2-3-1969

Lunar Module (LM) Apollo Operations Handbook

National Aeronatics and Space Administration (NASA)

5.2.1 GUIDANCE, NAVIGATION, & CONTROL SUBSYSTEM

The Guidance, Navigation, and Control Subsystem (GN&CS) consists of a primary guidance and navigation section (PGNS), abort guidance section (AGS), control electronics section (CES), and radar section. GN&CS malfunction procedures are divided as follows:

- Integrated GN&CS flight displays (paragraph 5.2.2)
- Primary guidance and navigation section (paragraph 5.2.3)
- Abort guidance section (paragraph 5.2.4)
- Control electronics section (paragraph 5.2.5)

Radar section malfunctions are manifested by abnormal flight display readings or improper LGC operation. Therefore, these malfunctions are included in the malfunction procedures for the integrated GN&CS flight displays and the primary guidance and navigation section.

Major GN&CS malfunction symptoms A and B serve as entry points for GN&CS malfunction procedure paragraphs 5.2.2 through 5.2.5.

5.2.1.2 Assumptions

The GN&CS malfunction procedures assume that if the LM is in a critcal maneuver, the crew performs only those steps required to safe the LM. The crew can continue the diagnostic procedures at their convenience.

Table 5-1. GN&CS Procedure Entry Sheet

Symptom	Sym No.	Page No.
Total attitude abnormal	A	5.2-5
FDAI error needles abnormal	B	5.2-5

Table 5-2. GN&CS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
Abnormal vehicle dynamics	FDAI error needles abnormal	B	5.2-5
ORDEAL failure	Total attitude abnormal	A	5.2.5

SYMPTOM	PROCEDURE	REMARKS

A

Total attitude abnormal

1 FDAI OFF flag visible? — YES → INTEGRATED GN&CS FLT DISP 4 1

NO

2 One or both FDAI's in ORB RATE? — YES → 3 •FDAI 1 & 2 sw - INRTL Symptom remains? — NO → 4 ORDEAL FAILURE

YES

NO

5 Both FDAI's agree? — NO → INTEGRATED GN&CS FLT DISP 5 1

YES

6 Manual maneuver commanded when symptom appeared? — YES → 7 What mode?

NO → TBD

DIRECT → CES 18 1

PULSE → CES 17 1

PROPORTIONAL → CES 16a 1

B

FDAI error needles abnormal

1 Corrective action to regain vehicle control been necessary? — YES → 2 ABNORMAL VEHICLE DYNAMICS → CES 1 1

NO

3 FDAI OFF flag visible? — YES → INTEGRATED GN&CS FLT DISP 4 1

NO

4 Error needles oscillating at high rate? — YES → CES 14 1

NO

2

5 Vehicle drifting in all three axes? — YES → CES 13 1

NO

6 Symptom in one or more axes? — ONE → INTEGRATED GN&CS FLT DISP 1 1

MORE

7 Error needles failed at zero? — YES → AGS 6 1

NO

AGS 8 1

AGS 8a 3

AGS 8b 6

(1) Drift between ISS & ASA & computational difference between LGC & AEA do not constitute a symptom for this procedure.

PGNCS caused error needle anomalies have not been integrated beyond step 5.

(2) Drifting criteria are observed three-axis drift and/or absence of RCS jet firings.

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SYMPTOM	PROCEDURE	REMARKS

5.2.2 INTEGRATED GUIDANCE, NAVIGATION, & CONTROL SUBSYSTEM FLIGHT DISPLAYS

Table 5-3. INTEGRATED GN&CS FLT DISP Procedure Entry Sheet

Symptom	Sym No.	Page No.
Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5.2-11
AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5.2-11
RANGE ind pwr/sig fail lt	2	5.2-12
X pointer ind pwr fail lt goes on when X pointer is in use	3	5.2-13
FDAI pwr tb appears while FDAI is in use	4	5.2-13
One FDAI total attitude display goes to (and remains at) specific attitude	5	5.2-13
One FDAI total attitude display erratic or inaccurate	5a	5.2-13
FDAI rate needles abnormal	6	5.2-14
Tuning fork indicator displayed on MSN TMR ind	7	5.2-14

Table 5-4. INTEGRATED GN&CS FLT DISP Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
AEA - FDAI interface failure	One FDAI total attitude display goes to (and remains at) specific attitude	5	5.2-13
	One FDAI total attitude display erratic or inaccurate	5a	5.2-13
ATCA/rate gyro interface failed open. Rates in affected axis cannot be displayed. Needle movement possibly due to vibration	FDAI rate needles abnormal	6	5.2-14
D-c power to FDAI failed or FDAI shorted	FDAI pwr tb appears while FDAI is in use	4	5.2-13
Failure from MODE SEL sw to RANGE ind	RANGE ind pwr/sig fail lt	2	5.2-12
Failure of LR or AGS output to RANGE ind or failure of one deck of S/C: AGS sw	RANGE ind pwr/sig fail lt	2	5.2-12
Failure of RR output or line to RANGE indicator	RANGE ind pwr/sig fail lt	2	5.2-12
FDAI attitude error display failed	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5.2-11

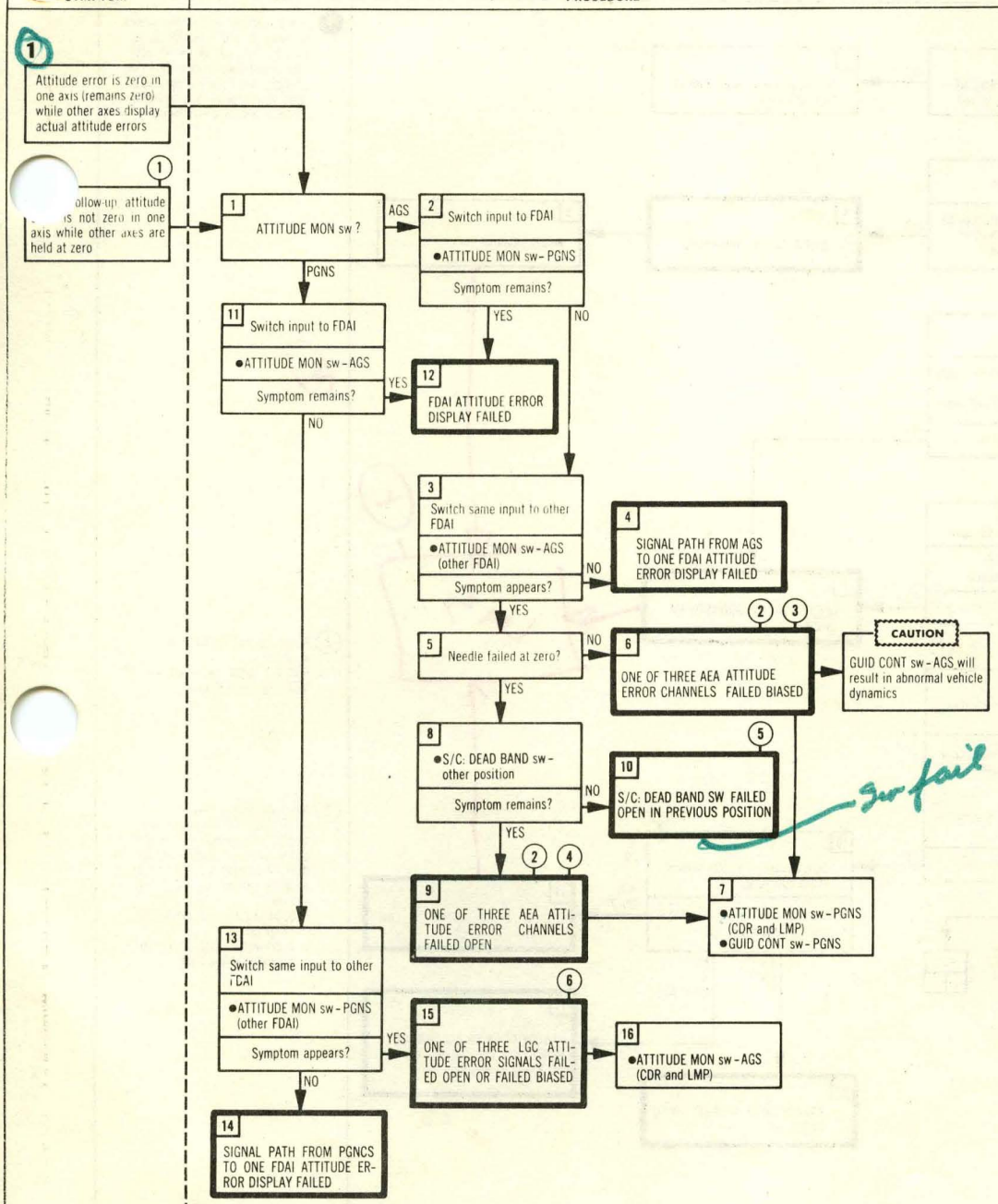
Table 5-4. INTEGRATED GN&CS FLT DISP Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11
FDAI pwr tb failed on	FDAI pwr tb appears while FDAI is in use	4	5. 2-13
FDAI rate needle failure	FDAI rate needles abnormal	6	5. 2-14
IMU - FDAI interface failure	One FDAI total attitude display goes to (and remains at) specific attitude	5	5. 2-13
	One FDAI total attitude display erratic or inaccurate	5a	5. 2-13
Loss of TE of PCMTEA	Tuning fork indicator displayed on MSN TMR ind	7	5. 2-14
Loss of 10 cps in TE of PCMTEA	Tuning fork indicator displayed on MSN TMR ind	7	5. 2-14
One FDAI total attitude display interconnect failure from AGS	One FDAI total attitude display goes to (and remains at) specific attitude	5	5. 2-13
	One FDAI total attitude display erratic or inaccurate	5a	5. 2-13
One FDAI total attitude display interconnect failure from PGNS	One FDAI total attitude display goes to (and remains at) specific attitude	5	5. 2-13
	One FDAI total attitude display erratic or inaccurate	5a	5. 2-13
One or three AEA attitude error channels failed biased	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5. 2-11
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11
One of three AEA attitude error channels failed open	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5. 2-11
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11

Table 5-4. INTEGRATED GN&CS FLT DISP Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
One of three LGC attitude error signals failed open or failed biased	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5. 2-11
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11
Open condition downstream of CB	RANGE ind pwr/sig fail lt	2	5. 2-12
Power to X pointer ind failed or X pointer ind shorted	X pointer ind pwr fail lt goes on when X pointer is in use	3	5. 2-13
RANGE indicator shorted	RANGE ind pwr/sig fail lt	2	5. 2-13
Rate gyro failed on	FDAI rate needles abnormal	6	5. 2-14
RATE SCALE sw failed open. Max rate displayed = 5° /sec	FDAI rate needles abnormal	6	5. 2-14
S/C: DEAD BAND sw failed open in previous position	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5. 2-11
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11
Signal path from AGS to one FDAI attitude error display failed	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5. 2-11
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11
Signal path from PGNCS to one FDAI attitude error display failed	Attitude error is zero in one axis (remains zero) while other axes display actual attitude errors	1	5. 2-11
	AGS in follow-up, attitude error is not zero in one axis while other axes are held at zero	1a	5. 2-11
Total attitude display failure	One FDAI total attitude display goes to (and remains at) specific attitude	5	5. 2-13
	One FDAI total attitude display erratic or inaccurate	5a	5. 2-13
X pointer ind pwr fail lt failed on	X pointer ind pwr fail lt goes on when X pointer is in use	3	5. 2-13

SYMPTOM	PROCEDURE	REMARKS



(1) Attitude errors are normally held at zero in AGS follow-up when
GUID CONT sw - PGNS
S/C: AGS sw - ATT HOLD
or
GUID CONT sw - PGNS
SOO = 0
or
S/C: AGS sw - ATT HOLD
ACA - out of detent

(2) FDAI attitude error display will show erroneous nonzero value in affected axis.

(3) When GUID CONT & ATTITUDE MON sw - AGS, attitude error signals go to FDAI & CES. Failure affects control of LM & display.

(4) One FDAI attitude error display is lost in one axis.

(5) S/C DEAD BAND sw - MAX or MIN capability is lost in one axis.

(6) When ATTITUDE MON sw - PGNS, LGC attitude error signals go to FDAI's. Failure affects display only.

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SYMPTOM	PROCEDURE	REMARKS

SYMPTOM	PROCEDURE	REMARKS

SYMPTOM

(2) (1) RANGE ind pwr/sig fail lt

Light on if:

Signal is lost

- 115v, 400 cps power falls below 90 ± 10v
- 28-vdc power falls below 22 ± 2v

PROCEDURE

1 RNG/ALT MON sw – RNG/RNG RT, RNDZ RADAR: NO TRACK lt – on?
- YES → 2 Normal condition when tracking lock – on is lost
- NO →

3 Check for short

Either CB FLT DISP: RNG/RNG RT or CB/AC BUS A: RNG/RNG RT open and cannot be reset?
- YES → 4 RANGE INDICATOR SHORTED → 5 •Open other cb
- NO →

6 Check for open

•CB FLT DISP: RNG/RNG RT – open
or
•CB/AC BUS A: RNG/RNG RT – open

RANGE ind pwr/sig fail lt – off?
- YES →
- NO →

8 Check alternate path for open

•Close CB (procedure 6)
•Open other circuit breaker

RANGE ind pwr/sig fail lt – off?
- YES → 7 OPEN CONDITION DOWNSTREAM OF CB
- NO →

(2) 9 Verify status of indicator – driving source (radar or AEA)

•Radar — Check transmitter power of source system (RADAR: SIGNAL STRENGTH ind)
or
•AEA — Observe normal operation of DEDA displays

Source operating normally?
- YES → (3) 10 Select alternate display source (when operating)

RANGE ind pwr/sig fail lt off due to new signal source?
- LR or AGS ONLY → 11 FAILURE OF RR OUTPUT OR LINE TO RANGE INDICATOR
- RR ONLY → 13 FAILURE FROM MODE SEL SW TO RANGE IND
- RR & LR or AGS → 12 FAILURE OF LR OR AGS OUTPUT TO RANGE IND OR FAILURE OF ONE DECK OF S/C AGS SW
- NO →

	PGNS	PGNS	AGS
	RR	LR	AEA
	6 1	8 1	1 1

REMARKS

(1) Lt will normally be 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 when range rate is below 10 fps. Neither condition indicates malfunction.

(2) Range ind pwr/sig fail lt is on when:
RNG/ALT MON sw – ALT/ALT RT MODE SEL sw – PGNS

(3) Alternate display sources:
a. RR range, RR range rate N78
b. LGC: range, range rate, θ N54
c. Latitude, longitude, altitude N43
d. DEDA address 337, LM altitude (h)
e. DEDA address 367, LM altitude rate
f. DEDA address 317, LM to CSM range (R)
g. DEDA address 440, range rate between LM and CSM.

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SYMPTOM	PROCEDURE	REMARKS
3 X pointer ind pwr fail lt goes on when X pointer is in use	1 Select zero signal •RATE ERR MON sw-LDG RDR/CMPTR •MODE SEL sw - PGNS X pointer ind-zero? YES → 2 X POINTER IND PWR FAIL LT FAILED ON NO → 3 POWER TO X POINTER IND FAILED OR X POINTER IND SHORTED	
4 FDAI pwr fb appears while FDAI is in use	1 •Corresponding FDAI (1 or 2) sw to other position (ORB RATE or INRTL) FDAI moves? YES → 2 FDAI PWR FB FAILED ON NO → 3 FDAI (1 or 2) sw - ORB RATE? YES → 4 •Wait 1 minute, and observe FDAI → 6 FDAI total attitude changes? YES → 2 NO → 7 D.C POWER TO FDAI FAILED OR FDAI SHORTED NO → 5 •ORDEAL FDAI (1 or 2) sw - ORB RATE	(1) Assumption: Ordeal is operating (2) ORB RATE & INRTL total attitude displays are identical 1 minute per orbital period. Therefore, waiting 1 minute resolves possible ambiguity
5 One FDAI total attitude display goes to (and remains at) specific attitude 5a One FDAI total attitude display erratic or inaccurate	1 ATTITUDE MON sw? AGS → 2 Switch input source to FDAI •ATTITUDE MON sw-PGNS; Symptom remains? NO → 3 Switch same input to other FDAI •ATTITUDE MON sw-AGS (other FDAI); Symptom appears? NO → 4 ONE FDAI TOTAL ATTITUDE DISPLAY INTERCONNECT FAILURE FROM AGS CAUTION: FDAI that displays symptom can be driven from one source only. YES → 5 AEA-FDAI INTERFACE FAILURE 6 •ATTITUDE MON sw-PGNS (CDR & LMP) YES → 8 TOTAL ATTITUDE DISPLAY FAILURE PGNS → 7 Switch input source to FDAI •ATTITUDE MON sw-AGS; Symptom remains? NO → 9 Switch input to other FDAI •ATTITUDE MON sw-PGNS (other FDAI); Symptom remains? NO → 10 ONE FDAI TOTAL ATTITUDE DISPLAY INTERCONNECT FAILURE FROM PGNS CAUTION: FDAI that displays symptom can be driven from one source only YES → 11 IMU-FDAI INTERFACE FAILURE 12 •ATTITUDE MON sw-PGNS (CDR & LMP)	(1) Specific attitude: 0°, 90°, 180° 270°, or 45°, 135°, 225°, 315° (2) Failure includes following: One of six IMU output lines fails (complete loss or magnitude/polarity error) or GASTA failure. (3) Failure includes following: One of six AEA output channels failed (complete loss, or magnitude/polarity error) or one of three AEA return lines failed.

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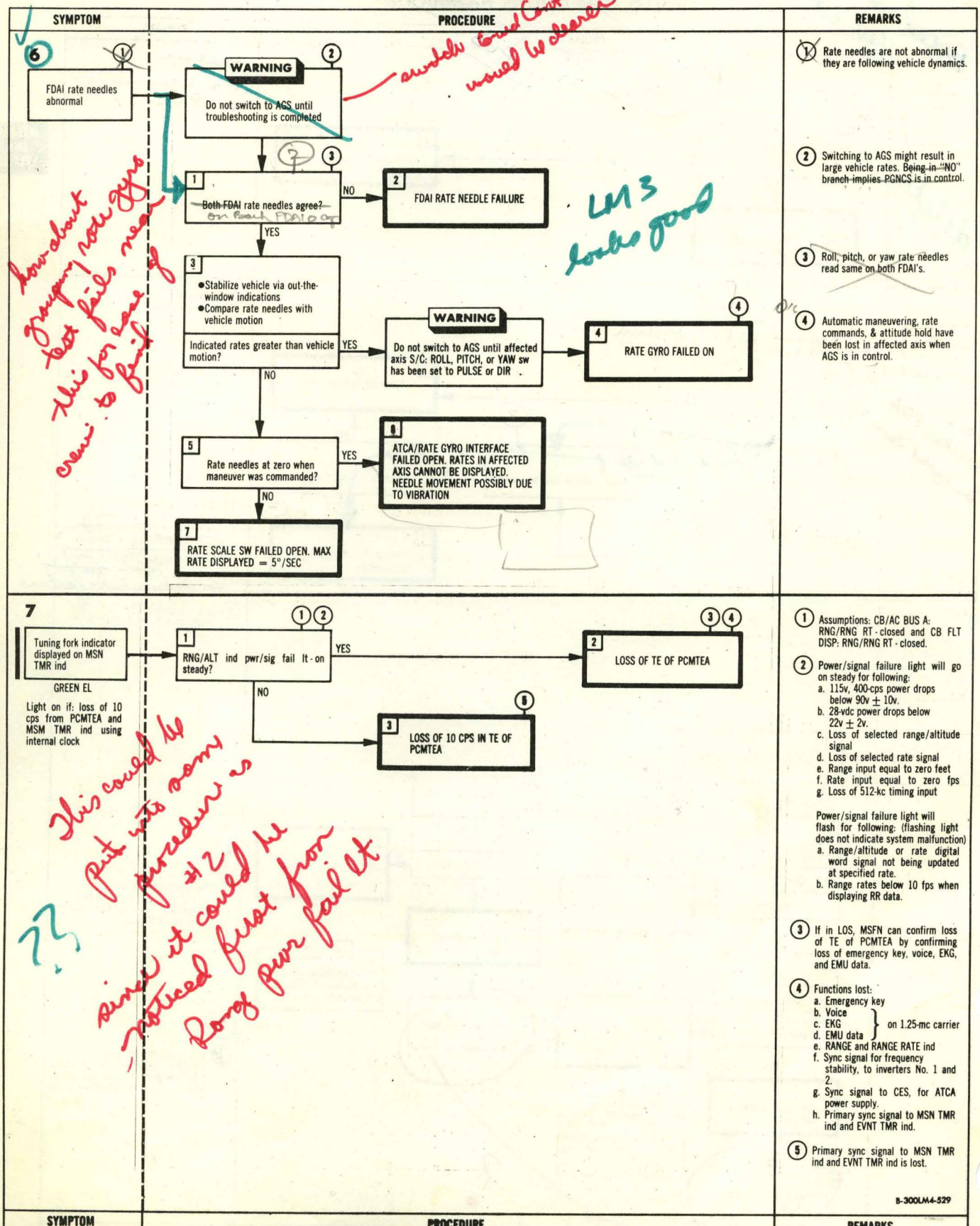
SYMPTOM
PROCEDURE
REMARKS
6
FDAI rate needles abnormal
WARNING
Do not switch to AGS until troubleshooting is completed
1
Both FDAI rate needles agree?
NO
2
FDAI RATE NEEDLE FAILURE
YES
3
•Stabilize vehicle via out-the-window indications
•Compare rate needles with vehicle motion
Indicated rates greater than vehicle motion?
YES
WARNING
Do not switch to AGS until affected axis S/C: ROLL, PITCH, or YAW sw has been set to PULSE or DIR .
4
RATE GYRO FAILED ON
NO
5
Rate needles at zero when maneuver was commanded?
YES
8
ATCA/RATE GYRO INTERFACE FAILED OPEN. RATES IN AFFECTED AXIS CANNOT BE DISPLAYED. NEEDLE MOVEMENT POSSIBLY DUE TO VIBRATION
NO
7
RATE SCALE SW FAILED OPEN. MAX RATE DISPLAYED = 5°/SEC
1 Rate needles are not abnormal if they are following vehicle dynamics.
2 Switching to AGS might result in large vehicle rates. Being in "NO" branch implies PGNCS is in control.
3 Roll, pitch, or yaw rate needles read same on both FDAI's.
4 Automatic maneuvering, rate commands, & attitude hold have been lost in affected axis when AGS is in control.
7
Tuning fork indicator displayed on MSN TMR ind
GREEN EL
Light on if: loss of 10 cps from PCMTEA and MSM TMR ind using internal clock
1
RNG/ALT ind pwr/sig fail lt-on steady?
YES
2
LOSS OF TE OF PCMTEA
NO
5
3
LOSS OF 10 CPS IN TE OF PCMTEA
1 Assumptions: CB/AC BUS A: RNG/RNG RT-closed and CB FLT DISP: RNG/RNG RT-closed.
2 Power/signal failure light will go on steady for following:
a. 115v, 400-cps power drops below 90v ± 10v.
b. 28-vdc power drops below 22v ± 2v.
c. Loss of selected range/altitude signal
d. Loss of selected rate signal
e. Range input equal to zero feet
f. Rate input equal to zero fps
g. Loss of 512-kc timing input
Power/signal failure light will flash for following: (flashing light does not indicate system malfunction)
a. Range/altitude or rate digital word signal not being updated at specified rate.
b. Range rates below 10 fps when displaying RR data.
3 If in LOS, MSFN can confirm loss of TE of PCMTEA by confirming loss of emergency key, voice, EKG, and EMU data.
4 Functions lost:
a. Emergency key
b. Voice
c. EKG
d. EMU data
} on 1.25-mc carrier
e. RANGE and RANGE RATE ind
f. Sync signal for frequency stability, to inverters No. 1 and 2.
g. Sync signal to CES, for ATCA power supply.
h. Primary sync signal to MSN TMR ind and EVNT TMR ind.
5 Primary sync signal to MSN TMR ind and EVNT TMR ind is lost.
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SYMPTOM
PROCEDURE
REMARKS

5.2.3 PRIMARY GUIDANCE & NAVIGATION SECTION

Table 5-5. PGNS Procedure Entry Sheet

Symptom	Sym No.	Page No.
ISS warn lt	1	5.2-19
ISS warn lt & TRACKER lt	2	5.2-20
ISS warn lt & PROG lt	3	5.2-20
LGC warn lt	4	5.2-21
LGC warn lt & RESTART lt	5	5.2-21
RNDZ RDR caut lt	6	5.2-22
RNDZ RDR caut lt & RNDZ RADAR: NO TRACK lt	7	5.2-22
LDG RDR caut lt	8	5.2-23
TRACKER lt	9	5.2-23
PROG lt & TRACKER lt	10	5.2-23
TEMP lt	11	5.2-24
GIMBAL LOCK lt	12	5.2-24
Abnormal DSKY response	13	5.2-25
Missing numerics or EL segments appear in PROG ind, VERB ind, NOUN ind, or registers	13a	5.2-25
Mark verb continues flashing after crew response	13b	5.2-26
V50 N25 continues flashing after crew response	13c	5.2-26

Table 5-6. PGNS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
AOT pb (CDR) or LGC logic failed	Mark verb continues flashing after crew response	13b	5.2-26
CDU +14-vdc power failure	ISS warn lt and TRACKER lt	2	5.2-20
CWEA failure	ISS warn lt	1	5.2-19
	LDG RDR caut lt	8	5.2-23
	LGC warn lt	4	5.2-21
	RNDZ RDR caut lt	6	5.2-22

Table 5-6. PGNS Failure/Symptom Cross-Reference Index (cont)

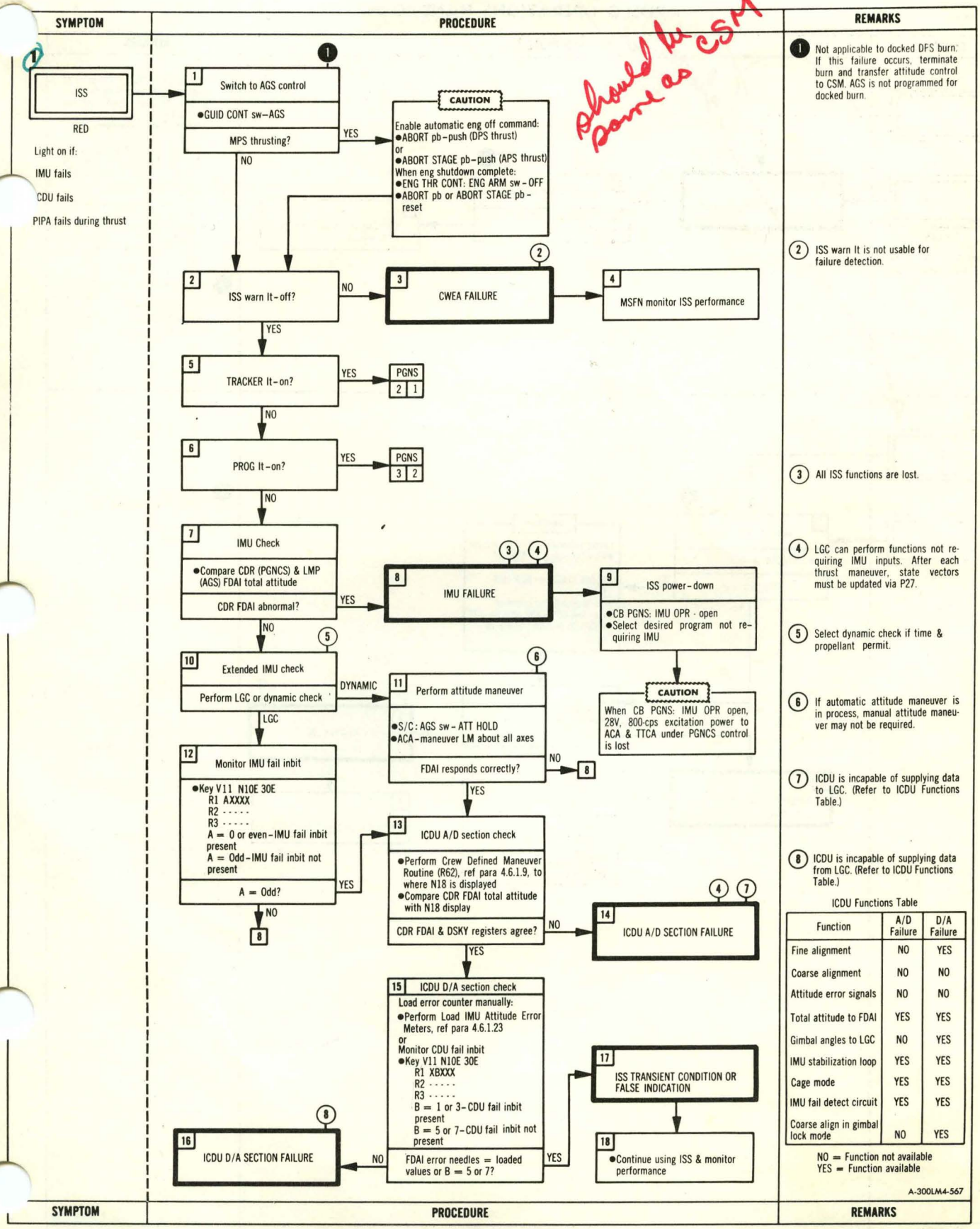
Failure	Symptom	Sym No.	Page No.
DSKY ENTR or PRO pb failed (depending on pb used)	Abnormal DSKY response	13	5.2-25
DSKY power supply failed (275 V, 800 cps)	Abnormal DSKY response	13	5.2-25
DSKY relay(s) failed	Missing numerics or EL segments appear in PROG ind, VERB ind, NOUN ind, or registers	13a	5.2-25
EL light failed	Missing numerics or EL segments appear in PROG ind, VERB ind, NOUN ind, or registers	13a	5.2-25
ENG THR CONT: THR CONT sw AUTO position failed open or LGC inbit failed open	V50 N25 continues flashing after crew response	13c	5.2-26
Gimbal lock detection circuit failure	GIMBAL LOCK lt	12	5.2-24
GUID CONT sw PGNS position failed open or LGC inbit failed open	V50 N25 continues flashing after crew response	13c	5.2-26
ICDU A/D section failure	ISS warn lt	1	5.2-19
ICDU D/A section failure	ISS warn lt	1	5.2-19
IMU failure	ISS warn lt	1	5.2-19
IMU has entered gimbal lock. Inertial reference is lost	GIMBAL LOCK lt	12	5.2-24
IMU temp control failure	TEMP lt	11	5.2-24
Integral lighting failed	Abnormal DSKY response	13	5.2-25
ISS transient condition or false indication	ISS warn lt	1	5.2-19
LGC failure	LGC warn lt	4	5.2-21
	LGC warn lt and RESTART lt	5	5.2-21
LGC output channel failure	TEMP lt	11	5.2-24
LGC power failure	LGC warn lt	4	5.2-21
LR data-good logic failure causing absence of data-good signal to LGC	LDG RDR caut lt	8	5.2-23
Numeric pb failed open	Missing numerics or EL segments appear in PROG ind, VERB ind, NOUN ind, or registers	13a	5.2-25
One DSKY pb failed closed	Missing numerics or EL segments appear in PROG ind, VERB ind, NOUN ind, or registers	13a	5.2-25
PIPA failure	ISS warn lt and PROG lt	3	5.2-20

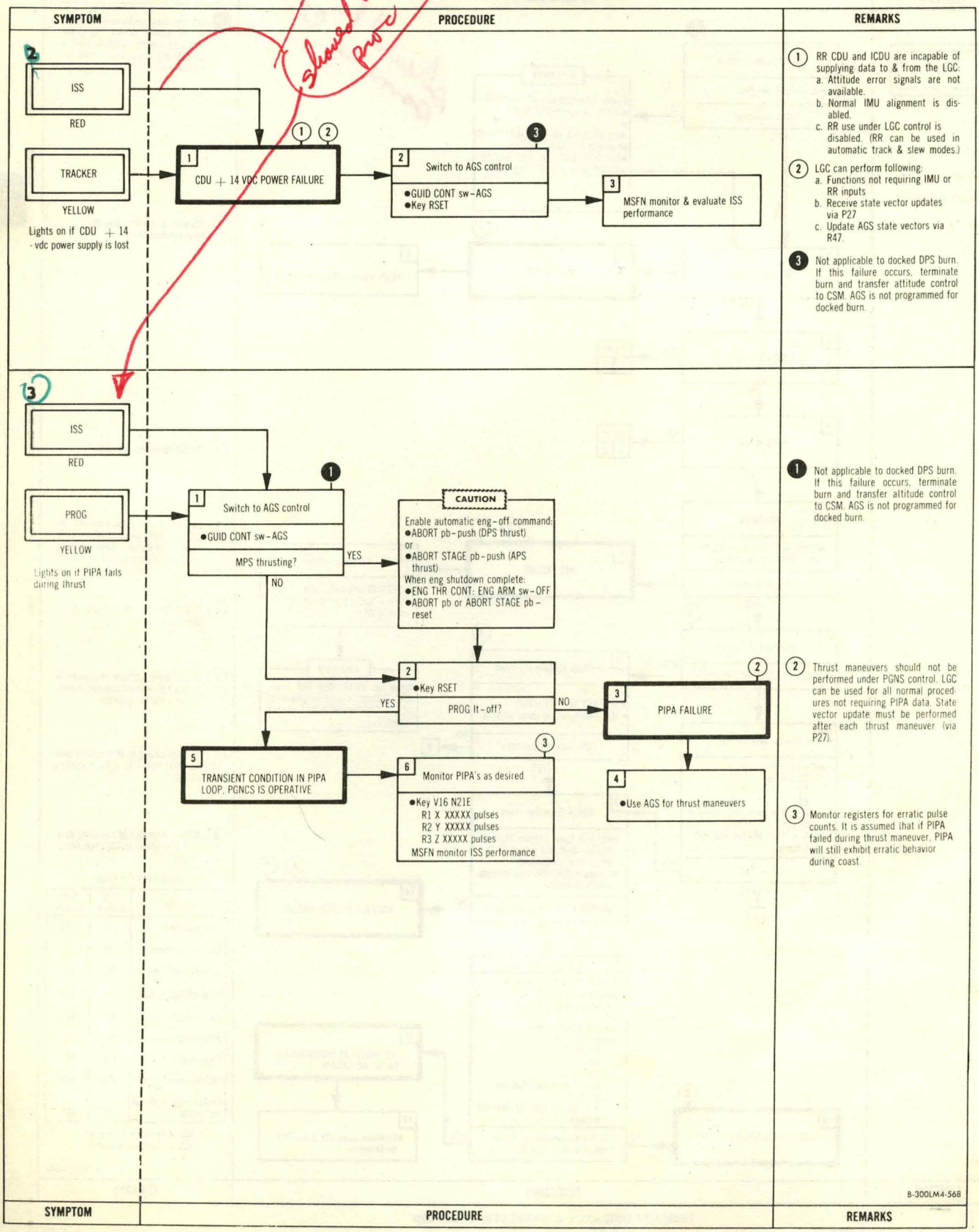
Table 5-6. PGNS Failure/Symptom Cross-Reference Index (cont)

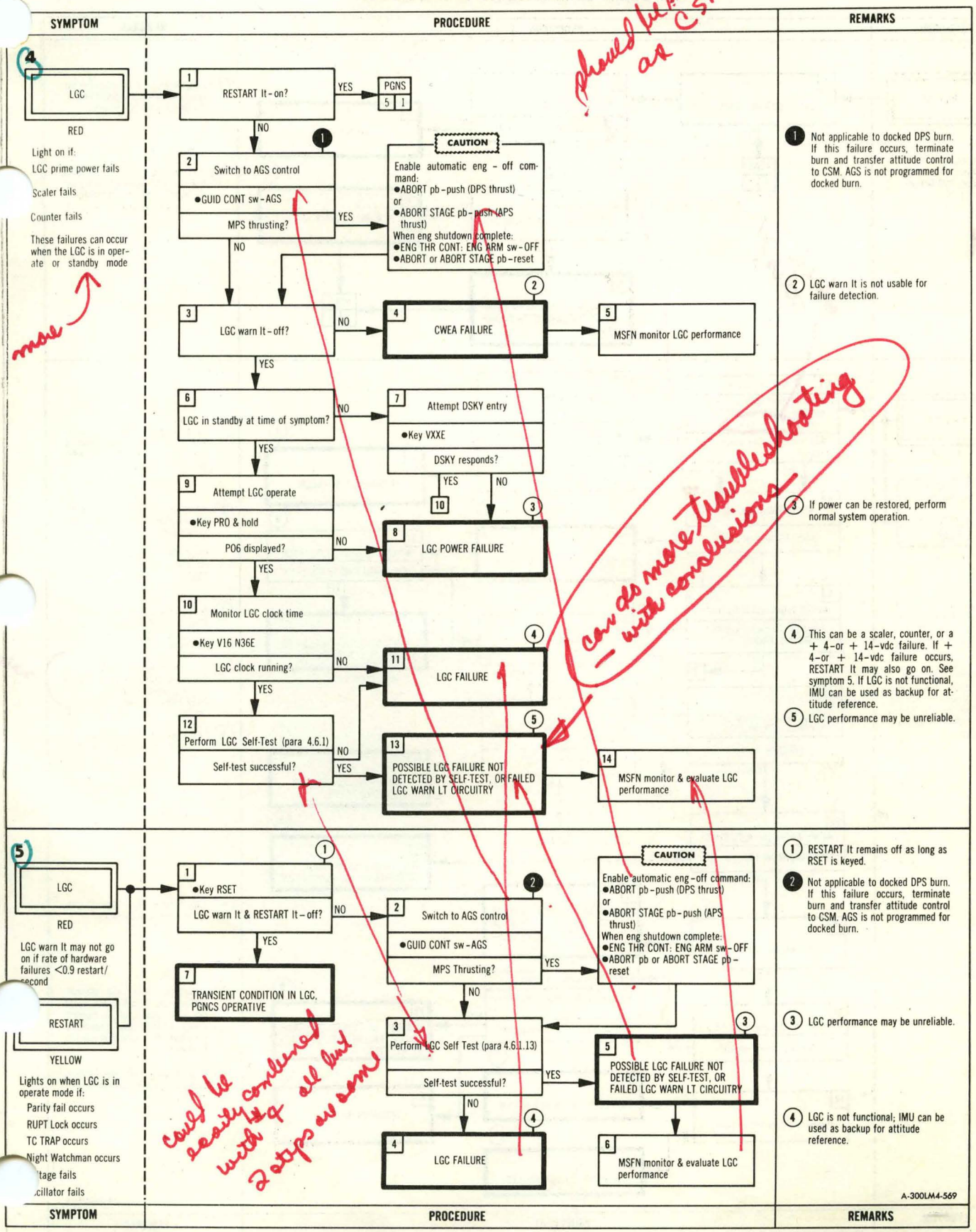
Failure	Symptom	Sym No.	Page No.
Possible LGC failure not detected by self-test, or failed LGC warn lt circuitry	LGC warn lt	4	5.2-21
	LGC warn lt and RESTART lt	5	5.2-21
Possible RR failure or transponder failure not detected by self-tests	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
PRO pb failed open	V50 N25 continues flashing after crew response	13c	5.2-26
RNDZ RADAR: NO TRACK lt failed off	RNDZ RDR caut lt	6	5.2-22
RNDZ RADAR: NO TRACK lt failed on	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
RNDZ RADAR sel LGC position failed open or LGC inbit failed open	V50 N25 continues flashing after crew response	13c	5.2-26
RNDZ RDR caut lt failed on	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
RR CDU failure	TRACKER lt	9	5.2-23
RR frequency tracker failure	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
RR range tracker failure	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
RR transmitter failure	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
S/C: PGNS sw - AUTO position failed open or LGC inbit failed open	V50 N25 continues flashing after crew response	13c	5.2-26
Temporary loss of track corrected by AGS acquisition	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
Temporary loss of track corrected by P20	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
Temp relay in DSKY failed closed	TEMP lt	11	5.2-24
TRACKER lt logic or CDU fail discrete circuit failure	TRACKER lt	9	5.2-23
Transient condition	PROG lt and TRACKER lt	10	5.2-23
Transient condition at time of symptom	Mark verb continues flashing after crew response	13b	5.2-26
Transient condition in gimbal lock detection circuit	GIMBAL LOCK lt	12	5.2-24
Transient condition in IMU temp control circuit	TEMP lt	11	5.2-24
Transient condition in LGC, PGNCS operative	LGC warn lt and RESTART lt	5	5.2-21

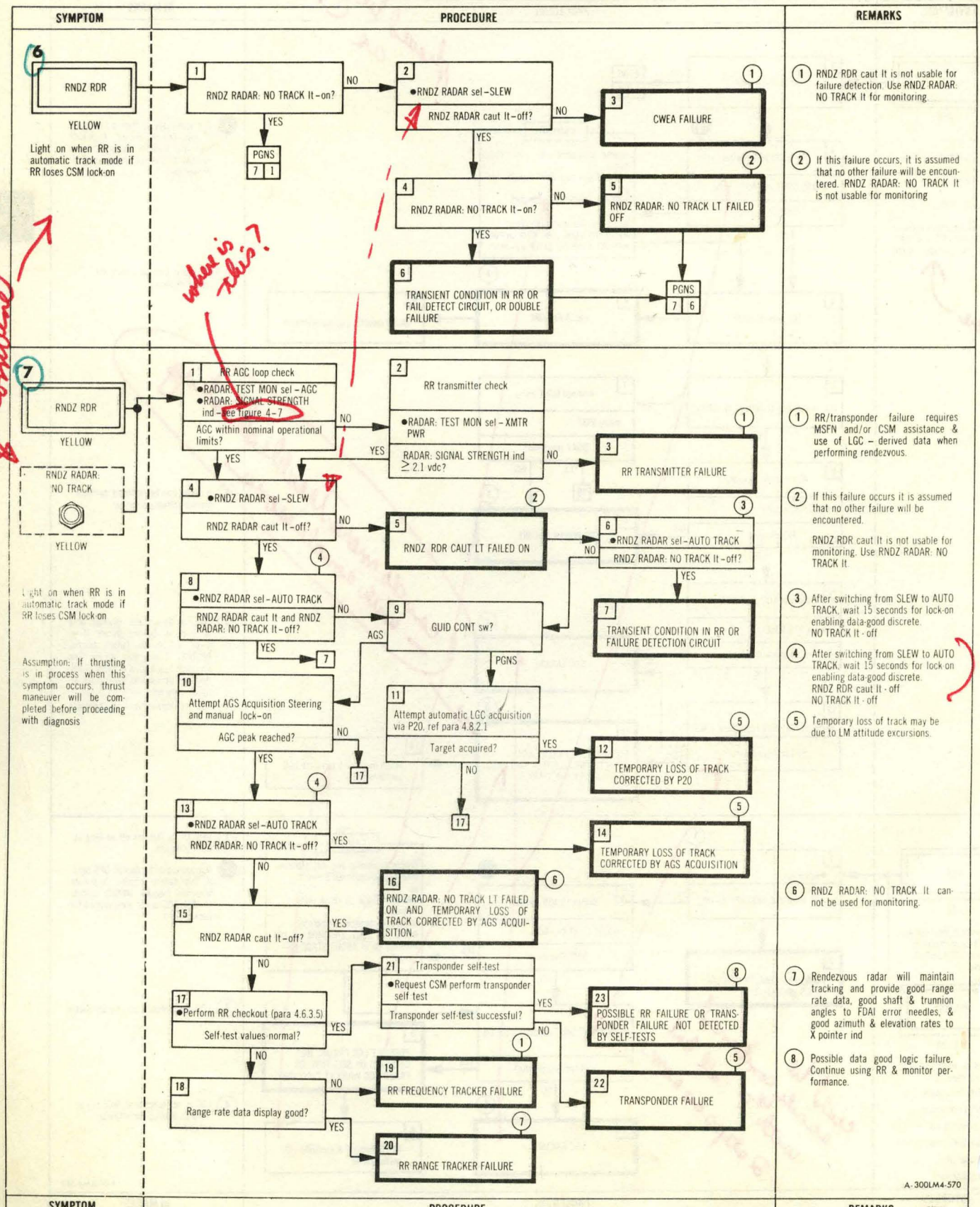
Table 5-6. PGNS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Transient condition in PIPA loop, PGNCS is operative	ISS warn lt and PROG lt	3	5.2-20
Transient condition in RR CDU circuit	PROG lt and TRACKER lt	10	5.2-23
	TRACKER lt	9	5.2-23
Transient condition in RR or fail detect circuit, or double failure	RNDZ RDR caut lt	6	5.2-22
Transient condition in RR or failure detection circuit	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22
Transponder failure	RNDZ RDR caut lt and RNDZ RADAR: NO TRACK lt	7	5.2-22


SYMPTOM
PROCEDURE
REMARKS
ISS
RED
Light on if:
IMU fails
CDU fails
PIPA fails during thrust
1 Switch to AGS control
●GUID CONT sw–AGS
MPS thrusting?
YES
NO
CAUTION
Enable automatic eng off command:
●ABORT pb–push (DPS thrust)
or
●ABORT STAGE pb–push (APS thrust)
When eng shutdown complete:
●ENG THR CONT: ENG ARM sw–OFF
●ABORT pb or ABORT STAGE pb–reset
2 ISS warn lt–off?
NO
3 CWEA FAILURE
4 MSFN monitor ISS performance
YES
5 TRACKER lt–on?
YES
PGNS 2 1
NO
6 PROG lt–on?
YES
PGNS 3 2
NO
7 IMU Check
●Compare CDR (PGNCS) & LMP (AGS) FDAI total attitude
CDR FDAI abnormal?
YES
8 IMU FAILURE
9 ISS power–down
●CB PGNS: IMU OPR – open
●Select desired program not requiring IMU
CAUTION
When CB PGNS: IMU OPR open, 28V, 800-cps excitation power to ACA & TTCA under PGNCS control is lost
NO
10 Extended IMU check
Perform LGC or dynamic check
DYNAMIC
11 Perform attitude maneuver
●S/C: AGS sw–ATT HOLD
●ACA–maneuver LM about all axes
FDAI responds correctly?
NO
8
YES
LGC
12 Monitor IMU fail inbit
●Key V11 N10E 30E
R1 AXXXX
R2 -----
R3 -----
A = 0 or even–IMU fail inbit present
A = Odd–IMU fail inbit not present
A = Odd?
YES
NO
8
13 ICDU A/D section check
●Perform Crew Defined Maneuver Routine (R62), ref para 4.6.1.9, to where N18 is displayed
●Compare CDR FDAI total attitude with N18 display
CDR FDAI & DSKY registers agree?
NO
14 ICDU A/D SECTION FAILURE
YES
15 ICDU D/A section check
Load error counter manually:
●Perform Load IMU Attitude Error Meters, ref para 4.6.1.23
or
Monitor CDU fail inbit
●Key V11 N10E 30E
R1 XBXXX
R2 -----
R3 -----
B = 1 or 3–CDU fail inbit present
B = 5 or 7–CDU fail inbit not present
FDAI error needles = loaded values or B = 5 or 7?
NO
16 ICDU D/A SECTION FAILURE
YES
17 ISS TRANSIENT CONDITION OR FALSE INDICATION
18 ●Continue using ISS & monitor performance
1 Not applicable to docked DFS burn. If this failure occurs, terminate burn and transfer attitude control to CSM. AGS is not programmed for docked burn.
2 ISS warn lt is not usable for failure detection.
3 All ISS functions are lost.
4 LGC can perform functions not requiring IMU inputs. After each thrust maneuver, state vectors must be updated via P27.
5 Select dynamic check if time & propellant permit.
6 If automatic attitude maneuver is in process, manual attitude maneuver may not be required.
7 ICDU is incapable of supplying data to LGC. (Refer to ICDU Functions Table.)
8 ICDU is incapable of supplying data from LGC. (Refer to ICDU Functions Table.)
ICDU Functions Table
Function | A/D Failure | D/A Failure
Fine alignment | NO | YES
Coarse alignment | NO | NO
Attitude error signals | NO | NO
Total attitude to FDAI | YES | YES
Gimbal angles to LGC | NO | YES
IMU stabilization loop | YES | YES
Cage mode | YES | YES
IMU fail detect circuit | YES | YES
Coarse align in gimbal lock mode | NO | YES
NO = Function not available
YES = Function available
A-300LM4-567
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
2
ISS
RED
TRACKER
YELLOW
Lights on if CDU + 14 -vdc power supply is lost
1 2
1 CDU + 14 VDC POWER FAILURE
3
2 Switch to AGS control
●GUID CONT sw-AGS
●Key RSET
3 MSFN monitor & evaluate ISS performance
(1) RR CDU and ICDU are incapable of supplying data to & from the LGC:
a. Attitude error signals are not available.
b. Normal IMU alignment is disabled.
c. RR use under LGC control is disabled. (RR can be used in automatic track & slew modes.)
(2) LGC can perform following:
a. Functions not requiring IMU or RR inputs
b. Receive state vector updates via P27
c. Update AGS state vectors via R47.
(3) Not applicable to docked DPS burn. If this failure occurs, terminate burn and transfer attitude control to CSM. AGS is not programmed for docked burn.
3
ISS
RED
PROG
YELLOW
Lights on if PIPA fails during thrust
1
1 Switch to AGS control
●GUID CONT sw-AGS
MPS thrusting?
YES
NO
CAUTION
Enable automatic eng-off command:
●ABORT pb-push (DPS thrust)
or
●ABORT STAGE pb-push (APS thrust)
When eng shutdown complete:
●ENG THR CONT: ENG ARM sw-OFF
●ABORT pb or ABORT STAGE pb-reset
2 ●Key RSET
PROG lt-off?
YES
NO
2
3 PIPA FAILURE
4 ●Use AGS for thrust maneuvers
5 TRANSIENT CONDITION IN PIPA LOOP. PGNCS IS OPERATIVE
3
6 Monitor PIPA's as desired
●Key V16 N21E
R1 X XXXXX pulses
R2 Y XXXXX pulses
R3 Z XXXXX pulses
MSFN monitor ISS performance
(1) Not applicable to docked DPS burn. If this failure occurs, terminate burn and transfer attitude control to CSM. AGS is not programmed for docked burn.
(2) Thrust maneuvers should not be performed under PGNS control. LGC can be used for all normal procedures not requiring PIPA data. State vector update must be performed after each thrust maneuver (via P27).
(3) Monitor registers for erratic pulse counts. It is assumed that if PIPA failed during thrust maneuver, PIPA will still exhibit erratic behavior during coast.
B-300LM4-568
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
4
LGC
RED
Light on if:
LGC prime power fails
Scaler fails
Counter fails
These failures can occur when the LGC is in operate or standby mode
1 RESTART lt-on?
YES
PGNS 5 1
NO
2 Switch to AGS control
●GUID CONT sw-AGS
MPS thrusting?
YES
NO
CAUTION
Enable automatic eng-off command:
●ABORT pb-push (DPS thrust)
or
●ABORT STAGE pb-push (APS thrust)
When eng shutdown complete:
●ENG THR CONT: ENG ARM sw-OFF
●ABORT or ABORT STAGE pb-reset
3 LGC warn lt-off?
NO
4 CWEA FAILURE
5 MSFN monitor LGC performance
YES
6 LGC in standby at time of symptom?
NO
7 Attempt DSKY entry
●Key VXXE
DSKY responds?
YES
NO
10
YES
9 Attempt LGC operate
●Key PRO & hold
P06 displayed?
NO
8 LGC POWER FAILURE
YES
10 Monitor LGC clock time
●Key V16 N36E
LGC clock running?
NO
11 LGC FAILURE
YES
12 Perform LGC Self-Test (para 4.6.1)
Self-test successful?
NO
YES
13 POSSIBLE LGC FAILURE NOT DETECTED BY SELF-TEST, OR FAILED LGC WARN LT CIRCUITRY
14 MSFN monitor & evaluate LGC performance
1 Not applicable to docked DPS burn. If this failure occurs, terminate burn and transfer attitude control to CSM. AGS is not programmed for docked burn.
2 LGC warn lt is not usable for failure detection.
3 If power can be restored, perform normal system operation.
4 This can be a scaler, counter, or a + 4-or + 14-vdc failure. If + 4-or + 14-vdc failure occurs, RESTART lt may also go on. See symptom 5. If LGC is not functional, IMU can be used as backup for attitude reference.
5 LGC performance may be unreliable.
5
LGC
RED
LGC warn lt may not go on if rate of hardware failures <0.9 restart/second
RESTART
YELLOW
Lights on when LGC is in operate mode if:
Parity fail occurs
RUPT Lock occurs
TC TRAP occurs
Night Watchman occurs
tage fails
cillator fails
1 ●Key RSET
LGC warn lt & RESTART lt-off?
NO
YES
7 TRANSIENT CONDITION IN LGC, PGNCS OPERATIVE
2 Switch to AGS control
●GUID CONT sw-AGS
MPS Thrusting?
YES
NO
CAUTION
Enable automatic eng-off command:
●ABORT pb-push (DPS thrust)
or
●ABORT STAGE pb-push (APS thrust)
When eng shutdown complete:
●ENG THR CONT: ENG ARM sw-OFF
●ABORT pb or ABORT STAGE pb-reset
3 Perform LGC Self Test (para 4.6.1.13)
Self-test successful?
YES
NO
5 POSSIBLE LGC FAILURE NOT DETECTED BY SELF-TEST, OR FAILED LGC WARN LT CIRCUITRY
4 LGC FAILURE
6 MSFN monitor & evaluate LGC performance
1 RESTART lt remains off as long as RSET is keyed.
2 Not applicable to docked DPS burn. If this failure occurs, terminate burn and transfer attitude control to CSM. AGS is not programmed for docked burn.
3 LGC performance may be unreliable.
4 LGC is not functional; IMU can be used as backup for attitude reference.
A-300LM4-569
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
6
RNDZ RDR
YELLOW
Light on when RR is in automatic track mode if RR loses CSM lock-on
1 RNDZ RADAR: NO TRACK lt-on?
NO
YES
PGNS 7 1
2 •RNDZ RADAR sel-SLEW
RNDZ RADAR caut lt-off?
NO
YES
3 CWEA FAILURE
4 RNDZ RADAR: NO TRACK lt-on?
NO
YES
5 RNDZ RADAR: NO TRACK LT FAILED OFF
6 TRANSIENT CONDITION IN RR OR FAIL DETECT CIRCUIT, OR DOUBLE FAILURE
PGNS 7 6
(1) RNDZ RDR caut lt is not usable for failure detection. Use RNDZ RADAR: NO TRACK lt for monitoring.
(2) If this failure occurs, it is assumed that no other failure will be encountered. RNDZ RADAR: NO TRACK lt is not usable for monitoring
7
RNDZ RDR
YELLOW
RNDZ RADAR: NO TRACK
YELLOW
Light on when RR is in automatic track mode if RR loses CSM lock-on
Assumption: If thrusting is in process when this symptom occurs, thrust maneuver will be completed before proceeding with diagnosis
1 RR AGC loop check
•RADAR: TEST MON sel-AGC
•RADAR: SIGNAL STRENGTH ind-see figure 4-7
AGC within nominal operational limits?
NO
YES
2 RR transmitter check
•RADAR: TEST MON sel-XMTR PWR
RADAR: SIGNAL STRENGTH ind ≥ 2.1 vdc?
YES
NO
3 RR TRANSMITTER FAILURE
4 •RNDZ RADAR sel-SLEW
RNDZ RADAR caut lt-off?
NO
YES
5 RNDZ RDR CAUT LT FAILED ON
6 •RNDZ RADAR sel-AUTO TRACK
RNDZ RADAR: NO TRACK lt-off?
NO
YES
7 TRANSIENT CONDITION IN RR OR FAILURE DETECTION CIRCUIT
8 •RNDZ RADAR sel-AUTO TRACK
RNDZ RADAR caut lt and RNDZ RADAR: NO TRACK lt-off?
NO
YES
9 GUID CONT sw?
AGS
PGNS
10 Attempt AGS Acquisition Steering and manual lock-on
AGC peak reached?
NO
YES
11 Attempt automatic LGC acquisition via P20, ref para 4.8.2.1
Target acquired?
YES
NO
12 TEMPORARY LOSS OF TRACK CORRECTED BY P20
13 •RNDZ RADAR sel-AUTO TRACK
RNDZ RADAR: NO TRACK lt-off?
YES
NO
14 TEMPORARY LOSS OF TRACK CORRECTED BY AGS ACQUISITION
15 RNDZ RADAR caut lt-off?
YES
NO
16 RNDZ RADAR: NO TRACK LT FAILED ON AND TEMPORARY LOSS OF TRACK CORRECTED BY AGS ACQUISITION.
17 •Perform RR checkout (para 4.6.3.5)
Self-test values normal?
YES
NO
21 Transponder self-test
•Request CSM perform transponder self test
Transponder self-test successful?
YES
NO
23 POSSIBLE RR FAILURE OR TRANSPONDER FAILURE NOT DETECTED BY SELF-TESTS
22 TRANSPONDER FAILURE
18 Range rate data display good?
NO
YES
19 RR FREQUENCY TRACKER FAILURE
20 RR RANGE TRACKER FAILURE
(1) RR/transponder failure requires MSFN and/or CSM assistance & use of LGC – derived data when performing rendezvous.
(2) If this failure occurs it is assumed that no other failure will be encountered.
RNDZ RDR caut lt is not usable for monitoring. Use RNDZ RADAR: NO TRACK lt
(3) After switching from SLEW to AUTO TRACK, wait 15 seconds for lock-on enabling data-good discrete.
NO TRACK lt - off
(4) After switching from SLEW to AUTO TRACK, wait 15 seconds for lock-on enabling data-good discrete.
RNDZ RDR caut lt - off
NO TRACK lt - off
(5) Temporary loss of track may be due to LM attitude excursions.
(6) RNDZ RADAR: NO TRACK lt cannot be used for monitoring.
(7) Rendezvous radar will maintain tracking and provide good range rate data, good shaft & trunnion angles to FDAI error needles, & good azimuth & elevation rates to X pointer ind
(8) Possible data good logic failure. Continue using RR & monitor performance.
A-300LM4-570
SYMPTOM
PROCEDURE
REMARKS

8

SYMPTOM

LDG RDR (1)

YELLOW

Light should go on only if there is CWEA failure, data-good failure, or loss of LR Power.

PROCEDURE

1 TRACKER lt-on? (1)

NO → 2 CWEA FAILURE (2)

YES → 3 LR DATA-GOOD LOGIC FAILURE CAUSING ABSENCE OF DATA-GOOD SIGNAL TO LGC (2) (3)

REMARKS

(1) TRACKER lt goes on if LR velocity or range data are no good. Discrete is present during LGC data-read sequence. In LM4 this implies a failure of the data-good logic.

(2) LM 4 is wired such that velocity & range data-good signals are always present 20 seconds after power is turned on.

(3) LR data are transmitted to MSFN regardless of status of data-good discretes.

9

SYMPTOM

TRACKER

YELLOW

Light on while RR is under LGC control if RR CDU fails

RNDZ RADAR: NO TRACK lt may also be on, but does not represent a malfunction if lock-on has not been achieved.

PROCEDURE

1 •Key RSET
TRACKER lt-off?

YES → 2 TRANSIENT CONDITION IN RR CDU CIRCUIT → 3 MSFN monitor & evaluate RR CDU performance

NO (1)

4 RR CDU check
•RATE/ERR MON sw-RNDZ RADAR
•Perform RR Coarse Align, ref para 4.6.3.6.
DSKY registers & FDAI error needles display input shaft & trunnion angles?

NO (2) → 6 RR CDU FAILURE → 7 Perform manual RR acquisition
If LM under PGNCS control:
•Perform Preferred Tracking Attitude Program (P25), ref para 4.6.1.19
•RADAR: TEST MON sel-AGC
•RATE/ERR MON sw-RNDZ RADAR
•X POINTER SCALE sw-as desired
•RNDZ RADAR: SLEW sw-slew antenna until RADAR: SIGNAL STRENGTH ind peaks
•Perform side-lobe check
•RNDZ RADAR sel-AUTO TRACK
If LM under AGS control:
•Perform AGS Manual Rendezvous Radar LM State Vector Update. (para 4.8.2)

YES (3)

5 TRACKER LT LOGIC OR CDU FAIL DISCRETE CIRCUIT FAILURE

REMARKS

(1) During RR Coarse Align respond to V04 N06 – Option with 00002 continous designate option. To permit comparison of DSKY registers & FDAI error needles, load 000.00° for both shaft & trunnion angles.

(2) RR is not usable under LGC control. Select slew & automatic track modes.

(3) TRACKER lt is not usable for monitoring. Use program alarms for monitoring.

10

SYMPTOM

PROG

YELLOW

TRACKER

YELLOW

Light on if data good loss occurs, during LGC data read sequence or RR CDU failure occurs while Rendezvous Navigation Program (P20) is in progress.

PROCEDURE

1 •Key RSET
PROG lt & TRACKER lt-off?

YES → 2 TRANSIENT CONDITION → 3 MSFN monitor & evaluate RR performance

NO (1) (2)

4 Call alarm
•Key V05 N09E
Alarm code?

00521 → 5 •Key KEY REL & RSET (3) → PGNS 7 | 11

00515

6 •Key KEY REL & RSET

7 Attempt to continue P20, ref para 4.8.2.1
CDU performance satisfactory?

YES → 8 TRANSIENT CONDITION IN RR CDU CIRCUIT → 9 Continue P20 → (3)

NO → PGNS 9 | 4

REMARKS

(1) Alarm codes:
00521 – Data good lapses
00515 – RR CDU fail

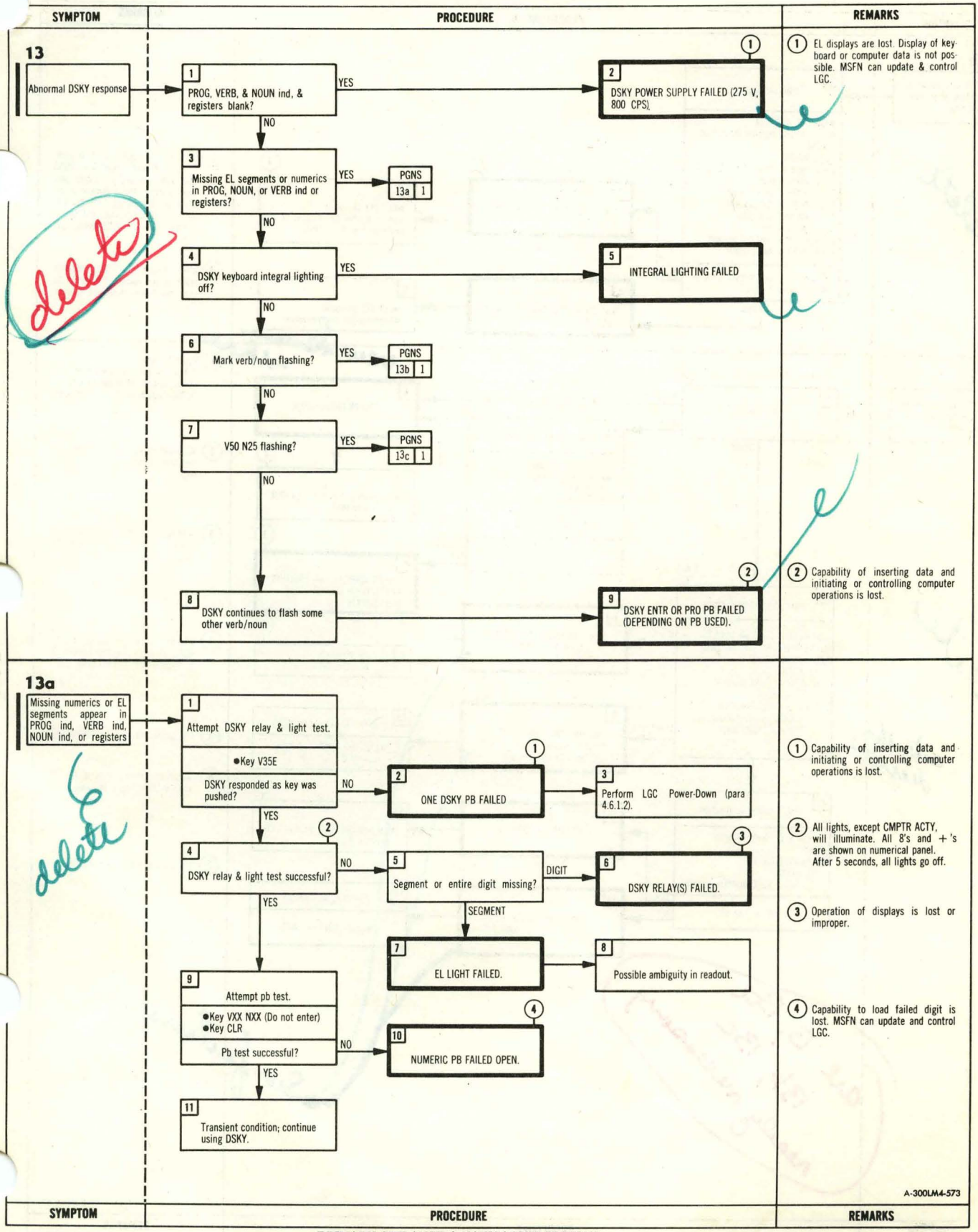
(2) If data good lapses, RNDZ RADAR – NO TRACK lt will go on.

