

Lovell

G&C  
DISPLAYS

PNGS

AGS

CES

DPS

APS

RCS

APOLLO 13	
LM MALFUNCTION PROCEDURES	
PART NUMBER	S/N
SKB32100076-386	

FINAL

*Sam Lovell*  
~~Sam Lovell~~  
Used during Apollo 13  
moser training - This  
training manual is from my  
personal collection  
3/16/70

3/16/70

1850.

APOLLO 13

LM MALFUNCTION PROCEDURES  
REVISION  
(FINAL)

MARCH 16, 1970

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Distribution of this document is controlled by Mr. J. W. O'Neill, Chief, Flight Planning Branch, Flight Crew Support Division.

ST. LOUIS

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**APOLLO FLIGHT DATA FILE**

**LM MALFUNCTION PROCEDURES**

**(FINAL)**

REVISION 3/16/70

**LIST OF EFFECTIVE PAGES**

\* INDICATES CURRENT CHANGE

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This Revision is a complete reprint and includes all changes to date.



LM MALFUNCTION PROCEDURES

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G & C DISPLAYS MALFUNCTION INDEX

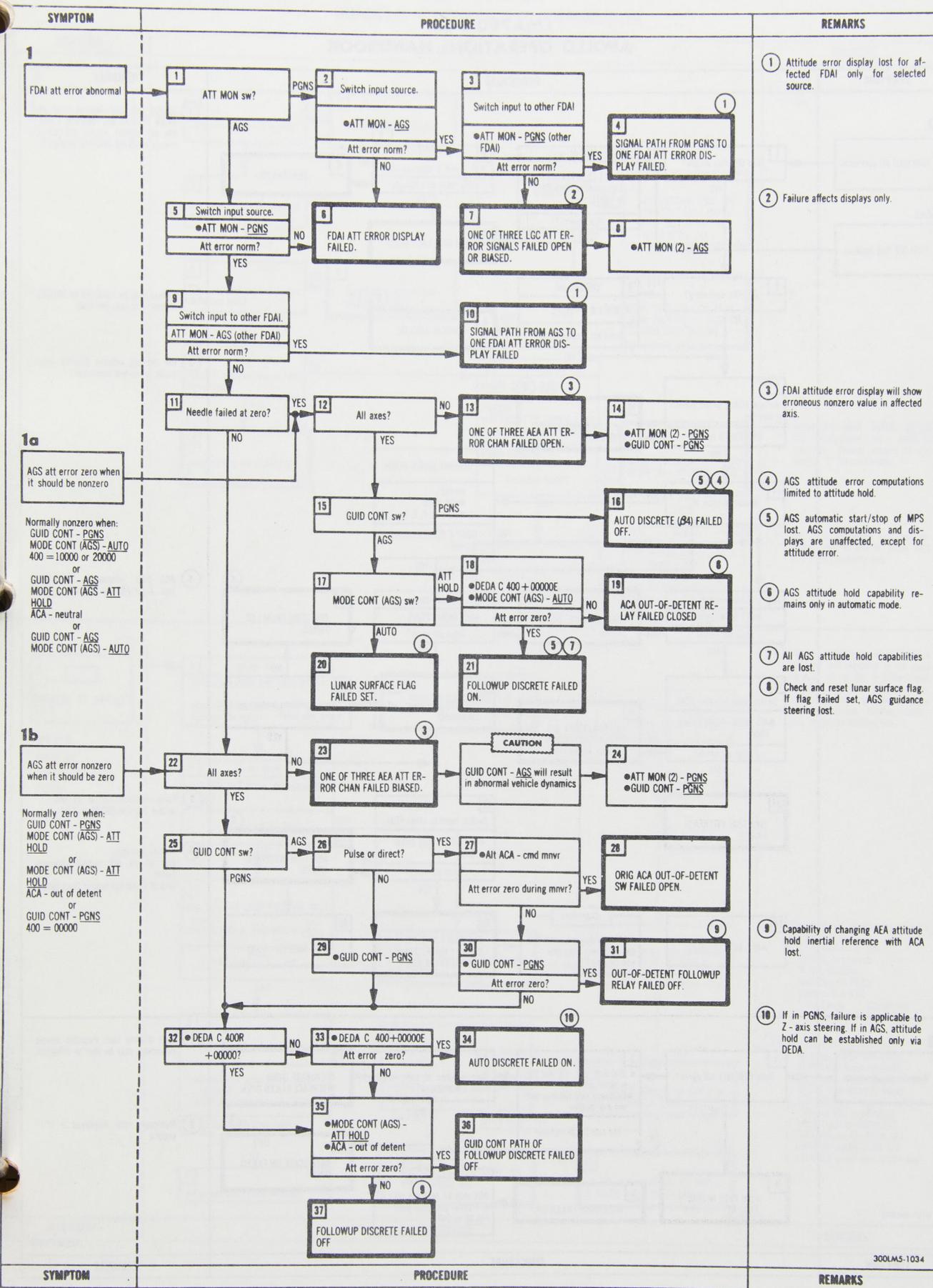
- 1 FDAI ATT ERR ABNORMAL
- 1a AGS ATT ERROR ZERO
- 1b AGS ATT ERROR NON ZERO
- 2 FDAI TOTAL ATT ABNORMAL
- 2a FDAI OFF FLAG APPEARS
- 3 RATE DISPLAY ABNORMAL
- 4 RATE GYRO TEST FAILS

5



SOURCE MOCATA  
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LM MALFUNCTION PROCEDURES



1 THRU  
3

4 THRU  
5

**LMA790-3-LM**  
**APOLLO OPERATIONS HANDBOOK**

SYMPOTM	PROCEDURE	REMARKS
2 FDAI total att abnormal	<p>1 FDAI OFF flag visible?</p> <p>YES → 2 ORDEAL pn1 • FDAI 1 (2) affected FDAI - alt position (ORB RATE or INRTL) FDAI moves? YES → 5 FDAI OFF FLAG FAILED.</p> <p>NO → 3 Wait 1 min &amp; observe FDAI. FDAI total att changes? YES → 4 FDAI FAILED.</p>	(1) Orbital rate and inertial total attitude displays are identical 1 minute per orbital period. Waiting 1 minute resolves possible ambiguity.
2a FDAI OFF flag appears	<p>6 ORDEAL operating?</p> <p>YES → 7 ORDEAL pn1 • FDAI 1 &amp; 2-INRTL Total att display norm? YES → 8 ORDEAL FAILURE.</p> <p>NO → 9 • Place FDAI's on alt inertial sources. Both FDAI's agree? YES → 10 JTO OR MANUAL MNVR PROBLEM</p> <p>11 Abnormal total att? DON'T KNOW → 12 Compare gimbal angles. • V49E • V16 N20E • Mnv to 0, 0, 0.</p> <p>DON'T KNOW → 13 Switch input. • ATT MON - AGS Total att norm? YES → 17 Switch input to other FDAI. • ATT MON - PGNS (other FDAI) Total att norm? NO → 14 FDAI TOTAL ATT DISPLAY FAILED.</p> <p>15 Switch input. • ATT MON - PGNS Total att norm? YES → 16 CDU ZERO FROM LGC FAILED.</p> <p>16 CDU ZERO FROM LGC FAILED.</p> <p>17 Switch input to other FDAI. • ATT MON - PGNS (other FDAI) Total att norm? NO → 18 ONE FDAI TOTAL ATT DISPLAY INTERCONNECT FAILURE FROM PGNS</p> <p>19 AGS/IMU alignment just completed? YES → 20 Orig symptom present in one axis only? NO → 22 Switch input to other FDAI. • ATT MON - AGS (other FDAI) Total att norm? YES → 23 AEA/FDAI INTERFACE FAILED.</p> <p>21 IMU/FDAI INTERFACE FAILED.</p> <p>24 • ATT MON (2)-AGS</p> <p>CAUTION FDAI that displays symptom can be driven from one source only.</p> <p>25 ONE FDAI TOTAL ATT DISPLAY INTERCONNECT FAILURE FROM AGS</p> <p>26 • ATT MON (2)-PGNS</p>	(2) Failure may be confined to ORDEAL resolvers to only one FDAI. (3) LM did not achieve desired automatic or manual maneuver. (4) AGS - IMU alignment capability lost. Align AGS by backup method. (5) Failure includes one of six IMU output lines or GASTA failure. (6) Failure includes: One of six AEA output channels failed. One of three AEA return lines failed.
3 Rate display abnormal	<p>1 Both FDAI rate ind agree?</p> <p>YES → 2 • Stabilize LM via out-the-window indication. • Compare rate needles with vehicle motion. Ind rate &gt; LM motion? YES → 6 RATE GYRO FAILED ON CAUTION AGS may be selected only if ATT CONT (affected axis) - PULSE or DIR</p> <p>NO → 3 Rate needles at zero when mnvr commanded? YES → 4 ATCA/RATE GYRO INTERFACE FAILED OPEN</p> <p>NO → 7 RATE SCALE SW FAILED OPEN.</p>	(1) Rate display lost. Possible needle movement may be due to vibration. (2) Maximum rate displayed > 5°/second. 300LMS-1019

**LMA790-3-LM  
APOLLO OPERATIONS HANDBOOK**

SYMPTOM	PROCEDURE	REMARKS
4  Rate gyro test fails	<pre> 1 Both FDAO rate ind agree? NO RATE NEEDLE FAILURE    YES 2 Any rate needle remains at zero? YES 3 Rate needles deflect in one direction only? YES GYRO TEST POS RT SW FAILED CLOSED.    NO 4 All rate needles peg in both directions? YES    NO RATE SCALE SW FAILED OFF. 5 Needles at zero? ALL TEST VOLTAGE LOST, OR GYRO TEST ROLL SW OR GYRO TEST POS RT SW FAILED OPEN.    ONE    TWO GYRO TEST ROLL SW FAILED INTO UNAFFECTED AXIS OR DOUBLE GYRO FAILURE. 6 Response norm? YES GYRO TEST ROLL SW FAILED OPEN IN AFFECTED AXIS.    NO 7 GUID CONT - AGS MODE CONT (AGS) - ATT HOLD    ATT CONT (3) - MODE CONT    ACA - cmd mnvr in axis    Monitor for smooth rate with damping. 8 ATT CONT (affected axis) - PULSE or DIR or GUID CONT - PGNS 9 10 Dynamic ck. 11 12 13 14 </pre>	<p>(1) Test all three axes in both directions.</p> <p>(2) Assumption: RATE SCALE - 25°/SEC, but switch failed open when test was run. Failure results in selection of 5°/second scale.</p> <p>(3) AGS rate command lost for affected axis. If roll or pitch, AGS DPS burn capability lost.</p>
5  RNG/RNG RT pwr/sig fail It  Light on if: Signal lost. A-C or d-c power to ind lost	<pre> 1 Ck for short. cb (11) FLT DISP: RNG/RNG RT or cb/AC BUS A: RNG/RNG RT - open &amp; cannot be reset? 2 RANGE &amp; RANGE RATE IND SHORTED. 3 Remove power to ind.    Other cb-open 4 Ck for open. cb (11) FLT DISP: RNG/RNG RT - open Pwr/sig fail It - off? 5 cb (11) FLT DISP: RNG/RNG RT - close cb/AC BUS A: RNG/RNG RT - open Pwr/sig fail It - off? 6 RANGE &amp; RANGE RATE IND FAILED DUE TO OPEN. 7 RR range &amp; range rate can be displayed on DSKY as backup to RANGE &amp; RANGE RATE ind. 8 Verify status of ind-driving source.    Radar - Ck xmt power signal strength    AEA - Ck operation via DEDA. Source operating normally? 9 Select alt display source (when operating). For which display source of pwr/sig fail It - off? 10 RR OUTPUT FAILED OR OPEN IN LINE TO RANGE &amp; RANGE RATE IND. 11 Correct source malfunction. 12 FAILURE BETWEEN MODE SEL SW &amp; RANGE IND 13 LR OR AGS OUTPUT TO RANGE &amp; RANGE RATE IND FAILED. </pre>	<p>(1) Light is normally on when power is supplied and indicator is not used by AGS, LR, or RR. If either input signal goes to zero, light goes on. Light may flash randomly if range rate is &lt;10 fps. Neither condition indicates malfunction.</p> <p>(2) RR range and range rate may be displayed if:  a. RR locked on to CSM.  b. P20 not in process.  c. R04 in process.  d. Monitor V16 N78:     R1 Range XXX.XX nm     R2 Range rate XXXX.X fps</p> <p>(3) Alternative display sources:  a. RR range, range rate -N78 (if R04 in process by V63E)  b. LGC range, range rate, θ - N54 (if R31 in process by V83E)  c. LGC (latitude, longitude, altitude - N43 (if P21 in process)  d. LM altitude (h) -DEDA 337  e. LM altitude rate -DEDA 367  f. LM-CSM range -DEDA 317  g. LM-CSM range rate -DEDA 440</p>

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LM MALFUNCTION PROCEDURES

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PNCS MALFUNCTION INDEX

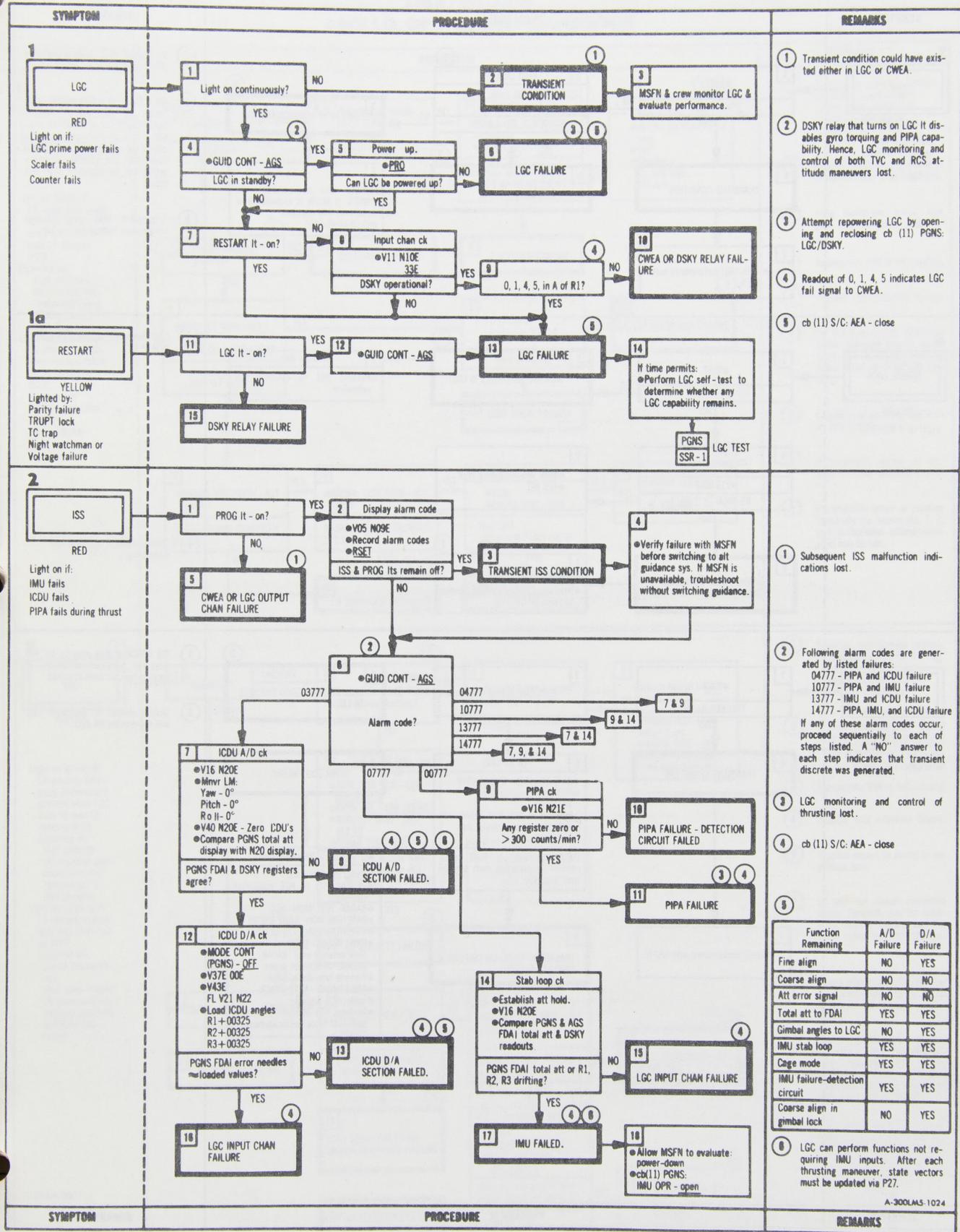
- 1      LGC
- 1a     RESTART
- 2     ISS
- 3     TEMP
- 4     GIMBAL LOCK
- 5     TRACKER
- 6     ALT
- 7     VEL
- 8     RNDZ RDR
- 8a    NOTRACK



SSR-1    LGC SELF TEST

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LM MALFUNCTION PROCEDURES

**LMA790-3-LM**  
**APOLLO OPERATIONS HANDBOOK**


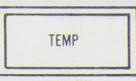
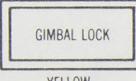
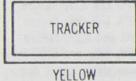
Function Remaining	A/D Failure	D/A Failure
Fine align	NO	YES
Coarse align	NO	NO
Att error signal	NO	NO
Total att to FDAO	YES	YES
Gimbal angles to LGC	NO	YES
IMU stab loop	YES	YES
Cage mode	YES	YES
IMU failure-detection circuit	YES	YES
Coarse align in gimbal lock	NO	YES

**5** LGC can perform functions not requiring IMU inputs. After each thrusting maneuver, state vectors must be updated via P27.

A-300LM-1024

REMARKS

**LMA790-3-LM  
APOLLO OPERATIONS HANDBOOK**

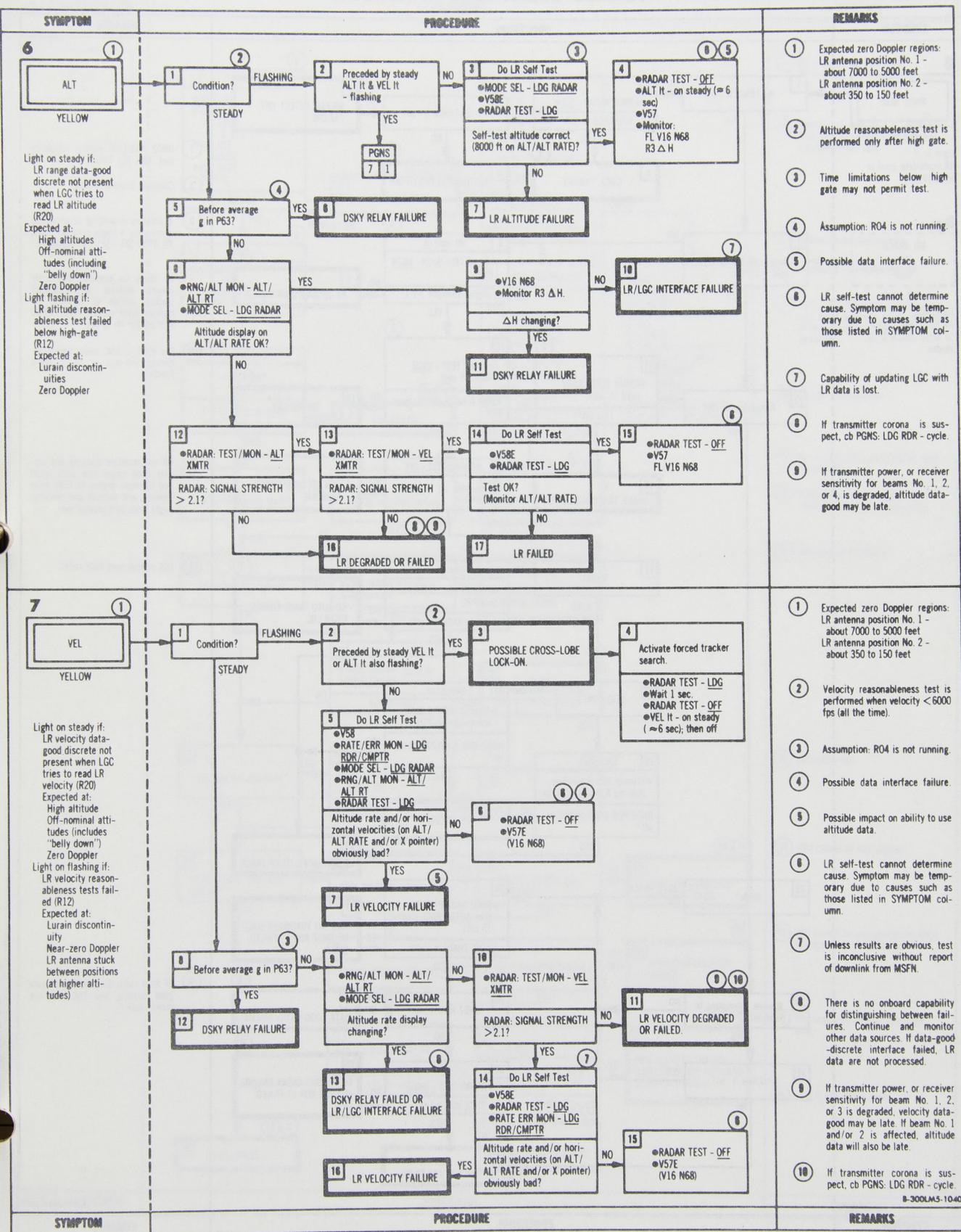
SYMPTOM	PROCEDURE	REMARKS
<b>3</b>   <b>TEMP</b> <b>YELLOW</b> Light on if IMU temp out of limits <126 F >134 F	<p>1 RSET TEMP lt-off?</p> <p>NO → 2 Input chan ck •VO1 N10E 30E 0, 1, 2, 3 in A of R1?</p> <p>YES → 4 TRANSIENT CONDITION</p> <p>2 NO → 3 IMU TEMP CONTROL FAILURE</p> <p>3 YES → 5 DSKY RELAY OR LGC OUTPUT CHAN FAILED.</p> <p>6 Verify IMU performance with MSFN. If MSFN is unavailable or confirms IMU unusable: •GUID CONT-AGS</p> <p>7 Verify IMU performance with MSFN.</p>	<p>1 R1 readout of 0, 1, 2, 3 indicates IMU temperature is within limits.</p> <p>2 GN &amp; CS performance will be unaffected by IMU out-of-tolerance temperature for at least 15 minutes. Critical maneuvers can be conducted within this time. IMU stab loop and velocity measurements will be degraded after this time.</p> <p>3 Subsequent IMU out-of-tolerance temperature indications are lost.</p>
<b>4</b>   <b>GIMBAL LOCK</b> <b>YELLOW</b> Light on if MGA > 70	<p>1 RSET NO ATT lt-on?</p> <p>NO → 2 INERTIAL REFERENCE IS LOST. •Perform P51 to establish att reference.</p> <p>YES → 4 Ck gimb angles. •V16 N20E R3 (MGA) <math>\geq \pm 70^\circ</math>?</p> <p>YES → 5 Mnvr to avoid gimbal lock. •KEY REL</p> <p>NO → 6 GIMBAL-LOCK DETECTION CIRCUIT FAILED.</p> <p>7 •KEY REL •Monitor DSKY-displayed angles to avoid gimbal lock.</p>	<p>1 LGC commands coarse align when MGA <math>\geq 85^\circ</math>.</p> <p>2 GIMBAL LOCK lt unusable for monitoring.</p>
<b>5</b>   <b>TRACKER</b> <b>YELLOW</b> Light on if data-good is lost or RR CDU fails while RR is under LGC control	<p>1 RSET TRACKER lt-off?</p> <p>NO → 2 PROGRAM ALARM CODE? 00521 → 3 LOSS OF DATA-GOOD DISCRETE TO LGC</p> <p>00515 → 5 Ck RR CDU. •RATE ERR MON-RNDZ RADAR •Perform RR coarse align V41 N72E Respond to V04 N12 option with 00002 (continuous designate). •V16 N72E DSKY registers &amp; FDAI error needles display input shaft &amp; trunnion angles?</p> <p>NO → 6 RR CDU FAILURE</p> <p>YES → 7 Verify performance with MSFN.</p> <p>8 TRACKER LT LOGIC OR CDU FAIL CIRCUIT FAILURE</p> <p>9 Manual RR acquisition. If under PGNS control: •Perform P25 or AGS acquisition steering. •RADAR TEST/MON-AOC •RATE/ERR MON-RNDZ RADAR •X POINTER SCALE-as desired •RNDZ RADAR-SLEW Slew antenna until RADAR SIGNAL STRENGTH peaks. •Perform side-lobe check. •RNDZ RADAR-AUTO TRACK If under AGS control: •Perform AGS Manual Rendezvous Radar LM State Vector Update.</p>	<p>1 NO TRACK lt may also be on, but does not represent malfunction if lock-on has not been achieved.</p> <p>2 Occurs without NO TRACK lt. LGC will not process RR data.</p>
SYMPTOM	PROCEDURE	REMARKS

