APOLLO 14	
CSM MALFUNCTION PROCEDURES	
PART NO.	S/N
SKB32100083-341	1002

THIS PAGE
INTENTIONALLY
LEFT BLANK

G & C MALFUNCTION INDEX

1 ABNORMAL VEHICLE DYNAMICS DURING SPS THRUSTING

2 FDAI ATT ERROR ABNORMAL

3 FDAI RATE IND ABNORMAL

4 FDAI TOTAL ATTITUDE DISPLAY ABNORMAL

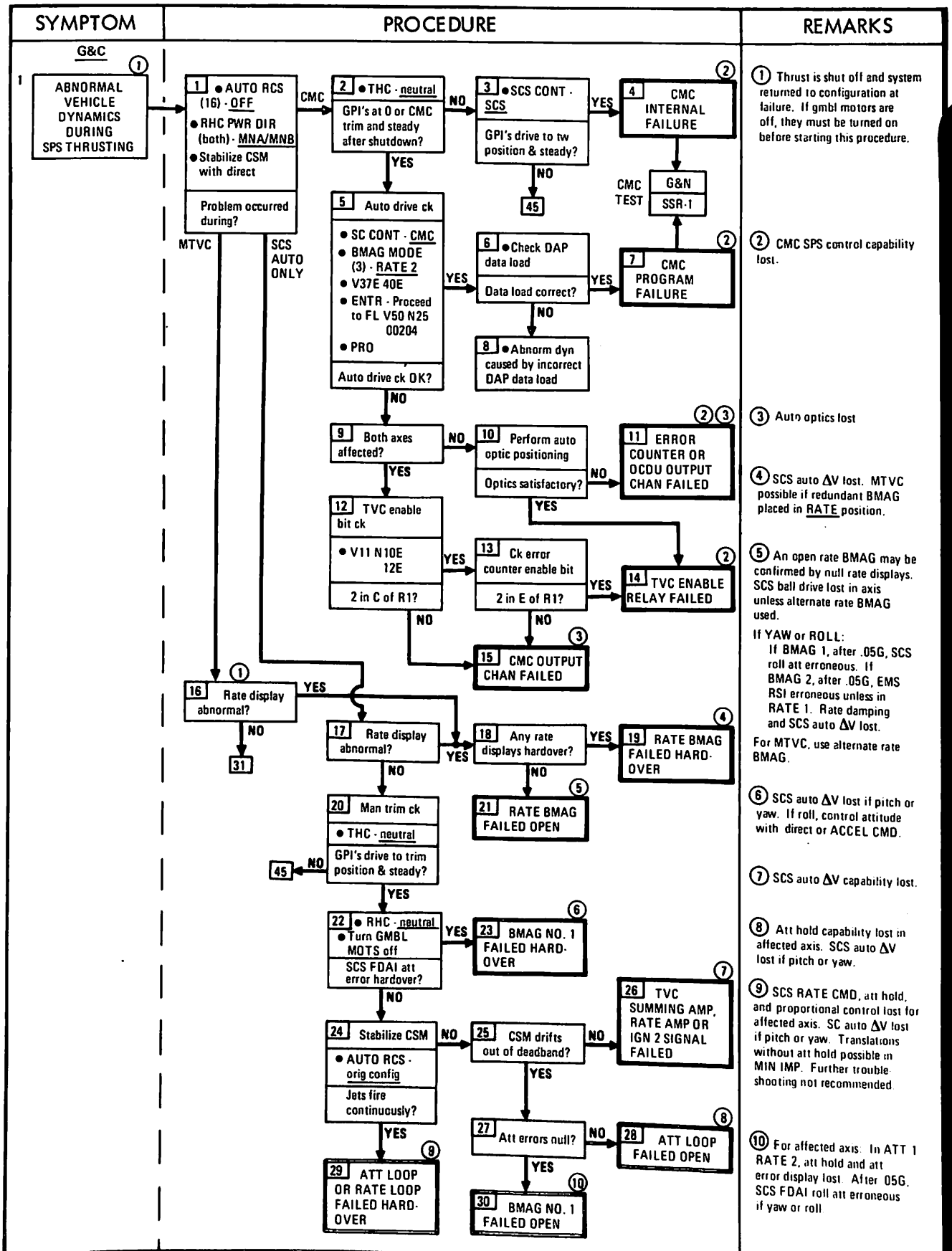
5 FDAI FAILS TO SLEW WITH ORDEAL

6 FDAI TOTAL ATT DOES NOT RESPOND TO GDC ALIGN

7 GPI/FUEL PRESS IND(S) PEGGED OR ZERO

8 BMAG 1 (2) TEMP

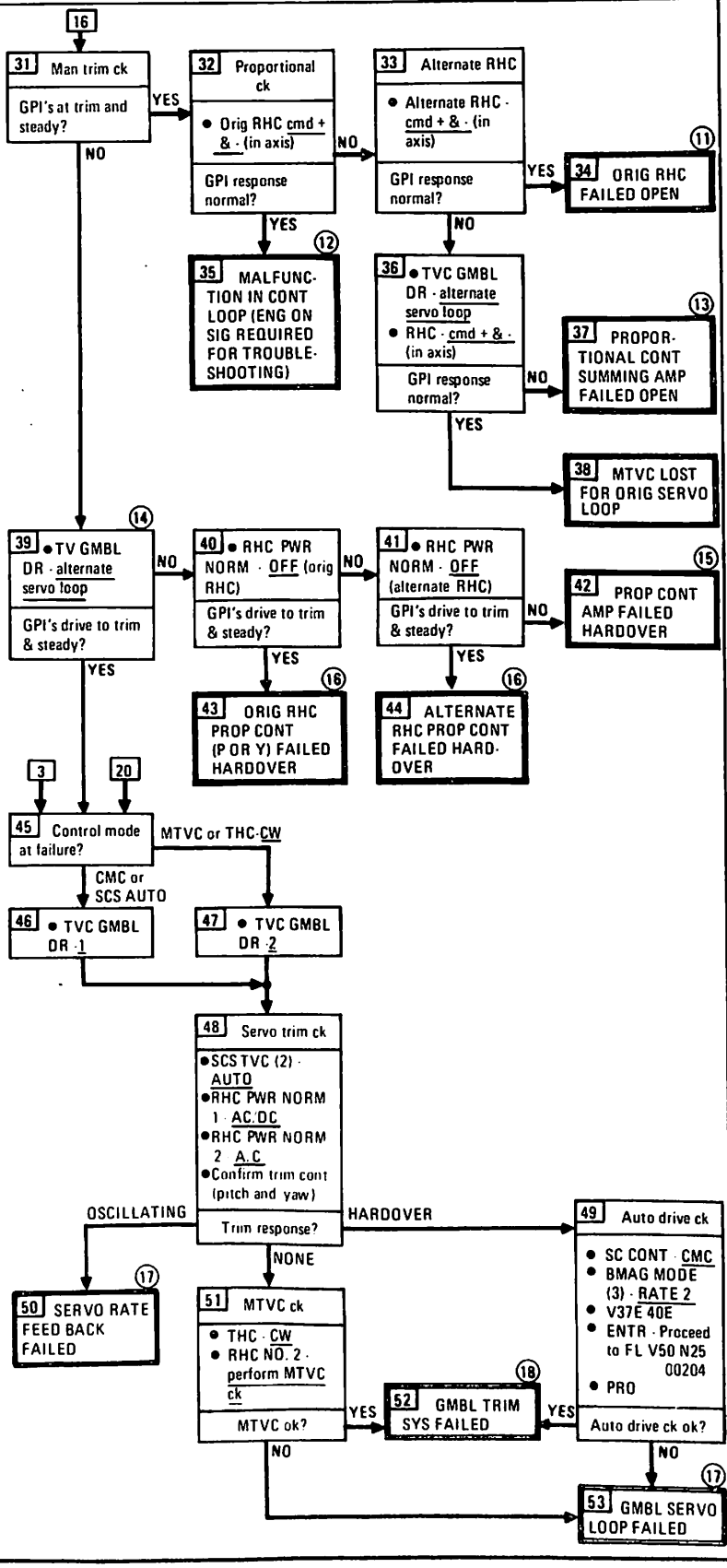
A ABNORMAL VEHICLE DYNAMICS (NON-SPS THRUSTING LM-INACTIVE)


SYMPTOM
PROCEDURE
REMARKS
G&C
1
ABNORMAL VEHICLE DYNAMICS DURING SPS THRUSTING
1 • AUTO RCS (16) - OFF • RHC PWR DIR (both) - MNA/MNB • Stabilize CSM with direct
Problem occurred during?
MTVC
SCS AUTO ONLY
CMC
2 • THC - neutral
GPI's at 0 or CMC trim and steady after shutdown?
NO
YES
3 • SCS CONT - SCS
GPI's drive to tw position & steady?
YES
NO
45
4 CMC INTERNAL FAILURE
CMC TEST
G&N
SSR-1
5 Auto drive ck
• SC CONT - CMC
• BMAG MODE (3) - RATE 2
• V37E 40E
• ENTR - Proceed to FL V50 N25 00204
• PRO
Auto drive ck OK?
6 • Check DAP data load
Data load correct?
7 CMC PROGRAM FAILURE
8 • Abnorm dyn caused by incorrect DAP data load
9 Both axes affected?
10 Perform auto optic positioning
Optics satisfactory?
11 ERROR COUNTER OR DCDU OUTPUT CHAN FAILED
12 TVC enable bit ck
• V11 N10E 12E
2 in C of R1?
13 Ck error counter enable bit
2 in E of R1?
14 TVC ENABLE RELAY FAILED
15 CMC OUTPUT CHAN FAILED
16 Rate display abnormal?
31
17 Rate display abnormal?
18 Any rate displays hardover?
19 RATE BMAG FAILED HARD-OVER
20 Man trim ck
• THC - neutral
GPI's drive to trim position & steady?
21 RATE BMAG FAILED OPEN
22 • RHC - neutral • Turn GMBL MOTS off
SCS FDAI att error hardover?
23 BMAG NO. 1 FAILED HARD-OVER
24 Stabilize CSM
• AUTO RCS - orig config
Jets fire continuously?
25 CSM drifts out of deadband?
26 TVC SUMMING AMP, RATE AMP OR IGN 2 SIGNAL FAILED
27 Att errors null?
28 ATT LOOP FAILED OPEN
29 ATT LOOP OR RATE LOOP FAILED HARD-OVER
30 BMAG NO. 1 FAILED OPEN
(1) Thrust is shut off and system returned to configuration at failure. If gmbl motors are off, they must be turned on before starting this procedure.
(2) CMC SPS control capability lost.
(3) Auto optics lost
(4) SCS auto ΔV lost. MTVC possible if redundant BMAG placed in RATE position.
(5) An open rate BMAG may be confirmed by null rate displays. SCS ball drive lost in axis unless alternate rate BMAG used.
If YAW or ROLL:
If BMAG 1, after .05G, SCS roll att erroneous. If BMAG 2, after .05G, EMS RSI erroneous unless in RATE 1. Rate damping and SCS auto ΔV lost.
For MTVC, use alternate rate BMAG.
(6) SCS auto ΔV lost if pitch or yaw. If roll, control attitude with direct or ACCEL CMD.
(7) SCS auto ΔV capability lost.
(8) Att hold capability lost in affected axis. SCS auto ΔV lost if pitch or yaw.
(9) SCS RATE CMD, att hold, and proportional control lost for affected axis. SC auto ΔV lost if pitch or yaw. Translations without att hold possible in MIN IMP. Further trouble shooting not recommended.
(10) For affected axis. In ATT 1 RATE 2, att hold and att error display lost. After 05G, SCS FDAI roll att erroneous if yaw or roll.
SM-2A-2272A

SYMPTOM	PROCEDURE	REMARKS

G&C

1 (Cont)



(11) SCS proportional control and MTVC lost for failed RHC.

(12) One probable failure could be loss of MTVC integrator in which case during MTVC the gimbal position directly follows the stick position.

(13) SCS proportional control and MTVC lost for both RHC's.

(14) If THC - CW at time of failure, servo No. 2 being used, select servo No. 1.

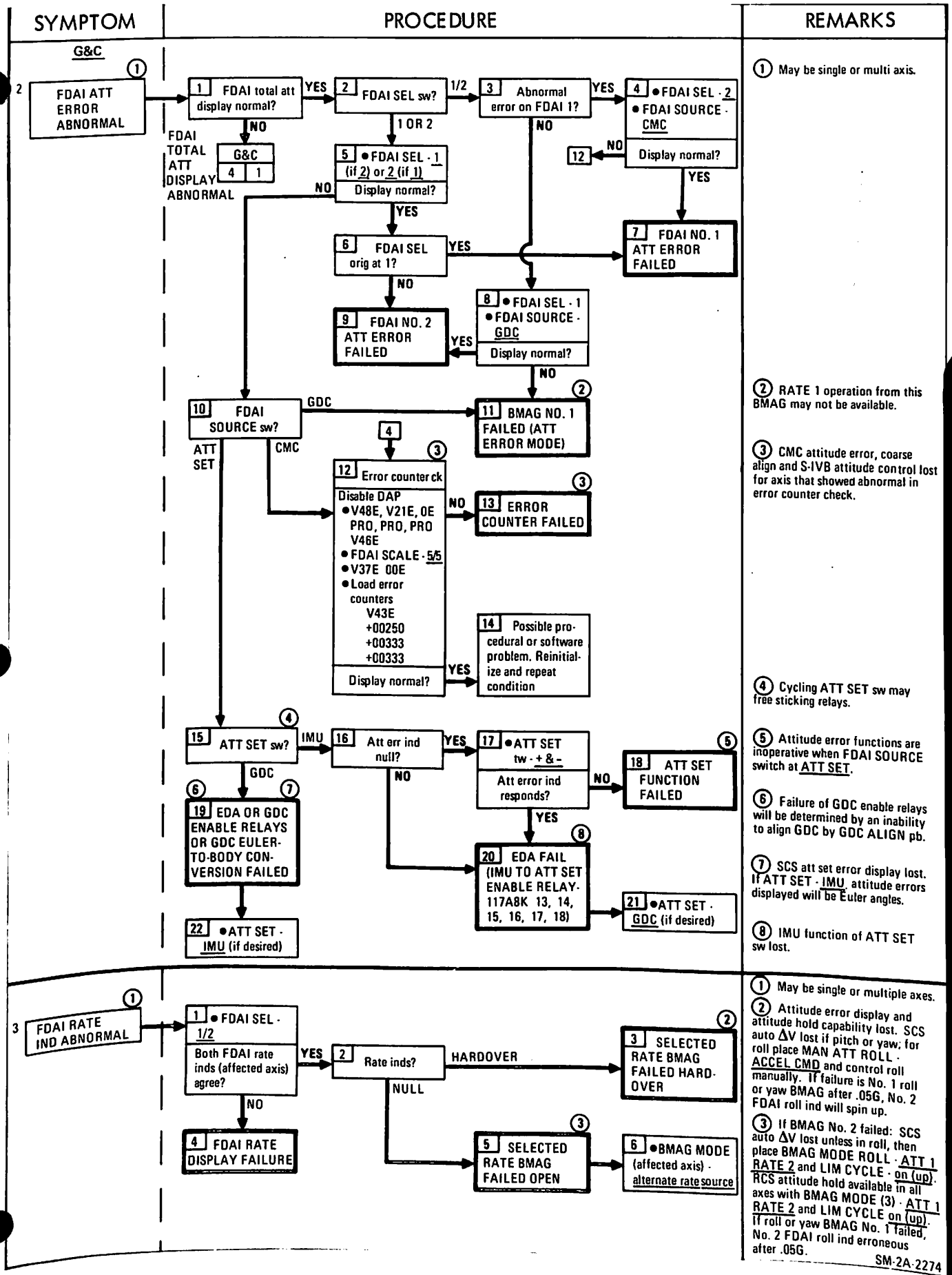
(15) No MTVC capability. RATE CMD lost in affected axis. Att hold possible if RHC's locked (or neutral) or RHC PWR NORM (2) - OFF. Disable affected axis if direct used.

(16) MTVC and proportional cont available with unaffected RHC, if affected RHC power is off (RHC PWR NORM - OFF) or RHC locked.

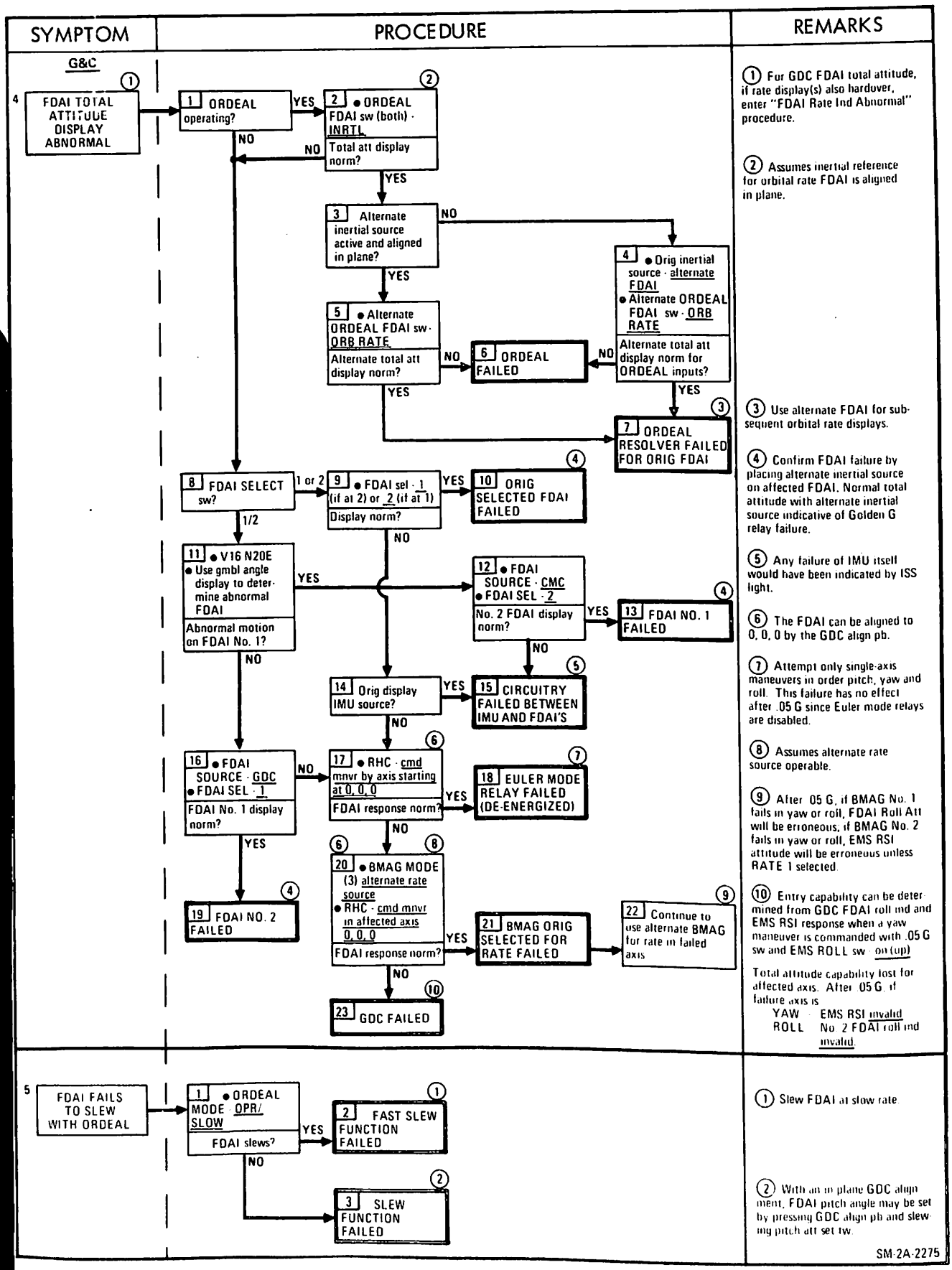
(17) Affected servo lost for all ΔV's.

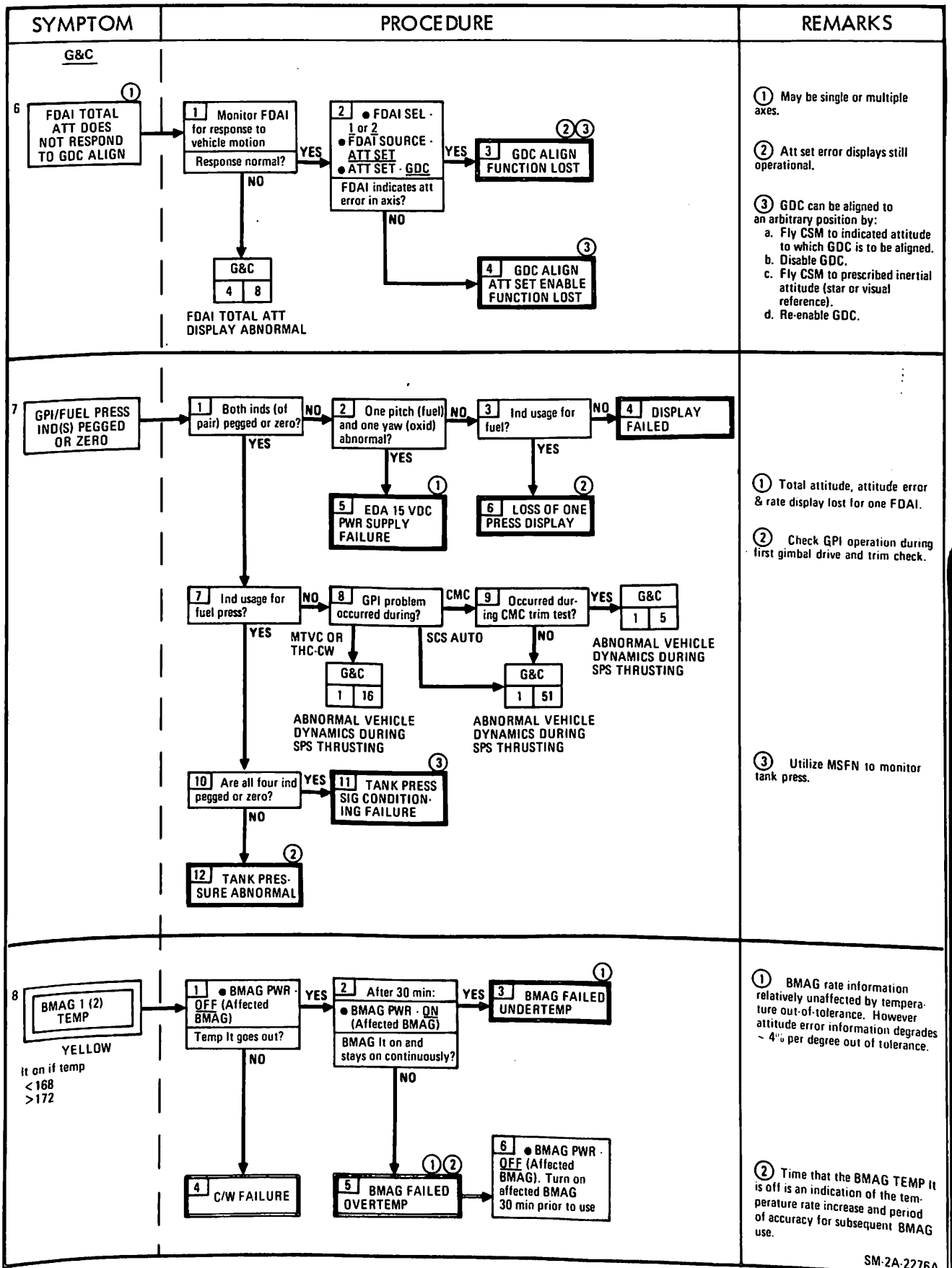
(18) CMC ΔV unaffected. On affected servo, SCS auto ΔV and trim lost, but MTVC without trim remains.

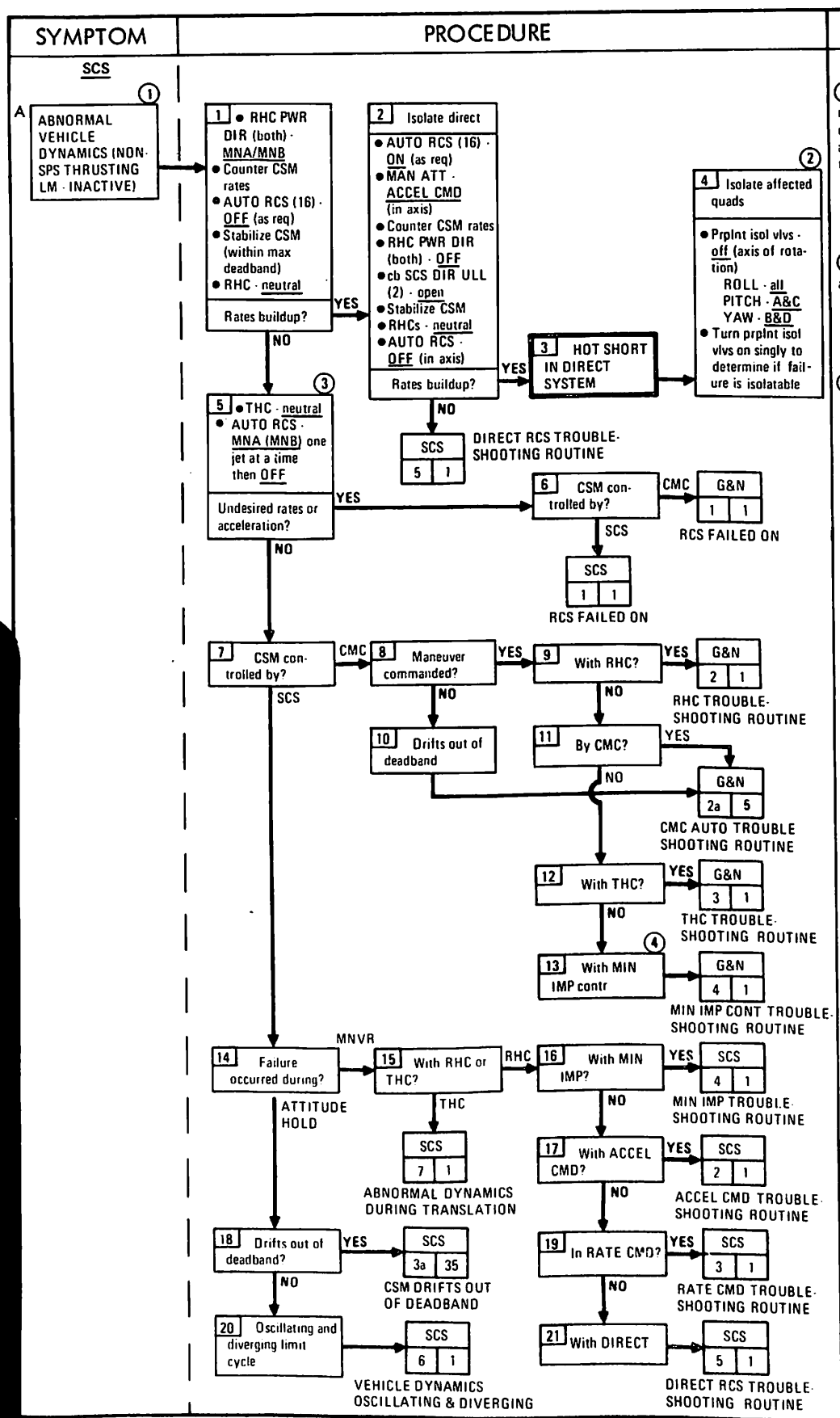
SM-2A 2273A


SYMPTOM
PROCEDURE
REMARKS
G&C
2 FDAI ATT ERROR ABNORMAL (1)
1 FDAI total att display normal?
YES
2 FDAI SEL sw?
1/2
3 Abnormal error on FDAI 1?
YES
4 • FDAI SEL - 2
• FDAI SOURCE - CMC
Display normal?
NO
12
YES
7 FDAI NO. 1 ATT ERROR FAILED
NO
FDAI TOTAL ATT DISPLAY ABNORMAL
G&C 4 1
1 OR 2
5 • FDAI SEL - 1 (if 2) or 2 (if 1)
Display normal?
NO
YES
6 FDAI SEL orig at 1?
YES
NO
8 • FDAI SEL - 1
• FDAI SOURCE - GDC
Display normal?
YES
9 FDAI NO. 2 ATT ERROR FAILED
NO
10 FDAI SOURCE sw?
GDC
ATT SET
CMC
11 BMAG NO. 1 FAILED (ATT ERROR MODE) (2)
4
12 Error counter ck (3)
Disable DAP
• V48E, V21E, 0E PRO, PRO, PRO V46E
• FDAI SCALE - 5/5
• V37E 00E
• Load error counters V43E +00250 +00333 +00333
Display normal?
NO
13 ERROR COUNTER FAILED (3)
YES
14 Possible procedural or software problem. Reinitialize and repeat condition
15 ATT SET sw? (4)
IMU
16 Att err ind null?
YES
17 • ATT SET tw - + & -
Att error ind responds?
NO
18 ATT SET FUNCTION FAILED (5)
YES
GDC
19 EDA OR GDC ENABLE RELAYS OR GDC EULER-TO-BODY CONVERSION FAILED (6) (7)
NO
20 EDA FAIL (IMU TO ATT SET ENABLE RELAY - 117A8K 13, 14, 15, 16, 17, 18) (8)
21 • ATT SET - GDC (if desired)
22 • ATT SET - IMU (if desired)
3 FDAI RATE IND ABNORMAL (1)
1 • FDAI SEL - 1/2
Both FDAI rate inds (affected axis) agree?
YES
2 Rate inds?
HARDOVER
3 SELECTED RATE BMAG FAILED HARDOVER (2)
NULL
NO
4 FDAI RATE DISPLAY FAILURE
5 SELECTED RATE BMAG FAILED OPEN (3)
6 • BMAG MODE (affected axis) - alternate rate source
(1) May be single or multi axis.
(2) RATE 1 operation from this BMAG may not be available.
(3) CMC attitude error, coarse align and S-IVB attitude control lost for axis that showed abnormal in error counter check.
(4) Cycling ATT SET sw may free sticking relays.
(5) Attitude error functions are inoperative when FDAI SOURCE switch at ATT SET.
(6) Failure of GDC enable relays will be determined by an inability to align GDC by GDC ALIGN pb.
(7) SCS att set error display lost. If ATT SET - IMU, attitude errors displayed will be Euler angles.
(8) IMU function of ATT SET sw lost.
(1) May be single or multiple axes.
(2) Attitude error display and attitude hold capability lost. SCS auto ΔV lost if pitch or yaw; for roll place MAN ATT ROLL - ACCEL CMD and control roll manually. If failure is No. 1 roll or yaw BMAG after .05G, No. 2 FDAI roll ind will spin up.
(3) If BMAG No. 2 failed: SCS auto ΔV lost unless in roll, then place BMAG MODE ROLL - ATT 1 RATE 2 and LIM CYCLE - on (up). RCS attitude hold available in all axes with BMAG MODE (3) - ATT 1 RATE 2 and LIM CYCLE on (up). If roll or yaw BMAG No. 1 failed, No. 2 FDAI roll ind erroneous after .05G.
SM-2A-2274

2 THRU 5


SYMPTOM
PROCEDURE
REMARKS
G&C
4 FDAI TOTAL ATTITUDE DISPLAY ABNORMAL
1 ORDEAL operating?
YES
NO
2 • ORDEAL FDAI sw (both) · INRTL
Total att display norm?
NO
YES
3 Alternate inertial source active and aligned in plane?
NO
YES
4 • Orig inertial source · alternate FDAI
• Alternate ORDEAL FDAI sw · ORB RATE
Alternate total att display norm for ORDEAL inputs?
NO
YES
5 • Alternate ORDEAL FDAI sw · ORB RATE
Alternate total att display norm?
NO
YES
6 ORDEAL FAILED
7 ORDEAL RESOLVER FAILED FOR ORIG FDAI
8 FDAI SELECT sw?
1 or 2
1/2
9 • FDAI sel · 1 (if at 2) or 2 (if at 1)
Display norm?
YES
NO
10 ORIG SELECTED FDAI FAILED
11 • V16 N20E
• Use gmbl angle display to determine abnormal FDAI
Abnormal motion on FDAI No. 1?
YES
NO
12 • FDAI SOURCE · CMC
• FDAI SEL · 2
No. 2 FDAI display norm?
YES
NO
13 FDAI NO. 1 FAILED
14 Orig display IMU source?
YES
NO
15 CIRCUITRY FAILED BETWEEN IMU AND FDAI'S
16 • FDAI SOURCE · GDC
• FDAI SEL · 1
FDAI No. 1 display norm?
NO
YES
17 • RHC · cmd mnvr by axis starting at 0, 0, 0
FDAI response norm?
YES
NO
18 EULER MODE RELAY FAILED (DE-ENERGIZED)
19 FDAI NO. 2 FAILED
20 • BMAG MODE (3) alternate rate source
• RHC · cmd mnvr in affected axis 0, 0, 0
FDAI response norm?
YES
NO
21 BMAG ORIG SELECTED FOR RATE FAILED
22 Continue to use alternate BMAG for rate in failed axis
23 GDC FAILED
5 FDAI FAILS TO SLEW WITH ORDEAL
1 • ORDEAL MODE · OPR/SLOW
FDAI slews?
YES
NO
2 FAST SLEW FUNCTION FAILED
3 SLEW FUNCTION FAILED
(1) For GDC FDAI total attitude, if rate display(s) also hardover, enter "FDAI Rate Ind Abnormal" procedure.
(2) Assumes inertial reference for orbital rate FDAI is aligned in plane.
(3) Use alternate FDAI for subsequent orbital rate displays.
(4) Confirm FDAI failure by placing alternate inertial source on affected FDAI. Normal total attitude with alternate inertial source indicative of Golden G relay failure.
(5) Any failure of IMU itself would have been indicated by ISS light.
(6) The FDAI can be aligned to 0, 0, 0 by the GDC align pb.
(7) Attempt only single-axis maneuvers in order pitch, yaw and roll. This failure has no effect after .05 G since Euler mode relays are disabled.
(8) Assumes alternate rate source operable.
(9) After .05 G, if BMAG No. 1 fails in yaw or roll, FDAI Roll Att will be erroneous; if BMAG No. 2 fails in yaw or roll, EMS RSI attitude will be erroneous unless RATE 1 selected.
(10) Entry capability can be determined from GDC FDAI roll ind and EMS RSI response when a yaw maneuver is commanded with .05 G sw and EMS ROLL sw on (up).
Total attitude capability lost for affected axis. After .05 G, if failure axis is
YAW EMS RSI invalid
ROLL No. 2 FDAI roll ind invalid.
(1) Slew FDAI at slow rate.
(2) With an in plane GDC alignment, FDAI pitch angle may be set by pressing GDC align pb and slewing pitch att set tw.

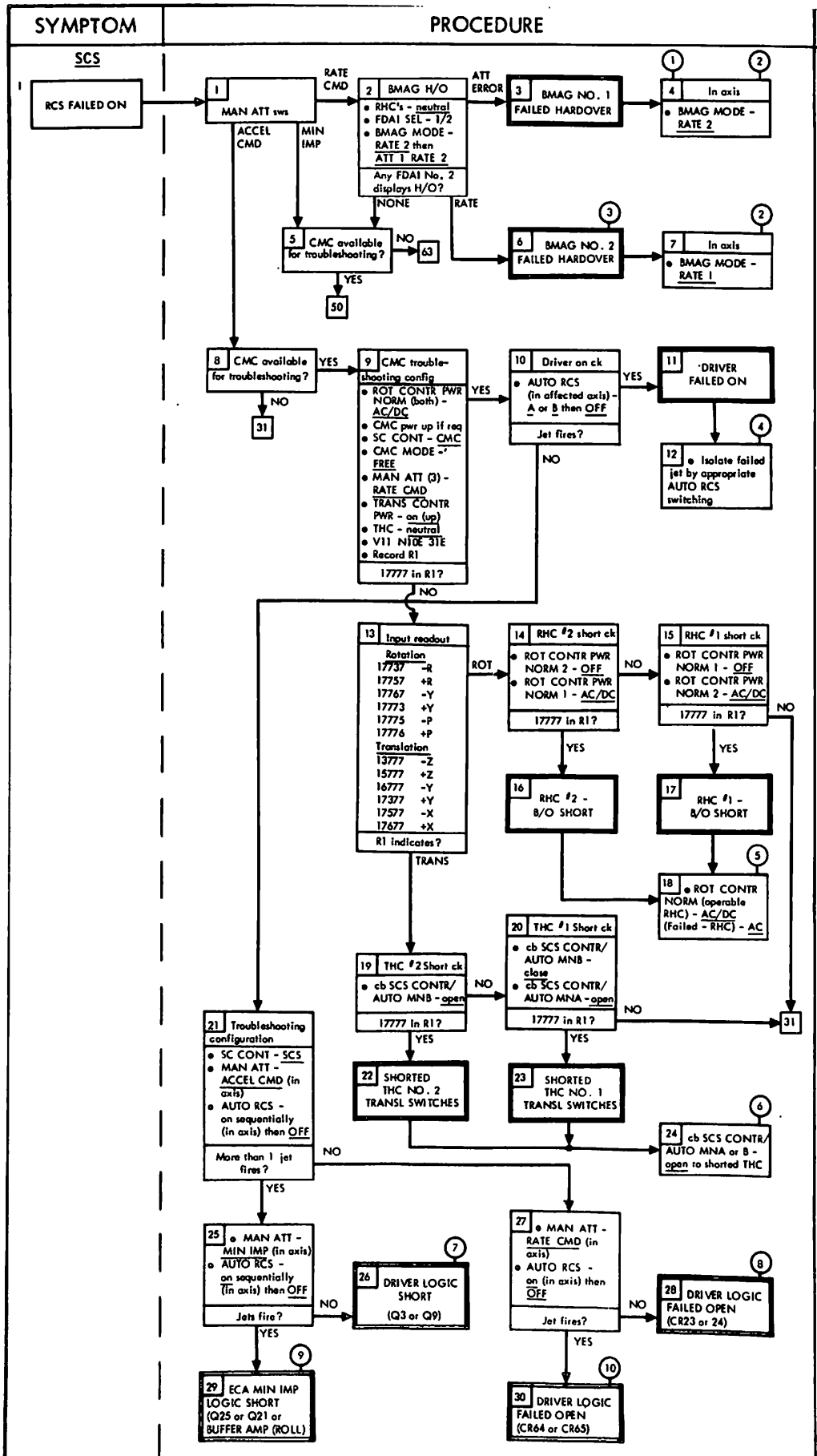

SYMPTOM
PROCEDURE
REMARKS
G&C
6
FDAI TOTAL ATT DOES NOT RESPOND TO GDC ALIGN
1 Monitor FDAI for response to vehicle motion
Response normal?
YES
NO
2 • FDAI SEL · 1 or 2 • FDAI SOURCE · ATT SET • ATT SET · GDC
FDAI indicates att error in axis?
YES
NO
3 GDC ALIGN FUNCTION LOST
4 GDC ALIGN ATT SET ENABLE FUNCTION LOST
G&C 4 8
FDAI TOTAL ATT DISPLAY ABNORMAL
1 May be single or multiple axes.
2 Att set error displays still operational.
3 GDC can be aligned to an arbitrary position by:
a. Fly CSM to indicated attitude to which GDC is to be aligned.
b. Disable GDC.
c. Fly CSM to prescribed inertial attitude (star or visual reference).
d. Re-enable GDC.
7
GPI/FUEL PRESS IND(S) PEGGED OR ZERO
1 Both inds (of pair) pegged or zero?
NO
YES
2 One pitch (fuel) and one yaw (oxid) abnormal?
NO
YES
3 Ind usage for fuel?
NO
YES
4 DISPLAY FAILED
5 EDA 15 VDC PWR SUPPLY FAILURE
6 LOSS OF ONE PRESS DISPLAY
7 Ind usage for fuel press?
NO
YES
8 GPI problem occurred during?
CMC
MTVC OR THC-CW
SCS AUTO
9 Occurred during CMC trim test?
YES
NO
G&C 1 5
ABNORMAL VEHICLE DYNAMICS DURING SPS THRUSTING
G&C 1 16
ABNORMAL VEHICLE DYNAMICS DURING SPS THRUSTING
G&C 1 51
ABNORMAL VEHICLE DYNAMICS DURING SPS THRUSTING
10 Are all four ind pegged or zero?
YES
NO
11 TANK PRESS SIG CONDITIONING FAILURE
12 TANK PRESSURE ABNORMAL
1 Total attitude, attitude error & rate display lost for one FDAI.
2 Check GPI operation during first gimbal drive and trim check.
3 Utilize MSFN to monitor tank press.
8
BMAG 1 (2) TEMP
YELLOW
It on if temp
<168
>172
1 • BMAG PWR · OFF (Affected BMAG)
Temp It goes out?
YES
NO
2 After 30 min:
• BMAG PWR · ON (Affected BMAG)
BMAG It on and stays on continuously?
YES
NO
3 BMAG FAILED UNDERTEMP
4 C/W FAILURE
5 BMAG FAILED OVERTEMP
6 • BMAG PWR · OFF (Affected BMAG). Turn on affected BMAG 30 min prior to use
1 BMAG rate information relatively unaffected by temperature out-of-tolerance. However attitude error information degrades ~ 4°/s per degree out of tolerance.
2 Time that the BMAG TEMP It is off is an indication of the temperature rate increase and period of accuracy for subsequent BMAG use.
SM-2A-2276A


SYMPTOM
PROCEDURE
REMARKS
SCS
A
1
ABNORMAL VEHICLE DYNAMICS (NON-SPS THRUSTING LM - INACTIVE)
1 • RHC PWR DIR (both) - MNA/MNB
• Counter CSM rates
• AUTO RCS (16) - OFF (as req)
• Stabilize CSM (within max deadband)
• RHC - neutral
Rates buildup?
YES
NO
2 Isolate direct
• AUTO RCS (16) - ON (as req)
• MAN ATT - ACCEL CMD (in axis)
• Counter CSM rates
• RHC PWR DIR (both) - OFF
• cb SCS DIR ULL (2) - open
• Stabilize CSM
• RHCs - neutral
• AUTO RCS - OFF (in axis)
Rates buildup?
YES
NO
3 HOT SHORT IN DIRECT SYSTEM
2
4 Isolate affected quads
• Prplnt isol vlvs - off (axis of rotation)
ROLL - all
PITCH - A&C
YAW - B&D
• Turn prplnt isol vlvs on singly to determine if failure is isolatable
SCS 5 1 DIRECT RCS TROUBLE-SHOOTING ROUTINE
3
5 • THC - neutral
• AUTO RCS - MNA (MNB) one jet at a time then OFF
Undesired rates or acceleration?
YES
NO
6 CSM controlled by?
CMC
G&N 1 1 RCS FAILED ON
SCS
SCS 1 1 RCS FAILED ON
7 CSM controlled by?
CMC
SCS
8 Maneuver commanded?
YES
NO
9 With RHC?
YES
G&N 2 1 RHC TROUBLE-SHOOTING ROUTINE
NO
10 Drifts out of deadband
11 By CMC?
YES
G&N 2a 5 CMC AUTO TROUBLE SHOOTING ROUTINE
NO
12 With THC?
YES
G&N 3 1 THC TROUBLE-SHOOTING ROUTINE
NO
4
13 With MIN IMP contr
G&N 4 1 MIN IMP CONT TROUBLE-SHOOTING ROUTINE
14 Failure occurred during?
MNVR
ATTITUDE HOLD
15 With RHC or THC?
RHC
THC
16 With MIN IMP?
YES
SCS 4 1 MIN IMP TROUBLE-SHOOTING ROUTINE
NO
SCS 7 1 ABNORMAL DYNAMICS DURING TRANSLATION
17 With ACCEL CMD?
YES
SCS 2 1 ACCEL CMD TROUBLE-SHOOTING ROUTINE
NO
18 Drifts out of deadband?
YES
SCS 3a 35 CSM DRIFTS OUT OF DEADBAND
NO
19 In RATE CMD?
YES
SCS 3 1 RATE CMD TROUBLE-SHOOTING ROUTINE
NO
20 Oscillating and diverging limit cycle
SCS 6 1 VEHICLE DYNAMICS OSCILLATING & DIVERGING
21 With DIRECT
SCS 5 1 DIRECT RCS TROUBLE-SHOOTING ROUTINE
1 Abnormal dynamics is defined to mean undesired rates or accelerations during uncommanded maneuvers or abnormal response during commanded maneuvers.
2 Auto RCS switches for all jets on affected quad should be placed to off position before quad isolation.
3 CSM should be stabilized within the attitude deadband (if in an attitude hold mode) to preclude normal jet firings resulting from being outside rate or attitude deadbands.
4 Would occur in FREE mode only.
SM-2A-2277A

THIS PAGE
INTENTIONALLY
LEFT BLANK

SCS

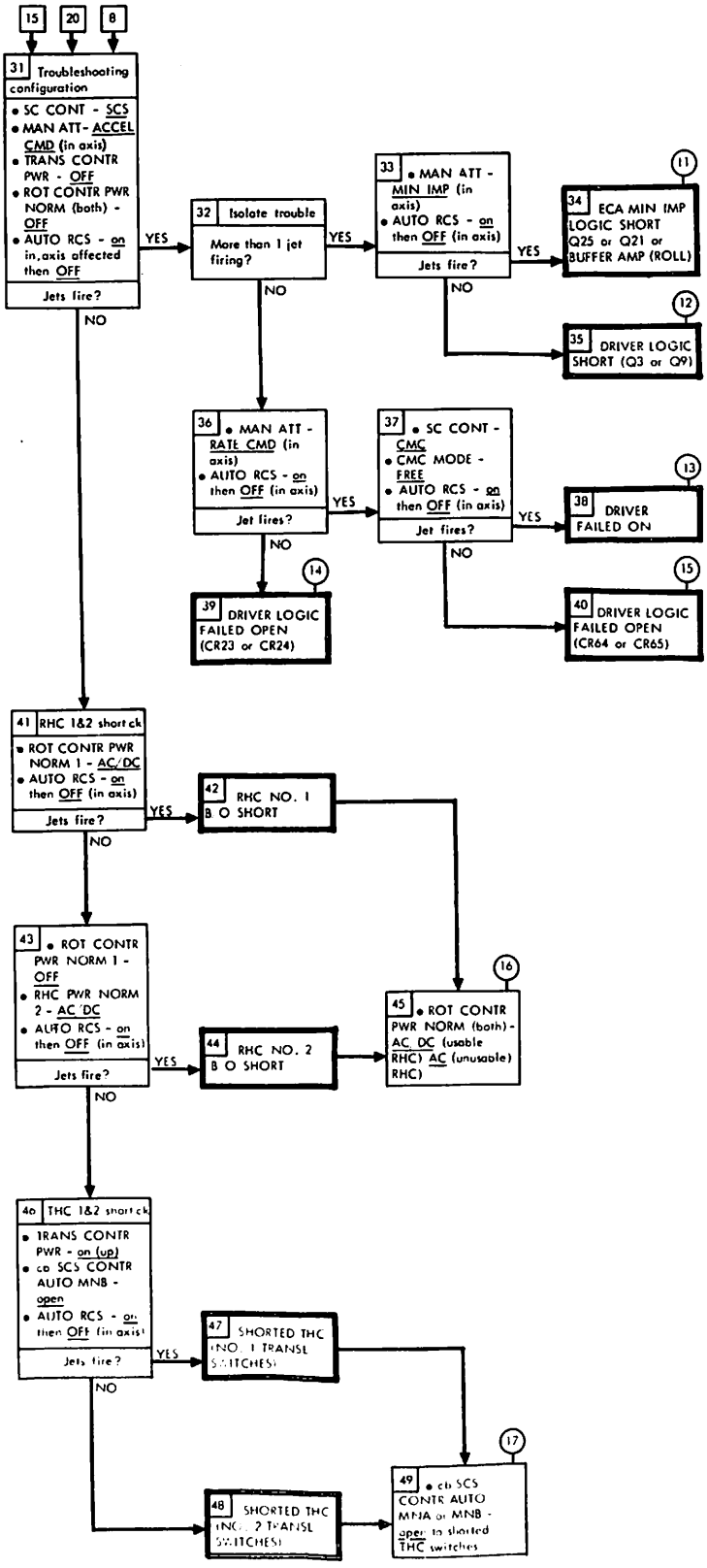
SCS MALFUNCTION INDEX


SYMPTOM
PROCEDURE
REMARKS
SCS
RCS FAILED ON
1 MAN ATT sws
ACCEL CMD
MIN IMP
RATE CMD
2 BMAG H/O
• RHC's - neutral
• FDAI SEL - 1/2
• BMAG MODE - RATE 2 then ATT 1 RATE 2
Any FDAI No. 2 displays H/O?
NONE
RATE
ATT ERROR
3 BMAG NO. 1 FAILED HARDOVER
4 In axis
• BMAG MODE - RATE 2
5 CMC available for troubleshooting?
NO
63
YES
50
6 BMAG NO. 2 FAILED HARDOVER
7 In axis
• BMAG MODE - RATE 1
8 CMC available for troubleshooting?
YES
NO
31
9 CMC trouble-shooting config
• ROT CONTR PWR NORM (both) - AC/DC
• CMC pwr up if req
• SC CONT - CMC
• CMC MODE - FREE
• MAN ATT (3) - RATE CMD
• TRANS CONTR PWR - on (up)
• THC - neutral
• V11 N10E 31E
• Record R1
17777 in R1?
10 Driver on ck
• AUTO RCS (in affected axis) - A or B then OFF
Jet fires?
YES
NO
11 DRIVER FAILED ON
12 • Isolate failed jet by appropriate AUTO RCS switching
13 Input readout
Rotation
17737 -R
17757 +R
17767 -Y
17773 +Y
17775 -P
17776 +P
Translation
13777 -Z
15777 +Z
16777 -Y
17377 +Y
17577 -X
17677 +X
R1 indicates?
ROT
TRANS
14 RHC #2 short ck
• ROT CONTR PWR NORM 2 - OFF
• ROT CONTR PWR NORM 1 - AC/DC
17777 in R1?
15 RHC #1 short ck
• ROT CONTR PWR NORM 1 - OFF
• ROT CONTR PWR NORM 2 - AC/DC
17777 in R1?
16 RHC #2 - B/O SHORT
17 RHC #1 - B/O SHORT
18 • ROT CONTR NORM (operable RHC) - AC/DC (Failed - RHC) - AC
19 THC #2 Short ck
• cb SCS CONTR/ AUTO MNB - open
17777 in R1?
20 THC #1 Short ck
• cb SCS CONTR/ AUTO MNB - close
• cb SCS CONTR/ AUTO MNA - open
17777 in R1?
21 Troubleshooting configuration
• SC CONT - SCS
• MAN ATT - ACCEL CMD (in axis)
• AUTO RCS - on sequentially (in axis) then OFF
More than 1 jet fires?
22 SHORTED THC NO. 2 TRANSL SWITCHES
23 SHORTED THC NO. 1 TRANSL SWITCHES
24 cb SCS CONTR/ AUTO MNA or B - open to shorted THC
25 • MAN ATT - MIN IMP (in axis)
• AUTO RCS - on sequentially (in axis) then OFF
Jets fire?
26 DRIVER LOGIC SHORT (Q3 or Q9)
27 • MAN ATT - RATE CMD (in axis)
• AUTO RCS - on (in axis) then OFF
Jet fires?
28 DRIVER LOGIC FAILED OPEN (CR23 or 24)
29 ECA MIN IMP LOGIC SHORT (Q25 or Q21 or BUFFER AMP (ROLL)
30 DRIVER LOGIC FAILED OPEN (CR64 or CR65)
31
(1) If failure is in roll or yaw after 0.05G, GDC driven ball will spin up.
(2) Attitude hold lost in affected axis. SCS auto ΔV lost if pitch or yaw. If roll, control attitude by direct or ACCEL CMD.
(3) BMAG No. 2 hardover will cause FDAI No. 2 total attitude to drive randomly in Euler modes.
(4) Affected thruster lost for all auto coil operation. Direct mode unaffected.
(5) Direct sws in affected RHC still functional. Affected RHC lost for SCS and G/N attitude control. If RHC 2, swap RHC 1 to CDRs position and leave RHC 2 off. For ΔV's replace RHC 2 to CDR's position and leave in AC only.
(6) Still have translation capability through redundant switches in THC. Select operable enable bus with AUTO RCS.
(7) ACCEL CMD lost in pitch or yaw.
(8) ACCEL CMD lost for that jet.
(9) All SCS RCS (auto coils) lost for affected axis. Disable affected jets with AUTO RCS sws and use direct.
(10) SCS auto RCS coil modes lost for affected jet. If affected jet is in roll, loss of either +Y or Z translation. If affected jet is in pitch or yaw loss of 4 jet +or -X trans.
SM-2A-1944E

SYMPTOM	PROCEDURE	REMARKS

SCS

1 Cont



(11) All SCS RCS (auto coils) lost for affected axis. Disable affected jets with AUTO RCS sws and use direct control.

(12) ACCEL CMD lost in pitch or yaw. Use alternate quad pair for roll.

(13) This jet lost for all SCS & G N control modes. Disable jet with AUTO RCS sws and use direct control.

(14) ACCEL CMD lost for this jet.

(15) SCS AUTO RCS coil modes lost for affected jet. If affected jet is in roll loss of either Y or Z trans. If affected jet is in pitch or yaw, loss of 4 jet + or -X trans.

(16) Direct sws in affected RHC still functional. Affected RHC lost for SCS and G N attitude control. If RHC 2, swap RHC 1 to CDR's position and leave RHC 2 off. For V's replace RHC 2 to CDR's position and leave in AC only.

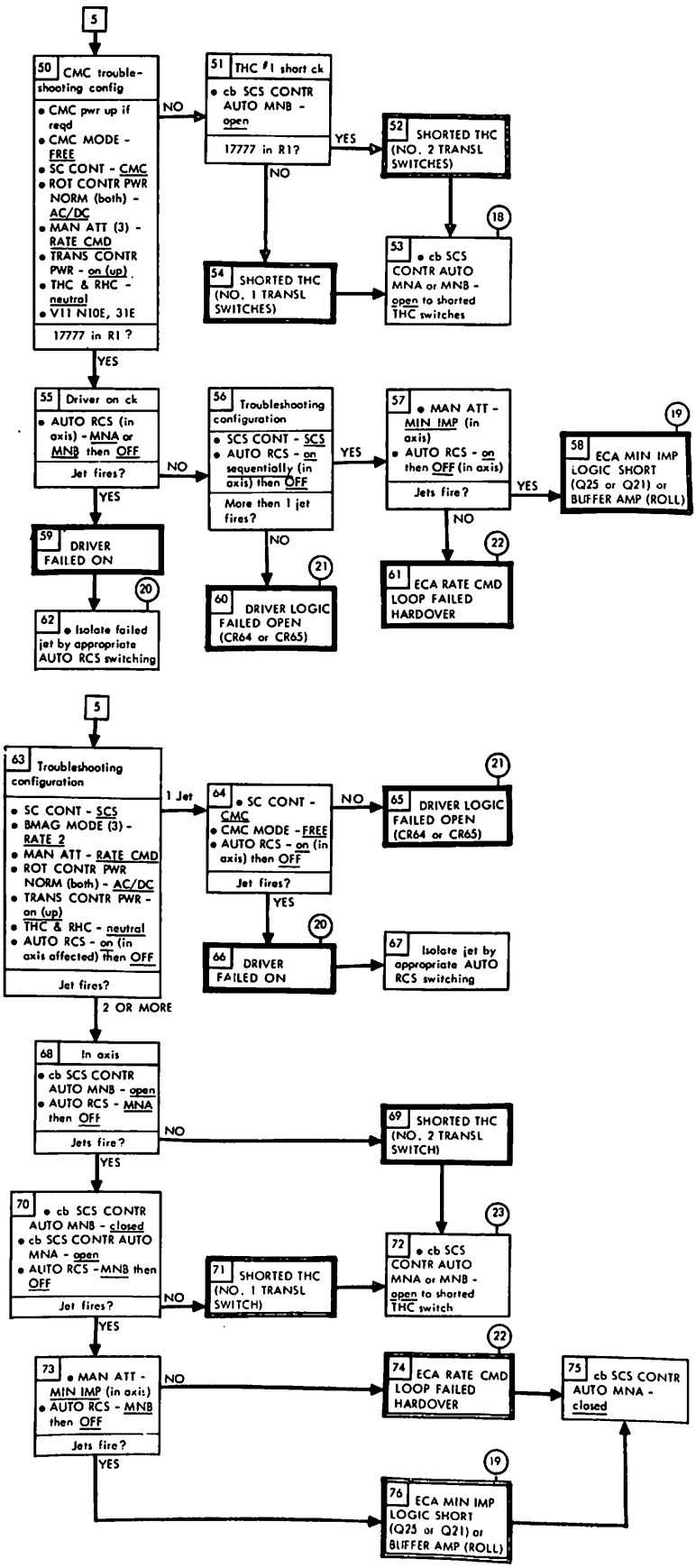
(17) Still have translation capability through redundant sws in THC. Select operable enable bus with AUTO RCS.

SM-2A-194 (D)

SYMPTOM	PROCEDURE	REMARKS

SCS

1 cont



(18) Still have translation capability through redundant sws in THC. Select operable enable bus with AUTO RCS.

(19) All SCS RCS (auto coils) lost for affected axis. Disable affected jets with AUTO RCS sws and use direct control.

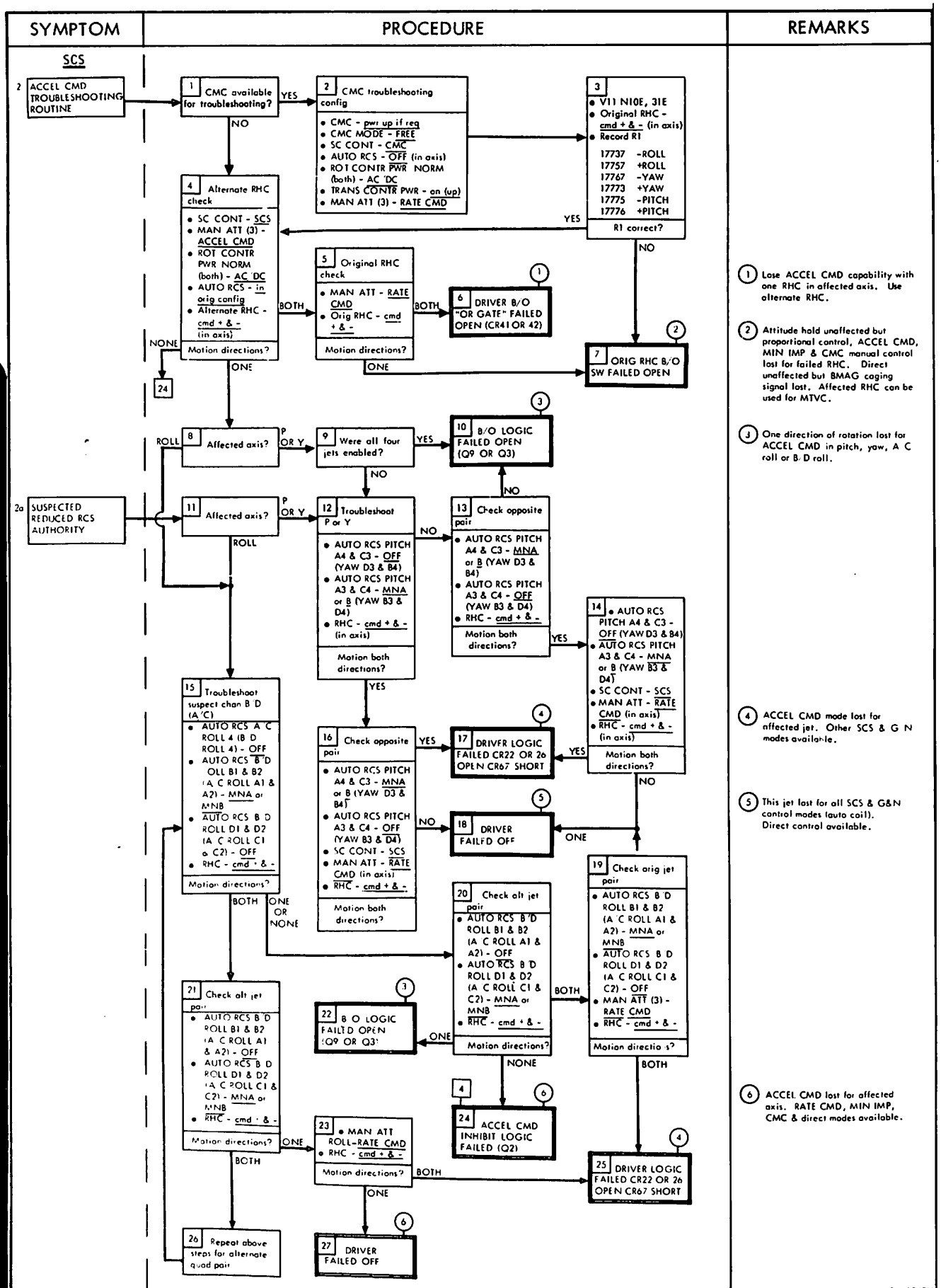
(20) This jet lost for SCS & G&N control modes. Use direct control in affected axis.

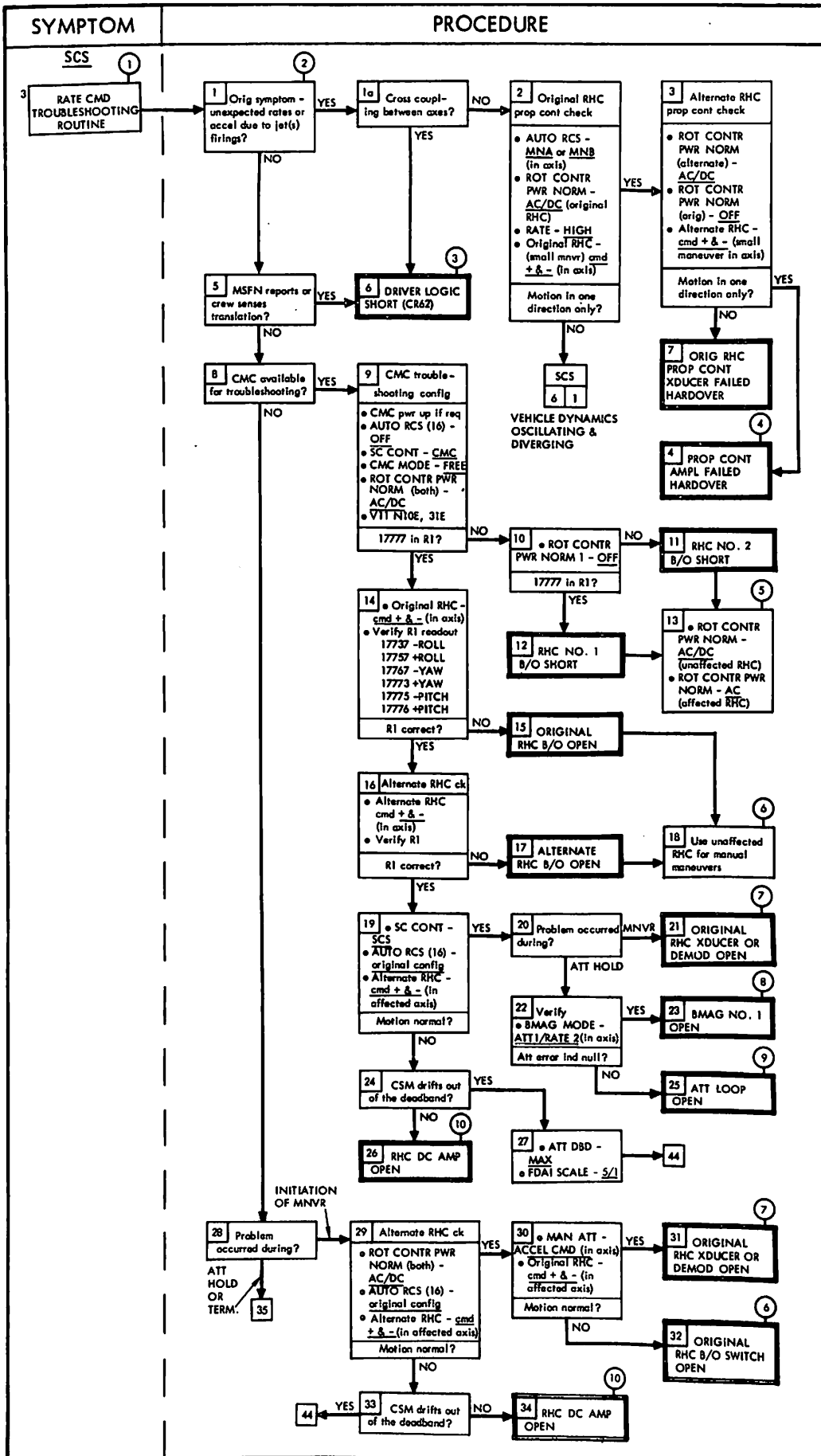
(21) SCS AUTO RCS coil modes lost for affected jet. If affected jet is in roll loss of either -Y or Z trans. If affected jet is in pitch or yaw loss of 4 jet + or -X trans.

