SKYLAB

CSM MALFUNCTION PROCEDURES

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PREPARED BY: _____

JAMES L. BAKER
BOOK MANAGER

APPROVED BY: _____

JOHN O'NEILL
FLIGHT PLANNING BRANCH
CREW PROCEDURES DIVISION

It is requested that any organization having comments, questions, or suggestions concerning this document contact James L. Baker, Flight Planning Branch, CG5, Building 4, Room 225B, telephone 483-4471.

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ALL SKYLAB MISSIONS

CSM MALFUNCTION PROCEDURES

LIST OF EFFECTIVE PAGES

Basic 2/1/72
Revision A 9/1/72

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G&C

G&C MALFUNCTIONS INDEX

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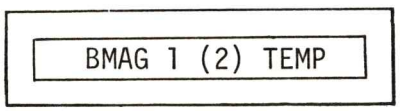
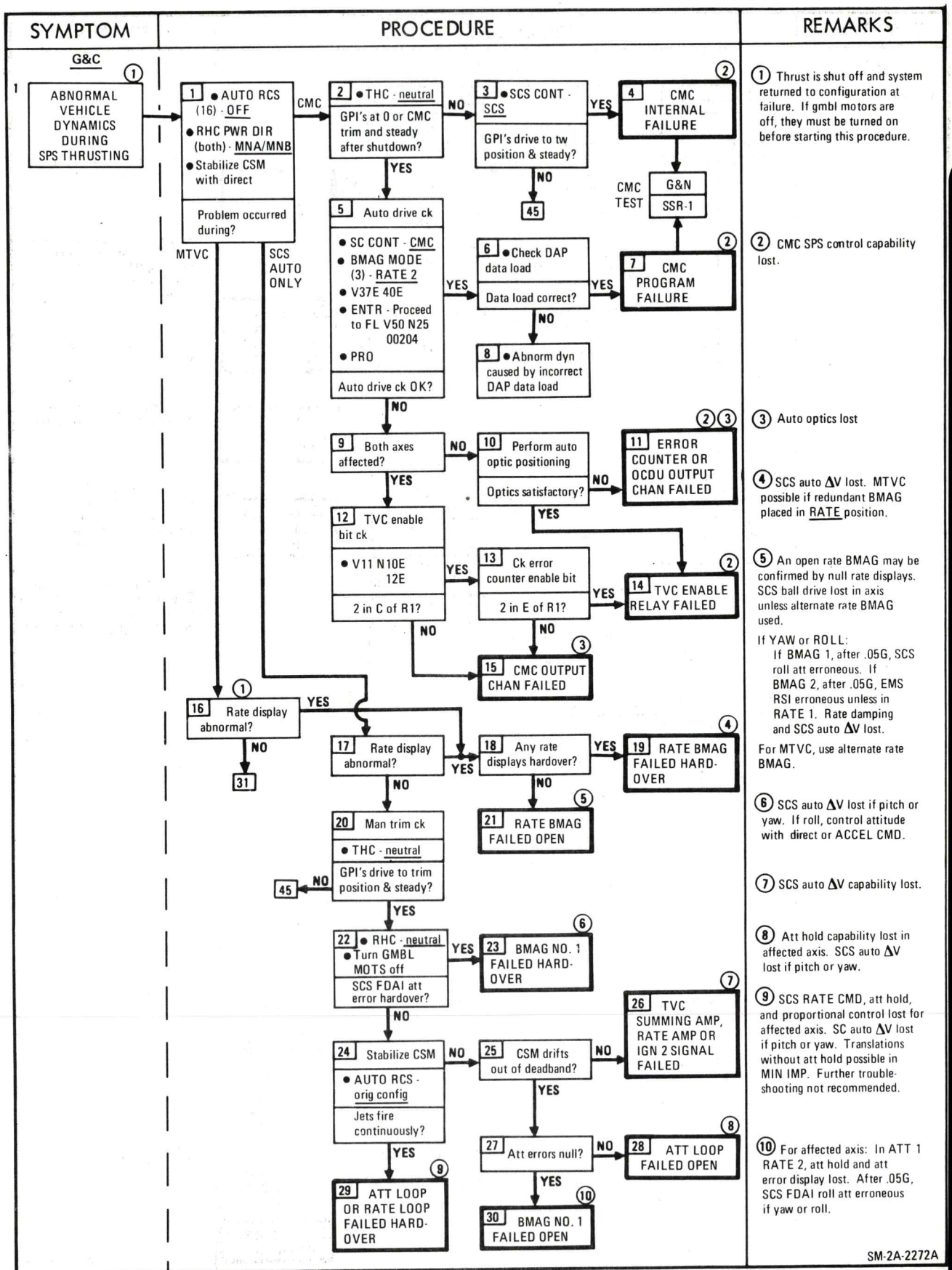
6 FDAI TOTAL ATT DOES NOT RESPOND TO GDC ALIGN

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

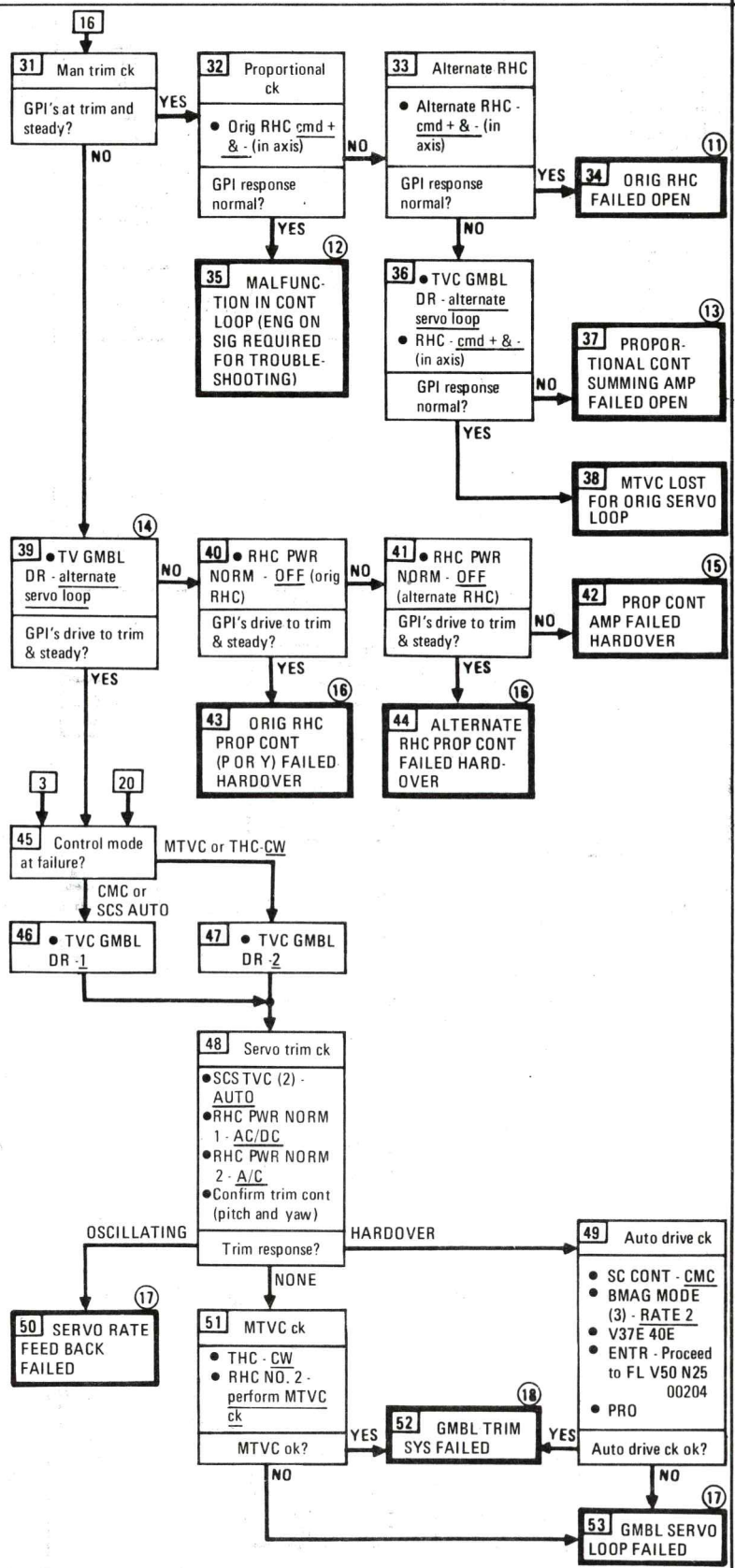
8 

YELLOW

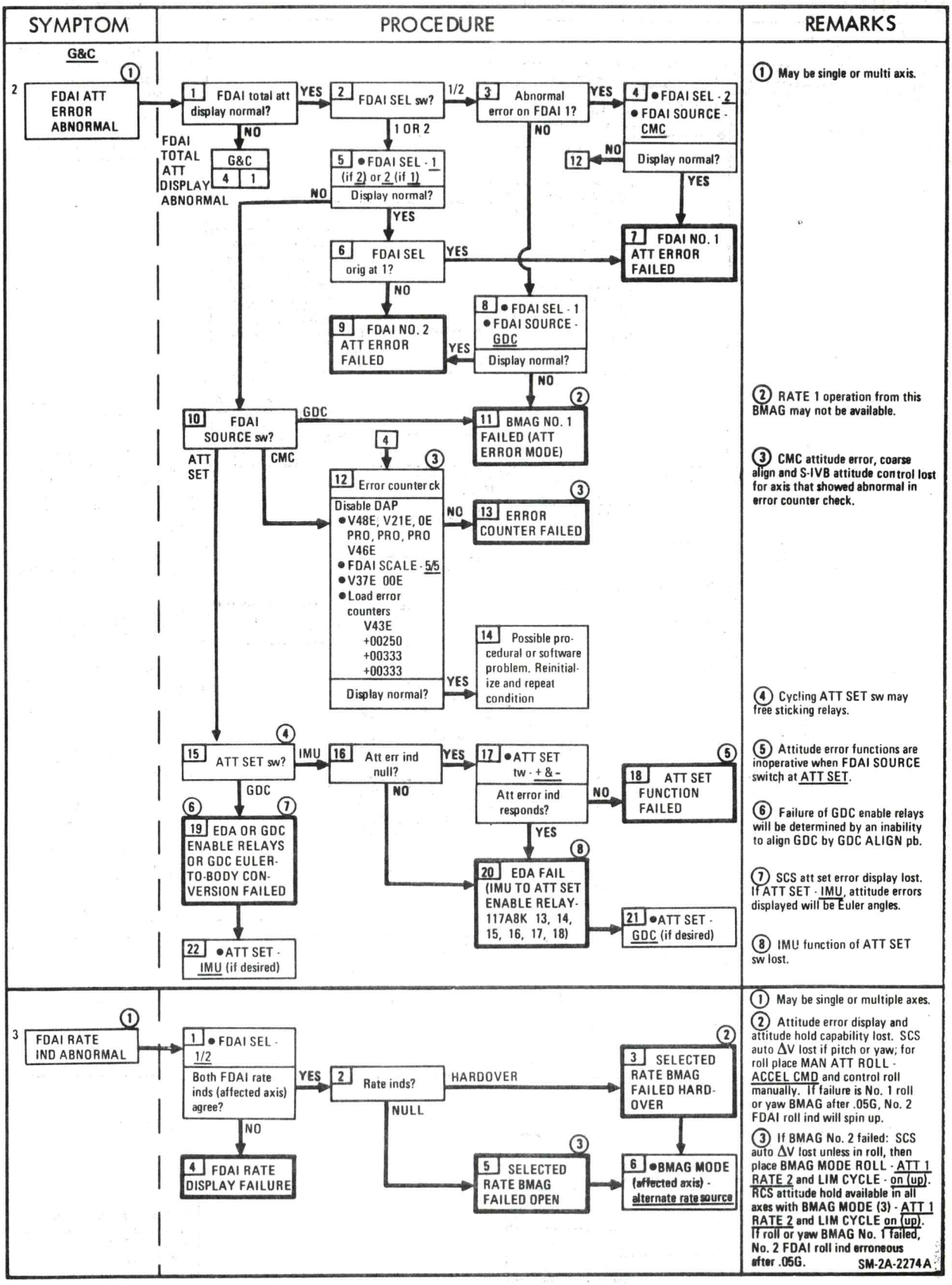
A ABNORMAL VEHICLE DYNAMICS (NON SPS THRUSTING)


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?
CMC
MTVC
SCS AUTO ONLY
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 OCDU 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

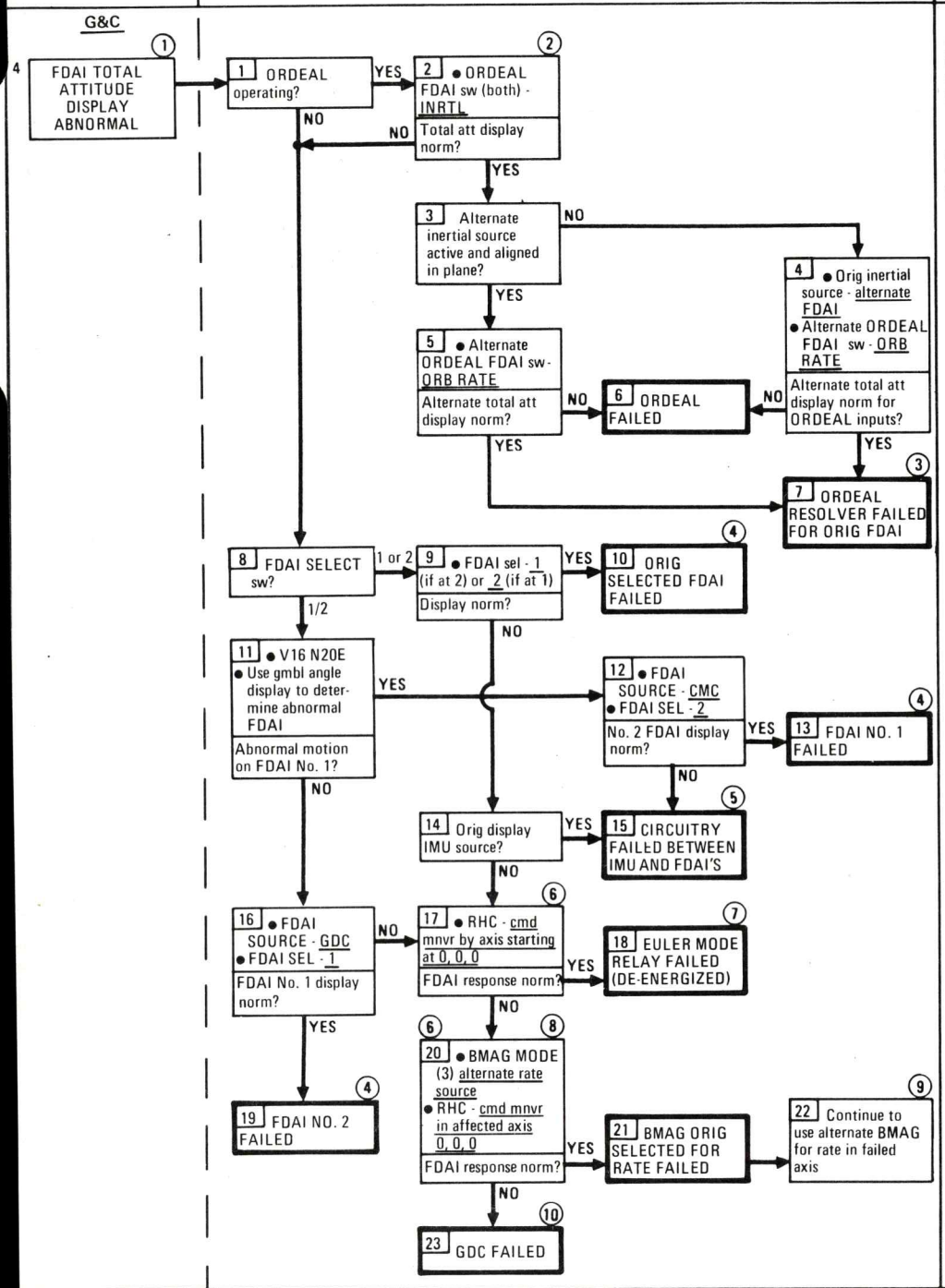
1 (CONT)

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 FDAI total att display normal?
YES
NO
2 FDAI SEL sw?
1/2
1 OR 2
3 Abnormal error on FDAI 1?
YES
NO
4 • FDAI SEL - 2 • FDAI SOURCE - CMC
Display normal?
12
NO
YES
FDAI TOTAL ATT DISPLAY ABNORMAL
G&C 4 1
5 • FDAI SEL - 1 (if 2) or 2 (if 1)
Display normal?
NO
YES
6 FDAI SEL orig at 1?
YES
NO
7 FDAI NO. 1 ATT ERROR FAILED
8 • FDAI SEL - 1 • FDAI SOURCE - GDC
Display normal?
9 FDAI NO. 2 ATT ERROR FAILED
YES
NO
10 FDAI SOURCE sw?
GDC
ATT SET
CMC
11 BMAG NO. 1 FAILED (ATT ERROR MODE)
12 Error counter ck
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
YES
13 ERROR COUNTER FAILED
14 Possible procedural or software problem. Reinitialize and repeat condition
15 ATT SET sw?
IMU
GDC
16 Att err ind null?
YES
NO
17 • ATT SET tw - + & -
Att error ind responds?
NO
YES
18 ATT SET FUNCTION FAILED
19 EDA OR GDC ENABLE RELAYS OR GDC EULER-TO-BODY CONVERSION FAILED
20 EDA FAIL (IMU TO ATT SET ENABLE RELAY-117A8K 13, 14, 15, 16, 17, 18)
21 • ATT SET - GDC (if desired)
22 • ATT SET - IMU (if desired)
3
FDAI RATE IND ABNORMAL
1 • FDAI SEL - 1/2
Both FDAI rate inds (affected axis) agree?
YES
NO
2 Rate inds?
HARDOVER
NULL
3 SELECTED RATE BMAG FAILED HARD-OVER
4 FDAI RATE DISPLAY FAILURE
5 SELECTED RATE BMAG FAILED OPEN
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-2274A

SYMPTOM	PROCEDURE	REMARKS



(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.

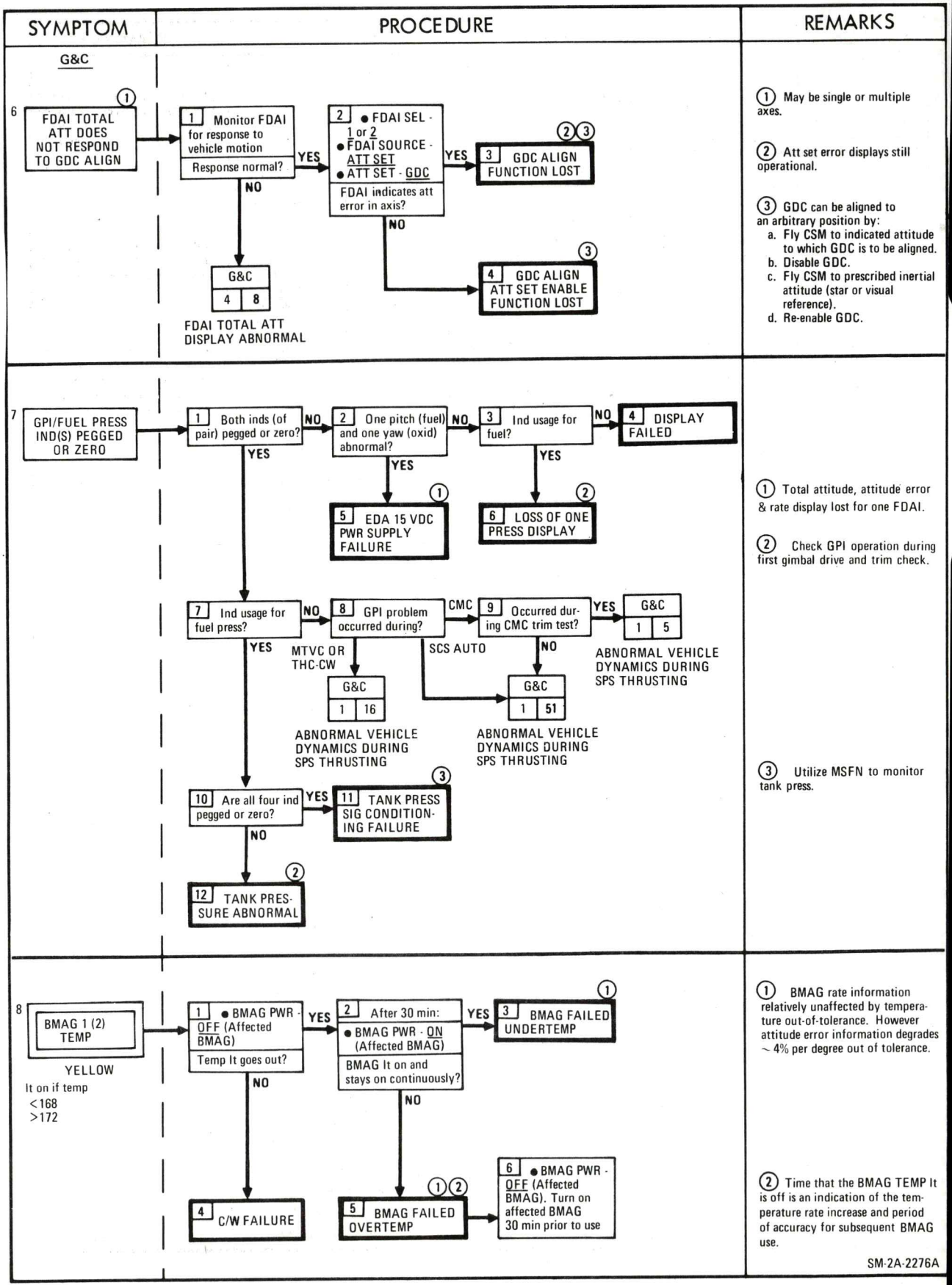
(10) Entry capability can be determined from GDC FDAI roll ind and EMS RSI response when a yaw maneuver is commanded with .05 G sw and EMS ROLL sw - on (up).

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.

SM-2A-2275


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?
MTVC OR THC-CW
CMC
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.
6 THRU 8
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% 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.

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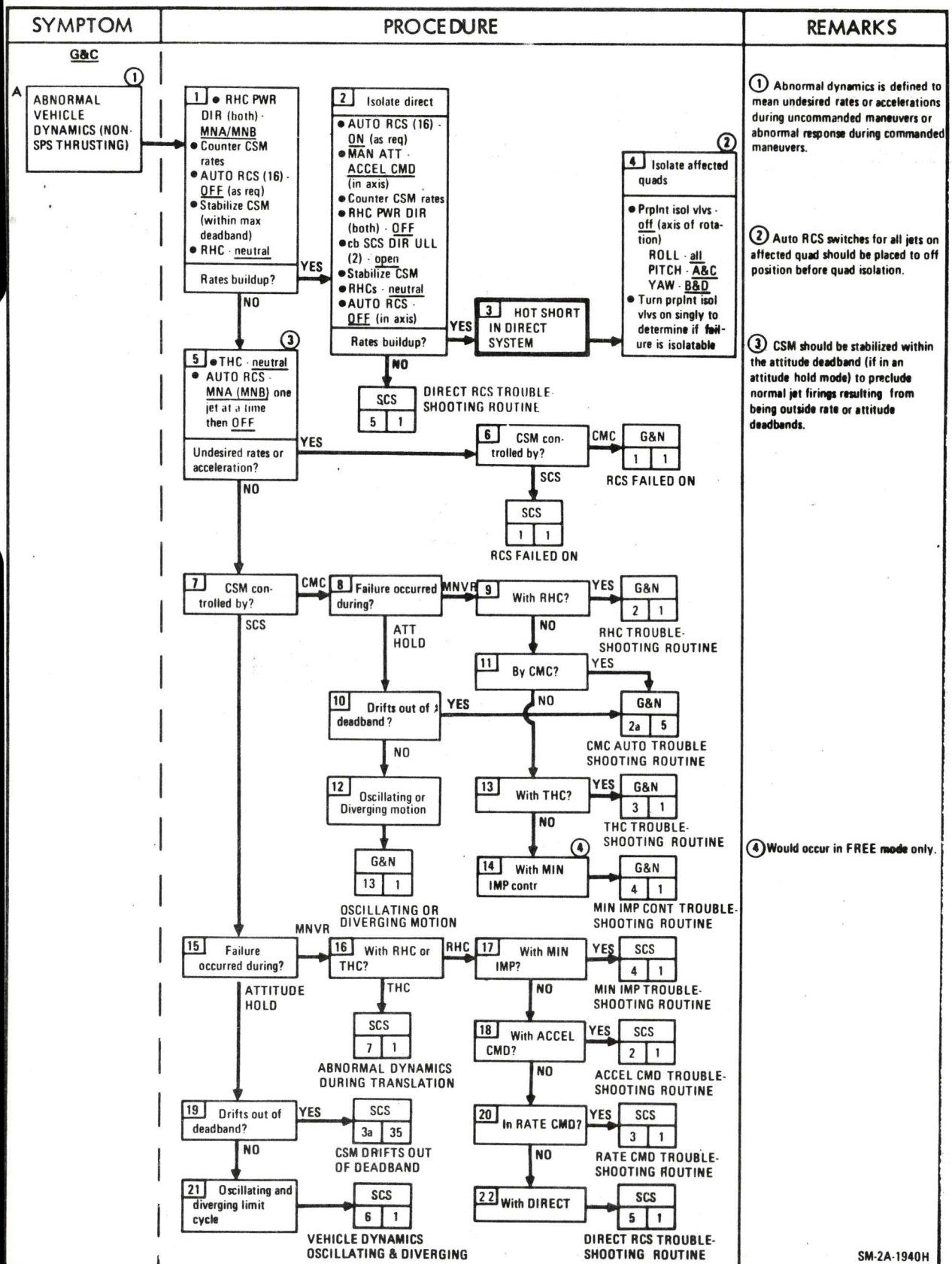
SYMPTOM
PROCEDURE
REMARKS
G&C
A
(1)
ABNORMAL VEHICLE DYNAMICS (NON-SPS THRUSTING)
1 • RHC PWR DIR (both) - MNA/MNB
• Counter CSM rates
• AUTO RCS (16) - OFF (as req)
• Stabilize CSM (within max deadband)
• RHC - neutral
Rates buildup?
YES
NO
2 Isolate direct
• AUTO RCS (16) - ON (as req)
• MAN ATT - 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
• PrpInt isol vlvs - off (axis of rotation)
ROLL - all
PITCH - A&C
YAW - B&D
• Turn prpint isol vlvs on singly to determine if failure is isolatable
(3)
5 • THC - neutral
• AUTO RCS - MNA (MNB) one jet at a time then OFF
Undesired rates or acceleration?
YES
NO
SCS 5 1
DIRECT RCS TROUBLE-SHOOTING ROUTINE
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 Failure occurred during?
MNVR
ATT HOLD
9 With RHC?
YES
G&N 2 1
RHC TROUBLE-SHOOTING ROUTINE
NO
11 By CMC?
YES
NO
10 Drifts out of deadband?
YES
NO
G&N 2a 5
CMC AUTO TROUBLE SHOOTING ROUTINE
12 Oscillating or Diverging motion
G&N 13 1
OSCILLATING OR DIVERGING MOTION
13 With THC?
YES
G&N 3 1
THC TROUBLE-SHOOTING ROUTINE
NO
(4)
14 With MIN IMP contr
G&N 4 1
MIN IMP CONT TROUBLE-SHOOTING ROUTINE
15 Failure occurred during?
MNVR
ATTITUDE HOLD
16 With RHC or THC?
RHC
THC
SCS 7 1
ABNORMAL DYNAMICS DURING TRANSLATION
17 With MIN IMP?
YES
SCS 4 1
MIN IMP TROUBLE-SHOOTING ROUTINE
NO
18 With ACCEL CMD?
YES
SCS 2 1
ACCEL CMD TROUBLE-SHOOTING ROUTINE
NO
19 Drifts out of deadband?
YES
SCS 3a 35
CSM DRIFTS OUT OF DEADBAND
NO
20 In RATE CMD?
YES
SCS 3 1
RATE CMD TROUBLE-SHOOTING ROUTINE
NO
21 Oscillating and diverging limit cycle
SCS 6 1
VEHICLE DYNAMICS OSCILLATING & DIVERGING
22 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-1940H

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SCS

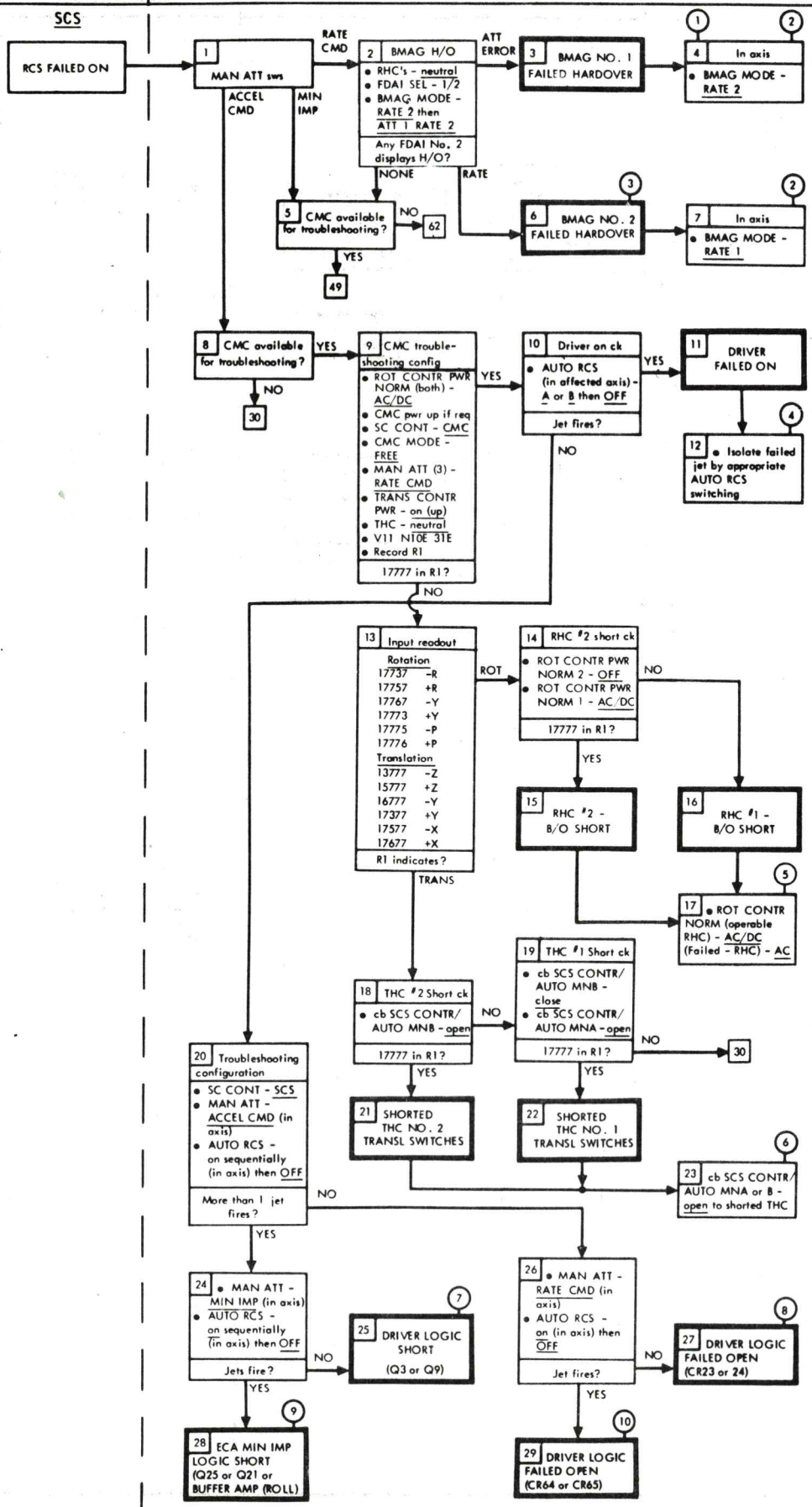
SCS MALFUNCTIONS INDEX

SYMPTOM

SCS

RCS FAILED ON

PROCEDURE



REMARKS

(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.

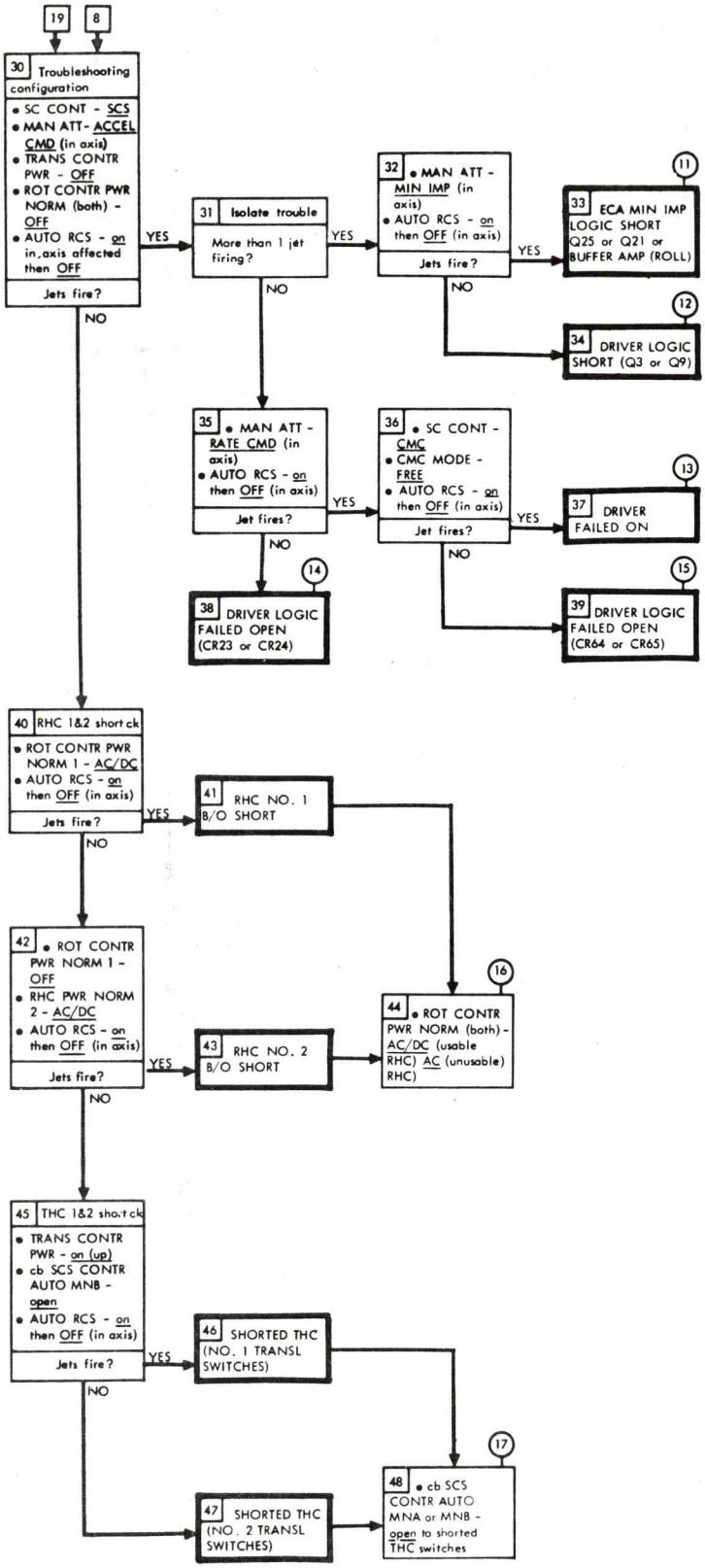
SM-2A-1944F

1 (CONT)

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.

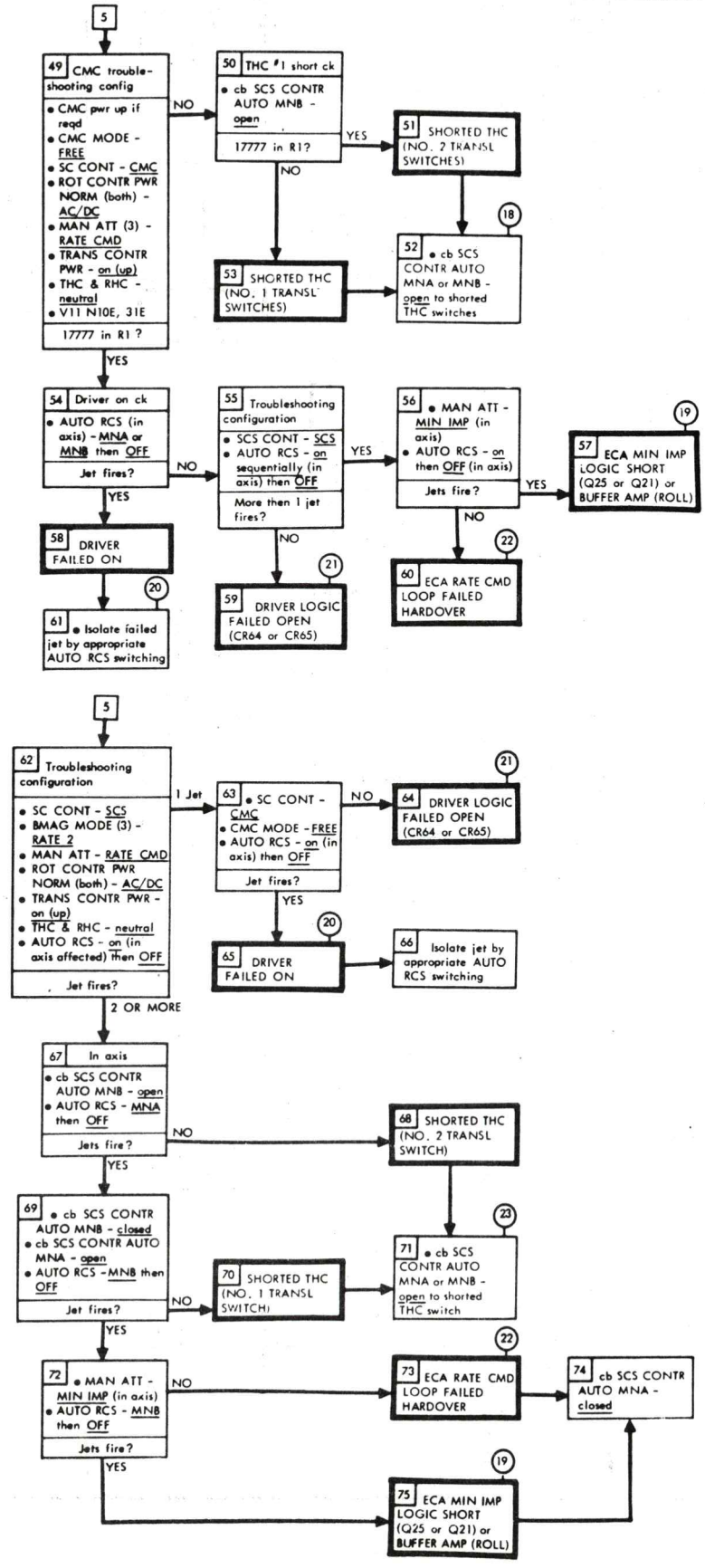
(16) Direct sws in affected RHC still functional. Affected RHC lost for SCS and G/N attitude control. If RHC 2, swap RHC 1 to CDR's position and leave RHC 2 off. For ΔV's replace RHC 2 to CDR's position and leave in AC only.

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

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.