LM MALFUNCTION PROCEDURES

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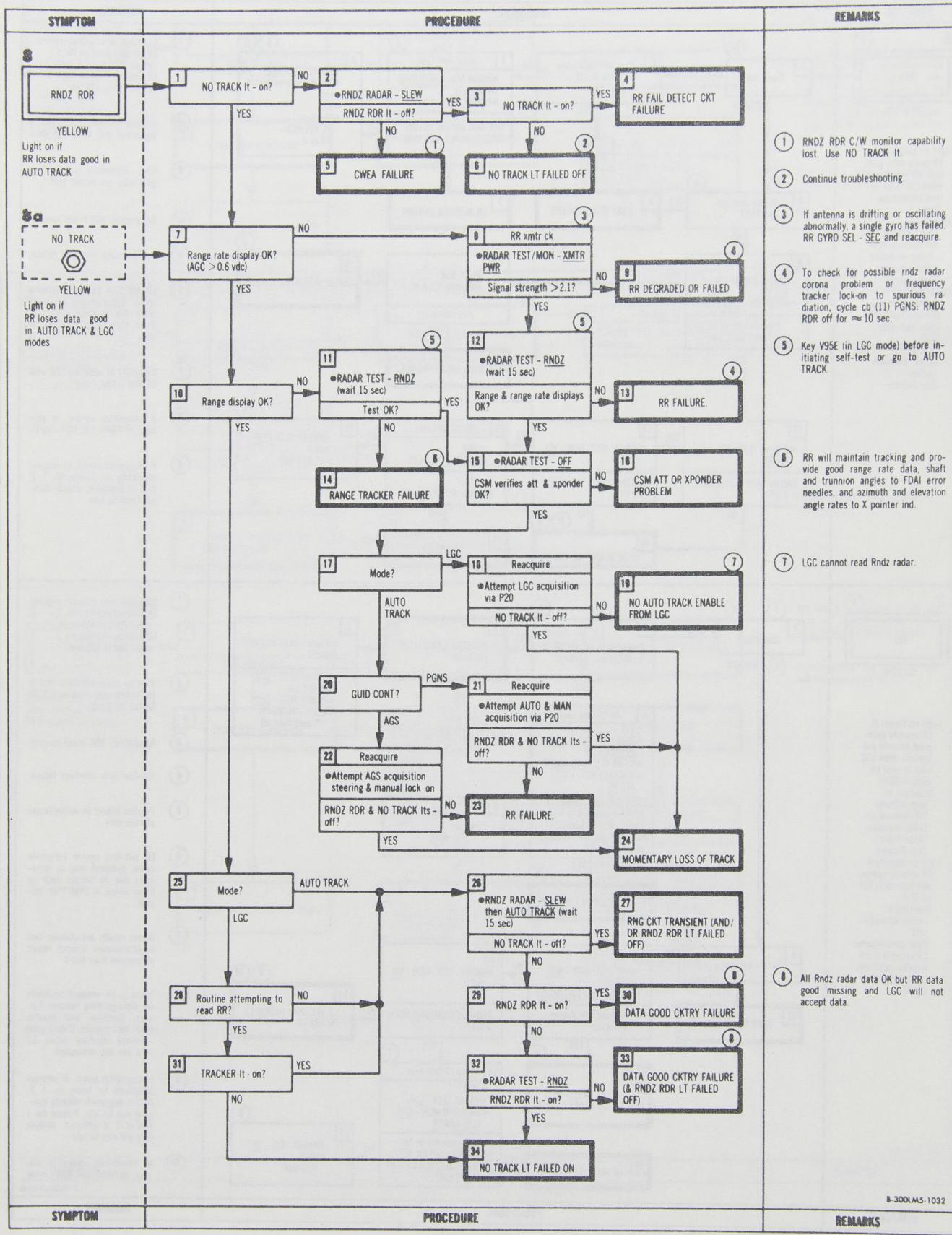
## LM MALFUNCTION PROCEDURES



6 THRU 8a

SSR-1

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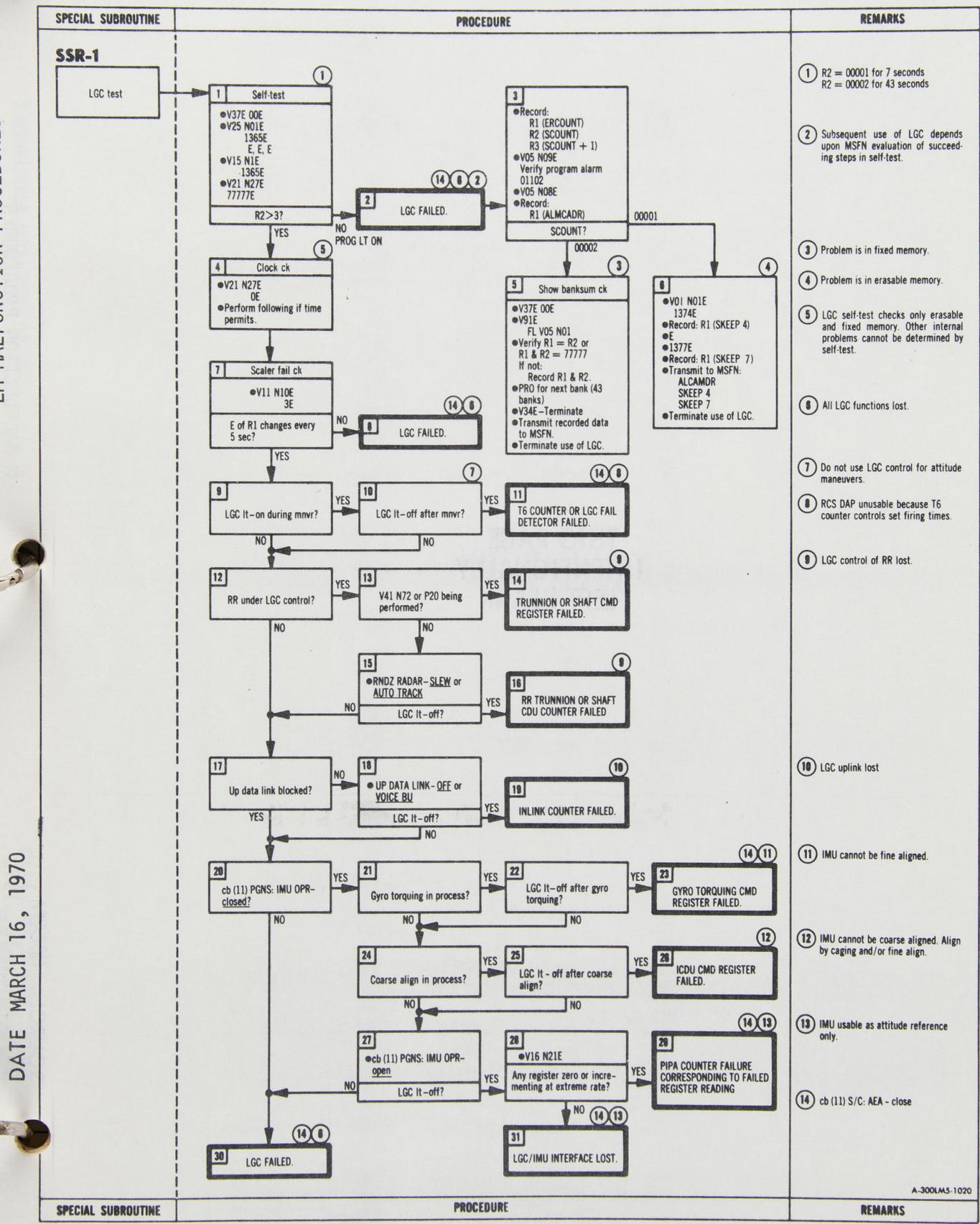


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LM MALFUNCTION PROCEDURES

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LM MALFUNCTION PROCEDURES



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LM MALFUNCTION PROCEDURES

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AGS MALFUNCTION INDEX

1

AGS

2

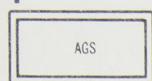
DEDA RESPONSE  
ABNORMAL

LM MALFUNCTION PROCEDURES

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## LM MALFUNCTION PROCEDURES

SYMPTOM	PROCEDURE	REMARKS
<p><b>1</b>            RED          Light on if:          ASA power supplies out of tolerance          ASA heater fails on (actuated at 150° ± 5°F)          AEA fails to complete minor cycle within 20 milliseconds          AEA test mode discrete signals failure condition          Light latches on when AEA failure is detected. O<sub>2</sub>/H<sub>2</sub>O QTY MON must be set to C/W RESET position to unlatch.</p>	<pre>     1 PGNS available?     NO • MODE CONT (AGS) - ATT HOLD     YES • GUID CONT - PGNS     • DEDA C 412R     DEDA responds?     NO 5 AEA POWER SUPPLY FAILED.     YES 6 +10000 displayed within 5 to 30 sec?     NO 7 AEA self-test     • DEDA C 412+0000E     • DEDA C 412R     +10000 displayed within 5 to 30 sec?     NO 8 AGS SELF-TEST DETECTED FAILURE.     YES 9 • O<sub>2</sub>/H<sub>2</sub>O QTY MON - C/W RESET     AGS warn lt - off?     NO 10 TRANSIENT CONDITION TRIGGERING SELF-TEST FAIL DISCRETE     YES 11 Ck for AEA-induced latchup     • O<sub>2</sub>/H<sub>2</sub>O QTY MON - C/W RESET     AGS warn lt - off     NO 12 In-flight gyro &amp; accel calib     • DEDA C 400+6000E     or     If PGNS unavailable:     • DEDA C 400+7000E     ASA performs OK?     YES 13 CWEA FAILED.     NO 14 AEA MAY HAVE EXPERIENCED A RESTART     15 MSFN verifies ASA heater operation.     ASA heater OK?     NO 16 ASA HEATER FAILURE     YES 17 Update &amp; align AEA.     Reconfigure 400 &amp; 410 through 417 as required.     18 ASA POWER SUPPLY FAILED.     19 • cb (16) S/C ASA - open   </pre>	<p>(1) AGS lost.  (2) AGS self-test status 412+X0000  X = 0 Test not complete  X = 1 Test successful  X = 3 Logic test failure  X = 4 Memory test failure  X = 7 Logic and memory test failure  (3) AGS operations not recommended.  (4) O<sub>2</sub>/H<sub>2</sub>O QTY MON performs latch-up release when set to C/W RESET.  (5) For PGNS unavailable: C 400+70000 checks accelerometers only.  (6) AEA restart changes: 470 to -73320, 400 and 410 through 417 to +00000.</p>
<p><b>2</b>          DEDA response abnormal</p>	<pre>     1 Registers remain blank?     YES 2 DEDA FAILURE     NO 3 OPR ERR lt - on?     YES 4 • CLR     OPR ERR lt - off?     YES 8 OPR ERR LT FAILED OFF.     NO 5 • Digit pb - push     Digit displayed?     YES 9 OPR ERR LT FAILED ON.     NO 6 CLR PB FAILED OPEN.     7 DEDA controls freeze, but can be returned to normal via CLR pb?     YES 3     NO 10 DEDA FAILURE   </pre>	<p>(1) Readout and enter functions are lost. AGS flight displays are available, but will become less and less reliable due to inability to be updated, aligned or calibrated.  (2) OPR ERR display lost.  (3) MSFN can confirm DEDA readouts  a. For following failures, AGS/DEDA capability is unaffected: EL segments  HOLD pb open  b. For following failure, readout and enter capability is lost:  CLR pb closed  Digit pb closed  ENTR pb closed  HOLD pb closed  READOUT pb closed  AGS flight displays are available, but will become less and less reliable due to inability to be updated, aligned, or calibrated.  c. The pb capability is lost for following failures:  Digit pb open  ENTR pb open*  + or - pb open*  *AGS can no longer be aligned, updated, or calibrated. AEA routines via SXZ entry are lost.</p>
SYMPTOM	PROCEDURE	REMARKS

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LM MALFUNCTION PROCEDURES

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CES MALFUNCTION INDEX

- 1 ABNORMAL VEHICLE DYNAMICS (NON-MPS)
- 2 LM DRIFTS OUT OF DEADBAND
- 3 PGNS MINIMUM IMPULSE (V76) COMMANDS ABNORMAL
- 4 AGS PULSE OR DIRECT COMMANDS ABNORMAL
- 5 PROPORTIONAL MODE COMMANDS ABNORMAL
- 6 TTCA COMMANDS ABNORMAL
- 7 ABNORMAL DYNAMICS DURING MPS THRUSTING

- 8 

ENG GMBL
- 9 NO MPS SHUTDOWN
- 9a PREMATURE MPS IGNITION
- 10 NO MPS IGNITION AT TIG = 0
- 11 ENG THRUST AND CMD THRUST IND DO NOT AGREE

- 12 

PRE AMPS
- 13 

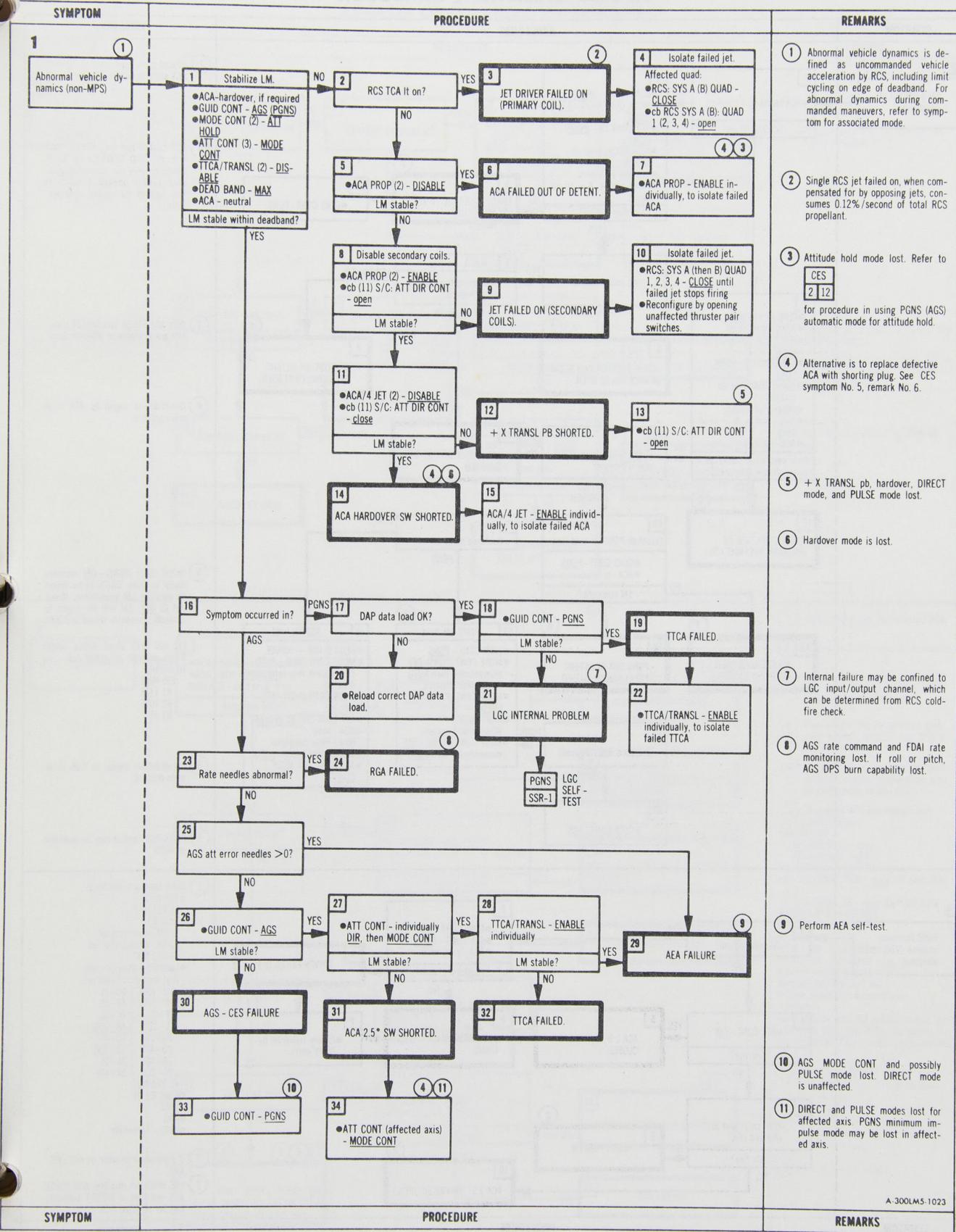
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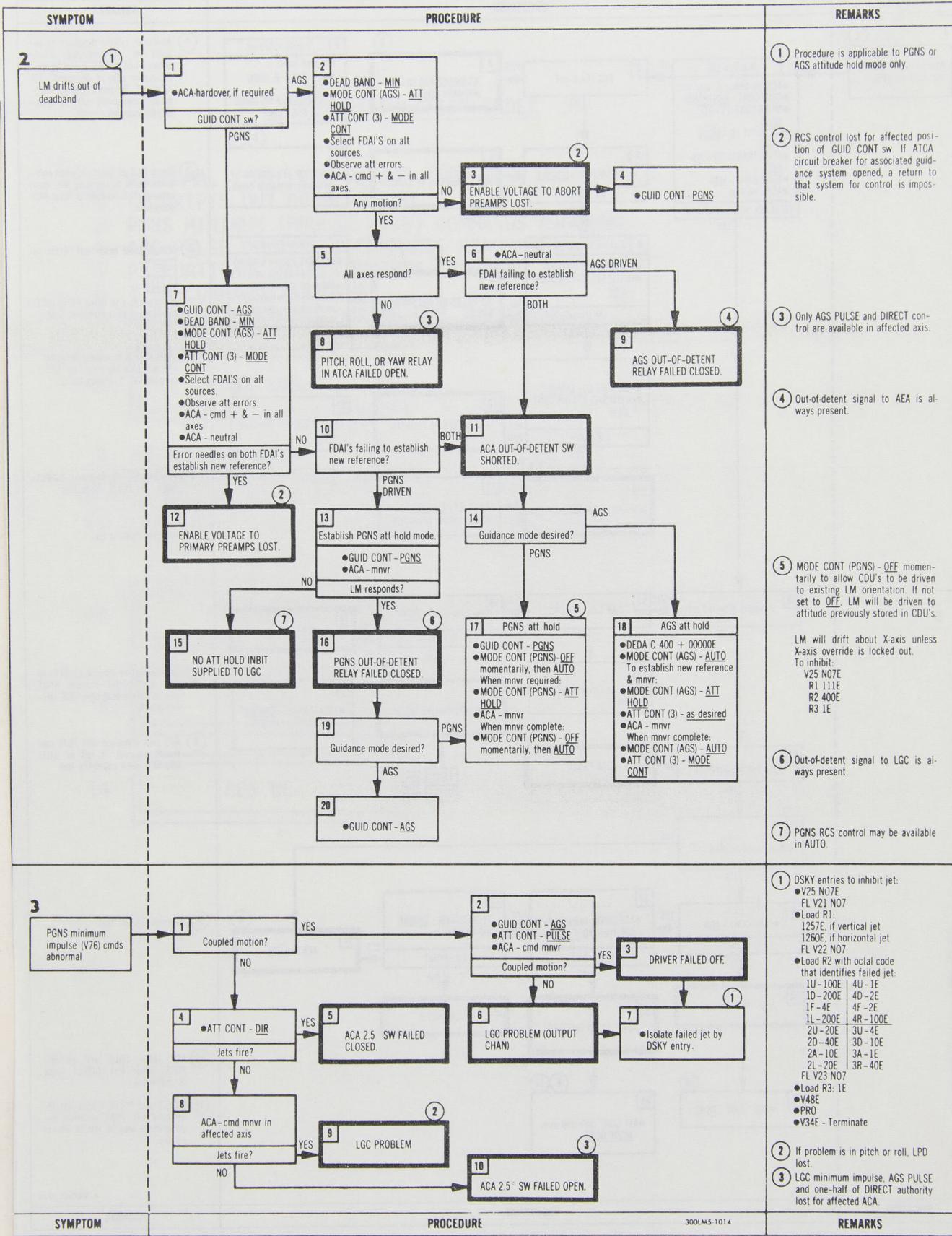
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3LMA790-3-LM  
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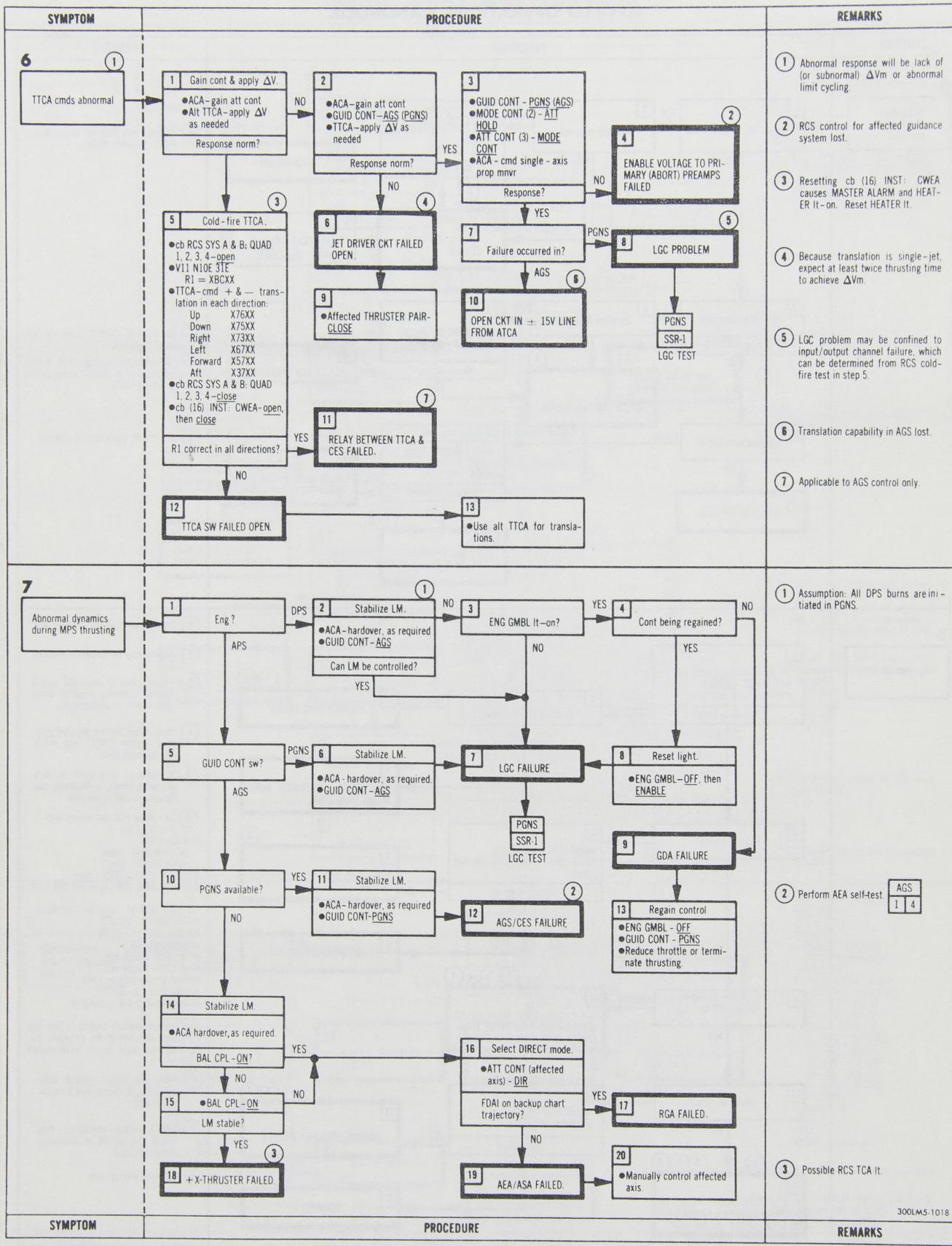
LM MALFUNCTION PROCEDURES

