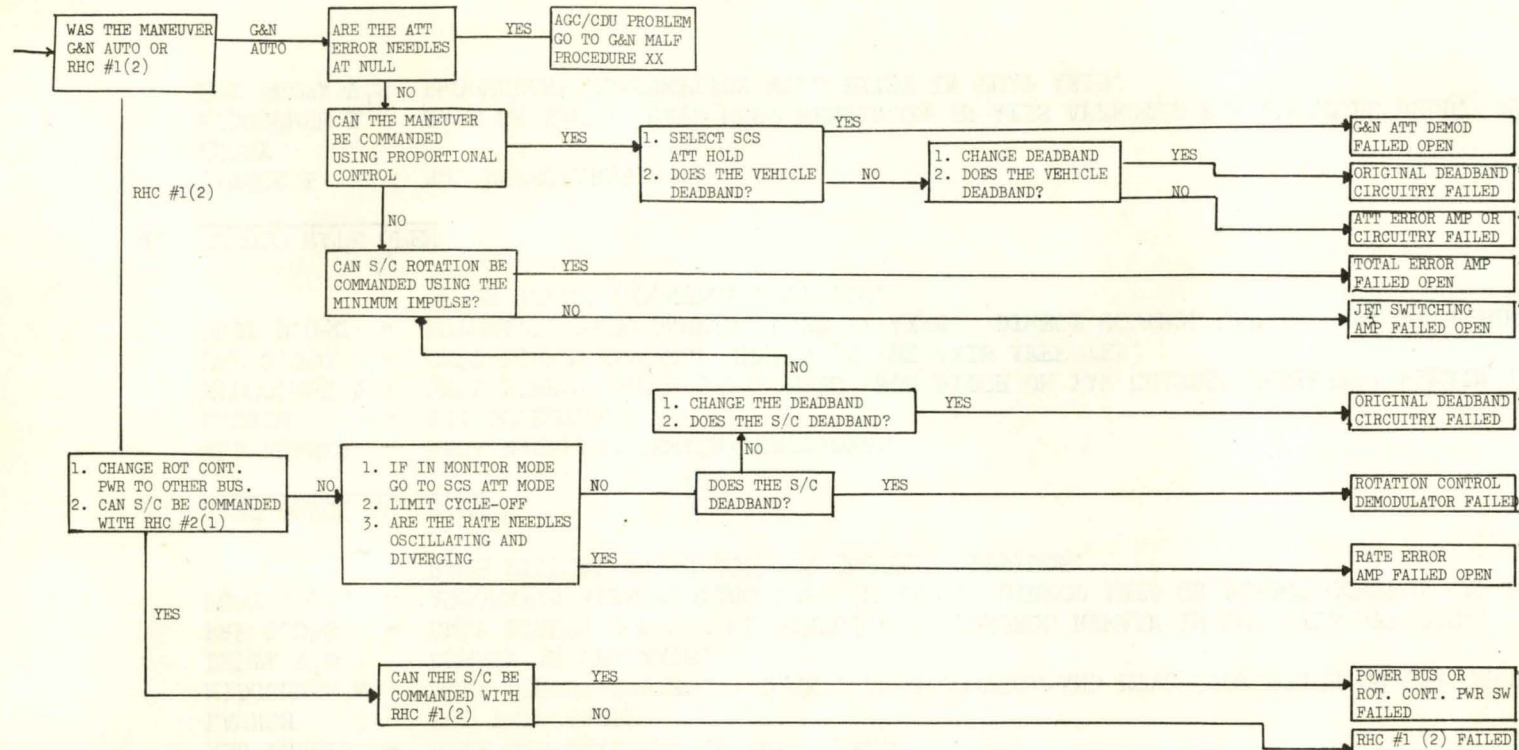
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PROCEDURE

REMARKS



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1. G&N ATTITUDE DEMOD OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER - G&N AUTO CONTROL LOST IN ONE AXIS. DIRECT OR PROPORTIONAL CONTROL OF RCS REMAINS. SCS V OR
PHASES MTVC FOR BURNS AND MANUAL G&N FOR ENTRY. SCS ATTITUDE FOR ATTITUDE HOLD.

2. ATTITUDE ERROR AMPLIFIER OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER - AUTO CONTROL FROM EITHER G&N OR SCS HOLD SIGNALS LOST IN THIS AXIS. DIRECT RCS CONTROL AND
PHASES MINIMUM IMPULSE CONTROL ARE THE ONLY REMAINING RCS CONTROL PATHS FOR THE AFFECTED AXIS

3. TOTAL ERROR AMPLIFIER OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER - AUTO ATTITUDE AND RATE PROPORTIONAL RATE CONTROL IS LOST IN THIS AXIS. DIRECT CONTROL IS THE
PHASES ONLY REMAINING CONTROL PATH OTHER THAN MINIMUM IMPULSE CONTROL.

4. SWITCHING AMPLIFIER OPEN

LAUNCH - NOT DETECTABLE
ALL OTHER - AUTO ATTITUDE AND RATE AND PROPORTIONAL RATE CONTROL IS LOST IN THIS AXIS. DIRECT CONTROL IS THE
PHASES ONLY REMAINING CONTROL.

5. DEADBAND CIRCUITRY FAILED

LAUNCH - NOT DETECTABLE
ALL OTHER - MANUAL ATTITUDE HOLD REQUIRED WHEN AFFECTED DEADBAND IS SELECTED.
PHASES

6. ROTATION CONTROL DEMODULATOR OPEN

ALL PHASES- THE USE OF PROPORTIONAL RCS CONTROL AND MANUAL TVC ARE LOST FOR THE REMAINDER OF THE MISSION.
AUTO TVC MODES WITH RATE DAMPING AND NO MANUAL INPUT MTVC BACKUP ARE STILL AVAILABLE. DIRECT AND
AUTO RCS CONTROL STILL REMAIN FOR ALL MODES.

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7. RATE ERROR AMPLIFIER OPEN

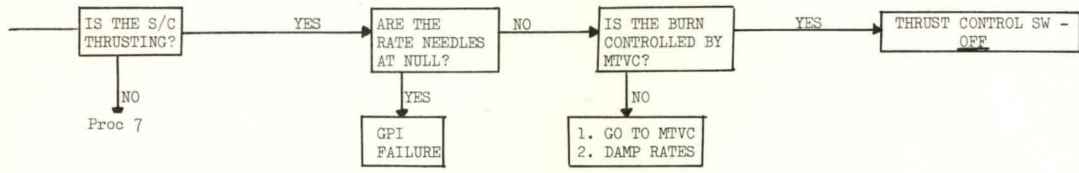
ALL PHASES - RATE DISPLAYS REMAIN FUNCTIONAL
LAUNCH - NOT DETECTABLE
MIDCOURSE
& V'S - DIRECT RCS IS ONLY AVAILABLE CONTROL MODE IN THAT AXIS.
PRE-0.05G - ONLY DIRECT CONTROL AVAILABLE IN AFFECTED AXIS
POST-0.05G - AUTOMATIC RATE DAMPING LOST IN AXIS. DIRECT RCS CAN BE USED WITH THE ACTIVE RATE DISPLAY OR IN ROLL TO CONTROL ATTITUDE.

8. ONE ROTATION CONTROL LOST

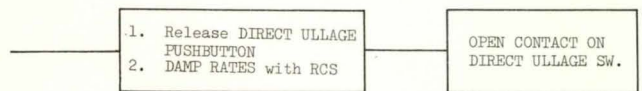
ALL PHASES - USE THE OPERATIONAL ROTATION CONTROL AT BOTH THE G&N LEB STATION AND PILOTS STATION FOR PROPORTIONAL CONTROL. DIRECT CONTROL SHOULD STILL BE FUNCTIONAL IN THE OTHER CONTROL.

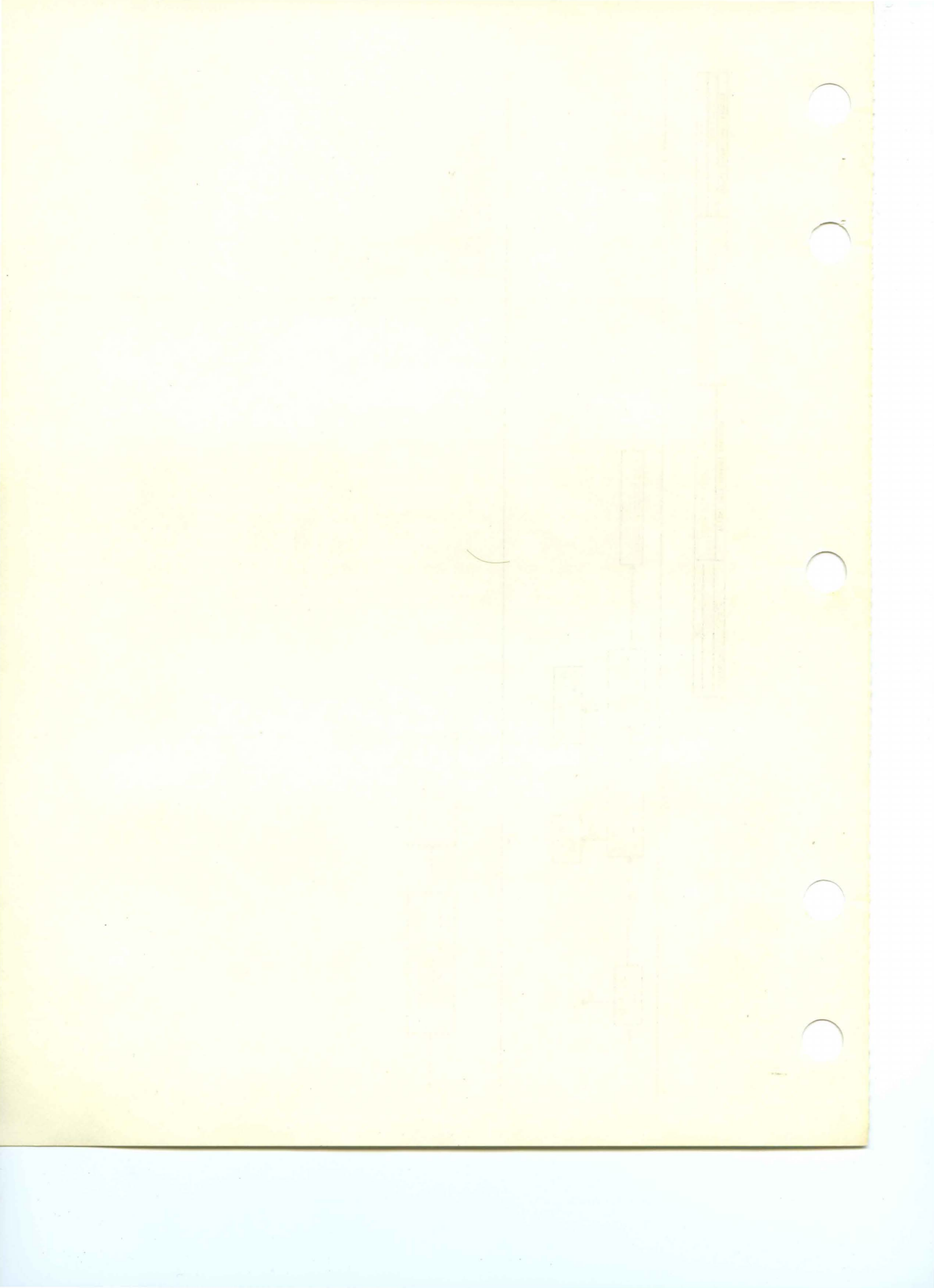
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SCS 23	PROCEDURE	REMARKS
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SCS 24		1. If direct ullage is needed use the abort position of the THC to command direct ullage through the sequence.
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PROCEDURES ENTRY SHEET