(22) SCS RATE CMD, attitude hold & prop cont lost for affected jet. SCS auto ΔV lost if pitch or yaw but operable in roll in ACCEL CMD. Translation without attitude hold possible in MIN IMP or ACCEL CMD.

(23) Still have translation capability through redundant sws in THC. Select operable enable bus with AUTO RCS.

1-50 THRU 2a

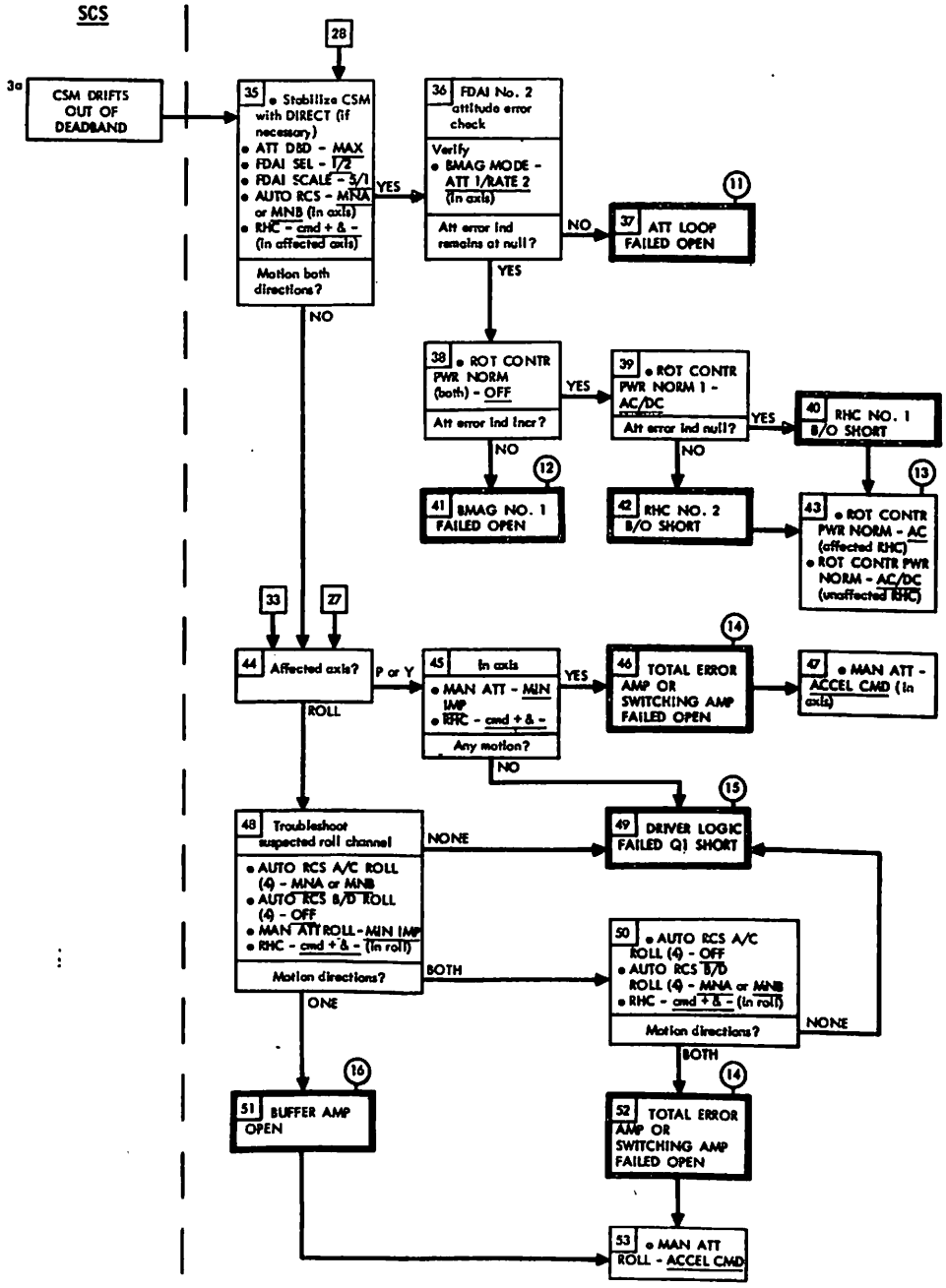

SYMPTOM
PROCEDURE
REMARKS
SCS
2 ACCEL CMD TROUBLESHOOTING ROUTINE
1 CMC available for troubleshooting?
YES
NO
2 CMC troubleshooting config
• CMC - pwr up if req
• CMC MODE - FREE
• SC CONT - CMC
• AUTO RCS - OFF (in axis)
• ROT CONTR PWR NORM (both) - AC DC
• TRANS CONTR PWR - on (up)
• MAN ATT (3) - RATE CMD
3
• V11 N10E, 31E
• Original RHC - cmd + & - (in axis)
• Record R1
17737 -ROLL
17757 +ROLL
17767 -YAW
17773 +YAW
17775 -PITCH
17776 +PITCH
R1 correct?
YES
NO
4 Alternate RHC check
• SC CONT - SCS
• MAN ATT (3) - ACCEL CMD
• ROT CONTR PWR NORM (both) - AC DC
• AUTO RCS - in orig config
• Alternate RHC - cmd + & - (in axis)
Motion directions?
NONE
ONE
BOTH
5 Original RHC check
• MAN ATT - RATE CMD
• Orig RHC - cmd + & -
Motion directions?
BOTH
ONE
6 DRIVER B/O "OR GATE" FAILED OPEN (CR41 OR 42)
7 ORIG RHC B/O SW FAILED OPEN
24
2a SUSPECTED REDUCED RCS AUTHORITY
8 Affected axis?
ROLL
P OR Y
9 Were all four jets enabled?
YES
NO
10 B/O LOGIC FAILED OPEN (Q9 OR Q3)
11 Affected axis?
ROLL
P OR Y
12 Troubleshoot P or Y
• AUTO RCS PITCH A4 & C3 - OFF (YAW D3 & B4)
• AUTO RCS PITCH A3 & C4 - MNA or B (YAW B3 & D4)
• RHC - cmd + & - (in axis)
Motion both directions?
NO
YES
13 Check opposite pair
• AUTO RCS PITCH A4 & C3 - MNA or B (YAW D3 & B4)
• AUTO RCS PITCH A3 & C4 - OFF (YAW B3 & D4)
• RHC - cmd + & -
Motion both directions?
NO
YES
14
• AUTO RCS PITCH A4 & C3 - OFF (YAW D3 & B4)
• AUTO RCS PITCH A3 & C4 - MNA or B (YAW B3 & D4)
• SC CONT - SCS
• MAN ATT - RATE CMD (in axis)
• RHC - cmd + & - (in axis)
Motion both directions?
YES
NO
15 Troubleshoot suspect chan B D (A C)
• AUTO RCS A C ROLL 4 (B D ROLL 4) - OFF
• AUTO RCS B D ROLL B1 & B2 (A C ROLL A1 & A2) - MNA or MNB
• AUTO RCS B D ROLL D1 & D2 (A C ROLL C1 & C2) - OFF
• RHC - cmd + & -
Motion directions?
BOTH
ONE OR NONE
16 Check opposite pair
• AUTO RCS PITCH A4 & C3 - MNA or B (YAW D3 & B4)
• AUTO RCS PITCH A3 & C4 - OFF (YAW B3 & D4)
• SC CONT - SCS
• MAN ATT - RATE CMD (in axis)
• RHC - cmd + & -
Motion both directions?
YES
NO
17 DRIVER LOGIC FAILED CR22 OR 26 OPEN CR67 SHORT
YES
18 DRIVER FAILED OFF
NO
ONE
19 Check orig jet pair
• AUTO RCS B D ROLL B1 & B2 (A C ROLL A1 & A2) - MNA or MNB
• AUTO RCS B D ROLL D1 & D2 (A C ROLL C1 & C2) - OFF
• MAN ATT (3) - RATE CMD
• RHC - cmd + & -
Motion directions?
BOTH
20 Check alt jet pair
• AUTO RCS B D ROLL B1 & B2 (A C ROLL A1 & A2) - OFF
• AUTO RCS B D ROLL D1 & D2 (A C ROLL C1 & C2) - MNA or MNB
• RHC - cmd + & -
Motion directions?
BOTH
ONE
NONE
21 Check alt jet pair
• AUTO RCS B D ROLL B1 & B2 (A C ROLL A1 & A2) - OFF
• AUTO RCS B D ROLL D1 & D2 (A C ROLL C1 & C2) - MNA or MNB
• RHC - cmd + & -
Motion directions?
BOTH
ONE
22 B O LOGIC FAILED OPEN (Q9 OR Q3)
23
• MAN ATT ROLL-RATE CMD
• RHC - cmd + & -
Motion directions?
BOTH
ONE
24 ACCEL CMD INHIBIT LOGIC FAILED (Q2)
25 DRIVER LOGIC FAILED CR22 OR 26 OPEN CR67 SHORT
26 Repeat above steps for alternate quad pair
27 DRIVER FAILED OFF
(1) Lose ACCEL CMD capability with one RHC in affected axis. Use alternate RHC.
(2) Attitude hold unaffected but proportional control, ACCEL CMD, MIN IMP & CMC manual control lost for failed RHC. Direct unaffected but BMAG caging signal lost. Affected RHC can be used for MTVC.
(3) One direction of rotation lost for ACCEL CMD in pitch, yaw, A C roll or B D roll.
(4) ACCEL CMD mode lost for affected jet. Other SCS & G N modes available.
(5) This jet lost for all SCS & G&N control modes (auto coil). Direct control available.
(6) ACCEL CMD lost for affected axis. RATE CMD, MIN IMP, CMC & direct modes available.
SM-2A-1947H


SYMPTOM
PROCEDURE
REMARKS
SCS
3 RATE CMD TROUBLESHOOTING ROUTINE
1 Orig symptom - unexpected rates or accel due to jet(s) firings?
YES
NO
1a Cross coupling between axes?
NO
YES
2 Original RHC prop cont check
• AUTO RCS - MNA or MNB (in axis)
• ROT CONTR PWR NORM - AC/DC (original RHC)
• RATE - HIGH
• Original RHC - (small mnvr) cmd + & - (in axis)
Motion in one direction only?
YES
NO
3 Alternate RHC prop cont check
• ROT CONTR PWR NORM (alternate) - AC/DC
• ROT CONTR PWR NORM (orig) - OFF
• Alternate RHC - cmd + & - (small maneuver in axis)
Motion in one direction only?
YES
NO
5 MSFN reports or crew senses translation?
YES
NO
6 DRIVER LOGIC SHORT (CR62)
7 ORIG RHC PROP CONT XDUCER FAILED HARDOVER
4 PROP CONT AMPL FAILED HARDOVER
SCS 6 1
VEHICLE DYNAMICS OSCILLATING & DIVERGING
8 CMC available for troubleshooting?
YES
NO
9 CMC trouble-shooting config
• CMC pwr up if req
• AUTO RCS (16) - OFF
• SC CONT - CMC
• CMC MODE - FREE
• ROT CONTR PWR NORM (both) - AC/DC
• VTI N10E, 31E
17777 in R1?
NO
YES
10 • ROT CONTR PWR NORM 1 - OFF
17777 in R1?
NO
YES
11 RHC NO. 2 B/O SHORT
12 RHC NO. 1 B/O SHORT
13 • ROT CONTR PWR NORM - AC/DC (unaffected RHC)
• ROT CONTR PWR NORM - AC (affected RHC)
14 • Original RHC - cmd + & - (in axis)
• Verify R1 readout
17737 -ROLL
17757 +ROLL
17767 -YAW
17773 +YAW
17775 -PITCH
17776 +PITCH
R1 correct?
NO
YES
15 ORIGINAL RHC B/O OPEN
16 Alternate RHC ck
• Alternate RHC cmd + & - (in axis)
• Verify R1
R1 correct?
NO
YES
17 ALTERNATE RHC B/O OPEN
18 Use unaffected RHC for manual maneuvers
19 • SC CONT - SCS
• AUTO RCS (16) - original config
• Alternate RHC - cmd + & - (in affected axis)
Motion normal?
YES
NO
20 Problem occurred during? MNVR
ATT HOLD
21 ORIGINAL RHC XDUCER OR DEMOD OPEN
22 Verify
• BMAG MODE - ATT/RATE 2 (in axis)
Att error ind null?
YES
NO
23 BMAG NO. 1 OPEN
24 CSM drifts out of the deadband?
YES
NO
25 ATT LOOP OPEN
26 RHC DC AMP OPEN
27 • ATT DBD - MAX
• FDAI SCALE - 5/1
44
INITIATION OF MNVR
28 Problem occurred during?
ATT HOLD OR TERM.
35
29 Alternate RHC ck
• ROT CONTR PWR NORM (both) - AC/DC
• AUTO RCS (16) - original config
• Alternate RHC - cmd + & - (in affected axis)
Motion normal?
YES
NO
30 • MAN ATT - ACCEL CMD (in axis)
• Original RHC - cmd + & - (in affected axis)
Motion normal?
YES
NO
31 ORIGINAL RHC XDUCER OR DEMOD OPEN
32 ORIGINAL RHC B/O SWITCH OPEN
33 CSM drifts out of the deadband?
YES
NO
34 RHC DC AMP OPEN
1 Assumes full thruster operation except in roll.
2 Assumes RCS thrusters fail on where identified in the "A" flow.
3 Failure causes translation when rotation cmds given. Attitude hold RATE CMD & MIN IMP lost in one direction for affected axis (pitch, yaw, A/C roll, B/D roll). Translation without attitude hold possible with MAN ATT - MIN IMP.
4 For PROP CONT AMP failed hardover, MTVC and RATE CMD lost in affected axis. Attitude hold possible if RHC's locked (or neutral) or if ROT CONTR PWR NORM (both) - OFF. Disable thrusters in affected axis if direct used.
5 Direct sws in affected RHC still functional. One RHC lost; however, RATE CMD mode in failed RHC still possible when breakout switches closed in same axis by operable RHC. MTVC ok when ROT CONTR PWR NORM (affected RHC) is at AC
6 Attitude hold unaffected but prop cont, ACCEL CMD, MIN IMP & CMC man cont lost for failed RHC. Direct unaffected but BMAG coging signal lost. Affected RHC can be used for MTVC.
7 SCS prop cont & MTVC lost for failed RHC.
8 For affected axis: In ATT 1 RATE 2, att hold & att error display lost. SCS auto ΔV possible if roll, by controlling attitude manually. After .05 G, SCS FDAI roll attitude erroneous if yaw or roll.
9 Attitude hold capability lost in affected axis. SCS auto ΔV lost if pitch or yaw, but possible if roll by placing MAN ATT ROLL - ACCEL CMD.
10 SCS prop cont & MTVC lost for both RHCs.

3 THRU 3a

SYMPTOM	PROCEDURE	REMARKS

SCS



(11) Attitude hold capability lost in affected axis. SCS auto ΔV lost if pitch or yaw, but possible if roll by placing MAN ATT ROLL - ACCEL CMD.

(12) For affected axis: In ATT 1 RATE 2, att hold & att error display lost. SCS auto ΔV possible if roll, by controlling att manually. After .05 G, SCS FDAI roll attitude erroneous if yaw or roll.

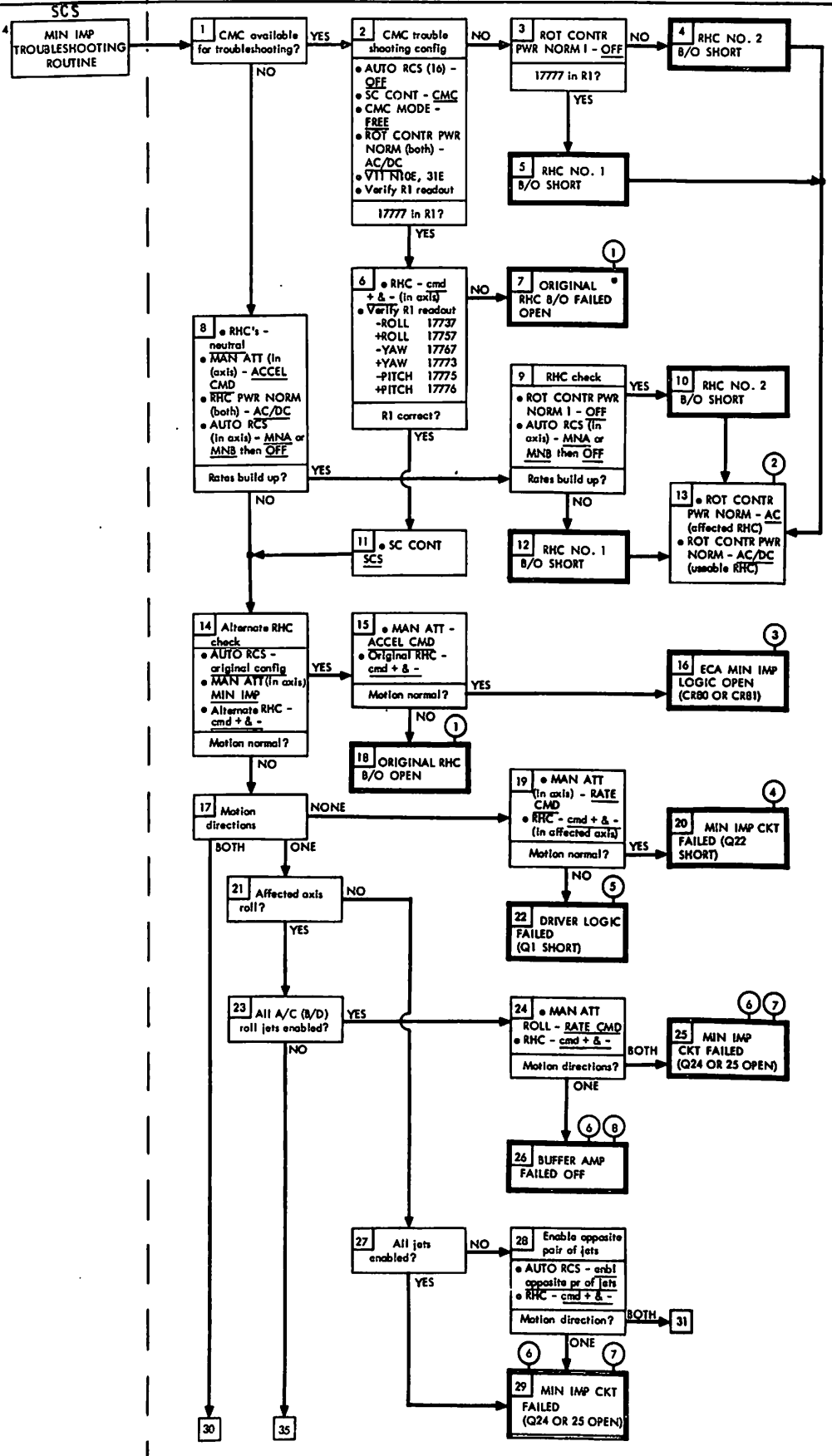
(13) Direct sws in affected RHC still functional. One RHC lost; however, RATE CMD mode in failed RHC still possible when breakout switches closed in same axis by operable RHC. MTVC ok when ROT CONTR PWR NORM (affected RHC) is at AC.

(14) All RATE CMD & attitude hold capability lost for affected axis. Translation possible with MAN ATT sw in RATE CMD & attitude control in affected axis by direct or MIN IMP.

(15) Lose all SCS modes except ACCEL CMD. No Translation on affected axis. Direct control available.

(16) One polarity lost in RATE CMD & MIN IMP. Translation capability remains but attitude hold lost.

SYMPTOM	PROCEDURE	REMARKS



(1) Loss prop cont ACCEL CMD, MIN IMP & CMC MAN CONT for failed RHC. Direct unaffected but BMAG caging signal lost. Affected RHC can be used for MTVC. Attitude hold unaffected.

(2) Direct sw's in affected RHC still functional. Affected RHC lost for SCS and G/N attitude control. If RHC 2 swap RHC 1 to CDR's position and leave RHC 2 off. For ΔV's replace RHC 2 to CDR's position and leave in AC only.

(3) Loss of MIN IMP cont in one direction of affected axis. RATE CMD & ACCEL CMD still available. BMAG cage function still operational.

(4) Loss MIN IMP in both directions of affected axis. RATE CMD & ACCEL CMD still available.

(5) RATE CMD and MIN IMP lost for affected axis (pitch, yaw, A/C roll or B/D roll). SCS translation capability from affected thrusters lost except by DIR ULL. ACCEL CMD and G/N modes unaffected.

(6) Min engine on time protection lost for RATE CMD & ACCEL CMD.

(7) Loss MIN IMP in one direction of affected axis. RATE CMD & ACCEL CMD available. Translation unaffected.

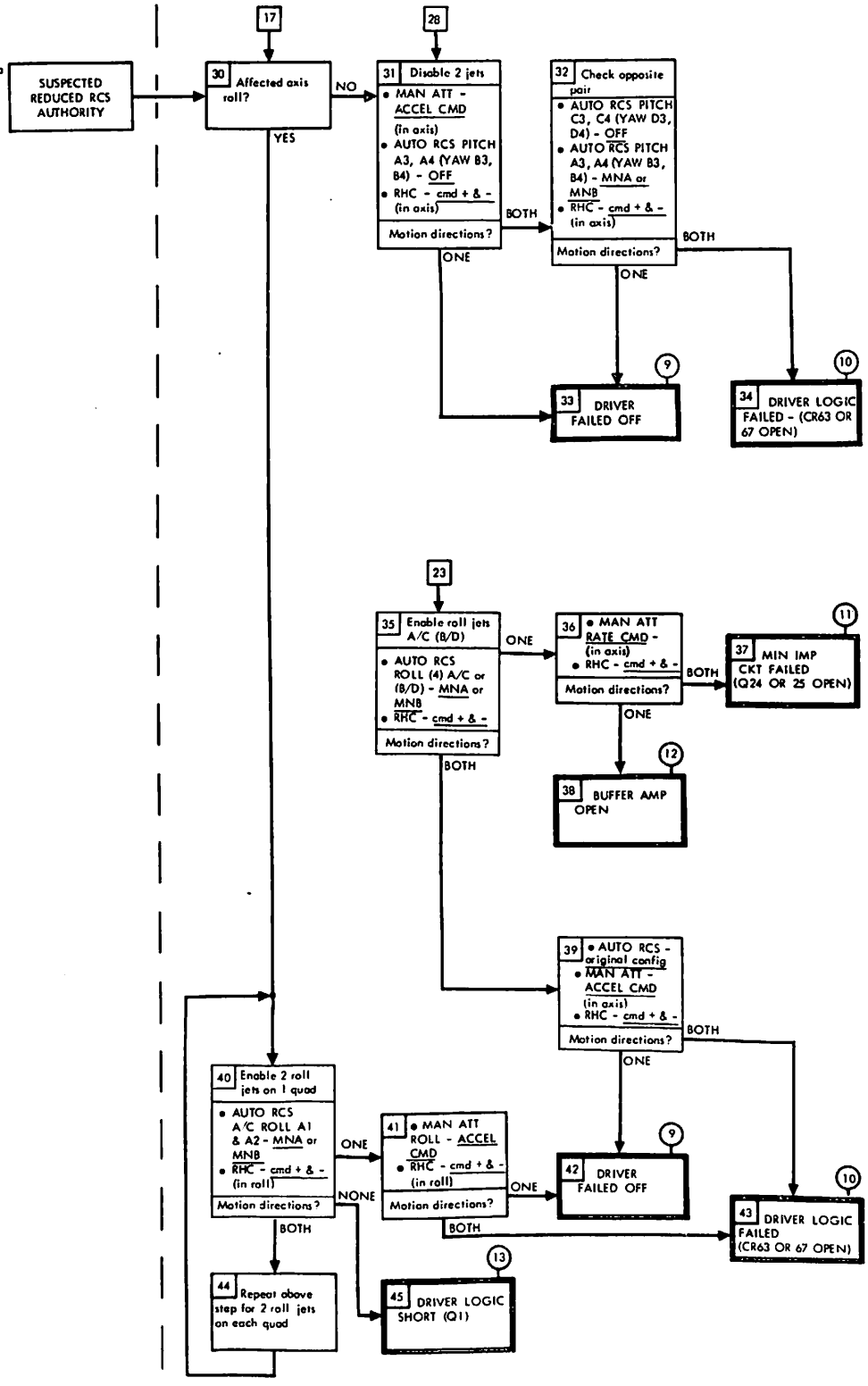
(8) Loss MIN IMP & RATE CMD in one direction of roll axis. ACCEL CMD available. Roll attitude hold lost. SCS auto ΔV unaffected but control roll attitude manually with ACCEL CMD.

4 THRU 4a

SYMPTOM	PROCEDURE	REMARKS

SCS

4 (cont)



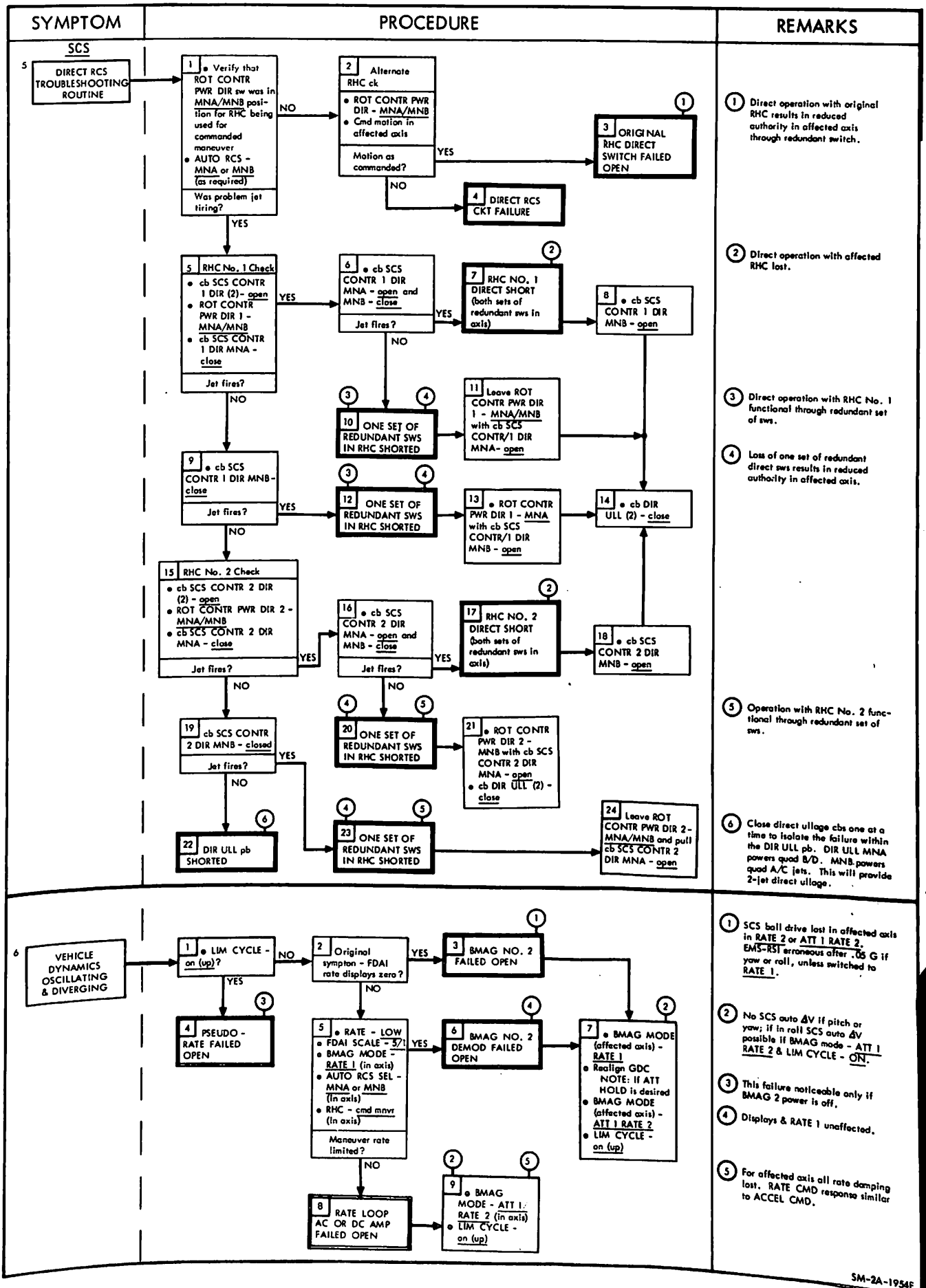
(9) This jet lost for all SCS & G/N control modes. Direct mode of operation available.

(10) Lose RATE CMD & MIN IMP modes. ACCEL CMD still available.

(11) Lose MIN IMP in one direction of affected axis. RATE CMD & ACCEL CMD available. Translation uneffected.

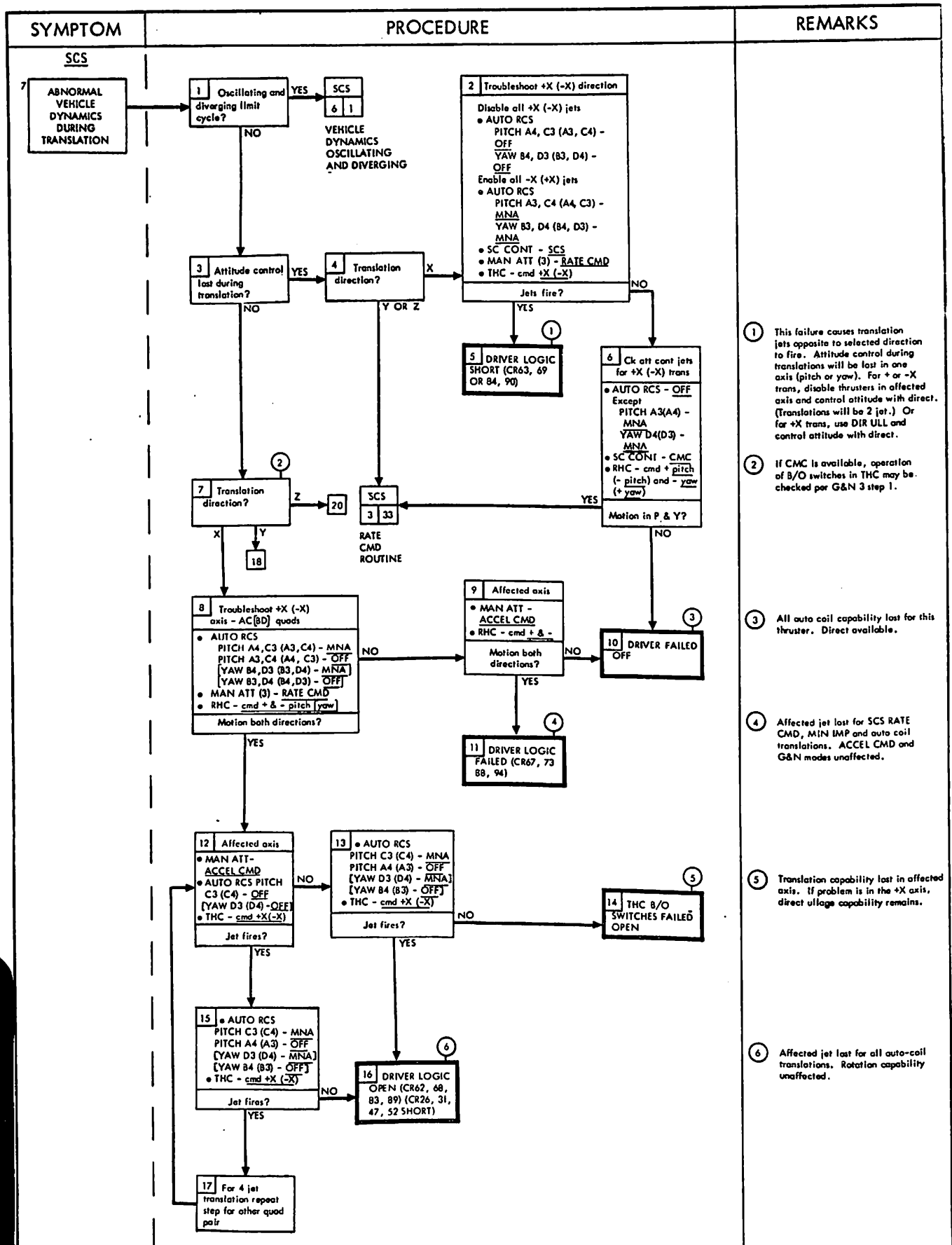
(12) Lose MIN IMP & RATE CMD in one direction of roll axis. ACCEL CMD available.

(13) RATE CMD and MIN IMP lost for affected axis (pitch, yaw, A/C roll or B/D roll). SCS translation capability from affected thrusters lost except by DIR ULL. ACCEL CMD and G&N modes unaffected.



5 THRU 7-17

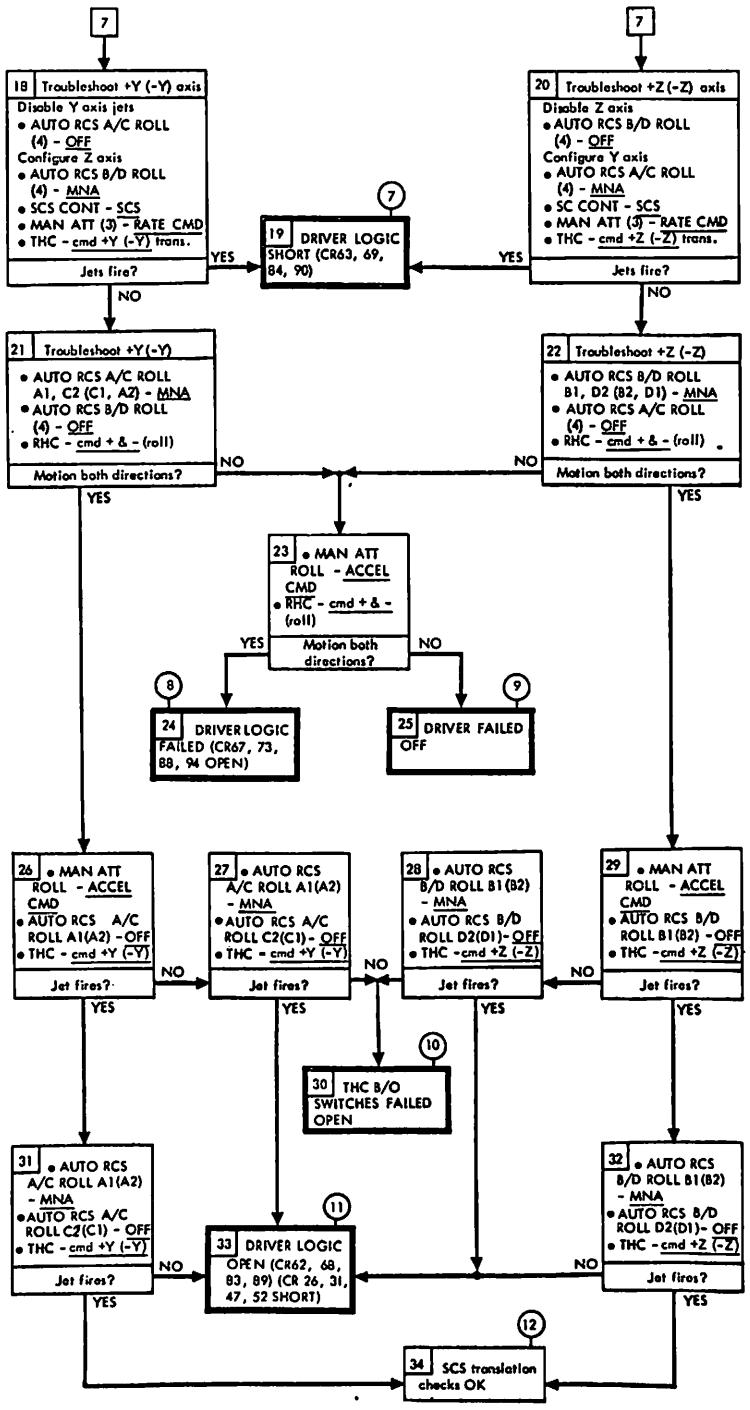
SM-2A-1954F


SYMPTOM
PROCEDURE
REMARKS
SCS
7 ABNORMAL VEHICLE DYNAMICS DURING TRANSLATION
1 Oscillating and diverging limit cycle?
YES
NO
SCS 6 1
VEHICLE DYNAMICS OSCILLATING AND DIVERGING
2 Troubleshoot +X (-X) direction
Disable all +X (-X) jets
• AUTO RCS
PITCH A4, C3 (A3, C4) - OFF
YAW B4, D3 (B3, D4) - OFF
Enable all -X (+X) jets
• AUTO RCS
PITCH A3, C4 (A4, C3) - MNA
YAW B3, D4 (B4, D3) - MNA
• SC CONT - SCS
• MAN ATT (3) - RATE CMD
• THC - cmd +X (-X)
Jets fire?
NO
YES
1
5 DRIVER LOGIC SHORT (CR63, 69 OR 84, 90)
6 Ck att cont jets for +X (-X) trans
• AUTO RCS - OFF
Except
PITCH A3(A4) - MNA
YAW D4(D3) - MNA
• SC CONT - CMC
• RHC - cmd + pitch (- pitch) and - yaw (+ yaw)
Motion in P & Y?
YES
NO
3 Attitude control lost during translation?
YES
NO
4 Translation direction?
X
Y OR Z
2
7 Translation direction?
Z
20
SCS 3 33
RATE CMD ROUTINE
X
Y
18
8 Troubleshoot +X (-X) axis - AC (BD) quads
• AUTO RCS
PITCH A4, C3 (A3, C4) - MNA
PITCH A3, C4 (A4, C3) - OFF
[YAW B4, D3 (B3, D4) - MNA]
[YAW B3, D4 (B4, D3) - OFF]
• MAN ATT (3) - RATE CMD
• RHC - cmd + & - pitch [yaw]
Motion both directions?
NO
YES
9 Affected axis
• MAN ATT - ACCEL CMD
• RHC - cmd + & -
Motion both directions?
NO
YES
3
10 DRIVER FAILED OFF
4
11 DRIVER LOGIC FAILED (CR67, 73 88, 94)
12 Affected axis
• MAN ATT - ACCEL CMD
• AUTO RCS PITCH C3 (C4) - OFF
[YAW D3 (D4) - OFF]
• THC - cmd +X (-X)
Jet fires?
NO
YES
13 • AUTO RCS
PITCH C3 (C4) - MNA
PITCH A4 (A3) - OFF
[YAW D3 (D4) - MNA]
[YAW B4 (B3) - OFF]
• THC - cmd +X (-X)
Jet fires?
NO
YES
5
14 THC B/O SWITCHES FAILED OPEN
15 • AUTO RCS
PITCH C3 (C4) - MNA
PITCH A4 (A3) - OFF
[YAW D3 (D4) - MNA]
[YAW B4 (B3) - OFF]
• THC - cmd +X (-X)
Jet fires?
NO
YES
6
16 DRIVER LOGIC OPEN (CR62, 68, 83, 89) (CR26, 31, 47, 52 SHORT)
17 For 4 jet translation repeat step for other quad pair
1 This failure causes translation jets opposite to selected direction to fire. Attitude control during translations will be lost in one axis (pitch or yaw). For + or -X trans, disable thrusters in affected axis and control attitude with direct. (Translations will be 2 jet.) Or for +X trans, use DIR ULL and control attitude with direct.
2 If CMC is available, operation of B/O switches in THC may be checked per G&N 3 step 1.
3 All auto coil capability lost for this thruster. Direct available.
4 Affected jet lost for SCS RATE CMD, MIN IMP and auto coil translations. ACCEL CMD and G&N modes unaffected.
5 Translation capability lost in affected axis. If problem is in the +X axis, direct ullage capability remains.
6 Affected jet lost for all auto-coil translations. Rotation capability unaffected.

SYMPTOM	PROCEDURE	REMARKS

SCS

7 (Cont)



(7) One direction of Y or Z translation lost.

(8) Affected jet lost for SCS RATE CMD, MIN IMP and auto coil translations. ACCEL CMD and G/N modes unaffected.

(9) All auto coil capability lost for this thruster. Direct available.

(10) Translation capability lost in affected axis. If problem is in the +X axis, direct ullage capability remains.

(11) Affected jet lost for all auto-coil translations. Rotation capability unaffected.

(12) Abnormal dynamics may be due to thruster degradation.

THIS PAGE
INTENTIONALLY
LEFT BLANK

THIS PAGE
INTENTIONALLY
LEFT BLANK

G & N MALFUNCTION INDEX

1 RCS FAILED ON

2 RHC TROUBLESHOOTING ROUTINE

2a CMC AUTO TROUBLESHOOTING ROUTINE

2b SUSPECTED REDUCED RCS AUTHORITY

3 THC TROUBLESHOOTING ROUTINE

4 MIN IMP CONT TROUBLESHOOTING ROUTINE

5 CMC

6 ISS

7 GIMBAL LOCK

8 TEMP

9 RESTART

10 TRACKER

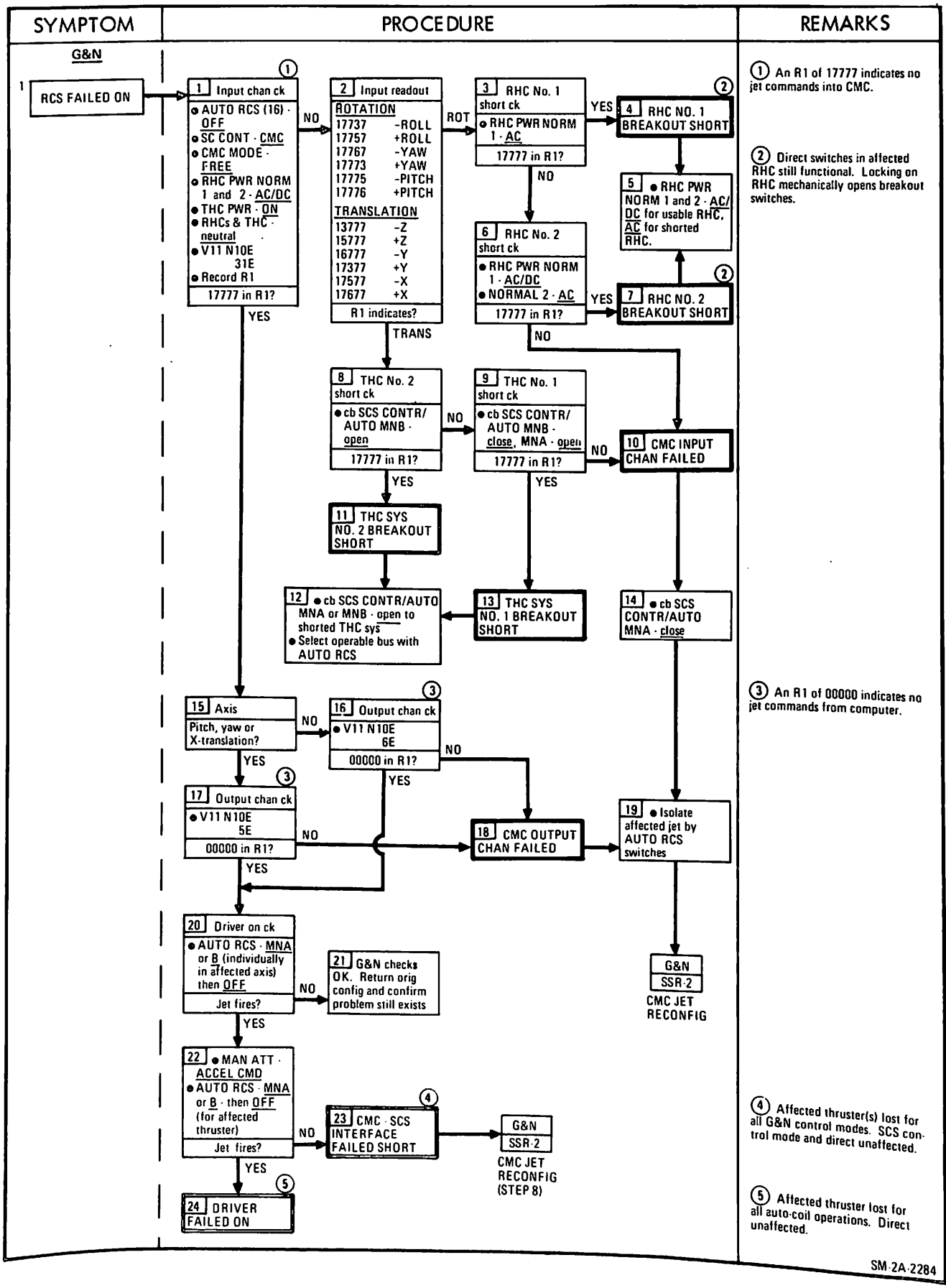
11 PROG

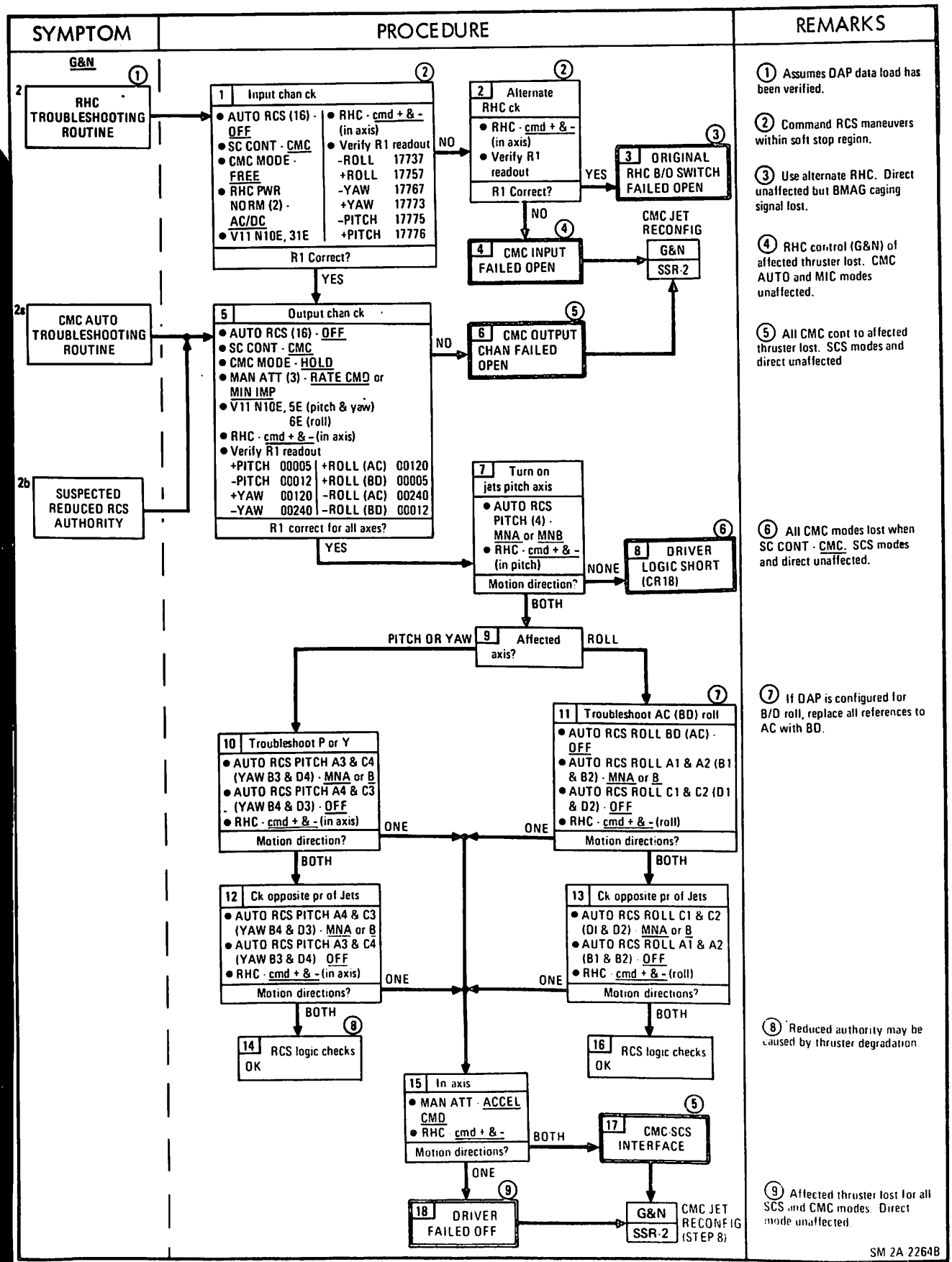
12 ALARM CODES

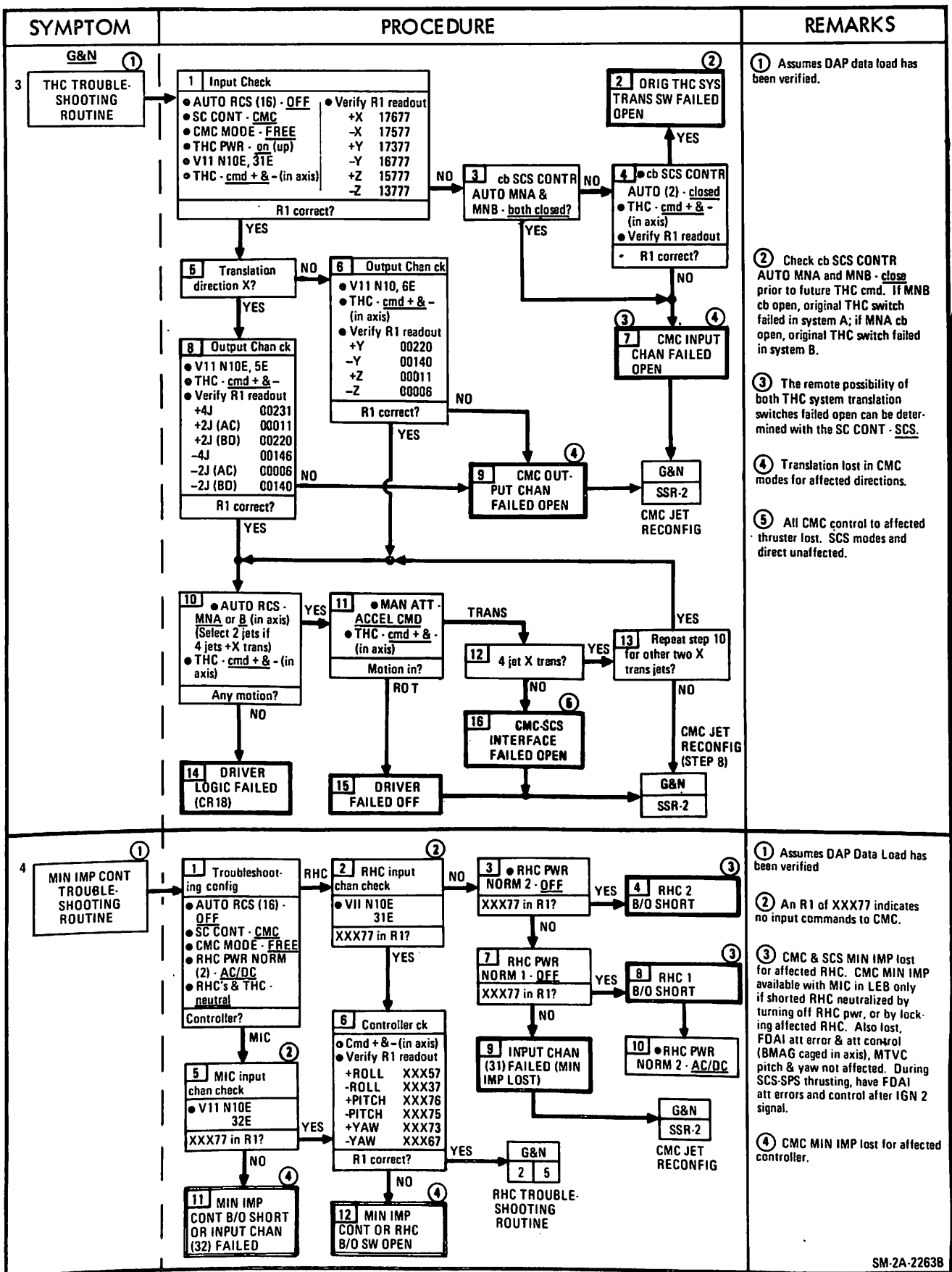
SSR-1 CMC SELF CHECK

SSR-2 CMC JET RE-CONFIG

SSR-3 FRESH START


SYMPTOM
PROCEDURE
REMARKS
G&N
1
RCS FAILED ON
1 Input chan ck
• AUTO RCS (16) · OFF
• SC CONT · CMC
• CMC MODE · FREE
• RHC PWR NORM 1 and 2 · AC/DC
• THC PWR · ON
• RHCs & THC · neutral
• V11 N10E 31E
• Record R1
17777 in R1?
NO
YES
2 Input readout
ROTATION
17737 -ROLL
17757 +ROLL
17767 -YAW
17773 +YAW
17775 -PITCH
17776 +PITCH
TRANSLATION
13777 -Z
15777 +Z
16777 -Y
17377 +Y
17577 -X
17677 +X
R1 indicates?
ROT
TRANS
3 RHC No. 1 short ck
• RHC PWR NORM 1 · AC
17777 in R1?
YES
NO
4 RHC NO. 1 BREAKOUT SHORT
5 • RHC PWR NORM 1 and 2 · AC/DC for usable RHC, AC for shorted RHC.
6 RHC No. 2 short ck
• RHC PWR NORM 1 · AC/DC
• NORMAL 2 · AC
17777 in R1?
YES
NO
7 RHC NO. 2 BREAKOUT SHORT
8 THC No. 2 short ck
• cb SCS CONTR/AUTO MNB · open
17777 in R1?
NO
YES
9 THC No. 1 short ck
• cb SCS CONTR/AUTO MNB · close, MNA · open
17777 in R1?
NO
YES
10 CMC INPUT CHAN FAILED
11 THC SYS NO. 2 BREAKOUT SHORT
12 • cb SCS CONTR/AUTO MNA or MNB · open to shorted THC sys
• Select operable bus with AUTO RCS
13 THC SYS NO. 1 BREAKOUT SHORT
14 • cb SCS CONTR/AUTO MNA · close
15 Axis
Pitch, yaw or X-translation?
NO
YES
16 Output chan ck
• V11 N10E 6E
00000 in R1?
NO
YES
17 Output chan ck
• V11 N10E 5E
00000 in R1?
NO
YES
18 CMC OUTPUT CHAN FAILED
19 • Isolate affected jet by AUTO RCS switches
20 Driver on ck
• AUTO RCS · MNA or B (individually in affected axis) then OFF
Jet fires?
NO
YES
21 G&N checks OK. Return orig config and confirm problem still exists
G&N
SSR-2
CMC JET RECONFIG
22 • MAN ATT · ACCEL CMD
• AUTO RCS · MNA or B · then OFF (for affected thruster)
Jet fires?
NO
YES
23 CMC · SCS INTERFACE FAILED SHORT
G&N
SSR-2
CMC JET RECONFIG (STEP 8)
24 DRIVER FAILED ON
1 An R1 of 17777 indicates no jet commands into CMC.
2 Direct switches in affected RHC still functional. Locking on RHC mechanically opens breakout switches.
3 An R1 of 00000 indicates no jet commands from computer.
4 Affected thruster(s) lost for all G&N control modes. SCS control mode and direct unaffected.
5 Affected thruster lost for all auto-coil operations. Direct unaffected.
SM-2A-2284


SYMPTOM
PROCEDURE
REMARKS
G&N
2 RHC TROUBLESHOOTING ROUTINE
2a CMC AUTO TROUBLESHOOTING ROUTINE
2b SUSPECTED REDUCED RCS AUTHORITY
1 Input chan ck
• AUTO RCS (16) - OFF
• SC CONT - CMC
• CMC MODE - FREE
• RHC PWR NORM (2) - AC/DC
• V11 N10E, 31E
• RHC - cmd + & - (in axis)
• Verify R1 readout
-ROLL 17737
+ROLL 17757
-YAW 17767
+YAW 17773
-PITCH 17775
+PITCH 17776
R1 Correct?
NO
YES
2 Alternate RHC ck
• RHC - cmd + & - (in axis)
• Verify R1 readout
R1 Correct?
YES
NO
3 ORIGINAL RHC B/O SWITCH FAILED OPEN
4 CMC INPUT FAILED OPEN
CMC JET RECONFIG
G&N
SSR-2
5 Output chan ck
• AUTO RCS (16) - OFF
• SC CONT - CMC
• CMC MODE - HOLD
• MAN ATT (3) - RATE CMD or MIN IMP
• V11 N10E, 5E (pitch & yaw) 6E (roll)
• RHC - cmd + & - (in axis)
• Verify R1 readout
+PITCH 00005 +ROLL (AC) 00120
-PITCH 00012 +ROLL (BD) 00005
+YAW 00120 -ROLL (AC) 00240
-YAW 00240 -ROLL (BD) 00012
R1 correct for all axes?
NO
YES
6 CMC OUTPUT CHAN FAILED OPEN
7 Turn on jets pitch axis
• AUTO RCS PITCH (4) - MNA or MNB
• RHC - cmd + & - (in pitch)
Motion direction?
NONE
BOTH
8 DRIVER LOGIC SHORT (CR18)
9 Affected axis?
PITCH OR YAW
ROLL
10 Troubleshoot P or Y
• AUTO RCS PITCH A3 & C4 (YAW B3 & D4) - MNA or B
• AUTO RCS PITCH A4 & C3 (YAW B4 & D3) - OFF
• RHC - cmd + & - (in axis)
Motion direction?
ONE
BOTH
11 Troubleshoot AC (BD) roll
• AUTO RCS ROLL BD (AC) - OFF
• AUTO RCS ROLL A1 & A2 (B1 & B2) - MNA or B
• AUTO RCS ROLL C1 & C2 (D1 & D2) - OFF
• RHC - cmd + & - (roll)
Motion directions?
ONE
BOTH
12 Ck opposite pr of Jets
• AUTO RCS PITCH A4 & C3 (YAW B4 & D3) - MNA or B
• AUTO RCS PITCH A3 & C4 (YAW B3 & D4) OFF
• RHC - cmd + & - (in axis)
Motion directions?
ONE
BOTH
13 Ck opposite pr of Jets
• AUTO RCS ROLL C1 & C2 (D1 & D2) - MNA or B
• AUTO RCS ROLL A1 & A2 (B1 & B2) - OFF
• RHC - cmd + & - (roll)
Motion directions?
ONE
BOTH
14 RCS logic checks OK
16 RCS logic checks OK
15 In axis
• MAN ATT - ACCEL CMD
• RHC - cmd + & -
Motion directions?
BOTH
ONE
17 CMC-SCS INTERFACE
18 DRIVER FAILED OFF
G&N
SSR-2
CMC JET RECONFIG (STEP 8)
1 Assumes DAP data load has been verified.
2 Command RCS maneuvers within soft stop region.
3 Use alternate RHC. Direct unaffected but BMAG caging signal lost.
4 RHC control (G&N) of affected thruster lost. CMC AUTO and MIC modes unaffected.
5 All CMC cont to affected thruster lost. SCS modes and direct unaffected
6 All CMC modes lost when SC CONT - CMC. SCS modes and direct unaffected.
7 If DAP is configured for B/D roll, replace all references to AC with BD.
8 Reduced authority may be caused by thruster degradation
9 Affected thruster lost for all SCS and CMC modes. Direct mode unaffected.
SM 2A 2264B



(1) Assumes DAP data load has been verified.

(2) Check cb SCS CONTR AUTO MNA and MNB - close prior to future THC cmd. If MNB cb open, original THC switch failed in system A; if MNA cb open, original THC switch failed in system B.

(3) The remote possibility of both THC system translation switches failed open can be determined with the SC CONT - SCS.

(4) Translation lost in CMC modes for affected directions.

(5) All CMC control to affected thruster lost. SCS modes and direct unaffected.

(1) Assumes DAP Data Load has been verified

(2) An R1 of XXX77 indicates no input commands to CMC.

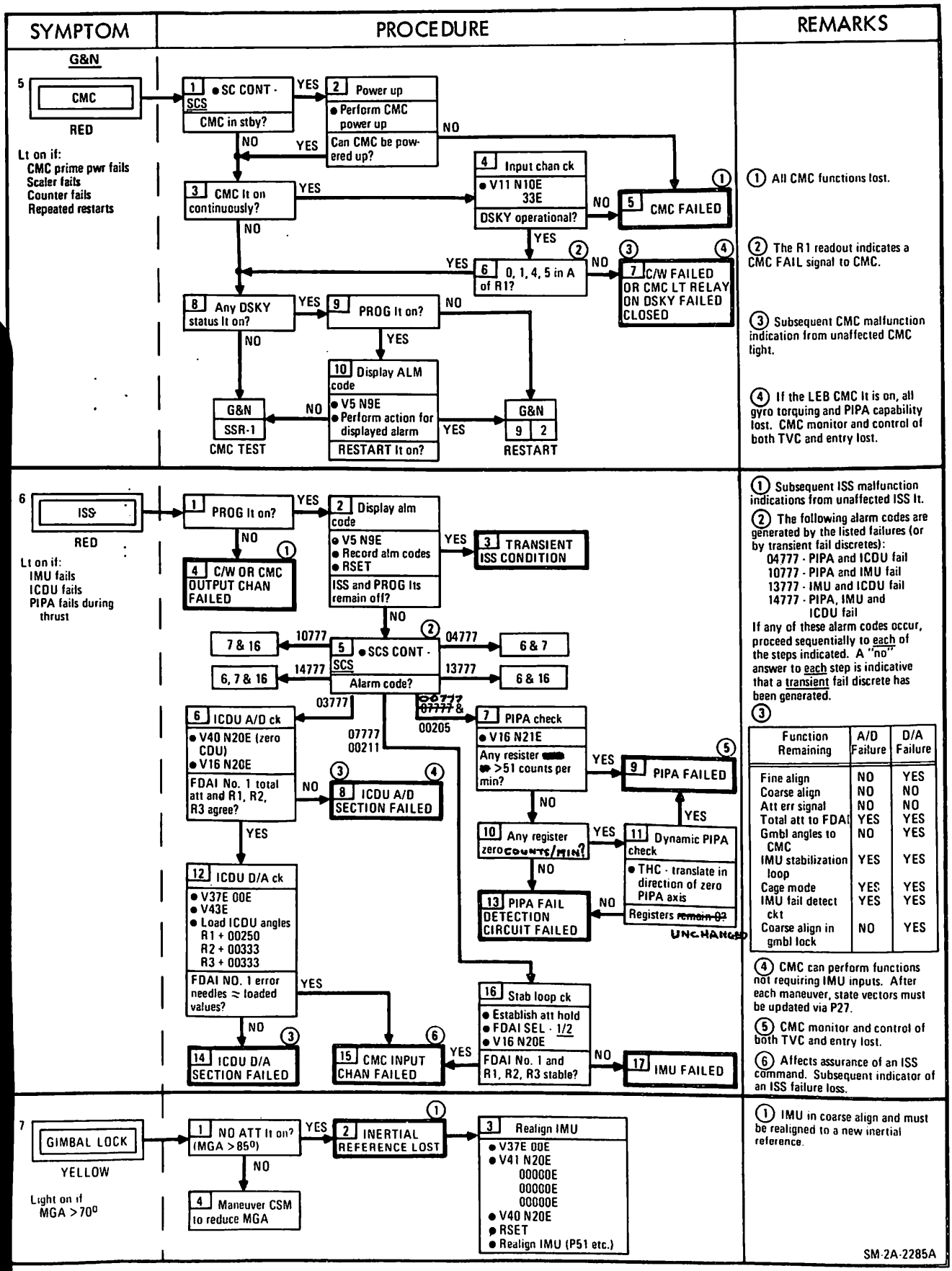
(3) CMC & SCS MIN IMP lost for affected RHC. CMC MIN IMP available with MIC in LEB only if shorted RHC neutralized by turning off RHC pwr, or by locking affected RHC. Also lost, FDAI att error & att control (BMAG caged in axis), MTVC pitch & yaw not affected. During SCS-SPS thrusting, have FDAI att errors and control after IGN 2 signal.