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14

**LMA790-3-LM  
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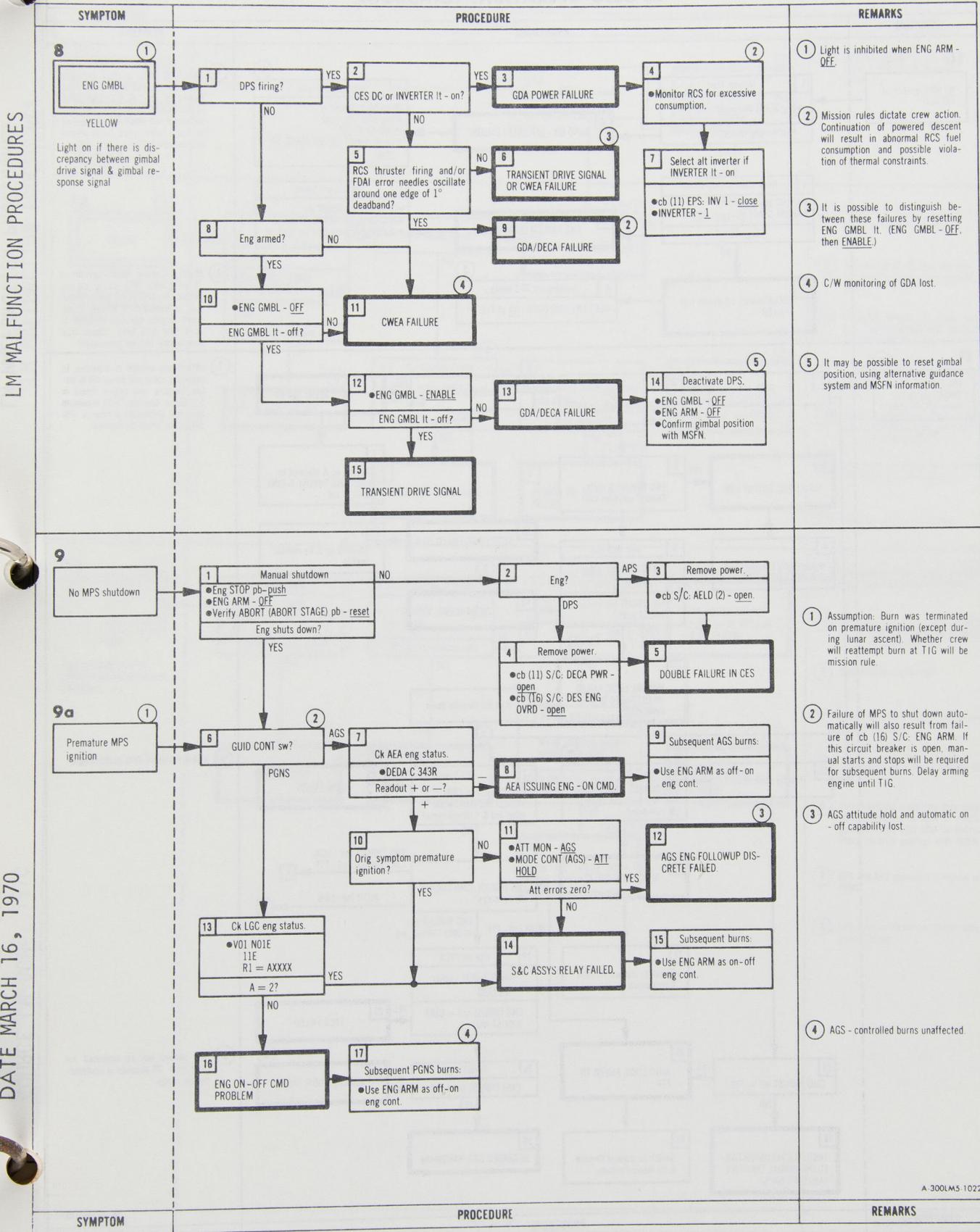
LMA790-3-LM  
APOLLO OPERATIONS HANDBOOK

SYMPOTM	PROCEDURE	REMARKS
4 AGS pulse or direct cmds abnormal	<p>1 Excessive or uncommanded rates? YES → 2 Symptom occurred in? PULSE → 3 Prop mnvr  •ATT CONT (3) - MODE  CONT  •ACA - cmd mnvr  Response norm? NO → 4 ATCA FAILURE</p> <p>DIR  NO → 5 ACA 2.5° SW FAILED CLOSED.  •ATT CONT (affected axis) - MODE CONT</p> <p>7 •Alt ACA - cmd mnvr Response norm? YES → 8 Symptom occurred in? PULSE → 9 •ATT CONT (3) - PULSE  •Orig ACA - cmd mnvr  Response norm? YES → 10 ACA 2.5° SW FAILED OPEN.</p> <p>12 Symptom occurred in? PULSE → 13 Prop mnvr  •ATT CONT (3) - MODE  CONT  •ACA - cmd mnvr  Response norm? YES → 14 PULSE MODE ENABLE RELAY FAILED (TYP K19).  NO → 16 JET DRIVER/PREAMP FAILED OFF.</p> <p>15 JET FAILED OFF (SEC.)</p>	<p>1 Affected axis may be available in PGNS (if preamp failed)</p> <p>2 One-half of DIRECT authority lost for affected ACA.</p> <p>3 LGC minimum impulse, AGS PULSE, and one-half of DIRECT authority lost for affected ACA.</p> <p>4 AGS PULSE mode lost for affected axis.</p>
5 Prop cmds abnormal	<p>1 •ACA - hardover, if required  •ACA PROP - DISABLE  •Alt ACA - cmd prop mnvr  Response norm? YES → 2 Orig symptom no mnvr? YES → 3 ACA PROP CONT FAILED.</p> <p>NO → 4 PROP CONT TRANSDUCER HUNG UP OUT OF NEUTRAL.</p> <p>5 Coupled motion? YES → 6 •GUID CONT - AGS (PGNS)  •ACA - cmd + &amp; - in affected axis  Response norm? YES → 7 PGNS - RCS (CES - RCS) INTERFACE FAILURE.</p> <p>NO → 8 JET DRIVER FAILED OFF.</p> <p>9 GUID CONT sw? PGNS → 10 S &amp; C CONT ASSYS RELAY FAILED OPEN OR LGC PROP INPUT PROBLEM OR OPEN CIRCUIT IN ONE ACA.</p> <p>AGS → 11 Excessive rates? YES → 12 •GUID CONT - PGNS  •Perform rate gyro test.  Successful? YES → 13 SUMMING AMPLIFIER SHORTED.  NO → 15 RGA FAILED.</p> <p>14 S &amp; C CONT ASSYS RELAY OR SUMMING AMPLIFIER FAILED OPEN OR OPEN CIRCUIT IN ONE ACA.</p>	<p>1 Prop control lost for affected ACA.</p> <p>2 Failure may be single or multiaxis.</p> <p>3 Failure could be open LGC output channel, summing amplifier, pulse rate module, or preamplifier.</p> <p>4 Prop control lost for affected guidance system. DIRECT and PULSE control unaffected.</p> <p>5 If symptom is present in both guidance modes, malfunction may be open circuit in one ACA.</p> <p>6 To remove ACA and replace with shorting plug:  •cb (11) S/C  ATT DIR CONT - open  ATCA (PGNS) - open  •cb (16) S/C ATCA (AGS) - open  •cb (11) COMM: CDR - open (for CDR ACA) or  cb (16) COMM: SE - open (for LMP ACA)  •ACA PROP (2) - DISABLE  •AUDIO CONT (2) - NORM  On suspected ACA:  •P &amp; J 709 - disconnect  •P &amp; J 708 - disconnect  •Install jumper plug on J 709  •Install dust cap on J 708  •Close above cb's &amp; reconfigure switches.  Since vehicle attitude control is lost during switch over, use of this procedure during controlled flight is not recommended</p> <p>7 PGNS and DIRECT control unaffected PULSE control may be available in AGS.</p> <p>8 DIRECT control unaffected. Prop control may be OK in alternative guidance system.</p> <p>9 FDAL rate displays lost.</p>

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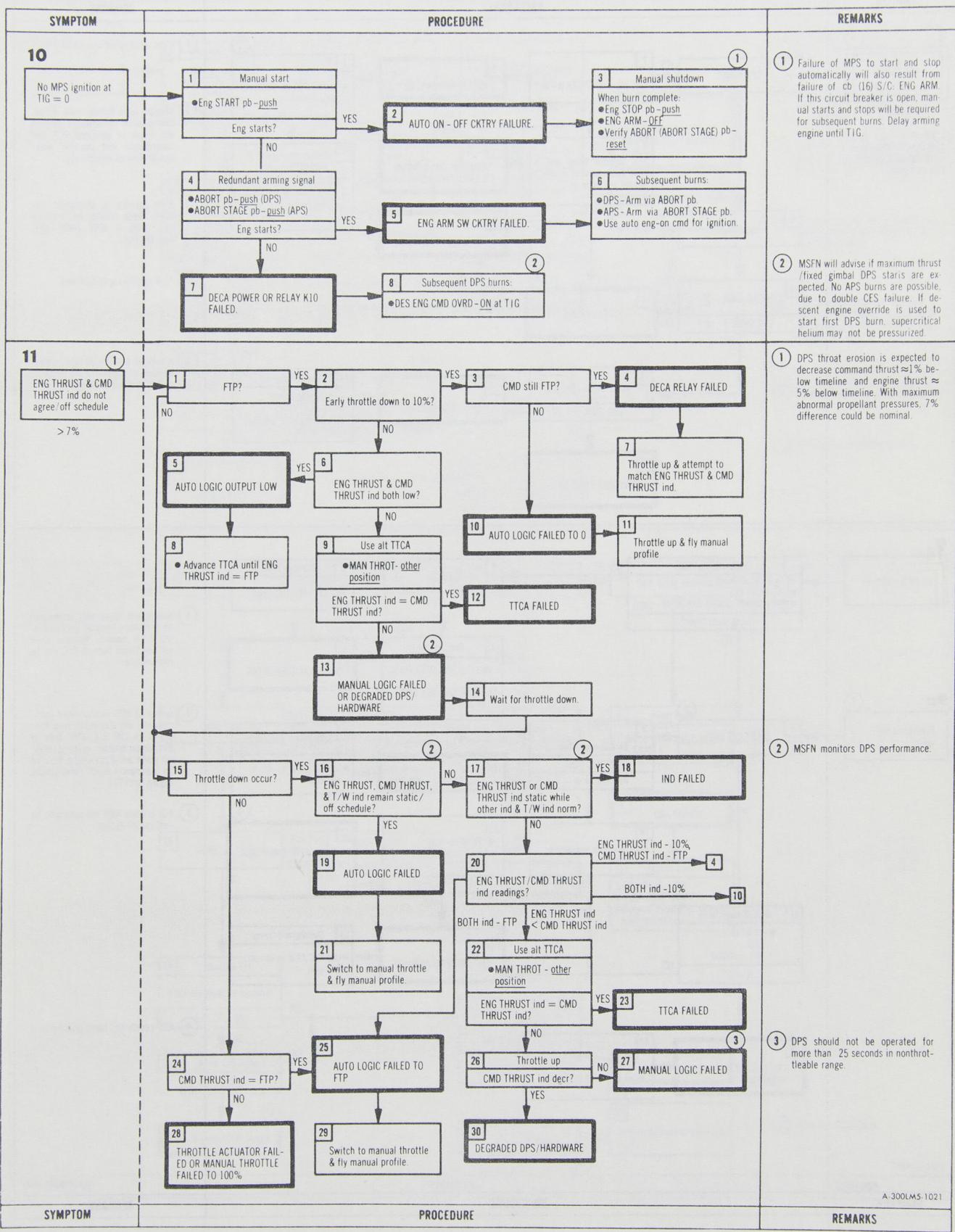
LM MALFUNCTION PROCEDURES



8 THRU 11

12 THRU 14

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SYMPTOM	PROCEDURE	REMARKS
<b>12</b>  YELLOW Light on if either -4.7-vdc power supply is out of tolerance	<p>1 CES AC It-on?</p> <p>YES → 2 ONE OR BOTH -4.7-VDC PREAMP BIAS POWER SUPPLIES FAILED.</p> <p>NO → 1 CES AC It-on?</p>	<p>① Sporadic jet firings are possible if both power supplies failed.</p>
<b>13</b>  RED Light on if ATCA a-c power supplies are out of tolerance	<p>1 Reset light &amp; perform rate gyro test. •GUID CONT-PGNS •GYRO TEST POS RT-POS RT •Observe rate needles &amp; light.</p> <p>CES AC It remains on?</p> <p>YES → 4 CWEA FAILURE</p> <p>NO → 2 Rate displays null?</p> <p>YES → 3 SINGLE-PHASE ATCA POWER SUPPLY FAILED.</p> <p>NO → 5 Reinitialize CWEA •cb (16) INST: CWEA-open, then close</p> <p>CES AC It remains off?</p> <p>YES → 8 TRANSIENT CONDITION</p> <p>NO → 6 Make small mnvr via PGNS rate mode.</p> <p>Rate inds &gt;0?</p> <p>YES → 7 POWER SUPPLY VOLTAGE OUT OF TOLERANCE (1.0 OR 3dB) OR 1.0 OF 3dB FAILED.</p> <p>NO → 2 (7)</p> <p>9 POWER TO RATE GYRO FAILED.</p>	<p>① If AGS is in control, true CES a-c failure causes loss of damping.</p> <p>② AGS control of LM lost, but AEA remains for computation purposes only.</p> <p>③ RR usable only in LGC mode. Shaft and trunnion power lost in SLEW and AUTO TRACK.</p> <p>④ Subsequent CES a-c monitoring lost.</p> <p>⑤ Resetting cb (16) INST: CWEA causes MASTER ALARM and HEATER It-on. Reset HEATER It.</p> <p>⑥ Rate gyro assembly will probably not restart after shutdown.</p> <p>⑦ FDI rate needles are invalid.</p>
<b>14</b>  RED Light on if ATCA d-c power supplies are out of tolerance	<p>1 Reset light. •GUID CONT-PGNS •GYRO TEST POS RT-POS RT</p> <p>CES DC It remains on?</p> <p>YES → 5 CWEA FAILURE</p> <p>NO → 2 Reinitialize CWEA. •cb (16) INST: CWEA-open, then close</p> <p>CES DC It remains off?</p> <p>YES → 6 TRANSIENT CONDITION</p> <p>NO → 3 Staged?</p> <p>YES → 4 ATCA POWER SUPPLY (-15V, ±6V, AND/OR +4.3V) FAILED.</p> <p>NO → 7 Enable throttle actuator. •Eng STOP pb-push •ENG ARM-DES</p> <p>MSFN reports throttle at max?</p> <p>YES → 9 ±15V OR +4.3V ATCA POWER SUPPLY FAILED.</p> <p>NO → 8 ±6V ATCA POWER SUPPLY FAILED.</p>	<p>① Assumption: LM is stable and MPS burns completed or terminated.</p> <p>② Resetting cb (16) INST: CWEA causes MASTER ALARM and HEATER It-on. Reset HEATER It.</p> <p>③ AGS attitude control lost.</p> <p>④ Subsequent APS burns should be started manually.</p> <p>⑤ Subsequent CES d-c monitoring lost.</p> <p>⑥ This transient condition may have caused throttle to lock in 100% position. Cycle ENG ARM sw and/or check throttle position with MSFN.</p> <p>⑦ DPS and APS operation is normal in PGNS.</p> <p>⑧ DPS fixed at maximum throttle with gimbal locked.</p>
SYMPTOM	PROCEDURE	REMARKS

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DPS MALFUNCTION INDEX

1      DES REG

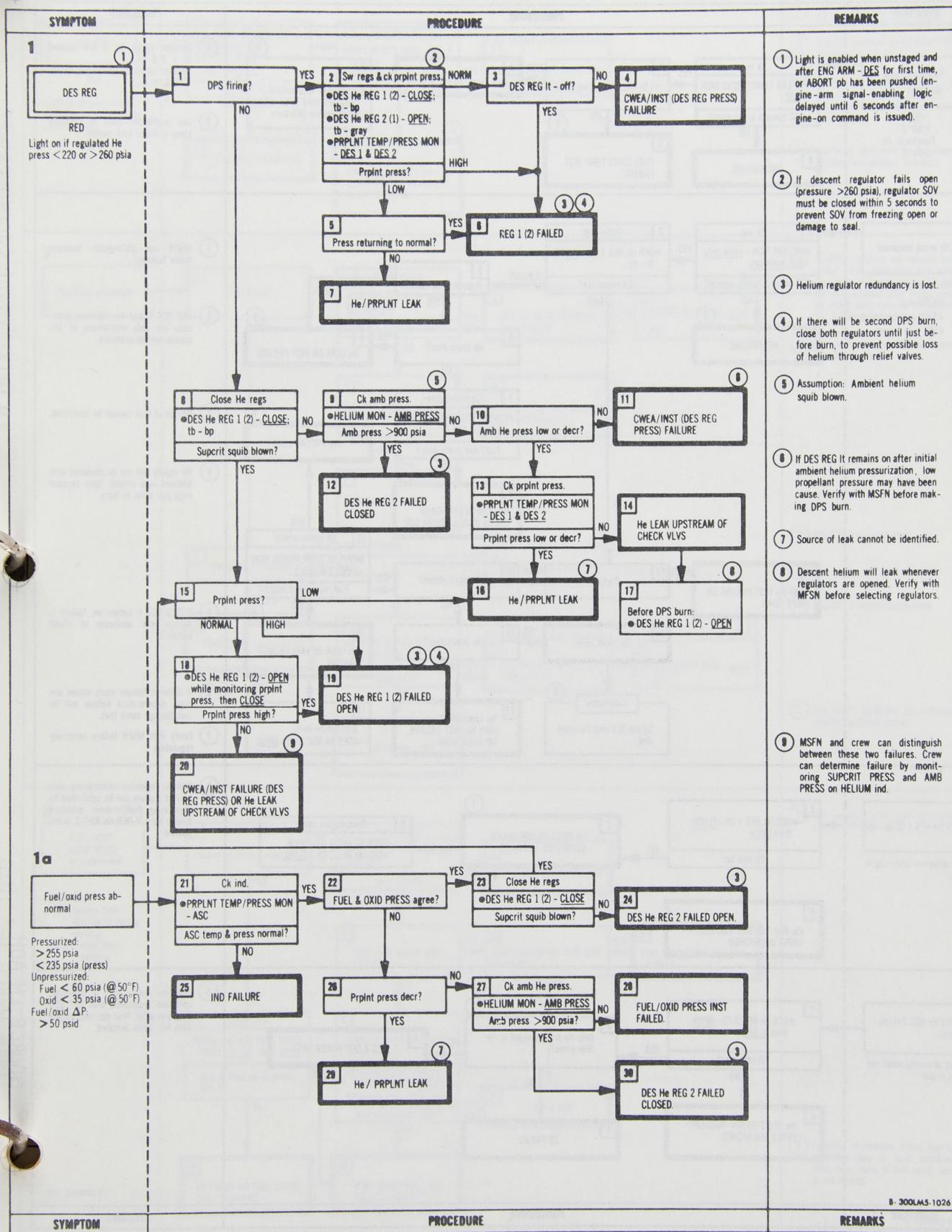
- 1a FUEL/OXID PRESS ABNORMAL
- 2 FUEL/OXID TEMP ABNORMAL
- 3 HE PRESS ABNORMAL
- 4 DES HE REG 1(2) TB-BP
- 5 DES HE REG 2(1) TB-GRAY

6      DES QTY

- 7 PQGS IND ABNORMAL
- 8 FUEL VENT/OXID VENT TB-ABNORMAL

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SYMPTOM	PROCEDURE	REMARKS
<b>2</b>  Fuel/oxid temp abnormal >90° F <50° F Fuel/oxid Δt >10° F	<p>1 Ck ind. •PRPLNT TEMP/PRESS MON - ASC</p> <p>YES → 2 At between both fuel (oxid) ind &lt;10° F?</p> <p>NO → 5 IND FAILURE</p> <p>2 ASC temp &amp; press norm?</p> <p>YES → 3 HEAT SOAK OR COLD SOAK</p> <p>NO → 4 If possible, reorient LM to bring affected temp within limits before DPS burn</p> <p>3 FUEL (OXID) TEMP INST FAILURE</p>	<p>1 Descent tanks No. 1 are located at + Y &amp; - Z. Descent tanks No. 2 are located at - Y &amp; + Z.</p> <p>2 Use unaffected temp to estimate temp of failed tank sensor.</p>
<b>3</b>  He press abnormal Supcrit: > or < timeline Amb: >1750 psia <1300 psia (unpress) <200 psia (press)	<p>1 Ck ind. •HELIUM MON - cycle thru ASC positions</p> <p>YES → 2 Close regs. •DES He REG 1 (2) - CLOSE; tb - bp</p> <p>ASC press &amp; temps normal?</p> <p>NO → 4 IND FAILURE</p> <p>2 Abnormal sys?</p> <p>SUPCRIT → 3 Supcrit squib blown?</p> <p>AMB → 5 He press decr?</p> <p>YES → 6 He LEAK OR INST FAILURE</p> <p>NO → 7 Ck prplnt press. •PRPLNT TEMP/PRESS MON - DES.1 &amp; DES.2</p> <p>Fuel/oxid press decr?</p> <p>YES → 8 He/PRPLNT LEAK</p> <p>NO → 9 He LEAK UPSTREAM OF CHECK VLVS &amp; BELOW SOV</p> <p>10 AMB He INST FAILURE OR HEAT SOAK</p> <p>HIGH → 11 Press?</p> <p>LOW → 12 Amb squib blown?</p> <p>YES → 13 Ck prplnt press. •PRPLNT TEMP/PRESS MON - DES.1 &amp; DES.2</p> <p>Fuel/oxid press decr?</p> <p>YES → 14 He TANK LEAK</p> <p>NO → 15 He press decr?</p> <p>YES → 16 He LEAK OR AMB He INST FAILURE</p> <p>NO → 17 He TANK LEAK, AMB He INST FAILURE, OR COLD SOAK</p> <p>Just before burn: •DES He REG 1 (2) - OPEN</p> <p>CAUTION Do not fire amb He squib vlv.</p>	<p>1 MSFN can distinguish between these failures.</p> <p>2 DES REG It and fuel/oxidizer pressure are only indications of abnormal helium pressure.</p> <p>3 Source of leak cannot be identified.</p> <p>4 He supply will not be depleted with descent regs closed. Open descent regs just prior to burn.</p> <p>5 If DES REG It comes on, failure is helium leak upstream of check valves.</p> <p>6 If ambient helium squib valves are fired, supercritical helium will be lost through same leak.</p> <p>7 Verify with MSFN before selecting regulators.</p>
<b>4</b>  DES He REG 1 (2) tp - bp BP abnormal when reg in use	<p>1 •DES He REG 1 (2) - CLOSE, then OPEN</p> <p>TB still bp?</p> <p>YES → 2 He REG 1 (2) SOV FAILED CLOSED OR TB FAILED.</p> <p>NO → 4 He REG 1 (2) SOV INADVERTENTLY UNLATCHED.</p> <p>3 Reconfigure regs. •DES He REG 2 (1) - OPEN •DES He REG 1 (2) - CLOSE</p>	<p>1 Helium regulator redundancy may be lost. Failure can be confirmed by decreasing fuel/oxidizer pressure during burn if DES He REG 2 is not opened.</p>
<b>5</b>  DES He REG 2 (1) tb - gray Gray abnormal when reg not in use	<p>1 •DES He REG 2 (1) - OPEN, then CLOSE</p> <p>TB still gray?</p> <p>YES → 2 Amb He press pegged or no SHe press?</p> <p>YES → 3 REG 2 SOV FAILED OPEN.</p> <p>NO → 5 TB FAILED.</p> <p>NO → 4 He REG 2 (1) SOV INADVERTENTLY UNLATCHED.</p>	<p>1 Question valid only if abnormal condition associated with DES REG 2 tb and after first descent engine burn has been initiated.</p>