SECTION 9.1.2

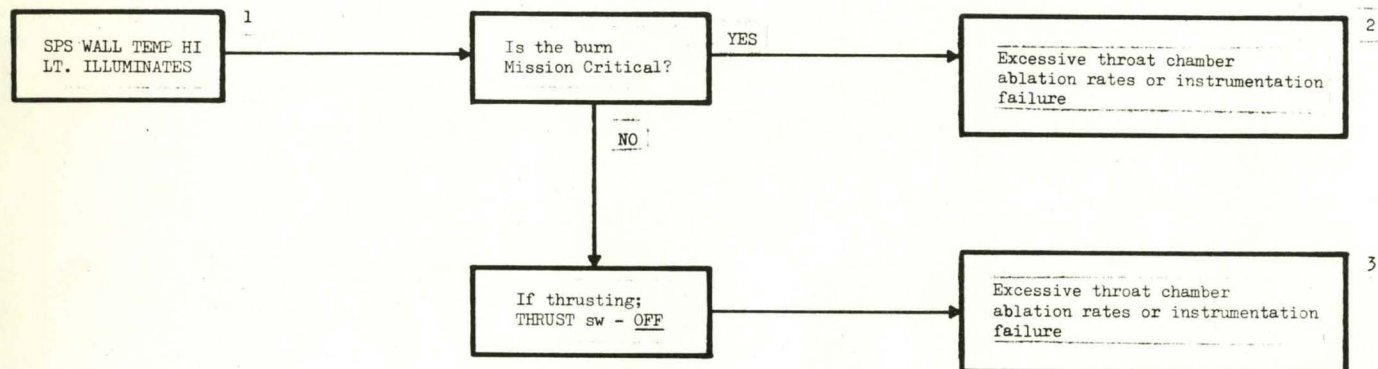
SPS MALFUNCTION PROCEDURES

SYMPTOM	SYMPTOM NUMBER	STEP	PAGE
SPS ROUGH ECO DURING MISSION CRITICAL BURN	1	1	2
SPS ROUGH ECO DURING NON-MISSION CRITICAL BURN	2	1	3
PITCH OR YAW GMBL DR FAIL C & W LIGHT ILLUMINATES DURING MISSION CRITICAL BURN	3	1	4
PITCH OR YAW GMBL DR FAIL C & W LIGHT ILLUMINATES DURING NON-MISSION CRITICAL BURN	4	1	5
SPS PRESS C & W LIGHT ILLUMINATES DURING THRUSTING	5	1	6
FUEL AND/OR OX TANK PRESS LOW DURING THRUSTING	5	2	6
FUEL AND/OR OX TANK PRESS HIGH DURING THRUSTING	5	7	7
SPS PRESS C & W LIGHT ILLUMINATES DURING NON- THRUSTING	6	1	8
FUEL AND/OR OX TANK PRESS LOW DURING NON-THRUSTING	6	2	8
FUEL AND/OR OX TANK PRESS HIGH DURING NON-THRUSTING	6	6	9
SPS WALL TEMP HI C & W LIGHT ILLUMINATES	7	1	10
PROPELLANT HEATERS FAIL TO RAISE TEMPERATURE	8	1	10
PROPELLANT TEMPERATURE READING ABNORMAL	9	1	11
NO RESPONSE OF OX FLOW FLAGS TO OX FLOW ADJUSTMENT	10	1	11
ABNORMAL PROPELLANT QUANTITY READOUT	11	1	11
UN BALANCE METER IS ERRATIC OR PEGGED	12	1	13
LOSS OF SPS HELIUM TANK PRESSURE	13	1	13
ABNORMAL SPS HELIUM VALVE TB INDICATION	14	1	14

SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
1 SPS ROUGH ECO DURING MISSION CRITICAL BURN				Light illuminates if 70 ± 20 msec at a vibration level of 180g's peak-to-peak or 30-70 msec at a vibration level of 360g's peak-to-peak. Light is extinguished when FCSM circuitry is reset. THRUST SW-ON overrides the FCSM monitors. Monitor PRESS ENG INLET FUEL and OX for decreased pressure or unbalanced pressure and flow.	Excessive engine vibration due to combustion instability.
	1	FCSM G&N or SCS SW- <u>VERRIDE</u> / <u>RESET</u>	2	1. If in G&N ΔV , automatic restart of the engine will occur if <10 sec has elapsed since shutdown. If >10 sec V50N11 will flash, and the ENTER must be depressed for automatic restart.	
	2	FCSM G&N SCS SW- <u>G&N</u> or <u>SCS</u> a. G&N b. SCS	4 3	2a. <u>VERRIDE</u> / <u>RESET</u> has re-started engine. Interruption of engine "ON" command occurs during switching transient.	
	3	THRUST ON - <u>DEPRESS</u>	4		
	4	Monitor SPS ROUGH ECO light a. Re-illuminates b. Remains extinguished	5 →		4b. Transient vibration level sensed in SPS engine.

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	Service Propulsion System Malfunction Procedure	SECTION 9.1.2	PAGE 2

PROCEDURE



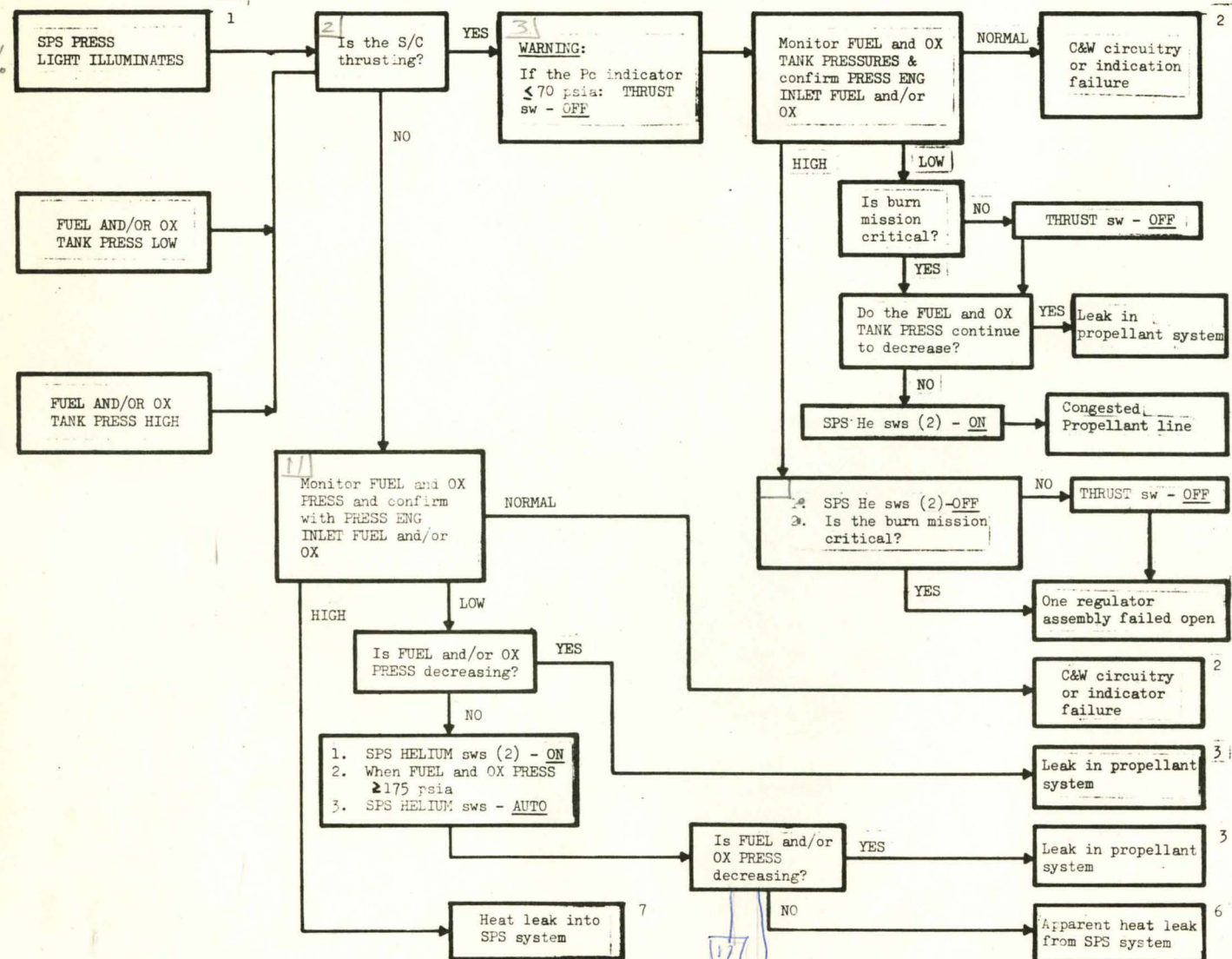
REMARKS

1. Light illuminates when throat surface temperature is 380°F or greater. Ablation rates will be severe that loss of chamber may be expected at any-time, resulting in catastrophic failure. Maximum temperature should occur 30 min after shut down.
2. Complete loss of the SPS should be expected at any time.
3. MSFN can confirm wall temperature over 380°F. Loss of entire chamber very possible upon refiring of SPS

SYSTEM	SPS-1
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PROCEDURES

REMARKS



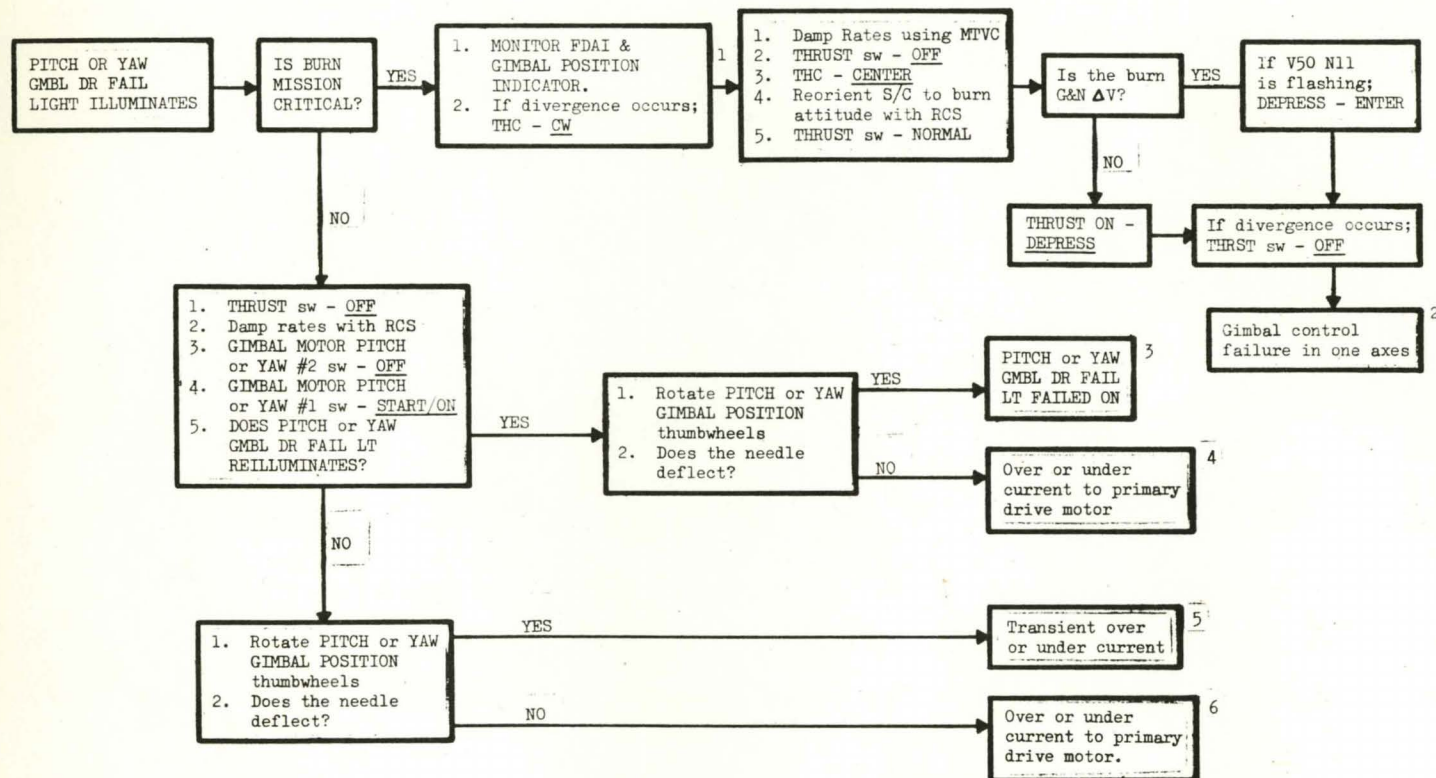
1. Light illuminates if FUEL or OX TANK PRESS IS >200 psia or <160 psia. Normal operating pressure is 171-179 psia.
2. Monitoring of SPS pressure gages is required for all subsequent burns
3. SPS inoperable
WARNING: - Subsequent repressurization considered dangerous due to possibility of tank rupture.
4. Tanks are manually repressurized for subsequent burns. Burns are not to exceed 20 sec if propellant tank pressure cannot be raised during manual repressurization; SPS not operable propellant tank pressure <160 psia.
5. With helium supply shut off, propellant tank ullage pressures are sufficient to provide 20 seconds of operation. After 20 seconds, O/F ratio becomes too high and engine operation may become rough. SPS will not be operable after this 20 seconds.
6. SPS is functional
Tanks are manually repressurized for next burn if 175 psia is not obtainable: SPS HELIUM sws (2) - OFF. Major leak in pressurization systems SPS not operable for tank pressures <160 psia.
7. SPS is functional