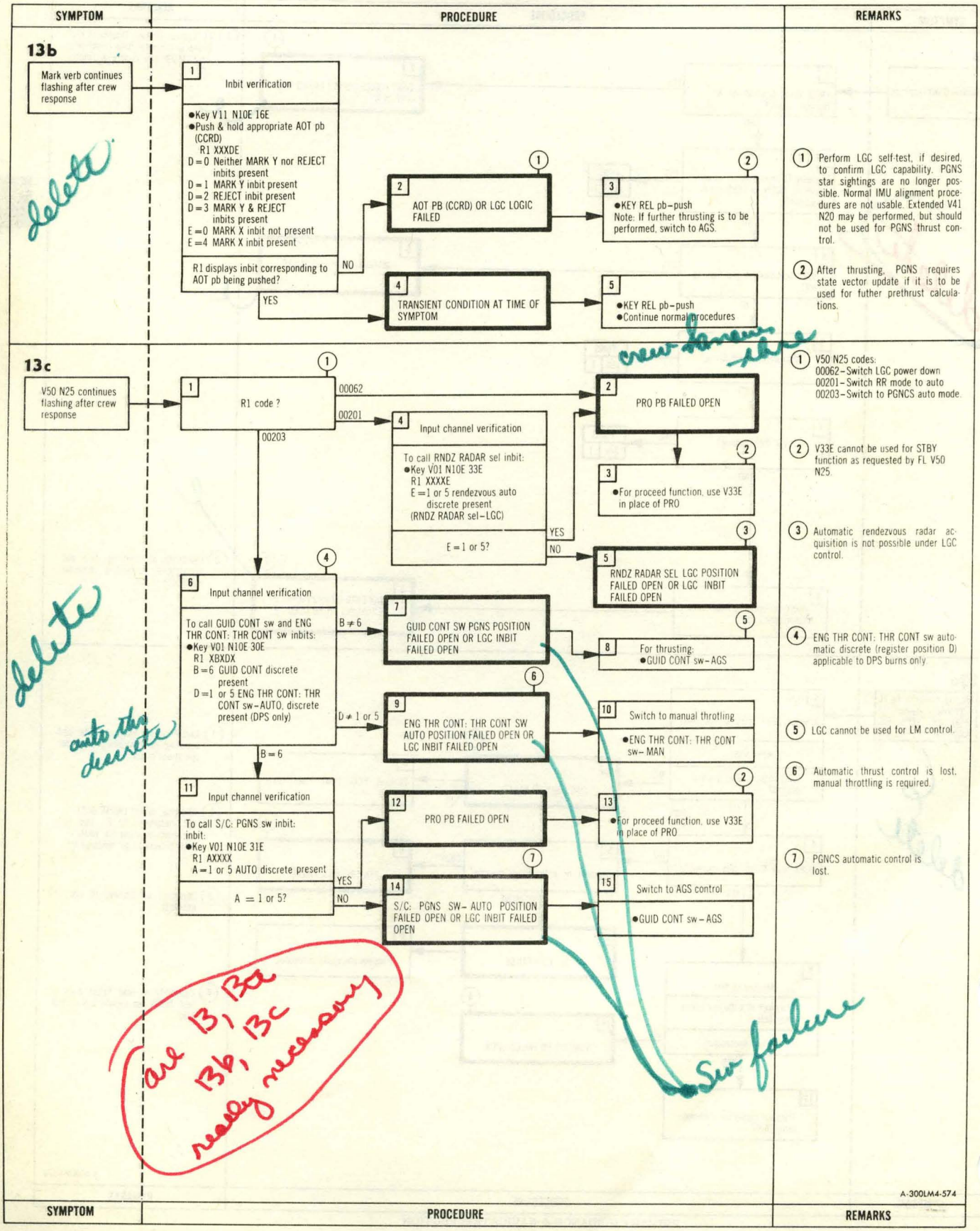
(3) Program 20 automatically selects RR designate routine for automatic reacquisition.

B-300LM4-571

SYMPTOM	PROCEDURE	REMARKS
11 TEMP (YELLOW). Light on if IMU temperature is not within 126.3° to 134.3°F.	1 •Key RSET — TEMP lt - off? YES → 2 TRANSIENT CONDITION IN IMU TEMP CONTROL CIRCUIT → 3 MSFN monitor & evaluate ISS performance. NO → 4 Input channel check for out-of-limits temp: •Key V01 N10E 30E; R1 AXXXX; R2 - - - - -; R3 - - - - -; A >3 - temp out of limits — A >3? NO → 5 Output channel check - temp caution relay: •Key V01 N10E 11E; R1 XXXDX; R2 - - - - -; R3 - - - - -; D = Odd-temp caution bit present; D = 0 or even - temp caution bit not present — D = Odd? NO → 6 TEMP RELAY IN DSKY FAILED CLOSED. YES → 7 LGC OUTPUT CHANNEL FAILURE. YES → (1) 8 IMU TEMP CONTROL FAILURE → (2) 9 MSFN evaluate ISS performance. If MSFN not available or if MSFN confirms ISS not usable, switch to AGS control.	(1) G&N system performance will be unaffected by IMU temperature out of limits for at least 15 minutes. Critical maneuvers can be continued within this time. (2) IMU stabilization loop and velocity measurement accuracy is degraded after 15 minutes depending on temperature excursion from nominal range.
12 GIMBAL LOCK (YELLOW). Light on if MGA >± 70° from zero position	1 •Key RSET — NO ATT lt - on? YES → (1) 2 IMU HAS ENTERED GIMBAL LOCK. INERTIAL REFERENCE IS LOST. → 3 IMU gimbal angles will hold at present attitude. •Perform P51 (para 4.9.1) to establish inertial reference. NO → 4 Monitor present gimbal angles: •Key V16 N20E; R1 OGA XXX.X X°; R2 IGA XXX.X X°; R3 MGA XXX.X X° — R3 (MGA) >± 70° ? YES → (2) 5 Avoid gimbal lock: •Key KEY REL; •Perform P52 to realign IMU or •ACA - maneuver to avoid gimbal lock. NO → 6 •Key KEY REL — GIMBAL LOCK lt - off? NO → (3) 8 GIMBAL LOCK DETECTION CIRCUIT FAILURE → 9 Monitor FDAI and/or DSKY displayed angles to avoid gimbal lock. YES → 7 TRANSIENT CONDITION IN GIMBAL LOCK DETECTION CIRCUIT	(1) To prevent gimbal oscillations, LGC commands a coarse alignment when MGA >± 85°. (2) Gimbal lock is imminent. LM attitude or IMU orientation must be changed. (3) GIMBAL LOCK lt is not usable for monitoring.

A-300LM4-572


SYMPTOM
PROCEDURE
REMARKS
13
Abnormal DSKY response
1 PROG, VERB, & NOUN ind, & registers blank?
YES
2 DSKY POWER SUPPLY FAILED (275 V, 800 CPS).
NO
3 Missing EL segments or numerics in PROG, NOUN, or VERB ind or registers?
YES
PGNS 13a 1
NO
4 DSKY keyboard integral lighting off?
YES
5 INTEGRAL LIGHTING FAILED
NO
6 Mark verb/noun flashing?
YES
PGNS 13b 1
NO
7 V50 N25 flashing?
YES
PGNS 13c 1
NO
8 DSKY continues to flash some other verb/noun
9 DSKY ENTR OR PRO PB FAILED (DEPENDING ON PB USED).
(1) EL displays are lost. Display of keyboard or computer data is not possible. MSFN can update & control LGC.
(2) Capability of inserting data and initiating or controlling computer operations is lost.
13a
Missing numerics or EL segments appear in PROG ind, VERB ind, NOUN ind, or registers
1 Attempt DSKY relay & light test.
•Key V35E
DSKY responded as key was pushed?
NO
2 ONE DSKY PB FAILED
3 Perform LGC Power-Down (para 4.6.1.2).
YES
4 DSKY relay & light test successful?
NO
5 Segment or entire digit missing?
DIGIT
6 DSKY RELAY(S) FAILED.
SEGMENT
7 EL LIGHT FAILED.
8 Possible ambiguity in readout.
YES
9 Attempt pb test.
•Key VXX NXX (Do not enter)
•Key CLR
Pb test successful?
NO
10 NUMERIC PB FAILED OPEN.
YES
11 Transient condition; continue using DSKY.
(1) Capability of inserting data and initiating or controlling computer operations is lost.
(2) All lights, except CMPTR ACTY, will illuminate. All 8's and + 's are shown on numerical panel. After 5 seconds, all lights go off.
(3) Operation of displays is lost or improper.
(4) Capability to load failed digit is lost. MSFN can update and control LGC.
A-300LM4-573
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
13b
Mark verb continues flashing after crew response
1 Inbit verification
●Key V11 N10E 16E
●Push & hold appropriate AOT pb (CCRD)
R1 XXXDE
D=0 Neither MARK Y nor REJECT inbits present
D=1 MARK Y inbit present
D=2 REJECT inbit present
D=3 MARK Y & REJECT inbits present
E=0 MARK X inbit not present
E=4 MARK X inbit present
R1 displays inbit corresponding to AOT pb being pushed?
NO
YES
2 AOT PB (CCRD) OR LGC LOGIC FAILED
3 ●KEY REL pb–push
Note: If further thrusting is to be performed, switch to AGS.
4 TRANSIENT CONDITION AT TIME OF SYMPTOM
5 ●KEY REL pb–push
●Continue normal procedures
(1) Perform LGC self-test, if desired, to confirm LGC capability. PGNS star sightings are no longer possible. Normal IMU alignment procedures are not usable. Extended V41 N20 may be performed, but should not be used for PGNS thrust control.
(2) After thrusting, PGNS requires state vector update if it is to be used for futher prethrust calculations.
13c
V50 N25 continues flashing after crew response
1 R1 code ?
00062
00201
00203
2 PRO PB FAILED OPEN
3 ●For proceed function, use V33E in place of PRO
4 Input channel verification
To call RNDZ RADAR sel inbit:
●Key V01 N10E 33E
R1 XXXXE
E=1 or 5 rendezvous auto discrete present
(RNDZ RADAR sel–LGC)
E=1 or 5?
YES
NO
5 RNDZ RADAR SEL LGC POSITION FAILED OPEN OR LGC INBIT FAILED OPEN
6 Input channel verification
To call GUID CONT sw and ENG THR CONT: THR CONT sw inbits:
●Key V01 N10E 30E
R1 XBXDX
B=6 GUID CONT discrete present
D=1 or 5 ENG THR CONT: THR CONT sw–AUTO, discrete present (DPS only)
B≠6
D≠1 or 5
B=6
7 GUID CONT SW PGNS POSITION FAILED OPEN OR LGC INBIT FAILED OPEN
8 For thrusting:
●GUID CONT sw–AGS
9 ENG THR CONT: THR CONT SW AUTO POSITION FAILED OPEN OR LGC INBIT FAILED OPEN
10 Switch to manual throttling
●ENG THR CONT: THR CONT sw–MAN
11 Input channel verification
To call S/C: PGNS sw inbit: inbit:
●Key V01 N10E 31E
R1 AXXXX
A=1 or 5 AUTO discrete present
A = 1 or 5?
YES
NO
12 PRO PB FAILED OPEN
13 ●For proceed function, use V33E in place of PRO
14 S/C: PGNS SW–AUTO POSITION FAILED OPEN OR LGC INBIT FAILED OPEN
15 Switch to AGS control
●GUID CONT sw–AGS
(1) V50 N25 codes:
00062–Switch LGC power down
00201–Switch RR mode to auto
00203–Switch to PGNCS auto mode.
(2) V33E cannot be used for STBY function as requested by FL V50 N25.
(3) Automatic rendezvous radar acquisition is not possible under LGC control.
(4) ENG THR CONT: THR CONT sw automatic discrete (register position D) applicable to DPS burns only.
(5) LGC cannot be used for LM control.
(6) Automatic thrust control is lost, manual throttling is required.
(7) PGNCS automatic control is lost.
A-300LM4-574
SYMPTOM
PROCEDURE
REMARKS

Don Clark - Grumman
Ted Skook - TRW

5.2.4 ABORT GUIDANCE SECTION

Table 5-7. AGS Procedure Entry Sheet

Symptom	Sym No.	Page No.
AGS warn lt	1	5.2-31
DEDA response is abnormal	2	5.2-32
DEDA and/or FDAI anomaly when AGS STATUS sw position is changed	3	5.2-33
AGS Initialization complete code is not displayed within 10 seconds after DSKY display flashes	4	5.2-33
No change in DEDA ΔV display during thrusting	5	5.2-34
Attitude error needles failed at zero	6	5.2-34
In deadband, attitude hold error signals are displayed when guidance or Z-body axis steering submodes of operation are commanded	7	5.2-35
Attitude error signals are non zero when GUID CONT sw - PGNS, S00 = 0 (Attitude Hold Submode)	8	5.2-35
Attitude error signals are non zero when GUID CONT sw - PGNS, S/C: AGS sw - ATT HOLD S00 = 1 or 2 (Guidance steering or Z-body axis steering)	8a	5.2-35
Attitude error signals are non zero when S/C: AGS sw - ATT HOLD, ACA - out of detent, S00 = 1 or 2 (Guidance steering or Z-body axis steering)	8b	5.2-35
PGNCS and AGS total attitude displays disagree in one or more axes immediately following PGNCS/AGS alignment	9	5.2-35
MASTER ALARM with AGS warn lt temporarily on or without any caution or warning light on (excluding cases when it is known that some other system triggered MASTER ALARM (only) as part of specific sequence)	10	5.2-36

Table 5-8. AGS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
AEA has experienced restart	MASTER ALARM with AGS warn lt temporarily on or without any caution or warning light on (excluding cases when it is known that some other system triggered MASTER ALARM (only) as part of specific sequence)	10	5.2-36
AEA power supply failure	AGS warn lt	1	5.2-31
AGS accelerometer failure	No change in DEDA ΔV display during thrusting	5	5.2-34
AGS self-test detected failure	AGS warn lt	1	5.2-31
AGS STATUS sw - STAND BY contracts failed open	DEDA and/or FDAI anomaly when AGS STATUS sw position is changed	3	5.2-33
ASA heater, CWEA, or AEA test mode fail discrete failure	AGS warn lt	1	5.2-31
ASA heater failure	AGS warn lt	1	5.2-31
Auto discrete (β_4) failed off	Attitude error needles failed at zero	6	5.2-34

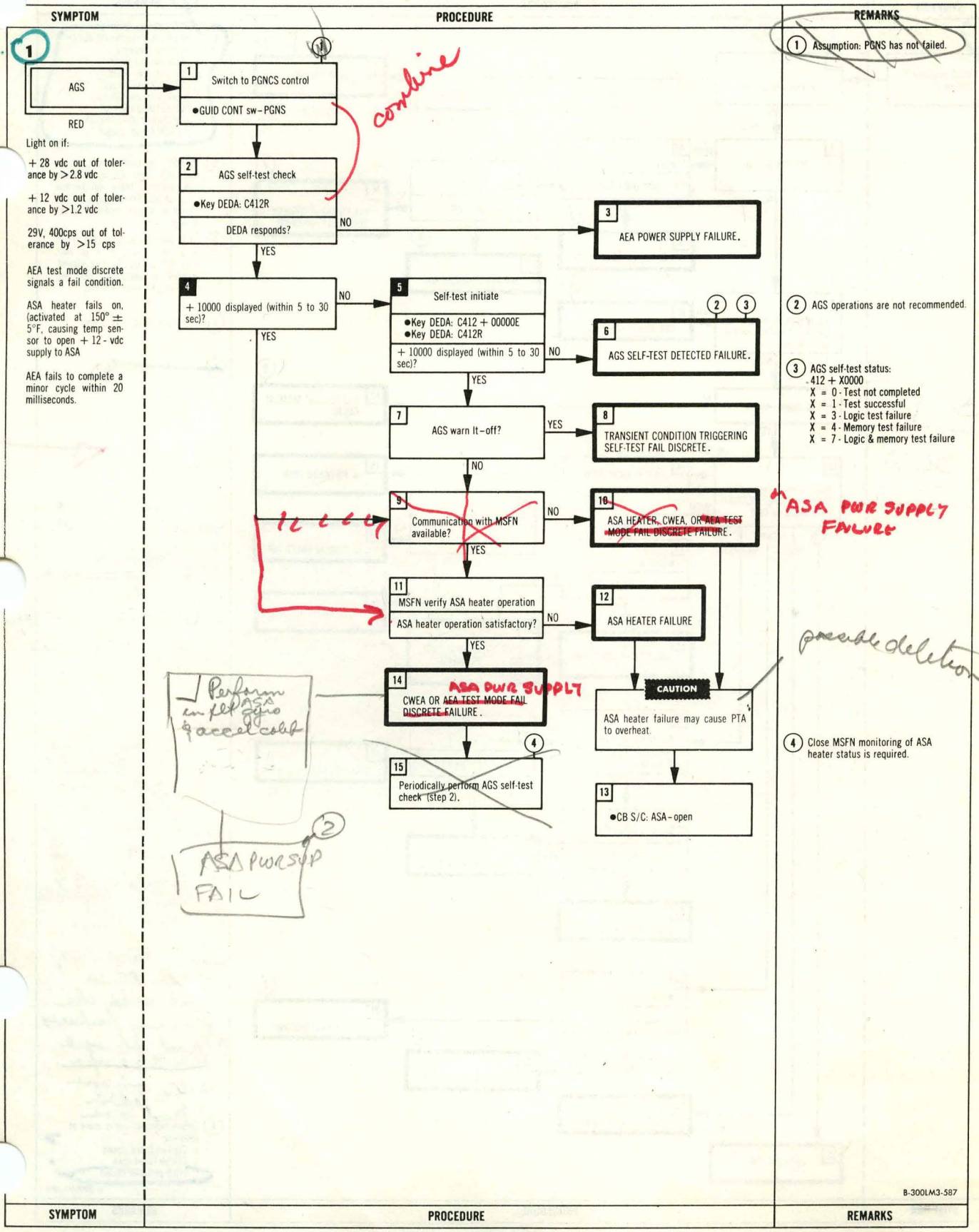
Table 5-8. AGS Failure/Symptom Cross-Reference Index (cont)

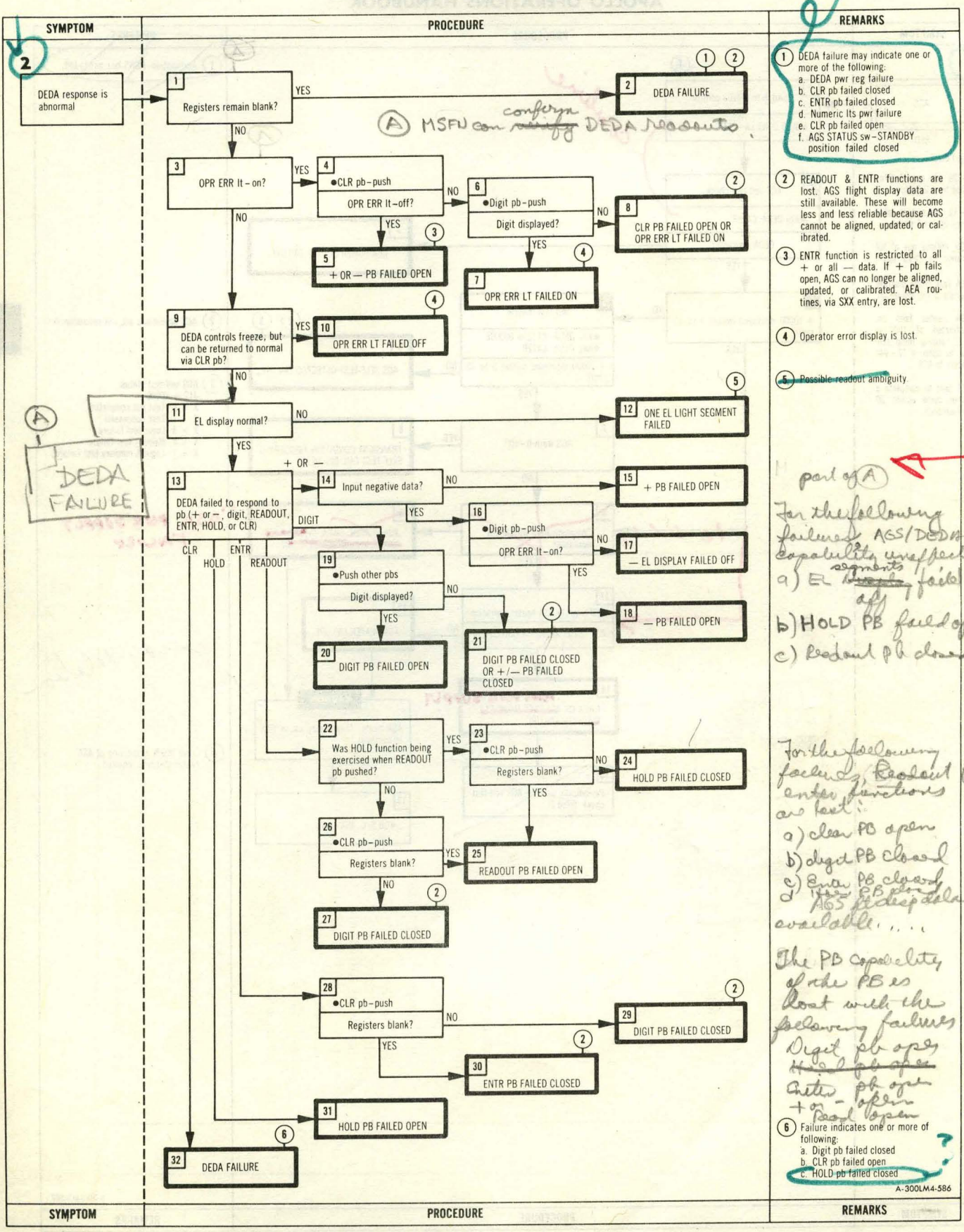
Failure	Symptom	Sum No.	Page No.
Automatic discrete (β_4) failed off	In deadband, attitude hold error signals are displayed when guidance or Z-body axis steering submodes of operation are commanded	7	5.2-35
Automatic discrete (β_4) failed on	Attitude error signals are non zero when GUID CONT sw - PGNS S/C: AGS sw - ATT HOLD S00 = 1 or 2 (Guidance steering or Z-body axis steering)	8a	5.2-35
CDU zero from LGC failed	PGNCS and AGS total attitude displays disagree in one or more axes immediately following PGNCS/AGS alignment	9	5.2-35
CLR pb failed open or OPR ERR lt failed on	DEDA response is abnormal	2	5.2-32
CWEA or AEA test mode fail discrete failure	AGS warn lt	1	5.2-31
DEDA failure	DEDA response is abnormal	2	5.2-32
DEDA failure or DEDA-AEA interconnection failure	AGS Initialization complete code is not displayed within 10 seconds after DSKY display flashes	4	5.2-33
Digit pb failed closed	DEDA response is abnormal	2	5.2-32
Digit pb failed closed or +/-pb failed closed	DEDA response is abnormal	2	5.2-32
Digit pb failed open	DEDA response is abnormal	2	5.2-32
ENTR pb failed closed	DEDA response is abnormal	2	5.2-32
Followup discrete (β_3) failed	Attitude error needles failed at zero	6	5.2-34
Guidance control path of followup discrete (β_3) failed off	Attitude error signals are non zero when GUID CONT sw - PGNS, S00 = 0 (Attitude Hold Submode)	8	5.2-35
	Attitude error signals are non zero when GUID CONT sw - PGNS S/C: AGS sw - ATT HOLD S00 = 1 or 2 (Guidance steering or Z-body axis steering)	8a	5.2-35
HOLD pb failed closed	DEDA response is abnormal	2	5.2-32
HOLD pb failed open	DEDA response is abnormal	2	5.2-32
Intermittent out-of-tolerance condition in nonlatching circuit	MASTER ALARM with AGS warn lt temporarily on or without any caution or warning light on (excluding cases when it is known that some other system triggered MASTER ALARM (only) as part of specific sequence)	10	5.2-36
One axis out-of-detent path followup failed off	Attitude error signals are non zero when S/C: AGS sw - ATT HOLD ACA - out of detent S00 = 1 or 2 (Guidance steering or Z-body axis steering)	8b	5.2-35
One EL light segment failed	DEDA response is abnormal	2	5.2-32

Table 5-8. AGS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Out-of-detent path of followup discrete (β_3) failed off	Attitude error signals are non zero when S/C: AGS sw - ATT HOLD ACA - out of detent S00 = 1 or 2 (Guidance steering or Z-body axis steering)	8b	5.2-35
Out-of-detent switch or relay failed closed	Attitude error needles failed at zero	6	5.2-34
One of six AEA Euler angle inputs failed	PGNCS and AGS total attitude displays disagree in one or more axes immediately following PGNCS/AGS alignment	9	5.2-35
OPR ERR lt failed off	DEDA response is abnormal	2	5.2-32
OPR ERR lt failed on	DEDA response is abnormal	2	5.2-32
+ or - pb failed open	DEDA response is abnormal	2	5.2-32
+ pb failed open	DEDA response is abnormal	2	5.2-32
- pb failed open	DEDA response is abnormal	2	5.2-32
- EL display failed off	DEDA response is abnormal	2	5.2-32
READOUT pb failed open	No change in DEDA ΔV display during thrusting	5	5.2-34
	DEDA response is abnormal	2	5.2-32
Stop pulse from PGNCS not received or PGNCS downlink register failure	AGS Initialization complete code is not displayed within 10 seconds after DSKY display flashes	4	5.2-33
Transient condition triggering self-test fail discrete	AGS warn lt	1	5.2-31
Transient malfunction, such as ID word not found during first execution of R47	AGS Initialization complete code is not displayed within 10 seconds after DSKY display flashes	4	5.2-33

AGS

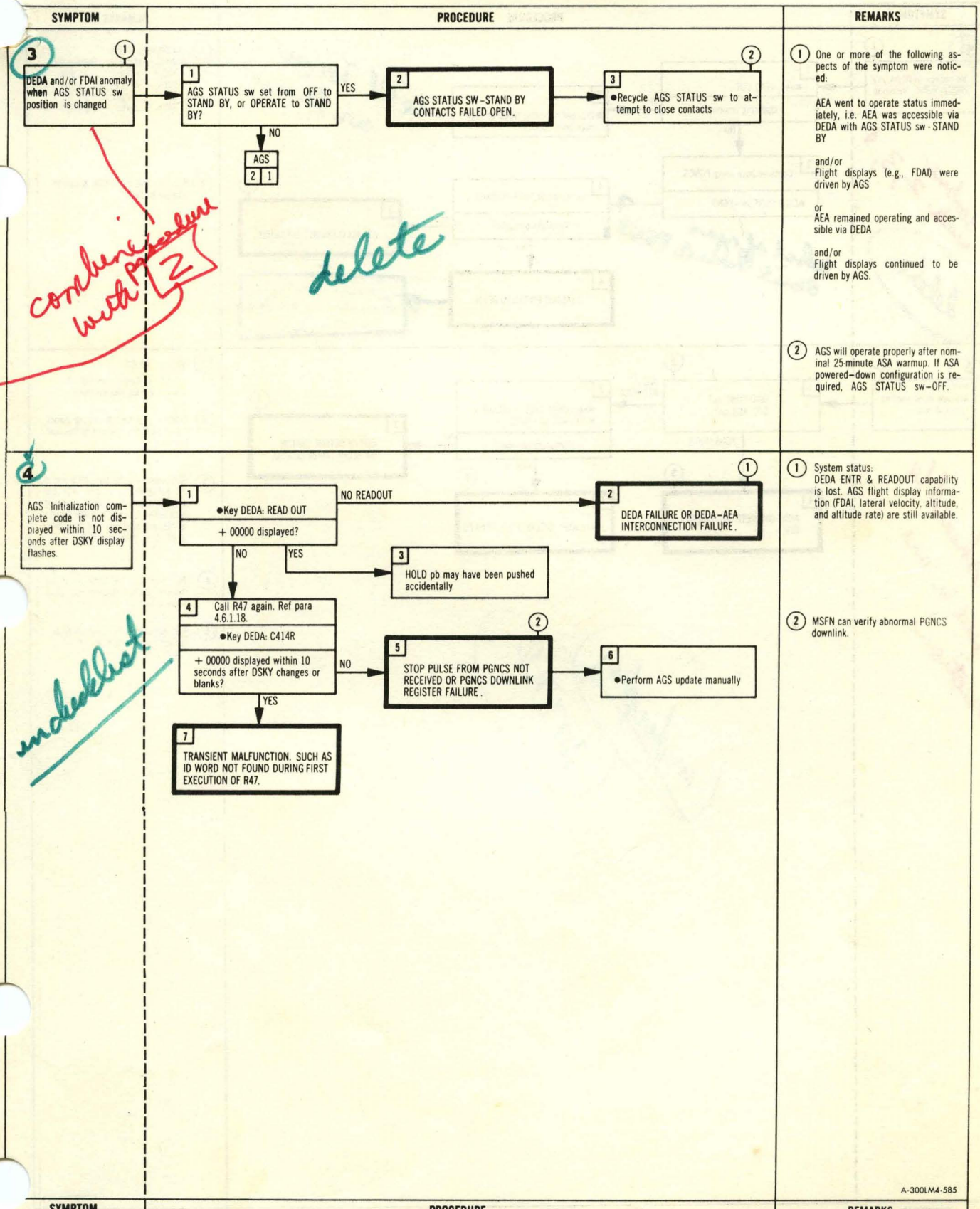

SYMPTOM
PROCEDURE
REMARKS
1
AGS
RED
Light on if:
+ 28 vdc out of tolerance by > 2.8 vdc
+ 12 vdc out of tolerance by > 1.2 vdc
29V, 400cps out of tolerance by > 15 cps
AEA test mode discrete signals a fail condition.
ASA heater fails on, (activated at 150° ± 5°F, causing temp sensor to open + 12 - vdc supply to ASA
AEA fails to complete a minor cycle within 20 milliseconds.
1
Switch to PGNCS control
•GUID CONT sw - PGNS
2
AGS self-test check
•Key DEDA: C412R
DEDA responds?
NO
YES
3
AEA POWER SUPPLY FAILURE.
4
+ 10000 displayed (within 5 to 30 sec)?
NO
YES
5
Self-test initiate
•Key DEDA: C412 + 00000E
•Key DEDA: C412R
+ 10000 displayed (within 5 to 30 sec)?
NO
YES
6
AGS SELF-TEST DETECTED FAILURE.
7
AGS warn lt - off?
YES
NO
8
TRANSIENT CONDITION TRIGGERING SELF-TEST FAIL DISCRETE.
9
Communication with MSFN available?
NO
YES
10
ASA HEATER, CWEA, OR AEA TEST MODE FAIL DISCRETE FAILURE.
11
MSFN verify ASA heater operation
ASA heater operation satisfactory?
NO
YES
12
ASA HEATER FAILURE
14
CWEA OR AEA TEST MODE FAIL DISCRETE FAILURE.
15
Periodically perform AGS self-test check (step 2).
CAUTION
ASA heater failure may cause PTA to overheat.
13
•CB S/C: ASA - open
1 Assumption: PGNS has not failed.
2 AGS operations are not recommended.
3 AGS self-test status:
412 + X0000
X = 0 - Test not completed
X = 1 - Test successful
X = 3 - Logic test failure
X = 4 - Memory test failure
X = 7 - Logic & memory test failure
4 Close MSFN monitoring of ASA heater status is required.
B-300LM3-587
SYMPTOM
PROCEDURE
REMARKS



SYMPTOM | PROCEDURE | REMARKS

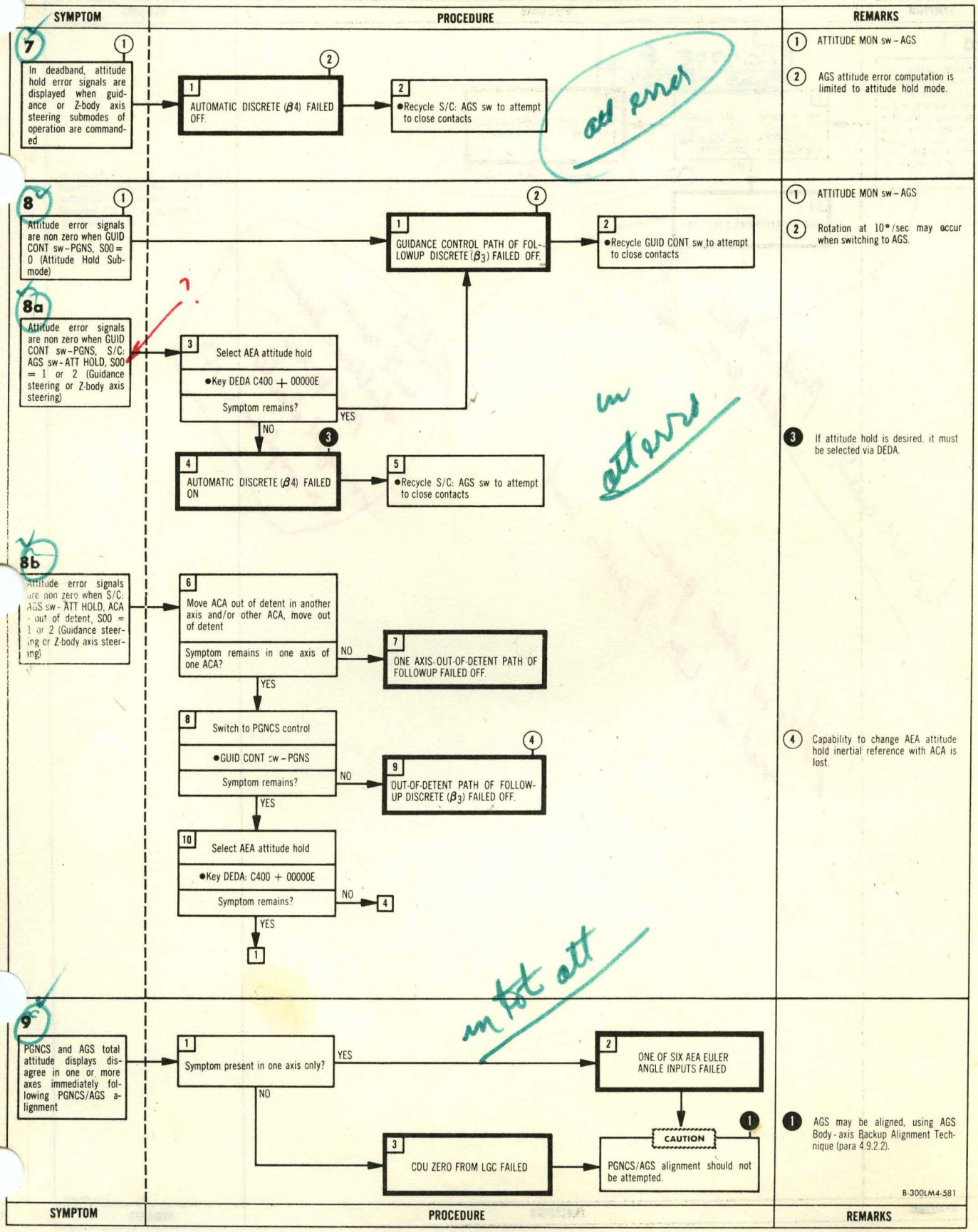
ABORT GUIDANCE SECTION

Basic Date 3 February 1969 Change Date _____ Page 5.2-32


SYMPTOM
PROCEDURE
REMARKS
3
(1)
DEDA and/or FDAI anomaly when AGS STATUS sw position is changed
1
AGS STATUS sw set from OFF to STAND BY, or OPERATE to STAND BY?
YES
NO
2
AGS STATUS SW-STAND BY CONTACTS FAILED OPEN.
3
•Recycle AGS STATUS sw to attempt to close contacts
(2)
AGS
2 1
combine with procedure 2
delete
(1) One or more of the following aspects of the symptom were noticed:
AEA went to operate status immediately, i.e. AEA was accessible via DEDA with AGS STATUS sw - STAND BY
and/or
Flight displays (e.g., FDAI) were driven by AGS
or
AEA remained operating and accessible via DEDA
and/or
Flight displays continued to be driven by AGS.
(2) AGS will operate properly after nominal 25-minute ASA warmup. If ASA powered-down configuration is required, AGS STATUS sw-OFF.
AGS
4
(1)
AGS Initialization complete code is not displayed within 10 seconds after DSKY display flashes.
1
•Key DEDA: READ OUT
+ 00000 displayed?
NO READOUT
2
DEDA FAILURE OR DEDA-AEA INTERCONNECTION FAILURE.
NO
YES
3
HOLD pb may have been pushed accidentally
4
Call R47 again. Ref para 4.6.1.18.
•Key DEDA: C414R
+ 00000 displayed within 10 seconds after DSKY changes or blanks?
NO
(2)
5
STOP PULSE FROM PGNCS NOT RECEIVED OR PGNCS DOWNLINK REGISTER FAILURE.
6
•Perform AGS update manually
YES
7
TRANSIENT MALFUNCTION, SUCH AS ID WORD NOT FOUND DURING FIRST EXECUTION OF R47.
checklist
(1) System status:
DEDA ENTR & READOUT capability is lost. AGS flight display information (FDAI, lateral velocity, altitude, and altitude rate) are still available.
(2) MSFN can verify abnormal PGNCS downlink.
A-300LM4-585
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS
5 ① No change in DEDA ΔV display during thrusting	① ●Key: READ OUT Updating resumed? YES → ② ●Proceed normally; HOLD pb may have been pushed NO → ③ Continue burn using PGNCS ●GUID CONT sw–PGNS → ④ Select other DEDA readouts Readouts possible? YES → ⑤ AGS ACCELEROMETER FAILURE. (②) NO → ⑥ READOUT PB FAILED OPEN.	① ΔV displays (DEDA): Address / Parameter / Quantization 500 / ΔVgx / .1 fps 501 / ΔVgy / .1 fps 502 / ΔVgz / .1 fps 370 / ΔVG / .1 fps ② AGS can still drive FDAI & can be aligned to IMU.
6 ① Attitude error needles failed at zero	① GUID CONT sw? S/C: AGS sw? (②) AGS/ATT HOLD → ② ●Key: DEDA C400 + 00000E ●S/C: AGS sw - AUTO Symptom remains? NO → ③ OUT-OF-DETENT SWITCH OR RELAY FAILED CLOSED. (③) YES → ④ FOLLOWUP DISCRETE (β_3) FAILED ON. (④) PGNS/AUTO → ⑤ AUTO DISCRETE (β_4) FAILED OFF. (⑤)	① S00 + X0000 X = 1 - Guidance steering X = 2 - Z-body axis steering ② Other logical switch setting combinations are not relevant to this malfunction. ③ AGS capabiltiy to turn MPS on or off automatically is lost. AGS can still compute & display guidance acquisition steering attitude signals, & retains attitude hold capability when S/C: AGS sw–AUTO ④ AGS capability is same as in Remark 3, except attitude hold capability is lost. ⑤ AGS attitude error computation is limited to attitude hold.

A-300LM4-582


SYMPTOM
PROCEDURE
REMARKS
7
In deadband, attitude hold error signals are displayed when guidance or Z-body axis steering submodes of operation are commanded
1
2
1 AUTOMATIC DISCRETE (β4) FAILED OFF.
2 •Recycle S/C: AGS sw to attempt to close contacts
1 ATTITUDE MON sw – AGS
2 AGS attitude error computation is limited to attitude hold mode.
8
Attitude error signals are non zero when GUID CONT sw – PGNS, S00 = 0 (Attitude Hold Submode)
8a
Attitude error signals are non zero when GUID CONT sw – PGNS, S/C: AGS sw – ATT HOLD, S00 = 1 or 2 (Guidance steering or Z-body axis steering)
1
2
1 GUIDANCE CONTROL PATH OF FOLLOWUP DISCRETE (β3) FAILED OFF.
2 •Recycle GUID CONT sw to attempt to close contacts
3 Select AEA attitude hold
•Key DEDA C400 + 00000E
Symptom remains?
YES
NO
3
4 AUTOMATIC DISCRETE (β4) FAILED ON
5 •Recycle S/C: AGS sw to attempt to close contacts
1 ATTITUDE MON sw – AGS
2 Rotation at 10°/sec may occur when switching to AGS.
3 If attitude hold is desired, it must be selected via DEDA.
8b
Attitude error signals are non zero when S/C: AGS sw – ATT HOLD, ACA – out of detent, S00 = 1 or 2 (Guidance steering or Z-body axis steering)
6 Move ACA out of detent in another axis and/or other ACA, move out of detent
Symptom remains in one axis of one ACA?
NO
YES
7 ONE AXIS-OUT-OF-DETENT PATH OF FOLLOWUP FAILED OFF.
8 Switch to PGNCS control
•GUID CONT sw – PGNS
Symptom remains?
NO
YES
4
9 OUT-OF-DETENT PATH OF FOLLOW-UP DISCRETE (β3) FAILED OFF.
10 Select AEA attitude hold
•Key DEDA: C400 + 00000E
Symptom remains?
NO
4
YES
1
4 Capability to change AEA attitude hold inertial reference with ACA is lost.
9
PGNCS and AGS total attitude displays disagree in one or more axes immediately following PGNCS/AGS alignment
1 Symptom present in one axis only?
YES
NO
2 ONE OF SIX AEA EULER ANGLE INPUTS FAILED
3 CDU ZERO FROM LGC FAILED
CAUTION
PGNCS/AGS alignment should not be attempted.
1
1 AGS may be aligned, using AGS Body-axis Backup Alignment Technique (para 4.9.2.2).
B-300LM4-581
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS
10 MASTER ALARM with AGS warn lt temporarily on or without any caution or warning light on (excluding cases when it is known that some other system triggered MASTER ALARM (only) as part of specific sequence).	1 Was parameter in AEA location 470 reset to —07332 or parameters in AEA locations 500 or 510 thru 517 reset to 00000? NO → 2 INTERMITTENT OUT-OF-TOLERANCE CONDITION IN NON-LATCHING CIRCUIT. YES → (1) 3 AEA HAS EXPERIENCED RESTART.	(1) At restart, various parameters (depending upon operation performed at time of restart) must be verified or modified before AEA automatic functions can be considered reliable.

5.2.5 CONTROL ELECTRONICS SECTION

Table 5-9. CES Procedure Entry Sheet

Symptom	Sym No.	Page No.
Abnormal vehicle dynamics	1	5.2-44
PRE AMPS caut lt	2	5.2-46
CES AC warn lt	3	5.2-46
CES AC warn lt & PRE AMPS caut lt	4	5.2-46
CES DC warn lt	5	5.2-47
MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
MPS does not thrust when EVNT TMR ind - 00:00	7	5.2-49
DPS does not respond to thrust increase or decrease command	8	5.2-50
ENG THRUST & CMD THRUST ind do not agree during DPS burn	9	5.2-51
No auto MPS shutdown	10	5.2-52
Unsuccessful manual APS shutdown	11	5.2-52
Rate Gyro Check fails	12	5.2-53
LM drifts	13	5.2-54
Single RCS jet failed on	14	5.2-55
CDR (LMP) ACA jammed out of detent. Proportional signals always present	15	5.2-55
Abnormal response to CDR (LMP) ACA commands	16	5.2-56
Abnormal proportional mode response	16a	5.2-56
Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Abnormal response to CDR (LMP) ACA direct mode commands	18	5.2-58
Absence of normal translation via CDR (LMP) TTCA	19	5.2-59

Table 5-10. CES Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
ACA jammed	Abnormal vehicle dynamics	1	5.2-44
ACA out-of-detent sw (internal) failed closed	LM drifts	13	5.2-54
AEA did not issue eng-off command or remove eng-on command, or AELD failure	No auto MPS shutdown	10	5.2-52
AELD failure	No auto MPS shutdown	10	5.2-52
Affected axis rate gyro failed	Rate Gyro Check fails	12	5.2-53
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 1 failed in DIR, if neg rotation is lost; deck No. 4, if pos rotation is lost	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 1 failed in MODE CONT position, if neg rotation is lost; deck No. 4, if pos rotation is lost	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 2 failed in PULSE position	Abnormal response to CDR (LMP) ACA direct mode commands	18	5.2-58
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 2 failed open or in MODE CONT position	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 2 failed in DIR position	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 2 failed open or in MODE CONT position, or ACA 2.5° sw (internal) failed open	Abnormal response to CDR (LMP) ACA direct mode commands	18	5.2-58
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 3 failed open or in MODE CONT position	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Affected axis S/C: ROLL, PITCH, or YAW sw deck No. 3 failed open, or in MODE CONT or PULSE position	Abnormal response to CDR (LMP) ACA direct mode commands	18	5.2-58
Affected TTCA enable sw deck No. 1 failed open or 28-volt line to TTCA failed	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
AGS did not issue eng-on command or did not remove eng-off command, or relay K8 of S & C control assy No. 2 failed open	MPS does not thrust when EVNT TMR ind - 00:00	7	5.2-59
ATCA failure	Abnormal vehicle dynamics	1	5.2-44

Table 5-10. CES Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Auto throttle circuit failure	DPS does not respond to thrust increase or decrease command	8	5.2-50
β_1 internal to AGS failed on or relay driver in AELD failed on	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
β_2 internal to AGS failed on or relay driver in AELD failed on	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
β_3 followup discrete to AGS failed on	No auto MPS shutdown	10	5.2-52
CDR ACA hardover (single contact) sw failed closed	Single RCS jet failed on	14	5.2-55
CDR (LMP) ACA 800-cps fuse blown or CDR (LMP) ACA PROP sw failed open	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
CDR (LMP) ACA jammed out of detent. Proportional signals always present.	CDR (LMP) ACA jammed out of detent. Proportional signals always present.	15	5.2-55
CDR (LMP) ACA out-of-detent sw (internal) failed open in affected axis	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
CDR (LMP) ACA single axis moveable xducer coil (internal) hung up in other than detent position	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
CDR (LMP) ACA 2.5° sw (internal) failed closed	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
	Abnormal response to CDR (LMP) ACA direct mode commands	18	5.2-58
CDR (LMP) ACA 2.5° sw (internal) failed open	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
CDR (LMP) ACA xducer sw (internal) or xducer coil (internal) failed open	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
CDR (LMP) eng STOP sw failure	Unsuccessful manual APS shutdown	11	5.2-52
CDR (LMP) TTCA failure or ENG THR CONT: MAIN THROT sw deck No. 1 or 2 failed to LMP (CDR), or (LMP) TTCA fuse blown	DPS does not respond to thrust increase or decrease command	8	5.2-50
CDR or LMP ACA hardover sw (single contact) failed closed	Abnormal vehicle dynamics	1	5.2-44
CDR or LMP ACA pulse/direct sw (internal) failed closed	Abnormal vehicle dynamics	1	5.2-44
CES d-c power supply failure	CES DC warn lt	5	5.2-47

Table 5-10. CES Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
CMD THRUST ind failure or ENG THR CONT: THR CONT sw deck No. 3 failed to auto	ENG THRUST & CMD THRUST ind do not agree during DPS burn	9	5.2-51
CMD THRUST ind failure or ENG THR CONT: THR CONT sw deck No. 3 failed to manual	ENG THRUST & CMD THRUST ind do not agree during DPS burn	9	5.2-51
CWEA failure	CES AC warn lt	3	5.2-46
	CES DC warn lt	5	5.2-47
DPS eng pressure transducer failure	ENG THRUST & CMD THRUST ind do not agree during DPS burn	9	5.2-51
DPS experienced excessive throat erosion	ENG THRUST & CMD THRUST ind do not agree during DPS burn	9	5.2-51
ENG ARM sw failure	MPS does not thrust when EVNT TMR ind - 00:00	7	5.2-49
ENG START sw failure	MPS does not thrust when EVNT TMR ind - 00:00	7	5.2-49
ENG THR CONT: MAIN THROT sw deck No. 2 failed open or manual throttle circuit failure	DPS does not respond to thrust increase or decrease command	8	5.2-50
ENG THRUST ind failure	ENG THRUST & CMD THRUST ind do not agree during DPS burn	9	5.2-51
Jet on-off command line is shorted	Abnormal vehicle dynamics	1	5.2-44
LGC did not issue eng-off command or remove eng-on command	No auto MPS shutdown	10	5.2-52
LGC did not issue eng-on command or did not remove eng-off command	MPS does not thrust when EVNT TMR ind - 00:00	7	5.2-49
LGC did not issue translation command	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
LMP ACA hardover (single contact) sw failed closed	Single RCS jet failed on	14	5.2-55
No enable voltage to primary preamps. S/C: PGNS sw deck No. 2 failed open	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
Out-of-detent relay K7 failed closed	LM drifts	13	5.2-54
Out-of-detent relay K8 failed closed	LM drifts	13	5.2-54
Pre amp power supply failure	PRE AMPS caut lt	2	5.2-46
Rate gyro failed on or solenoid driver failed on	Abnormal vehicle dynamics	1	5.2-44
Rate needle failure	Rate Gyro Check fails	12	5.2-53
RATE SCALE sw failed open	Rate Gyro Check fails	12	5.2-53
RCS oxid valve & fuel valve failed open (double failure) or solenoid driver shorted to ground	Single RCS jet failed on	14	5.2-55

Table 5-10. CES Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Relay driver in AELD failed closed	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
Relay K2, K3, or K4 in S & C control assy No. 2 failed open	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
Relay K2, K3, or K4 in S & C control assy No. 2 failed open or ATT CONT sw deck 3 failed to pulse or direct	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
Relay K5 in S & C control assy No. 2 or PGNCS relay K8 failed open	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
Relay K14 in S & C control assy No. 2 failed closed	Unsuccessful manual APS shutdown	11	5.2-52
Relay K14, K16 or K19 II in S & C control assy No. 2 failed closed	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
Relay K14 or K19 II in S & C control assy No. 2 failed closed	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
Relay K19 II in S & C control assy failed closed	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
Relay K19 II or K16A in S & C control assy No. 2 failed closed	MPS thrusts as soon as eng is armed via ENG THR CONT: ENG ARM sw	6	5.2-48
Relay K19 (yaw), K20 (pitch) or K21 (roll) in ATCA filed open	LM drifts	13	5.2-54
S/C: AGS sw deck No. 2 failed open. No enable voltage to abort pre amps	LM drifts	13	5.2-54
S/C: AGS sw deck No. 3 failed open. No enable voltage to primary pre amps	LM drifts	13	5.2-54
S/C: AGS sw deck No. 3 failed open. No enable voltage to abort pre amps	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
S/C: GYRO TEST ROLL sw failed into unaffected axis, or double gyro failure	Rate Gyro Check fails	12	5.2-53
S/C: GYRO REST POS RT sw failed into unaffected rate (pos or neg)	Rate Gyro Check fails	12	5.2-53
S/C: GYRO TEST ROLL sw failed open in affected axis	Rate Gyro Check fails	12	5.2-53
S/C: GYRO TEST ROLL sw or GYRO TEST POS RT sw failed open or less of test voltage	Rate Gyro Check fails	12	5.2-53

CES

Table 5-10. CES Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
S/C: PGNS sw deck 2 or S/C: AGS sw deck 3 failed open	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
S/C: PGNS sw deck No. 5 failed open. No attitude hold inbit supplied to LGC	LM drifts	13	5.2-54
Single axis in single direction failure of CDR (LMP) TTCA	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
Solenoid driver failed off	Abnormal response to CDR (LMP) ACA commands	16	5.2-56
	Abnormal proportional mode response	16a	5.2-56
	Abnormal response to CDR (LMP) ACA pulse mode commands	17	5.2-57
Solenoid driver failure	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
TCA valve failed open	Abnormal vehicle dynamics	1	5.2-44
Throttle valve actuator failure or DPS failure	DPS does not respond to thrust increase or decrease command	8	5.2-50
Transient out-of-limit condition triggered lt	CES AC warn lt	3	5.2-46
	CES DC warn lt	5	5.2-47
TTCA enable sw No. 2 failed open	Absence of normal translation via CDR (LMP) TTCA	19	5.2-59
TTCA/TRANSL AGS translation sw (internal) failed closed	Abnormal vehicle dynamics	1	5.2-44
TTCA/TRANSL PGNS translation sw (internal) failed closed	Abnormal vehicle dynamics	1	5.2-44
Voltage out of limits	CES AC warn lt	3	5.2-46
	CES DC warn lt	5	5.2-47
26 V, 800-cps, three-phase failure	CES AC warn lt	3	5.2-46
28 V, 800-cps, single-phase failure	CES AC warn lt and PRE AMPS caut lt	4	5.2-46
	CES AC warn lt	3	5.2-46
+X TRANSL pb (single deck) failed closed	Single RCS jet failed on	14	5.2-55
+X TRANSL sw failed on	Abnormal vehicle dynamics	1	5.2-44

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SYMPTOM	PROCEDURE	REMARKS

(Sheet 1 of 2)

Abnormal vehicle dynamics

1 ●Stabilize vehicle as necessary, with hardover

2 Terminate burn if eng is firing
- ●RCS: SYS A (B) ASC FEED 1 & 2 sw - CLOSE
- ●Eng STOP pb/lt - push
- ●ENG THR CONT: ENG ARM sw - OFF
- ●ABORT (ABORT STAGE) pb - reset
- ●Key DSKY: V34E

3 Ascent interconnect closed?
- NO → (1)
- YES → (2)

4 (2)
- ●RCS: SYS A (B) QUAD 1, 2, 3, & 4 sw - CLOSE
- ●RCS: SYS A (B) MAIN SOV sw - OPEN

5 (1) Safe sys
- ●S/C: PGNS sw - OFF
- ●S/C: AGS sw - OFF
- ●ACA/4 JET sw (CDR & LMP) - DISABLE
- ●S/C: ROLL, PITCH, & YAW sw - PULSE
- ●CB S/C: ATT DIR CONT - open
- ●RCS SYS A(B) ASC FEED 1 & 2 sw - CLOSE (if tb gray)
- ●RCS: SYS A(B) QUAD 1, 2, 3, & 4 sw - CLOSE (if OPEN)

6 Configure for troubleshooting
- ●S/C: ROLL, PITCH, & YAW sw - PULSE
- ●RCS: CRSFD sw - CLOSE
- ●RATE/ERR MON sw - LDG RDR/CMPTR
- ●TTCA/TRANSL sw (CDR & LMP) - DISABLE
- ●GUID CONT sw - AGS
- ●ACA PROP sw (CDR & LMP) - DISABLE

7 FDAI rate needle indications excessive in any axis?
- YES → **8** RATE GYRO FAILED ON OR SOLENOID DRIVER FAILED ON.
  - **WARNING**: When GUID CONT sw - AGS, do not set failed axis S/C: ROLL, PITCH, or YAW sw to MODE CONT.
- NO

9 ●RCS: SYS A (B) QUAD 1, 2, 3, & 4 sw - OPEN (individually)
Failure recurs?
- YES → **10** TCA VALVE FAILED OPEN
  - **11** ●Affected quad RCS: SYS A(B) QUAD 1, 2, 3, or 4 sw - CLOSE
- NO

12 ●CB S/C: ATT DIR CONT - close
Failure recurs?
- YES → **13** + X TRANSL SW FAILED ON
  - **14** Determine affected thruster
    - ●RCS SYS A: QUAD 2 & 4 TCA sw - CLOSE
    - ●RCS SYS B: QUAD 1 & 3 TCA sw - CLOSE
  - **15**
    - ●Open quad valves closed in step 14, individually, until failed jet fires
    - ●Firing jet RCS: SYS A (B) QUAD 1, 2, 3, or 4 sw - CLOSE
- NO

16 ●S/C ROLL, PITCH, & YAW sw - DIR (individually)
Failure recurs?
- YES → **17** CDR OR LMP ACA PULSE/DIRECT SW (INTERNAL) FAILED CLOSED
- NO → **18** (Sheet 2)

(1) Steps listed are suggested as order of priority. If situation is time-critical, sys may be safed as follows:
- ●S/C: AGS sw - OFF
- ●S/C: PGNS sw - OFF
- ●CB S/C: ATT DIR CONT - open
- ●RCS: SYS A & B MAIN SOV sw - CLOSE
- ●Perform step 5
- ●RCS: SYS A & B MAIN SOV sw - OPEN

(2) RCS TCA warn lt will go on & numerous RCS: SYS A (B) QUAD tb's will show red until reset by closing RCS: SYS A (B) QUAD sw.

(3) Alternate failure isolation procedure is to open CB S/C: ATT DIR CONT. This results in loss of + X TRANSL pb & hardover & direct modes for all jets

(4) Pulse & direct modes in affected axis are lost.

B-300LM4-589-1

SYMPTOM	PROCEDURE	REMARKS

SYMPTOM	PROCEDURE	REMARKS

(Sheet 2 of 2)

(cont)

Abnormal vehicle dynamics. (cont)

16

18 ●ACA/4 JET sw (CDR & LMP) - ENABLE (individually)
Failure recurs?
YES → 19 CDR OR LMP ACA HARDOVER SW (SINGLE CONTACT) FAILED CLOSED → 20 ●Affected ACA/4 JET sw (CDR or LMP) - DISABLE
NO ↓

21 ●S/C: AGS sw - ATT HOLD
Failure recurs?
YES → 22 ATCA FAILURE (5)
NO ↓

AGS CES FAIL

23 ●S/C: ROLL, PITCH, & YAW sw - MODE CONT
Failure recurs?

24 ●ACA PROP sw CDR (LMP) - ENABLE (individually)
Failure recurs?
YES → 25 ACA JAMMED (6) → 26 Disable ACA. ●Failed unit ACA PROP sw - DISABLE
NO ↓

27 ●TTCA/TRANSL sw (CDR & LMP) - ENABLE (individually)
Failure recurs?
YES → 28 ●Affected TTCA/TRANSL sw (CDR or LMP - DISABLE → 29 TTCA/TRANSL AGS TRANSLATION SW (INTERNAL) FAILED CLOSED
NO ↓

30 ●S/C: PGNS sw - ATT HOLD ●TTCA/TRANSL sw (CDR & LMP) - DISABLE ●GUID CONT sw - PGNS
Failure recurs?
YES → 31 JET ON-OFF COMMAND LINE IS SHORTED. → 32 Disable affected jet. ●RCS: SYS A (B) QUAD 1, 2, 3, & 4 sw - CLOSE ●Open above switches individually until jet fires. ●Affected jet RCS: SYS A (B) QUAD 1, 2, 3, or 4 sw - CLOSE ●All other RCS: SYS A (B) QUAD 1, 2, 3, & 4 sw - OPEN
NO ↓

33 ●TTCA/TRANSL sw (CDR & LMP) - ENABLE (individually)
Failure recurs?
YES → 34 ●Affected TTCA/TRANSL sw (CDR or LMP) - DISABLE → 35 TTCA/TRANSL PGNS TRANSLATION SW (INTERNAL) FAILED CLOSED
NO ↓

36 ●Consult MSFN for additional real-time troubleshooting.

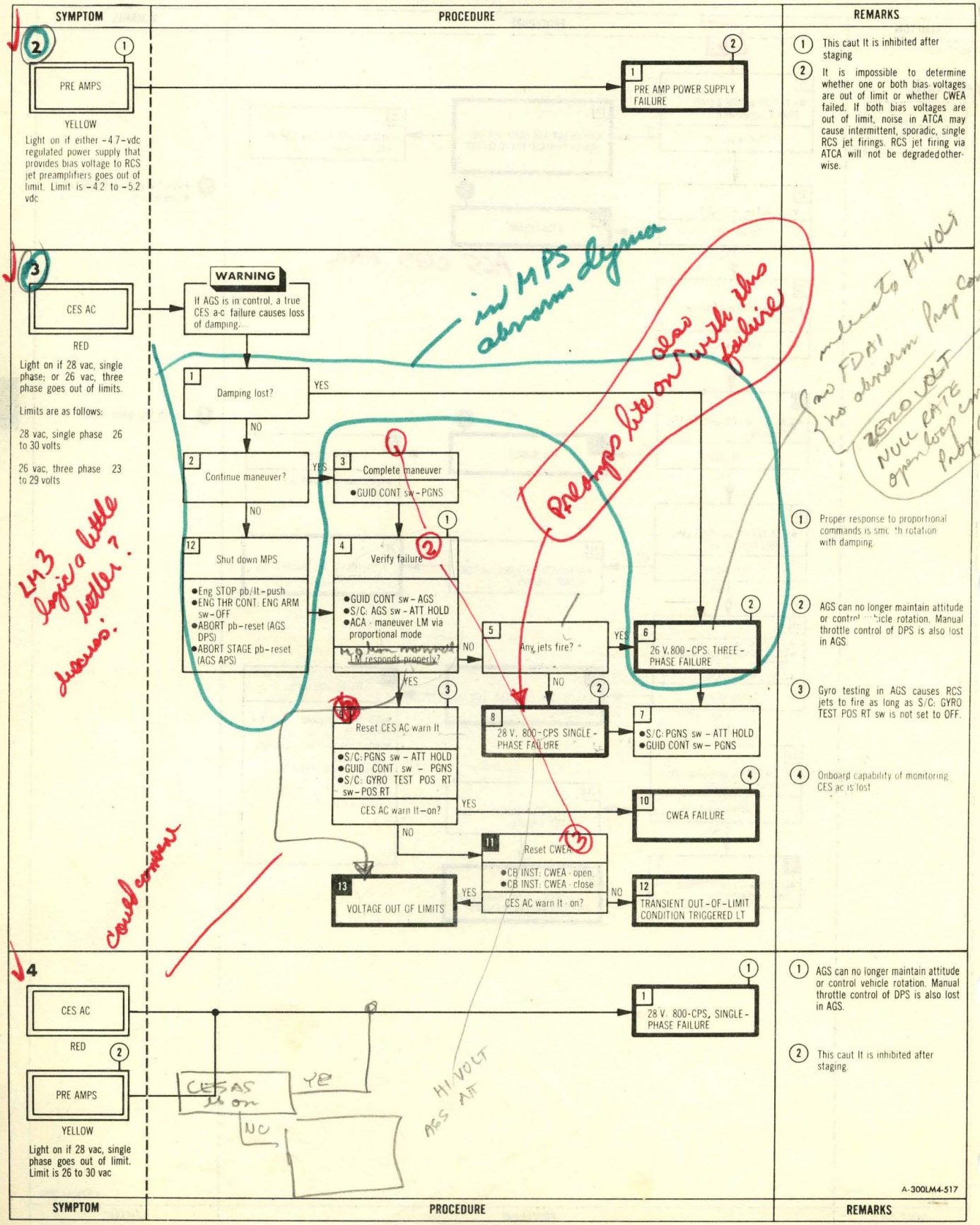
(5) AGS automatic and attitude hold modes are lost.

(6) Attitude hold mode is lost.