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6  Light on if burn time to prplnt depletion < 2 min at 25% thrust	<pre> 1 Reset low level sensor When prplnt settle: •PRPLNT QTY MON - cycle OFF, then DES 1 DES QTY lt - on? YES → 2 Ck prplnt qty. •PRPLNT QTY MON - DES 1 &amp; DES 2 Fuel or oxid qty ≤ 7%? YES → 3 PRPLNT LEAK OR DEGRADED ENG PERFORMANCE NO → 4 TRANSIENT CONDITION       CWEA OR LIQUID LOW-       LEVEL SENSOR IN PRPLNT       TANK FAILED ON.     </pre>	<p>(1) Light is inhibited when PRPLNT QTY MON - QEE or when staged.</p> <p>(2) DES QTY lt should go on when PQGS reading is in 4% to 7% range</p> <p>(3) If PQGS is turned on before propellants are settled, DES QTY lt will come on if a low level sensor is exposed.</p> <p>(4) Low-level indication is erroneous. Monitor fuel/oxidizer numerics.</p>
7 	<pre> 1 DPS firing? YES → 2 Ck alt source. •PRPLNT QTY MON - other DES position Fuel &amp; oxid qty norm? YES → 3 QTY PROBE IN AFFEKTED TANK FAILED.       4 PRPLNT QTY MON - good       sys NO → 5 Both fuel tanks &gt; 5% different from both oxid tanks? YES → 6 PRPLNT LEAK OR DEGRADED ENG PERFORMANCE NO → 7 •Continue DPS burn.     </pre> <p>8 Abnormal indication?</p> <p>BLANK (ONE OR BOTH)</p> <p>ONE ZERO → 9 PQGS IND FAILED.</p> <p>BOTH ZERO → 10 PQGS CONT UNIT FAILED.</p> <p>11 •PRPLNT QTY MON - other DES position</p> <p>PQGS norm?</p> <p>YES → 12 QTY PROBE IN AFFEKTED TANK FAILED.       13 PRPLNT QTY MON - good       sys</p> <p>NO → 14 SIG TO IND LOST</p>	<p>(1) Quantity readouts are reliable only under +X-acceleration. Fuel reading may indicate up to 5% low for ≈10 minutes after initial turn-on. PQGS duty cycle is 45 minutes on, 15 minutes off.</p> <p>(2) Use good system to estimate quantity of failed tank.</p> <p>(3) DES QTY lt is unaffected.</p> <p>(4) DES QTY lt may be inoperative.</p> <p>(5) Use fuel (oxidizer) to estimate quantity of failed system.</p>
8  Abnormal if: BP - before first venting or during venting Gray - after first venting	<pre> 1 Abnormal during venting? NO → 2 Recycle SOV. •FUEL (OXID) VENT - normal position TB - normal? YES → 3 FUEL (OXID) SOV TRANSIENT NO → 4 Have vent squibs been blown?     </pre> <p>5 Fuel (oxid) press &lt; 20 psia or decr?</p> <p>YES → 6 FUEL (OXID) VENT SOV FAIL-ED OPEN.</p> <p>7 Cycle SOV.</p> <p>•Affected vent FUEL (OXID) VENT - CLOSE, then OPEN</p> <p>She or fuel (oxid) press decr?</p> <p>YES → 10 TB FAILED OR FUEL (OXID) SOV TRANSIENT</p> <p>NO → 8 Check vent vlv after squib is blown.</p> <p>•PRPLNT TEMP/PRESS MON - DES 1 &amp; DES 2</p> <p>•Monitor fuel (oxid) press</p> <p>Fuel (oxid) press decr?</p> <p>YES → 9 TB FAILURE</p> <p>NO → 11 FUEL (OXID) VENT SOV FAILED CLOSED.</p>	<p>(1) Not applicable to zero-g conditions.</p> <p>(2) Fracture mechanics limits may be exceeded due to heat soakback after long burn, if fuel (oxid) tank is not vented.</p>

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APS MALFUNCTION INDEX

1

ASC PRESS

- 2 FUEL OR OXID TEMP ABNORMAL  
2a FUEL OR OXID PRESS ABNORMAL  
3 He PRESS ABNORMAL OR DECR  
3a He TEMP ABNORMAL

4

ASC QTY

5

ASC HI REG

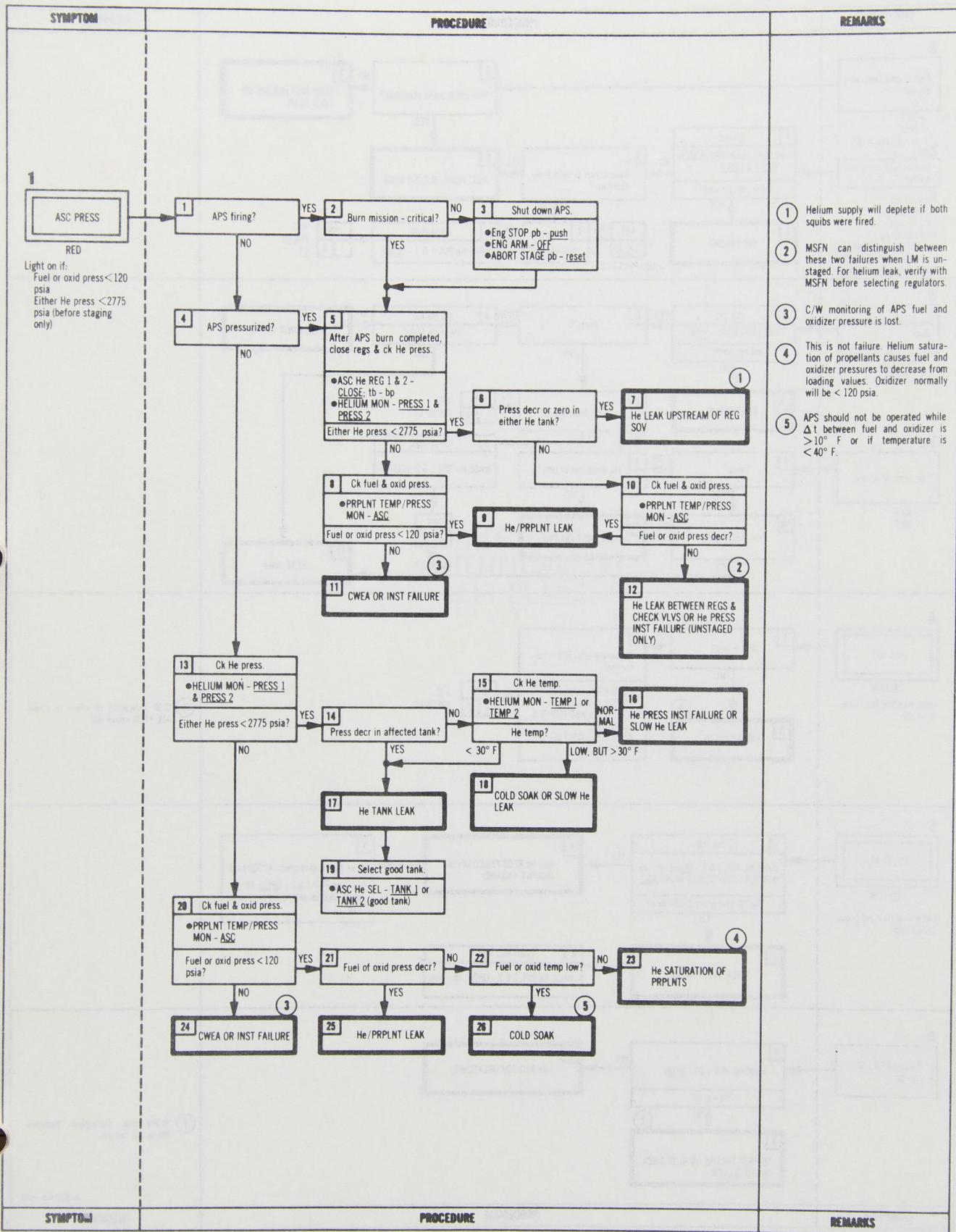
6 ASC He REG 1 (2) tb-bp

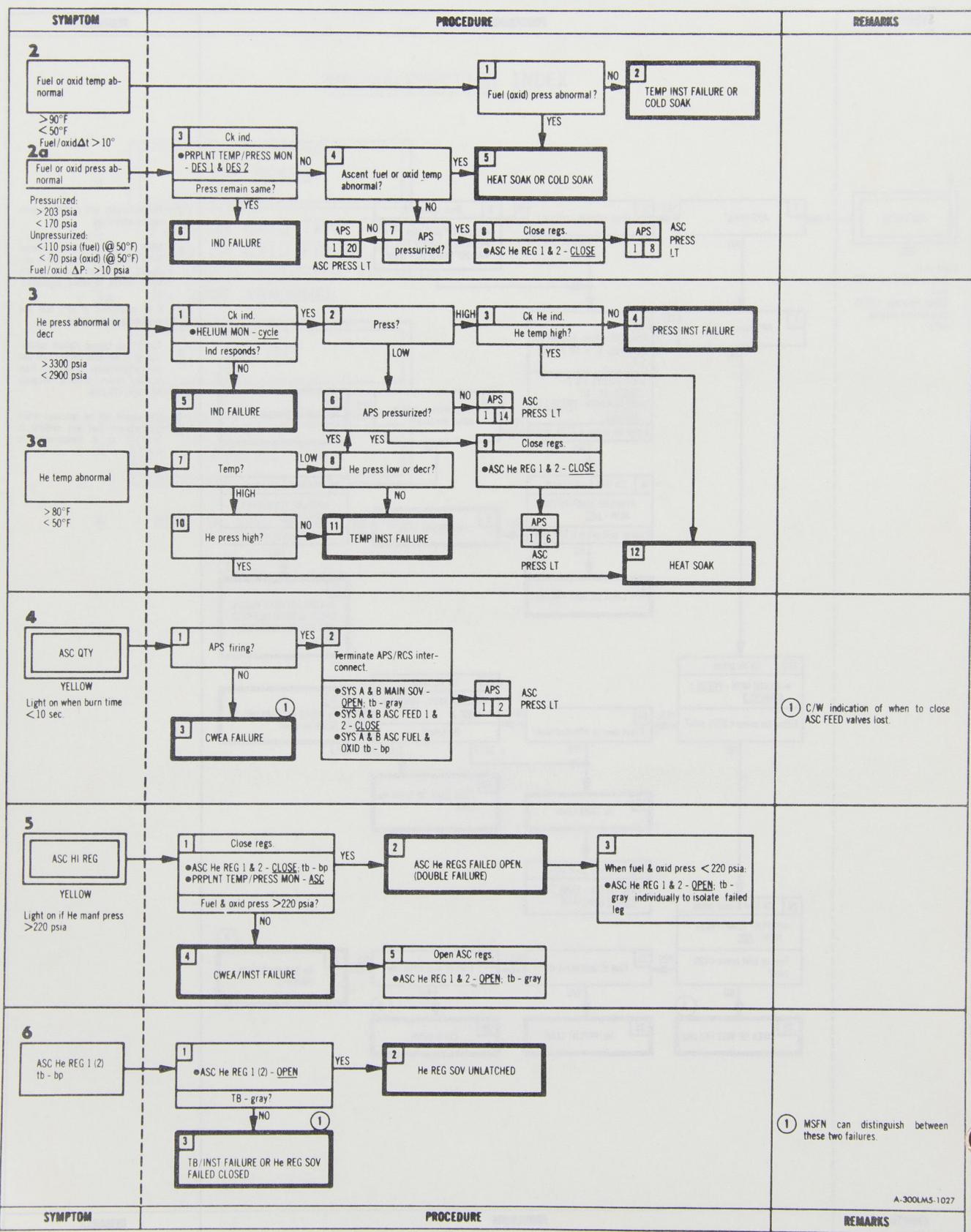
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RCS MALFUNCTION INDEX1      RCS

- 1a HE PRESS LOW OR DECR
- 1b PQMD ABNORMAL
- 2 RCS PRESS OR TEMP ABNORMAL

3      RCS A (B) REG4      RCS TCA

5a TB ABNORMAL (QUAD VLVS)

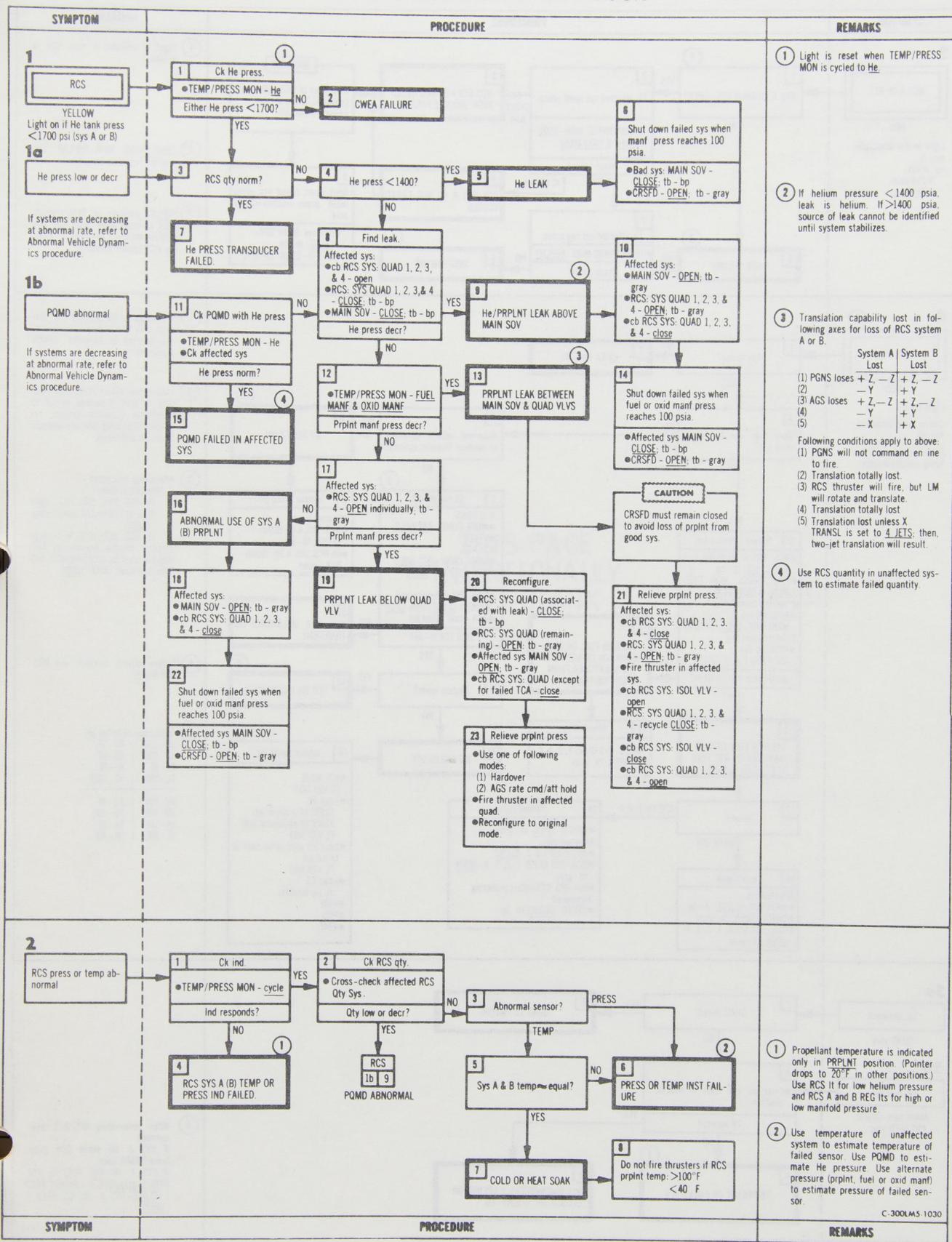
5b TB ABNORMAL (MAIN SOV, CRSFD, ASC FEED VLVS).

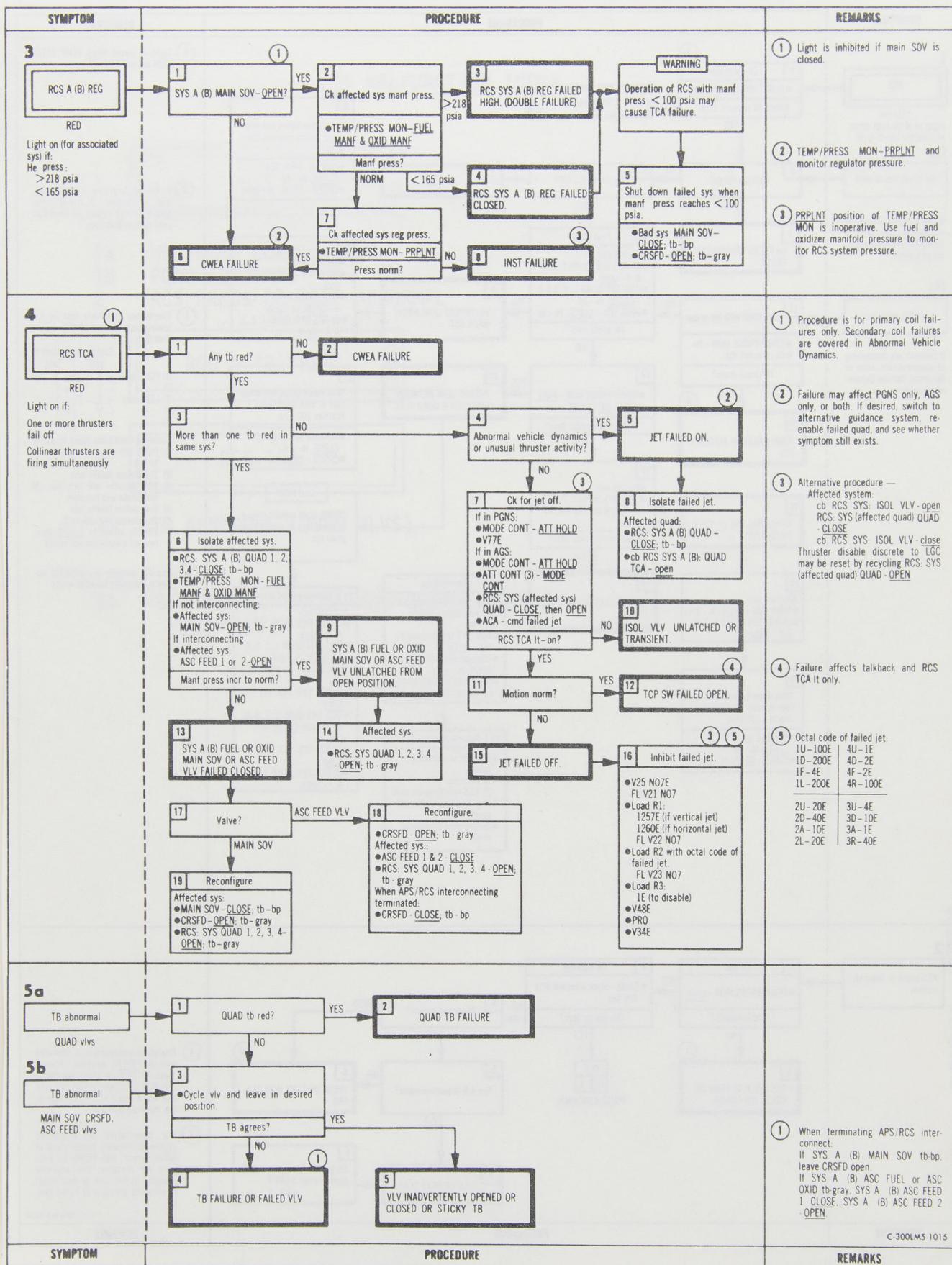
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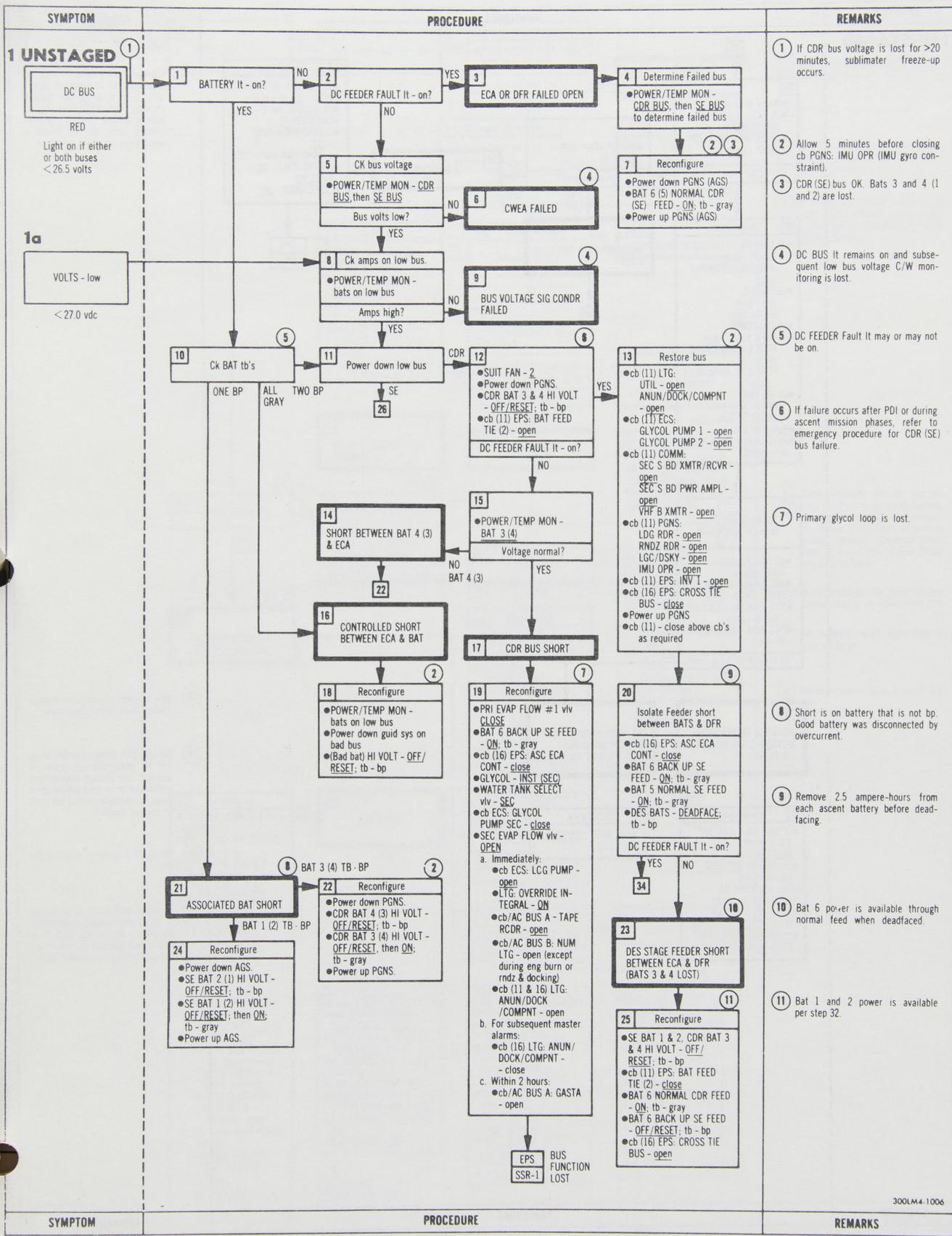
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EPS MALFUNCTION INDEX

1	UNSTAGED	DC BUS
1a	UNSTAGED	VOLTS - LOW
2	STAGED	DC BUS
3	UNSTAGED	BATTERY
4	STAGED	BATTERY
5	UNSTAGED	BAT TB ABNORMAL
6		INVERTER
6a		AC VOLTAGE HIGH
SSR-1		BUS FUNCTIONS LOST

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1  
THRU  
1a2  
THRU  
56  
THRU  
SSR-1