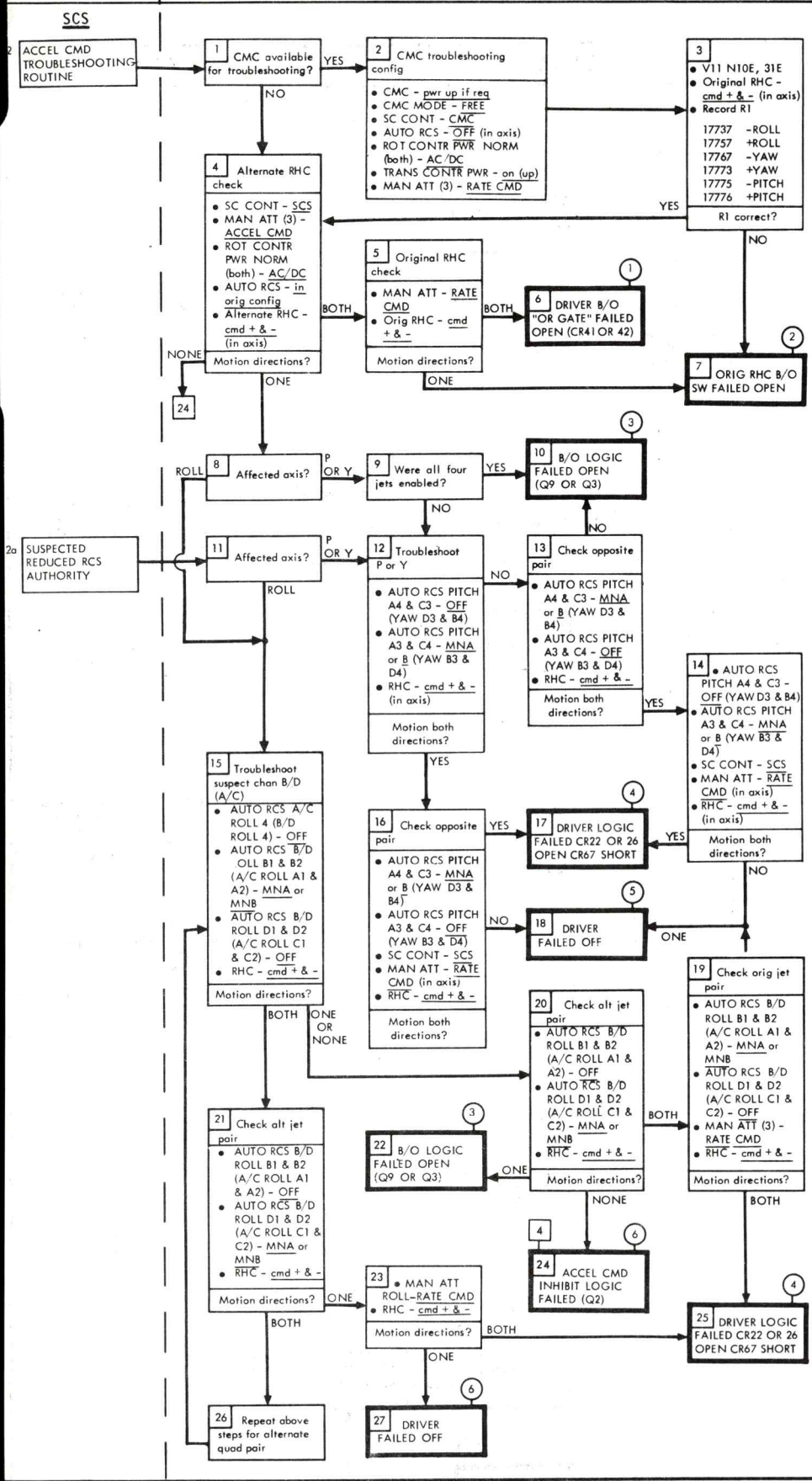
(22) SCS RATE CMD, attitude hold & prop cont lost for affected jet. SCS auto ΔV lost if pitch or yaw but operable in roll in ACCEL CMD. Translation without attitude hold possible in MIN IMP or ACCEL CMD.

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

1 (CONT)

2 THRU 2a

SYMPTOM	PROCEDURE	REMARKS



(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.

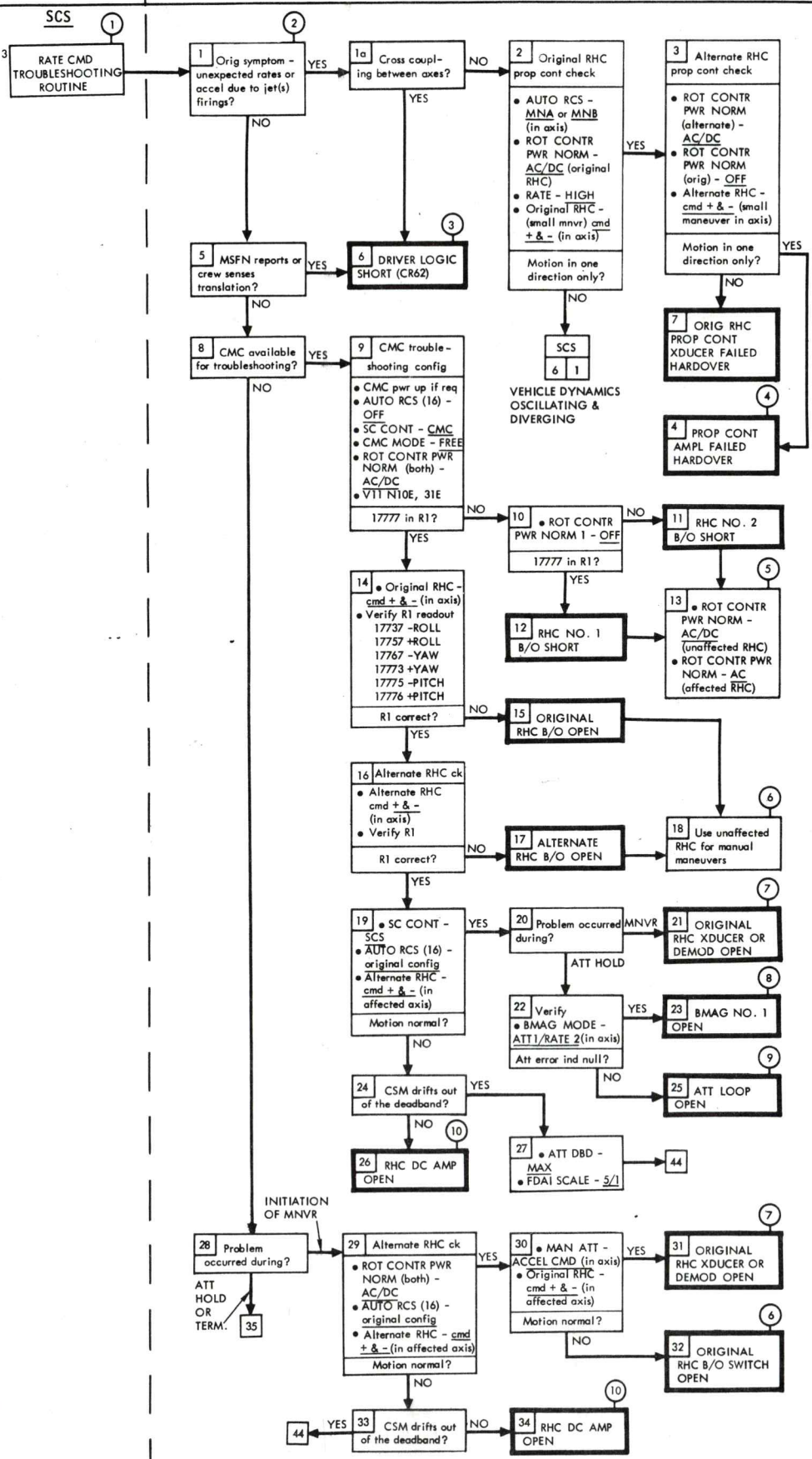
(4) ACCEL CMD mode lost for affected jet. Other SCS & G/N modes available.

(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



REMARKS

(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 caging 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.

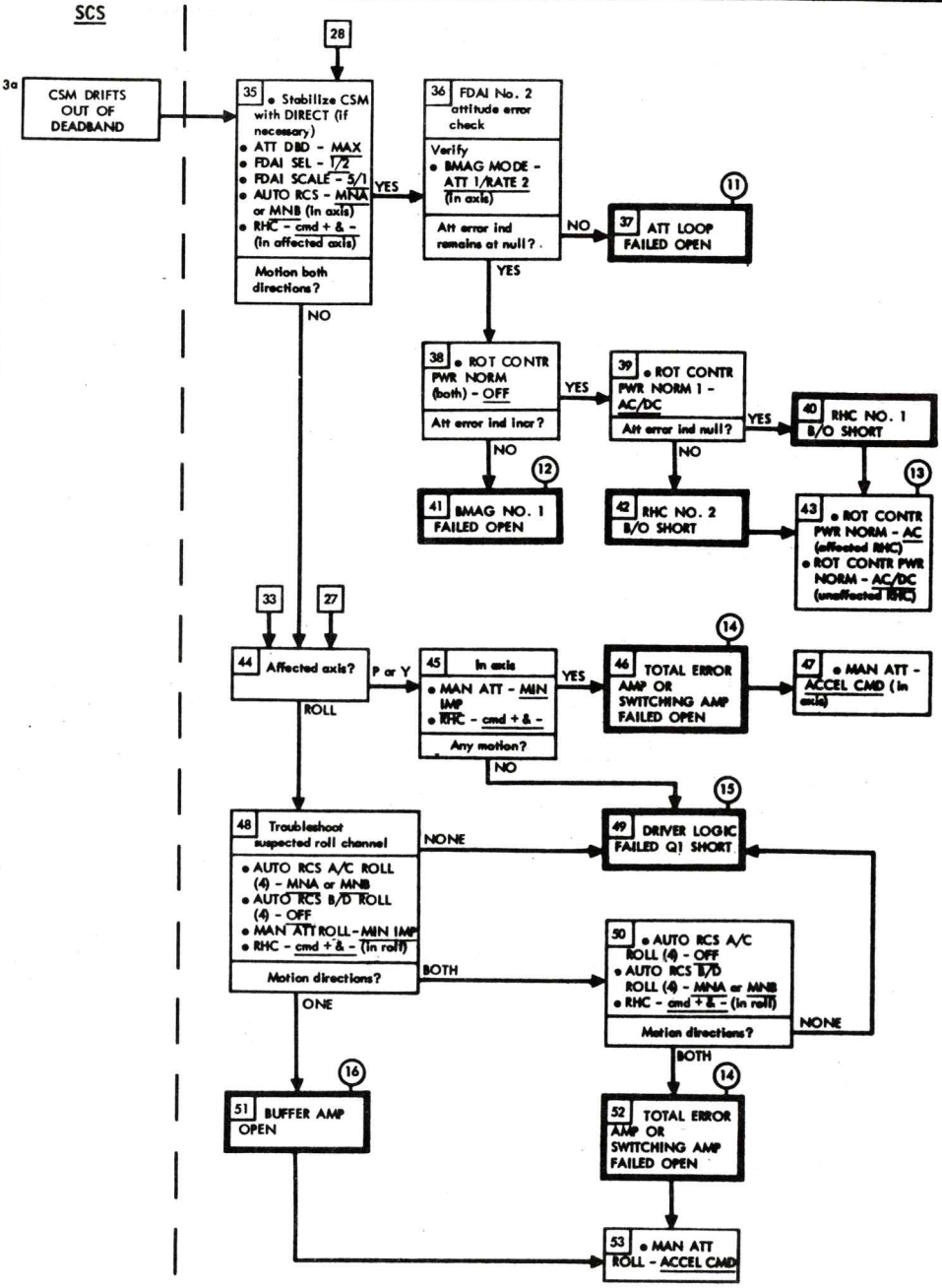
(10) SCS prop cont & MTVC lost for both RHCs.

SM-2A-1950G

3

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.

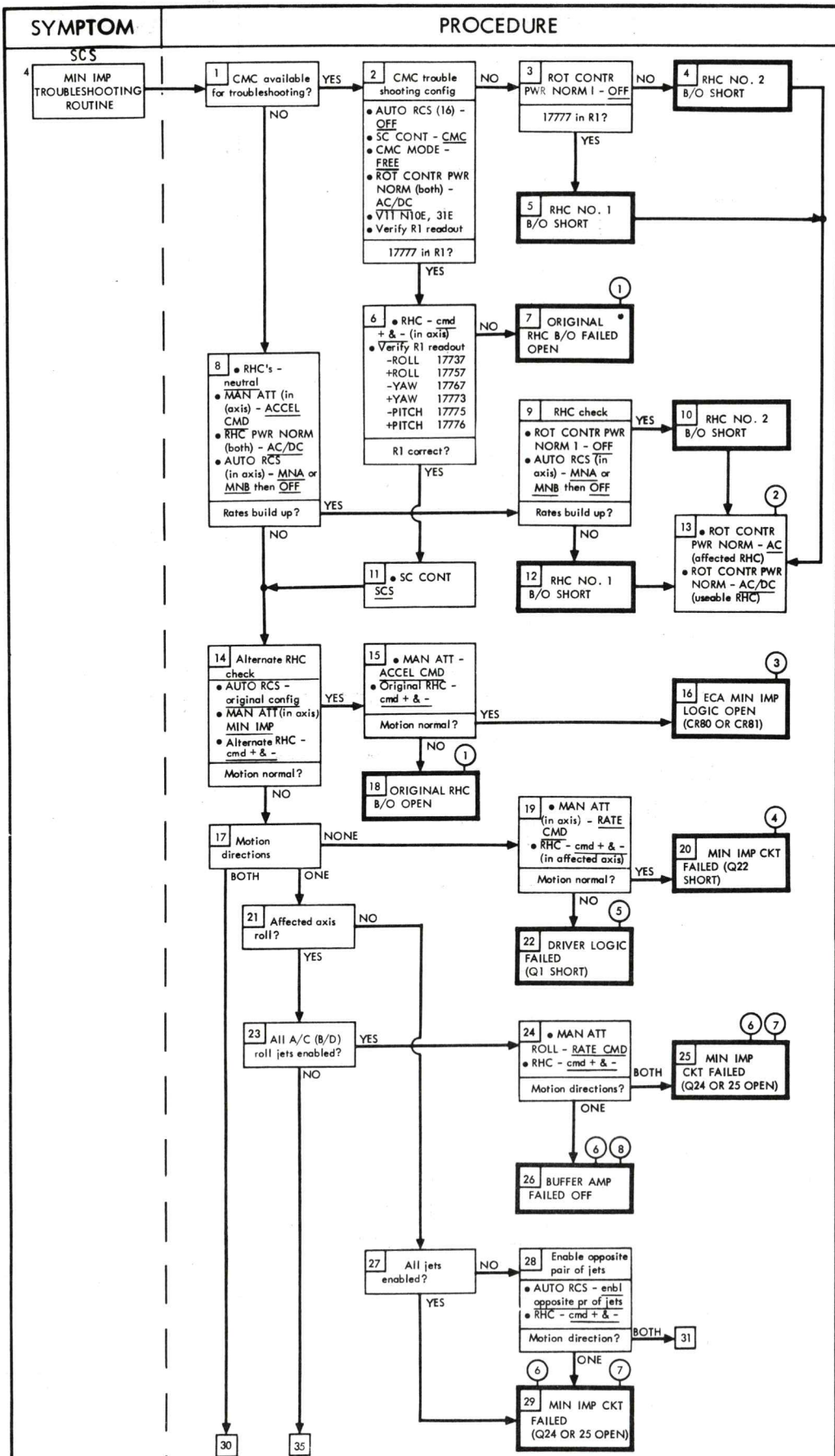
(12) For affected axis: In ATT 1 RATE 2, att hold & att error display lost. SCS auto ΔV possible if roll, by controlling att manually. After .05 G, SCS FDAI roll attitude erroneous if yaw or roll.

(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.



REMARKS

(1) Lose 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) Lose 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.

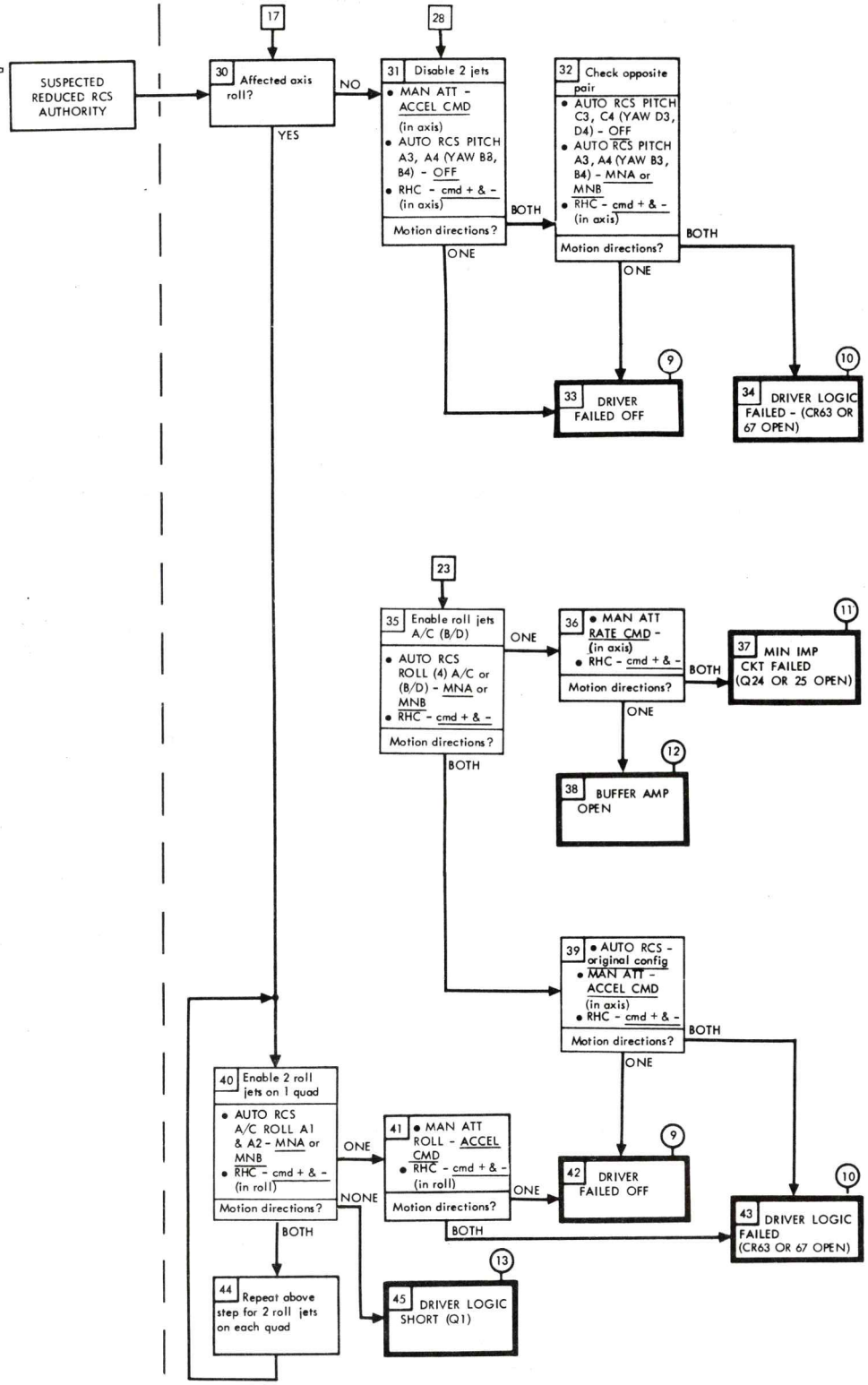
(7) Lose MIN IMP in one direction of affected axis. RATE CMD & ACCEL CMD available. Translation unaffected.

(8) Lose 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.

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.

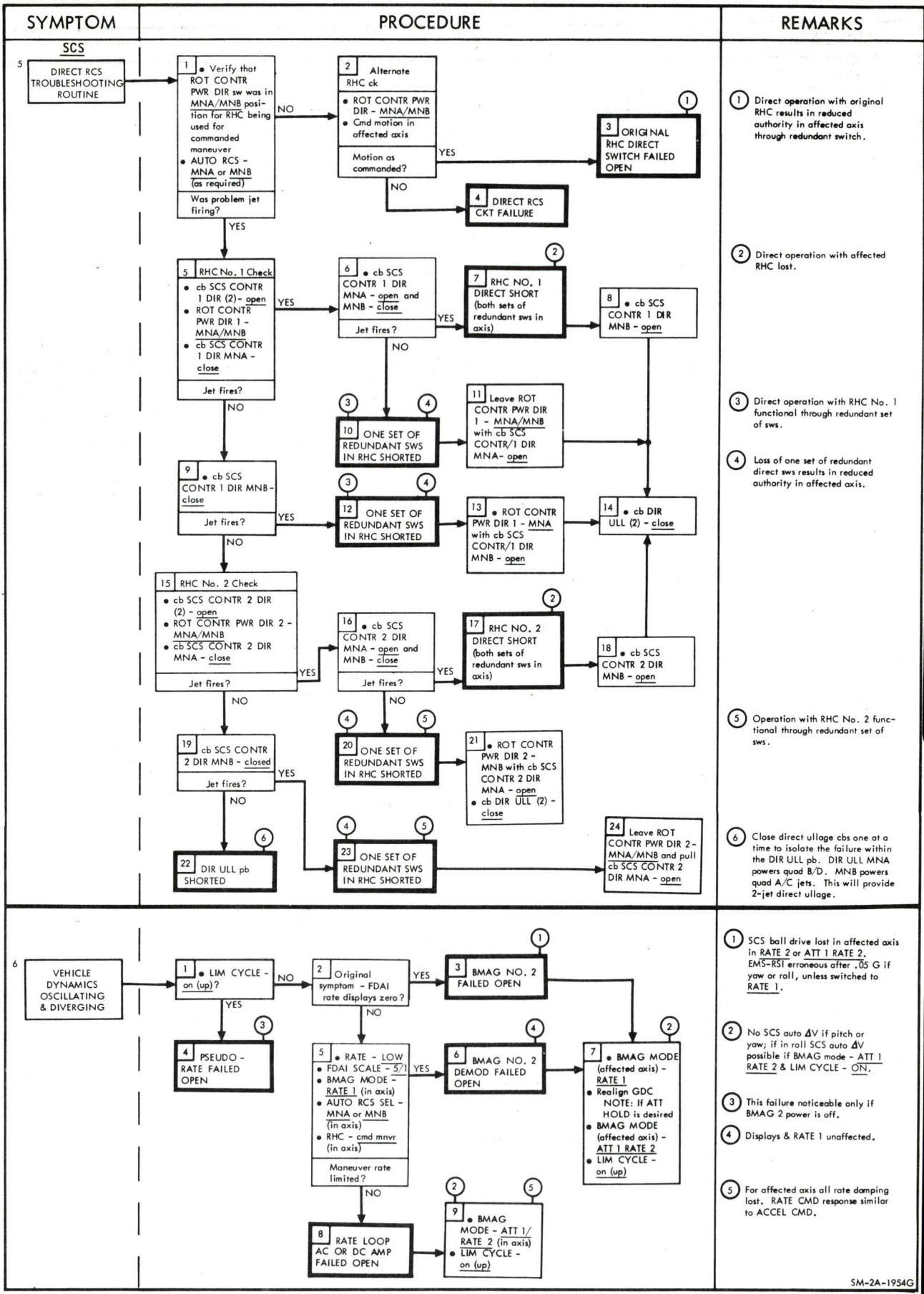
(11) Lose MIN IMP in one direction of affected axis. RATE CMD & ACCEL CMD available. Translation uneffected.

(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.

4 (CONT) THRU 4a

SM-2A-1953D


SYMPTOM
PROCEDURE
REMARKS
SCS
5
DIRECT RCS TROUBLESHOOTING ROUTINE
1 • Verify that ROT CONTR PWR DIR sw was in MNA/MNB position for RHC being used for commanded maneuver • AUTO RCS - MNA or MNB (as required) Was problem jet firing?
NO
2 Alternate RHC ck • ROT CONTR PWR DIR - MNA/MNB • Cmd motion in affected axis Motion as commanded?
YES
3 ORIGINAL RHC DIRECT SWITCH FAILED OPEN
1
NO
4 DIRECT RCS CKT FAILURE
YES
5 RHC No. 1 Check • cb SCS CONTR 1 DIR (2) - open • ROT CONTR PWR DIR 1 - MNA/MNB • cb SCS CONTR 1 DIR MNA - close Jet fires?
YES
6 • cb SCS CONTR 1 DIR MNA - open and MNB - close Jet fires?
YES
7 RHC NO. 1 DIRECT SHORT (both sets of redundant sws in axis)
2
8 • cb SCS CONTR 1 DIR MNB - open
NO
3 4
10 ONE SET OF REDUNDANT SWS IN RHC SHORTED
11 Leave ROT CONTR PWR DIR 1 - MNA/MNB with cb SCS CONTR/1 DIR MNA - open
NO
9 • cb SCS CONTR 1 DIR MNB - close Jet fires?
YES
3 4
12 ONE SET OF REDUNDANT SWS IN RHC SHORTED
13 • ROT CONTR PWR DIR 1 - MNA with cb SCS CONTR/1 DIR MNB - open
14 • cb DIR ULL (2) - close
NO
15 RHC No. 2 Check • cb SCS CONTR 2 DIR (2) - open • ROT CONTR PWR DIR 2 - MNA/MNB • cb SCS CONTR 2 DIR MNA - close Jet fires?
YES
16 • cb SCS CONTR 2 DIR MNA - open and MNB - close Jet fires?
YES
17 RHC NO. 2 DIRECT SHORT (both sets of redundant sws in axis)
2
18 • cb SCS CONTR 2 DIR MNB - open
NO
4 5
20 ONE SET OF REDUNDANT SWS IN RHC SHORTED
21 • ROT CONTR PWR DIR 2 - MNB with cb SCS CONTR 2 DIR MNA - open • cb DIR ULL (2) - close
19 cb SCS CONTR 2 DIR MNB - closed Jet fires?
YES
NO
6
22 DIR ULL pb SHORTED
4 5
23 ONE SET OF REDUNDANT SWS IN RHC SHORTED
24 Leave ROT CONTR PWR DIR 2 - MNA/MNB and pull cb SCS CONTR 2 DIR MNA - open
1 Direct operation with original RHC results in reduced authority in affected axis through redundant switch.
2 Direct operation with affected RHC lost.
3 Direct operation with RHC No. 1 functional through redundant set of sws.
4 Loss of one set of redundant direct sws results in reduced authority in affected axis.
5 Operation with RHC No. 2 functional through redundant set of sws.
6 Close direct ullage cbs one at a time to isolate the failure within the DIR ULL pb. DIR ULL MNA powers quad B/D. MNB powers quad A/C jets. This will provide 2-jet direct ullage.
6
VEHICLE DYNAMICS OSCILLATING & DIVERGING
1 • LIM CYCLE - on (up)?
NO
2 Original symptom - FDAI rate displays zero?
YES
3 BMAG NO. 2 FAILED OPEN
1
YES
3
4 PSEUDO - RATE FAILED OPEN
NO
5 • RATE - LOW • FDAI SCALE - 5/1 • BMAG MODE - RATE 1 (in axis) • AUTO RCS SEL - MNA or MNB (in axis) • RHC - cmd mnvr (in axis) Maneuver rate limited?
YES
4
6 BMAG NO. 2 DEMOD FAILED OPEN
2
7 • BMAG MODE (affected axis) - RATE 1 • Realign GDC NOTE: If ATT HOLD is desired • BMAG MODE (affected axis) - ATT 1 RATE 2 • LIM CYCLE - on (up)
NO
2 5
8 RATE LOOP AC OR DC AMP FAILED OPEN
9 • BMAG MODE - ATT 1/ RATE 2 (in axis) • LIM CYCLE - on (up)
1 SCS ball drive lost in affected axis in RATE 2 or ATT 1 RATE 2. EMS-RST erroneous after .05 G if yaw or roll, unless switched to RATE 1.
2 No SCS auto ΔV if pitch or yaw; if in roll SCS auto ΔV possible if BMAG mode - ATT 1 RATE 2 & LIM CYCLE - ON.
3 This failure noticeable only if BMAG 2 power is off.
4 Displays & RATE 1 unaffected.
5 For affected axis all rate damping lost. RATE CMD response similar to ACCEL CMD.
SM-2A-1954G

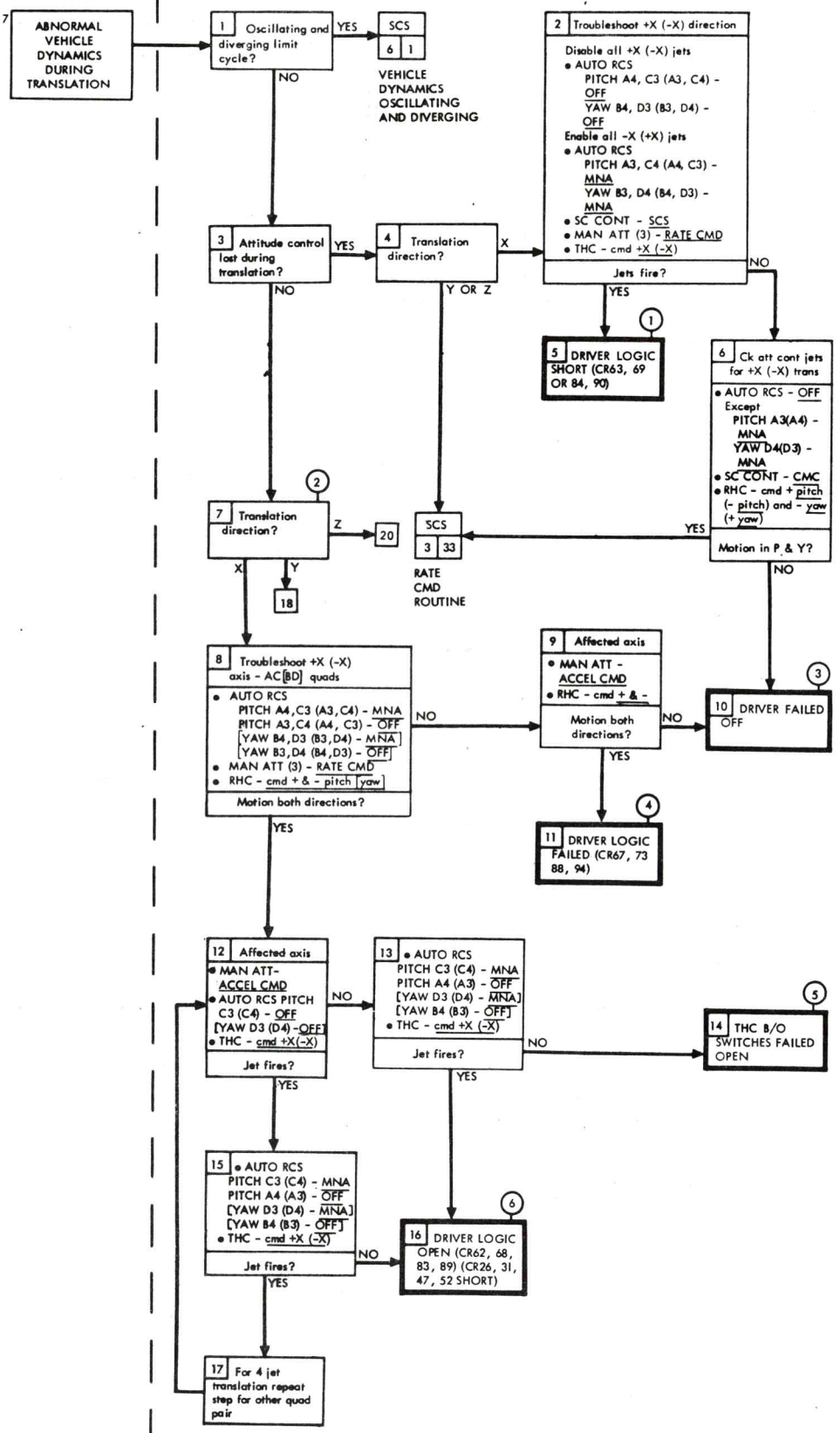
5 THRU 6

SYMPTOM

SCS

7 ABNORMAL VEHICLE DYNAMICS DURING TRANSLATION

PROCEDURE



REMARKS

(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.

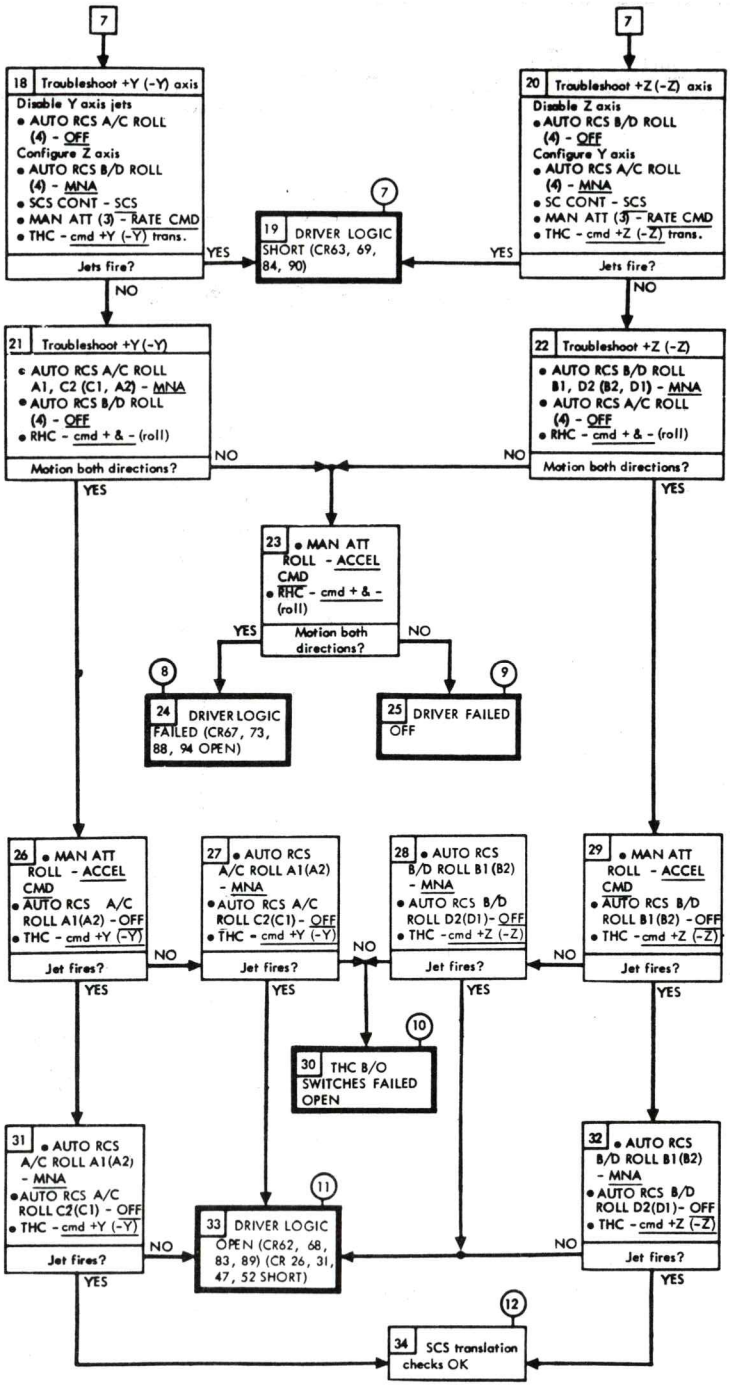
(6) Affected jet lost for all auto-coil translations. Rotation capability unaffected.

SM-2A-1955E

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.

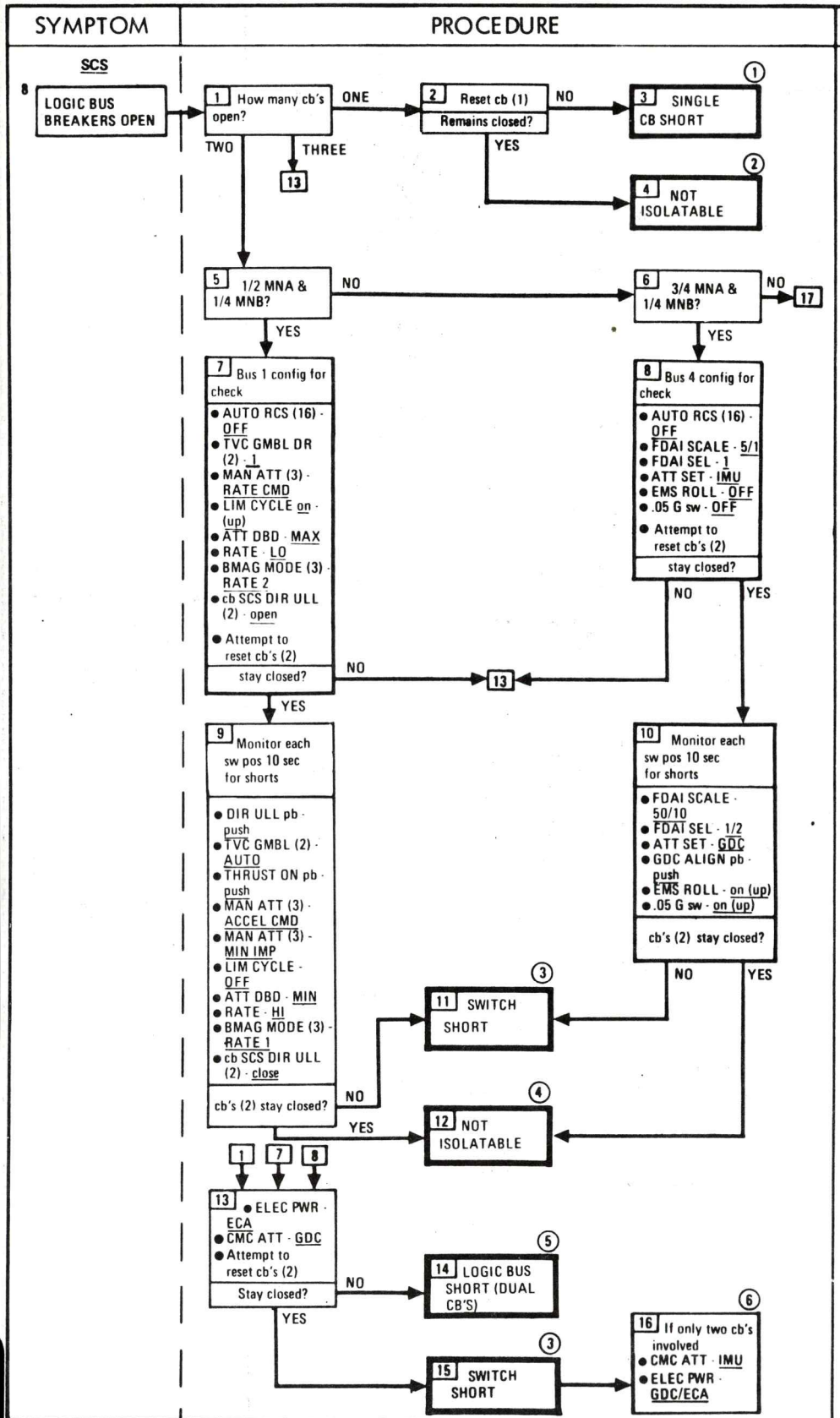
(9) All auto coil capability lost for this thruster. Direct available.

(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.