CES

A-300LM4-589-2

SYMPTOM	PROCEDURE	REMARKS


SYMPTOM
PROCEDURE
REMARKS
2
1
PRE AMPS
YELLOW
Light on if either -4.7-vdc regulated power supply that provides bias voltage to RCS jet preamplifiers goes out of limit. Limit is -4.2 to -5.2 vdc
2
1
PRE AMP POWER SUPPLY FAILURE
1 This caut lt is inhibited after staging
2 It is impossible to determine whether one or both bias voltages are out of limit or whether CWEA failed. If both bias voltages are out of limit, noise in ATCA may cause intermittent, sporadic, single RCS jet firings. RCS jet firing via ATCA will not be degraded otherwise.
3
CES AC
RED
Light on if 28 vac, single phase; or 26 vac, three phase goes out of limits.
Limits are as follows:
28 vac, single phase 26 to 30 volts
26 vac, three phase 23 to 29 volts
WARNING
If AGS is in control, a true CES a-c failure causes loss of damping.
1 Damping lost?
YES
NO
2 Continue maneuver?
YES
NO
3 Complete maneuver
•GUID CONT sw - PGNS
12 Shut down MPS
•Eng STOP pb/lt - push
•ENG THR CONT: ENG ARM sw - OFF
•ABORT pb - reset (AGS DPS)
•ABORT STAGE pb - reset (AGS APS)
4 Verify failure
•GUID CONT sw - AGS
•S/C: AGS sw - ATT HOLD
•ACA - maneuver LM via proportional mode
LM responds properly?
NO
YES
5 Any jets fire?
YES
NO
6 26 V, 800-CPS, THREE-PHASE FAILURE
8 28 V, 800-CPS SINGLE-PHASE FAILURE
7 •S/C: PGNS sw - ATT HOLD
•GUID CONT sw - PGNS
9 Reset CES AC warn lt
•S/C: PGNS sw - ATT HOLD
•GUID CONT sw - PGNS
•S/C: GYRO TEST POS RT sw - POS RT
CES AC warn lt - on?
YES
NO
10 CWEA FAILURE
11 Reset CWEA
•CB INST: CWEA - open
•CB INST: CWEA - close
CES AC warn lt - on?
YES
NO
13 VOLTAGE OUT OF LIMITS
12 TRANSIENT OUT-OF-LIMIT CONDITION TRIGGERED LT
1 Proper response to proportional commands is smooth rotation with damping
2 AGS can no longer maintain attitude or control vehicle rotation. Manual throttle control of DPS is also lost in AGS.
3 Gyro testing in AGS causes RCS jets to fire as long as S/C: GYRO TEST POS RT sw is not set to OFF.
4 Onboard capability of monitoring CES ac is lost
4
CES AC
RED
2
PRE AMPS
YELLOW
Light on if 28 vac, single phase goes out of limit. Limit is 26 to 30 vac
1
28 V, 800-CPS, SINGLE-PHASE FAILURE
1 AGS can no longer maintain attitude or control vehicle rotation. Manual throttle control of DPS is also lost in AGS.
2 This caut lt is inhibited after staging.
A-300LM4-517
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS

SYMPTOM

5

CES DC

RED

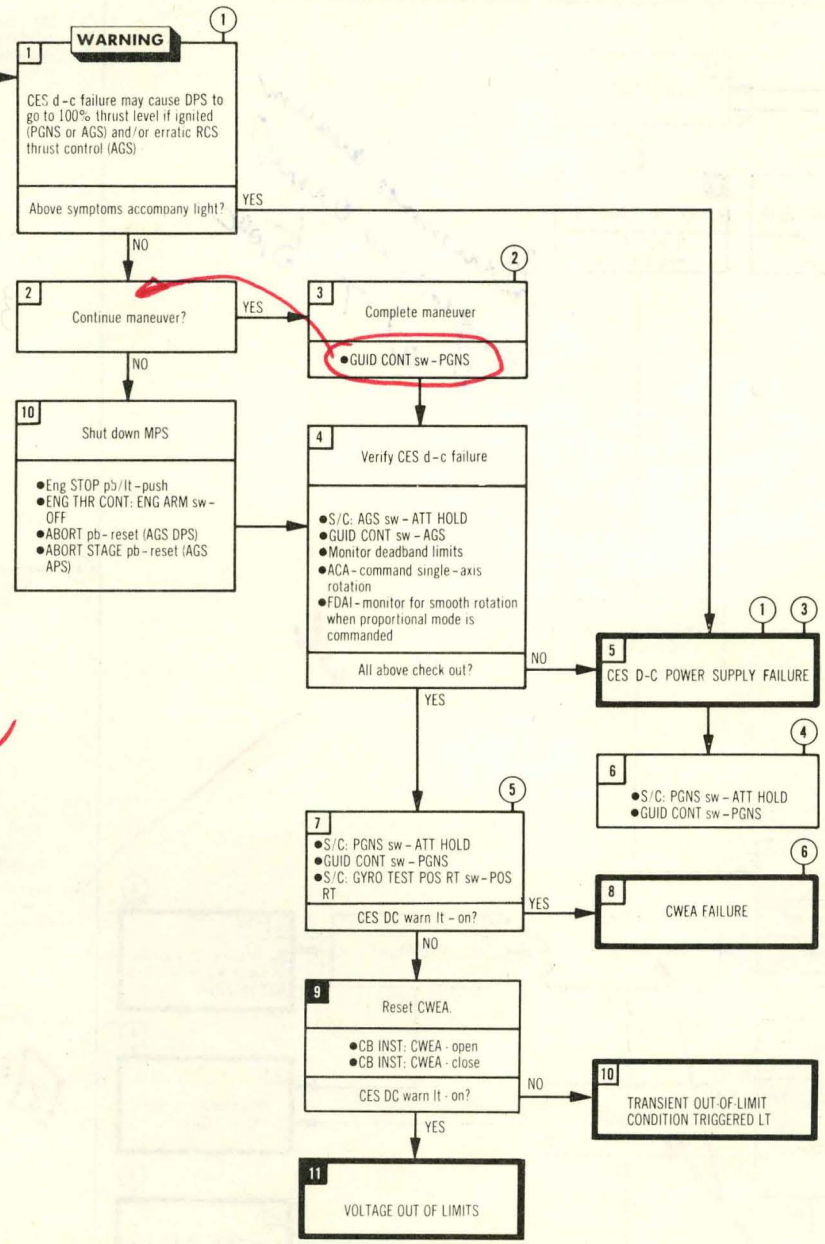
Light on if any of following ATCA power supplies goes t of limit:

a. +15 vdc
b. −15 vdc
c. +6 vdc
d. −6 vdc
e. +4.3 vdc

Limits are:

a. +14 to +16 vdc
b. −14 to −16 vdc
c. +5.4 to +6.6 vdc
d. −5.4 to −6.6 vdc
e. +3.8 to +4.8 vdc

PROCEDURE



REMARKS

(1) Depending on which power supply failed or is degraded, one or more of following symptoms may appear:
a. Jets come on at full thrust rather than % duty cycle when maneuver is commanded.
b. Deadband is inoperative.
c. Jet select logic is not operational.
d. Pulse ratio modulators are not operational.
e. DPS goes to 100% thrust.

(2) If DPS goes to 100% thrust, throttling capability of DPS is lost in either AGS or PGNCS.

(3) Power supplies have an interlocking feature; if one supply output is shorted, other d-c supplies also fail. If short eliminates itself, all supplies return to normal operation. If one supply is degraded, other supplies are not degraded.

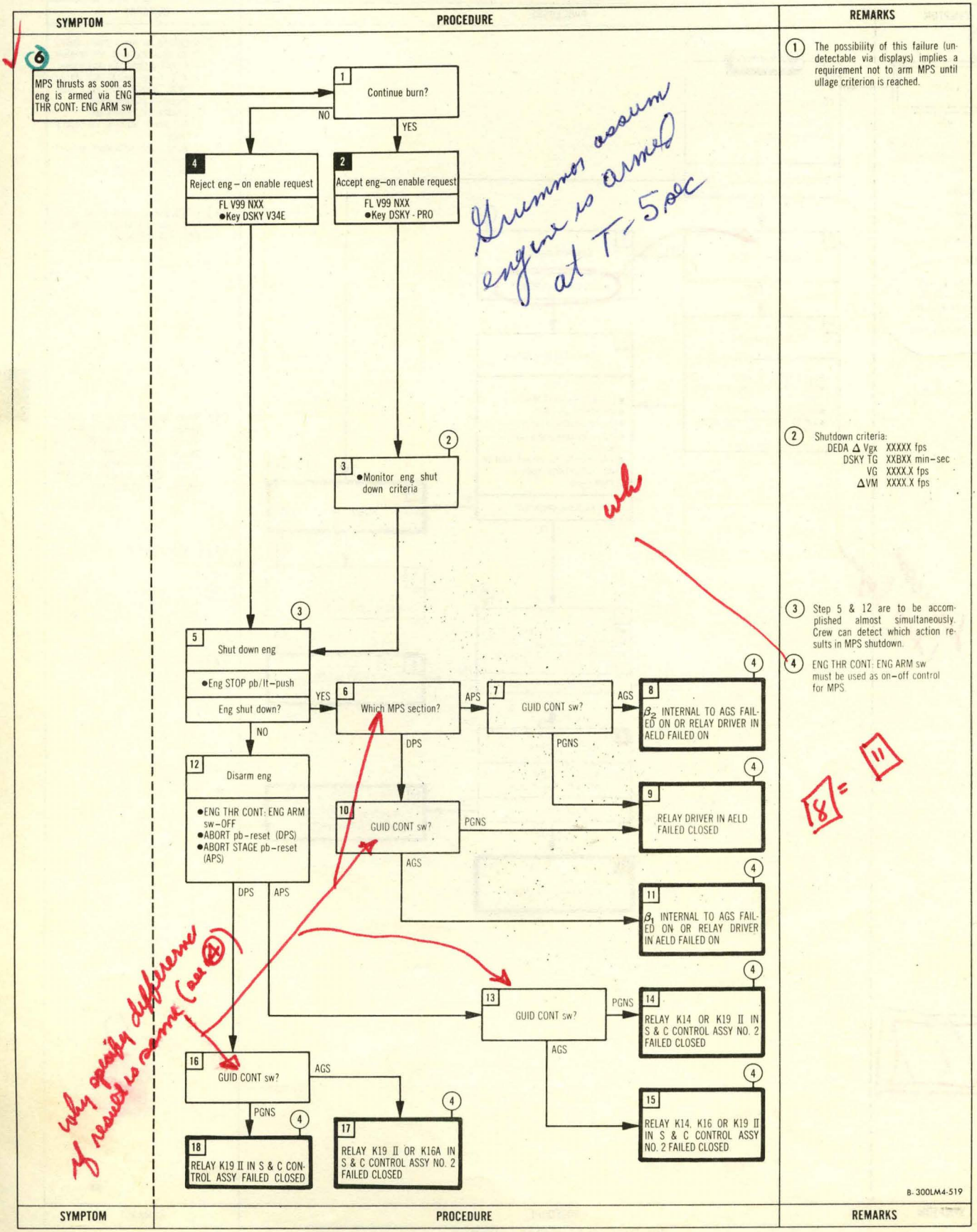
(4) AGS control is lost

(5) Gyro testing in AGS causes RCS jets to fire as long as S/C GYRO TEST POS RT sw is not set to OFF

(6) Onboard capability of monitoring CES dc is lost.

A-300LM4-518

CES

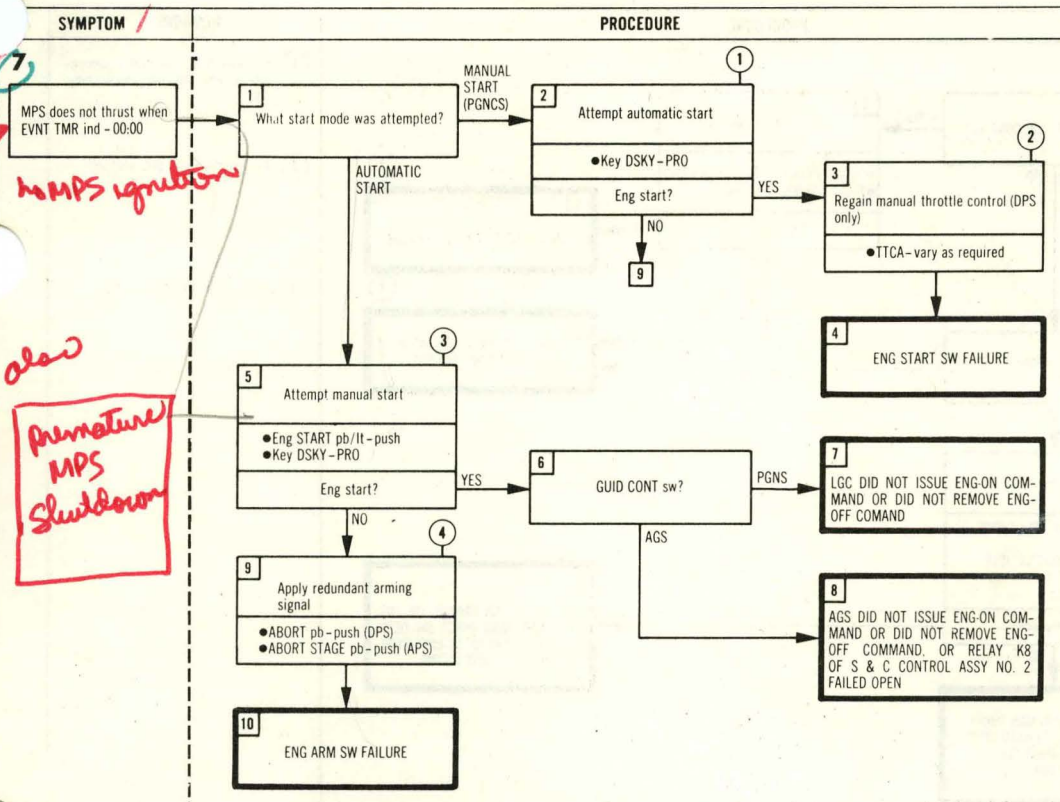


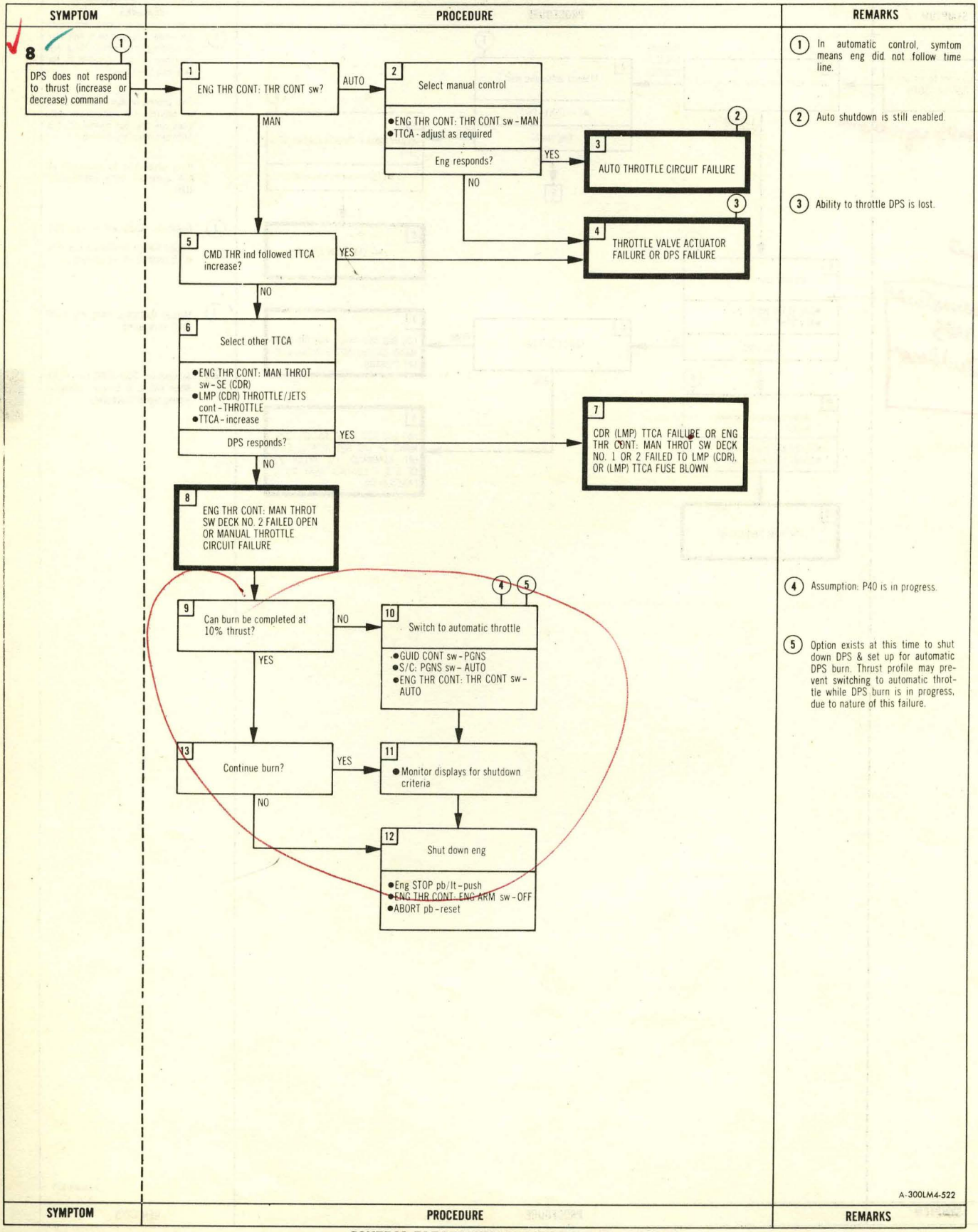
(1) The possibility of this failure (undetectable via displays) implies a requirement not to arm MPS until ullage criterion is reached.

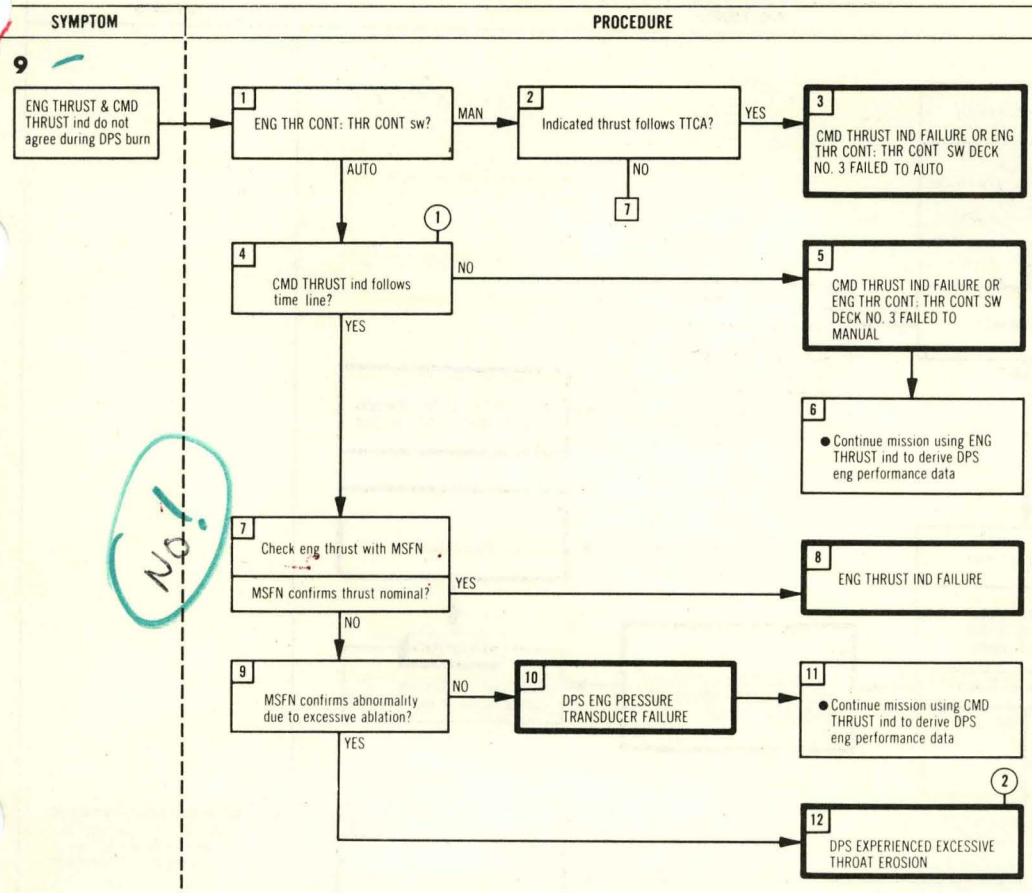
(2) Shutdown criteria:
DEDA Δ Vgx XXXXX fps
DSKY TG XXBXX min–sec
VG XXXX.X fps
ΔVM XXXX.X fps

(3) Step 5 & 12 are to be accomplished almost simultaneously. Crew can detect which action results in MPS shutdown.

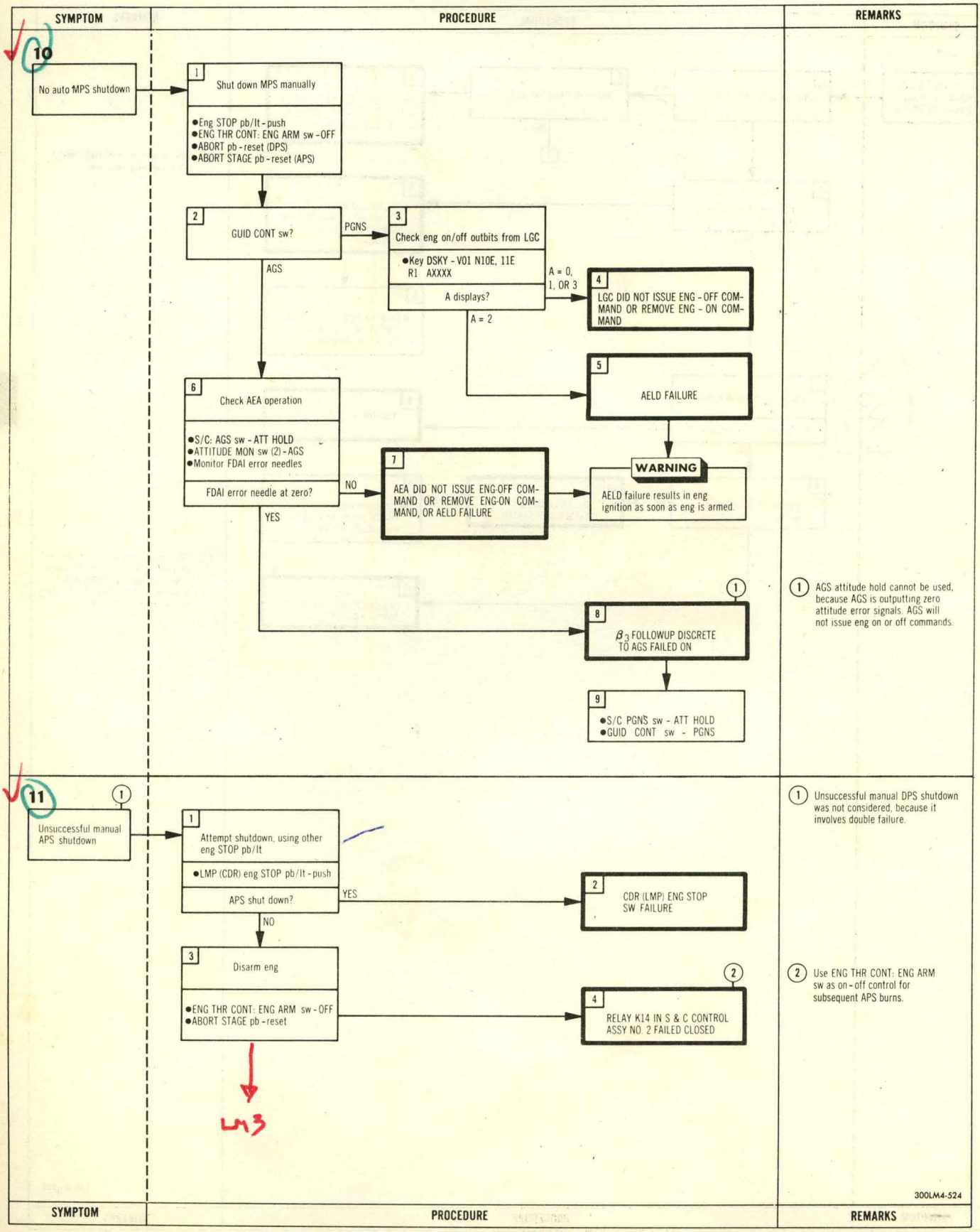
(4) ENG THR CONT: ENG ARM sw must be used as on–off control for MPS.

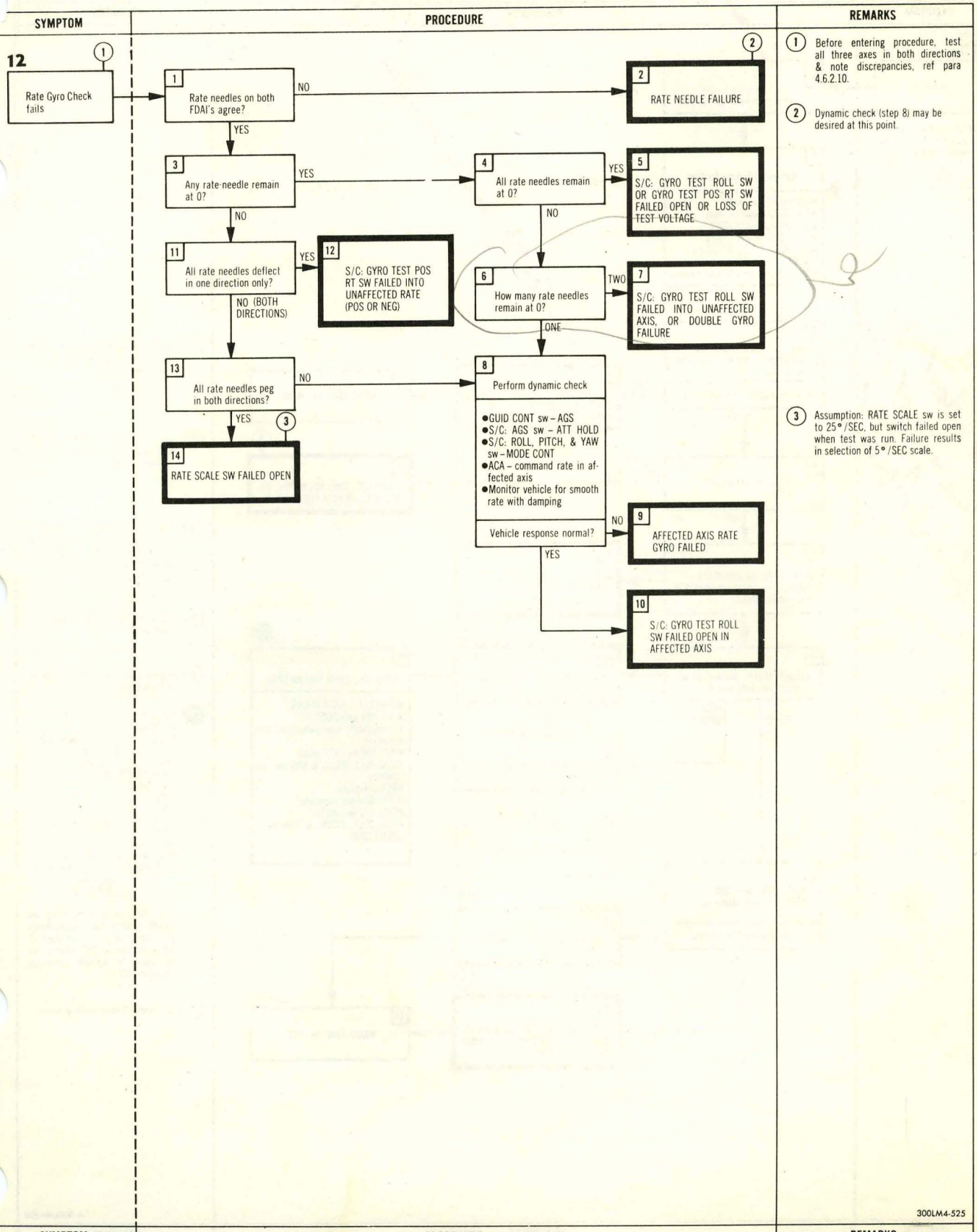

SYMPTOM
PROCEDURE
REMARKS
7
MPS does not thrust when EVNT TMR ind - 00:00
1
What start mode was attempted?
MANUAL START (PGNCS)
AUTOMATIC START
1
2
Attempt automatic start
•Key DSKY - PRO
Eng start?
YES
NO
9
2
3
Regain manual throttle control (DPS only)
•TTCA - vary as required
4
ENG START SW FAILURE
3
5
Attempt manual start
•Eng START pb/lt - push
•Key DSKY - PRO
Eng start?
YES
NO
6
GUID CONT sw?
PGNS
AGS
7
LGC DID NOT ISSUE ENG-ON COMMAND OR DID NOT REMOVE ENG-OFF COMAND
8
AGS DID NOT ISSUE ENG-ON COMMAND OR DID NOT REMOVE ENG-OFF COMMAND. OR RELAY K8 OF S & C CONTROL ASSY NO. 2 FAILED OPEN
4
9
Apply redundant arming signal
•ABORT pb - push (DPS)
•ABORT STAGE pb - push (APS)
10
ENG ARM SW FAILURE
(1) Successful eng ignition is only way of isolating this failure. There are no other onboard capabilities for detecting this failure.
This procedure assumes PGNCS is in control with appropriate program running, but manual start & throttle control are desired.
It is unrealistic to postulate an AGS automatic burn with manual start.
(2) Automatic shutdown is expected.
Regain manual throttle control within 26 seconds of eng ignition.
(3) Manual shutdown, using eng STOP pb/lt, is required.
(4) Assumption: GUID CONT sw - PGNS. When AGS is in control, redundant arming signal is present.
300LM4-520


SYMPTOM
PROCEDURE
REMARKS
8
(1) DPS does not respond to thrust (increase or decrease) command
1 ENG THR CONT: THR CONT sw?
AUTO
MAN
2 Select manual control
•ENG THR CONT: THR CONT sw - MAN
•TTCA - adjust as required
Eng responds?
YES
NO
(2) 3 AUTO THROTTLE CIRCUIT FAILURE
(3) 4 THROTTLE VALVE ACTUATOR FAILURE OR DPS FAILURE
5 CMD THR ind followed TTCA increase?
YES
NO
6 Select other TTCA
•ENG THR CONT: MAN THROT sw - SE (CDR)
•LMP (CDR) THROTTLE/JETS cont - THROTTLE
•TTCA - increase
DPS responds?
YES
NO
7 CDR (LMP) TTCA FAILURE OR ENG THR CONT: MAN THROT SW DECK NO. 1 OR 2 FAILED TO LMP (CDR), OR (LMP) TTCA FUSE BLOWN
8 ENG THR CONT: MAN THROT SW DECK NO. 2 FAILED OPEN OR MANUAL THROTTLE CIRCUIT FAILURE
(4) (5)
9 Can burn be completed at 10% thrust?
NO
YES
10 Switch to automatic throttle
•GUID CONT sw - PGNS
•S/C: PGNS sw - AUTO
•ENG THR CONT: THR CONT sw - AUTO
13 Continue burn?
YES
NO
11 •Monitor displays for shutdown criteria
12 Shut down eng
•Eng STOP pb/lt - push
•ENG THR CONT: ENG ARM sw - OFF
•ABORT pb - reset
(1) In automatic control, symtom means eng did not follow time line.
(2) Auto shutdown is still enabled.
(3) Ability to throttle DPS is lost.
(4) Assumption: P40 is in progress.
(5) Option exists at this time to shut down DPS & set up for automatic DPS burn. Thrust profile may prevent switching to automatic throttle while DPS burn is in progress, due to nature of this failure.
A-300LM4-522
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
9
ENG THRUST & CMD THRUST ind do not agree during DPS burn
1 ENG THR CONT: THR CONT sw?
MAN
AUTO
2 Indicated thrust follows TTCA?
YES
NO
7
3 CMD THRUST IND FAILURE OR ENG THR CONT: THR CONT SW DECK NO. 3 FAILED TO AUTO
1
4 CMD THRUST ind follows time line?
NO
YES
5 CMD THRUST IND FAILURE OR ENG THR CONT: THR CONT SW DECK NO. 3 FAILED TO MANUAL
6 ● Continue mission using ENG THRUST ind to derive DPS eng performance data
7 Check eng thrust with MSFN
MSFN confirms thrust nominal?
YES
8 ENG THRUST IND FAILURE
NO
9 MSFN confirms abnormality due to excessive ablation?
NO
10 DPS ENG PRESSURE TRANSDUCER FAILURE
11 ● Continue mission using CMD THRUST ind to derive DPS eng performance data
YES
2
12 DPS EXPERIENCED EXCESSIVE THROAT EROSION
(1) "NO" branch assumes ENG THRUST ind is following time line.
(2) DPS throat erosion is expected to decrease CMD thrust ≈ 1% below time line and ENG THRUST ≈ 5% below time line. Thus a 4% difference could be nominal.
300LM4-523
SYMPTOM
PROCEDURE
REMARKS

CES


SYMPTOM
PROCEDURE
REMARKS
10
No auto MPS shutdown
1
Shut down MPS manually
•Eng STOP pb/lt - push
•ENG THR CONT: ENG ARM sw - OFF
•ABORT pb - reset (DPS)
•ABORT STAGE pb - reset (APS)
2
GUID CONT sw?
PGNS
AGS
3
Check eng on/off outbits from LGC
•Key DSKY - V01 N10E, 11E
R1 AXXXX
A displays?
A = 0, 1, OR 3
A = 2
4
LGC DID NOT ISSUE ENG - OFF COMMAND OR REMOVE ENG - ON COMMAND
5
AELD FAILURE
6
Check AEA operation
•S/C: AGS sw - ATT HOLD
•ATTITUDE MON sw (2) - AGS
•Monitor FDAI error needles
FDAI error needle at zero?
NO
YES
7
AEA DID NOT ISSUE ENG-OFF COMMAND OR REMOVE ENG-ON COMMAND, OR AELD FAILURE
WARNING
AELD failure results in eng ignition as soon as eng is armed.
1
8
β_3 FOLLOWUP DISCRETE TO AGS FAILED ON
9
•S/C PGNS sw - ATT HOLD
•GUID CONT sw - PGNS
1
AGS attitude hold cannot be used, because AGS is outputting zero attitude error signals. AGS will not issue eng on or off commands.
11
1
Unsuccessful manual APS shutdown
1
Attempt shutdown, using other eng STOP pb/lt
•LMP (CDR) eng STOP pb/lt - push
APS shut down?
YES
NO
2
CDR (LMP) ENG STOP SW FAILURE
3
Disarm eng
•ENG THR CONT: ENG ARM sw - OFF
•ABORT STAGE pb - reset
2
4
RELAY K14 IN S & C CONTROL ASSY NO. 2 FAILED CLOSED
LM3
1
Unsuccessful manual DPS shutdown was not considered, because it involves double failure.
2
Use ENG THR CONT: ENG ARM sw as on - off control for subsequent APS burns.
300LM4-524
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
12
Rate Gyro Check fails
1 Rate needles on both FDAI's agree?
NO
2 RATE NEEDLE FAILURE
YES
3 Any rate needle remain at 0?
YES
4 All rate needles remain at 0?
YES
5 S/C: GYRO TEST ROLL SW OR GYRO TEST POS RT SW FAILED OPEN OR LOSS OF TEST VOLTAGE
NO
NO
11 All rate needles deflect in one direction only?
YES
12 S/C: GYRO TEST POS RT SW FAILED INTO UNAFFECTED RATE (POS OR NEG)
NO (BOTH DIRECTIONS)
6 How many rate needles remain at 0?
TWO
7 S/C: GYRO TEST ROLL SW FAILED INTO UNAFFECTED AXIS, OR DOUBLE GYRO FAILURE
ONE
13 All rate needles peg in both directions?
NO
8 Perform dynamic check
•GUID CONT sw – AGS
•S/C: AGS sw – ATT HOLD
•S/C: ROLL, PITCH, & YAW sw – MODE CONT
•ACA – command rate in affected axis
•Monitor vehicle for smooth rate with damping
Vehicle response normal?
NO
9 AFFECTED AXIS RATE GYRO FAILED
YES
YES
3
14 RATE SCALE SW FAILED OPEN
10 S/C: GYRO TEST ROLL SW FAILED OPEN IN AFFECTED AXIS
1 Before entering procedure, test all three axes in both directions & note discrepancies, ref para 4.6.2.10.
2 Dynamic check (step 8) may be desired at this point.
3 Assumption: RATE SCALE sw is set to 25°/SEC, but switch failed open when test was run. Failure results in selection of 5°/SEC scale.
300LM4-525
SYMPTOM
PROCEDURE
REMARKS

CES

SYMPTOM	PROCEDURE	REMARKS

13 LM drifts

LM drift is characterized by absence of RCS firing in one or more axes, increasing error of FDAI total attitude and/or error needles in one or more axes.

1 ●Control vehicle via hardover (if necessary) to avoid gimbal lock

2 Prepare for troubleshooting
- ●GUID CONT sw – AGS
- ●S/C: DEAD BAND sw – MIN
- ●S/C: AGS sw – ATT HOLD
- ●S/C: PGNS sw – ATT HOLD
- ●S/C: ROLL, PITCH, & YAW sw – MODE CONT
- ●Select FDAI's on alternate sources

3 ●ACA - command single - axis proportional rate (all three axes + or —)

Any axis responds (vehicle motion)?

NO → **4** S/C: AGS SW DECK NO. 2 FAILED OPEN. NO ENABLE VOLTAGE TO ABORT PRE AMPS (1) → **5** ●GUID CONT sw – PGNS

YES

6 All axes responded?

ONE AXIS DID NOT RESPOND → **7** RELAY K19 (YAW), K20 (PITCH), OR K21 (ROLL) IN ATCA FAILED OPEN (2)

YES

8 Error needles on both FDAI's establish new reference when ACA returned to detent?

YES → **9** S/C: AGS SW DECK NO. 3 FAILED OPEN. NO ENABLE VOLTAGE TO PRIMARY PRE AMPS (3) (4)

NO

10 Which FDAI error needles did not establish new reference?

BOTH → **11** ACA OUT-OF-DETENT SW (INTERNAL) FAILED CLOSED (6) → **12** Establish attitude hold via DEDA
- ●Key DEDA C 400+00000E
- ●S/C AGS sw – AUTO

To establish new reference and maneuver:
- ●S/C AGS sw – ATT HOLD
- ●S/C: ROLL, PITCH, & YAW sw – as desired
- ●ACA – maneuver

When maneuver complete:
- ●S/C: AGS sw – AUTO
- ●S/C: ROLL, PITCH, & YAW sw – MODE CONT

PGNS DRIVEN

AGS DRIVEN → **13** OUT-OF-DETENT RELAY K7 FAILED CLOSED (7) → **14** ●GUID CONT sw – PGNS

15 ●GUID CONT sw – PGNS
●ACA – rotate in single axis only (+ or —)

Jets fire (vehicle motion)?

YES → **16** OUT OF DETENT RELAY K8 FAILED CLOSED

NO → **18** S/C: PGNS SW DECK NO. 5 FAILED OPEN. NO ATTITUDE HOLD INBIT SUPPLIED TO LGC (4) → **17** ●GUID CONT sw – AGS

(1) AGS proportional mode, pulse mode, attitude hold, guidance steering, & translation are lost.

(2) AGS proportional mode, attitude hold, & guidance steering in affected axis are lost.

(3) If both FDAI's establish new reference, PGNS attitude hold discrete is verified. PGNS proportional mode, attitude hold, guidance steering, & translation are lost.

(4) Use PGNS for computational purposes only.

(5) Neither PGNS nor AGS can display attitude error.

● If PGNS guidance is desired:
- ●GUID CONT sw - PGNS
- ●S/C: PGNS sw - OFF (momentarily)
- ●S/C: PGNS sw - AUTO

Lock out x-axis override:
- Key DSKY V25 N07E
- R1 1102E
- R2 400E
- R3 1E

As rotation maneuvers are required:
- ●S/C: PGNS sw - ATT HOLD
- ●ACA - maneuver

When maneuver is complete:
- ●S/C: PGNS sw - OFF (momentarily)

NOTE

S/C: PGNS sw is momentarily set to OFF to allow CDU's to be driven to existing vehicle orientation. If sw is not set to OFF, vehicle will be driven to attitude previously stored in CDU's.

(7) AGS cannot display attitude errors.

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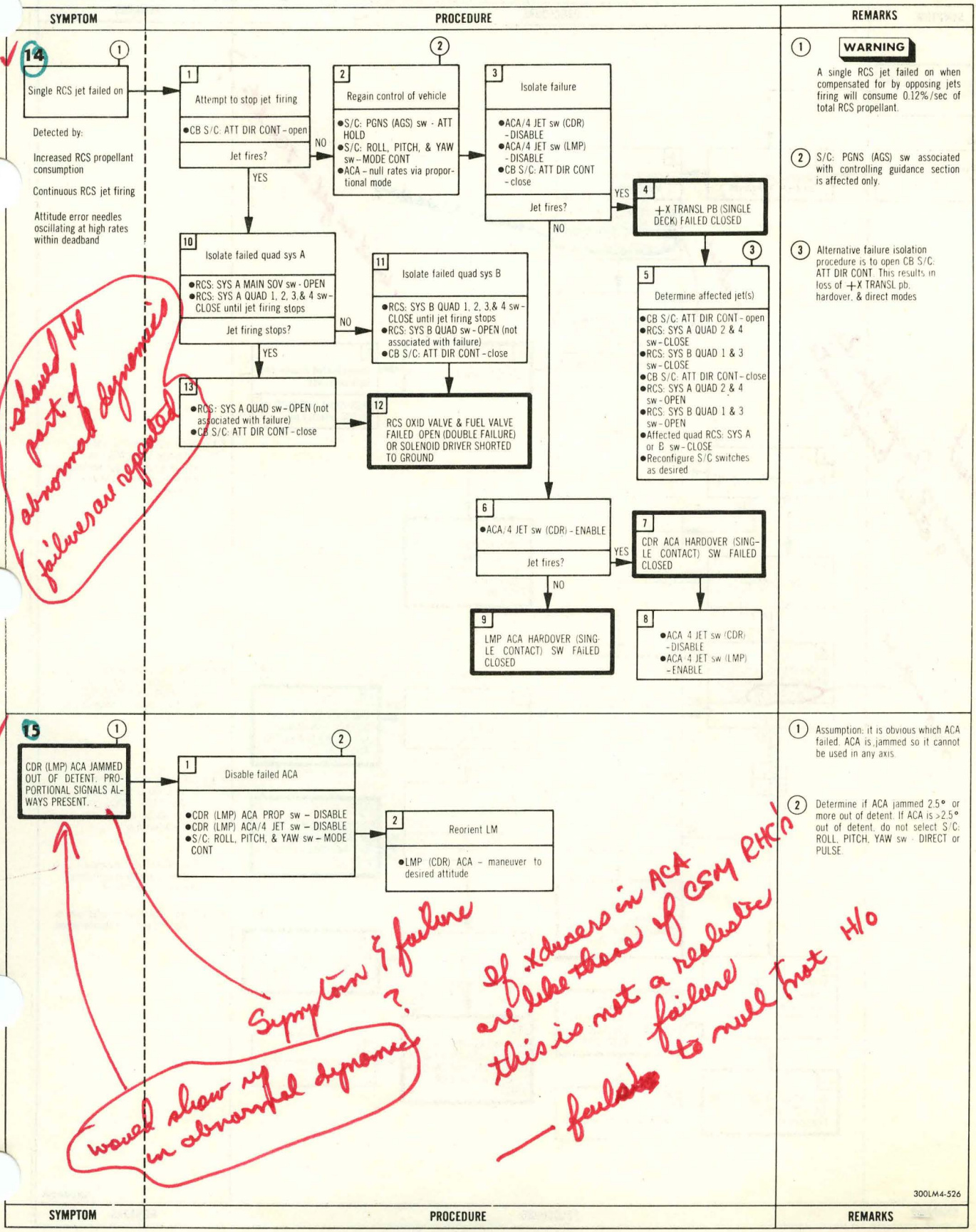
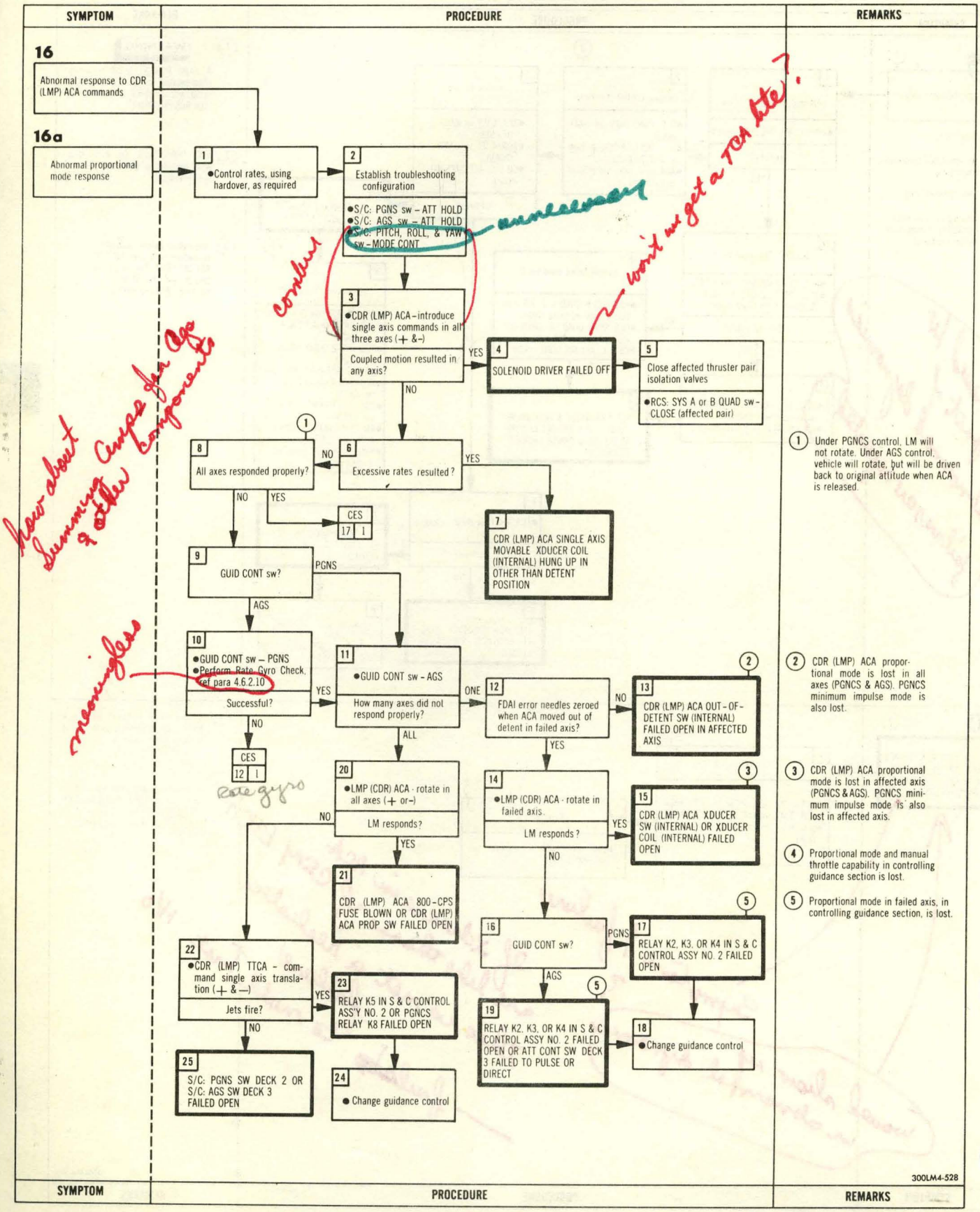

SYMPTOM
PROCEDURE
REMARKS
14
Single RCS jet failed on
Detected by:
Increased RCS propellant consumption
Continuous RCS jet firing
Attitude error needles oscillating at high rates within deadband
1 Attempt to stop jet firing
●CB S/C: ATT DIR CONT - open
Jet fires?
NO
YES
2 Regain control of vehicle
●S/C: PGNS (AGS) sw - ATT HOLD
●S/C: ROLL, PITCH, & YAW sw - MODE CONT
●ACA - null rates via proportional mode
3 Isolate failure
●ACA/4 JET sw (CDR) - DISABLE
●ACA/4 JET sw (LMP) - DISABLE
●CB S/C: ATT DIR CONT - close
Jet fires?
YES
NO
4 +X TRANSL PB (SINGLE DECK) FAILED CLOSED
5 Determine affected jet(s)
●CB S/C: ATT DIR CONT - open
●RCS: SYS A QUAD 2 & 4 sw - CLOSE
●RCS: SYS B QUAD 1 & 3 sw - CLOSE
●CB S/C: ATT DIR CONT - close
●RCS: SYS A QUAD 2 & 4 sw - OPEN
●RCS: SYS B QUAD 1 & 3 sw - OPEN
●Affected quad RCS: SYS A or B sw - CLOSE
●Reconfigure S/C switches as desired
10 Isolate failed quad sys A
●RCS: SYS A MAIN SOV sw - OPEN
●RCS: SYS A QUAD 1, 2, 3, & 4 sw - CLOSE until jet firing stops
Jet firing stops?
NO
YES
11 Isolate failed quad sys B
●RCS: SYS B QUAD 1, 2, 3, & 4 sw - CLOSE until jet firing stops
●RCS: SYS B QUAD sw - OPEN (not associated with failure)
●CB S/C: ATT DIR CONT - close
13 ●RCS: SYS A QUAD sw - OPEN (not associated with failure)
●CB S/C: ATT DIR CONT - close
12 RCS OXID VALVE & FUEL VALVE FAILED OPEN (DOUBLE FAILURE) OR SOLENOID DRIVER SHORTED TO GROUND
6 ●ACA/4 JET sw (CDR) - ENABLE
Jet fires?
YES
NO
7 CDR ACA HARDOVER (SINGLE CONTACT) SW FAILED CLOSED
9 LMP ACA HARDOVER (SINGLE CONTACT) SW FAILED CLOSED
8 ●ACA 4 JET sw (CDR) - DISABLE
●ACA 4 JET sw (LMP) - ENABLE
WARNING
A single RCS jet failed on when compensated for by opposing jets firing will consume 0.12%/sec of total RCS propellant.
2 S/C: PGNS (AGS) sw associated with controlling guidance section is affected only.
3 Alternative failure isolation procedure is to open CB S/C: ATT DIR CONT. This results in loss of +X TRANSL pb. hardover, & direct modes
15
CDR (LMP) ACA JAMMED OUT OF DETENT. PROPORTIONAL SIGNALS ALWAYS PRESENT.
1 Disable failed ACA
●CDR (LMP) ACA PROP sw - DISABLE
●CDR (LMP) ACA/4 JET sw - DISABLE
●S/C: ROLL, PITCH, & YAW sw - MODE CONT
2 Reorient LM
●LMP (CDR) ACA - maneuver to desired attitude
1 Assumption: it is obvious which ACA failed. ACA is jammed so it cannot be used in any axis.
2 Determine if ACA jammed 2.5° or more out of detent. If ACA is >2.5° out of detent, do not select S/C: ROLL, PITCH, YAW sw - DIRECT or PULSE.
300LM4-526
SYMPTOM
PROCEDURE
REMARKS

CES


SYMPTOM
PROCEDURE
REMARKS
16
Abnormal response to CDR (LMP) ACA commands
16a
Abnormal proportional mode response
1
•Control rates, using hardover, as required
2
Establish troubleshooting configuration
•S/C: PGNS sw – ATT HOLD
•S/C: AGS sw – ATT HOLD
•S/C: PITCH, ROLL, & YAW sw – MODE CONT
3
•CDR (LMP) ACA – introduce single axis commands in all three axes (+ &–)
Coupled motion resulted in any axis?
YES
4
SOLENOID DRIVER FAILED OFF
5
Close affected thruster pair isolation valves
•RCS: SYS A or B QUAD sw – CLOSE (affected pair)
NO
1
8
All axes responded properly?
NO
6
Excessive rates resulted?
YES
YES
NO
CES
17 1
7
CDR (LMP) ACA SINGLE AXIS MOVABLE XDUCER COIL (INTERNAL) HUNG UP IN OTHER THAN DETENT POSITION
9
GUID CONT sw?
PGNS
AGS
10
•GUID CONT sw – PGNS
•Perform Rate Gyro Check, ref para 4.6.2.10
Successful?
YES
NO
CES
12 1
11
•GUID CONT sw – AGS
How many axes did not respond properly?
ONE
ALL
12
FDAI error needles zeroed when ACA moved out of detent in failed axis?
NO
YES
2
13
CDR (LMP) ACA OUT-OF-DETENT SW (INTERNAL) FAILED OPEN IN AFFECTED AXIS
20
•LMP (CDR) ACA - rotate in all axes (+ or–)
LM responds?
NO
YES
14
•LMP (CDR) ACA - rotate in failed axis.
LM responds?
YES
NO
3
15
CDR (LMP) ACA XDUCER SW (INTERNAL) OR XDUCER COIL (INTERNAL) FAILED OPEN
21
CDR (LMP) ACA 800-CPS FUSE BLOWN OR CDR (LMP) ACA PROP SW FAILED OPEN
5
16
GUID CONT sw?
PGNS
AGS
17
RELAY K2, K3, OR K4 IN S & C CONTROL ASSY NO. 2 FAILED OPEN
22
•CDR (LMP) TTCA - command single axis translation (+ &–)
Jets fire?
YES
NO
23
RELAY K5 IN S & C CONTROL ASS'Y NO. 2 OR PGNCS RELAY K8 FAILED OPEN
5
19
RELAY K2, K3, OR K4 IN S & C CONTROL ASSY NO. 2 FAILED OPEN OR ATT CONT SW DECK 3 FAILED TO PULSE OR DIRECT
18
•Change guidance control
25
S/C: PGNS SW DECK 2 OR S/C: AGS SW DECK 3 FAILED OPEN
24
• Change guidance control
1 Under PGNCS control, LM will not rotate. Under AGS control, vehicle will rotate, but will be driven back to original attitude when ACA is released.
2 CDR (LMP) ACA proportional mode is lost in all axes (PGNCS & AGS). PGNCS minimum impulse mode is also lost.
3 CDR (LMP) ACA proportional mode is lost in affected axis (PGNCS & AGS). PGNCS minimum impulse mode is also lost in affected axis.
4 Proportional mode and manual throttle capability in controlling guidance section is lost.
5 Proportional mode in failed axis, in controlling guidance section, is lost.
300LM4-528
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS

17

Abnormal response to CDR (LMP) ACA pulse mode commands

1 ●GUID CONT sw–AGS ●S/C: ROLL, PITCH, & YAW sw–PULSE
Jets fire immediately when pulse mode is selected? YES → 2 CDR (LMP) ACA 2.5 ° SW (INTERNAL) FAILED CLOSED (2)
NO

3 ●CDR (LMP) ACA–rotate in + & – direction in all axes
Jets fire? YES → CES 18 1
NO

4 Coupled motion in any axis? YES → 5 SOLENOID DRIVER FAILED OFF
NO

6 Response lost in both directions (+ & –)? YES → 7 ●Affected axis S/C: ROLL, PITCH, or YAW sw–DIR ●ACA - command + or – rotation
Jets fire? NO → 8 AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 3 FAILED OPEN OR IN MODE CONT POSITION (2)
YES

9 Balanced couple (single-axis motion)? NO → 10 AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 2 FAILED OPEN OR IN MODE CONT POSITION (2)
YES → 11 AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 2 FAILED IN DIR POSITION (3)

12 ●Affected axis S/C: ROLL, PITCH, or YAW sw–DIR ●ACA- command rotation in failed direction
Jets fire? NO → 13 CDR (LMP) ACA 2.5 ° SW (INTERNAL) FAILED OPEN (3)
YES

14 Balanced couple (single-axis motion)? YES → 15 AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 1 FAILED IN DIR, IF NEG ROTATION LOST; DECK NO. 4, IF POS ROTATION LOST (3)
NO → 16 AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 1 FAILED IN MODE CONT POSITION, IF NEG ROTATION IS LOST; DECK NO. 4, IF POS ROTATION IS LOST (2)

(1) Failures to be considered affect one axis only. Procedures apply to affected axis only and are applicable to any axis.

(2) Pulse and direct mode control is lost in affected axis.

(3) Pulse mode control is lost in affected axis.

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SYMPTOM	PROCEDURE	REMARKS

SYMPTOM	PROCEDURE	REMARKS

18

Abnormal response to CDR (LMP) ACA direct mode commands

(1)

1
- GUID CONT sw – AGS
- S/C: ROLL, PITCH, & YAW sw – DIR

Jets fire immediately when DIR is selected?

YES → (2) **2** CDR (LMP) ACA 2.5° SW (INTERNAL) FAILED CLOSED

NO

3
- CDR (LMP) ACA – rotate + & – in all axis

One jet fires?

NO → (3) **4** AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 3 FAILED OPEN; OR IN MODE CONT OR PULSE POSITION

YES

5
- Affected axis S/C: ROLL, PITCH, or YAW sw – PULSE
- ACA – rotate

Proper jets fire?

YES → (3) **6** AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 2 FAILED IN PULSE POSITION

NO → (4) **7** AFFECTED AXIS S/C: ROLL, PITCH, OR YAW SW DECK NO. 2 FAILED OPEN OR IN MODE CONT POSITION, OR ACA 2.5° SW (INTERNAL) FAILED OPEN

(1) Failures to be considered affect one axis only. Procedures apply to affected axis only and are applicable to any axis.

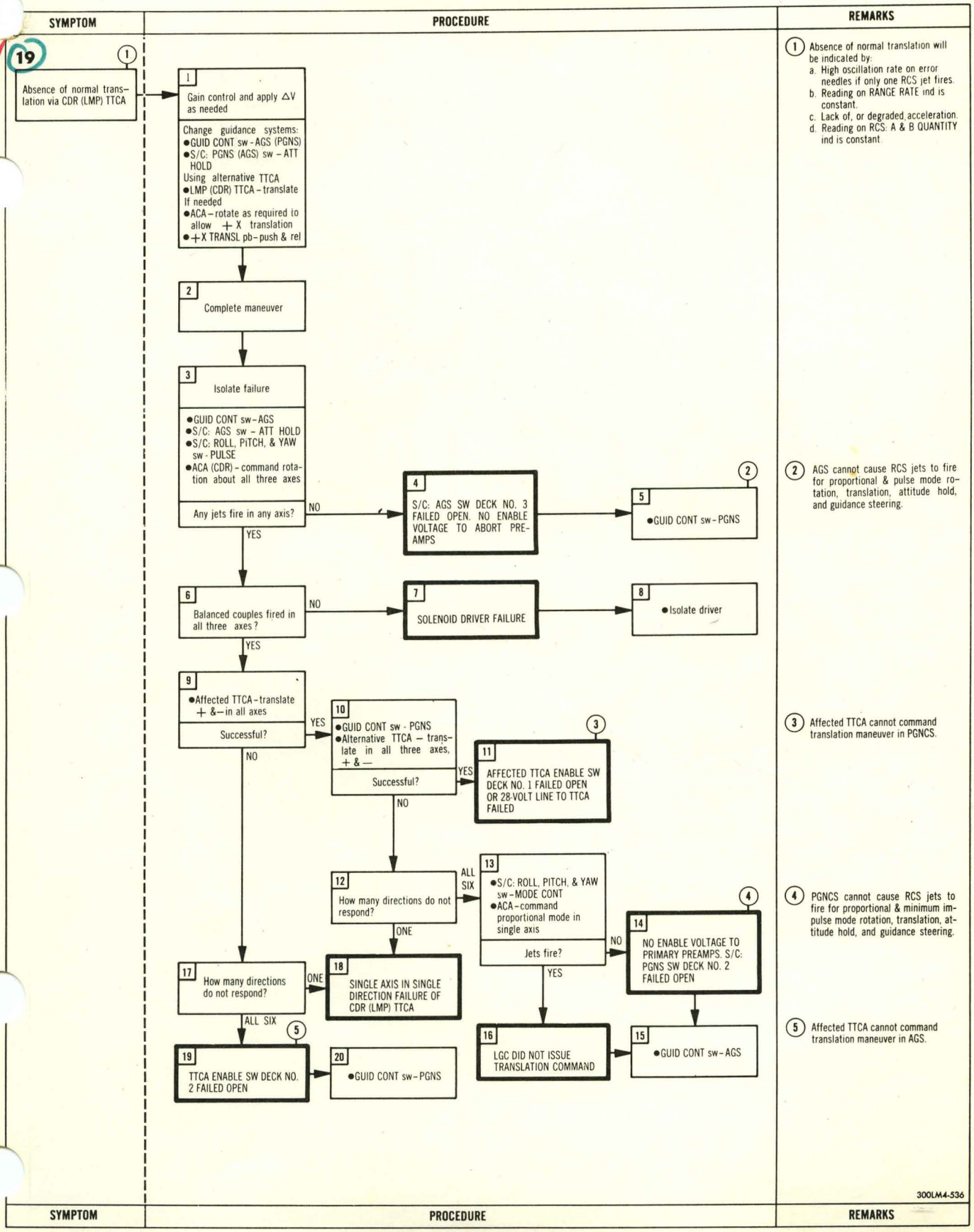
(2) Do not set affected axis S/C: ROLL, PITCH, or YAW sw in PULSE or DIR.

(3) Direct mode control in affected axis is lost.

(4) Pulse & direct mode control is lost in affected axis.

A-300LM4-531

SYMPTOM	PROCEDURE	REMARKS


SYMPTOM
PROCEDURE
REMARKS
19
Absence of normal translation via CDR (LMP) TTCA
1
Gain control and apply ΔV as needed
Change guidance systems:
●GUID CONT sw - AGS (PGNS)
●S/C: PGNS (AGS) sw – ATT HOLD
Using alternative TTCA
●LMP (CDR) TTCA – translate
If needed
●ACA – rotate as required to allow + X translation
●+X TRANSL pb – push & rel
2
Complete maneuver
3
Isolate failure
●GUID CONT sw – AGS
●S/C: AGS sw – ATT HOLD
●S/C: ROLL, PITCH, & YAW sw - PULSE
●ACA (CDR) – command rotation about all three axes
Any jets fire in any axis?
NO
YES
4
S/C: AGS SW DECK NO. 3 FAILED OPEN. NO ENABLE VOLTAGE TO ABORT PRE-AMPS
5
●GUID CONT sw – PGNS
6
Balanced couples fired in all three axes?
NO
YES
7
SOLENOID DRIVER FAILURE
8
●Isolate driver
9
●Affected TTCA – translate + & – in all axes
Successful?
YES
NO
10
●GUID CONT sw - PGNS
●Alternative TTCA – translate in all three axes, + & –
Successful?
YES
NO
11
AFFECTED TTCA ENABLE SW DECK NO. 1 FAILED OPEN OR 28-VOLT LINE TO TTCA FAILED
12
How many directions do not respond?
ALL SIX
ONE
13
●S/C: ROLL, PITCH, & YAW sw – MODE CONT
●ACA – command proportional mode in single axis
Jets fire?
NO
YES
14
NO ENABLE VOLTAGE TO PRIMARY PREAMPS. S/C: PGNS SW DECK NO. 2 FAILED OPEN
15
●GUID CONT sw – AGS
16
LGC DID NOT ISSUE TRANSLATION COMMAND
17
How many directions do not respond?
ONE
ALL SIX
18
SINGLE AXIS IN SINGLE DIRECTION FAILURE OF CDR (LMP) TTCA
19
TTCA ENABLE SW DECK NO. 2 FAILED OPEN
20
●GUID CONT sw – PGNS
1 Absence of normal translation will be indicated by:
a. High oscillation rate on error needles if only one RCS jet fires.
b. Reading on RANGE RATE ind is constant.
c. Lack of, or degraded, acceleration.
d. Reading on RCS: A & B QUANTITY ind is constant.
2 AGS cannot cause RCS jets to fire for proportional & pulse mode rotation, translation, attitude hold, and guidance steering.
3 Affected TTCA cannot command translation maneuver in PGNCS.
4 PGNCS cannot cause RCS jets to fire for proportional & minimum impulse mode rotation, translation, attitude hold, and guidance steering.
5 Affected TTCA cannot command translation maneuver in AGS.
300LM4-536
SYMPTOM
PROCEDURE
REMARKS

CES

5.2.6 DESCENT PROPULSION SECTION

5.2.6.1 General

- Double failures are not considered.
- During descent engine burns, continue the burn unless it becomes apparent that an explosion could occur.
- The DPS is loaded with helium and propellants according to prescribed values.
- The DPS has been checked before use.
- The status of all tb's has been checked and verified before entering the tb malfunction procedures.

5.2.6.2 Assumptions

5.2.6.2.1 Off-Nominal Helium Pressure, or Propellant Temperature or Pressure, Indication

- Large leaks are not considered.
- These are troubleshooting procedures intended to locate, identify, and isolate off-nominal conditions that do not trigger the CWEA or provide discrete malfunction indications.
- The crew does not enter into this symptom unless they have had an obvious off-nominal condition.
- Cold-soak is not a malfunction.

5.2.6.2.2 DES REG Warning Light

- The descent engine arming signal is present.

5.2.6.2.3 DES QTY Warning Light

- If the light goes on when the engine is firing, shut down the engine when propellant quantity remaining reaches 6%, to avoid possible engine explosion.

5.2.6.2.4 ENG GMBL Caution Light

- Excessive RCS propellants will be consumed if this light goes on while the descent engine is firing.

5.2.6.2.5 MPS: PRESS Indicator Power Fail Light On

- The status of the light is verified by cross-checking with APS propellant pressures.

5.2.6.2.6 Abnormal PQGS Indication

- Quantity indications are not reliable until after ullage settling.