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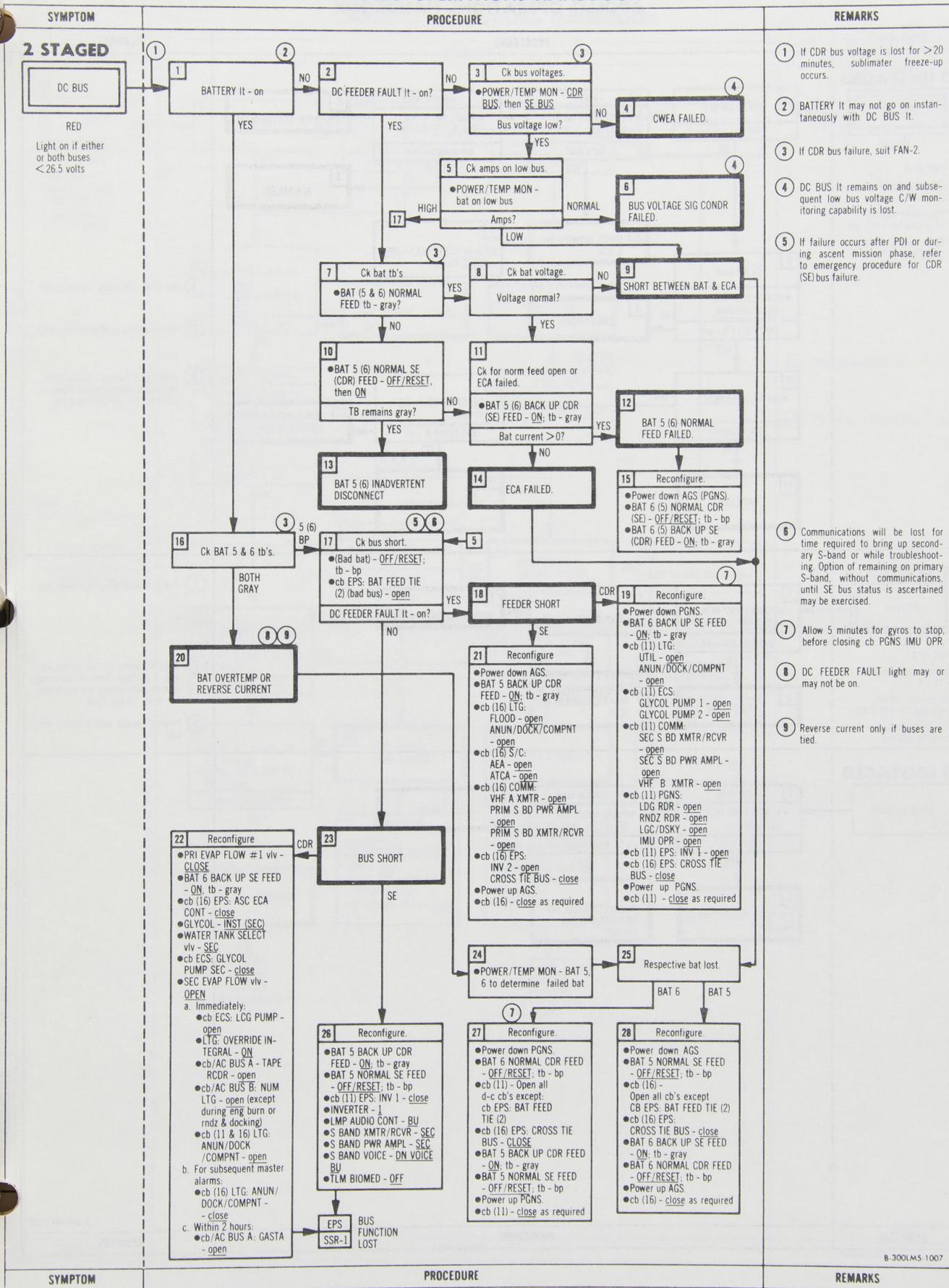
SYMPTOM	PROCEDURE	REMARKS
<b>1 UNSTAGED</b> cont	<pre> graph TD     11((11)) --&gt; 26[26]     26[26] -- NO --&gt; 27[27]     26[26] -- YES --&gt; 30[30]     27[27] -- NO --&gt; 28[28]     27[27] -- YES --&gt; 31[31]     28[28] --&gt; 29[29]     29[29] --&gt; 32[32]     30[30] --&gt; 32[32]     31[31] --&gt; 24[24]     32[32] -- NO --&gt; 33[33]     32[32] -- YES --&gt; 20[20]     33[33] -- NO --&gt; 13[13]     33[33] -- YES --&gt; 34[34]     13[13] --&gt; 20[20]     34[34] --&gt; 20[20]     20[20] --&gt; 14[14]     14[14] --&gt; 35[35]     35[35] --&gt; 15[15]     36[36] --&gt; 16[16]     16[16] --&gt; 29[29]     29[29] --&gt; 32[32]     32[32] --&gt; 35[35]     32[32] --&gt; 36[36]     </pre> <p><b>26</b></p> <ul style="list-style-type: none"> <li>• Power down AGS</li> <li>• SE BAT 1 &amp; 2 HI VOLT - OFF/RESET; tb - bp</li> <li>• cb (16) EPS: BAT FEED TIE (2) - open</li> </ul> <p>DC FEEDER FAULT It - on?</p> <p><b>27</b></p> <ul style="list-style-type: none"> <li>• POWER/TEMP MON - BAT 1 (2)</li> </ul> <p>Voltage normal?</p> <p><b>28</b> SE BUS SHORT</p> <p><b>29</b> Reconfigure</p> <ul style="list-style-type: none"> <li>• BAT 5 BACK UP CDR FEED - ON; tb - gray</li> <li>• cb (11) EPS: INV 1 - close</li> <li>• INVERTER - 1</li> <li>• S BAND XMTR/RCVR - SEC</li> <li>• S BAND PWR AMPL - SEC</li> <li>• S BAND VOICE - ON VOICE BU</li> <li>• TLM BIOMED - QEF</li> </ul> <p>BUS FUNCTIONS LOST</p> <p><b>EPS</b></p> <p><b>SSR-1</b></p> <p><b>30</b> Restore bus</p> <ul style="list-style-type: none"> <li>• cb (16) LTG: FLOOD - open ANUN/DOCK/COMPNT - open</li> <li>• cb (16) S/C: AEA - open ATCA - open</li> <li>• cb (16) COMM: VHF A XMTR - open PRIM S BD PWR AMPL - open PRIM S BD XMTR/RCVR - open</li> <li>• cb (16) EPS: INV 2 - open CROSS TIE BUS - close</li> <li>• Power up AGS</li> <li>• cb (16)-close above cb's as required</li> </ul> <p><b>31</b> SHORT BETWEEN BAT 2 (1) &amp; ECA</p> <p><b>32</b> Isolate feeder short between bats &amp; DFR</p> <ul style="list-style-type: none"> <li>• cb (16) EPS: ASC ECA CONT - close</li> <li>• BAT 5 BACK UP CDR FEED - ON; tb - gray</li> <li>• BAT 6 NORMAL CDR FEED - ON; tb - gray</li> <li>• DES BATS - DEADFACE, tb - bp</li> </ul> <p>DC FEEDER FAULT It - on?</p> <p><b>33</b> DES STAGE FEEDER SHORT BETWEEN ECA &amp; DFR (BATS 1 &amp; 2 LOST)</p> <p><b>34</b> ASC STAGE FEEDER SHORT BETWEEN DFR &amp; BUS (BATS 3 &amp; 4 OR 1 &amp; 2 LOST)</p> <p><b>35</b> Reconfigure</p> <ul style="list-style-type: none"> <li>• SE BAT 1 &amp; 2, CDR BAT 3 &amp; 4 HI VOLT - OFF/RESET; tb - bp</li> <li>• cb (16) EPS: BAT FEED TIE (2) - close</li> <li>• BAT 5 NORMAL SE FEED - ON; tb - gray</li> <li>• BAT 5 BACK UP CDR FEED - OFF/RESET; tb - bp</li> <li>• cb (16) EPS: CROSS TIE BUS - open</li> </ul> <p><b>36</b> Reconfigure</p> <ul style="list-style-type: none"> <li>• DES BATS - CONNECT; tb - gray</li> </ul>	<p><b>12</b> Communications will be lost for time required to bring up secondary S-band or while troubleshooting. Option of remaining on primary S-band, without communications, until SE bus status is ascertained may be exercised.</p> <p><b>13</b> Bat 5 power is available through normal feed when deadfaced.</p> <p><b>14</b> Bat 6 (if CDR feeder shorted) or bat 5 (if SE feeder shorted) power is available only through backup feed and should be so used before abort stage, to preclude placing bat 6 (5) on shorted feeder.</p> <p><b>15</b> Bat 3 and 4 power is available per step 32</p> <p><b>16</b> To power both buses with descent batteries only, remove nonessential equipment until total load &lt;50 amp. (Two descent batteries will not support two fully loaded buses.)</p>
SYMPTOM	PROCEDURE	REMARKS

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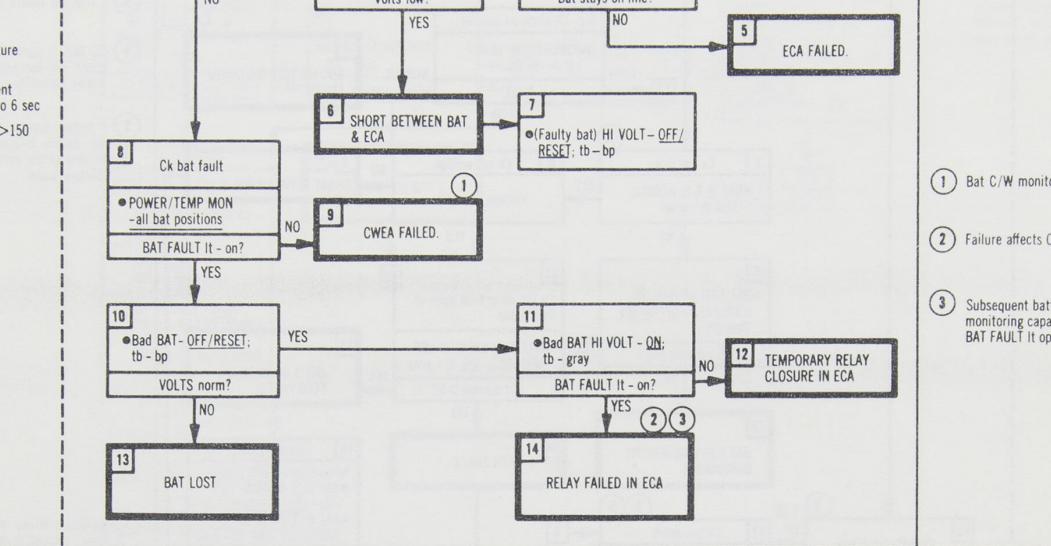
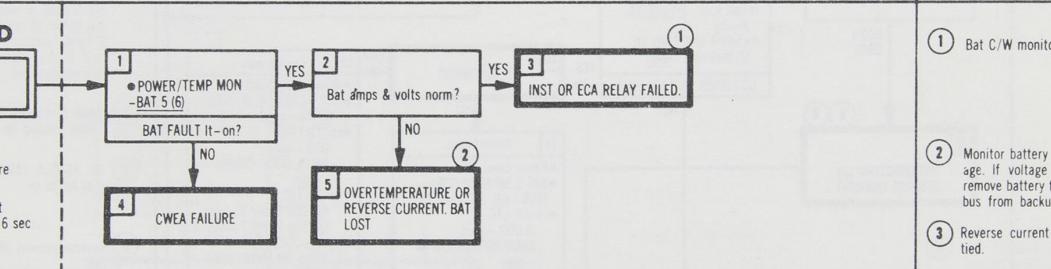
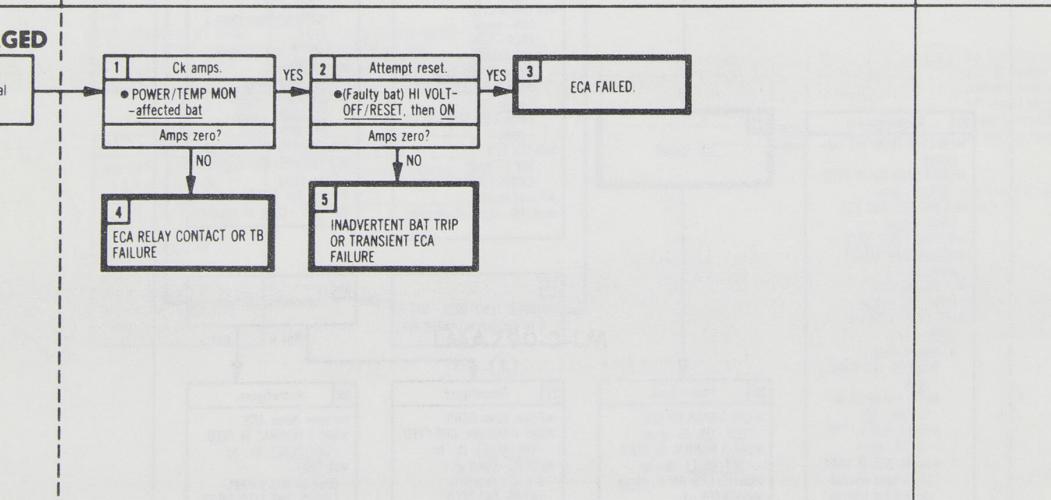
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SYMPOTM	PROCEDURE	REMARKS
<b>3 UNSTAGED</b>   <p><b>BATTERY YELLOW</b> Light on if: Bat overtemperature <math>\geq 145^{\circ}\text{F}</math> Bat reverse current &gt;10 amp for 4 to 6 sec Bat overcurrent &gt;150 to 200 amp</p>	<pre> graph TD     A[BATTERY] --&gt; B[•Ck all bat tb's Any tb's bp?]     B -- NO --&gt; C[Ck bat fault •POWER/TEMP MON -all bat positions BAT FAULT It - on?]     C -- YES --&gt; D[•Bad BAT- OFF/RESET; tb - bp VOLTS norm?]     D -- NO --&gt; E[BAT LOST]     D -- YES --&gt; F[•(Faulty bat) HI VOLT- OFF/RESET, then ON Volts low? YES --&gt; G[Attempt reset. •(Faulty bat) HI VOLT- OFF/RESET, then ON Bat stays on line? NO --&gt; H[ECA FAILED.]]     F -- YES --&gt; G     G -- NO --&gt; I[•(Faulty bat) HI VOLT- OFF/ RESET; tb - bp]     I --&gt; J[SHORT BETWEEN BAT &amp; ECA]     J --&gt; K[•(Faulty bat) HI VOLT- OFF/ RESET; tb - bp]     K --&gt; L[1 CWEA FAILED.]     L --&gt; M[11 •Bad BAT HI VOLT - ON; tb - gray BAT FAULT It - on? YES --&gt; N[12 TEMPORARY RELAY CLOSURE IN ECA]     N -- NO --&gt; O[14 RELAY FAILED IN ECA]     </pre>	<p>(1) Bat C/W monitoring capability lost.</p> <p>(2) Failure affects C/W indications only.</p> <p>(3) Subsequent battery - malfunction monitoring capability lost. However, BAT FAULT It operates normally.</p>
<b>4 STAGED</b>   <p><b>BATTERY YELLOW</b> Light on if: Bat overtemperature <math>\geq 145^{\circ}\text{F}</math> Bat reverse current &gt;10 amp for 4 to 6 sec Bat overcurrent &gt;150 to 200 amp</p>	<pre> graph TD     A[BATTERY] --&gt; B[•POWER/TEMP MON - BAT 5 (6) BAT FAULT It - on?]     B -- NO --&gt; C[CWEA FAILURE]     B -- YES --&gt; D[2 Batamps &amp; volts norm?]     D -- YES --&gt; E[3 INST OR ECA RELAY FAILED.]     D -- NO --&gt; F[5 OVERTEMPORATURE OR REVERSE CURRENT. BAT LOST]     </pre>	<p>(1) Bat C/W monitoring capability lost.</p> <p>(2) Monitor battery for decreasing voltage. If voltage starts to decrease, remove battery from line and power bus from backup feed.</p> <p>(3) Reverse current only if buses are tied.</p>
<b>5 UNSTAGED</b>   <p><b>Bat tb abnormal</b></p>	<pre> graph TD     A[Bat tb abnormal] --&gt; B[1 Ck amps. •POWER/TEMP MON - affected bat Amps zero?]     B -- NO --&gt; C[4 ECA RELAY CONTACT OR TB FAILURE]     B -- YES --&gt; D[2 Attempt reset. •(Faulty bat) HI VOLT- OFF/RESET, then ON Amps zero?]     D -- NO --&gt; E[5 INADVERTENT BAT TRIP OR TRANSIENT ECA FAILURE]     D -- YES --&gt; F[3 ECA FAILED.]     </pre>	<p>A 300LM4-1009</p>

LIM MALFUNCTION PROCEDURES

SOURCE LM AOH  
DATE MARCH 16, 1970

**LMA790-3-LM**  
**APOLLO OPERATIONS HANDBOOK**

SYMPTOM	PROCEDURE	REMARKS
<b>6</b>  <b>YELLOW</b> Light on if: Bus A a-c voltage <112 volts Frequency <398 cps or >402 cps	<p>1 EL failed?</p> <p>NO → 2 POWER/TEMP MON-AC BUS VOLTS- green band?</p> <p>YES → 3 Select alt inverter            •cb (11) EPS: INV 1 - close            •INVERTER-1</p> <p>4 INVERTER NO. 2 FREQUENCY FAILURE</p> <p>5 cb/AC BUS B: BUS TIE INV 1 - open            cb/AC BUS A: BUS TIE INV 1 - open</p> <p>INVERTER It - off?</p> <p>YES → 6 INVERTER NO. 1 FEEDER SHORT</p> <p>7 CWEA OR SIG COND FAILURE</p> <p>8 Select alt inverter            •cb/AC BUS B: BUS TIE INV 1 - close            •cb/AC BUS A: BUS TIE INV 1 - close            •cb (11) EPS: INV 1 - close            •INVERTER-1</p> <p>INVERTER It - off?</p> <p>YES → 9 Reconfigure.            •INVERTER-2            •cb (11) EPS: INV 1 - open</p>	<p>1 Assumption: Inverter No. 2 is on. If inverter No. 1 is operating, replace all references to inverter No. 2 with inverter No. 1.</p> <p>2 INVERTER It remains on.</p> <p>3 Monitor a-c voltage on VOLTS ind.</p>
<b>6a</b>  (out of green band)	<p>NO → 10 Select alt inverter.            •cb (11) EPS: INV 1 - close            •INVERTER-1</p> <p>A-C volts norm?</p> <p>YES → 11 INVERTER NO. 2 VOLTAGE FAILURE</p> <p>12 •cb (16) EPS: INV 2 - open</p> <p>13 cb/AC BUS B: BUS TIE INV 1 &amp; 2 - open            cb/AC BUS A: BUS TIE INV 2 - open</p> <p>INVERTER It - off?</p> <p>NO → 16 cb/AC BUS B: BUS TIE INV 1 - close            cb/AC BUS A: BUS TIE INV 1 - open</p> <p>Numeric Its brighten?</p> <p>YES → 20 A-C BUS A SHORTED.</p> <p>EPS SSR-1</p> <p>BUS FUNCTIONS LOST</p> <p>17 CWEA OR SIG COND FAILURE</p> <p>18 A-C BUS B SHORTED.</p> <p>19 •cb (16) EPS: INV 2 - open</p> <p>21 Reconfigure.            •INVERTER-2            •cb/AC BUS A: BUS TIE INV 1 - close            •cb/AC BUS A &amp; B: BUS TIE INV 2 - close            •cb (11) EPS: INV 1 - open</p> <p>22 Reconfigure.            •cb/AC BUS B: BUS TIE INV 1 - open            •cb/AC BUS A: BUS TIE INV 2 - close            •INVERTER-2            •cb (11) EPS: INV 1 - open</p> <p>EPS SSR-1</p> <p>BUS FUNCTIONS LOST</p>	6 THRU SSR-1

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**SPECIAL SUBROUTINE  
SSR-1**

**Bus functions lost**

**AC BUS B**

AC BUS B: SE WIND HTR  
He/PGNS PROPUL DISP  
He MON  
DES QTY  
S BD ANT  
Auto/man ant slew  
ORDEAL  
AGS  
AGS att mon  
AOT LAMP (R)  
SE FDAI  
NUM LTC  
BUS TIE INV 2  
BUS TIE INV 1

**AC BUS A**

AC BUS A: BUS TIE INV 2  
BUS TIE INV 1  
AC BUS VOLT  
AC bus monitor  
CDR WIND HTR  
TAPE RCDR  
AOT LAMP (R)  
RNDZ RDR  
Auto/man ant slew  
DECA GMBL  
GDA lock-up  
Man thrott  
Thrust to 100%  
INTGL LTC  
CDR FDAI  
GASTA  
PGNS att & rate needles  
RNG/RNG RT ALT/ALT RT meter

**CDR BUS**

FLT DISP: ORDEAL  
COAS  
CDR FDAI & alt needles  
GASTA  
PGNS alt & rate needles  
RNG/RNG RT ALT/ALT RT meter  
CDR X - PNTR  
MISSION TIMER  
THRUST meter

RCS SYS A: ASC FEED 1  
Last position  
ASC FEED 2  
Last position  
ISOL VLV  
Last position  
QUAD 1 TCA }  
QUAD 2 TCA } All close  
QUAD 3 TCA }  
QUAD 4 TCA }  
MAIN SOV  
Last position

PROPL: DES He REG/VENT  
REQ — last position  
VENT — disabled

HTR: RNDZ RDR STBY heaters  
RNDZ RDR OPR heaters  
LDG RDR heater  
AOT heater  
DOCK WINDOW heater

INST: SIG CONDR 1  
Propellant tb's  
Some meters  
Some CWEA Its come on

STAB/CONT: ABORT STAGE (R, except no auto eng arm)  
ATCA PGNS  
LGC control of RCS  
AELD (R)  
ENG CONT  
DPS abort stage  
ATT DIR CONT  
ENG START OVRD  
Manual start  
DECA PWR  
DPS eng-on comm  
DPS shuts down  
Eng to 100% throttle  
No auto-eng off

ED: LDG GEAR FLAG  
LOGIC PWR A

LTG: ANUN/DOCK/COMPNT  
Lighting (R)

PGNS: IMP OPR  
IMU STBY  
LGC/DISKY  
RNDZ RDR  
LDG RDR  
SIG STR DISP

COMM: CDR AUDIO center  
VHF A RCVR  
VHF B XMTR  
SEC S BD XMTR/RCVR  
SEC S BD PWR AMPL  
UP DATA LINK

ECS: GLYCOL PUMP AUTO TRNFR  
GLYCOL PUMP 1  
GLYCOL PUMP 2  
CABIN FAN 1  
SUIT FAN 1

HEATERS RCS SYS A/B-1: QUAD 1 heater  
QUAD 2 heater  
QUAD 3 heater  
QUAD 4 heater

EPS: DES ECA CONT (R)  
DES ECA (R)  
ASC ECA CONT (R)  
ASC ECA (R)  
INV 1  
DC BUS VOLT

**LMP BUS**

FLT DISP: EVENT TIMER/SE FDAI &  
rate needles  
SE X-PTNR

RCS SYS B: ASC FEED 1  
Last position  
ASC FEED 2  
Last position  
ISOL VLV  
Last position  
QUAD 1 TCA }  
QUAD 2 TCA } All close  
QUAD 3 TCA }  
QUAD 4 TCA }  
CRSF  
Last position  
TEMP/PRESS DISP FLAG  
PQGS DISP

RCS qty  
MAIN SOV  
Last position

PROPL: DISP/ENG OVRD LOGIC  
MPS meters inoperative  
PQGS  
FUEL/OX qtys  
ASC He REG  
Last position

INST: SIG CONDR 2  
EPS tb's  
Some meters  
Some CWEA Its come on  
PCM/TE  
TM XMT  
Timing signals  
SIG SENSOR  
CWEA

STAB/CONT: DES ENG OVRD  
ATCA (AGS)

AGS stab cont  
ABORT STAGE (R, except no eng fire enable)  
ATCA  
RR-LGC mode lost  
False TCA firings  
AELD (R)  
Auto APS commands  
ASA  
AGS  
ENG ARM  
DPS/APS auto eng ON/OFF  
DPS/APS shuts down  
AEA  
AGS

ED: LOGIC PWR B

LTG: MASTER ALARM  
ANUN/DOCK/COMPNT (R)  
TRACK light  
FLOOD lighting

COMM: DISP

S-bd ant  
SE AUDIO  
VHF A XMTR  
VHF B RCVR  
PRIM S BD PWR AMPL  
PRIM S BD XMTR/RCVR  
S BD ANT  
Auto/man ant slew

PMP  
VHF RCV  
S-BAND XMT/RCV

TV  
ECS: SUIT FLOW CONT  
Torn-suit protection  
SUIT/CABIN REPRESS

DISP  
GLYCOL PUMP SEC  
CABIN FAN 2  
CABIN FAN CONT  
CABIN REPRESS  
Auto repress

SUIT FAN 2  
SUIT FAN ΔP  
DIVERT VLV  
Auto close  
CO<sub>2</sub> SENSOR

EPS: DES ECA CONT (R)  
DES ECA (R)  
ASC ECA CONT (R)  
ASC ECA (R)  
INV 2

DC BUS VOLT  
DISP  
Volts/amps  
Tb's

CAMR: SEQ

HTR RCS SYS A/B-2: S-BD ANT heater

DISP  
QUAD 4 heater  
QUAD 3 heater  
QUAD 2 heater  
QUAD 1 heater

LM MALFUNCTION PROCEDURES

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COMM MALFUNCTION INDEX

- 1 LOSS OF ICS
- 2 ONE CREWMAN HAS ABNORMAL (UNSELECTED) HOT MIKE
- 3 LOSS OF VHF VOICE COMM WITH CSM
- 4 LOSS OF S-BAND VOICE COMM