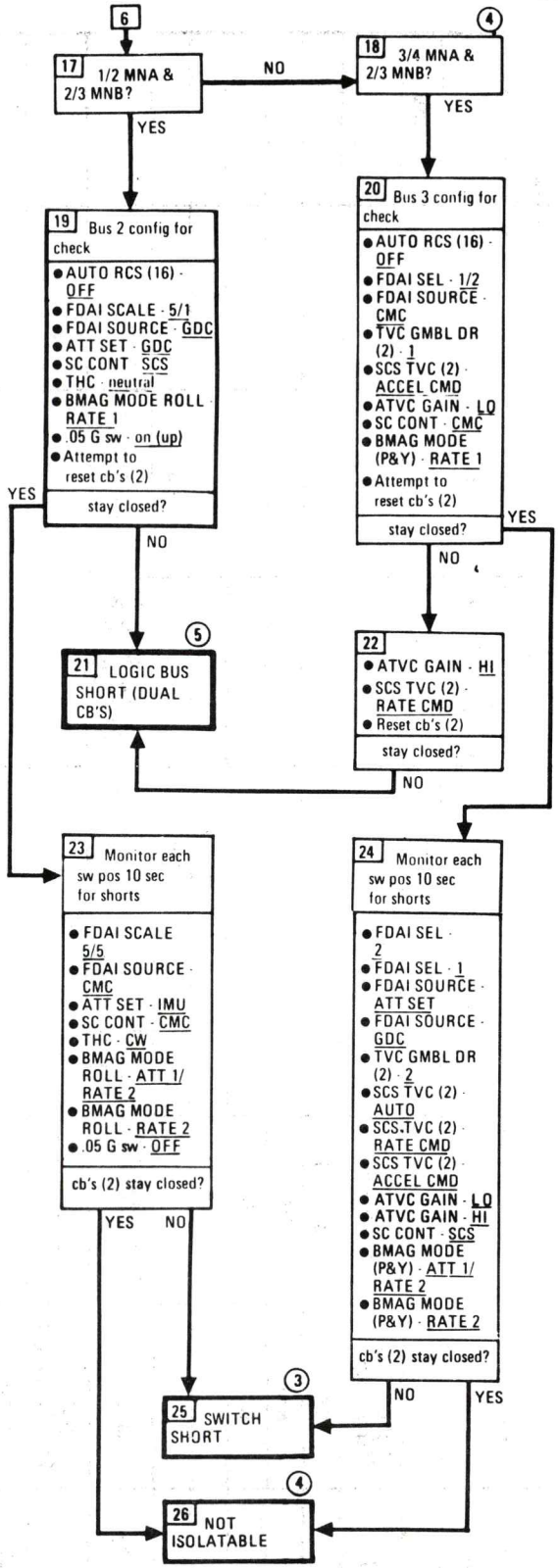
SM-2A-1956E


SYMPTOM
PROCEDURE
REMARKS
SCS
8
LOGIC BUS BREAKERS OPEN
1 How many cb's open?
ONE
TWO
THREE
13
2 Reset cb (1) Remains closed?
NO
YES
3 SINGLE CB SHORT
4 NOT ISOLATABLE
5 1/2 MNA & 1/4 MNB?
NO
YES
6 3/4 MNA & 1/4 MNB?
NO
17
YES
7 Bus 1 config for check
• AUTO RCS (16) · OFF
• TVC GMBL DR (2) · 1
• MAN ATT (3) · RATE CMD
• LIM CYCLE on · (up)
• ATT DBD · MAX
• RATE · LO
• BMAG MODE (3) · RATE 2
• cb SCS DIR ULL (2) · open
• Attempt to reset cb's (2)
stay closed?
NO
YES
8 Bus 4 config for check
• AUTO RCS (16) · OFF
• FDAI SCALE · 5/1
• FDAI SEL · 1
• ATT SET · IMU
• EMS ROLL · OFF
• .05 G sw · OFF
• Attempt to reset cb's (2)
stay closed?
NO
YES
9 Monitor each sw pos 10 sec for shorts
• DIR ULL pb · push
• TVC GMBL (2) · AUTO
• THRUST ON pb · push
• MAN ATT (3) · ACCEL CMD
• MAN ATT (3) · MIN IMP
• LIM CYCLE · OFF
• ATT DBD · MIN
• RATE · HI
• BMAG MODE (3) · RATE 1
• cb SCS DIR ULL (2) · close
cb's (2) stay closed?
NO
YES
10 Monitor each sw pos 10 sec for shorts
• FDAI SCALE · 50/10
• FDAI SEL · 1/2
• ATT SET · GDC
• GDC ALIGN pb · push
• EMS ROLL · on (up)
• .05 G sw · on (up)
cb's (2) stay closed?
NO
YES
11 SWITCH SHORT
3
12 NOT ISOLATABLE
4
1
7
8
13 • ELEC PWR · ECA
• CMC ATT · GDC
• Attempt to reset cb's (2)
Stay closed?
NO
YES
14 LOGIC BUS SHORT (DUAL CB'S)
5
15 SWITCH SHORT
3
16 If only two cb's involved
• CMC ATT · IMU
• ELEC PWR · GDC/ECA
6
1 Loss of one breaker does not affect SCS functional modes. Redundancy in logic bus power is lost with a single breaker short.
2 Original problem is not isolatable per this flow. An intermittent short or vibration may have caused problem.
3 Lose affected position of switch. Use alternate function for remainder of mission. If CMC ATT sw is affected function, logic buses 1 and 4 may be restored by leaving CMC ATT sw in GDC position and closing affected breakers. FDAI total att is lost for both FDAI's when CMC ATT · GDC
4 See remarks 2. For repeated opening of same two cb's beyond 10 seconds, repeat the 10 second check for low current shorts.
5 In order to determine required switch configuration resulting from bus failure as well as special effects pertaining to flight mode capabilities, refer to pages 2-16, 2-17, 2-18, 2-19, and 2-20
6 CMC ATT sw may be left in the IMU position by opening affected breakers, disabling either bus 1 or 4. Refer to remark 3.
SM-2A-2356A

SYMPTOM	PROCEDURE	REMARKS

SCS (Cont)

8



SM-2A-2357B

8 (CONT

CONTROL	SCS LOGIC BUS POWER LOSS							
	BUS 1		BUS 2		BUS 3		BUS 4	
	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT
FDAI SCALE			5/5	5/1 50/15			50/15	5/5 5/1
FDAI SEL					1 & 2	1/2	1/2	1 2
FDAI SOURCE			CMC	GDC	ATT SET GDC	CMC		
ATT SET			IMU	GDC			GDC	IMU
MAN ATT (3)	ACCEL CMD MIN IMP	RATE CMD						
LIM CYCLE	OFF	on (up)						
ATT DBD	MIN	MAX						
RATE	HI	LO						
THC			CW	neutral				
SC CONT			CMC	CMC	SCS	CMC		
BMAG MODE (3)	RATE 1	ATT 1/RATE 2 RATE 2	(R) RATE 2 ATT 1/RATE 2	(R) RATE 1	(P,Y) RATE 2 ATT 1/RATE 2	(P,Y) RATE 1		
DIR ULL pb	push (logic only)	———						
THRUST ON pb	push							
GDC ALIGN							push	———
SCS TVC (2)					all	———		
ATVC GAIN					LO	HI		
EMS ROLL							on (up)	OFF
.05 G sw			OFF	OFF			.05 G	OFF
TVC GMBL DR (2)	AUTO	1 2			2	1 AUTO		

SM-2A-SL-2019

SCS LOGIC BUS POWER LOSS

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
CMC CONTROL MODE (SC CONT - CMC)	• No effect	• CMC attitude control may exist since G&N power not affected by LOGIC BUS 2 short	• No effect	• No effect
RCS CONTROL	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage
	SCS/SM RCS: • Control modes restricted to positions shown for BUS 1 corrective action, page 2-16	SCS/SM RCS: • P & Y not affected • For manual roll BMAG MODE (R) - RATE 1 MAN ATT (R) - RATE CMD, ACCEL CMD or MIN IMP • For SCS att hold (R) BMAG MODE (R) - ATT 1/RATE 2 LIM CYCLE - on (up)	SCS SM/CM RCS: • MAN ATT (3) - ACCEL CMD operational (CMC or SCS) • MAN ATT (3) - MIN IMP operational if THC - CW • MAN ATT (R) - RATE CMD operational if THC-CW & SC CONT - CMC • MAN ATT (P,Y) - RATE CMD operational if THC-CW & BMAG MODE - RATE 1 or ATT 1/RATE 2 & LIM CYCLE - on (up)	SCS/SM RCS: • No effect
	SCS/CM RCS: • Use direct RCS only • Disable auto RCS RCS CMD - OFF or AUTO RCS (12) - OFF • Use single ring only	SCS/CM RCS: • P & Y not affected • Roll axis BMAG MODE (R) - RATE 1 MAN ATT (R) - RATE CMD or ACCEL CMD • .05 G function operational		SCS/CM RCS: • Roll to yaw coupling loss for post .05 G

SM-2A-SL-2020

SCS LOGIC BUS POWER LOSS (SPECIAL EFFECTS)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
SPS CONTROL	Gimbal Control: • SCS auto TVC functional • MTVC rate cmd functional with: BMAG MODE (P,Y) - ATT 1/RATE 2 or RATE 2 • No direct ullage (for logic) • ACCEL CMD operational • THC-CW operational • If servo 1 failure TVC GMBL DR (2) - 2	Gimbal Control: • SC CONT - CMC (simultaneous CMC & SCS TVC occurs) • CMC ΔV capability exists if: SCS TVC (2) - ACCEL CMD SCS trim to 0.0° • Auto switchover function lost - switch to 2 by TVC GMBL DR (2) - 2	Gimbal Control: • SCS auto TVC lost • MTVC - Rate cmd operational with RATE 1 only • Accel cmd operational with RATE 2 (P,Y) • Manual switch to servo 2 with TVC GMBL DR - 2 is lost - Use: TVC GMBL DR (2) - AUTO THC-CW	Gimbal Control: • No effect
	Thrust on/off: • CMC thrust on not affected • Ullage - THC +X or DIR ULL as backup (no direct ullage for logic function) • SCS thrust on SPS THRUST - on (up) only • SCS thrust termination ΔV THRUST A (B) - OFF	Thrust on/off: • No effect	Thrust on/off: • CMC thrust on not affected • THRUST ON pb operational if THC-CW • ΔV ind operational (for thrust termination)	Thrust on/off: • No effect

SM-2A-SL-2021

SCS LOGIC BUS POWER LOSS (SPECIAL EFFECTS)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
THC	• No effect	• THC-CW function lost - use SC CONT - SCS	• No effect	• No effect
DISPLAYS	Pre/Post .05 G: • All displays operational except RATE 1 (No source for rate display or for att ref)	Pre- .05 G: • FDAI SEL - 1/2 operational except (ball 2) att error • CMC source (ball 1) operational except CDU error • Total att, att error (ball 2) lost if: FDAI SOURCE - CMC FDAI SEL - 2 • Att error lost if: FDAI SOURCE - ATT SET ATT SET - IMU • FDAI SCALE - 5/5 lost • Yaw rate display indicates roll coupling • R & P rate display normal • BMAG R, P, Y att error (ball 2) lost if: FDAI SEL - 1/2 or FDAI SOURCE - GDC	Pre/Post .05 G: • FDAI SEL - 1/2 operational • FDAI SEL - 1 & 2 lost (for both CMC or GDC) • FDAI SOURCE - ATT SET function lost • All displays (rate, att error, total att) valid for FDAI SEL - 1/2 only • BMAG 1 & 2 rate valid	Pre/Post .05 G: • FDAI SCALE - 50/15 lost • FDAI SEL - 1 or 2 only • FDAI SOURCE - CMC or GDC operational • GDC & RSI align lost

SM-2A-SL-2022

SCS LOGIC BUS POWER LOSS (SPECIAL EFFECTS)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
		Post .05 G: • FDAI SEL - 1/2 operational • Ball 1 - CMC source operational • Ball 2 - CMC source lost • SCS - total att, rate display, att errors normal		Post .05 G: • Display of roll to yaw coupling not void (actual coupling does not exist)

SM-2A-SL-2023

SCS LOGIC BUS POWER LOSS (SPECIAL EFFECTS)

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G&N MALFUNCTIONS INDEX

1 RCS FAILED ON

2 RCH TROUBLESHOOTING ROUTINE

2a CMC AUTO TROUBLESHOOTING ROUTINE

2b SUSPECTED REDUCED RCS AUTHORITY

3 THC TROUBLESHOOTING ROUTINE

4 MIN IMP CONT TROUBLESHOOTING ROUTINE

5 CMC

RED

6 ISS

RED

7 GIMBAL LOCK

YELLOW

8 TEMP

YELLOW

9 RESTART

YELLOW

10 TRACKER

YELLOW

11 PROG

YELLOW

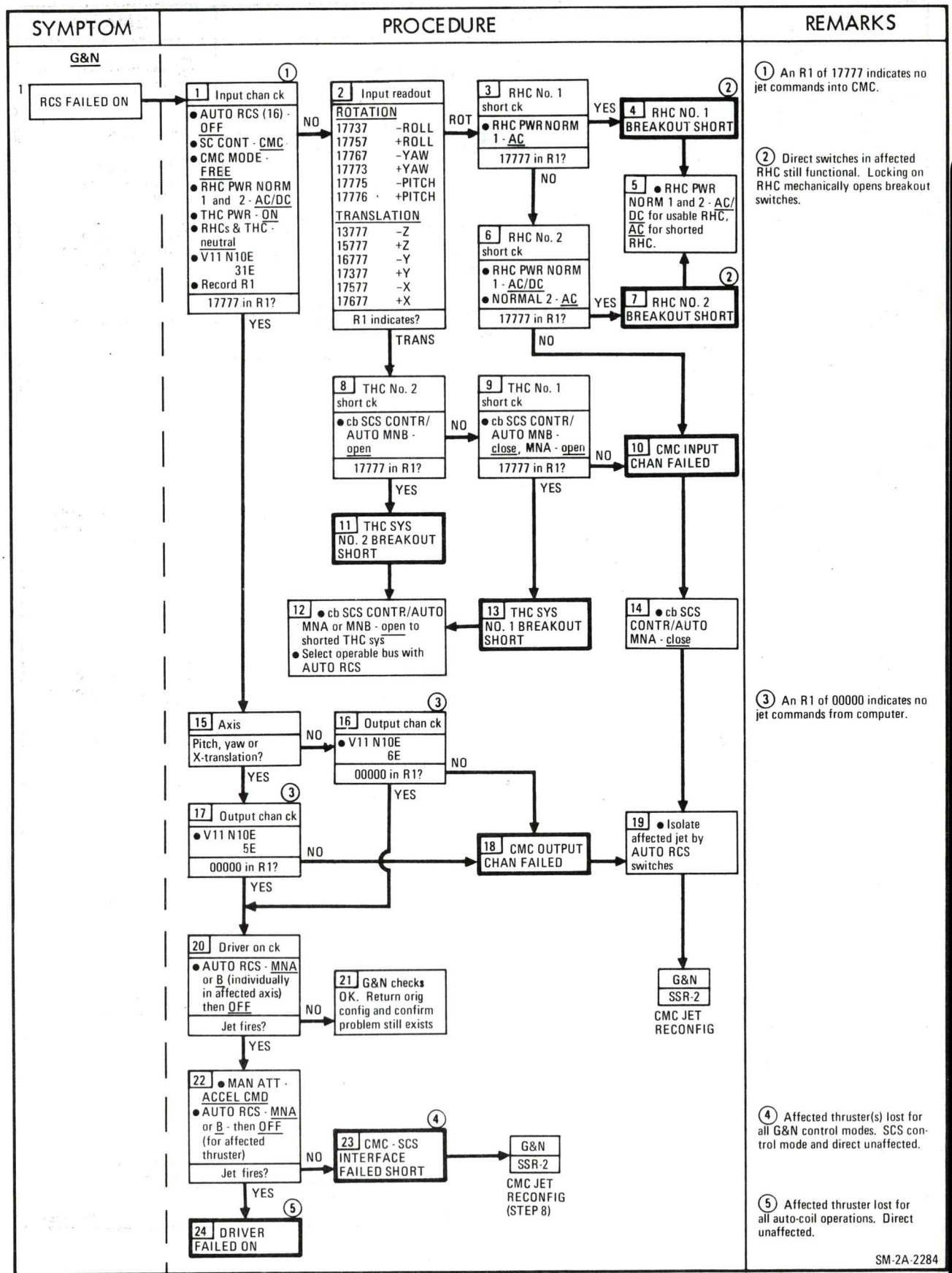
12 00205
00207
00210
00213
00211
00212
00217
01105
01106
01107
01407

13 OSCILLATING OR DIVERGING MOTION

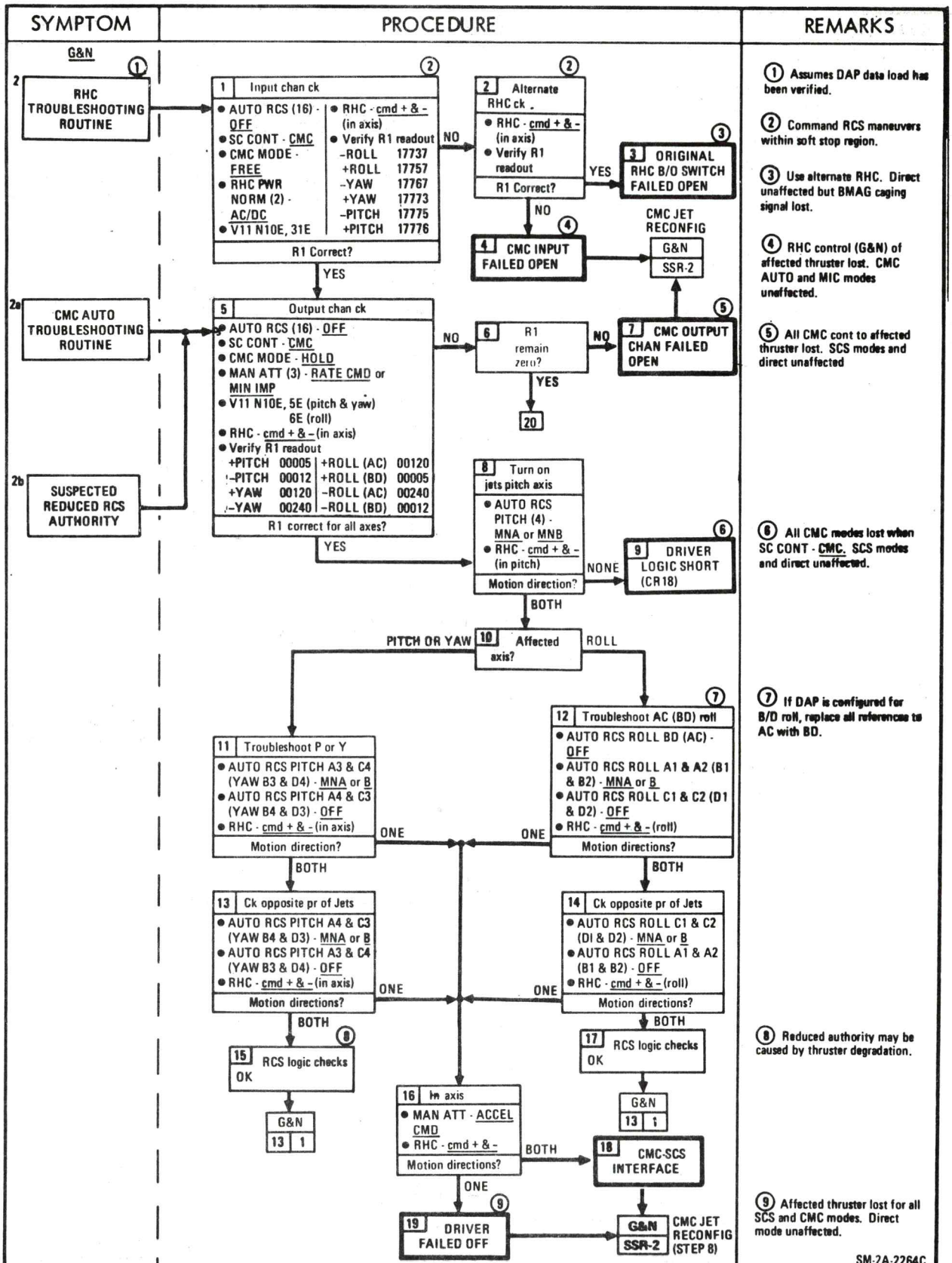
SSR-1 CMC TEST

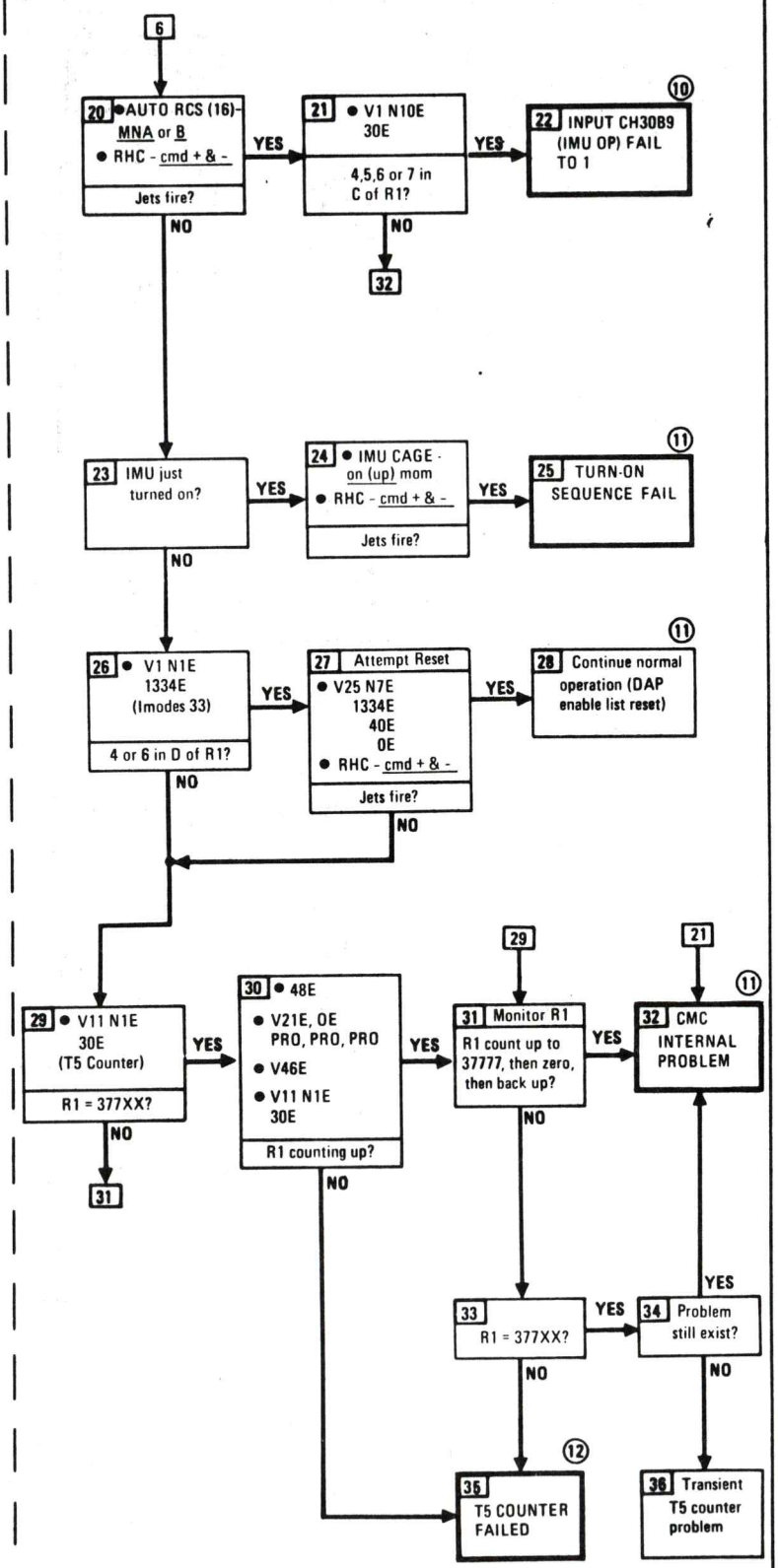
SSR-2 CMC JET RE-CONFIG

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?
YES
NO
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

2 THRU 2b

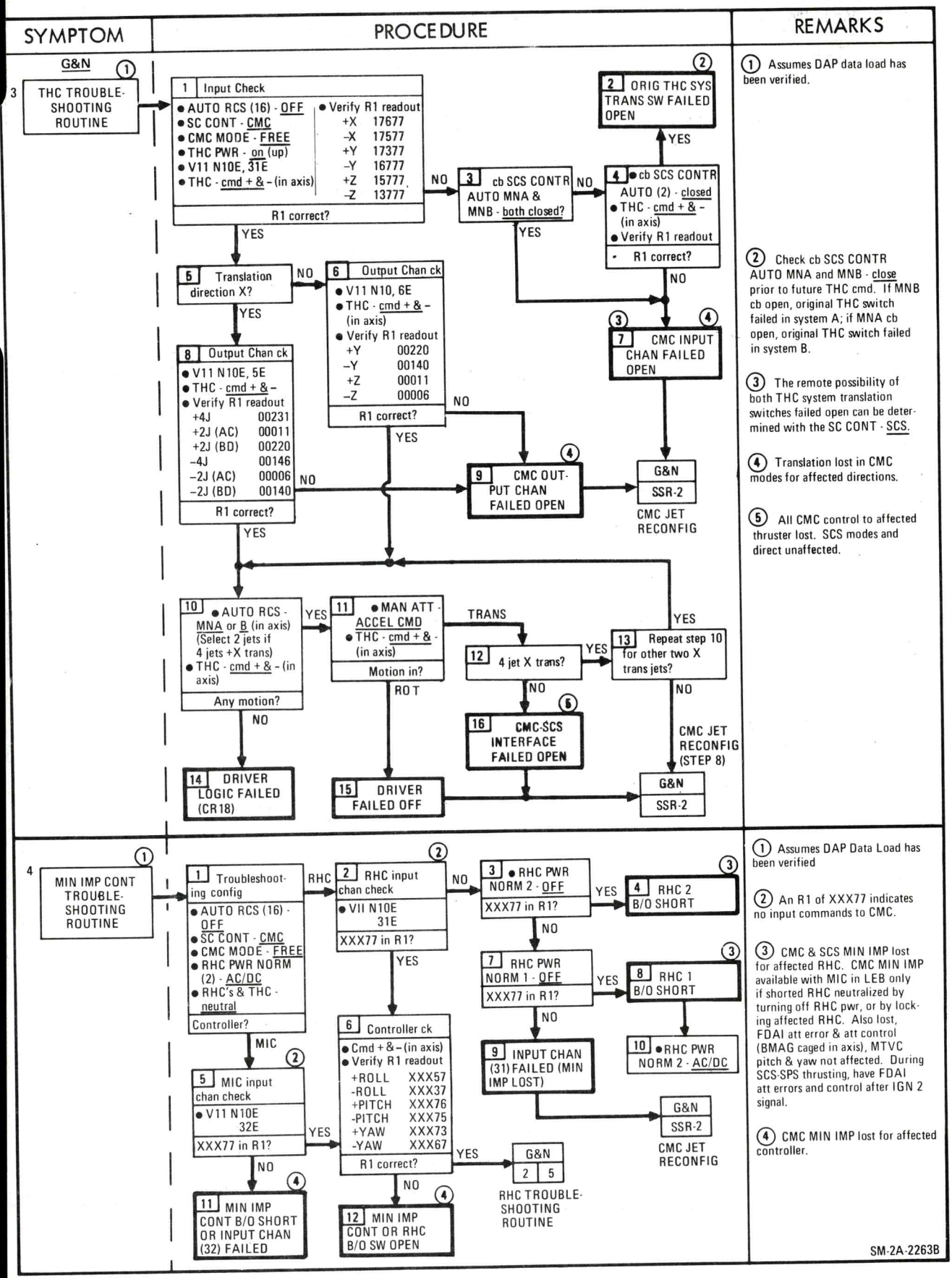

SYMPTOM
PROCEDURE
REMARKS
G&N
2 RHC TROUBLESHOOTING ROUTINE
2a CMC AUTO TROUBLESHOOTING ROUTINE
2b SUSPECTED REDUCED RCS AUTHORITY
1 Input chan ck
• AUTO RCS (16) - OFF
• SC CONT - CMC
• CMC MODE - FREE
• RHC PWR NORM (2) - AC/DC
• V11 N10E, 31E
• RHC - cmd + & - (in axis)
• Verify R1 readout
-ROLL 17737
+ROLL 17757
-YAW 17767
+YAW 17773
-PITCH 17775
+PITCH 17776
R1 Correct?
NO
2 Alternate RHC ck
• RHC - cmd + & - (in axis)
• Verify R1 readout
R1 Correct?
YES
3 ORIGINAL RHC B/O SWITCH FAILED OPEN
NO
4 CMC INPUT FAILED OPEN
CMC JET RECONFIG
G&N
SSR-2
YES
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
6 R1 remain zero?
NO
7 CMC OUTPUT CHAN FAILED OPEN
YES
20
YES
8 Turn on jets pitch axis
• AUTO RCS PITCH (4) - MNA or MNB
• RHC - cmd + & - (in pitch)
Motion direction?
NONE
9 DRIVER LOGIC SHORT (CR18)
BOTH
PITCH OR YAW
10 Affected axis?
ROLL
11 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?
12 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
ONE
BOTH
BOTH
13 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?
14 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
ONE
BOTH
BOTH
15 RCS logic checks OK
G&N 13 1
17 RCS logic checks OK
G&N 13 1
16 In axis
• MAN ATT - ACCEL CMD
• RHC - cmd + & -
Motion directions?
BOTH
18 CMC-SCS INTERFACE
ONE
19 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-2264C

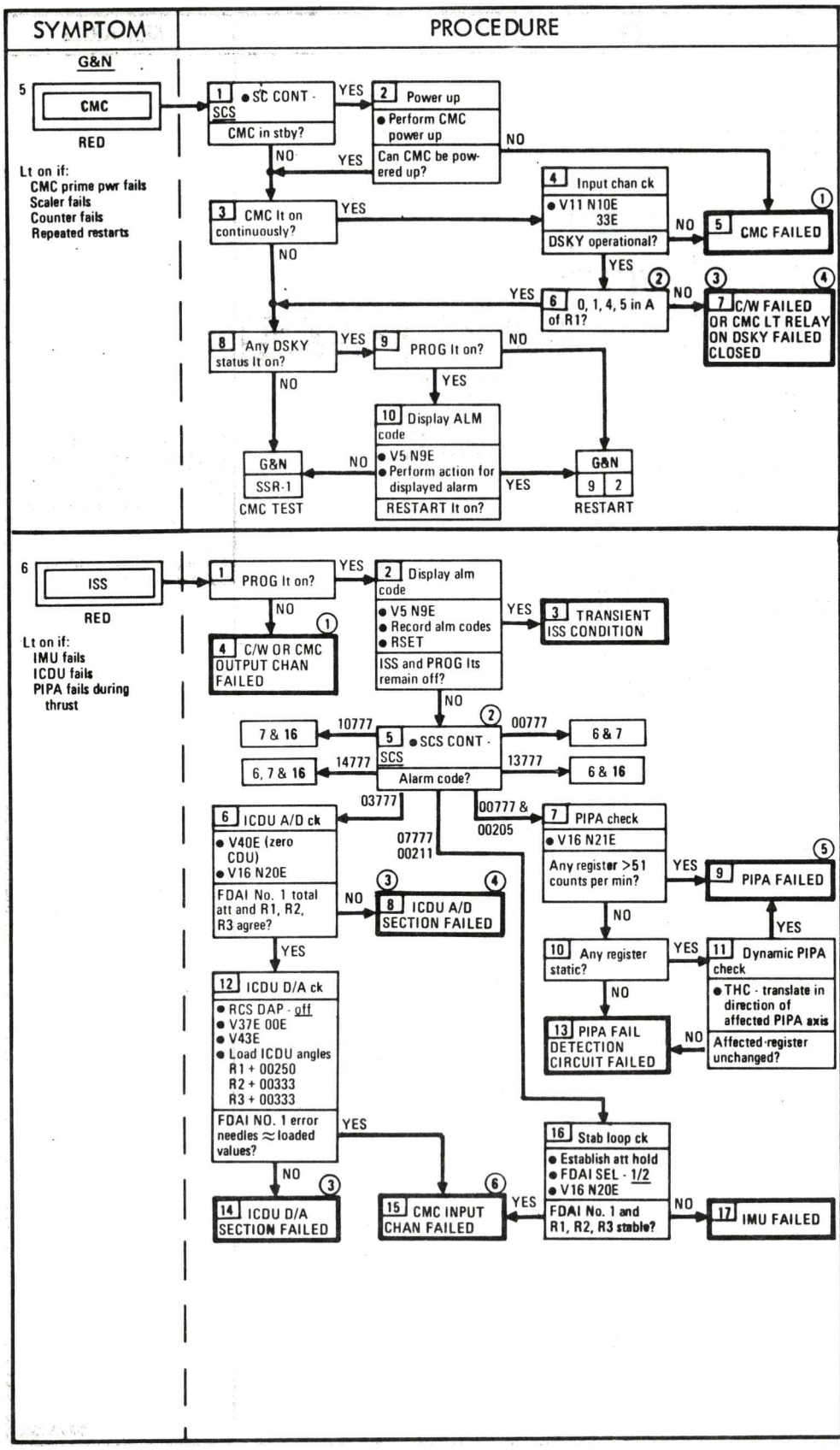
SYMPTOM	PROCEDURE	REMARKS
G&N 2 (CONT)		(10) If necessary to perform P51, use GDC REFSMMAT Determination, step 3, to bypass P51 logic; (11) Perform G&N SSR-1, as time permits. (12) All G&N control modes including TVC lost.

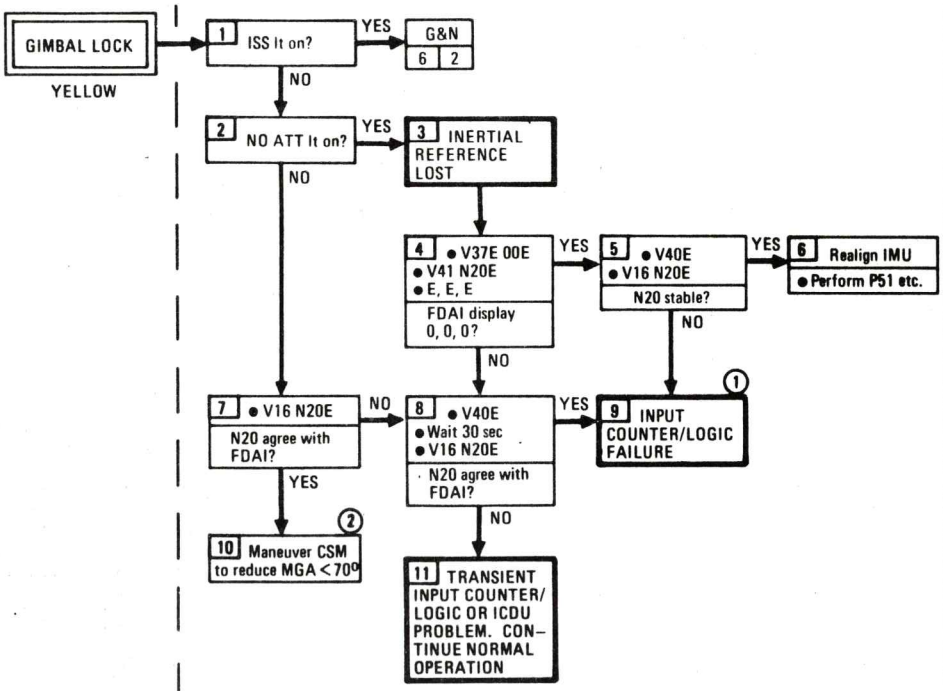
SM-2A-2421

2 (CONT)