DPS

Table 5-11. DPS Procedure Entry Sheet

Symptom	Sym No.	Page No.
Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
DES REG warn lt	2	5.2-68
DES QTY warn lt	3	5.2-69
ENG GMBL caut lt	4	5.2-69
MPS: PRESS ind pwr fail lt on	5	5.2-69
DES He REG 1 (2) tb - bp	6	5.2-70
DES He REG 2 (1) tb - gray	7	5.2-70
Before venting: DES PROPUL: FUEL (OXID) VENT tb - gray	8	5.2-70
After venting: DES PROPUL: FUEL (OXID) VENT tb - bp	9	5.2-70
Abnormal PQGS indication	10	5.2-71

Table 5-12. DPS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
Ambient helium leak upstream of quad check vlvs	Off-nominal helium pressure of propellant temp or pressure indication	1	5.2-66
Cold soak or slow leak. Verify with MSFN	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
C/W circuitry failure	DES QTY warn lt	3	5.2-69
C/W circuitry failure or liquid low-level sensor in propellant tank failed on	DES QTY warn lt	3	5.2-69
CWEA failure	DES REG warn lt	2	5.2-68
	ENG GMBL caut lt	4	5.2-69
Descent helium reg 1 failed closed	DES REG warn lt	2	5.2-68
Descent helium reg 1 failed open	DES REG warn lt	2	5.2-68
Descent helium reg 1 failure	DES REG warn lt	2	5.2-68
Fuel (oxid) vent SOV failed closed	After venting: DES PROPUL: FUEL (OXID) VENT tb - bp	9	5.2-70
Fuel (oxid) vent SOV failed open	Before venting: DES PROPUL: FUEL (OXID) VENT tb - gray	8	5.2-70

Table 5-12. DPS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Fuel (oxid) vent SOV transient failure	Before venting: DES PROPUL: FUEL (OXID) VENT tb - gray	8	5.2-70
GDA failure	ENG GMBL caut lt	4	5.2-69
Heat soak	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Helium leak	DES REG warn lt	2	5.2-68
Helium leak downstream of quad check vlvs	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Helium leak downstream of quad check valves in affected leg.	DES REG warn lt	2	5.2-68
Helium leak in ambient tank	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Helium leak upstream of quad check valves in affected leg.	DES REG warn lt	2	5.2-68
Helium pressure xducer failure	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Helium reg 1 (2) SOV failed closed	DES He REG 1 (2) tb - bp	6	5.2-70
Helium reg 1 (2) SOV inadvertently unlatched	DES He REG 1 (2) tb - bp	6	5.2-70
Helium reg 2 (1) SOV failed open	DES He REG 2 (1) tb - gray	7	5.2-70
Helium reg 2 (1) SOV inadvertently opened	DES He REG 2 (1) tb - gray	7	5.2-70
Ind failure	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Instrumentation failure	DES REG warn lt	2	5.2-68
MPS: FUEL & OXID QUANTITY ind failure	Abnormal PQGS indication	10	5.2-71
MPS: PRESS ind pwr fail lt failed on	MPS: PRESS ind pwr fail lt on	5	5.2-69
Possible propellant leak	Abnormal PQGS indication	10	5.2-71
Power to MPS: FUEL & OXID PRESS ind is lost	MPS: PRESS ind pwr fail lt on	5	5.2-69
PQGS failure	Abnormal PQGS indication	10	5.2-71
PQGS failure in propellant tanks No. 1 (2)	Abnormal PQGS indication	10	5.2-71
PQGS power failure	Abnormal PQGS indication	10	5.2-71

DPS

Table 5-12. DPS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Primary descent helium reg failed high or low	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Primary descent helium reg is leaking or regulating high	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Primary descent helium reg regulating low	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Probable heat or cold soak	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Probable xducer failure. Verify with MSFN	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Propellant leak in off-nominal propellant section	DES REG warn lt	2	5.2-68
Propellant leak or degraded eng performance	DES QTY warn lt	3	5.2-69
Propellant leak, verify interface pressure with MSFN	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Quantity-sensing probe failure	Abnormal PQGS indication	10	5.2-71
Secondary descent helium reg failed closed	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Secondary descent helium reg failed high or open	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Signal line to ind is lost	Abnormal PQGS indication	10	5.2-71
Tb failure	After venting: DES PROPUL: FUEL (OXID) VENT tb - bp	9	5.2-70
Tb failure or instrumentation failure & inadvertently stuck valve	DES He REG 2 (1) tb - gray	7	5.2-70
Tb or instrumentation failure	Before venting: DES PROPUL: FUEL (OXID) VENT tb - gray	8	5.2-70
	DES He REG 1 (2) tb - bp	6	5.2-70
Transient drive signal	ENG GMBL caut lt	4	5.2-69
Xducer failure	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66
Xducer failure in affected sys	Off-nominal helium pressure or propellant temp or pressure indication	1	5.2-66

DPS

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SYMPTOM | **PROCEDURE** | **REMARKS**

1 (Sheet 1 of 2)

Off-nominal helium pressure or propellant temp or pressure indication

1 Select alternative source
- ●Cycle HELIUM MON sel or PRPLNT TEMP/PRESS MON sw
- Associated ind responds?

NO → 2 IND FAILURE

YES

3 Ind reads full scale, high, or low?

YES → CAUTION: MSFN must monitor affected helium pressures or propellant temp or pressure → 4 XDUCER FAILURE IN AFFECTED SYS

NO

5 Supercritical helium pressure abnormal?

YES → 6 Consult MSFN (no onboard diagnostic capability)

NO

7 Eng firing?

YES → 8 Propellant tank pressures normal?

YES → 9 ●When burn completed, proceed → 14

NO → 10 Switch to secondary reg
- ●DES He REG 1 sw - CLOSE
- ●DES He REG 2 sw - OPEN
- Propellant tank pressures normal?

YES → 11 PRIMARY DESCENT HELIUM REG FAILED HIGH OR LOW

NO → 12 PROBABLE XDUCER FAILURE. VERIFY WITH MSFN

NO → 13 Supercritical helium explosive vlvs were fired?

YES

NO → 24 (sheet 2)

14 Temp & pressure indications off-nominal in same direction?

YES → 15 Off-nominal in high direction?

NO → 16 COLD SOAK OR SLOW LEAK. VERIFY WITH MSFN

YES → 17 HEAT SOAK

NO

18 MSFN verifies pressure reading anomaly with interface pressure reading?

YES → 19 Pressure low?

YES → 20 PRIMARY DESCENT HELIUM REG REGULATING LOW → 21 Switch to secondary reg
- ●DES He REG 1 sw - CLOSE
- ●DES He REG 2 sw - OPEN

NO → 22 PRIMARY DESCENT HELIUM REG IS LEAKING OR REGULATING HIGH.

NO → 23 XDUCER FAILURE

REMARKS

(1) MSFN must monitor all APS/DPS temp & pressures for affected ind.

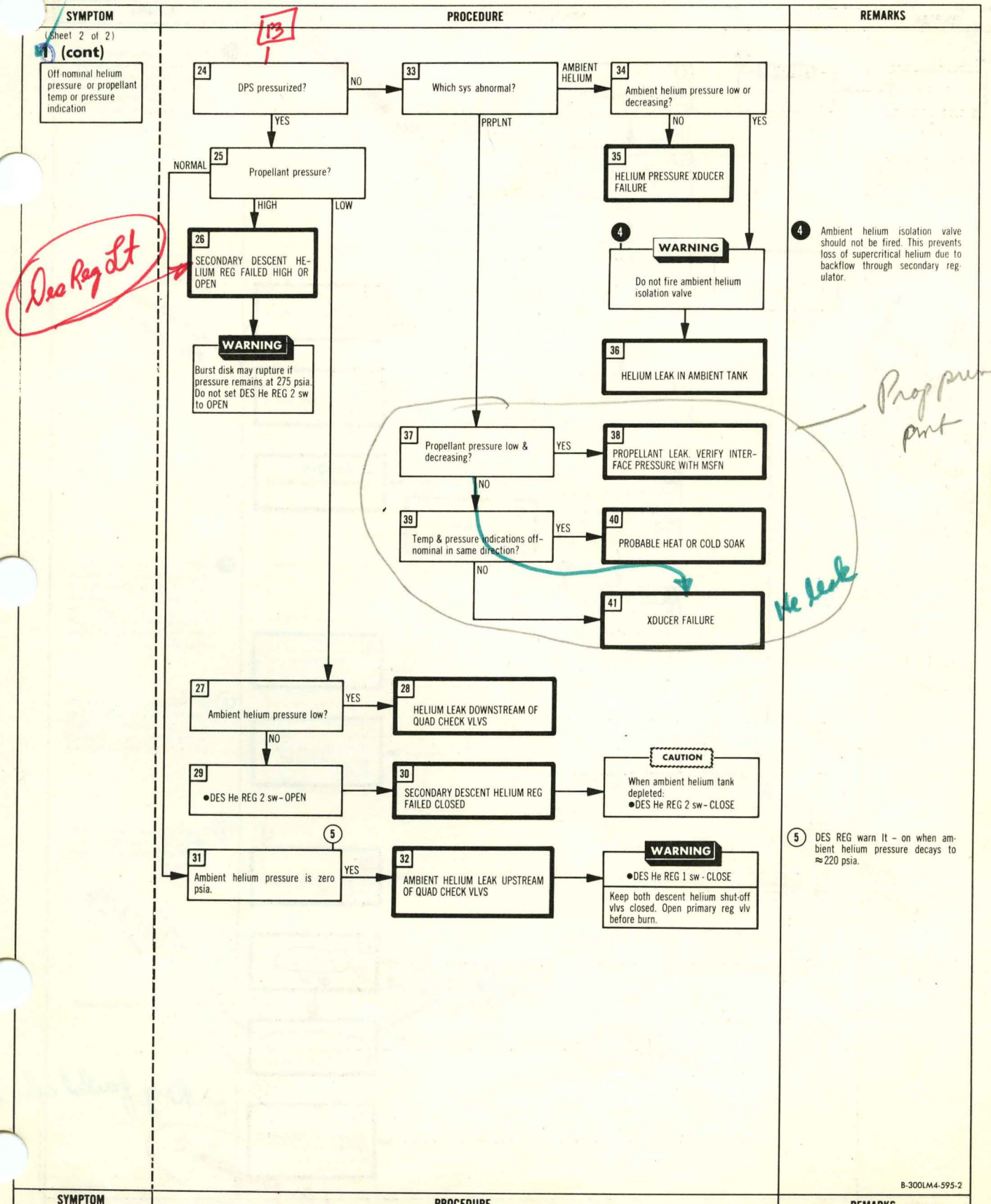
(2) Open xducer results in low indication; shorted xducer, in high indication.

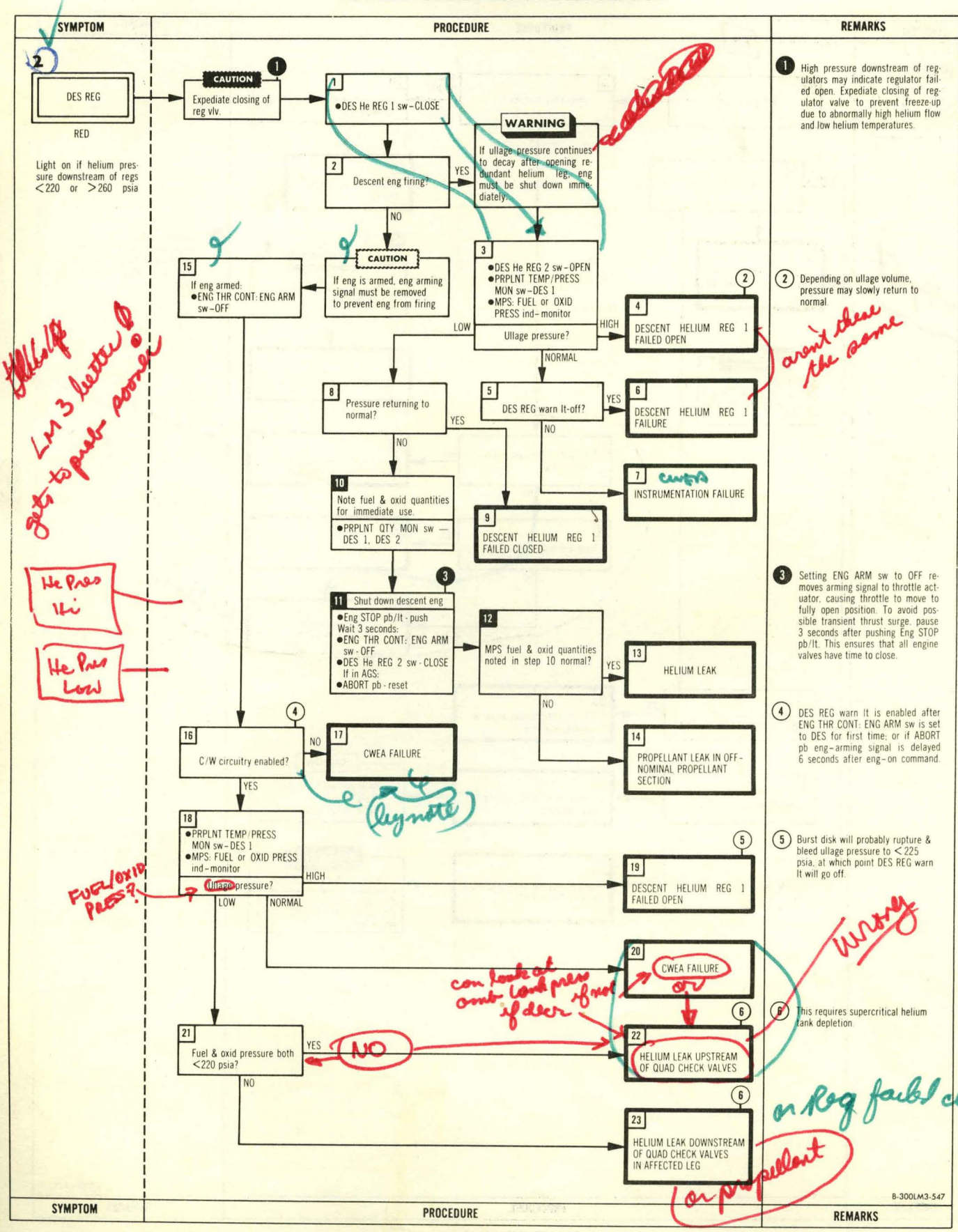
Possibility exists that, upon initial power-up, completely depleted ambient helium tank will have effect of open xducer. This cannot be determined onboard without MSFN assistance.

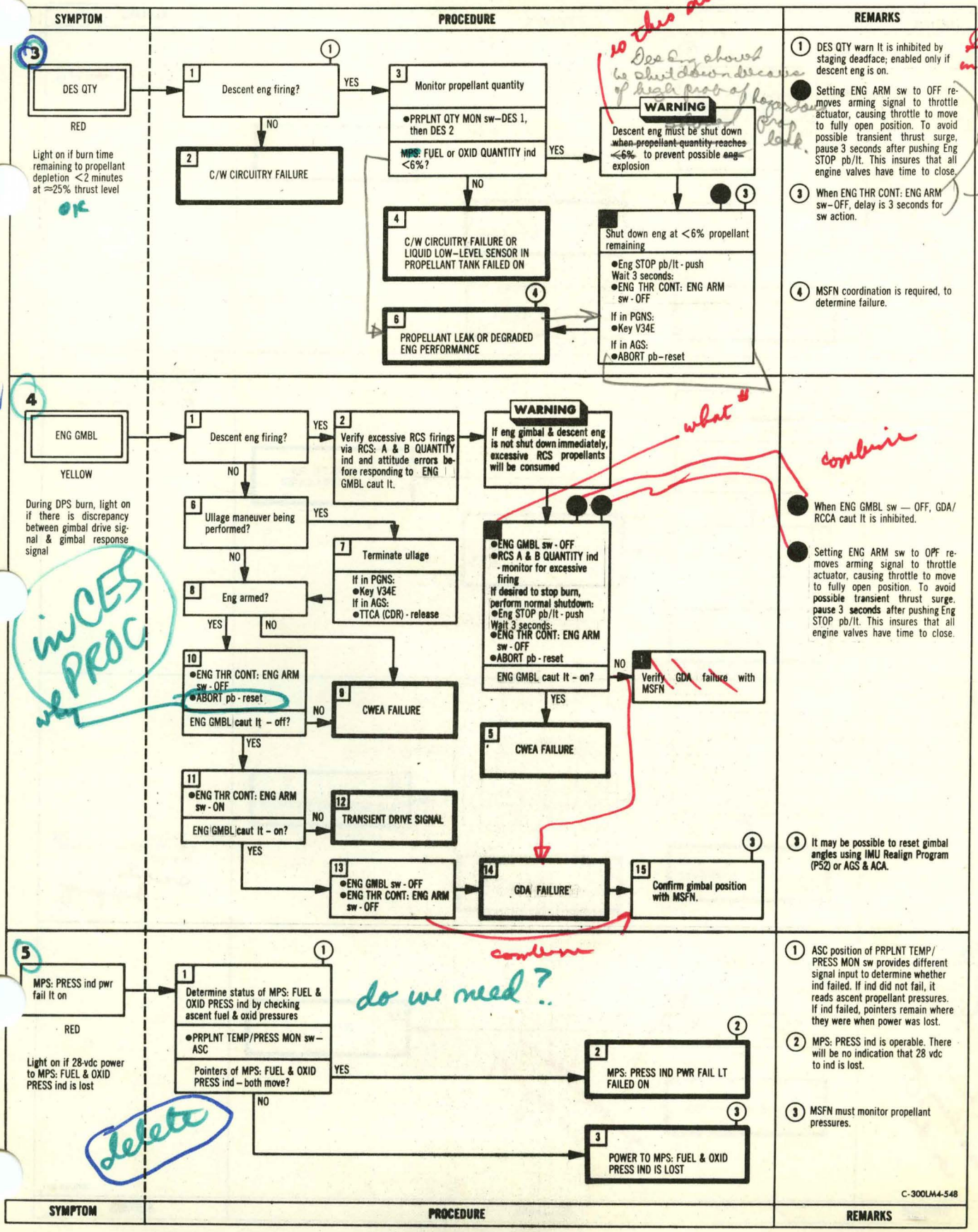
(3) MSFN has alternative pressure telemetry point.

A-300LM4-595-1

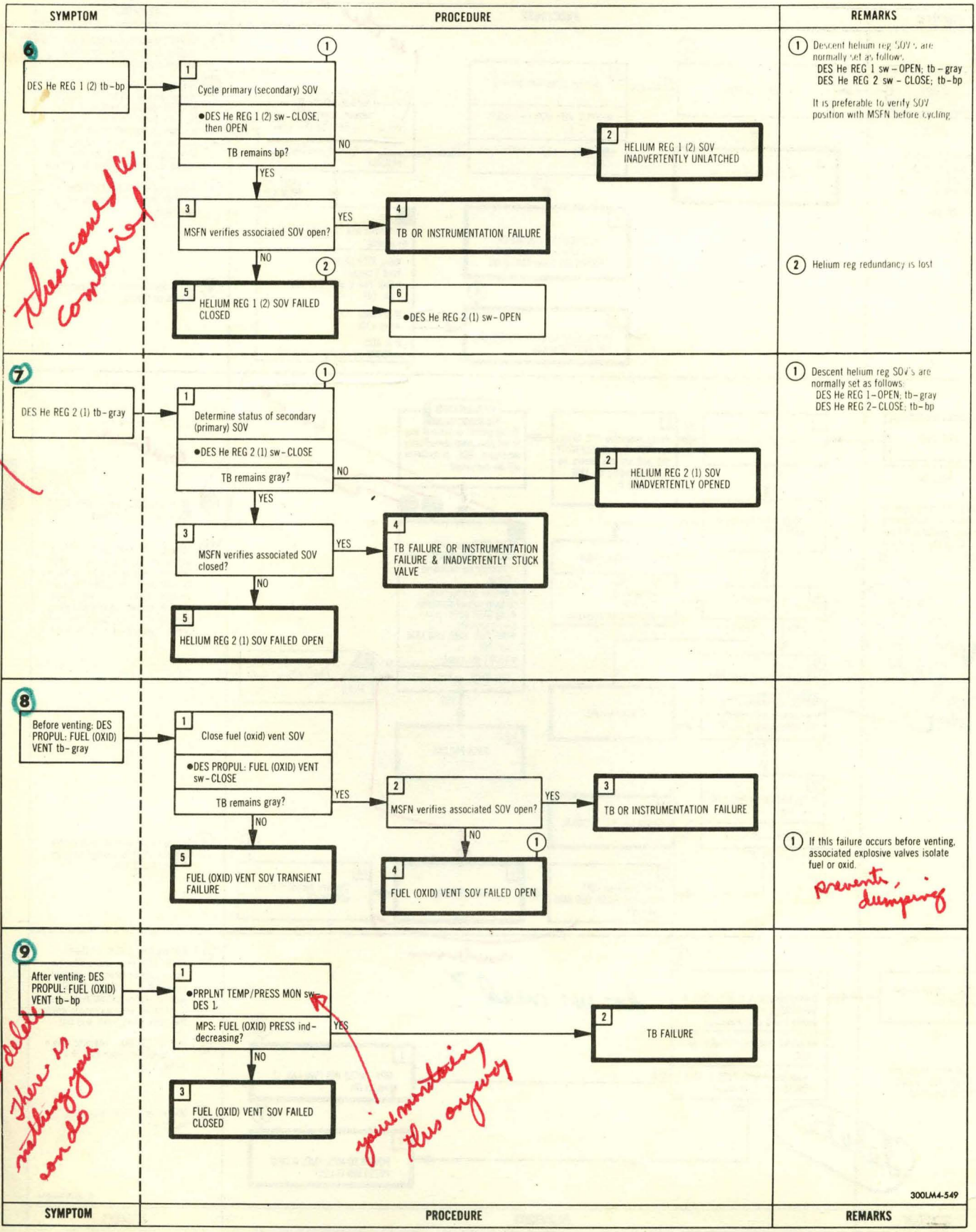
SYMPTOM | **PROCEDURE** | **REMARKS**

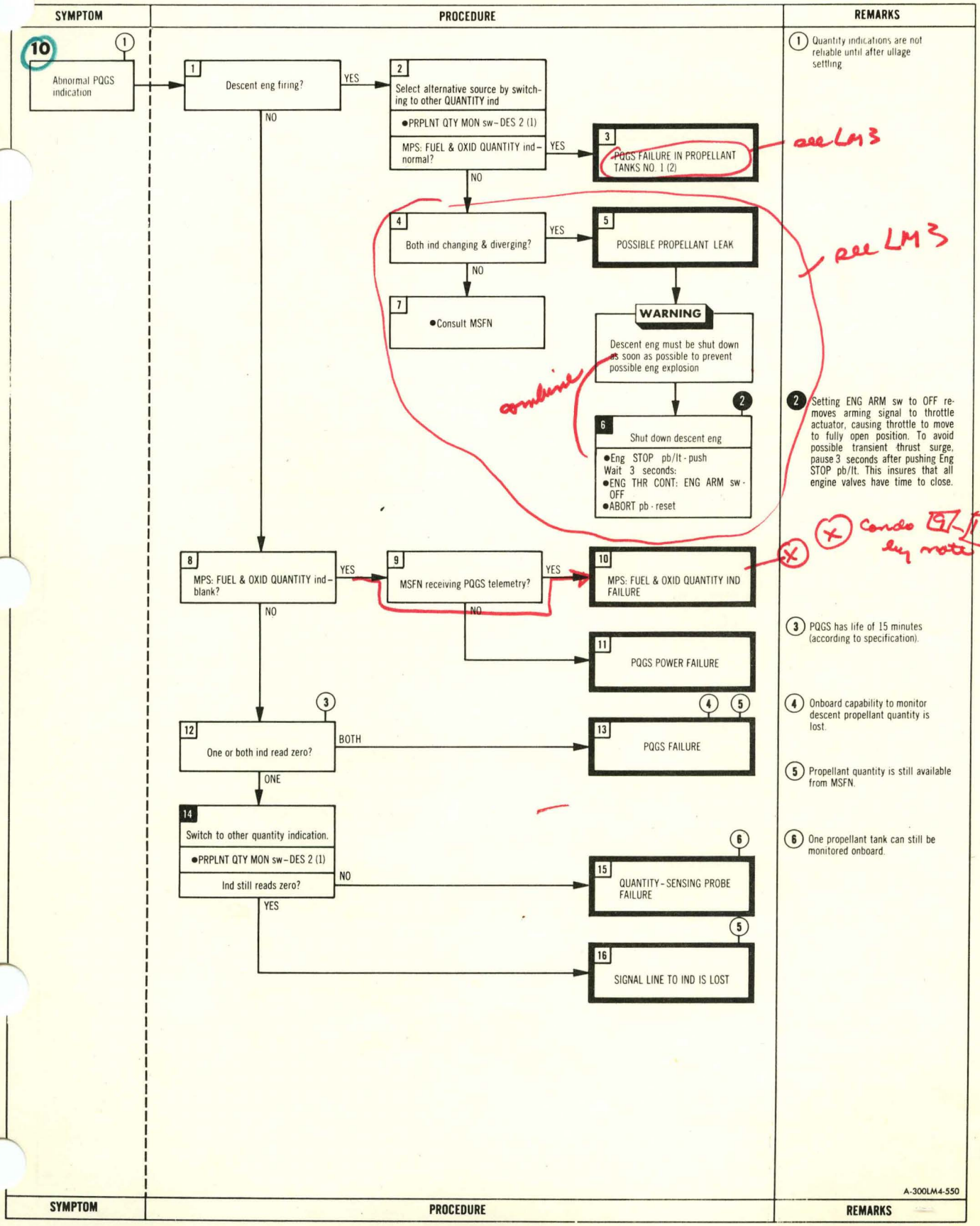

SYMPTOM
PROCEDURE
REMARKS
(Sheet 2 of 2)
1 (cont)
Off nominal helium pressure or propellant temp or pressure indication
24 DPS pressurized?
NO
33 Which sys abnormal?
AMBIENT HELIUM
34 Ambient helium pressure low or decreasing?
YES
PRPLNT
NO
YES
35 HELIUM PRESSURE XDUCER FAILURE
25 Propellant pressure?
NORMAL
HIGH
LOW
26 SECONDARY DESCENT HELIUM REG FAILED HIGH OR OPEN
WARNING
Burst disk may rupture if pressure remains at 275 psia. Do not set DES He REG 2 sw to OPEN
4
WARNING
Do not fire ambient helium isolation valve
36 HELIUM LEAK IN AMBIENT TANK
4 Ambient helium isolation valve should not be fired. This prevents loss of supercritical helium due to backflow through secondary regulator.
37 Propellant pressure low & decreasing?
YES
38 PROPELLANT LEAK. VERIFY INTERFACE PRESSURE WITH MSFN
NO
39 Temp & pressure indications off-nominal in same direction?
YES
40 PROBABLE HEAT OR COLD SOAK
NO
41 XDUCER FAILURE
27 Ambient helium pressure low?
YES
28 HELIUM LEAK DOWNSTREAM OF QUAD CHECK VLVS
NO
29 •DES He REG 2 sw - OPEN
30 SECONDARY DESCENT HELIUM REG FAILED CLOSED
CAUTION
When ambient helium tank depleted:
•DES He REG 2 sw - CLOSE
5
31 Ambient helium pressure is zero psia.
YES
32 AMBIENT HELIUM LEAK UPSTREAM OF QUAD CHECK VLVS
WARNING
•DES He REG 1 sw - CLOSE
Keep both descent helium shut-off vlvs closed. Open primary reg vlv before burn.
5 DES REG warn lt - on when ambient helium pressure decays to ≈220 psia.
B-300LM4-595-2
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
2
DES REG
RED
Light on if helium pressure downstream of regs <220 or >260 psia
CAUTION
1
Expedite closing of reg vlv.
1
●DES He REG 1 sw-CLOSE
2
Descent eng firing?
YES
WARNING
If ullage pressure continues to decay after opening redundant helium leg, eng must be shut down immediately.
NO
CAUTION
If eng is armed, eng arming signal must be removed to prevent eng from firing
15
If eng armed:
●ENG THR CONT: ENG ARM sw-OFF
3
●DES He REG 2 sw-OPEN
●PRPLNT TEMP/PRESS MON sw-DES 1
●MPS: FUEL or OXID PRESS ind-monitor
Ullage pressure?
LOW
HIGH
NORMAL
2
4
DESCENT HELIUM REG 1 FAILED OPEN
8
Pressure returning to normal?
YES
NO
5
DES REG warn lt-off?
YES
NO
6
DESCENT HELIUM REG 1 FAILURE
7
INSTRUMENTATION FAILURE
10
Note fuel & oxid quantities for immediate use.
●PRPLNT QTY MON sw — DES 1, DES 2
9
DESCENT HELIUM REG 1 FAILED CLOSED
3
11
Shut down descent eng
●Eng STOP pb/lt - push
Wait 3 seconds:
●ENG THR CONT: ENG ARM sw - OFF
●DES He REG 2 sw - CLOSE
If in AGS:
●ABORT pb - reset
12
MPS fuel & oxid quantities noted in step 10 normal?
YES
NO
13
HELIUM LEAK
14
PROPELLANT LEAK IN OFF-NOMINAL PROPELLANT SECTION
4
16
C/W circuitry enabled?
NO
YES
17
CWEA FAILURE
18
●PRPLNT TEMP/PRESS MON sw-DES 1
●MPS: FUEL or OXID PRESS ind-monitor
Ullage pressure?
HIGH
LOW
NORMAL
5
19
DESCENT HELIUM REG 1 FAILED OPEN
20
CWEA FAILURE
OR
6
21
Fuel & oxid pressure both <220 psia?
YES
NO
6
22
HELIUM LEAK UPSTREAM OF QUAD CHECK VALVES
6
23
HELIUM LEAK DOWNSTREAM OF QUAD CHECK VALVES IN AFFECTED LEG
1 High pressure downstream of regulators may indicate regulator failed open. Expedite closing of regulator valve to prevent freeze-up due to abnormally high helium flow and low helium temperatures.
2 Depending on ullage volume, pressure may slowly return to normal
3 Setting ENG ARM sw to OFF removes arming signal to throttle actuator, causing throttle to move to fully open position. To avoid possible transient thrust surge, pause 3 seconds after pushing Eng STOP pb/lt. This ensures that all engine valves have time to close.
4 DES REG warn lt is enabled after ENG THR CONT: ENG ARM sw is set to DES for first time; or if ABORT pb eng-arming signal is delayed 6 seconds after eng-on command.
5 Burst disk will probably rupture & bleed ullage pressure to < 225 psia, at which point DES REG warn lt will go off.
6 This requires supercritical helium tank depletion.
B-300LM3-547
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
3
DES QTY
RED
Light on if burn time remaining to propellant depletion <2 minutes at ≈25% thrust level
1 Descent eng firing?
YES
NO
2 C/W CIRCUITRY FAILURE
3 Monitor propellant quantity
●PRPLNT QTY MON sw–DES 1, then DES 2
MPS: FUEL or OXID QUANTITY ind <6%?
YES
NO
4 C/W CIRCUITRY FAILURE OR LIQUID LOW–LEVEL SENSOR IN PROPELLANT TANK FAILED ON
6 PROPELLANT LEAK OR DEGRADED ENG PERFORMANCE
WARNING
Descent eng must be shut down when propellant quantity reaches <6% to prevent possible eng explosion
Shut down eng at <6% propellant remaining
●Eng STOP pb/lt - push
Wait 3 seconds:
●ENG THR CONT: ENG ARM sw - OFF
If in PGNS:
●Key V34E
If in AGS:
●ABORT pb–reset
1 DES QTY warn lt is inhibited by staging deadface; enabled only if descent eng is on.
Setting ENG ARM sw to OFF removes arming signal to throttle actuator, causing throttle to move to fully open position. To avoid possible transient thrust surge, pause 3 seconds after pushing Eng STOP pb/lt. This insures that all engine valves have time to close.
3 When ENG THR CONT: ENG ARM sw–OFF, delay is 3 seconds for sw action.
4 MSFN coordination is required, to determine failure.
4
ENG GMBL
YELLOW
During DPS burn, light on if there is discrepancy between gimbal drive signal & gimbal response signal
1 Descent eng firing?
YES
NO
2 Verify excessive RCS firings via RCS: A & B QUANTITY ind and attitude errors before responding to ENG GMBL caut lt.
WARNING
If eng gimbal & descent eng is not shut down immediately, excessive RCS propellants will be consumed
6 Ullage maneuver being performed?
YES
NO
7 Terminate ullage
If in PGNS:
●Key V34E
If in AGS:
●TTCA (CDR) - release
8 Eng armed?
YES
NO
10 ●ENG THR CONT: ENG ARM sw - OFF
●ABORT pb - reset
ENG GMBL caut lt – off?
NO
YES
9 CWEA FAILURE
11 ●ENG THR CONT: ENG ARM sw - ON
ENG GMBL caut lt – on?
NO
YES
12 TRANSIENT DRIVE SIGNAL
13 ●ENG GMBL sw - OFF
●ENG THR CONT: ENG ARM sw - OFF
14 GDA FAILURE
15 Confirm gimbal position with MSFN.
●ENG GMBL sw - OFF
●RCS A & B QUANTITY ind - monitor for excessive firing
If desired to stop burn, perform normal shutdown:
●Eng STOP pb/lt - push
Wait 3 seconds:
●ENG THR CONT: ENG ARM sw - OFF
●ABORT pb - reset
ENG GMBL caut lt – on?
NO
YES
1 Verify GDA failure with MSFN
5 CWEA FAILURE
When ENG GMBL sw — OFF, GDA/RCCA caut lt is inhibited.
Setting ENG ARM sw to OFF removes arming signal to throttle actuator, causing throttle to move to fully open position. To avoid possible transient thrust surge, pause 3 seconds after pushing Eng STOP pb/lt. This insures that all engine valves have time to close.
3 It may be possible to reset gimbal angles using IMU Realign Program (P52) or AGS & ACA.
5
MPS: PRESS ind pwr fail lt on
RED
Light on if 28-vdc power to MPS: FUEL & OXID PRESS ind is lost
1 Determine status of MPS: FUEL & OXID PRESS ind by checking ascent fuel & oxid pressures
●PRPLNT TEMP/PRESS MON sw–ASC
Pointers of MPS: FUEL & OXID PRESS ind – both move?
YES
NO
2 MPS: PRESS IND PWR FAIL LT FAILED ON
3 POWER TO MPS: FUEL & OXID PRESS IND IS LOST
1 ASC position of PRPLNT TEMP/PRESS MON sw provides different signal input to determine whether ind failed. If ind did not fail, it reads ascent propellant pressures. If ind failed, pointers remain where they were when power was lost.
2 MPS: PRESS ind is operable. There will be no indication that 28 vdc to ind is lost.
3 MSFN must monitor propellant pressures.
C-300LM4-548
SYMPTOM
PROCEDURE
REMARKS

DPS


SYMPTOM
PROCEDURE
REMARKS
6
DES He REG 1 (2) tb-bp
1
Cycle primary (secondary) SOV
•DES He REG 1 (2) sw-CLOSE, then OPEN
TB remains bp?
NO
YES
2
HELIUM REG 1 (2) SOV INADVERTENTLY UNLATCHED
3
MSFN verifies associated SOV open?
YES
4
TB OR INSTRUMENTATION FAILURE
NO
2
5
HELIUM REG 1 (2) SOV FAILED CLOSED
6
•DES He REG 2 (1) sw-OPEN
1 Descent helium reg SOV's are normally set as follows:
DES He REG 1 sw - OPEN; tb - gray
DES He REG 2 sw - CLOSE; tb - bp
It is preferable to verify SOV position with MSFN before cycling
2 Helium reg redundancy is lost
7
DES He REG 2 (1) tb-gray
1
Determine status of secondary (primary) SOV
•DES He REG 2 (1) sw-CLOSE
TB remains gray?
NO
YES
2
HELIUM REG 2 (1) SOV INADVERTENTLY OPENED
3
MSFN verifies associated SOV closed?
YES
4
TB FAILURE OR INSTRUMENTATION FAILURE & INADVERTENTLY STUCK VALVE
NO
5
HELIUM REG 2 (1) SOV FAILED OPEN
1 Descent helium reg SOV's are normally set as follows:
DES He REG 1-OPEN; tb-gray
DES He REG 2-CLOSE; tb-bp
8
Before venting: DES PROPUL: FUEL (OXID) VENT tb-gray
1
Close fuel (oxid) vent SOV
•DES PROPUL: FUEL (OXID) VENT sw-CLOSE
TB remains gray?
YES
NO
2
MSFN verifies associated SOV open?
YES
NO
3
TB OR INSTRUMENTATION FAILURE
5
FUEL (OXID) VENT SOV TRANSIENT FAILURE
1
4
FUEL (OXID) VENT SOV FAILED OPEN
1 If this failure occurs before venting, associated explosive valves isolate fuel or oxid.
9
After venting: DES PROPUL: FUEL (OXID) VENT tb-bp
1
•PRPLNT TEMP/PRESS MON sw DES 1
MPS: FUEL (OXID) PRESS ind-decreasing?
YES
NO
2
TB FAILURE
3
FUEL (OXID) VENT SOV FAILED CLOSED
300LM4-549
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
10
Abnormal PQGS indication
1
Descent eng firing?
YES
NO
2
Select alternative source by switching to other QUANTITY ind
•PRPLNT QTY MON sw–DES 2 (1)
MPS: FUEL & OXID QUANTITY ind–normal?
YES
NO
3
PQGS FAILURE IN PROPELLANT TANKS NO. 1 (2)
4
Both ind changing & diverging?
YES
NO
5
POSSIBLE PROPELLANT LEAK
7
•Consult MSFN
WARNING
Descent eng must be shut down as soon as possible to prevent possible eng explosion
2
6
Shut down descent eng
•Eng STOP pb/lt - push
Wait 3 seconds:
•ENG THR CONT: ENG ARM sw - OFF
•ABORT pb - reset
8
MPS: FUEL & OXID QUANTITY ind–blank?
YES
NO
9
MSFN receiving PQGS telemetry?
YES
NO
10
MPS: FUEL & OXID QUANTITY IND FAILURE
11
PQGS POWER FAILURE
3
12
One or both ind read zero?
BOTH
ONE
4
5
13
PQGS FAILURE
14
Switch to other quantity indication.
•PRPLNT QTY MON sw–DES 2 (1)
Ind still reads zero?
NO
YES
6
15
QUANTITY-SENSING PROBE FAILURE
5
16
SIGNAL LINE TO IND IS LOST
(1) Quantity indications are not reliable until after ullage settling
(2) Setting ENG ARM sw to OFF removes arming signal to throttle actuator, causing throttle to move to fully open position. To avoid possible transient thrust surge, pause 3 seconds after pushing Eng STOP pb/lt. This insures that all engine valves have time to close.
(3) PQGS has life of 15 minutes (according to specification).
(4) Onboard capability to monitor descent propellant quantity is lost.
(5) Propellant quantity is still available from MSFN.
(6) One propellant tank can still be monitored onboard.
A-300LM4-550
SYMPTOM
PROCEDURE
REMARKS

5.2.7 ASCENT PROPULSION SECTION

5.2.7.1 General

- Double failures are not considered, except that in the ASC HI REG caut lt malfunction procedure a double failure (series-parallel regulators) causes the ASC HI REG caut lt to go on.
- During ascent engine burns, continue the burn unless it becomes apparent that an explosion could occur.
- The APS is loaded with helium and propellants according to prescribed values.
- The APS has been checked before use.
- The status of all tb's has been checked and verified before entering the tb malfunction procedures.

5.2.7.2 Assumptions

5.2.7.2.1 Off-Nominal Helium, or Propellant Temperature or Pressure, Indication

- Large leaks are not considered.
- These are troubleshooting procedures that cover off-nominal and anomalous conditions that do not trigger the CWEA or provide discrete malfunction indications.
- The crew does not enter into this symptom unless they have had an obvious off-nominal condition.
- Cold-soak is not a malfunction.

5.2.7.2.2 ASC PRESS Warning Light

- If this light goes on during a burn, immediately shut down the engine.

5.2.7.2.3 ASC QTY Caution Light

- A malfunction does not exist if this light goes on at the nominal time.
- If a propellant leak occurs while the ascent engine is firing, complete the maneuver with RCS propellants.

5.2.7.2.4 MPS: PRESS Indicator Power Fail Light On

- The status of the light is verified by cross-checking with the DPS propellant pressures.

Table 5-13. APS Procedure Entry Sheet

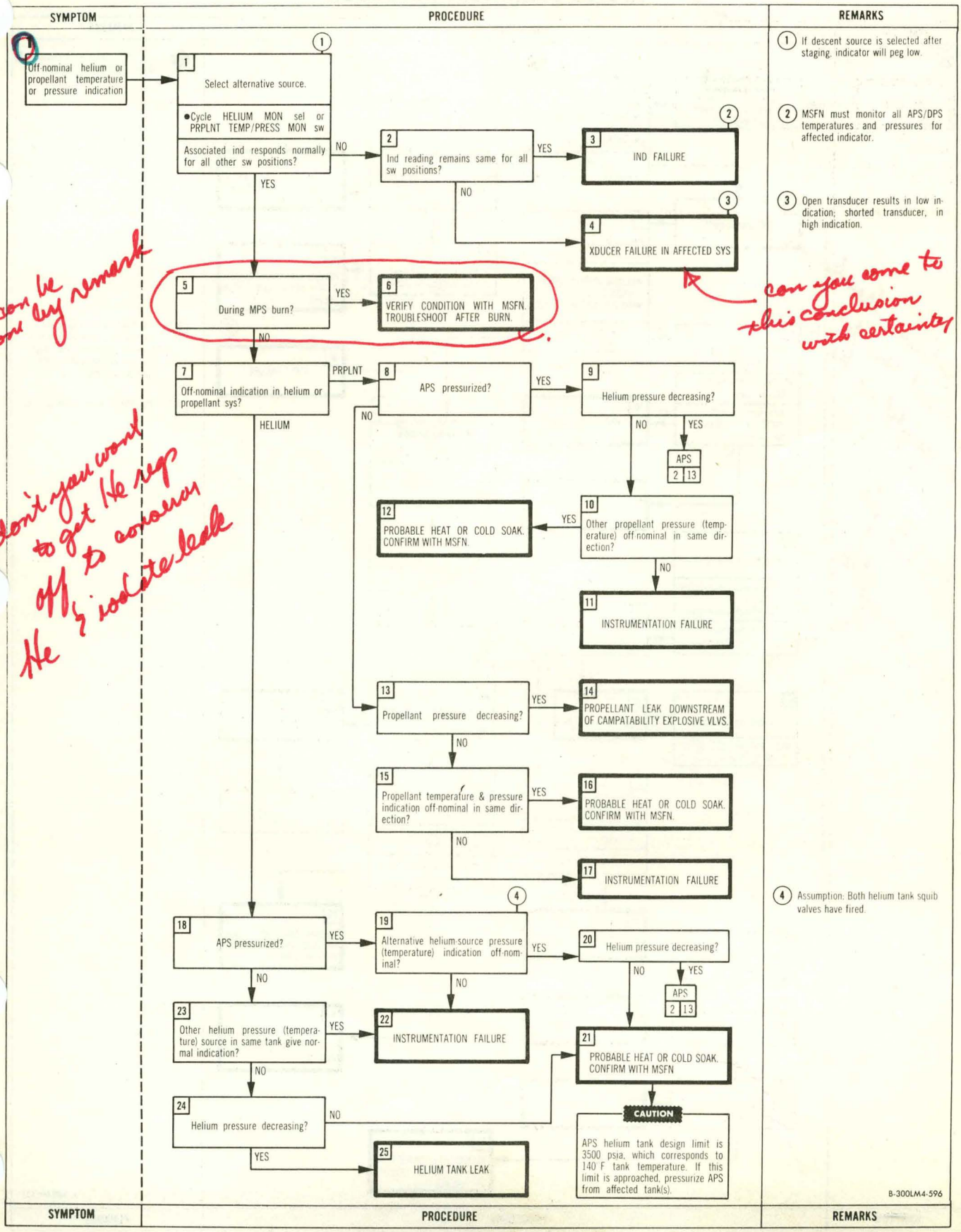
Symptom	Sym No.	Page No.
Off-nominal helium or propellant temp or pressure indication	1	5.2-77
ASC PRESS warn lt	2	5.2-78
ASC HI REG caut lt	3	5.2-79
ASC QTY caut lt	4	5.2-80
MPS: PRESS ind pwr fail lt on	5	5.2-81
ASC He REG 1 (2) tb - bp	6	5.2-81

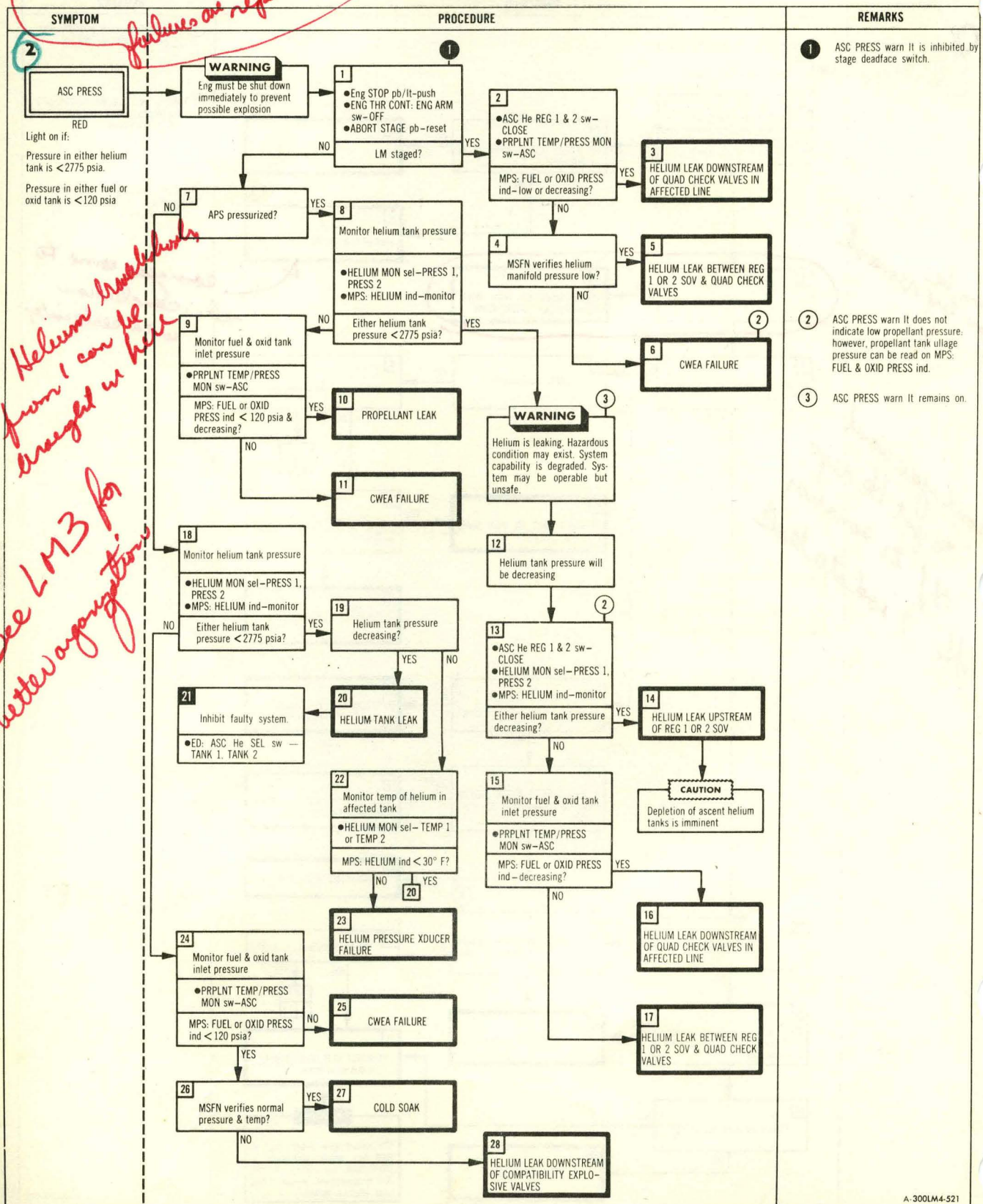
Table 5-14. APS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
Ascent He reg failed open in leg determined by MSFN	ASC HI REG caut lt	3	5.2-79
Ascent He reg 1 (2) failed open	ASC HI REG caut lt	3	5.2-79
Cold soak	ASC PRESS warn lt	2	5.2-78
CWEA failure	ASC PRESS warn lt	2	5.2-78
	ASC HI REG caut lt	3	5.2-79
CWEA or instrumentation failure	ASC HI REG caut lt	3	5.2-79
Fuel or oxid leak	ASC QTY caut lt	4	5.2-80
Heat or cold soak	Off-nominal helium or propellant temp or pressure indication	1	5.2-77
Helium leak between reg 1 or 2 SOV & quad check valves	ASC PRESS warn lt	2	5.2-78
Helium leak downstream of compatibility explosive valves	ASC PRESS warn lt	2	5.2-78
Helium leak downstream of quad check valves in affected line	ASC PRESS warn lt	2	5.2-78
Helium leak upstream of reg 1 or 2 SOV	ASC PRESS warn lt	2	5.2-78
Helium pressure xducer failure	ASC PRESS warn lt	2	5.2-78

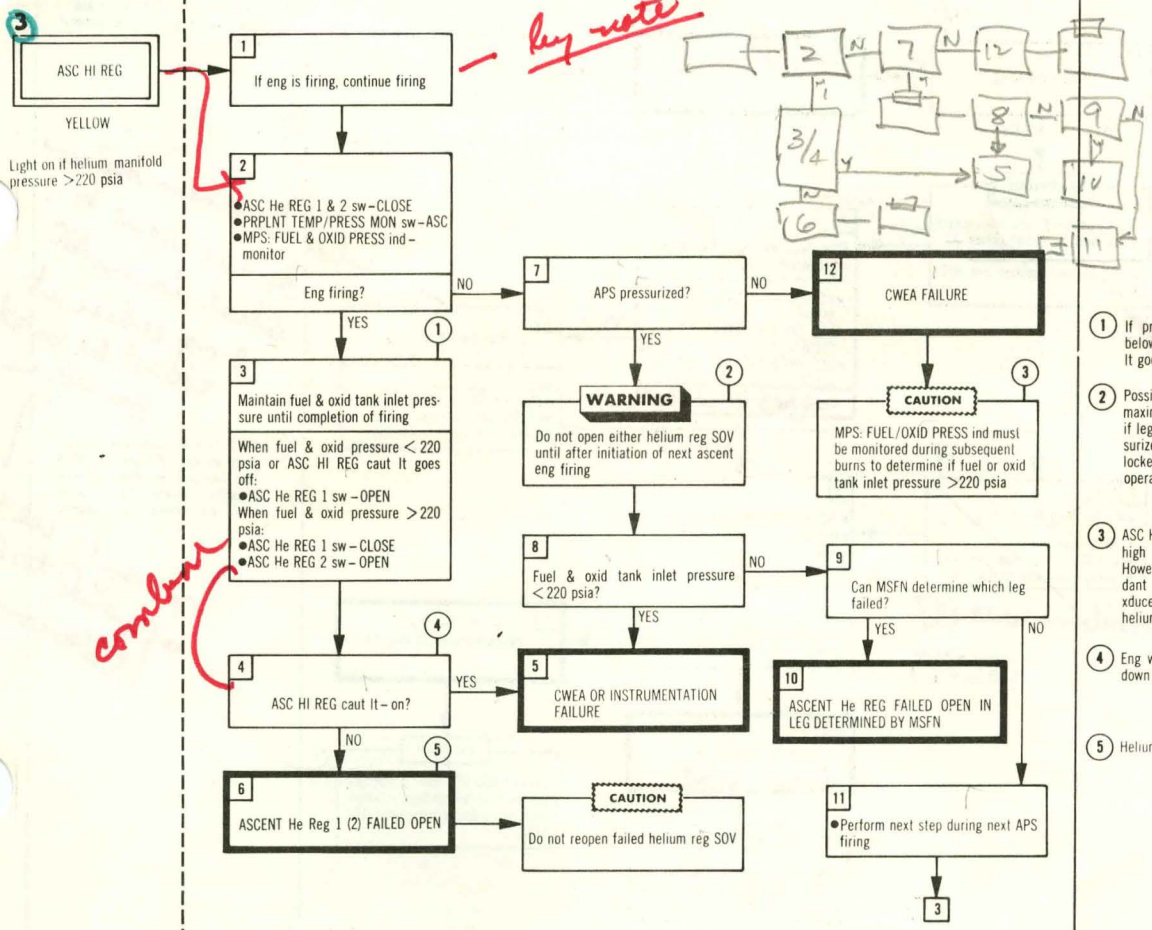
Table 5-14. APS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Helium reg 1 (2) SOV failed closed	ASC He REG 1 (2) tb - bp	6	5.2-81
Helium reg 1 (2) SOV inadvertently unlatched	ASC He REG 1 (2) tb - bp	6	5.2-81
Helium tank leak	Off-nominal helium or propellant temp or pressure indication	1	5.2-77
	ASC PRESS warn lt	2	5.2-78
Ind failure	Off-nominal helium or propellant temp or pressure indication	1	5.2-77
Instrumentation failure	ASC QTY caut lt	4	5.2-80
Loss of power to MPS: FUEL & OXID PRESS ind	MPS: PRESS ind pwr fail lt on	5	5.2-81
MPS: PRESS ind pwr fail lt failed on	MPS: PRESS ind pwr fail lt on	5	5.2-81
Probable heat or cold soak. Confirm with MSFN	Off-nominal helium or propellant temp or pressure indication	1	5.2-77
Propellant leak	ASC PRESS warn lt	2	5.2-78
Propellant leak downstream of compatibility explosive vlvs	Off-nominal helium or propellant temp or pressure indication	1	5.2-77
Tb failure, or instrumentation failure and inadvertent stuck valve	ASC He REG 1 (2) tb - bp	6	5.2-81
Xducer failure	Off-nominal helium or propellant temp or pressure indication	1	5.2-77
Xducer failure in affected sys	Off-nominal helium or propellant temp or pressure indication	1	5.2-77


SYMPTOM
PROCEDURE
REMARKS
Off-nominal helium or propellant temperature or pressure indication
1 Select alternative source.
•Cycle HELIUM MON sel or PRPLNT TEMP/PRESS MON sw
Associated ind responds normally for all other sw positions?
NO
2 Ind reading remains same for all sw positions?
YES
3 IND FAILURE
NO
4 XDUCER FAILURE IN AFFECTED SYS
YES
5 During MPS burn?
YES
6 VERIFY CONDITION WITH MSFN. TROUBLESHOOT AFTER BURN.
NO
7 Off-nominal indication in helium or propellant sys?
PRPLNT
8 APS pressurized?
YES
9 Helium pressure decreasing?
NO
YES
APS 2 13
HELIUM
NO
10 Other propellant pressure (temperature) off-nominal in same direction?
YES
12 PROBABLE HEAT OR COLD SOAK. CONFIRM WITH MSFN.
NO
11 INSTRUMENTATION FAILURE
13 Propellant pressure decreasing?
YES
14 PROPELLANT LEAK DOWNSTREAM OF CAMPATABILITY EXPLOSIVE VLVS.
NO
15 Propellant temperature & pressure indication off-nominal in same direction?
YES
16 PROBABLE HEAT OR COLD SOAK. CONFIRM WITH MSFN.
NO
17 INSTRUMENTATION FAILURE
18 APS pressurized?
YES
19 Alternative helium-source pressure (temperature) indication off-nominal?
YES
20 Helium pressure decreasing?
NO
YES
APS 2 13
NO
23 Other helium pressure (temperature) source in same tank give normal indication?
YES
22 INSTRUMENTATION FAILURE
NO
24 Helium pressure decreasing?
NO
21 PROBABLE HEAT OR COLD SOAK. CONFIRM WITH MSFN
YES
25 HELIUM TANK LEAK
CAUTION
APS helium tank design limit is 3500 psia, which corresponds to 140 F tank temperature. If this limit is approached, pressurize APS from affected tank(s).
1 If descent source is selected after staging, indicator will peg low.
2 MSFN must monitor all APS/DPS temperatures and pressures for affected indicator.
3 Open transducer results in low indication; shorted transducer, in high indication.
4 Assumption: Both helium tank squib valves have fired.
B-300LM4-596
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
2
ASC PRESS
RED
Light on if:
Pressure in either helium tank is <2775 psia.
Pressure in either fuel or oxid tank is <120 psia
WARNING
Eng must be shut down immediately to prevent possible explosion
1
•Eng STOP pb/lt-push
•ENG THR CONT: ENG ARM sw-OFF
•ABORT STAGE pb-reset
LM staged?
NO
YES
2
•ASC He REG 1 & 2 sw-CLOSE
•PRPLNT TEMP/PRESS MON sw-ASC
MPS: FUEL or OXID PRESS ind-low or decreasing?
YES
3
HELIUM LEAK DOWNSTREAM OF QUAD CHECK VALVES IN AFFECTED LINE
NO
4
MSFN verifies helium manifold pressure low?
YES
5
HELIUM LEAK BETWEEN REG 1 OR 2 SOV & QUAD CHECK VALVES
NO
6
CWEA FAILURE
7
APS pressurized?
NO
YES
8
Monitor helium tank pressure
•HELIUM MON sel-PRESS 1, PRESS 2
•MPS: HELIUM ind-monitor
Either helium tank pressure <2775 psia?
NO
YES
9
Monitor fuel & oxid tank inlet pressure
•PRPLNT TEMP/PRESS MON sw-ASC
MPS: FUEL or OXID PRESS ind < 120 psia & decreasing?
YES
10
PROPELLANT LEAK
NO
11
CWEA FAILURE
WARNING
Helium is leaking. Hazardous condition may exist. System capability is degraded. System may be operable but unsafe.
12
Helium tank pressure will be decreasing
13
•ASC He REG 1 & 2 sw-CLOSE
•HELIUM MON sel-PRESS 1, PRESS 2
•MPS: HELIUM ind-monitor
Either helium tank pressure decreasing?
YES
14
HELIUM LEAK UPSTREAM OF REG 1 OR 2 SOV
NO
15
Monitor fuel & oxid tank inlet pressure
•PRPLNT TEMP/PRESS MON sw-ASC
MPS: FUEL or OXID PRESS ind-decreasing?
YES
16
HELIUM LEAK DOWNSTREAM OF QUAD CHECK VALVES IN AFFECTED LINE
NO
17
HELIUM LEAK BETWEEN REG 1 OR 2 SOV & QUAD CHECK VALVES
CAUTION
Depletion of ascent helium tanks is imminent
18
Monitor helium tank pressure
•HELIUM MON sel-PRESS 1, PRESS 2
•MPS: HELIUM ind-monitor
Either helium tank pressure <2775 psia?
NO
YES
19
Helium tank pressure decreasing?
YES
NO
20
HELIUM TANK LEAK
21
Inhibit faulty system.
•ED: ASC He SEL sw — TANK 1, TANK 2
22
Monitor temp of helium in affected tank
•HELIUM MON sel-TEMP 1 or TEMP 2
MPS: HELIUM ind < 30° F?
NO
YES
20
23
HELIUM PRESSURE XDUCER FAILURE
24
Monitor fuel & oxid tank inlet pressure
•PRPLNT TEMP/PRESS MON sw-ASC
MPS: FUEL or OXID PRESS ind < 120 psia?
NO
25
CWEA FAILURE
YES
26
MSFN verifies normal pressure & temp?
YES
27
COLD SOAK
NO
28
HELIUM LEAK DOWNSTREAM OF COMPATIBILITY EXPLOSIVE VALVES
1 ASC PRESS warn lt is inhibited by stage deadface switch.
2 ASC PRESS warn lt does not indicate low propellant pressure; however, propellant tank ullage pressure can be read on MPS: FUEL & OXID PRESS ind.
3 ASC PRESS warn lt remains on.
A-300LM4-521
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS



(1) If propellant tank pressure drops below ≈135 psia, ASC PRESS warn lt goes on

(2) Possibility exists of approaching maximum design operating pressure if leg with failed–open reg is pressurized and propellant tanks are locked up at greater than normal operating pressure.

(3) ASC HI REG caut lt will not indicate high helium manifold pressure. However, MSFN can monitor redundant helium manifold pressure xducer to provide real-time data on helium manifold status.

(4) Eng will continue to burn in blowdown mode.

(5) Helium reg redundancy is lost.

300LM4-541

SYMPTOM	PROCEDURE	REMARKS

SYMPTOM

(4) (1) ASC QTY — YELLOW

Light on when ≈ 10 seconds of propellant burn time remains.

PROCEDURE

(2) 1 Ascent eng firing? — NO → 8 INSTRUMENTATION FAILURE

CAUTION: Loss of ASC QTY caut lt removes cue to close ascent feed interconnect valves during APS firing

YES →

WARNING: Fuel & oxid ascent feed interconnect valves must be closed before ~~termination of thrusting maneuver~~, to prevent helium ingestion into RCS thrusters

APS →

2 Shut down APS/RCS fuel & oxid interconnect
- RCS: SYS A & B MAIN SOV sw - OPEN
- RCS: SYS A ASC FEED 1 & 2 sw - CLOSE
- RCS: SYS B ASC FEED 1 & 2 sw - CLOSE

YES → 3 Shut down ascent eng
- Eng STOP pb/lt - push
- ENG THR CONT: ENG ARM sw - OFF
- ABORT STAGE pb - reset
- ASC He REG 1 & 2 sw - CLOSE

NO →

4
- Monitor DSKY for ΔV to go

If ΔV is required:
- + X TRANSL pb - push and hold
- Continue burn with RCS thrusters

5
- PRPLNT TEMP/PRESS MON sw - ASC
- MPS: FUEL & OXID PRESS ind - monitor for decrease
- Compare status of fuel & oxid pressure with MSFN

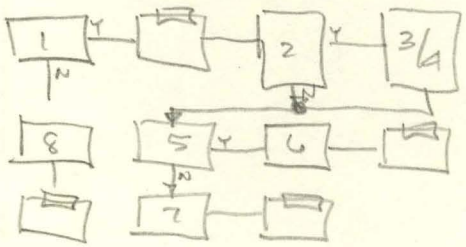
MSFN verifies fuel & oxid quantities normal? — YES → 6 INSTRUMENTATION FAILURE

CAUTION: Loss of ASC QTY caut lt removes cue to close ascent feed interconnect valves during subsequent APS firing

NO →

7 FUEL OR OXID LEAK

CAUTION: Propellant may be leaking into vehicle causing damage to components of other subsystems



REMARKS

(1) Malfunction does not exist if ASC QTY caut lt goes on at nominal time.

(2) ASC QTY caut lt is inhibited when ascent eng is not firing.

(3) MSFN receives same low-level discrete as ASC QTY caut lt. MSFN also has program that computes propellant quantity from low-bit-rate data received on telemetry.

300LM4-542

SYMPTOM	PROCEDURE	REMARKS
5 MPS: PRESS ind pwr fail lt on RED Light on if 28-vdc power to MPS: FUEL & OXID PRESS ind is lost.	(1) 1 Determine status of MPS: FUEL & OXID PRESS ind by checking descent fuel & oxid pressure •PRPLNT TEMP/PRESS MON sw - DES 1 Both pointers on MPS: FUEL & OXID PRESS ind - zero or normal? YES → (2) 2 MPS: PRESS IND PWR FAIL LT FAILED ON NO → (3) 3 LOSS OF POWER TO MPS: FUEL & OXID PRESS IND	(1) DES 1 position of PRPLNT TEMP/PRESS MON sw is used to provide different signal input to determine status of ind. Provided ind has not failed, it will read descent propellant pressures if unstaged; zero, if staged. If ind has failed, pointers will remain in position indicated when power was lost. (2) Ind is operable. There will be no indication if 28 vdc to ind is lost. (3) MSFN will have to monitor propellant pressures.
6 ASC He REG 1 (2) tb - bp	(1) 1 Determine status of primary (secondary) SOV •ASC He REG 1 (or 2) sw - OPEN TB remains bp? NO → (2) 2 HELIUM REG 1 (2) SOV INADVERTENTLY UNLATCHED YES 3 MSFN verifies associated SOV open? YES → (2) 4 TB FAILURE, OR INSTRUMENTATION FAILURE AND INADVERTENT STUCK VALVE NO → (2) 5 HELIUM REG 1 (2) SOV FAILED CLOSED	(1) APS helium reg 1 & 2 SOV's are normally open at all times. (2) Helium reg redundancy is lost.
SYMPTOM	PROCEDURE	REMARKS

A-300LM4-544

5.2.8 REACTION CONTROL SUBSYSTEM

5.2.8.1 General

- The integrity of the RCS is verified before entering the off-nominal condition indicated in the "symptom" column of each RCS malfunction procedure.

5.2.8.2 Assumptions

5.2.8.2.1 RCS Caution Light

- An RCS propellant leak can cause the RCS caut lt to go on, but this will only happen if a leak occurs when the propellant quantity is very low or if the propellant tanks rupture. (The probability of the propellant tanks rupturing is very remote.)

5.2.8.2.2 RCS TCA Warning Light

- A translation maneuver must be completed before any action is taken regarding the RCS TCA warn lt, except if two or more red tb's appear for the same RCS system (A or B). Appearance of the red tb's would indicate that the main SOV's or ascent feed vlvs unlatched or failed closed.
- Crossfeed vlvs are not open.
- Ascent feed vlvs are not open, except during +X-translation.