SYSTEM	SPS-2
DATE	FEB. 16, 1967
S/C	012

17
ECS
1/11

PROCEDURES

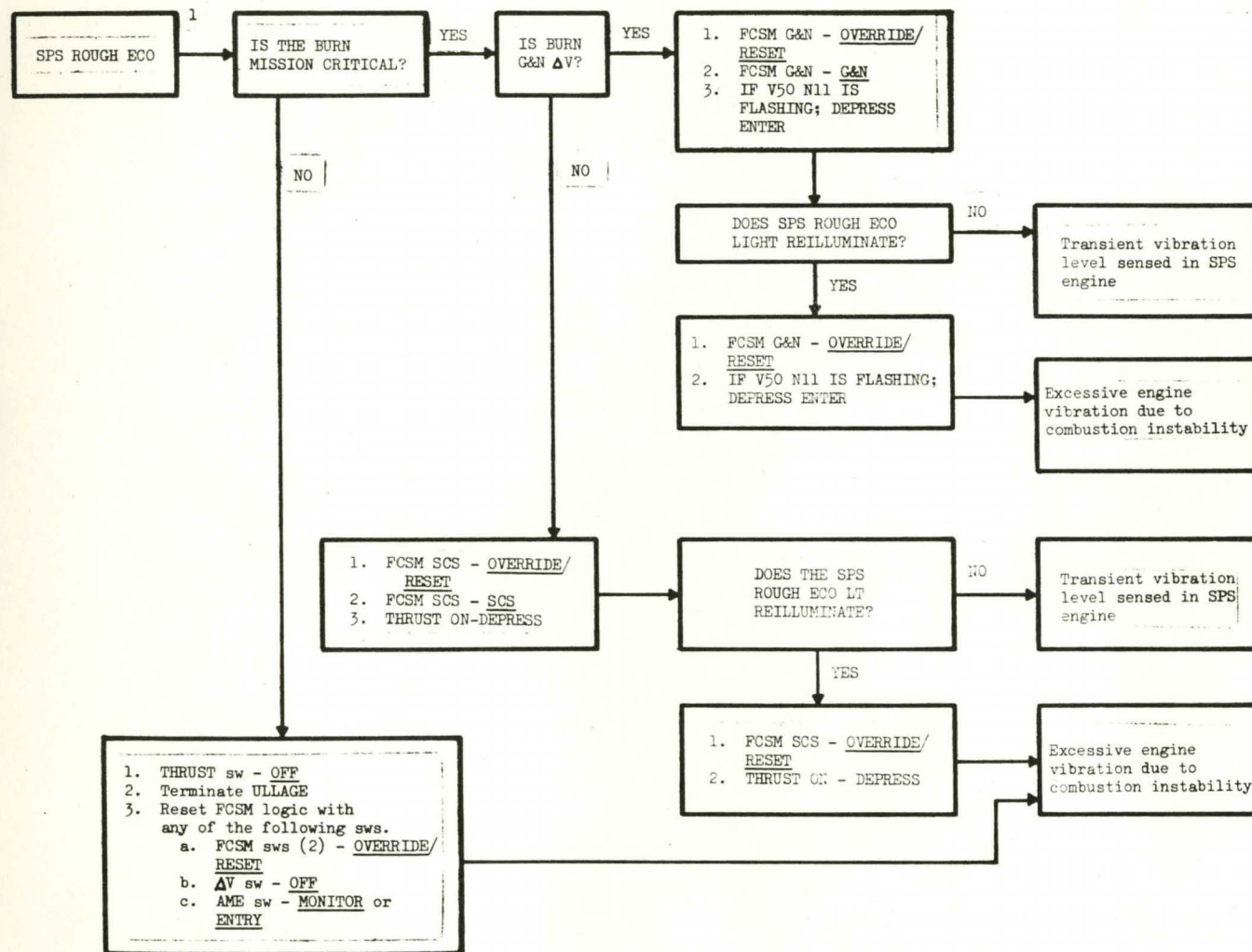
REMARKS



1. This action initiates MTVC operation.
2. SPS is inoperative as gimbal control is lost in one axis
3. For any subsequent burns, the GIMBAL POSITION indicator must be monitored with the FDAI for divergence from planned heading as these are the only means of monitoring the status of the gimbal motors.
4. SPS now functional on secondary gimbal drive motor. Any subsequent burns must be monitored for gimbal motor failure on the GIMBAL POSITION indicator and the FDAI.
5. SPS functional, but gimbal switchover may occur at any time during thrusting.
6. GMBL DR FAIL light should also have re-illuminated. Motor is unable to assume the load and drops off the line.

SYSTEM	SPS-3
DATE	FEB. 16, 1967
S/C	012

D.O. Evans 1126/67



REMARKS

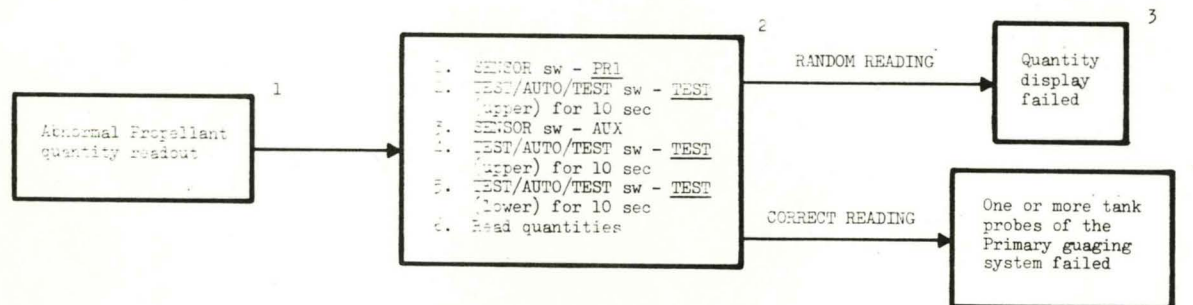
1. Light illuminates if 70 + 20 msec at a vibration level of 180g's peak-to-peak or 30-70 msec at a vibration level of 360g's peak-to-peak. Light is extinguished when FCSM circuitry is reset. THRUST SW-ON overrides the FCSM monitors. Monitor PRESS ENG INLET FUEL and OX for decreased pressure or unbalanced pressure and flow.

2 Continue normal procedures

SYSTEM	SPS-4
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S/C	012

PROCEDURES

REMARKS



1. Complete any thrusting activity prior to check of quantity readout.
2. In TEST mode the display will not move for the first 4.5 sec. Next it will race for 1 sec, and then will roll steadily at 2 to 4 digits per sec. If display reacts as above after primary system failure, then failure is in a tank probe. If tank probe is not failed, then random or bogey readings will be displayed.
3. MSFN must not supply any propellant quantity data.
4. Continue in AUX mode. Telemetry will provide total quantities from auxiliary system, and sump tank quantities from PRI system.

SYSTEM	SPS-5
DATE	FEB. 16, 1967
S/C	012

PROCEDURES ENTRY SHEET

SECTION 9.1.3

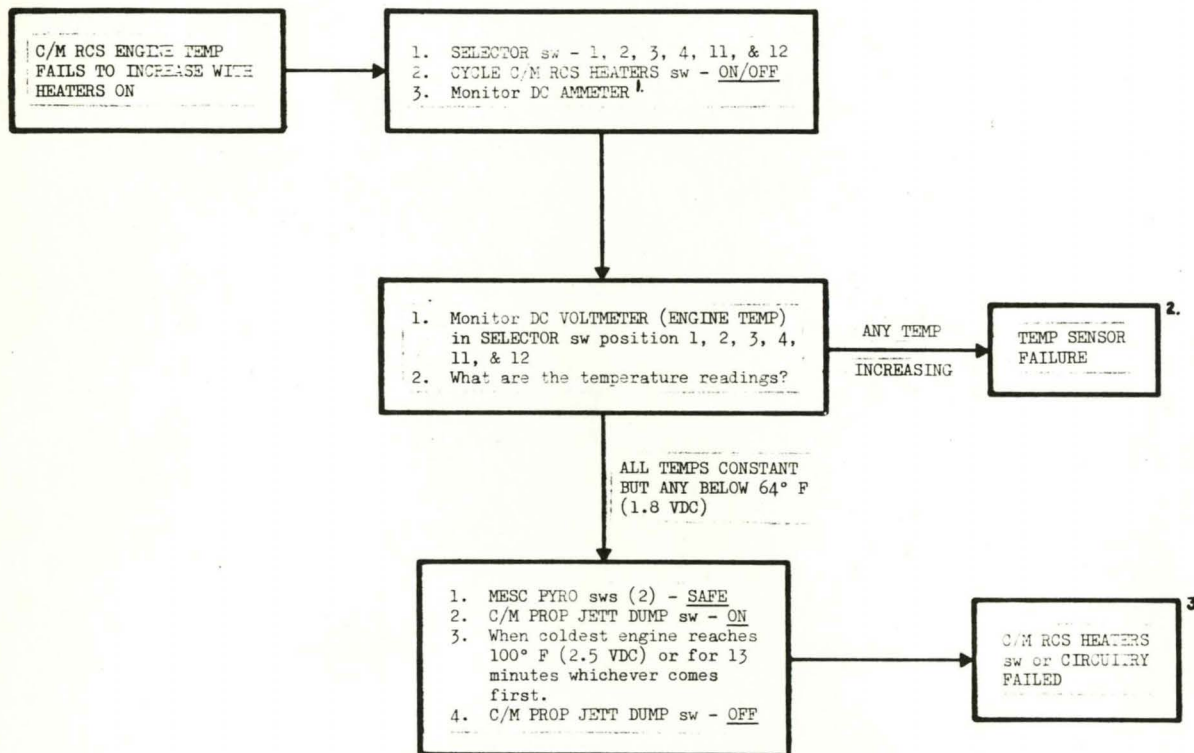
RCS MALFUNCTION PROCEDURES

SYMPTOM	SYMPTOM NUMBER	STEP	PAGE
<u>S/M RCS</u>			
S/M RCS C&W LIGHT ILLUMINATES	1	1	2
S/M RCS TEMP PKG LOW	1	4	2
S/M RCS TEMP PKG HIGH	1	10	3
S/M RCS PRESS MANF LOW	1	19	5
S/M RCS PRESS MANF HIGH	1	22	5
S/M RCS PRESS He LOW OR DECREASING	2	1	7
<u>C/M RCS</u>			
C/M RCS ENGINE TEMP FAILS TO INCREASE WITH HEATERS ON	3	1	9
C/M RCS C&W LIGHT ILLUMINATES	4	1	10
C/M RCS PRESS F OR OX HIGH	4	3	11
C/M RCS PRESS F OR OX LOW	4	4	11
C/M RCS PRESS He LOW	5	1	12

SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
1. S/M RCS A (B,C,D) Light illuminates	1.	S/M RCS A(B,C,D) Helium 1 & 2 sws <u>OFF</u>	2.	Light illuminates if TEMP PKG is >175° or <63°; or if PRESS MANF is <155 psia or >215 psia.	
	2.	RCS INDICATOR sw - <u>S/M A(B,C,D)</u>	3.		
	3.	Monitor S/M RCS TEMP PKG	3.	Normal operating range: 115 - 175°F	
	a.	LOW	4.		
	b.	HIGH	10.	3b. Boost heating may cause the temperature to rise above 200°F, but it should drop during the first rev. Prolonged RCS firing and solar heat soak orientation may result in a high TEMP PKG.	
	c.	NORMAL	18.		
S/M RCS TEMP PKG LOW	4.	If TEMP PKG <45°F: SCS CHANNEL sws A&C ROLL (B&D ROLL) and PITCH (YAW)-OFF	5.	4. Two SCS CHANNEL sws and DIRECT RCS must be disabled to electrically isolate the affec- ted quad, however the opposite quad on the S/M is also disabled.	
	5.	DIRECT RCS - <u>OFF</u>	6.	Actuation at temperatures lower than 63°F can result in incom- plete combustion and dangerous pressure spikes.	
WARNING: If there was probable engine valve actuation while the quad's PKG TEMP was below 45°F: S/M RCS A(B,C,D) PRO- PELLANT SW - <u>OFF</u> ; SCS CHANNEL sws (2) - <u>ON</u> . Reactivate the quad only in an emergency; S/M RCS A(B,C,D) HELIUM 1 & 2 sws - <u>ON</u> . If the quad is reactivated, the first pulse on each jet of the quad should be a minimum of one second in duration in order to attempt disapation of possible residue.					
	6.	S/M RCS A(B,C,D) HELIUM 1&2 sws- <u>ON</u> (if applicable)	7.		
	7.	If possible, reorient S/C with quad A(B,C,D) in sunlight and monitor S/M RCS TEMP PKG			
PREPARED BY: <i>CH</i>	FLIGHT CREW SUPPORT DIVISION		RCS Malfunction Procedure		APOLLO OPERATIONS HANDBOOK
DATE: Jan. 27, 1967					S/C 012 REV FINAL
					SECTION 9.1.3 PAGE 2