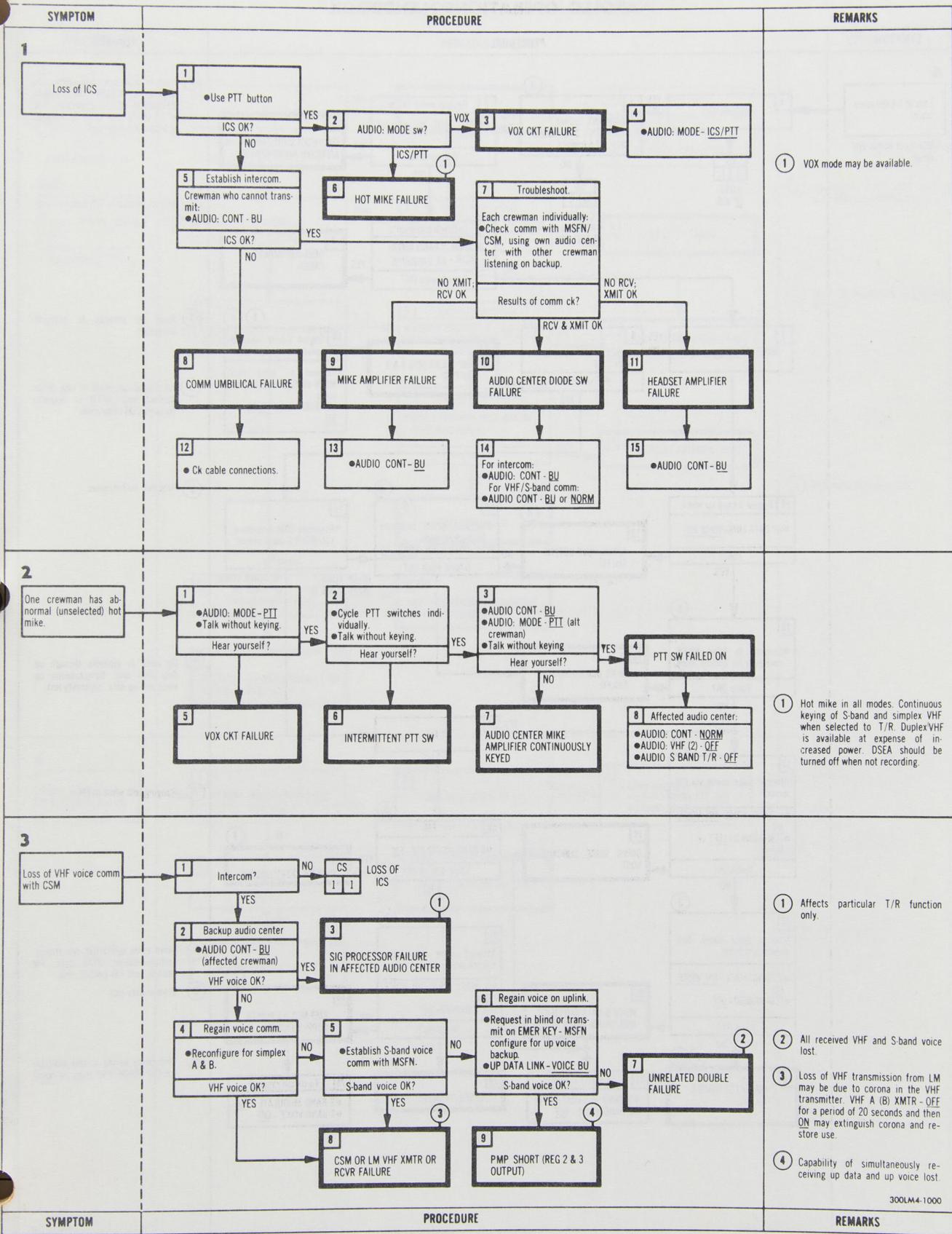
5

S BD RCVR

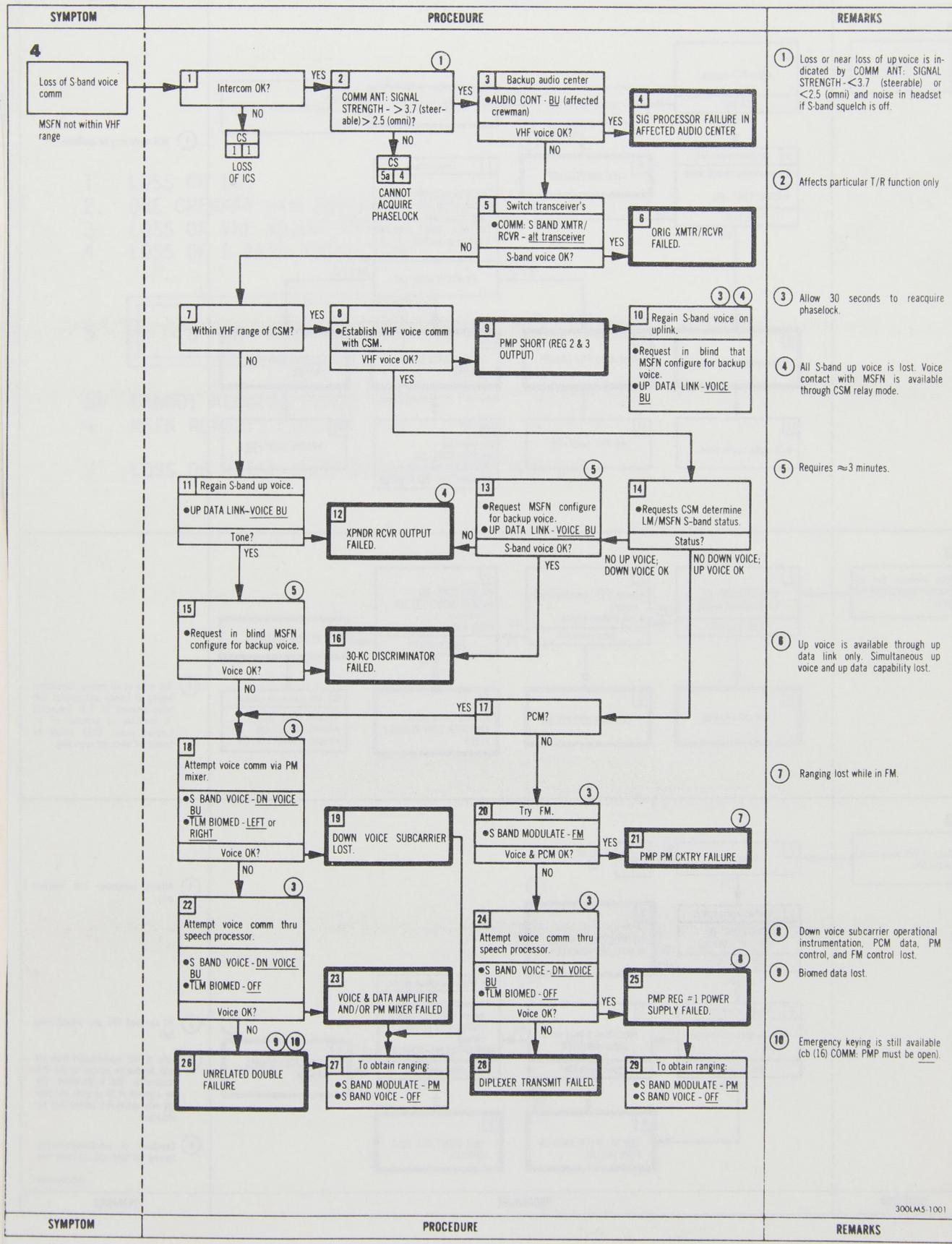
- 5a CANNOT ACQUIRE PHASE LOCK
- 6 MSFN REPORTS LOSS OF PCM. S-BAND VOICE OK
- 7 LOSS OF VOICE COMM WITH EVA (ONE MAN EVA)

LM MALFUNCTION PROCEDURES

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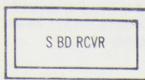
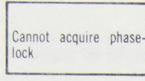
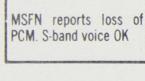


LM MALFUNCTION PROCEDURES

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## LM MALFUNCTION PROCEDURES

SYMPTOM	PROCEDURE	REMARKS
<b>5</b>  <b>5a</b> 	<pre>     graph TD       1[S-band comm retained?] -- NO --&gt; 2[CWEA FAILED.]       1 -- YES --&gt; 3[Reset light. • S BAND RANGE-OFF/RESET, then TV/CWEA ENABLE If light not off: • S BAND RANGE-OFF/RESET]        4[Antenna?]       4 -- OMNI --&gt; 5[Switch transceivers. • S BAND XMTR/RCVR - SEC (PRIM)]       5 -- Phaselock? --&gt; 6[DIPLEXER FAILED.]       5 -- YES --&gt; 7[Antenna responds to manual pointing cmd?]       7 -- NO --&gt; 10[Select omni antenna. • Select favorable omni antenna (V64E if necessary).]       10 -- Phaselock? --&gt; 11[STEERABLE ANTENNA FAILED.]       10 -- YES --&gt; 8[Switch transceivers. • S BAND XMTR/RCVR - SEC (PRIM)]       8 -- Phaselock? --&gt; 9[PRIM (SEC) XMTR/RCVR FAILED.]       8 -- YES --&gt; 12[DIPLEXER FAILED.]       12 --&gt; 13[This initial activation?]       13 -- NO --&gt; 15[STEERABLE ANTENNA TOTALLY OR PARTIALLY IMMOBILIZED.]       13 -- YES --&gt; 14[ANTENNA LOCKING MECHANISM FAILED TO RELEASE.]     </pre>	<p>(1) Assumption: VHF voice contacts with CSM were attempted.</p> <p>(2) Allow 30 seconds for phaselock acquisition.</p> <p>(3) All S-band functions lost.</p>
<b>6</b> 	<pre>     graph TD       1[S BAND MODULATE-FM (PM) PCM OK?] -- NO --&gt; 4[TLM PCM-LO (H)]       1 -- YES --&gt; 2[PMP FAILURE (PM MIXER)]       2 --&gt; 3[When ranging desired: • S BAND MODULATE - PM • S BAND RANGE - RANGE]        4 -- PCM OK? --&gt; 5[PCMTEA HBR (LBR) CIRCUIT FAILURE]       4 -- NO --&gt; 6[PMP OR PCMTEA FAILURE]     </pre>	<p>(1) Simultaneous ranging and PCM capability lost.</p> <p>(2) HBR (LBR) PCM lost.</p> <p>(3) S-band telemetry lost.</p>

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SYMPOTM	PROCEDURE	REMARKS
<p><b>7</b></p> <p>Loss of voice comm with EVA (one-man EVA)</p>	<pre> graph TD     1[MSFN/LM comm OK?] -- NO --&gt; 2[AUDIO CONT - BU BU audio center: • RELAY ON (8 or 12) — RELAY OFF]     1 -- YES --&gt; 5[Notify MSFN of problem BU audio center: • RELAY ON (12 or 8) — RELAY OFF Audio center: • AUDIO: VHF B - T/R • COMM: VHF B - XMTR — VOICE]     2 -- Comm OK? -- NO --&gt; 3[cb COMM: AUDIO (2) - open • Connect to alternate crewman's umbilical. cb COMM: AUDIO (2) - close]     2 -- Comm OK? -- YES --&gt; 4[UMBILICAL FAILURE]     3 -- Comm OK? -- NO --&gt; 4[UMBILICAL FAILURE]     3 -- Comm OK? -- YES --&gt; 6[AUDIO CENTER FAILURE]     5 -- Comm OK? -- NO --&gt; 10[TOTAL VHF VOICE COMM FAILURE OF EVA OR LM (COMM CARRIER, EVA PWR SUPPLY, DIPLEXER, ETC)]     5 -- Comm OK? -- YES --&gt; 8[LM XMTR A OR LM RCVR B OR EVA XMTR B OR EVA RCVR A FAILURE]     6 --&gt; 8     8 --&gt; 9[LM may be reconfigured to backup - relay mode if desired.]     9 --&gt; 11[If MSFN originally reported no loss of EMU data, return to normal relay configuration.]   </pre>	<p>① EVA will wait at least 3 minutes following communications loss before changing modes.</p> <p>② Configures LM for transmission and reception on both VHF frequencies.</p> <p>③ Loss of EMU data relay capability</p>
SYMPOTM	PROCEDURE	REMARKS

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LM MALFUNCTION PROCEDURES

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ECS MALFUNCTION INDEX

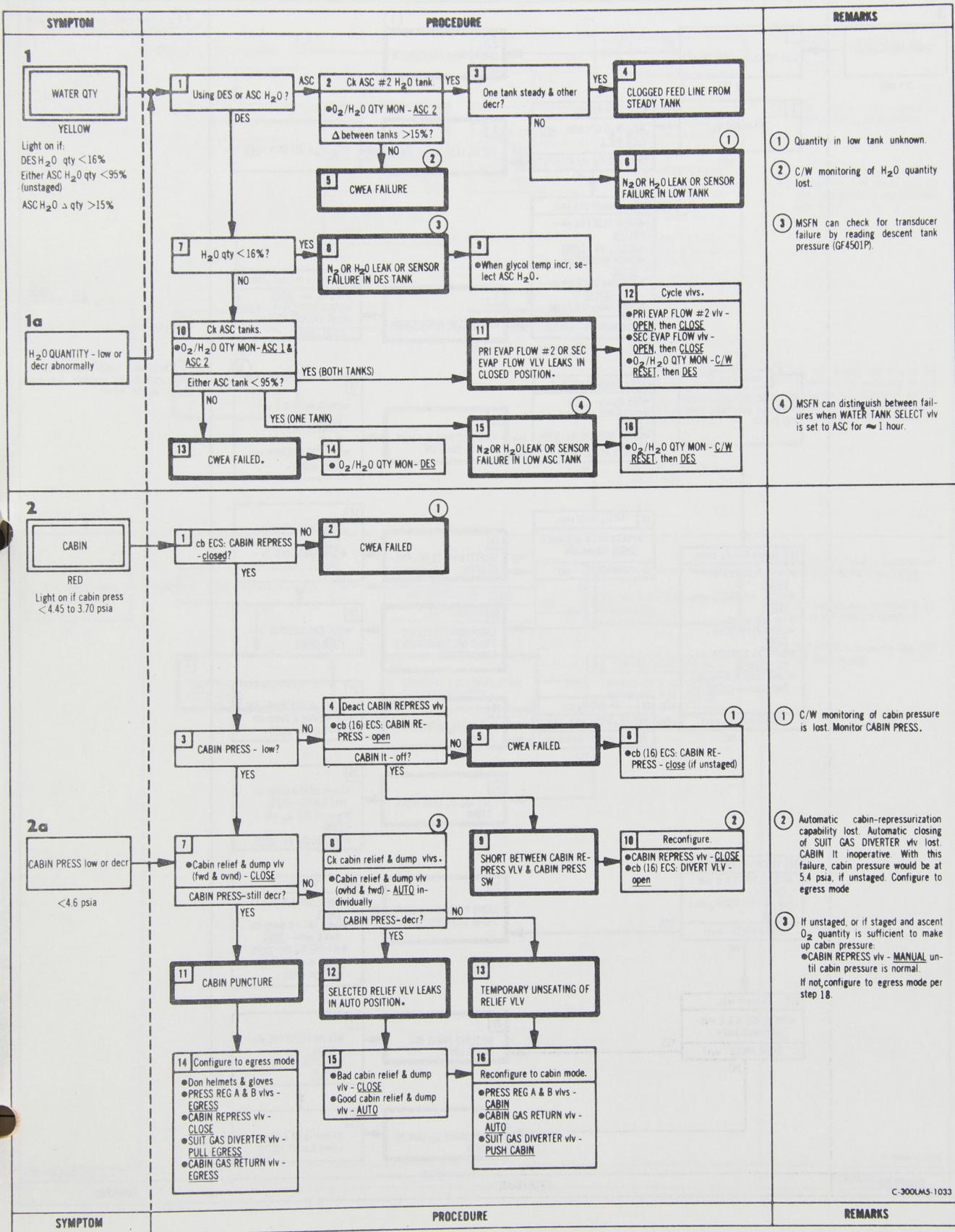
1	WATER QTY	8	GLYCOL
1a	H <sub>2</sub> O QUANTITY-LOW OR DECR ABNORMALLY	8a	GLYCOL TEMP - HIGH OR INCR
2	CABIN	9	GLYCOL
2a	CABIN PRESS-LOW OR DECR		
3	CABIN PRESS - HIGH		
4	SUIT/FAN	10	GLYCOL PRESS LOW OR DECR
4a	SUIT PRESS-LOW		
5	SUIT PRESS-HIGH (EGRESS MODE)		
6	O <sub>2</sub> QTY		
6a	O <sub>2</sub> QUANTITY - LOW OR DECR		
7	ECS		
7a	SUIT FAN		
7b	H <sub>2</sub> O SEP		
7c	CO <sub>2</sub>		
7d	PART PRESS CO <sub>2</sub> - HIGH		
7e	GLYCOL		

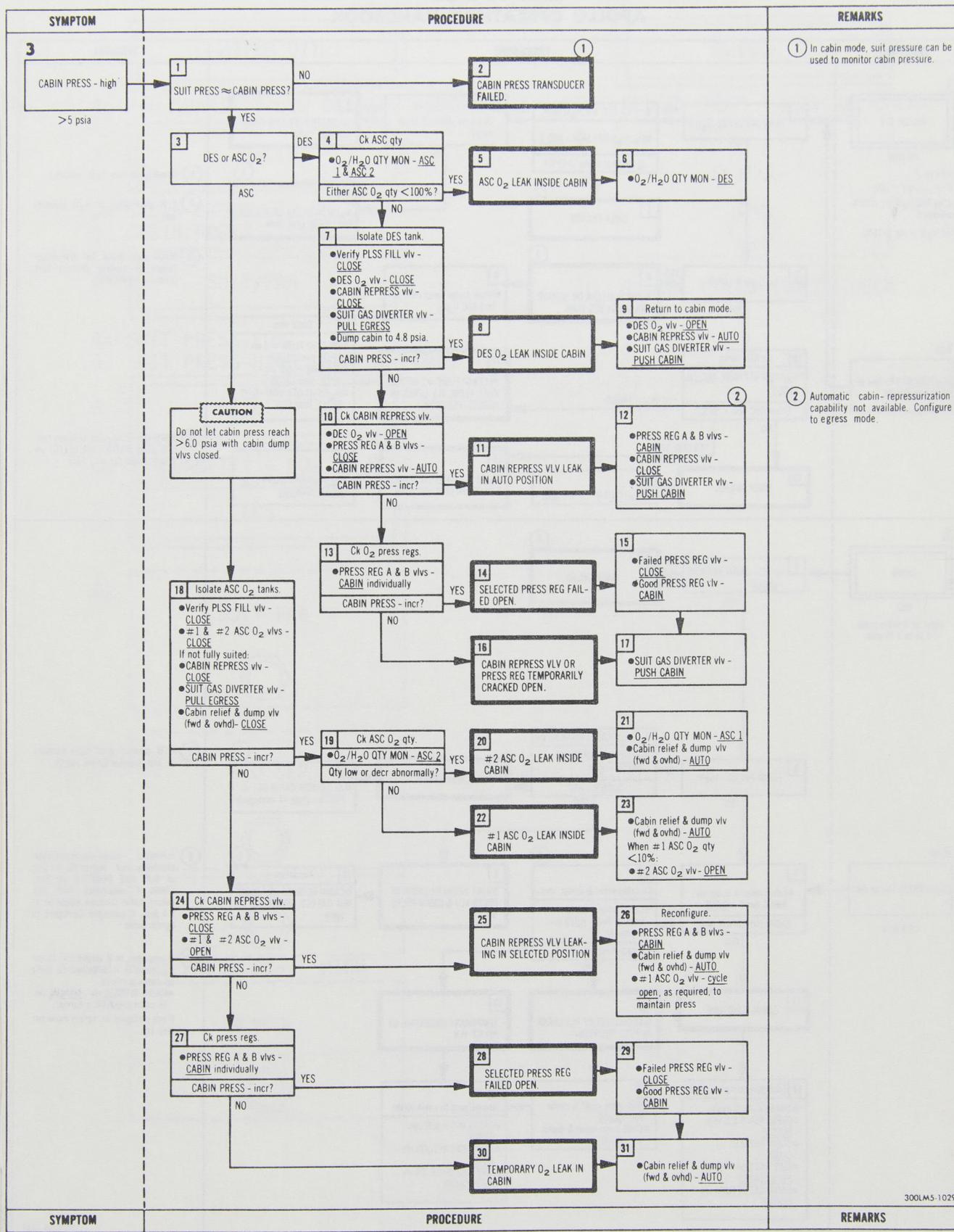
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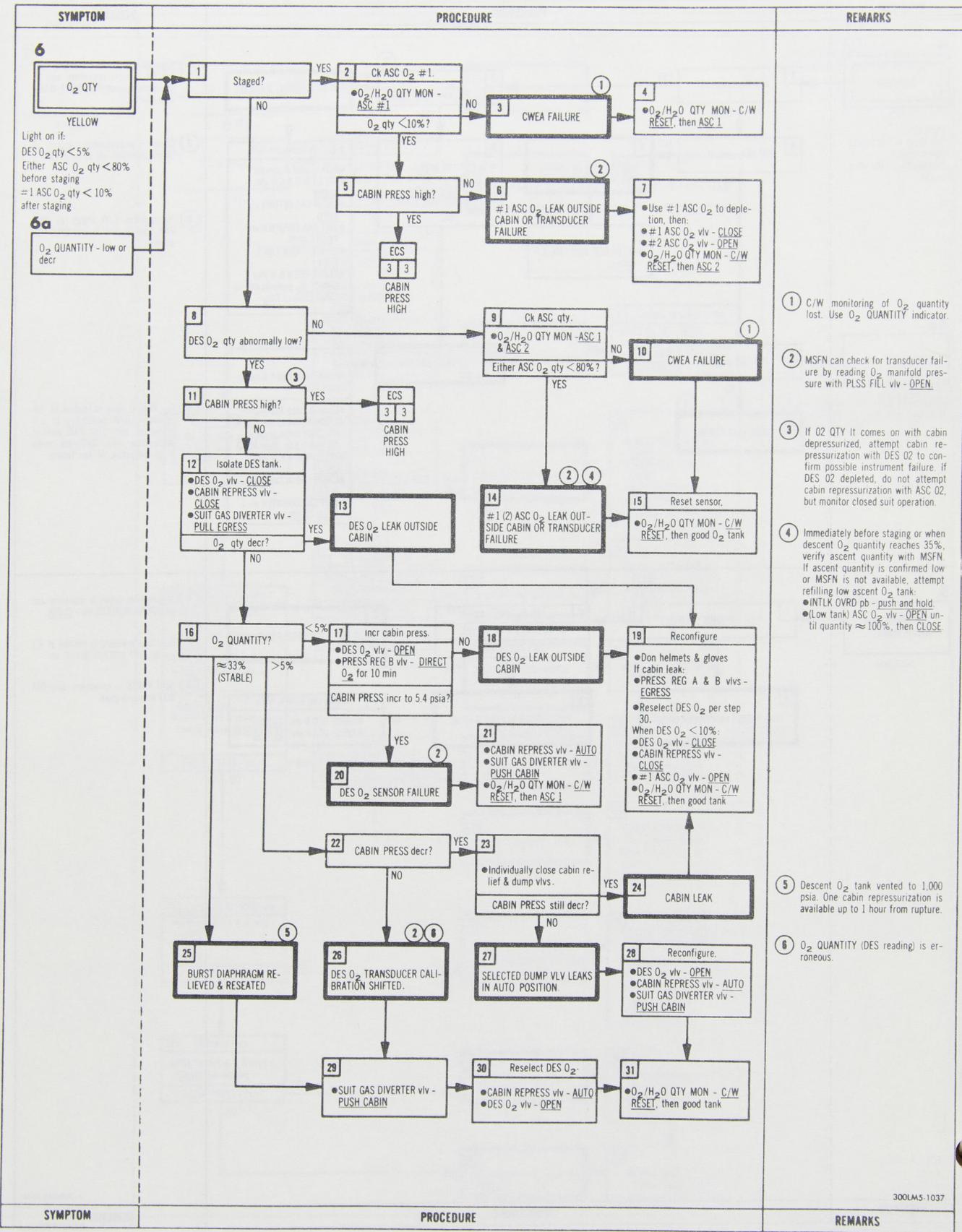
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LM MALFUNCTION PROCEDURES