5.2.8.2.3 Talkback Anomaly

- The status of all tb's is checked and verified before entering the tb anomaly malfunction procedure.

5.2.8.2.4 PQMD Off Nominal

- Temp compensation of the PQMD pressure xducer has considerable time lag. During periods of high propellant use, the PQMD may indicate 5% to 10% low for several minutes.
- The PQMD malfunction procedure is primarily for detection of leaks and xducer failures. It is not applicable to off-nominal performance of the thrusters or digital autopilot.

5.2.8.2.5 Off-Nominal RCS Propellant or Helium Indication

- A helium reg failure is not considered in this malfunction procedure because the RCS: A & B PRESS ind are not sensitive enough to reflect regulated helium pressure changes less than 20 psia. However, the RCS A & B REG warn lt alerts the crew to high and low regulated helium pressure.

RCS

Table 5-15. RCS Procedure Entry Sheet

Symptom	Sym No.	Page No.
RCS caut lt	1	5.2-87
RCS A REG warn lt & RCS B REG warn lt	2	5.2-88
RCS TCA warn lt	3	5.2-89
RCS isolation vlvs, main SOV, crossfeed vlvs, ascent feed vlvs tb anomaly	4	5.2-89
PQMD off-nominal	5	5.2-90

Table 5-15. RCS Procedure Entry Sheet (cont)

Symptom	Sym No.	Page No.
Off-nominal RCS propellant or helium indication	6	5.2-91
RCS: PRESS ind pwr fail lt on	7	5.2-91
RCS: QUANTITY ind pwr fail lt on	8	5.2-91

Table 5-16. RCS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
C/W circuit failure	RCS TCA warn lt	3	5.2-89
CWEA failure	RCS A REG warn lt & RCS B REG warn lt	2	5.2-88
	RCS caut lt	1	5.2-87
Fuel or oxid isolation vlv unlatched	RCS TCA warn lt	3	5.2-89
Helium leak	RCS caut lt	1	5.2-87
Helium p/t sensor failure	PQMD off-nominal	5	5.2-90
Instrumentation failure	RCS caut lt	1	5.2-87
Jet failed off	RCS TCA warn lt	3	5.2-89
Jet failed on	RCS TCA warn lt	3	5.2-89
Leak in lines downstream of thruster pair isolation vlvs or failed-open TCA vlv	PQMD off-nominal	5	5.2-90
Measurement indicating abnormality has instrumentation failure	Off-nominal RCS propellant or helium indication	6	5.2-91
Power to RCS: A & B PRESS ind is lost	RCS: PRESS ind pwr fail lt on	7	5.2-91
Power to RCS: A & B QUANTITY ind is lost	RCS: QUANTITY ind pwr fail lt on	8	5.2-91
PQMD failed in affected sys	PQMD off-nominal	5	5.2-90
Propellant leak upstream of main SOV vlvs or helium tank leak	PQMD off-nominal	5	5.2-90
Propellant manifold leak in affected sys	PQMD off-nominal	5	5.2-90
RCS: A & B QUANTITY ind pwr fail lt failed on	RCS: QUANTITY ind pwr fail lt on	8	5.2-91

Table 5-16. RCS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
RCS sys A (B) reg failed closed	RCS A REG warn lt & RCS B REG warn lt	2	5.2-88
RCS sys A (B) reg failed high (dual reg in one sys)	RCS A REG warn lt & RCS B REG warn lt	2	5.2-88
RCS: A (B) TEMP or PRESS ind failure or RCS: TEMP/PRESS MON sel failure	Off-nominal RCS propellant or helium indication	6	5.2-91
RCS: PRESS ind pwr fail lt failed on	RCS: PRESS ind pwr fail lt on	7	5.2-91
Reg outlet pressure xducer or instrumentation failure	RCS A REG warn lt & RCS B REG warn lt	2	5.2-88
Sys A (B) fuel or oxid main SOV or sys A (B) ASC feed fuel or oxid vlv hard fail close	RCS TCA warn lt	3	5.2-89
Sys A (B) fuel or oxid main SOV or sys A (B) ASC feed fuel or oxid vlv unlatched	RCS TCA warn lt	3	5.2-89
Tb failure	RCS isolation vlvs, main SOV, cross-feed vlvs, ascent feed vlvs tb anomaly	4	5.2-89
Vlv unlatched	RCS isolation vlvs, main SOV, cross-feed vlvs, ascent feed vlvs tb anomaly	4	5.2-89

SYMPTOM	PROCEDURE	REMARKS

1

RCS

YELLOW

Light on if helium tank pressure (sys A or B) ≤ 1,700 psia.

(1) 1 Monitor helium tank pressure for affected sys

RCS: A or B PRESS ind ≤ 1,700 psia?

NO → (2) 2 CWEA FAILURE

YES

3 RCS quantity abnormally low?

NO → (3) 4 INSTRUMENTATION FAILURE

YES

(4) 5 HELIUM LEAK

6 Helium explosive vlvs blown?

YES → 7 Shut down failed sys when ~~helium pressure drops to 500 psia or~~ propellant pressure drops to 140 psia.

- RCS: CRSFD sw – OPEN
- RCS: SYS A or B MAIN SOV sw – CLOSE

NO

CAUTION

Do not pressurize unless leakage rate is low enough to permit use of affected sys (A or B)

8 If decision is not to pressurize

- RCS: CRSFD sw – OPEN
- RCS: SYS A or B MAIN SOV sw – CLOSE

(1) If RCS TEMP/PRESS MON sel is set to He, RCS caut lt goes off

(2) RCS caut lt cannot be reset. Helium tank pressure should be monitored frequently on RCS: A or B PRESS ind

(3) For subsequent burns:
a. Propellant quantity remaining in sys A & B, as indicated on QUANTITY ind, should be approximately the same for both sys.
b. RCS: TEMP/PRESS MON sel - He
c. Sys A & B helium pressures, as indicated on PRESS ind, should be approximately same for both sys.

(4) Sys redundancy is lost when pressure of affected helium tank drops to between 400 and 500 psia.

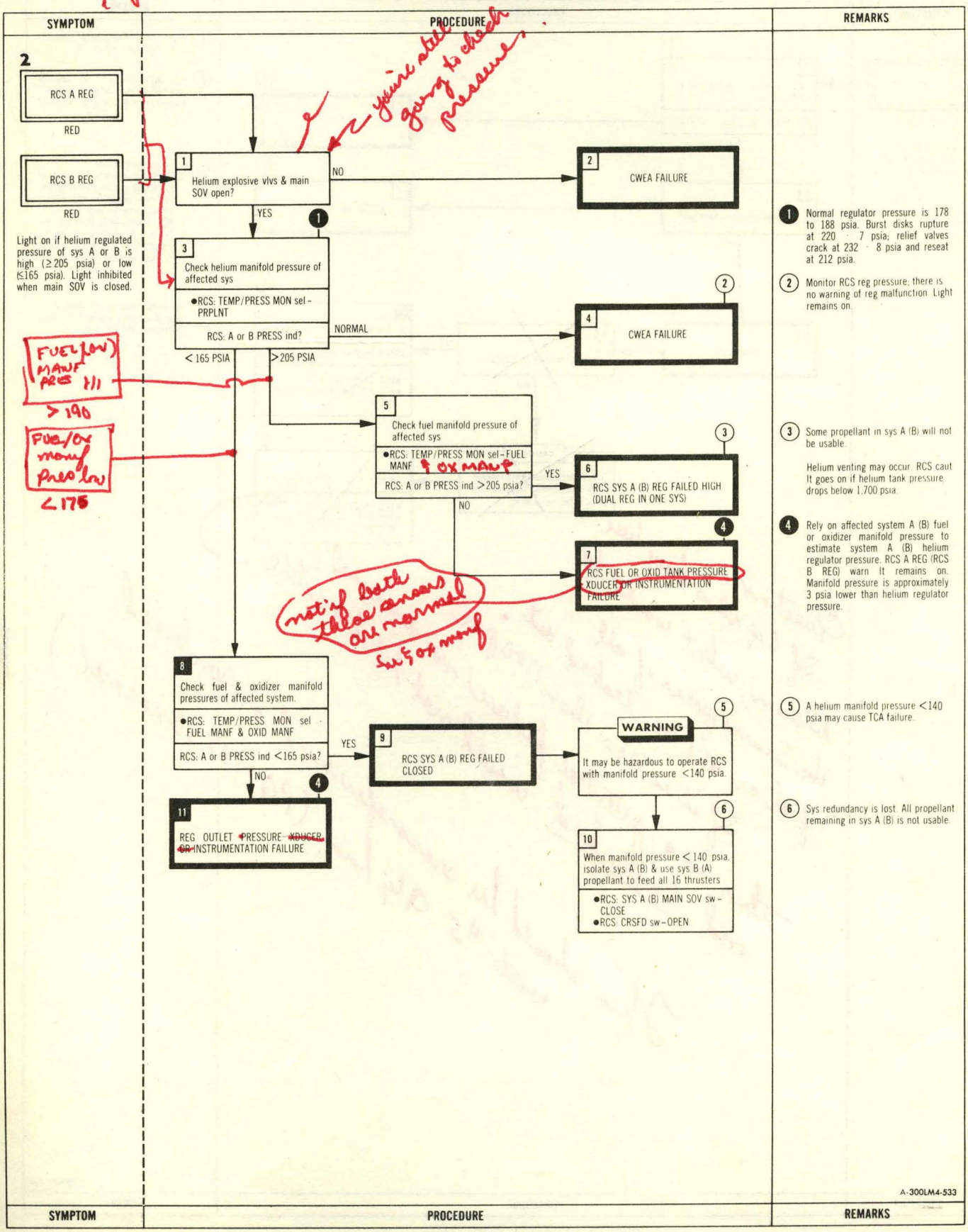
Question – If Exp valve blown, what would be He Source press if all fuel or all ox leaked out? If it is less than 1700 psi thus is a potential failure (not discussed) and Crossfeed would not be desirable

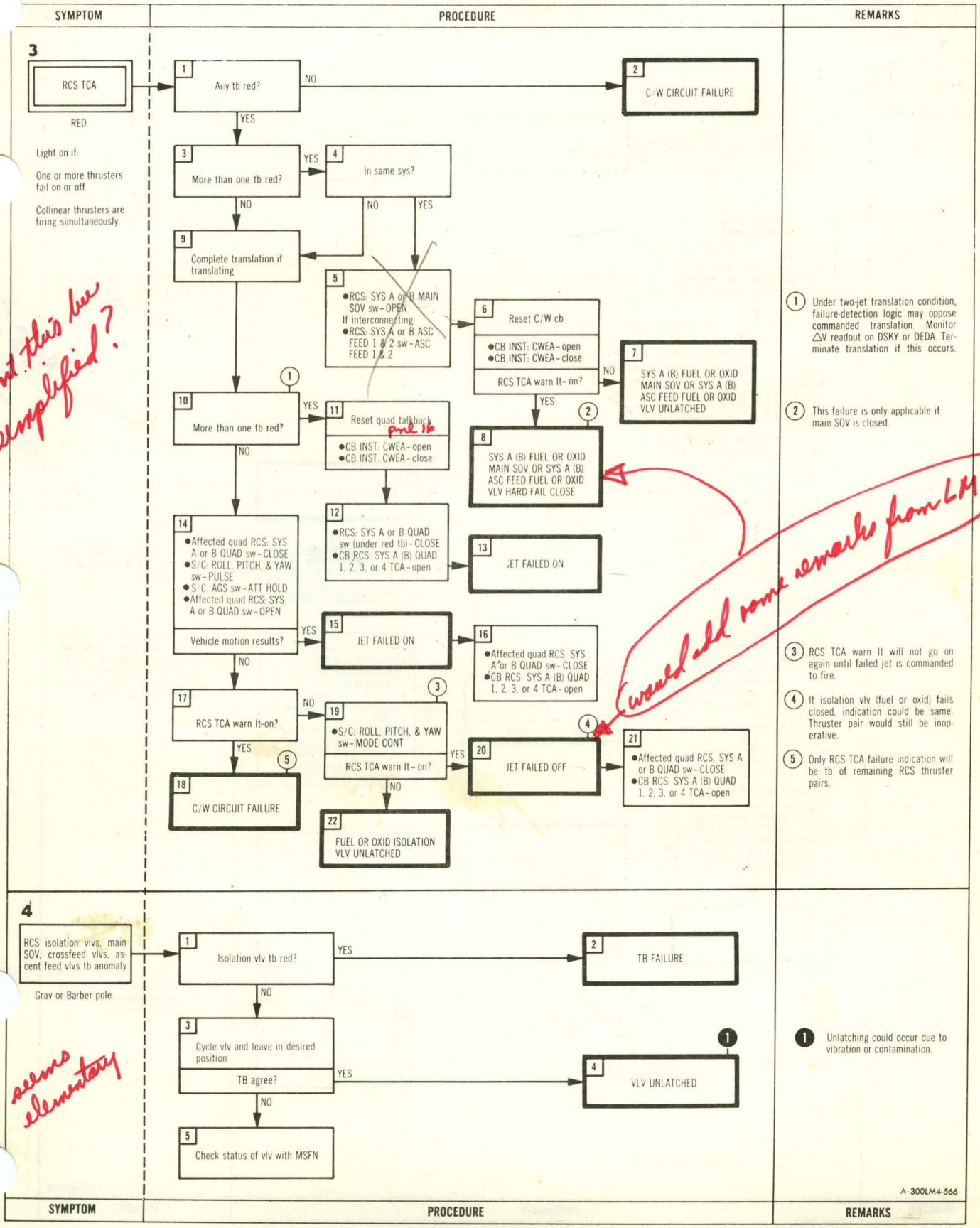
This should be crossfeed or combined with #5 Qty low. (PQM D abnormal)

A-300LM4-532

RCS

SYMPTOM | PROCEDURE | REMARKS


SYMPTOM
PROCEDURE
REMARKS
2
RCS A REG
RED
RCS B REG
RED
Light on if helium regulated pressure of sys A or B is high (≥205 psia) or low (≤165 psia). Light inhibited when main SOV is closed.
1 Helium explosive vlvs & main SOV open?
NO
2 CWEA FAILURE
YES
1
3 Check helium manifold pressure of affected sys
•RCS: TEMP/PRESS MON sel - PRPLNT
RCS: A or B PRESS ind?
NORMAL
2
4 CWEA FAILURE
< 165 PSIA
>205 PSIA
5 Check fuel manifold pressure of affected sys
•RCS: TEMP/PRESS MON sel - FUEL MANF
RCS: A or B PRESS ind >205 psia?
YES
3
6 RCS SYS A (B) REG FAILED HIGH (DUAL REG IN ONE SYS)
NO
4
7 RCS FUEL OR OXID TANK PRESSURE XDUCER OR INSTRUMENTATION FAILURE
8 Check fuel & oxidizer manifold pressures of affected system.
•RCS: TEMP/PRESS MON sel - FUEL MANF & OXID MANF
RCS: A or B PRESS ind <165 psia?
YES
9 RCS SYS A (B) REG FAILED CLOSED
5
WARNING
It may be hazardous to operate RCS with manifold pressure <140 psia.
NO
4
11 REG OUTLET PRESSURE XDUCER OR INSTRUMENTATION FAILURE
6
10 When manifold pressure < 140 psia, isolate sys A (B) & use sys B (A) propellant to feed all 16 thrusters
•RCS: SYS A (B) MAIN SOV sw - CLOSE
•RCS: CRSFD sw - OPEN
1 Normal regulator pressure is 178 to 188 psia. Burst disks rupture at 220 ± 7 psia; relief valves crack at 232 ± 8 psia and reseat at 212 psia.
2 Monitor RCS reg pressure; there is no warning of reg malfunction. Light remains on.
3 Some propellant in sys A (B) will not be usable.
Helium venting may occur. RCS caut lt goes on if helium tank pressure drops below 1,700 psia.
4 Rely on affected system A (B) fuel or oxidizer manifold pressure to estimate system A (B) helium regulator pressure. RCS A REG (RCS B REG) warn lt remains on. Manifold pressure is approximately 3 psia lower than helium regulator pressure.
5 A helium manifold pressure <140 psia may cause TCA failure.
6 Sys redundancy is lost. All propellant remaining in sys A (B) is not usable.
A-300LM4-533
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
3
RCS TCA
RED
Light on if:
One or more thrusters fail on or off.
Collinear thrusters are firing simultaneously.
1 Any tb red?
NO
2 C/W CIRCUIT FAILURE
YES
3 More than one tb red?
YES
4 In same sys?
NO
NO
YES
9 Complete translation if translating
5 ●RCS: SYS A or B MAIN SOV sw - OPEN
If interconnecting:
●RCS: SYS A or B ASC FEED 1 & 2 sw - ASC FEED 1 & 2
6 Reset C/W cb
●CB INST: CWEA - open
●CB INST: CWEA - close
RCS TCA warn lt - on?
NO
7 SYS A (B) FUEL OR OXID MAIN SOV OR SYS A (B) ASC FEED FUEL OR OXID VLV UNLATCHED
YES
2
8 SYS A (B) FUEL OR OXID MAIN SOV OR SYS A (B) ASC FEED FUEL OR OXID VLV HARD FAIL CLOSE
1
10 More than one tb red?
YES
11 Reset quad talkback
●CB INST: CWEA - open
●CB INST: CWEA - close
NO
12 ●RCS: SYS A or B QUAD sw (under red tb) - CLOSE
●CB RCS: SYS A (B) QUAD 1, 2, 3, or 4 TCA - open
13 JET FAILED ON
14 ●Affected quad RCS: SYS A or B QUAD sw - CLOSE
●S/C: ROLL, PITCH, & YAW sw - PULSE
●S/C: AGS sw - ATT HOLD
●Affected quad RCS: SYS A or B QUAD sw - OPEN
Vehicle motion results?
YES
15 JET FAILED ON
16 ●Affected quad RCS: SYS A or B QUAD sw - CLOSE
●CB RCS: SYS A (B) QUAD 1, 2, 3, or 4 TCA - open
NO
17 RCS TCA warn lt-on?
NO
3
19 ●S/C: ROLL, PITCH, & YAW sw - MODE CONT
RCS TCA warn lt - on?
YES
20 JET FAILED OFF
4
21 ●Affected quad RCS: SYS A or B QUAD sw - CLOSE
●CB RCS: SYS A (B) QUAD 1, 2, 3, or 4 TCA - open
YES
5
18 C/W CIRCUIT FAILURE
NO
22 FUEL OR OXID ISOLATION VLV UNLATCHED
1 Under two-jet translation condition, failure-detection logic may oppose commanded translation. Monitor ΔV readout on DSKY or DEDA. Terminate translation if this occurs.
2 This failure is only applicable if main SOV is closed.
3 RCS TCA warn lt will not go on again until failed jet is commanded to fire.
4 If isolation vlv (fuel or oxid) fails closed, indication could be same. Thruster pair would still be inoperative.
5 Only RCS TCA failure indication will be tb of remaining RCS thruster pairs.
4
RCS isolation vlvs, main SOV, crossfeed vlvs, ascent feed vlvs tb anomaly
Grav or Barber pole
1 Isolation vlv tb red?
YES
2 TB FAILURE
NO
3 Cycle vlv and leave in desired position
TB agree?
YES
1
4 VLV UNLATCHED
NO
5 Check status of vlv with MSFN
1 Unlatching could occur due to vibration or contamination.
A-300LM4-566
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS

5

PQMD off-nominal

1 Check helium tank pressure of sys showing low quantity
- ●RCS: TEMP/PRESS MON sel – He
- ●RCS: A or B PRESS ind – monitor

Helium tank pressure?

NORMAL → **2** PQMD FAILED IN AFFECTED SYS (1) → **3** ●Check with MSFN whether ind or xducer failed (2)

LOW →

WARNING
If, during burn, RCS A (B) PQMD approaches 19%, close isolation vlvs and main SOV in affected sys to prevent possibility of injection.

4 Close RCS: QUAD switches of affected sys individually & monitor pressures.
- ●CB RCS SYS A or B: QUAD 4, 3, 2, 1 TCA – open
- ●RCS: SYS A or B QUAD 1, 2, 3, 4 sw – CLOSE; tb – bp
- ●RCS: SYS A or B MAIN SOV sw – CLOSE; tb – bp
- ●RCS: A or B PRESS ind – note helium tank pressure for subsequent use in diagnostic procedure
- ●RCS: TEMP/PRESS MON sel – FUEL MANF
- ●RCS: A or B PRESS ind – monitor pressure of manifold associated with low propellant quantity

Propellant manifold pressure?

< 170 PSIA → **5** PROPELLANT MANIFOLD LEAK IN AFFECTED SYS (3)
- **CAUTION**: RCS: CRSFD sw must remain in CLOSE position to avoid loss of propellant from good system.

≥ 170 PSIA (4) →

6 Open RCS: QUAD switches of affected sys individually & monitor manifold pressures
- ●RCS: SYS A or B QUAD 1 sw – OPEN; tb – gray
- ●RCS: TEMP/PRESS MON sel – FUEL MANF & OXID MANF
- ●RCS: A or B PRESS ind – monitor
- ●Repeat above sequence for RCS: SYS A or B QUAD 2, 3, & 4 sw

Propellant manifold pressure drops to vapor pressure?

YES → **7** LEAK IN LINES DOWNSTREAM OF THRUSTER PAIR ISOLATION VLVS OR FAILED – OPEN TCA VLV
- **8** ●RCS: SYS A or B QUAD sw (associated with leak, last one opened) – CLOSE
- ●RCS: SYS A or B QUAD sw (remaining switches in failed sys) – OPEN
- ●RCS: SYS A or B MAIN SOV sw – OPEN; tb – gray
- ●CB RCS SYS A or B: QUAD 1, 2, 3, or 4 TCA (all cb's, except cb for failed quad TCA) – close

NO →

9 Monitor helium tank pressure
- ●RCS: TEMP/PRESS MON sel – He
- ●RCS: A or B PRESS ind – monitor

Any pressure decay from helium tank pressure noted in step 4?

YES → **10** PROPELLANT LEAK UPSTREAM OF MAIN SOV VLVS OR HELIUM TANK LEAK → **11** Reconfigure affected system
- ●RCS: SYS A or B MAIN SOV sw – OPEN; tb – gray
- ●CB RCS SYS A or B: QUAD 4, 3, 2, 1 TCA – close

(5) → **12**
- ●When He pressure decreases to 500 psia or propellant pressure decreases to 140 psia, shutdown main sov of affected system.
- ●RCS CRSFD sw – OPEN

NO →

13 HELIUM P/T SENSOR FAILURE

(1) For subsequent burns, monitor RCS: PRESS & QUANTITY ind & determine quantity of propellant remaining in affected sys as follows:
- ●Compare helium tank pressure readings for both sys. Readings should be approximately equal.
- ●Note quantity of propellant remaining in good sys. Reading represents quantity of propellant remaining in affected sys.

(2) If QUANTITY ind failed internally, MSFN can give indication of quantity remaining for affected system. If PQMD failed, MSFN will not be able to provide indication of quantity.

(3) Use this propellant as last alternative.

PGNCS capability to translate in + Z, — Z, or — Y directions is lost if RCS system A is isolated via QUAD switches.

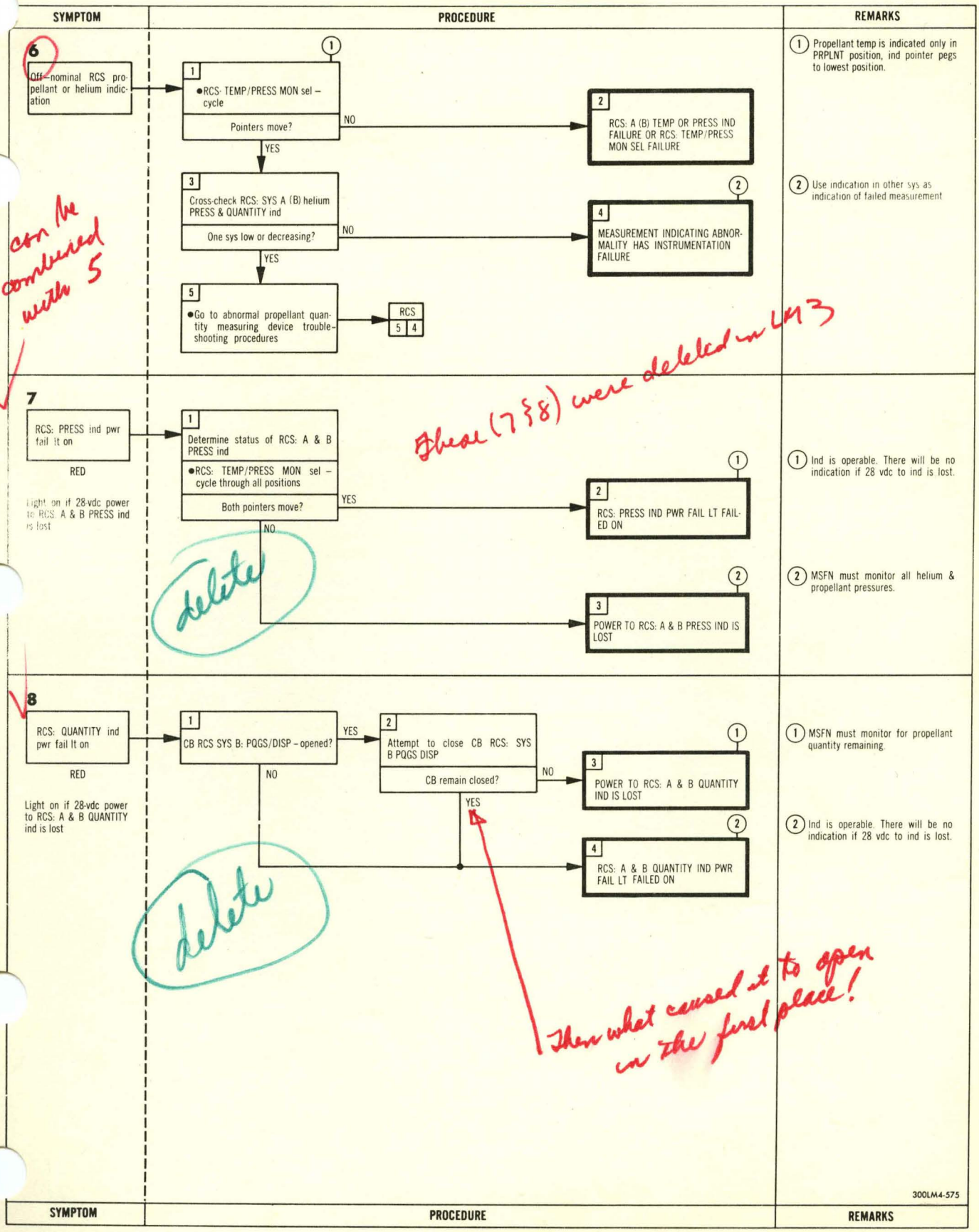
PGNCS capability to translate in + Z, — Z, or + Y directions is lost if RCS system B is isolated via QUAD switches.

(4) Vapor pressure of fuel and oxidizer is a function of their temperature. If fuel manifold pressure reading is < 5 psia and/or oxidizer manifold pressure reading < 30 psia, vapor pressure is displayed.

(5) With MSFN coordination, it may be possible to use any amount of RCS residual in leaking sys.

B-300LM4-576

SYMPTOM	PROCEDURE	REMARKS


SYMPTOM
PROCEDURE
REMARKS
6
Off-nominal RCS propellant or helium indication
1
•RCS: TEMP/PRESS MON sel – cycle
Pointers move?
NO
YES
2
RCS: A (B) TEMP OR PRESS IND FAILURE OR RCS: TEMP/PRESS MON SEL FAILURE
3
Cross-check RCS: SYS A (B) helium PRESS & QUANTITY ind
One sys low or decreasing?
NO
YES
4
MEASUREMENT INDICATING ABNORMALITY HAS INSTRUMENTATION FAILURE
5
•Go to abnormal propellant quantity measuring device trouble-shooting procedures
RCS 5 4
(1) Propellant temp is indicated only in PRPLNT position, ind pointer pegs to lowest position.
(2) Use indication in other sys as indication of failed measurement
can be combined with 5
7
RCS: PRESS ind pwr fail lt on
RED
Light on if 28-vdc power to RCS: A & B PRESS ind is lost
1
Determine status of RCS: A & B PRESS ind
•RCS: TEMP/PRESS MON sel – cycle through all positions
Both pointers move?
YES
NO
2
RCS: PRESS IND PWR FAIL LT FAILED ON
3
POWER TO RCS: A & B PRESS IND IS LOST
delete
These (7 & 8) were deleted in LM 3
(1) Ind is operable. There will be no indication if 28 vdc to ind is lost.
(2) MSFN must monitor all helium & propellant pressures.
8
RCS: QUANTITY ind pwr fail lt on
RED
Light on if 28-vdc power to RCS: A & B QUANTITY ind is lost
1
CB RCS SYS B: PQGS/DISP – opened?
YES
NO
2
Attempt to close CB RCS: SYS B PQGS DISP
CB remain closed?
NO
YES
3
POWER TO RCS: A & B QUANTITY IND IS LOST
4
RCS: A & B QUANTITY IND PWR FAIL LT FAILED ON
delete
Then what caused it to open in the first place!
(1) MSFN must monitor for propellant quantity remaining.
(2) Ind is operable. There will be no indication if 28 vdc to ind is lost.
300LM4-575
SYMPTOM
PROCEDURE
REMARKS

RCS

5.2.9 ELECTRICAL POWER SUBSYSTEM

5.2.9.1 Assumptions

- Troubleshooting will be performed when mission phase and task loading permit. Accordingly, certain malfunction procedures will not be performed until a main engine burn or critical maneuver is completed.
- Malfunction procedures are entered from normal operational modes. Procedures for checkout modes are not included.
- Inverter No. 2 is on line.
- No a-c circuit breaker opened before entering these procedures.
- These malfunction procedures make no distinction as to whether a d-c circuit breaker opened or was initially open.
- In the case of loss of bus, recovery procedures for equipment other than EPS are not included (except for certain critical ECS recovery procedures indicated in symptoms 1 and 2 and for a recovery procedure for regaining EL lighting in symptom 4).
- Symptoms 1 and 2 assume that one or both CB EPS: CROSS TIE BAL LOAD opened.
- A partial short as referred to in these procedures: (1) Affects either CDR or SE bus in such a way as to cause the bus voltage to drop below 26.5 volts; (2) Does not draw current of sufficient magnitude to actuate the associated ECA overcurrent relay (150 to 200 amps per ECA).

Table 5-17. EPS Procedure Entry Sheet

Symptom	Sym No.	Page No.
DC BUS warn lt (UNSTAGED)	1	5.2-96
DC BUS warn lt (STAGED)	2	5.2-98
C/W PWR caut lt (UNSTAGED)	3	5.2-100
DC BUS FAULT comp caut lt	3a	5.2-100
EPS tb - bp	3b	5.2-100
Flood lights lost if on	3c	5.2-100
EL lighting lost if EPS: INVERTER sw - 2	3d	5.2-100
C/W PWR caut lt (STAGED)	4	5.2-101
All EPS tb - bp	4a	5.2-101
Flood lights lost if on	4b	5.2-101
EL lighting lost if EPS: INVERTER sw - 2	4c	5.2-101
BATTERY caut lt (UNSTAGED)	5	5.2-102
BATTERY caut lt (STAGED)	6	5.2-103
INVERTER caut lt	7	5.2-104
Cannot turn descent battery off low tap (UNSTAGED)	8	5.2-105

EPS

Table 5-18. EPS Failure/Symptom Cross-Reference Index

Failure	Symptom	Symp No.	Page No.
A-c bus A short (bus lost, including EPS a-c instrumentation)	INVERTER cault lt	7	5.2-104
A-c bus B short	INVERTER caut lt	7	5.2-104
Bat lost due to reverse current	DC BUS warn lt (UNSTAGED)	1	5.2-96
Bat main fed contactor inadvertently opened	C/W PWR caut lt (STAGED)	4	5.2-101
Bat overtemperature	BATTERY caut lt (UNSTAGED)	5	5.2-102
	C/W PWR caut lt (STAGED)	4	5.2-101
Battery is lost because of short between battery & ECA	BATTERY caut lt (UNSTAGED)	5	5.2-102
Battery is lost due to ECA failure	BATTERY caut lt (UNSTAGED)	5	5.2-102
Bat 6 (5) overtemperature	DC BUS warn lt (STAGED)	2	5.2-98
Bat 1 short (bat lost)	C/W PWR caut lt (UNSTAGED)	3	5.2-100
Bat 2 short (bat lost)	C/W PWR caut lt (UNSTAGED)	3	5.2-100
Bus short	C/W PWR caut lt (STAGED)	4	5.2-101
	DC BUS warn lt (UNSTAGED)	1	5.2-96
CDR bus short	DC BUS warn lt (STAGED)	2	5.2-98
CDR(SE) bus partial short	DC BUS warn lt (STAGED)	2	5.2-98
	DC BUS warn lt (UNSTAGED)	1	5.2-96
CDR (SE) bus voltage signal conditioner failed	DC BUS warn lt (UNSTAGED)	1	5.2-96
CDR (SE) signal conditioner failure	DC BUS warn lt (STAGED)	2	5.2-98
CWEA failure	BATTERY caut lt (STAGED)	6	5.2-103
	BATTERY caut lt (UNSTAGED)	5	5.2-102
	DC BUS warn lt (STAGED)	1	5.2-96
	DC BUS warn lt (UNSTAGED)	2	5.2-98
CWEA or instrument failure	INVERTER caut lt	7	5.2-104
EPS: INVERTER sw failed open in all positions (a-c power is lost)	INVERTER caut lt	7	5.2-104
Fault between ECA 3 & bat 5	C/W PWR caut lt (STAGED)	4	5.2-101
Faulty battery low volt switch failed on	Cannot turn descent battery off low tap	8	5.2-105
Feeder short between ECA & bus	C/W PWR caut lt (STAGED)	4	5.2-101
	DC BUS warn lt (STAGED)	2	5.2-98
Feeder short between DFR & bus (bat 3 & 4 lost)	DC BUS warn lt (UNSTAGED)	1	5.2-96

Table 5-18. EPS Failure/Symptom Cross-Reference Index (cont.)

Failure	Symptom	Symp No.	Page No.
Inadvertent actuation of ECA over-current relay	BATTERY caut lt (UNSTAGED)	5	5.2-102
Instrumentation failure	INVERTER caut lt	7	5.2-104
Inverter 2 failure	INVERTER caut lt	7	5.2-104
Open circuit between bat & ECA	C/W PWR caut lt (STAGED)	4	5.2-101
Open circuit between ECA & bus	C/W PWR caut lt (STAGED)	4	5.2-101
Open circuit between switch & reset coil	Cannot turn descent battery off low tap	8	5.2-105
Overcurrent contact closed without coil action	DC BUS warn lt (STAGED)	2	5.2-98
Overtemperature or false ECA indication	BATTERY caut lt (STAGED)	6	5.2-103
Partial short between DFR & bus	DC BUS warn lt (UNSTAGED)	1	5.2-96
Partial short between ECA & DFR	DC BUS warn lt (UNSTAGED)	1	5.2-96
Reverse current	BATTERY caut lt (STAGED)	6	5.2-103
	BATTERY caut lt (UNSTAGED)	5	5.2-102
	C/W PWR caut lt (STAGED)	4	5.2-101
SE bus short	C/W PWR caut lt (UNSTAGED)	3	5.2-100
Short between bat & current-sensing coil, or bat expended	DC BUS warn lt (STAGED)	2	5.2-98
Short between current-monitoring coil & main contact	DC BUS warn lt (STAGED)	2	5.2-98
Short between deadface & bus (Bat 1 & 2 lost)	C/W PWR caut lt (UNSTAGED)	3	5.2-100
Short between ECA & bat 6	DC BUS warn lt (STAGED)	2	5.2-98
Short between ECA & deadface (bat 1 & 2 lost)	C/W PWR caut lt (UNSTAGED)	3	5.2-100
Short between ECA & DFR (bat 3 & 4 lost)	DC BUS warn lt (UNSTAGED)	1	5.2-96
Short between main contact & bus	DC BUS warn lt (STAGED)	2	5.2-98
Short between switch & reset coil	Cannot turn descent battery off low tap	8	5.2-105
Shorted bat 4 (3)	DC BUS warn lt (UNSTAGED)	1	5.2-96
Short on feeder line from inverter 2 to buses A & B causing loss of inverter	INVERTER caut lt	7	5.2-104
Short on inverter 1 path (loss of inverter)	INVERTER caut lt	7	5.2-104

EPS

SYMPTOM	PROCEDURE	REMARKS

Sheet 1 of 2

1 UNSTAGED

DC BUS

RED

Light on if either or both buses < 26.5 volts.

1 BATTERY caut lt on?

YES → 2 EPS: DC BUS FAULT comp caut lt - on?

YES → 3 CDR bus power failure

NO → 12 •EPS: POWER/TEMP MON sel - rotate thru BAT positions; EPS: BAT FAULT comp caut lt - on

NO → 15 •EPS: POWER/TEMP MON sel - CDR BUS, then SE BUS; •EPS: VOLTS ind - read; CDR (SE) bus voltage low?

YES → 13 LOSS OF BATTERY DUE TO REVERSE CURRENT → 14 •Faulty battery HI VOLT sw - OFF/RESET until BATTERY caut lt - off; tb - bp; •CB EPS: CROSS TIE BAL LOADS (2) - close

NO → 16 CWEA FAILURE

Vbat 3 ≈ Vbat 4 ≥ 28 VDC
(Vbat 1 ≈ Vbat 2 ≥ 28 VDC)
CURRENT NORMAL

17 •EPS: POWER/TEMP MON sel - BAT 4; Then 3 (BAT 2, then 1)

Vbat 3 ≈ Vbat 4 < 28 VDC
(Vbat 1 ≈ Vbat 2 < 28 VDC)
CURRENT NOT NORMAL

→ 18 CDR (SE) BUS VOLTAGE SIGNAL CONDITIONER FAILED

WARNING
Crew can be asphyxiated in 1 to 3 minutes if suit flow stops when crew is fully suited.

•SUIT FAN sel - 2

4 EPS: CDR BAT 3 & 4 tb?

BAT 3 (4) tb - bp → 5 SHORTED BAT 4 (3)

BOTH tb - bp

CAUTION
Before repowering bus, remove these loads:
•CB PGNS: IMU OPR - open
•CB PGNS: LGC/DSKY - open

6 Recover good bat & remove failed bat from line.

•EPS: CDR BAT 4 (3) HI VOLT sw - OFF/RESET; tb - bp
•EPS: DC BUS FAULT comp caut lt - off
•EPS: CDR BAT 3 (4) HI VOLT sw - OFF/RESET, then ON; tb - gray
•DC BUS warn lt - off
•BATTERY caut lt - off
•CB EPS: CROSS TIE BAL LOADS (2) - close

19 •CB EPS: BAT FEED TIE (2) - open; Bat 3 & 4 (1 & 2) EPS: VOLTS & AMPS ind?

CURRENT > 0

CURRENT = 0
VOLTAGE ≥ 28 VOLTS

20 CDR (SE) BUS PARTIAL SHORT

21 •EPS: CDR (SE) BAT 3 & 4 (1 & 2) HI VOLT sw - OFF/RESET; tb - bp
•EPS: BAT 6 (5) BACK UP SE (CDR) FEED sw - ON; tb - gray

22 Apply ascent battery power to good bus.

•EPS: BAT 5 (6) NORMAL SE (CDR) FEED sw - ON; tb - gray
•Pnl 16 CB EPS: ASC ECA CONT - close
•EPS: DES BATS sw - DEADFACE; tb - bp

EPS: VOTS & AMPS ind?

CURRENT = 0
VOLTAGE ≥ 28 VOLTS → 25 (SHEET 2)

CURRENT > 0 → 23 (SHEET 2)

7 •Open all pnl 11 d-c cb's, except:
CB EPS:
BAT FEED TIE (2) - close
XLUNAR BUS TIE - close
DC BUS VOLT - close
•Pnl 11 CB EPS: BAT FEED TIE (2) - open

EPS: DC BUS FAULT comp caut lt - on?

YES → 8 CDR BUS SHORT → 9 •EPS: CDR BAT 3 & 4 HI VOLT sw - OFF/RESET; tb - bp; •EPS: BAT 6 BACK UP SE FEED sw - ON; tb - gray

NO → 11 •Pnl 11 CB EPS: BAT FEED TIE (2) - close; •EPS: BAT 5 NORMAL SE FEED sw - ON; tb - gray; •Pnl 16 CB EPS: ASC ECA CONT - close; •EPS: DES BATS sw - DEADFACE; tb - bp

EPS: DC BUS FAULT comp caut lt - on?

NO → 27 (SHEET 2)

YES → 33 (SHEET 2)

9 10 •WATER TANK SELECT vlv - SEC; •GLYCOL sel - INST (SEC); •CB ECS: GLYCOL PUMP SEC - close; •SEC EVAP FLOW vlv - OPEN; •Reconfigure electrical load for secondary glycol loop operation per normal procedure.

EPS SSR-1 BUS FUNCTIONS LOST

REMARKS

1 Assumption: One or both CB EPS: CROSS TIE BAL LOADS have opened, except for CWEA or CDR (SE) signal conditioner failure. (See steps 16 and 18.)

2 Due to lack of grounding, spurious readings will be observed on ammeter when monitoring bus voltage.

3 CDR bus functions lost.
COMM:
CDR AUDIO
UP DATA LINK
ECS:
CABIN FAN 1
GLYCOL PUMP AUTO TRNFR
GLYCOL PUMP 1
GLYCOL PUMP 2
SUIT FAN 1
ED:
LDG GEAR FLAG
FLT DISP:
COAS
GASTA
MSN TMR
ORDEAL
RNG/RNG RT
THRUST
HTR:
AOT
DOCK WINDOW
LDG RDR
RNDZ RDR
INST:
SIG CONDR 1
PGNS:
IMU
LDG RDR
LGC/DSKY
RNDZ RDR
SIG STR DISP
PROPUL:
DES He REG/VENT
S/C:
ATCA (PGNS)
ATT DIR CONT
DECA PWR
ENG CONT
ENG START OVRD

4 Assumption: DC BUS FAULT comp caut lt remains on when pnl 11 d-c load cb's are opened.

5 If EPS: CDR BAT 3 tb - bp when overcurrent kicks bat 3 off line, bat 3 is good, but overcurrent results from feeding shorted bat 4. If EPS: CDR BAT 4 tb - bp, condition is reversed.

6 If reverse - current relay in ECA is tripped, faulty battery HI VOLT sw must be held in OFF/RESET position for 1.5 to 4 seconds to reset relay.

7 CB EPS: CROSS TIE BAL LOADS may open depending upon bus load and battery condition. If this CB opens, then CB EPS: CROSS TIE BUS (2) should be closed.

8 DC BUS warn lt remains on. Low bus voltage C & W monitoring is lost.

9 Primary glycol is inoperative. Only secondary glycol loop is operational.

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LM 3 did not consider "partial shorts" of this nature

Question: how can you have a "partial short" as in 23 & 25? Batts, yes, but wiring?

why repeat?

FAILURE	PROCEDURE	REMARKS
Sheet 2 of 2 **1 UNSTAGED** DC BUS warn lt (cont)		
23 PARTIAL SHORT BETWEEN ECA AND DFR	BAT 1 & 2 LOST → 24 ●EPS: SE BAT 1 & 2 HI VOLT sw - OFF/RESET; tb - bp → EPS 3 9 BAT 3 & 4 LOST → 28	
25 PARTIAL SHORT BETWEEN DFR AND BUS	BAT 1 & 2 LOST → 26 ●EPS: SE BAT 1 & 2 HI VOLT sw - OFF/RESET; tb - bp → EPS 3 19 BAT 3 & 4 LOST → 34	
27 SHORT BETWEEN ECA & DFR (BAT 3 & 4 LOST)	28 ●EPS: CDR BAT 3 & 4 HI VOLT sw - OFF/RESET; tb - bp → 29 Repower bus as required: DES & ASC BATS → 30 To power both buses from descent and ascent bats: ●Pnl 11 CB EPS: BAT FEED TIE (2) - open; ●CB EPS: CROSS TIE BUS (2) - close; ●EPS: DES BATS sw - CONNECT; tb - gray; ●EPS: BAT 6 BACK UP SE FEED sw - ON; tb - gray; ●EPS: BAT 5 NORMAL SE FEED sw - OFF/RESET; tb - bp ASC BATS → 31 To power both buses from ascent bats only: ●EPS: BAT 6 NORMAL CDR FEED sw - ON; tb - gray; ●CB EPS: CROSS TIE BAL LOADS (2) - close 30 & 31 → 32 ●Close pnl 11 d-c cb's, as required, to activate subsystems.	
33 FEEDER SHORT BETWEEN DFR & BUS (BAT 3 & 4 LOST)	34 ●EPS: CDR BAT 3 & 4 HI VOLT sw - OFF/RESET; tb - bp → 35 Repower bus as required: DES & ASC BATS → 36 To power both buses from descent and ascent bats: ●Pnl 11 CB EPS: BAT FEED TIE (2) - open; ●CB EPS: CROSS TIE BUS (2) - close; ●EPS: DES BATS sw - CONNECT; tb - gray; ●EPS: BAT 6 BACK UP SE FEED sw - ON; tb - gray; ●EPS: BAT 5 NORMAL SE FEED sw - OFF/RESET; tb - bp ASC BATS → 37 (10) To power both buses from ascent bats only: ●Pnl 11 CB EPS: BAT FEED TIE (2) - open; ●EPS: BAT 6 BACK UP SE FEED sw - ON; tb - gray; ●CB EPS: CROSS TIE BUS (2) - close 36 & 37 → 38 ●Close pnl 11 d-c cb's, as required, to activate subsystems.	(10) In case of short between DFR and bus on CDR side, powering LM d-c system with ascent batteries only would place both batteries on short circuit. Panel 11 CB EPS: BAT FEED TIE (2) should be opened to isolate short.
FAILURE	PROCEDURE	REMARKS

27 → 28/29 → 31 → 30/36 → 38
33 → 34/35 → 37

EPS

C-300LM4-510-2

SYMPTOM	PROCEDURE	REMARKS

Sheet 1 of 2

2 STAGED

DC BUS — RED

Light on if either or both buses <26.5 vdc

1 BATTERY caut lt-on? — YES → 2 EPS: DC BUS FAULT comp caut lt-on? — NO → 3 •EPS: POWER/TEMP MON sel-CDR, SE BUS •EPS: VOLTS ind-determine that CDR (SE) bus is low → 4 •EPS: POWER/TEMP MON sel-BAT 6, 5 •EPS: BAT FAULT comp caut lt-on for BAT 6 (5) → 5 BAT 6 (5) OVERTEMPERATURE → 6 •EPS: BAT 6 (5) NORMAL CDR (SE) FEED sw-OFF/RESET; tb-bp •CB EPS: CROSS TIE BUS (2)-close

2 YES → 4 7 CDR bus power failure

WARNING: Crew can be asphyxiated in 1 to 3 minutes if suit flow stops when crew is fully suited. •SUIT FAN sel-2

5 8 •Open all pnl 11 d-c cb's, except CB EPS: BAT FEED TIE (2)-close, XLUNAR BUS TIE-close, DC BUS VOLT-close •EPS: BAT 6 NORMAL CDR FEED sw-OFF/RESET; tb-bp •Pnl 11 CB EPS: BAT FEED TIE (2)-open

EPS: DC BUS FAULT comp caut lt-on? — YES → 4 9 CDR BUS SHORT → 6 11 •WATER TANK SELECT vlv-SEC •GLYCOL sel-INST (SEC) •CB ECS: GLYCOL PUMP SEC-close •SEC EVAP FLOW vlv-OPEN •Reconfigure electrical load for secondary glycol loop operation per normal procedure.

NO → 7 10 •EPS: BAT 6 BACK UP SE FEED sw-ON; tb-gray

12 FEEDER SHORT BETWEEN ECA & BUS

13 Repower CDR bus with both ascent bats — •CB EPS: CROSS TIE BUS (2)-close •EPS: BAT 6 BACK UP FEED sw-ON; tb-gray → 14 •Close pnl 11 d-c cb's, as required to activate subsystems.

15 EPS: DC BUS FAULT comp caut lt-on? — YES → 4 16 CDR bus power failure → 5 17 •Open all pnl 11 d-c cb's, except: CB EPS: BAT FEED TIE (2)-close, XLUNAR BUS TIE-close, DC BUS VOLT-close •EPS: BAT 6 NORMAL CDR FEED sw-OFF/RESET; tb bp •EPS: DC BUS FAULT comp caut lt-off → 18 SHORT BETWEEN ECA & BAT 6 → 19 Repower CDR bus with only bat 5 — •CB EPS: CROSS TIE BUS (2)-close → 20 •Close pnl 11 cb's, as required, for activation of essential subsystems only.

NO → 21 EPS: BAT 6 (5) NORMAL CDR (SE) FEED tb?

BP → 22 OVERCURRENT CONTACT CLOSED WITHOUT COIL ACTION → 23 •EPS: BAT 6 (5) BACK UP SE (CDR) FEED sw-ON; tb-gray •CB EPS: CROSS TIE BUS (2)-close

GRAY → 2 24 •EPS: POWER/TEMP MON sel-CDR, SE BUS — EPS: VOLTS ind-CDR (SE) bus low?

NO → 8 25 CWEA FAILURE

YES → 26 (Sheet 2)

REMARKS

1. Assumption: If originally closed (orbital contingency only), one or both CB EPS: CROSS TIE BAL LOADS have opened, except for CWEA or CDR (SE) signal conditioner failure. (See steps 25 & 27).
2. Due to lack of grounding, spurious readings will be observed on ammeter when monitoring bus voltage.
3. Bat voltage reading should confirm low bus voltage indication.
4. Bus functions lost:
   - COMM: CDR AUDIO, UP DATA LINK
   - ECS: CABIN FAN 1, GLYCOL PUMP AUTO TRNFR, GLYCOL PUMP 1, GLYCOL PUMP 2, SUIT FAN 1
   - FLT DISP: COAS, GASTA, MSN TMR, ORDEAL, RNG/RNG RT, THRUST
   - HTR: AOT, DOCK WINDOW, RNDZ RDR
   - INST: SIG CONDR 1
   - PGNS: IMU, LGC/DSKY, RNDZ RDR, SIG STR DISP
   - S/C: ATCA (PGNS), ATT DIR CONT, ENG CONT, ENG START OVRD
5. Assumption: DC BUS FAULT comp caut lt remains on when pnl 11 d-c load cb's are opened.
6. Primary glycol is inoperative. Only secondary glycol loop is operational.
7. Both ascent bats now power SE bus.
8. DC BUS warn lt remains on. Low bus voltage C/W monitoring is lost.

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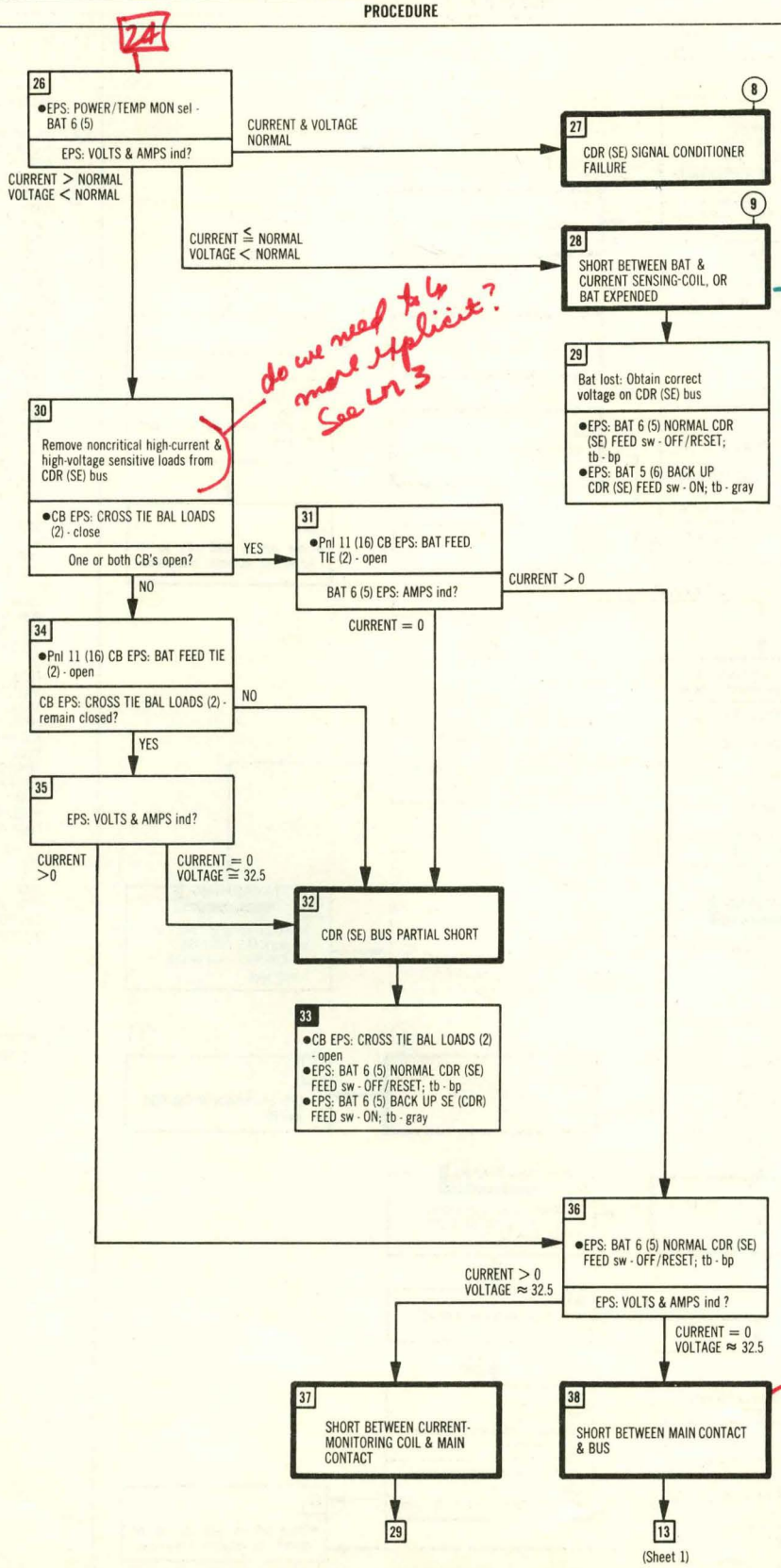
SYMPTOM	PROCEDURE	REMARKS

Sheet 2 of 2

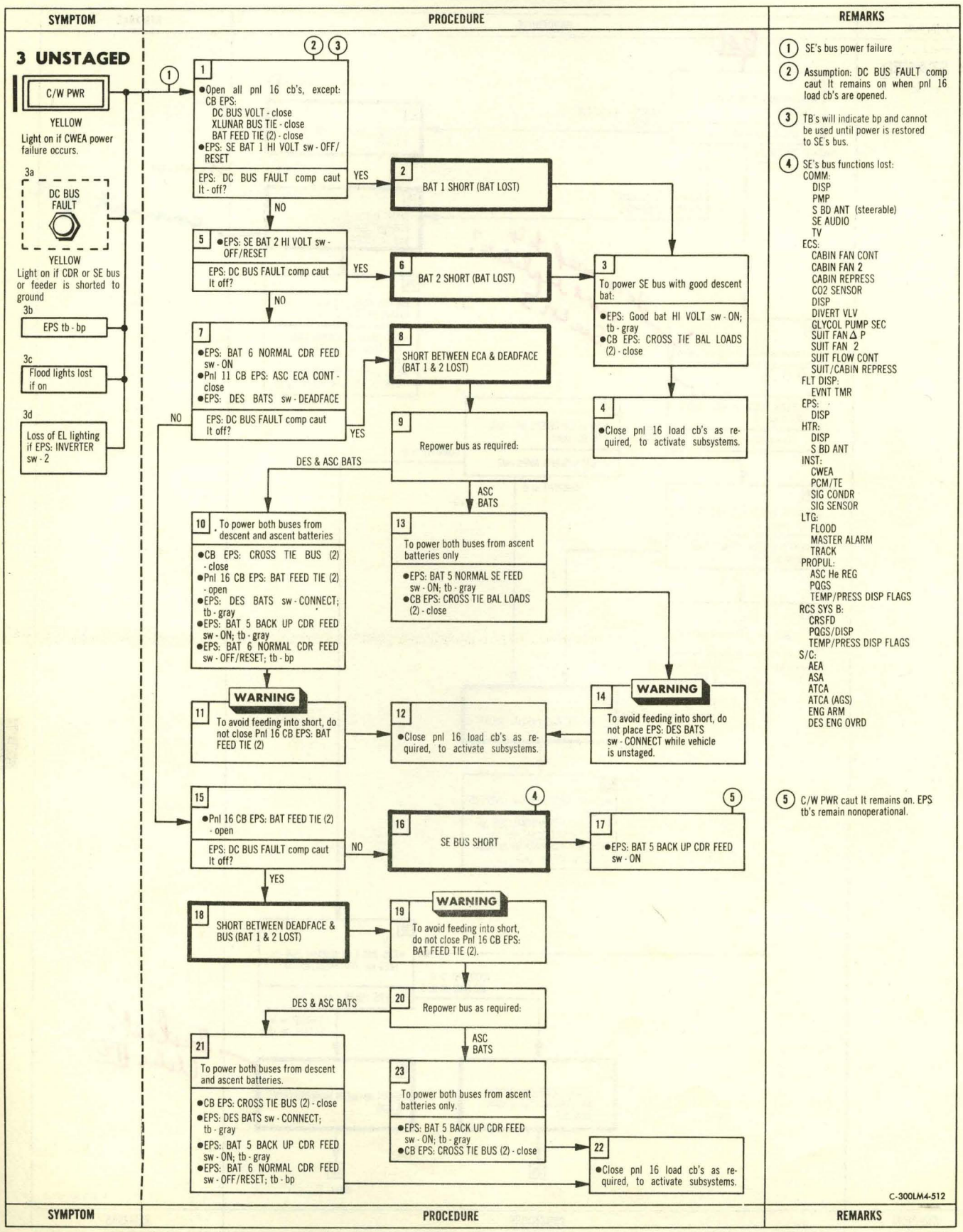
2 STAGED

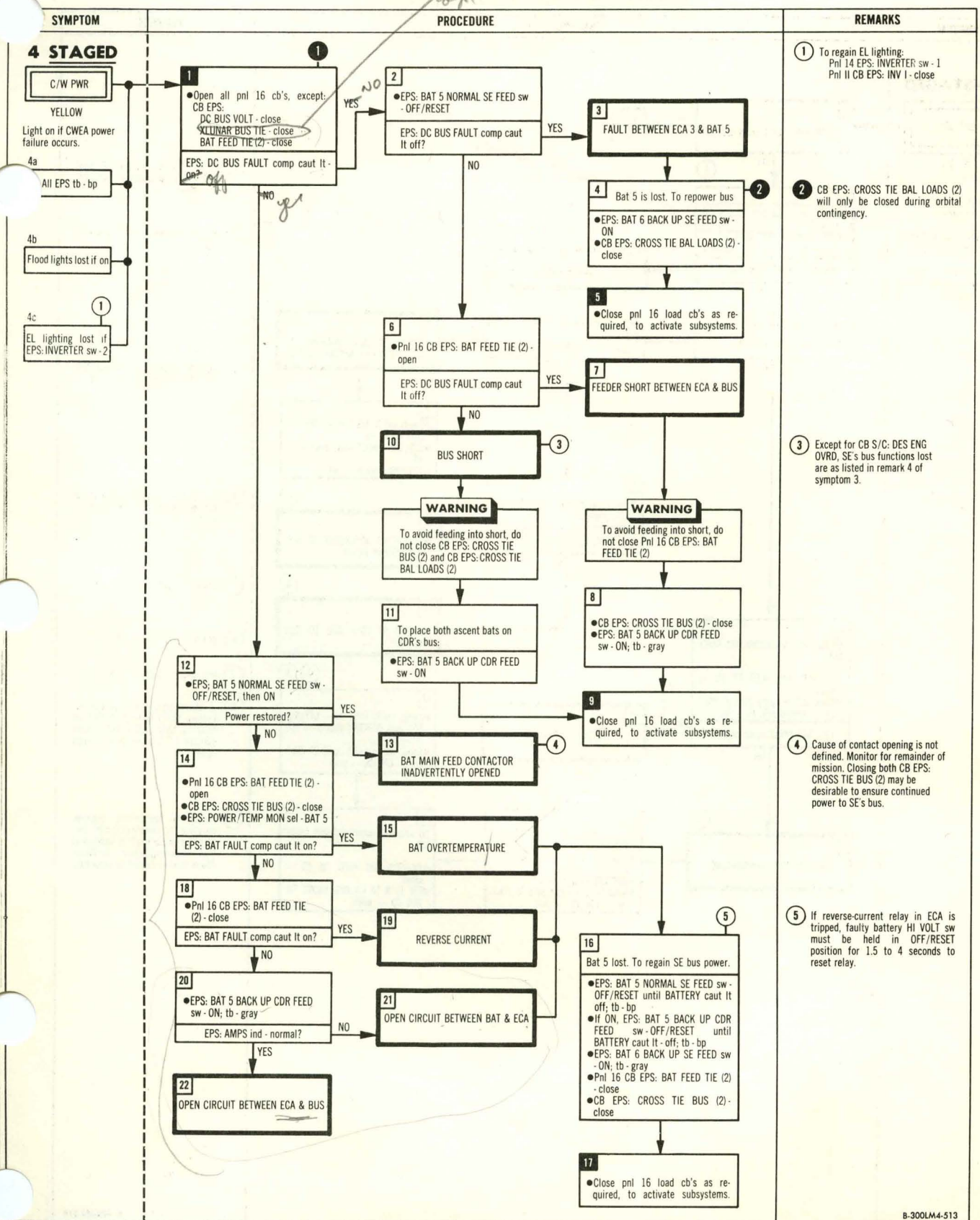
DC BUS warn lt (cont)



SYMPTOM	PROCEDURE	REMARKS

EPS


SYMPTOM
PROCEDURE
REMARKS
3 UNSTAGED
C/W PWR
YELLOW
Light on if CWEA power failure occurs.
3a
DC BUS FAULT
YELLOW
Light on if CDR or SE bus or feeder is shorted to ground
3b
EPS tb - bp
3c
Flood lights lost if on
3d
Loss of EL lighting if EPS: INVERTER sw - 2
1
•Open all pnl 16 cb's, except: CB EPS: DC BUS VOLT - close XLUNAR BUS TIE - close BAT FEED TIE (2) - close
•EPS: SE BAT 1 HI VOLT sw - OFF/RESET
EPS: DC BUS FAULT comp caut lt - off?
YES
NO
2
BAT 1 SHORT (BAT LOST)
5
•EPS: SE BAT 2 HI VOLT sw - OFF/RESET
EPS: DC BUS FAULT comp caut lt off?
YES
NO
6
BAT 2 SHORT (BAT LOST)
3
To power SE bus with good descent bat:
•EPS: Good bat HI VOLT sw - ON; tb - gray
•CB EPS: CROSS TIE BAL LOADS (2) - close
4
•Close pnl 16 load cb's as required, to activate subsystems.
7
•EPS: BAT 6 NORMAL CDR FEED sw - ON
•Pnl 11 CB EPS: ASC ECA CONT - close
•EPS: DES BATS sw - DEADFACE
EPS: DC BUS FAULT comp caut lt off?
NO
YES
8
SHORT BETWEEN ECA & DEADFACE (BAT 1 & 2 LOST)
9
Repower bus as required:
DES & ASC BATS
ASC BATS
10
To power both buses from descent and ascent batteries
•CB EPS: CROSS TIE BUS (2) - close
•Pnl 16 CB EPS: BAT FEED TIE (2) - open
•EPS: DES BATS sw - CONNECT; tb - gray
•EPS: BAT 5 BACK UP CDR FEED sw - ON; tb - gray
•EPS: BAT 6 NORMAL CDR FEED sw - OFF/RESET; tb - bp
13
To power both buses from ascent batteries only
•EPS: BAT 5 NORMAL SE FEED sw - ON; tb - gray
•CB EPS: CROSS TIE BAL LOADS (2) - close
WARNING
11
To avoid feeding into short, do not close Pnl 16 CB EPS: BAT FEED TIE (2)
12
•Close pnl 16 load cb's as required, to activate subsystems.
WARNING
14
To avoid feeding into short, do not place EPS: DES BATS sw - CONNECT while vehicle is unstaged.
15
•Pnl 16 CB EPS: BAT FEED TIE (2) - open
EPS: DC BUS FAULT comp caut lt off?
NO
YES
4
16
SE BUS SHORT
5
17
•EPS: BAT 5 BACK UP CDR FEED sw - ON
18
SHORT BETWEEN DEADFACE & BUS (BAT 1 & 2 LOST)
WARNING
19
To avoid feeding into short, do not close Pnl 16 CB EPS: BAT FEED TIE (2).
20
Repower bus as required:
DES & ASC BATS
ASC BATS
21
To power both buses from descent and ascent batteries.
•CB EPS: CROSS TIE BUS (2) - close
•EPS: DES BATS sw - CONNECT; tb - gray
•EPS: BAT 5 BACK UP CDR FEED sw - ON; tb - gray
•EPS: BAT 6 NORMAL CDR FEED sw - OFF/RESET; tb - bp
23
To power both buses from ascent batteries only.
•EPS: BAT 5 BACK UP CDR FEED sw - ON; tb - gray
•CB EPS: CROSS TIE BUS (2) - close
22
•Close pnl 16 load cb's as required, to activate subsystems.
1 SE's bus power failure
2 Assumption: DC BUS FAULT comp caut lt remains on when pnl 16 load cb's are opened.
3 TB's will indicate bp and cannot be used until power is restored to SE's bus.
4 SE's bus functions lost:
COMM:
DISP
PMP
S BD ANT (steerable)
SE AUDIO
TV
ECS:
CABIN FAN CONT
CABIN FAN 2
CABIN REPRESS
CO2 SENSOR
DISP
DIVERT VLV
GLYCOL PUMP SEC
SUIT FAN Δ P
SUIT FAN 2
SUIT FLOW CONT
SUIT/CABIN REPRESS
FLT DISP:
EVNT TMR
EPS:
DISP
HTR:
DISP
S BD ANT
INST:
CWEA
PCM/TE
SIG CONDR
SIG SENSOR
LTG:
FLOOD
MASTER ALARM
TRACK
PROPUL:
ASC He REG
PQGS
TEMP/PRESS DISP FLAGS
RCS SYS B:
CRSFD
PQGS/DISP
TEMP/PRESS DISP FLAGS
S/C:
AEA
ASA
ATCA
ATCA (AGS)
ENG ARM
DES ENG OVRD
5 C/W PWR caut lt remains on. EPS tb's remain nonoperational.
C-300LM4-512
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
4 STAGED
C/W PWR
YELLOW
Light on if CWEA power failure occurs.
4a
All EPS tb - bp
4b
Flood lights lost if on
4c
EL lighting lost if EPS: INVERTER sw - 2
1
•Open all pnl 16 cb's, except: CB EPS: DC BUS VOLT - close XLUNAR BUS TIE - close BAT FEED TIE (2) - close
EPS: DC BUS FAULT comp caut lt - on?
YES
NO
2
•EPS: BAT 5 NORMAL SE FEED sw - OFF/RESET
EPS: DC BUS FAULT comp caut lt off?
YES
NO
3
FAULT BETWEEN ECA 3 & BAT 5
4
Bat 5 is lost. To repower bus
•EPS: BAT 6 BACK UP SE FEED sw - ON
•CB EPS: CROSS TIE BAL LOADS (2) - close
5
•Close pnl 16 load cb's as required, to activate subsystems.
6
•Pnl 16 CB EPS: BAT FEED TIE (2) - open
EPS: DC BUS FAULT comp caut lt off?
YES
NO
7
FEEDER SHORT BETWEEN ECA & BUS
10
BUS SHORT
WARNING
To avoid feeding into short, do not close CB EPS: CROSS TIE BUS (2) and CB EPS: CROSS TIE BAL LOADS (2)
11
To place both ascent bats on CDR's bus:
•EPS: BAT 5 BACK UP CDR FEED sw - ON
WARNING
To avoid feeding into short, do not close Pnl 16 CB EPS: BAT FEED TIE (2)
8
•CB EPS: CROSS TIE BUS (2) - close
•EPS: BAT 5 BACK UP CDR FEED sw - ON; tb - gray
9
•Close pnl 16 load cb's as required, to activate subsystems.
12
•EPS; BAT 5 NORMAL SE FEED sw - OFF/RESET, then ON
Power restored?
YES
NO
13
BAT MAIN FEED CONTACTOR INADVERTENTLY OPENED
14
•Pnl 16 CB EPS: BAT FEED TIE (2) - open
•CB EPS: CROSS TIE BUS (2) - close
•EPS: POWER/TEMP MON sel - BAT 5
EPS: BAT FAULT comp caut lt on?
YES
NO
15
BAT OVERTEMPERATURE
18
•Pnl 16 CB EPS: BAT FEED TIE (2) - close
EPS: BAT FAULT comp caut lt on?
YES
NO
19
REVERSE CURRENT
20
•EPS: BAT 5 BACK UP CDR FEED sw - ON; tb - gray
EPS: AMPS ind - normal?
NO
YES
21
OPEN CIRCUIT BETWEEN BAT & ECA
22
OPEN CIRCUIT BETWEEN ECA & BUS
16
Bat 5 lost. To regain SE bus power.
•EPS: BAT 5 NORMAL SE FEED sw - OFF/RESET until BATTERY caut lt off; tb - bp
•If ON, EPS: BAT 5 BACK UP CDR FEED sw - OFF/RESET until BATTERY caut lt - off; tb - bp
•EPS: BAT 6 BACK UP SE FEED sw - ON; tb - gray
•Pnl 16 CB EPS: BAT FEED TIE (2) - close
•CB EPS: CROSS TIE BUS (2) - close
17
•Close pnl 16 load cb's as required, to activate subsystems.
1 To regain EL lighting: Pnl 14 EPS: INVERTER sw - 1 Pnl II CB EPS: INV I - close
2 CB EPS: CROSS TIE BAL LOADS (2) will only be closed during orbital contingency.
3 Except for CB S/C: DES ENG OVRD, SE's bus functions lost are as listed in remark 4 of symptom 3.
4 Cause of contact opening is not defined. Monitor for remainder of mission. Closing both CB EPS: CROSS TIE BUS (2) may be desirable to ensure continued power to SE's bus.
5 If reverse-current relay in ECA is tripped, faulty battery HI VOLT sw must be held in OFF/RESET position for 1.5 to 4 seconds to reset relay.
B-300LM4-513
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS

5 UNSTAGED

BATTERY

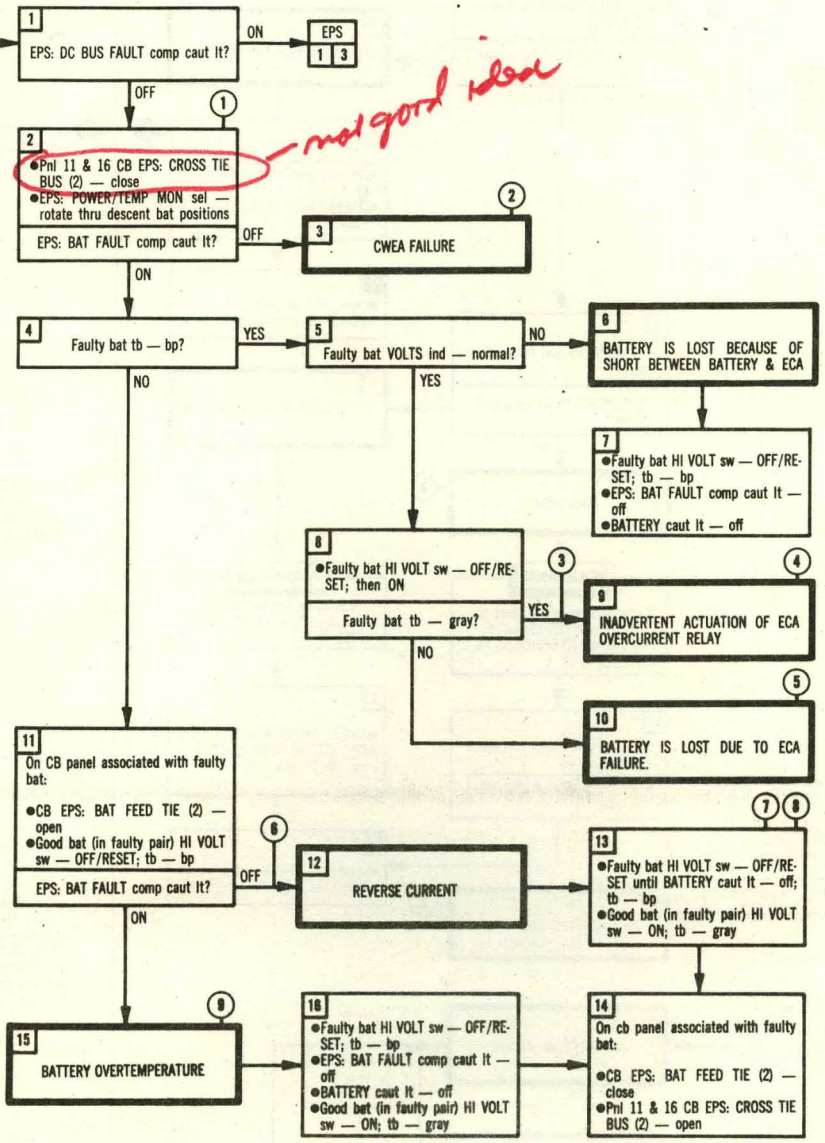
YELLOW

Light on if:

Bat overtemperature ≥145°F (Nominal)

Bat reverse current >10 amp for 4 to 6 seconds.