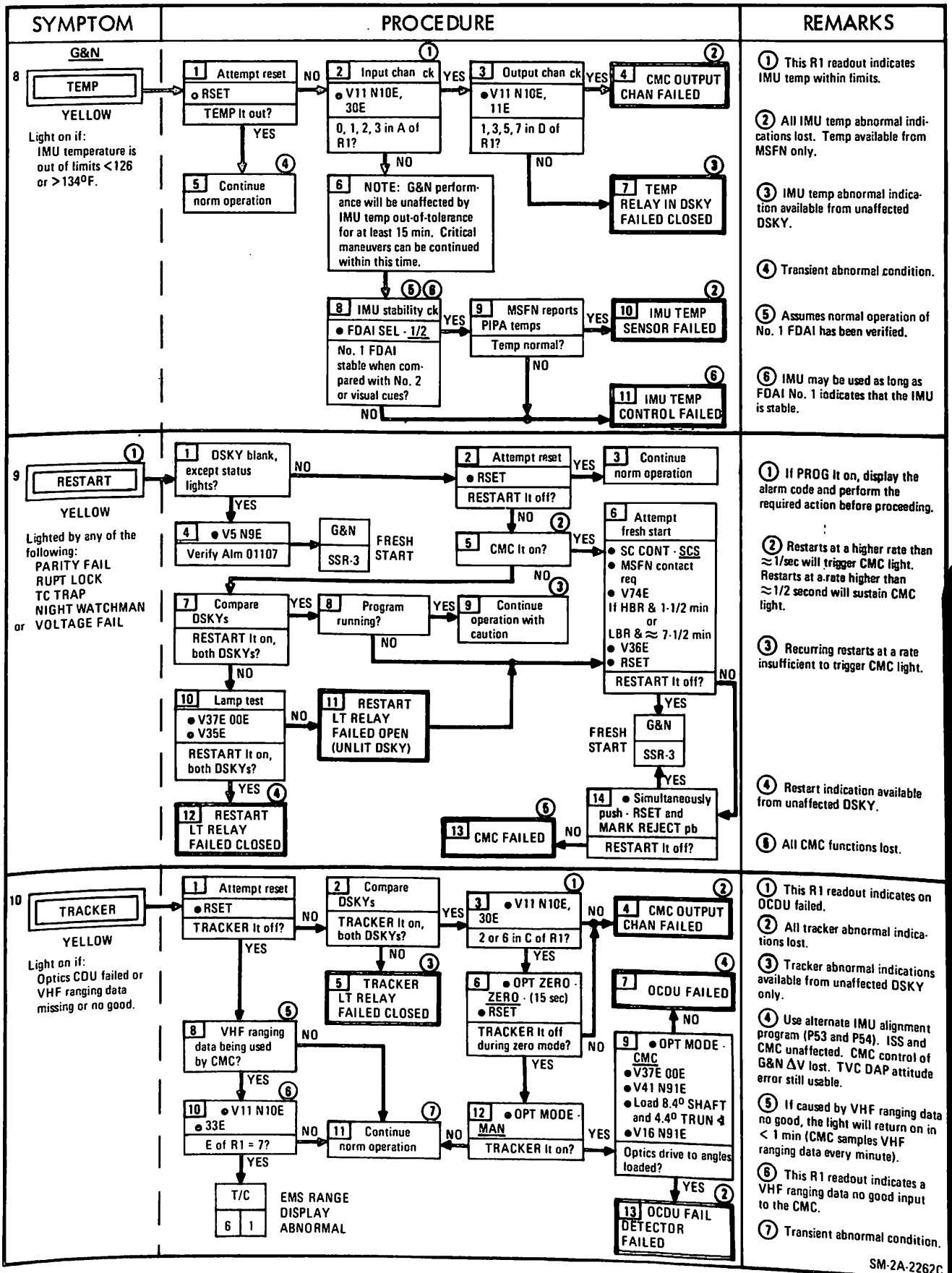
(4) CMC MIN IMP lost for affected controller.

SM-2A-2263B

DATE ~~12/23/70~~ 1/12/71

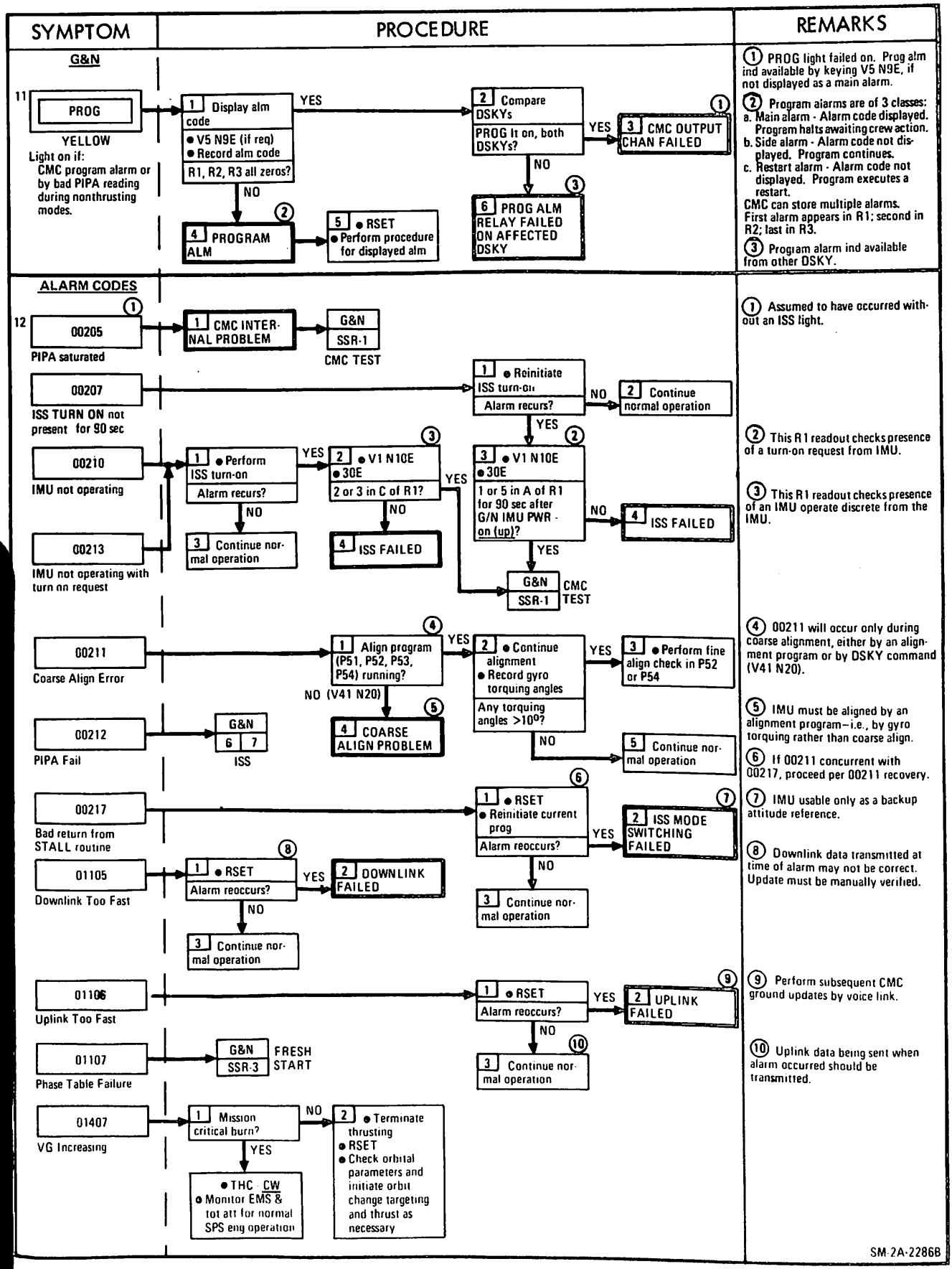
PEN & INK ~~1/4/71~~

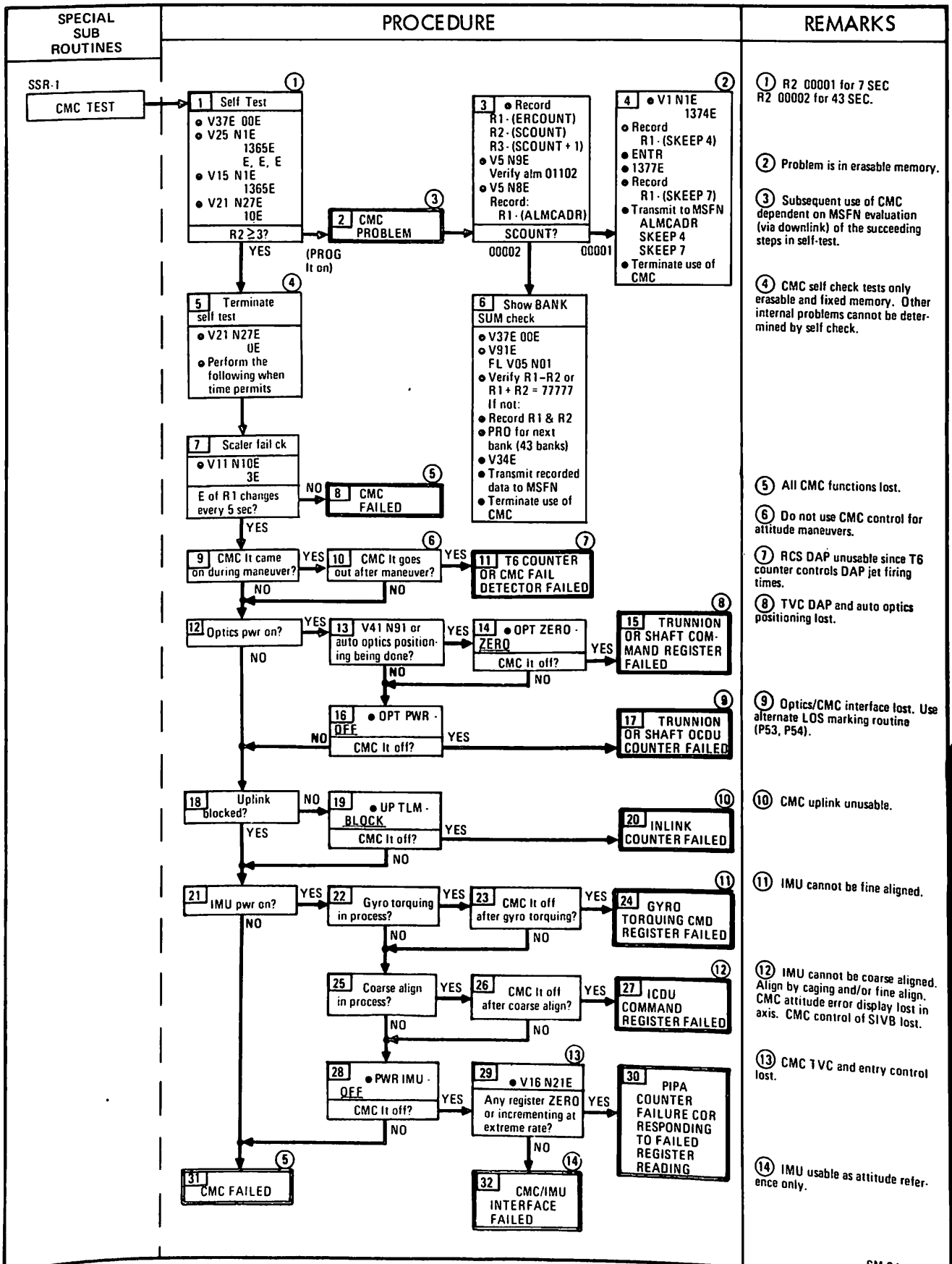




8 THRU 12

SM-2A-2262C


SYMPTOM
PROCEDURE
REMARKS
G&N
11
PROG
YELLOW
Light on if:
CMC program alarm or by bad PIPA reading during nonthrusting modes.
1 Display alm code
• V5 N9E (if req)
• Record alm code
R1, R2, R3 all zeros?
YES
NO
2 Compare DSKYs
PROG lt on, both DSKYs?
YES
NO
3 CMC OUTPUT CHAN FAILED
6 PROG ALM RELAY FAILED ON AFFECTED DSKY
4 PROGRAM ALM
5 • RSET
• Perform procedure for displayed alm
ALARM CODES
12
00205
PIPA saturated
1 CMC INTERNAL PROBLEM
G&N SSR-1
CMC TEST
00207
ISS TURN ON not present for 90 sec
00210
IMU not operating
00213
IMU not operating with turn on request
1 • Reinitiate ISS turn-on
Alarm recurs?
NO
2 Continue normal operation
YES
1 • Perform ISS turn-on
Alarm recurs?
2 • V1 N10E
• 30E
2 or 3 in C of R1?
3 • V1 N10E
• 30E
1 or 5 in A of R1 for 90 sec after G/N IMU PWR - on (up)?
4 ISS FAILED
3 Continue normal operation
4 ISS FAILED
G&N SSR-1 CMC TEST
00211
Coarse Align Error
1 Align program (P51, P52, P53, P54) running?
NO (V41 N20)
2 • Continue alignment
• Record gyro torquing angles
Any torquing angles >10°?
3 • Perform fine align check in P52 or P54
4 COARSE ALIGN PROBLEM
5 Continue normal operation
00212
PIPA Fail
G&N 6 7 ISS
00217
Bad return from STALL routine
1 • RSET
• Reinitiate current prog
Alarm reoccurs?
2 ISS MODE SWITCHING FAILED
3 Continue normal operation
01105
Downlink Too Fast
1 • RSET
Alarm reoccurs?
2 DOWNLINK FAILED
3 Continue normal operation
01106
Uplink Too Fast
1 • RSET
Alarm reoccurs?
2 UPLINK FAILED
3 Continue normal operation
01107
Phase Table Failure
G&N SSR-3 FRESH START
01407
VG Increasing
1 Mission critical burn?
YES
NO
• THC CW
• Monitor EMS & tot att for normal SPS eng operation
2 • Terminate thrusting
• RSET
• Check orbital parameters and initiate orbit change targeting and thrust as necessary
1 PROG light failed on. Prog alm ind available by keying V5 N9E, if not displayed as a main alarm.
2 Program alarms are of 3 classes:
a. Main alarm - Alarm code displayed. Program halts awaiting crew action.
b. Side alarm - Alarm code not displayed. Program continues.
c. Restart alarm - Alarm code not displayed. Program executes a restart.
CMC can store multiple alarms. First alarm appears in R1; second in R2; last in R3.
3 Program alarm ind available from other DSKY.
1 Assumed to have occurred without an ISS light.
2 This R1 readout checks presence of a turn-on request from IMU.
3 This R1 readout checks presence of an IMU operate discrete from the IMU.
4 00211 will occur only during coarse alignment, either by an alignment program or by DSKY command (V41 N20).
5 IMU must be aligned by an alignment program—i.e., by gyro torquing rather than coarse align.
6 If 00211 concurrent with 00217, proceed per 00211 recovery.
7 IMU usable only as a backup attitude reference.
8 Downlink data transmitted at time of alarm may not be correct. Update must be manually verified.
9 Perform subsequent CMC ground updates by voice link.
10 Uplink data being sent when alarm occurred should be transmitted.
SM-2A-2286B



SSR-1 THRU SSR-3

SM-2A-2287A

SPECIAL SUB-ROUTINES	PROCEDURE	REMARKS

SSR-2

CMC JET RE-CONFIG

1 Rotation? YES → 2 Axis? ROLL / PITCH or YAW

NO → 3 Translation direction? X / Y or Z

4 Jet Determination (1)

Output Chan 5	Jet	Input Chan 31
00001*	C3	
00002*	C4	
00010*	A4	
00005	A3, C3	X7776
00004*	A3	
00012	A4, C4	X7775
00020*	D3	
00040*	D4	
00100*	B3	
00120	B3, D3	X7773
00200*	B4	
00240	B4, D4	X7767

5 Jet Determination (1)

Output Chan 6	Jet	Input Chan 31
00001*	B1	
00002*	B2	
00004*	D1	
00005	B1, D1	X7757
00010*	D2	
00012	B2, D2	X7737
00020*	A1	
00040*	A2	
00100*	C1	
00120	A1, C1	X7757
00200*	C2	
00240	A2, C2	X7737

6 Jet Determination (2)

Output Chan 6	Dir	Jet	Input Chan 31
00006	-Z	B2, D1	X3777
00011	+Z	B1, D2	X5777
00140	-Y	A2, C1	X6777
00220	+Y	A1, C2	X7377

7 Jet Determination (2)

Output Chan 5	Dir	Jet	Input Chan 31
00006	-(2J)	A3, C4	X7577
00011	+(2J)	A4, C3	X7677
00140	-(2J)	B3, D4	X7577
00146	-(4J)	A3, B3, C4, D4	X7577
00220	+(2J)	B4, D3	X7677
00231	+(4J)	A4, B4, C3, D3	X7677

8 Axis of failed jet? ROLL / PITCH or YAW

9 Initiate DAP load
- V48E
- FL V04 N46
- V24E

Failed jet in quads? A or C / B or D

10 Initiate DAP load
- V48E
- FL V04 N46
- V24E

Failed jet in quad? A or C / B or D

11 A(C) isolation (3) (4)
- AUTO RCS A/C ROLL failed thruster - OFF (RCS failed on only)
- ABCDE E
- 01111 E
- PRO

12 B(D) isolation (3) (4)
- AUTO RCS B/D ROLL failed thruster - OFF (RCS failed on only)
- ABCDE E
- 11111 E
- PRO

13 A(C) isolation (3) (5)
- AUTO RCS PITCH failed thruster - OFF (RCS failed on only)
- A01DE E
- 11111 E
- PRO

14 B(D) isolation (3) (5)
- AUTO RCS YAW failed thruster - OFF (RCS failed on only)
- A10DE E
- 11111 E
- PRO

15 Complete DAP load (6)
- FL V06 N47
- PRO
- FL V06 N48
- PRO

(1) Starred (*) outputs are single jet commands. For RCS failed on, the failed jet is the indicated jet. For output channel failed open, the failed jet is the corresponding jet in the rotational couple, e.g., command + pitch. Should observe 00005 in chan 5 (A3, C3 + pitch couple). If observe 00004, C3 can not be commanded on by CMC.

(2) If R1 (output chan) contains a number not listed, determine the failed jet from the R1 (output) readout when a rotation command is given.

(3) In R1, A is vehicle configuration:
- 0 - No DAP
- 1 - CSM only
- 2 - CSM + LM (asc + des)
- 3 - CSM + SIVB
- 6 - CSM + LM (asc only)

In R1, B is quad A/C for X translation:
- 0 - FAIL A/C
- 1 - USE A/C

In R1, C is quad B/D for X translation:
- 0 - FAIL B/D
- 1 - USE B/D

In R1, D is DAP deadband:
- 0 - 0.5°
- 1 - 5.0°

E is the DAP rate:
- 0 - 0.05°/sec
- 1 - 0.20°/sec
- 2 - 0.5°/sec
- 3 - 2.0°/sec

In R2, A is roll selection
- 0 - Use B/D
- 1 - Use A/C

(4) Translation (Y or Z) will be single jet and result in excessive RCS prplnt consumption.

(5) Rotations (pitch or yaw) will be single jet. X translations will be 2 jet.

(6) N47 and N48 display other DAP parameters assumed to be correct.

SSR-3

FRESH START

1 Restore erasable memory (1) (2) (4)
- Contact MSFN
- V74E (erasable dump downlink)
- Do P27 (as necessary)

2 Restart DAP & re-establish REFSMMAT (3)
- V46E
- Do P51

Fresh start by V36? NO / YES

3 Fresh start re-occurs? YES → 4 CMC FAILED

NO → 5 Select initial prog of mission phase & continue operation

(1) State vector and CMC time should be updated. All nonpad-loaded parameters, except time & state vector, will be properly updated by CMC programs in their proper sequence as if CMC had just been turned on when fresh start occurred.

(2) Extended V74 permits MSFN to examine all pertinent erasable locations to determine if any parameters need reloading.

(3) DAP is shut off by fresh start & must be re-initiated by V46.

(4) REFSMMAT, SURF FLAG, LMOONFLG, CMOONFLG, and NODOPO 1 flag are not changed by fresh start. All other flagwords are reset by fresh start. DRIFTFLG (bit 15, flagword 2) should be set by:
V25 N7E, 76E, 40000E, 1E For all others proper flags are set again by performance of CMC programs in normal sequence.

SM-2A-2288A

THIS PAGE
INTENTIONALLY
LEFT BLANK

DATE 6/18/70

SPS

SPS MALFUNCTION INDEX

1 SPS PRESS

1a FUEL AND/OR OXID PRESS HIGH

1b FUEL AND/OR OXID PRESS LOW

1c FUEL AND OXID $\Delta P > 20$ PSI

2 PITCH (YAW) GMBL 1 (2)

3 SPS PREMATURE SHUTDOWN

3a NO SPS IGNITION

4 SPS ENG DOES NOT SHUTDOWN AUTO

4a SPS THRUST LT ON NON THRUSTING

5 SPS Pc ABNORMAL

6 SPS He VLV tb-ABNORMAL

7 He PRESS LOW OR DECR

8 GN2 A(B) PRESS LOW

8a SPS INJ VLV PARTIALLY OPEN

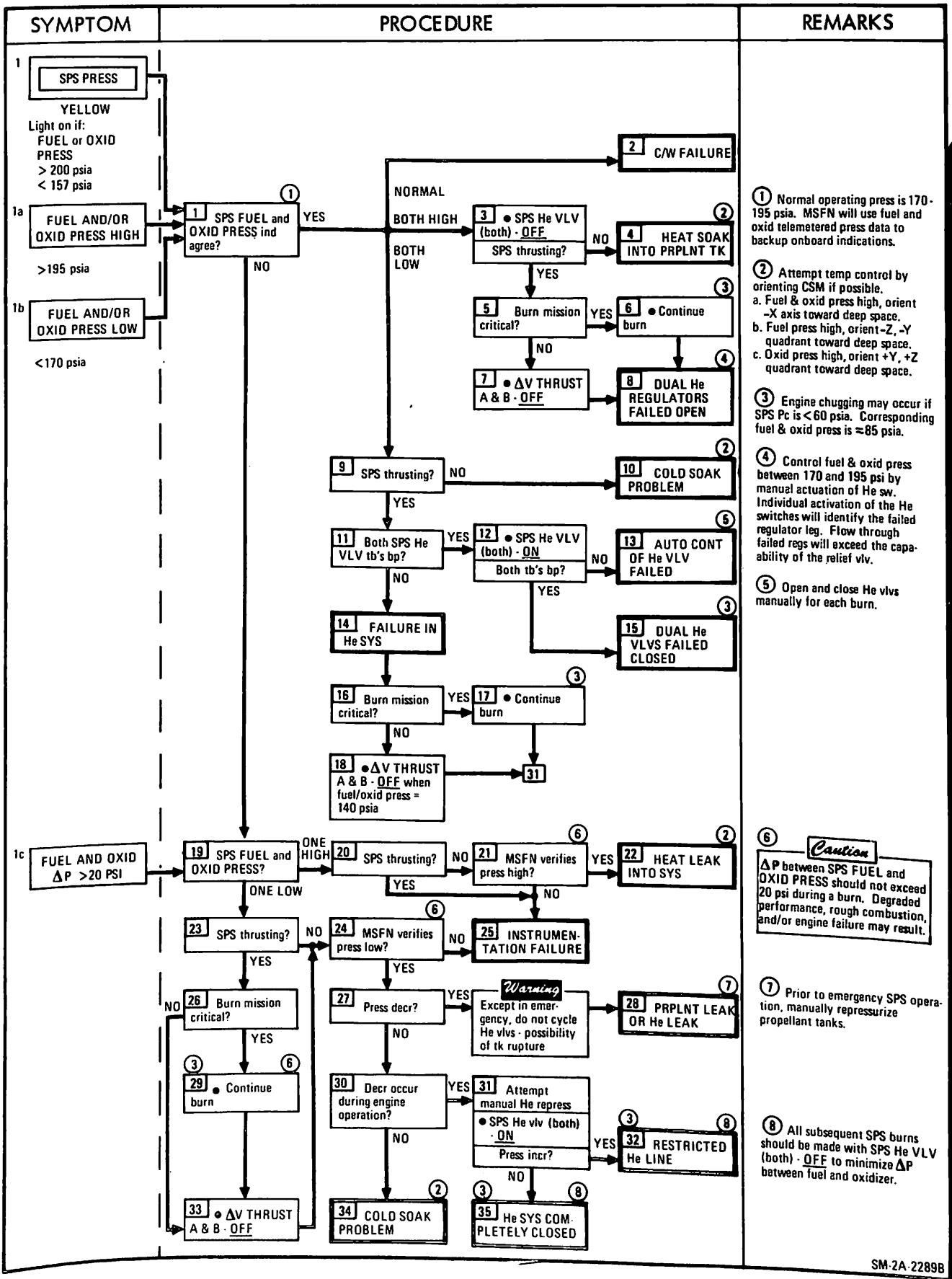
9 SPS INJ VLV IND ABNORMAL

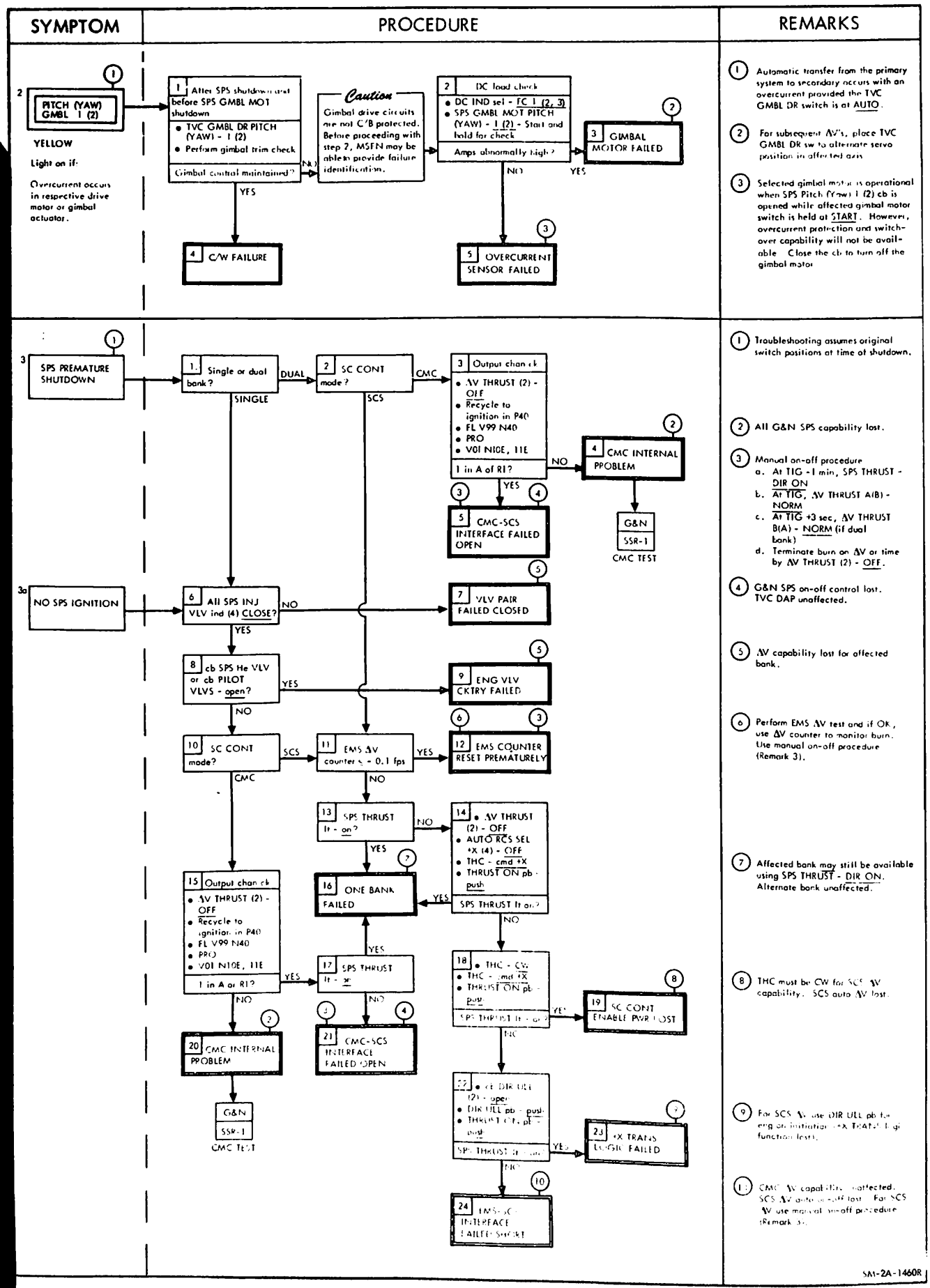
10 NO PRPLNT TEMP CONTROL

11 NO RESPONSE OF SPS OXID VLV tb DURING FLOW ADJUST

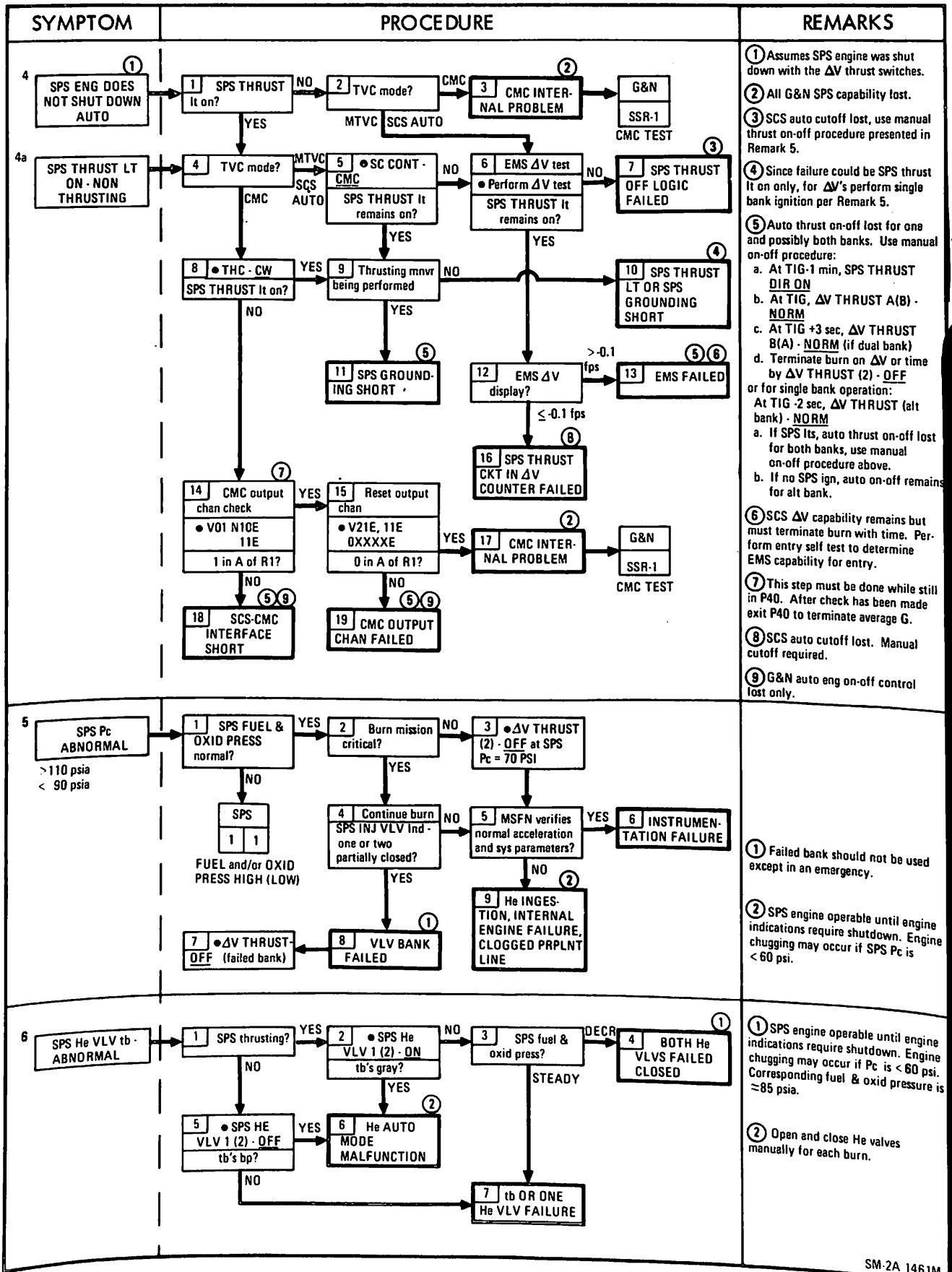
12 SPS OXIDE UNBAL IND ERRATIC OR PEGGED

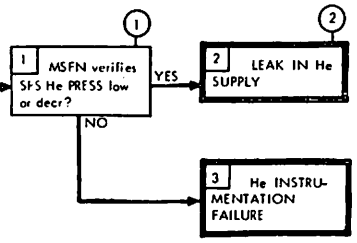
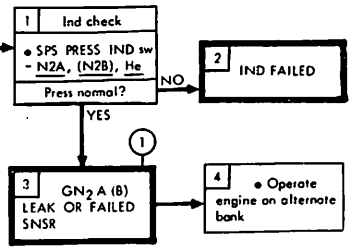
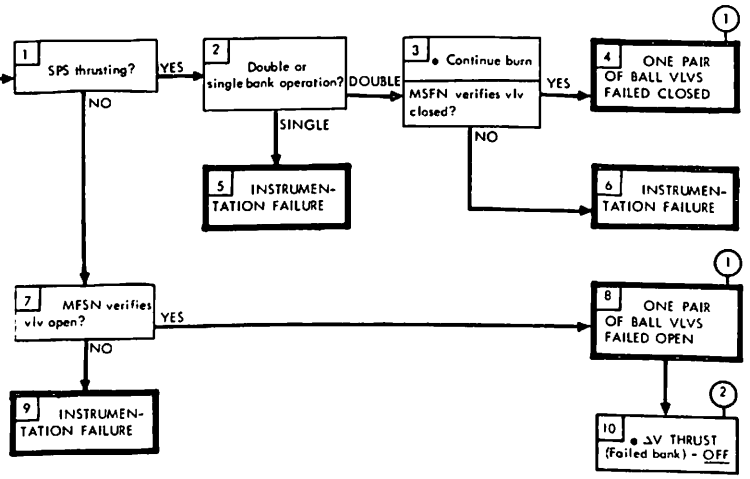
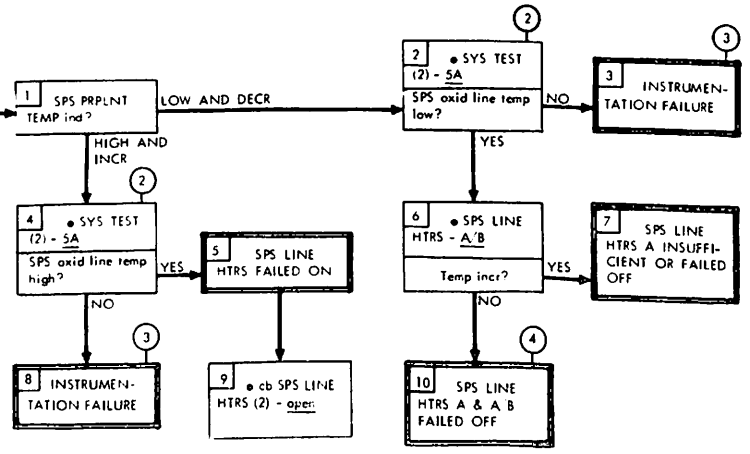
13 SPS OXID (FUEL) QTY IND READOUT ABNORMAL


SYMPTOM
PROCEDURE
REMARKS
1 SPS PRESS YELLOW Light on if: FUEL or OXID PRESS > 200 psia < 157 psia
1a FUEL AND/OR OXID PRESS HIGH >195 psia
1b FUEL AND/OR OXID PRESS LOW <170 psia
1c FUEL AND OXID ΔP >20 PSI
1 SPS FUEL and OXID PRESS ind agree?
YES
NO
NORMAL
BOTH HIGH
BOTH LOW
2 C/W FAILURE
3 • SPS He VLV (both) - OFF SPS thrusting?
4 HEAT SOAK INTO PRPLNT TK
5 Burn mission critical?
6 • Continue burn
7 • ΔV THRUST A & B - OFF
8 DUAL He REGULATORS FAILED OPEN
9 SPS thrusting?
10 COLD SOAK PROBLEM
11 Both SPS He VLV tb's bp?
12 • SPS He VLV (both) - ON Both tb's bp?
13 AUTO CONT OF He VLV FAILED
14 FAILURE IN He SYS
15 DUAL He VLVS FAILED CLOSED
16 Burn mission critical?
17 • Continue burn
18 • ΔV THRUST A & B - OFF when fuel/oxid press = 140 psia
19 SPS FUEL and OXID PRESS?
ONE HIGH
ONE LOW
20 SPS thrusting?
21 MSFN verifies press high?
22 HEAT LEAK INTO SYS
23 SPS thrusting?
24 MSFN verifies press low?
25 INSTRUMENTATION FAILURE
26 Burn mission critical?
27 Press decr?
Warning
Except in emergency, do not cycle He vlvs - possibility of tk rupture
28 PRPLNT LEAK OR He LEAK
29 • Continue burn
30 Decr occur during engine operation?
31 Attempt manual He repress • SPS He vlv (both) - ON Press incr?
32 RESTRICTED He LINE
33 • ΔV THRUST A & B - OFF
34 COLD SOAK PROBLEM
35 He SYS COMPLETELY CLOSED
(1) Normal operating press is 170-195 psia. MSFN will use fuel and oxid telemetered press data to backup onboard indications.
(2) Attempt temp control by orienting CSM if possible.
a. Fuel & oxid press high, orient -X axis toward deep space.
b. Fuel press high, orient -Z, -Y quadrant toward deep space.
c. Oxid press high, orient +Y, +Z quadrant toward deep space.
(3) Engine chugging may occur if SPS Pc is < 60 psia. Corresponding fuel & oxid press is ≈85 psia.
(4) Control fuel & oxid press between 170 and 195 psi by manual actuation of He sw. Individual activation of the He switches will identify the failed regulator leg. Flow through failed regs will exceed the capability of the relief vlv.
(5) Open and close He vlvs manually for each burn.
(6) Caution
ΔP between SPS FUEL and OXID PRESS should not exceed 20 psi during a burn. Degraded performance, rough combustion, and/or engine failure may result.
(7) Prior to emergency SPS operation, manually repressurize propellant tanks.
(8) All subsequent SPS burns should be made with SPS He VLV (both) - OFF to minimize ΔP between fuel and oxidizer.
SM-2A-2289B

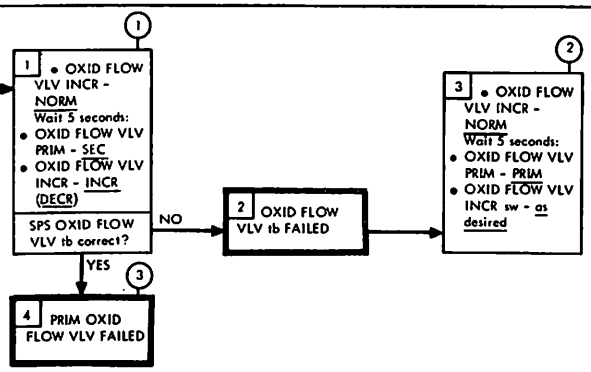
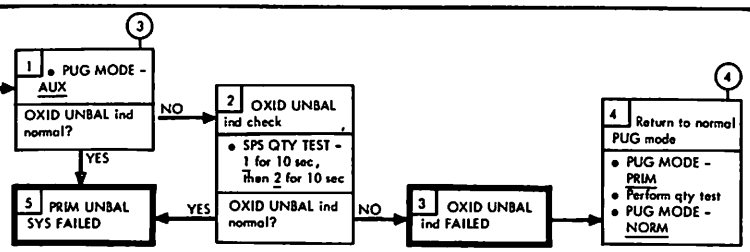
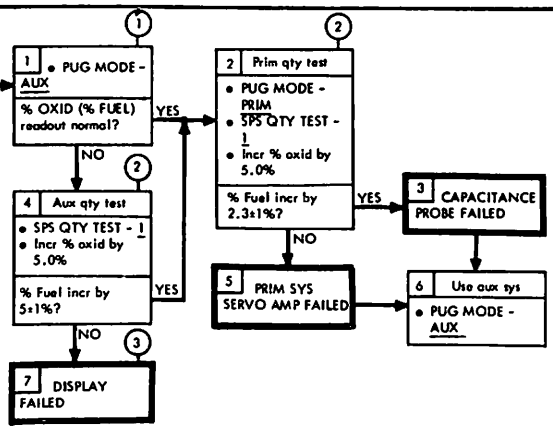

SYMPTOM
PROCEDURE
REMARKS
2 PITCH (YAW) GMBL 1 (2)
YELLOW
Light on if:
Overcurrent occurs in respective drive motor or gimbal actuator.
1 After SPS shutdown and before SPS GMBL MOT shutdown
• TVC GMBL DR PITCH (YAW) - 1 (2)
• Perform gimbal trim check
Gimbal control maintained?
NO
YES
Caution
Gimbal drive circuits are not C/B protected. Before proceeding with step 2, MSFN may be able to provide failure identification.
2 DC load check
• DC IND sel - FC 1 (2, 3)
• SPS GMBL MOT PITCH (YAW) - 1 (2) - Start and hold for check
Amps abnormally high?
NO
YES
3 GIMBAL MOTOR FAILED
4 C/W FAILURE
5 OVERCURRENT SENSOR FAILED
1 Automatic transfer from the primary system to secondary occurs with an overcurrent provided the TVC GMBL DR switch is at AUTO.
2 For subsequent ΔV's, place TVC GMBL DR sw to alternate servo position in affected axis
3 Selected gimbal motor is operational when SPS Pitch (Yaw) 1 (2) cb is opened while affected gimbal motor switch is held at START. However, overcurrent protection and switch-over capability will not be available. Close the cb to turn off the gimbal motor
3 SPS PREMATURE SHUTDOWN
1. Single or dual bank?
DUAL
SINGLE
2 SC CONT mode?
CMC
SCS
3 Output chan ck
• ΔV THRUST (2) - OFF
• Recycle to ignition in P40
• FL V99 N40
• PRO
• VOI N10E, 11E
1 in A or R1?
NO
YES
4 CMC INTERNAL PROBLEM
G&N SSR-1
CMC TEST
5 CMC-SCS INTERFACE FAILED OPEN
3a NO SPS IGNITION
6 All SPS INJ VLV ind (4) CLOSE?
NO
YES
7 VLV PAIR FAILED CLOSED
8 cb SPS He VLV or cb PILOT VLVS - open?
YES
NO
9 ENG VLV CKTRY FAILED
10 SC CONT mode?
SCS
CMC
11 EMS ΔV counter ≤ - 0.1 fps
YES
NO
12 EMS COUNTER RESET PREMATURELY
13 SPS THRUST lt - on?
NO
YES
14 • ΔV THRUST (2) - OFF
• AUTO RCS SEL +X (4) - OFF
• THC - cmd +X
• THRUST ON pb - push
SPS THRUST lt on?
YES
NO
16 ONE BANK FAILED
15 Output chan ck
• ΔV THRUST (2) - OFF
• Recycle to ignition in P40
• FL V99 N40
• PRO
• VOI N10E, 11E
1 in A or R1?
YES
NO
17 SPS THRUST lt - on
YES
NO
18 • THC - CW
• THC - cmd +X
• THRUST ON pb - push
SPS THRUST lt - on?
YES
NO
19 SC CONT ENABLE PWR LOST
20 CMC INTERNAL PROBLEM
G&N SSR-1
CMC TEST
21 CMC-SCS INTERFACE FAILED OPEN
22 • CB DIR ULL (2) - open
• DIR ULL pb - push
• THRUST ON pb - push
SPS THRUST lt - on?
YES
NO
23 +X TRANS LOGIC FAILED
24 CMC-SCS INTERFACE FAILED SHORT
1 Troubleshooting assumes original switch positions at time of shutdown.
2 All G&N SPS capability lost.
3 Manual on-off procedure
a. At TIG - 1 min, SPS THRUST - DIR ON
b. At TIG, ΔV THRUST A(B) - NORM
c. At TIG +3 sec, ΔV THRUST B(A) - NORM (if dual bank)
d. Terminate burn on ΔV or time by ΔV THRUST (2) - OFF.
4 G&N SPS on-off control lost. TVC DAP unaffected.
5 ΔV capability lost for affected bank.
6 Perform EMS ΔV test and if OK, use ΔV counter to monitor burn. Use manual on-off procedure (Remark 3).
7 Affected bank may still be available using SPS THRUST - DIR ON. Alternate bank unaffected.
8 THC must be CW for SCS ΔV capability. SCS auto ΔV lost.
9 For SCS ΔV use DIR ULL pb for eng on initiation. +X TRANS logic function lost.
10 CMC ΔV capability unaffected. SCS ΔV auto on-off lost. For SCS ΔV use manual on-off procedure (Remark 3).

SM-2A-1460R


SYMPTOM
PROCEDURE
REMARKS
4
SPS ENG DOES NOT SHUT DOWN AUTO
1 SPS THRUST lt on?
NO
2 TVC mode?
CMC
3 CMC INTERNAL PROBLEM
G&N
SSR-1
CMC TEST
YES
MTVC
SCS AUTO
4a
SPS THRUST LT ON - NON THRUSTING
4 TVC mode?
MTVC
SCS AUTO
5 • SC CONT - CMC
SPS THRUST lt remains on?
NO
6 EMS ΔV test
• Perform ΔV test
SPS THRUST lt remains on?
NO
7 SPS THRUST OFF LOGIC FAILED
CMC
YES
8 • THC - CW
SPS THRUST lt on?
YES
9 Thrusting mnvr being performed
NO
10 SPS THRUST LT OR SPS GROUNDING SHORT
NO
YES
11 SPS GROUNDING SHORT
12 EMS ΔV display?
>-0.1 fps
13 EMS FAILED
≤-0.1 fps
16 SPS THRUST CKT IN ΔV COUNTER FAILED
14 CMC output chan check
• V01 N10E 11E
1 in A of R1?
YES
15 Reset output chan
• V21E, 11E 0XXXXE
0 in A of R1?
YES
17 CMC INTERNAL PROBLEM
G&N
SSR-1
CMC TEST
NO
18 SCS-CMC INTERFACE SHORT
NO
19 CMC OUTPUT CHAN FAILED
1 Assumes SPS engine was shut down with the ΔV thrust switches.
2 All G&N SPS capability lost.
3 SCS auto cutoff lost, use manual thrust on-off procedure presented in Remark 5.
4 Since failure could be SPS thrust lt on only, for ΔV's perform single bank ignition per Remark 5.
5 Auto thrust on-off lost for one and possibly both banks. Use manual on-off procedure:
a. At TIG-1 min, SPS THRUST DIR ON
b. At TIG, ΔV THRUST A(B) - NORM
c. At TIG +3 sec, ΔV THRUST B(A) - NORM (if dual bank)
d. Terminate burn on ΔV or time by ΔV THRUST (2) - OFF
or for single bank operation:
At TIG -2 sec, ΔV THRUST (alt bank) - NORM
a. If SPS lts, auto thrust on-off lost for both banks, use manual on-off procedure above.
b. If no SPS ign, auto on-off remains for alt bank.
6 SCS ΔV capability remains but must terminate burn with time. Perform entry self test to determine EMS capability for entry.
7 This step must be done while still in P40. After check has been made exit P40 to terminate average G.
8 SCS auto cutoff lost. Manual cutoff required.
9 G&N auto eng on-off control lost only.
4 THRU 10
5
SPS Pc ABNORMAL
>110 psia
< 90 psia
1 SPS FUEL & OXID PRESS normal?
YES
2 Burn mission critical?
NO
3 • ΔV THRUST (2) - OFF at SPS Pc = 70 PSI
YES
NO
SPS 1 1
FUEL and/or OXID PRESS HIGH (LOW)
4 Continue burn
SPS INJ VLV Ind - one or two partially closed?
NO
5 MSFN verifies normal acceleration and sys parameters?
YES
6 INSTRUMENTATION FAILURE
NO
YES
9 He INGESTION, INTERNAL ENGINE FAILURE, CLOGGED PRPLNT LINE
7 • ΔV THRUST - OFF (failed bank)
8 VLV BANK FAILED
1 Failed bank should not be used except in an emergency.
2 SPS engine operable until engine indications require shutdown. Engine chugging may occur if SPS Pc is < 60 psi.
6
SPS He VLV tb - ABNORMAL
1 SPS thrusting?
YES
2 • SPS He VLV 1 (2) - ON
tb's gray?
NO
3 SPS fuel & oxid press?
DECR
4 BOTH He VLVS FAILED CLOSED
STEADY
NO
YES
5 • SPS HE VLV 1 (2) - OFF
tb's bp?
YES
6 He AUTO MODE MALFUNCTION
NO
7 tb OR ONE He VLV FAILURE
1 SPS engine operable until engine indications require shutdown. Engine chugging may occur if Pc is < 60 psi. Corresponding fuel & oxid pressure is ≈85 psia.
2 Open and close He valves manually for each burn.

SYMPTOM	PROCEDURE	REMARKS
7 He PRESS LOW OR DECR		(1) MSFN will monitor redundant He press instrumentation. (2) He depletion imminent. SPS engine operable until engine indications require shutdown. Engine chugging may occur if SPS Pc is <60 psi. Corresponding fuel & oxid pressure is ≈85 psia.
8 GN2 A (B) PRESS LOW - 400 PSI 8a SPS INJ VLV PARTIALLY OPEN		(1) Operation at <350 psi results in partially open ball vlvs and hazardous engine operation.
9 SPS INJ VLV IND ABNORMAL One open during non-thrusting One or two closed during burn period (or burn attempt)		(1) SPS operable on redundant bank if one bank failed. (2) Failed bank should not be used except in an emergency.
10 NO PRPLNT TEMP CONTROL		(1) Normal range 45-75°F. (2) Assumes CSM not in inertial hold mode which might normally result in differences between SPS prplnt temp and SPS oxid line temp. (3) Use oxid line temp for SPS prplnt temp. (4) Prplnt temp may be incr by CSM orientation or by firing SPS engine. At 27°F the propellants become slushy and the fuel & oxid ratio becomes unpredictable.

SM-2A-1462K

SYMPTOM	PROCEDURE	REMARKS
11 NO RESPONSE OF SPS OXID VLV tb DURING FLOW ADJUST (OXID FLOW VLV PRIM - PRIM)		(1) OXID FLOW VLV INCR sw cannot operate unless power applied through a thrust an signal or through the SPS QTY TEST sw. If flow vlv position was changed by the SPS QTY TEST sw, % FUEL & % OXID quantity readouts must be returned to original values. (2) The secondary sliding gate vlv must be in the nominal flow position (rather than INCR or DECR) before switching to the prim oxid flow vlv or misalignment of the secondary vlv could make the primary vlv inoperative. (3) Sec vlv has sufficient range to compensate for prim vlv failure in any position and still provide vlv openings for INCR, NORM or DECR oxid flow.
12 SPS OXID UNBAL IND ERRATIC OR PEGGED		(1) Assumes qty indicating sys normal. (2) The unbalance meter will behave erratically for approximately 25 seconds after engine ignition. This is caused by propellant dynamics. (3) Assumes CSM is still thrusting. If thrust has terminated, proceed with step 2. (4) Actuation of SPS QTY TEST sw here will realign digital display to prim sys.
13 SPS OXID (FUEL) QTY IND READOUT ABNORMAL		(1) Assumes SPS is still thrusting. If thrusting terminated before step 1 is complete, proceed to step 4. (2) Complete thrusting prior to qty test. (3) MSFN must now supply any prplnt quantity data.

11 THRU 13

THIS PAGE
INTENTIONALLY
LEFT BLANK

THIS PAGE
INTENTIONALLY
LEFT BLANK

RCS MALFUNCTION INDEX

1 SM RCS A(BCD)

1a SM RCS PKG TEMP LOW

1b SM RCS PKG TEMP HIGH

1c SM RCS SEC FUEL PRESS LOW

1d SM RCS SEC FUEL PRESS HIGH

2 SM RCS He PRESS LOW OR DECR

2a SM RCS PRPLNT QTY LOW OR DECR

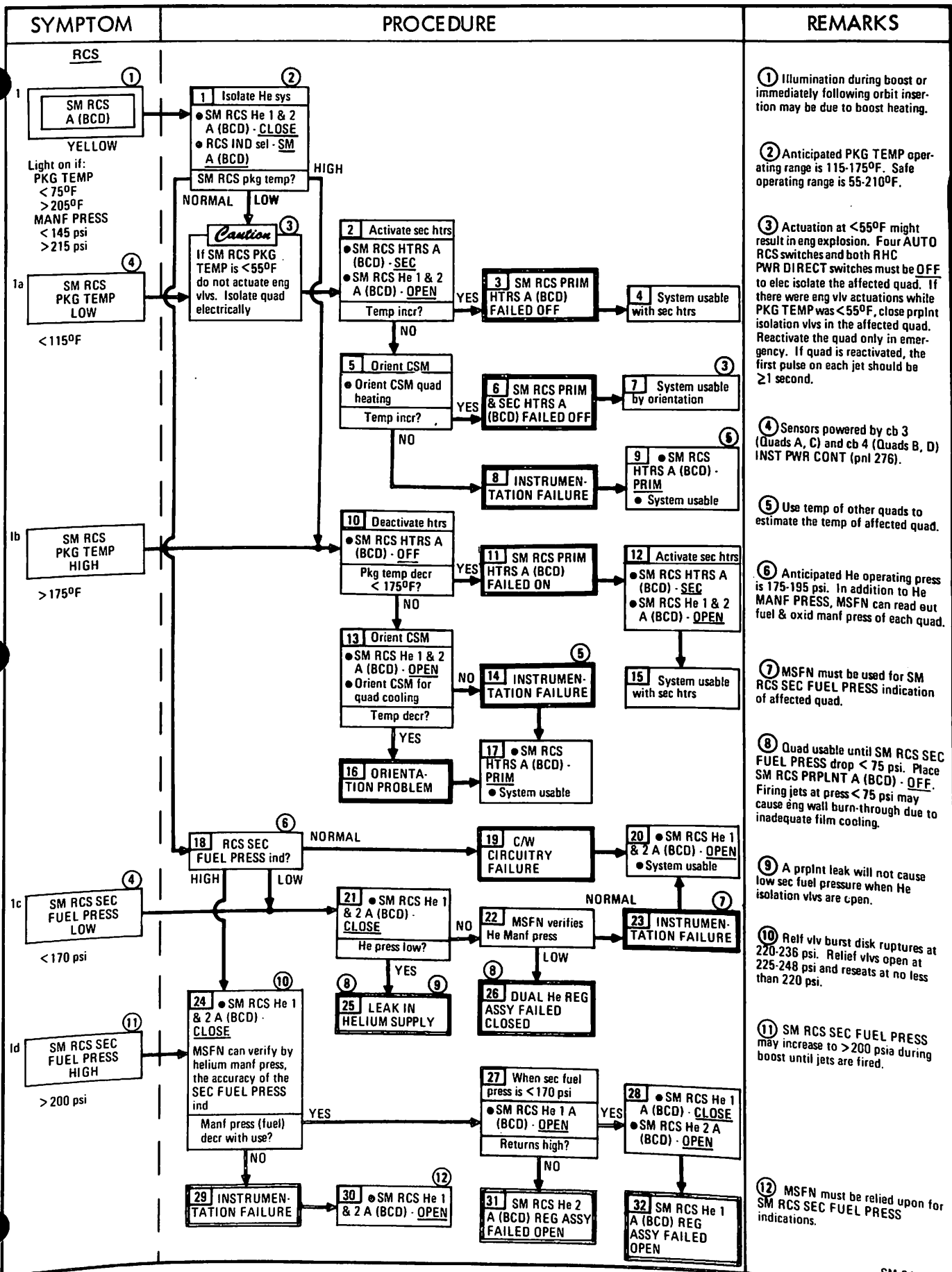
3 CM RCS 1(2)

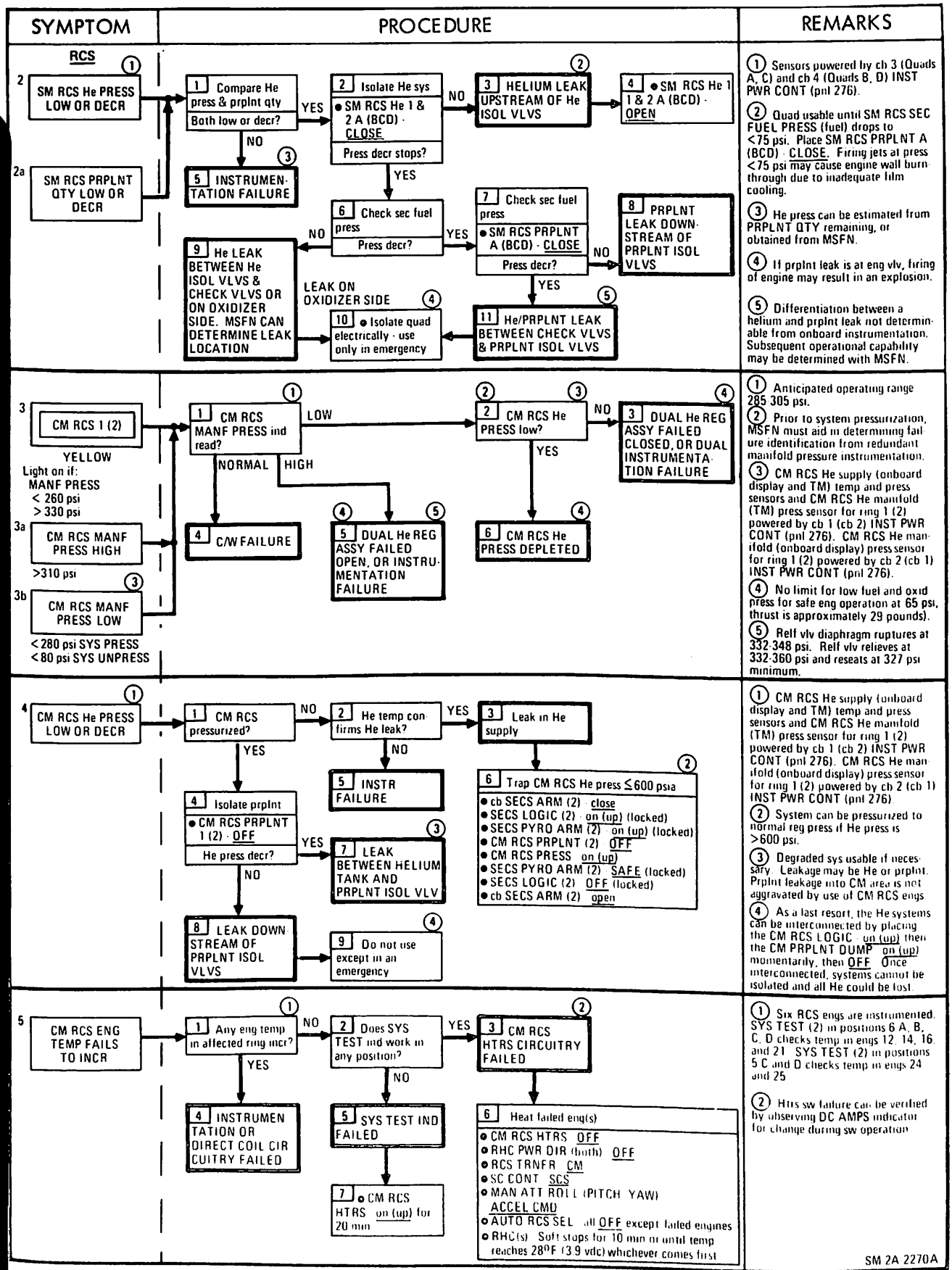
3a CM RCS MANF PRESS HIGH

3b CM RCS MANF PRESS LOW

4 CM RCS He PRESS LOW OR DECR

5 CM RCS ENG TEMP FAILS TO INCR


SYMPTOM
PROCEDURE
REMARKS
RCS
1 SM RCS A (BCD) YELLOW
Light on if: PKG TEMP < 75°F > 205°F MANF PRESS < 145 psi > 215 psi
1a SM RCS PKG TEMP LOW <115°F
1b SM RCS PKG TEMP HIGH >175°F
1c SM RCS SEC FUEL PRESS LOW <170 psi
1d SM RCS SEC FUEL PRESS HIGH >200 psi
1 Isolate He sys
• SM RCS He 1 & 2 A (BCD) - CLOSE
• RCS IND sel - SM A (BCD)
SM RCS pkg temp?
HIGH
NORMAL
LOW
Caution
If SM RCS PKG TEMP is <55°F do not actuate eng vlvs. Isolate quad electrically
2 Activate sec htrs
• SM RCS HTRS A (BCD) - SEC
• SM RCS He 1 & 2 A (BCD) - OPEN
Temp incr?
YES
NO
3 SM RCS PRIM HTRS A (BCD) FAILED OFF
4 System usable with sec htrs
5 Orient CSM
• Orient CSM quad heating
Temp incr?
YES
NO
6 SM RCS PRIM & SEC HTRS A (BCD) FAILED OFF
7 System usable by orientation
8 INSTRUMENTATION FAILURE
9 • SM RCS HTRS A (BCD) - PRIM
• System usable
10 Deactivate htrs
• SM RCS HTRS A (BCD) - OFF
Pkg temp decr < 175°F?
YES
NO
11 SM RCS PRIM HTRS A (BCD) FAILED ON
12 Activate sec htrs
• SM RCS HTRS A (BCD) - SEC
• SM RCS He 1 & 2 A (BCD) - OPEN
13 Orient CSM
• SM RCS He 1 & 2 A (BCD) - OPEN
• Orient CSM for quad cooling
Temp decr?
NO
YES
14 INSTRUMENTATION FAILURE
15 System usable with sec htrs
16 ORIENTATION PROBLEM
17 • SM RCS HTRS A (BCD) - PRIM
• System usable
18 RCS SEC FUEL PRESS ind?
HIGH
LOW
NORMAL
19 C/W CIRCUITRY FAILURE
20 • SM RCS He 1 & 2 A (BCD) - OPEN
• System usable
21 • SM RCS He 1 & 2 A (BCD) - CLOSE
He press low?
NO
YES
22 MSFN verifies He Manf press
LOW
NORMAL
23 INSTRUMENTATION FAILURE
25 LEAK IN HELIUM SUPPLY
26 DUAL He REG ASSY FAILED CLOSED
24 • SM RCS He 1 & 2 A (BCD) - CLOSE
MSFN can verify by helium manf press, the accuracy of the SEC FUEL PRESS ind
Manf press (fuel) decr with use?
YES
NO
27 When sec fuel press is <170 psi
• SM RCS He 1 A (BCD) - OPEN
Returns high?
YES
NO
28 • SM RCS He 1 A (BCD) - CLOSE
• SM RCS He 2 A (BCD) - OPEN
29 INSTRUMENTATION FAILURE
30 • SM RCS He 1 & 2 A (BCD) - OPEN
31 SM RCS He 2 A (BCD) REG ASSY FAILED OPEN
32 SM RCS He 1 A (BCD) REG ASSY FAILED OPEN
1 Illumination during boost or immediately following orbit insertion may be due to boost heating.
2 Anticipated PKG TEMP operating range is 115-175°F. Safe operating range is 55-210°F.
3 Actuation at <55°F might result in eng explosion. Four AUTO RCS switches and both RHC PWR DIRECT switches must be OFF to elec isolate the affected quad. If there were eng vlv actuations while PKG TEMP was <55°F, close prplnt isolation vlvs in the affected quad. Reactivate the quad only in emergency. If quad is reactivated, the first pulse on each jet should be ≥1 second.
4 Sensors powered by cb 3 (Quads A, C) and cb 4 (Quads B, D) INST PWR CONT (pnl 276).
5 Use temp of other quads to estimate the temp of affected quad.
6 Anticipated He operating press is 175-195 psi. In addition to He MANF PRESS, MSFN can read out fuel & oxid manf press of each quad.
7 MSFN must be used for SM RCS SEC FUEL PRESS indication of affected quad.
8 Quad usable until SM RCS SEC FUEL PRESS drop < 75 psi. Place SM RCS PRPLNT A (BCD) - OFF. Firing jets at press < 75 psi may cause eng wall burn-through due to inadequate film cooling.
9 A prplnt leak will not cause low sec fuel pressure when He isolation vlvs are open.
10 Relf vlv burst disk ruptures at 220-236 psi. Relief vlvs open at 225-248 psi and reseats at no less than 220 psi.
11 SM RCS SEC FUEL PRESS may increase to >200 psia during boost until jets are fired.
12 MSFN must be relied upon for SM RCS SEC FUEL PRESS indications.