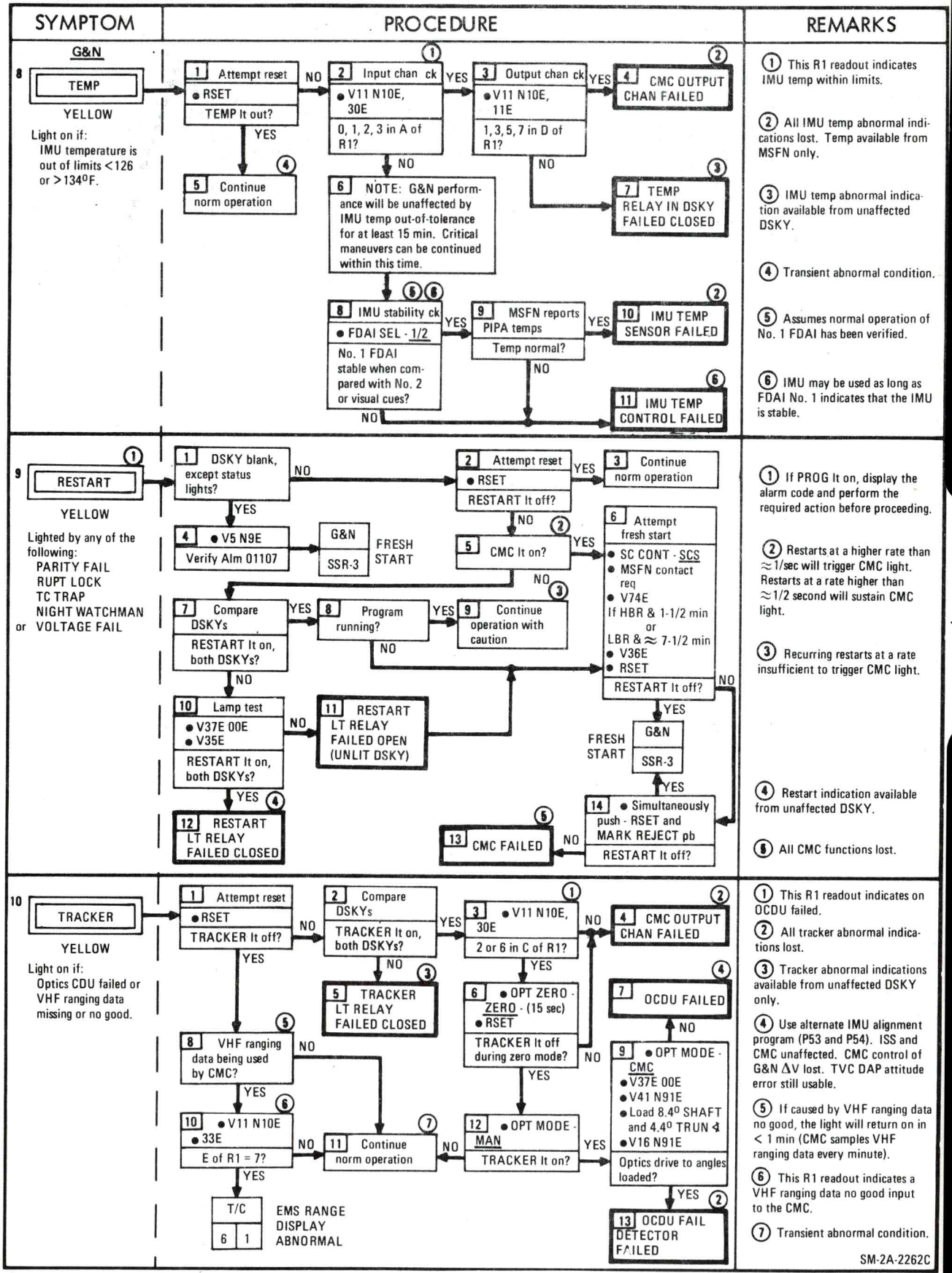
3 THRU 4

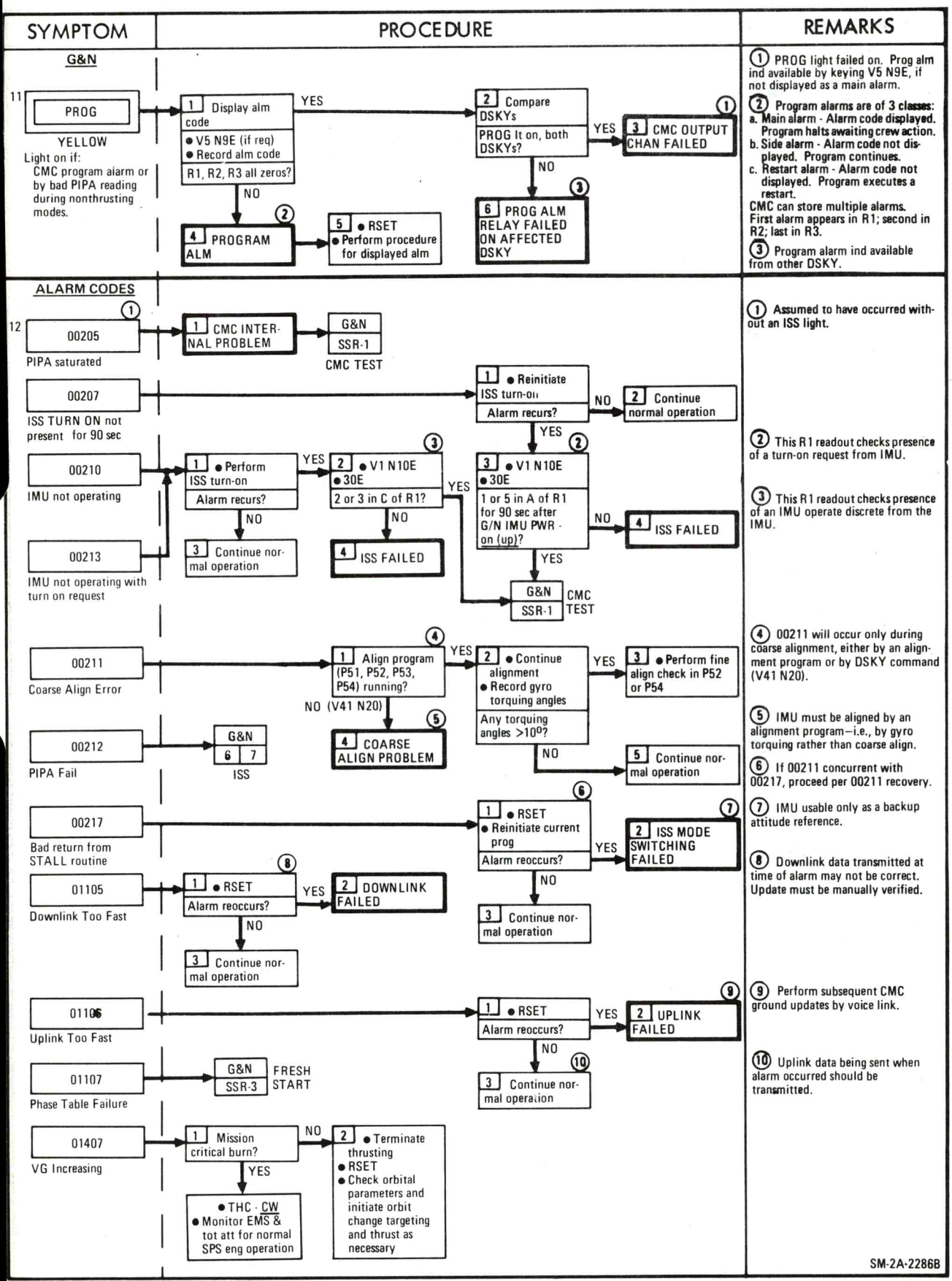

SYMPTOM
PROCEDURE
REMARKS
G&N
3 THC TROUBLE-SHOOTING ROUTINE
1 Input Check
• AUTO RCS (16) - OFF
• SC CONT - CMC
• CMC MODE - FREE
• THC PWR - on (up)
• V11 N10E, 31E
• THC - cmd + & - (in axis)
• Verify R1 readout
+X 17677
-X 17577
+Y 17377
-Y 16777
+Z 15777
-Z 13777
R1 correct?
NO
3 cb SCS CONTR AUTO MNA & MNB - both closed?
NO
4 • cb SCS CONTR AUTO (2) - closed
• THC - cmd + & - (in axis)
• Verify R1 readout
R1 correct?
YES
2 ORIG THC SYS TRANS SW FAILED OPEN
YES
NO
YES
5 Translation direction X?
NO
6 Output Chan ck
• V11 N10, 6E
• THC - cmd + & - (in axis)
• Verify R1 readout
+Y 00220
-Y 00140
+Z 00011
-Z 00006
R1 correct?
NO
YES
3 4 7 CMC INPUT CHAN FAILED OPEN
YES
8 Output Chan ck
• V11 N10E, 5E
• THC - cmd + & -
• Verify R1 readout
+4J 00231
+2J (AC) 00011
+2J (BD) 00220
-4J 00146
-2J (AC) 00006
-2J (BD) 00140
R1 correct?
NO
4 9 CMC OUTPUT CHAN FAILED OPEN
G&N SSR-2
CMC JET RECONFIG
YES
10 • AUTO RCS - MNA or B (in axis) (Select 2 jets if 4 jets +X trans)
• THC - cmd + & - (in axis)
Any motion?
YES
11 • MAN ATT - ACCEL CMD
• THC - cmd + & - (in axis)
Motion in?
TRANS
ROT
12 4 jet X trans?
YES
13 Repeat step 10 for other two X trans jets?
YES
NO
NO
5 16 CMC-SCS INTERFACE FAILED OPEN
CMC JET RECONFIG (STEP 8)
NO
14 DRIVER LOGIC FAILED (CR18)
15 DRIVER FAILED OFF
G&N SSR-2
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.
4 MIN IMP CONT TROUBLE-SHOOTING ROUTINE
1 Troubleshooting config
• AUTO RCS (16) - OFF
• SC CONT - CMC
• CMC MODE - FREE
• RHC PWR NORM (2) - AC/DC
• RHC's & THC - neutral
Controller?
RHC
2 RHC input chan check
• VII N10E 31E
XXX77 in R1?
NO
3 • RHC PWR NORM 2 - OFF
XXX77 in R1?
YES
4 RHC 2 B/O SHORT
NO
7 RHC PWR NORM 1 - OFF
XXX77 in R1?
YES
8 RHC 1 B/O SHORT
NO
9 INPUT CHAN (31) FAILED (MIN IMP LOST)
G&N SSR-2
CMC JET RECONFIG
10 • RHC PWR NORM 2 - AC/DC
YES
YES
6 Controller ck
• Cmd + & - (in axis)
• Verify R1 readout
+ROLL XXX57
-ROLL XXX37
+PITCH XXX76
-PITCH XXX75
+YAW XXX73
-YAW XXX67
R1 correct?
YES
G&N 2 5
RHC TROUBLE-SHOOTING ROUTINE
NO
4 12 MIN IMP CONT OR RHC B/O SW OPEN
MIC
2 5 MIC input chan check
• V11 N10E 32E
XXX77 in R1?
YES
NO
4 11 MIN IMP CONT B/O SHORT OR INPUT CHAN (32) FAILED
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


SYMPTOM
PROCEDURE
REMARKS
G&N
5
CMC
RED
Lt on if:
CMC prime pwr fails
Scaler fails
Counter fails
Repeated restarts
1 • SC CONT - SCS CMC in stby?
YES
2 Power up
• Perform CMC power up
Can CMC be powered up?
NO
YES
NO
3 CMC lt on continuously?
YES
4 Input chan ck
• V11 N10E 33E
DSKY operational?
NO
5 CMC FAILED
YES
NO
6 0, 1, 4, 5 in A of R1?
YES
NO
7 C/W FAILED OR CMC LT RELAY ON DSKY FAILED CLOSED
8 Any DSKY status lt on?
YES
9 PROG lt on?
NO
YES
NO
10 Display ALM code
• V5 N9E
• Perform action for displayed alarm
RESTART lt on?
YES
NO
G&N SSR-1
CMC TEST
G&N 9 2
RESTART
(1) All CMC functions lost.
(2) The R1 readout indicates a CMC FAIL signal to CMC.
(3) Subsequent CMC malfunction indication from unaffected CMC light.
(4) If the LEB CMC lt is on, all gyro torquing and PIPA capability lost. CMC monitor and control of both TVC and entry lost.
5 THRU 6
6
ISS
RED
Lt on if:
IMU fails
ICDU fails
PIPA fails during thrust
1 PROG lt on?
YES
NO
2 Display alm code
• V5 N9E
• Record alm codes
• RSET
ISS and PROG lts remain off?
YES
3 TRANSIENT ISS CONDITION
4 C/W OR CMC OUTPUT CHAN FAILED
NO
10777
7 & 16
5 • SCS CONT - SCS Alarm code?
00777
6 & 7
14777
6, 7 & 16
13777
6 & 16
03777
00777 & 00205
07777 00211
6 ICDU A/D ck
• V40E (zero CDU)
• V16 N20E
FDAI No. 1 total att and R1, R2, R3 agree?
NO
8 ICDU A/D SECTION FAILED
YES
7 PIPA check
• V16 N21E
Any register >51 counts per min?
YES
9 PIPA FAILED
NO
10 Any register static?
YES
11 Dynamic PIPA check
• THC - translate in direction of affected PIPA axis
Affected register unchanged?
NO
YES
13 PIPA FAIL DETECTION CIRCUIT FAILED
12 ICDU D/A ck
• RCS DAP - off
• V37E 00E
• V43E
• Load ICDU angles
R1 + 00250
R2 + 00333
R3 + 00333
FDAI NO. 1 error needles ≈ loaded values?
YES
NO
14 ICDU D/A SECTION FAILED
15 CMC INPUT CHAN FAILED
16 Stab loop ck
• Establish att hold
• FDAI SEL - 1/2
• V16 N20E
FDAI No. 1 and R1, R2, R3 stable?
YES
NO
17 IMU FAILED
(1) Subsequent ISS malfunction indications from unaffected ISS lt.
(2) The following alarm codes are generated by the listed failures (or by transient fail discretes):
04777 - PIPA and ICDU fail
10777 - PIPA and IMU fail
13777 - IMU and ICDU fail
14777 - PIPA, IMU and ICDU fail
If any of these alarm codes occur, proceed sequentially to each of the steps indicated. A "no" answer to each step is indicative that a transient fail discrete has been generated.
(3)
Function Remaining | A/D Failure | D/A Failure
Fine align | NO | YES
Coarse align | NO | NO
Att err signal | NO | NO
Total att to FDAI | YES | YES
Gmbl angles to CMC | NO | YES
IMU stabilization loop | YES | YES
Cage mode | YES | YES
IMU fail detect ckt | YES | YES
Coarse align in gmbl lock | NO | YES
(4) CMC can perform functions not requiring IMU inputs (e.g., P77). After each maneuver, state vectors must be updated via P27.
(5) CMC monitor and control of both TVC and entry lost.
(6) Affects assurance of an ISS command. Subsequent indicator of an ISS failure loss.
SM-2A-2285F

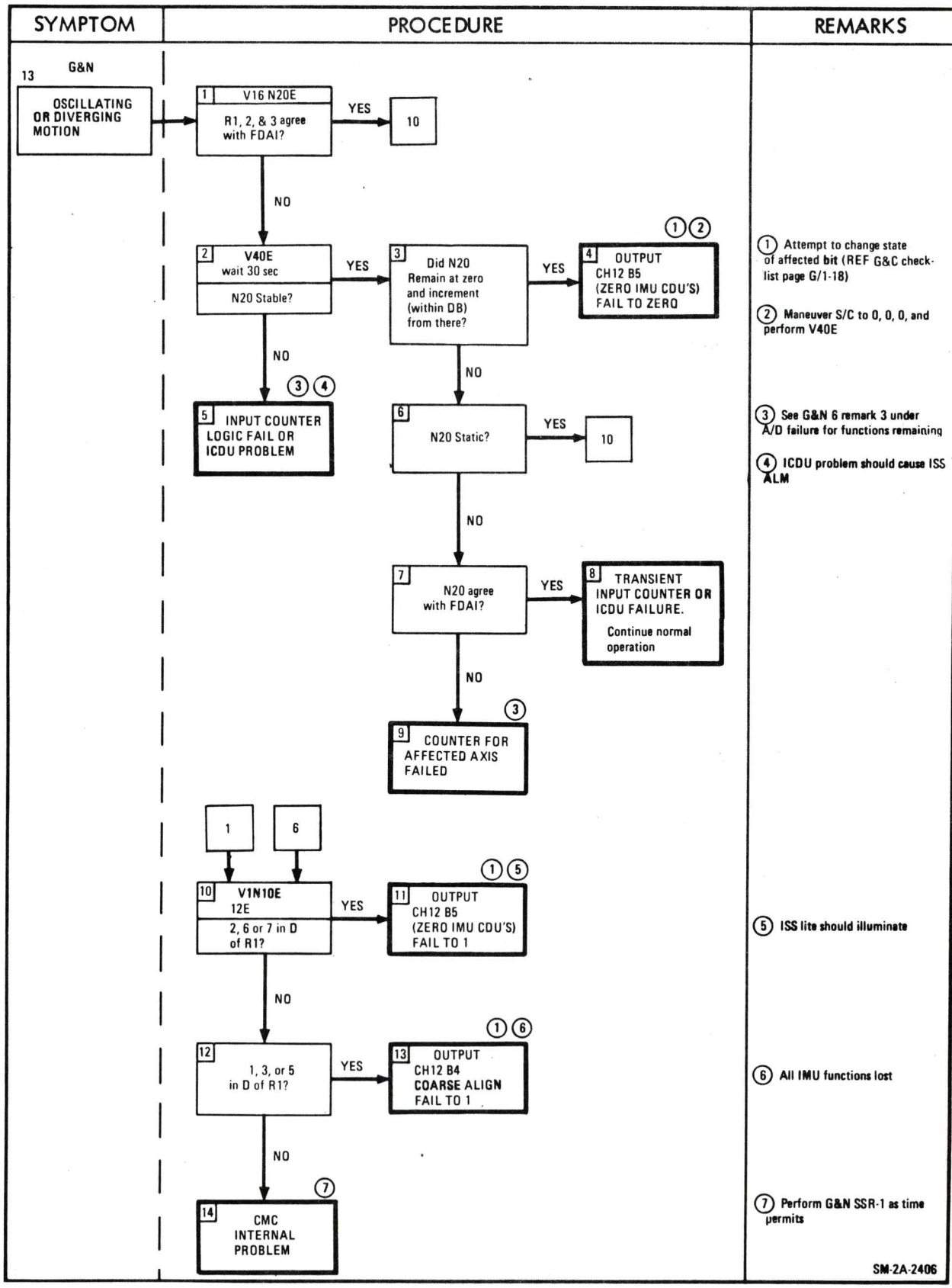
SYMPTOM	PROCEDURE	REMARKS
G&N 7 GIMBAL LOCK YELLOW		(1) If yaw axis failed, IMU will coarse align unless Saturn DAP and AVE G selected, or perform continuous V40E. See G&N 6 Remark (3) under A/D failure for functions remaining. (2) If MGA already < 70°, perform SSR-1 as time permits.

SM-2A-2363

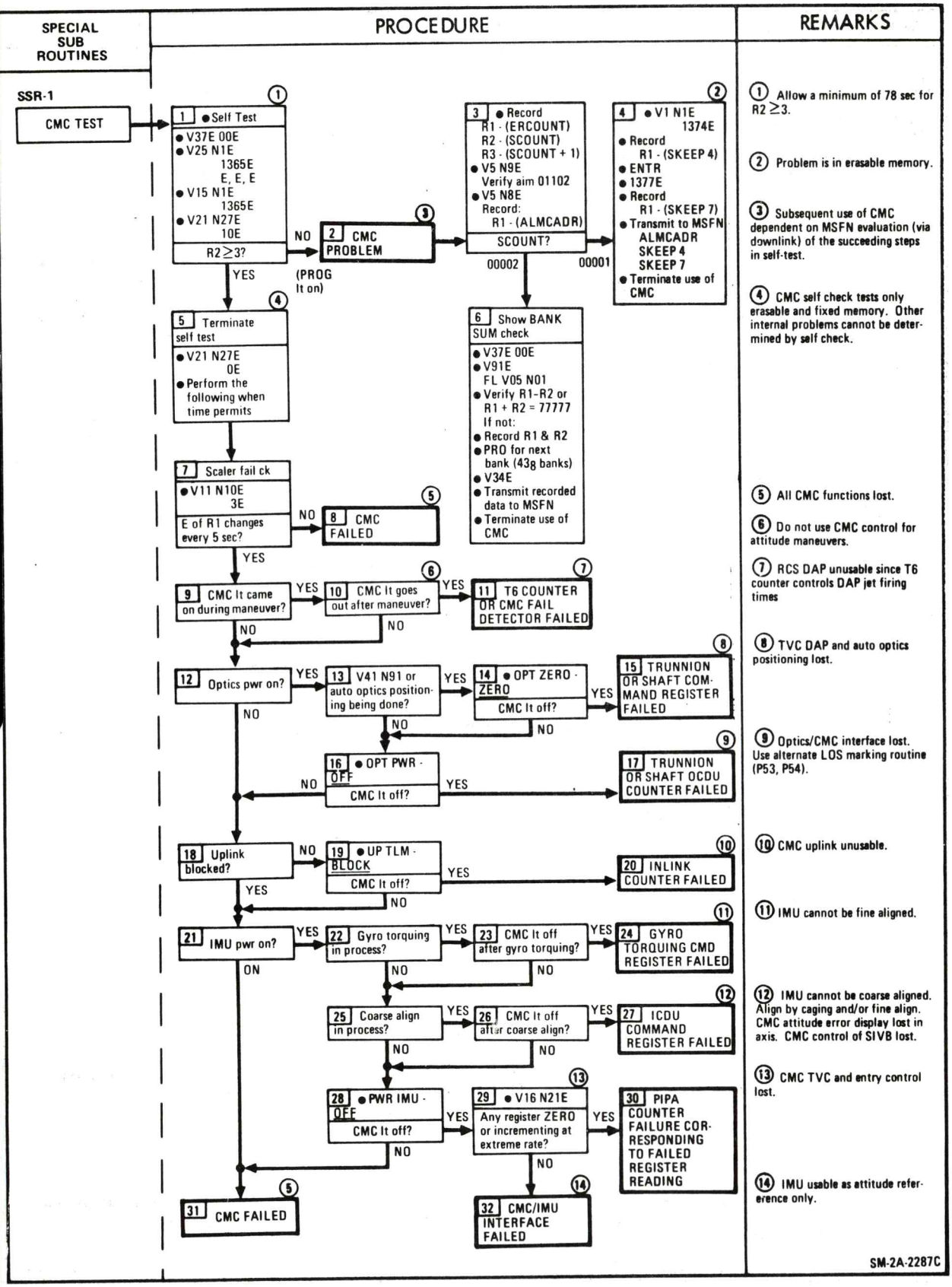

SYMPTOM
PROCEDURE
REMARKS
8
G&N
TEMP
YELLOW
Light on if:
IMU temperature is out of limits <126 or >134°F.
1 Attempt reset
• RSET
TEMP lt out?
NO
YES
2 Input chan ck
• V11 N10E, 30E
0, 1, 2, 3 in A of R1?
YES
NO
3 Output chan ck
• V11 N10E, 11E
1, 3, 5, 7 in D of R1?
YES
NO
4 CMC OUTPUT CHAN FAILED
5 Continue norm operation
6 NOTE: G&N performance will be unaffected by IMU temp out-of-tolerance for at least 15 min. Critical maneuvers can be continued within this time.
7 TEMP RELAY IN DSKY FAILED CLOSED
8 IMU stability ck
• FDAI SEL - 1/2
No. 1 FDAI stable when compared with No. 2 or visual cues?
YES
NO
9 MSFN reports PIPA temps
Temp normal?
YES
NO
10 IMU TEMP SENSOR FAILED
11 IMU TEMP CONTROL FAILED
(1) This R1 readout indicates IMU temp within limits.
(2) All IMU temp abnormal indications lost. Temp available from MSFN only.
(3) IMU temp abnormal indication available from unaffected DSKY.
(4) Transient abnormal condition.
(5) Assumes normal operation of No. 1 FDAI has been verified.
(6) IMU may be used as long as FDAI No. 1 indicates that the IMU is stable.
9
RESTART
YELLOW
Lighted by any of the following:
PARITY FAIL
RUPT LOCK
TC TRAP
NIGHT WATCHMAN
or VOLTAGE FAIL
1 DSKY blank, except status lights?
YES
NO
2 Attempt reset
• RSET
RESTART lt off?
YES
NO
3 Continue norm operation
4 • V5 N9E
Verify Alm 01107
G&N
SSR-3
FRESH START
5 CMC lt on?
YES
NO
6 Attempt fresh start
• SC CONT - SCS
• MSFN contact req
• V74E
If HBR & 1-1/2 min
or
LBR & ≈ 7-1/2 min
• V36E
• RSET
RESTART lt off?
YES
NO
7 Compare DSKYs
RESTART lt on, both DSKYs?
YES
NO
8 Program running?
YES
NO
9 Continue operation with caution
10 Lamp test
• V37E 00E
• V35E
RESTART lt on, both DSKYs?
YES
NO
11 RESTART LT RELAY FAILED OPEN (UNLIT DSKY)
12 RESTART LT RELAY FAILED CLOSED
13 CMC FAILED
NO
14 • Simultaneously push - RSET and MARK REJECT pb
RESTART lt off?
YES
NO
FRESH START
G&N
SSR-3
YES
(1) If PROG lt on, display the alarm code and perform the required action before proceeding.
(2) Restarts at a higher rate than ≈1/sec will trigger CMC light. Restarts at a rate higher than ≈1/2 second will sustain CMC light.
(3) Recurring restarts at a rate insufficient to trigger CMC light.
(4) Restart indication available from unaffected DSKY.
(5) All CMC functions lost.
10
TRACKER
YELLOW
Light on if:
Optics CDU failed or VHF ranging data missing or no good.
1 Attempt reset
• RSET
TRACKER lt off?
NO
YES
2 Compare DSKYs
TRACKER lt on, both DSKYs?
YES
NO
3 • V11 N10E, 30E
2 or 6 in C of R1?
YES
NO
4 CMC OUTPUT CHAN FAILED
5 TRACKER LT RELAY FAILED CLOSED
6 • OPT ZERO - ZERO - (15 sec)
• RSET
TRACKER lt off during zero mode?
YES
NO
7 OCDU FAILED
8 VHF ranging data being used by CMC?
YES
NO
9 • OPT MODE - CMC
• V37E 00E
• V41 N91E
• Load 8.4° SHAFT and 4.4° TRUN
• V16 N91E
Optics drive to angles loaded?
YES
10 • V11 N10E
• 33E
E of R1 = 7?
YES
NO
11 Continue norm operation
12 • OPT MODE - MAN
TRACKER lt on?
YES
NO
13 OCDU FAIL DETECTOR FAILED
T/C
6 1
EMS RANGE DISPLAY ABNORMAL
(1) This R1 readout indicates on OCDU failed.
(2) All tracker abnormal indications lost.
(3) Tracker abnormal indications available from unaffected DSKY only.
(4) Use alternate IMU alignment program (P53 and P54). ISS and CMC unaffected. CMC control of G&N ΔV lost. TVC DAP attitude error still usable.
(5) If caused by VHF ranging data no good, the light will return on in < 1 min (CMC samples VHF ranging data every minute).
(6) This R1 readout indicates a VHF ranging data no good input to the CMC.
(7) Transient abnormal condition.
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
4 PROGRAM ALM
5 • RSET
• Perform procedure for displayed alm
6 PROG ALM RELAY FAILED ON AFFECTED DSKY
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
1 • Reinitiate ISS turn-on
Alarm recurs?
NO
2 Continue normal operation
YES
00210
IMU not operating
00213
IMU not operating with turn on request
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
5 Continue normal operation
00212
PIPA Fail
G&N 6 7 ISS
4 COARSE ALIGN PROBLEM
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?
NO
YES
2 • Terminate thrusting
• RSET
• Check orbital parameters and initiate orbit change targeting and thrust as necessary
• THC - CW
• Monitor EMS & tot att for normal SPS eng operation
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

11 THRU 12


SYMPTOM
PROCEDURE
REMARKS
13 G&N
OSCILLATING OR DIVERGING MOTION
1 V16 N20E
R1, 2, & 3 agree with FDAI?
YES
10
NO
2 V40E
wait 30 sec
N20 Stable?
YES
3 Did N20 Remain at zero and increment (within DB) from there?
YES
1 2
4 OUTPUT CH12 B5 (ZERO IMU CDU'S) FAIL TO ZERO
NO
3 4
5 INPUT COUNTER LOGIC FAIL OR ICDU PROBLEM
NO
6 N20 Static?
YES
10
NO
7 N20 agree with FDAI?
YES
8 TRANSIENT INPUT COUNTER OR ICDU FAILURE. Continue normal operation
NO
3
9 COUNTER FOR AFFECTED AXIS FAILED
1
6
10 V1N10E 12E
2, 6 or 7 in D of R1?
YES
1 5
11 OUTPUT CH12 B5 (ZERO IMU CDU'S) FAIL TO 1
NO
12 1, 3, or 5 in D of R1?
YES
1 6
13 OUTPUT CH12 B4 COARSE ALIGN FAIL TO 1
NO
7
14 CMC INTERNAL PROBLEM
1 Attempt to change state of affected bit (REF G&C checklist page G/1-18)
2 Maneuver S/C to 0, 0, 0, and perform V40E
3 See G&N 6 remark 3 under A/D failure for functions remaining
4 ICDU problem should cause ISS ALM
5 ISS lite should illuminate
6 All IMU functions lost
7 Perform G&N SSR-1 as time permits
SM-2A-2406

13


SPECIAL SUB ROUTINES
PROCEDURE
REMARKS
SSR-1
CMC TEST
1 ● Self Test
● V37E 00E
● V25 N1E
1365E
E, E, E
● V15 N1E
1365E
● V21 N27E
10E
R2≥3?
NO
2 CMC PROBLEM
(PROG lt on)
YES
3 ● Record
R1 - (ERCOUNT)
R2 - (SCOUNT)
R3 - (SCOUNT + 1)
● V5 N9E
Verify aim 01102
● V5 N8E
Record:
R1 - (ALMCADR)
SCOUNT?
00002
00001
4 ● V1 N1E
1374E
● Record
R1 - (SKEEP 4)
● ENTR
● 1377E
● Record
R1 - (SKEEP 7)
● Transmit to MSFN
ALMCADR
SKEEP 4
SKEEP 7
● Terminate use of CMC
6 Show BANK SUM check
● V37E 00E
● V91E
FL V05 N01
● Verify R1-R2 or R1 + R2 = 77777
If not:
● Record R1 & R2
● PRO for next bank (43g banks)
● V34E
● Transmit recorded data to MSFN
● Terminate use of CMC
5 Terminate self test
● V21 N27E
0E
● Perform the following when time permits
7 Scaler fail ck
● V11 N10E
3E
E of R1 changes every 5 sec?
NO
8 CMC FAILED
YES
9 CMC lt came on during maneuver?
YES
10 CMC lt goes out after maneuver?
YES
11 T6 COUNTER OR CMC FAIL DETECTOR FAILED
NO
NO
12 Optics pwr on?
YES
13 V41 N91 or auto optics positioning being done?
YES
14 ● OPT ZERO - ZERO
CMC lt off?
YES
15 TRUNNION OR SHAFT COMMAND REGISTER FAILED
NO
NO
NO
16 ● OPT PWR - OFF
CMC lt off?
NO
YES
17 TRUNNION OR SHAFT OCDU COUNTER FAILED
18 Uplink blocked?
NO
19 ● UP TLM - BLOCK
CMC lt off?
YES
20 INLINK COUNTER FAILED
YES
NO
21 IMU pwr on?
YES
22 Gyro torquing in process?
YES
23 CMC lt off after gyro torquing?
YES
24 GYRO TORQUING CMD REGISTER FAILED
ON
NO
NO
25 Coarse align in process?
YES
26 CMC lt off after coarse align?
YES
27 ICDU COMMAND REGISTER FAILED
NO
NO
28 ● PWR IMU - OFF
CMC lt off?
YES
29 ● V16 N21E
Any register ZERO or incrementing at extreme rate?
YES
30 PIPA COUNTER FAILURE CORRESPONDING TO FAILED REGISTER READING
NO
NO
31 CMC FAILED
32 CMC/IMU INTERFACE FAILED
1 Allow a minimum of 78 sec for R2 ≥3.
2 Problem is in erasable memory.
3 Subsequent use of CMC dependent on MSFN evaluation (via downlink) of the succeeding steps in self-test.
4 CMC self check tests only erasable and fixed memory. Other internal problems cannot be determined by self check.
5 All CMC functions lost.
6 Do not use CMC control for attitude maneuvers.
7 RCS DAP unusable since T6 counter controls DAP jet firing times
8 TVC DAP and auto optics positioning lost.
9 Optics/CMC interface lost. Use alternate LOS marking routine (P53, P54).
10 CMC uplink unusable.
11 IMU cannot be fine aligned.
12 IMU cannot be coarse aligned. Align by caging and/or fine align. CMC attitude error display lost in axis. CMC control of SIVB lost.
13 CMC TVC and entry control lost.
14 IMU usable as attitude reference only.
SM-2A-2287C

SPECIAL SUB-ROUTINES | PROCEDURE | REMARKS

SSR-2

CMC JET RE-CONFIG

1 Rotation? — YES → 2 Axis? — ROLL → 5 Jet Determination; PITCH or YAW → 4 Jet Determination

NO → 3 Translation direction? — X → 7 Jet Determination; Y or Z → 6 Jet Determination

6 Jet Determination

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

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

4 Jet Determination

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

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

8 Axis of failed jet? — ROLL → 9 Initiate DAP load; PITCH or YAW → 10 Initiate DAP load

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

Failed jet in quads? — A or C → 11 A(C) isolation; B or D → 12 B(D) isolation

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

Failed jet in quad? — A or C → 13 A(C) isolation; B or D → 14 B(D) isolation

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

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

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

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

15 Complete DAP load
- 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 (undocked)
- V45E (docked)
- Do P51

Fresh start by V36?

3 Fresh start re-occurs? — NO → 5 Select initial prog of mission phase & continue operation; YES → 4 CMC FAILED

(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) REFSMFLG HDSUPFLG, and NODOPO 1 flag are not changed by fresh start. All other flagwords are reset by fresh start. Flags are set again by performance of CMC programs in normal sequence.

SM-2A-1828J

SSR-2 THRU SSR-3

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SPS MALFUNCTIONS INDEX

1 SPS PRESS

YELLOW

1a FUEL AND/OR OXID PRESS HIGH

1b FUEL AND/OR OXID PRESS LOW

1c FUEL AND OXID ΔP >20 PSI

2 PITCH (YAW) GMBL 1 (2)

YELLOW

3 SPS PREMATURE SHUTDOWN

3a NO SPS IGNITION

4 SPS ENG DOES NOT SHUT DOWN AUTO

4a SPS THRUST LT ON - NON THRUSTING

5 SPS Pc ABNORMAL

6 SPS He VLV tb - ABNORMAL

7 He PRESS LOW OR DECR

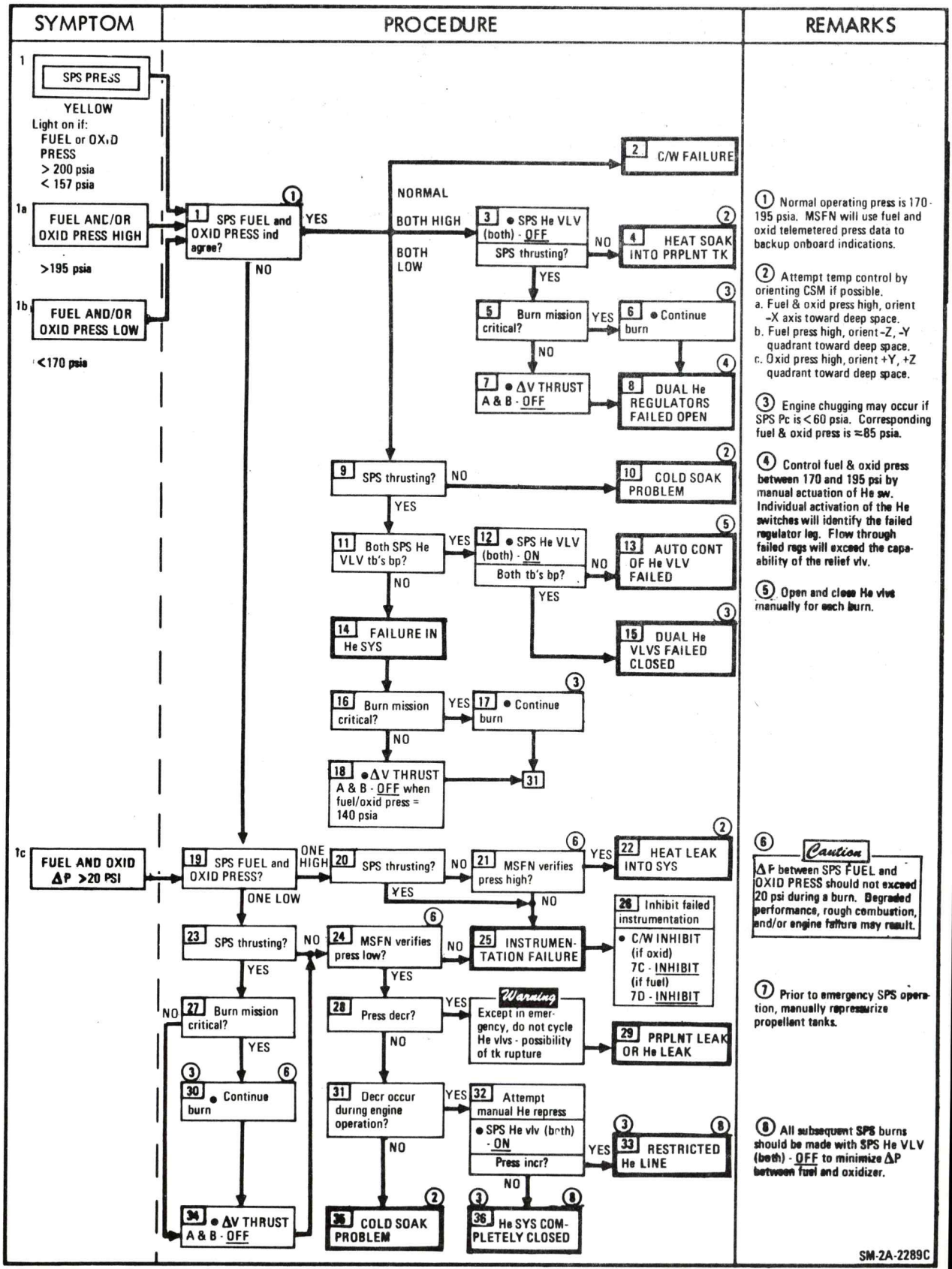
8 N2 A (B) PRESS LOW

8a SPS INJ VLV PARTIALLY OPEN

9 SPS INJ VLV IND ABNORMAL

10 NO PRPLNT LINE TEMP CONTROL

1 THRU 1c


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 Inhibit failed instrumentation
• C/W INHIBIT (if oxid) 7C - INHIBIT (if fuel) 7D - INHIBIT
27 Burn mission critical?
28 Press decr?
Warning
Except in emergency, do not cycle He vlvs - possibility of tk rupture
29 PRPLNT LEAK OR He LEAK
30 • Continue burn
31 Decr occur during engine operation?
32 Attempt manual He repress
• SPS He vlv (both) - ON
Press incr?
33 RESTRICTED He LINE
34 • ΔV THRUST A & B - OFF
35 COLD SOAK PROBLEM
36 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-2289C

2 THRU 3a

SYMPTOM

2 PITCH (YAW) GMBL 1 (2)

YELLOW

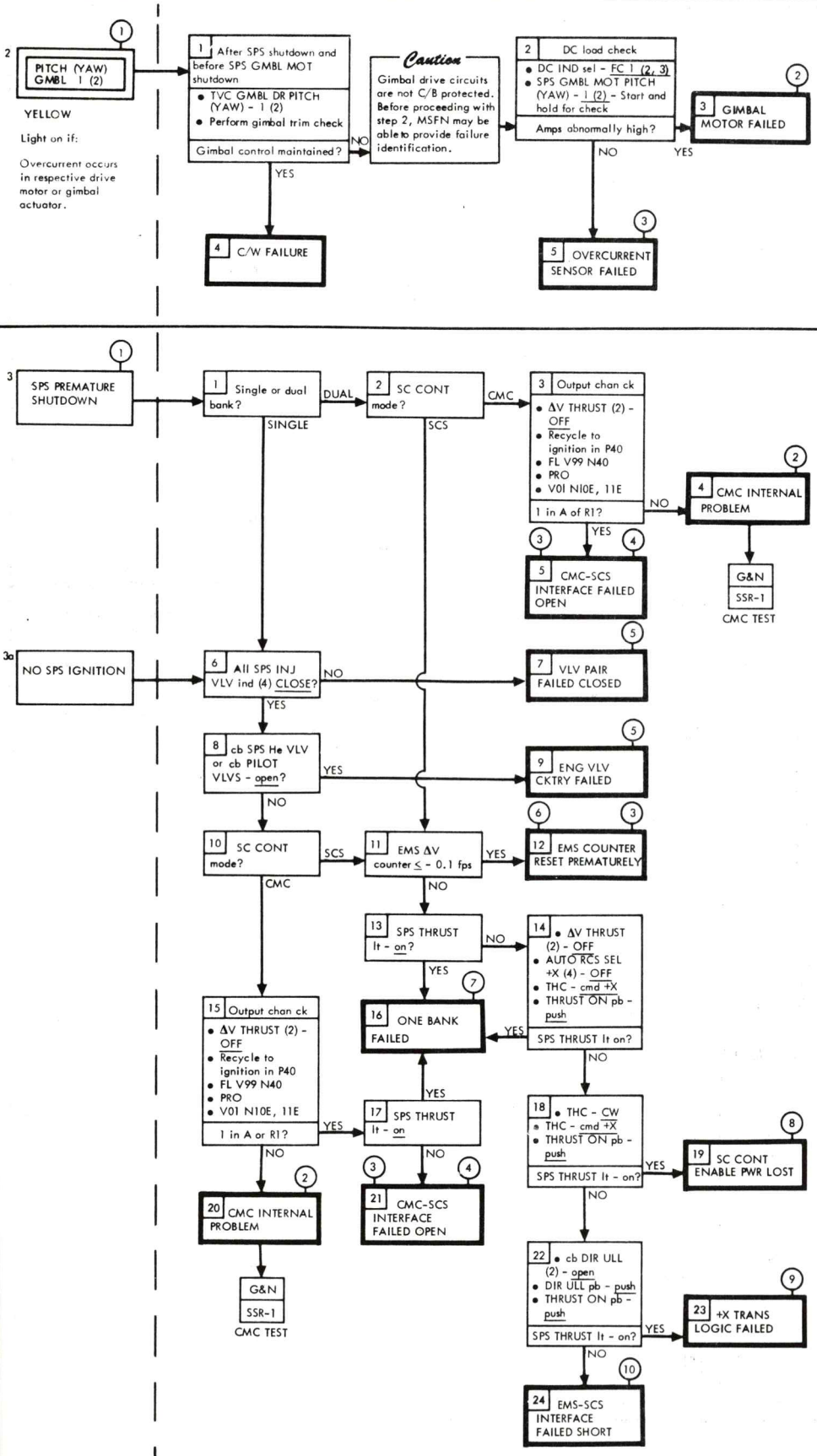
Light on if:

Overcurrent occurs in respective drive motor or gimbal actuator.