Bat overcurrent minimum ultimate trip: 150 to 200 amp.



(1) CB EPS: CROSS TIE BUS (2) must be kept closed to ensure sufficient bus power.

(2) Battery monitoring via CWEA is lost.

(3) BATTERY caut lt — off and EPS: BAT FAULT comp caut lt — off.

(4) Cause of battery disconnect is not defined. Monitor for remainder of mission.

(5) BATTERY caut lt remains on.

(6) BATTERY caut lt — off.

(7) One descent battery is lost.

(8) If reverse-current relay in ECA has tripped, faulty battery HI VOLT sw must be held in OFF/RESET position for 1.5 to 4 seconds to reset relay.

(9) Failure of overcurrent, overtemperature, or reverse-current contact may cause fault, in addition to true overtemperature condition. These failures cannot be separated.

A-300LM4-514

SYMPTOM	PROCEDURE	REMARKS

6 STAGED

BATTERY

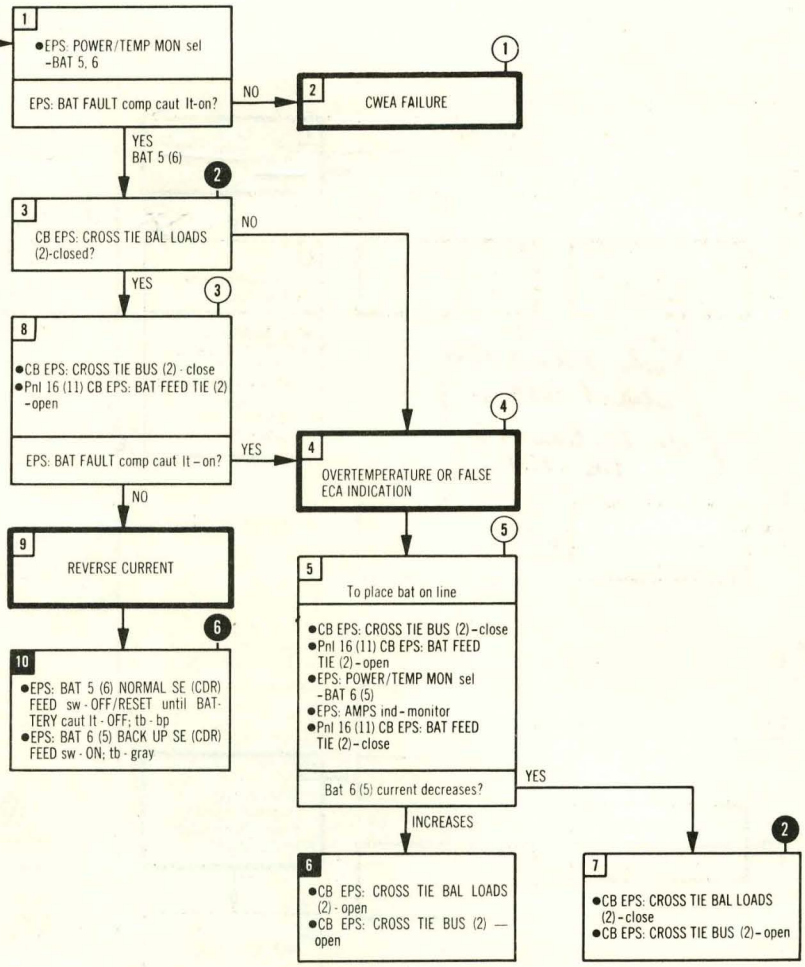
YELLOW

Light on if:

...mperature ≥ 145°F

Bat reverse current > 10 amp for 4 to 6 sec

Bat overcurrent minimum ultimate trip – 150 to 200 amp



(1) C/W cannot be used for bat malfunction indications. Maintain close check of bat status.

(2) CB EPS: CROSS TIE BAL LOADS (2) will only be closed during orbital contingency.

(3) Bat 5 feeds pnl 16 CB EPS: BAT FEED TIE (2). Bat 6 feeds pnl II CB EPS: BAT FEED TIE (2).

(4) Bat may be placed on line as long as it supplies positive current and DC BUS warn lt remains off.

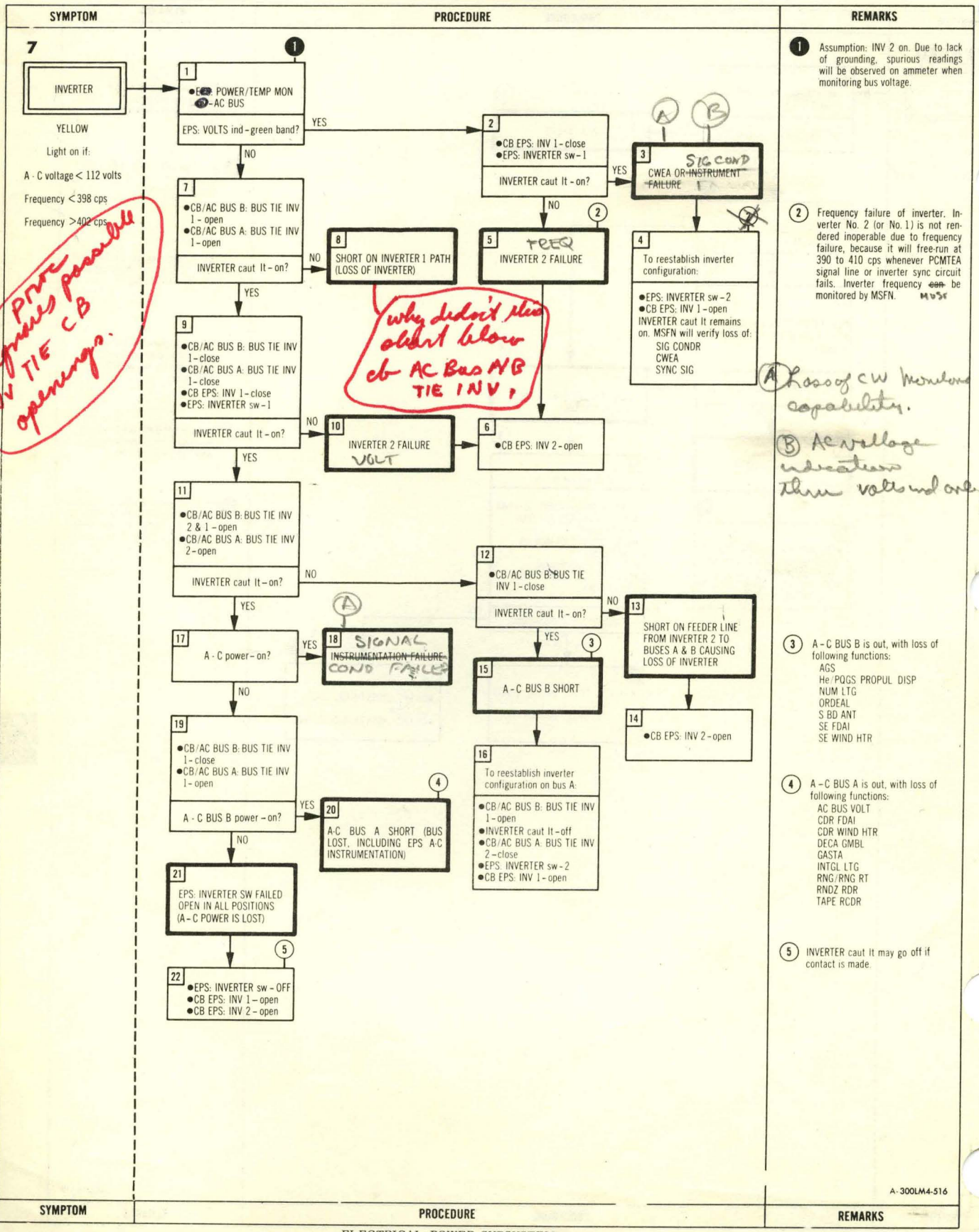
(5) Because BATTERY caut lt remains on, monitoring capability is lost when faulty bat is on line.

(6) If reverse-current relay in ECA has tripped, faulty battery HI VOLT sw must be held in OFF/RESET position for 1.5 to 4 seconds to reset relay.

B-300LM4-515

SYMPTOM	PROCEDURE	REMARKS

EPS



Prove spurious possible INV TIE CB openings.

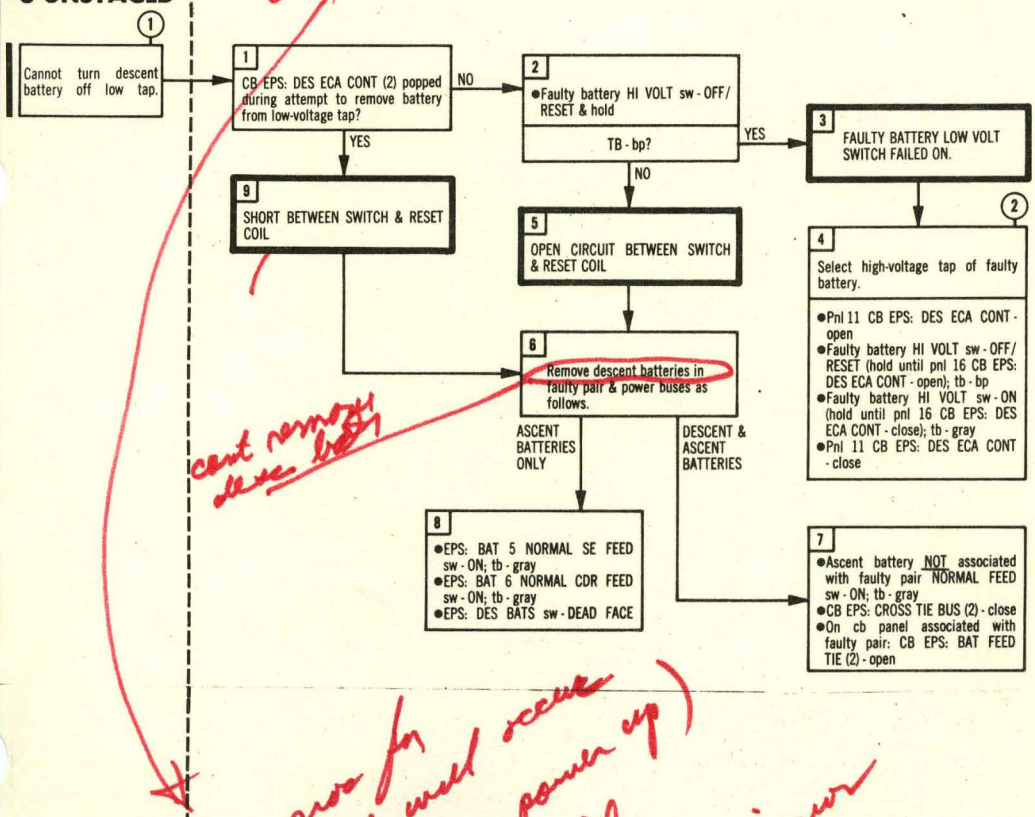
why doesn't this alert below do AC Bus A/B TIE INV,

(A) Loss of CW monitoring capability.

(B) AC voltage indications thru volts and only

delete

SYMPTOM	PROCEDURE	REMARKS
8 UNSTAGED		



(1) Assumption: Removal has been attempted, using both HI and LOW VOLT switches.

(2) Faulty battery will be placed on low-voltage tap when HI VOLT sw is set to OFF/RESET and released. Refer to step 4 for removal.

cant remove desc batt

This is a prob for a prob that will occur only once (during power up) If it happens we'll solve it by Real time w/ we blown the mission

EPS

300LM4-612

SYMPTOM	PROCEDURE	REMARKS

5.2.10 COMMUNICATIONS SUBSYSTEM

5.2.10.1 Assumptions

- Troubleshooting procedures such as checking sw's, cb's, redundant PTT pb's, alternative antennas, etc are performed before entering malfunction procedures.
- These malfunction procedures do not assume a particular Communications Subsystem sw configuration other than that required to operate the equipment before entry into the procedures.
- Malfunction procedures are entered from normal operational modes. (Procedures are not included for checkout modes.)

Table 5-19. CS Procedure Entry Sheet

Symptom	Sym No.	Page No.
Loss of intercom	1	5.2-111
One crewman has abnormal (unselected) hot mike condition	2	5.2-112
Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
Loss of VHF A simplex voice comm with CSM. MSFN not available - not within LOS	4	5.2-114
Cannot acquire S-band Ø lock	5	5.2-114
Loss of S-band voice comm	6	5.2-115
MSFN reports loss of S-band ranging	7	5.2-116
MSFN reports loss of LM S-band telemetry, S-band voice OK	8	5.2-116
S-BD RCVR caut lt	9	5.2-116

Table 5-20. CS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
Audio center failure	Loss of intercom	1	5.2-111
Audio center ICS circuitry failure	Loss of intercom	1	5.2-111
Audio center mike amplifier continuously keyed	One crewman has abnormal (unselected) hot mike condition	2	5.2-112
Audio center removing key has abnormal hot mike condition	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
Comm carrier or comm cable failure	Loss of intercom	1	5.2-111
Common S-band rcvr or SPA 30 kc subcarrier output circuit failure	Loss of S-band voice comm	6	5.2-115
CSM or LM xmtr or rcvr failure	Loss of VHF A simplex voice comm with CSM. MSFN not available (not within LOS)	4	5.2-114

CS

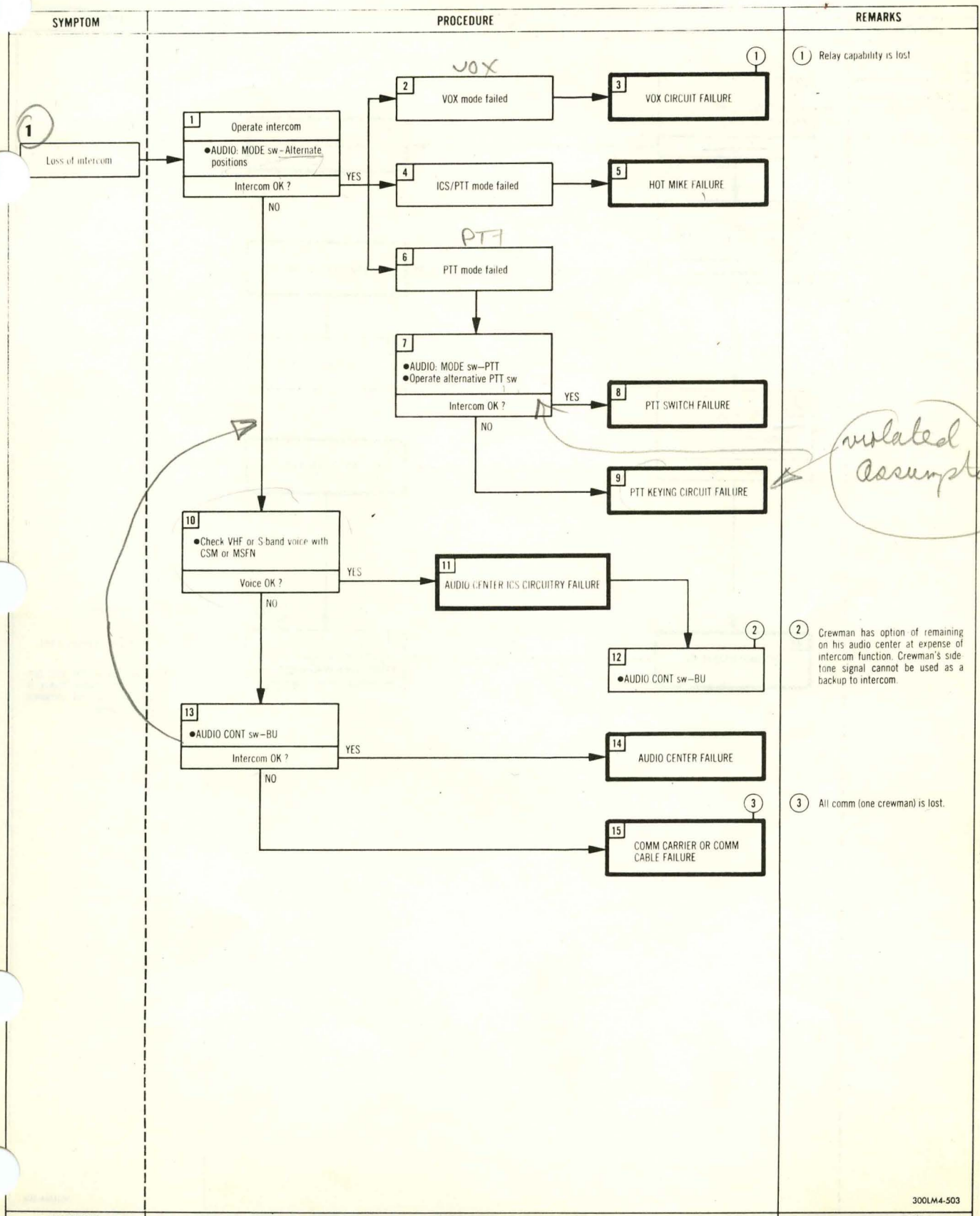
Table 5-20. CS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
CWEA failure	S BD RCVR caut lt	9	5.2-116
Failure in CSM	Loss of VHF A simplex voice comm with CSM. MSFN not available (not within LOS)	4	5.2-114
Hot mike failure	Loss of intercom	1	5.2-111
Intermittant PTT switch	One crewman has abnormal (unselected) hot mike condition	2	5.2-112
Loss of 512 kc from PCMTEA	Loss of S-band voice comm	6	5.2-115
PCMTEA HBR circuit failure	MSFN reports loss of LM S-band telemetry, S-band voice OK	8	5.2-116
PMP failure (e.g., high-pass filter, data modulator amplifier) or PCMTEA failure	MSFN reports loss of LM S-band telemetry, S-band voice OK	8	5.2-116
PMP failure (e.g., PM mixer)	MSFN reports loss of LM S-band telemetry, S-band voice OK	8	5.2-116
PMP power supply failure	Loss of S-band voice comm	6	5.2-115
PMP PM circuitry failure (e.g., PM mixer)	Loss of S-band voice comm	6	5.2-115
PMP S-band voice circuit failure	Loss of S-band voice comm	6	5.2-115
Primary S-band rcvr failure	Cannot acquire S-band Ø lock	5	5.2-114
	S BD RCVR caut lt	9	5.2-116
Primary S-band rcvr 30 kc output circuit failure	Loss of S-band voice comm	6	5.2-115
Primary S-band xmtr failure	Loss of S-band voice comm	6	5.2-115
Primary xmtr/rcvr ranging circuit failure	MSFN reports loss of S-band ranging	7	5.2-116
PTT keying circuit failure	Loss of intercom	1	5.2-111
PTT switch failed on	One crewman has abnormal (unselected) hot mike condition	2	5.2-112
PTT switch failure	Loss of intercom	1	5.2-111
S-band antenna system failure (e.g., RF switch, coax, diplexer, or xcvr RF diode switch)	Cannot acquire S-band Ø lock	5	5.2-114
	S BD RCVR caut lt	9	5.2-116
Short in range enable circuit	MSFN reports loss of S-band ranging	7	5.2-116
Short on VHF A keying line	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
VHF A coax cable failure	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113

Table 5-20. CS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
VHF A rcvr failure	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
VHF antenna system failure	Loss of VHF A simplex voice comm with CSM. MSFN not available (not within LOS)	4	5.2-114
VHF antenna system failure; (e.g., diplexer or RF switch)	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
VHF A xmtr or keying circuit failed open	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
VHF keying circuitry common to both xmtrs failed open	Loss of VHF A simplex voice comm with MSFN or CSM	3	5.2-113
VOX circuit failure	Loss of intercom	1	5.2-111
	One crewman has abnormal (unselected) hot mike condition	2	5.2-112

CS


SYMPTOM
PROCEDURE
REMARKS
1
Loss of intercom
1
Operate intercom
•AUDIO: MODE sw–Alternate positions
Intercom OK ?
YES
NO
2
VOX mode failed
3
VOX CIRCUIT FAILURE
4
ICS/PTT mode failed
5
HOT MIKE FAILURE
6
PTT mode failed
7
•AUDIO: MODE sw–PTT
•Operate alternative PTT sw
Intercom OK ?
YES
NO
8
PTT SWITCH FAILURE
9
PTT KEYING CIRCUIT FAILURE
10
•Check VHF or S-band voice with CSM or MSFN
Voice OK ?
YES
NO
11
AUDIO CENTER ICS CIRCUITRY FAILURE
12
•AUDIO CONT sw–BU
13
•AUDIO CONT sw–BU
Intercom OK ?
YES
NO
14
AUDIO CENTER FAILURE
15
COMM CARRIER OR COMM CABLE FAILURE
1 Relay capability is lost
2 Crewman has option of remaining on his audio center at expense of intercom function. Crewman's sidetone signal cannot be used as a backup to intercom.
3 All comm (one crewman) is lost.
300LM4-503
SYMPTOM
PROCEDURE
REMARKS

CS

SYMPTOM	PROCEDURE	REMARKS

2

One crewman has abnormal (unselected) hot mike condition

1
- AUDIO: MODE sw – PTT
- Talk without keying

~~Side tone heard?~~ hear yourself?

NO → **2** VOX CIRCUIT FAILURE

YES

3
- Individually cycle PTT switches on comm cable and ACA – Talk without keying

~~Side tone heard?~~ hear yourself

NO → **4** INTERMITTENT PTT SWITCH

5 Do not use failed switch

YES

6
- AUDIO CONT sw – BU
- ~~AUDIO~~ MODE sw (second crewman) – PTT
- Talk without keying

Side tone heard?

NO → **7** AUDIO CENTER MIKE AMPLIFIER CONTINUOUSLY KEYED

YES

9 PTT SWITCH FAILED ON

8 affected
- AUDIO CONT sw – NORM
- AUDIO: ~~VHF A sw – OFF~~ RCV

~~S-band~~ RCV
VHF (2) – RCV

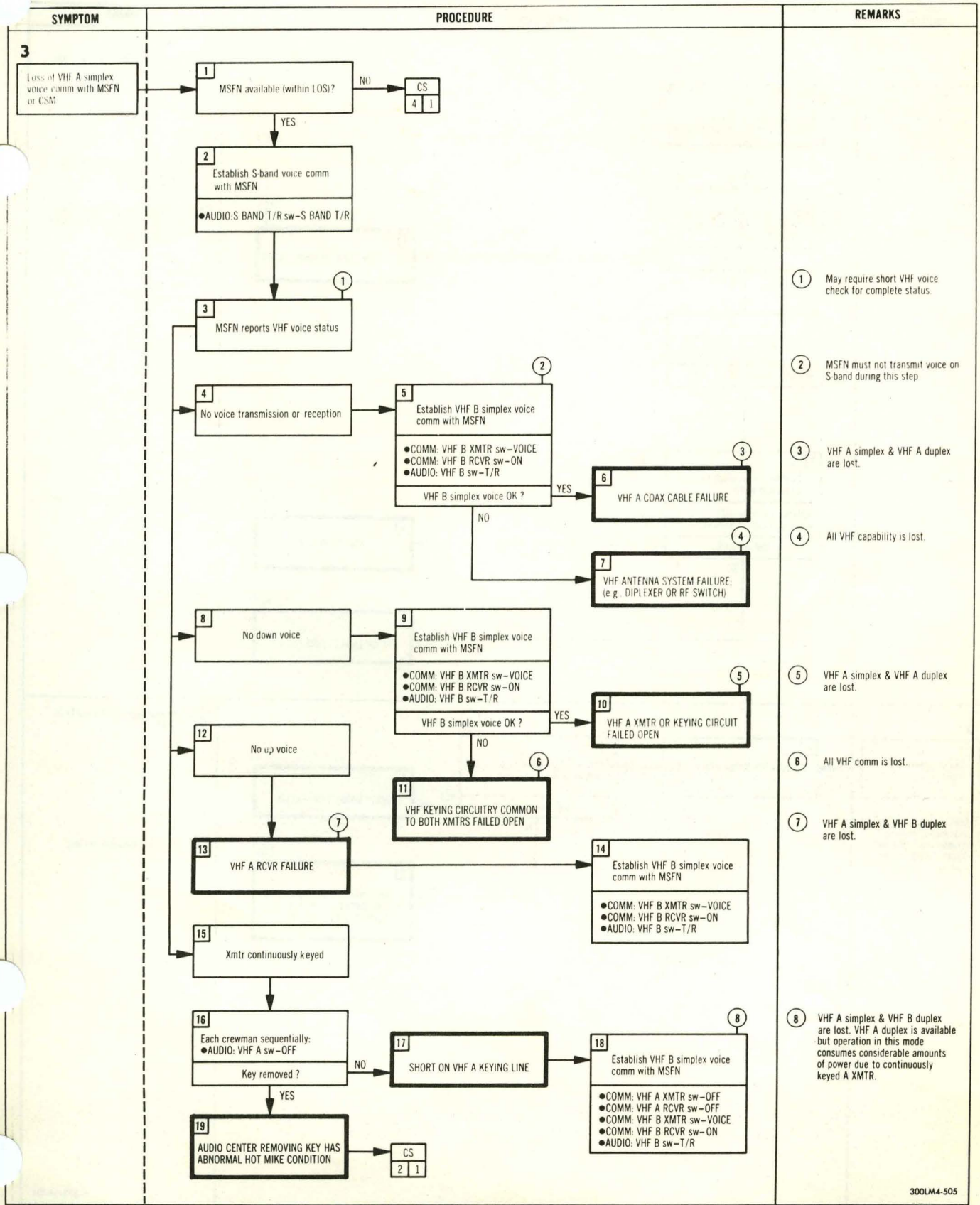
(1) (2)

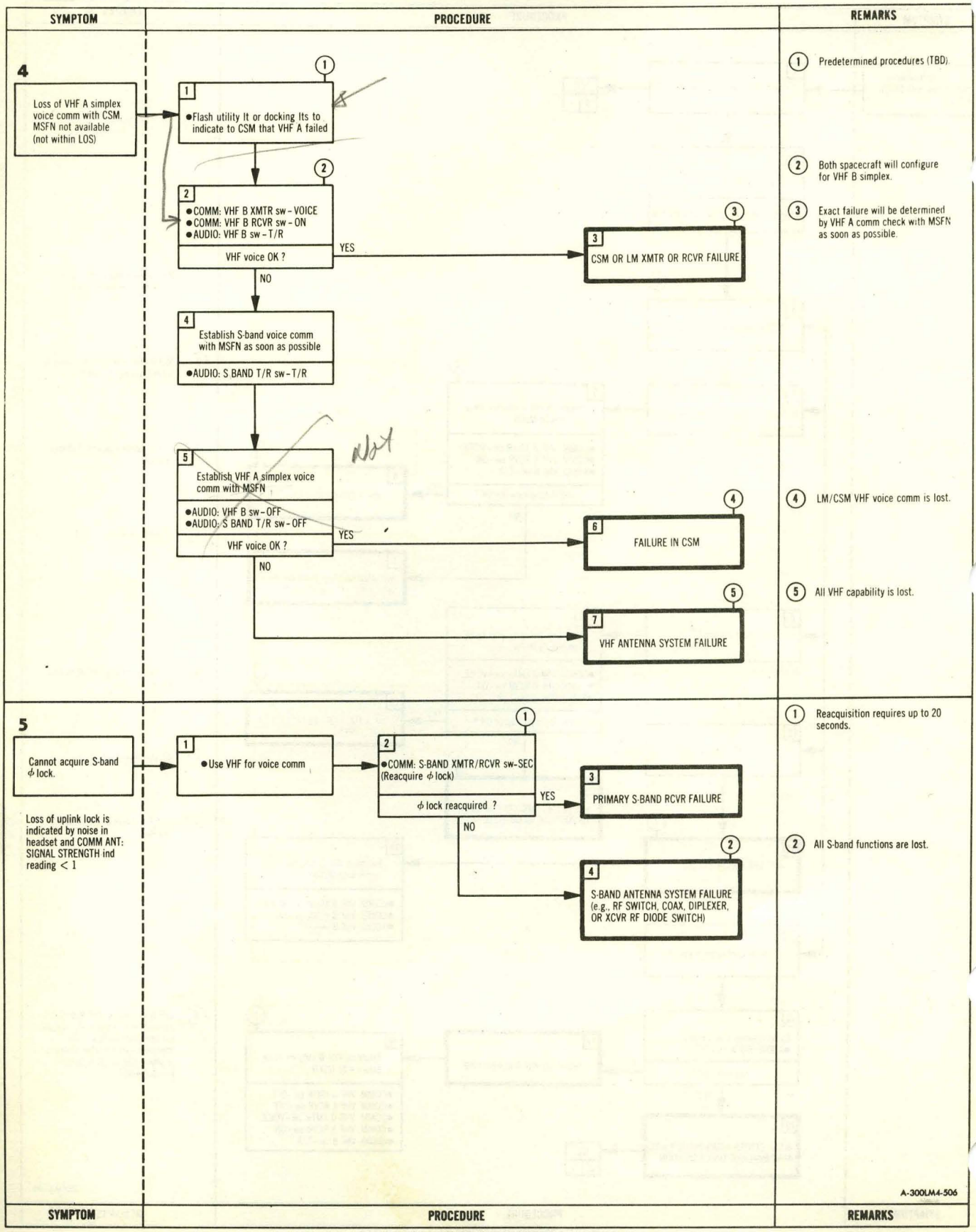
(1) Hot mike in all modes.

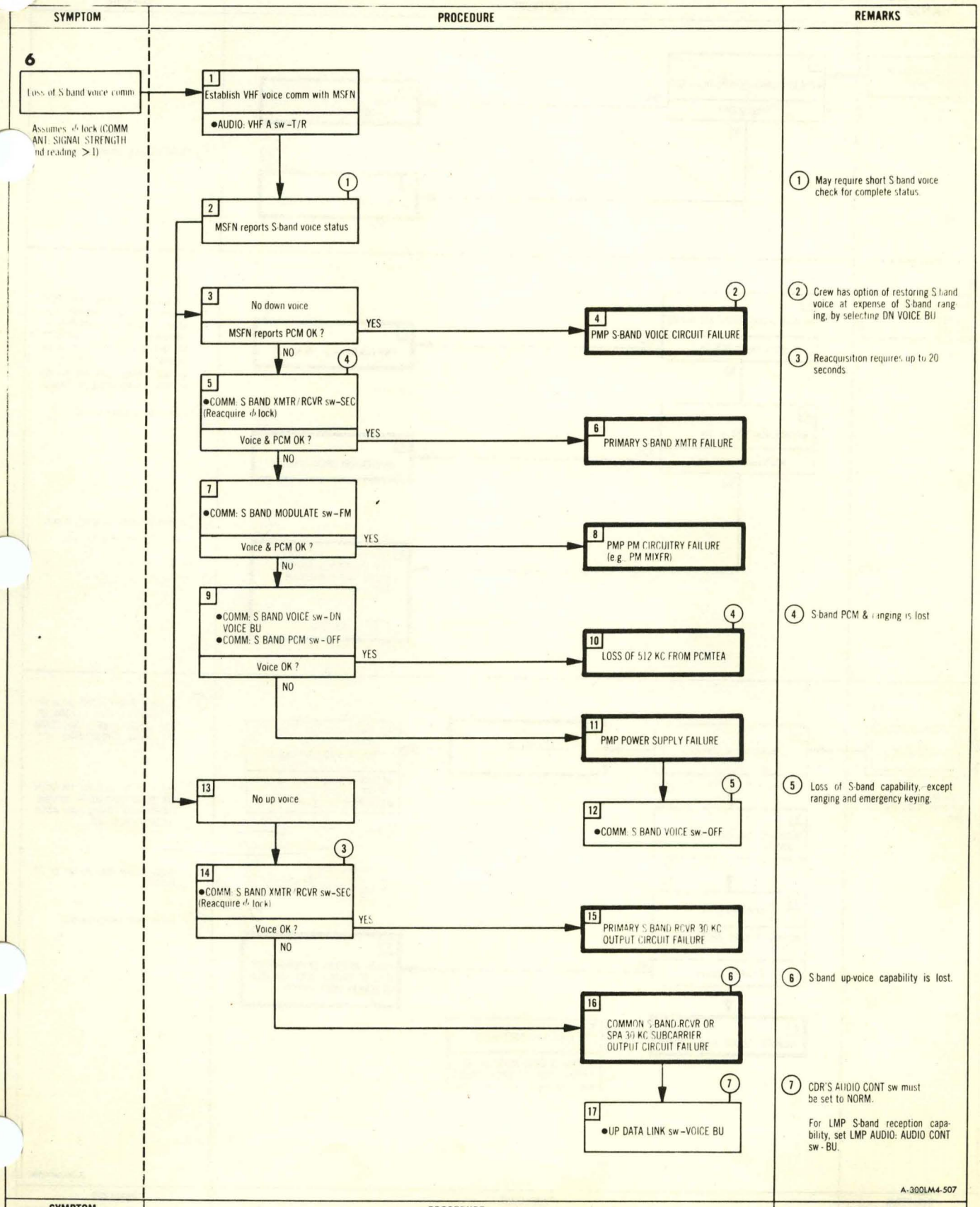
(2) VHF comm (one crewman) is lost.

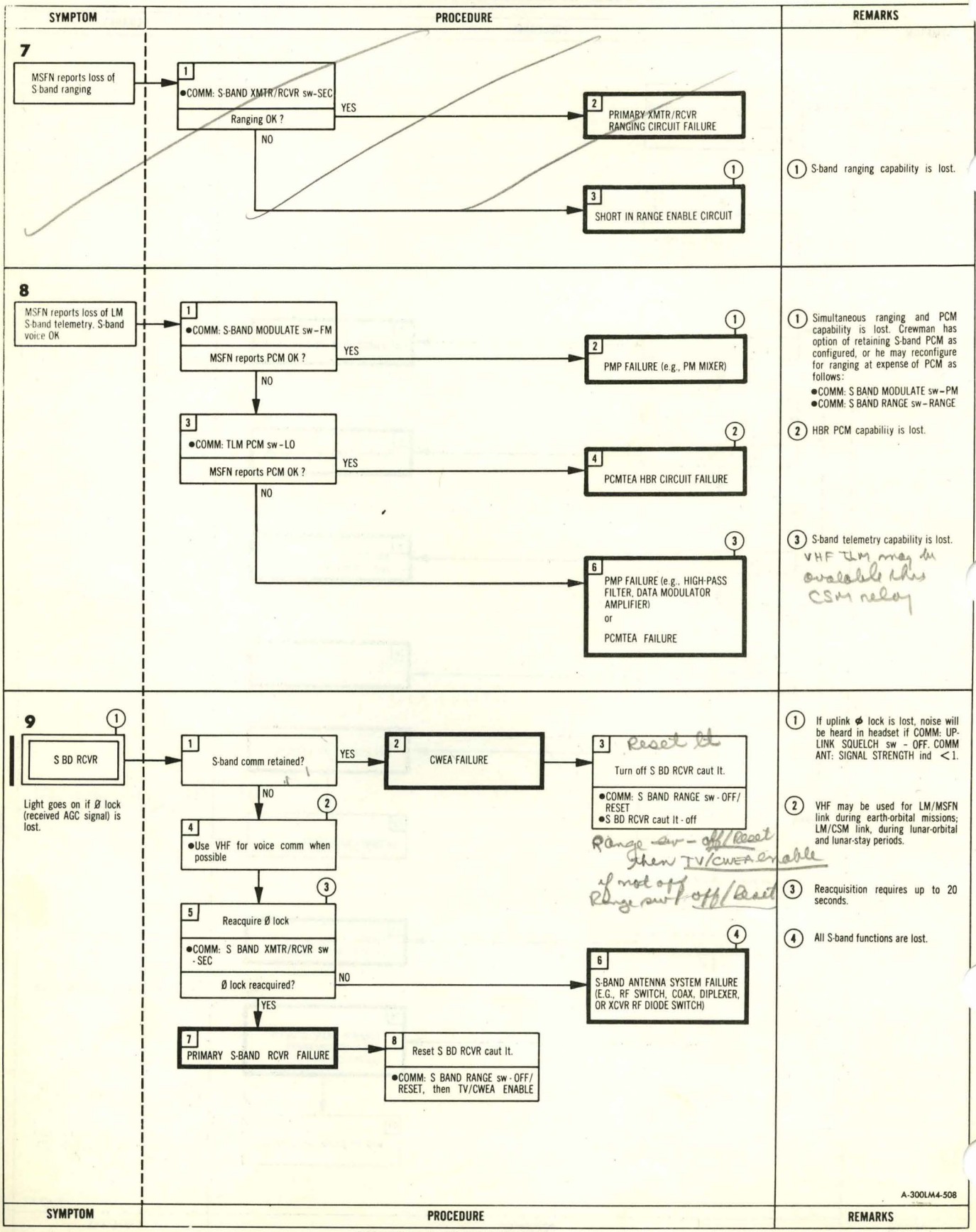
Continuous key on VHF xmtr precludes use of simplex. Duplex is available for use, but consumes considerable power.

300LM4-504


SYMPTOM
PROCEDURE
REMARKS
3
Loss of VHF A simplex voice comm with MSFN or CSM
1 MSFN available (within LOS)?
NO
CS 4 1
YES
2 Establish S-band voice comm with MSFN
●AUDIO: S BAND T/R sw–S BAND T/R
3 MSFN reports VHF voice status
4 No voice transmission or reception
5 Establish VHF B simplex voice comm with MSFN
●COMM: VHF B XMTR sw–VOICE
●COMM: VHF B RCVR sw–ON
●AUDIO: VHF B sw–T/R
VHF B simplex voice OK ?
YES
6 VHF A COAX CABLE FAILURE
NO
7 VHF ANTENNA SYSTEM FAILURE; (e.g., DIPLEXER OR RF SWITCH)
8 No down voice
9 Establish VHF B simplex voice comm with MSFN
●COMM: VHF B XMTR sw–VOICE
●COMM: VHF B RCVR sw–ON
●AUDIO: VHF B sw–T/R
VHF B simplex voice OK ?
YES
10 VHF A XMTR OR KEYING CIRCUIT FAILED OPEN
NO
11 VHF KEYING CIRCUITRY COMMON TO BOTH XMTRS FAILED OPEN
12 No up voice
13 VHF A RCVR FAILURE
14 Establish VHF B simplex voice comm with MSFN
●COMM: VHF B XMTR sw–VOICE
●COMM: VHF B RCVR sw–ON
●AUDIO: VHF B sw–T/R
15 Xmtr continuously keyed
16 Each crewman sequentially:
●AUDIO: VHF A sw–OFF
Key removed ?
NO
17 SHORT ON VHF A KEYING LINE
18 Establish VHF B simplex voice comm with MSFN
●COMM: VHF A XMTR sw–OFF
●COMM: VHF A RCVR sw–OFF
●COMM: VHF B XMTR sw–VOICE
●COMM: VHF B RCVR sw–ON
●AUDIO: VHF B sw–T/R
YES
19 AUDIO CENTER REMOVING KEY HAS ABNORMAL HOT MIKE CONDITION
CS 2 1
(1) May require short VHF voice check for complete status.
(2) MSFN must not transmit voice on S-band during this step
(3) VHF A simplex & VHF A duplex are lost.
(4) All VHF capability is lost.
(5) VHF A simplex & VHF A duplex are lost.
(6) All VHF comm is lost.
(7) VHF A simplex & VHF B duplex are lost.
(8) VHF A simplex & VHF B duplex are lost. VHF A duplex is available but operation in this mode consumes considerable amounts of power due to continuously keyed A XMTR.
300LM4-505
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
4
Loss of VHF A simplex voice comm with CSM. MSFN not available (not within LOS)
1
●Flash utility lt or docking lts to indicate to CSM that VHF A failed
2
●COMM: VHF B XMTR sw - VOICE
●COMM: VHF B RCVR sw - ON
●AUDIO: VHF B sw - T/R
VHF voice OK ?
YES
NO
3
CSM OR LM XMTR OR RCVR FAILURE
4
Establish S-band voice comm with MSFN as soon as possible
●AUDIO: S BAND T/R sw - T/R
5
Establish VHF A simplex voice comm with MSFN
●AUDIO: VHF B sw - OFF
●AUDIO: S BAND T/R sw - OFF
VHF voice OK ?
YES
NO
6
FAILURE IN CSM
7
VHF ANTENNA SYSTEM FAILURE
(1) Predetermined procedures (TBD).
(2) Both spacecraft will configure for VHF B simplex.
(3) Exact failure will be determined by VHF A comm check with MSFN as soon as possible.
(4) LM/CSM VHF voice comm is lost.
(5) All VHF capability is lost.
5
Cannot acquire S-band ϕ lock.
Loss of uplink lock is indicated by noise in headset and COMM ANT: SIGNAL STRENGTH ind reading < 1
1
●Use VHF for voice comm
2
●COMM: S-BAND XMTR/RCVR sw-SEC (Reacquire ϕ lock)
ϕ lock reacquired ?
YES
NO
3
PRIMARY S-BAND RCVR FAILURE
4
S-BAND ANTENNA SYSTEM FAILURE (e.g., RF SWITCH, COAX, DIPLEXER, OR XCVR RF DIODE SWITCH)
(1) Reacquisition requires up to 20 seconds.
(2) All S-band functions are lost.
A-300LM4-506
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
6
Loss of S band voice comm
Assumes ∅ lock (COMM ANT SIGNAL STRENGTH ind reading > 1)
1 Establish VHF voice comm with MSFN
●AUDIO: VHF A sw – T/R
2 MSFN reports S-band voice status
3 No down voice
MSFN reports PCM OK ?
YES
4 PMP S-BAND VOICE CIRCUIT FAILURE
NO
5 ●COMM: S BAND XMTR/RCVR sw – SEC (Reacquire ∅ lock)
Voice & PCM OK ?
YES
6 PRIMARY S BAND XMTR FAILURE
NO
7 ●COMM: S BAND MODULATE sw – FM
Voice & PCM OK ?
YES
8 PMP PM CIRCUITRY FAILURE (e.g., PM MIXER)
NO
9 ●COMM: S BAND VOICE sw – DN VOICE BU
●COMM: S BAND PCM sw – OFF
Voice OK ?
YES
10 LOSS OF 512 KC FROM PCMTEA
NO
11 PMP POWER SUPPLY FAILURE
12 ●COMM: S BAND VOICE sw – OFF
13 No up voice
14 ●COMM: S BAND XMTR/RCVR sw – SEC (Reacquire ∅ lock)
Voice OK ?
YES
15 PRIMARY S BAND RCVR 30 KC OUTPUT CIRCUIT FAILURE
NO
16 COMMON S BAND RCVR OR SPA 30 KC SUBCARRIER OUTPUT CIRCUIT FAILURE
17 ●UP DATA LINK sw – VOICE BU
(1) May require short S band voice check for complete status.
(2) Crew has option of restoring S band voice at expense of S-band ranging, by selecting DN VOICE BU
(3) Reacquisition requires up to 20 seconds
(4) S band PCM & ranging is lost
(5) Loss of S-band capability, except ranging and emergency keying.
(6) S band up-voice capability is lost.
(7) CDR'S AUDIO CONT sw must be set to NORM.
For LMP S-band reception capability, set LMP AUDIO: AUDIO CONT sw - BU.
A-300LM4-507
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
7
MSFN reports loss of S band ranging
1
•COMM: S-BAND XMTR/RCVR sw-SEC
Ranging OK ?
YES
NO
2
PRIMARY XMTR/RCVR RANGING CIRCUIT FAILURE
3
SHORT IN RANGE ENABLE CIRCUIT
(1) S-band ranging capability is lost.
8
MSFN reports loss of LM S-band telemetry, S-band voice OK
1
•COMM: S-BAND MODULATE sw-FM
MSFN reports PCM OK ?
YES
NO
2
PMP FAILURE (e.g., PM MIXER)
3
•COMM: TLM PCM sw-LO
MSFN reports PCM OK ?
YES
NO
4
PCMTEA HBR CIRCUIT FAILURE
6
PMP FAILURE (e.g., HIGH-PASS FILTER, DATA MODULATOR AMPLIFIER)
or
PCMTEA FAILURE
(1) Simultaneous ranging and PCM capability is lost. Crewman has option of retaining S-band PCM as configured, or he may reconfigure for ranging at expense of PCM as follows:
•COMM: S BAND MODULATE sw-PM
•COMM: S BAND RANGE sw-RANGE
(2) HBR PCM capability is lost.
(3) S-band telemetry capability is lost.
VHF TLM may be available thru CSM relay
9
S BD RCVR
Light goes on if Ø lock (received AGC signal) is lost.
1
S-band comm retained?
YES
NO
2
CWEA FAILURE
3
Reset lt
Turn off S BD RCVR caut lt.
•COMM: S BAND RANGE sw - OFF/RESET
•S BD RCVR caut lt - off
Range sw - off/Reset then TV/CWEA enable
if not off Range sw off/Reset
4
•Use VHF for voice comm when possible
5
Reacquire Ø lock
•COMM: S BAND XMTR/RCVR sw - SEC
Ø lock reacquired?
NO
YES
6
S-BAND ANTENNA SYSTEM FAILURE (E.G., RF SWITCH, COAX, DIPLEXER, OR XCVR RF DIODE SWITCH)
7
PRIMARY S-BAND RCVR FAILURE
8
Reset S BD RCVR caut lt.
•COMM: S BAND RANGE sw - OFF/RESET, then TV/CWEA ENABLE
(1) If uplink ϕ lock is lost, noise will be heard in headset if COMM: UP-LINK SQUELCH sw - OFF. COMM ANT: SIGNAL STRENGTH ind < 1.
(2) VHF may be used for LM/MSFN link during earth-orbital missions; LM/CSM link, during lunar-orbital and lunar-stay periods.
(3) Reacquisition requires up to 20 seconds.
(4) All S-band functions are lost.
A-300LM4-508
SYMPTOM
PROCEDURE
REMARKS

5.2.11 ENVIRONMENTAL CONTROL SUBSYSTEM

Table 5-21. ECS Procedure Entry Sheet

Symptom	Sym No.	Page No.
ECS caut lt	1	5.2-123
ECS caut lt & SUIT FAN comp caut lt	2	5.2-123
ECS caut lt & CO2 comp caut lt	3	5.2-124
ECS caut lt & H2O SEP comp caut lt	4	5.2-124
GLYCOL comp caut lt	5	5.2-125
MASTER ALARM pb/lt, ECS caut lt, & GLYCOL comp caut lt	5a	5.2-125
GLYCOL caut lt	6	5.2-126
CABIN warn lt	7	5.2-127
WATER QTY caut lt	8	5.2-128
ECS: CABIN TEMP ind high	9	5.2-129
ECS: SUIT PRESS ind >4.0 psia	10	5.2-129
O2 QTY caut lt	11	5.2-130
Abnormal decay of descent O2 before C/W activation	12	5.2-131
SUIT/FAN warn lt	13	5.2-132
High cabin pressure	14	5.2-133
ECS: PRESS, GLYCOL, & QUANTITY ind pwr fail lts on	15	5.2-134
ECS: GLYCOL ind pwr fail lt on	16	5.2-134
ECS: PRESS ind pwr fail lt on	17	5.2-135
ECS: QUANTITY ind pwr fail lt on	18	5.2-135

Table 5-22. ECS Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
Ascent 1 (2) O2 line leak inside cabin	High cabin pressure	14	5.2-133
Ascent 1 O2 line leak inside cabin	High cabin pressure	14	5.2-133
Ascent 2 O2 line leak inside cabin	High cabin pressure	14	5.2-133
Ascent 2 (1) O2 leak inside cabin	High cabin pressure	14	5.2-133
Ascent tank No. 1 (2) O2 supply is lost	CABIN warn lt	7	5.2-127

ECS

Table 5-22. ECS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Auto operation of cabin temp vlv failed	ECS: CABIN TEMP ind high	9	5.2-129
Burst diaphragm relief vlv relieved & reseated	Abnormal decay of descent O2 before C/W activation	12	5.2-131
Cabin fan No. 1 circuitry failure	ECS: CABIN TEMP ind high	9	5.2-129
Cabin fan No. 2 circuitry failure	ECS: CABIN TEMP ind high	9	5.2-129
Cabin pressure xducer or indicator failed	High cabin pressure	14	5.2-133
Cabin puncture	CABIN warn lt	7	5.2-127
Cabin relief & dump vlv (fwd) leaks in auto	CABIN warn lt	7	5.2-127
Cabin relief & dump vlv (ovhd) leaks in auto	CABIN warn lt	7	5.2-127
CABIN REPRESS vlv leak	High cabin pressure	14	5.2-133
CABIN REPRESS vlv leaks in AUTO position	Abnormal decay of descent O2 before C/W activation	12	5.2-131
	High cabin pressure	14	5.2-133
Cabin temp xducer failed	ECS: CABIN TEMP ind high	9	5.2-129
CB ECS: DISP - open inadvertently	ECS: PRESS, GLYCOL, & QUANTITY ind pwr fail lts on	15	5.2-134
CO2 partial pressure sensor failure	ECS caut lt and CO2 comp caut lt	3	5.2-124
C/W circuitry failure	ECS caut lt	1	5.2-123
	ECS caut lt and CO2 comp caut lt	3	5.2-118
CWEA failure	WATER QTY caut lt	8	5.2-128
	O2 QTY caut lt	11	5.2-130
CWEA or glycol low-level sensor failure, or slow leak in primary glycol loop	GLYCOL caut lt	6	5.2-126
CWEA or signal conditioner failure	CABIN warn lt	7	5.2-127
CWEA or signal conditioner failure, or short circuit between CABIN REPRESS vlv & cabin pressure sw	CABIN warn lt	7	5.2-127
CWEA signal conditioner failure, suit isol vlv electrical contacts failed closed, or short circuit between CABIN REPRESS vlv & cabin pressure sw	CABIN warn lt	7	5.2-127

Table 5-22. ECS Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Descent O2 leak outside cabin	Abnormal decay of descent O2 before C/W activation	12	5.2-131
	O2 QTY caut lt	11	5.2-130
Descent O2 line leak inside cabin	High cabin pressure	14	5.2-133
Descent O2 quantity xducer failed	O2 QTY caut lt	11	5.2-130
Descent O2 supply is lost	CABIN warn lt	7	5.2-127
Descent O2 xducer calibration shift	Abnormal decay of descent O2 before C/W activation	12	5.2-131
ECS: PART PRESS CO2 ind failure	ECS caut lt and CO2 comp caut lt	3	5.2-124
ECS: PRESS ind pwr fail lt failed on	ECS: GLYCOL ind pwr fail lt on	16	5.2-134
	ECS: PRESS ind pwr fail lt on	17	5.2-135
ECS: QUANTITY ind pwr fail lt failed on	ECS: QUANTITY ind pwr fail lt on	18	5.2-135
Electrical contacts of one suit isol vlv failed closed or short circuit between CABIN REPRESS vlv & cabin pressure sw	CABIN warn lt	7	5.2-127
Glycol pump Δ P switch failed closed (low)	GLYCOL comp caut lt	5	5.2-125
Glycol pump No. 1 & auto transfer failed	GLYCOL comp caut lt	5	5.2-125
Glycol pump No. 1 failed	GLYCOL comp caut lt	5	5.2-125
	MASTER ALARM pb/lt, ECS caut lt, & GLYCOL comp caut lt	5a	5.2-125
Glycol pump No. 2 failed following auto transfer	GLYCOL comp caut lt	5	5.2-125
Glycol temp signal conditioner or instrumentation failure	GLYCOL caut lt	6	5.2-126
H2O leak in ascent tank No. 1	WATER QTY caut lt	8	5.2-128
H2O leak in ascent tank No. 2	WATER QTY caut lt	8	5.2-128
H2O or N2 leak in descent tank, or instrumentation failure	WATER QTY caut lt	8	5.2-128
H2O separator failed	ECS caut lt and H2O SEP comp caut lt	4	5.2-121
H2O separator instrumentation failure	ECS caut lt and H2O SEP comp caut lt	4	5.2-124
Leak in #1 ASC O2 line inside cabin	O2 QTY caut lt	11	5.2-130

ECS

Table 5-22. ECS Failure/Symptom Cross-Reference Index (cont)

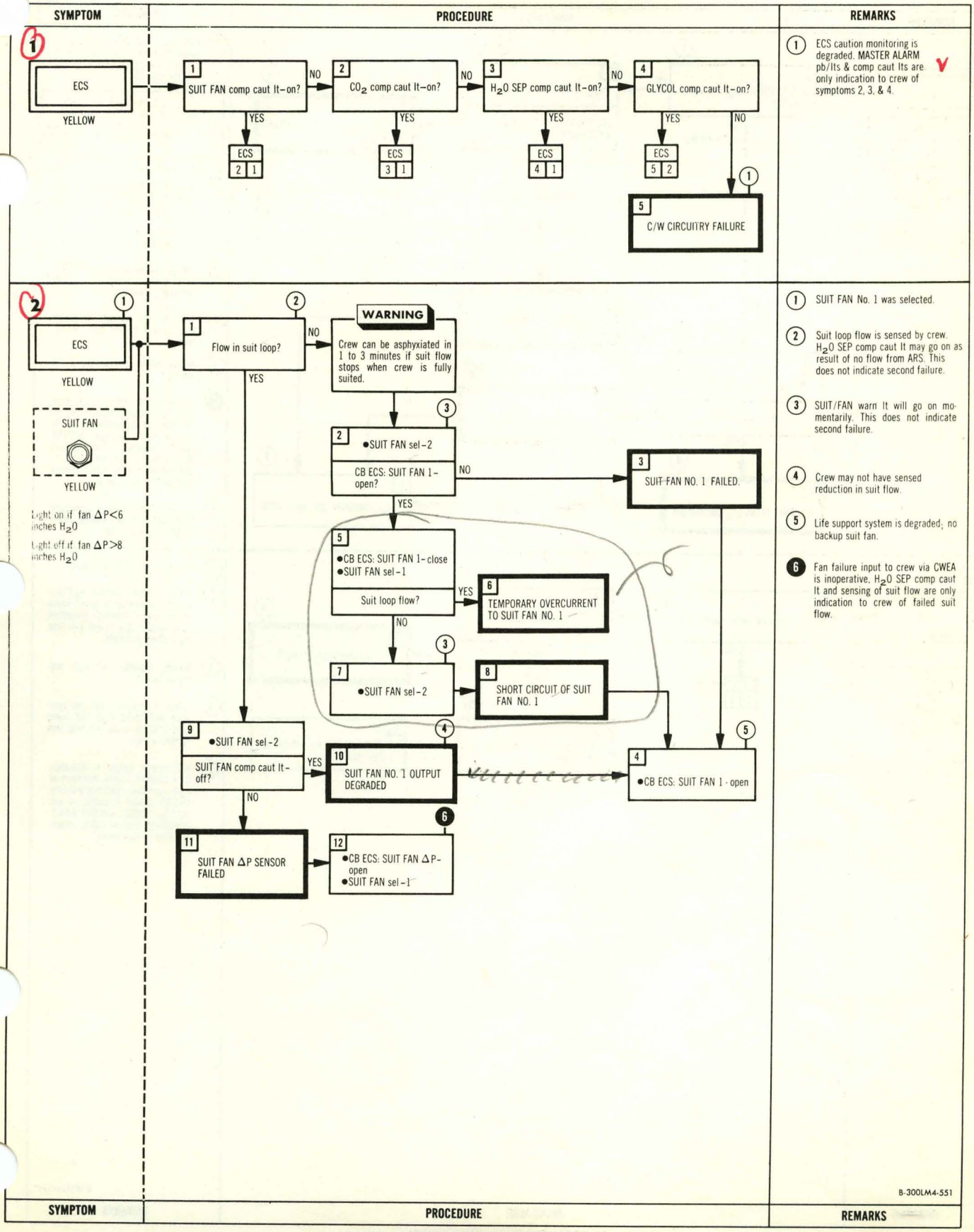
Failure	Symptom	Sym No.	Page No.
Leak in #1 ASC O2 outside cabin	O2 QTY caut lt	11	5.2-130
Leak in #2 ASC O2 inside cabin	O2 QTY caut lt	11	5.2-130
Leak in ARS/PGA	SUIT/FAN warn lt	13	5.2-132
Leak in descent O2 supply between DES O2 vlv & descent O2 supply line penetration of cabin	Abnormal decay of descent O2 C/W activation	12	5.2-131
Loss of power to ECS: SUIT & CABIN PRESS ind	ECS: SUIT PRESS ind > 4.0 psia	10	5.2-129
Low descent O2 quantity & pressure	O2 QTY caut lt	11	5.2-130
Low H2O quantity, or N2 leak	WATER QTY caut lt	8	5.2-128
Normal mission use	O2 QTY caut lt	11	5.2-130
Open circuit between CB ECS: DISP & ECS indicators	ECS: PRESS, GLYCOL, & QUANTITY ind pwr fail lts on	15	5.2-134
Power to ECS: GLYCOL ind is lost	ECS: GLYCOL ind pwr fail lt on	16	5.2-134
Power to ECS: PRESS ind is lost	ECS: PRESS ind pwr fail lt on	17	5.2-135
Power to ECS: QUANTITY ind is lost	ECS: QUANTITY ind pwr fail lt on	18	5.2-135
PRESS REG A failed open	High cabin pressure	14	5.2-133
PRESS REG A vlv failed open	Abnormal decay of O2 before C/W activation	12	5.2-131
	High cabin pressure	14	5.2-133
PRESS REG A vlv regulating high or failed open	ECS: SUIT PRESS ind > 4.0 psia	10	5.2-129
PRESS REG B failed open	Abnormal decay of descent O2 before C/W activation	12	5.2-131
	High cabin pressure	14	5.2-133
PRESS REG B vlv failed open	High cabin pressure	14	5.2-133
PRESS REG B vlv regulating high or failed open	ECS: SUIT PRESS ind > 4.0 psia	10	5.2-129
Prim evap flow No. 1 vlv closed temporarily	GLYCOL caut lt	6	5.2-126
Prim evap flow No. 2 vlv or sec evap flow vlv leaks in close position	WATER QTY caut lt	8	5.2-128
Primary glycol loop leak	GLYCOL comp caut lt	5	5.2-125
Primary glycol loop pumps No. 1 & 2 inoperative	GLYCOL comp caut lt	5	5.2-125
Primary LiOH cartridge failed or saturated	ECS caut lt and CO2 comp caut lt	3	5.2-124