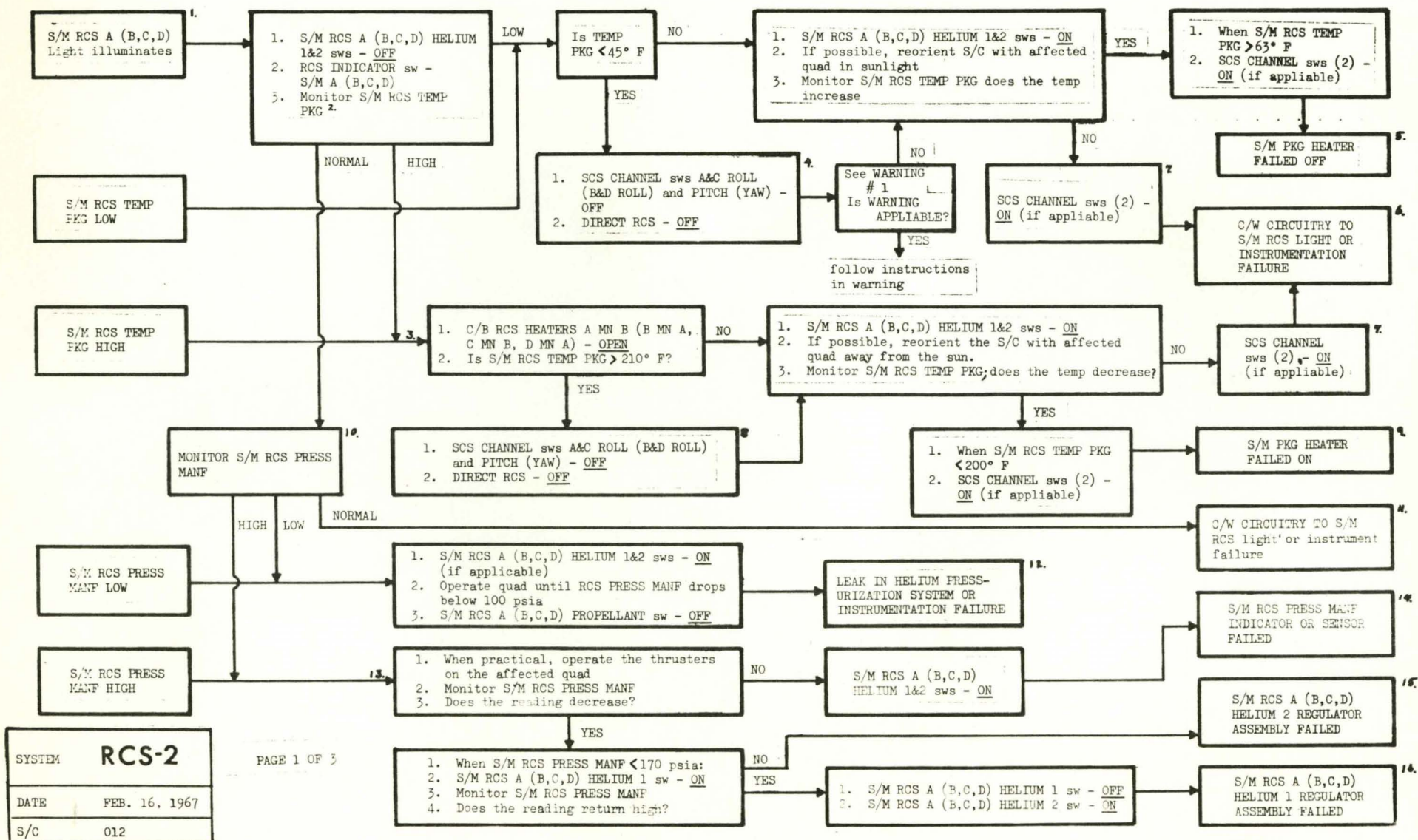
PROCEDURE

REMARKS



1. Indicates thruster temperature
2. Use one of other engine temps for that of affected engine.
3. All engines will be heated with the exception of the two + pitch engines.

SYSTEM	RCS-1
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S/C	012



REMARKS

WARNING # 1: If there was probable engine valve actuation while the quad's PKG TEMP was below 45°F: S/M RCS A(B,C,D) PROPELLANT SW - OFF; SCS CHANNEL sws (2) - ON. Re-activate the quad only in an emergency; S/M RCS A(B,C,D) HELIUM 1 & 2 sws - ON. If the quad is reactivated, the first pulse on each jet of the quad should be a minimum of one second in duration in order to attempt disipation of possible residue.

1. Light illuminates if TEMP PKG is >175° or <63°; or if PRESS MANF is <155 psia or >215 psia.
2. Normal operating range: 115 - 175°F
3. Boost heating may cause the temperature to rise above 200°F, but it should drop during the first rev. Prolonged RCS firing and solar heat soak orientation may result in a high TEMP PKG.
4. Two SCS CHANNEL sws and DIRECT RCS must be disabled to electrically isolate the affected quad, however the opposite quad on the S/M is also disabled. Actuation at temperatures lower than 63°F can result in incomplete combustion and dangerous pressure spikes.
5. Temperature of quad must be maintained using solar heating.
6. If the indicator failed, S/M RCS A(B,C,D) light will not be illuminated; however, if the sensor failed the light will be on. Use the temperature of the other quads to determine temp of the affected quad, and continuous monitoring of the affected quad is advised, if the sensor failed. If the indicator failed temperatures should be obtained from ground TM
7. Use system normally
8. Two SCS CHANNEL sws and the DIRECT RCS must be disabled to electrically isolate the affected quad, however the opposite quad on the S/M is also disabled.
If the engine valves are actuated above 220°F, deformation of the valve seats can occur with possible leakage of propellants.
9. Use the C/B to manually maintain the TEMP PKG within limits of 70°F - 210°F.
CAUTION: If temp falls below 63°F go to TEMP PKG LOW.
10. Normal Helium operating pressure: 177 psia - 185 psia. In addition to HELIUM MANIFOLD PRESSURES MSFN can read out FUEL MANIFOLD PRESSURES on all quads and OXIDIZER MANIFOLD PRESSURES on quads A&D.
11. RCS SELECTOR sw should be left in the affected quad position after every system status checks.
12. Firing jets at pressures lower than 100 psia may cause engine wall burn-through due to inadequate film cooling. Refer to S/M RCS 2 (S/M RCS PRESS He LOW or DECREASING) Reactivation of the quad should only be accomplished in an emergency.
13. Burst disks receptive at 220 - 236 psia. Relief valves open at 225 -248 psia and reseal at about 220 psia. Some loss of helium is to be expected throughout these ranges.
14. If indicator failed, S/M RCS A(B,C,D) light will not be illumated. If sensor failed light will be illuminated.

SYSTEM	RCS-2
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REMARKS

15. Quad is fully functional on redundant regulator assembly. If pressure was between 185 - 194 psia the primary regulator has failed and the secondary regulator was controlling Redundancy in the affected leg lost and should be used only as a last resort in case of failure closed in the other leg. If second set of regulators fail cycle S/M RCS HELIUM 1 or 2 sw to maintain adequate manifold pressure.

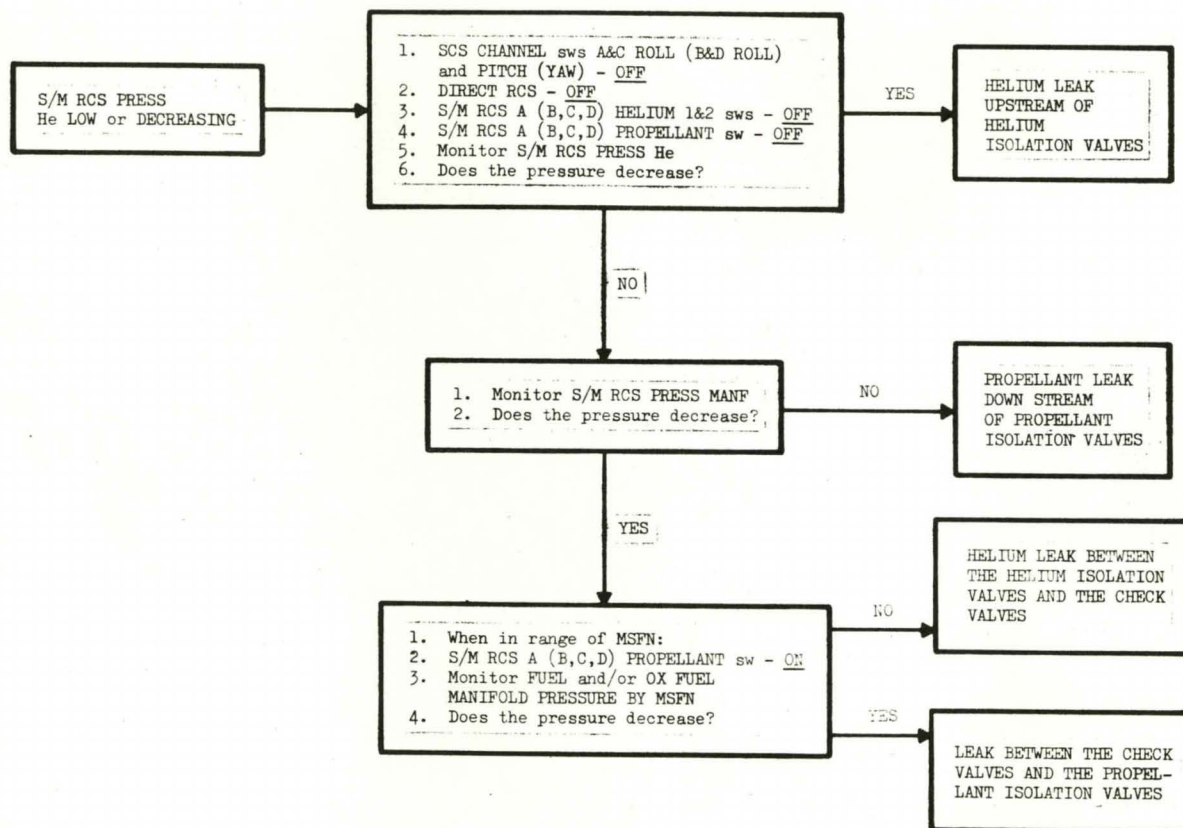
16. Pressure will decrease with use of the quad and the light (if on) will extinguish when pressure drops below 215 psia.

Quad is fully functional on redundant regulator assembly. If pressure was between 185 - 194 psia the primary regulator has failed and the secondary regulator was controlling Redundancy in the affected leg lost and should be used only as a last resort in case of failure closed in the other leg. If second set of regulators fail cycle S/M RCS HELIUM 1 or 2 sw to maintain adequate manifold pressure.

SYSTEM	RCS-2
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PROCEDURES

REMARKS



SYSTEM	RCS-3
DATE	FEB. 16, 1967
S/C	012

PROCEDURES ENTRY SHEET

SECTION 9.1.4

EPS MALFUNCTION PROCEDURES

<u>SYMPTOMS</u>	<u>NO.</u>	<u>STEP</u>	<u>PAGE</u>
<u>CRYOGENICS</u>			
O ₂ (H ₂) PRESS LIGHT ILLUMINATES	1	1	2
O ₂ (H ₂) TANK 1 (AND/OR 2) PRESSURE LOW	1	2	2
O ₂ (H ₂) TANK 1 (AND/OR 2) PRESSURE HIGH	1	20	6
O ₂ (H ₂) TANK 1 (AND/OR 2) PRESSURE HIGH	1	20	6
<u>FUEL CELLS</u>			
F/C 1 (2 OR 3) LIGHT ILLUMINATES	1	1	10
FUEL CELL MODULE TEMP CON EXH HIGH	1a	1.00	11
FUEL CELL MODULE TEMP CONT EXH LOW	1b	2.00	14
FUEL CELL 1 (2 or 3) CIR & SEP MOTORS (AC) C/B OPEN	1c	3.00	16
FUEL CELL FLOW - O ₂ (H ₂) - HIGH	1d	4.00	17
FUEL CELL FLOW - O ₂ (H ₂) - LOW	1e	5.00	18
F/C 1 (2 OR 3) PH - HIGH - FLAG STRIPED	1f	6.00	20
O ₂ REG OUT PRESS HIGH - FLAG STRIPED	1g	7.00	22
H ₂ REG OUT PRESS HIGH - FLAG STRIPED	1h	8.00	24
O ₂ & H ₂ REG OUT PRESS - HIGH OR			
O ₂ & H ₂ & N ₂ REG OUT PRESS HIGH	1i	9.00	25
F/C 1 (2 or 3) RAD OUT TEMP - LOW	1j.	10.00	26
FUEL CELL 1 (2 OR 3) MODULE SKIN TEMP LOW (<375°F)	1k	11.00	27
FUEL CELL 1 (2 or 3) MODULE SKIN TEMP HIGH (>450°F)	1l	12.00	29

PROCEDURES ENTRY SHEET

(CONTINUED)

<u>SYMPTOMS</u>	<u>NO.</u>	<u>STEP</u>	<u>PAGE</u>
<u>POWER DISTRIBUTION</u>			
MN BUS A (B) UNDERVOLT LIGHT-ON DC VOLTS >26V	1	1	30
DC VOLTS METER INDICATES PYRO BATTERY A(B) BELOW 35 VOLTS	2	1	31
BATTERY CHGR OUTPUT CURRENT DROPS TO ZERO & CIRCUIT BREAKERS BATTERY CHARGER MN A&B OPEN	3	1	32
BATT CHGR OUTPUT CURRENT ZERO (IN ALL SWITCH POSITION)	4	1	33
DC INDICATORS - BAT BUS A(B), DC VOLTS 27-30 & DC AMPS >ZERO WITH BUS SWS OFF	5	1	34
BATT CHGR VOLTAGE 40 VDC AND CURRENT ZERO WHEN CHARGING BATTERY A(B,C)	6	1	36
INV 1 (2 or 3) TEMP $\geq 190^{\circ}\text{F}$ (MSFN MONITORING CAPABILITY)	7	1	37
AC BUS FAIL LIGHT ILLUMINATED	8	1	40
AC BUS FAIL LIGHT & AC BUS 1 (2) OVERLOAD LIGHT ILLUMINATED	9	1	42
AC BUS 1 & 2 FREQUENCY INDICATES <393 CPS OR >407 CPS (SINGLE INVERTER OPERATION)	10	1	45
AC BUS FAIL LIGHT ILLUMINATED & AC BUS 1 (2) VOLTAGE <90v (DUAL INVERTER)	11	1	46
AC BUS FAIL LIGHT ON AFTER AC INVERTER 2 (1) IS APPLIED TO AC BUS 2(1)	12	1	47
MN BUS A & B UNDERVOLT LIGHT, AC BUS 1 & 2, & F/C BUS DISCONNECT LIGHTS ILLUMINATE (DUAL INVERTER CONFIGURATION)	13	1	49
MN BUS A&B UNDERVOLT LIGHT, AC BUS 1&2 & F/C BUS DISCONNECT LIGHTS ILLUMINATE (SINGLE INVERTER CONFIGURATION)	14	1	50