SYMPTOM
PROCEDURE
REMARKS
RCS
2 SM RCS He PRESS LOW OR DECR
2a SM RCS PRPLNT QTY LOW OR DECR
1 Compare He press & prplnt qty
Both low or decr?
YES
NO
2 Isolate He sys
• SM RCS He 1 & 2 A (BCD) · CLOSE
Press decr stops?
NO
YES
3 HELIUM LEAK UPSTREAM OF He ISOL VLVS
4 • SM RCS He 1 & 2 A (BCD) · OPEN
5 INSTRUMENTATION FAILURE
6 Check sec fuel press
Press decr?
NO
YES
7 Check sec fuel press
• SM RCS PRPLNT A (BCD) · CLOSE
Press decr?
NO
YES
8 PRPLNT LEAK DOWNSTREAM OF PRPLNT ISOL VLVS
9 He LEAK BETWEEN He ISOL VLVS & CHECK VLVS OR ON OXIDIZER SIDE. MSFN CAN DETERMINE LEAK LOCATION
LEAK ON OXIDIZER SIDE
10 • Isolate quad electrically · use only in emergency
11 He/PRPLNT LEAK BETWEEN CHECK VLVS & PRPLNT ISOL VLVS
1 Anticipated operating range 285 305 psi.
2 Prior to system pressurization, MSFN must aid in determining failure identification from redundant manifold pressure instrumentation.
3 CM RCS He supply (onboard display and TM) temp and press sensors and CM RCS He manifold (TM) press sensor for ring 1 (2) powered by cb 1 (cb 2) INST PWR CONT (pnl 276). CM RCS He manifold (onboard display) press sensor for ring 1 (2) powered by cb 2 (cb 1) INST PWR CONT (pnl 276).
4 No limit for low fuel and oxid press for safe eng operation at 65 psi, thrust is approximately 29 pounds).
5 Relf vlv diaphragm ruptures at 332-348 psi. Relf vlv relieves at 332-360 psi and reseats at 327 psi minimum.
1 Sensors powered by cb 3 (Quads A, C) and cb 4 (Quads B, D) INST PWR CONT (pnl 276).
2 Quad usable until SM RCS SEC FUEL PRESS (fuel) drops to <75 psi. Place SM RCS PRPLNT A (BCD) · CLOSE. Firing jets at press <75 psi may cause engine wall burnthrough due to inadequate film cooling.
3 He press can be estimated from PRPLNT QTY remaining, or obtained from MSFN.
4 If prplnt leak is at eng vlv, firing of engine may result in an explosion.
5 Differentiation between a helium and prplnt leak not determinable from onboard instrumentation. Subsequent operational capability may be determined with MSFN.
3 CM RCS 1 (2)
YELLOW
Light on if:
MANF PRESS
< 260 psi
> 330 psi
3a CM RCS MANF PRESS HIGH
>310 psi
3b CM RCS MANF PRESS LOW
<280 psi SYS PRESS
<80 psi SYS UNPRESS
1 CM RCS MANF PRESS ind read?
LOW
NORMAL
HIGH
2 CM RCS He PRESS low?
NO
YES
3 DUAL He REG ASSY FAILED CLOSED, OR DUAL INSTRUMENTATION FAILURE
4 C/W FAILURE
5 DUAL He REG ASSY FAILED OPEN, OR INSTRUMENTATION FAILURE
6 CM RCS He PRESS DEPLETED
4 CM RCS He PRESS LOW OR DECR
1 CM RCS pressurized?
NO
YES
2 He temp confirms He leak?
YES
NO
3 Leak in He supply
4 Isolate prplnt
• CM RCS PRPLNT 1 (2) · OFF
He press decr?
YES
NO
5 INSTR FAILURE
6 Trap CM RCS He press ≤600 psia
• cb SECS ARM (2) · close
• SECS LOGIC (2) · on (up) (locked)
• SECS PYRO ARM (2) · on (up) (locked)
• CM RCS PRPLNT (2) · OFF
• CM RCS PRESS · on (up)
• SECS PYRO ARM (2) · SAFE (locked)
• SECS LOGIC (2) · OFF (locked)
• cb SECS ARM (2) · open
7 LEAK BETWEEN HELIUM TANK AND PRPLNT ISOL VLV
8 LEAK DOWNSTREAM OF PRPLNT ISOL VLVS
9 Do not use except in an emergency
1 CM RCS He supply (onboard display and TM) temp and press sensors and CM RCS He manifold (TM) press sensor for ring 1 (2) powered by cb 1 (cb 2) INST PWR CONT (pnl 276). CM RCS He manifold (onboard display) press sensor for ring 1 (2) powered by cb 2 (cb 1) INST PWR CONT (pnl 276).
2 System can be pressurized to normal reg press if He press is >600 psi.
3 Degraded sys usable if necessary. Leakage may be He or prplnt. Prplnt leakage into CM area is not aggravated by use of CM RCS engs.
4 As a last resort, the He systems can be interconnected by placing the CM RCS LOGIC · on (up) then the CM PRPLNT DUMP · on (up) momentarily, then OFF. Once interconnected, systems cannot be isolated and all He could be lost.
5 CM RCS ENG TEMP FAILS TO INCR
1 Any eng temp in affected ring incr?
NO
YES
2 Does SYS TEST ind work in any position?
YES
NO
3 CM RCS HTRS CIRCUITRY FAILED
4 INSTRUMENTATION OR DIRECT COIL CIRCUITRY FAILED
5 SYS TEST IND FAILED
6 Heat failed eng(s)
• CM RCS HTRS · OFF
• RHC PWR DIR (both) · OFF
• RCS TRNFR · CM
• SC CONT · SCS
• MAN ATT ROLL (PITCH YAW) · ACCEL CMD
• AUTO RCS SEL · all OFF except failed engines
• RHC(s) · Soft stops for 10 min or until temp reaches 280°F (39 vdc) whichever comes first
7 • CM RCS HTRS · on (up) for 20 min
1 Six RCS engs are instrumented. SYS TEST (2) in positions 6 A, B, C, D checks temp in engs 12, 14, 16, and 21. SYS TEST (2) in positions 5 C and D checks temp in engs 24 and 25.
2 Htrs sw failure can be verified by observing DC AMPS indicator for change during sw operation.
SM 2A 2270A

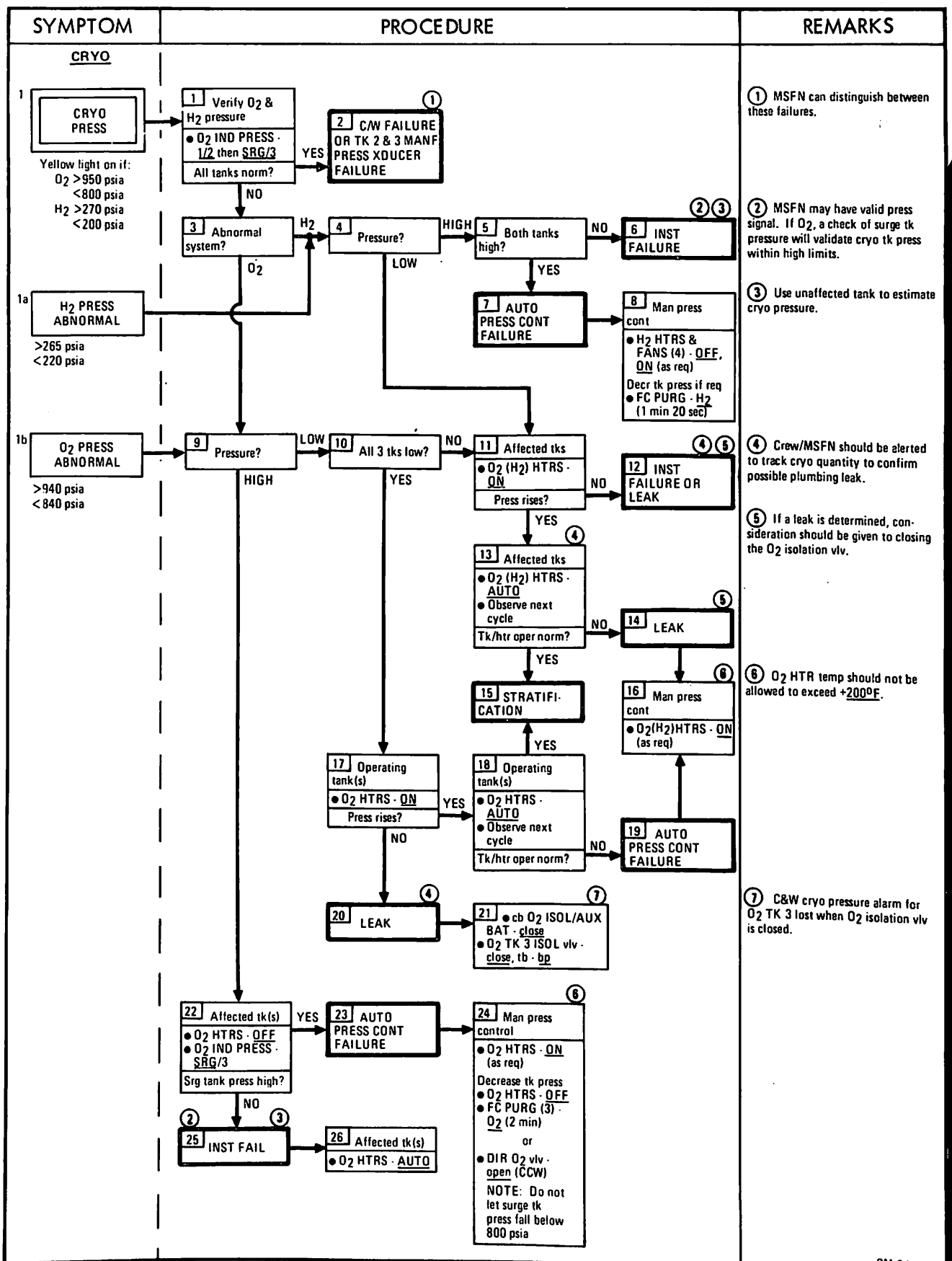
THIS PAGE
INTENTIONALLY
LEFT BLANK

CRYO MALFUNCTION INDEX

1 CRYO PRESS

1a $O_2(H_2)$ CRYO PRESS HI

1b $O_2(H_2)$ CRYO PRESS LOW


SYMPTOM
PROCEDURE
REMARKS
CRYO
1
CRYO PRESS
Yellow light on if:
O2 >950 psia
<800 psia
H2 >270 psia
<200 psia
1 Verify O2 & H2 pressure
• O2 IND PRESS · 1/2 then SRG/3
All tanks norm?
YES
2 C/W FAILURE OR TK 2 & 3 MANF PRESS XDUCER FAILURE
NO
3 Abnormal system?
H2
O2
4 Pressure?
HIGH
LOW
5 Both tanks high?
NO
6 INST FAILURE
YES
7 AUTO PRESS CONT FAILURE
8 Man press cont
• H2 HTRS & FANS (4) · OFF, ON (as req)
Decr tk press if req
• FC PURG · H2 (1 min 20 sec)
1a
H2 PRESS ABNORMAL
>265 psia
<220 psia
1b
O2 PRESS ABNORMAL
>940 psia
<840 psia
9 Pressure?
LOW
HIGH
10 All 3 tks low?
NO
YES
11 Affected tks
• O2 (H2) HTRS · ON
Press rises?
NO
12 INST FAILURE OR LEAK
YES
13 Affected tks
• O2 (H2) HTRS · AUTO
• Observe next cycle
Tk/htr oper norm?
NO
14 LEAK
YES
15 STRATIFICATION
16 Man press cont
• O2(H2)HTRS · ON (as req)
YES
17 Operating tank(s)
• O2 HTRS · ON
Press rises?
YES
18 Operating tank(s)
• O2 HTRS · AUTO
• Observe next cycle
Tk/htr oper norm?
NO
19 AUTO PRESS CONT FAILURE
NO
20 LEAK
21 • cb O2 ISOL/AUX BAT · close
• O2 TK 3 ISOL vlv · close, tb · bp
22 Affected tk(s)
• O2 HTRS · OFF
• O2 IND PRESS · SRG/3
Srg tank press high?
YES
23 AUTO PRESS CONT FAILURE
NO
25 INST FAIL
26 Affected tk(s)
• O2 HTRS · AUTO
24 Man press control
• O2 HTRS · ON (as req)
Decrease tk press
• O2 HTRS · OFF
• FC PURG (3) · O2 (2 min)
or
• DIR O2 vlv · open (CCW)
NOTE: Do not let surge tk press fall below 800 psia
1 MSFN can distinguish between these failures.
2 MSFN may have valid press signal. If O2, a check of surge tk pressure will validate cryo tk press within high limits.
3 Use unaffected tank to estimate cryo pressure.
4 Crew/MSFN should be alerted to track cryo quantity to confirm possible plumbing leak.
5 If a leak is determined, consideration should be given to closing the O2 isolation vlv.
6 O2 HTR temp should not be allowed to exceed +200°F.
7 C&W cryo pressure alarm for O2 TK 3 lost when O2 isolation vlv is closed.

SM-2A-2322

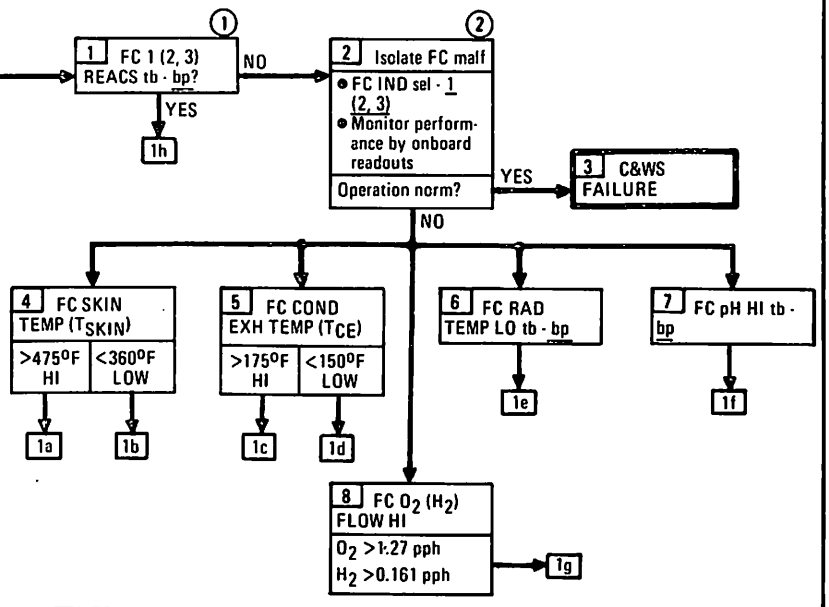
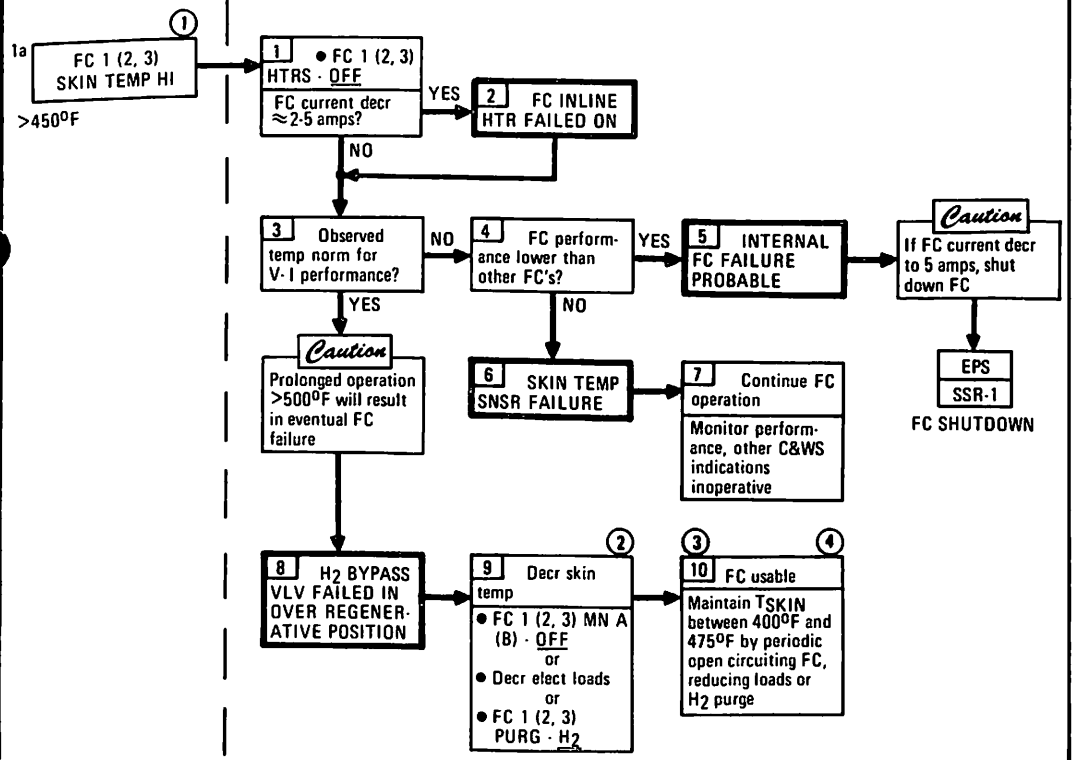
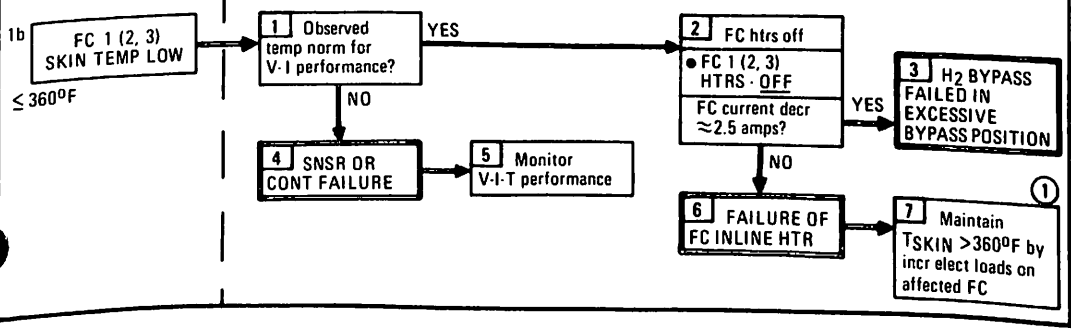
THIS PAGE
INTENTIONALLY
LEFT BLANK

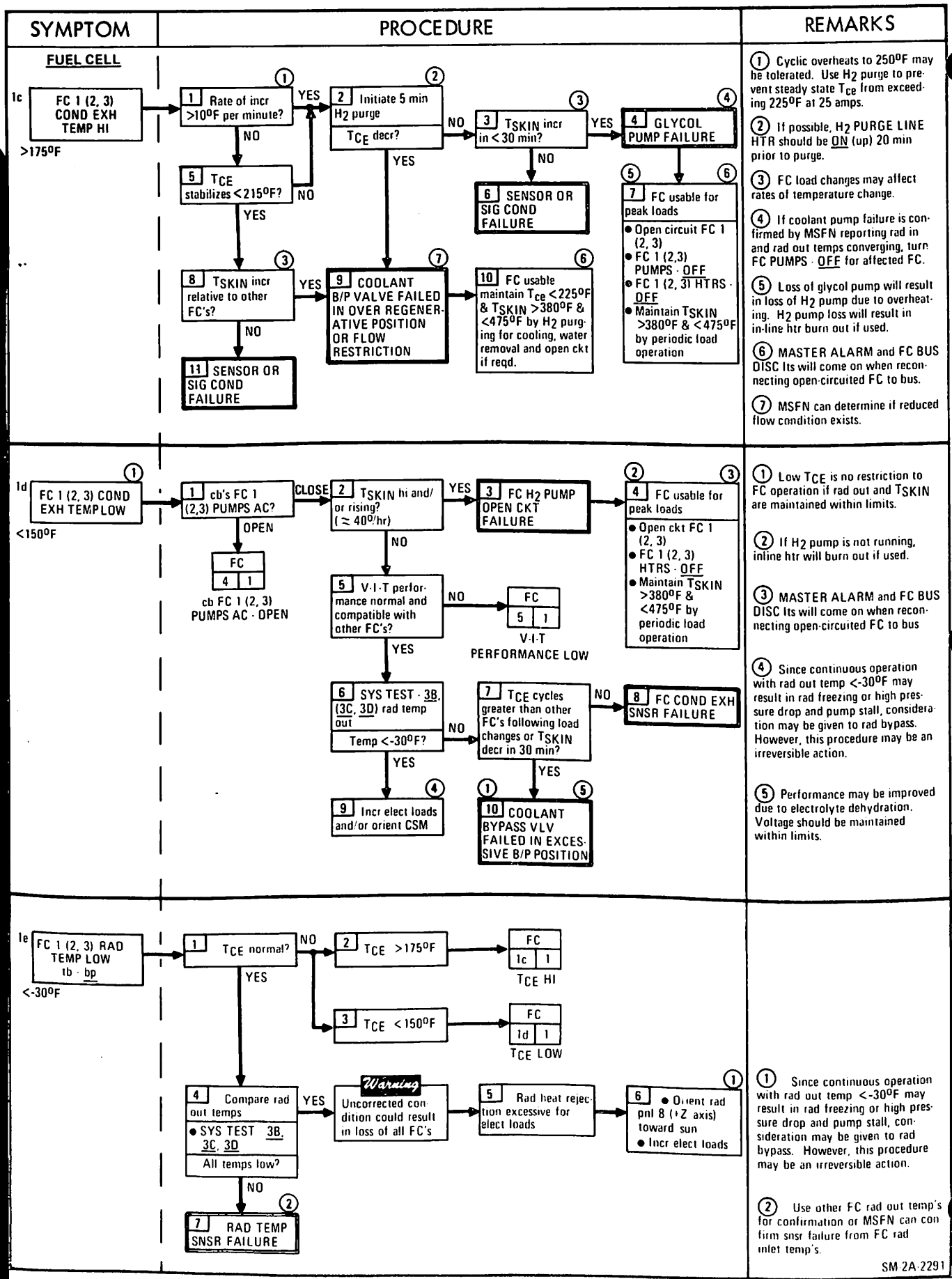
THIS PAGE
INTENTIONALLY
LEFT BLANK

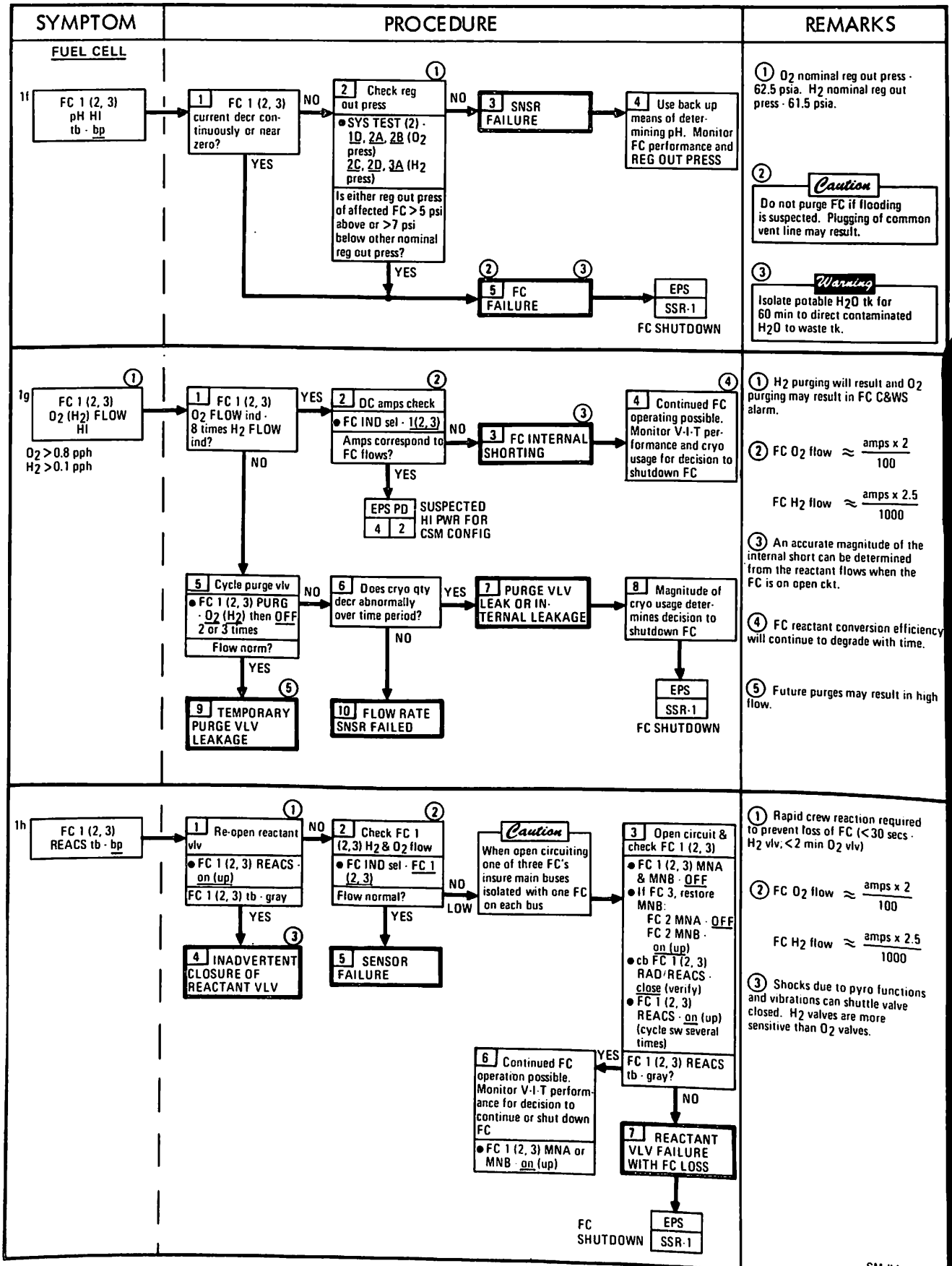
FUEL CELL MALFUNCTION INDEX

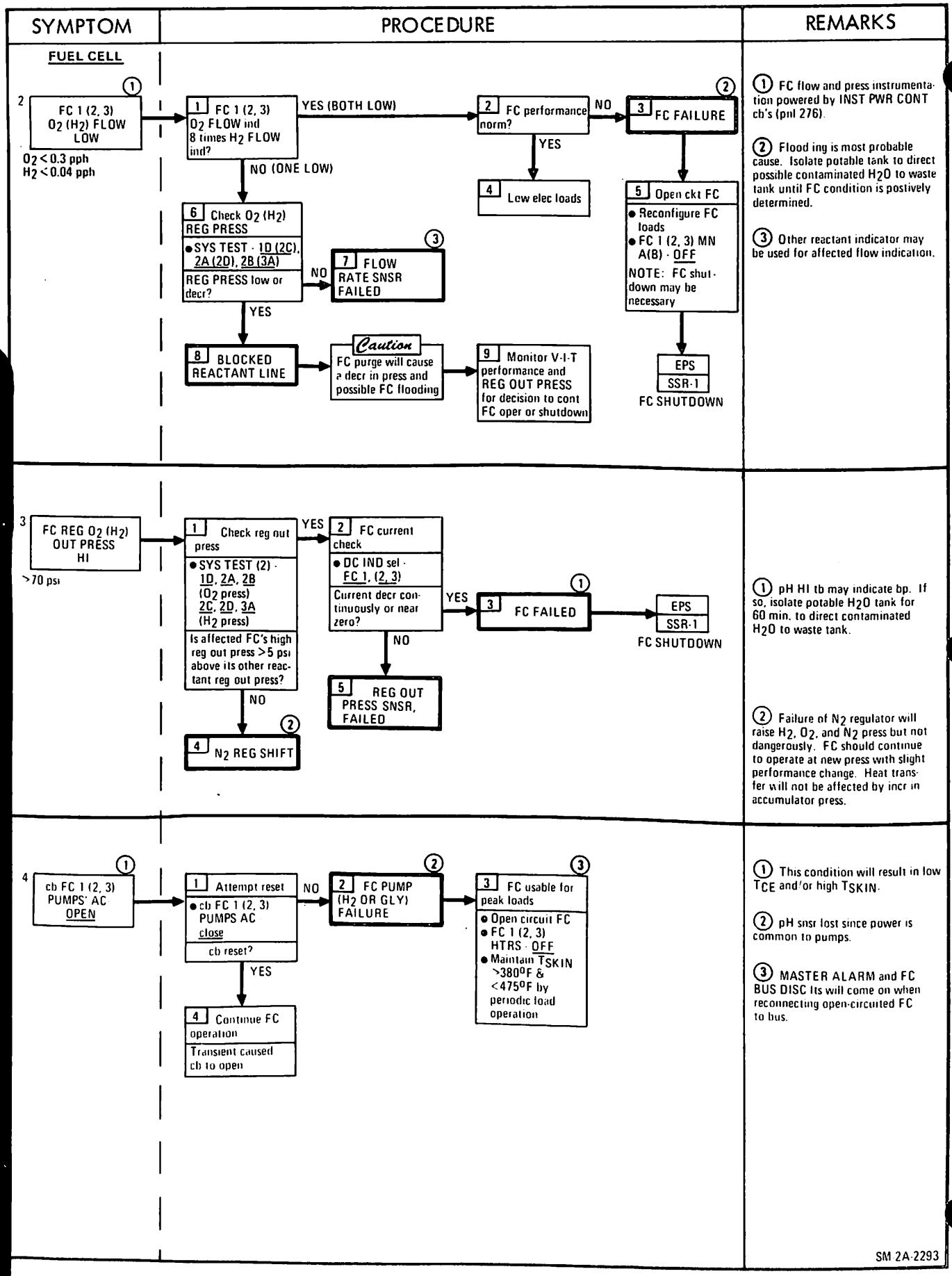
1 FC 1 (2,3)

1a FC 1 (2,3) SKIN TEMP HI
1b FC 1 (2,3) SKIN TEMP LOW
1c FC 1 (2,3) MOD COND EXH TEMP HI
1d FC 1 (2,3) COND EXH TEMP LOW
1e FC 1 (2,3) RAD TEMP LOW tb - bp
1f FC 1 (2,3) pH HI tb - bp
1g FC 1 (2,3) $O_2(H_2)$ FLOW HI
2 FC 1 (2,3) $O_2(H_2)$ FLOW LOW
3 FC REG $O_2(H_2)$ OUT PRESS HI
4 cbFC 1 (2,3) PUMPS AC - OPEN
5 FC 1 (2,3) V-1-T PERFORMANCE LOW

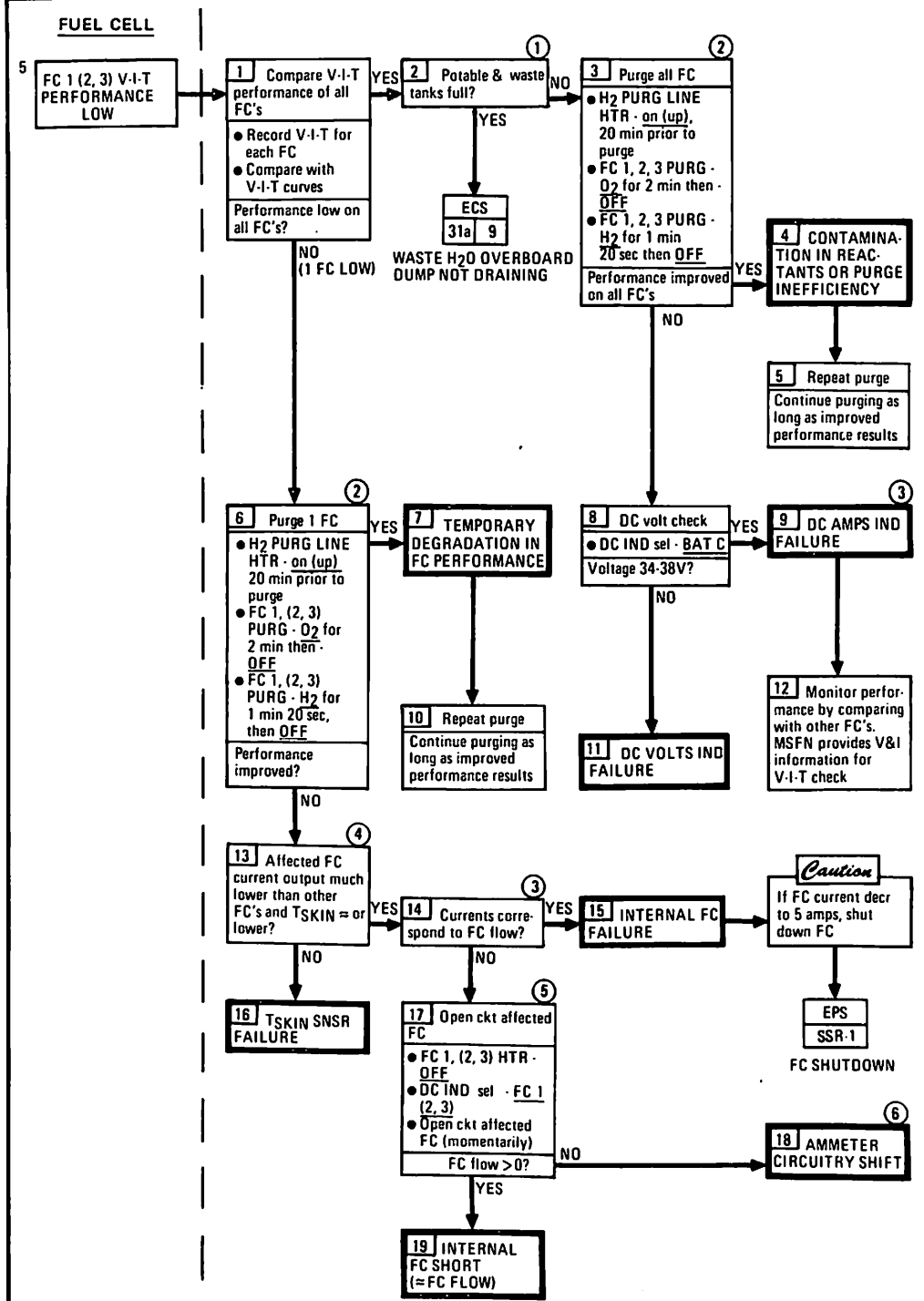
SYMPTOM	PROCEDURE	REMARKS
FUEL CELL 1 FC 1 (2, 3) YELLOW Light on if: One or more of the seven monitored functions exceeds its limits.		(1) Closure of H_2 and/or O_2 reactant valve will activate tb & C/W FC status light. Present configuration for FC RAD/REAC cb's is closed. Rapid crew reaction required to prevent loss of FC. <30 secs - H_2 vlv <2 min - O_2 vlv (2) FC pump cb's, O_2 and H_2 flow low, O_2 and H_2 reg out press, and sys performance are part of sys verification, but are not monitored by Caution and Warning sys.
1a FC 1 (2, 3) SKIN TEMP HI >450°F		(1) If T_{CE} also abnormal, enter appropriate T_{CE} procedure (1c or 1d). (2) Purging H_2 will tend to reduce FC temp. H_2 purge flow is 0.7 pph. H_2 purge should be preceded whenever possible by ≈20 min of H_2 purge line htr operation. Criticality of operation above 500°F may preclude this operation. (3) Reactivate inline htr on open circuit F/C. (4) MASTER ALARM and FC BUS DISC lts will come on when reconnecting open-circuited FC to bus.
1b FC 1 (2, 3) SKIN TEMP LOW ≤360°F		(1) If T_{SKIN} continues to decr, FC operation may continue until ≈330°F with degraded output.


SYMPTOM
PROCEDURE
REMARKS
FUEL CELL
1c
FC 1 (2, 3) COND EXH TEMP HI
>175°F
1 Rate of incr >10°F per minute?
YES
NO
2 Initiate 5 min H2 purge
TCE decr?
NO
YES
3 TSKIN incr in < 30 min?
YES
NO
4 GLYCOL PUMP FAILURE
5 TCE stabilizes < 215°F?
NO
YES
6 SENSOR OR SIG COND FAILURE
5 6
7 FC usable for peak loads
• Open circuit FC 1 (2, 3)
• FC 1 (2,3) PUMPS - OFF
• FC 1 (2, 3) HTRS - OFF
• Maintain TSKIN >380°F & <475°F by periodic load operation
3
8 TSKIN incr relative to other FC's?
YES
NO
9 COOLANT B/P VALVE FAILED IN OVER REGENERATIVE POSITION OR FLOW RESTRICTION
7
10 FC usable maintain TCE <225°F & TSKIN >380°F & <475°F by H2 purging for cooling, water removal and open ckt if reqd.
6
11 SENSOR OR SIG COND FAILURE
1 Cyclic overheats to 250°F may be tolerated. Use H2 purge to prevent steady state TCE from exceeding 225°F at 25 amps.
2 If possible, H2 PURGE LINE HTR should be ON (up) 20 min prior to purge.
3 FC load changes may affect rates of temperature change.
4 If coolant pump failure is confirmed by MSFN reporting rad in and rad out temps converging, turn FC PUMPS - OFF for affected FC.
5 Loss of glycol pump will result in loss of H2 pump due to overheating. H2 pump loss will result in in-line htr burn out if used.
6 MASTER ALARM and FC BUS DISC lts will come on when reconnecting open-circuited FC to bus.
7 MSFN can determine if reduced flow condition exists.
1d
FC 1 (2, 3) COND EXH TEMP LOW
<150°F
1
1 cb's FC 1 (2,3) PUMPS AC?
CLOSE
OPEN
FC 4 1
cb FC 1 (2, 3) PUMPS AC - OPEN
2 TSKIN hi and/or rising? (≈ 40°/hr)
YES
NO
3 FC H2 PUMP OPEN CKT FAILURE
2
4 FC usable for peak loads
3
• Open ckt FC 1 (2, 3)
• FC 1 (2, 3) HTRS - OFF
• Maintain TSKIN >380°F & <475°F by periodic load operation
5 V-I-T performance normal and compatible with other FC's?
NO
FC 5 1
V-I-T PERFORMANCE LOW
YES
6 SYS TEST - 3B, (3C, 3D) rad temp out
Temp <-30°F?
NO
YES
7 TCE cycles greater than other FC's following load changes or TSKIN decr in 30 min?
NO
8 FC COND EXH SNSR FAILURE
YES
1
9 Incr elect loads and/or orient CSM
4
10 COOLANT BYPASS VLV FAILED IN EXCESSIVE B/P POSITION
5
1 Low TCE is no restriction to FC operation if rad out and TSKIN are maintained within limits.
2 If H2 pump is not running, inline htr will burn out if used.
3 MASTER ALARM and FC BUS DISC lts will come on when reconnecting open-circuited FC to bus
4 Since continuous operation with rad out temp <-30°F may result in rad freezing or high pressure drop and pump stall, consideration may be given to rad bypass. However, this procedure may be an irreversible action.
5 Performance may be improved due to electrolyte dehydration. Voltage should be maintained within limits.
1e
FC 1 (2, 3) RAD TEMP LOW
tb - bp
<-30°F
1 TCE normal?
NO
YES
2 TCE >175°F
FC 1c 1
TCE HI
3 TCE <150°F
FC 1d 1
TCE LOW
4 Compare rad out temps
• SYS TEST 3B, 3C, 3D
All temps low?
YES
NO
Warning
Uncorrected condition could result in loss of all FC's
5 Rad heat rejection excessive for elect loads
1
6 • Orient rad pnl 8 (+Z axis) toward sun
• Incr elect loads
2
7 RAD TEMP SNSR FAILURE
1 Since continuous operation with rad out temp <-30°F may result in rad freezing or high pressure drop and pump stall, consideration may be given to rad bypass. However, this procedure may be an irreversible action.
2 Use other FC rad out temp's for confirmation or MSFN can confirm snsr failure from FC rad inlet temp's.
SM 2A-2291


SYMPTOM
PROCEDURE
REMARKS
FUEL CELL
1f
FC 1 (2, 3) pH HI tb · bp
1 FC 1 (2, 3) current decr continuously or near zero?
NO
YES
2 Check reg out press
• SYS TEST (2) · 1D, 2A, 2B (O_2 press) 2C, 2D, 3A (H_2 press)
Is either reg out press of affected FC > 5 psi above or >7 psi below other nominal reg out press?
NO
YES
3 SNSR FAILURE
4 Use back up means of determining pH. Monitor FC performance and REG OUT PRESS
5 FC FAILURE
EPS SSR·1
FC SHUTDOWN
1 O_2 nominal reg out press · 62.5 psia. H_2 nominal reg out press · 61.5 psia.
2 Caution
Do not purge FC if flooding is suspected. Plugging of common vent line may result.
3 Warning
Isolate potable H_2O tk for 60 min to direct contaminated H_2O to waste tk.
1f THRU 4
1g
FC 1 (2, 3) O_2 (H_2) FLOW HI
O_2 > 0.8 pph
H_2 > 0.1 pph
1 FC 1 (2, 3) O_2 FLOW ind · 8 times H_2 FLOW ind?
YES
NO
2 DC amps check
• FC IND sel · 1(2, 3)
Amps correspond to FC flows?
NO
YES
3 FC INTERNAL SHORTING
4 Continued FC operating possible. Monitor V·I·T performance and cryo usage for decision to shutdown FC
EPS PD 4 2 SUSPECTED HI PWR FOR CSM CONFIG
5 Cycle purge vlv
• FC 1 (2, 3) PURG · O_2 (H_2) then OFF 2 or 3 times
Flow norm?
NO
YES
6 Does cryo qty decr abnormally over time period?
YES
NO
7 PURGE VLV LEAK OR INTERNAL LEAKAGE
8 Magnitude of cryo usage determines decision to shutdown FC
EPS SSR·1
FC SHUTDOWN
9 TEMPORARY PURGE VLV LEAKAGE
10 FLOW RATE SNSR FAILED
1 H_2 purging will result and O_2 purging may result in FC C&WS alarm.
2 FC O_2 flow ≈ amps x 2 / 100
FC H_2 flow ≈ amps x 2.5 / 1000
3 An accurate magnitude of the internal short can be determined from the reactant flows when the FC is on open ckt.
4 FC reactant conversion efficiency will continue to degrade with time.
5 Future purges may result in high flow.
1h
FC 1 (2, 3) REACS tb · bp
1 Re-open reactant vlv
• FC 1 (2, 3) REACS · on (up)
FC 1 (2, 3) tb · gray
NO
YES
2 Check FC 1 (2,3) H_2 & O_2 flow
• FC IND sel · FC 1 (2, 3)
Flow normal?
NO LOW
YES
Caution
When open circuiting one of three FC's insure main buses isolated with one FC on each bus
3 Open circuit & check FC 1 (2, 3)
• FC 1 (2, 3) MNA & MNB · OFF
• If FC 3, restore MNB: FC 2 MNA · OFF FC 2 MNB · on (up)
• cb FC 1 (2, 3) RAD/REACS · close (verify)
• FC 1 (2, 3) REACS · on (up) (cycle sw several times)
FC 1 (2, 3) REACS tb · gray?
YES
NO
4 INADVERTENT CLOSURE OF REACTANT VLV
5 SENSOR FAILURE
6 Continued FC operation possible. Monitor V·I·T performance for decision to continue or shut down FC
• FC 1 (2, 3) MNA or MNB · on (up)
7 REACTANT VLV FAILURE WITH FC LOSS
FC SHUTDOWN
EPS SSR·1
1 Rapid crew reaction required to prevent loss of FC (<30 secs · H_2 vlv; <2 min O_2 vlv)
2 FC O_2 flow ≈ amps x 2 / 100
FC H_2 flow ≈ amps x 2.5 / 1000
3 Shocks due to pyro functions and vibrations can shuttle valve closed. H_2 valves are more sensitive than O_2 valves.
SM·2A·2292A


SYMPTOM
PROCEDURE
REMARKS
FUEL CELL
2
FC 1 (2, 3) O2 (H2) FLOW LOW
O2 < 0.3 pph
H2 < 0.04 pph
1 FC 1 (2, 3) O2 FLOW ind 8 times H2 FLOW ind?
YES (BOTH LOW)
NO (ONE LOW)
2 FC performance norm?
NO
YES
3 FC FAILURE
4 Low elec loads
5 Open ckt FC
• Reconfigure FC loads
• FC 1 (2, 3) MN A(B) - OFF
NOTE: FC shutdown may be necessary
EPS
SSR-1
FC SHUTDOWN
6 Check O2 (H2) REG PRESS
• SYS TEST - 1D (2C), 2A (2D), 2B (3A)
REG PRESS low or decr?
NO
YES
7 FLOW RATE SNSR FAILED
8 BLOCKED REACTANT LINE
Caution
FC purge will cause a decr in press and possible FC flooding
9 Monitor V-I-T performance and REG OUT PRESS for decision to cont FC oper or shutdown
(1) FC flow and press instrumentation powered by INST PWR CONT cb's (pnl 276).
(2) Flood ing is most probable cause. Isolate potable tank to direct possible contaminated H2O to waste tank until FC condition is postively determined.
(3) Other reactant indicator may be used for affected flow indication.
3
FC REG O2 (H2) OUT PRESS HI
>70 psi
1 Check reg out press
• SYS TEST (2) - 1D, 2A, 2B (O2 press) 2C, 2D, 3A (H2 press)
Is affected FC's high reg out press >5 psi above its other reactant reg out press?
YES
NO
2 FC current check
• DC IND sel - FC 1, (2, 3)
Current decr continuously or near zero?
YES
NO
3 FC FAILED
EPS
SSR-1
FC SHUTDOWN
4 N2 REG SHIFT
5 REG OUT PRESS SNSR, FAILED
(1) pH HI tb may indicate bp. If so, isolate potable H2O tank for 60 min. to direct contaminated H2O to waste tank.
(2) Failure of N2 regulator will raise H2, O2, and N2 press but not dangerously. FC should continue to operate at new press with slight performance change. Heat transfer will not be affected by incr in accumulator press.
4
cb FC 1 (2, 3) PUMPS AC OPEN
1 Attempt reset
• cb FC 1 (2, 3) PUMPS AC close
cb reset?
NO
YES
2 FC PUMP (H2 OR GLY) FAILURE
3 FC usable for peak loads
• Open circuit FC
• FC 1 (2, 3) HTRS - OFF
• Maintain TSKIN >380°F & <475°F by periodic load operation
4 Continue FC operation
Transient caused cb to open
(1) This condition will result in low TCE and/or high TSKIN.
(2) pH snsr lost since power is common to pumps.
(3) MASTER ALARM and FC BUS DISC lts will come on when reconnecting open-circuited FC to bus.
SM 2A-2293

SYMPTOM	PROCEDURE	REMARKS



(1) If both potable & waste H_2O tanks are full, possible freezing of waste H_2O dump line may be cause.

(2) Verify purge flow by incr in reactant flow.

(3) Ammeter accuracy can be verified by FC reactant flow

$$FC\ O_2\ flow \approx \frac{amps \times 2}{100}$$

$$FC\ H_2\ flow \approx \frac{amps \times 2.5}{1000}$$

(4) If only 2 FC's are in operation, both FC's should be tied to both buses for this check. Time must be allowed for T_{SKIN} to stabilize.

(5) MASTER ALARM and FC BUS DISC lts will come on when reconnecting open-circuited FC to bus.

(6) Use reactant flow rates to estimate current.

5 THRU 19

SM-2A-2294A

THIS PAGE
INTENTIONALLY
LEFT BLANK

THIS PAGE
INTENTIONALLY
LEFT BLANK

PWR

PWR DISTR MALFUNCTION INDEX

1 MN BUS A(B) UNDERVOLT

1a AS BUS 1(2)

1b AC BUS 1(2) OVERLOAD

1c MN BUS A(B) INDICATES < 26 FDC

1d AC BUS 1(2) VOLTAGE LOW

1e AC BUS 1(2) VOLTAGE HIGH

2 INV 1(2,3) TEMP HI

3 FC BUS DISCONNECT

4 SUSPECTED HI CURRENT FOR CSM CONFIG

5 BAT CHGR CURRENT ZERO

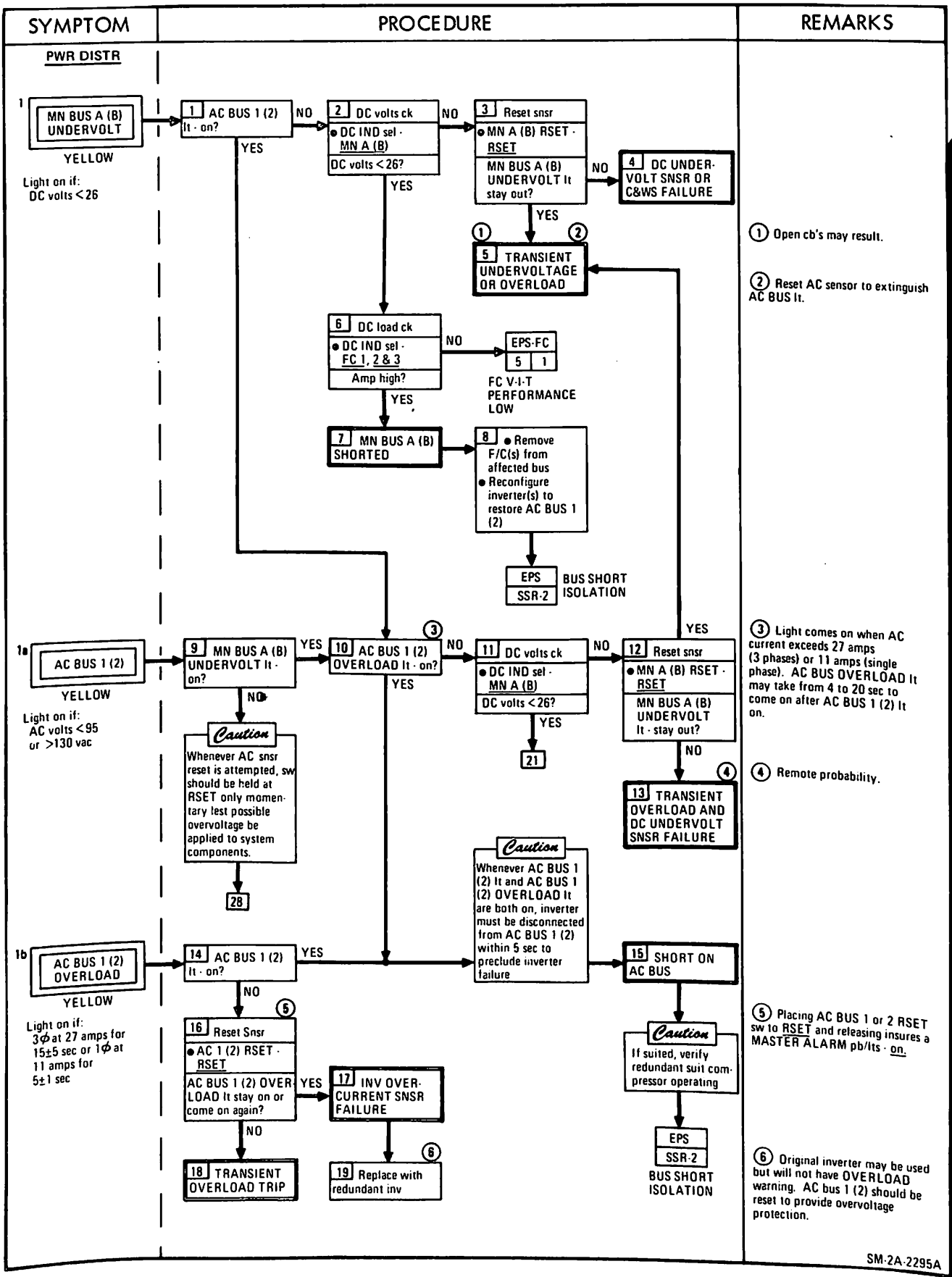
6 BAT BUS A(B) CURRENT > 1.0 WITH MN BUS TIE(2) - OFF

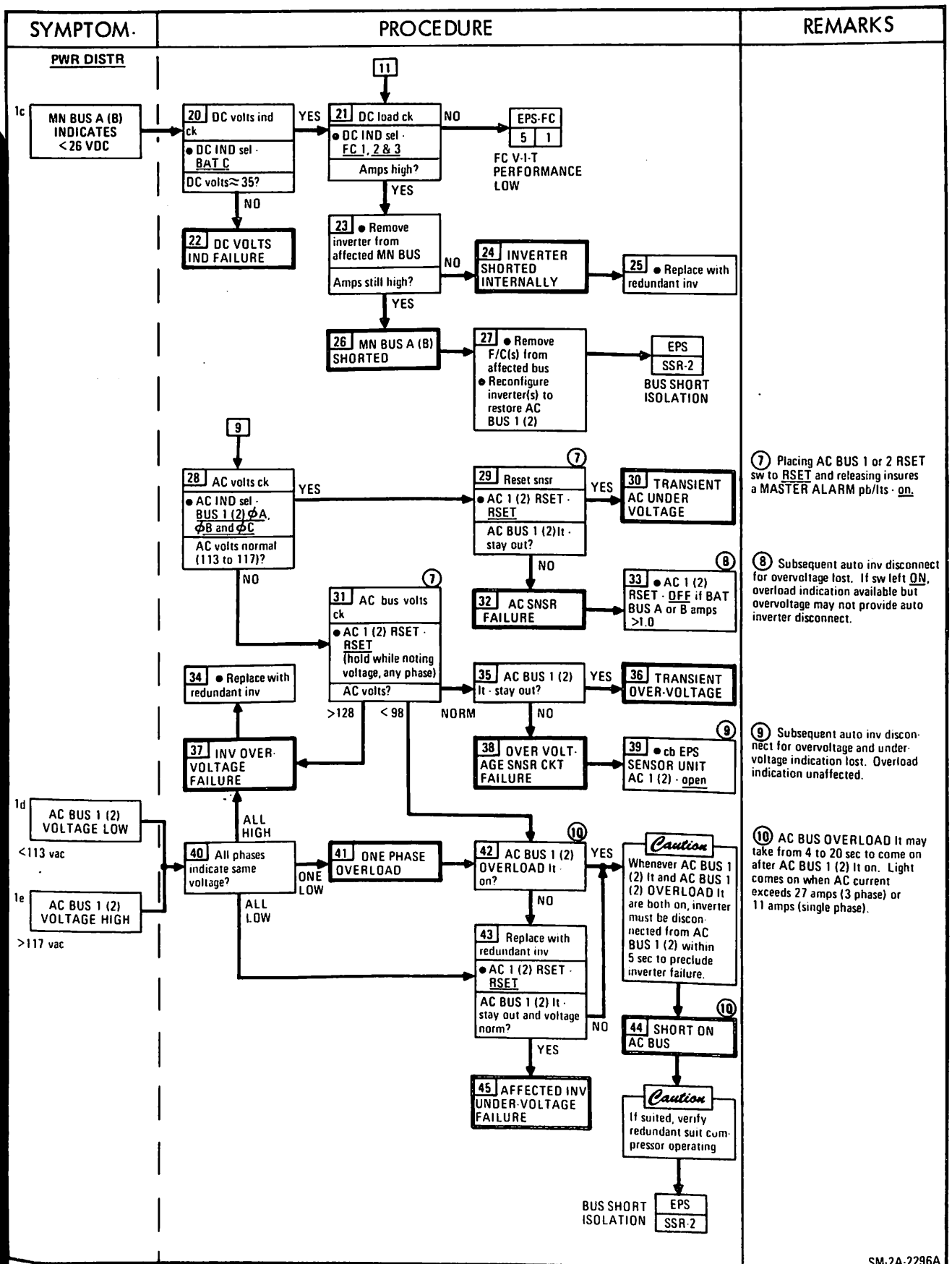
6a FC tb ALL GRAY

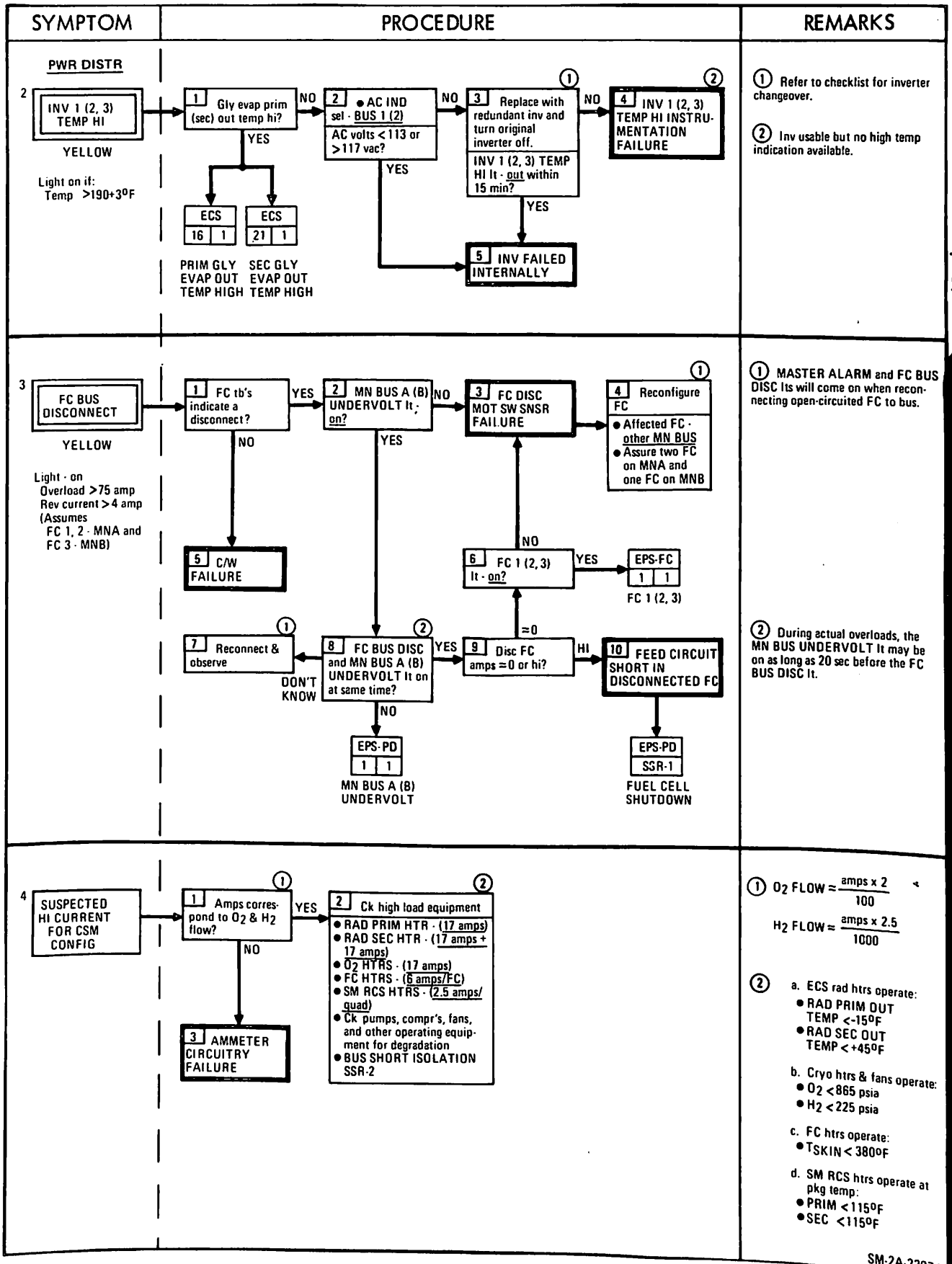
7 PYRO BAT VOLTAGE < 35 VDC

SSR-1 FUEL CELL SHUTDOWN

SSR-2 BUS SHORT ISOLATION


SYMPTOM
PROCEDURE
REMARKS
PWR DISTR
1
MN BUS A (B) UNDERVOLT
YELLOW
Light on if: DC volts < 26
1 AC BUS 1 (2) lt · on?
NO
YES
2 DC volts ck
• DC IND sel · MN A (B)
DC volts < 26?
NO
YES
3 Reset snsr
• MN A (B) RSET · RSET
MN BUS A (B) UNDERVOLT lt stay out?
NO
YES
4 DC UNDER-VOLT SNSR OR C&WS FAILURE
(1) (2)
5 TRANSIENT UNDERVOLTAGE OR OVERLOAD
6 DC load ck
• DC IND sel · FC 1, 2 & 3
Amp high?
NO
YES
EPS-FC 5 1
FC V-I-T PERFORMANCE LOW
7 MN BUS A (B) SHORTED
8 • Remove F/C(s) from affected bus
• Reconfigure inverter(s) to restore AC BUS 1 (2)
EPS SSR-2
BUS SHORT ISOLATION
1a
AC BUS 1 (2)
YELLOW
Light on if: AC volts < 95 or > 130 vac
9 MN BUS A (B) UNDERVOLT lt · on?
YES
NO
10 AC BUS 1 (2) OVERLOAD lt · on?
(3)
NO
YES
11 DC volts ck
• DC IND sel · MN A (B)
DC volts < 26?
NO
YES
21
12 Reset snsr
• MN A (B) RSET · RSET
MN BUS A (B) UNDERVOLT lt · stay out?
YES
NO
13 TRANSIENT OVERLOAD AND DC UNDERVOLT SNSR FAILURE
(4)
Caution
Whenever AC snsr reset is attempted, sw should be held at RSET only momentary test possible overvoltage be applied to system components.
28
Caution
Whenever AC BUS 1 (2) lt and AC BUS 1 (2) OVERLOAD lt are both on, inverter must be disconnected from AC BUS 1 (2) within 5 sec to preclude inverter failure
1b
AC BUS 1 (2) OVERLOAD
YELLOW
Light on if: 3φ at 27 amps for 15±5 sec or 1φ at 11 amps for 5±1 sec
14 AC BUS 1 (2) lt · on?
YES
NO
15 SHORT ON AC BUS
(5)
16 Reset Snsr
• AC 1 (2) RSET · RSET
AC BUS 1 (2) OVERLOAD lt stay on or come on again?
YES
NO
17 INV OVER-CURRENT SNSR FAILURE
(6)
18 TRANSIENT OVERLOAD TRIP
19 Replace with redundant inv
Caution
If suited, verify redundant suit compressor operating
EPS SSR-2
BUS SHORT ISOLATION
(1) Open cb's may result.
(2) Reset AC sensor to extinguish AC BUS lt.
(3) Light comes on when AC current exceeds 27 amps (3 phases) or 11 amps (single phase). AC BUS OVERLOAD lt may take from 4 to 20 sec to come on after AC BUS 1 (2) lt on.
(4) Remote probability.
(5) Placing AC BUS 1 or 2 RSET sw to RSET and releasing insures a MASTER ALARM pb/lts · on.
(6) Original inverter may be used but will not have OVERLOAD warning. AC bus 1 (2) should be reset to provide overvoltage protection.
SM-2A-2295A