SYMPTOM	PROCEDURE	REMARKS
<b>4</b>  RED Light on if: Suit press <3.12 psia in egress mode Suit fan No. 2 fails while in use	<p>1 PGA flow stopped? YES → 2 SUIT ISOL vlv - SUIT DISC?</p> <p>NO → 4 SUIT FAN comp It - on?</p> <p>YES → 5 SUIT FAN Δ P SW (INTERNAL) FAILED CLOSED</p> <p>NO → 8 cb (16) ECS: SUIT FAN Δ P - open</p> <p>2 SUIT ISOL vlv - SUIT DISC? YES → 3 SUIT FAN NO. 2 FAILED.</p> <p>NO → 6 • Ck PGA cuff gage. • SUIT ISOL vlv (CDR &amp; LMP) - SUIT FLOW (hold) • cb (16) ECS: SUIT FLOW CONT - open</p> <p>3 SUIT FAN NO. 2 FAILED.</p> <p>7 Reconfigure ECS.            • Doff helmet &amp; gloves            • PRESS REG A &amp; B vlv - CABIN            • CABIN GAS RETURN vlv - AUTO            • SUIT GAS DIVERTER vlv - PUSH CABIN            • cb ECS: CABIN FAN 1 - close            • PRESS REG A &amp; B vlv - DIRECT O<sub>2</sub> periodically, to purge cabin of CO<sub>2</sub> </p>	<p>① Assumptions: (1) Suit warning: suit fan No. 1 is in operation; and (2) fan warning: suit fan No. 1 is inoperative.</p> <p>② Cabin repressurization occurs if CABIN REPRESS vlv is enabled.</p> <p>③ No suit/fan C/W inputs to SUIT FAN comp It, ECS It, and SUIT/FAN warn lt.</p>
<b>4a</b>  <3.6 psia	<p>9 PGA cuff gage low? YES → 10 PGA LEAK</p> <p>NO → 12 CWEA/INST FAILURE</p> <p>10 PGA LEAK → 11 Repressurize cabin &amp; reconfigure ECS.            • Close &amp; latch fwd hatch            • CABIN REPRESS vlv - MANUAL until cabin press is 4.6 to 5.0 psia, then AUTO            • PRESS REG A &amp; B vlv - CABIN            • CABIN GAS RETURN vlv - AUTO            • SUIT GAS DIVERTER vlv - PUSH CABIN         </p>	<p>④ O<sub>2</sub> flow is only indication of fan operation. C/W monitoring of suit protection lost. SUIT/FAN warn lt inoperative. Use SUIT/FAN comp lt as indication of fan failure.</p>
<b>5</b>  >4.0 psia	<p>1 PGA cuff press &gt;4.0 psi? YES → 2 Ck O<sub>2</sub> press reg.            • PRESS REG A vlv - CLOSE            SUIT PRESS-decr?</p> <p>NO → 4 SUIT PRESS TRANSDUCER OR SIG COND FAILED</p> <p>2 Ck O<sub>2</sub> press reg.            • PRESS REG A vlv - CLOSE            SUIT PRESS-decr? YES → 3 PRESS REG A VLV REGULATING HIGH OR FAILED OPEN.</p> <p>NO → 5 PRESS REG B VLV REGULATING HIGH OR FAILED OPEN.</p> <p>3 PRESS REG A VLV REGULATING HIGH OR FAILED OPEN.</p> <p>6 Reset PRESS REG A vlv.            • PRESS REG B vlv - CLOSE            • PRESS REG A vlv - EGRESS         </p>	<p>① Assumption: Cabin is depressurized and CABIN REPRESS vlv - CLOSE.</p> <p>② Suit loop pressure is limited to 4.3 psi by SUIT CIRCUIT RELIEF vlv.</p> <p>③ SUIT PRESS is erroneous. Use PGA cuff pressure gage.</p>
SYMPTOM	PROCEDURE	REMARKS

4  
THRU  
6a7  
THRU  
8a9  
THRU  
10

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RESOURCE LM AOH  
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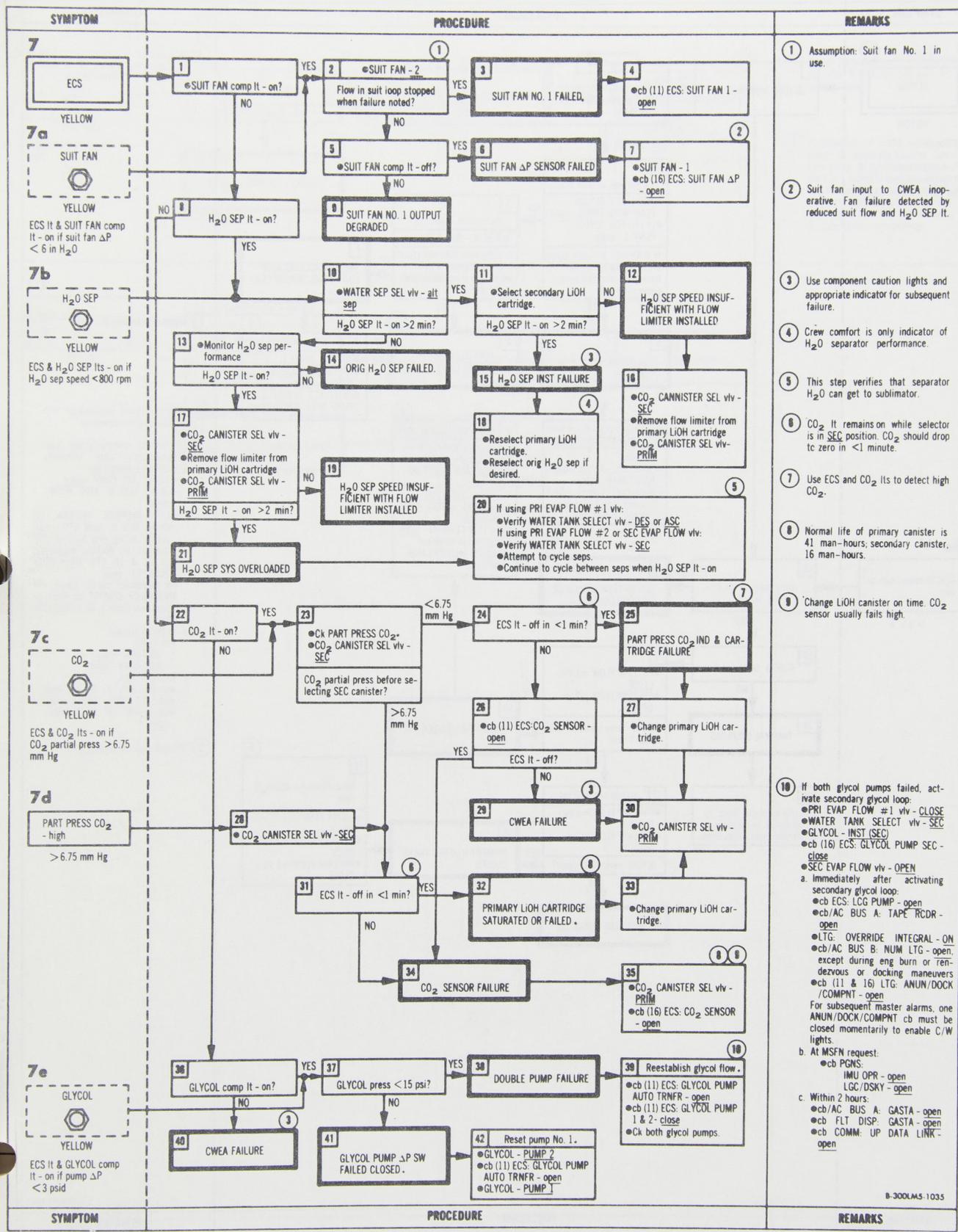
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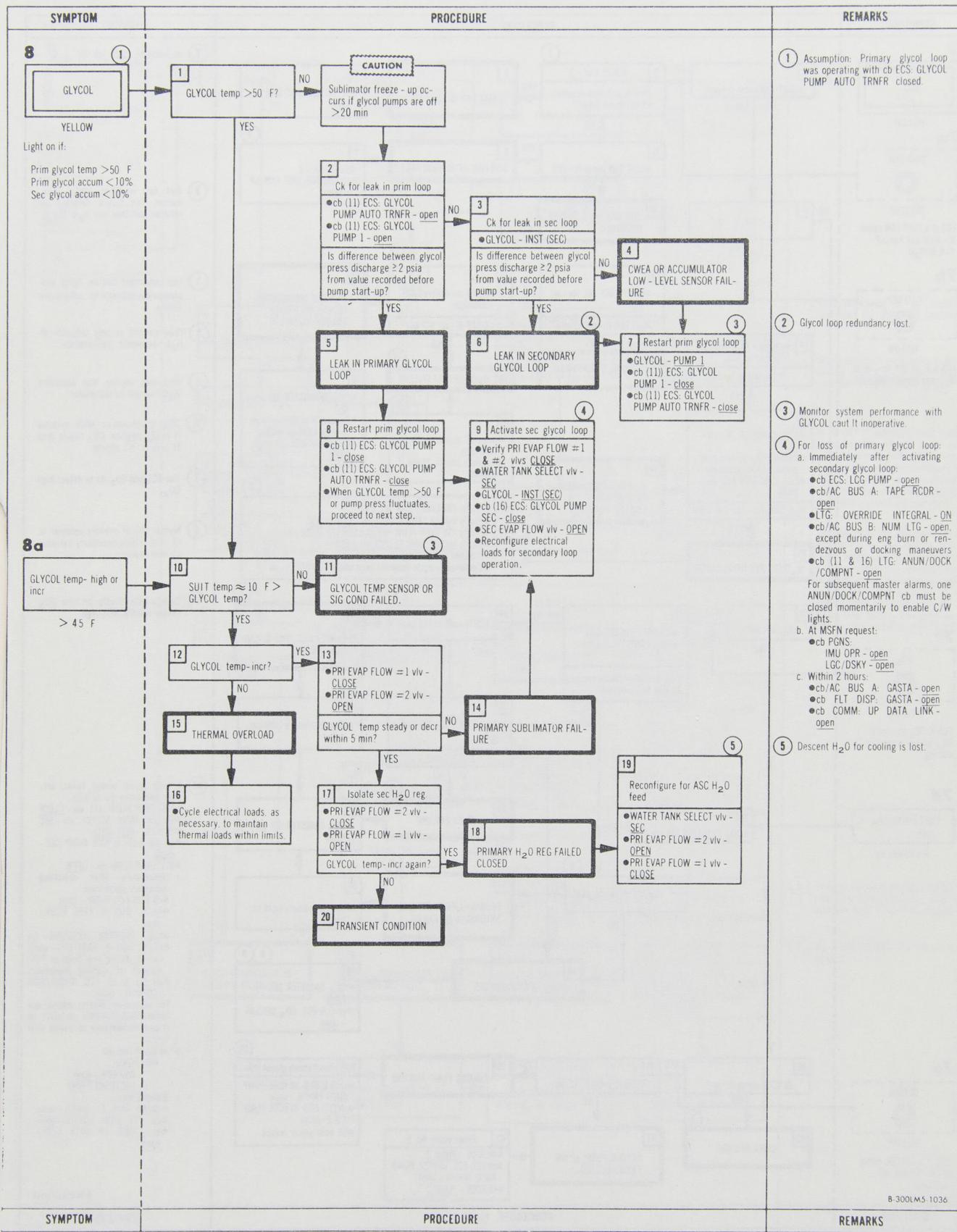
## LM MALFUNCTION PROCEDURES

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LM MALFUNCTION PROCEDURES

7 THRU  
8a9 THRU  
10

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## LM MALFUNCTION PROCEDURES

SYMPTOM	PROCEDURE	REMARKS
<b>9</b>  <b>GLYCOL</b> <b>YELLOW</b> Light on if pump $\Delta P < 3$ psid	<pre> graph LR     A[9 GLYCOL YELLOW Light on if pump ΔP &lt; 3 psid] --&gt; B[1 GLYCOL - PUMP 2 GLYCOL comp lt - on?]     B -- YES --&gt; C[2 GLYCOL COMP LT RELAY FAILED CLOSED.]     C --&gt; D[3 Reselect pump No. 1. cb (11) ECS: GLYCOL PUMP AUTO TRNFR - open GLYCOL - PUMP 1 cb (11) ECS: GLYCOL PUMP AUTO TRNFR - close]     B -- NO --&gt; E[4 GLYCOL PUMP NO. 1 FAILED.]   </pre>	<p>(1) Glycol pump automatic transfer is operable. Monitor GLYCOL ind. for pump failures.</p> <p>(2) A temporary <math>\Delta P</math> switch failure will result in automatic transfer. Confirm pump No. 1 failure by re-setting automatic transfer circuit and reselecting pump No. 1 while monitoring glycol pressure. Do not stop glycol flow for <math>&gt;2</math> minutes if sublimator is operating.</p>
<b>10</b> <b>GLYCOL press - low or decr</b> $<17$ psia	<pre> graph TD     A[10 GLYCOL press - low or decr &lt;17 psia] --&gt; B[1 Compare glycol pumps. cb (11) ECS: GLYCOL PUMP AUTO TRNFR - open GLYCOL - PUMP 2]     B -- YES --&gt; C[2 GLYCOL PUMP NO. 1 DEGRADED OR BYPASS VLV FAILED OPEN.]     C --&gt; D[3 cb (11) ECS: GLYCOL PUMP 1 - open]     B -- NO --&gt; E[4 GLYCOL PRESS TRANSDUCER CALIBRATION SHIFTED.]     E --&gt; F[5 Reconfigure. GLYCOL - PUMP 1 cb (11) ECS: GLYCOL PUMP AUTO TRNFR - close]   </pre>	
SYMPOTM	PROCEDURE	REMARKS

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LM MALFUNCTION PROCEDURES

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ED MALFUNCTION INDEX

- 1 ED RELAYS
- 2 STAGE SEQ RLY SYS A & B  
LTS - OFF WHEN MASTER ARM - ON

LM MALFUNCTION PROCEDURES

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LMA790-3-LM  
APOLLO OPERATIONS HANDBOOK

## LM MALFUNCTION PROCEDURES

SYMPTOM	PROCEDURE	REMARKS
1  ED RELAYS YELLOW Light on if ED relays K1 through K6 are closed when MASTER ARM-OFF	<p>1 [1] STAGE SEQ RLY SYS A (B) It - on? YES → <b>WARNING</b> Partial staging may occur if MASTER ARM-ON NO → <b>CWEA FAILED.</b></p> <p>2 [3] ED SYS A (B) RELAY (K1, 2, 3, 4, 5, 5A, OR 6) FAILED CLOSED. ① → <b>4</b> Reset relay. •cb ED: LOGIC PWR A (B)-close •STAGE RELAY-RESET</p> <p>5 [5] ED SYS A (B) STAGE CMD RELAY K2 TEMPORARILY FAILED CLOSED.</p> <p>6 [6] •cb ED:LOGIC PWR A (B)-open 7 [7] Function desired? ABORT STAGE → <b>8</b> •cb ED: LOGIC PWR A (B)-close •Initiate abort stage sequence.</p> <p>10 [10] APS PRESS &amp; MANUAL STAGING SYS A → <b>9</b> •ASC He SEL-BOTH •MASTER ARM-ON •ASC He PRESS-FIRE •MASTER ARM-OFF When staging desired: •cb (11) ED: LOGIC PWR A-close •ASC He PRESS-FIRE (hold) •STAGE-FIRE •MASTER ARM-ON •ASC He PRESS-SAFE •MASTER ARM-OFF</p> <p>SYS B → <b>11</b> •ASC He SEL-BOTH •MASTER ARM-ON •ASC He PRESS-FIRE When staging desired: •STAGE-FIRE •cb (16) ED: LOGIC PWR B-close •ASC He PRESS-FIRE •MASTER ARM-OFF</p>	<p>① MSFN can confirm failure via telemetry.</p> <p>② This procedure provides for APS pressurization with ED system B, followed by APS pressurization with ED system A, and staging with ED systems A and B.</p> <p>③ This procedure provides for APS pressurization with ED system A; staging with ED system A, then ED system B; and pressurization with ED system B.</p>
2  STAGE SEQ RLY SYS A & B Its - off when MASTER ARM - ON	<p>1 [1] Recycle sw. •MASTER ARM-recycle</p> <p>2 [2] STAGE SEQ RLY SYS A &amp; B It - on? NO → <b>MASTER ARM SW FAILED OFF (DOUBLE FAILURE)</b> YES → <b>4</b> TRANSIENT CONDITION</p> <p>3 [3] Alt method of arming ED bus •cb S/C: ABORT STAGE (2) - open •ABORT STAGE pb - push ED RELAYS It - on MASTER ALARM - on •MASTER ALARM - reset •ED: (desired function) - FIRE •ABORT STAGE pb - reset •cb S/C: ABORT STAGE (2) - close</p>	<p>① This method pressurizes ascent tanks as soon as ABORT STAGE pb is pushed.</p>

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LM MALFUNCTION PROCEDURES

LM MALFUNCTION PROCEDURES

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HTRS MALFUNCTION INDEX

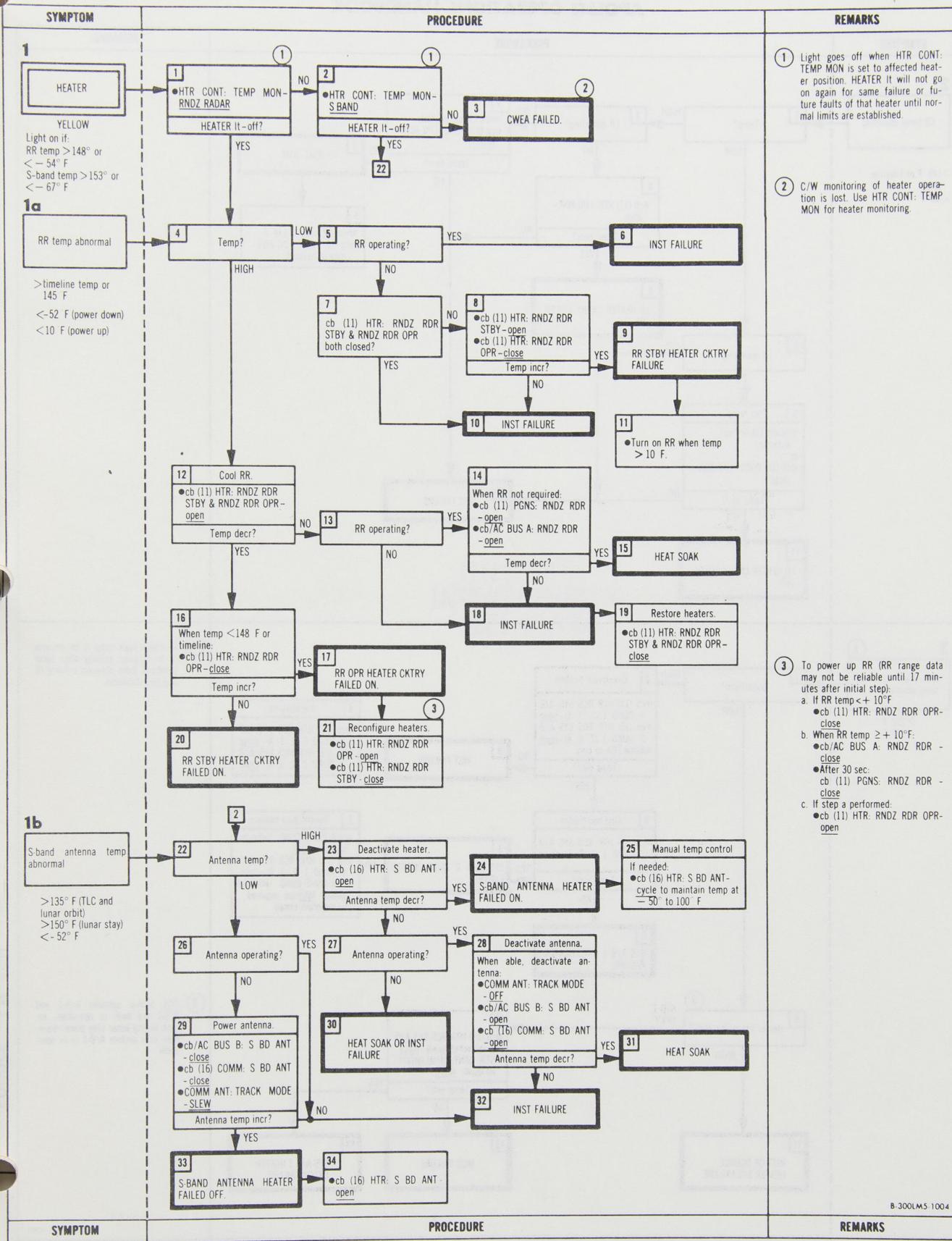
1

HEATER

- 1a RR TEMP ABNORMAL
- 1b S-BAND ANTENNA TEMP ABNORMAL
- 2 LR TEMP ABNORMAL
- 3 RCS QUAD 1 (2, 3, 4) TEMP ABNORMAL

LM MALFUNCTION PROCEDURES

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**LMA790-3-LM**  
**APOLLO OPERATIONS HANDBOOK**


**LMA790-3-LM**  
**APOLLO OPERATIONS HANDBOOK**

SYMPTOM	PROCEDURE	REMARKS
<b>2</b> LR temp abnormal  >145°F or timeline temp < 60°F	<p>1 Temp? HIGH → 2 LR operating?</p> <p>NO → 5 cb (11) HTR: LDG RDR - open Temp decr? YES → 7 LR HEATER CKTRY FAILED ON.</p> <p>YES → 3 When LR not needed: •cb (11) PGNS: LDG RDR - open Temp decr? YES → 4 HEAT SOAK When LR temp &lt;148°F: •cb (11) PGNS: LDG RDR - close (if needed)</p> <p>8 LR operating? YES → 9 Incr temp: •Orient LM to heat antenna. or •cb (11) PGNS: LDG RDR - close Temp incr? YES → 11 LR HEATER CKTRY FAILED OFF.</p> <p>NO → 10 INST FAILURE</p>	
<b>3</b> RCS quad 1 (2, 3, 4) temp abnormal  >190°F <125°F	<p>1 Quad temp? HIGH → 2 Deactivate heaters. •cb (11) HTR RCS SYS A/B 1: QUAD 1 (2, 3, 4)-open •cb (16) HTR RCS SYS A/B 2: QUAD 1 (2, 3, 4)-open •Allow TCA to cool. Temp decr? YES → 3 INST FAILURE NO → 4 Reconfigure •cb (11) HTR RCS SYS A/B 1: QUAD 1 (2, 3, 4)-close •cb (16) HTR RCS SYS A/B 2: QUAD 1 (2, 3, 4)-close</p> <p>5 Find bad heater •cb (16) HTR RCS SYS A/B 2: QUAD 1 (2, 3, 4)-close Temp incr? YES → 6 SYS A/B 2 AUTO HEATER FAILURE NO → 7 Reconfigure heaters •HTR CONT: QUAD (affected quad) - DEF •cb (11) HTR RCS SYS A/B 1: QUAD 1 (2, 3, 4)-close •HTR CONT: QUAD (affected quad) - MAN (as required to maintain temp)</p> <p>8 SYS A/B 1 AUTO HEATER FAILURE</p> <p>9 Heater sys in operation? A/B 1 ONLY → 10 •cb (16) HTR RCS SYS A/B 2: (affected quad)- close •HTR: CONT: QUAD (affected quad) - AUTO Temp incr? YES → 13 SYS A/B 1 HEATER CKTRY FAILURE NO → 12 INST FAILURE</p> <p>BOTH → 11 INST OR DOUBLE HEATER SYS FAILURE</p>	<p>① Abnormal high temp is for periods of no thruster activity after temp soakback from previous activity (if any) has stabilized.</p> <p>② RCS heater systems A/B-1 and A/B-2 are both in operation, except during lunar stay power-down; then only system A/B-1 is in operation.</p>
<b>SYMPOTM</b>	<b>PROCEDURE</b>	<b>REMARKS</b>

LM MALFUNCTION PROCEDURES

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CAMERA MALFUNCTION INDEX16mm

- A CANNOT START CAMERA
- B CANNOT STOP CAMERA
- C CAMERA STOPS IMMEDIATELY AFTER START
- D CAMERA RUNS 24 FPS IN ALL MODES SELECTED
- E CAMERA RUNS BUT FILM NOT TRANSPORTING