AC BUS 1 & 2
FREQ INDICATES
393 CPS or 407 cps
single INV
OPERATION

1. PHASE LOCK Sw-ON
2. Verify INV PHASE
SYNC PWR C/B'S-
OPEN
3. Monitor frequency

freq = 393 to 407 cps

freq = 393 or 407

Replace INV 1(2)
with INV 2(1)

CTE
Malfunction

1. PHASE LOCK Sw-OFF
2. AC BUS 1&2 RESET-OFF
3. AC INV 2(1)-MN B(A)-ON
4. AC INV 1(2)-AC BUS 1&2-OFF
5. AC INV 1(2) MN A(B)-OFF
6. AC INV 2(1)-AC BUS 1 & 2 - ON
7. AC BUS 1&2 RESET-ON

Monitor:
AC FREQ

freq = 400 cps

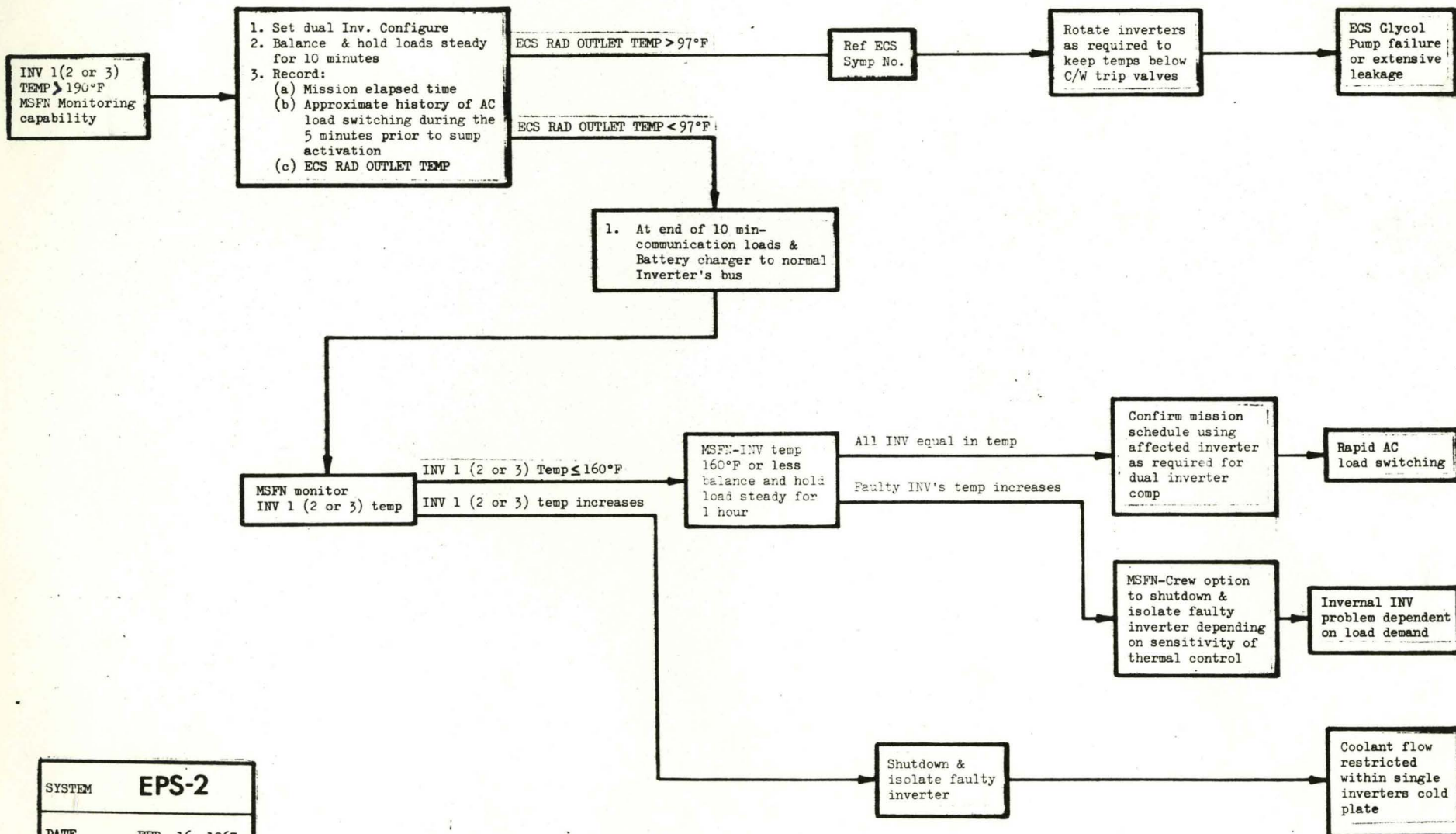
freq 393 or 407 cps

Inverter 1(2)
oscillator failure

MSFN-closely
monitor
frequency

Frequency
meter failure

SYSTEM	EPS-1
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SYSTEM	EPS-2
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PROCEDURES ENTRY SHEET

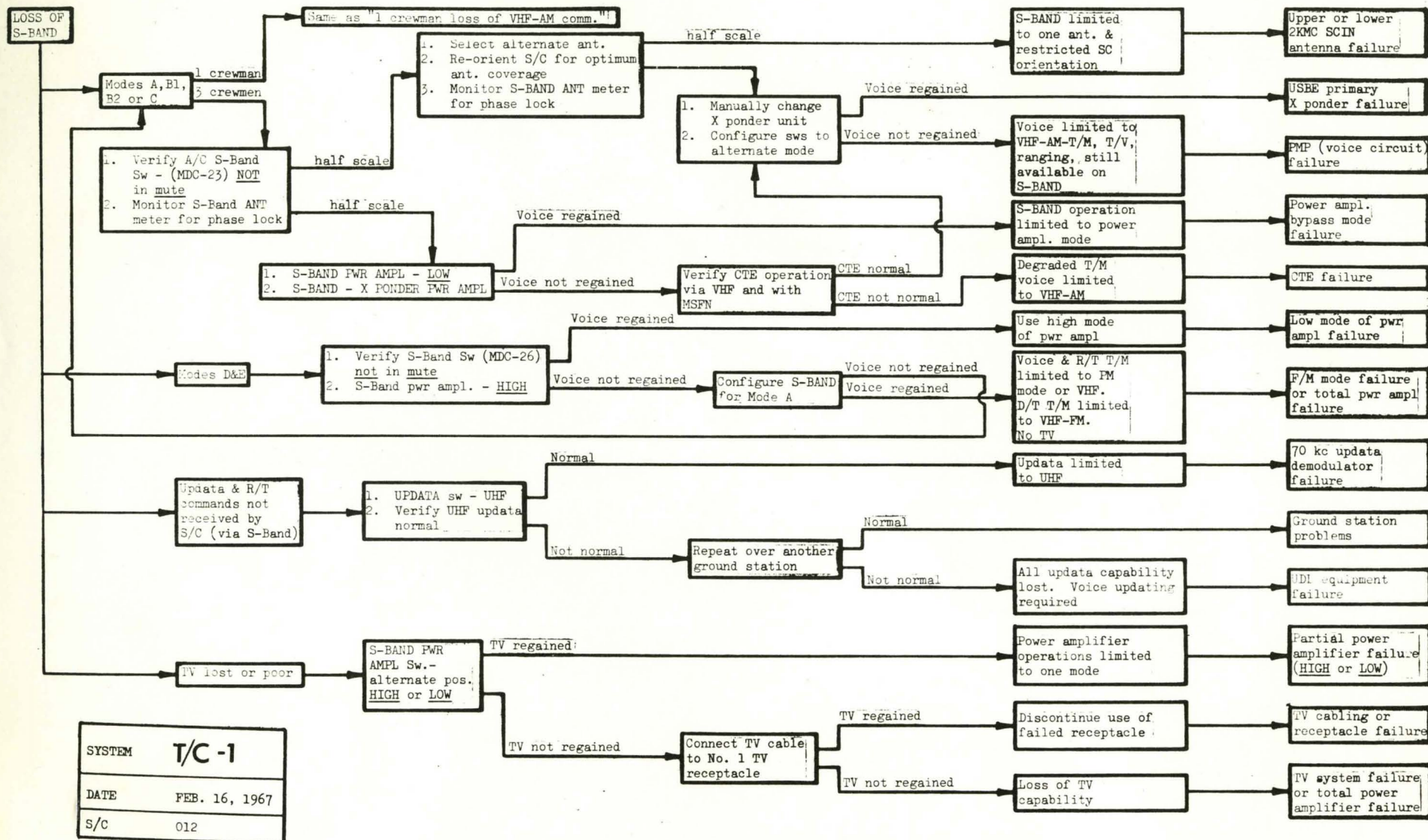
SECTION 9.1.5

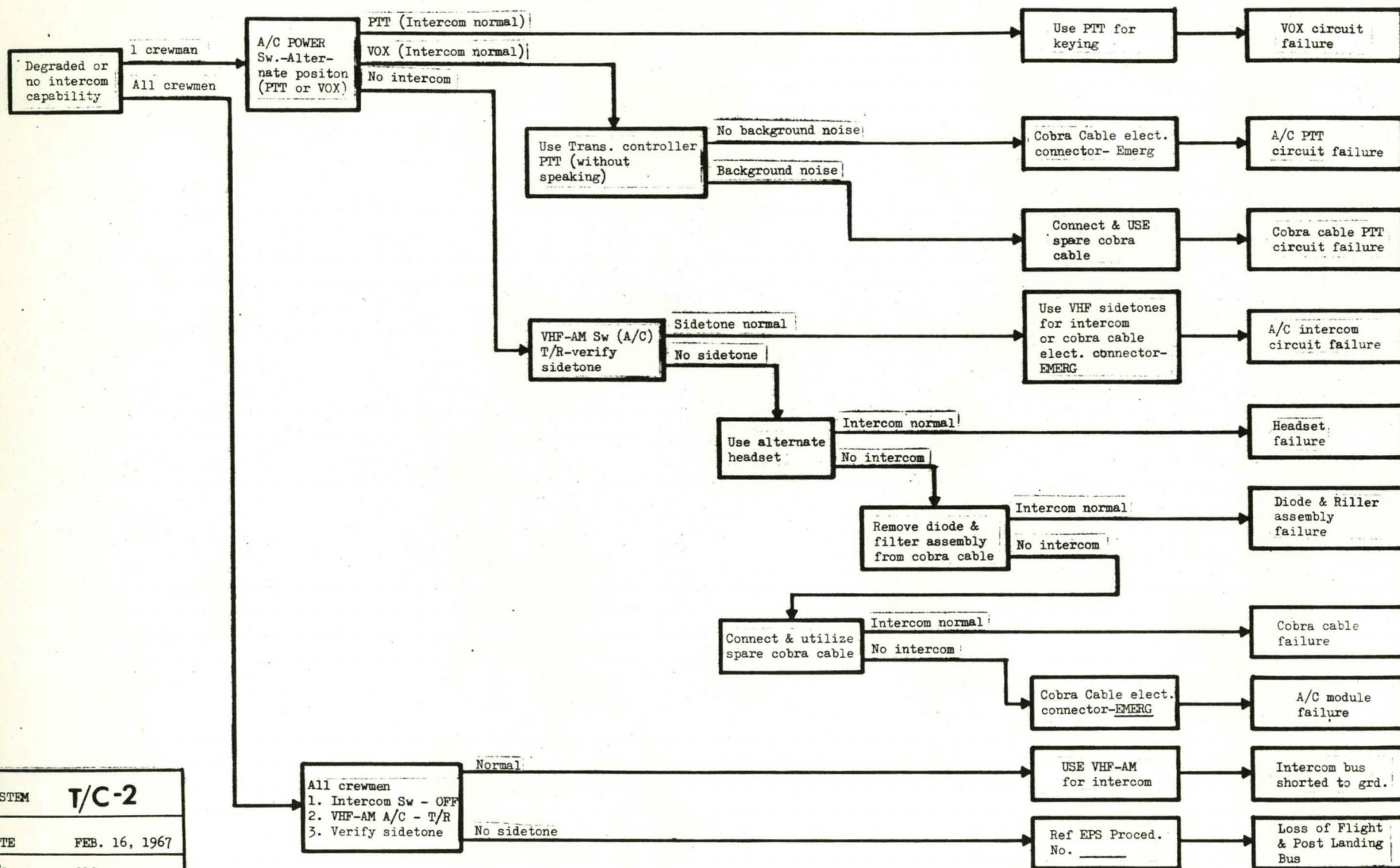
TELECOMMUNICATIONS MALFUNCTION PROCEDURES