SYMPTOM
PROCEDURE
REMARKS
PWR DISTR
1c
MN BUS A (B) INDICATES <26 VDC
20 DC volts ind ck
• DC IND sel · BAT C
DC volts≈35?
YES
NO
21 DC load ck
• DC IND sel · FC 1, 2 & 3
Amps high?
NO
EPS-FC 5 1
FC V-I-T PERFORMANCE LOW
YES
22 DC VOLTS IND FAILURE
11
23 • Remove inverter from affected MN BUS
Amps still high?
NO
24 INVERTER SHORTED INTERNALLY
25 • Replace with redundant inv
YES
26 MN BUS A (B) SHORTED
27 • Remove F/C(s) from affected bus
• Reconfigure inverter(s) to restore AC BUS 1 (2)
EPS SSR-2
BUS SHORT ISOLATION
9
28 AC volts ck
• AC IND sel · BUS 1 (2) ΦA, ΦB and ΦC
AC volts normal (113 to 117)?
YES
NO
7
29 Reset snsr
• AC 1 (2) RSET · RSET
AC BUS 1 (2) lt · stay out?
YES
30 TRANSIENT AC UNDER VOLTAGE
NO
8
33 • AC 1 (2) RSET · OFF if BAT BUS A or B amps >1.0
32 AC SNSR FAILURE
7
31 AC bus volts ck
• AC 1 (2) RSET · RSET (hold while noting voltage, any phase)
AC volts?
>128
<98
NORM
34 • Replace with redundant inv
37 INV OVER-VOLTAGE FAILURE
35 AC BUS 1 (2) lt · stay out?
YES
36 TRANSIENT OVER-VOLTAGE
NO
9
38 OVER VOLTAGE SNSR CKT FAILURE
39 • cb EPS SENSOR UNIT AC 1 (2) · open
1d
AC BUS 1 (2) VOLTAGE LOW
<113 vac
1e
AC BUS 1 (2) VOLTAGE HIGH
>117 vac
ALL HIGH
40 All phases indicate same voltage?
ONE LOW
ALL LOW
41 ONE PHASE OVERLOAD
10
42 AC BUS 1 (2) OVERLOAD lt · on?
YES
NO
Caution
Whenever AC BUS 1 (2) lt and AC BUS 1 (2) OVERLOAD lt are both on, inverter must be disconnected from AC BUS 1 (2) within 5 sec to preclude inverter failure.
43 Replace with redundant inv
• AC 1 (2) RSET · RSET
AC BUS 1 (2) lt · stay out and voltage norm?
NO
YES
10
44 SHORT ON AC BUS
45 AFFECTED INV UNDER-VOLTAGE FAILURE
Caution
If suited, verify redundant suit compressor operating
BUS SHORT ISOLATION
EPS SSR-2
(7) Placing AC BUS 1 or 2 RSET sw to RSET and releasing insures a MASTER ALARM pb/lts · on.
(8) Subsequent auto inv disconnect for overvoltage lost. If sw left ON, overload indication available but overvoltage may not provide auto inverter disconnect.
(9) Subsequent auto inv disconnect for overvoltage and undervoltage indication lost. Overload indication unaffected.
(10) AC BUS OVERLOAD lt may take from 4 to 20 sec to come on after AC BUS 1 (2) lt on. Light comes on when AC current exceeds 27 amps (3 phase) or 11 amps (single phase).
SM-2A-2296A


SYMPTOM
PROCEDURE
REMARKS
PWR DISTR
2
INV 1 (2, 3) TEMP HI
YELLOW
Light on if:
Temp >190+3°F
1 Gly evap prim (sec) out temp hi?
NO
2 • AC IND sel - BUS 1 (2)
AC volts < 113 or >117 vac?
NO
3 Replace with redundant inv and turn original inverter off.
INV 1 (2, 3) TEMP HI lt - out within 15 min?
NO
4 INV 1 (2, 3) TEMP HI INSTRU-MENTATION FAILURE
YES
YES
YES
ECS 16 1
ECS 21 1
PRIM GLY EVAP OUT TEMP HIGH
SEC GLY EVAP OUT TEMP HIGH
5 INV FAILED INTERNALLY
1 Refer to checklist for inverter changeover.
2 Inv usable but no high temp indication available.
2 THRU SSR-1
3
FC BUS DISCONNECT
YELLOW
Light - on
Overload >75 amp
Rev current >4 amp
(Assumes
FC 1, 2 - MNA and
FC 3 - MNB)
1 FC tb's indicate a disconnect?
YES
2 MN BUS A (B) UNDERVOLT lt - on?
NO
3 FC DISC MOT SW SNSR FAILURE
4 Reconfigure FC
• Affected FC - other MN BUS
• Assure two FC on MNA and one FC on MNB
NO
YES
5 C/W FAILURE
6 FC 1 (2, 3) lt - on?
YES
EPS-FC 1 1
FC 1 (2, 3)
NO
7 Reconnect & observe
DON'T KNOW
8 FC BUS DISC and MN BUS A (B) UNDERVOLT lt on at same time?
YES
9 Disc FC amps = 0 or hi?
=0
HI
10 FEED CIRCUIT SHORT IN DISCONNECTED FC
NO
EPS-PD 1 1
MN BUS A (B) UNDERVOLT
EPS-PD SSR-1
FUEL CELL SHUTDOWN
1 MASTER ALARM and FC BUS DISC lts will come on when recon-necting open-circuited FC to bus.
2 During actual overloads, the MN BUS UNDERVOLT lt may be on as long as 20 sec before the FC BUS DISC lt.
4
SUSPECTED HI CURRENT FOR CSM CONFIG
1 Amps corres-pond to O2 & H2 flow?
YES
NO
2 Ck high load equipment
• RAD PRIM HTR - (17 amps)
• RAD SEC HTR - (17 amps + 17 amps)
• O2 HTRS - (17 amps)
• FC HTRS - (6 amps/FC)
• SM RCS HTRS - (2.5 amps/ quad)
• Ck pumps, compr's, fans, and other operating equip-ment for degradation
• BUS SHORT ISOLATION SSR-2
3 AMMETER CIRCUITRY FAILURE
1 O2 FLOW ≈ amps x 2 / 100
H2 FLOW ≈ amps x 2.5 / 1000
2 a. ECS rad htrs operate:
• RAD PRIM OUT TEMP <-15°F
• RAD SEC OUT TEMP < +45°F
b. Cryo htrs & fans operate:
• O2 < 865 psia
• H2 < 225 psia
c. FC htrs operate:
• TSKIN < 380°F
d. SM RCS htrs operate at pkg temp:
• PRIM < 115°F
• SEC < 115°F

SYMPTOM	PROCEDURE	REMARKS
PWR DISTR 5 BAT CHGR CURRENT ZERO	1 Bat chgr volts >38? YES → 2 • BAT CHG · other bats · Current still zero? NO → 3 OPEN CKT IN ONE BAT CHGR CKT (1) 2 • BAT CHG · other bats · Current still zero? YES → 6 • BAT CHG · A (B, C) • cb BAT CHGR BAT A (B, C) CHG · open · Chgr volts incr? NO → 7 OPEN BAT CHARGING CKT TO ALL BATS (2) Chgr volts incr? YES → 9 DC AMMETER FAILURE 1 Bat chgr volts >38? NO → 4 • BAT CHG · other bats · Bat chgr volts >38? YES → 5 DC AMMETER FAILED (AND ORIG BAT LOW) 4 • BAT CHG · other bats · Bat chgr volts >38? NO → 8 BAT CHGR OR CHGR CONT RELAY FAILED (2)	(1) Affected battery might still be charged through BAT TIE cb's. (2) Battery charging capability lost.
6 BAT BUS A (B) CURRENT >1.0 WITH MN BUS TIE (2) · OFF (1) 6a FC tb's ALL GRAY (2)	1 • DC IND sel · BAT BUS B (A) · Current >1.0? NO → 2 • cb MN A (B) BAT BUS A (B) · open · Current still >1.0? YES → 3 BAT BUS A (B) SHORTED 2 • cb MN A (B) BAT BUS A (B) · open · Current still >1.0? NO → 5 MN BUS TIE MOT SW FAILURE (3) 1 • DC IND sel · BAT BUS B (A) · Current >1.0? YES → 4 BAT RLY BUS SHORTED → EPS SSR-2 BUS SHORT ISOLATION 3 BAT BUS A (B) SHORTED → EPS SSR-2 BUS SHORT ISOLATION	(1) Bat bus current will be <1.0 amps for all mission phases except: a. Prelaunch (<3.0 amps) b. Boost & insertion c. ΔV maneuvers d. Deorbits & entry. (2) Not valid after CM/SM separation. (3) If A, B & C bats on MN buses, cycling MN bus tie switches may correct the problem. If not, MN bus tie will have to be accomplished by cb action. May have to change battery through other battery bus.
7 PYRO BAT VOLTAGE <35 VDC	1 Replace pyro bat with entry bat • cb PYRO A (B) SEQ A (B) · open • cb PYRO A (B) BAT BUS A (B) · close • DC IND sel · PYRO BAT A (B) • Verify DC volts ≧ BAT BUS A (B). • DC IND sel · BAT BUS A (B) BAT BUS A (B) amps incr? YES → 2 PYRO A (B) FEED CKT SHORTED (1) BAT BUS A (B) amps incr? NO → 3 PYRO BAT A (B) FAILED	(1) It is crew option to leave a main battery connected to a known short to retain redundant pyro circuit capability. If dc amps >30, expect cb PYRO A (B) BAT BUS A (B) to open within 1 to 5 min and loss of redundant pyro circuit.
SPECIAL SUB ROUTINE SSR 1 FUEL CELL SHUTDOWN	1 Configure for 2 FC's with one FC on each bus → 2 • FC 1 (2, 3) HTRS OFF • FC 1 (2, 3) PUMPS OFF • cb FC 1 (2, 3) PUMPS AC open • FC 1 (2, 3) REACS OFF • cb FC 1 (2, 3) RAD REACS open → 3 Relieve press on KOH of faulty FC at $T_{SKIN} \leq 200^{0}F$ (1) • H_2 PURG LINE HTR (on up) 20 min prior to purge • FC 1 (2, 3) PURG · O_2 • FC 1 (2, 3) PURG H_2 (when O_2 approaches stable value) • FC 1 (2, 3) PURG OFF (after H_2 approaches stable value) • H_2 PURG LINE HTR OFF	(1) FC will not reach $T_{SKIN} = 200^{0}F$ for approximately 24 hours. KOH will be solidified at $T_{SKIN} \leq 200^{0}F$ The press is relieved to reduce the possibility of corrosive fluid leaking into the SM and to insure sealing of the check vlv, isolating the potable water from the FC.

SPECIAL SUB ROUTINE

SSR-2

BUS SHORT ISOLATION

PROCEDURE

1 Remove all equipment from affected bus

2 Affected bus?

AC 1 (2)

MNA (B)

BAT A (B)

BAT RLY BUS

16

22

Caution

Whenever AC BUS 1 (2) lt and AC BUS 1 (2) OVERLOAD lt are both on, inverter must be disconnected from AC BUS 1 (2) within 5 sec to preclude inverter failure

3 Bat chgr to bat bus

- cb BAT A ENTRY/PL - open (pnl 250)
- cb BAT RLY - BUS BAT B - open (pnl 5)
- BAT CHG - A
- DC IND sel - BAT CHGR

Bat chgr amps > 0?

NO

4 Return to original configuration. Close cb's to isolate affected equip.

YES

(1)

8 Current drain on BAT RLY BUS. Bus loss depends on magnitude of current drain

11 Isolate BAT RLY BUS from BAT A & B

- cb BAT RLY BUS BAT A - open
- cb BAT RLY BUS BAT B - open
- Return BAT RLY BUS load to original config

12 BAT RLY BUS non-transferable loads

EPS/CRYO
- FC reacs vlvs, latch ckt & tb's
- FC rad bypass vlvs & tb's
- FC to bus cont & tb's
- DC undervolt sensing if CW NORM - ACK
- AC over/undervolt sensing & CW lt
- AC ovld CW lt (if CW NORM - ACK)
- Inverter cont (DC & AC)
- AUX bat to MNA & B switching
- O_2 Tank 3 isol vlv & tb

5 • INV 1(2) - to affected bus

AC BUS 1(2) OVERLOAD lt on?

NO

6 Individually close equip cb's or sws while monitoring FC current

YES

7 AFFECTED AC BUS LOST

AC1

AC2

9 AC1 BUS reconfiguration

- INV 1 - OFF
- INV 1 AC1 - OFF
- SUIT COMPR (both) - AC2
- FDAI SEL - 2
- BMAG MODE (3) - RATE 2
- S BD PWR AMPL PRIM - SEC
- S BD XPNDR - SEC
- FC 1 PUMPS - AC2
- GLY PUMPS - 2 AC2
- BMAG 1 PWR - OFF
- G/N PWR - AC2
- SIG CONDR/DR BIAS PWR 1 - AC2
- Maintain GLY EVAP TEMP INLET temp > 40°F
- RAD FLOW CONT AUTO - 2
- BAT CHGR - AC2

13 AC1 BUS non-transferable loads

EPS/CRYO
- Tank 1 H_2 fans
- Tank 1 H_2 & O_2 qty & temp sig condr (ØC)

ECS
- Cabin fan 1
- Man cont prim evap stm vlv (ØC)
- Auto cont prim gly cont vlv (ØA)
- Sec loop evap cooling (ØA)
- Elect cont suit heat exch gly bypass vlv (ØB)
- Rad flow contr 1 & rad isol vlvs (ØC)

SCS
- GDC (all modes except RSI)
- FDAI 1
- BMAG 1 (ATT HOLD, RATE CMD)
- Min Imp (ØA)
- RHC 1 MTVC (ØA)
- Rate cmd prop att cont (ØA)
- Auto ΔV (ØA)
- No 1 pitch & yaw needles on GPI (ØA)
- SII fuel & SIVB fuel & oxid press for ind No 1 (ØA)

LIGHTING
- FDAI 1
- EMS numerics & grid
- Mission timer numerics (pnl 2)
- DSKY numerics (pnl 2)
- EL for pnls 1 thru 6, 15, 16, 229, 275
- Sys 1 SM running lts (8 elements) & EVA lt (1 element)

10 AC2 BUS reconfiguration

- INV 2 - OFF
- INV 2 AC2 - OFF
- ELEC PWR - ECA
- Verify OMNI in proper configuration for MSFN
- FC 2 & 3 PUMPS - AC1
- BMAG 2 PWR - OFF
- FDAI SEL - 1
- SIG CONDR/DR BIAS PWR 2 - AC1
- BMAG MODE (3) - RATE 1
- Activate SEC COOL LOOP
- Shut down PRIM EVAP

14 AC2 BUS non-transferable loads

EPS/CRYO
- Tank 2 H_2 fans
- Tank 2 H_2 & O_2 qty & temp sig condr (ØC)
- AC utility outlet (pnl 201)
- Tank 3 O_2 qty & temp sig condr (ØC)

ECS
- Cabin fan 2
- Prim evap temp cont unit (ØA)
- Auto cabin temp cont unit ØC
- Rad flow contr 2 & isol vlvs (ØC)

SCS
- MTVC (RATE CMD, ACCEL CMD)
- Prop rate cmd (TVC, ATT CONT)
- FDAI 2
- BMAG 2
- RSI (ØA)
- GDC (ØA)
- Auto ΔV (TVC) (ØA)
- Ordeal
- No 2 pitch & yaw needles on GPI (ØA)
- SII fuel & SIVB fuel & oxid press for indicator No 2 (ØA)

LIGHTING
- EMS roll att & scroll lts
- Mission timer numerics (pnl 306)
- DSKY numerics (pnl 140)
- EL for pnls 10, 100, 101, 122, 226, 306
- Sys 2 CM running lts (8 elements) & EVA lt (1 element)
- Docking target & spot lt

REMARKS

(1) If short circuit amps < 2.0, it is a crew option to maintain bat relay bus powered to retain AC bus sensors and FC overcurrent/reverse current protection functions. Increased battery recharge cycle may be required. If short circuit > 2.0 amps, close bat relay bat A or bat B cb's only when required to operate equipment connected to bat relay bus.

SSR-2

SM-2A-22488

SYMPTOM	PROCEDURE	REMARKS

(2) MASTER ALARM and FC BUS DISC lts will come on when reconnecting open-circuited FC to bus

(3) Place two batteries on remaining bus for SPS maneuvers.

2

16 • DC IND sel - FC 1(3)
• FC 1(3) MN BUS A (B) - on (momentarily)
DC amps >25?

NO: 15 Individually close equip cb's or sws while monitoring FC current

YES: 17 AFFECTED MAIN DC BUS LOST

MNA / MNB

18 MN BUS A reconfiguration

- FC 2, 3 - MNB only
- FC 1 MNB - on (up) (if reqd)
- FC 1 MNA - OFF
- INV 1 AC1 - OFF
- INV 1 - OFF
- INV 3 - MNB
- INV 3 AC1 - on (up)
- cb MNA BAT BUS A - open
- cb MNB BAT C - close
- SUIT H_2O ACCUM AUTO 2
- BMAG MODE (3) - RATE 2
- FDAI SEL - 2
- URINE DUMP - HTR B
- WASTE H_2O DUMP - HTR B
- RHC PWR DIR 2 - MNB
- AUTO RCS SEL (16) - MNB (as reqd)
- RAD PRIM HTR - 1
- RAD FLOW CONT AUTO - 2
- SPS LINE HTRS - A/B (as reqd)
- SCS TVC (2) - RATE CMD
- Use RHC's for RCS dump, not CM PRPLNT DUMP sw

19 MN BUS B reconfiguration

- FC 1, 2 - MNA only
- FC 3 MNA - on (up) (if reqd)
- FC 3 MNB - OFF
- INV 2 AC2 - OFF
- INV 2 - OFF
- INV 3 - MNA
- INV 3 AC2 - on (up)
- cb MNB BAT BUS B - open
- cb MNA BAT C - close
- BMAG MODE (3) - RATE 1
- RHC PWR DIR 1 - MNA
- AUTO RCS SEL (16) - MNA (as reqd)
- ELEC PWR - ECA
- RAD PRIM HTR - 2
- RAD FLOW CONT AUTO - 1
- Use RHC's for RCS dump, not CM PRPLNT DUMP sw

20 MN BUS A non-transferable loads

EPS/CRYO
- Tank 1 H_2 htr
- Tank 1 O_2 100W htr
- Tank 2 & 3 O_2 50W htrs
- Tank 2 O_2 htr temp sig condr
- Tank 3 O_2 htr temp & press sig condr
- Inverter 1 pwr
- Utility outlets (pnl 15 & 16)
- Tank 1 O_2 vac-ion pump

ECS
- CO_2 PP ind, CW lt & PSM
- Prim 2 rad htr cont
- Rad flow contr 1 & auto select
- Rad isol vlv man sel
- H_2O accum 1 auto & man cont
- Urine & waste H_2O dump htr A
- Steam duct htr A
- Sec rad htr cont
- Sec rad in & out temp ind & PCM

RCS
- CM sys 1 htrs
- CM sys 1 fuel & oxid purge
- CM oxid interconnect
- CM fuel He interconnect
- CM sys 1 prplnt dump (42 sec TD)
- CM sys 1 prplnt isol vlv & tb
- SM B & D He 1 & 2 isol vlv & tb
- SM B & D prim/sec prplnt isol vlv & tb
- SM B & D sec fuel press isol vlv
- SM B & D htrs
- Transfer mot sw 1

SPS
- Pitch & yaw (prim) gmbl mots
- Enable pwr sol driver 1
- He vlv 1 & tb
- Pilot vlv 1 & 2
- Prim pilot pre-vlv
- Line htrs A
- PUGS test

SCS
- FDAI 1 total attitude
- GDC (except RSI)
- BMAG 1 htr & CW temp lt (eventually lose BMAG 1 as temp decreases)
- Auto coils CM RCS 1 (if prior to CM/SM sep)
- Direct ullage yaw D3 & B4
- Auto ΔV
- Auto attitude hold
- Rate 1 MTVC
- RHC pwr dir 1
  a. MNA/MNB to half of jets
  b. MNA to all jets
- RHC pwr dir 2, MNA/MNB to half of jets

LIGHTING
- RH girth shelf flood (fixed mode)
- RH couch flood (fixed mode)
- LH girth shelf flood (variable mode)
- LH couch flood (variable mode)
- LH & RH strut flood (variable mode)
- LH optical align sight
- Rendezvous lt
- Sys A tunnel lts (6 elements)

DISPLAYS & CONTROLS
- Mission elapsed timer (pnl 2)

DOCKING
- Sys A probe connector (however A & B connectors may be switched)

21 MN BUS B non-transferable loads

EPS/CRYO
- Tank 2 H_2 htr
- Tank 2 & 3 O_2 100W htrs
- Tank 1 O_2 50W htr
- Tank 1 O_2 htr temp sig condr
- Tank 2 & 3 O_2 manf press sig condr
- Inverter 2 pwr
- Utility outlet (pnl 100)
- LM power
- Tank 2 O_2 vac-ion pump

ECS
- O_2 high flow CW lt
- Prim 1 rad htr cont
- Rad flow contr 2
- Prim rad in temp ind & PCM
- H_2O accum 2 auto & man cont
- Urine & waste dump htr B
- Steam duct htr B

RCS
- CM sys 2 htrs
- CM sys 2 fuel & oxid purge
- CM fuel interconnect
- CM oxid He interconnect
- CM sys 2 prplnt dump (42 sec TD)
- CM sys 2 prplnt isol vlv & tb
- SM A & C He 1 & 2 isol vlv & tb
- SM A & C prim/sec prplnt isol vlv & tb
- SM A & C sec fuel press isol vlv
- SM A & C htrs
- Transfer mot sw 2

SPS
- Pitch & yaw (sec) gmbl motrs
- Enable pwr sol driver 2
- He vlv 2 & tb
- Pilot vlvs (3 & 4)
- Line htrs B
- Sec pilot pre vlv

SCS
- FDAI 2 total attitude
- GDC
- BMAG 2 htr & CW temp lt (eventually lose BMAG 2 as temp decreases)
- Auto coils CM RCS 2 (if prior to CM/SM sep)
- Direct ullage pitch C3 & A4
- Auto ΔV (maybe degraded)
- Min imp increased to ~12 MS
- RSI
- Ordeal
- RHC pwr dir 1, MNA/MNB to half of jets
- RHC pwr dir 2
  a. MNA/MNB to half of jets
  b. MNB to all jets

LIGHTING
- LH girth shelf flood (fixed mode)
- LH couch flood (fixed mode)
- LH & RH strut flood (fixed mode)
- RH couch flood (variable mode)
- RH girth shelf flood (variable mode)
- RH optical align sight
- Sys B tunnel lts (6 elements)
- Spotlight door initiator

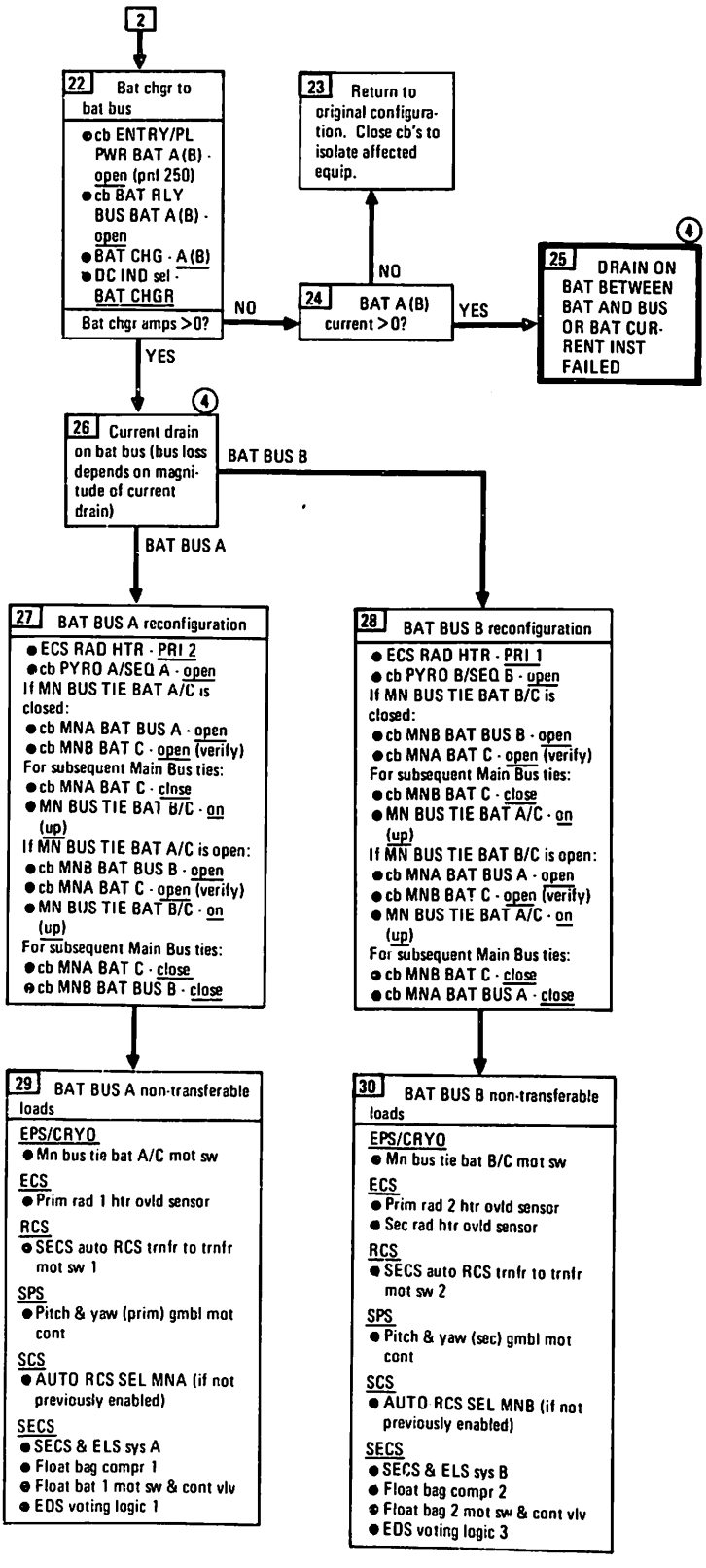
DISPLAYS & CONTROLS
- Mission elapsed timer (pnl 306)

DOCKING
- Sys B probe connector (however A & B connectors may be switched)

SM 2A 22498

SYMPTOM	PROCEDURE	REMARKS

SSR-2 (CONT)



(4) If cb RAD HTRS OVLD BAT A and/or BAT B are opened to reduce battery drain, they should not be closed unless batteries are tied to main buses. This prevents possible disconnect of ECS radiator heaters by a false overload signal.

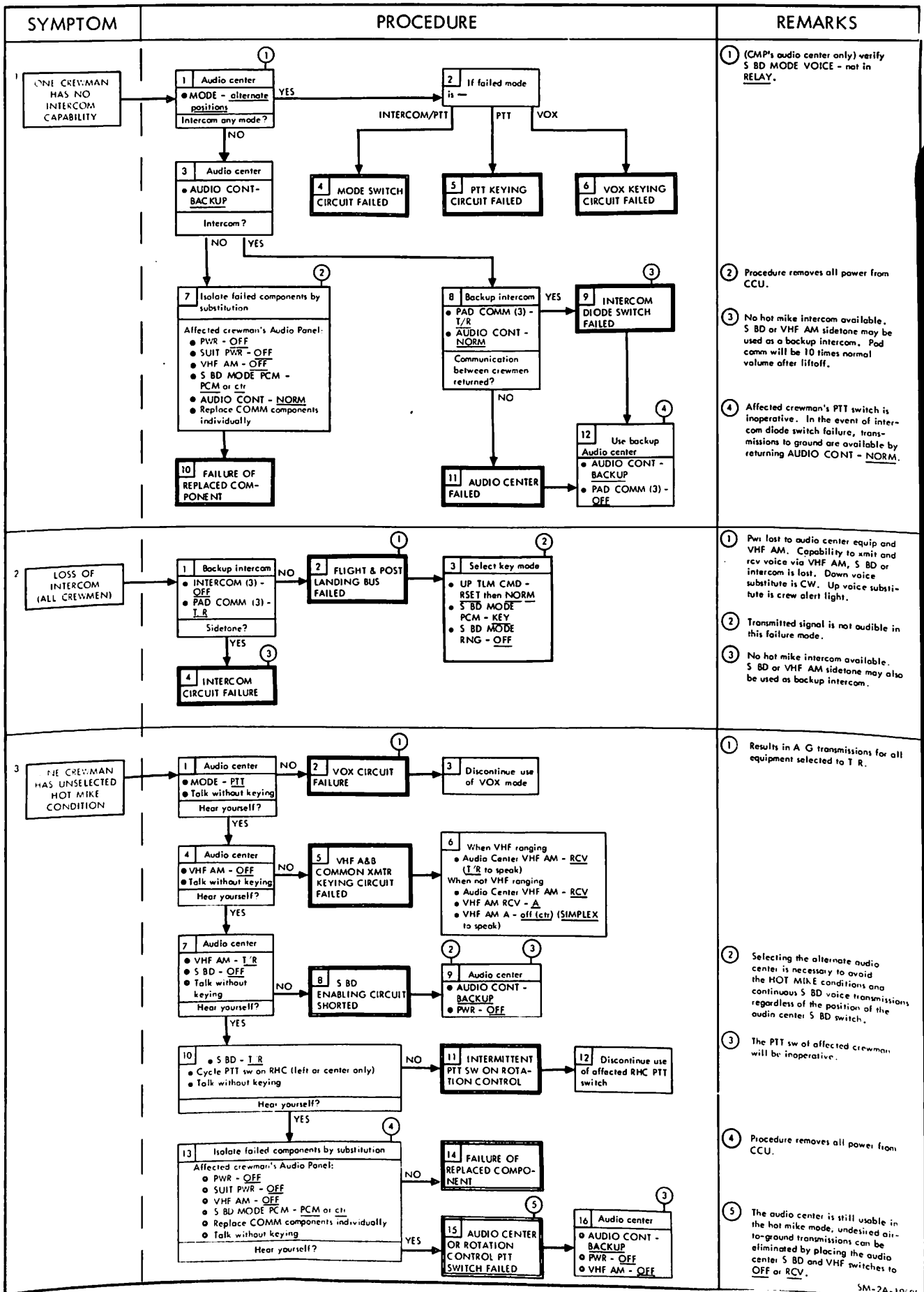
THIS PAGE
INTENTIONALLY
LEFT BLANK

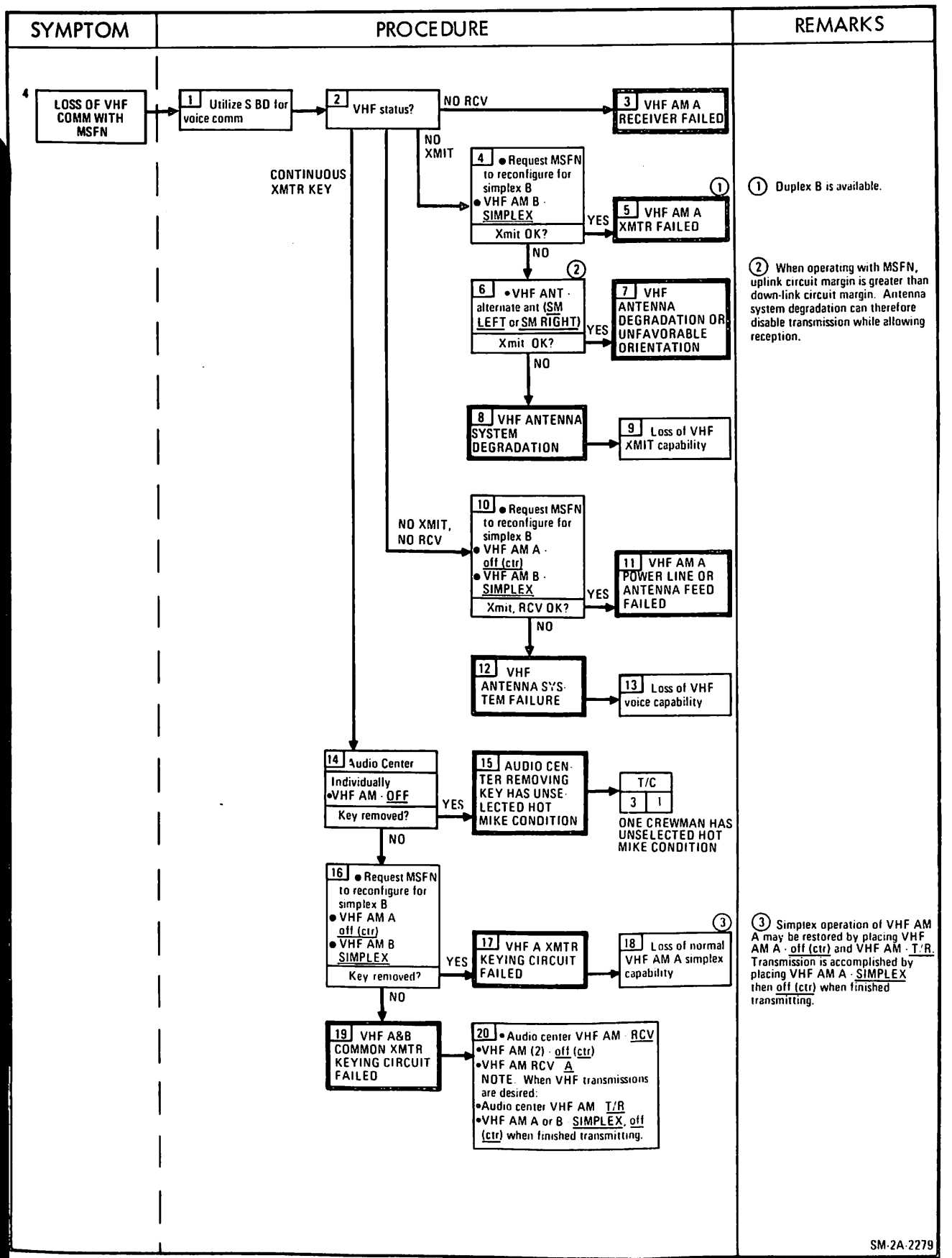
T/C

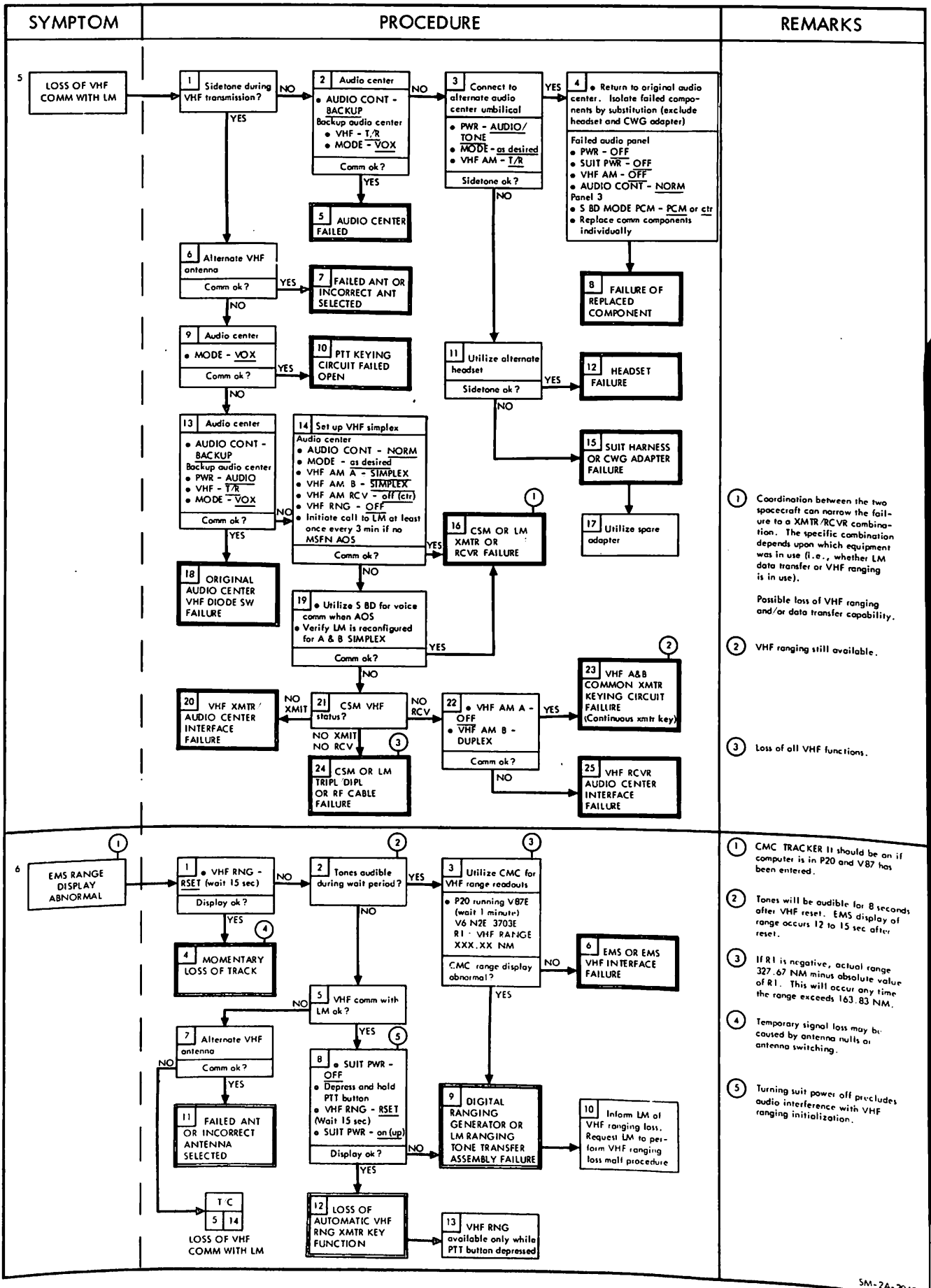
THIS PAGE
INTENTIONALLY
LEFT BLANK

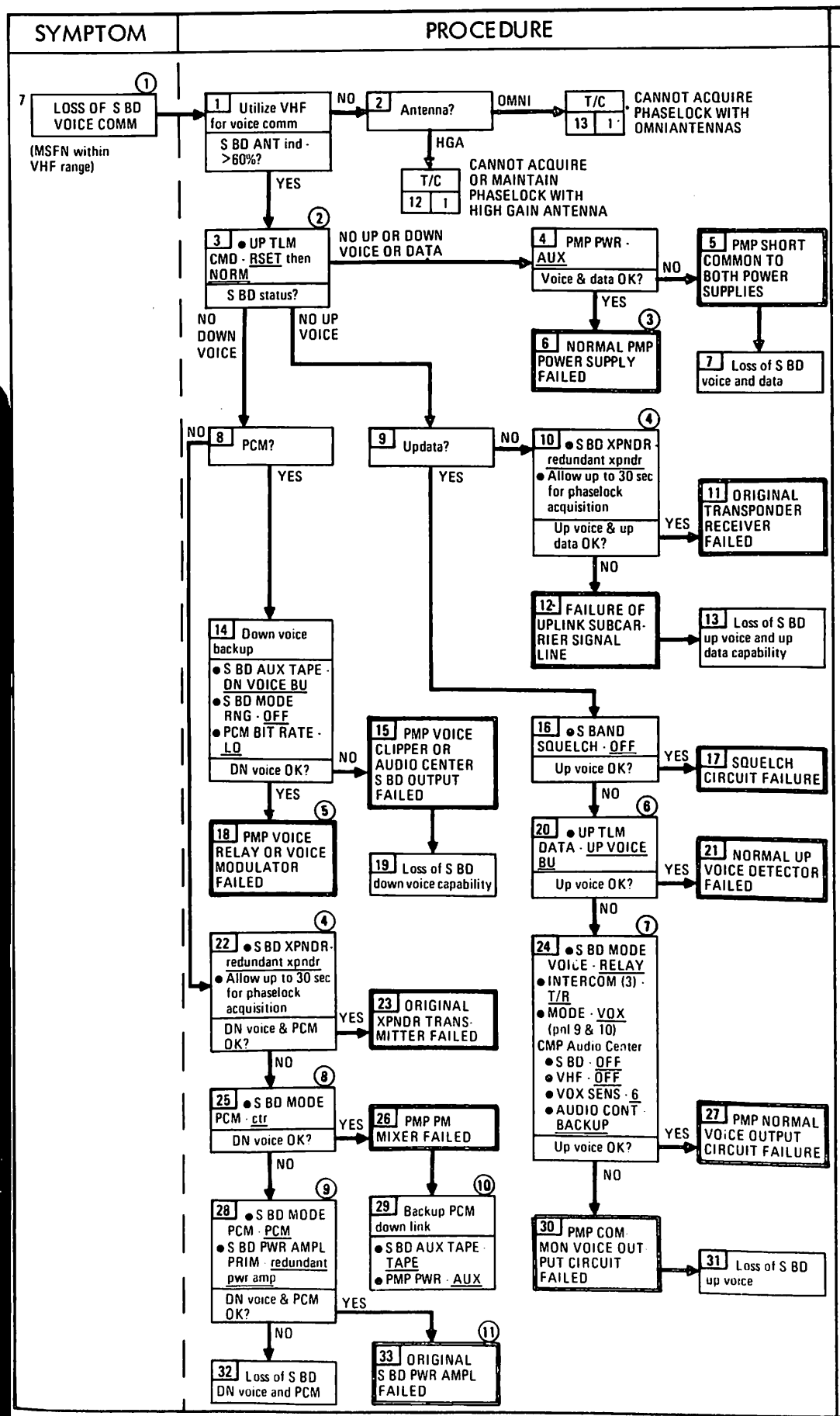
T/C

TELECOMM MALFUNCTION INDEX


SYMPTOM
PROCEDURE
REMARKS
1 ONE CREWMAN HAS NO INTERCOM CAPABILITY
1 Audio center
• MODE - alternate positions
Intercom any mode?
YES
NO
2 If failed mode is —
INTERCOM/PTT
PTT
VOX
3 Audio center
• AUDIO CONT - BACKUP
Intercom?
4 MODE SWITCH CIRCUIT FAILED
5 PTT KEYING CIRCUIT FAILED
6 VOX KEYING CIRCUIT FAILED
7 Isolate failed components by substitution
Affected crewman's Audio Panel:
• PWR - OFF
• SUIT PWR - OFF
• VHF AM - OFF
• S BD MODE PCM - PCM or ctr
• AUDIO CONT - NORM
• Replace COMM components individually
8 Backup intercom
• PAD COMM (3) - T/R
• AUDIO CONT - NORM
Communication between crewmen returned?
9 INTERCOM DIODE SWITCH FAILED
10 FAILURE OF REPLACED COMPONENT
11 AUDIO CENTER FAILED
12 Use backup Audio center
• AUDIO CONT - BACKUP
• PAD COMM (3) - OFF
1 (CMP's audio center only) verify S BD MODE VOICE - not in RELAY.
2 Procedure removes all power from CCU.
3 No hot mike intercom available. S BD or VHF AM sidetone may be used as a backup intercom. Pad comm will be 10 times normal volume after liftoff.
4 Affected crewman's PTT switch is inoperative. In the event of intercom diode switch failure, transmissions to ground are available by returning AUDIO CONT - NORM.
2 LOSS OF INTERCOM (ALL CREWMEN)
1 Backup intercom
• INTERCOM (3) - OFF
• PAD COMM (3) - T/R
Sidetone?
NO
YES
2 FLIGHT & POST LANDING BUS FAILED
3 Select key mode
• UP TLM CMD - RSET then NORM
• S BD MODE PCM - KEY
• S BD MODE RNG - OFF
4 INTERCOM CIRCUIT FAILURE
1 Pwr lost to audio center equip and VHF AM. Capability to xmit and rcv voice via VHF AM, S BD or intercom is lost. Down voice substitute is CW. Up voice substitute is crew alert light.
2 Transmitted signal is not audible in this failure mode.
3 No hot mike intercom available. S BD or VHF AM sidetone may also be used as backup intercom.
3 ONE CREWMAN HAS UNSELECTED HOT MIKE CONDITION
1 Audio center
• MODE - PTT
• Talk without keying
Hear yourself?
NO
YES
2 VOX CIRCUIT FAILURE
3 Discontinue use of VOX mode
4 Audio center
• VHF AM - OFF
• Talk without keying
Hear yourself?
5 VHF A&B COMMON XMTR KEYING CIRCUIT FAILED
6 When VHF ranging
• Audio Center VHF AM - RCV (T/R to speak)
When not VHF ranging
• Audio Center VHF AM - RCV
• VHF AM RCV - A
• VHF AM A - off (ctr) (SIMPLEX to speak)
7 Audio center
• VHF AM - T/R
• S BD - OFF
• Talk without keying
Hear yourself?
8 S BD ENABLING CIRCUIT SHORTED
9 Audio center
• AUDIO CONT - BACKUP
• PWR - OFF
10
• S BD - T/R
• Cycle PTT sw on RHC (left or center only)
• Talk without keying
Hear yourself?
11 INTERMITTENT PTT SW ON ROTATION CONTROL
12 Discontinue use of affected RHC PTT switch
13 Isolate failed components by substitution
Affected crewman's Audio Panel:
• PWR - OFF
• SUIT PWR - OFF
• VHF AM - OFF
• S BD MODE PCM - PCM or ctr
• Replace COMM components individually
• Talk without keying
Hear yourself?
14 FAILURE OF REPLACED COMPONENT
15 AUDIO CENTER OR ROTATION CONTROL PTT SWITCH FAILED
16 Audio center
• AUDIO CONT - BACKUP
• PWR - OFF
• VHF AM - OFF
1 Results in A G transmissions for all equipment selected to T/R.
2 Selecting the alternate audio center is necessary to avoid the HOT MIKE conditions and continuous S BD voice transmissions regardless of the position of the audio center S BD switch.
3 The PTT sw of affected crewman will be inoperative.
4 Procedure removes all power from CCU.
5 The audio center is still usable in the hot mike mode, undesired air-to-ground transmissions can be eliminated by placing the audio center S BD and VHF switches to OFF or RCV.


SYMPTOM
PROCEDURE
REMARKS
4 LOSS OF VHF COMM WITH MSFN
1 Utilize S BD for voice comm
2 VHF status?
NO RCV
3 VHF AM A RECEIVER FAILED
NO XMIT
CONTINUOUS XMTR KEY
4 • Request MSFN to reconfigure for simplex B • VHF AM B · SIMPLEX Xmit OK?
YES
5 VHF AM A XMTR FAILED
NO
6 • VHF ANT · alternate ant (SM LEFT or SM RIGHT) Xmit OK?
YES
7 VHF ANTENNA DEGRADATION OR UNFAVORABLE ORIENTATION
NO
8 VHF ANTENNA SYSTEM DEGRADATION
9 Loss of VHF XMIT capability
NO XMIT, NO RCV
10 • Request MSFN to reconfigure for simplex B • VHF AM A · off (ctr) • VHF AM B · SIMPLEX Xmit, RCV OK?
YES
11 VHF AM A POWER LINE OR ANTENNA FEED FAILED
NO
12 VHF ANTENNA SYSTEM FAILURE
13 Loss of VHF voice capability
14 Audio Center Individually •VHF AM · OFF Key removed?
YES
15 AUDIO CENTER REMOVING KEY HAS UNSELECTED HOT MIKE CONDITION
T/C 3 1
ONE CREWMAN HAS UNSELECTED HOT MIKE CONDITION
NO
16 • Request MSFN to reconfigure for simplex B • VHF AM A off (ctr) • VHF AM B SIMPLEX Key removed?
YES
17 VHF A XMTR KEYING CIRCUIT FAILED
18 Loss of normal VHF AM A simplex capability
NO
19 VHF A&B COMMON XMTR KEYING CIRCUIT FAILED
20 • Audio center VHF AM · RCV • VHF AM (2) · off (ctr) • VHF AM RCV · A NOTE: When VHF transmissions are desired: • Audio center VHF AM · T/R • VHF AM A or B · SIMPLEX, off (ctr) when finished transmitting.
1 Duplex B is available.
2 When operating with MSFN, uplink circuit margin is greater than down-link circuit margin. Antenna system degradation can therefore disable transmission while allowing reception.
3 Simplex operation of VHF AM A may be restored by placing VHF AM A · off (ctr) and VHF AM · T/R. Transmission is accomplished by placing VHF AM A · SIMPLEX then off (ctr) when finished transmitting.
SM-2A-2279


SYMPTOM
PROCEDURE
REMARKS
5
LOSS OF VHF COMM WITH LM
1 Sidetone during VHF transmission?
NO
YES
2 Audio center
• AUDIO CONT - BACKUP
Backup audio center
• VHF - T/R
• MODE - VOX
Comm ok?
YES
NO
5 AUDIO CENTER FAILED
3 Connect to alternate audio center umbilical
• PWR - AUDIO/TONE
• MODE - as desired
• VHF AM - T/R
Sidetone ok?
YES
NO
4 • Return to original audio center. Isolate failed components by substitution (exclude headset and CWG adapter)
Failed audio panel
• PWR - OFF
• SUIT PWR - OFF
• VHF AM - OFF
• AUDIO CONT - NORM
Panel 3
• S BD MODE PCM - PCM or ctr
• Replace comm components individually
8 FAILURE OF REPLACED COMPONENT
6 Alternate VHF antenna
Comm ok?
YES
NO
7 FAILED ANT OR INCORRECT ANT SELECTED
9 Audio center
• MODE - VOX
Comm ok?
YES
NO
10 PTT KEYING CIRCUIT FAILED OPEN
11 Utilize alternate headset
Sidetone ok?
YES
NO
12 HEADSET FAILURE
13 Audio center
• AUDIO CONT - BACKUP
Backup audio center
• PWR - AUDIO
• VHF - T/R
• MODE - VOX
Comm ok?
NO
YES
14 Set up VHF simplex
Audio center
• AUDIO CONT - NORM
• MODE - as desired
• VHF AM A - SIMPLEX
• VHF AM B - SIMPLEX
• VHF AM RCV - off (ctr)
• VHF RNG - OFF
• Initiate call to LM at least once every 3 min if no MSFN AOS
Comm ok?
YES
NO
1
16 CSM OR LM XMTR OR RCVR FAILURE
15 SUIT HARNESS OR CWG ADAPTER FAILURE
17 Utilize spare adapter
18 ORIGINAL AUDIO CENTER VHF DIODE SW FAILURE
19 • Utilize S BD for voice comm when AOS
• Verify LM is reconfigured for A & B SIMPLEX
Comm ok?
YES
NO
2
23 VHF A&B COMMON XMTR KEYING CIRCUIT FAILURE (Continuous xmtr key)
20 VHF XMTR / AUDIO CENTER INTERFACE FAILURE
NO XMIT
21 CSM VHF status?
NO RCV
NO XMIT NO RCV
3
24 CSM OR LM TRIPL DIPL OR RF CABLE FAILURE
22 • VHF AM A - OFF
• VHF AM B - DUPLEX
Comm ok?
YES
NO
25 VHF RCVR AUDIO CENTER INTERFACE FAILURE
1 Coordination between the two spacecraft can narrow the failure to a XMTR/RCVR combination. The specific combination depends upon which equipment was in use (i.e., whether LM data transfer or VHF ranging is in use).
Possible loss of VHF ranging and/or data transfer capability.
2 VHF ranging still available.
3 Loss of all VHF functions.
6
EMS RANGE DISPLAY ABNORMAL
1
1 • VHF RNG - RSET (wait 15 sec)
Display ok?
NO
YES
2 Tones audible during wait period?
YES
NO
3 Utilize CMC for VHF range readouts
• P20 running V87E (wait 1 minute) V6 N2E 3703E
R1 = VHF RANGE XXX.XX NM
CMC range display abnormal?
NO
YES
6 EMS OR EMS VHF INTERFACE FAILURE
4
4 MOMENTARY LOSS OF TRACK
5 VHF comm with LM ok?
NO
YES
5
7 Alternate VHF antenna
Comm ok?
NO
YES
8 • SUIT PWR - OFF
• Depress and hold PTT button
• VHF RNG - RSET (Wait 15 sec)
• SUIT PWR - on (up)
Display ok?
NO
YES
9 DIGITAL RANGING GENERATOR OR LM RANGING TONE TRANSFER ASSEMBLY FAILURE
10 Inform LM of VHF ranging loss. Request LM to perform VHF ranging loss mal1 procedure
11 FAILED ANT OR INCORRECT ANTENNA SELECTED
T/C 5 14
LOSS OF VHF COMM WITH LM
12 LOSS OF AUTOMATIC VHF RNG XMTR KEY FUNCTION
13 VHF RNG available only while PTT button depressed
1 CMC TRACKER 11 should be on if computer is in P20 and V87 has been entered.
2 Tones will be audible for 8 seconds after VHF reset. EMS display of range occurs 12 to 15 sec after reset.
3 If R1 is negative, actual range 327.67 NM minus absolute value of R1. This will occur any time the range exceeds 163.83 NM.
4 Temporary signal loss may be caused by antenna nulls or antenna switching.
5 Turning suit power off precludes audio interference with VHF ranging initialization.


SYMPTOM
PROCEDURE
REMARKS
7 (1) LOSS OF S BD VOICE COMM
(MSFN within VHF range)
1 Utilize VHF for voice comm
S BD ANT ind - >60%?
NO
2 Antenna?
OMNI
T/C 13 1
CANNOT ACQUIRE PHASELOCK WITH OMNIANTENNAS
HGA
T/C 12 1
CANNOT ACQUIRE OR MAINTAIN PHASELOCK WITH HIGH GAIN ANTENNA
YES
(2)
3 • UP TLM CMD - RSET then NORM
S BD status?
NO UP OR DOWN VOICE OR DATA
4 PMP PWR - AUX
Voice & data OK?
NO
5 PMP SHORT COMMON TO BOTH POWER SUPPLIES
YES
(3)
6 NORMAL PMP POWER SUPPLY FAILED
7 Loss of S BD voice and data
NO DOWN VOICE
NO UP VOICE
NO
8 PCM?
YES
9 Updata?
NO
YES
(4)
10 • S BD XPNDR - redundant xpndr
• Allow up to 30 sec for phaselock acquisition
Up voice & up data OK?
YES
11 ORIGINAL TRANSPONDER RECEIVER FAILED
NO
12 FAILURE OF UPLINK SUBCARRIER SIGNAL LINE
13 Loss of S BD up voice and up data capability
14 Down voice backup
• S BD AUX TAPE - DN VOICE BU
• S BD MODE RNG - OFF
• PCM BIT RATE - LO
DN voice OK?
NO
15 PMP VOICE CLIPPER OR AUDIO CENTER S BD OUTPUT FAILED
YES
(5)
18 PMP VOICE RELAY OR VOICE MODULATOR FAILED
19 Loss of S BD down voice capability
16 • S BAND SQUELCH - OFF
Up voice OK?
YES
17 SQUELCH CIRCUIT FAILURE
NO
(6)
20 • UP TLM DATA - UP VOICE BU
Up voice OK?
YES
21 NORMAL UP VOICE DETECTOR FAILED
NO
(7)
24 • S BD MODE VOICE - RELAY
• INTERCOM (3) - T/R
• MODE - VOX (pnl 9 & 10)
CMP Audio Center
• S BD - OFF
• VHF - OFF
• VOX SENS - 6
• AUDIO CONT - BACKUP
Up voice OK?
YES
27 PMP NORMAL VOICE OUTPUT CIRCUIT FAILURE
NO
30 PMP COM MON VOICE OUT PUT CIRCUIT FAILED
31 Loss of S BD up voice
(4)
22 • S BD XPNDR - redundant xpndr
• Allow up to 30 sec for phaselock acquisition
DN voice & PCM OK?
YES
23 ORIGINAL XPNDR TRANSMITTER FAILED
NO
(8)
25 • S BD MODE PCM - ctr
DN voice OK?
YES
26 PMP PM MIXER FAILED
NO
(9)
28 • S BD MODE PCM - PCM
• S BD PWR AMPL PRIM - redundant pwr amp
DN voice & PCM OK?
YES
(10)
29 Backup PCM down link
• S BD AUX TAPE - TAPE
• PMP PWR - AUX
(11)
33 ORIGINAL S BD PWR AMPL FAILED
NO
32 Loss of S BD DN voice and PCM
(1) Loss or near loss of upvoice is indicated by S BD ant ind < 60% (approx), and noise in headset if S BD SQUELCH - OFF. Loss of normal down voice should be anticipated if S BD ant ind 80% (approx).
(2) Notify MSFN of UP TLM reset action.
(3) The capability is lost to transmit recorded PCM.
(4) When S BD XPNDR - redundant xpndr, hesitate momentarily in OFF.
(5) Loss of capability of simultaneous transmission of down voice and HBR PCM.
(6) Notify MSFN to transmit voice on the up data subcarrier. Backup up voice and up data transmission must be time shared. Action will result in 1-2 KHz tone in headset until MSFN configures for up voice backup.
(7) CMP PTT switch will be inoperative. S BD reception will be via intercom bus.
(8) Provides an alternate voice circuit, but no PCM capability.
(9) The power amplifier requires a 90 sec warmup period.
(10) S BD AUX TAPE - TAPE activates the FM transmitter and the alternate power amplifier which requires a 90 sec warmup period. It is crew option to transmit real time PCM, recorded data, or TV via the FM transmitter.
(11) With one of the power amplifiers failed the capability is lost to transmit FM (recorded data or TV) simultaneously with PM transmission of real time PCM and voice.
SM-2A-2281

SYMPTOM

8 LOSS OF S BD VOICE COMM

(MSFN not within VHF range)

PROCEDURE

1 Is LM within line-of-sight?

NO → 2 Broadcast steps as performed; S-BD ANT ind - >60%?

NO → 3 Antenna?

OMNI → T/C 13 1 — CANNOT ACQUIRE PHASELOCK WITH OMNIANTENNAS

HGA → T/C 12 1 — CANNOT ACQUIRE OR MAINTAIN PHASELOCK WITH HIGH GAIN ANTENNA

YES → 4 CSM/MSFN coordination will be through LM

T/C 7 1 — LOSS OF SBD VOICE COMM (MSFN within VHF range)

YES → 5 • S BD SQLCH - OFF; Voice ok?

YES → 6 SQUELCH CIRCUIT FAILURE

NO → 7 Audio center • S BD - T/R • VHF, PAD COMM, INTERCOMM - OFF; Sidetone?

YES → 10 • UP TLM CMD - RESET then NORM; Voice comm?

YES → 11 INADVERTENT RTC RELAY OPERATION

NO → 14 Record on DSE steps and results as performed (LBR & voice) • INTERCOM - T/R • UP TLM DATA - UP VOICE BU (wait up to 1 min for tone); Tone?

YES → 15 Request in blind MCC send crew alert - on, off-on, off (wait 1 min); Response?

YES → 16 FAILED PMP UP VOICE DETECTOR

→ 17 Request MCC configure for up voice backup (requires ≥ 3 min)

NO (DN VOICE PROBLEM) → (3)

18 • UP TLM DATA - DATA • S BD MODE PCM - ctr; Voice OK?

NO → 19 • S BD AUX TAPE - DN VOICE BU • S BD MODE RNG - OFF; Voice OK?

YES → (4) 20 PMP OR XPNDR VOICE CIRCUIT FAILURE

NO → 22 • S BD PWR AMPL HI - redundant pwr ampl (wait 90 sec for warmup); Voice OK?

YES → 23 ORIGINAL PWR AMPL FAILED

NO → (5) 25 • S BD XPNDR - redundant xpndr (wait for > 60% S BD ANT ind); Voice OK?

NO → 26 PMP/AUDIO CENTER INTERFACE FAILURE

YES → 24 ORIGINAL PM XMTR FAILED

(UP VOICE PROBLEM & POSSIBLE DN VOICE PROBLEM)

27 • UP TLM DATA - DATA • S BD MODE PCM - KEY (attempt key); Key side tone?

YES → 28 • S BD MODE PCM - ctr; Voice comm?

YES → 29 PCM +18 VDC POWER SHORT WHEN S BD NORM MODE PCM - PCM

NO → (5) 31 • S BD MODE PCM - PCM • S BD XPNDR - redundant xpndr Wait for S BD ANT ind > 60%; Voice comm?

YES → 32 FAILED SUBCARRIER AMPL IN XPNDR

NO → 34 FAILED UPLINK COAX BETWEEN XPNDR & PMP, DOWNLINK OK

(6) 30 • S BD MODE PCM - KEY

Key continuous dashes for one minute and standby for normal voice response from MSFN

When key not required • S BD MODE PCM - PCM

Delayed downlink voice may be available via FM DSE dumps

(6) 33 (Crew ask questions) ground will reply by morse code. Orient for optimum HGA coverage.

DASH = Approx 10% increase for 10 secs

DOT Approx 10% increase in S BD indicator 5 secs.

Cue ground when ready to copy.

35

REMARKS

(1) Due to numerous variables in lunar distance comm capabilities, this procedure attempts only to restore voice comm. Appropriate reconfiguration to restore maximum capability will be done real time based on nature of failure.

(2) Loss or near loss of up voice is indicated by S BD ANT ind > 60% (approx), and noise in headset if S BD SQUELCH OFF. Loss of normal down voice should be anticipated if S BD ant ind < 80% (approx).

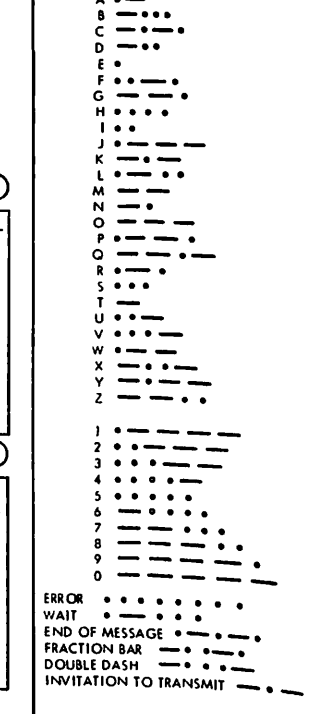
8 THRU 10

(3) If configuration is already in DN VOICE BU, continue troubleshooting. Normal voice may be available on HGA or when MSFN range <130K NM.

(4) Normal down voice via relay and DUPLEX A (conference mode) may still be available.