3 SPS PREMATURE SHUTDOWN

3a NO SPS IGNITION

PROCEDURE



REMARKS

(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.

(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).

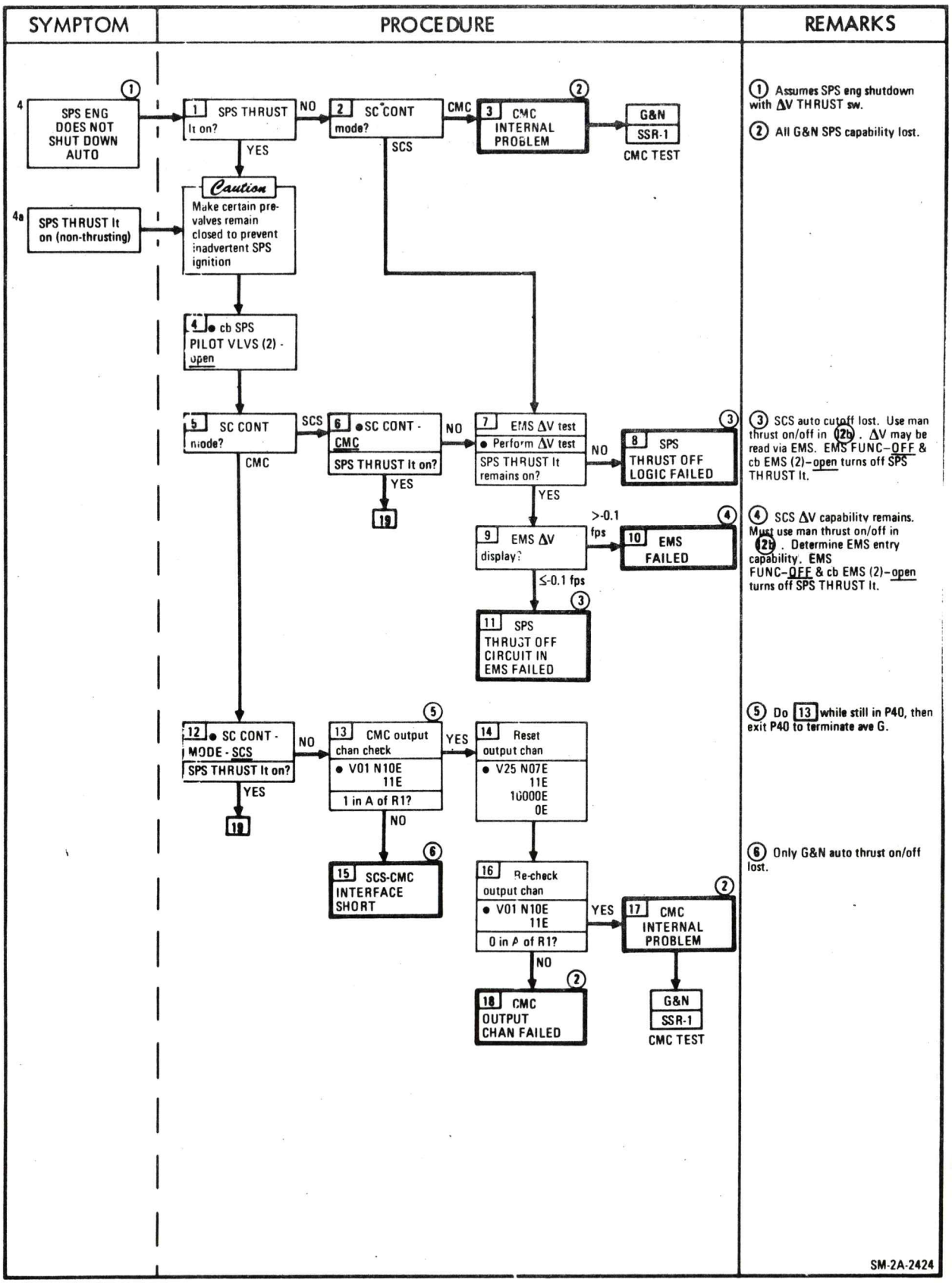
(7) Affected bank may still be available using SPS THRUST - DIR ON. Alternate bank unaffected.

(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).

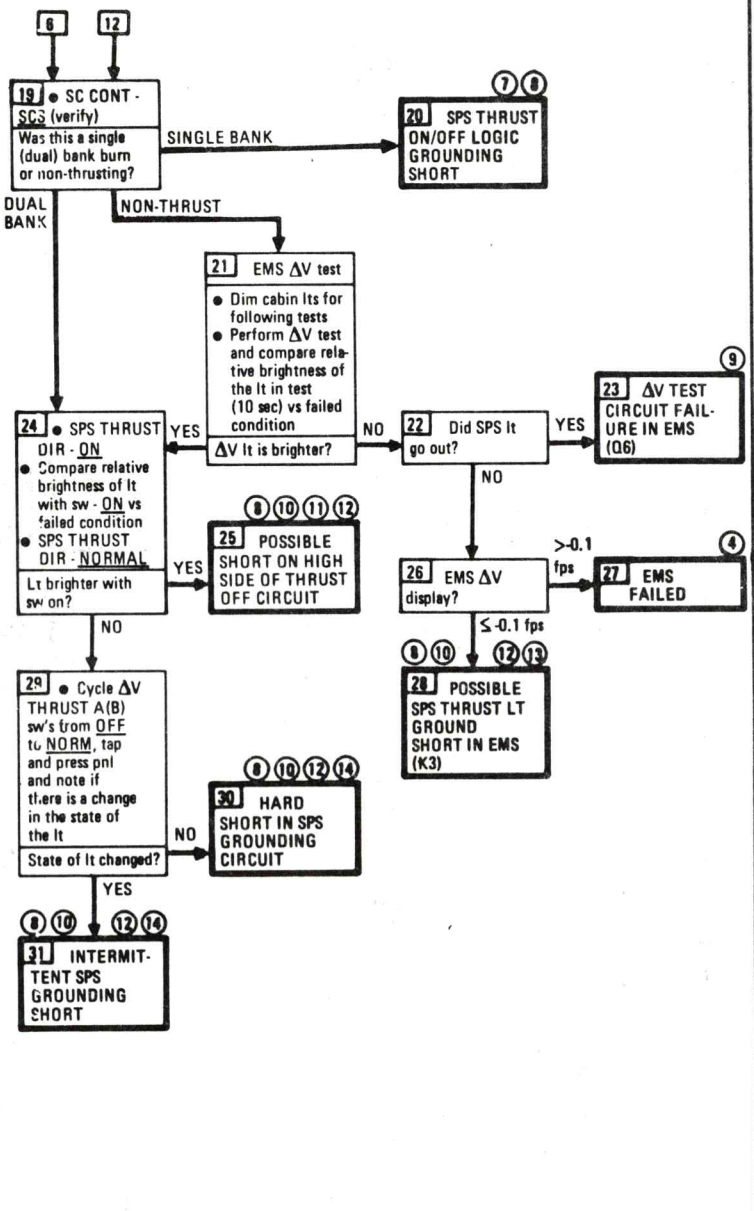
SM-2A-1460R


SYMPTOM
PROCEDURE
REMARKS
4 SPS ENG DOES NOT SHUT DOWN AUTO
4a SPS THRUST lt on (non-thrusting)
1 SPS THRUST lt on?
NO
YES
2 SC CONT mode?
CMC
SCS
3 CMC INTERNAL PROBLEM
G&N
SSR-1
CMC TEST
Caution
Make certain pre-valves remain closed to prevent inadvertent SPS ignition
4 • cb SPS PILOT VLVS (2) - open
5 SC CONT mode?
SCS
CMC
6 • SC CONT - CMC
SPS THRUST lt on?
YES
19
7 EMS ΔV test
• Perform ΔV test
SPS THRUST lt remains on?
NO
8 SPS THRUST OFF LOGIC FAILED
YES
9 EMS ΔV display?
>-0.1 fps
10 EMS FAILED
≤-0.1 fps
11 SPS THRUST OFF CIRCUIT IN EMS FAILED
12 • SC CONT - MODE - SCS
SPS THRUST lt on?
NO
YES
19
13 CMC output chan check
• V01 N10E 11E
1 in A of R1?
YES
NO
14 Reset output chan
• V25 N07E 11E 10000E 0E
15 SCS-CMC INTERFACE SHORT
16 Re-check output chan
• V01 N10E 11E
0 in A of R1?
YES
NO
17 CMC INTERNAL PROBLEM
G&N
SSR-1
CMC TEST
18 CMC OUTPUT CHAN FAILED
(1) Assumes SPS eng shutdown with ΔV THRUST sw.
(2) All G&N SPS capability lost.
(3) SCS auto cutoff lost. Use man thrust on/off in (2b). ΔV may be read via EMS. EMS FUNC–OFF & cb EMS (2)–open turns off SPS THRUST lt.
(4) SCS ΔV capability remains. Must use man thrust on/off in (2b). Determine EMS entry capability. EMS FUNC–OFF & cb EMS (2)–open turns off SPS THRUST lt.
(5) Do 13 while still in P40, then exit P40 to terminate ave G.
(6) Only G&N auto thrust on/off lost.
SM-2A-2424

4a (CONT)

SYMPTOM	PROCEDURE	REMARKS

4 (cont)



(7) Auto on/off lost for this bank. Use man thrust on/off in (12a). Short test burn in (10) may be performed (further verify failure). For alt single bank burns, perform (12a).

(8) If ignition occurs in (10), failure on low side of thrust circuit. Auto on/off lost for that bank (bank operable using man thrust on/off).

(9) Lose SPS THRUST lt test (in EMS ΔV test). If monitor SPS arming via SPS THRUST lt:
- cb EMS (2) - close
- EMS FUNC - ΔV
- EMS MODE - STBY
- Set ΔV ind - negative value

Auto thrust on/off still available via EMS but above monitoring capability lost (i.e., SPS THRUST lt comes on) when EMS test done & ΔV ind set prior to next burn.

(10) Test burn (≈1 sec duration)
Set up for SCS TVC mode
Monitor in P47
If failure intermittent, establish failure condition before doing burn (tapping/pushing panel, cycling/teasing sw).
Perform nominal SCS burn except:
- No SCS THRUST pb (failure turns eng on)

Burn prep
- cb SPS PILOT VLV (2) - open

TIG -1 min
- ΔV THRUST A(B) - NORM

[For single bank, use affected sw only. For dual bank or non-thrusting, sel affected bank sw if known, otherwise, test burn using bank A(B)]

TIG
- cb SPS PILOT VLV MNA (MNB) - close

[For single bank, use affected cb only. For dual bank or non-thrusting, close affected bank cb if known, otherwise, try test burn using bank A(B)]

IGNITION
- cb SPS PILOT VLV MNA (MNB) - open
- ΔV THRUST A(B) - OFF

NO IGNITION
- Wait ≈3 sec
- cb SPS PILOT VLV MNA (MNB) - open
- ΔV THRUST A(B) - OFF

(11) If no ignition in (10), failure on high side of thrust circuit. If cb did not open, may require longer time dependent on location & resistance of short.

REMARKS (CON'T)

(12) Alternate thrust proced (after fault isolated)

a. SPS THRUST lt circuit failure or normal single bank burns (using alt bank)
Perform nominal burn except:

Burn prep
- EMS FUNC - OFF
- cb EMS (2) - close

ECO
- EMS FUNC - OFF
- cb EMS (2) - open (turns SPS THRUST lt off)

b. Man thrust on/off using failed bank (for dual bank operation)
Perform nominal burn except:

Burn prep
- cb SPS PILOT VLV (2) - open (verify)
- EMS FUNC - OFF (verify)
- cb EMS (2) - close

TIG -1 min
- cb SPS PILOT VLV (operable bank) - close
- ΔV THRUST (2) - NORM

IGN +3 sec
- cb SPS PILOT VLV (failed bank) - close

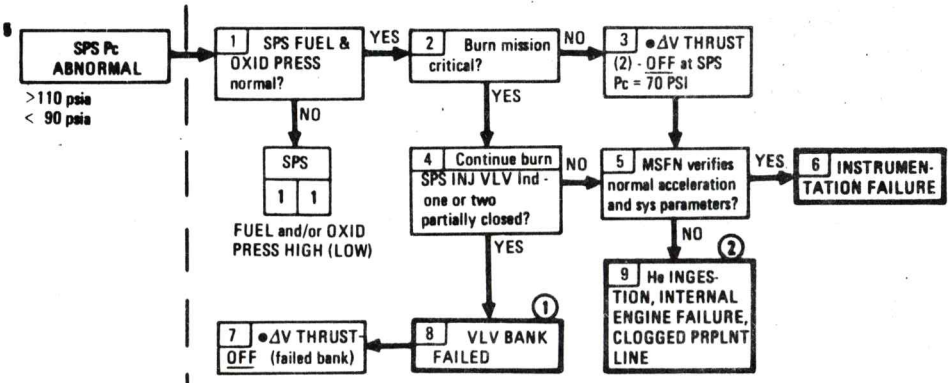
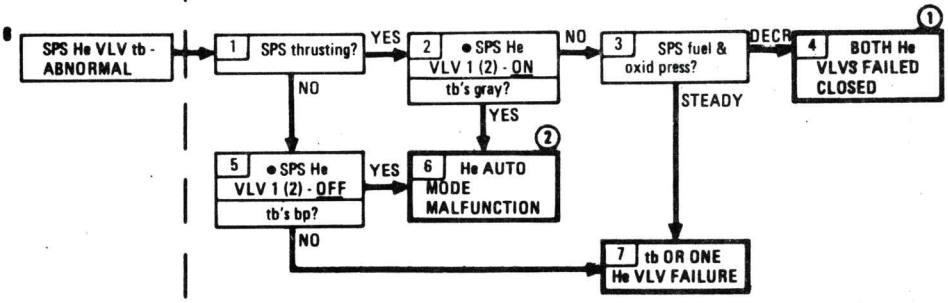
xxxxxxxxxxxxxxxxx
x x
If SCS THC - +X THRUST ON pb - push
x x
xxxxxxxxxxxxxxxxx

ECO [LOI: ECO -40 sec / TEI: ECO -10 sec]
- cb SPS PILOT VLV (failed bank) - open
- Use normal shutdown for operable bank
- cb EMS (2) - open

(13) If no ignition in (10), failure in SPS THRUST lt circuit. Auto on/off exists for both banks. Ignore SPS THRUST lt as cue for eng armed & thrust on/off. cb EMS (2) - open turns off SPS THRUST lt.

(14) If no ignition in (10), failure in alt bank. Repeat (10) to further isolate failure. If SPS THRUST lt no longer on, short may have fused, or if intermittent, short may be lost temporarily. If short cannot be re-established (tapping, cycling, etc.), both banks available (use auto thrust on/off).

SM-2A-2425

SYMPTOM	PROCEDURE	REMARKS
● SPS Pc ABNORMAL >110 psia < 90 psia		(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.
● SPS He VLV tb - ABNORMAL		(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.

5 THRU 6

SM-2A-1461Q

7 THRU 10

SYMPTOM	PROCEDURE	REMARKS
7 He PRESS LOW OR DECR	1 MSFN verifies SPS He PRESS low or decr? YES → 2 LEAK IN He SUPPLY; NO → 3 He INSTRUMENTATION FAILURE	(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 N2 A (B) PRESS LOW · 400 PSI 8a SPS INJ VLV PARTIALLY OPEN	1 Ind check • SPS PRESS IND sw - N2A, (N2B), He; Press normal? NO → 2 IND FAILED; YES → 3 N2 A (B) LEAK OR FAILED SNSR (1) → 4 • Operate engine on alternate bank	(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 thrusting? YES → 2 Double or single bank operation? DOUBLE → 3 • Continue burn; MSFN verifies vlv closed? YES → 4 ONE PAIR OF BALL VLVS FAILED CLOSED (1); NO → 6 INSTRUMENTATION FAILURE; SINGLE → 5 INSTRUMENTATION FAILURE NO → 7 MFSN verifies vlv open? YES → 8 ONE PAIR OF BALL VLVS FAILED OPEN (1) → 10 • ΔV THRUST (failed bank) - OFF (2); NO → 9 INSTRUMENTATION FAILURE	(1) SPS operable on redundant bank if one bank failed. (2) Failed bank should not be used except in an emergency.
10 NO PRPLNT LINE TEMP CONTROL → TBD		

SM2A-207BC

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RCS MALFUNCTIONS INDEX

1 SM RCS A (BCD)

YELLOW

1a SM RCS PKG TEMP HIGH

1b SM RCS PKG TEMP LOW

1c SM RCS QUAD FUEL TK PRESS LOW

1d SM RCS QUAD FUEL TK PRESS HIGH

2 SM RCS He PRESS LOW OR DECR

2a SM RCS PRPLNT QTY LOW OR DECREASING

3 SM RCS PRIM FUEL TK TEMP A(B)(C)(D) HIGH

3a SM RCS PRIM FUEL TK TEMP A(B)(C)(D) LOW

4 SM RCS PSM

YELLOW

5 He TANK PRESS HIGH

5a He TANK PRESS LOW

6 CM RCS 1 (2)

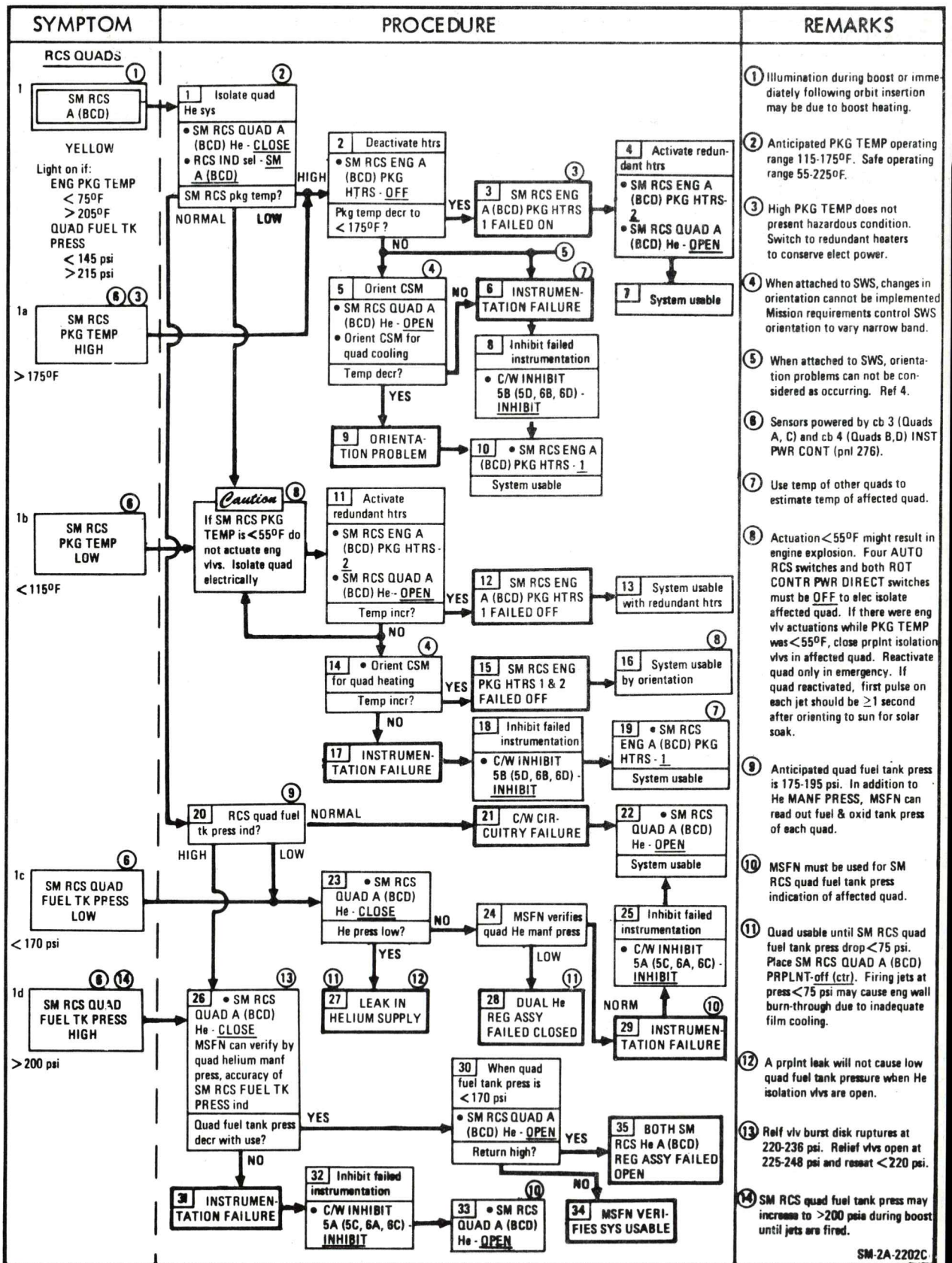
YELLOW

6a CM RCS MANF PRESS HIGH

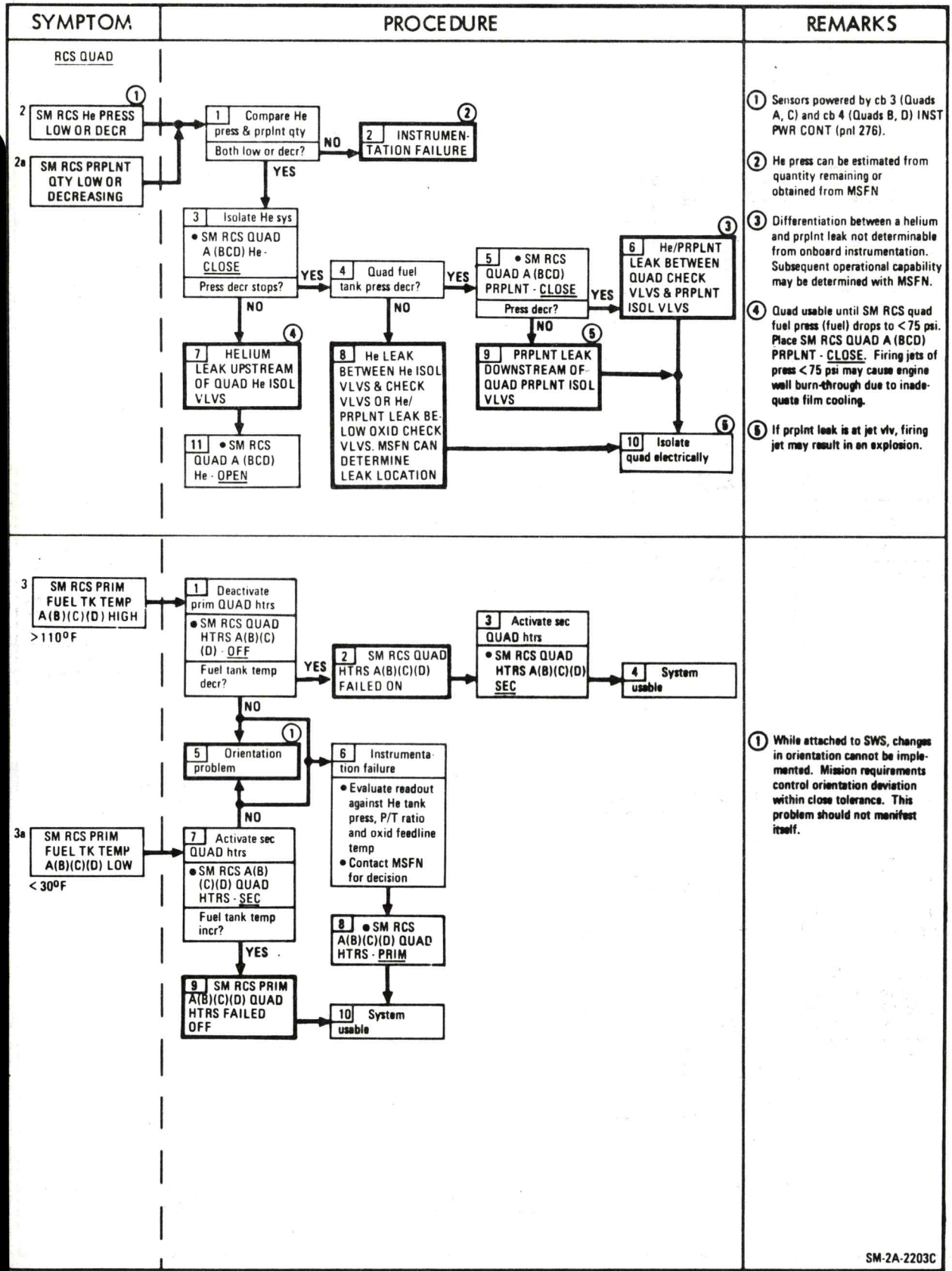
6b CM RCS MANF PRESS LOW

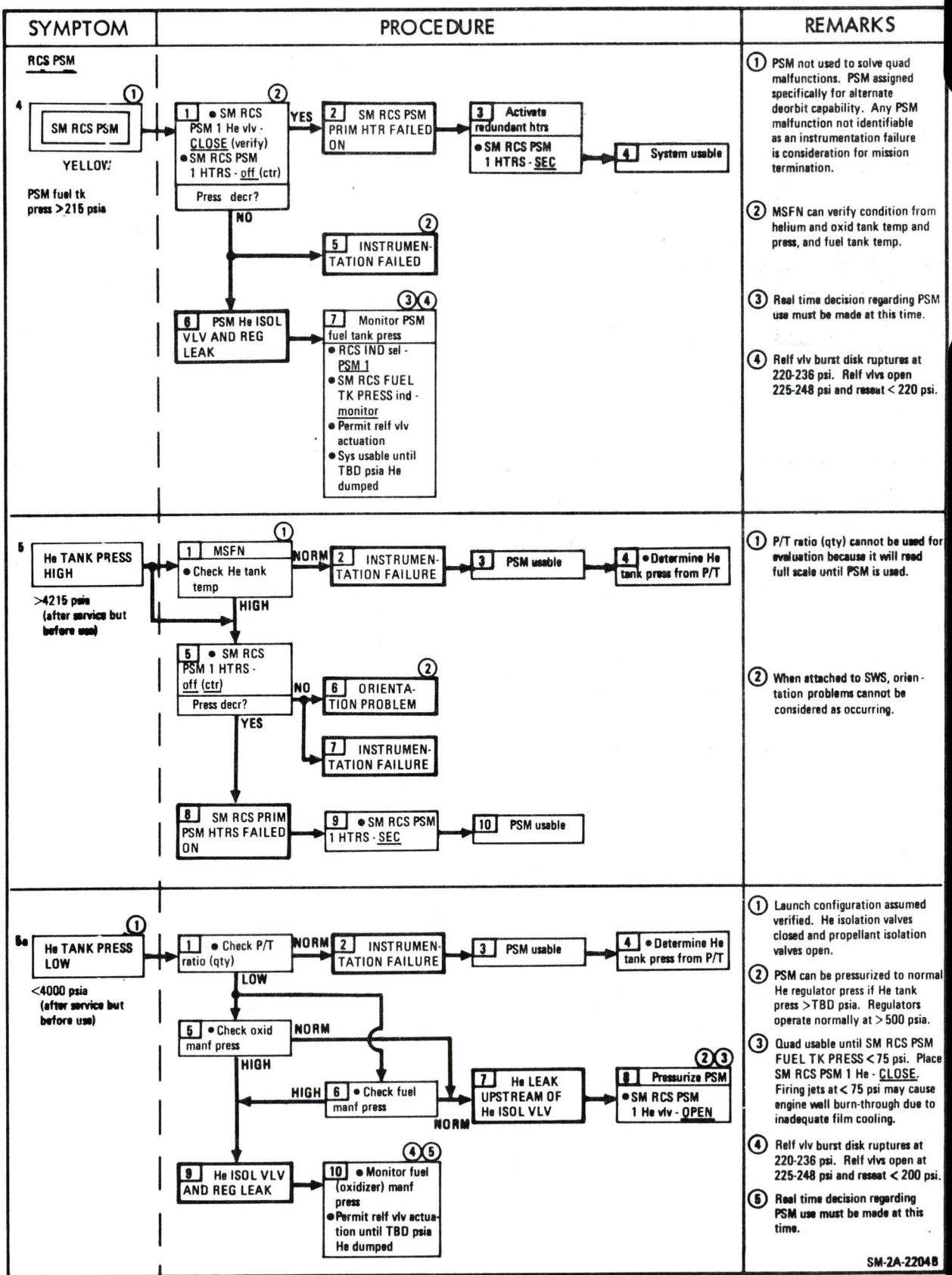
7 CM RCS He PRESS LOW OR DECR

8 CM RCS ENG TEMP FAILS TO INCR


SYMPTOM
PROCEDURE
REMARKS
RCS QUADS
1
SM RCS A (BCD)
YELLOW
Light on if:
ENG PKG TEMP
< 75°F
> 205°F
QUAD FUEL TK PRESS
< 145 psi
> 215 psi
1a
SM RCS PKG TEMP HIGH
> 175°F
1b
SM RCS PKG TEMP LOW
< 115°F
1c
SM RCS QUAD FUEL TK PRESS LOW
< 170 psi
1d
SM RCS QUAD FUEL TK PRESS HIGH
> 200 psi
1 Isolate quad He sys
• SM RCS QUAD A (BCD) He - CLOSE
• RCS IND sel - SM A (BCD)
SM RCS pkg temp?
HIGH
NORMAL
LOW
2 Deactivate htrs
• SM RCS ENG A (BCD) PKG HTRS - OFF
Pkg temp decr to < 175°F?
YES
NO
3 SM RCS ENG A (BCD) PKG HTRS 1 FAILED ON
4 Activate redundant htrs
• SM RCS ENG A (BCD) PKG HTRS - 2
• SM RCS QUAD A (BCD) He - OPEN
7 System usable
5 Orient CSM
• SM RCS QUAD A (BCD) He - OPEN
• Orient CSM for quad cooling
Temp decr?
NO
YES
6 INSTRUMENTATION FAILURE
8 Inhibit failed instrumentation
• C/W INHIBIT 5B (5D, 6B, 6D) - INHIBIT
9 ORIENTATION PROBLEM
10 • SM RCS ENG A (BCD) PKG HTRS - 1
System usable
Caution
If SM RCS PKG TEMP is < 55°F do not actuate eng vlvs. Isolate quad electrically
11 Activate redundant htrs
• SM RCS ENG A (BCD) PKG HTRS - 2
• SM RCS QUAD A (BCD) He - OPEN
Temp incr?
YES
NO
12 SM RCS ENG A (BCD) PKG HTRS 1 FAILED OFF
13 System usable with redundant htrs
14 • Orient CSM for quad heating
Temp incr?
YES
NO
15 SM RCS ENG PKG HTRS 1 & 2 FAILED OFF
16 System usable by orientation
17 INSTRUMENTATION FAILURE
18 Inhibit failed instrumentation
• C/W INHIBIT 5B (5D, 6B, 6D) - INHIBIT
19 • SM RCS ENG A (BCD) PKG HTRS - 1
System usable
20 RCS quad fuel tk press ind?
NORMAL
HIGH
LOW
21 C/W CIRCUITRY FAILURE
22 • SM RCS QUAD A (BCD) He - OPEN
System usable
23 • SM RCS QUAD A (BCD) He - CLOSE
He press low?
YES
NO
24 MSFN verifies quad He manf press
LOW
25 Inhibit failed instrumentation
• C/W INHIBIT 5A (5C, 6A, 6C) - INHIBIT
NORM
27 LEAK IN HELIUM SUPPLY
28 DUAL He REG ASSY FAILED CLOSED
29 INSTRUMENTATION FAILURE
26 • SM RCS QUAD A (BCD) He - CLOSE
MSFN can verify by quad helium manf press, accuracy of SM RCS FUEL TK PRESS ind
Quad fuel tank press decr with use?
YES
NO
30 When quad fuel tank press is < 170 psi
• SM RCS QUAD A (BCD) He - OPEN
Return high?
YES
NO
35 BOTH SM RCS He A (BCD) REG ASSY FAILED OPEN
31 INSTRUMENTATION FAILURE
32 Inhibit failed instrumentation
• C/W INHIBIT 5A (5C, 6A, 6C) - INHIBIT
33 • SM RCS QUAD A (BCD) He - OPEN
34 MSFN VERIFIES SYS USABLE
1 Illumination during boost or immediately following orbit insertion may be due to boost heating.
2 Anticipated PKG TEMP operating range 115-175°F. Safe operating range 55-225°F.
3 High PKG TEMP does not present hazardous condition. Switch to redundant heaters to conserve elect power.
4 When attached to SWS, changes in orientation cannot be implemented Mission requirements control SWS orientation to vary narrow band.
5 When attached to SWS, orientation problems can not be considered as occurring. Ref 4.
6 Sensors powered by cb 3 (Quads A, C) and cb 4 (Quads B,D) INST PWR CONT (pnl 276).
7 Use temp of other quads to estimate temp of affected quad.
8 Actuation < 55°F might result in engine explosion. Four AUTO RCS switches and both ROT CONTR PWR DIRECT switches must be OFF to elec isolate affected quad. If there were eng vlv actuations while PKG TEMP was < 55°F, close prplnt isolation vlvs in affected quad. Reactivate quad only in emergency. If quad reactivated, first pulse on each jet should be ≥1 second after orienting to sun for solar soak.
9 Anticipated quad fuel tank press is 175-195 psi. In addition to He MANF PRESS, MSFN can read out fuel & oxid tank press of each quad.
10 MSFN must be used for SM RCS quad fuel tank press indication of affected quad.
11 Quad usable until SM RCS quad fuel tank press drop < 75 psi. Place SM RCS QUAD A (BCD) PRPLNT-off (ctr). Firing jets at press < 75 psi may cause eng wall burn-through due to inadequate film cooling.
12 A prplnt leak will not cause low quad fuel tank pressure when He isolation vlvs are open.
13 Relf vlv burst disk ruptures at 220-236 psi. Relief vlvs open at 225-248 psi and reseat < 220 psi.
14 SM RCS quad fuel tank press may increase to > 200 psia during boost until jets are fired.
SM-2A-2202C

2 THRU 3a


SYMPTOM
PROCEDURE
REMARKS
RCS QUAD
2 SM RCS He PRESS LOW OR DECR
2a SM RCS PRPLNT QTY LOW OR DECREASING
1 Compare He press & prplnt qty
Both low or decr?
NO
2 INSTRUMENTATION FAILURE
YES
3 Isolate He sys
• SM RCS QUAD A (BCD) He - CLOSE
Press decr stops?
YES
4 Quad fuel tank press decr?
YES
5 • SM RCS QUAD A (BCD) PRPLNT - CLOSE
Press decr?
YES
6 He/PRPLNT LEAK BETWEEN QUAD CHECK VLVS & PRPLNT ISOL VLVS
NO
7 HELIUM LEAK UPSTREAM OF QUAD He ISOL VLVS
11 • SM RCS QUAD A (BCD) He - OPEN
NO
8 He LEAK BETWEEN He ISOL VLVS & CHECK VLVS OR He/PRPLNT LEAK BELOW OXID CHECK VLVS. MSFN CAN DETERMINE LEAK LOCATION
NO
9 PRPLNT LEAK DOWNSTREAM OF QUAD PRPLNT ISOL VLVS
10 Isolate quad electrically
3 SM RCS PRIM FUEL TK TEMP A(B)(C)(D) HIGH
>110°F
1 Deactivate prim QUAD htrs
• SM RCS QUAD HTRS A(B)(C)(D) - OFF
Fuel tank temp decr?
YES
2 SM RCS QUAD HTRS A(B)(C)(D) FAILED ON
3 Activate sec QUAD htrs
• SM RCS QUAD HTRS A(B)(C)(D) SEC
4 System usable
NO
5 Orientation problem
6 Instrumentation failure
• Evaluate readout against He tank press, P/T ratio and oxid feedline temp
• Contact MSFN for decision
3a SM RCS PRIM FUEL TK TEMP A(B)(C)(D) LOW
<30°F
7 Activate sec QUAD htrs
• SM RCS A(B)(C)(D) QUAD HTRS - SEC
Fuel tank temp incr?
YES
8 • SM RCS A(B)(C)(D) QUAD HTRS - PRIM
9 SM RCS PRIM A(B)(C)(D) QUAD HTRS FAILED OFF
10 System usable
1 Sensors powered by cb 3 (Quads A, C) and cb 4 (Quads B, D) INST PWR CONT (pnl 276).
2 He press can be estimated from quantity remaining or obtained from MSFN
3 Differentiation between a helium and prplnt leak not determinable from onboard instrumentation. Subsequent operational capability may be determined with MSFN.
4 Quad usable until SM RCS quad fuel press (fuel) drops to < 75 psi. Place SM RCS QUAD A (BCD) PRPLNT - CLOSE. Firing jets of press < 75 psi may cause engine wall burn-through due to inadequate film cooling.
5 If prplnt leak is at jet vlv, firing jet may result in an explosion.
1 While attached to SWS, changes in orientation cannot be implemented. Mission requirements control orientation deviation within close tolerance. This problem should not manifest itself.
SM-2A-2203C


SYMPTOM
PROCEDURE
REMARKS
RCS PSM
4
SM RCS PSM
YELLOW
PSM fuel tk press >215 psia
1 • SM RCS PSM 1 He vlv - CLOSE (verify) • SM RCS PSM 1 HTRS - off (ctr) Press decr?
YES
2 SM RCS PSM PRIM HTR FAILED ON
3 Activate redundant htrs • SM RCS PSM 1 HTRS - SEC
4 System usable
NO
5 INSTRUMENTATION FAILED
6 PSM He ISOL VLV AND REG LEAK
7 Monitor PSM fuel tank press • RCS IND sel - PSM 1 • SM RCS FUEL TK PRESS ind - monitor • Permit relf vlv actuation • Sys usable until TBD psia He dumped
(1) PSM not used to solve quad malfunctions. PSM assigned specifically for alternate deorbit capability. Any PSM malfunction not identifiable as an instrumentation failure is consideration for mission termination.
(2) MSFN can verify condition from helium and oxid tank temp and press, and fuel tank temp.
(3) Real time decision regarding PSM use must be made at this time.
(4) Relf vlv burst disk ruptures at 220-236 psi. Relf vlvs open 225-248 psi and reseat < 220 psi.
5
He TANK PRESS HIGH
>4215 psia (after service but before use)
1 MSFN • Check He tank temp
NORM
2 INSTRUMENTATION FAILURE
3 PSM usable
4 • Determine He tank press from P/T
HIGH
5 • SM RCS PSM 1 HTRS - off (ctr) Press decr?
NO
6 ORIENTATION PROBLEM
YES
7 INSTRUMENTATION FAILURE
8 SM RCS PRIM PSM HTRS FAILED ON
9 • SM RCS PSM 1 HTRS - SEC
10 PSM usable
(1) P/T ratio (qty) cannot be used for evaluation because it will read full scale until PSM is used.
(2) When attached to SWS, orientation problems cannot be considered as occurring.
5a
He TANK PRESS LOW
<4000 psia (after service but before use)
1 • Check P/T ratio (qty)
NORM
2 INSTRUMENTATION FAILURE
3 PSM usable
4 • Determine He tank press from P/T
LOW
5 • Check oxid manf press
NORM
HIGH
6 • Check fuel manf press
HIGH
NORM
7 He LEAK UPSTREAM OF He ISOL VLV
8 Pressurize PSM • SM RCS PSM 1 He vlv - OPEN
9 He ISOL VLV AND REG LEAK
10 • Monitor fuel (oxidizer) manf press • Permit relf vlv actuation until TBD psia He dumped
(1) Launch configuration assumed verified. He isolation valves closed and propellant isolation valves open.
(2) PSM can be pressurized to normal He regulator press if He tank press >TBD psia. Regulators operate normally at >500 psia.
(3) Quad usable until SM RCS PSM FUEL TK PRESS <75 psi. Place SM RCS PSM 1 He - CLOSE. Firing jets at <75 psi may cause engine well burn-through due to inadequate film cooling.
(4) Relf vlv burst disk ruptures at 220-236 psi. Relf vlvs open at 225-248 psi and reseat < 200 psi.
(5) Real time decision regarding PSM use must be made at this time.
SM-2A-22048