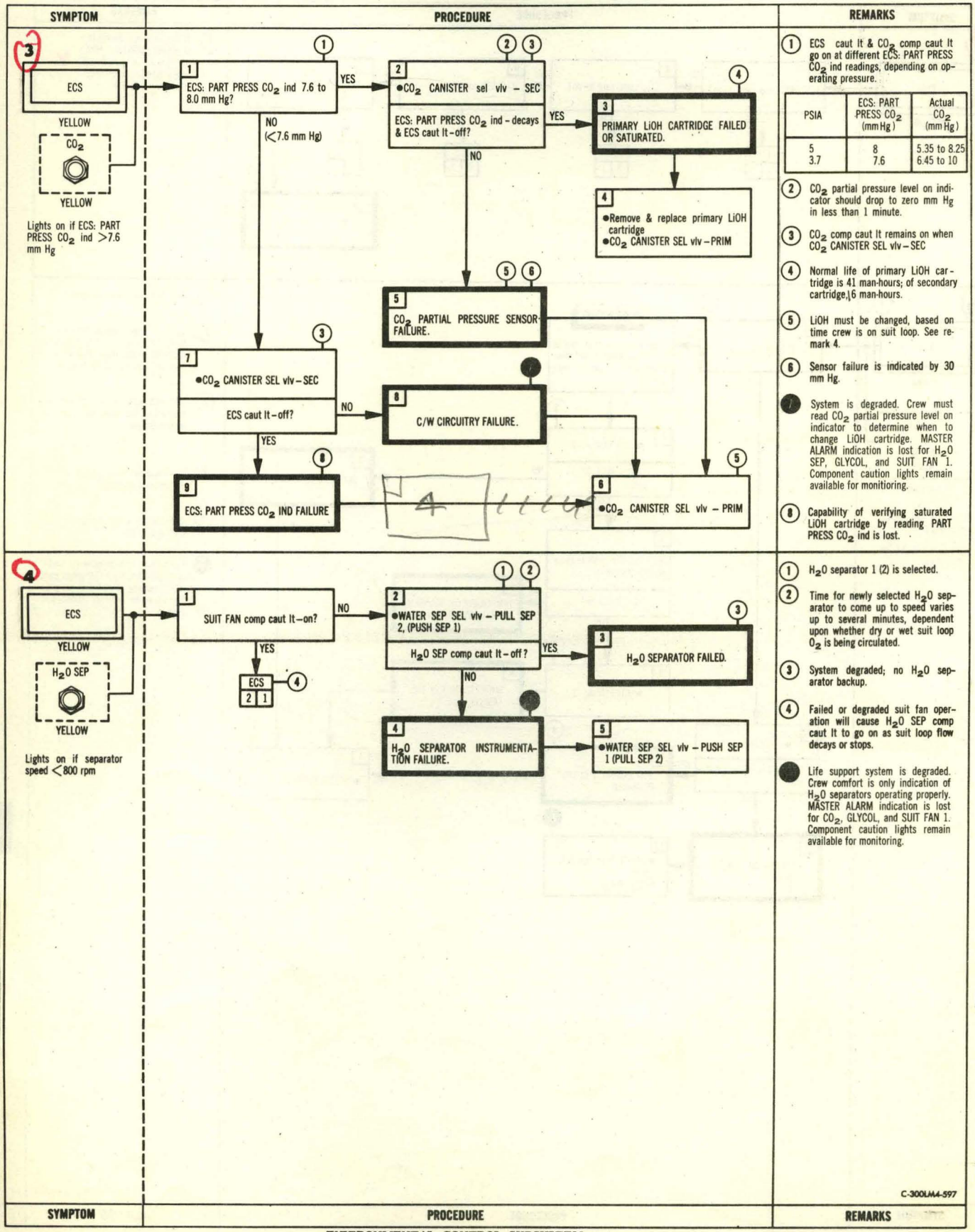
Table 5-22. ECS Failure/Symptom Cross-Reference Index (cont)

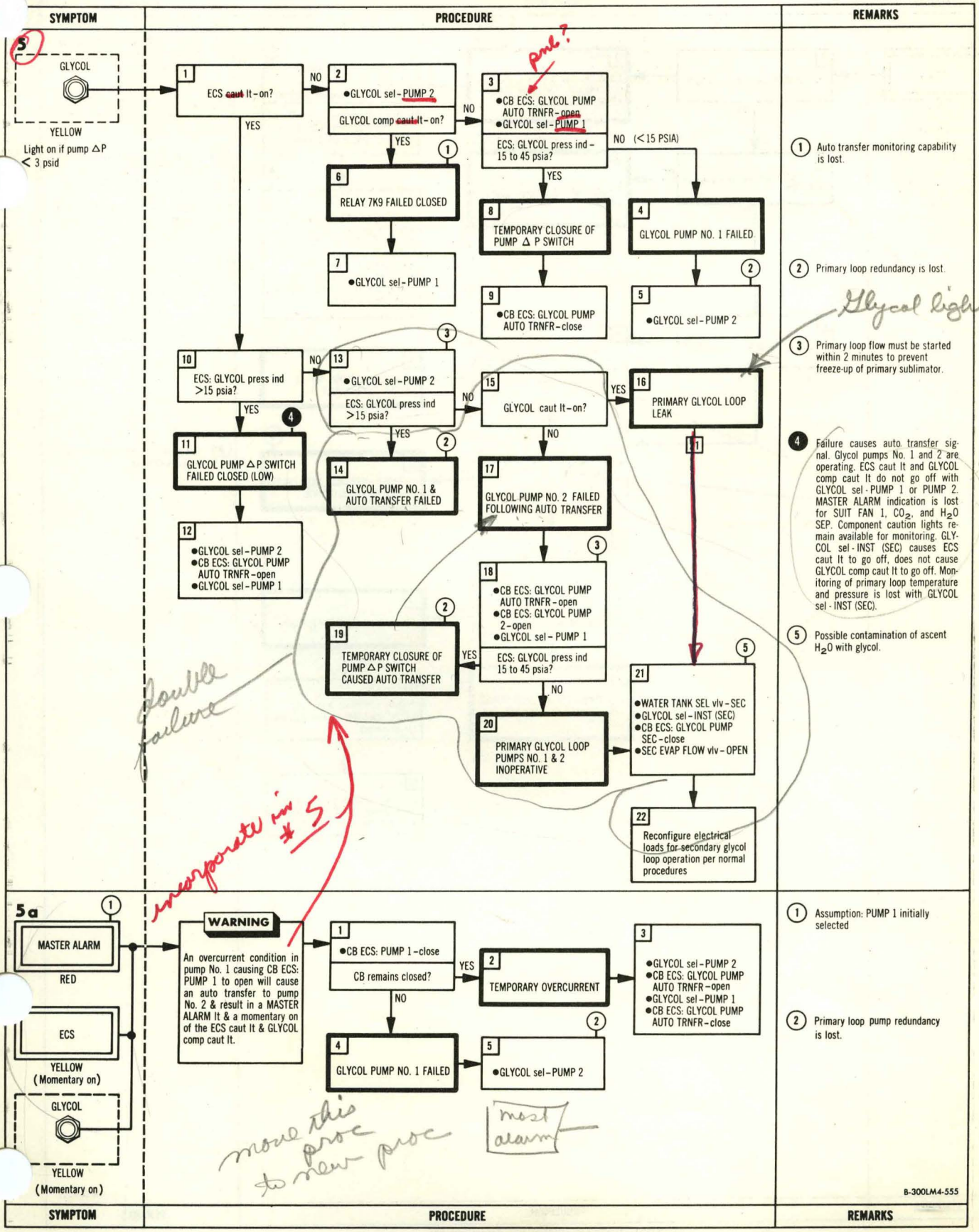
Failure	Symptom	Sym No.	Page No.
Primary pressure reg failed closed or a line blockage	GLYCOL caut lt	6	5.2-126
Primary sublimator failure	GLYCOL caut lt	6	5.2-126
ΔP switch failure or CWEA failure	SUIT/FAN warn lt	13	5.2-132
Relay 7K5 failed open	ECS: CABIN TEMP ind high	9	5.2-129
Relay 7K7 contacts failed closed	CABIN warn lt	7	5.2-127
Relay 7K9 failed closed	GLYCOL comp caut lt	5	5.2-125
Short circuit between CABIN REPRESS vlv & cabin pressure sw	CABIN warn lt	7	5.2-127
Short circuit in ECS display circuitry	ECS: PRESS, GLYCOL, & QUANTITY ind pwr fail lts on	15	5.2-134
Short circuit of suit fan No. 1	ECS caut lt & SUIT FAN comp caut lt	2	5.2-123
Suit fan ΔP sensor failed	ECS caut lt & SUIT FAN comp caut lt	2	5.2-123
Suit fan ΔP sw failed	SUIT/FAN warn lt	13	5.2-132
Suit fan No. 1 failed	ECS caut lt & SUIT FAN comp caut lt	2	5.2-123
Suit fan No. 1 output degraded	ECS caut lt & SUIT FAN comp caut lt	2	5.2-123
Suit fan No. 2 failed	SUIT/FAN warn lt	13	5.2-132
Suit pressure xducer failed	ECS: SUIT PRESS ind >4.0 psia	10	5.2-129
	SUIT/FAN warn lt	13	5.2-132
Temporary closure of pump ΔP switch	GLYCOL comp caut lt	5	5.2-125
Temporary closure of pump ΔP switch caused auto transfer	GLYCOL comp caut lt	5	5.2-125
Temporary leak inside cabin	High cabin pressure	14	5.2-133
Temporary overcurrent	MASTER ALARM pb/lt, ECS caut lt, & GLYCOL comp caut lt	5a	5.2-125
Temporary overcurrent opened CB	ECS: CABIN TEMP ind high	9	5.2-129
Temporary overcurrent to suit fan No. 1	ECS caut lt & SUIT FAN comp caut lt	2	5.2-123
Temporary unseating of cabin relief & dump vlv (fwd or ovhd)	CABIN warn lt	7	5.2-127
Temporary unseating of CABIN REPRESS vlv or temporarily failed-open pressure reg	Abnormal decay of descent O2 before C/W activation	12	5.2-131
Thermal overload or degraded performance of primary sublimator	GLYCOL caut lt	6	5.2-126
Xducer failed or loss of ascent 1 O2	O2 QTY caut lt	11	5.2-130

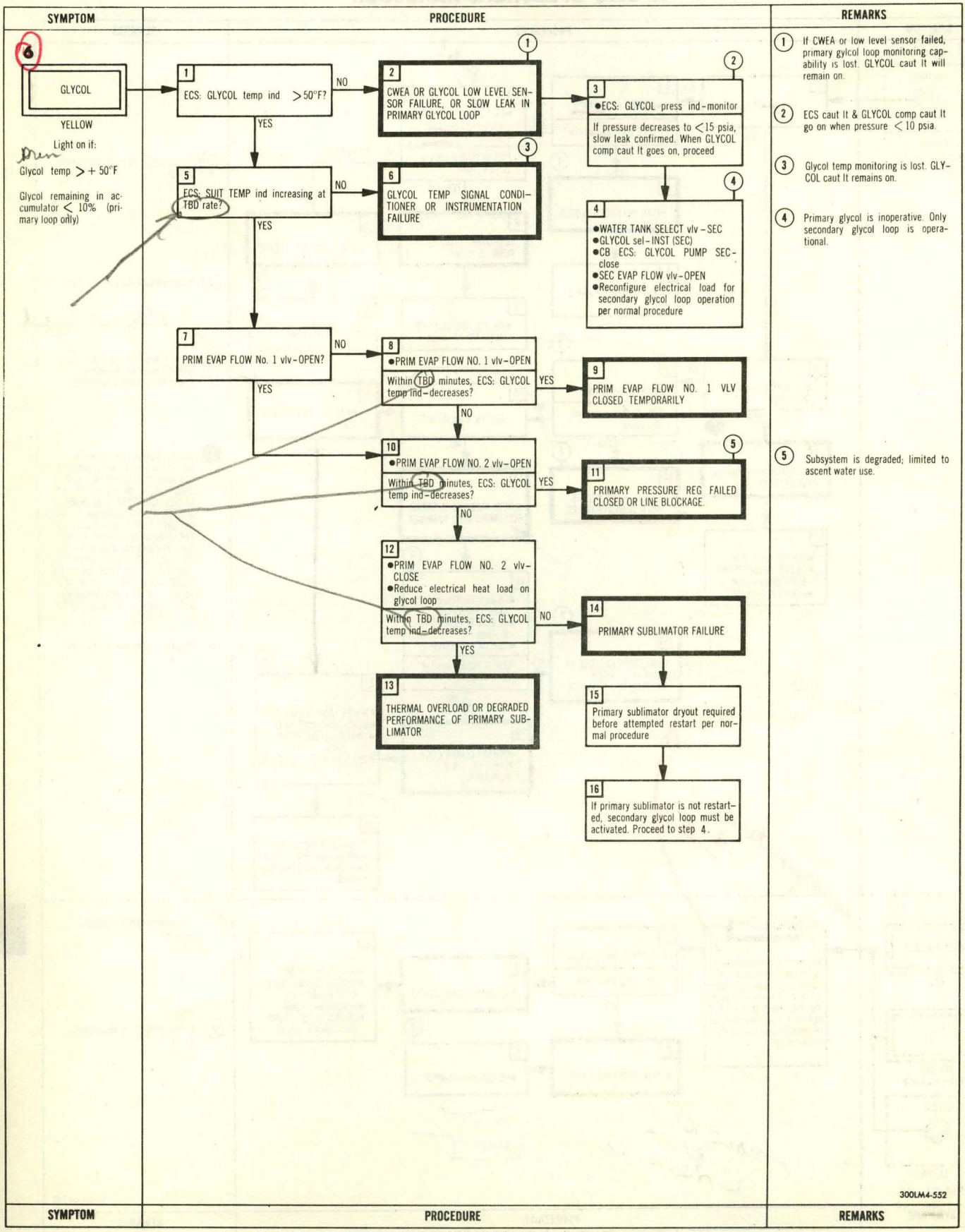
Table 5-22. ECS Failure/Symptom Cross-Reference Index (cont)

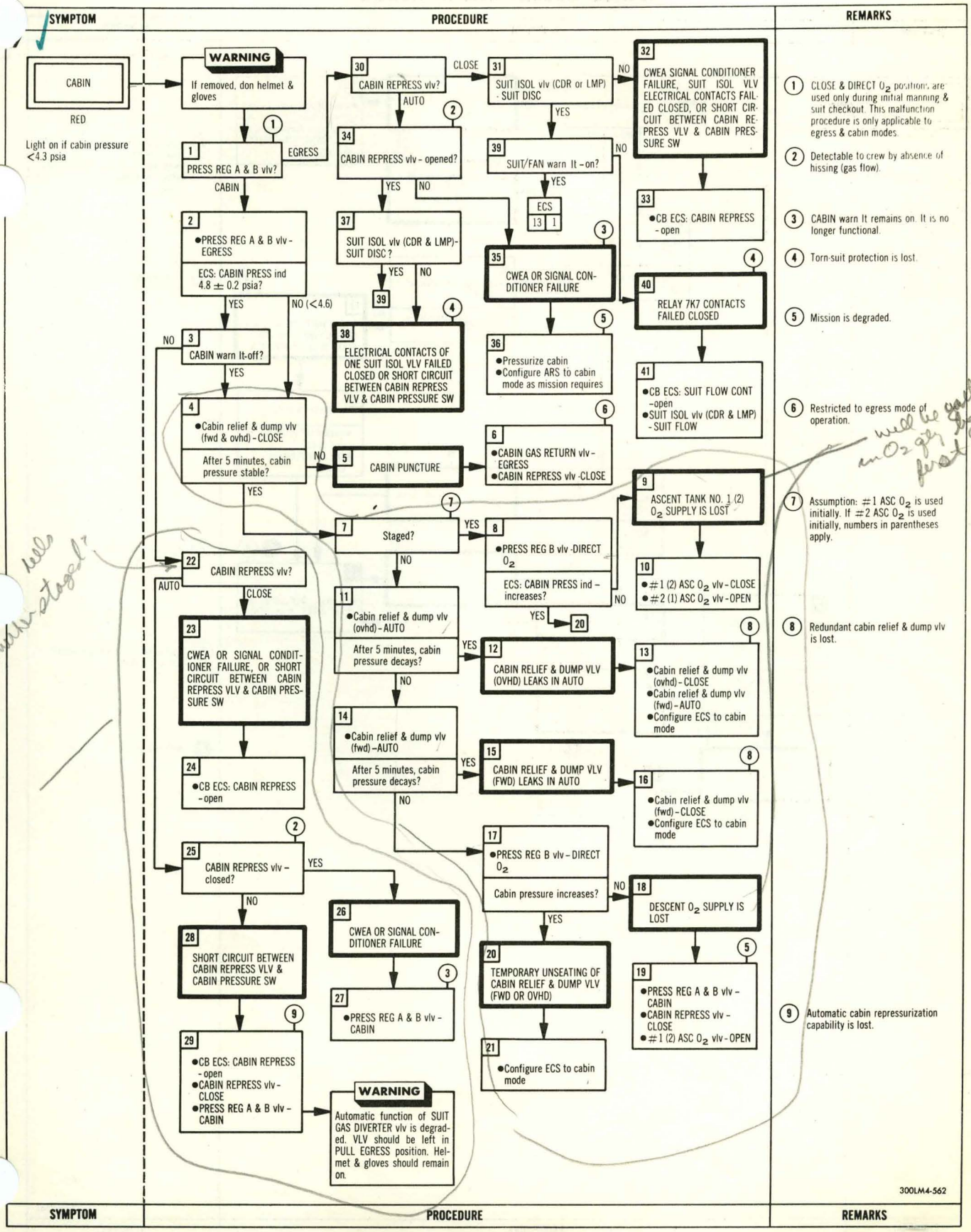
Failure	Symptom	Sym No.	Page No.
Xducer failure	O2 QTY caut lt	11	5.2-130
Xducer failure or H20 or N2 leak in tank with lesser quantity	WATER QTY caut lt	8	5.2-128
Xducer failure or loss of #1 ASC O2 outside cabin	O2 QTY caut lt	11	5.2-130
Xducer failure or loss of #2 ASC O2 outside cabin	O2 QTY caut lt	11	5.2-130
7K5 relay grounded	ECS: CABIN TEMP ind high	9	5.2-129


SYMPTOM
PROCEDURE
REMARKS
1
ECS
YELLOW
1 SUIT FAN comp caut lt–on?
NO
2 CO_2 comp caut lt–on?
NO
3 H_2O SEP comp caut lt–on?
NO
4 GLYCOL comp caut lt–on?
YES
ECS 2 1
ECS 3 1
ECS 4 1
ECS 5 2
NO
1
5 C/W CIRCUITRY FAILURE
(1) ECS caution monitoring is degraded. MASTER ALARM pb/lts & comp caut lts are only indication to crew of symptoms 2, 3, & 4.
2
1
ECS
YELLOW
SUIT FAN
YELLOW
Light on if fan ΔP<6 inches H_2O
Light off if fan ΔP>8 inches H_2O
2
1 Flow in suit loop?
NO
WARNING
Crew can be asphyxiated in 1 to 3 minutes if suit flow stops when crew is fully suited.
YES
3
2 •SUIT FAN sel–2
CB ECS: SUIT FAN 1–open?
NO
3 SUIT FAN NO. 1 FAILED.
YES
5 •CB ECS: SUIT FAN 1–close
•SUIT FAN sel–1
Suit loop flow?
YES
6 TEMPORARY OVERCURRENT TO SUIT FAN NO. 1
NO
3
7 •SUIT FAN sel–2
8 SHORT CIRCUIT OF SUIT FAN NO. 1
4
9 •SUIT FAN sel–2
SUIT FAN comp caut lt–off?
YES
10 SUIT FAN NO. 1 OUTPUT DEGRADED
5
4 •CB ECS: SUIT FAN 1–open
NO
6
11 SUIT FAN ΔP SENSOR FAILED
12 •CB ECS: SUIT FAN ΔP–open
•SUIT FAN sel–1
(1) SUIT FAN No. 1 was selected.
(2) Suit loop flow is sensed by crew. H_2O SEP comp caut lt may go on as result of no flow from ARS. This does not indicate second failure.
(3) SUIT/FAN warn lt will go on momentarily. This does not indicate second failure.
(4) Crew may not have sensed reduction in suit flow.
(5) Life support system is degraded; no backup suit fan.
(6) Fan failure input to crew via CWEA is inoperative. H_2O SEP comp caut lt and sensing of suit flow are only indication to crew of failed suit flow.
B-300LM4-551
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
3
ECS
YELLOW
CO_2
YELLOW
Lights on if ECS: PART PRESS CO_2 ind >7.6 mm Hg
1
ECS: PART PRESS CO_2 ind 7.6 to 8.0 mm Hg?
YES
NO (<7.6 mm Hg)
2
•CO_2 CANISTER sel vlv – SEC
ECS: PART PRESS CO_2 ind – decays & ECS caut lt–off?
YES
NO
3
PRIMARY LiOH CARTRIDGE FAILED OR SATURATED.
4
•Remove & replace primary LiOH cartridge
•CO_2 CANISTER SEL vlv – PRIM
5
CO_2 PARTIAL PRESSURE SENSOR FAILURE.
7
•CO_2 CANISTER SEL vlv – SEC
ECS caut lt–off?
NO
YES
8
C/W CIRCUITRY FAILURE.
9
ECS: PART PRESS CO_2 IND FAILURE
6
•CO_2 CANISTER SEL vlv – PRIM
1 CO_2 comp caut lt & CO_2 comp caut lt go on at different ECS: PART PRESS CO_2 ind readings, depending on operating pressure.
PSIA | ECS: PART PRESS CO_2 (mm Hg) | Actual CO_2 (mm Hg)
5 | 8 | 5.35 to 8.25
3.7 | 7.6 | 6.45 to 10
2 CO_2 partial pressure level on indicator should drop to zero mm Hg in less than 1 minute.
3 CO_2 comp caut lt remains on when CO_2 CANISTER SEL vlv – SEC
4 Normal life of primary LiOH cartridge is 41 man-hours; of secondary cartridge, 6 man-hours.
5 LiOH must be changed, based on time crew is on suit loop. See remark 4.
6 Sensor failure is indicated by 30 mm Hg.
7 System is degraded. Crew must read CO_2 partial pressure level on indicator to determine when to change LiOH cartridge. MASTER ALARM indication is lost for H_2O SEP, GLYCOL, and SUIT FAN 1. Component caution lights remain available for monitioring.
8 Capability of verifying saturated LiOH cartridge by reading PART PRESS CO_2 ind is lost.
4
ECS
YELLOW
H_2O SEP
YELLOW
Lights on if separator speed <800 rpm
1
SUIT FAN comp caut lt–on?
NO
YES
ECS 2 1
2
•WATER SEP SEL vlv – PULL SEP 2, (PUSH SEP 1)
H_2O SEP comp caut lt–off?
YES
NO
3
H_2O SEPARATOR FAILED.
4
H_2O SEPARATOR INSTRUMENTATION FAILURE.
5
•WATER SEP SEL vlv – PUSH SEP 1 (PULL SEP 2)
1 H_2O separator 1 (2) is selected.
2 Time for newly selected H_2O separator to come up to speed varies up to several minutes, dependent upon whether dry or wet suit loop O_2 is being circulated.
3 System degraded; no H_2O separator backup.
4 Failed or degraded suit fan operation will cause H_2O SEP comp caut lt to go on as suit loop flow decays or stops.
Life support system is degraded. Crew comfort is only indication of H_2O separators operating properly. MASTER ALARM indication is lost for CO_2, GLYCOL, and SUIT FAN 1. Component caution lights remain available for monitoring.
C-300LM4-597
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
5
GLYCOL
YELLOW
Light on if pump ΔP < 3 psid
1 ECS caut lt-on?
NO
YES
2 •GLYCOL sel-PUMP 2
GLYCOL comp caut lt-on?
NO
YES
3 •CB ECS: GLYCOL PUMP AUTO TRNFR-open
•GLYCOL sel-PUMP 1
ECS: GLYCOL press ind-15 to 45 psia?
NO (<15 PSIA)
YES
6 RELAY 7K9 FAILED CLOSED
7 •GLYCOL sel-PUMP 1
8 TEMPORARY CLOSURE OF PUMP Δ P SWITCH
9 •CB ECS: GLYCOL PUMP AUTO TRNFR-close
4 GLYCOL PUMP NO. 1 FAILED
5 •GLYCOL sel-PUMP 2
10 ECS: GLYCOL press ind >15 psia?
NO
YES
11 GLYCOL PUMP ΔP SWITCH FAILED CLOSED (LOW)
12 •GLYCOL sel-PUMP 2
•CB ECS: GLYCOL PUMP AUTO TRNFR-open
•GLYCOL sel-PUMP 1
13 •GLYCOL sel-PUMP 2
ECS: GLYCOL press ind >15 psia?
NO
YES
14 GLYCOL PUMP NO. 1 & AUTO TRANSFER FAILED
15 GLYCOL caut lt-on?
YES
NO
16 PRIMARY GLYCOL LOOP LEAK
17 GLYCOL PUMP NO. 2 FAILED FOLLOWING AUTO TRANSFER
18 •CB ECS: GLYCOL PUMP AUTO TRNFR-open
•CB ECS: GLYCOL PUMP 2-open
•GLYCOL sel-PUMP 1
ECS: GLYCOL press ind 15 to 45 psia?
YES
NO
19 TEMPORARY CLOSURE OF PUMP ΔP SWITCH CAUSED AUTO TRANSFER
20 PRIMARY GLYCOL LOOP PUMPS NO. 1 & 2 INOPERATIVE
21 •WATER TANK SEL vlv-SEC
•GLYCOL sel-INST (SEC)
•CB ECS: GLYCOL PUMP SEC-close
•SEC EVAP FLOW vlv-OPEN
22 Reconfigure electrical loads for secondary glycol loop operation per normal procedures
1 Auto transfer monitoring capability is lost.
2 Primary loop redundancy is lost.
3 Primary loop flow must be started within 2 minutes to prevent freeze-up of primary sublimator.
4 Failure causes auto. transfer signal. Glycol pumps No. 1 and 2 are operating. ECS caut lt and GLYCOL comp caut lt do not go off with GLYCOL sel-PUMP 1 or PUMP 2. MASTER ALARM indication is lost for SUIT FAN 1, CO_2, and H_2O SEP. Component caution lights remain available for monitoring. GLYCOL sel-INST (SEC) causes ECS caut lt to go off, does not cause GLYCOL comp caut lt to go off. Monitoring of primary loop temperature and pressure is lost with GLYCOL sel-INST (SEC).
5 Possible contamination of ascent H_2O with glycol.
5a
MASTER ALARM
RED
ECS
YELLOW (Momentary on)
GLYCOL
YELLOW (Momentary on)
WARNING
An overcurrent condition in pump No. 1 causing CB ECS: PUMP 1 to open will cause an auto transfer to pump No. 2 & result in a MASTER ALARM lt & a momentary on of the ECS caut lt & GLYCOL comp caut lt.
1 •CB ECS: PUMP 1-close
CB remains closed?
YES
NO
2 TEMPORARY OVERCURRENT
3 •GLYCOL sel-PUMP 2
•CB ECS: GLYCOL PUMP AUTO TRNFR-open
•GLYCOL sel-PUMP 1
•CB ECS: GLYCOL PUMP AUTO TRNFR-close
4 GLYCOL PUMP NO. 1 FAILED
5 •GLYCOL sel-PUMP 2
1 Assumption: PUMP 1 initially selected
2 Primary loop pump redundancy is lost.
B-300LM4-555
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
6
GLYCOL
YELLOW
Light on if:
Glycol temp > + 50°F
Glycol remaining in accumulator < 10% (primary loop only)
1 ECS: GLYCOL temp ind >50°F?
NO
YES
2 CWEA OR GLYCOL LOW LEVEL SENSOR FAILURE, OR SLOW LEAK IN PRIMARY GLYCOL LOOP
3 •ECS: GLYCOL press ind-monitor
If pressure decreases to <15 psia, slow leak confirmed. When GLYCOL comp caut lt goes on, proceed
4 •WATER TANK SELECT vlv-SEC
•GLYCOL sel-INST (SEC)
•CB ECS: GLYCOL PUMP SEC-close
•SEC EVAP FLOW vlv-OPEN
•Reconfigure electrical load for secondary glycol loop operation per normal procedure
5 ECS: SUIT TEMP ind increasing at TBD rate?
NO
YES
6 GLYCOL TEMP SIGNAL CONDITIONER OR INSTRUMENTATION FAILURE
7 PRIM EVAP FLOW No. 1 vlv-OPEN?
NO
YES
8 •PRIM EVAP FLOW NO. 1 vlv-OPEN
Within TBD minutes, ECS: GLYCOL temp ind-decreases?
YES
NO
9 PRIM EVAP FLOW NO. 1 VLV CLOSED TEMPORARILY
10 •PRIM EVAP FLOW NO. 2 vlv-OPEN
Within TBD minutes, ECS: GLYCOL temp ind-decreases?
YES
NO
11 PRIMARY PRESSURE REG FAILED CLOSED OR LINE BLOCKAGE.
12 •PRIM EVAP FLOW NO. 2 vlv-CLOSE
•Reduce electrical heat load on glycol loop
Within TBD minutes, ECS: GLYCOL temp ind-decreases?
NO
YES
13 THERMAL OVERLOAD OR DEGRADED PERFORMANCE OF PRIMARY SUBLIMATOR
14 PRIMARY SUBLIMATOR FAILURE
15 Primary sublimator dryout required before attempted restart per normal procedure
16 If primary sublimator is not restarted, secondary glycol loop must be activated. Proceed to step 4.
1 If CWEA or low level sensor failed, primary gylcol loop monitoring capability is lost. GLYCOL caut lt will remain on.
2 ECS caut lt & GLYCOL comp caut lt go on when pressure < 10 psia.
3 Glycol temp monitoring is lost. GLYCOL caut lt remains on.
4 Primary glycol is inoperative. Only secondary glycol loop is operational.
5 Subsystem is degraded; limited to ascent water use.
300LM4-552
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
CABIN
RED
Light on if cabin pressure <4.3 psia
WARNING
If removed, don helmet & gloves
1 PRESS REG A & B vlv?
EGRESS
CABIN
2 •PRESS REG A & B vlv - EGRESS
ECS: CABIN PRESS ind 4.8 ± 0.2 psia?
YES
NO (<4.6)
NO
3 CABIN warn lt-off?
YES
4 •Cabin relief & dump vlv (fwd & ovhd) - CLOSE
After 5 minutes, cabin pressure stable?
NO
5 CABIN PUNCTURE
YES
7 Staged?
YES
NO
8 •PRESS REG B vlv -DIRECT O_2
ECS: CABIN PRESS ind - increases?
NO
YES
20
9 ASCENT TANK NO. 1 (2) O_2 SUPPLY IS LOST
10 •#1 (2) ASC O_2 vlv - CLOSE
•#2 (1) ASC O_2 vlv - OPEN
11 •Cabin relief & dump vlv (ovhd) - AUTO
After 5 minutes, cabin pressure decays?
YES
12 CABIN RELIEF & DUMP VLV (OVHD) LEAKS IN AUTO
13 •Cabin relief & dump vlv (ovhd) - CLOSE
•Cabin relief & dump vlv (fwd) - AUTO
•Configure ECS to cabin mode
14 •Cabin relief & dump vlv (fwd) - AUTO
After 5 minutes, cabin pressure decays?
YES
15 CABIN RELIEF & DUMP VLV (FWD) LEAKS IN AUTO
16 •Cabin relief & dump vlv (fwd) - CLOSE
•Configure ECS to cabin mode
17 •PRESS REG B vlv - DIRECT O_2
Cabin pressure increases?
NO
YES
18 DESCENT O_2 SUPPLY IS LOST
19 •PRESS REG A & B vlv - CABIN
•CABIN REPRESS vlv - CLOSE
•#1 (2) ASC O_2 vlv - OPEN
20 TEMPORARY UNSEATING OF CABIN RELIEF & DUMP VLV (FWD OR OVHD)
21 •Configure ECS to cabin mode
22 CABIN REPRESS vlv?
AUTO
CLOSE
23 CWEA OR SIGNAL CONDITIONER FAILURE, OR SHORT CIRCUIT BETWEEN CABIN REPRESS VLV & CABIN PRESSURE SW
24 •CB ECS: CABIN REPRESS - open
25 CABIN REPRESS vlv - closed?
YES
NO
26 CWEA OR SIGNAL CONDITIONER FAILURE
27 •PRESS REG A & B vlv - CABIN
28 SHORT CIRCUIT BETWEEN CABIN REPRESS VLV & CABIN PRESSURE SW
29 •CB ECS: CABIN REPRESS - open
•CABIN REPRESS vlv - CLOSE
•PRESS REG A & B vlv - CABIN
WARNING
Automatic function of SUIT GAS DIVERTER vlv is degraded. VLV should be left in PULL EGRESS position. Helmet & gloves should remain on.
30 CABIN REPRESS vlv?
CLOSE
AUTO
31 SUIT ISOL vlv (CDR or LMP) - SUIT DISC
NO
YES
32 CWEA SIGNAL CONDITIONER FAILURE, SUIT ISOL VLV ELECTRICAL CONTACTS FAILED CLOSED, OR SHORT CIRCUIT BETWEEN CABIN REPRESS VLV & CABIN PRESSURE SW
33 •CB ECS: CABIN REPRESS - open
34 CABIN REPRESS vlv - opened?
YES
NO
37 SUIT ISOL vlv (CDR & LMP) - SUIT DISC?
YES
NO
38 ELECTRICAL CONTACTS OF ONE SUIT ISOL VLV FAILED CLOSED OR SHORT CIRCUIT BETWEEN CABIN REPRESS VLV & CABIN PRESSURE SW
39 SUIT/FAN warn lt - on?
YES
NO
ECS 13 1
35 CWEA OR SIGNAL CONDITIONER FAILURE
36 •Pressurize cabin
•Configure ARS to cabin mode as mission requires
6 •CABIN GAS RETURN vlv - EGRESS
•CABIN REPRESS vlv - CLOSE
40 RELAY 7K7 CONTACTS FAILED CLOSED
41 •CB ECS: SUIT FLOW CONT - open
•SUIT ISOL vlv (CDR & LMP) - SUIT FLOW
1 CLOSE & DIRECT O_2 positions are used only during initial manning & suit checkout. This malfunction procedure is only applicable to egress & cabin modes.
2 Detectable to crew by absence of hissing (gas flow).
3 CABIN warn lt remains on. It is no longer functional.
4 Torn-suit protection is lost.
5 Mission is degraded.
6 Restricted to egress mode of operation.
7 Assumption: #1 ASC O_2 is used initially. If #2 ASC O_2 is used initially, numbers in parentheses apply.
8 Redundant cabin relief & dump vlv is lost.
9 Automatic cabin repressurization capability is lost.
300LM4-562

SYMPTOM	PROCEDURE	REMARKS

8

WATER QTY

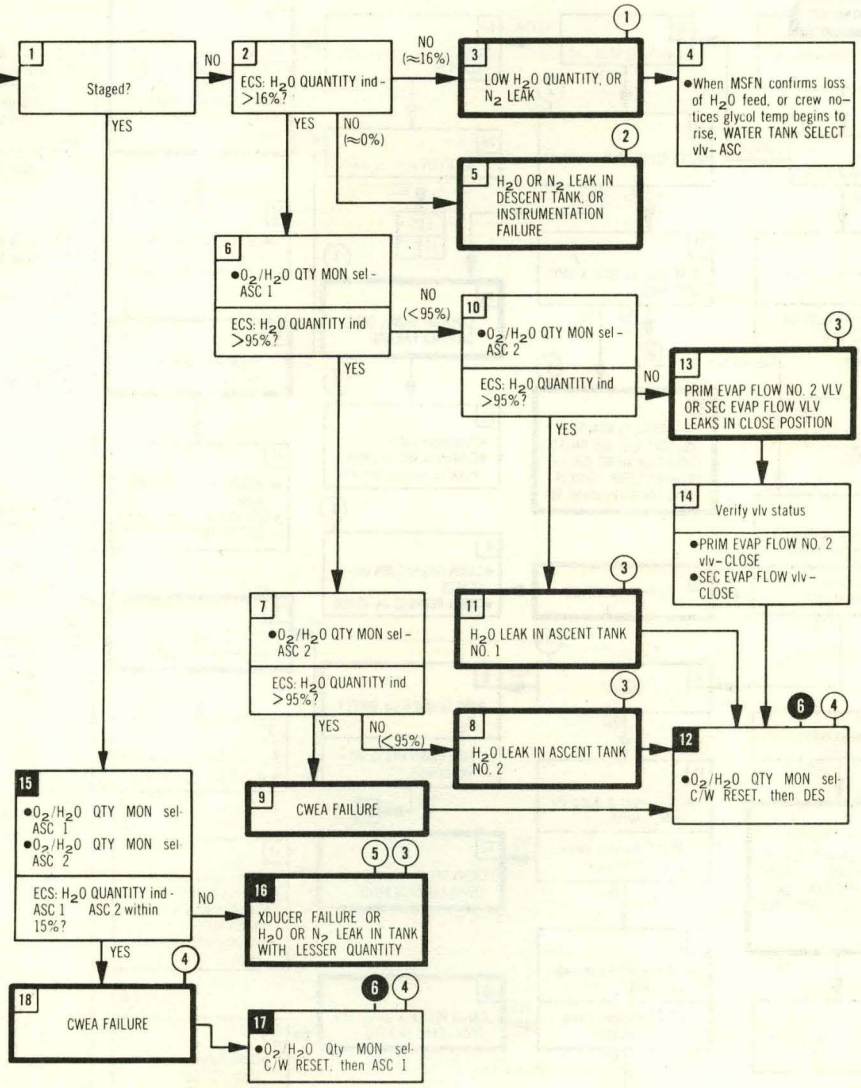
YELLOW

Light on if:

Descent H_2O quantity $<16\%$

When unstaged, either ascent H_2O tank quantity is $<95\%$

When staged, H_2O quantity in ascent tank No. 1 $\neq$ ascent tank No. 2 by $>15\%$



(1) Normal mission use.

(2) H_2O quantity remaining in descent tank is unknown. Increase in glycol temp above +50°F is only indication that descent tank is depleted.

(3) System capability is degraded by loss of H_2O.

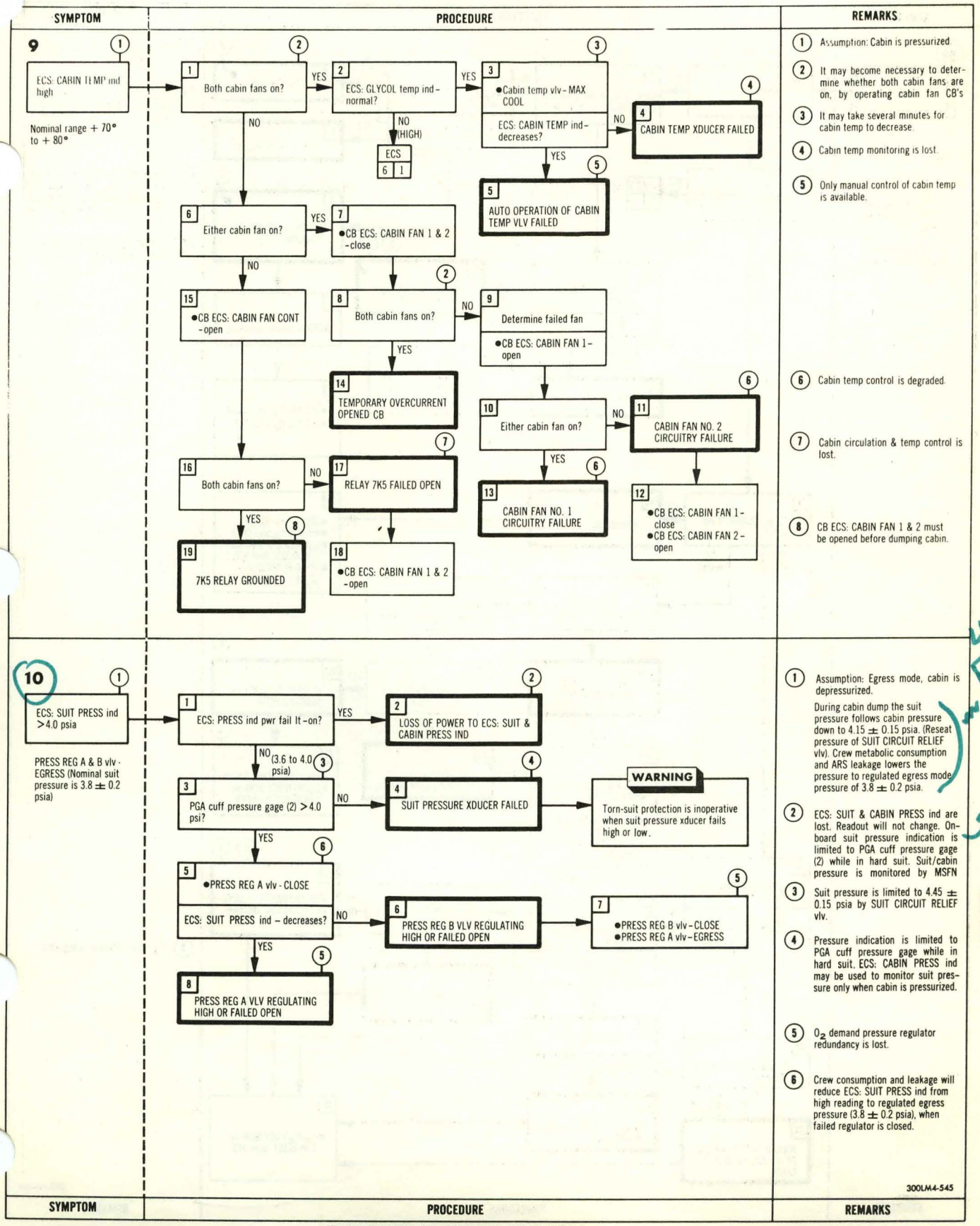
(4) H_2O quantity status is limited to reading of ECS H_2O QUANTITY ind.

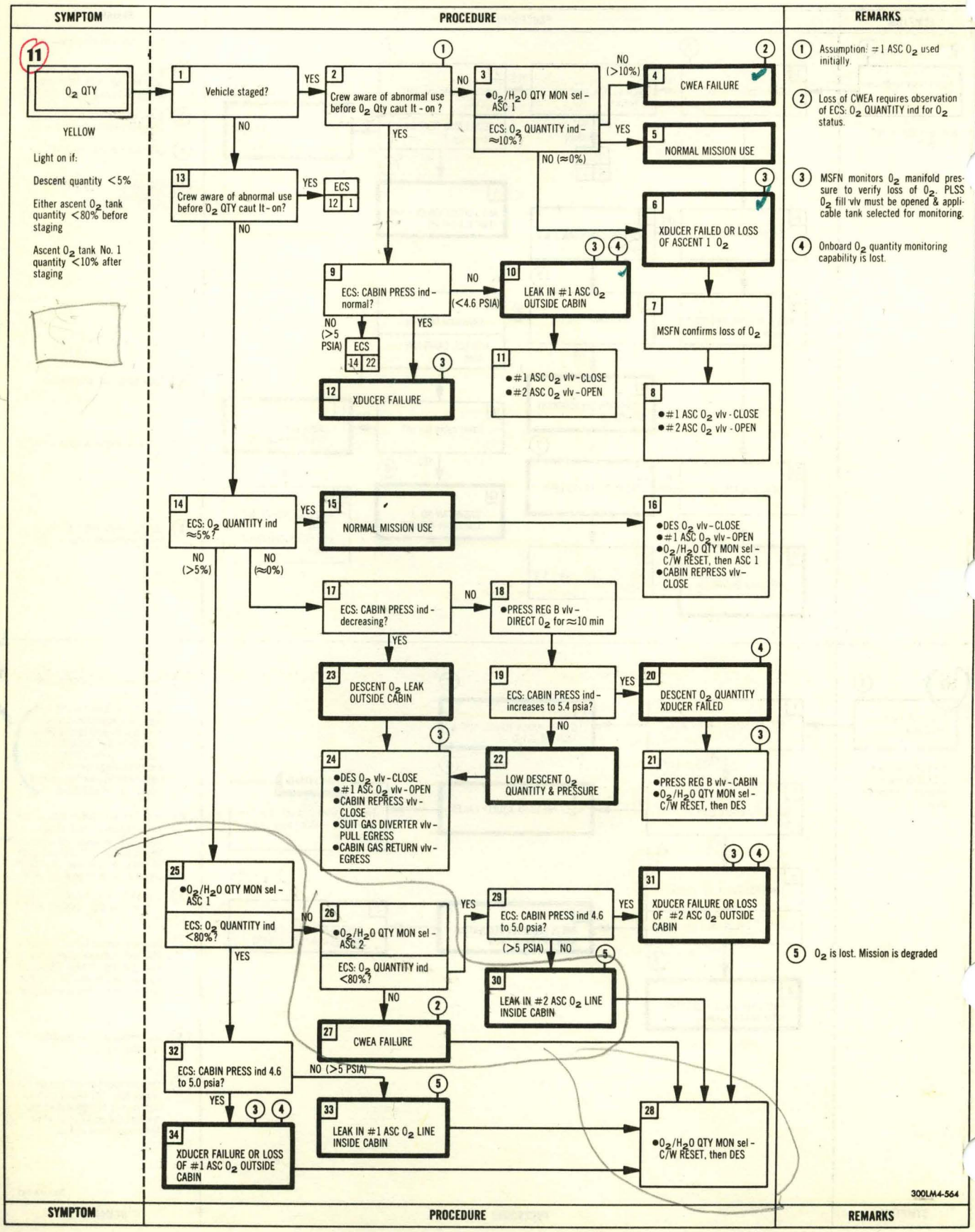
(5) H_2O quantity remaining in ascent tank is unknown.

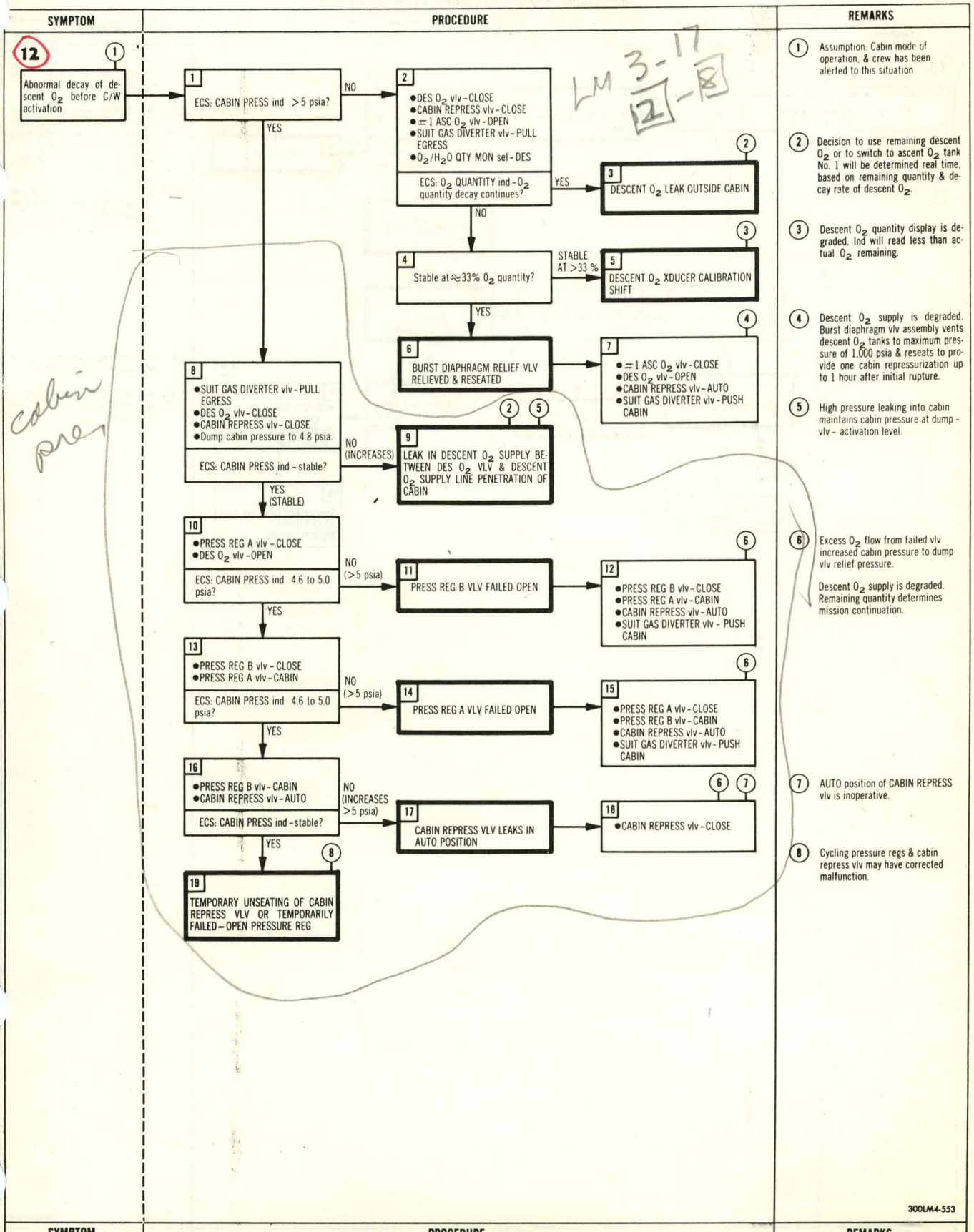
(6) WATER QTY caut lt is reset.

A-300LM4-563

SYMPTOM	PROCEDURE	REMARKS


SYMPTOM
PROCEDURE
REMARKS
9
ECS: CABIN TEMP ind high
Nominal range + 70° to + 80°
1 Both cabin fans on?
YES
2 ECS: GLYCOL temp ind - normal?
NO (HIGH)
ECS 6 1
3 •Cabin temp vlv - MAX COOL
ECS: CABIN TEMP ind - decreases?
NO
4 CABIN TEMP XDUCER FAILED
YES
5 AUTO OPERATION OF CABIN TEMP VLV FAILED
NO
6 Either cabin fan on?
YES
7 •CB ECS: CABIN FAN 1 & 2 - close
NO
15 •CB ECS: CABIN FAN CONT - open
8 Both cabin fans on?
NO
9 Determine failed fan
•CB ECS: CABIN FAN 1 - open
YES
14 TEMPORARY OVERCURRENT OPENED CB
10 Either cabin fan on?
NO
11 CABIN FAN NO. 2 CIRCUITRY FAILURE
YES
13 CABIN FAN NO. 1 CIRCUITRY FAILURE
12 •CB ECS: CABIN FAN 1 - close
•CB ECS: CABIN FAN 2 - open
16 Both cabin fans on?
NO
17 RELAY 7K5 FAILED OPEN
YES
19 7K5 RELAY GROUNDED
18 •CB ECS: CABIN FAN 1 & 2 - open
(1) Assumption: Cabin is pressurized.
(2) It may become necessary to determine whether both cabin fans are on, by operating cabin fan CB's
(3) It may take several minutes for cabin temp to decrease.
(4) Cabin temp monitoring is lost.
(5) Only manual control of cabin temp is available.
(6) Cabin temp control is degraded.
(7) Cabin circulation & temp control is lost.
(8) CB ECS: CABIN FAN 1 & 2 must be opened before dumping cabin.
10
ECS: SUIT PRESS ind >4.0 psia
PRESS REG A & B vlv - EGRESS (Nominal suit pressure is 3.8 ± 0.2 psia)
1 ECS: PRESS ind pwr fail lt - on?
YES
2 LOSS OF POWER TO ECS: SUIT & CABIN PRESS IND
NO (3.6 to 4.0 psia)
3 PGA cuff pressure gage (2) > 4.0 psi?
NO
4 SUIT PRESSURE XDUCER FAILED
WARNING
Torn-suit protection is inoperative when suit pressure xducer fails high or low.
YES
5 •PRESS REG A vlv - CLOSE
ECS: SUIT PRESS ind - decreases?
NO
6 PRESS REG B VLV REGULATING HIGH OR FAILED OPEN
7 •PRESS REG B vlv - CLOSE
•PRESS REG A vlv - EGRESS
YES
8 PRESS REG A VLV REGULATING HIGH OR FAILED OPEN
(1) Assumption: Egress mode, cabin is depressurized.
During cabin dump the suit pressure follows cabin pressure down to 4.15 ± 0.15 psia. (Reseat pressure of SUIT CIRCUIT RELIEF vlv). Crew metabolic consumption and ARS leakage lowers the pressure to regulated egress mode pressure of 3.8 ± 0.2 psia.
(2) ECS: SUIT & CABIN PRESS ind are lost. Readout will not change. On-board suit pressure indication is limited to PGA cuff pressure gage (2) while in hard suit. Suit/cabin pressure is monitored by MSFN
(3) Suit pressure is limited to 4.45 ± 0.15 psia by SUIT CIRCUIT RELIEF vlv.
(4) Pressure indication is limited to PGA cuff pressure gage while in hard suit. ECS: CABIN PRESS ind may be used to monitor suit pressure only when cabin is pressurized.
(5) O_2 demand pressure regulator redundancy is lost.
(6) Crew consumption and leakage will reduce ECS: SUIT PRESS ind from high reading to regulated egress pressure (3.8 ± 0.2 psia), when failed regulator is closed.
300LM4-545
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
11
O_2 QTY
YELLOW
Light on if:
Descent quantity <5%
Either ascent O_2 tank quantity <80% before staging
Ascent O_2 tank No. 1 quantity <10% after staging
1 Vehicle staged?
2 Crew aware of abnormal use before O_2 Qty caut lt - on ?
3 •O_2/H_2O QTY MON sel - ASC 1
ECS: O_2 QUANTITY ind - ≈10%?
4 CWEA FAILURE
5 NORMAL MISSION USE
6 XDUCER FAILED OR LOSS OF ASCENT 1 O_2
7 MSFN confirms loss of O_2
8 •#1 ASC O_2 vlv - CLOSE
•#2 ASC O_2 vlv - OPEN
9 ECS: CABIN PRESS ind - normal?
10 LEAK IN #1 ASC O_2 OUTSIDE CABIN
11 •#1 ASC O_2 vlv - CLOSE
•#2 ASC O_2 vlv - OPEN
12 XDUCER FAILURE
13 Crew aware of abnormal use before O_2 QTY caut lt - on?
ECS 12 1
14 ECS: O_2 QUANTITY ind ≈5%?
15 NORMAL MISSION USE
16 •DES O_2 vlv - CLOSE
•#1 ASC O_2 vlv - OPEN
•O_2/H_2O QTY MON sel - C/W RESET, then ASC 1
•CABIN REPRESS vlv - CLOSE
17 ECS: CABIN PRESS ind - decreasing?
18 •PRESS REG B vlv - DIRECT O_2 for ≈10 min
19 ECS: CABIN PRESS ind - increases to 5.4 psia?
20 DESCENT O_2 QUANTITY XDUCER FAILED
21 •PRESS REG B vlv - CABIN
•O_2/H_2O QTY MON sel - C/W RESET, then DES
22 LOW DESCENT O_2 QUANTITY & PRESSURE
23 DESCENT O_2 LEAK OUTSIDE CABIN
24 •DES O_2 vlv - CLOSE
•#1 ASC O_2 vlv - OPEN
•CABIN REPRESS vlv - CLOSE
•SUIT GAS DIVERTER vlv - PULL EGRESS
•CABIN GAS RETURN vlv - EGRESS
25 •O_2/H_2O QTY MON sel - ASC 1
ECS: O_2 QUANTITY ind <80%?
26 •O_2/H_2O QTY MON sel - ASC 2
ECS: O_2 QUANTITY ind <80%?
27 CWEA FAILURE
28 •O_2/H_2O QTY MON sel - C/W RESET, then DES
29 ECS: CABIN PRESS ind 4.6 to 5.0 psia?
30 LEAK IN #2 ASC O_2 LINE INSIDE CABIN
31 XDUCER FAILURE OR LOSS OF #2 ASC O_2 OUTSIDE CABIN
32 ECS: CABIN PRESS ind 4.6 to 5.0 psia?
33 LEAK IN #1 ASC O_2 LINE INSIDE CABIN
34 XDUCER FAILURE OR LOSS OF #1 ASC O_2 OUTSIDE CABIN
YES
NO
NO (>10%)
NO (≈0%)
NO (<4.6 PSIA)
NO (>5 PSIA)
NO (≈0%)
(>5 PSIA)
1 Assumption: #1 ASC O_2 used initially.
2 Loss of CWEA requires observation of ECS: O_2 QUANTITY ind for O_2 status.
3 MSFN monitors O_2 manifold pressure to verify loss of O_2. PLSS O_2 fill vlv must be opened & applicable tank selected for monitoring.
4 Onboard O_2 quantity monitoring capability is lost.
5 O_2 is lost. Mission is degraded
300LM4-564


SYMPTOM
PROCEDURE
REMARKS
12
Abnormal decay of descent O_2 before C/W activation
1 ECS: CABIN PRESS ind >5 psia?
NO
2 •DES O_2 vlv - CLOSE •CABIN REPRESS vlv - CLOSE •≠1 ASC O_2 vlv - OPEN •SUIT GAS DIVERTER vlv - PULL EGRESS •O_2/H_2O QTY MON sel - DES
ECS: O_2 QUANTITY ind - O_2 quantity decay continues?
YES
3 DESCENT O_2 LEAK OUTSIDE CABIN
NO
4 Stable at ≈33% O_2 quantity?
STABLE AT >33 %
5 DESCENT O_2 XDUCER CALIBRATION SHIFT
YES
6 BURST DIAPHRAGM RELIEF VLV RELIEVED & RESEATED
7 •≠1 ASC O_2 vlv - CLOSE •DES O_2 vlv - OPEN •CABIN REPRESS vlv - AUTO •SUIT GAS DIVERTER vlv - PUSH CABIN
YES
8 •SUIT GAS DIVERTER vlv - PULL EGRESS •DES O_2 vlv - CLOSE •CABIN REPRESS vlv - CLOSE •Dump cabin pressure to 4.8 psia.
ECS: CABIN PRESS ind - stable?
NO (INCREASES)
9 LEAK IN DESCENT O_2 SUPPLY BETWEEN DES O_2 VLV & DESCENT O_2 SUPPLY LINE PENETRATION OF CABIN
YES (STABLE)
10 •PRESS REG A vlv - CLOSE •DES O_2 vlv - OPEN
ECS: CABIN PRESS ind 4.6 to 5.0 psia?
NO (>5 psia)
11 PRESS REG B VLV FAILED OPEN
12 •PRESS REG B vlv - CLOSE •PRESS REG A vlv - CABIN •CABIN REPRESS vlv - AUTO •SUIT GAS DIVERTER vlv - PUSH CABIN
YES
13 •PRESS REG B vlv - CLOSE •PRESS REG A vlv - CABIN
ECS: CABIN PRESS ind 4.6 to 5.0 psia?
NO (>5 psia)
14 PRESS REG A VLV FAILED OPEN
15 •PRESS REG A vlv - CLOSE •PRESS REG B vlv - CABIN •CABIN REPRESS vlv - AUTO •SUIT GAS DIVERTER vlv - PUSH CABIN
YES
16 •PRESS REG B vlv - CABIN •CABIN REPRESS vlv - AUTO
ECS: CABIN PRESS ind - stable?
NO (INCREASES >5 psia)
17 CABIN REPRESS VLV LEAKS IN AUTO POSITION
18 •CABIN REPRESS vlv - CLOSE
YES
19 TEMPORARY UNSEATING OF CABIN REPRESS VLV OR TEMPORARILY FAILED - OPEN PRESSURE REG
(1) Assumption: Cabin mode of operation, & crew has been alerted to this situation.
(2) Decision to use remaining descent O_2 or to switch to ascent O_2 tank No. 1 will be determined real time, based on remaining quantity & decay rate of descent O_2.
(3) Descent O_2 quantity display is degraded. Ind will read less than actual O_2 remaining.
(4) Descent O_2 supply is degraded. Burst diaphragm vlv assembly vents descent O_2 tanks to maximum pressure of 1,000 psia & reseats to provide one cabin repressurization up to 1 hour after initial rupture.
(5) High pressure leaking into cabin maintains cabin pressure at dump - vlv - activation level.
(6) Excess O_2 flow from failed vlv increased cabin pressure to dump vlv relief pressure.
Descent O_2 supply is degraded. Remaining quantity determines mission continuation.
(7) AUTO position of CABIN REPRESS vlv is inoperative.
(8) Cycling pressure regs & cabin repress vlv may have corrected malfunction.
300LM4-553
SYMPTOM
PROCEDURE
REMARKS

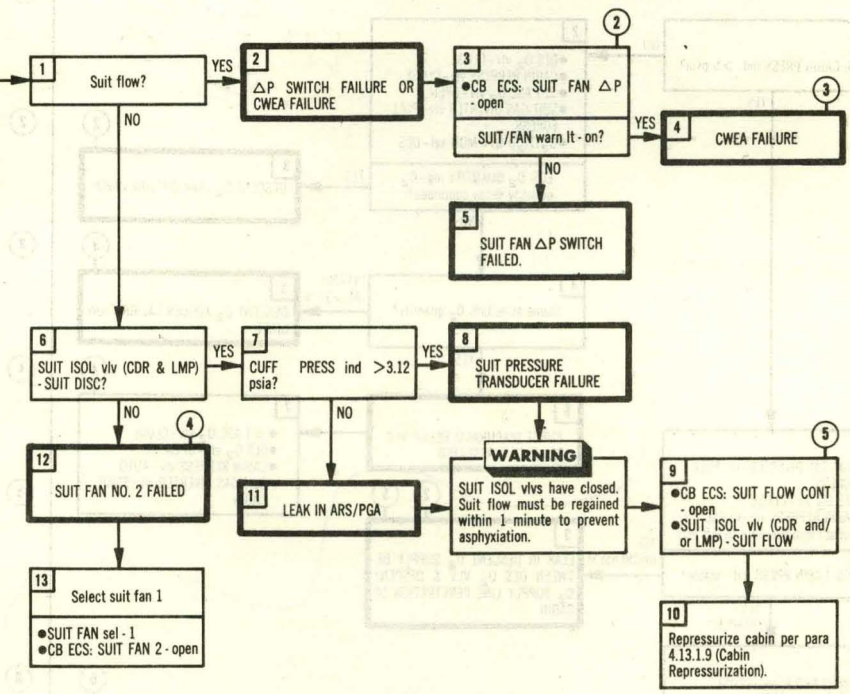
SYMPTOM	PROCEDURE	REMARKS

13

(1) SUIT/FAN

RED

Light on if suit pressure <3.12 psia or suit fan No. 2 fails when selected.