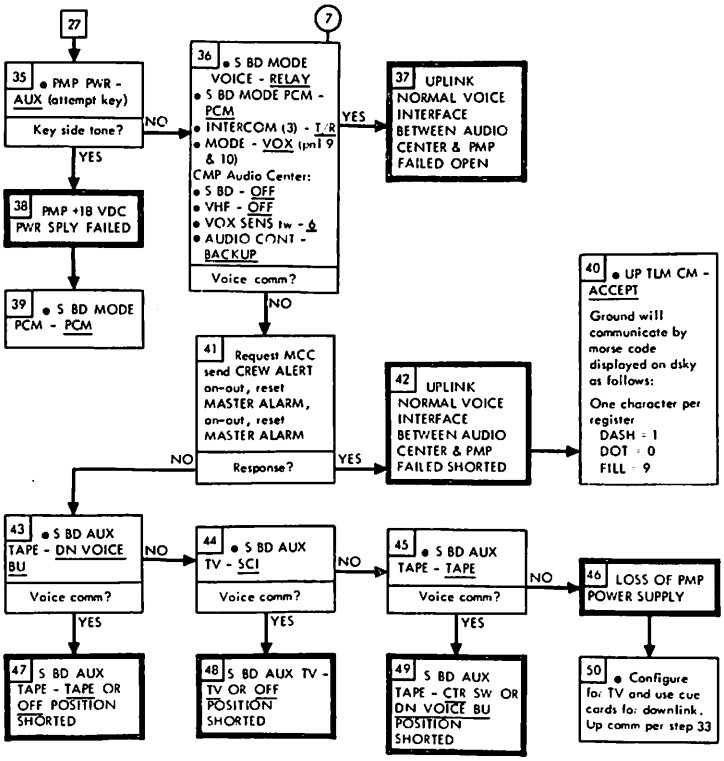
(5) When S BD XPNDR - redundant xpndr, hesitate momentarily in OFF.

(6) INTERNATIONAL MORSE CODE



SYMPTOM	PROCEDURE	REMARKS

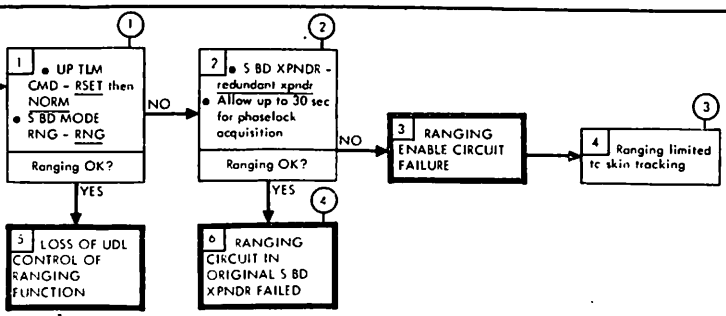
8 (Cont)



7 CMP PTT switch will be inoperative. S BD reception will be via intercom bus.

---

9 MSFN REPORTS LOSS OF RANGING



1 Coordinate with MSFN

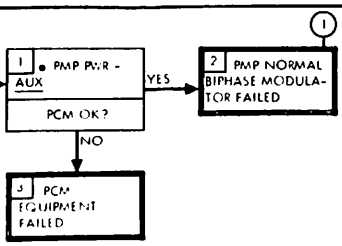
2 When SBD XPNDR-redundant xpndr, hesitate momentarily in OFF.

3 Skin tracking performed by ground radar, no crew action required.

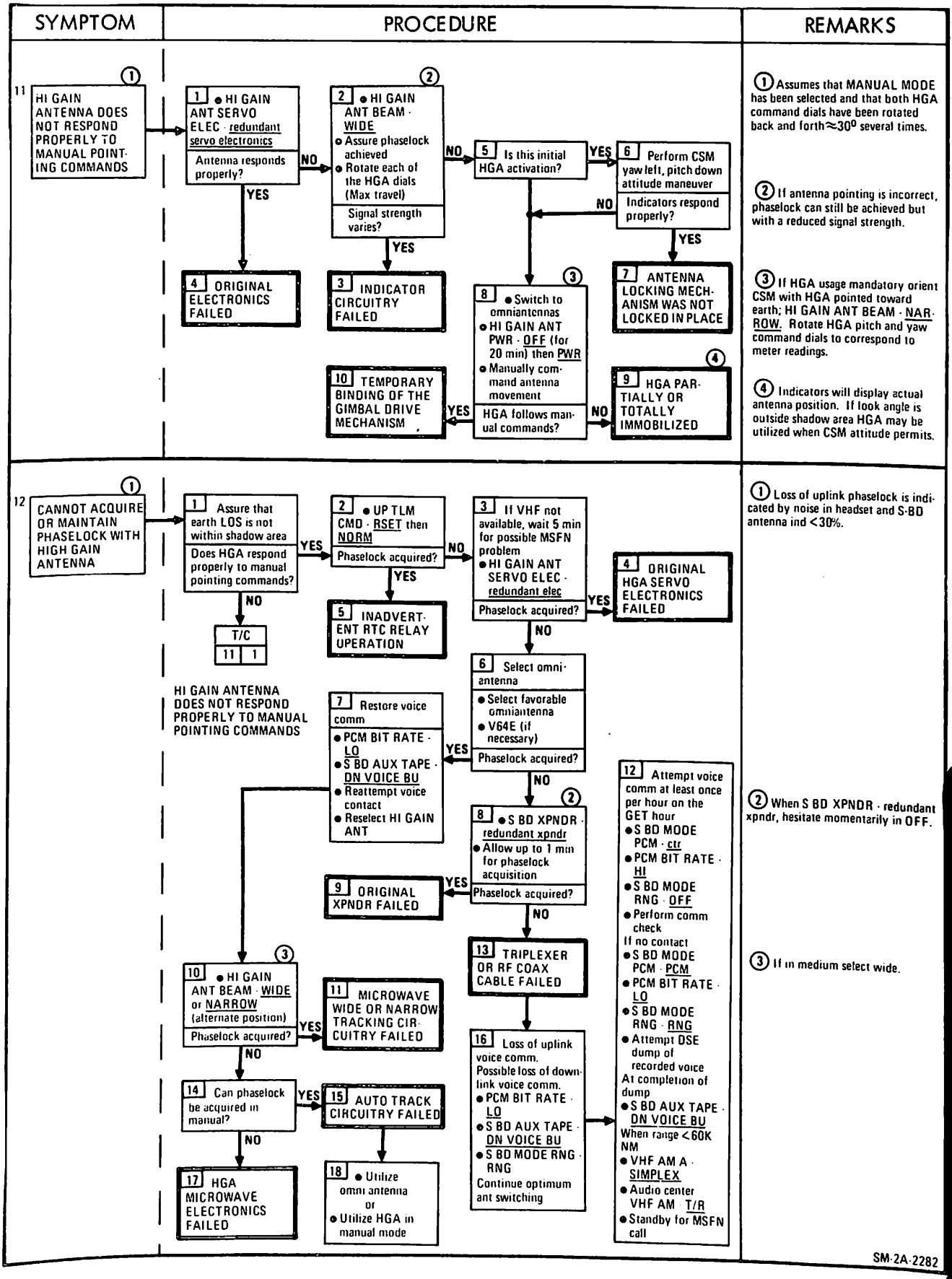
4 Original XPNDR is usable for all functions except ranging.

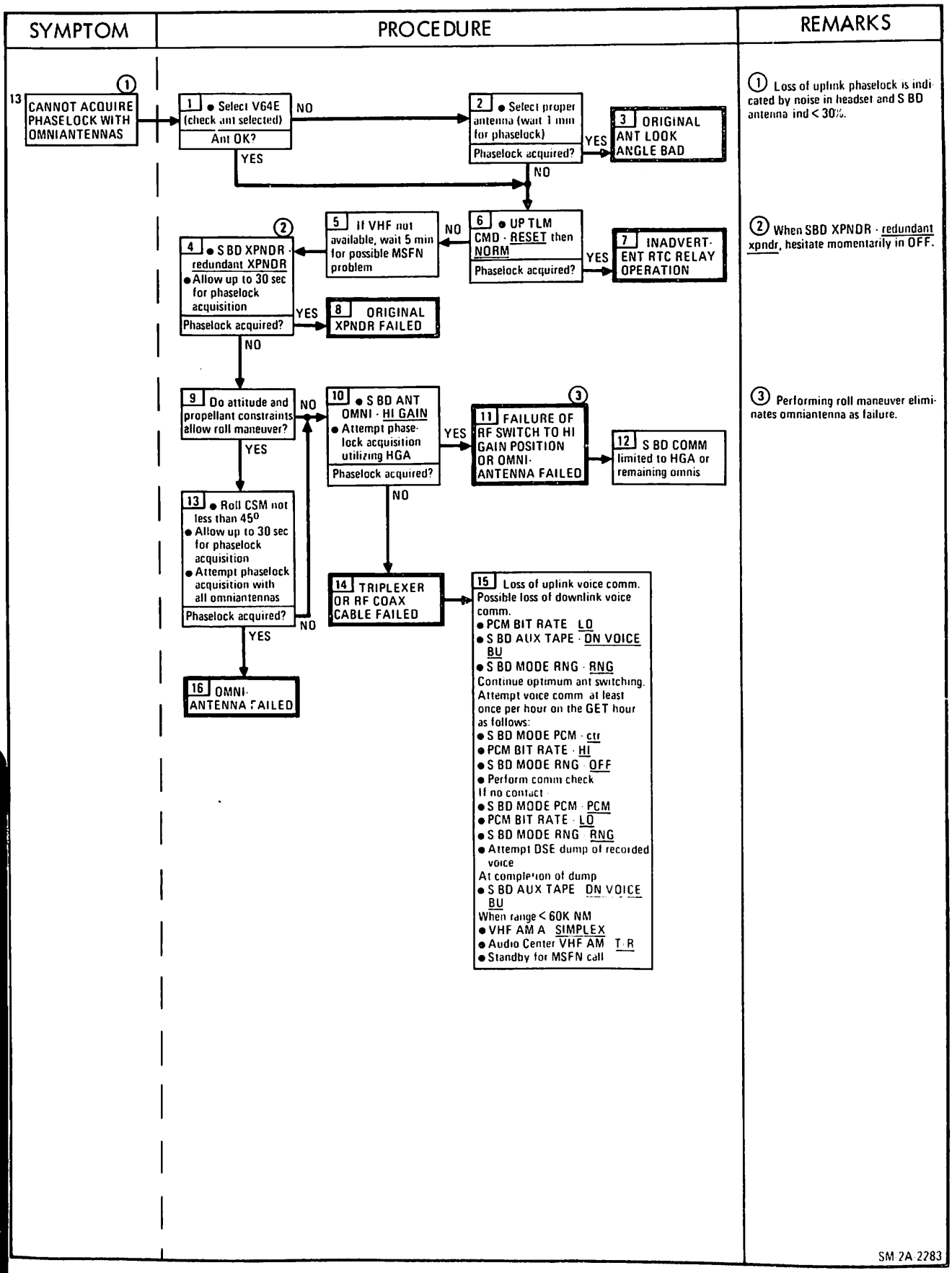
---

10 MSFN REPORTS LOSS OF REAL TIME PCM



1 The capability is lost to transmit recorded PCM simultaneously with real time PCM.


SYMPTOM
PROCEDURE
REMARKS
11
HI GAIN ANTENNA DOES NOT RESPOND PROPERLY TO MANUAL POINTING COMMANDS
1 • HI GAIN ANT SERVO ELEC · redundant servo electronics
Antenna responds properly?
NO
YES
2 • HI GAIN ANT BEAM · WIDE
• Assure phaselock achieved
• Rotate each of the HGA dials (Max travel)
Signal strength varies?
YES
3 INDICATOR CIRCUITRY FAILED
4 ORIGINAL ELECTRONICS FAILED
NO
5 Is this initial HGA activation?
YES
6 Perform CSM yaw left, pitch down attitude maneuver
Indicators respond properly?
NO
YES
7 ANTENNA LOCKING MECHANISM WAS NOT LOCKED IN PLACE
8 • Switch to omniantennas
• HI GAIN ANT PWR · OFF (for 20 min) then PWR
• Manually command antenna movement
HGA follows manual commands?
YES
NO
9 HGA PARTIALLY OR TOTALLY IMMOBILIZED
10 TEMPORARY BINDING OF THE GIMBAL DRIVE MECHANISM
(1) Assumes that MANUAL MODE has been selected and that both HGA command dials have been rotated back and forth ≈30° several times.
(2) If antenna pointing is incorrect, phaselock can still be achieved but with a reduced signal strength.
(3) If HGA usage mandatory orient CSM with HGA pointed toward earth; HI GAIN ANT BEAM · NARROW. Rotate HGA pitch and yaw command dials to correspond to meter readings.
(4) Indicators will display actual antenna position. If look angle is outside shadow area HGA may be utilized when CSM attitude permits.
12
CANNOT ACQUIRE OR MAINTAIN PHASELOCK WITH HIGH GAIN ANTENNA
1 Assure that earth LOS is not within shadow area
Does HGA respond properly to manual pointing commands?
YES
NO
T/C 11 1
2 • UP TLM CMD · RSET then NORM
Phaselock acquired?
YES
NO
5 INADVERTENT RTC RELAY UPERATION
3 If VHF not available, wait 5 min for possible MSFN problem
• HI GAIN ANT SERVO ELEC · redundant elec
Phaselock acquired?
YES
4 ORIGINAL HGA SERVO ELECTRONICS FAILED
NO
6 Select omni antenna
• Select favorable omniantenna
• V64E (if necessary)
Phaselock acquired?
YES
NO
HI GAIN ANTENNA DOES NOT RESPOND PROPERLY TO MANUAL POINTING COMMANDS
7 Restore voice comm
• PCM BIT RATE · LO
• S BD AUX TAPE · DN VOICE BU
• Reattempt voice contact
• Reselect HI GAIN ANT
8 • S BD XPNDR · redundant xpndr
• Allow up to 1 min for phaselock acquisition
Phaselock acquired?
YES
9 ORIGINAL XPNDR FAILED
NO
13 TRIPLEXER OR RF COAX CABLE FAILED
10 • HI GAIN ANT BEAM · WIDE or NARROW (alternate position)
Phaselock acquired?
YES
11 MICROWAVE WIDE OR NARROW TRACKING CIRCUITRY FAILED
NO
14 Can phaselock be acquired in manual?
YES
15 AUTO TRACK CIRCUITRY FAILED
NO
17 HGA MICROWAVE ELECTRONICS FAILED
18 • Utilize omni antenna or • Utilize HGA in manual mode
16 Loss of uplink voice comm. Possible loss of downlink voice comm.
• PCM BIT RATE · LO
• S BD AUX TAPE · DN VOICE BU
• S BD MODE RNG · RNG
Continue optimum ant switching
12 Attempt voice comm at least once per hour on the GET hour
• S BD MODE PCM · ctr
• PCM BIT RATE · HI
• S BD MODE RNG · OFF
• Perform comm check
If no contact
• S BD MODE PCM · PCM
• PCM BIT RATE · LO
• S BD MODE RNG · RNG
• Attempt DSE dump of recorded voice
At completion of dump
• S BD AUX TAPE · DN VOICE BU
When range < 60K NM
• VHF AM A · SIMPLEX
• Audio center VHF AM · T/R
• Standby for MSFN call
(1) Loss of uplink phaselock is indicated by noise in headset and S-BD antenna ind < 30%.
(2) When S BD XPNDR · redundant xpndr, hesitate momentarily in OFF.
(3) If in medium select wide.
11 THRU 13
SM-2A-2282


SYMPTOM
PROCEDURE
REMARKS
13 CANNOT ACQUIRE PHASELOCK WITH OMNIANTENNAS
1 • Select V64E (check ant selected)
Ant OK?
NO
YES
2 • Select proper antenna (wait 1 min for phaselock)
Phaselock acquired?
YES
3 ORIGINAL ANT LOOK ANGLE BAD
NO
6 • UP TLM CMD - RESET then NORM
Phaselock acquired?
NO
YES
7 INADVERTENT RTC RELAY OPERATION
5 If VHF not available, wait 5 min for possible MSFN problem
4 • S BD XPNDR - redundant XPNDR
• Allow up to 30 sec for phaselock acquisition
Phaselock acquired?
YES
8 ORIGINAL XPNDR FAILED
NO
9 Do attitude and propellant constraints allow roll maneuver?
NO
YES
10 • S BD ANT OMNI - HI GAIN
• Attempt phaselock acquisition utilizing HGA
Phaselock acquired?
YES
11 FAILURE OF RF SWITCH TO HI GAIN POSITION OR OMNI-ANTENNA FAILED
12 S BD COMM limited to HGA or remaining omnis
NO
13 • Roll CSM not less than 45°
• Allow up to 30 sec for phaselock acquisition
• Attempt phaselock acquisition with all omniantennas
Phaselock acquired?
NO
YES
14 TRIPLEXER OR RF COAX CABLE FAILED
15 Loss of uplink voice comm.
Possible loss of downlink voice comm.
• PCM BIT RATE LO
• S BD AUX TAPE - ON VOICE BU
• S BD MODE RNG - RNG
Continue optimum ant switching.
Attempt voice comm at least once per hour on the GET hour as follows:
• S BD MODE PCM - ctr
• PCM BIT RATE - HI
• S BD MODE RNG - OFF
• Perform comm check
If no contact
• S BD MODE PCM - PCM
• PCM BIT RATE - LO
• S BD MODE RNG - RNG
• Attempt DSE dump of recorded voice
At completion of dump
• S BD AUX TAPE ON VOICE BU
When range < 60K NM
• VHF AM A SIMPLEX
• Audio Center VHF AM T-R
• Standby for MSFN call
16 OMNI-ANTENNA FAILED
1 Loss of uplink phaselock is indicated by noise in headset and S BD antenna ind < 30%.
2 When SBD XPNDR - redundant xpndr, hesitate momentarily in OFF.
3 Performing roll maneuver eliminates omniantenna as failure.

THIS PAGE
INTENTIONALLY
LEFT BLANK

ECS MALFUNCTION INDEX

O_2 FLOW HI

1a O_2 FLOW HIGH
2 O_2 FLOW LOW
3 SURGE TANK PRESS HIGH
4 CABIN PRESS HIGH OR INCREASING
5 SURGE TANK PRESS LOW
6 CABIN PRESS LOW OR DECREASING
7 CREW UNCOMFORTABLE IN CABIN
7a CABIN HUMIDITY HIGH
8 CLINGING SUIT

9 SUIT COMPRESSOR

9a SUIT COMPR Δ P LOW
10 BALLOONED PGA
11 CREW UNCOMFORTABLE IN SUIT LOOP
11a SUIT CKT HUMIDITY HIGH

12 CO_2 PP HI

12a CO_2 PART PRESS HIGH
12b CO_2 PRESS LOW
13 CO_2 FILTER SEIZURE WITHIN CANISTER

14 GLYCOL TEMP LOW

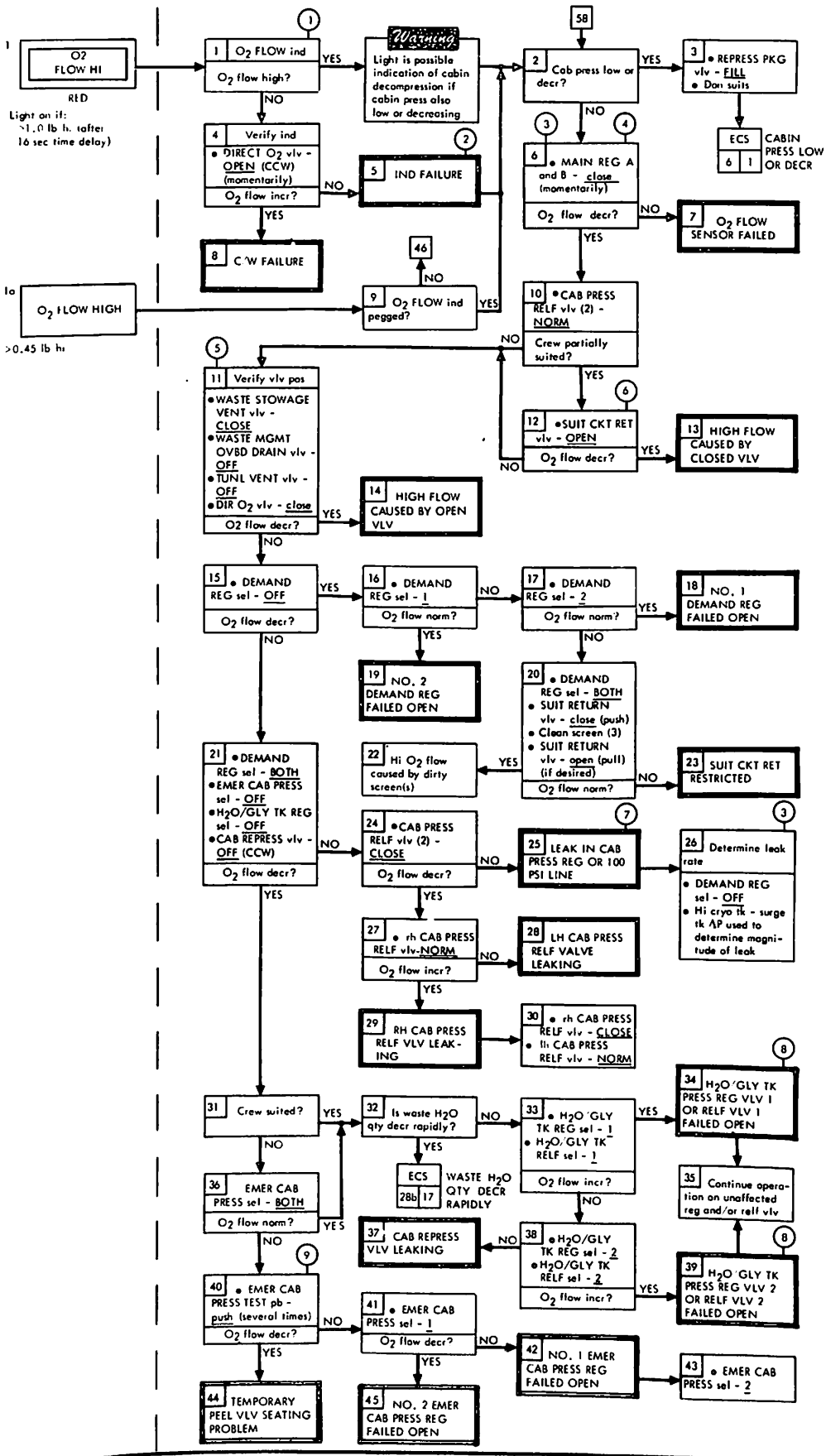
14a PRIM ECS RAD OUT TEMP LOW
15 PRIM ECS RAD OUT TEMP HIGH
16 PRIM GLY EVAP OUT TEMP HIGH
16a PRIM STEAM PRESS LOW
17 PRIM GLY EVAP OUT TEMP LOW
18 PRIM GLY ACCUM QTY HIGH
18a PRIM GLY DISCH PRESS HIGH
19 PRIM GLY ACCUM QTY LOW OR DECREASING
20 PRIM GLY DISCH PRESS LOW
21 SEC GLY EVAP OUT TEMP HIGH
21a SEC STEAM PRESS LOW
22 SEC GLY EVAP OUT TEMP LOW
23 SEC ECS RAD OUT TEMP HIGH
24 SEC ECS RAD OUT TEMP LOW
25 SEC GLY ACCUM QTY HIGH
26 SEC GLY ACCUM QTY DECREASING
27 SEC GLY DISCH PRESS LOW
28 H_2O DUMPING OVERBOARD
28a POTABLE H_2O QUANTITY DECREASING RAPIDLY
28b WASTE H_2O QUANTITY DECREASING RAPIDLY
29 FOOD PREP WATER TEMP LOW
30 ENTRAPPED GAS IN POTABLE H_2O
31 URINE OVERBOARD DUMP NOT DRAINING
31a WASTE H_2O OVERBOARD DUMP NOT DRAINING
32 INADEQUATE VENTILATION AFTER LANDING
33 WATER INFLOW AFTER LANDING
SSR-1 SECONDARY LOOP ACTIVATION
SSR-2 FROZEN STEAM DUCT

SYMPTOM

1 O2 FLOW HI
RED
Light on if:
>1.0 lb hr after 16 sec time delay)

1a O_2 FLOW HIGH
>0.45 lb hr

PROCEDURE



REMARKS

(1) Normal range 0.25 to 0.45 lb/hr.

(2) Continue with O_2 Flow Hi procedure and use C/W lt and surge tank bleed down as indication of O_2 flow.

(3) A surge tank - Cryo tank ΔP of 50 psi will verify a high O_2 flow.
Typical HI CRYO TK-SURGE TK ΔP:
50 PSI ≈ 1.0 lb/hr
100 PSI ≈ 2.5 lb/hr
150 PSI ≈ 3.5 lb hr
400 PSI ≈ 5.5 lb hr

(4) Placing the MAIN REG A & B - closed and noting a decrease in O_2 flow will validate the sensor indication.

(5) This action verifies that inadvertently opened valve has not caused increased O_2 flow. However, high O_2 flow normal during cabin gas changeover.

(6) Assumes partially suited mode is:
• SUIT CKT RET vlv - open
• DEMAND REG vlv - BOTH

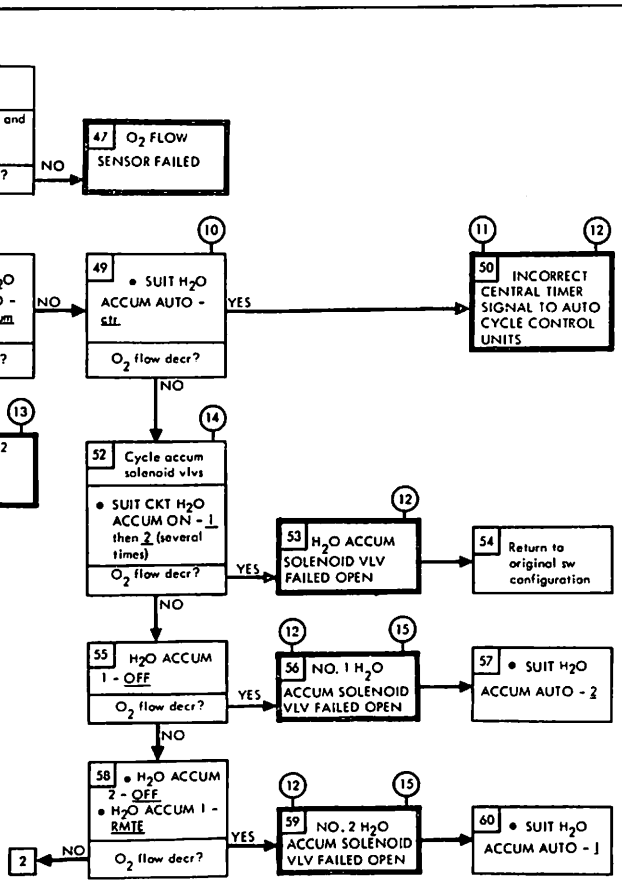
(7) If leak is not isolated and O_2 flow remains high, mission time may be extended by shutting off the main O_2 regulators, re-opening them when necessary to maintain cabin pressure and for actuation of the cyclic accumulators. Placing the WASTE STOWAGE VENT valve to VENT may prevent the cabin relief valve from actuating.

(8) MSFN can distinguish between these two failures by reporting tank bladder pressure.

(9) PRESS-TO-TEST operation may reseal leaky peel valve.

SYMPTOM	PROCEDURE	REMARKS

1(Cont)



(10) Removes power from H_2O accumulator.

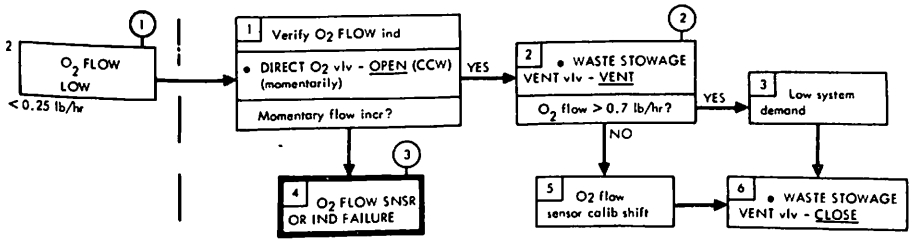
(11) H_2O accumulator can be manually operated.

(12) Max O_2 bleed into suit loop will be 0.55 lb/hr (from which metabolic use and cabin leakage will be taken).

(13) This failure does not necessarily preclude manual operation of the affected H_2O accumulator.

(14) Cycling operation may free sticking valve.

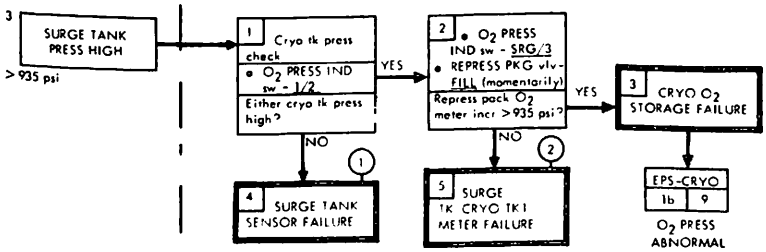
(15) Loss of electrical cyclic control of affected H_2O accumulator. Periodic manual valve operation the only means of actuating H_2O accumulator.



(1) Normal range 0.25 - 0.45 lb/hr.

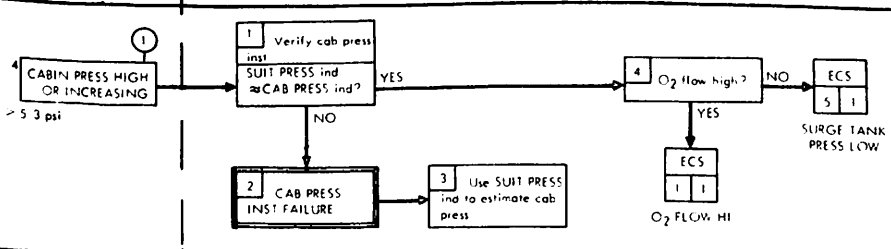
(2) May take up to 45 minutes max.

(3) MSFN can distinguish between these two failures.



(1) Use highest cryo tank indication to estimate surge tank pressure

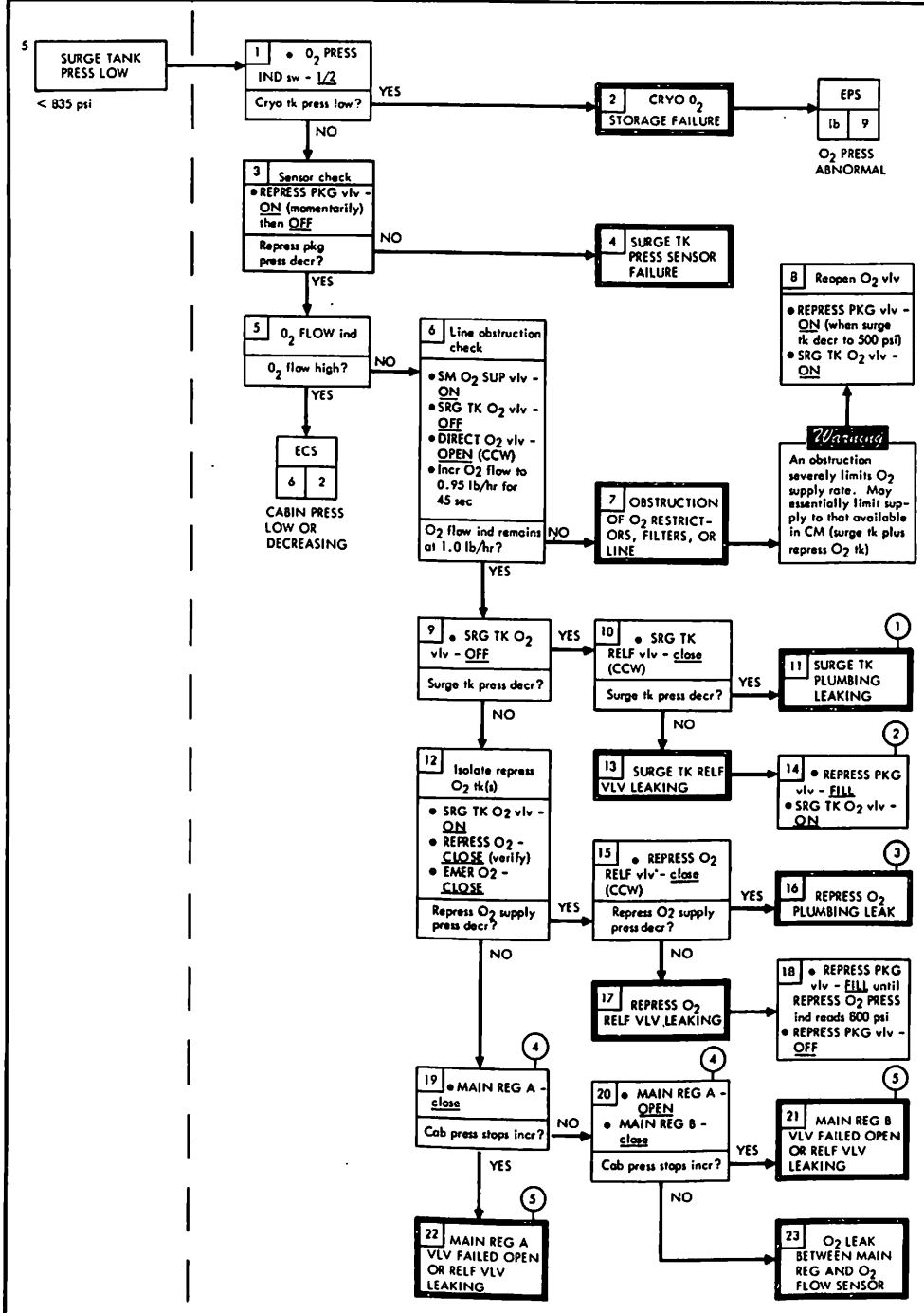
(2) Surge tank pressure may be determined by momentarily positioning REPRESS PKG vlv - FILL and read repress pack press meter after stabilization



(1) Cabin pressure > 5.3 psi is normal after insertion. Normal range is 4.7 to 5.3 psi.

SM-2A-1504S

SYMPTOM	PROCEDURE	REMARKS



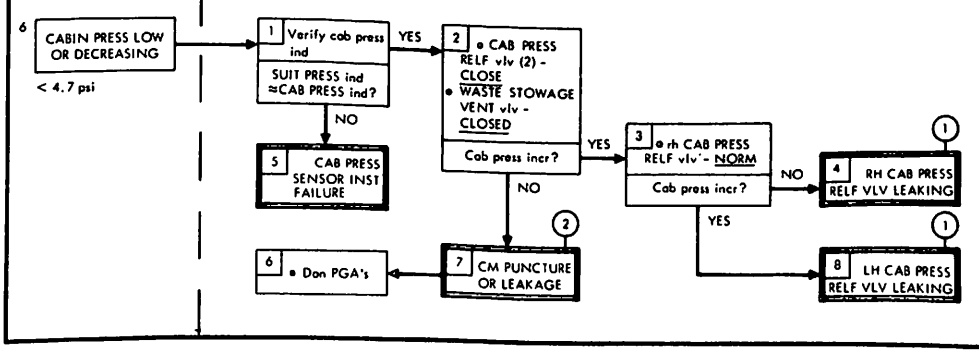
(1) REPRESS PKG vlv - FILL; repress O_2 supply to perform surge tank function.

(2) Use REPRESS O_2 RELF vlv for surge tank pressure relief.

(3) If subsequent O_2 mask use is necessary, position REPRESS PKG vlv to FILL. Excessive O_2 consumption results.

(4) This step may require considerable time.

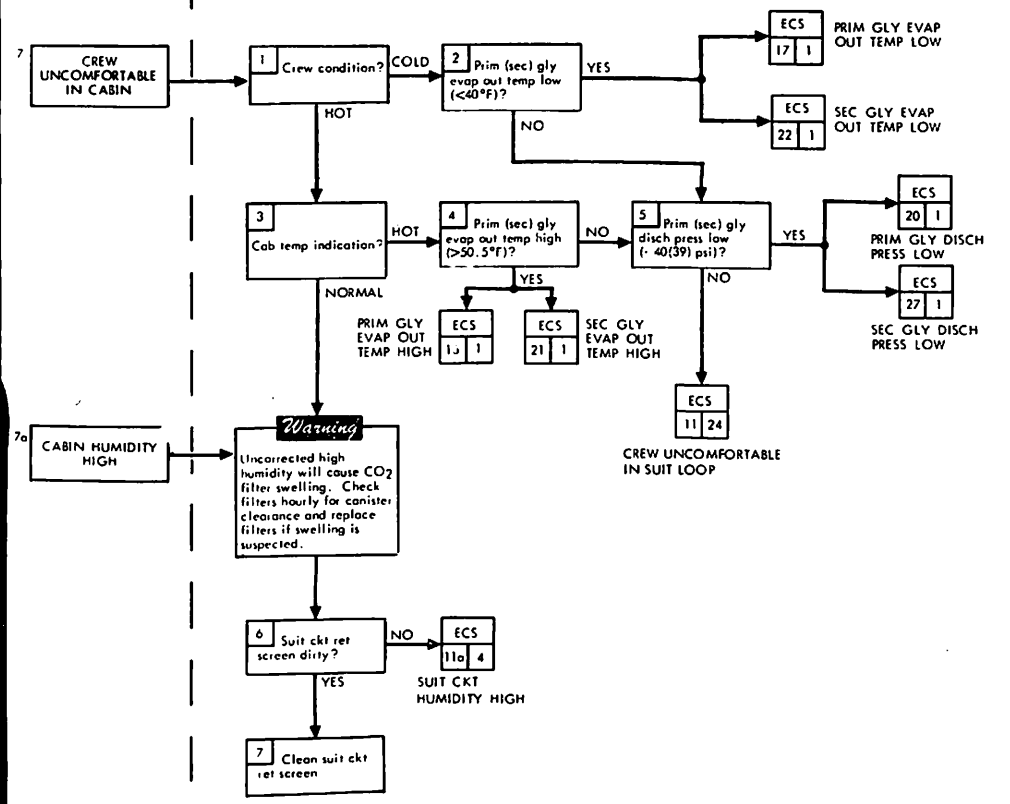
(5) MSFN can distinguish between these two failures by reporting O_2 system pressure.

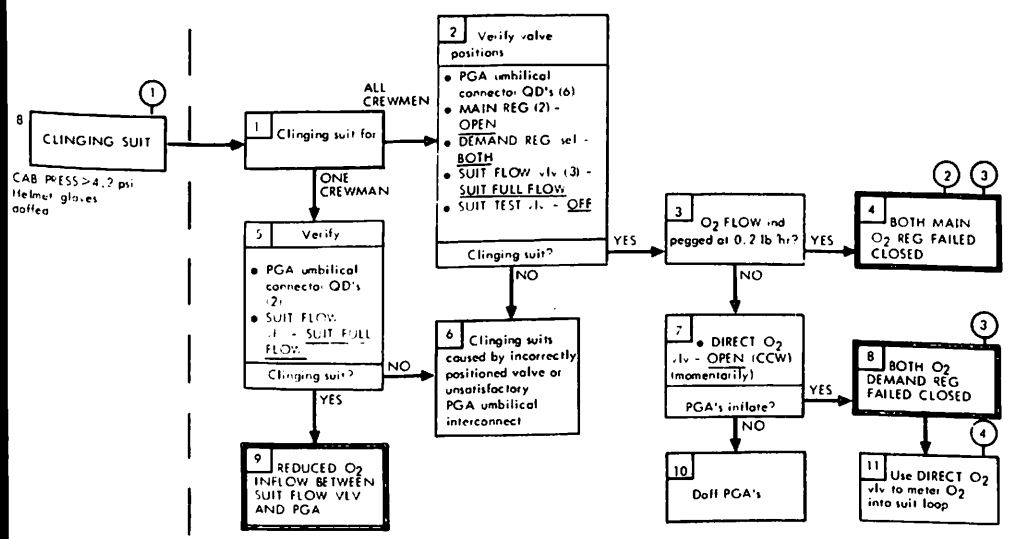


(1) Maintain close position on leaking valve. Cabin pressure relief valve redundancy lost.

(2) Maintain fully suited mode. Excessive O_2 consumption if cabin pressure is maintained. The suit circuit should be purged to eliminate accumulated H_2 as follows:
a. Periodic purge (every 6 hours) - DIRECT O_2 vlv - OPEN (fully) for one minute then closed.
b. After use of water gun for drinking, provided O_2 supply permits DIRECT O_2 vlv - OPEN (fully) for 8 seconds then closed.

SYMPTOM	PROCEDURE	REMARKS





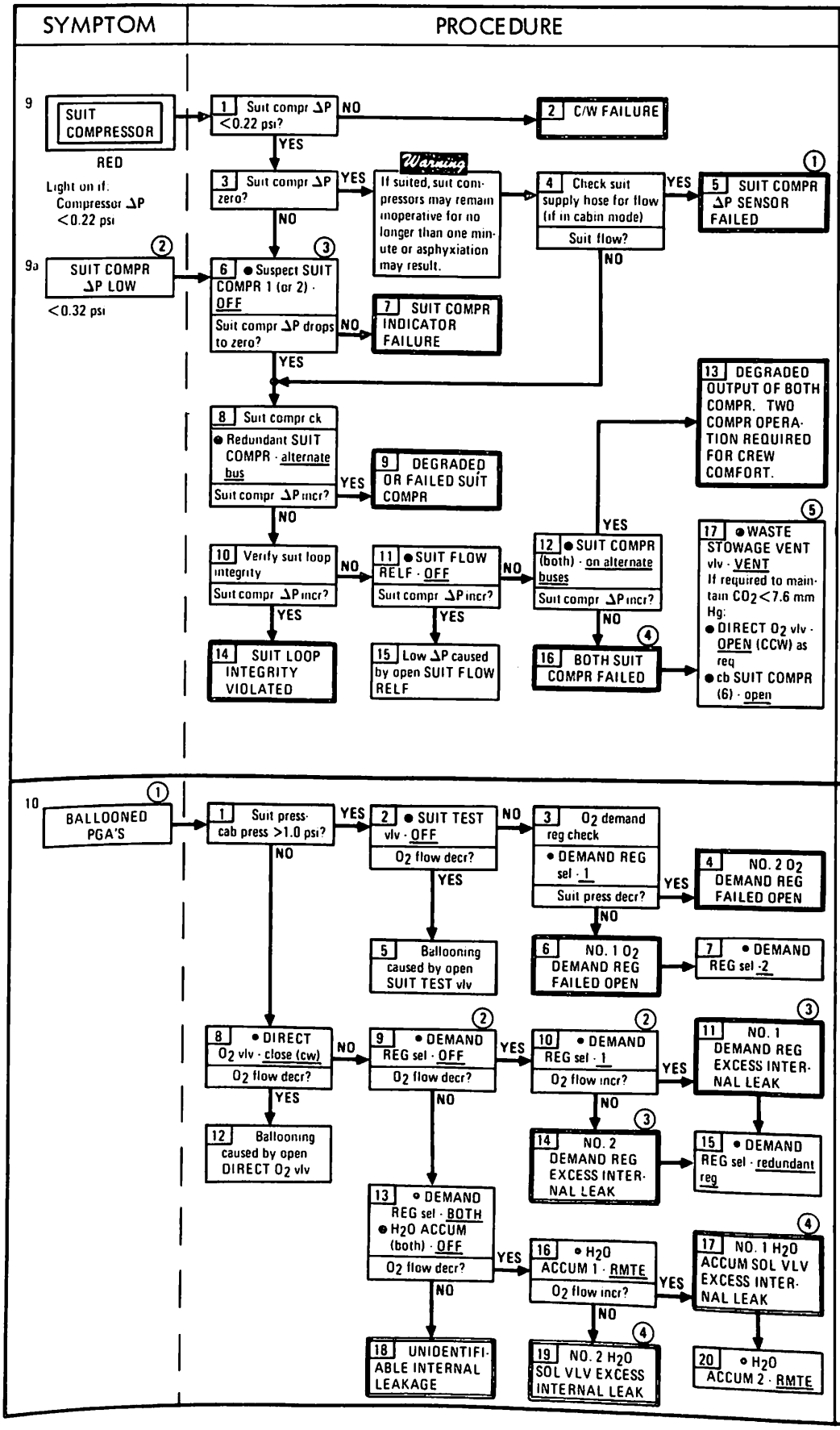
(1) Valid only for non-reversed hose configuration.

(2) MSFN can verify loss of 100 psi circuit. Open close REPRESS vlv to maintain ≥ 5 psia cabin press.

(3) Doff PGA's closed suit operations are lost.

(4) Metabolic requirement per crewman is approximately 0.1 lb/hr.

SM-2A-1506J



① Subsequent compressor operation verified by monitoring supply hose flow and humidity level.

② Unsuited compressor ΔP of approximately 0.275 psid is normal with SUIT FLOW valve in SUIT FULL FLOW position.

③ Pressure rise across suit compressor is 0.36 psi in cabin mode (5.0 psi) and 0.26 psi at emergency suit pressure (3.75 psi). Suit compr ΔP of 0.1 psi will adequately scrub cabin air for unsuited operation.

④ Humidity and CO_2 control lost. Inadequate suit ventilation obtained by opening DIRECT O_2 vlv. PGAs will balloon up to 0.32 psi above cabin if in suited mode. Use emergency O_2 masks if in cabin mode since CO_2 indicator inoperative. Some consideration may be given to taping a CO_2 absorber element to the cabin fan inlet.

Metabolic Load BTU/HR/Man	O_2 Flow - 3 men masked LB/HR at 5 psia cab press
1500	6.6
750	3.4
500	2.2
400	1.6

⑤ With CO_2 level at 0.1 mm Hg at time of suit compr failure, CO_2 will remain <7.6 mm Hg for times shown at following WASTE STOWAGE VENT vlv positions.

VLV Position	Minutes
CLOSE	74
VENT	77
VENT plus side hatch dump venting	80

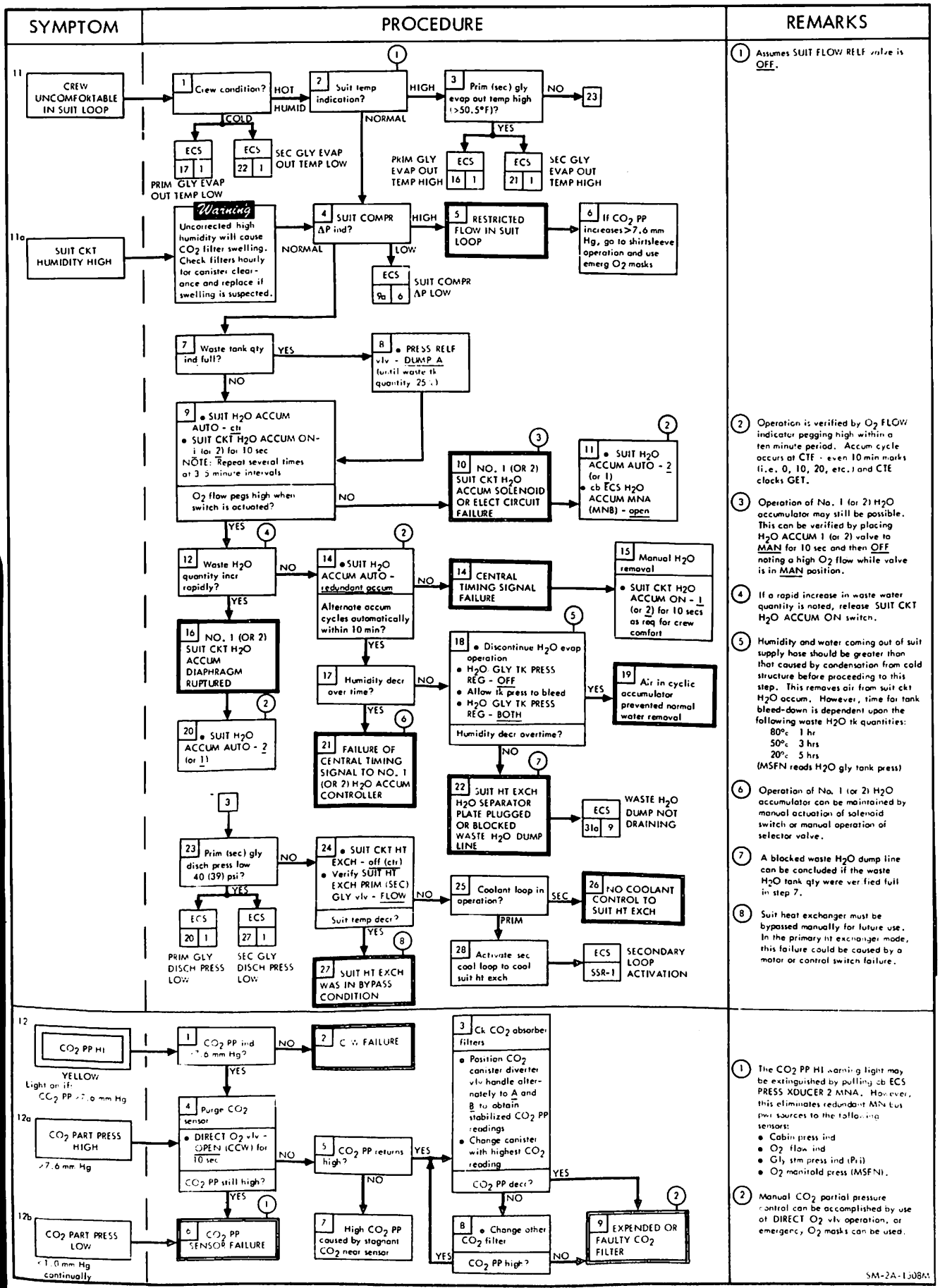
① Slightly ballooned can be verified by the suit-to-cabin ΔP indicator >zero. Cabin to suit ΔP maintained at 2.5 to 3.5 in H_2O.

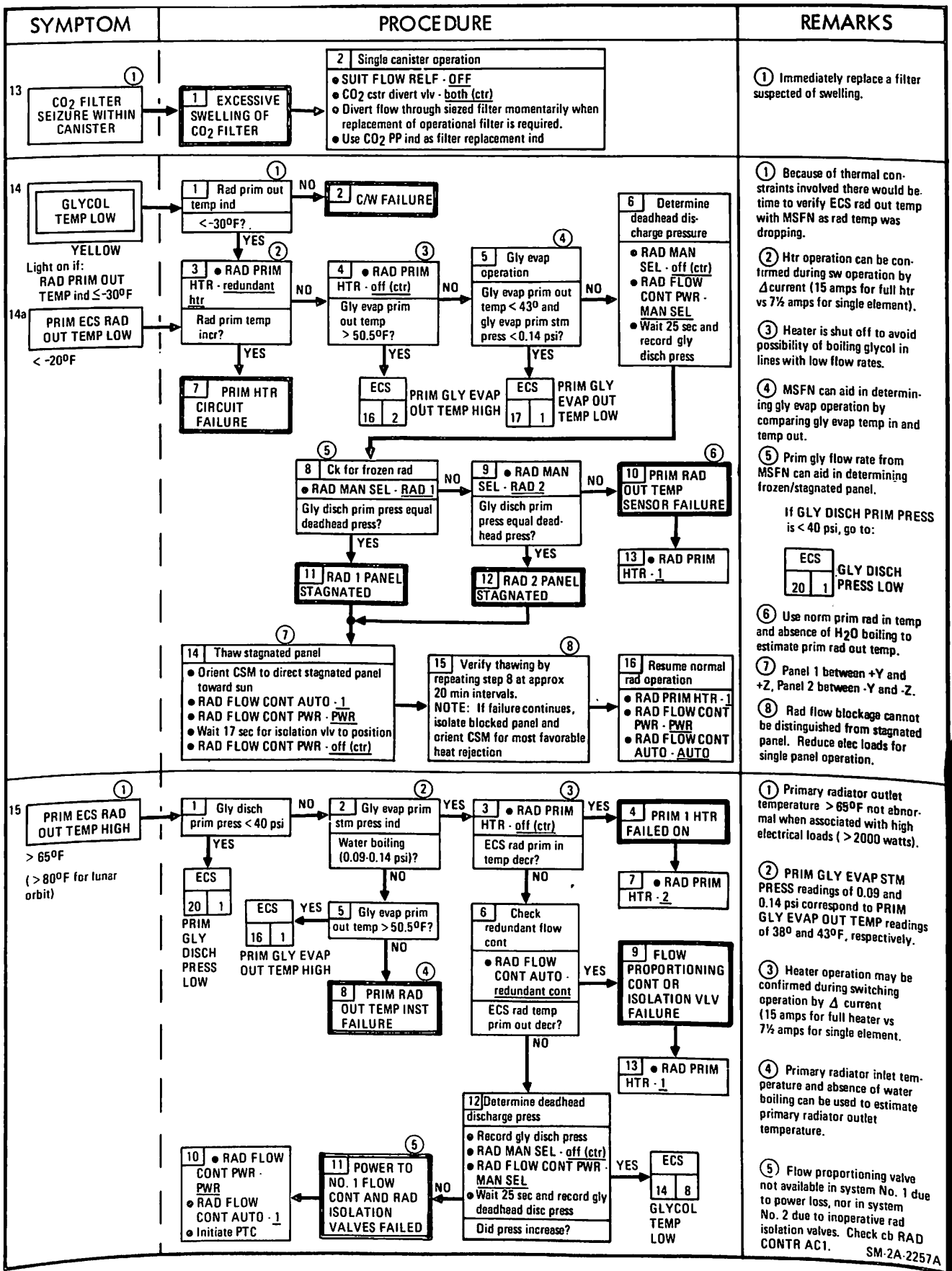
② Recycling valve serveral times may correct excessive O_2 flow.

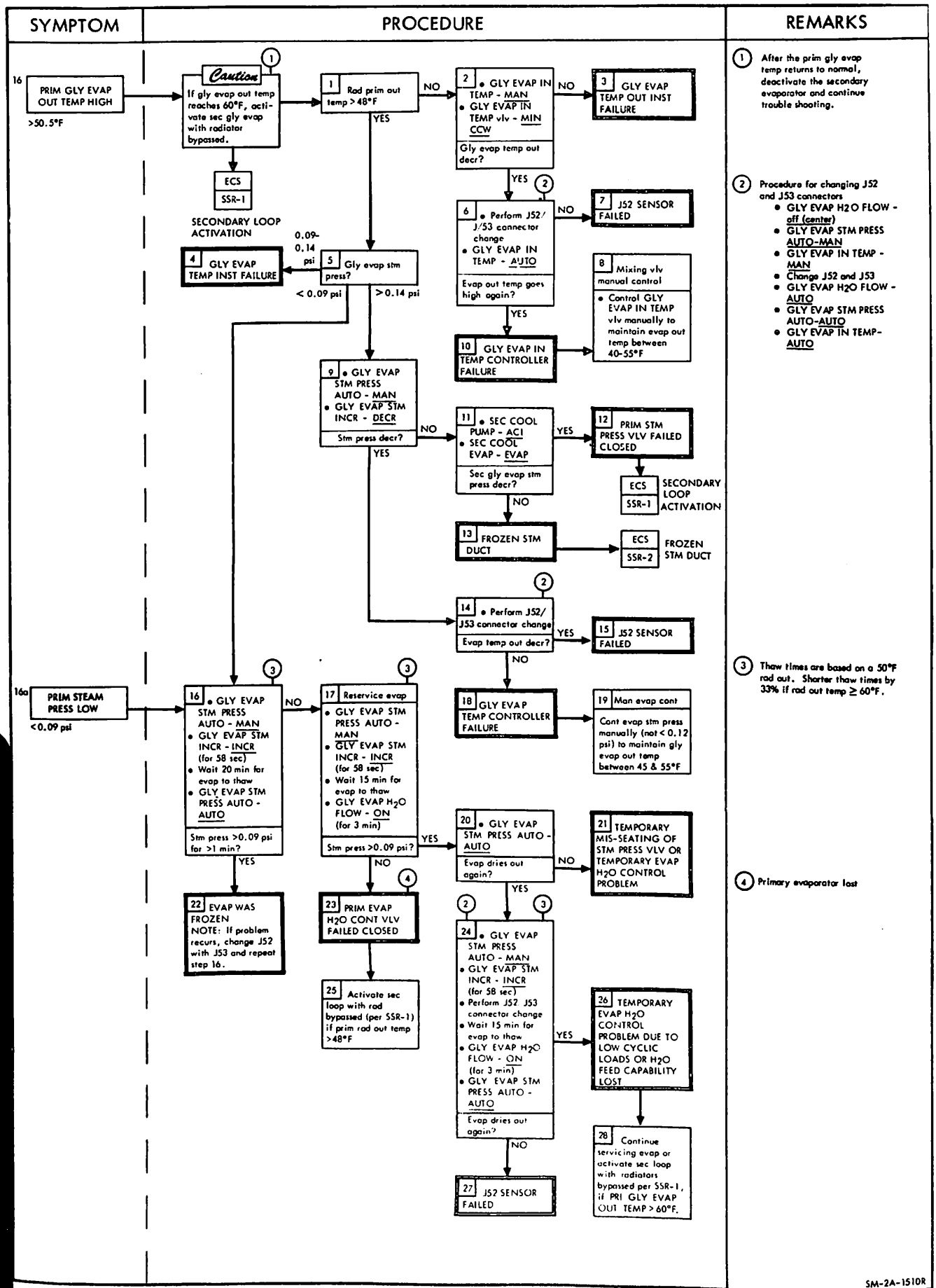
③ Leaking O_2 demand regulator is still operational and may be used for depressurized cabin mode.

④ H_2O accumulators may be used manually for H_2O removal with excessive O_2 usage.