6 THRU 8

SYMPTOM	PROCEDURE	REMARKS
6 CM RCS 1 (2) YELLOW Light on if: MANF PRESS < 260 psi > 330 psi 6a CM RCS MANF PRESS HIGH >310 psi 6b CM RCS MANF PRESS LOW < 280 psi SYS PRESS < 80 psi SYS UNPRESS	1 CM RCS MANF PRESS ind read? (1) LOW → 2 CM RCS He PRESS low? (2)(3) NO → 3 DUAL He REG ASSY FAILED CLOSED, OR DUAL INSTRUMENTATION FAILURE (4); YES → 6 CM RCS He PRESS DEPLETED (4); NORMAL → 4 C/W FAILURE; HIGH → 5 DUAL He REG ASSY FAILED OPEN, OR INSTRUMENTATION FAILURE (4)(5)	(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.
7 CM RCS He PRESS LOW OR DECR (1) → 1 CM RCS pressurized? NO → 2 He temp confirms He leak? YES → 3 Leak in He supply (2) YES → 4 Isolate prplnt: • CM RCS PRPLNT 1 (2) · OFF; He press decr? YES → 7 LEAK BETWEEN HELIUM TANK AND PRPLNT ISOL VLV (3); NO → 8 LEAK DOWN STREAM OF PRPLNT ISOL VLVS → 9 Do not use except in an emergency (4) NO → 5 INSTR FAILURE 6 Trap CM RCS Regulator He press: • cb SECS ARM (2) · close • SECS LOGIC (2) · on (up) (locked) • SECS PYRO ARM (2) · on (up) (locked) • CM RCS PRPLNT (2) · ON • CM RCS PRESS · on (up) • SECS PYRO ARM (2) · SAFE (locked) • SECS LOGIC (2) · OFF (locked) • cb SECS ARM (2) · open 10 Purge engine feed lines: • CB RCS LOGIC (2) · close • CM RCS PRPLNT (2) · OFF • CM RCS LOGIC · ON • CM RCS HTRS · ON; After lines purged • CM RCS HTRS · OFF • CM RCS LOGIC · OFF • cb RCS LOGIC (2) · OPEN	(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) Regulator lock-up can be attained if He press is >1250 psia. (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.
8 CM RCS ENG TEMP FAILS TO INCR → 1 Any eng temp in affected ring incr? (1) NO → 2 Does SYS TEST ind work in any position? YES → 3 CM RCS HTRS CIRCUITRY FAILED (2) YES → 4 INSTRUMENTATION OR DIRECT COIL CIRCUITRY FAILED NO → 5 SYS TEST IND FAILED → 7 • CM RCS HTRS · on (up) for 20 min 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 28°F (3.9 vdc) whichever comes first	(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-2209C

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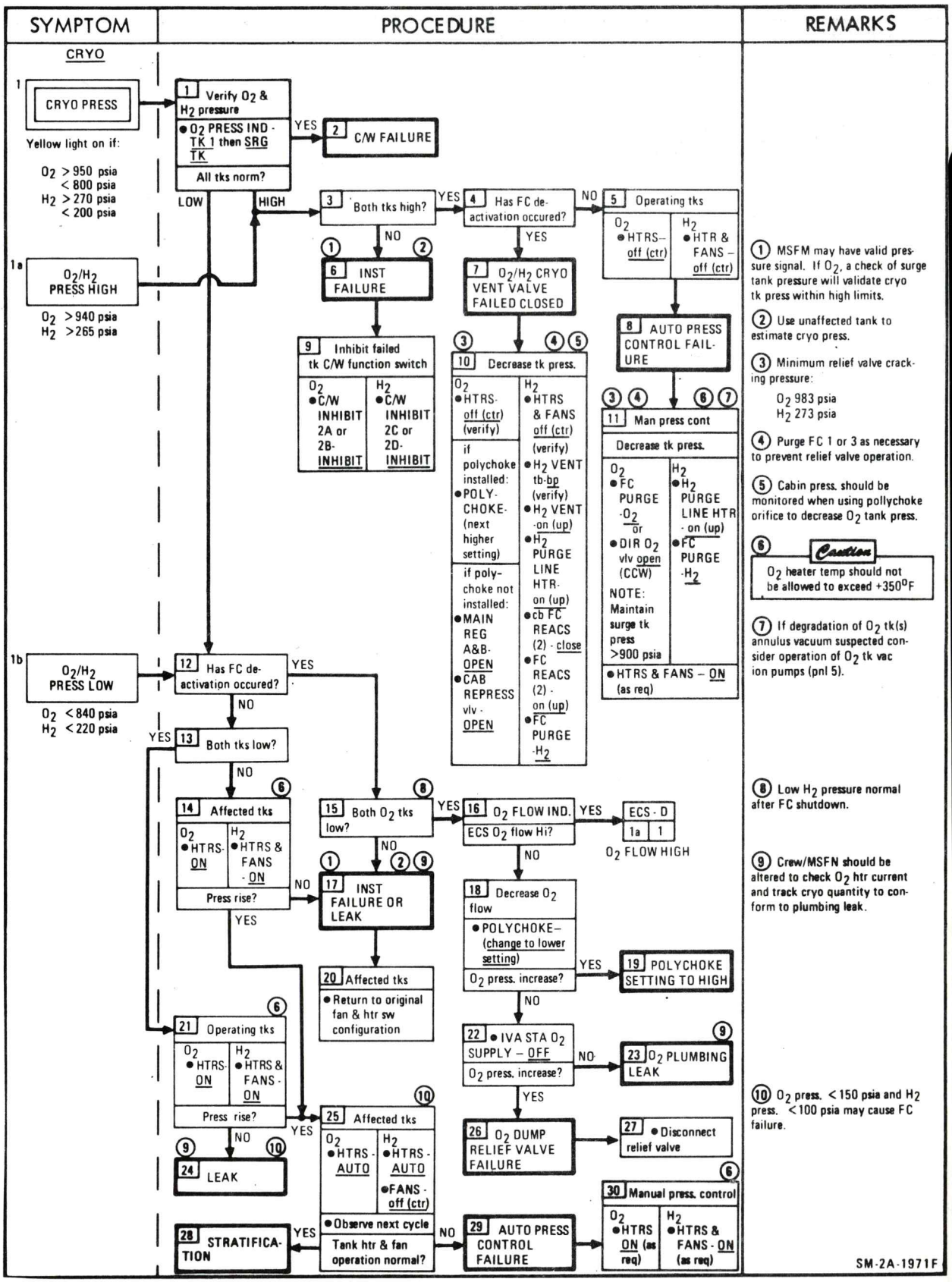
CRYO MALFUNCTIONS INDEX


SYMPTOM
PROCEDURE
REMARKS
CRYO
1
CRYO PRESS
Yellow light on if:
O_2 > 950 psia
< 800 psia
H_2 > 270 psia
< 200 psia
1a
O_2/H_2 PRESS HIGH
O_2 > 940 psia
H_2 > 265 psia
1b
O_2/H_2 PRESS LOW
O_2 < 840 psia
H_2 < 220 psia
1 Verify O_2 & H_2 pressure
● O_2 PRESS IND - TK 1 then SRG TK
All tks norm?
YES
2 C/W FAILURE
LOW
HIGH
3 Both tks high?
YES
4 Has FC de-activation occured?
NO
5 Operating tks
O_2 ● HTRS - off (ctr)
H_2 ● HTR & FANS - off (ctr)
NO
6 INST FAILURE
9 Inhibit failed tk C/W function switch
O_2 ● C/W INHIBIT 2A or 2B - INHIBIT
H_2 ● C/W INHIBIT 2C or 2D - INHIBIT
7 O_2/H_2 CRYO VENT VALVE FAILED CLOSED
8 AUTO PRESS CONTROL FAILURE
10 Decrease tk press.
O_2 ● HTRS - off (ctr) (verify)
if polychoke installed: ● POLY-CHOKE - (next higher setting)
if poly-choke not installed: ● MAIN REG A&B - OPEN ● CAB REPRESS vlv - OPEN
H_2 ● HTRS & FANS off (ctr) (verify) ● H_2 VENT tb-bp (verify) ● H_2 VENT - on (up) ● H_2 PURGE LINE HTR - on (up) ● cb FC REACS (2) - close ● FC REACS (2) - on (up) ● FC PURGE - H_2
11 Man press cont
Decrease tk press.
O_2 ● FC PURGE - O_2 or ● DIR O_2 vlv open (CCW)
NOTE: Maintain surge tk press >900 psia
H_2 ● H_2 PURGE LINE HTR - on (up) ● FC PURGE - H_2
● HTRS & FANS - ON (as req)
12 Has FC de-activation occured?
YES
NO
13 Both tks low?
YES
NO
14 Affected tks
O_2 ● HTRS - ON
H_2 ● HTRS & FANS - ON
Press rise?
NO
YES
15 Both O_2 tks low?
YES
NO
16 O_2 FLOW IND. ECS O_2 flow Hi?
YES
ECS - D 1a 1
O_2 FLOW HIGH
NO
17 INST FAILURE OR LEAK
18 Decrease O_2 flow
● POLYCHOKE - (change to lower setting)
O_2 press. increase?
YES
19 POLYCHOKE SETTING TO HIGH
NO
20 Affected tks
● Return to original fan & htr sw configuration
21 Operating tks
O_2 ● HTRS - ON
H_2 ● HTRS & FANS - ON
Press rise?
YES
NO
22 ● IVA STA O_2 SUPPLY - OFF
O_2 press. increase?
NO
23 O_2 PLUMBING LEAK
YES
24 LEAK
25 Affected tks
O_2 ● HTRS - AUTO
H_2 ● HTRS - AUTO ● FANS - off (ctr)
● Observe next cycle
Tank htr & fan operation normal?
NO
YES
26 O_2 DUMP RELIEF VALVE FAILURE
27 ● Disconnect relief valve
29 AUTO PRESS CONTROL FAILURE
30 Manual press. control
O_2 ● HTRS ON (as req)
H_2 ● HTRS & FANS - ON (as req)
28 STRATIFICATION
(1) MSFM may have valid pressure signal. If O_2, a check of surge tank pressure will validate cryo tk press within high limits.
(2) Use unaffected tank to estimate cryo press.
(3) Minimum relief valve cracking pressure:
O_2 983 psia
H_2 273 psia
(4) Purge FC 1 or 3 as necessary to prevent relief valve operation.
(5) Cabin press. should be monitored when using pollychoke orifice to decrease O_2 tank press.
(6) Caution
O_2 heater temp should not be allowed to exceed +350°F
(7) If degradation of O_2 tk(s) annulus vacuum suspected consider operation of O_2 tk vac ion pumps (pnl 5).
(8) Low H_2 pressure normal after FC shutdown.
(9) Crew/MSFN should be altered to check O_2 htr current and track cryo quantity to conform to plumbing leak.
(10) O_2 press. < 150 psia and H_2 press. < 100 psia may cause FC failure.
SM-2A-1971F

2

SYMPTOM	PROCEDURE	REMARKS

2 CRYO

O_2 TK1(2) HTR TEMP

Yellow light on if htr temp > 350°F

1 Verify O_2 tk1(2) htr temp
- SYS TEST(2) 10C (tk1) 11C (tk2)

Volts reading >3.6 vdc?

NO → (1) 2 C/W FAILURE

YES →

3 Reconfigure affected tk htr
- O_2 HTR 1(2) - off (ctr)

Htr temp decrease?

NO → 4 O_2 TK1(2) HTR SENSOR FAILURE → (1) 5 Inhibit failed tank C/W function switch
- C/W INHIBIT 1C(1D) - INHIBIT

→ 8 Affected tks
Return to original htr configuration

YES →

6 HTR TEMP EXCEEDED C/W LIMIT → (2) 7 Monitor tk 1(2) press to maintain press >800 psia
- O_2 HTR 1(2) - AUTO (as req)

(1) Periodic monitoring of O_2 tank htr temp using system test meter may be required. Verify htr temp with MSFN.

(2) Consideration should be given to single or dual htr element operation.

SM-2A-1972G

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FUEL CELL MALFUNCTIONS INDEX

1 FC 1 (3)

YELLOW

1a FC 1 (3) SKIN TEMP HI

1b FC 1 (3) SKIN TEMP LOW

1c FC 1 (3) COND EXH TEMP HI

1d FC 1 (3) COND EXH TEMP LOW

1e FC 1 (3) pH HI tb - bp

1f FC 1 (3) REACS tb - bp

2 FC 1 (3) O_2 (H_2) FLOW HI

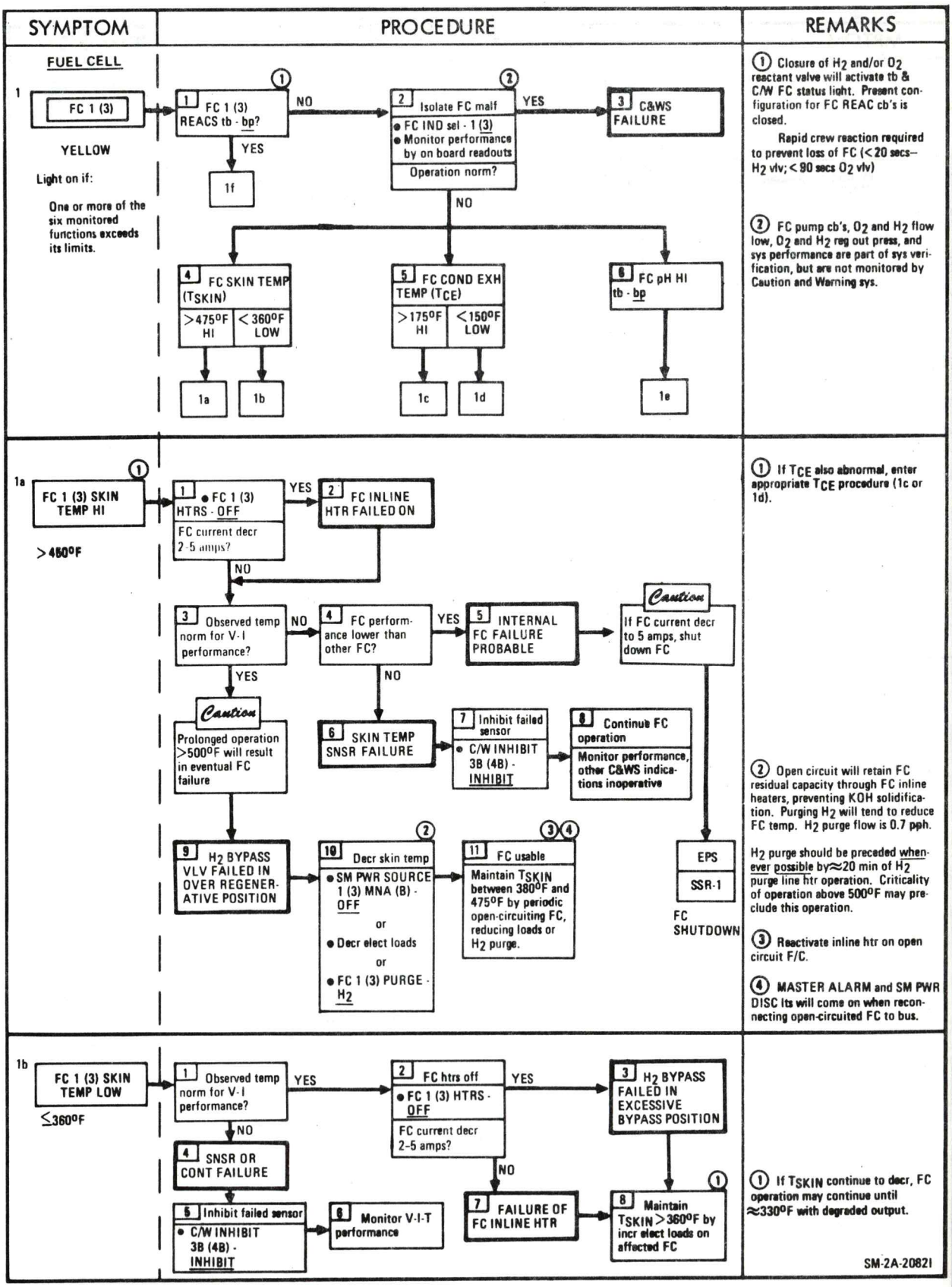
3 FC 1 (3) O_2 (H_2) FLOW LOW

4 FC REG O_2 (H_2) OUT PRESS HI

5 cb FC 1 (3) PUMPS AC - OPEN

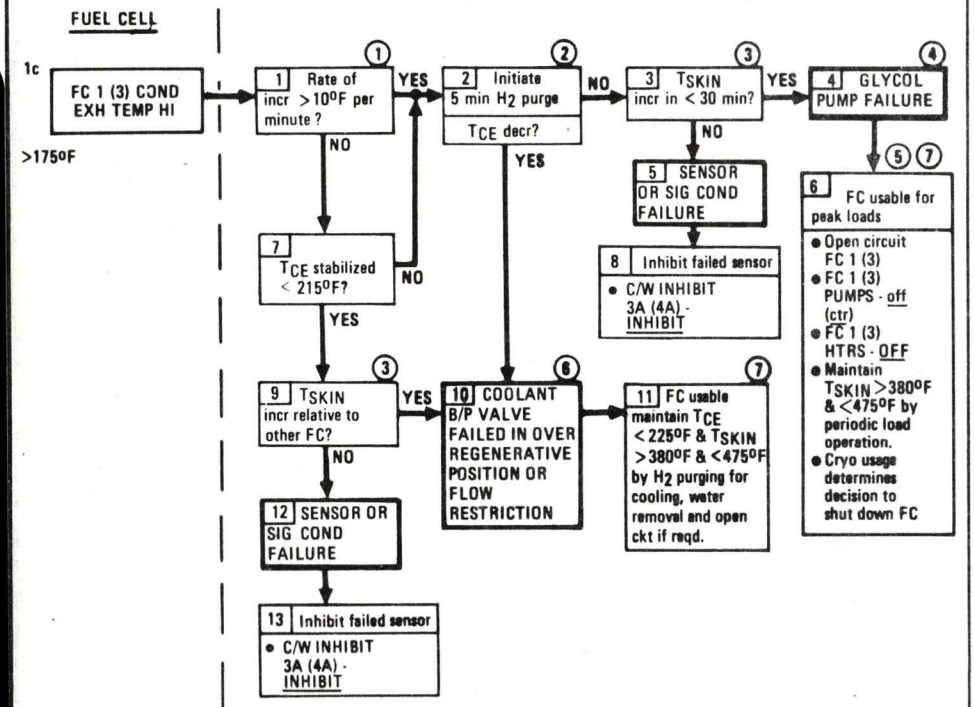
6 FC 1 (3) V-I-T PERFORMANCE LOW

1 THRU 1b


SYMPTOM
PROCEDURE
REMARKS
FUEL CELL
1
FC 1 (3)
YELLOW
Light on if:
One or more of the six monitored functions exceeds its limits.
1 FC 1 (3) REACS tb - bp?
NO
YES
2 Isolate FC malf
• FC IND sel - 1 (3)
• Monitor performance by on board readouts
Operation norm?
YES
3 C&WS FAILURE
1f
NO
4 FC SKIN TEMP (TSKIN)
>475°F HI
<360°F LOW
5 FC COND EXH TEMP (TCE)
>175°F HI
<150°F LOW
6 FC pH HI
tb - bp
1a
1b
1c
1d
1e
1 Closure of H2 and/or O2 reactant valve will activate tb & C/W FC status light. Present configuration for FC REAC cb's is closed.
Rapid crew reaction required to prevent loss of FC (<20 secs–H2 vlv; <90 secs O2 vlv)
2 FC pump cb's, O2 and H2 flow low, O2 and H2 reg out press, and sys performance are part of sys verification, but are not monitored by Caution and Warning sys.
1a
FC 1 (3) SKIN TEMP HI
>450°F
1 • FC 1 (3) HTRS - OFF
FC current decr 2-5 amps?
YES
2 FC INLINE HTR FAILED ON
NO
3 Observed temp norm for V-I performance?
NO
4 FC performance lower than other FC?
YES
5 INTERNAL FC FAILURE PROBABLE
Caution
If FC current decr to 5 amps, shut down FC
YES
NO
Caution
Prolonged operation >500°F will result in eventual FC failure
6 SKIN TEMP SNSR FAILURE
7 Inhibit failed sensor
• C/W INHIBIT 3B (4B) - INHIBIT
8 Continue FC operation
Monitor performance, other C&WS indications inoperative
9 H2 BYPASS VLV FAILED IN OVER REGENERATIVE POSITION
10 Decr skin temp
• SM PWR SOURCE 1 (3) MNA (B) - OFF
or
• Decr elect loads
or
• FC 1 (3) PURGE - H2
11 FC usable
Maintain TSKIN between 380°F and 475°F by periodic open-circuiting FC, reducing loads or H2 purge.
EPS
SSR-1
FC SHUTDOWN
1 If TCE also abnormal, enter appropriate TCE procedure (1c or 1d).
2 Open circuit will retain FC residual capacity through FC inline heaters, preventing KOH solidification. Purging H2 will tend to reduce FC temp. H2 purge flow is 0.7 pph.
H2 purge should be preceded whenever possible by≈20 min of H2 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 SM PWR DISC lts will come on when reconnecting open-circuited FC to bus.
1b
FC 1 (3) SKIN TEMP LOW
≤360°F
1 Observed temp norm for V-I performance?
YES
2 FC htrs off
• FC 1 (3) HTRS - OFF
FC current decr 2-5 amps?
YES
3 H2 BYPASS FAILED IN EXCESSIVE BYPASS POSITION
NO
4 SNSR OR CONT FAILURE
5 Inhibit failed sensor
• C/W INHIBIT 3B (4B) - INHIBIT
6 Monitor V-I-T performance
7 FAILURE OF FC INLINE HTR
8 Maintain TSKIN >360°F by incr elect loads on affected FC
1 If TSKIN continue to decr, FC operation may continue until ≈330°F with degraded output.
SM-2A-20821

1c THRU 1d

SYMPTOM	PROCEDURE	REMARKS



① Cyclic overheats to 250°F may be tolerated. Use H_2 purge to prevent steady state T_{CE} from exceeding 225°F at 25 amps.

② If possible, H_2 PURG LINE HTR should be on (up) 20 minutes prior to purge.

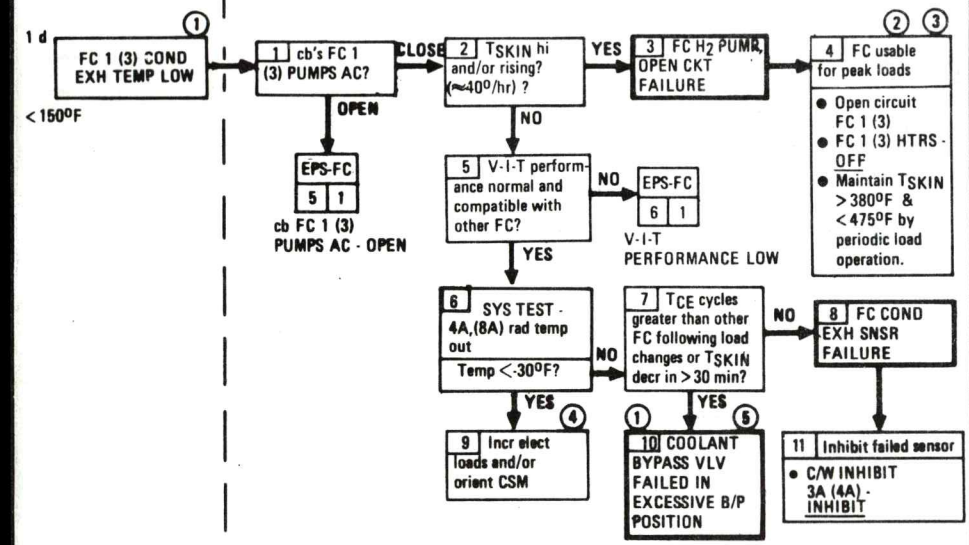
③ FC load changes may affect rates of temperature change.

④ If coolant pump failure is confirmed by MSFN report rad in and rad out temps converging, turn FC PUMPS - off (ctr) for affected FC.

⑤ Loss of glycol pump will result in loss of H_2 pump due to overheating. H_2 pump loss will result in in-line htr burn out if used.

⑥ MSFN can determine if reduced flow condition exists.

⑦ MASTER ALARM and SM PWR DISC lts will come on when reconnecting open-circuited FC to bus.



① Low T_{CE} is no restriction to FC operation if rad out and T_{SKIN} are maintained within limits.

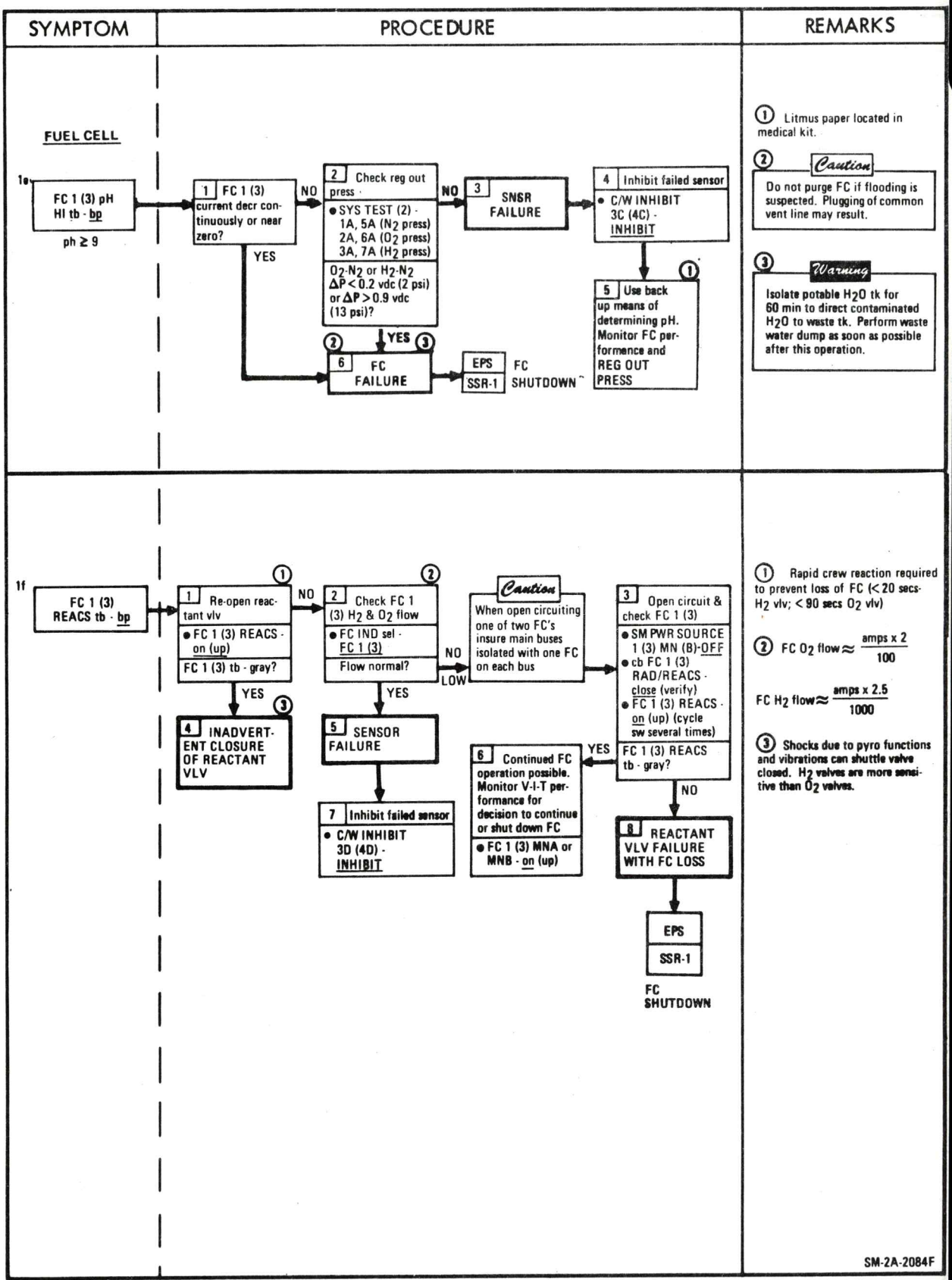
② If H_2 pump is not running, inline htr will burn out if used.

③ MASTER ALARM and SM PWR DISC lts will come on when reconnecting open-circuited FC to bus.

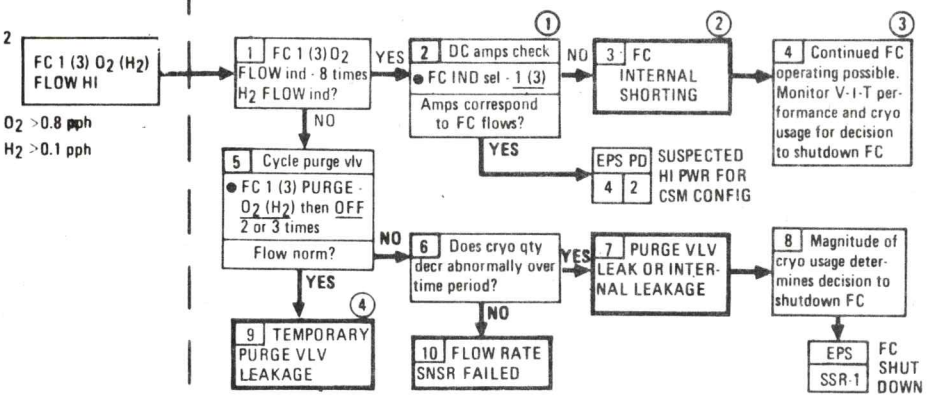
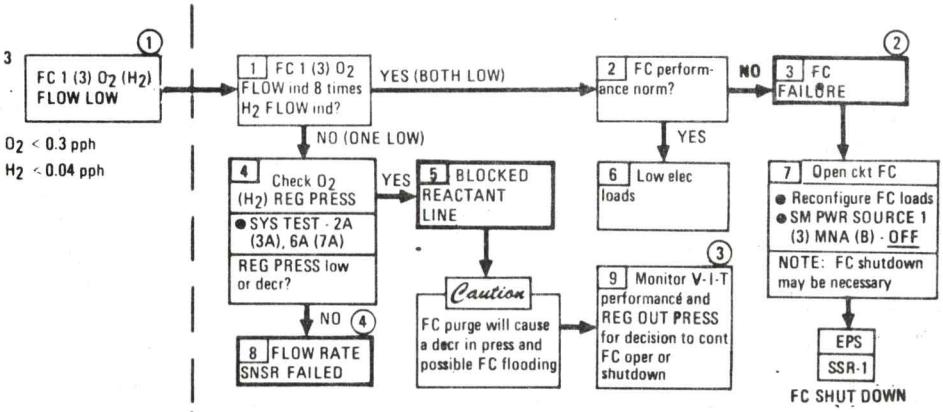
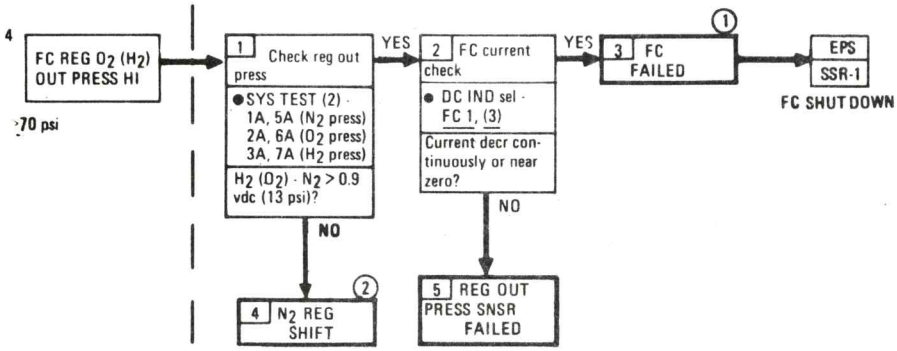
④ Since continuous operation with rad out temp <-30°F may result in rad freezing or high pressure drop and pump stall, consideration may be given to rad bypass. However, this procedure may be an irreversible action.

⑤ Performance may be improved due to electrolyte dehydration. Voltage should be maintained within limits.

SM-2A-20831


SYMPTOM
PROCEDURE
REMARKS
FUEL CELL
1e
FC 1 (3) pH HI tb - bp
ph ≥ 9
1 FC 1 (3) current decr continuously or near zero?
NO
YES
2 Check reg out press
• SYS TEST (2) - 1A, 5A (N2 press) 2A, 6A (O2 press) 3A, 7A (H2 press)
O2-N2 or H2-N2 ΔP < 0.2 vdc (2 psi) or ΔP > 0.9 vdc (13 psi)?
YES
3 SNSR FAILURE
4 Inhibit failed sensor
• C/W INHIBIT 3C (4C) - INHIBIT
5 Use back up means of determining pH. Monitor FC performance and REG OUT PRESS
6 FC FAILURE
EPS SSR-1 FC SHUTDOWN
1f
FC 1 (3) REACS tb - bp
1 Re-open reactant vlv
• FC 1 (3) REACS - on (up)
FC 1 (3) tb - gray?
YES
4 INADVERTENT CLOSURE OF REACTANT VLV
2 Check FC 1 (3) H2 & O2 flow
• FC IND sel - FC 1 (3)
Flow normal?
NO LOW
YES
5 SENSOR FAILURE
7 Inhibit failed sensor
• C/W INHIBIT 3D (4D) - INHIBIT
Caution
When open circuiting one of two FC's insure main buses isolated with one FC on each bus
3 Open circuit & check FC 1 (3)
• SM PWR SOURCE 1 (3) MN (B)-OFF
• cb FC 1 (3) RAD/REACS - close (verify)
• FC 1 (3) REACS - on (up) (cycle sw several times)
FC 1 (3) REACS tb - gray?
YES
6 Continued FC operation possible. Monitor V-I-T performance for decision to continue or shut down FC
• FC 1 (3) MNA or MNB - on (up)
NO
8 REACTANT VLV FAILURE WITH FC LOSS
EPS SSR-1
FC SHUTDOWN
1 Litmus paper located in medical kit.
2 Caution
Do not purge FC if flooding is suspected. Plugging of common vent line may result.
3 Warning
Isolate potable H2O tk for 60 min to direct contaminated H2O to waste tk. Perform waste water dump as soon as possible after this operation.
1 Rapid crew reaction required to prevent loss of FC (< 20 secs- H2 vlv; < 90 secs O2 vlv)
2 FC O2 flow ≈ amps x 2 / 100
FC H2 flow ≈ amps x 2.5 / 1000
3 Shocks due to pyro functions and vibrations can shuttle valve closed. H2 valves are more sensitive than O2 valves.
SM-2A-2084F

2 THRU 4

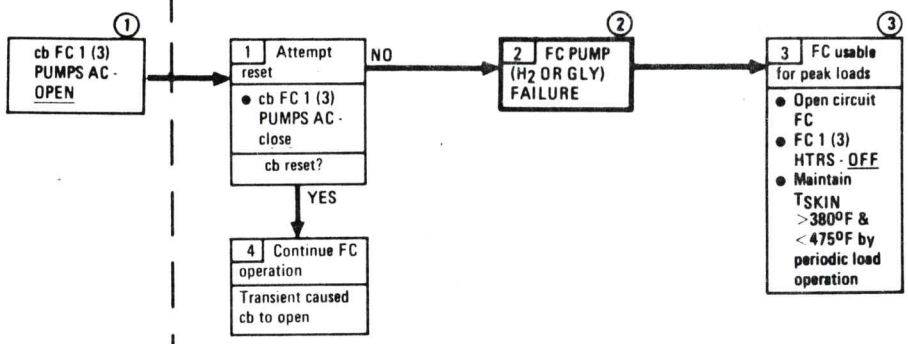
SYMPTOM	PROCEDURE	REMARKS
2 FC 1 (3) O_2 (H_2) FLOW HI O_2 >0.8 pph H_2 >0.1 pph		(1) FC O_2 FLOW = $\frac{\text{amps} \times 2}{100}$ FC H_2 FLOW = $\frac{\text{amps} \times 2.5}{1000}$ (2) An accurate magnitude of the internal short can be determined from the reactant flows when the FC is on open ckt. (3) FC reactant conversion efficiency will continue to degrade with time. (4) Future purges may result in high flow.
3 FC 1 (3) O_2 (H_2) FLOW LOW O_2 < 0.3 pph H_2 < 0.04 pph		(1) FC flow and press instrumentation powered by INST PWR CONT cb's (pnl 276). (2) Flooding is most probable cause. Isolate potable tank to direct possible contaminated H_2O to waste tank until FC condition is positively determined. (3) If reactant ΔP drops to less than 2 psi above N_2, shut down FC to avoid flooding. (4) Other reactant indicator may be used for affected flow indication.
4 FC REG O_2 (H_2) OUT PRESS HI >70 psi		(1) pH HI tb may indicate bp. If so, isolate potable H_2O tank for 60 min, to direct contaminated H_2O to waste tank. (2) Failure of N_2 regulator will raise H_2O, O_2, and N_2 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.

SM-2A-2360A

SYMPTOM	PROCEDURE	REMARKS

FUEL CELL

5

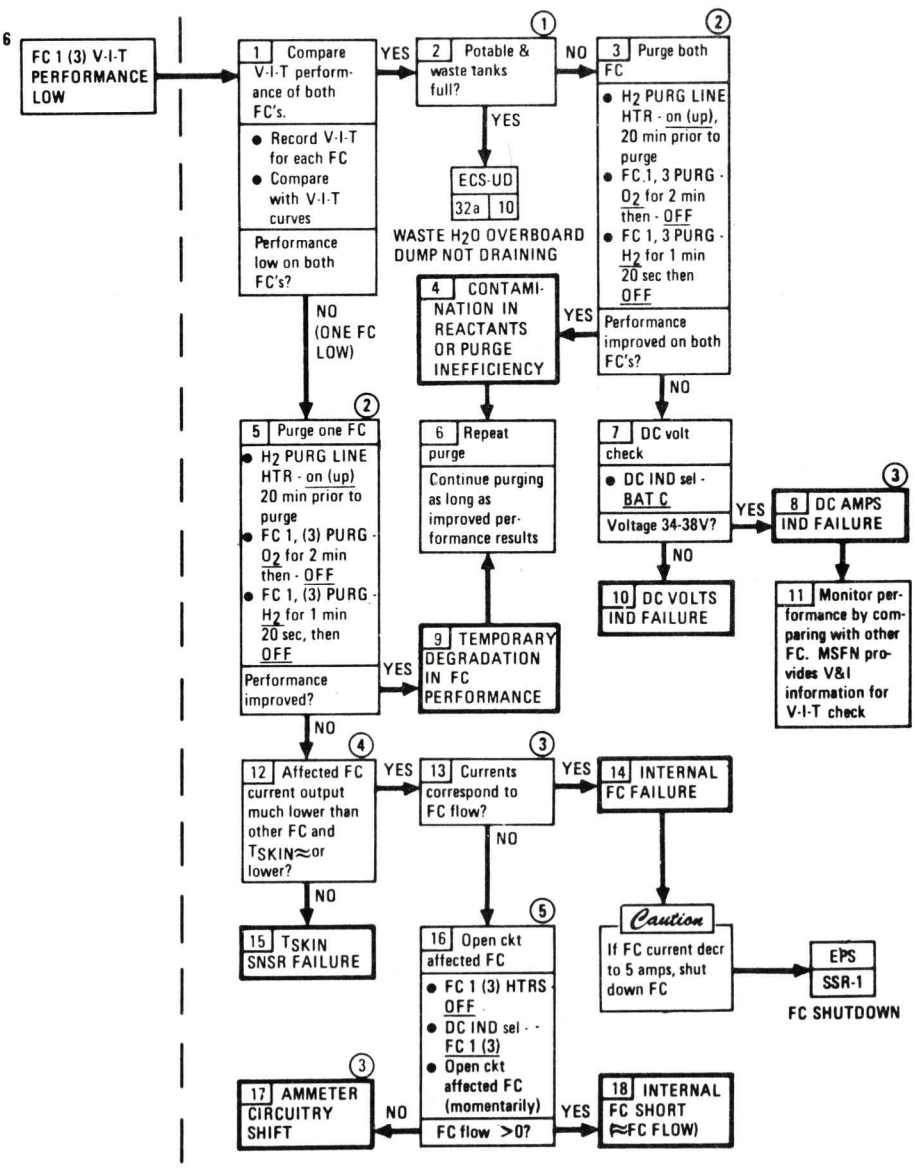


(1) This condition will result in low T_{CE} and/or high T_{SKIN}.