SYMPTOMS	SYMPTOM NUMBER	STEP	PAGE
ONE CREWMAN HAS DEGRADED OR NO INTERCOM CAPABILITY	1	1	2
ALL CREWMEN HAVE DEGRADED OR NO INTERCOM CAPABILITY	2	1	4
CONTINUOUS BACKGROUND NOISE IN ONE OR MORE CREWMENS' HEADSET	3	1	4
ONE CREWMAN LOSS OF EITHER OF THE FOLLOWING TELECOMMUNICATIONS: VHF-AM OR S- BAND	4	1	6
ALL CREWMEN LOSE VHF-AM OPERATION (IN-FLIGHT)	5	1	7
ALL CREWMEN LOSE USBE VOICE OPERATION (MODES A,B1,B2,OR C)	6	1	8
ALL CREWMEN LOSE USBE VOICE OPERATION (MODES D OR E)	7	1	10
MSFN REPORTS VHF-FM TELEMETRY POOR OR LOST	8	1	11
UHF UPDATA AND REAL-TIME COMMANDS NOT RECEIVED BY S/C	9	1	12
S-BAND UPDATA AND REAL-TIME COMMANDS NOT RECEIVED BY S/C (S-BAND VOICE NORMAL)	10	1	14
MSFN REPORTS PARTIAL OR COMPLETE LOSS OF C-BAND TRACKING	11	1	14
MSFN REPORTS TV RECEPTION LOST (OR POOR) S-BAND VOICE & DATA NORMAL)	12	1	15 .
NO VOICE RECORD FLAG INDICATION WHEN ATTEMPTING VOICE RECORDING (INTERCOM NORMAL)	13	1	15
VHF-AM POOR OR LOST AFTER SPLASHDOWN	14	1	17
HF VOICE POOR OR LOST AFTER SPLASHDOWN	15	1	18
MSFN REPORTS LOSS OF VHF-FM DATA AND C-BAND RANGING (VHF-AM AND S-BAND NORMAL)	16	1	19
MSFN REPORTS VHF-FM AND S-BAND PLAYBACK TIM POOR OR LOST	16	1	19

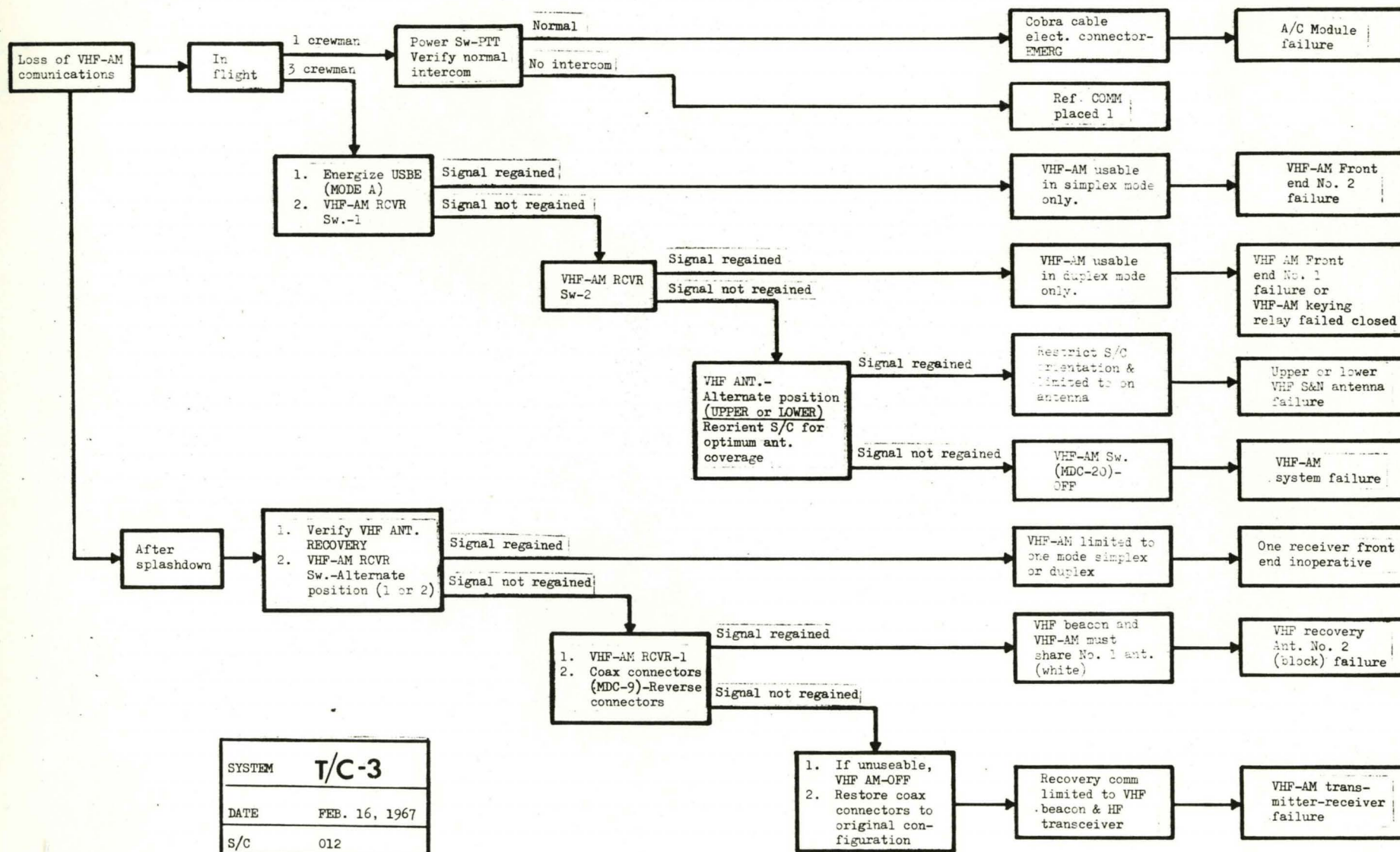
SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE	
1. One crewman has degraded or no intercom capability.	1	Audio Center (A/C) POWER sw - Alternate position - (<u>VOX</u> or <u>PTT</u>)				
		(a) Intercom normal - - After switching to PTT - After switching to VOX	→	(1a) Crewman limited to PTT mode of keying. Loss of "hot mike" capability.	(1a) VOX circuit failure.	
		2				
		3				
	2	Key intercom using translational controller PTT button (without speaking.)		(2) This step can be accomplished only by the CP and SP. P should go directly to step 6.		
		(a) No background noise	→	(2a) Crewman limited to VOX mode of keying. Loss of VHF-AM and S-Band voice capability.	(2a) A/C PTT circuit failure.	
		(b) Background noise present	→		(2b) Cobra cable PTT circuit failure.	
	3	VHF-AM sw - (A/C) - <u>T/R</u> , verify VHF sidetone.		(3) VHF sidetone can be verified regardless of VHF-AM (MDC-20) switch position.		
		(a) Sidetone normal	→		(3a) A/C intercom circuit failure.	
		(b) No sidetone				

PREPARED BY: <i>A. Brooks</i>	FLIGHT CREW SUPPORT DIVISION	Telecommunications System Malfunction Procedures	APOLLO OPERATIONS HANDBOOK	
<i>John</i>	DATE: Jan. 27, 1967		S/C 012	REV FINAL
<i>Ed. Rike</i>			SECTION 9.1.5	PAGE 2





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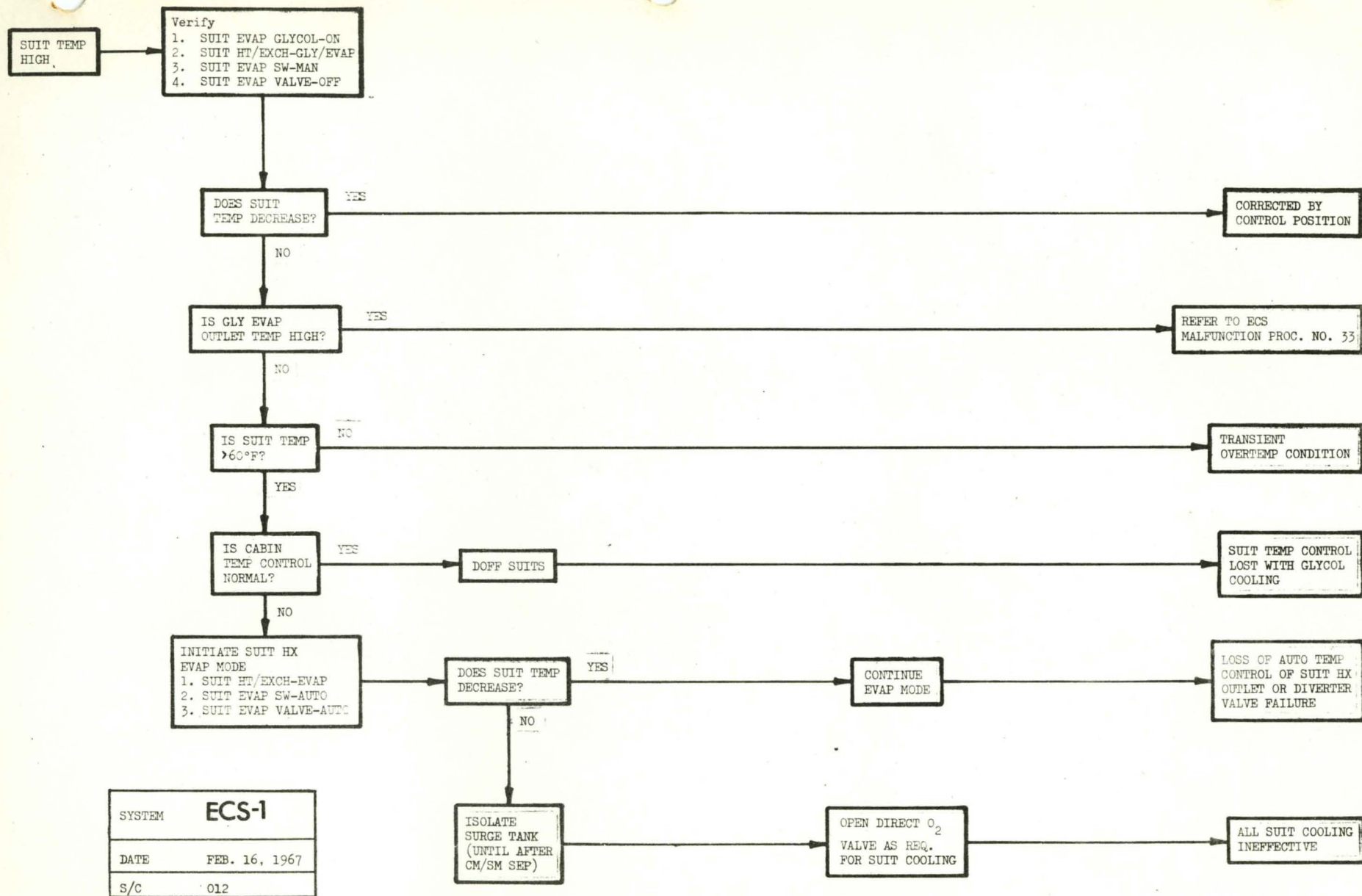