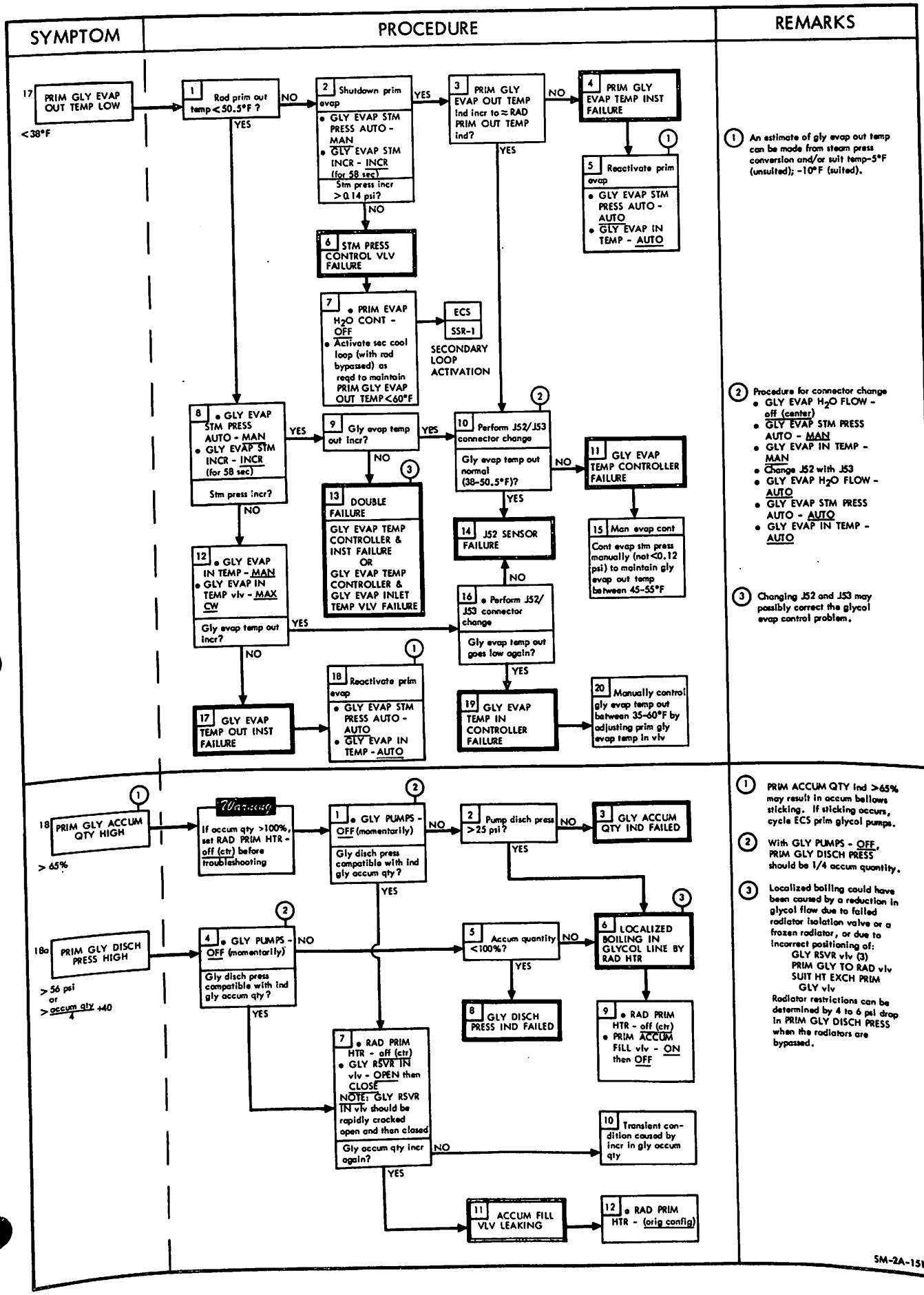
9 THRU 12b


SYMPTOM
PROCEDURE
REMARKS
11 CREW UNCOMFORTABLE IN SUIT LOOP
1 Crew condition?
HOT HUMID
COLD
2 Suit temp indication?
HIGH
NORMAL
3 Prim (sec) gly evap out temp high (>50.5°F)?
NO
23
YES
ECS 17 1 PRIM GLY EVAP OUT TEMP LOW
ECS 22 1 SEC GLY EVAP OUT TEMP LOW
PRIM GLY EVAP OUT TEMP HIGH
ECS 16 1
ECS 21 1 SEC GLY EVAP OUT TEMP HIGH
11a SUIT CKT HUMIDITY HIGH
Warning
Uncorrected high humidity will cause CO_2 filter swelling. Check filters hourly for canister clearance and replace if swelling is suspected.
4 SUIT COMPR ΔP ind?
HIGH
NORMAL
LOW
5 RESTRICTED FLOW IN SUIT LOOP
6 If CO_2 PP increases >7.6 mm Hg, go to shirtsleeve operation and use emerg O_2 masks
ECS 9a 6 SUIT COMPR ΔP LOW
7 Waste tank qty ind full?
YES
8 • PRESS RELF vlv - DUMP A (until waste tk quantity 25%)
NO
9 • SUIT H_2O ACCUM AUTO - ctr
• SUIT CKT H_2O ACCUM ON - 1 (or 2) for 10 sec
NOTE: Repeat several times at 3-5 minute intervals
O_2 flow pegs high when switch is actuated?
NO
3
10 NO. 1 (OR 2) SUIT CKT H_2O ACCUM SOLENOID OR ELECT CIRCUIT FAILURE
2
11 • SUIT H_2O ACCUM AUTO - 2 (or 1)
• cb ECS H_2O ACCUM MNA (MNB) - open
YES
4
12 Waste H_2O quantity incr rapidly?
NO
2
14 • SUIT H_2O ACCUM AUTO - redundant accum
Alternate accum cycles automatically within 10 min?
NO
14 CENTRAL TIMING SIGNAL FAILURE
15 Manual H_2O removal
• SUIT CKT H_2O ACCUM ON - 1 (or 2) for 10 secs as req for crew comfort
YES
16 NO. 1 (OR 2) SUIT CKT H_2O ACCUM DIAPHRAGM RUPTURED
5
18 • Discontinue H_2O evap operation
• H_2O GLY TK PRESS REG - OFF
• Allow tk press to bleed
• H_2O GLY TK PRESS REG - BOTH
Humidity decr overtime?
17 Humidity decr over time?
NO
YES
19 Air in cyclic accumulator prevented normal water removal
YES
2
20 • SUIT H_2O ACCUM AUTO - 2 (or 1)
6
21 FAILURE OF CENTRAL TIMING SIGNAL TO NO. 1 (OR 2) H_2O ACCUM CONTROLLER
NO
7
22 SUIT HT EXCH H_2O SEPARATOR PLATE PLUGGED OR BLOCKED WASTE H_2O DUMP LINE
ECS 31a 9 WASTE H_2O DUMP NOT DRAINING
3
23 Prim (sec) gly disch press low 40 (39) psi?
NO
24 • SUIT CKT HT EXCH - off (ctr)
• Verify SUIT HT EXCH PRIM (SEC) GLY vlv - FLOW
Suit temp decr?
NO
25 Coolant loop in operation?
SEC
26 NO COOLANT CONTROL TO SUIT HT EXCH
PRIM
YES
ECS 20 1 PRIM GLY DISCH PRESS LOW
ECS 27 1 SEC GLY DISCH PRESS LOW
YES
8
27 SUIT HT EXCH WAS IN BYPASS CONDITION
28 Activate sec cool loop to cool suit ht exch
ECS SSR-1 SECONDARY LOOP ACTIVATION
12 CO_2 PP HI
YELLOW
Light on if: CO_2 PP >7.6 mm Hg
1 CO_2 PP ind >7.6 mm Hg?
NO
2 C/W FAILURE
YES
12a CO_2 PART PRESS HIGH
>7.6 mm Hg
4 Purge CO_2 sensor
• DIRECT O_2 vlv - OPEN (CCW) for 10 sec
CO_2 PP still high?
NO
5 CO_2 PP returns high?
YES
NO
YES
1
6 CO_2 PP SENSOR FAILURE
12b CO_2 PART PRESS LOW
<1.0 mm Hg continually
7 High CO_2 PP caused by stagnant CO_2 near sensor
3 Ck CO_2 absorber filters
• Position CO_2 canister diverter vlv handle alternately to A and B to obtain stabilized CO_2 PP readings
• Change canister with highest CO_2 reading
CO_2 PP decr?
YES
NO
8 • Change other CO_2 filter
CO_2 PP high?
YES
NO
2
9 EXPENDED OR FAULTY CO_2 FILTER
1 Assumes SUIT FLOW RELF valve is OFF.
2 Operation is verified by O_2 FLOW indicator pegging high within a ten minute period. Accum cycle occurs at CTE - even 10 min marks (i.e. 0, 10, 20, etc.) and CTE clocks GET.
3 Operation of No. 1 (or 2) H_2O accumulator may still be possible. This can be verified by placing H_2O ACCUM 1 (or 2) valve to MAN for 10 sec and then OFF noting a high O_2 flow while valve is in MAN position.
4 If a rapid increase in waste water quantity is noted, release SUIT CKT H_2O ACCUM ON switch.
5 Humidity and water coming out of suit supply hose should be greater than that caused by condensation from cold structure before proceeding to this step. This removes air from suit ckt H_2O accum. However, time for tank bleed-down is dependent upon the following waste H_2O tk quantities:
80% 1 hr
50% 3 hrs
20% 5 hrs
(MSFN reads H_2O gly tank press)
6 Operation of No. 1 (or 2) H_2O accumulator can be maintained by manual actuation of solenoid switch or manual operation of selector valve.
7 A blocked waste H_2O dump line can be concluded if the waste H_2O tank qty were ver fied full in step 7.
8 Suit heat exchanger must be bypassed manually for future use. In the primary ht exchanger mode, this failure could be caused by a motor or control switch failure.
1 The CO_2 PP HI warning light may be extinguished by pulling cb ECS PRESS XDUCER 2 MNA. However, this eliminates redundant MN Bus pwr sources to the following sensors:
• Cabin press ind
• O_2 flow ind
• Gly stm press ind (Pri)
• O_2 manifold press (MSFN).
2 Manual CO_2 partial pressure control can be accomplished by use of DIRECT O_2 vlv operation, or emergency O_2 masks can be used.
SM-2A-130BM


SYMPTOM
PROCEDURE
REMARKS
13
CO2 FILTER SEIZURE WITHIN CANISTER
1 EXCESSIVE SWELLING OF CO2 FILTER
2 Single canister operation
• SUIT FLOW RELF - OFF
• CO2 cstr divert vlv - both (ctr)
• Divert flow through siezed filter momentarily when replacement of operational filter is required.
• Use CO2 PP ind as filter replacement ind
(1) Immediately replace a filter suspected of swelling.
14
GLYCOL TEMP LOW
YELLOW
Light on if:
RAD PRIM OUT TEMP ind ≤-30°F
14a
PRIM ECS RAD OUT TEMP LOW
< -20°F
1 Rad prim out temp ind <-30°F?
NO
2 C/W FAILURE
YES
3 • RAD PRIM HTR - redundant htr
Rad prim temp incr?
NO
YES
7 PRIM HTR CIRCUIT FAILURE
4 • RAD PRIM HTR - off (ctr)
Gly evap prim out temp > 50.5°F?
NO
YES
ECS 16 2 PRIM GLY EVAP OUT TEMP HIGH
5 Gly evap operation
Gly evap prim out temp < 43° and gly evap prim stm press <0.14 psi?
NO
YES
ECS 17 1 PRIM GLY EVAP OUT TEMP LOW
6 Determine deadhead discharge pressure
• RAD MAN SEL - off (ctr)
• RAD FLOW CONT PWR - MAN SEL
• Wait 25 sec and record gly disch press
8 Ck for frozen rad
• RAD MAN SEL - RAD 1
Gly disch prim press equal deadhead press?
NO
YES
11 RAD 1 PANEL STAGNATED
9 • RAD MAN SEL - RAD 2
Gly disch prim press equal deadhead press?
NO
YES
12 RAD 2 PANEL STAGNATED
10 PRIM RAD OUT TEMP SENSOR FAILURE
13 • RAD PRIM HTR - 1
14 Thaw stagnated panel
• Orient CSM to direct stagnated panel toward sun
• RAD FLOW CONT AUTO - 1
• RAD FLOW CONT PWR - PWR
• Wait 17 sec for isolation vlv to position
• RAD FLOW CONT PWR - off (ctr)
15 Verify thawing by repeating step 8 at approx 20 min intervals.
NOTE: If failure continues, isolate blocked panel and orient CSM for most favorable heat rejection
16 Resume normal rad operation
• RAD PRIM HTR - 1
• RAD FLOW CONT PWR - PWR
• RAD FLOW CONT AUTO - AUTO
(1) Because of thermal constraints involved there would be time to verify ECS rad out temp with MSFN as rad temp was dropping.
(2) Htr operation can be confirmed during sw operation by Δcurrent (15 amps for full htr vs 7½ amps for single element).
(3) Heater is shut off to avoid possibility of boiling glycol in lines with low flow rates.
(4) MSFN can aid in determining gly evap operation by comparing gly evap temp in and temp out.
(5) Prim gly flow rate from MSFN can aid in determining frozen/stagnated panel.
If GLY DISCH PRIM PRESS is < 40 psi, go to:
ECS 20 1 GLY DISCH PRESS LOW
(6) Use norm prim rad in temp and absence of H2O boiling to estimate prim rad out temp.
(7) Panel 1 between +Y and +Z, Panel 2 between -Y and -Z.
(8) Rad flow blockage cannot be distinguished from stagnated panel. Reduce elec loads for single panel operation.
13 THRU 16a
15
PRIM ECS RAD OUT TEMP HIGH
> 65°F
(>80°F for lunar orbit)
1 Gly disch prim press < 40 psi
NO
YES
ECS 20 1 PRIM GLY DISCH PRESS LOW
2 Gly evap prim stm press ind
Water boiling (0.09-0.14 psi)?
YES
NO
ECS 16 1 PRIM GLY EVAP OUT TEMP HIGH
5 Gly evap prim out temp > 50.5°F?
YES
NO
8 PRIM RAD OUT TEMP INST FAILURE
3 • RAD PRIM HTR - off (ctr)
ECS rad prim in temp decr?
YES
NO
4 PRIM 1 HTR FAILED ON
7 • RAD PRIM HTR - 2
6 Check redundant flow cont
• RAD FLOW CONT AUTO - redundant cont
ECS rad temp prim out decr?
YES
NO
9 FLOW PROPORTIONING CONT OR ISOLATION VLV FAILURE
13 • RAD PRIM HTR - 1
12 Determine deadhead discharge press
• Record gly disch press
• RAD MAN SEL - off (ctr)
• RAD FLOW CONT PWR - MAN SEL
• Wait 25 sec and record gly deadhead disc press
Did press increase?
YES
ECS 14 8 GLYCOL TEMP LOW
NO
11 POWER TO NO. 1 FLOW CONT AND RAD ISOLATION VALVES FAILED
10 • RAD FLOW CONT PWR - PWR
• RAD FLOW CONT AUTO - 1
• Initiate PTC
(1) Primary radiator outlet temperature >65°F not abnormal when associated with high electrical loads (>2000 watts).
(2) PRIM GLY EVAP STM PRESS readings of 0.09 and 0.14 psi correspond to PRIM GLY EVAP OUT TEMP readings of 38° and 43°F, respectively.
(3) Heater operation may be confirmed during switching operation by Δ current (15 amps for full heater vs 7½ amps for single element.
(4) Primary radiator inlet temperature and absence of water boiling can be used to estimate primary radiator outlet temperature.
(5) Flow proportioning valve not available in system No. 1 due to power loss, nor in system No. 2 due to inoperative rad isolation valves. Check cb RAD CONTR AC1.
SM-2A-2257A


SYMPTOM
PROCEDURE
REMARKS
16 PRIM GLY EVAP OUT TEMP HIGH
>50.5°F
Caution
If gly evap out temp reaches 60°F, activate sec gly evap with radiator bypassed.
ECS SSR-1
SECONDARY LOOP ACTIVATION
1 Rad prim out temp > 48°F
NO
YES
2 • GLY EVAP IN TEMP - MAN • GLY EVAP IN TEMP vlv - MIN CCW
Gly evap temp out decr?
NO
3 GLY EVAP TEMP OUT INST FAILURE
YES
6 • Perform J52/J53 connector change • GLY EVAP IN TEMP - AUTO
Evap out temp goes high again?
NO
7 J52 SENSOR FAILED
YES
8 Mixing vlv manual control
• Control GLY EVAP IN TEMP vlv manually to maintain evap out temp between 40-55°F
10 GLY EVAP IN TEMP CONTROLLER FAILURE
0.09-0.14 psi
5 Gly evap stm press?
< 0.09 psi
> 0.14 psi
4 GLY EVAP TEMP INST FAILURE
9 • GLY EVAP STM PRESS AUTO - MAN • GLY EVAP STM INCR - DECR
Stm press decr?
NO
YES
11 • SEC COOL PUMP - ACI • SEC COOL EVAP - EVAP
Sec gly evap stm press decr?
NO
YES
12 PRIM STM PRESS VLV FAILED CLOSED
ECS SSR-1 SECONDARY LOOP ACTIVATION
13 FROZEN STM DUCT
ECS SSR-2 FROZEN STM DUCT
14 • Perform J52/J53 connector change
Evap temp out decr?
YES
15 J52 SENSOR FAILED
NO
18 GLY EVAP TEMP CONTROLLER FAILURE
19 Man evap cont
Cont evap stm press manually (not < 0.12 psi) to maintain gly evap out temp between 45 & 55°F
16a PRIM STEAM PRESS LOW
<0.09 psi
16 • GLY EVAP STM PRESS AUTO - MAN • GLY EVAP STM INCR - INCR (for 58 sec) • Wait 20 min for evap to thaw • GLY EVAP STM PRESS AUTO - AUTO
Stm press >0.09 psi for >1 min?
NO
YES
22 EVAP WAS FROZEN NOTE: If problem recurs, change J52 with J53 and repeat step 16.
17 Reservice evap
• GLY EVAP STM PRESS AUTO - MAN • GLY EVAP STM INCR - INCR (for 58 sec) • Wait 15 min for evap to thaw • GLY EVAP H_2O FLOW - ON (for 3 min)
Stm press >0.09 psi?
YES
NO
20 • GLY EVAP STM PRESS AUTO - AUTO
Evap dries out again?
NO
YES
21 TEMPORARY MIS-SEATING OF STM PRESS VLV OR TEMPORARY EVAP H_2O CONTROL PROBLEM
23 PRIM EVAP H_2O CONT VLV FAILED CLOSED
25 Activate sec loop with rad bypassed (per SSR-1) if prim rad out temp >48°F
24 • GLY EVAP STM PRESS AUTO - MAN • GLY EVAP STM INCR - INCR (for 58 sec) • Perform J52 J53 connector change • Wait 15 min for evap to thaw • GLY EVAP H_2O FLOW - ON (for 3 min) • GLY EVAP STM PRESS AUTO - AUTO
Evap dries out again?
YES
NO
26 TEMPORARY EVAP H_2O CONTROL PROBLEM DUE TO LOW CYCLIC LOADS OR H_2O FEED CAPABILITY LOST
28 Continue servicing evap or activate sec loop with radiators bypassed per SSR-1, if PRI GLY EVAP OUT TEMP > 60°F.
27 J52 SENSOR FAILED
1 After the prim gly evap temp returns to normal, deactivate the secondary evaporator and continue trouble shooting.
2 Procedure for changing J52 and J53 connectors
• GLY EVAP H2O FLOW - off (center)
• GLY EVAP STM PRESS AUTO-MAN
• GLY EVAP IN TEMP - MAN
• Change J52 and J53
• GLY EVAP H2O FLOW - AUTO
• GLY EVAP STM PRESS AUTO-AUTO
• GLY EVAP IN TEMP- AUTO
3 Thaw times are based on a 50°F rad out. Shorter thaw times by 33% if rad out temp ≥ 60°F.
4 Primary evaporator last

SM-2A-1510R

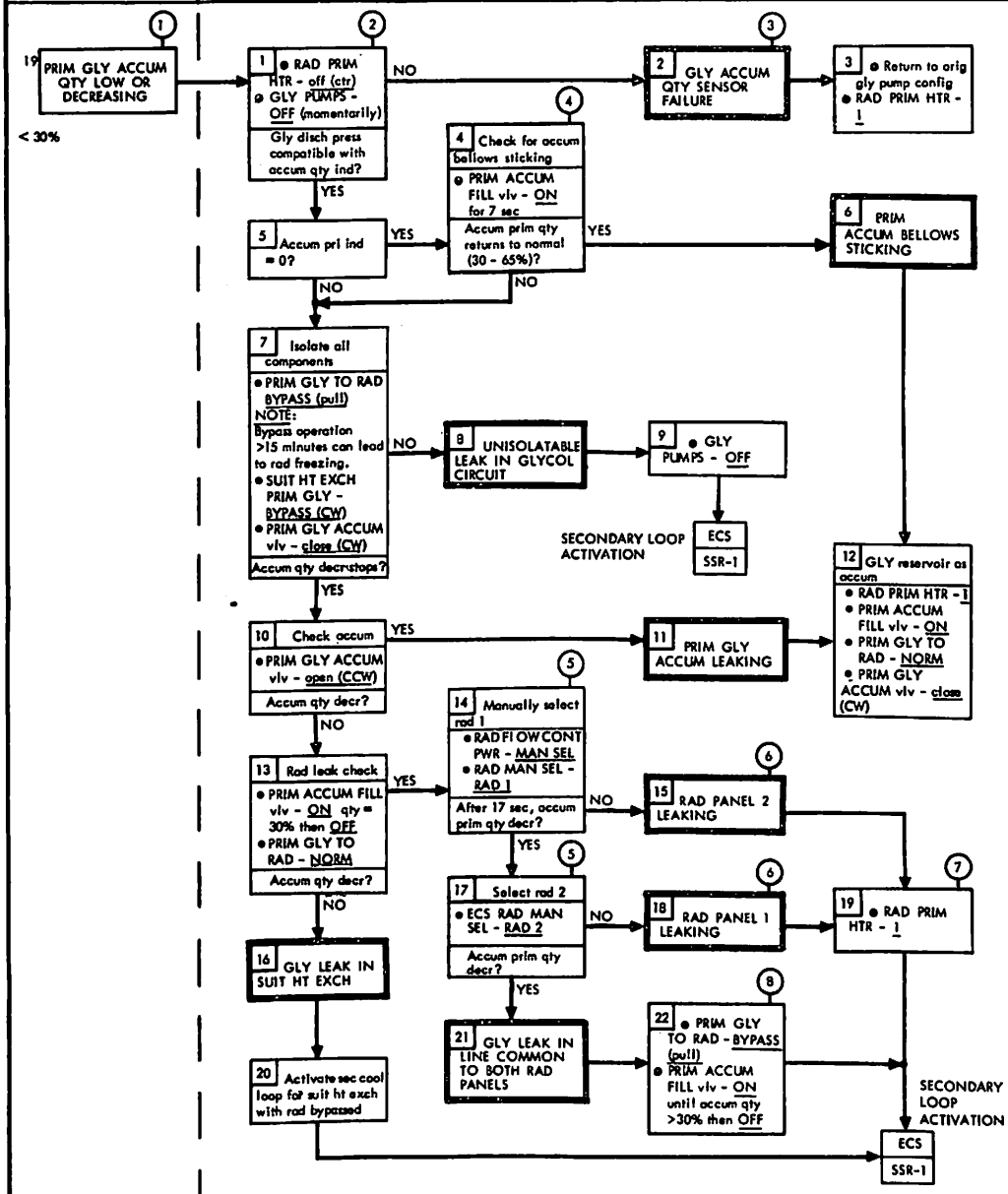

SYMPTOM
PROCEDURE
REMARKS
17 PRIM GLY EVAP OUT TEMP LOW
<38°F
1 Rad prim out temp < 50.5°F ?
NO
YES
2 Shutdown prim evap
• GLY EVAP STM PRESS AUTO - MAN
• GLY EVAP STM INCR - INCR (for 58 sec)
Stm press incr >0.14 psi?
YES
NO
3 PRIM GLY EVAP OUT TEMP ind incr to ≈ RAD PRIM OUT TEMP ind?
NO
YES
4 PRIM GLY EVAP TEMP INST FAILURE
5 Reactivate prim evap
• GLY EVAP STM PRESS AUTO - AUTO
• GLY EVAP IN TEMP - AUTO
6 STM PRESS CONTROL VLV FAILURE
7 • PRIM EVAP H2O CONT - OFF
• Activate sec cool loop (with rad bypassed) as reqd to maintain PRIM GLY EVAP OUT TEMP <60°F
ECS
SSR-1
SECONDARY LOOP ACTIVATION
8 • GLY EVAP STM PRESS AUTO - MAN
• GLY EVAP STM INCR - INCR (for 58 sec)
Stm press incr?
YES
NO
9 Gly evap temp out incr?
YES
NO
10 Perform J52/J53 connector change
Gly evap temp out normal (38-50.5°F)?
NO
YES
11 GLY EVAP TEMP CONTROLLER FAILURE
12 • GLY EVAP IN TEMP - MAN
• GLY EVAP IN TEMP vlv - MAX CW
Gly evap temp out incr?
YES
NO
13 DOUBLE FAILURE
GLY EVAP TEMP CONTROLLER & INST FAILURE
OR
GLY EVAP TEMP CONTROLLER & GLY EVAP INLET TEMP VLV FAILURE
14 J52 SENSOR FAILURE
15 Man evap cont
Cont evap stm press manually (not <0.12 psi) to maintain gly evap out temp between 45-55°F
16 • Perform J52/J53 connector change
Gly evap temp out goes low again?
NO
YES
17 GLY EVAP TEMP OUT INST FAILURE
18 Reactivate prim evap
• GLY EVAP STM PRESS AUTO - AUTO
• GLY EVAP IN TEMP - AUTO
19 GLY EVAP TEMP IN CONTROLLER FAILURE
20 Manually control gly evap temp out between 35-60°F by adjusting prim gly evap temp in vlv
1 An estimate of gly evap out temp can be made from steam press conversion and/or suit temp-5°F (unsuited); -10°F (suited).
2 Procedure for connector change
• GLY EVAP H2O FLOW - off (center)
• GLY EVAP STM PRESS AUTO - MAN
• GLY EVAP IN TEMP - MAN
• Change J52 with J53
• GLY EVAP H2O FLOW - AUTO
• GLY EVAP STM PRESS AUTO - AUTO
• GLY EVAP IN TEMP - AUTO
3 Changing J52 and J53 may possibly correct the glycol evap control problem.
18 PRIM GLY ACCUM QTY HIGH
> 65%
Warning
If accum qty >100%, set RAD PRIM HTR - off (ctr) before troubleshooting
1 • GLY PUMPS - OFF (momentarily)
Gly disch press compatible with ind gly accum qty?
NO
YES
2 Pump disch press >25 psi?
NO
YES
3 GLY ACCUM QTY IND FAILED
18a PRIM GLY DISCH PRESS HIGH
> 56 psi
or
> accum qty / 4 +40
4 • GLY PUMPS - OFF (momentarily)
Gly disch press compatible with ind gly accum qty?
NO
YES
5 Accum quantity <100%?
NO
YES
6 LOCALIZED BOILING IN GLYCOL LINE BY RAD HTR
8 GLY DISCH PRESS IND FAILED
9 • RAD PRIM HTR - off (ctr)
• PRIM ACCUM FILL vlv - ON then OFF
7 • RAD PRIM HTR - off (ctr)
• GLY RSVR IN vlv - OPEN then CLOSE
NOTE: GLY RSVR IN vlv should be rapidly cracked open and then closed
Gly accum qty incr again?
NO
YES
10 Transient condition caused by incr in gly accum qty
11 ACCUM FILL VLV LEAKING
12 • RAD PRIM HTR - (orig config)
1 PRIM ACCUM QTY ind >65% may result in accum bellows sticking. If sticking occurs, cycle ECS prim glycol pumps.
2 With GLY PUMPS - OFF, PRIM GLY DISCH PRESS should be 1/4 accum quantity.
3 Localized boiling could have been caused by a reduction in glycol flow due to failed radiator isolation valve or a frozen radiator, or due to incorrect positioning of:
GLY RSVR vlv (3)
PRIM GLY TO RAD vlv
SUIT HT EXCH PRIM GLY vlv
Radiator restrictions can be determined by 4 to 6 psi drop in PRIM GLY DISCH PRESS when the radiators are bypassed.
SM-2A-1511N

17 THRU 20

SYMPTOM

PROCEDURE

REMARKS



(1) Normal range is 30-65% Sensor powered by cb ECS PRESS XDUCER 1 MDC-5. If the glycol leak is slow (~5%/hr) the leak source may be more rapidly detected by momentarily placing the gly accum vlv off after each component is isolated.

(2) With pump off, glycol disch press should equal 1/4 accumulator quantity.

(3) Use gly disch press when pump off (momentarily) to estimate accum qty ind. With GLY PUMPS - OFF accumulator quantity should be 4 times pump disch press.

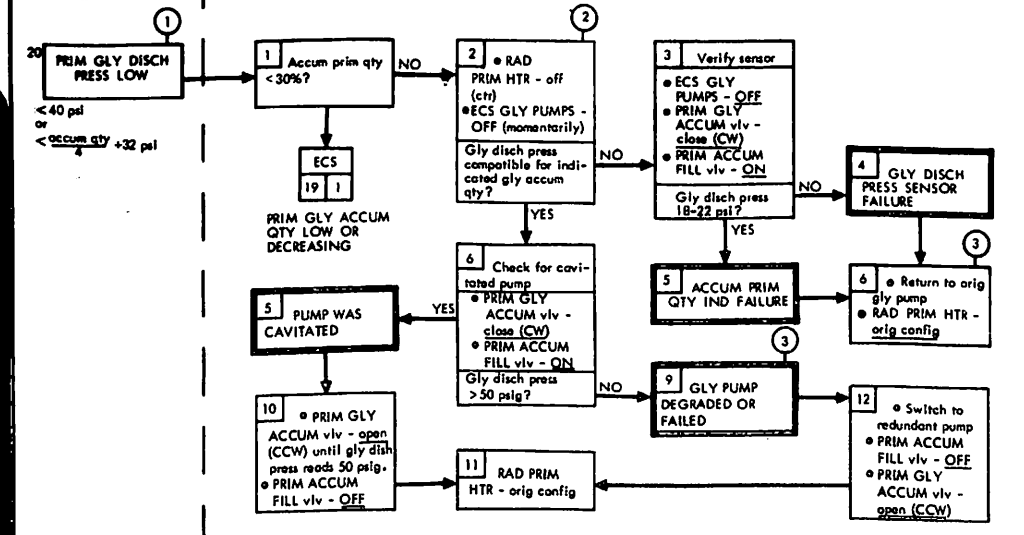
(4) Cycling the primary ECS glycol pump may free a sticking accumulator bellows.

(5) Radiator isolation valves take 17 sec to position.

(6) Half of radiator heat rejection capability lost.

(7) The secondary radiator will freeze unless secondary coolant loop activated.

(8) Use primary coolant loop in evaporative mode when required for G&N operation. Constraints are evaporator H_2O consumption.

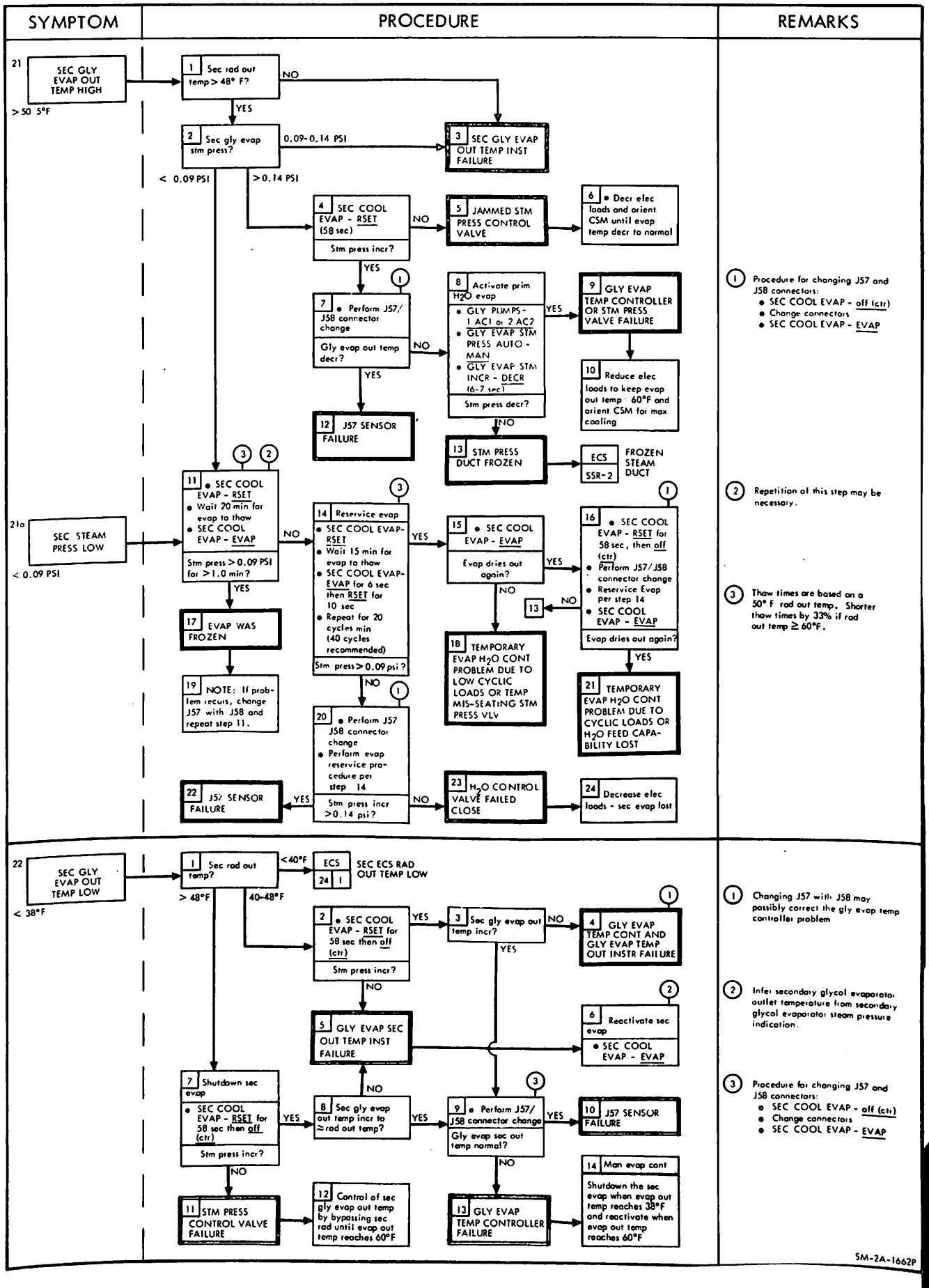


(1) With radiators by-passed, pump disch press is nominally 2 psi lower than with radiators operating.

(2) With GLY PUMPS - OFF, glycol discharge press should equal 1/4 accumulator quantity indication.

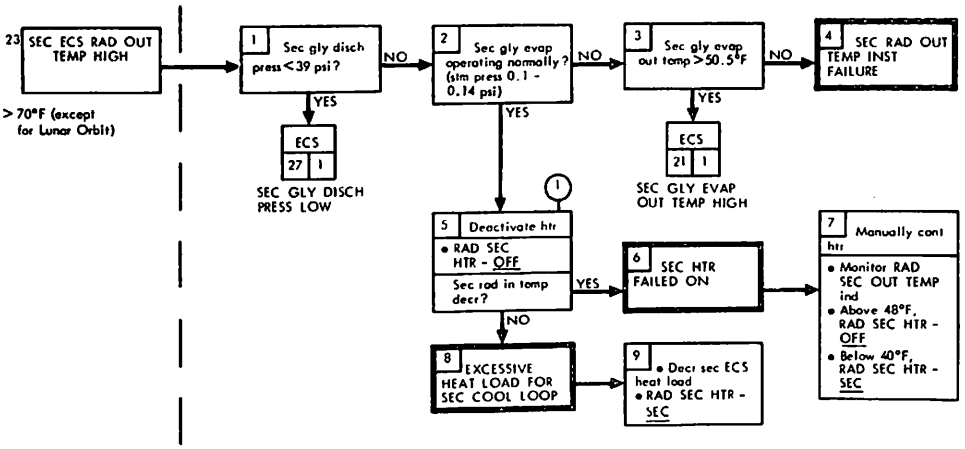
(3) Degraded glycol pump may be verified by checking GLY PRIM COLDPLATE flow rate with MSFN.

SM-2A1661J

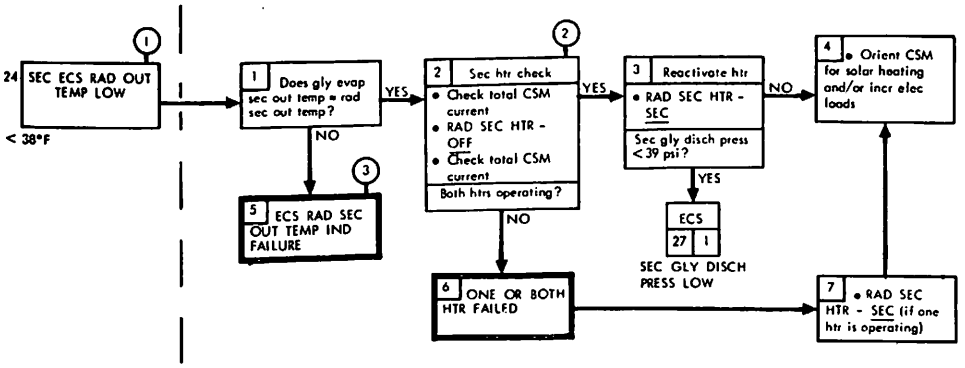

SYMPTOM
PROCEDURE
REMARKS
21 SEC GLY EVAP OUT TEMP HIGH
> 50 5°F
1 Sec rad out temp > 48° F?
NO
YES
2 Sec gly evap stm press?
0.09-0.14 PSI
3 SEC GLY EVAP OUT TEMP INST FAILURE
< 0.09 PSI
>0.14 PSI
4 SEC COOL EVAP - RSET (58 sec)
Stm press incr?
NO
5 JAMMED STM PRESS CONTROL VALVE
6 • Decr elec loads and orient CSM until evap temp decr to normal
YES
7 • Perform J57/J58 connector change
Gly evap out temp decr?
NO
8 Activate prim H2O evap
• GLY PUMPS - 1 AC1 or 2 AC2
• GLY EVAP STM PRESS AUTO - MAN
• GLY EVAP STM INCR - DECR (6-7 sec)
Stm press decr?
YES
9 GLY EVAP TEMP CONTROLLER OR STM PRESS VALVE FAILURE
10 Reduce elec loads to keep evap out temp 60°F and orient CSM for max cooling
NO
12 J57 SENSOR FAILURE
13 STM PRESS DUCT FROZEN
ECS SSR-2 FROZEN STEAM DUCT
21a SEC STEAM PRESS LOW
< 0.09 PSI
11 • SEC COOL EVAP - RSET
• Wait 20 min for evap to thaw
• SEC COOL EVAP - EVAP
Stm press > 0.09 PSI for >1.0 min?
NO
YES
14 Reservice evap
• SEC COOL EVAP - RSET
• Wait 15 min for evap to thaw
• SEC COOL EVAP - EVAP for 6 sec then RSET for 10 sec
• Repeat for 20 cycles min (40 cycles recommended)
Stm press > 0.09 psi?
NO
15 • SEC COOL EVAP - EVAP
Evap dries out again?
YES
NO
16 • SEC COOL EVAP - RSET for 58 sec, then off (ctr)
• Perform J57/J58 connector change
• Reservice Evap per step 14
• SEC COOL EVAP - EVAP
Evap dries out again?
YES
NO
13
17 EVAP WAS FROZEN
18 TEMPORARY EVAP H2O CONT PROBLEM DUE TO LOW CYCLIC LOADS OR TEMP MIS-SEATING STM PRESS VLV
21 TEMPORARY EVAP H2O CONT PROBLEM DUE TO CYCLIC LOADS OR H2O FEED CAPABILITY LOST
19 NOTE: If problem recurs, change J57 with J58 and repeat step 11.
20 • Perform J57 J58 connector change
• Perform evap reservice procedure per step 14
Stm press incr >0.14 psi?
YES
NO
22 J57 SENSOR FAILURE
23 H2O CONTROL VALVE FAILED CLOSE
24 Decrease elec loads - sec evap lost
1 Procedure for changing J57 and J58 connectors:
• SEC COOL EVAP - off (ctr)
• Change connectors
• SEC COOL EVAP - EVAP
2 Repetition of this step may be necessary.
3 Thaw times are based on a 50° F rad out temp. Shorter thaw times by 33% if rad out temp ≥ 60°F.
22 SEC GLY EVAP OUT TEMP LOW
< 38°F
1 Sec rad out temp?
<40°F
ECS 24 1 SEC ECS RAD OUT TEMP LOW
> 48°F
40-48°F
2 • SEC COOL EVAP - RSET for 58 sec then off (ctr)
Stm press incr?
YES
3 Sec gly evap out temp incr?
NO
4 GLY EVAP TEMP CONT AND GLY EVAP TEMP OUT INSTR FAILURE
NO
5 GLY EVAP SEC OUT TEMP INST FAILURE
6 Reactivate sec evap
• SEC COOL EVAP - EVAP
7 Shutdown sec evap
• SEC COOL EVAP - RSET for 58 sec then off (ctr)
Stm press incr?
YES
8 Sec gly evap out temp incr to ≈ rad out temp?
YES
9 • Perform J57/J58 connector change
Gly evap sec out temp normal?
YES
10 J57 SENSOR FAILURE
NO
11 STM PRESS CONTROL VALVE FAILURE
12 Control of sec gly evap out temp by bypassing sec rad until evap out temp reaches 60°F
13 GLY EVAP TEMP CONTROLLER FAILURE
14 Man evap cont
Shutdown the sec evap when evap out temp reaches 38°F and reactivate when evap out temp reaches 60°F
1 Changing J57 with J58 may possibly correct the gly evap temp controller problem
2 Infer secondary glycol evaporator outlet temperature from secondary glycol evaporator steam pressure indication.
3 Procedure for changing J57 and J58 connectors:
• SEC COOL EVAP - off (ctr)
• Change connectors
• SEC COOL EVAP - EVAP
SM-2A-1662P

21 THRU 26

SYMPTOM	PROCEDURE	REMARKS



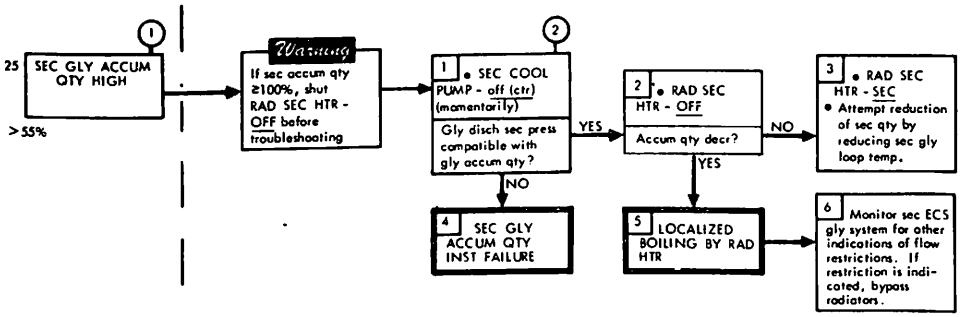
(1) Heater operation can be confirmed by ammeter change during switching operation. Δ current will be:
30 amp - both operating
15 amp - one operating



(1) Assumes secondary loop is in operation. Sensor is powered by cb ECS RAD CONT/HTRS MNA (MDC-5).

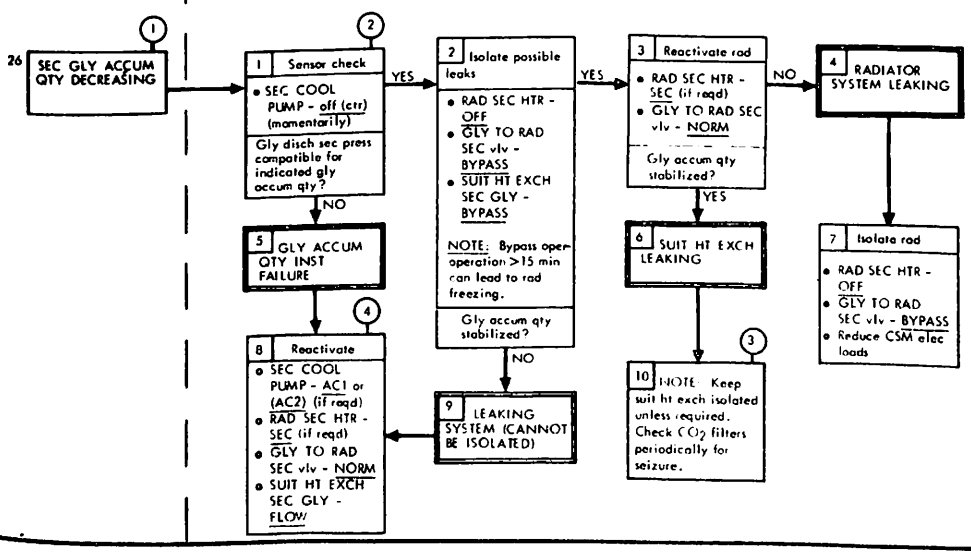
(2) Heater operation can be confirmed by ammeter change during switching operation. Δ current will be:
30 amp - both operating
15 amp - one operating

(3) Use SEC GLY EVAP OUT TEMP indicator with ECS RAD SEC IN TEMP indicator to estimate secondary radiator outlet temperature.



(1) Normal range 30-55%.

(2) With glycol pump off, glycol discharge press should equal 1/4 accumulator quantity.



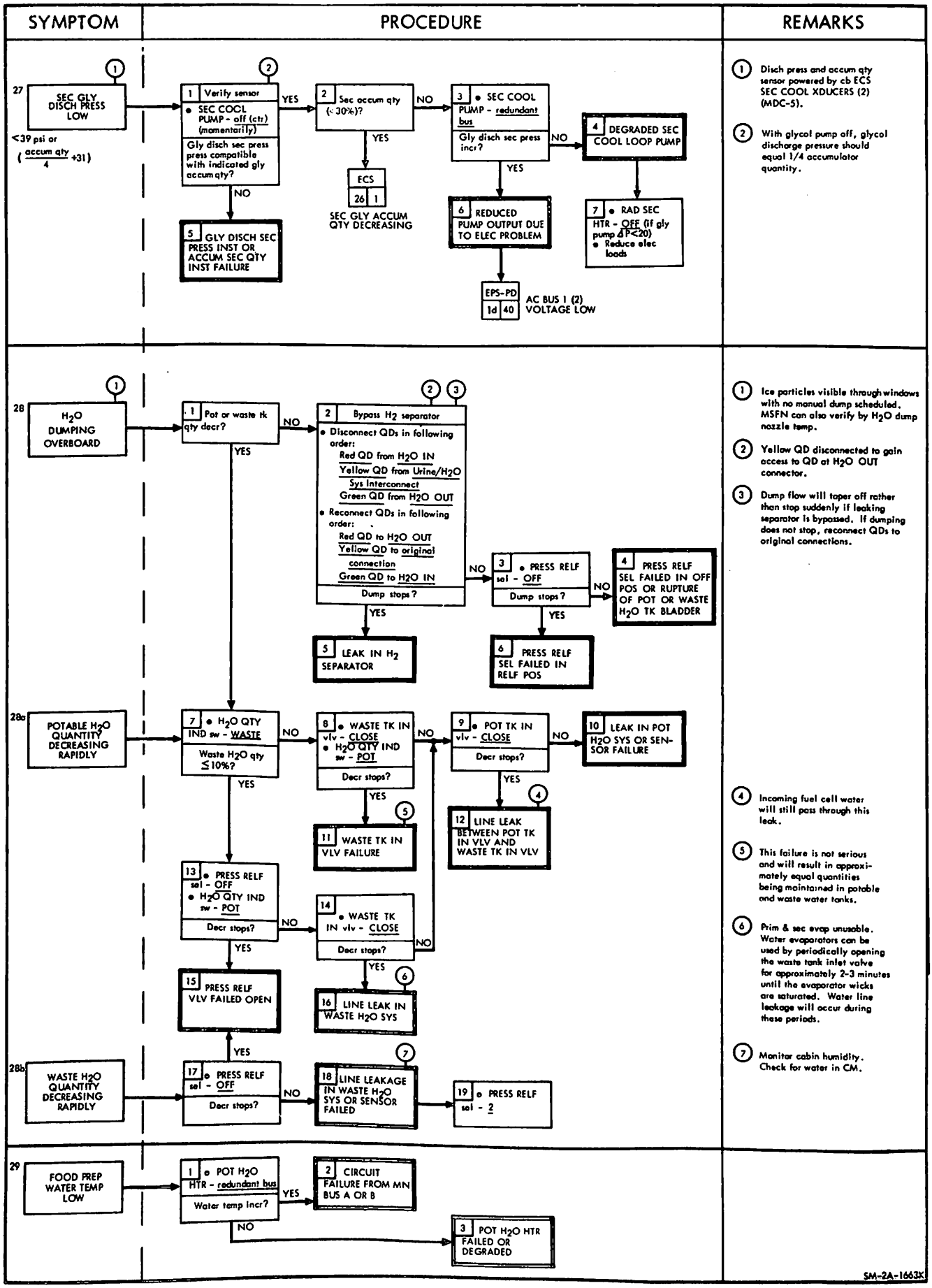
(1) This symptom is also valid when secondary glycol loop is not in operation. Accum qty and disch press sensors powered by cb SEC COOL XDUCER (MDC-5). Normal range is 30-55%.

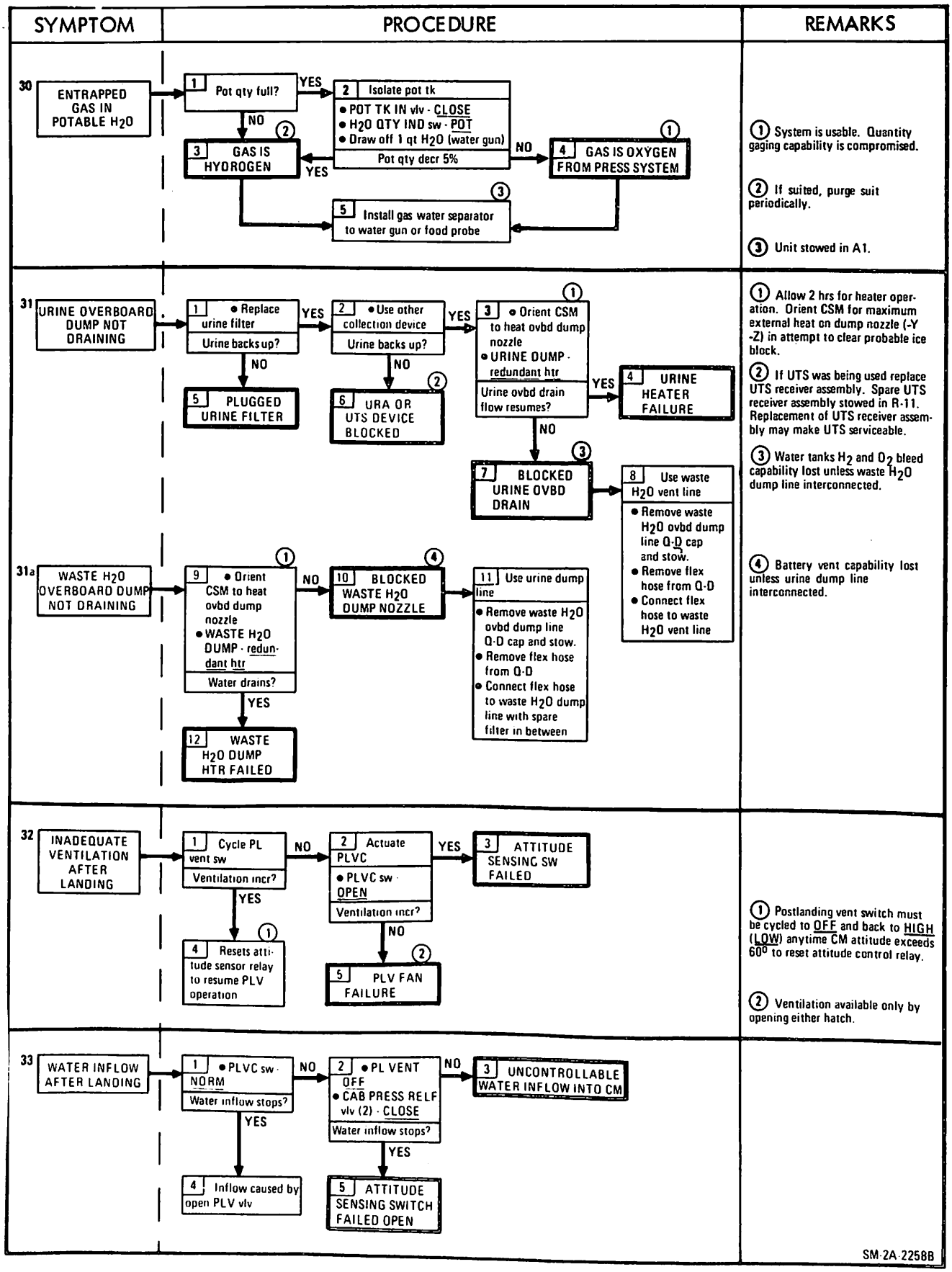
(2) With pump off, glycol discharge pressure should equal 1 4 gly accum quantity.

(3) Humidity control and suit loop cooling not available from secondary loop when suit ht exch is bypassed. A glycol leak will exist whenever the secondary suit ht exch is used and could result in glycol contamination in the suit loop.

(4) If leak is determined, temporary deactivation of pump may conserve glycol for future use. Radiator heater to be OFF when pump is OFF.

SM-2A-1666G


SYMPTOM
PROCEDURE
REMARKS
27
SEC GLY DISCH PRESS LOW
<39 psi or (accum qty / 4 +31)
1 Verify sensor
• SEC COOL PUMP - off (ctr) (momentarily)
Gly disch sec press press compatible with indicated gly accum qty?
YES
NO
2 Sec accum qty (<30%)?
YES
ECS 26 1
SEC GLY ACCUM QTY DECREASING
NO
3 • SEC COOL PUMP - redundant bus
Gly disch sec press incr?
YES
NO
4 DEGRADED SEC COOL LOOP PUMP
5 GLY DISCH SEC PRESS INST OR ACCUM SEC QTY INST FAILURE
6 REDUCED PUMP OUTPUT DUE TO ELEC PROBLEM
7 • RAD SEC HTR - OFF (if gly pump ΔP<20)
• Reduce elec loads
EPS-PD 1d 40
AC BUS 1 (2) VOLTAGE LOW
1 Disch press and accum qty sensor powered by cb ECS SEC COOL XDUCERS (2) (MDC-5).
2 With glycol pump off, glycol discharge pressure should equal 1/4 accumulator quantity.
28
H2O DUMPING OVERBOARD
1 Pot or waste tk qty decr?
YES
NO
2 Bypass H2 separator
• Disconnect QDs in following order:
Red QD from H2O IN
Yellow QD from Urine/H2O Sys Interconnect
Green QD from H2O OUT
• Reconnect QDs in following order:
Red QD to H2O OUT
Yellow QD to original connection
Green QD to H2O IN
Dump stops?
YES
NO
3 • PRESS RELF sel - OFF
Dump stops?
YES
NO
4 PRESS RELF SEL FAILED IN OFF POS OR RUPTURE OF POT OR WASTE H2O TK BLADDER
5 LEAK IN H2 SEPARATOR
6 PRESS RELF SEL FAILED IN RELF POS
1 Ice particles visible through windows with no manual dump scheduled. MSFN can also verify by H2O dump nozzle temp.
2 Yellow QD disconnected to gain access to QD at H2O OUT connector.
3 Dump flow will taper off rather than stop suddenly if leaking separator is bypassed. If dumping does not stop, reconnect QDs to original connections.
28a
POTABLE H2O QUANTITY DECREASING RAPIDLY
7 • H2O QTY IND sw - WASTE
Waste H2O qty ≤10%?
YES
NO
8 • WASTE TK IN vlv - CLOSE
• H2O QTY IND sw - POT
Decr stops?
YES
NO
9 • POT TK IN vlv - CLOSE
Decr stops?
YES
NO
10 LEAK IN POT H2O SYS OR SENSOR FAILURE
11 WASTE TK IN VLV FAILURE
12 LINE LEAK BETWEEN POT TK IN VLV AND WASTE TK IN VLV
4 Incoming fuel cell water will still pass through this leak.
5 This failure is not serious and will result in approximately equal quantities being maintained in potable and waste water tanks.
13 • PRESS RELF sel - OFF
• H2O QTY IND sw - POT
Decr stops?
YES
NO
14 • WASTE TK IN vlv - CLOSE
Decr stops?
YES
NO
15 PRESS RELF VLV FAILED OPEN
16 LINE LEAK IN WASTE H2O SYS
6 Prim & sec evap unusable. Water evaporators can be used by periodically opening the waste tank inlet valve for approximately 2-3 minutes until the evaporator wicks are saturated. Water line leakage will occur during these periods.
28b
WASTE H2O QUANTITY DECREASING RAPIDLY
17 • PRESS RELF sel - OFF
Decr stops?
YES
NO
18 LINE LEAKAGE IN WASTE H2O SYS OR SENSOR FAILED
19 • PRESS RELF sel - 2
7 Monitor cabin humidity. Check for water in CM.
29
FOOD PREP WATER TEMP LOW
1 • POT H2O HTR - redundant bus
Water temp incr?
YES
NO
2 CIRCUIT FAILURE FROM MN BUS A OR B
3 POT H2O HTR FAILED OR DEGRADED
SM-2A-1663K


SYMPTOM
PROCEDURE
REMARKS
30
ENTRAPPED GAS IN POTABLE H2O
1 Pot qty full?
YES
NO
2 Isolate pot tk
• POT TK IN vlv - CLOSE
• H2O QTY IND sw - POT
• Draw off 1 qt H2O (water gun)
Pot qty decr 5%
NO
4 GAS IS OXYGEN FROM PRESS SYSTEM
3 GAS IS HYDROGEN
YES
5 Install gas water separator to water gun or food probe
(1) System is usable. Quantity gaging capability is compromised.
(2) If suited, purge suit periodically.
(3) Unit stowed in A1.
31
URINE OVERBOARD DUMP NOT DRAINING
1 • Replace urine filter
Urine backs up?
YES
NO
2 • Use other collection device
Urine backs up?
YES
NO
3 • Orient CSM to heat ovbd dump nozzle
• URINE DUMP - redundant htr
Urine ovbd drain flow resumes?
YES
NO
4 URINE HEATER FAILURE
5 PLUGGED URINE FILTER
6 URA OR UTS DEVICE BLOCKED
7 BLOCKED URINE OVBD DRAIN
8 Use waste H2O vent line
• Remove waste H2O ovbd dump line Q-D cap and stow.
• Remove flex hose from Q-D
• Connect flex hose to waste H2O vent line
(1) Allow 2 hrs for heater operation. Orient CSM for maximum external heat on dump nozzle (-Y -Z) in attempt to clear probable ice block.
(2) If UTS was being used replace UTS receiver assembly. Spare UTS receiver assembly stowed in R-11. Replacement of UTS receiver assembly may make UTS serviceable.
(3) Water tanks H2 and O2 bleed capability lost unless waste H2O dump line interconnected.
31a
WASTE H2O OVERBOARD DUMP NOT DRAINING
9 • Orient CSM to heat ovbd dump nozzle
• WASTE H2O DUMP - redundant htr
Water drains?
NO
10 BLOCKED WASTE H2O DUMP NOZZLE
11 Use urine dump line
• Remove waste H2O ovbd dump line Q-D cap and stow.
• Remove flex hose from Q-D
• Connect flex hose to waste H2O dump line with spare filter in between
YES
12 WASTE H2O DUMP HTR FAILED
(4) Battery vent capability lost unless urine dump line interconnected.
32
INADEQUATE VENTILATION AFTER LANDING
1 Cycle PL vent sw
Ventilation incr?
NO
2 Actuate PLVC
• PLVC sw - OPEN
Ventilation incr?
YES
NO
3 ATTITUDE SENSING SW FAILED
4 Resets attitude sensor relay to resume PLV operation
5 PLV FAN FAILURE
YES
(1) Postlanding vent switch must be cycled to OFF and back to HIGH (LOW) anytime CM attitude exceeds 60° to reset attitude control relay.
(2) Ventilation available only by opening either hatch.
33
WATER INFLOW AFTER LANDING
1 • PLVC sw - NORM
Water inflow stops?
NO
2 • PL VENT - OFF
• CAB PRESS RELF vlv (2) - CLOSE
Water inflow stops?
NO
3 UNCONTROLLABLE WATER INFLOW INTO CM
YES
4 Inflow caused by open PLV vlv
5 ATTITUDE SENSING SWITCH FAILED OPEN
YES
SM-2A-225BB

SECONDARY SUB ROUTINES	PROCEDURE	REMARKS

SSR-1

SECONDARY LOOP ACTIVATION

1 Simultaneous prim and sec loop operation desired?

YES

① Caution ②

For simultaneous cool loop operation only rad of one cool loop should be used. For loop bypassing rad:

- PRIM/(SEC) GLY TO RAD vlv - BYPASS
- PRIM/(SEC) RAD HTR - OFF

NO

③ 3 Deactivate prim loop

- PRIM EVAP H_2O CONT vlv - OFF
- ECS RAD PRIM HTR - off (ctr)
- GLY EVAP STM PRESS AUTO - MAN
- GLY EVAP STM INCR - INCR for 58 sec
- GLY PUMPS - OFF

2 Activate sec loop

- ECS IND sel - SEC
- GLY TO RAD SEC vlv - NORM (rad open)
- SEC COOL PUMP - AC1 (or AC2)
- SEC GLY DISCH PRESS ind - >39 psi
- RAD SEC HTR - SEC (rad open)
- SEC EVAP H_2O CONT vlv - AUTO
- SEC COOL EVAP - EVAP
- SEC GLY EVAP OUT TEMP ind - 40-50.5°F
- SUIT HT EXCH SEC GLY vlv - FLOW (if reqd)

5 If a return to prim operation is desired, proceed as follows:

6 Deactivate sec loop

- RAD SEC HTR - OFF
- SEC COOL EVAP - RESET for 58 sec then off (ctr)
- SEC COOL PUMP - off (ctr)
- SEC EVAP H_2O CONT vlv - OFF

4 Activate prim loop

- ECS IND sel - PRIM
- PRIM GLY TO RAD vlv - NORM
- GLY PUMPS - 1 AC1
- PRIM GLY DISCH PRESS ind - >40 psi
- RAD PRIM HTR - 1
- GLY EVAP IN TEMP - AUTO
- PRIM EVAP H_2O CONT vlv - AUTO
- GLY EVAP STM PRESS AUTO - AUTO
- PRIM GLY EVAP OUT TEMP - ind 40-50°F
- SUIT CKT HT EXH - ON for 30 secs then off (ctr)
- CAB TEMP - AUTO

① If one panel of the primary radiator is lost, the secondary radiator should be used, otherwise the secondary radiator will be lost due to freezing.

② Operation of both coolant loops simultaneously may result in low rad out temp. To preclude rad freezing, terminate evap operation if possible.

③ G&N, DSE, and signal conditioners are not coldplated on secondary loop. Usage limits for this equipment are as follows:

G&N 17% duty cycle with max on time of 1 hr 55 min.

DSE 66% duty cycle with max on time of 2 hrs.

SSR-2

FROZEN STEAM DUCT

1 Initiate manual operation

- Orient steam vent outlet to sun (-Y, -Z)
- GLY EVAP STM AUTO - MAN
- GLY EVAP STM INCR - INCR (58 sec)
- GLY EVAP IN TEMP - MAN
- GLY EVAP H_2O FLOW - off (ctr)
- GLY EVAP IN TEMP vlv - adjust (to obtain prim evap out temp ~ 60°)
- GLY EVAP STM INCR - DECR (6-7 sec)

ECS rad prim out temp <-30°F?

NO

YES

2 Stm press changes (decr) from stabilized value within 15 min?

YES

NO

3 Service evap when stm press >0.14 psi.

- GLY EVAP H_2O FLOW - ON (2 min) then off (ctr)

Gly evap temp out <47°F?

YES

NO

① 4 Activate sec coolant loop

- SEC COOL EVAP - off (ctr)
- SEC COOL PUMP - AC1 or AC2
- RAD SEC HTR - SEC
- RAD PRIM HTR - off (ctr)
- PRIM GLY TO RAD - BYPASS (pull)

5 Cycle H_2O

- GLY EVAP H_2O FLOW - ON 1 min - off (ctr) 15 min

Gly evap temp out <47°F?

NO

YES

6 Resume norm opr

- GLY EVAP STM PRESS AUTO - AUTO
- GLY EVAP H_2O FLOW - AUTO
- GLY EVAP IN TEMP - AUTO
- PRIM GLY TO RAD vlv - NORM
- RAD PRIM HTR - PRIM 1
- RAD SEC HTR - OFF
- SEC COOL PUMP - off (ctr)

① Primary glycol evaporator temperature inlet can be approximated by secondary radiator inlet temperature.