(2) pH sensor lost since power is common to pumps.

(3) MASTER ALARM and SM PWR DISC lts will come on when reconnecting open-circuited FC to bus.

6



(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.

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

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

(4) If 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 SM PWR DISC lts will come on when reconnecting open-circuited FC to bus.

5 THRU 6

SM-2A-2085G

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PWR DIST MALFUNCTIONS INDEX

1 MN BUS A(B) UNDERVOLT

YELLOW

1a AC BUS 1(2)

YELLOW

1b AC BUS 1(2) OVERLOAD

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

1d AC BUS 1(2) VOLTAGE LOW

1e AC BUS 1(2) VOLTAGE HIGH

2 INV 1 TEMP HI

YELLOW

3 SM PWR DISCONNECT

YELLOW

4 SUSPECTED HI CURRENT FOR CSM CONFIG

5 BAT CHGR CURRENT ZERO

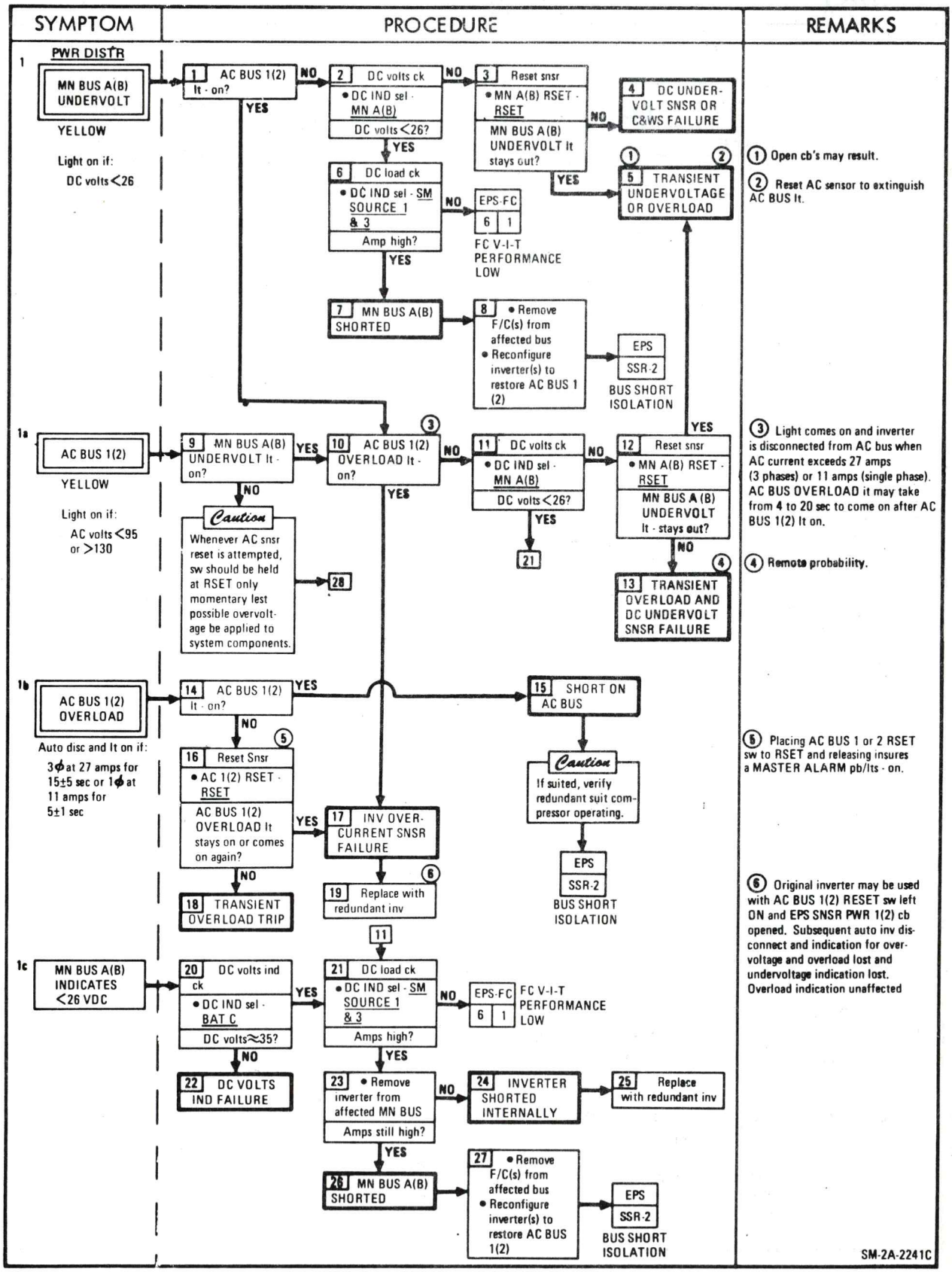
6 BAT BUS A(B) CURRENT >1.0 WITH MN BUS TIE (2) - OFF

6a FC tb's ALL GRAY

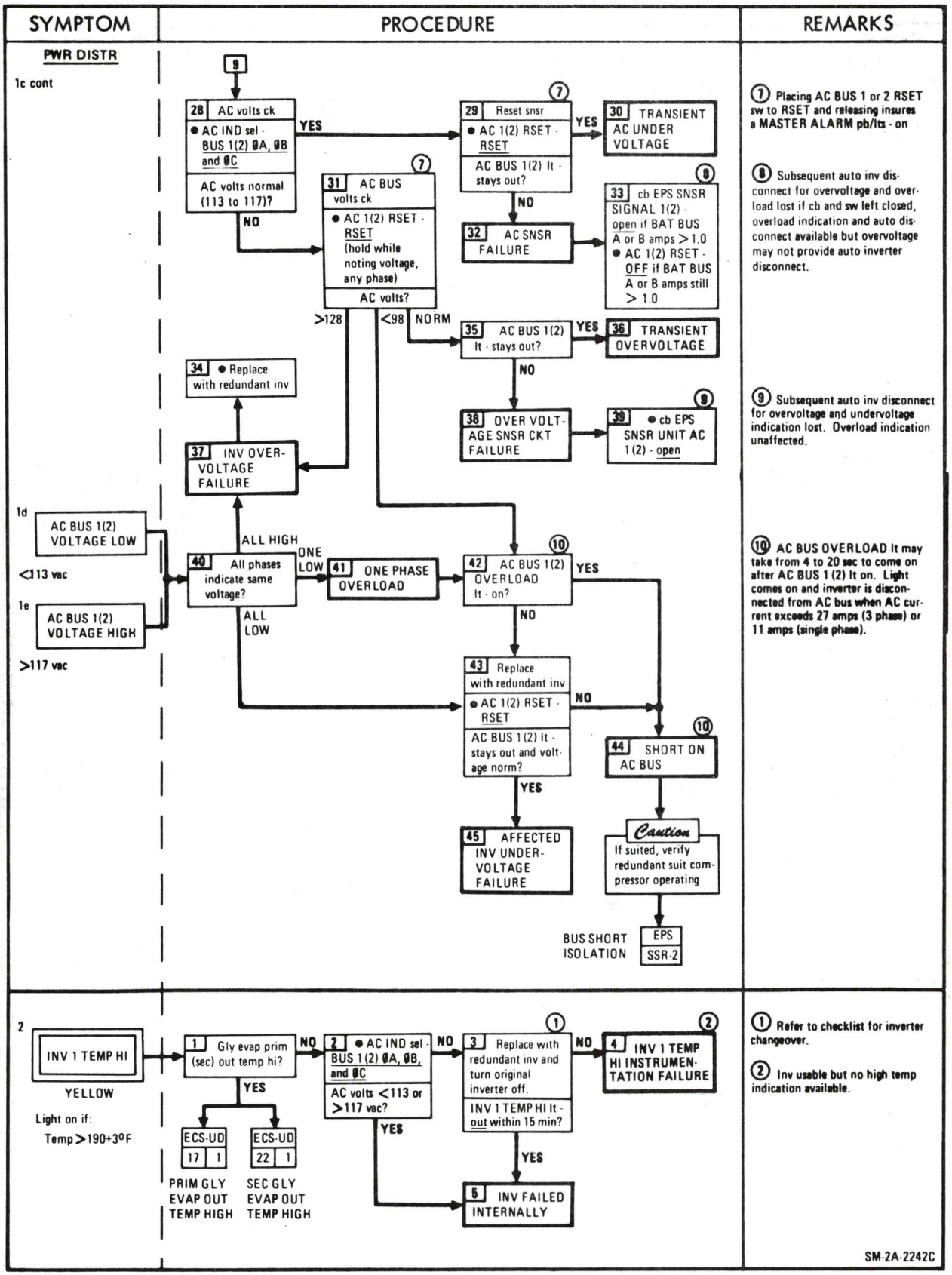
7 PYRO BAT VOLTAGE <35 VDC

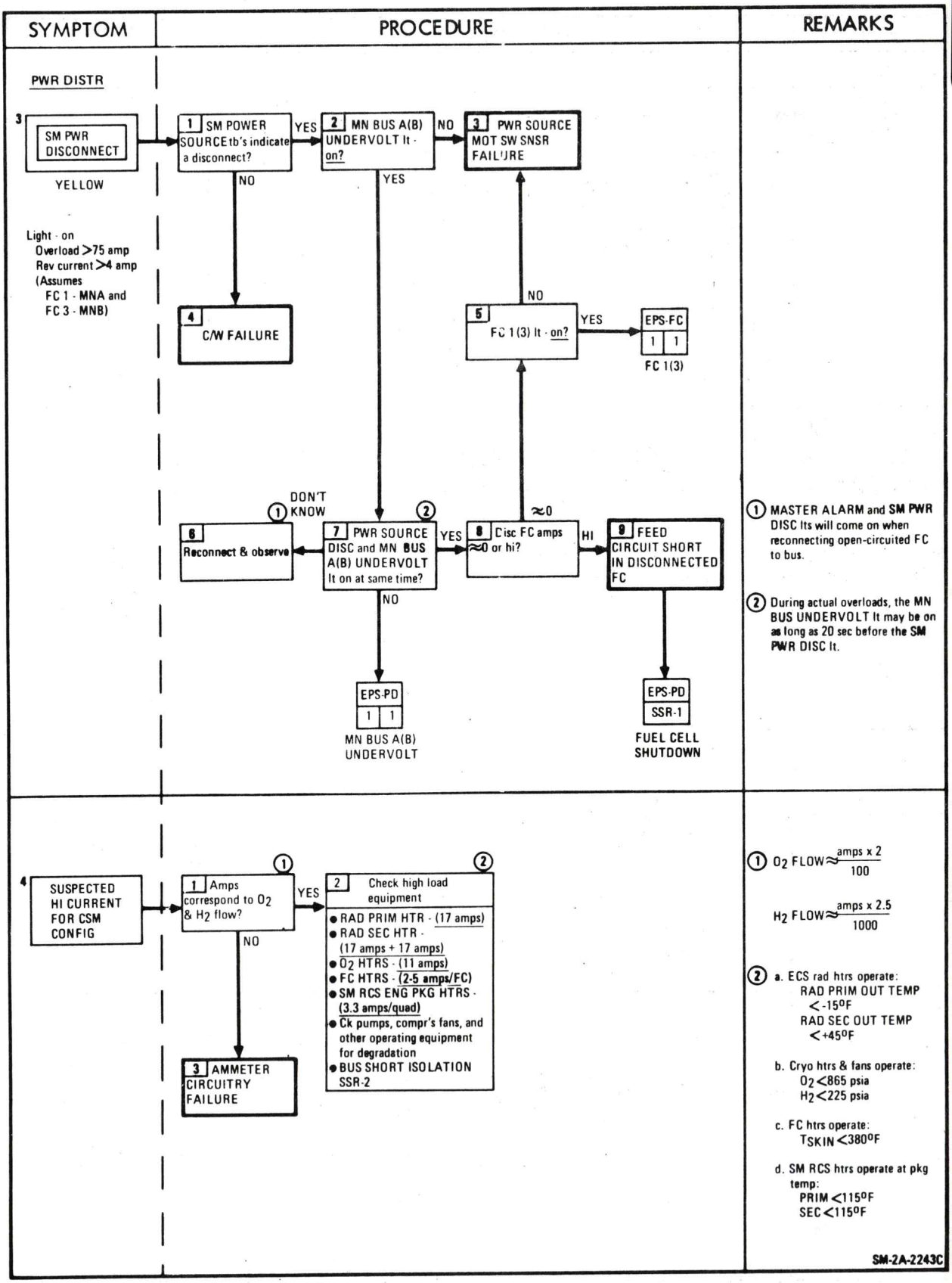
SSR-1 FUEL CELL SHUTDOWN

SSR-2 BUS SHORT ISOLATION

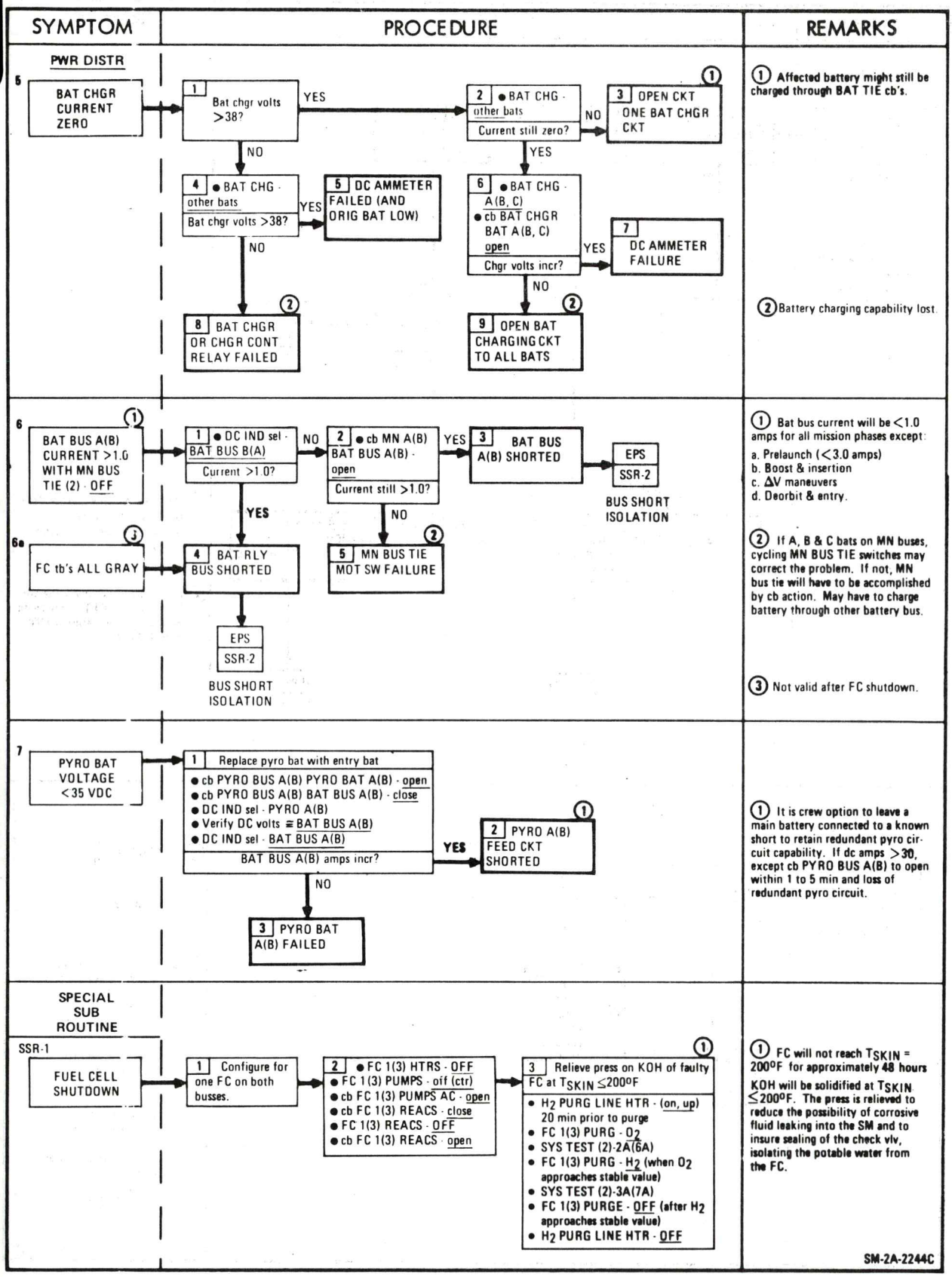

SYMPTOM
PROCEDURE
REMARKS
1
PWR DISTR
MN BUS A(B) UNDERVOLT
YELLOW
Light on if:
DC volts <26
1 AC BUS 1(2) lt - on?
NO
YES
2 DC volts ck
• DC IND sel - MN A(B)
DC volts <26?
NO
YES
3 Reset snsr
• MN A(B) RSET - RSET
MN BUS A(B) UNDERVOLT lt stays out?
NO
YES
4 DC UNDER-VOLT SNSR OR C&WS FAILURE
6 DC load ck
• DC IND sel - SM SOURCE 1 & 3
Amp high?
NO
YES
EPS-FC 6 1
FC V-I-T PERFORMANCE LOW
1
2
5 TRANSIENT UNDERVOLTAGE OR OVERLOAD
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
9 MN BUS A(B) UNDERVOLT lt - on?
YES
NO
3
10 AC BUS 1(2) OVERLOAD lt - on?
NO
YES
11 DC volts ck
• DC IND sel - MN A(B)
DC volts <26?
NO
YES
12 Reset snsr
• MN A(B) RSET - RSET
MN BUS A (B) UNDERVOLT lt - stays out?
NO
YES
21
4
13 TRANSIENT OVERLOAD AND DC UNDERVOLT SNSR FAILURE
Caution
Whenever AC snsr reset is attempted, sw should be held at RSET only momentary lest possible overvoltage be applied to system components.
28
1b
AC BUS 1(2) OVERLOAD
Auto disc and lt 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
Caution
If suited, verify redundant suit compressor operating.
EPS SSR-2
BUS SHORT ISOLATION
5
16 Reset Snsr
• AC 1(2) RSET - RSET
AC BUS 1(2) OVERLOAD lt stays on or comes on again?
YES
NO
17 INV OVER-CURRENT SNSR FAILURE
18 TRANSIENT OVERLOAD TRIP
6
19 Replace with redundant inv
11
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 - SM SOURCE 1 & 3
Amps high?
NO
YES
EPS-FC 6 1
FC V-I-T PERFORMANCE LOW
22 DC VOLTS IND FAILURE
23 • Remove inverter from affected MN BUS
Amps still high?
NO
YES
24 INVERTER SHORTED INTERNALLY
25 Replace with redundant inv
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
1 Open cb's may result.
2 Reset AC sensor to extinguish AC BUS lt.
3 Light comes on and inverter is disconnected from AC bus when AC current exceeds 27 amps (3 phases) or 11 amps (single phase). AC BUS OVERLOAD it 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 with AC BUS 1(2) RESET sw left ON and EPS SNSR PWR 1(2) cb opened. Subsequent auto inv disconnect and indication for overvoltage and overload lost and undervoltage indication lost. Overload indication unaffected
SM-2A-2241C

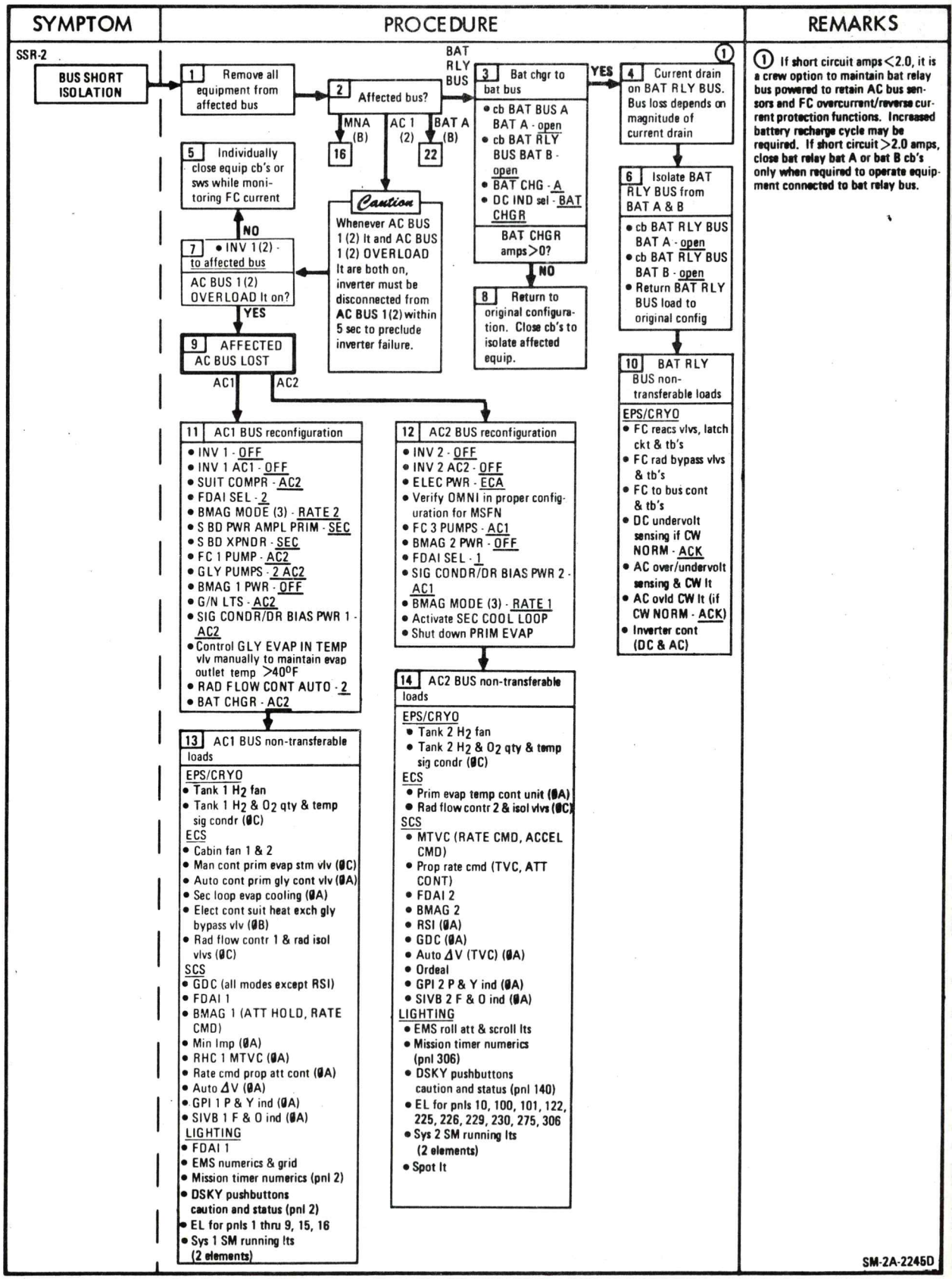
1c (CONT) THRU 2




SYMPTOM
PROCEDURE
REMARKS
PWR DISTR
3
SM PWR DISCONNECT
YELLOW
Light - on
Overload >75 amp
Rev current >4 amp
(Assumes
FC 1 - MNA and
FC 3 - MNB)
1 SM POWER SOURCE tb's indicate a disconnect?
YES
2 MN BUS A(B) UNDERVOLT lt - on?
NO
3 PWR SOURCE MOT SW SNSR FAILURE
NO
YES
4 C/W FAILURE
NO
5 FC 1(3) lt - on?
YES
EPS-FC 1 1
FC 1(3)
DON'T KNOW
1
2
6 Reconnect & observe
7 PWR SOURCE DISC and MN BUS A(B) UNDERVOLT lt on at same time?
YES
8 Disc FC amps ≈0 or hi?
≈0
HI
9 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 SM PWR DISC lts will come on when reconnecting open-circuited FC to bus.
2 During actual overloads, the MN BUS UNDERVOLT lt may be on as long as 20 sec before the SM PWR DISC lt.
4
SUSPECTED HI CURRENT FOR CSM CONFIG
1
1 Amps correspond to O2 & H2 flow?
YES
2
2 Check high load equipment
• RAD PRIM HTR - (17 amps)
• RAD SEC HTR - (17 amps + 17 amps)
• O2 HTRS - (11 amps)
• FC HTRS - (2-5 amps/FC)
• SM RCS ENG PKG HTRS - (3.3 amps/quad)
• Ck pumps, compr's fans, and other operating equipment for degradation
• BUS SHORT ISOLATION SSR-2
NO
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
SM-2A-2243C

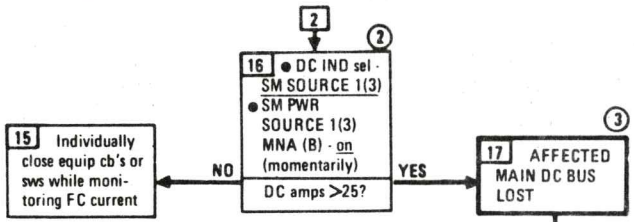
5 THRU SSR-1


SYMPTOM
PROCEDURE
REMARKS
PWR DISTR
5
BAT CHGR CURRENT ZERO
1 Bat chgr volts >38?
YES
NO
2 ● BAT CHG · other bats
Current still zero?
NO
YES
3 OPEN CKT ONE BAT CHGR CKT
1
4 ● BAT CHG · other bats
Bat chgr volts >38?
YES
NO
5 DC AMMETER FAILED (AND ORIG BAT LOW)
6 ● BAT CHG · A(B, C)
● cb BAT CHGR BAT A(B, C) open
Chgr volts incr?
YES
NO
7 DC AMMETER FAILURE
2
8 BAT CHGR OR CHGR CONT RELAY FAILED
2
9 OPEN BAT CHARGING CKT TO ALL BATS
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
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
NO
3 BAT BUS A(B) SHORTED
EPS
SSR-2
BUS SHORT ISOLATION
YES
6a
FC tb's ALL GRAY
J
4 BAT RLY BUS SHORTED
2
5 MN BUS TIE MOT SW FAILURE
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. Deorbit & entry.
2 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 charge battery through other battery bus.
3 Not valid after FC shutdown.
7
PYRO BAT VOLTAGE <35 VDC
1 Replace pyro bat with entry bat
● cb PYRO BUS A(B) PYRO BAT A(B) · open
● cb PYRO BUS A(B) BAT BUS A(B) · close
● DC IND sel · PYRO A(B)
● Verify DC volts ≅ BAT BUS A(B)
● DC IND sel · BAT BUS A(B)
BAT BUS A(B) amps incr?
YES
NO
2 PYRO A(B) FEED CKT SHORTED
1
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, except cb PYRO 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 one FC on both busses.
2 ● FC 1(3) HTRS · OFF
● FC 1(3) PUMPS · off (ctr)
● cb FC 1(3) PUMPS AC · open
● cb FC 1(3) REACS · close
● FC 1(3) REACS · OFF
● cb FC 1(3) REACS · open
3 Relieve press on KOH of faulty FC at TSKIN ≤200°F
1
● H2 PURG LINE HTR · (on, up) 20 min prior to purge
● FC 1(3) PURG · O2
● SYS TEST (2)-2A(6A)
● FC 1(3) PURG · H2 (when O2 approaches stable value)
● SYS TEST (2)-3A(7A)
● FC 1(3) PURGE · OFF (after H2 approaches stable value)
● H2 PURG LINE HTR · OFF
1 FC will not reach TSKIN = 200°F for approximately 48 hours KOH will be solidified at TSKIN ≤200°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.
SM-2A-2244C


SYMPTOM
PROCEDURE
REMARKS
SSR-2
BUS SHORT ISOLATION
1 Remove all equipment from affected bus
2 Affected bus?
MNA (B) 16
AC 1 (2)
BAT A (B) 22
BAT RLY BUS
3 Bat chgr to bat bus
• cb BAT BUS A BAT A - open
• cb BAT RLY BUS BAT B - open
• BAT CHG - A
• DC IND sel - BAT CHGR
BAT CHGR amps>0?
YES
NO
4 Current drain on BAT RLY BUS. Bus loss depends on magnitude of current drain
1
6 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
10 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)
8 Return to original configuration. Close cb's to isolate affected equip.
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.
5 Individually close equip cb's or sws while monitoring FC current
7 • INV 1(2) - to affected bus
AC BUS 1(2) OVERLOAD lt on?
NO
YES
9 AFFECTED AC BUS LOST
AC1
AC2
11 AC1 BUS reconfiguration
• INV 1 - OFF
• INV 1 AC1 - OFF
• SUIT COMPR - AC2
• FDAI SEL - 2
• BMAG MODE (3) - RATE 2
• S BD PWR AMPL PRIM - SEC
• S BD XPNDR - SEC
• FC 1 PUMP - AC2
• GLY PUMPS - 2 AC2
• BMAG 1 PWR - OFF
• G/N LTS - AC2
• SIG CONDR/DR BIAS PWR 1 - AC2
• Control GLY EVAP IN TEMP vlv manually to maintain evap outlet temp >40°F
• RAD FLOW CONT AUTO - 2
• BAT CHGR - AC2
12 AC2 BUS reconfiguration
• INV 2 - OFF
• INV 2 AC2 - OFF
• ELEC PWR - ECA
• Verify OMNI in proper configuration for MSFN
• FC 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
13 AC1 BUS non-transferable loads
EPS/CRYO
• Tank 1 H2 fan
• Tank 1 H2 & O2 qty & temp sig condr (ØC)
ECS
• Cabin fan 1 & 2
• 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)
• GPI 1 P & Y ind (ØA)
• SIVB 1 F & O ind (ØA)
LIGHTING
• FDAI 1
• EMS numerics & grid
• Mission timer numerics (pnl 2)
• DSKY pushbuttons caution and status (pnl 2)
• EL for pnls 1 thru 9, 15, 16
• Sys 1 SM running lts (2 elements)
14 AC2 BUS non-transferable loads
EPS/CRYO
• Tank 2 H2 fan
• Tank 2 H2 & O2 qty & temp sig condr (ØC)
ECS
• Prim evap temp cont unit (ØA)
• 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
• GPI 2 P & Y ind (ØA)
• SIVB 2 F & O ind (ØA)
LIGHTING
• EMS roll att & scroll lts
• Mission timer numerics (pnl 306)
• DSKY pushbuttons caution and status (pnl 140)
• EL for pnls 10, 100, 101, 122, 225, 226, 229, 230, 275, 306
• Sys 2 SM running lts (2 elements)
• Spot lt
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.
SM-2A-2245D

SSR-2 (CONT)

SYMPTOM	PROCEDURE	REMARKS
SSR-2 (CONT)		② MASTER ALARM and SM PWR DISC lts will come on when reconnecting open-circuited FC to bus. ③ Place two batteries on remaining bus for SPS maneuvers.



18 MN BUS A reconfiguration

- SM PWR SOURCE 2, 3 - MNB only
- SM PWR SOURCE 1 MNA - OFF
- SM PWR SOURCE 1 MNB - on up (if req)
- 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
- SM RCS B&D eng pkg htrs - 2
- SM RCS B&D quad htrs - SEC
- 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 HTRS - SEC
- SCS TVC (2) - RATE CMD
- Use RHC'S for RCS dump, not CM PRPLNT DUMP sw

19 MN BUS B reconfiguration

- SM PWR SOURCE 1, 2 - MNA only
- SM PWR SOURCE 3 MNB - OFF
- SM PWR SOURCE 3 MNA - on up (if req)
- 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
- SPS HTRS - PRIM
- Use RHC'S for RCS dump, not CM PRPLNT DUMP sw
- SM RCS A&C quad htrs - SEC
- SM RCS PSM1 htrs - SEC
- SM RCS A&C eng pkg htrs - 2

20 MN BUS A non-transferable loads

EPS/CRYO
- Tank 1 H_2 htr
- Tank 1 O_2 100w htr
- Tank 2 O_2 50w htr
- Tank 1 O_2 vac-ion pump

ECS
- Prim evap H_2O man cont
- 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
- SM H_2O vlv (open position)

RCS
- CM sys 1 htrs
- CM sys 1 fuel & oxid purge
- CM oxid interconnect
- CM fuel/He interconnect
- CM sys 1 prplnt dump (61 sec TD)
- CM sys 1 prplnt isol vlv & tb
- SM B & D quad He 1 & 2 isol vlv & tb
- SM B & D quad prim/sec prplnt isol vlv & tb
- SM B & D quad sec fuel press isol vlv
- SM B & D PSM prplnt isol vlvs & tbs
- SM PSM prim manif isol valves (redundant)
- SM PSM prim He isol vlv (redundant)
- Transfer mot sw 1

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

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
- 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 O_2 100w htr
- Tank 1 O_2 50w htr
- Tank 2 O_2 vac-ion pump

ECS
- Sec evap H_2O vlv man cont
- 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 (61 sec TD)
- CM sys 2 prplnt isol vlv & tb
- SM A & C quad He 1 & 2 isol vlv & tb
- SM A & C quad prim/sec prplnt isol vlv & tb
- SM A & C quad sec fuel press isol vlv
- SM A & C PSM prplnt isol vlvs & tbs
- SM PSM sec manif isol vlvs (redundant)
- SM PSM sec He isol vlv (redundant)
- Transfer mot sw 2

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

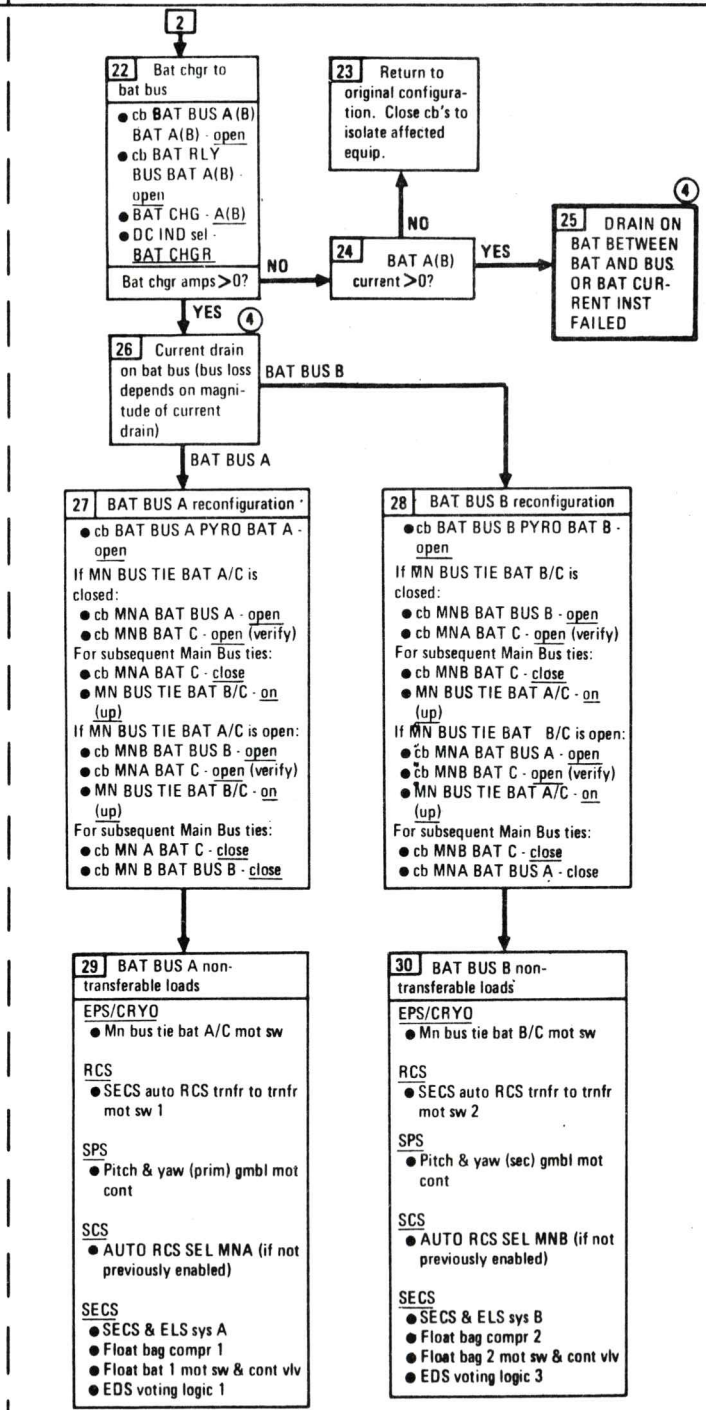
SCS
- FDAI 2 total attitude
- GDC
- BMAG 2 htr & CW temp lt (eventually lose BMAG 2 as temp decreases)
- Auto coils CM RCS 2 (if prior to CM/SM sep)
- Direct ullage pitch C3 & A4
- Auto ΔV (maybe degraded)
- Min imp increases to ≈42 MS
- RSI
- Ordeal
- RHC pwr dir 1, MNA/MNB to half of jets
- RHC pwr 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-2246E

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.