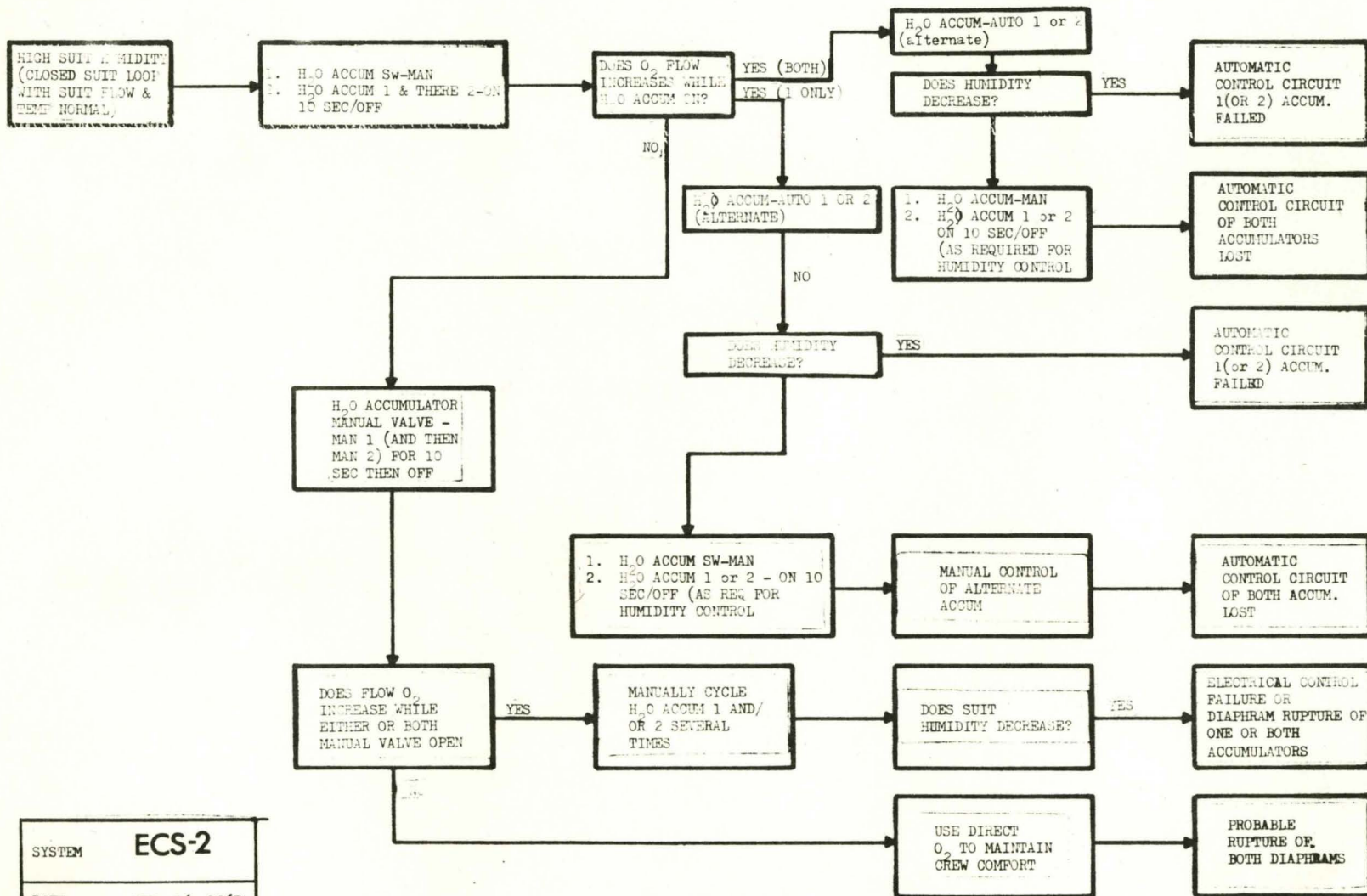
PROCEDURES ENTRY SHEET

SECTION 9.1.6
ECS MALFUNCTION PROCEDURES

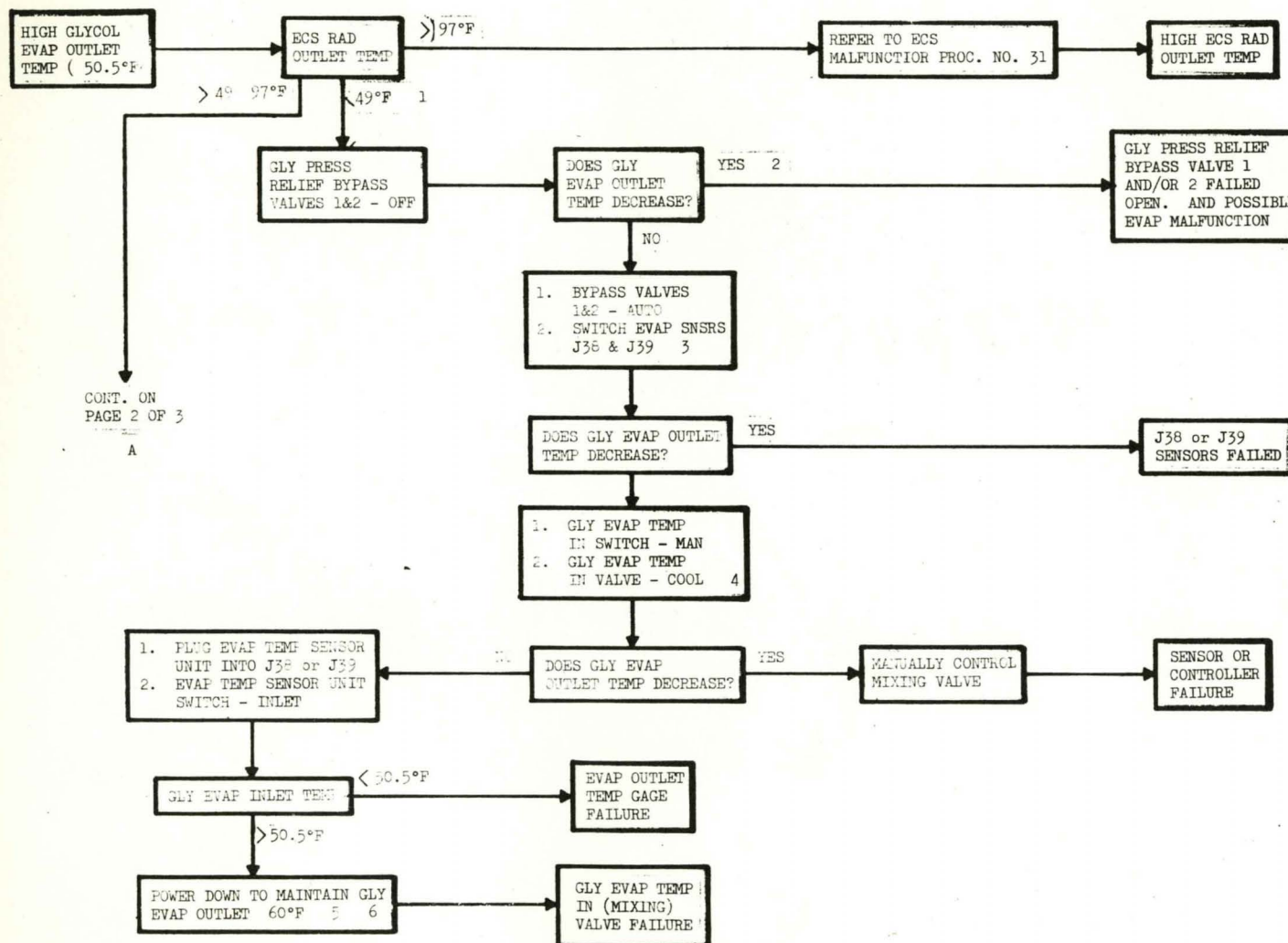
SYMPTOM	SYMPTOM NUMBER	STEP	PAGE
<u>OXYGEN SUPPLY SUBSYSTEM</u>			
O ₂ FLOW Hi C&W Lite - ON	1	1	3
FLOW O ₂ indicator - HIGH	1	4	3
FLOW O ₂ indicator - LOW	2	1	11
SURGE TANK PRESSURE HIGH	3	1	13
SURGE TANK PRESSURE LOW	4	1	14
100 psig O ₂ circuit pressure HIGH	5	1	15
100 psig O ₂ circuit pressure LOW	6	1	16
20 psig O ₂ circuit pressure HIGH	7	1	17
20 psig O ₂ circuit pressure LOW	8	1	18
<u>PRESSURE SUIT CIRCUIT SUBSYSTEM</u>			
CO ₂ PP Hi C&W Lite - ON	11	1	20
PART PRESS CO ₂ indicator - HIGH	11	2	20
LITHIUM HYDROXIDE CARTRIDGE SEIZURE	12	1	24
Ballooned P.G.A.	13	1	25
Clinging P.G.A.	14	1	28
LOW SUIT FLOW	15	1	31
Suit temperature HIGH	16	1	34
Suit humidity HIGH	17	1	36
<u>CABIN PRESS & TEMP CONTROL SUBSYSTEM</u>			
CABIN PRESS - HIGH	21	1	39
CABIN PRESS - LOW	22	1	45
CABIN TEMP - HIGH	23	1	47
CABIN TEMP - LOW	24	1	48

Cabin humidity HIGH	25	1	49
<u>WATER/GLYCOL COOLANT SUBSYSTEM</u>			
GLYCOL TEMP Low C&W Lite - ON	31	1	50
ECS RAD OUTLET TEMP - LOW	31	2	50
ECS RADIATOR TEMP 1 or 2 - LOW	31	21	53
ECS RAD OUTLET TEMP - HIGH	32	1	55
Glycol evaporator outlet temp - HIGH	33	1	56
Glycol evaporator outlet temp - LOW	34	1	61
PRESS GLY DISCH - LOW	37	1	64
GLY ACCUM QUANTITY - LOW	37	2	64
GLY ACCUM QUANTITY - HIGH	39	1	68
<u>WATER SUPPLY SUBSYSTEM</u>			
Potable HOT H ₂ O temperature LOW	41	1	69
H ₂ O transfer failure	42	1	70
WATER quantity decrease rate HIGH	43	1	71
Gas leakage into H ₂ O subsystem	44	1	72
Potable and Waste water pressure HIGH	45	1	74
<u>WASTE MANAGEMENT SUBSYSTEM</u>			
Unable to dump urine	51	1	76
Low vacuum suction	52	1	77
Fecal canister vacuum LOW	53	1	78
<u>POST LANDING SUBSYSTEM</u>			
Inadequate ventilation after landing	61	1	78
Water inflow	62	1	81





SYSTEM	ECS-2
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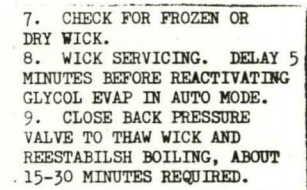


CONT. ON
PAGE 2 OF 3

A

1. EVAPORATOR OPERATION NOT REQUIRED.
2. REFER TO STEP 15 TO VERIFY EVAP OPERATION.
3. WHILE SWITCHING J38 - J39, ELECTRICALLY DEACTIVATE EVAP & MIXING VALVE.
4. SET CAREFULLY TO KEEP GLY EVAP OUTLET TEMP 45 + 3°F.
5. WHILE IN MIXING MODE.
6. TEMP 50.5 60°F INDICATES A MALFUNCTION, BUT ARE ACCEPTABLE FOR LIMITED OPERATION. IF UNABLE TO REDUCE TEMP 60°F OR POWER UP REQUIRED, MANUALLY OPERATE EVAP TO CONTROL EVAP OUTLET TEMP.

SYSTEM	ECS-3
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SYSTEM	ECS-3
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C.
CONT. FROM
PAGE 2 OF 3

B.
CONT. FROM
PAGE 2 OF 3

1. EVAP TEMP SENSOR
UNIT - NULL
2. CYCLE GLY EVAP
H₂O SWITCH. 10

DOES GLY EVAP
OUTLET TEMP
DECR 43°F?

YES 11

GLY EVAP CONTROLLER
(WATER SECT) FAILURE

NO

1. EVAP H₂O VALVE - OFF
2. CYCLE GLY EVAP
WATER CONTROL BYPASS
VALVE

DOES GLY EVAP
OUTLET TEMP
DECR 43°F?

YES 12

EVAP WATER VALVE
ELECTRICAL FAILURE

NO

POWER DOWN TO
MAINTAIN EVAP
OUTLET TEMP 60°F

EVAP FAILURE

1. CYCLE STEAM/URINE
DUCT HTR CB'S
MN A & MN B
2. GLY EVAP STEAM PRESS
SWITCH - AUTO
3. GLY EVAP H₂O SWITCH - OFF
4. ORIENT S/C WITH STEAM
DUCT OUTLET TO HEAT SOURCE