(1) Operating on suit fan No. 2 and suit fan No. 1 is still operable.

(2) SUIT/FAN warning lt and SUIT FAN comp caut lt - off when CB ECS: SUIT FAN ΔP - open. CWEA inputs of suit fan No. 1 or 2 are de-activated. Crew must rely on sensing O_2 flow.

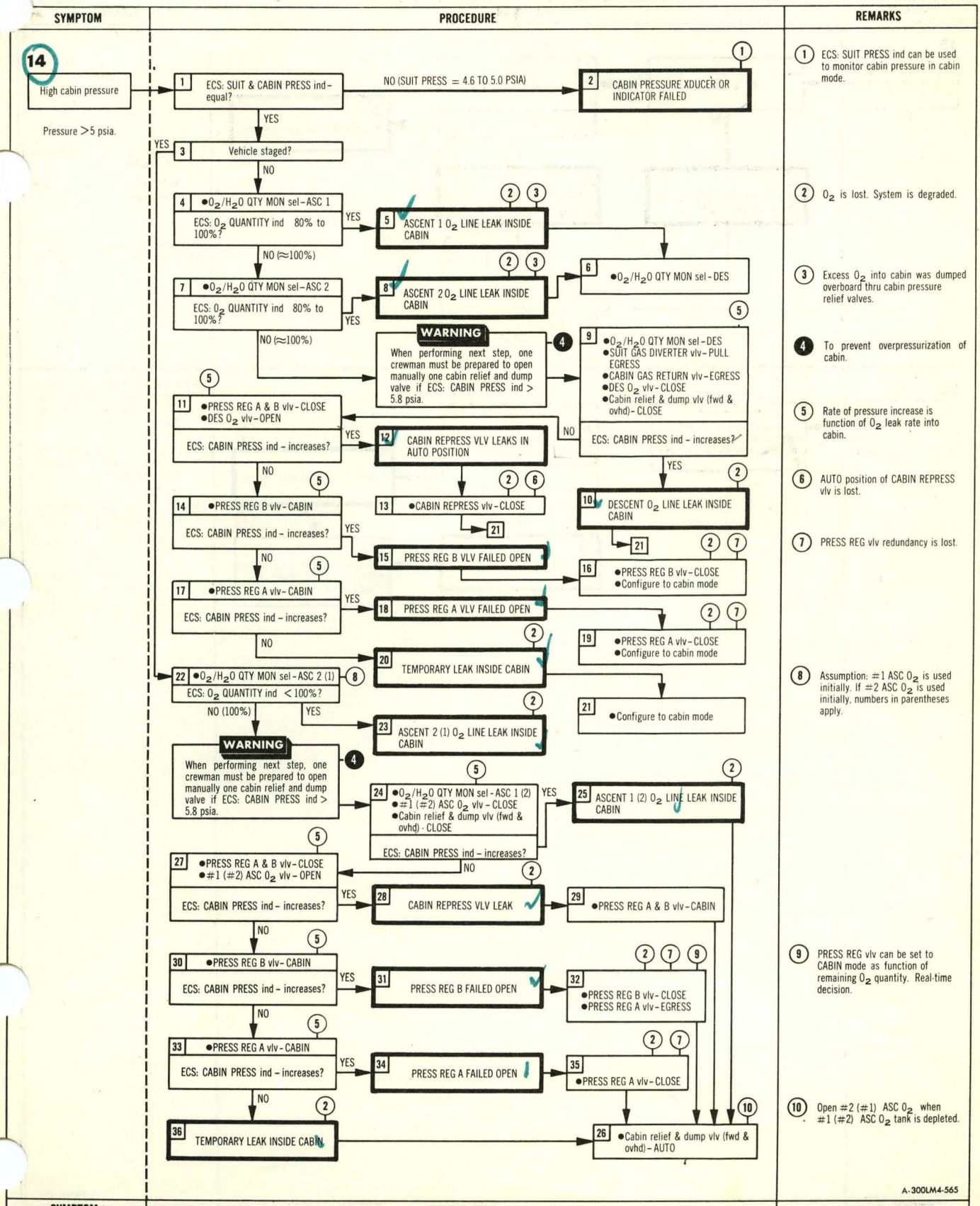
(3) SUIT/FAN warning is lost. If suit fan No. 2 fails, crew must rely on sensing O_2 flow.

(4) H_2O SEP comp caut lt will go on when H_2O separator $\leq$ 800 rps.

(5) Automatic torn suit protection is lost when CB ECS: SUIT FLOW CONT - open.

300LM4-554

SYMPTOM	PROCEDURE	REMARKS



(1) ECS: SUIT PRESS ind can be used to monitor cabin pressure in cabin mode.

(2) O_2 is lost. System is degraded.

(3) Excess O_2 into cabin was dumped overboard thru cabin pressure relief valves.

(4) To prevent overpressurization of cabin.

(5) Rate of pressure increase is function of O_2 leak rate into cabin.

(6) AUTO position of CABIN REPRESS vlv is lost.

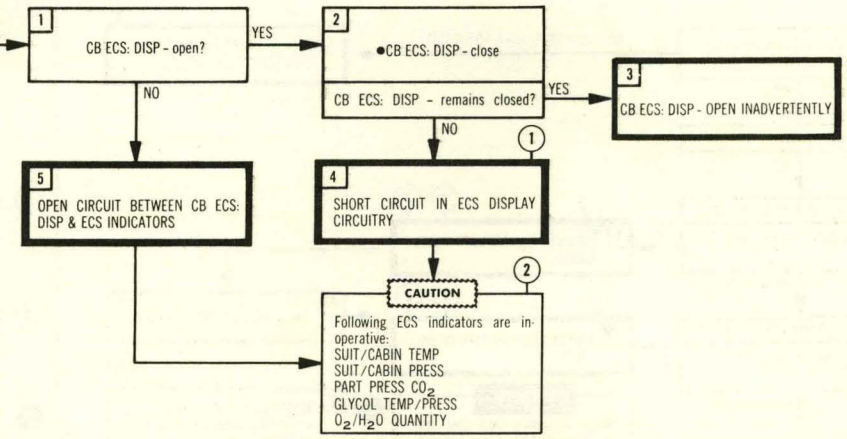
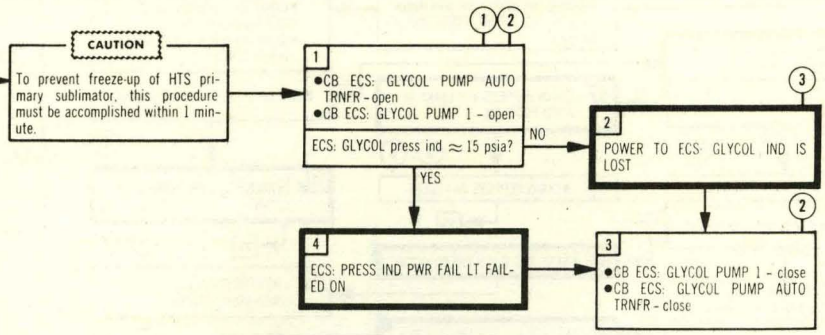
(7) PRESS REG vlv redundancy is lost.

(8) Assumption: #1 ASC O_2 is used initially. If #2 ASC O_2 is used initially, numbers in parentheses apply.

(9) PRESS REG vlv can be set to CABIN mode as function of remaining O_2 quantity. Real-time decision.

(10) Open #2 (#1) ASC O_2 when #1 (#2) ASC O_2 tank is depleted.

ECS

SYMPTOM	PROCEDURE	REMARKS
15 ECS: PRESS, GLYCOL & QUANTITY ind pwr fail lts on RED Lights on if ind 28-vdc power is lost.		(1) Onboard capability for monitoring ECS parameters is lost. MSFN can monitor ECS parameters while in LOS. (2) CWEA still alerts crew to ECS malfunctions, but fault isolation is limited.
16 ECS: GLYCOL ind pwr fail lt on RED Light on if ind 28-vdc power is lost		(1) Assumption: Pump No. 1 initially selected. MASTER ALARM pb/lt, ECS caut lt, & GLYCOL comp caut lt go on. (2) To prevent setting glycol pump automatic transfer circuitry, do not reverse sequence. (3) Onboard capability for monitoring glycol temperature pressure is lost. CWEA still alerts crew to primary glycol-loop malfunction. MSFN can monitor primary glycol-loop operation while in LOS.

B-300LM4-599

SYMPTOM	PROCEDURE	REMARKS

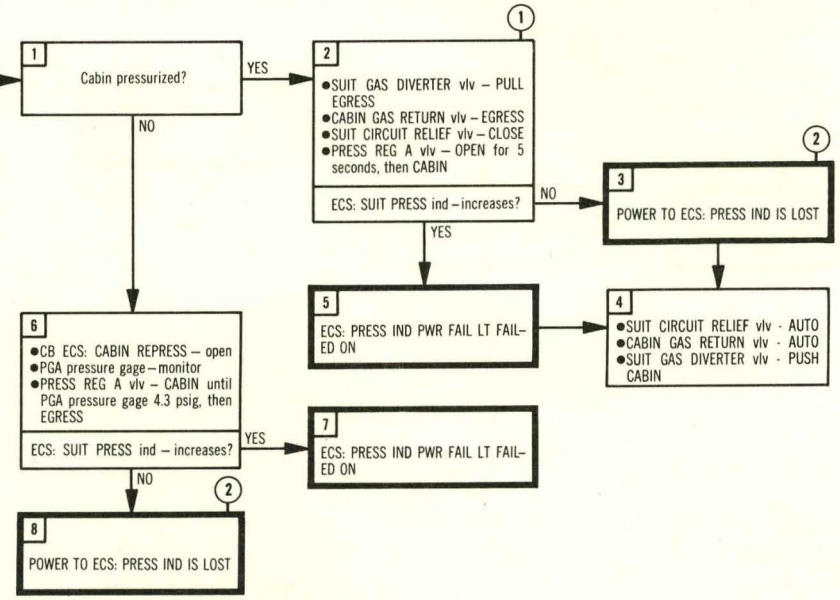
SYMPTOM	PROCEDURE	REMARKS

17

ECS: PRESS ind pwr fail lt on

RED

Light on if ind 28-vdc power is lost.



1. Assumption: Helmet & gloves are donned.

   PGA pressure gage is not useful at this time because minimum reading is 2.5 psig.

2. Onboard capability for monitoring suit & cabin pressure is lost.

   CWEA still alerts crew to low suit or cabin pressure.

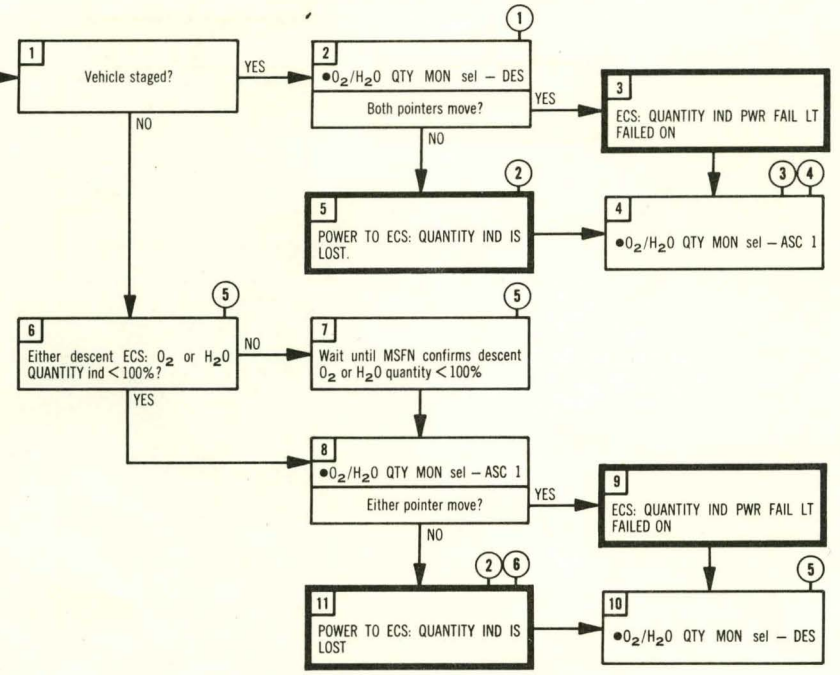
   MSFN can monitor suit & cabin pressure while in LOS.

18

ECS: QUANTITY ind pwr fail lt on

RED

Light on if ind 28-vdc power is lost.



1. DES position of O_2/H_2O QTY MON sel is used to provide a different signal input to determine status of indicator. If indicator has failed, pointers will remain in position indicated when power is lost.

2. Onboard capability for monitoring O_2 and H_2O quantity is lost.

3. Assumption: No. 1 ASC O_2 is being used; therefore, CWEA still alerts crew to low No. 1 ASC O_2 quantity.

4. Allows MSFN to monitor 1 ASC O_2 and H_2O quantity when in LOS.

5. MSFN can monitor descent quantity when in LOS.

6. CWEA still alerts crew to low descent O_2 or H_2O quantity or leak in ASC O_2 or H_2O tanks.

300LM4-600

SYMPTOM	PROCEDURE	REMARKS

ECS

5.2.12 EXPLOSIVE DEVICES

Table 5-23. ED Procedure Entry Sheet

Symptom	Sym No.	Page No.
ED RELAYS caut lt	1	5.2-139
Ascent fuel or oxid tank remains at blanket pressure after ascent pressurization	2	5.2-140
ED: STAGE SEQ RLY SYS A & B comp caut lt not on when attempting to set ED: MASTER ARM sw to ON	3	5.2-140

Table 5-24. ED Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Page No.
Ascent tank pressure indicator or circuitry failure	Ascent fuel or oxid tank remains at blanket pressure after ascent pressurization	2	5.2-140
CWEA failure	ED RELAYS caut lt	1	5.2-139
Double failure of ED: ASC He PRESS sw	Ascent fuel or oxid tank remains at blanket pressure after ascent pressurization	2	5.2-140
Double failure of ED: ASC He SEL sw or explosive vlvs	Ascent fuel or oxid tank remains at blanket pressure after ascent pressurization	2	5.2-140
ED: ASC He PRESS sw contacts did not make on first attempt	Ascent fuel or oxid tank remains at blanket pressure after ascent pressurization	2	5.2-140
ED: MASTER ARM sw contacts did not make on first attempt	ED: STAGE SEQ RLY SYS A & B comp caut lt not on when attempting to set ED: MASTER ARM sw to ON	3	5.2-140
ED: MASTER ARM sw failed off (double failure)	ED: STAGE SEQ RLY SYS A & B comp caut lt not on when attempting to set ED: MASTER ARM sw to ON	3	5.2-140
ED: MASTER ARM sw jammed off	ED: STAGE SEQ RLY SYS A & B comp caut lt not on when attempting to set ED: MASTER ARM sw to ON	3	5.2-140
ED sys A relay K1, K3, K4, K5, or K6 failed closed	ED RELAYS caut lt	1	5.2-139
ED sys A stage command relay K2 temporarily failed closed	ED RELAYS caut lt	1	5.2-139
ED sys B relay K1, K3, K4, K5, or K6 failed closed	ED RELAYS caut lt	1	5.2-139
ED sys B stage command relay K2 temporarily failed closed	ED RELAYS caut lt	1	5.2-139

ED

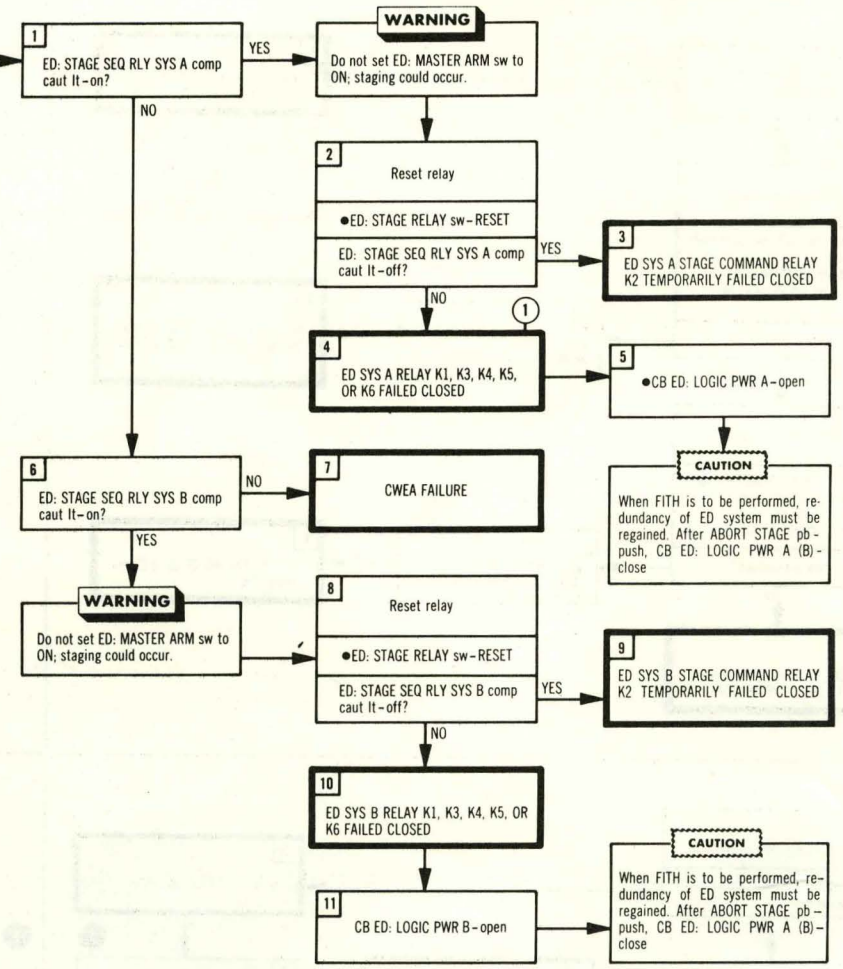
SYMPTOM	PROCEDURE	REMARKS

1

ED RELAYS

YELLOW

Light on if contacts of master arm relay K1 or relay K2 through K6 in staging sequence (stage command, cable cutting, deadfacing, and separation of nuts & bolts) fail closed.

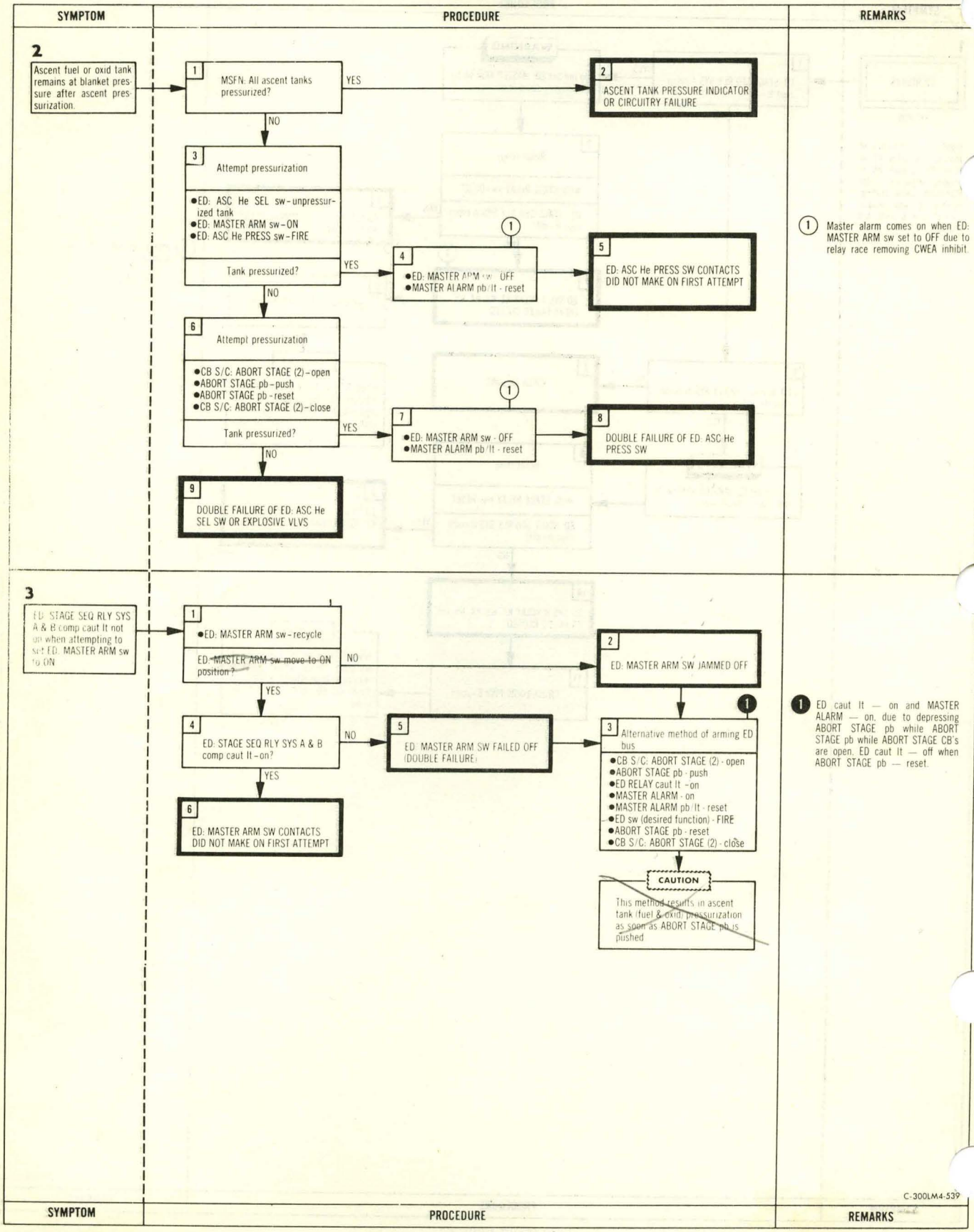


(1) MSFN can confirm failure via telemetry.

300LM4-538

SYMPTOM	PROCEDURE	REMARKS

ED


SYMPTOM
PROCEDURE
REMARKS
2
Ascent fuel or oxid tank remains at blanket pressure after ascent pressurization.
1 MSFN: All ascent tanks pressurized?
YES
2 ASCENT TANK PRESSURE INDICATOR OR CIRCUITRY FAILURE
NO
3 Attempt pressurization
●ED: ASC He SEL sw - unpressurized tank
●ED: MASTER ARM sw - ON
●ED: ASC He PRESS sw - FIRE
Tank pressurized?
YES
1
4 ●ED: MASTER ARM sw - OFF
●MASTER ALARM pb/lt - reset
5 ED: ASC He PRESS SW CONTACTS DID NOT MAKE ON FIRST ATTEMPT
NO
6 Attempt pressurization
●CB S/C: ABORT STAGE (2) - open
●ABORT STAGE pb - push
●ABORT STAGE pb - reset
●CB S/C: ABORT STAGE (2) - close
Tank pressurized?
YES
1
7 ●ED: MASTER ARM sw - OFF
●MASTER ALARM pb/lt - reset
8 DOUBLE FAILURE OF ED: ASC He PRESS SW
NO
9 DOUBLE FAILURE OF ED: ASC He SEL SW OR EXPLOSIVE VLVS
1 Master alarm comes on when ED: MASTER ARM sw set to OFF due to relay race removing CWEA inhibit.
3
ED: STAGE SEQ RLY SYS A & B comp caut lt not on when attempting to set ED: MASTER ARM sw to ON
1 ●ED: MASTER ARM sw - recycle
ED: MASTER ARM sw move to ON position?
NO
2 ED: MASTER ARM SW JAMMED OFF
YES
4 ED: STAGE SEQ RLY SYS A & B comp caut lt - on?
NO
5 ED: MASTER ARM SW FAILED OFF (DOUBLE FAILURE)
1
3 Alternative method of arming ED bus
●CB S/C: ABORT STAGE (2) - open
●ABORT STAGE pb - push
●ED RELAY caut lt - on
●MASTER ALARM - on
●MASTER ALARM pb/lt - reset
●ED sw (desired function) - FIRE
●ABORT STAGE pb - reset
●CB S/C: ABORT STAGE (2) - close
CAUTION
This method results in ascent tank (fuel & oxid) pressurization as soon as ABORT STAGE pb is pushed
YES
6 ED: MASTER ARM SW CONTACTS DID NOT MAKE ON FIRST ATTEMPT
1 ED caut lt — on and MASTER ALARM — on, due to depressing ABORT STAGE pb while ABORT STAGE pb while ABORT STAGE CB's are open. ED caut lt — off when ABORT STAGE pb — reset.
C-300LM4-539
SYMPTOM
PROCEDURE
REMARKS

SYMPTOM	PROCEDURE	REMARKS
4 EPS: VOLTS ind < 35 vdc open circuit	1 Affected battery is considered lost, but will be used in conjunction with other ED system to perform ED functions. ●CB ED: LOGIC PWR A (B) - open	
5 MSFN informs crew: closed failure in relay, (K7 thru K15) of sys A or B	1 Disarm failed ED system. Do not arm system until cryogenic pressurization. ●CB ED: LOGIC PWR A (B) - open	

300LM4-613

SYMPTOM | PROCEDURE | REMARKS

ED

5.2.13 LIGHTING

5.2.13.1 Assumptions

- Troubleshooting will be performed when mission phase and task loading permit. Accordingly, certain malfunction procedures will not be performed until a main engine burn or critical maneuver is completed.
- Malfunction procedures are entered from normal operational modes. Procedures for checkout modes are not included.

Table 5-25. LTG Procedure Entry Sheet

Symptom	Sym No.	Page No.
Overhead floodlights do not go on	1	5.2-147
Overhead floodlights remain on with LTG: FLOOD sw set to OFF & overhead hatch closed	2	5.2-147
EL numerics failed on	3	5.2-147
EL numerics failed off	4	5.2-148
EL panel lights failed off	5	5.2-149
EL panel lights failed on	6	5.2-150
MASTER ALARM pb/lt and tone come on without C/W, or comp caut lts	7	5.2-150
Docking lts do not go on	8	5.2-150
Tracking lt does not go on	9	5.2-150

Table 5-26. LTG Failure/Symptom Cross-Reference Index

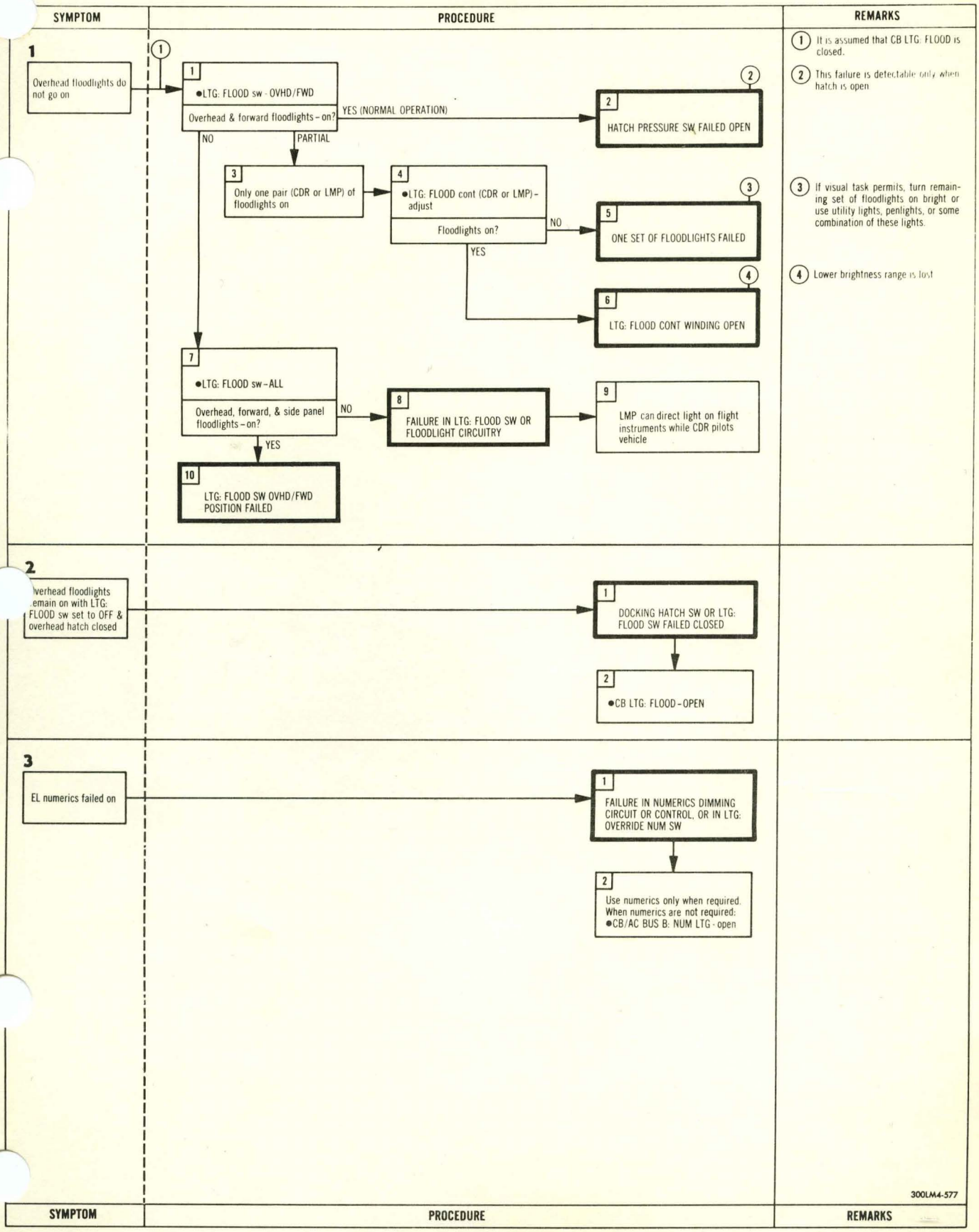
Failure	Symptom	Sym No.	Page No.
A-c dimmer failure	EL numerics failed off	4	5.2-148
Burned-out lamp or blown fuse in single output of lighting control assembly transformer	EL numerics failed off	4	5.2-148
CB failure or short in forward panels EL circuitry	EL panel lights failed off	5	5.2-149
CB left open	Docking lts do not go on	8	5.2-150
Circuitry failure in a-c dimmer high-power assembly	EL panel lights failed off	5	5.2-149
Docking hatch sw or LTG: FLOOD sw failed closed	Overhead floodlights remain on with LTG: FLOOD sw set to OFF & overhead hatch closed	2	5.2-147
Docking lights circuit open	Docking lts do not go on	8	5.2-150
Failure in CWEA	MASTER ALARM pb/lt and tone come on without C/W, or comp caut lts	7	5.2-150
Failure in d-c circuit of lighting control assembly	MASTER ALARM pb/lt and tone come on without C/W, or comp caut lts	7	5.2-150

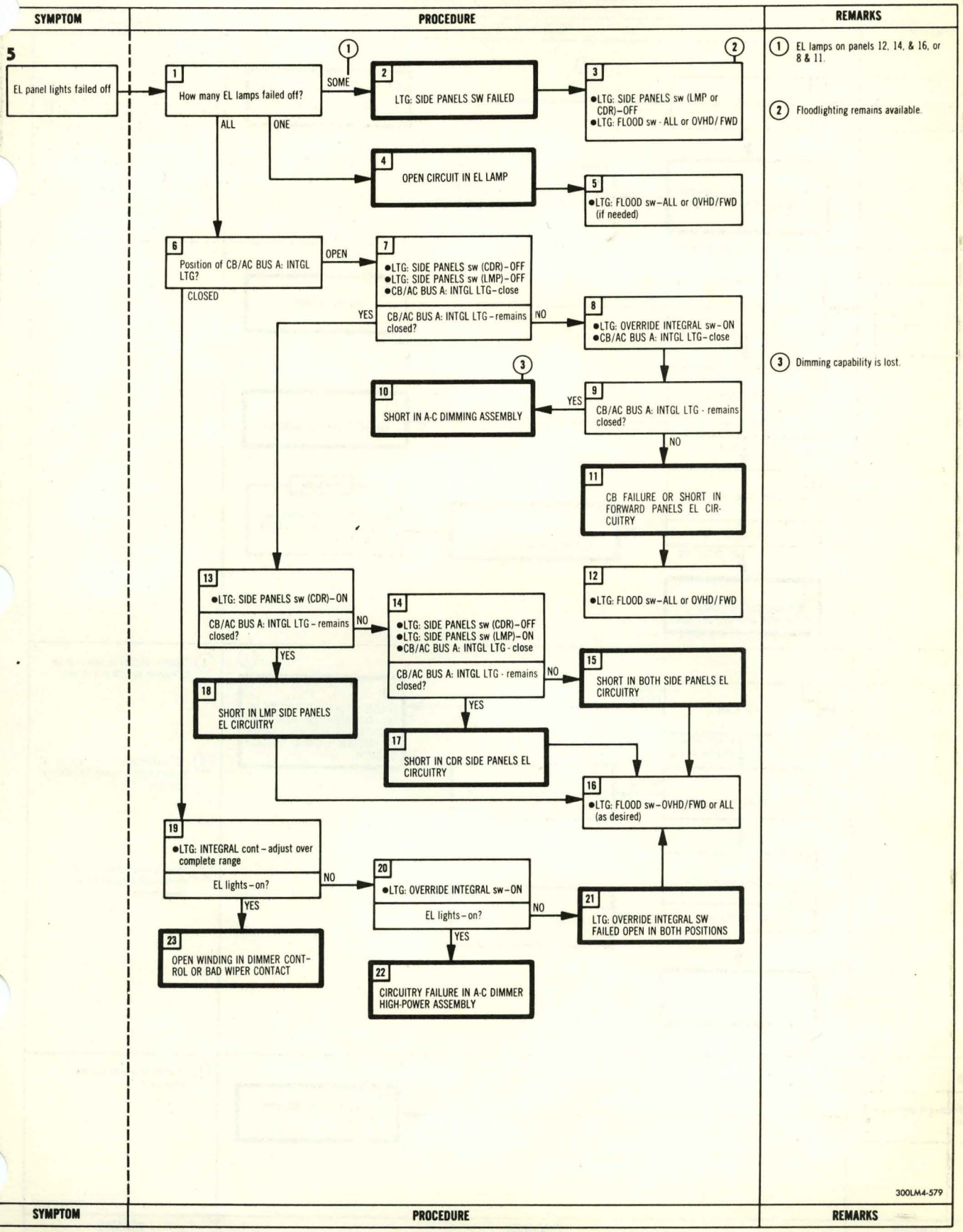
Table 5-26. LTG Failure/Symptom Cross-Reference Index (cont)

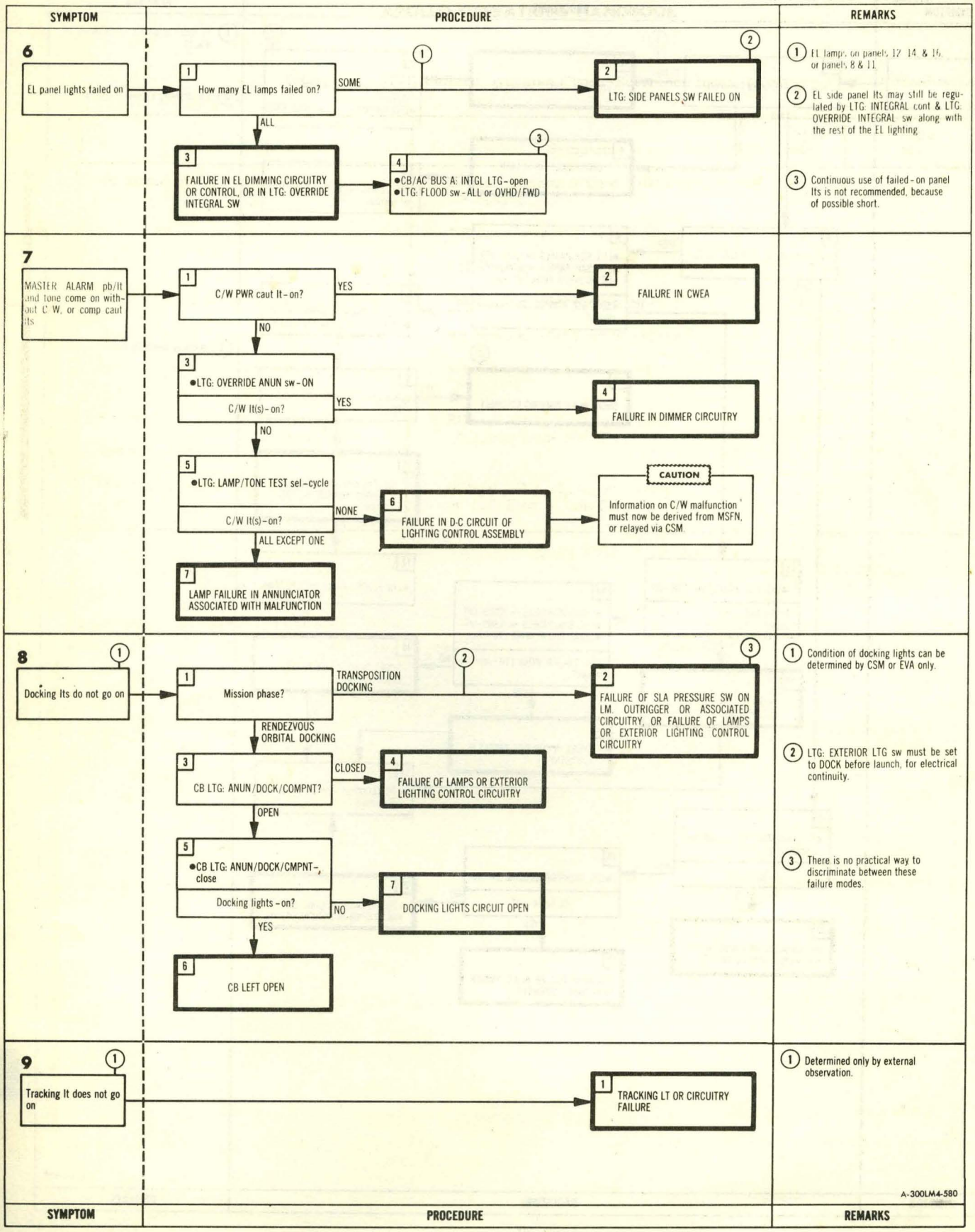
Failure	Symptom	Sym No.	Page No.
Failure in dimmer circuitry	MASTER ALARM pb/lt and tone come on without C/W, or comp caut lts	7	5.2-150
Failure in EL dimming circuitry or control, or in LTG: OVERRIDE INTEGRAL sw	EL panel lights failed on	6	5.2-150
Failure in LTG: FLOOD sw or floodlight circuitry	Overhead floodlights do not go on	1	5.2-147
Failure in numerics dimming circuit or control, or in LTG: OVERRIDE NUM sw	EL numerics failed on	3	5.2-147
Failure of lamps or exterior lighting control circuitry	Docking lts do not go on	8	5.2-150
Failure of SLA pressure sw on LM. Outrigger or associated circuitry, or failure of lamps or exterior lighting control circuitry	Docking lts do not go on	8	5.2-150
Hatch pressure sw failed open	Overhead floodlights do not go on	1	5.2-147
Lamp failure in annuciator associated with malfunction	MASTER ALARM pb/lt and tone come on without C/W, or comp caut lts	7	5.2-150
LTG: ANUM/NUM cont open winding or bad wiper contact	EL numerics failed off	4	5.2-148
LTG: FLOOD cont winding open	Overhead floodlights do not go on	1	5.2-147
LTG: FLOOD sw OVHD/FWD position failed	Overhead floodlights do not go on	1	5.2-147
LTG: OVERRIDE INTEGRAL sw failed open in both positions	EL panel lights failed off	5	5.2-149
LTG: OVERRIDE NUM sw failed or numeric lighting circuitry open	EL numerics failed off	4	5.2-148
LTG: SIDE PANELS sw failed	EL panel lights failed off	5	5.2-149
	EL panel lights failed on	6	5.2-150
One set of floodlights failed	Overhead floodlights do not go on	1	5.2-147
Open circuit in EL lamp	EL panel lights failed off	5	5.2-149
Open winding in dimmer control or bad wiper contact	EL panel lights failed off	5	5.2-149
Short in a-c dimmer low-power assembly or in LTG: ANUM/NUM cont	EL numerics failed off	4	5.2-148
Short in a-c dimming assembly	EL panel lights failed off	5	5.2-149
Short in both side panels EL circuitry	EL panel lights failed off	5	5.2-149
Short in CDR side panels EL circuitry	EL panel lights failed off	5	5.2-149

Table 5-26. LTG Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Short in LMP side panels EL circuitry	EL panel lights failed off	5	5.2-149
Short in numeric lighting assembly or CB/AC BUS B: NUM LTG failure	EL numerics failed off	4	5.2-148
Tracking lt or circuitry failure	Tracking lt does not go on	9	5.2-150


SYMPTOM
PROCEDURE
REMARKS
1
Overhead floodlights do not go on
1
●LTG: FLOOD sw - OVHD/FWD
Overhead & forward floodlights - on?
YES (NORMAL OPERATION)
2
HATCH PRESSURE SW FAILED OPEN
NO
PARTIAL
3
Only one pair (CDR or LMP) of floodlights on
4
●LTG: FLOOD cont (CDR or LMP) - adjust
Floodlights on?
NO
5
ONE SET OF FLOODLIGHTS FAILED
YES
6
LTG: FLOOD CONT WINDING OPEN
7
●LTG: FLOOD sw - ALL
Overhead, forward, & side panel floodlights - on?
NO
8
FAILURE IN LTG: FLOOD SW OR FLOODLIGHT CIRCUITRY
9
LMP can direct light on flight instruments while CDR pilots vehicle
YES
10
LTG: FLOOD SW OVHD/FWD POSITION FAILED
1 It is assumed that CB LTG: FLOOD is closed.
2 This failure is detectable only when hatch is open
3 If visual task permits, turn remaining set of floodlights on bright or use utility lights, penlights, or some combination of these lights.
4 Lower brightness range is lost
2
Overhead floodlights remain on with LTG: FLOOD sw set to OFF & overhead hatch closed
1
DOCKING HATCH SW OR LTG: FLOOD SW FAILED CLOSED
2
●CB LTG: FLOOD - OPEN
3
EL numerics failed on
1
FAILURE IN NUMERICS DIMMING CIRCUIT OR CONTROL, OR IN LTG: OVERRIDE NUM SW
2
Use numerics only when required. When numerics are not required:
●CB/AC BUS B: NUM LTG - open
300LM4-577
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
5
EL panel lights failed off
1 How many EL lamps failed off?
SOME
ALL
ONE
2 LTG: SIDE PANELS SW FAILED
3 •LTG: SIDE PANELS sw (LMP or CDR)–OFF •LTG: FLOOD sw - ALL or OVHD/FWD
4 OPEN CIRCUIT IN EL LAMP
5 •LTG: FLOOD sw–ALL or OVHD/FWD (if needed)
6 Position of CB/AC BUS A: INTGL LTG?
OPEN
CLOSED
7 •LTG: SIDE PANELS sw (CDR)–OFF •LTG: SIDE PANELS sw (LMP)–OFF •CB/AC BUS A: INTGL LTG–close
CB/AC BUS A: INTGL LTG–remains closed?
YES
NO
8 •LTG: OVERRIDE INTEGRAL sw–ON •CB/AC BUS A: INTGL LTG–close
9 CB/AC BUS A: INTGL LTG - remains closed?
YES
NO
10 SHORT IN A-C DIMMING ASSEMBLY
11 CB FAILURE OR SHORT IN FORWARD PANELS EL CIRCUITRY
12 •LTG: FLOOD sw–ALL or OVHD/FWD
13 •LTG: SIDE PANELS sw (CDR)–ON
CB/AC BUS A: INTGL LTG–remains closed?
NO
YES
14 •LTG: SIDE PANELS sw (CDR)–OFF •LTG: SIDE PANELS sw (LMP)–ON •CB/AC BUS A: INTGL LTG - close
CB/AC BUS A: INTGL LTG - remains closed?
NO
YES
15 SHORT IN BOTH SIDE PANELS EL CIRCUITRY
16 •LTG: FLOOD sw–OVHD/FWD or ALL (as desired)
17 SHORT IN CDR SIDE PANELS EL CIRCUITRY
18 SHORT IN LMP SIDE PANELS EL CIRCUITRY
19 •LTG: INTEGRAL cont–adjust over complete range
EL lights–on?
NO
YES
20 •LTG: OVERRIDE INTEGRAL sw–ON
EL lights–on?
NO
YES
21 LTG: OVERRIDE INTEGRAL SW FAILED OPEN IN BOTH POSITIONS
22 CIRCUITRY FAILURE IN A-C DIMMER HIGH-POWER ASSEMBLY
23 OPEN WINDING IN DIMMER CONTROL OR BAD WIPER CONTACT
1 EL lamps on panels 12, 14, & 16, or 8 & 11.
2 Floodlighting remains available.
3 Dimming capability is lost.
300LM4-579
SYMPTOM
PROCEDURE
REMARKS


SYMPTOM
PROCEDURE
REMARKS
6
EL panel lights failed on
1 How many EL lamps failed on?
SOME
ALL
2 LTG: SIDE PANELS SW FAILED ON
3 FAILURE IN EL DIMMING CIRCUITRY OR CONTROL, OR IN LTG: OVERRIDE INTEGRAL SW
4 •CB/AC BUS A: INTGL LTG-open •LTG: FLOOD sw-ALL or OVHD/FWD
(1) EL lamps on panels 12, 14, & 16, or panels 8 & 11.
(2) EL side panel lts may still be regulated by LTG: INTEGRAL cont & LTG: OVERRIDE INTEGRAL sw along with the rest of the EL lighting.
(3) Continuous use of failed-on panel lts is not recommended, because of possible short.
7
MASTER ALARM pb/lt and tone come on without C/W, or comp caut lts
1 C/W PWR caut lt-on?
YES
NO
2 FAILURE IN CWEA
3 •LTG: OVERRIDE ANUN sw-ON
C/W lt(s)-on?
YES
NO
4 FAILURE IN DIMMER CIRCUITRY
5 •LTG: LAMP/TONE TEST sel-cycle
C/W lt(s)-on?
NONE
ALL EXCEPT ONE
6 FAILURE IN D-C CIRCUIT OF LIGHTING CONTROL ASSEMBLY
CAUTION
Information on C/W malfunction must now be derived from MSFN, or relayed via CSM.
7 LAMP FAILURE IN ANNUNCIATOR ASSOCIATED WITH MALFUNCTION
8
(1)
Docking lts do not go on
1 Mission phase?
TRANSPOSITION DOCKING
(2)
RENDEZVOUS ORBITAL DOCKING
2 FAILURE OF SLA PRESSURE SW ON LM OUTRIGGER OR ASSOCIATED CIRCUITRY, OR FAILURE OF LAMPS OR EXTERIOR LIGHTING CONTROL CIRCUITRY
(3)
3 CB LTG: ANUN/DOCK/COMPNT?
CLOSED
OPEN
4 FAILURE OF LAMPS OR EXTERIOR LIGHTING CONTROL CIRCUITRY
5 •CB LTG: ANUN/DOCK/CMPNT-, close
Docking lights-on?
NO
YES
7 DOCKING LIGHTS CIRCUIT OPEN
6 CB LEFT OPEN
(1) Condition of docking lights can be determined by CSM or EVA only.
(2) LTG: EXTERIOR LTG sw must be set to DOCK before launch, for electrical continuity.
(3) There is no practical way to discriminate between these failure modes.
9
(1)
Tracking lt does not go on
1 TRACKING LT OR CIRCUITRY FAILURE
(1) Determined only by external observation.
A-300LM4-580
SYMPTOM
PROCEDURE
REMARKS

5.2.12 HEATERS

5.2.12.1 Assumptions

5.2.12.1.1 HEATER caut lt (RCS)

- Assume no action will be taken during a critical mission phase.
- One heat system (4/QUAD) can maintain temperature above 119°F.

Table 5-23. HTR Procedure Entry Sheet

Symptom	Sym No.	Part No.
HEATER caut lt	1	5.2-153
RCS QUAD 1, 2, 3, or 4 temp < 119°F or > 190°F	2	5.2-153
S-band antenna temp < -64°F or > +153°F	3	5.2-154
RR temp < -54°F or > +148°F	4	5.2-155
LR temp < -19°F or > +148°F	5	5.2-155

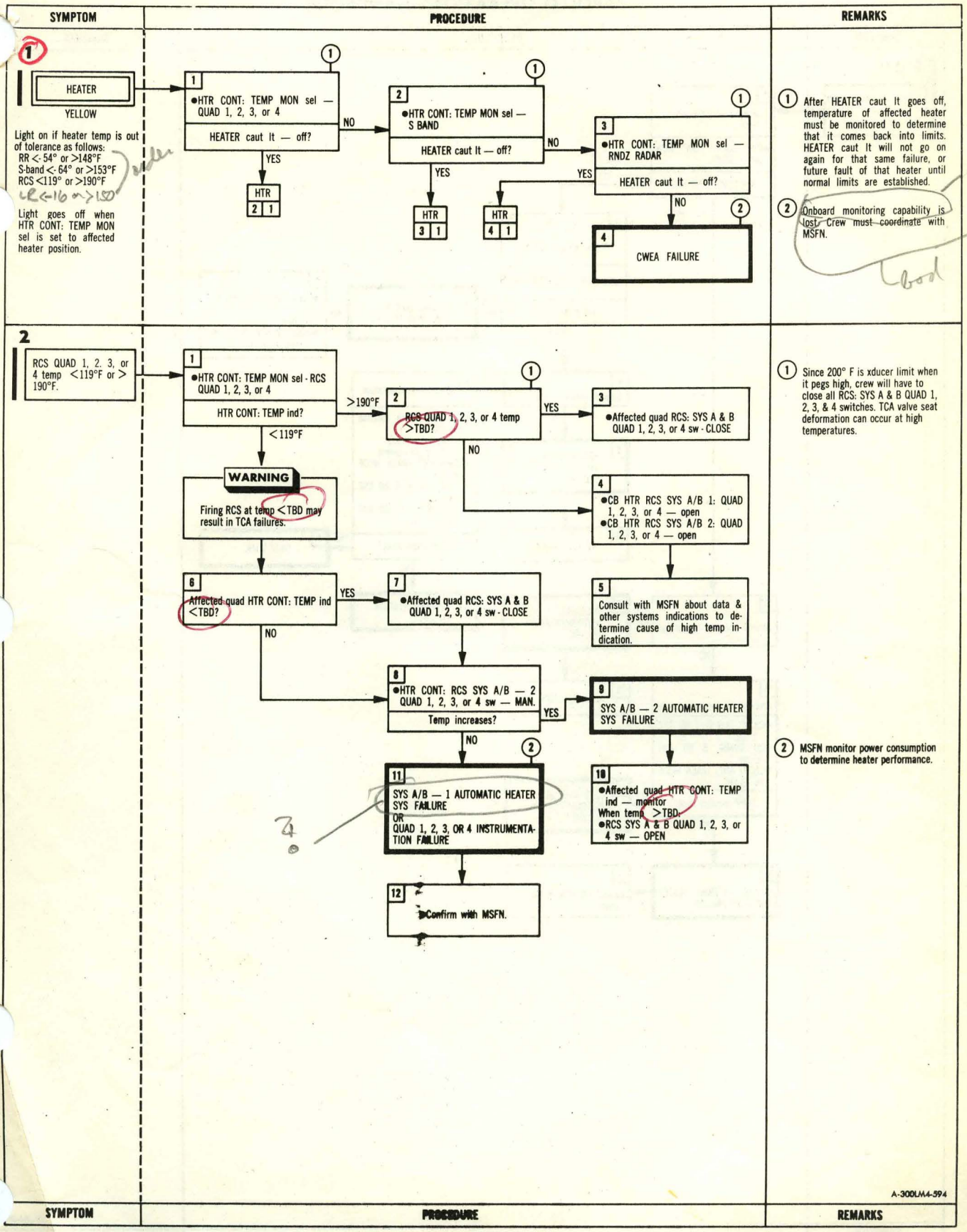
Table 5-24. HTR Failure/Symptom Cross-Reference Index

Failure	Symptom	Sym No.	Part No.
Cold soak or instrumentation failure	S-band antenna temp < -64°F or > +153°F	3	5.2-154
	RR temp < -54°F or > +148°F	4	5.2-155
CWEA failure	HEATER caut lt	1	5.2-153
Heater circuitry failure or cold soak	LR temp < -19°F or > +148°F	5	5.2-155
Heat soak	S-band antenna temp < -64°F or > +153°F	3	5.2-154
	RR temp < -54°F or > +148°F	4	5.2-155
Heat soak or instrumentation failure	S-band antenna temp < -64°F or > +153°F	3	5.2-154
	RR temp < -54°F or > +148°F	4	5.2-155
	LR temp < -19°F or > +148°F	5	5.2-155
Instrumentation failure	S-band antenna temp < -64°F or > +153°F	3	5.2-154
	RR temp < -54°F or > +148°F	4	5.2-155
	LR temp < -19°F or > +148°F	5	5.2-155
LR heater circuitry failure	LR temp < -19°F or > +148°F	5	5.2-155

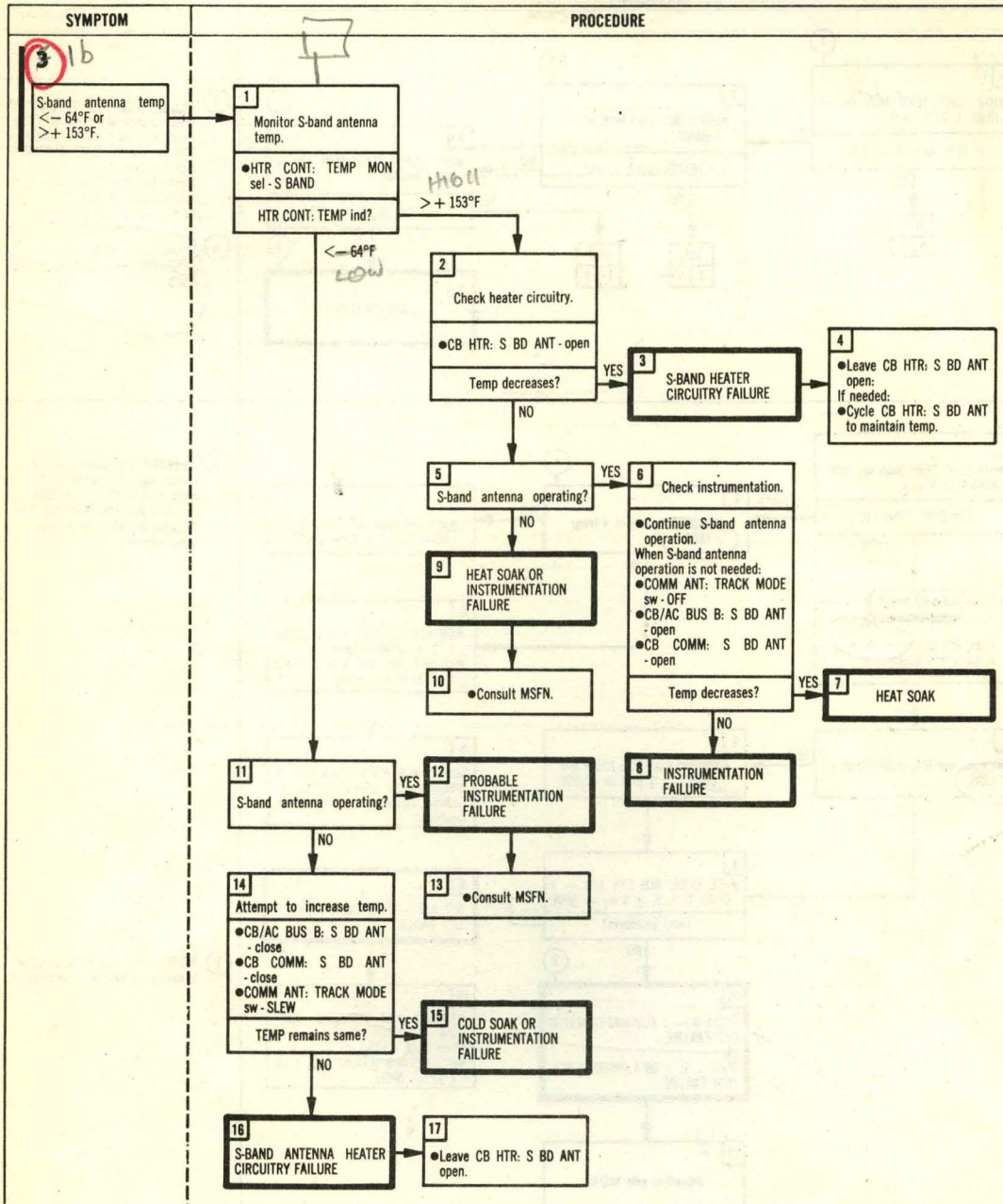
HTR

Table 5-24. HTR Failure/Symptom Cross-Reference Index (cont)

Failure	Symptom	Sym No.	Page No.
Probable instrumentation failure	S-band antenna temp < -64°F or > +153°F	3	5.2-154
	RR temp < -54°F or > +148°F	4	5.2-155
	LR temp < -19° or > +148°F	5	5.2-155
Rndz rdr opr heater circuitry failure	RR temp < -54°F or > +148°F	4	5.2-155
Rndz rdr stby heater circuitry failure	RR temp < -54°F or > +148°F	4	5.2-155
S-band antenna heater circuitry failure	S-band antenna temp < -64°F or > +153°F	3	5.2-154
Sys A/B-1 automatic heater sys failure or quad 1, 2, 3, or 4 instrumentation failure	RCS QUAD 1, 2, 3, or 4 temp < 119°F or > 190°F	2	5.2-153
Sys A/B-2 automatic heater sys failure	RCS QUAD 1, 2, 3, or 4 temp < 119°F or > 190°F	2	5.2-153


SYMPTOM
PROCEDURE
REMARKS
1
HEATER
YELLOW
Light on if heater temp is out of tolerance as follows:
RR <-54° or >148°F
S-band <-64° or >153°F
RCS <119° or >190°F
Light goes off when HTR CONT: TEMP MON sel is set to affected heater position.
1
•HTR CONT: TEMP MON sel — QUAD 1, 2, 3, or 4
HEATER caut lt — off?
NO
YES
HTR 2 1
2
•HTR CONT: TEMP MON sel — S BAND
HEATER caut lt — off?
NO
YES
HTR 3 1
3
•HTR CONT: TEMP MON sel — RNDZ RADAR
HEATER caut lt — off?
YES
NO
HTR 4 1
4
CWEA FAILURE
1 After HEATER caut lt goes off, temperature of affected heater must be monitored to determine that it comes back into limits. HEATER caut lt will not go on again for that same failure, or future fault of that heater until normal limits are established.
2 Onboard monitoring capability is lost. Crew must coordinate with MSFN.
2
RCS QUAD 1, 2, 3, or 4 temp <119°F or >190°F.
1
•HTR CONT: TEMP MON sel - RCS QUAD 1, 2, 3, or 4
HTR CONT: TEMP ind?
>190°F
<119°F
2
RCS QUAD 1, 2, 3, or 4 temp >TBD?
YES
NO
3
•Affected quad RCS: SYS A & B QUAD 1, 2, 3, or 4 sw - CLOSE
4
•CB HTR RCS SYS A/B 1: QUAD 1, 2, 3, or 4 — open
•CB HTR RCS SYS A/B 2: QUAD 1, 2, 3, or 4 — open
5
Consult with MSFN about data & other systems indications to determine cause of high temp indication.
WARNING
Firing RCS at temp <TBD may result in TCA failures.
6
Affected quad HTR CONT: TEMP ind <TBD?
YES
NO
7
•Affected quad RCS: SYS A & B QUAD 1, 2, 3, or 4 sw - CLOSE
8
•HTR CONT: RCS SYS A/B — 2 QUAD 1, 2, 3, or 4 sw — MAN.
Temp increases?
YES
NO
9
SYS A/B — 2 AUTOMATIC HEATER SYS FAILURE
10
•Affected quad HTR CONT: TEMP ind — monitor When temp >TBD:
•RCS SYS A & B QUAD 1, 2, 3, or 4 sw — OPEN
11
SYS A/B — 1 AUTOMATIC HEATER SYS FAILURE
OR
QUAD 1, 2, 3, OR 4 INSTRUMENTATION FAILURE
12
Confirm with MSFN.
1 Since 200° F is xducer limit when it pegs high, crew will have to close all RCS: SYS A & B QUAD 1, 2, 3, & 4 switches. TCA valve seat deformation can occur at high temperatures.
2 MSFN monitor power consumption to determine heater performance.
A-300LM4-594
SYMPTOM
PROCEDURE
REMARKS

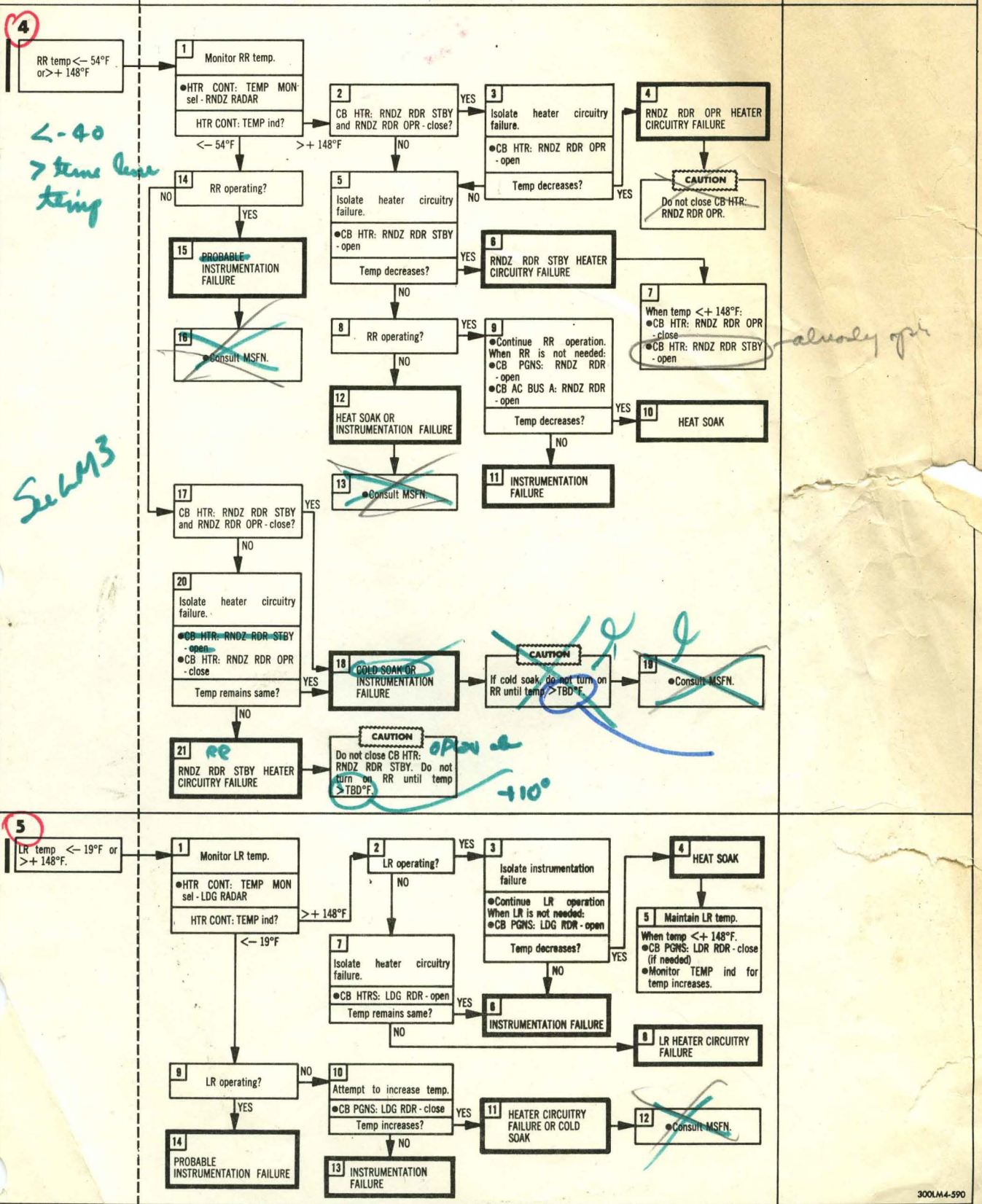
SYMPTOM	PROCEDURE	REMARKS



SYMPTOM	PROCEDURE	REMARKS

300LM4-59

SYMPTOM	PROCEDURE	REMARKS



SYMPTOM	PROCEDURE	REMARKS

300LM4-590

HTR