THIS PAGE
INTENTIONALLY
LEFT BLANK

THIS PAGE
INTENTIONALLY
LEFT BLANK

EMS MALFUNCTION INDEX

1 .05G LT ON (TEST 1)

2 G/V SCROLL ASSY DOES NOT SLEW (TEST 1)

3 .05G LT OUT (TEST 2)

4 LIFT VECTOR DN LT WILL NOT COME ON (TEST 3)

4a RNG IND WILL NOT SLEW (TEST 3)

5 V-AXIS ONLY OR MULTIPLE DISPLAYS ABNORMAL (TEST 4)

6 RNG IND ONLY ABNORMAL (TEST 4)

7 G-AXIS ONLY ABNORMAL (TEST 4)

8 LIFT VECTOR UP LT NOT ON (TEST 5)

8a G-AXIS DOES NOT DRIVE (TEST 5)

9 RNG IND DOES NOT SLEW IN RNG SET

9a G-AXIS DOES NOT ZERO IN RNG SET

10 V-AXIS DOES NOT SLEW IN VO SET

11 ΔV/RNG IND ABNORMAL IN ΔV TEST

12 SPS THRUST LT NOT ON IN ΔV TEST

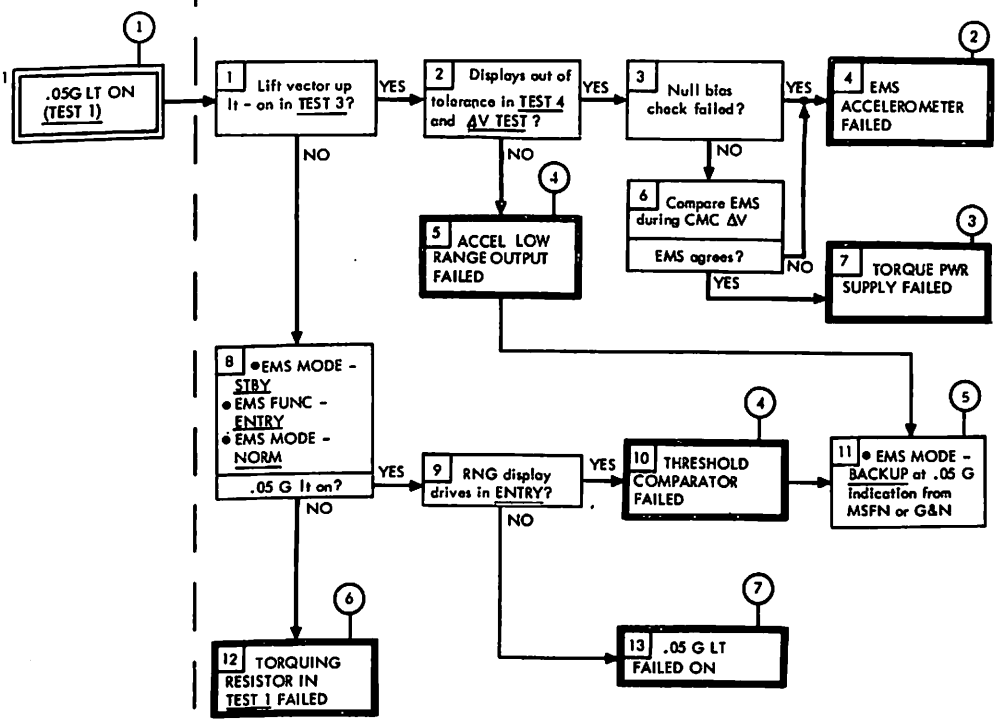
13 ΔV IND DOES NOT SLEW IN ΔV SET

14 ΔV/RNG IND FAILS TO COUNT DURING ΔV

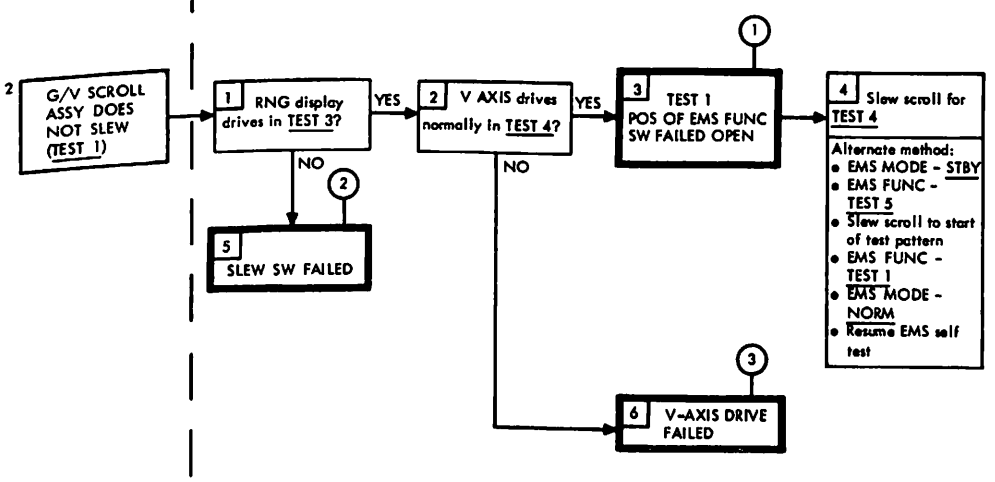
15 EITHER LIFT VECTOR LT ON AFTER 2G

EMS

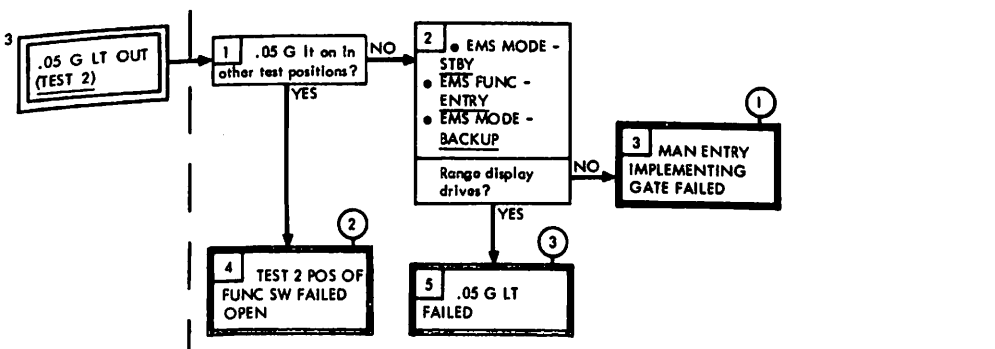
SYMPTOM	PROCEDURE	REMARKS



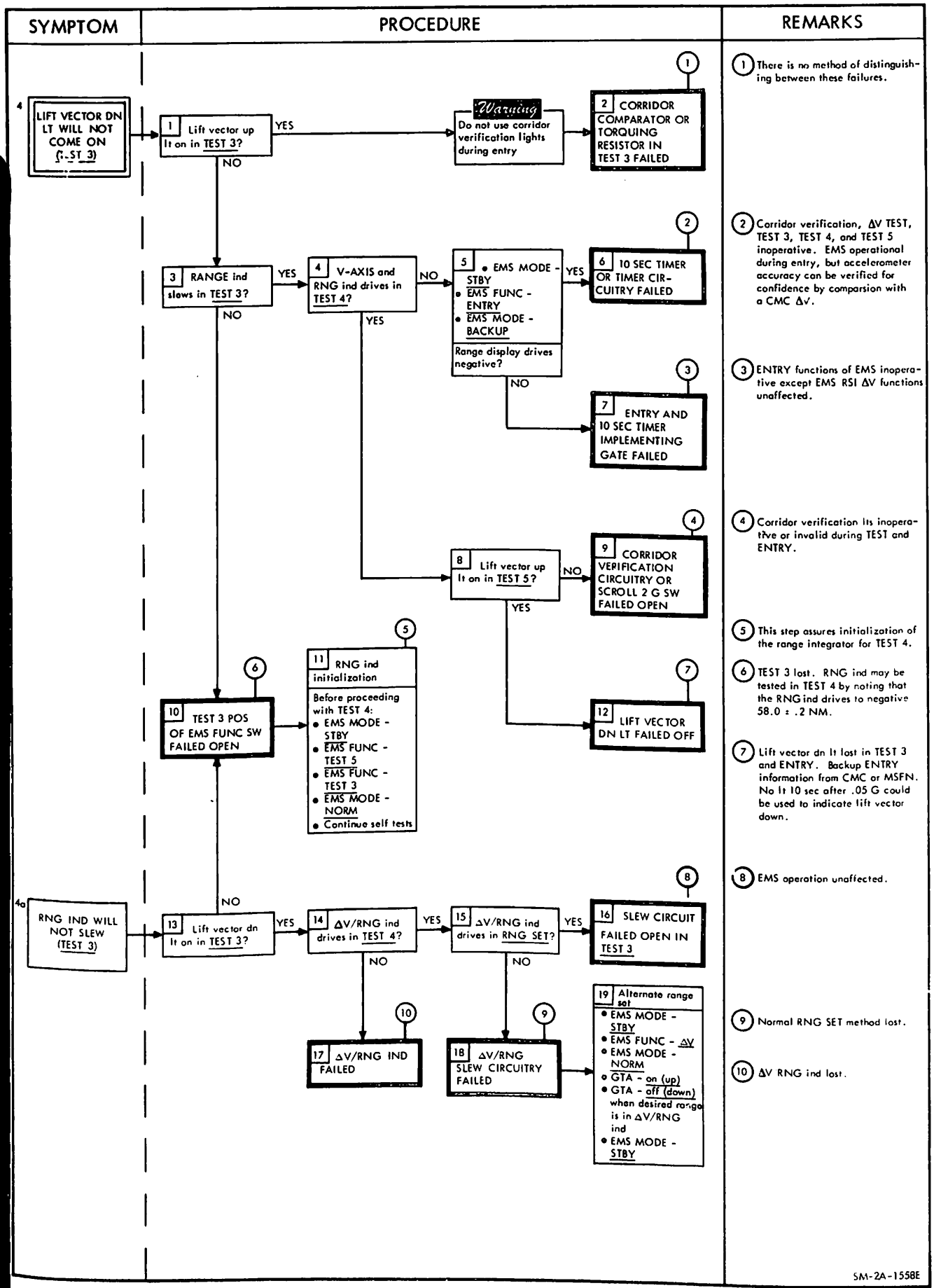
1. The EMS MODE sw assumed to be in STBY for at least 5 sec before self-test started.
2. EMS lost except EMS RSI.
3. All self test capability lost. For entry, G-Drive, and corridor verification will be erroneous. ΔV/RNG ind, V AXIS and EMS RSI unaffected.
4. AUTO position functions of EMS MODE sw lost for entry only.
5. Corridor verification inoperative with EMS MODE sw - BACKUP.
6. EMS FUNC - TEST 1 lost only.
7. Loss of threshold cue only (.05 G lt). RNG ind operation is indication of .05 G.



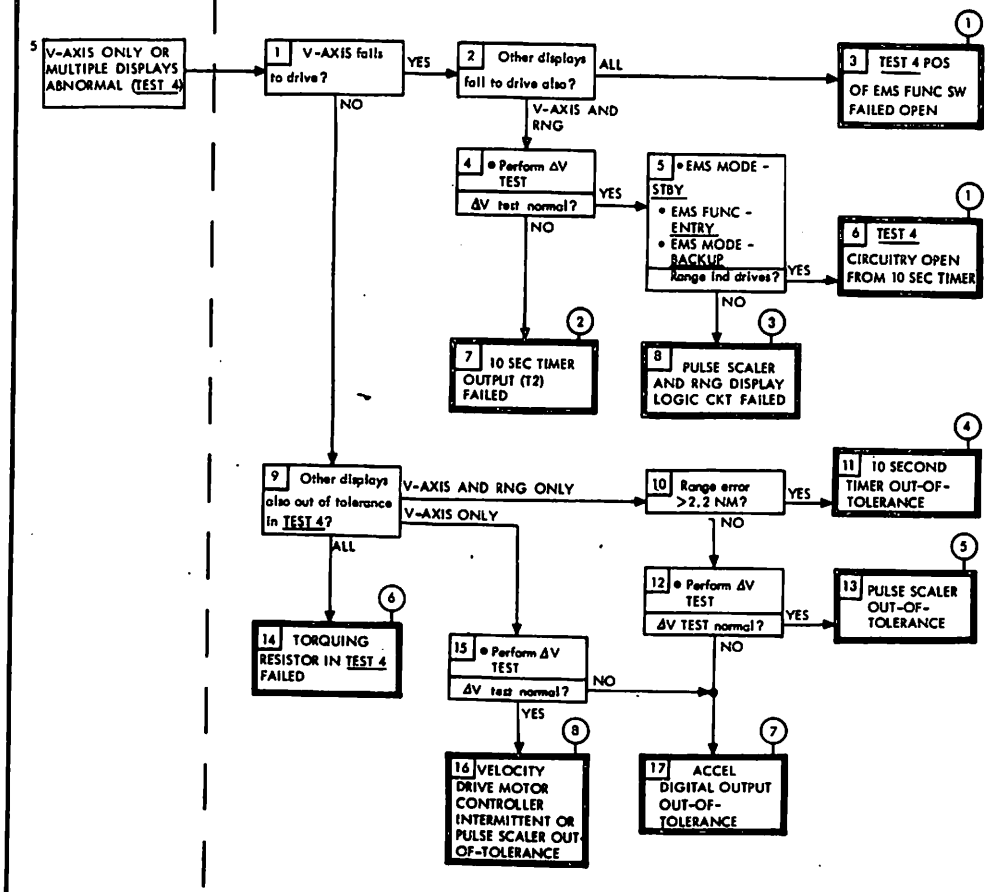
1. EMS FUNC - TEST 1 capability lost only.
2. RNG SET capability lost. SCS ΔV possible only if ΔV display is driven positive by placing the GTA sw - on (up), then - off (down) at the desired value. G&N or ΔV maneuver with the SPS THRUST - DIR ON can be monitored by the change in the ΔV display (down to -9999 fps). Vo can be set by using EMS FUNC - TEST 4 (repeatedly if necessary), stopping the V drive at the desired value by EMS FUNC - TEST 5. No backup capability available.
3. EMS lost for ENTRY except threshold, corridor, and EMS RSI. ΔV functions unaffected.



1. ENTRY functions of EMS inoperative except EMS RSI. ΔV functions unaffected.
2. EMS FUNC - TEST 2 inoperative.
3. EMS operation unaffected. RNG ind operation is indication of .05 G.


SYMPTOM
PROCEDURE
REMARKS
4 LIFT VECTOR DN LT WILL NOT COME ON (TEST 3)
1 Lift vector up lt on in TEST 3?
YES
NO
Warning
Do not use corridor verification lights during entry
1
2 CORRIDOR COMPARATOR OR TORQUING RESISTOR IN TEST 3 FAILED
3 RANGE ind slews in TEST 3?
YES
NO
4 V-AXIS and RNG ind drives in TEST 4?
NO
YES
5 • EMS MODE - STBY • EMS FUNC - ENTRY • EMS MODE - BACKUP
Range display drives negative?
YES
NO
2
6 10 SEC TIMER OR TIMER CIRCUITRY FAILED
3
7 ENTRY AND 10 SEC TIMER IMPLEMENTING GATE FAILED
8 Lift vector up lt on in TEST 5?
NO
YES
4
9 CORRIDOR VERIFICATION CIRCUITRY OR SCROLL 2 G SW FAILED OPEN
5
11 RNG ind initialization
Before proceeding with TEST 4:
• EMS MODE - STBY
• EMS FUNC - TEST 5
• EMS FUNC - TEST 3
• EMS MODE - NORM
• Continue self tests
6
10 TEST 3 POS OF EMS FUNC SW FAILED OPEN
7
12 LIFT VECTOR DN LT FAILED OFF
4a RNG IND WILL NOT SLEW (TEST 3)
13 Lift vector dn lt on in TEST 3?
YES
NO
14 ΔV/RNG ind drives in TEST 4?
YES
NO
15 ΔV/RNG ind drives in RNG SET?
YES
NO
8
16 SLEW CIRCUIT FAILED OPEN IN TEST 3
10
17 ΔV/RNG IND FAILED
9
18 ΔV/RNG SLEW CIRCUITRY FAILED
19 Alternate range set
• EMS MODE - STBY
• EMS FUNC - ΔV
• EMS MODE - NORM
• GTA - on (up)
• GTA - off (down) when desired range is in ΔV/RNG ind
• EMS MODE - STBY
1 There is no method of distinguishing between these failures.
2 Corridor verification, ΔV TEST, TEST 3, TEST 4, and TEST 5 inoperative. EMS operational during entry, but accelerometer accuracy can be verified for confidence by comparsion with a CMC ΔV.
3 ENTRY functions of EMS inoperative except EMS RSI ΔV functions unaffected.
4 Corridor verification lts inoperative or invalid during TEST and ENTRY.
5 This step assures initialization of the range integrator for TEST 4.
6 TEST 3 lost. RNG ind may be tested in TEST 4 by noting that the RNG ind drives to negative 58.0 ± .2 NM.
7 Lift vector dn lt lost in TEST 3 and ENTRY. Backup ENTRY information from CMC or MSFN. No lt 10 sec after .05 G could be used to indicate lift vector down.
8 EMS operation unaffected.
9 Normal RNG SET method lost.
10 ΔV RNG ind lost.
SM-2A-1558E

SYMPTOM / PROCEDURE / REMARKS



(1) EMS FUNC - TEST 4 capability lost. EMS operational but accelerometer accuracy can be verified only by performing a ΔV TEST.

(2) TEST 4 and ΔV TEST only lost.

(3) V-axis and range display lost.

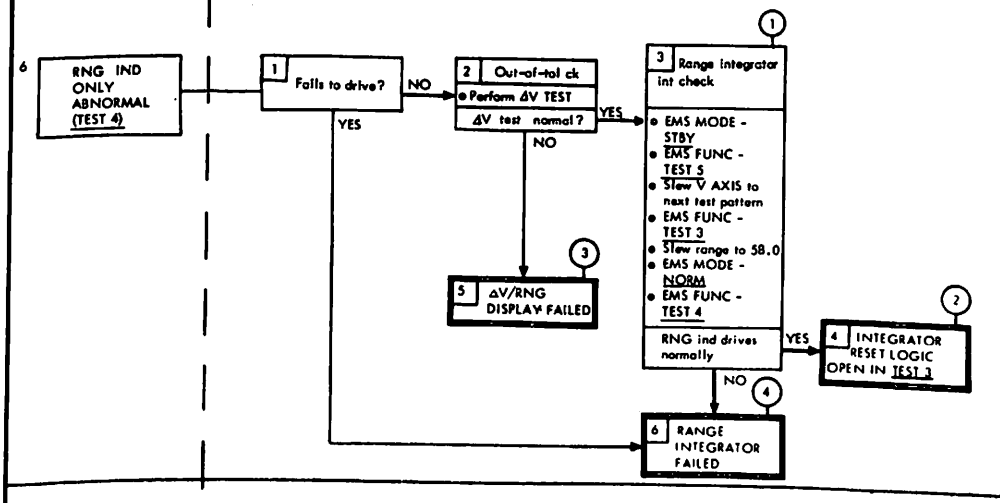
(4) This failure will invalidate the ΔV TEST and TEST 4, except the G-axis display. EMS should be operational but corridor verification erroneous during entry.

(5) V AXIS and RNG information erroneous only.

(6) EMS FUNC - TEST 4 lost but EMS operation during entry should be normal.

(7) V AXIS, ΔV and RNG information erroneous. Other EMS information unaffected. MSFN may be able to supply a correction factor for this error.

(8) There is no method of distinguishing between these two failures. Scroll velocity information will be erroneous. Range readout of uncertain validity.

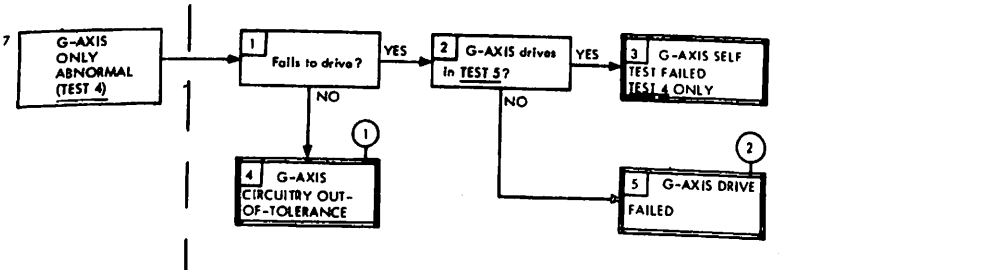


(1) This check constrained by test pattern availability.

(2) EMS ENTRY and ΔV functions unaffected.

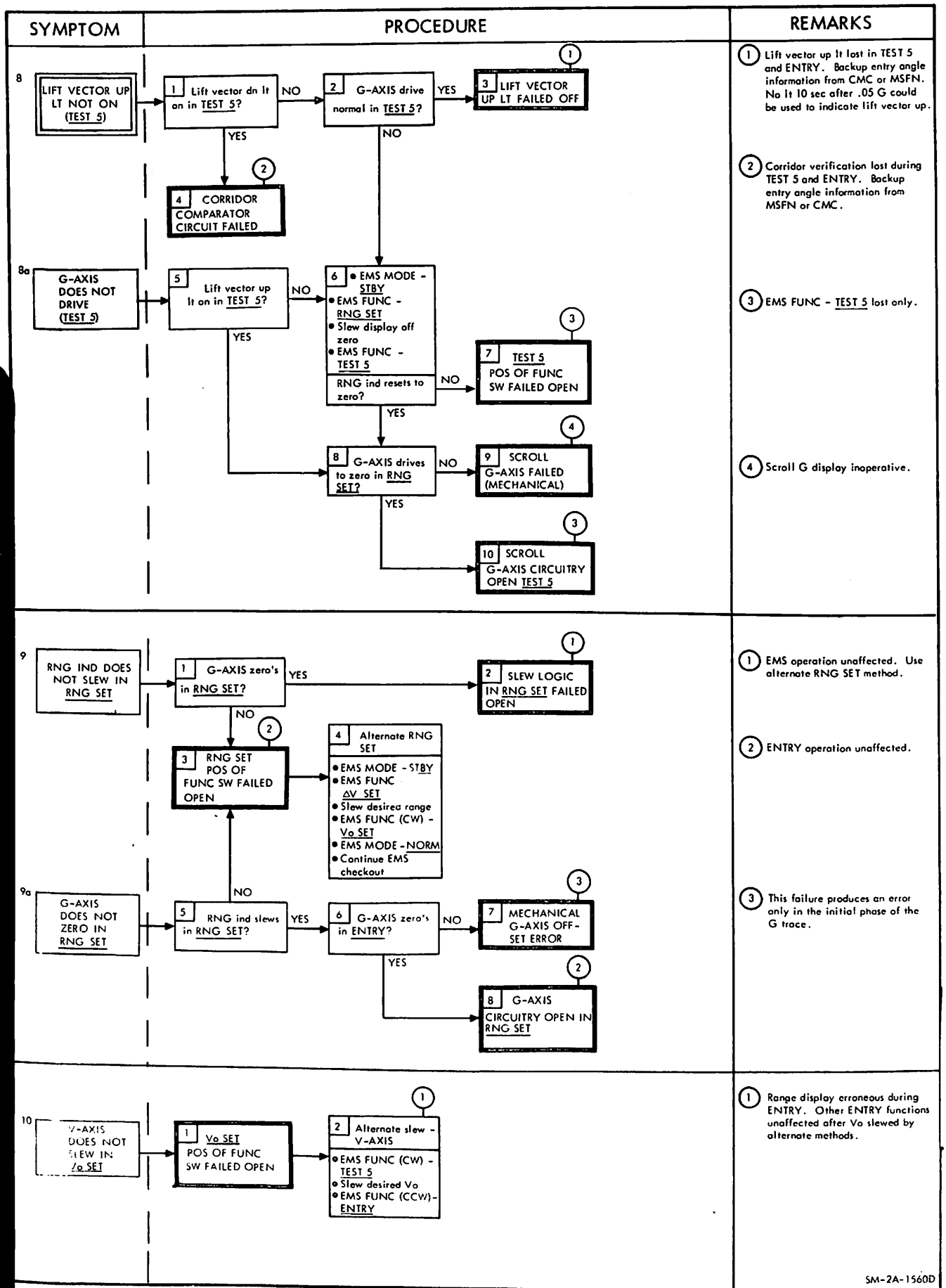
(3) RNG and ΔV displays lost.

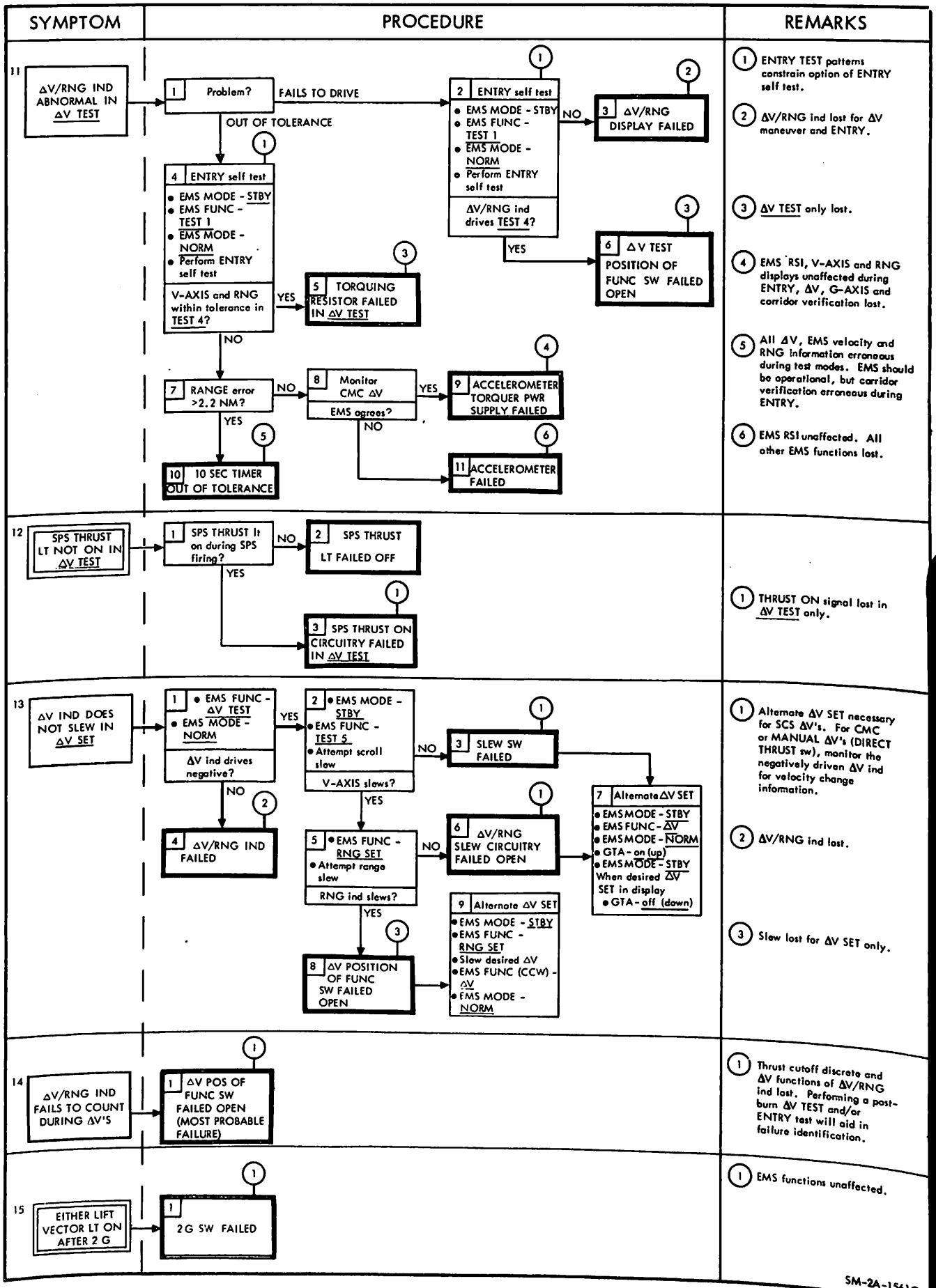
(4) RNG display lost.



(1) Scroll G display erroneous.

(2) Scroll G display lost. Backup G information from CMC or G meter.


SYMPTOM
PROCEDURE
REMARKS
8
LIFT VECTOR UP LT NOT ON (TEST 5)
1 Lift vector dn lt on in TEST 5?
NO
2 G-AXIS drive normal in TEST 5?
YES
3 LIFT VECTOR UP LT FAILED OFF
YES
NO
4 CORRIDOR COMPARATOR CIRCUIT FAILED
8a
G-AXIS DOES NOT DRIVE (TEST 5)
5 Lift vector up lt on in TEST 5?
NO
6 • EMS MODE - STBY • EMS FUNC - RNG SET • Slew display off zero • EMS FUNC - TEST 5
RNG ind resets to zero?
NO
7 TEST 5 POS OF FUNC SW FAILED OPEN
YES
8 G-AXIS drives to zero in RNG SET?
NO
9 SCROLL G-AXIS FAILED (MECHANICAL)
YES
10 SCROLL G-AXIS CIRCUITRY OPEN TEST 5
1 Lift vector up lt lost in TEST 5 and ENTRY. Backup entry angle information from CMC or MSFN. No lt 10 sec after .05 G could be used to indicate lift vector up.
2 Corridor verification lost during TEST 5 and ENTRY. Backup entry angle information from MSFN or CMC.
3 EMS FUNC - TEST 5 lost only.
4 Scroll G display inoperative.
9
RNG IND DOES NOT SLEW IN RNG SET
1 G-AXIS zero's in RNG SET?
YES
2 SLEW LOGIC IN RNG SET FAILED OPEN
NO
3 RNG SET POS OF FUNC SW FAILED OPEN
4 Alternate RNG SET
• EMS MODE - STBY • EMS FUNC ΔV SET • Slew desired range • EMS FUNC (CW) - Vo SET • EMS MODE - NORM • Continue EMS checkout
9a
G-AXIS DOES NOT ZERO IN RNG SET
5 RNG ind slews in RNG SET?
NO
YES
6 G-AXIS zero's in ENTRY?
NO
7 MECHANICAL G-AXIS OFF-SET ERROR
YES
8 G-AXIS CIRCUITRY OPEN IN RNG SET
1 EMS operation unaffected. Use alternate RNG SET method.
2 ENTRY operation unaffected.
3 This failure produces an error only in the initial phase of the G trace.
10
V-AXIS DOES NOT SLEW IN Vo SET
1 Vo SET POS OF FUNC SW FAILED OPEN
2 Alternate slew - V-AXIS
• EMS FUNC (CW) - TEST 5 • Slew desired Vo • EMS FUNC (CCW) - ENTRY
1 Range display erroneous during ENTRY. Other ENTRY functions unaffected after Vo slewed by alternate methods.


SYMPTOM
PROCEDURE
REMARKS
11
ΔV/RNG IND ABNORMAL IN ΔV TEST
1 Problem?
FAILS TO DRIVE
OUT OF TOLERANCE
2 ENTRY self test
• EMS MODE - STBY
• EMS FUNC - TEST 1
• EMS MODE - NORM
• Perform ENTRY self test
ΔV/RNG ind drives TEST 4?
NO
3 ΔV/RNG DISPLAY FAILED
YES
6 ΔV TEST POSITION OF FUNC SW FAILED OPEN
4 ENTRY self test
• EMS MODE - STBY
• EMS FUNC - TEST 1
• EMS MODE - NORM
• Perform ENTRY self test
V-AXIS and RNG within tolerance in TEST 4?
YES
5 TORQUING RESISTOR FAILED IN ΔV TEST
NO
7 RANGE error >2.2 NM?
NO
8 Monitor CMC ΔV
EMS agrees?
YES
9 ACCELEROMETER TORQUER PWR SUPPLY FAILED
NO
11 ACCELEROMETER FAILED
YES
10 10 SEC TIMER OUT OF TOLERANCE
1 ENTRY TEST patterns constrain option of ENTRY self test.
2 ΔV/RNG ind lost for ΔV maneuver and ENTRY.
3 ΔV TEST only lost.
4 EMS RSI, V-AXIS and RNG displays unaffected during ENTRY, ΔV, G-AXIS and corridor verification lost.
5 All ΔV, EMS velocity and RNG information erroneous during test modes. EMS should be operational, but corridor verification erroneous during ENTRY.
6 EMS RSI unaffected. All other EMS functions lost.
11 THRU 15
12
SPS THRUST LT NOT ON IN ΔV TEST
1 SPS THRUST lt on during SPS firing?
NO
2 SPS THRUST LT FAILED OFF
YES
3 SPS THRUST ON CIRCUITRY FAILED IN ΔV TEST
1 THRUST ON signal lost in ΔV TEST only.
13
ΔV IND DOES NOT SLEW IN ΔV SET
1 • EMS FUNC - ΔV TEST
• EMS MODE - NORM
ΔV ind drives negative?
YES
2 • EMS MODE - STBY
• EMS FUNC - TEST 5
• Attempt scroll slew
V-AXIS slews?
NO
3 SLEW SW FAILED
NO
4 ΔV/RNG IND FAILED
YES
5 • EMS FUNC - RNG SET
• Attempt range slew
RNG ind slews?
NO
6 ΔV/RNG SLEW CIRCUITRY FAILED OPEN
YES
8 ΔV POSITION OF FUNC SW FAILED OPEN
7 Alternate ΔV SET
• EMS MODE - STBY
• EMS FUNC - ΔV
• EMS MODE - NORM
• GTA - on (up)
• EMS MODE - STBY
When desired ΔV SET in display
• GTA - off (down)
9 Alternate ΔV SET
• EMS MODE - STBY
• EMS FUNC - RNG SET
• Slew desired ΔV
• EMS FUNC (CCW) - ΔV
• EMS MODE - NORM
1 Alternate ΔV SET necessary for SCS ΔV's. For CMC or MANUAL ΔV's (DIRECT THRUST sw), monitor the negatively driven ΔV ind for velocity change information.
2 ΔV/RNG ind lost.
3 Slew lost for ΔV SET only.
14
ΔV/RNG IND FAILS TO COUNT DURING ΔV'S
1 ΔV POS OF FUNC SW FAILED OPEN (MOST PROBABLE FAILURE)
1 Thrust cutoff discrete and ΔV functions of ΔV/RNG ind lost. Performing a post-burn ΔV TEST and/or ENTRY test will aid in failure identification.
15
EITHER LIFT VECTOR LT ON AFTER 2 G
1 2G SW FAILED
1 EMS functions unaffected.

THIS PAGE
INTENTIONALLY
LEFT BLANK

THIS PAGE
INTENTIONALLY
LEFT BLANK

DOCK AND HATCH MALFUNCTION INDEX

DOCKING

1 DOCK PROBE WILL NOT FOLD

2 DOCK PROBE EXTD/REL tb A (B) REMAINS GRAY AFTER CAPTURE (TLD ONLY)

HATCH

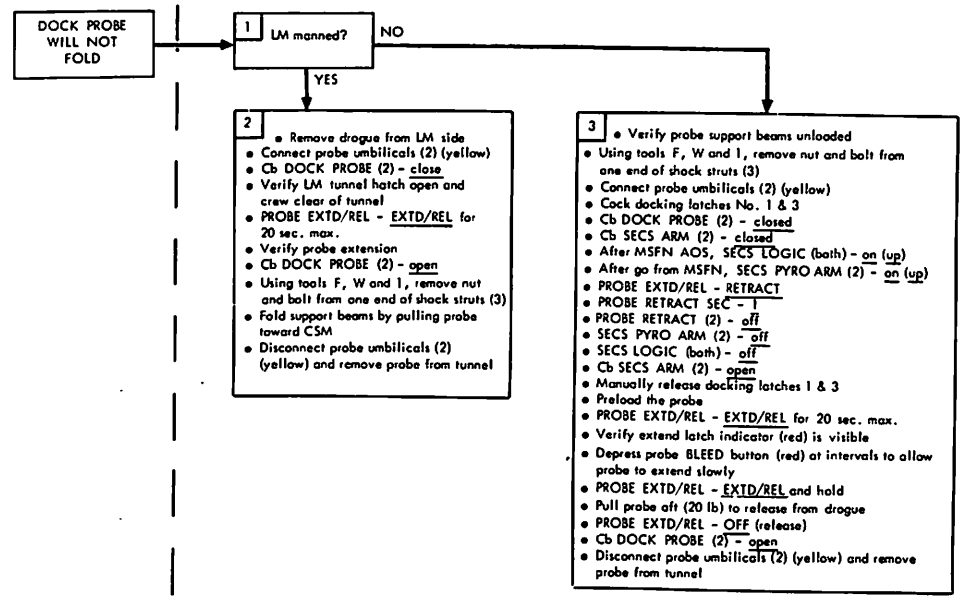
1 FWD HATCH WILL NOT UNLATCH

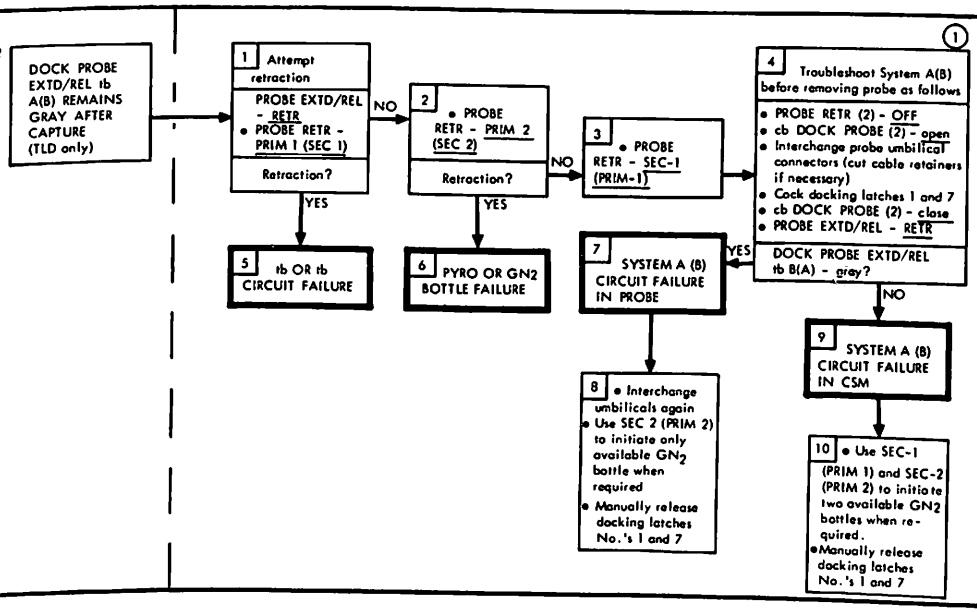
2 FWD HATCH WILL NOT LATCH

D1 THRU H2

SYMPTOM	PROCEDURE	REMARKS

DOCKING





(1) Probe telemetry will be lost when probe umbilicals are interchanged.

SYMPTOM	PROCEDURE	REMARKS

HATCH

1 FWD HATCH WILL NOT UNLATCH

1 Does actr handle drive clutch engage gearbox?

NO → 2 Assume failure of actr handle to engage and drive gearbox

YES → 3 Assume failure is frozen gearbox.

2 → 4
- Unstow actr handle and push to stop to unlock gearbox
- AUX LATCH DRIVE - rotate 113° (use tool B)
- Remove tool B and verify hatch unlatch

3 → 5
- Remove gearbox mounting screws (3) and spacers (use tools Wand 4)
- Unstow actr handle and rotate away from hatch approx 30°
- Push actr handle outboard rotating gearbox approx 40° CCW to release latches
- Remove hatch from tunnel

5 → 6 To reinstall hatch
- Align hatch in tunnel
- Rotate gearbox approx 40° CW and reinstall gearbox mounting screws (3)

2 FWD HATCH WILL NOT LATCH

1
- Remove hatch to CM cabin
- Attempt to latch mechanism

Does actr handle drive gearbox?

NO → 2 Gearbox frozen
- Gearbox disconnect - 180° CCW (tool B)
- Position hatch in tunnel
- AUX LATCH DRIVE - LATCH (113° CW - tool B)
- Verify hatch latched, remove tool B (cannot remove hatch from LM side)

YES → 3 Frozen latch
- Inspect to identify frozen latch(es)
- Remove dome nuts from long pivot screws of frozen latch. (Use tools F, W, 2 and 4)
- Remove long pivot screws and rotate latch dog to clear striker plate
- Unlatch mechanism
- Install hatch

SM-2A-20538

THIS PAGE
INTENTIONALLY
LEFT BLANK

CAMERA MALFUNCTION INDEX

16mm

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

70mm

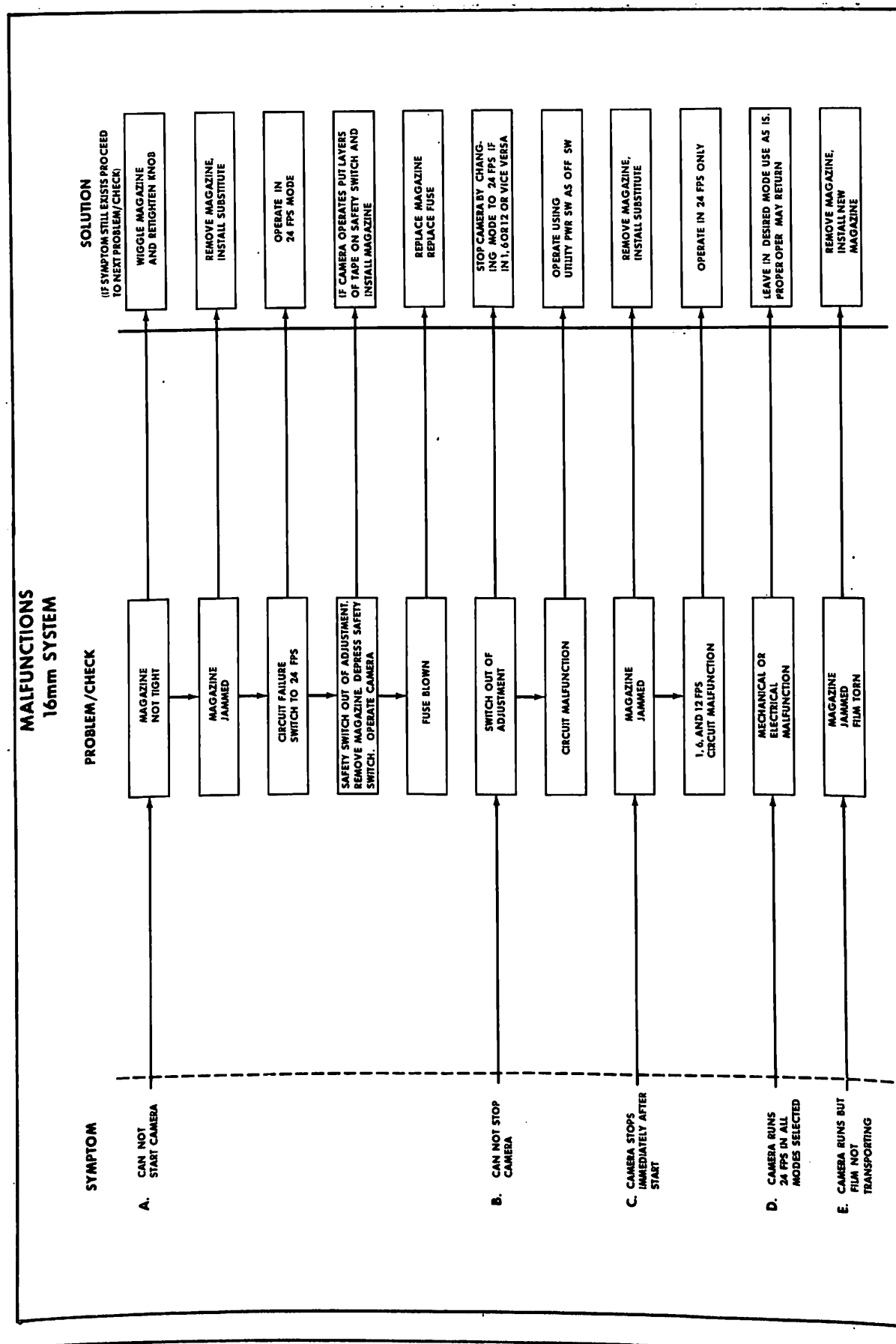
I CAMERA WITH MAGAZINE
- A SHUTTER FIRES/NO FILM ADVANCE
- B NO CAMERA ACTION/BUTTON CYCLED
- C SHUTTER FIRES/PARTIAL FILM ADVANCE
- D CANNOT ATTACH LENS

II CAMERA ONLY
- A NO CAMERA ACTION/BUTTON CYCLED

III INTERVALOMETER WITH CAMERA AND MAGAZINE
- A CAMERA DOES NOT CYCLE

LUNAR TOPOGRAPHIC CAMERA

POWER ON LIGHT NOT ILLUMINATED
MOTORS NOT OPERATING
END OF FILM LIGHT ILLUMINATED BEFORE FILM IS EXPENDED
FRAMES REMAIN INDICATOR NOT COUNTING END OF FILM LIGHT OFF
FILM ADVANCE SWITCH NOT OPERATING
CAMERA CYCLING RATE INCORRECT
SINGLE FRAME NOT OPERABLE
SPOOL LOCK KNOB INDICATORS ON MAGAZINE NOT ROTATING WHEN FRAMES REMAIN CHANGES
END OF FILM LIGHT NEVER ILLUMINATES
NO FMC, CAMERA MOVEMENT

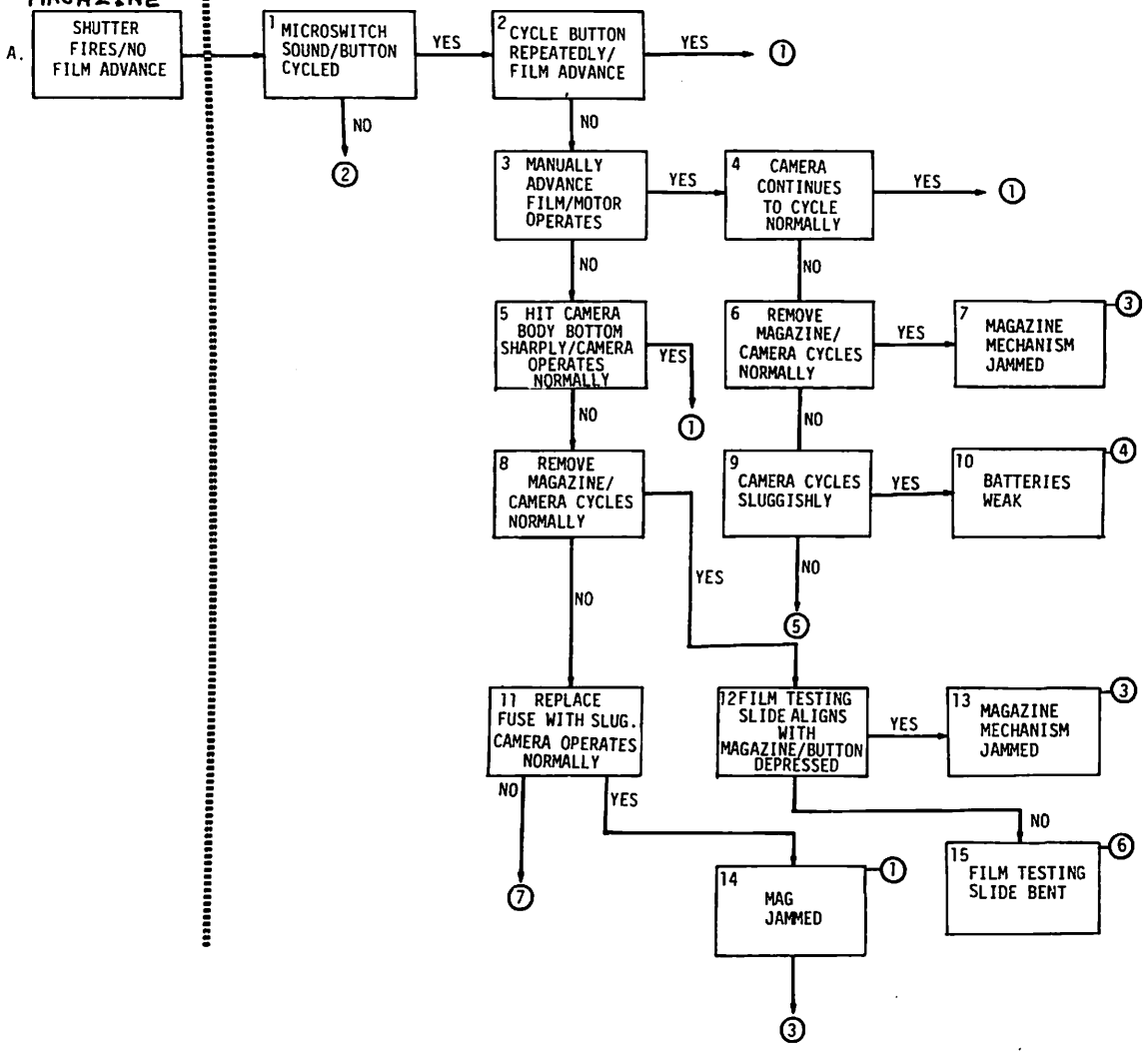

MALFUNCTIONS
16mm SYSTEM
SYMPTOM
PROBLEM/CHECK
SOLUTION
(IF SYMPTOM STILL EXISTS PROCEED TO NEXT PROBLEM/CHECK)
A. CAN NOT START CAMERA
MAGAZINE NOT TIGHT
WIGGLE MAGAZINE AND RETIGHTEN KNOB
MAGAZINE JAMMED
REMOVE MAGAZINE, INSTALL SUBSTITUTE
CIRCUIT FAILURE SWITCH TO 24 FPS
OPERATE IN 24 FPS MODE
SAFETY SWITCH OUT OF ADJUSTMENT. REMOVE MAGAZINE. DEPRESS SAFETY SWITCH. OPERATE CAMERA
IF CAMERA OPERATES PUT LAYERS OF TAPE ON SAFETY SWITCH AND INSTALL MAGAZINE
FUSE BLOWN
REPLACE MAGAZINE REPLACE FUSE
B. CAN NOT STOP CAMERA
SWITCH OUT OF ADJUSTMENT
STOP CAMERA BY CHANGING MODE TO 24 FPS IF IN 1, 6 OR 12 OR VICE VERSA
CIRCUIT MALFUNCTION
OPERATE USING UTILITY PWR SW AS OFF SW
C. CAMERA STOPS IMMEDIATELY AFTER START
MAGAZINE JAMMED
REMOVE MAGAZINE, INSTALL SUBSTITUTE
1, 6, AND 12 FPS CIRCUIT MALFUNCTION
OPERATE IN 24 FPS ONLY
D. CAMERA RUNS 24 FPS IN ALL MODES SELECTED
MECHANICAL OR ELECTRICAL MALFUNCTION
LEAVE IN DESIRED MODE USE AS IS. PROPER OPER MAY RETURN
E. CAMERA RUNS BUT FILM NOT TRANSPORTING
MAGAZINE JAMMED FILM TORN
REMOVE MAGAZINE, INSTALL NEW MAGAZINE

70mm CAMERA MALFUNCTIONS

PROCEDURES

SYMPTOM

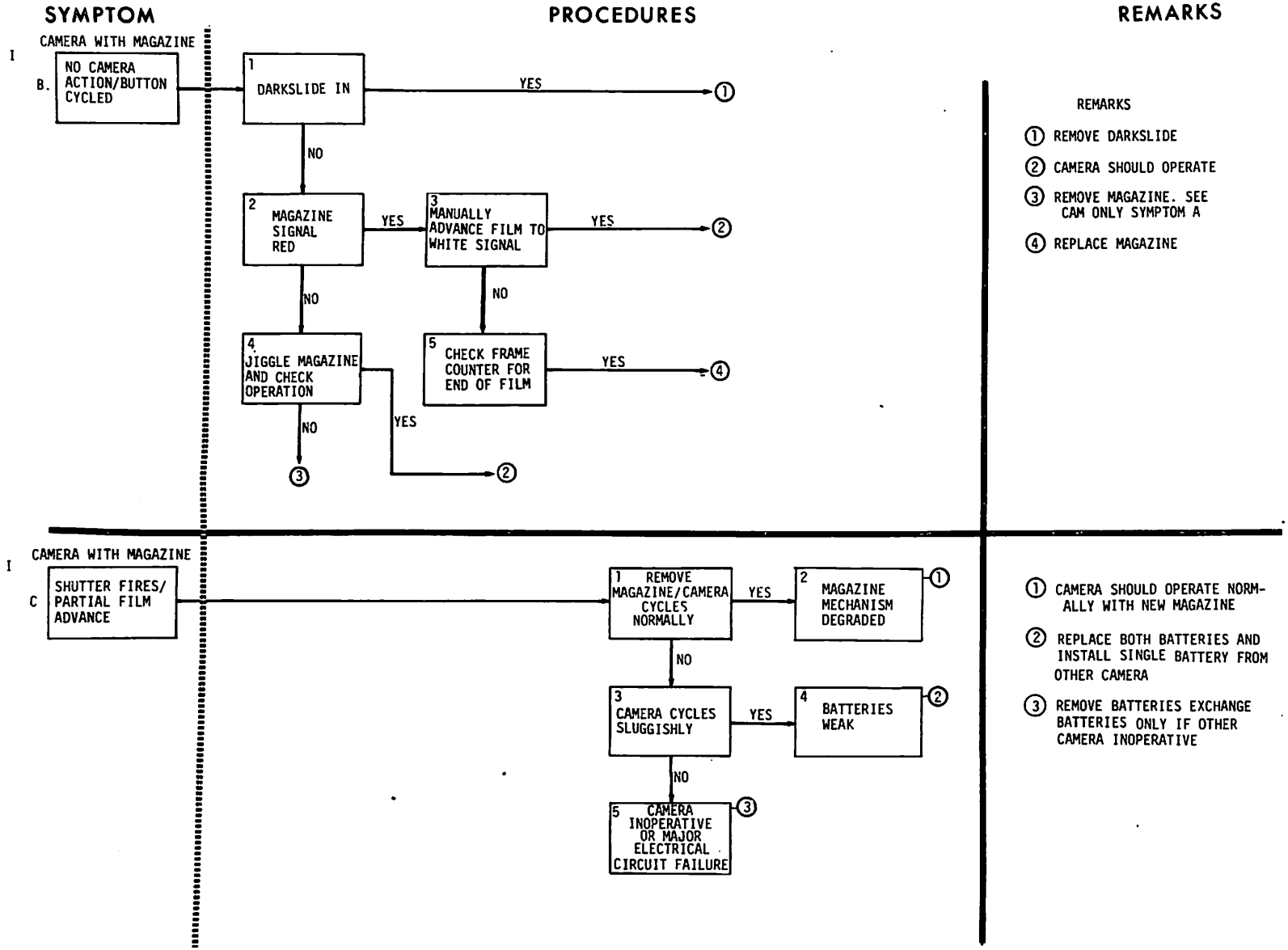
I. CAMERA WITH MAGAZINE



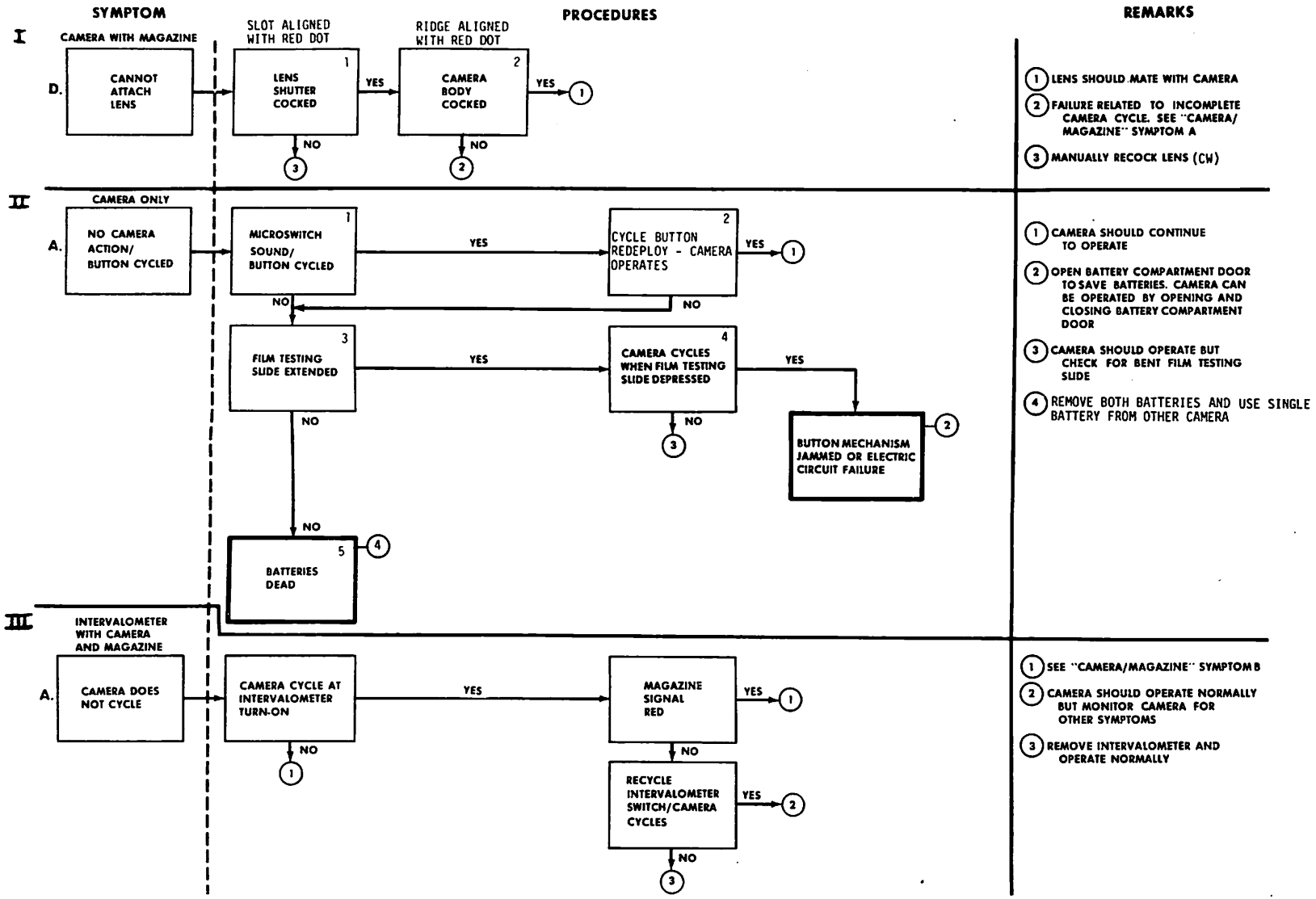
REMARKS

1. CAM SHOULD CONTINUE TO OPERATE BUT MONITOR OPERATION CLOSELY AS FAILURE CAN REOCCUR
2. REMOVE MAGAZINE AND SEE SYMPTOM A UNDER "CAMERA ONLY" SECTION
3. CAMERA SHOULD OPERATE NORMALLY WITH NEW MAGAZINE
4. REPLACE BOTH BATTERIES
5. IMPROBABLE FAILURE MODE
6. ATTEMPT TO STRAIGHTEN FILM TESTING SLIDE AND CYCLE CAMERA/MAGAZINE
7. CAMERA INOPERATIVE

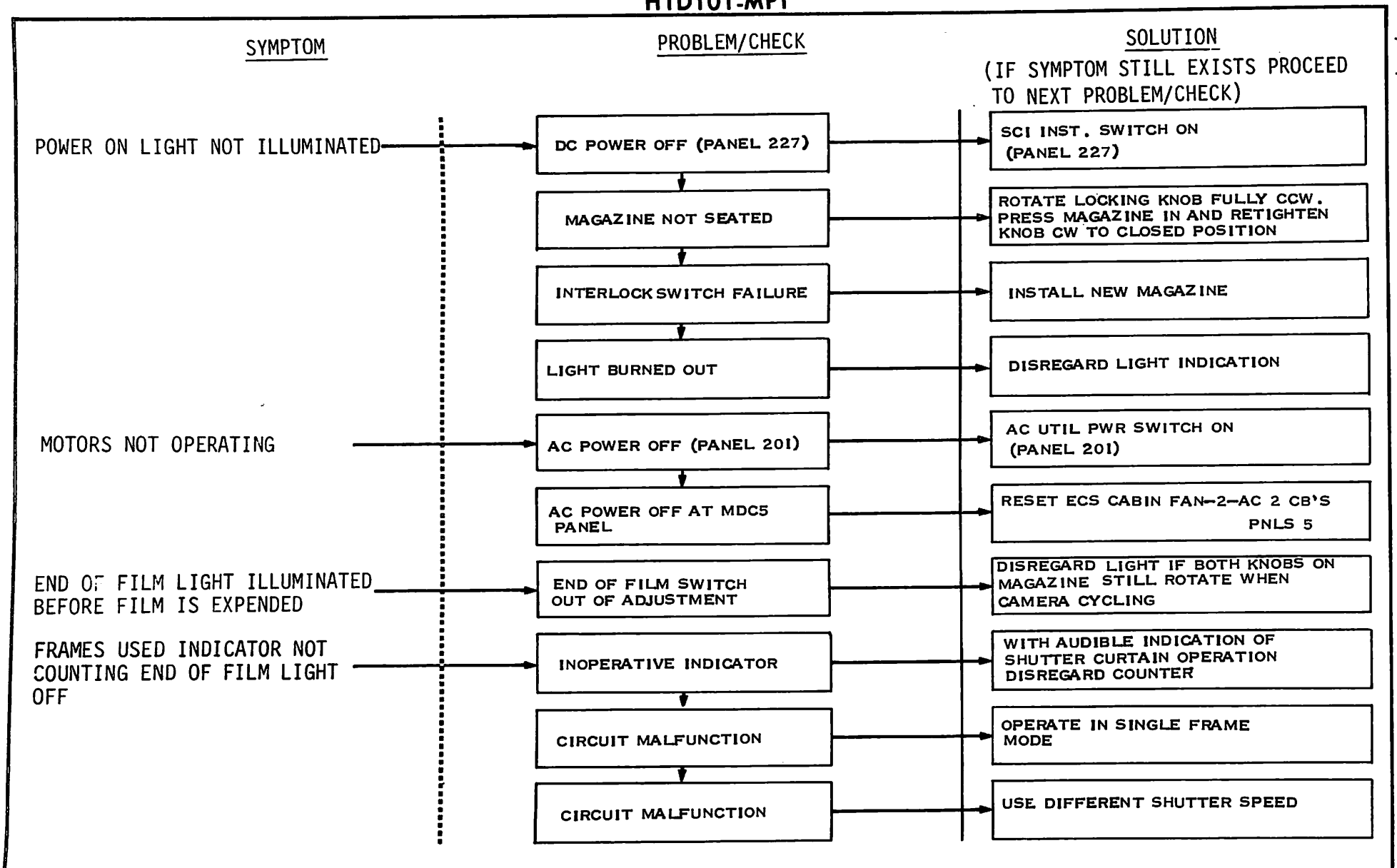
70mm CAMERA MALFUNCTIONS

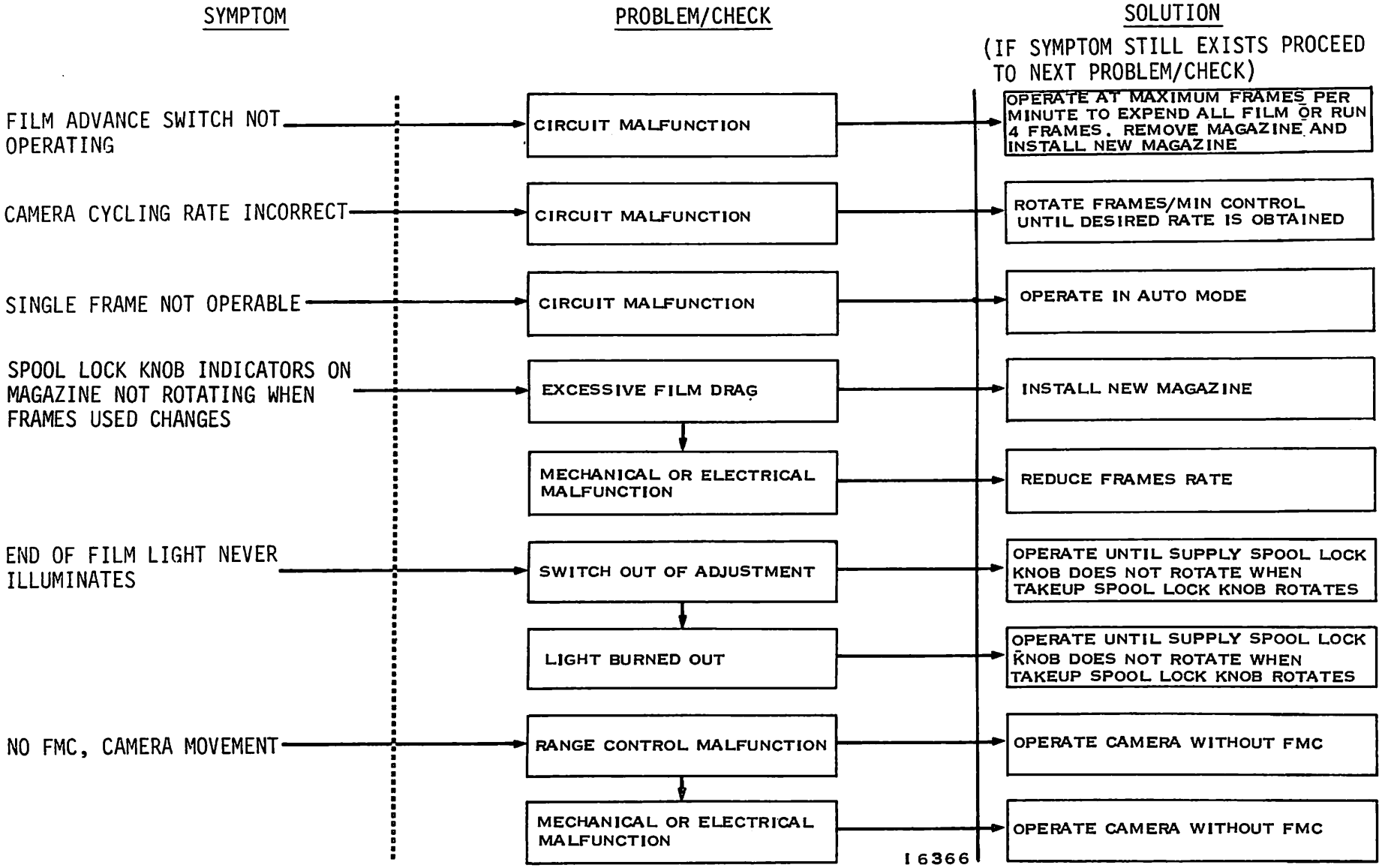


70mm CAMERA MALFUNCTIONS



PROCEDURE FOR: LUNAR TOPOGRAPHIC CAMERA (LTC) SYSTEM MALFUNCTIONS
HTD101-MP1




SYMPTOM
PROBLEM/CHECK
SOLUTION
(IF SYMPTOM STILL EXISTS PROCEED TO NEXT PROBLEM/CHECK)
FILM ADVANCE SWITCH NOT OPERATING
CIRCUIT MALFUNCTION
OPERATE AT MAXIMUM FRAMES PER MINUTE TO EXPEND ALL FILM OR RUN 4 FRAMES. REMOVE MAGAZINE AND INSTALL NEW MAGAZINE
CAMERA CYCLING RATE INCORRECT
CIRCUIT MALFUNCTION
ROTATE FRAMES/MIN CONTROL UNTIL DESIRED RATE IS OBTAINED
SINGLE FRAME NOT OPERABLE
CIRCUIT MALFUNCTION
OPERATE IN AUTO MODE
SPOOL LOCK KNOB INDICATORS ON MAGAZINE NOT ROTATING WHEN FRAMES USED CHANGES
EXCESSIVE FILM DRAG
INSTALL NEW MAGAZINE
MECHANICAL OR ELECTRICAL MALFUNCTION
REDUCE FRAMES RATE
END OF FILM LIGHT NEVER ILLUMINATES
SWITCH OUT OF ADJUSTMENT
OPERATE UNTIL SUPPLY SPOOL LOCK KNOB DOES NOT ROTATE WHEN TAKEUP SPOOL LOCK KNOB ROTATES
LIGHT BURNED OUT
OPERATE UNTIL SUPPLY SPOOL LOCK KNOB DOES NOT ROTATE WHEN TAKEUP SPOOL LOCK KNOB ROTATES
NO FMC, CAMERA MOVEMENT
RANGE CONTROL MALFUNCTION
OPERATE CAMERA WITHOUT FMC
MECHANICAL OR ELECTRICAL MALFUNCTION
OPERATE CAMERA WITHOUT FMC
I 6366

NO.	ITEM ⇨	ACTION	BACKOUT