DOES GLY EVAP OUTLET
TEMP DECREASE? 13

YES

GLY EVAP H₂O
SWITCH - AUTO

DUCT CLEAR AND
BOILING RESUMED

NO

POWER DOWN TO MAINTAIN
EVAP OUTLET TEMP 60°F

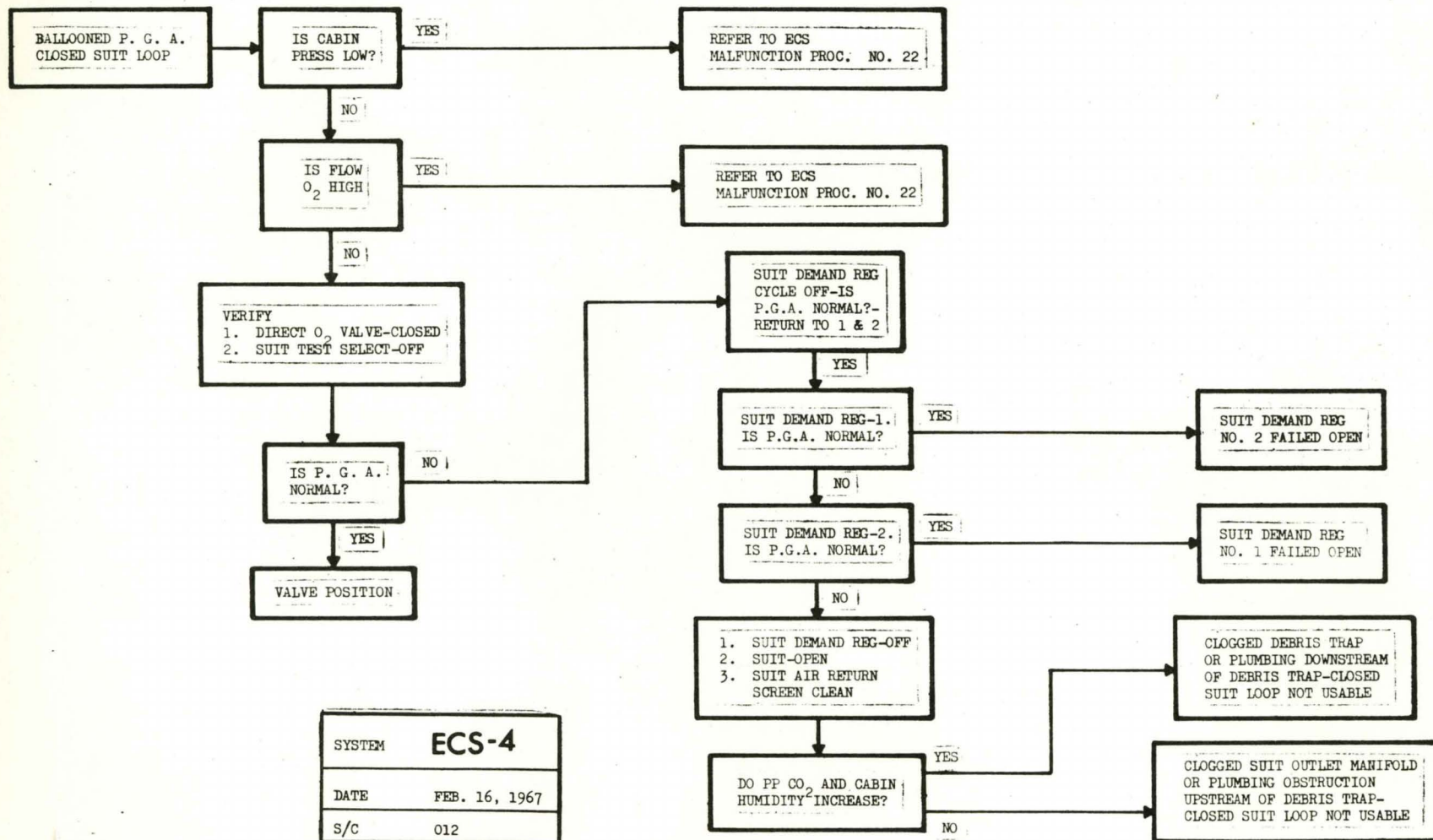
14

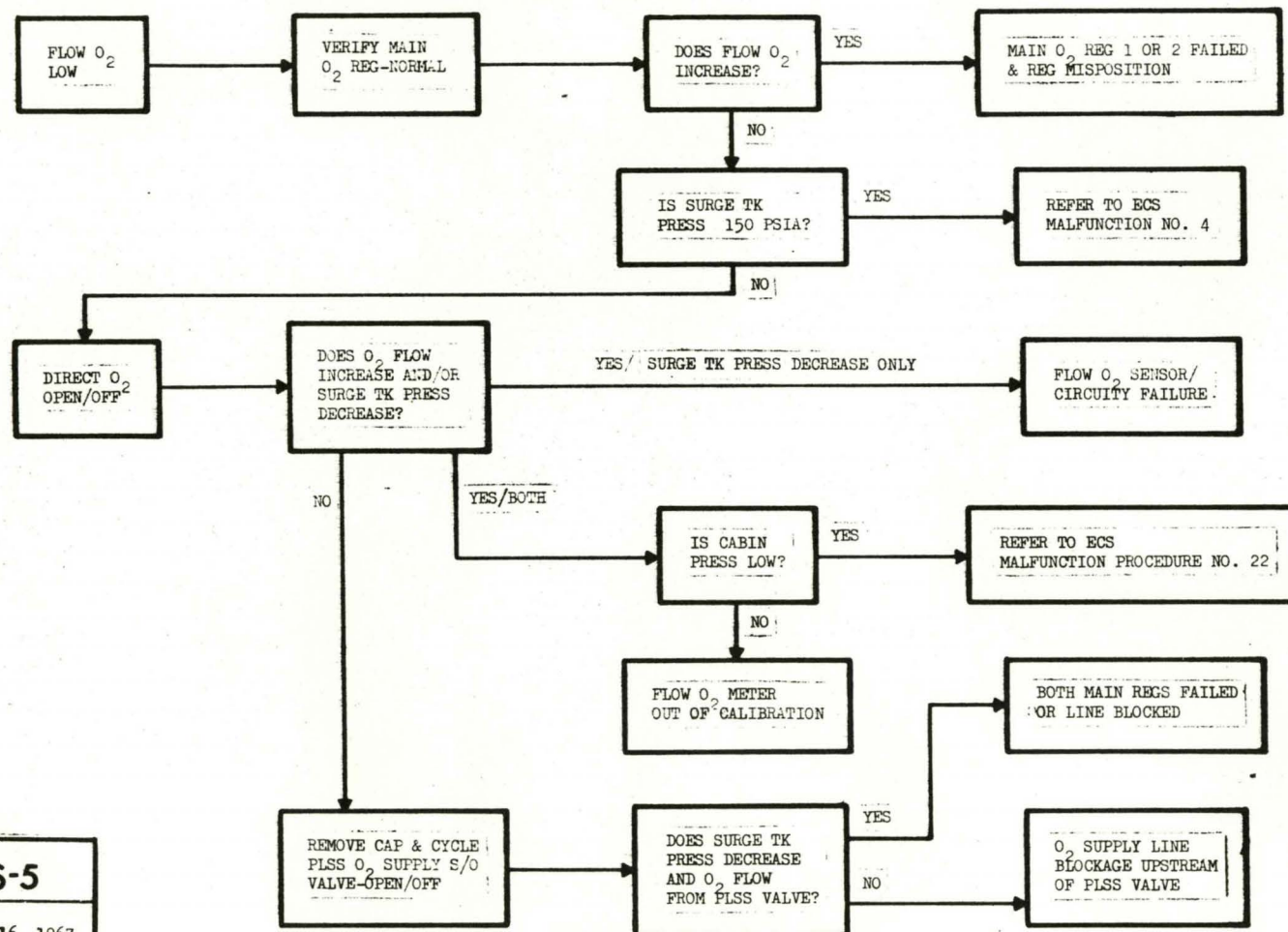
STEAM DUCT
STILL BLOCKED

REMARKS

10. MANUAL CONTROL OF
WATER TO WICK.
11. MANUAL CONTROL
OF WATER REQUIRED.
12. MANUAL BYPASS OF
WATER REQUIRED.
13. EXCESSIVE TIME
DELAY MAY BE REQUIRED.
14. CABIN PRESSURE
RELIEF MAY NOT BE
POSSIBLE THROUGH
STEAM DUCT.

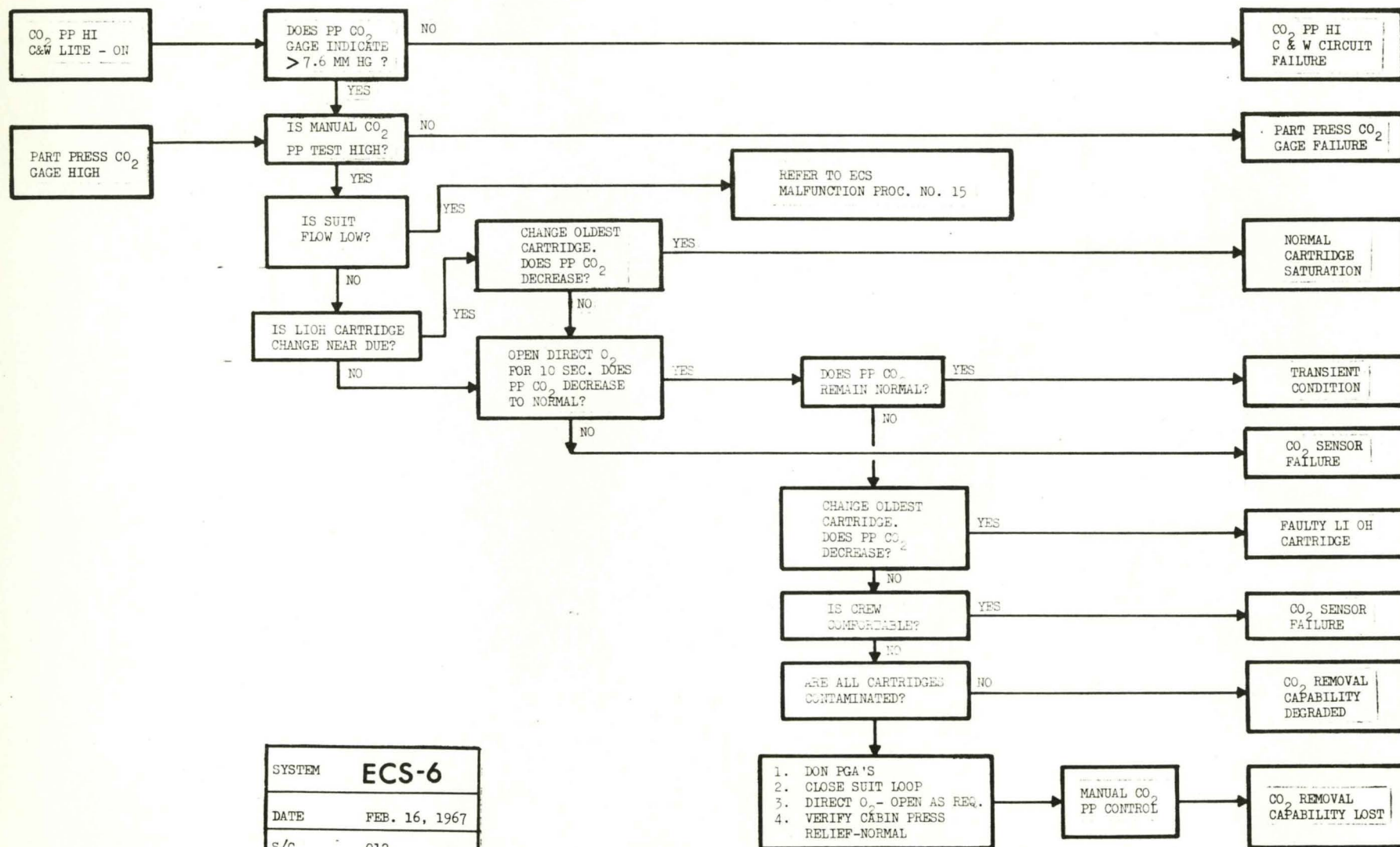
SYSTEM	ECS-3
DATE	FEB. 16, 1967
S/C	012





SYSTEM	ECS-5
DATE	FEB. 16, 1967
S/C	012

D.O. Evans 11/27/67



PROCEDURES ENTRY SHEET

SECTION 9.1.7 SEQUENTIAL MALFUNCTION PROCEDURES

SYMPTOM	SYMPTOM NUMBER	STEP	PAGE
LIFT - OFF lightout & DET's not counting	1	1	2
NO AUTO ABORT light - ON	2	1	2
LET fails to JETT	3	1	2
SIVB fails to shutdown	4	1	5
SLA seperation not sensed	5	1	5
SLA seperation sensed but L/V ENGINE #1 light ON	5b	1	6
C/M - S/M fault to seperate	6	1	6
APEX COVER fails to automatically jettison	7	1	7
One or both drogue chutes fail to deploy automatically	8	1	7
Drogue chute fails to release or pilot chute fails to deploy automatically	9	1	8
One or more pilot chutes fail to deploy automatically	10	1	8
One or two drogue chutes fail to release	11	1	9
Main chutes fail to release	12	1	9
C/M in stable II position with no audible sound of 1 and 2 compressor	13	1	10
C/M in stable II position and compressors are running	14	1	10
Audible sound of two compressors but not in stable I condition in 10 min.	14a	2	11
Audible sound of one compressor but not in stable I condition in 15 min.	14b	1	12

SYMPTOM	STEP	PROCEDURE	NEXT STEP	REMARKS	FAILURE
1. LIFT OFF light - not illuminated & DET's - not counting	1	LIFT OFF/NO AUTO ABORT light - <u>press</u> .	2	(1) EDS auto abort circuit will be activated from alternate source.	(1 & 2) Neither of the redundant lift off signals received from SIVB IU - therefore EDS auto abort circuit is inactive.
	2	START/STOP sw - <u>START</u> .		(2) DET's will start counting.	
NOTE: 61 sec TD's will never be activated (no effect on mission since OX DUMP AUTO switch will be used as back-up at 61 sec elapsed time from lift off). LIFT/OFF light will remain extinguished.					
2. NO AUTO ABORT light - illuminates at lift off	1	LIFT OFF/NO AUTO ABORT light - <u>press</u> .			(1) One or both of the redundant EDS enable circuits is not activated.
		(a) NO AUTO ABORT light - <u>extinguishes</u> .		(1a) EDS auto abort circuit is fully enabled.	
		(b) NO AUTO ABORT light - remains <u>illuminated</u> .		(1b) One or both of the EDS auto abort circuits is inactive & any subsequent abort should be initiated manually.	
3. Launch escape tower fails to jettison when LES MODE/TWR JETT SPS MODE switches 1 & 2 are placed to <u>TWR JETT SPS MODE</u> .					
a. Firing of frangible nuts only (audible)	1	LES MOTOR FIRE sw - <u>press</u> .			(1) TJM failed to operate.
		(a) Tower jettisons.		(1a) Tower jettisoned with LE motor.	
PREPARED BY: <u>R. Benson</u>		FLIGHT CREW SUPPORT DIVISION		APOLLO OPERATIONS HANDBOOK	
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				SECTION 9.1.7	PAGE 2