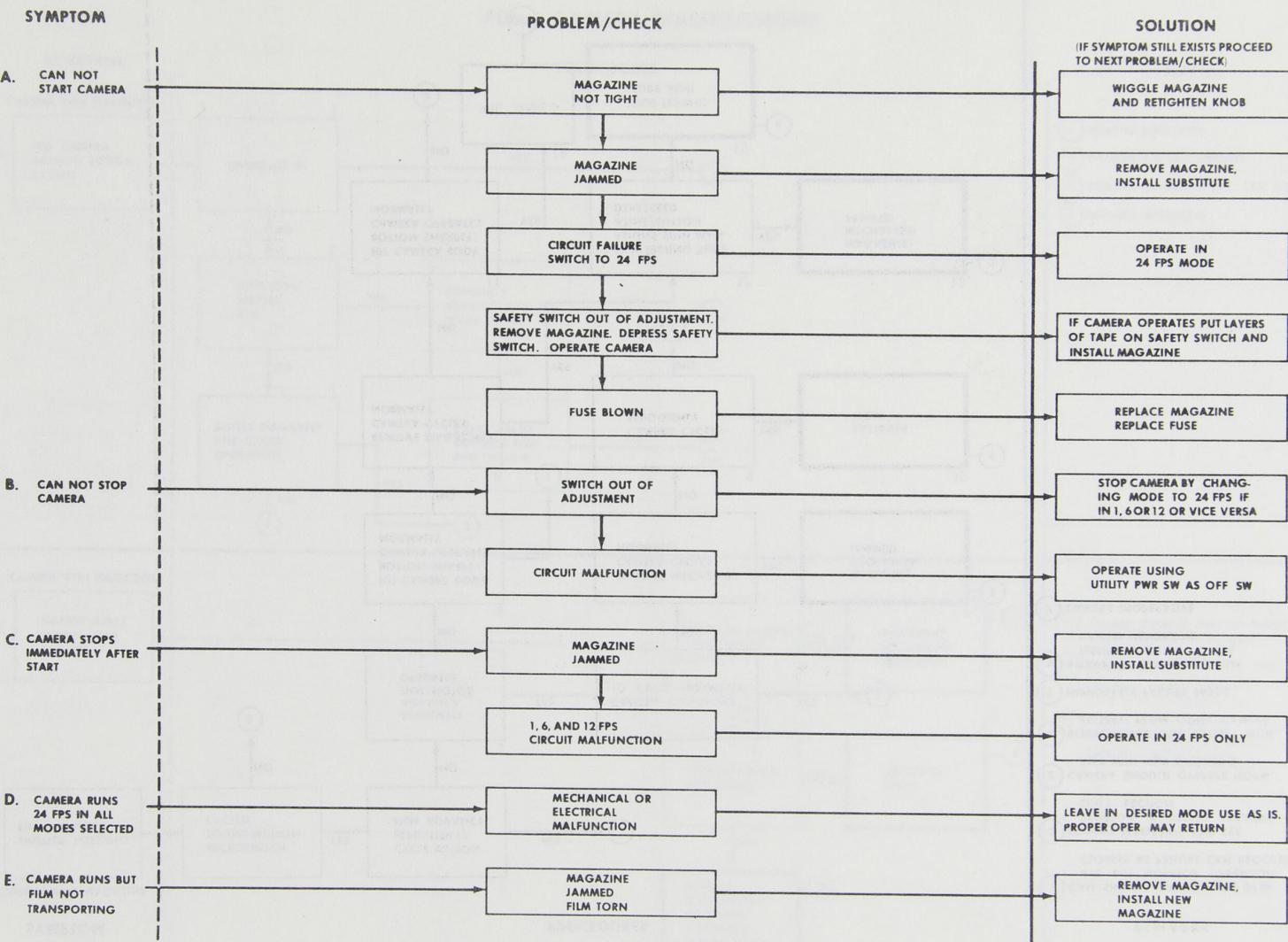
70mm

- I CAMERA WITH MAGAZINE
  - A SHUTTER FIRES/NO FILM ADVANCE
  - B NO CAMERA ACTION/BUTTON CYCLED
  - C SHUTTER FIRES/PARTIAL FILM ADVANCE
  - D CANNOT ATTACH LENS
- II CAMERA ONLY
  - A NO CAMERA ACTION/BUTTON CYCLED
- III CAMERA WITH MAGAZINE (EVA)
  - A NO CAMERA ACTION
  - B CAMERA BECOMES SLUGGISH

LM MALFUNCTION PROCEDURES

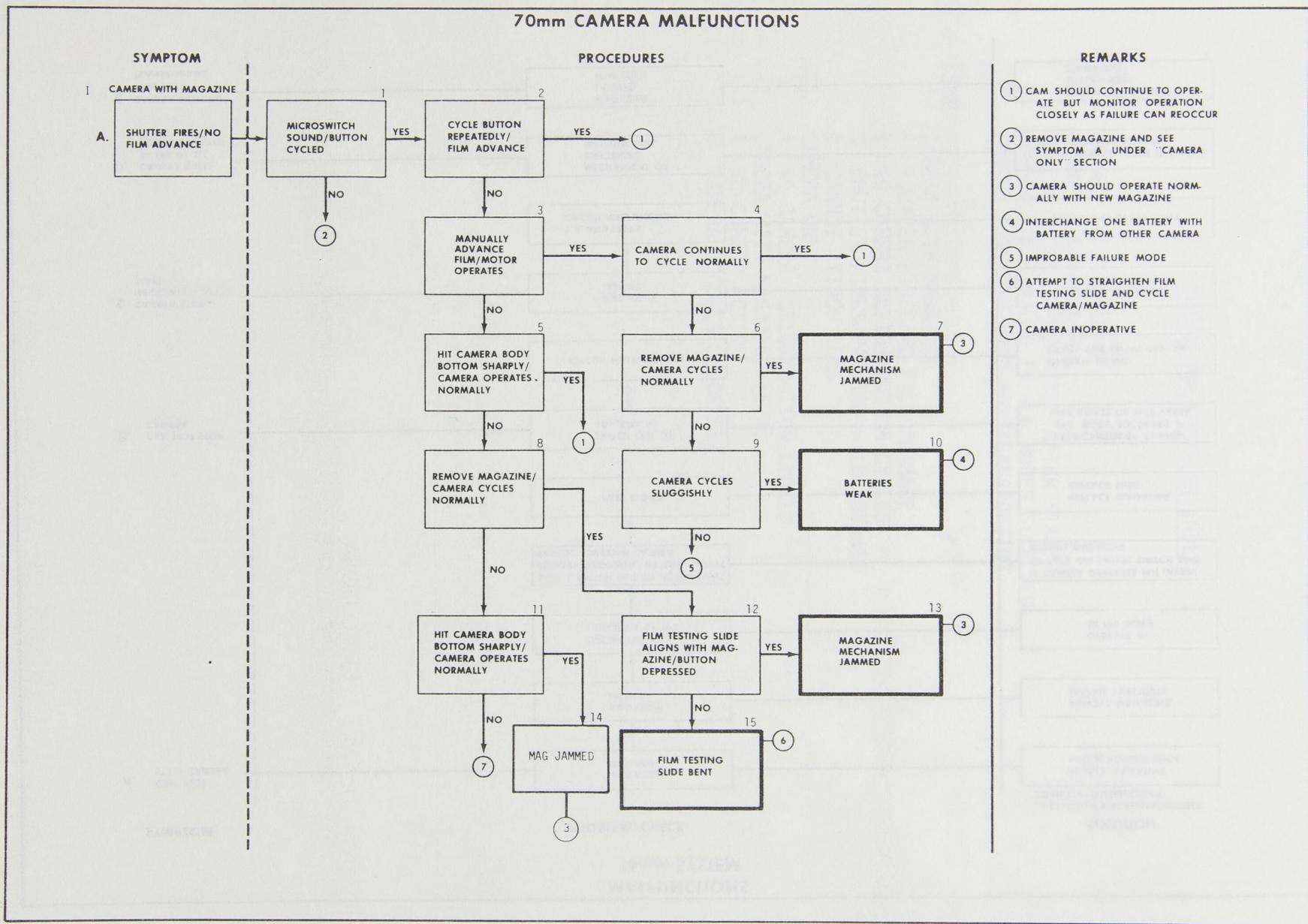
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MALFUNCTIONS  
16mm SYSTEM



16 A  
THRU  
70 IA  
mm  
II  
IB  
THRU  
IIA

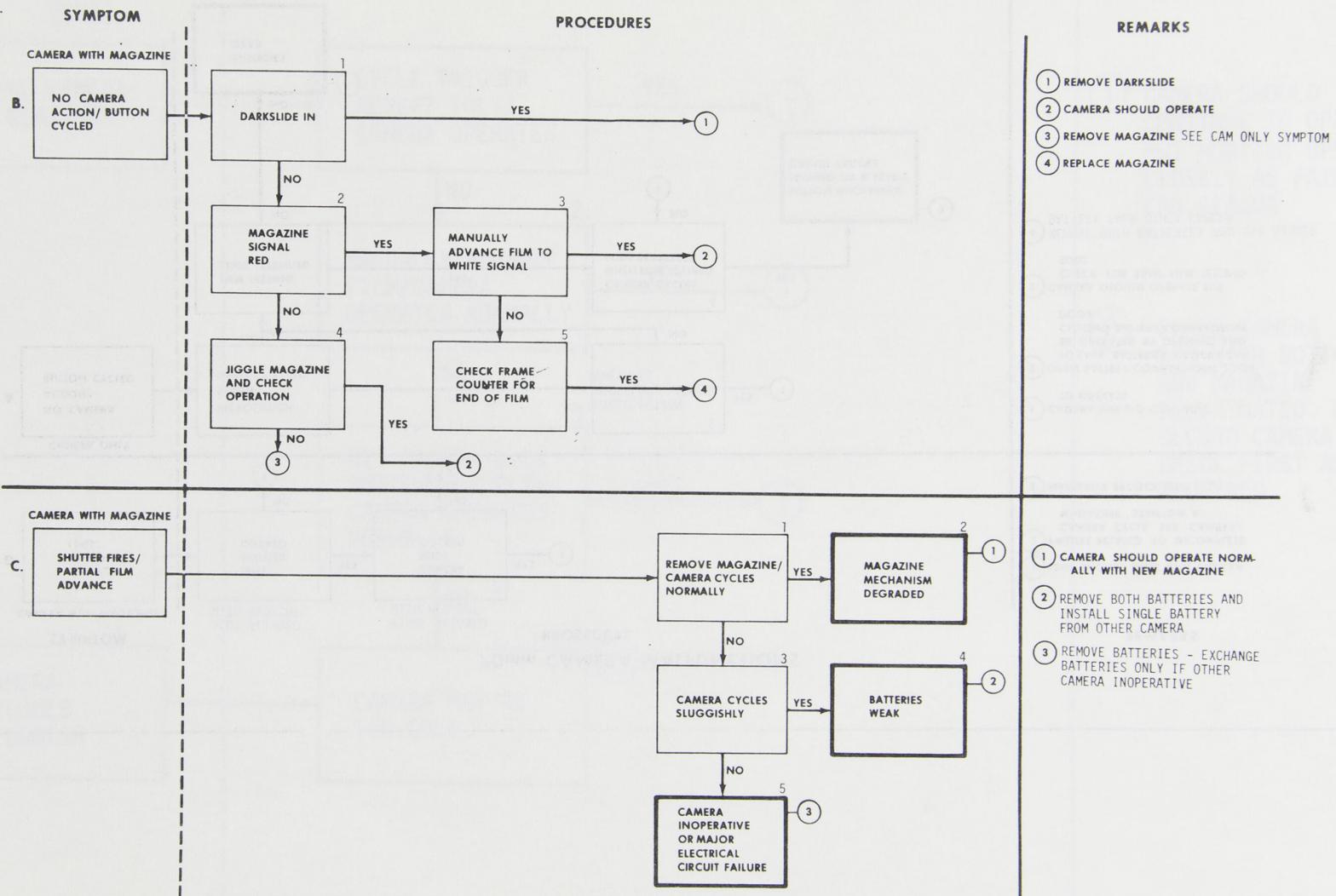
## 70mm CAMERA MALFUNCTIONS



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LM MALFUNCTION PROCEDURES

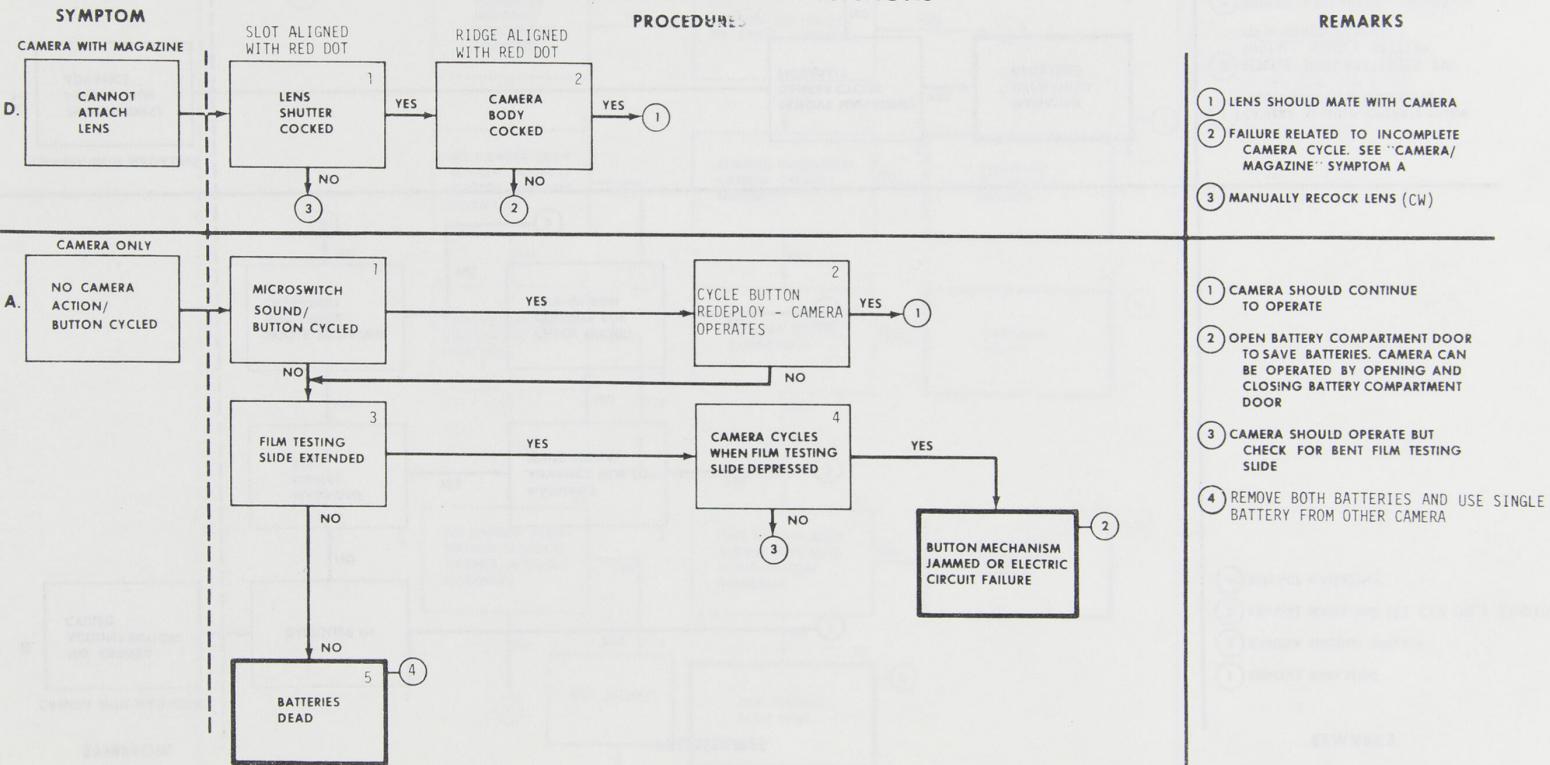
### 70mm CAMERA MALFUNCTIONS



70 mm IB THRU II A

## 70mm CAMERA MALFUNCTIONS

## PROCEDURE

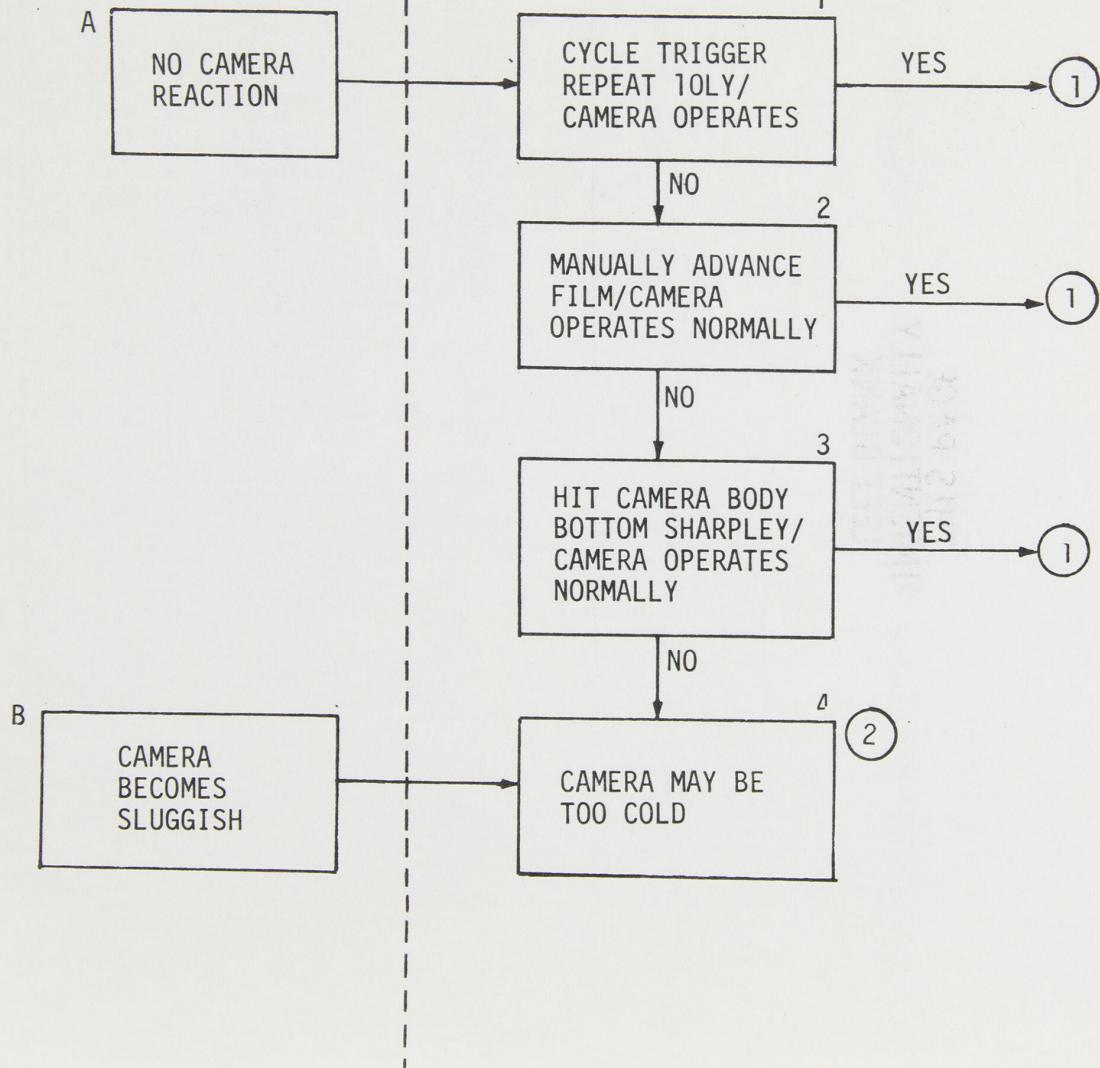


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LM MALFUNCTION PROCEDURES

70 MM CAMERA MALFUNCTIONS PROCEDURES

III CAMERA WITH MAGAZINE  
(EVA)



70mm  
III

① CAMERA SHOULD  
CONTINUE TO OPERATE  
BUT MONITOR OPERATION  
CLOSELY AS FAILURE  
CAN RECUR

② PLACE CAMERA IN  
SUN WITH BOTTOM  
AND MAGAZINE  
ILLUMINATED. USE  
SECOND CAMERA AND  
CHECK FIRST AS  
REQUIRED

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EMU MALFUNCTION INDEX

- 1 TONE AND LOW VENT FLOW FLAG [P]
- 2 TONE AND LOW PGA PRESSURE FLAG [O]
- 3 TONE AND HI O<sub>2</sub> FLOW FLAG [O]
- 4 TONE AND LOW FEEDWATER PRESSURE FLAG [A]
- 5 TONE ON, ALL FLAGS CLEAR
- 6 PGA PRESS GAGE LO (<3.7) - NO FLAG
- 7 PLSS O<sub>2</sub> QUANTITY ABNORMAL
- 8 PGA PRESSURE GAGE HI (>4.0)
- 9 LOSS OF PUMP NOISE
- 10 COOLING INADEQUATE
- 11 LOSS OF VOICE COMM

LM MALFUNCTION PROCEDURES

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## LM MALFUNCTION PROCEDURES

- 1 THRU  
11
- |       |  |
|-------|--|
| EMU 1 | TONE AND LOW VENT FLOW FLAG [P]  |
| 1     | FAN OFF/ON   |
| 2     | IF FLAG STILL ON AFTER 10 SEC ACTUATE OPS AND PURGE VLV  |
| EMU 2 | TONE AND LOW PGA PRESSURE FLAG [O]   |
| 1     | ACTUATE OPS  |
| 2     | IF FLAG STILL ON, CHECK CUFF GAGE, VERIFY TM, OPS OFF (SENSOR FAIL)  |
| EMU 3 | TONE AND HI O <sub>2</sub> FLOW FLAG [O]   |
| 1     | CHECK FOR LOW/HIGH PGA PRESS OR PLSS O <sub>2</sub> DECREASING   |
| 2     | IF LEAK CONFIRMED, ACTUATE OPS   |
| 3     | IF HIGH PGA PRESS, ACTUATE OPS, PLSS O <sub>2</sub> OFF (PLSS REG FAIL)  |
| 4     | IF NO APPARENT FAIL, VERIFY TM (SENSOR FAIL)   |
| EMU 4 | TONE AND LOW FEEDWATER PRESSURE FLAG [A]   |
| 1     | VERIFY FEEDWATER OPEN  |
| 2     | IF CLOSED: DIV VLV MIN COOL, FEEDWATER OPEN, WAIT 4 MIN.   |
| 3     | IF ADD'L COOL REQ'D, ACTUATE OPS AND PURGE VLV   |
| EMU 5 | TONE ON, ALL FLAGS CLEAR   |
| 1     | CHECK CUFF GAGE: IF <3.4, ACTUATE OPS  |
| 2     | IF PGA PRESS >3.4 AND TONE OFF: CHANGE MODE SW MOMENTARILY - NO TONE, NO FAILURE. <u>IF TONE ON AGAIN:</u>                               |
| 3     | CHECK LOW VENT FLOW FLAG: FAN OFF 5 SEC, VENT FLAG [P] SHOULD COME ON; FAN ON. <u>IF NO FLAG</u> , ACTUATE OPS AND PURGE VLV (FLAG FAIL) |
| 4     | CHECK HI O <sub>2</sub> FLOW FLAG: OBSERVE PLSS O <sub>2</sub> , IF DECREASING, ACTUATE OPS.   |
| 5     | CHECK FEEDWATER OPEN: IF CLOSED: DIV VLV MIN COOL, FEEDWATER OPEN. AFTER 4 MIN IF COOL INADEQUATE, ACTUATE OPS AND PURGE VLV.            |
| EMU 6 | PGA PRESS GAGE LO (<3.7) - NO FLAG   |
| 1     | ACTUATE OPS - CUFF GAGE SHOULD RISE (EMU LEAK OR REG SHIFT)  |
| 2     | IF NO GAGE RESPONSE, VERIFY TM - OPS OFF (GAGE FAIL)   |
| EMU 7 | PLSS O <sub>2</sub> QUANTITY ABNORMAL  |
| 1     | CHECK PGA PRESS GAGE OR HIGH O <sub>2</sub> FLOW FLAG [O]  |
| 2     | IF LEAK CONFIRMED, ACT. OPS  |
| 3     | IF HIGH PGA PRESS, ACT. OPS, PLSS O <sub>2</sub> OFF (PLSS REG FAIL)   |
| 4     | IF NO APPARENT FAIL, VERIFY TM (GAGE FAIL)   |

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- |        |  |
|--------|--|
| EMU 8  | <u>PGA PRESSURE GAGE HI (&gt;4.0)</u>  |
| 1      | IF HI O <sub>2</sub> FLOW FLAG [0] OR PLSS O <sub>2</sub> DECREASING, ACT. OPS AND PLSS O <sub>2</sub> OFF (PLSS REG FAIL) |
| 2      | IF NOT, VERIFY TM (POSS GAGE FAIL)   |
| EMU 9  | <u>LOSS OF PUMP NOISE</u>  |
| 1      | CHECK SIDETONE - IF NONE, ACTUATE OPS AND PURGE VLV (POWER FAIL). IF SIDETONE OK:  |
| 2      | CHECK PUMP ON.   |
| 3      | VERIFY TM FOR PUMP CONDITION   |
| 4      | IF ADD'L COOL REQ'D, ACTUATE OPS AND PURGE VLV   |
| EMU 10 | <u>COOLING INADEQUATE</u>  |
| 1      | VERIFY DIV VLV MAX   |
| 2      | IF FEASIBLE, ACTUATE GAS TRAP 5 SEC  |
| 3      | AFTER 3 MIN, IF ADD'L COOL REQ'D, ACTUATE OPS AND PURGE VLV  |
| EMU 11 | <u>LOSS OF VOICE COMM</u>  |
| 1      | CHECK VOL CONTROLS [WHEEL-A (MSFN): BLADE-B (EVA)]   |
| 2      | CYCLE PTT SW - MAIN AND MOM  |
| 3      | CDR (EVA 1) MODE SW TO B, LMP (EVA 2) TO A (HAND SIGNALS)  |
| 4      | IF NO COMM, CDR (EVA 1) TO A, LMP (EVA 2) TO B   |

LM MALFUNCTION PROCEDURES

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EMU

CAMERA

HTRS

ED

ECS

COMM

FPS