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T/C

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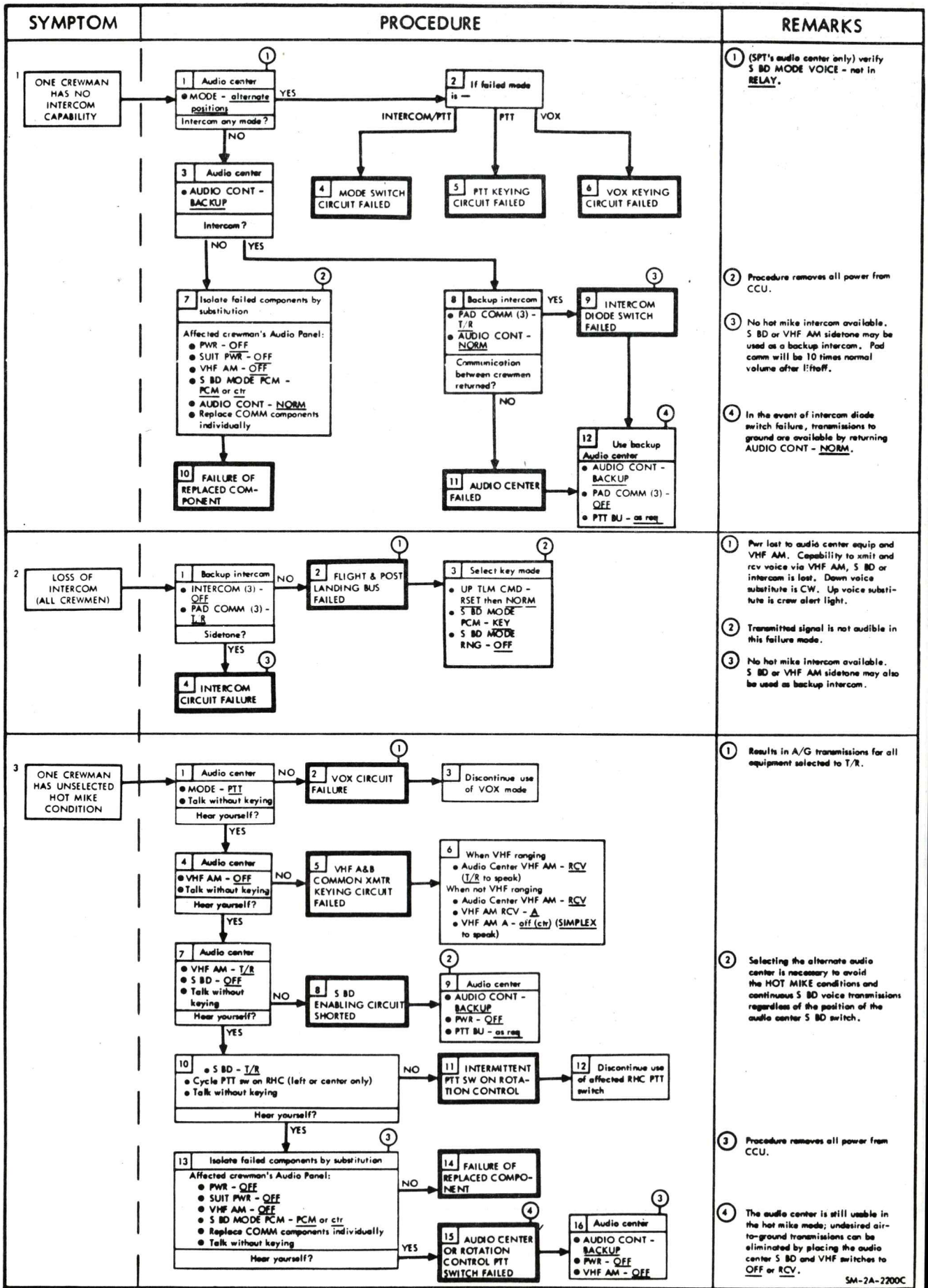
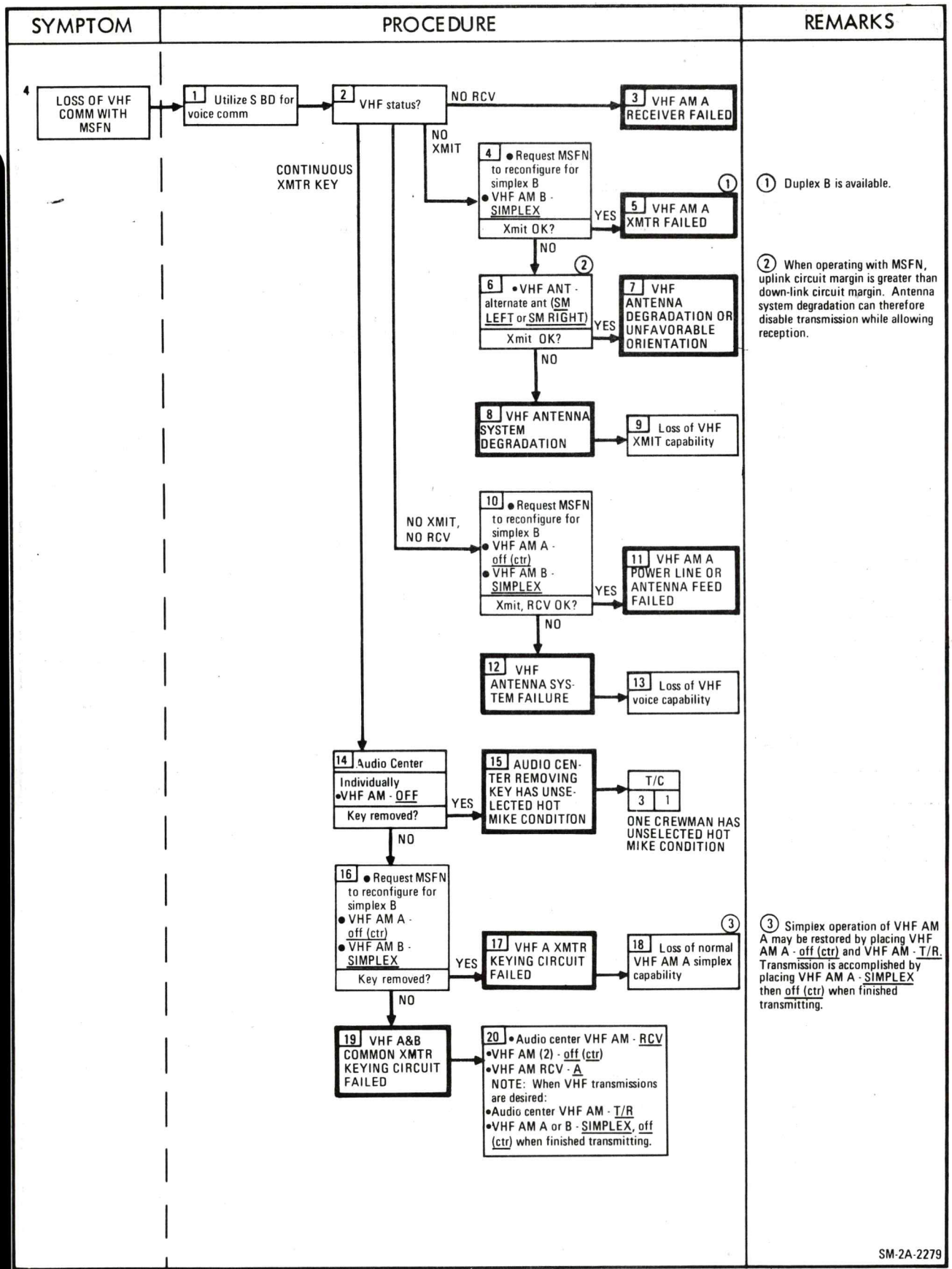
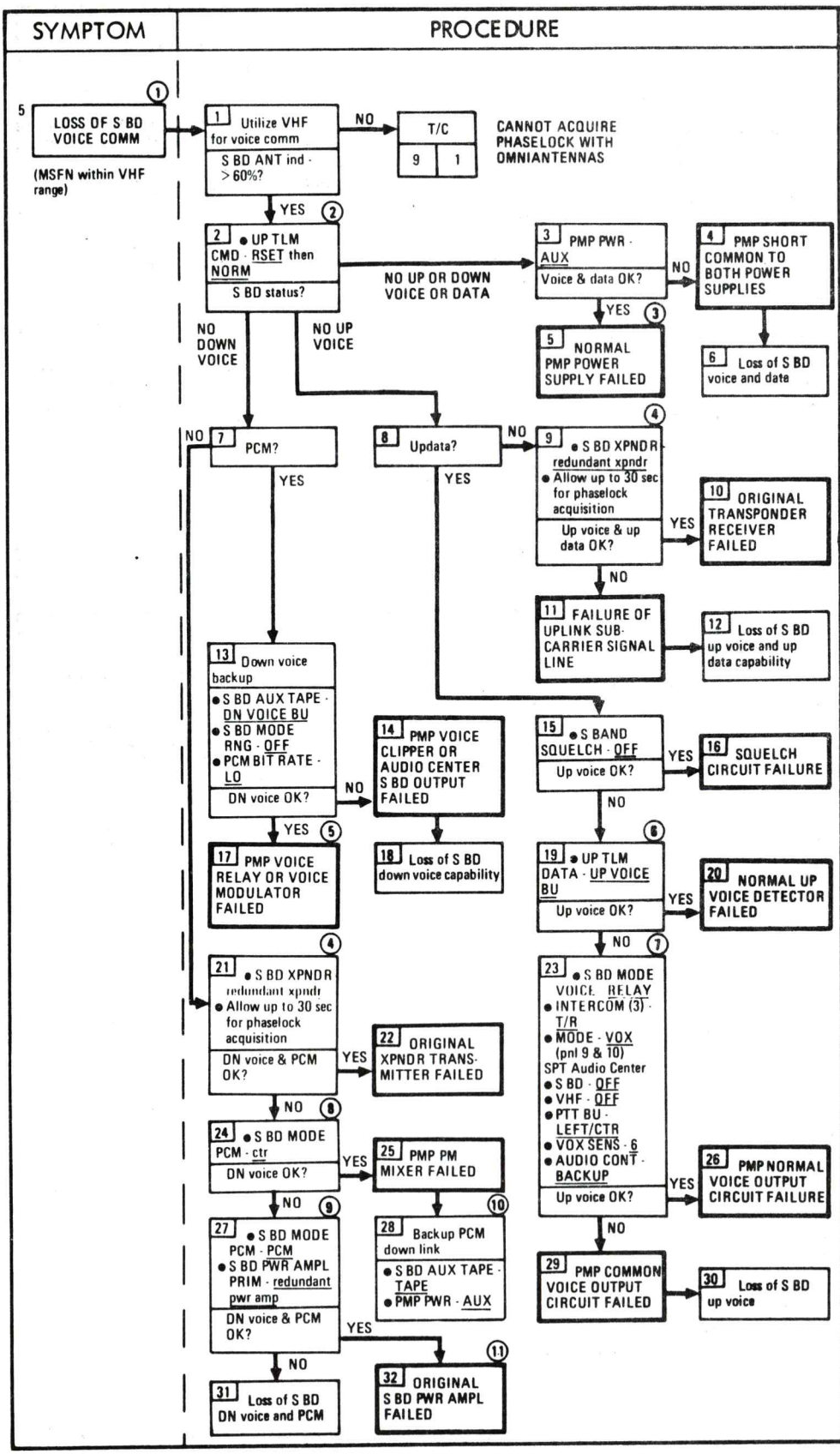
T/C MALFUNCTIONS INDEX


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
4 MODE SWITCH CIRCUIT FAILED
5 PTT KEYING CIRCUIT FAILED
6 VOX KEYING CIRCUIT FAILED
3 Audio center
• AUDIO CONT - BACKUP
Intercom?
NO
YES
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
10 FAILURE OF REPLACED COMPONENT
8 Backup intercom
• PAD COMM (3) - T/R
• AUDIO CONT - NORM
Communication between crewmen returned?
YES
NO
9 INTERCOM DIODE SWITCH FAILED
11 AUDIO CENTER FAILED
12 Use backup Audio center
• AUDIO CONT - BACKUP
• PAD COMM (3) - OFF
• PTT BU - as req
(1) (SPT'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 1!ftoff.
(4) 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?
NO
YES
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?
NO
YES
8 S BD ENABLING CIRCUIT SHORTED
9 Audio center
• AUDIO CONT - BACKUP
• PWR - OFF
• PTT BU - as req
10
• S BD - T/R
• Cycle PTT sw on RHC (left or center only)
• Talk without keying
Hear yourself?
NO
YES
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?
NO
YES
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) Procedure removes all power from CCU.
(4) 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.

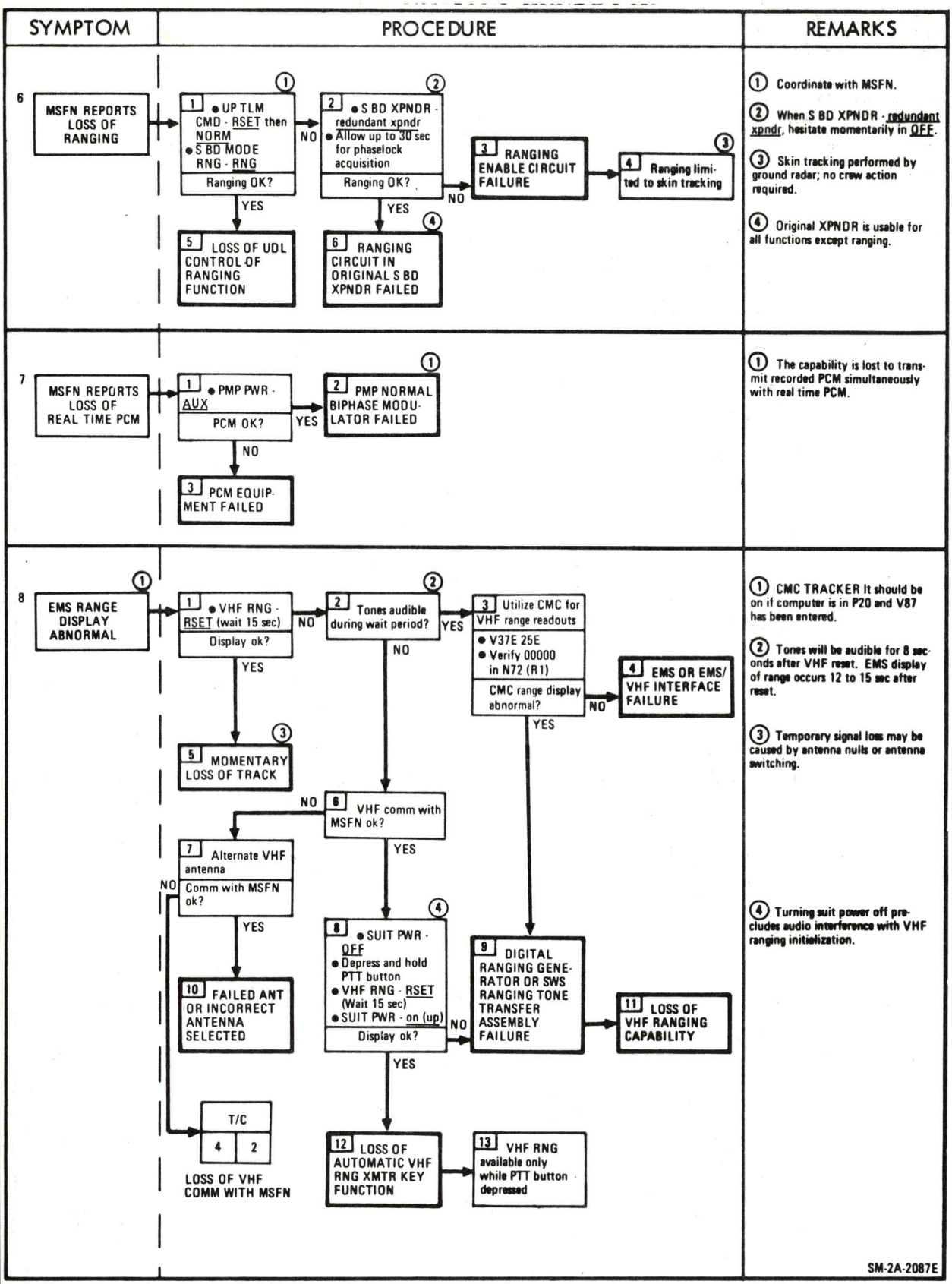
SM-2A-2200C

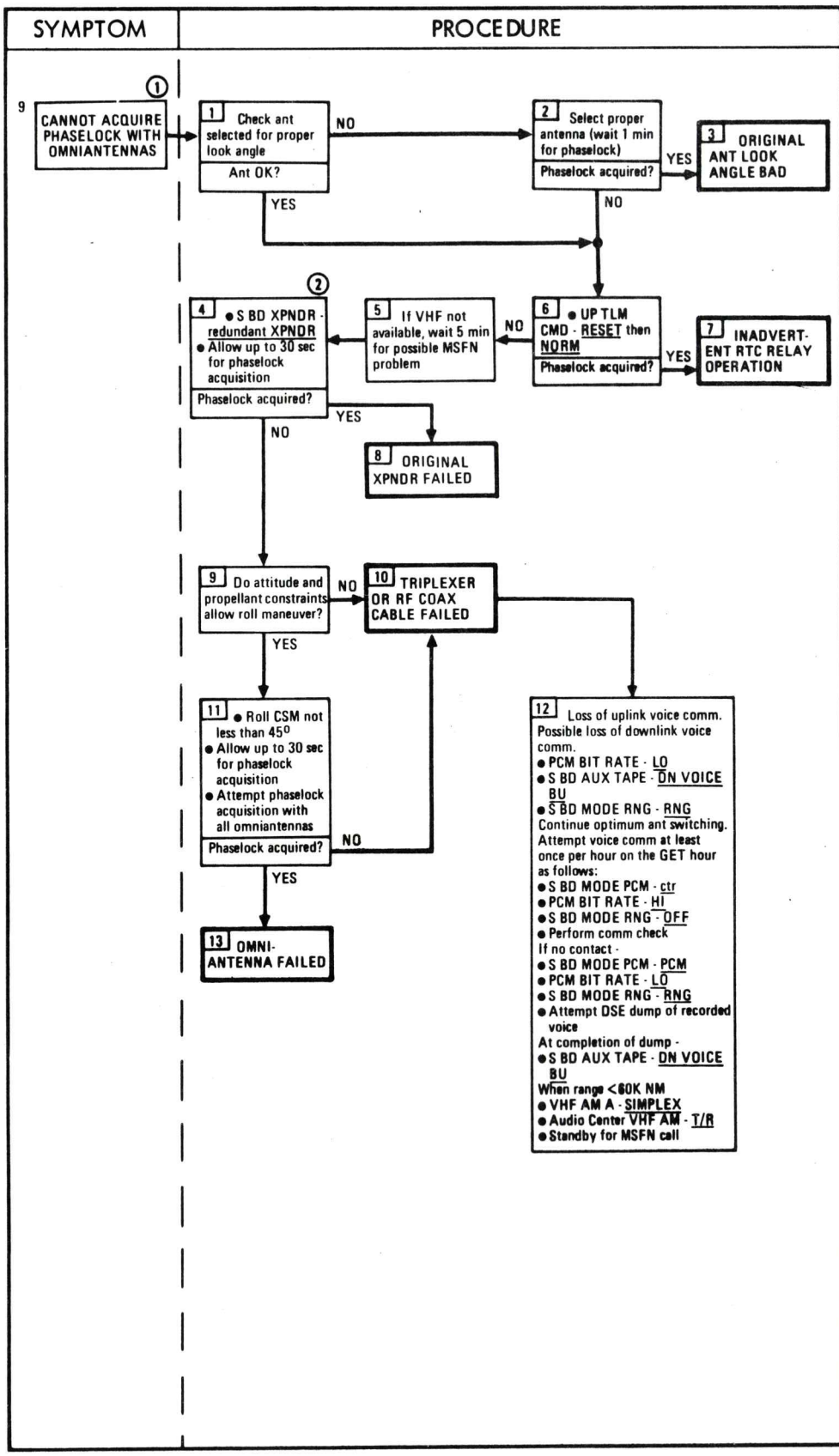
4


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
1
LOSS OF S BD VOICE COMM
(MSFN within VHF range)
1 Utilize VHF for voice comm
S BD ANT ind - > 60%?
NO
T/C
9 1
CANNOT ACQUIRE PHASELOCK WITH OMNIANTENNAS
YES
2
2 • UP TLM CMD - RSET then NORM
S BD status?
NO UP OR DOWN VOICE OR DATA
3 PMP PWR - AUX
Voice & data OK?
NO
4 PMP SHORT COMMON TO BOTH POWER SUPPLIES
YES
3
5 NORMAL PMP POWER SUPPLY FAILED
6 Loss of S BD voice and data
NO DOWN VOICE
NO UP VOICE
NO
7 PCM?
YES
8 Updata?
NO
YES
4
9 • S BD XPNDR - redundant xpndr
• Allow up to 30 sec for phaselock acquisition
Up voice & up data OK?
YES
10 ORIGINAL TRANSPONDER RECEIVER FAILED
NO
11 FAILURE OF UPLINK SUB-CARRIER SIGNAL LINE
12 Loss of S BD up voice and up data capability
13 Down voice backup
• S BD AUX TAPE - DN VOICE BU
• S BD MODE RNG - OFF
• PCM BIT RATE - LO
DN voice OK?
NO
14 PMP VOICE CLIPPER OR AUDIO CENTER S BD OUTPUT FAILED
YES
5
17 PMP VOICE RELAY OR VOICE MODULATOR FAILED
18 Loss of S BD down voice capability
15 • S BAND SQUELCH - OFF
Up voice OK?
YES
16 SQUELCH CIRCUIT FAILURE
NO
6
19 • UP TLM DATA - UP VOICE BU
Up voice OK?
YES
20 NORMAL UP VOICE DETECTOR FAILED
NO
7
23 • S BD MODE VOICE RELAY
• INTERCOM (3) - T/R
• MODE - VOX (pnl 9 & 10)
SPT Audio Center
• S BD - OFF
• VHF - OFF
• PTT BU - LEFT/CTR
• VOX SENS - 6
• AUDIO CONT - BACKUP
Up voice OK?
YES
26 PMP NORMAL VOICE OUTPUT CIRCUIT FAILURE
NO
29 PMP COMMON VOICE OUTPUT CIRCUIT FAILED
30 Loss of S BD up voice
4
21 • S BD XPNDR redundant xpndr
• Allow up to 30 sec for phaselock acquisition
DN voice & PCM OK?
YES
22 ORIGINAL XPNDR TRANSMITTER FAILED
NO
8
24 • S BD MODE PCM - ctr
DN voice OK?
YES
25 PMP PM MIXER FAILED
NO
9
27 • S BD MODE PCM - PCM
• S BD PWR AMPL PRIM - redundant pwr amp
DN voice & PCM OK?
YES
10
28 Backup PCM down link
• S BD AUX TAPE - TAPE
• PMP PWR - AUX
NO
31 Loss of S BD DN voice and PCM
11
32 ORIGINAL S BD PWR AMPL FAILED
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 KH$_Z$ tone in headset until MSFN configures for up voice backup.
7 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-2096D

6 THRU 8


SYMPTOM
PROCEDURE
REMARKS
6
MSFN REPORTS LOSS OF RANGING
1 • UP TLM CMD - RSET then NORM
• S BD MODE RNG - RNG
Ranging OK?
NO
2 • S BD XPNDR - redundant xpndr
• Allow up to 30 sec for phaselock acquisition
Ranging OK?
YES
NO
3 RANGING ENABLE CIRCUIT FAILURE
4 Ranging limited to skin tracking
YES
5 LOSS OF UDL CONTROL OF RANGING FUNCTION
6 RANGING CIRCUIT IN ORIGINAL S BD XPNDR FAILED
1 Coordinate with MSFN.
2 When S BD 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.
7
MSFN REPORTS LOSS OF REAL TIME PCM
1 • PMP PWR - AUX
PCM OK?
YES
NO
2 PMP NORMAL BIPHASE MODULATOR FAILED
3 PCM EQUIPMENT FAILED
1 The capability is lost to transmit recorded PCM simultaneously with real time PCM.
8
EMS RANGE DISPLAY ABNORMAL
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
• V37E 25E
• Verify 00000 in N72 (R1)
CMC range display abnormal?
NO
YES
4 EMS OR EMS/VHF INTERFACE FAILURE
5 MOMENTARY LOSS OF TRACK
6 VHF comm with MSFN ok?
NO
YES
7 Alternate VHF antenna
Comm with MSFN 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 SWS RANGING TONE TRANSFER ASSEMBLY FAILURE
11 LOSS OF VHF RANGING CAPABILITY
10 FAILED ANT OR INCORRECT ANTENNA SELECTED
T/C
4 2
LOSS OF VHF COMM WITH MSFN
12 LOSS OF AUTOMATIC VHF RNG XMTR KEY FUNCTION
13 VHF RNG available only while PTT button depressed
1 CMC TRACKER It 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 Temporary signal loss may be caused by antenna nulls or antenna switching.
4 Turning suit power off precludes audio interference with VHF ranging initialization.
SM-2A-2087E


SYMPTOM
PROCEDURE
REMARKS
9
① CANNOT ACQUIRE PHASELOCK WITH OMNIANTENNAS
1 Check ant selected for proper look angle
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
② 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
10 TRIPLEXER OR RF COAX CABLE FAILED
YES
11 • Roll CSM not less than 45°
• Allow up to 30 sec for phaselock acquisition
• Attempt phaselock acquisition with all omniantennas
Phaselock acquired?
NO
YES
13 OMNI-ANTENNA FAILED
12 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.
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 - 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%. If attempting to phase lock from SWS, verify S BD ANT OMNI sw is positioned to - REMOTE.
② When S BD XPNDR - redundant xpndr, hesitate momentarily in OFF.
SM-2A-2097C

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ECS UNDOCKED MALFUNCTIONS INDEX

1 O_2 FLOW HI

RED

1a O_2 FLOW HI

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

RED

9a SUIT COMPR ΔP LOW

10 BALLOONED PGA'S

11 CREW UNCOMFORTABLE IN SUIT LOOP

11a SUIT CKT HUMIDITY HIGH

12 CO_2 PP HI

YELLOW

12a CO_2 PART PRESS HIGH

12b CO_2 PART PRESS LOW

13 CO_2 FILTER SEIZURE WITHIN CANISTER

14 PRIM ECS RAD OUT TEMP LOW

15 PRIM ECS RAD OUT TEMP HIGH

16 GLYCOL FLOW LOW

17 PRIM GLY EVAP OUT TEMP HIGH

17a PRIM STEAM PRESS LOW

18 PRIM GLY EVAP OUT TEMP LOW

19 PRIM GLY ACCUM QTY HIGH

19a PRIM GLY DISCH PRESS HIGH

20 PRIM GLY ACCUM QTY LOW OR DECREASING

21 PRIM GLY DISCH PRESS LOW

22 SEC GLY EVAP OUT TEMP HIGH

22a SEC STEAM PRESS LOW

23 SEC GLY EVAP OUT TEMP LOW

24 SEC ECS RAD OUT TEMP HIGH

25 SEC ECS RAD OUT TEMP LOW

26 SEC GLY ACCUM QTY HIGH

27 SEC GLY ACCUM QTY DECREASING

28 SEC GLY DISCH PRESS LOW

29 H_2O DUMPING OVERBOARD

29a POTABLE H_2O QUANTITY DECREASING RAPIDLY

29b WASTE H_2O QUANTITY DECREASING RAPIDLY

30 FOOD PREP WATER TEMP LOW

31 ENTRAPPED GAS IN POTABLE H_2O

32 URINE OVERBOARD DUMP NOT DRAINING

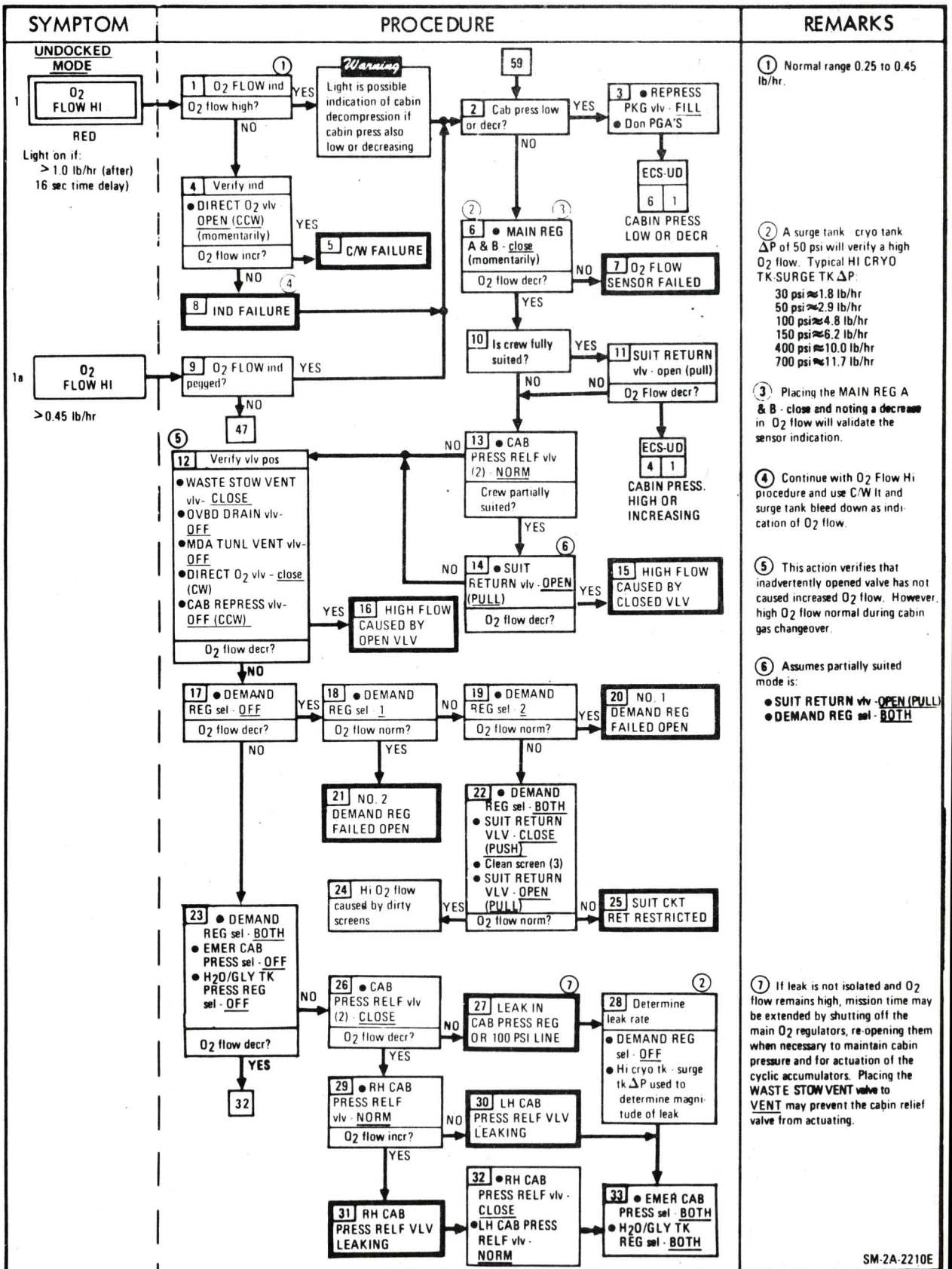
32a WASTE H_2O OVERBOARD DUMP NOT DRAINING

33 INADEQUATE VENTILATION AFTER LANDING

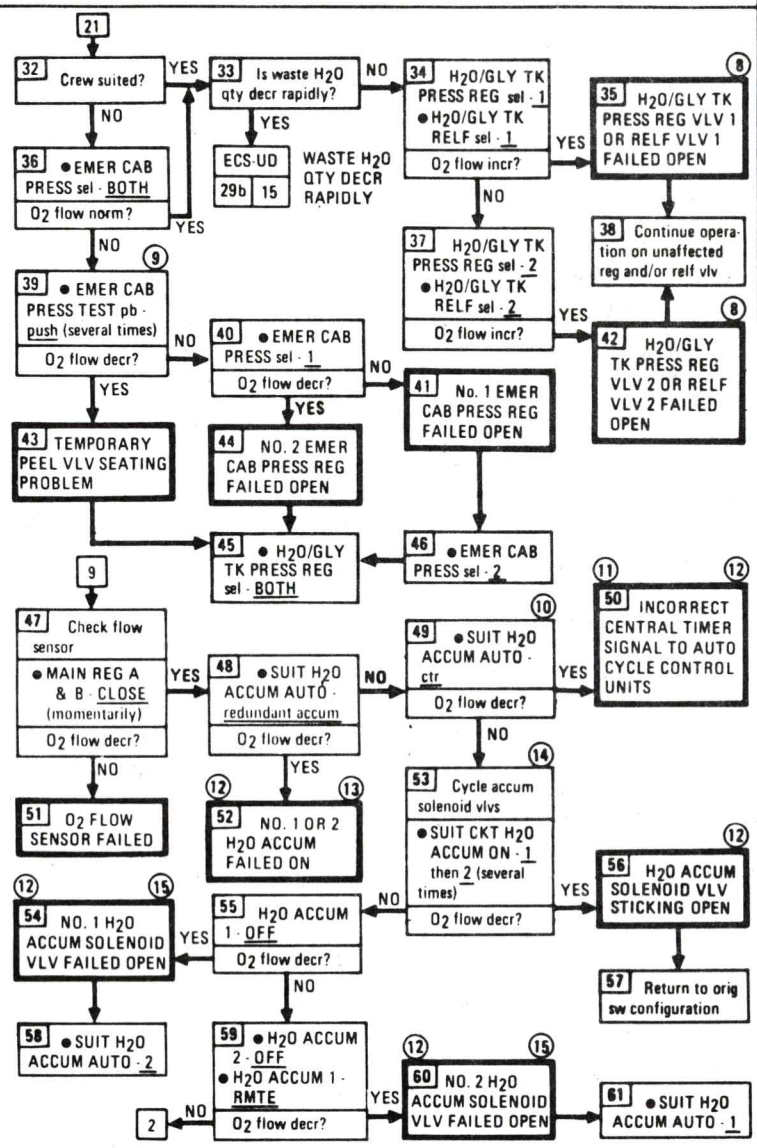
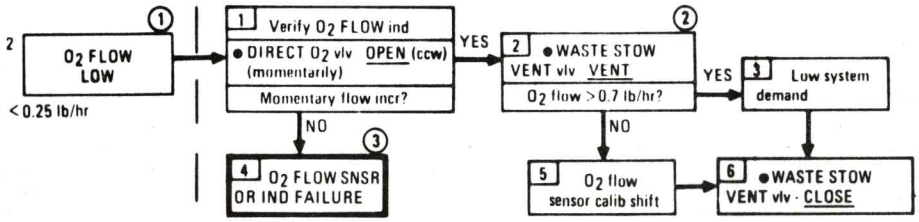
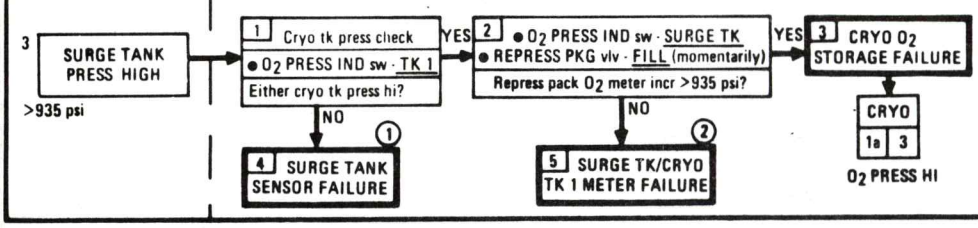
34 WATER INFLOW AFTER LANDING

SSR-1 SECONDARY LOOP ACTIVATION

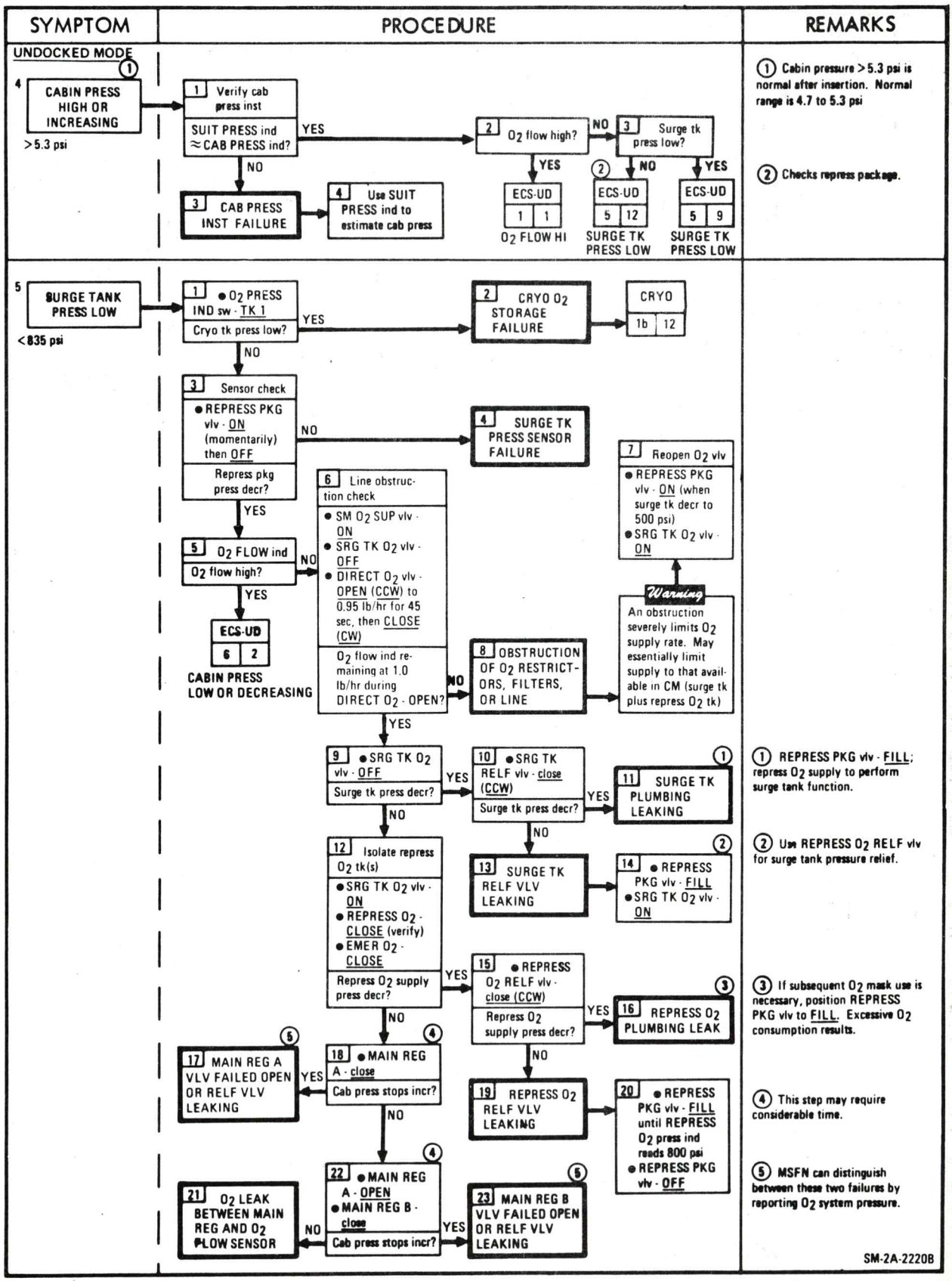
SSR-2 FROZEN STEAM DUCT


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
1
O2 FLOW HI
RED
Light on if:
> 1.0 lb/hr (after) 16 sec time delay)
1a
O2 FLOW HI
>0.45 lb/hr
1 O2 FLOW ind
O2 flow high?
YES
NO
Warning
Light is possible indication of cabin decompression if cabin press also low or decreasing
4 Verify ind
• DIRECT O2 vlv OPEN (CCW) (momentarily)
O2 flow incr?
YES
5 C/W FAILURE
NO
8 IND FAILURE
9 O2 FLOW ind pegged?
YES
NO
47
59
2 Cab press low or decr?
YES
NO
3 • REPRESS PKG vlv - FILL
• Don PGA'S
ECS-UD
6 1
CABIN PRESS LOW OR DECR
6 • MAIN REG A & B - close (momentarily)
O2 flow decr?
NO
7 O2 FLOW SENSOR FAILED
YES
10 Is crew fully suited?
YES
NO
11 SUIT RETURN vlv - open (pull)
O2 Flow decr?
NO
ECS-UD
4 1
CABIN PRESS. HIGH OR INCREASING
5
12 Verify vlv pos
• WASTE STOW VENT vlv- CLOSE
• OVBD DRAIN vlv- OFF
• MDA TUNL VENT vlv- OFF
• DIRECT O2 vlv - close (CW)
• CAB REPRESS vlv- OFF (CCW)
O2 flow decr?
NO
YES
16 HIGH FLOW CAUSED BY OPEN VLV
13 • CAB PRESS RELF vlv (2) - NORM
Crew partially suited?
YES
NO
6
14 • SUIT RETURN vlv - OPEN (PULL)
O2 flow decr?
YES
15 HIGH FLOW CAUSED BY CLOSED VLV
17 • DEMAND REG sel - OFF
O2 flow decr?
YES
NO
18 • DEMAND REG sel - 1
O2 flow norm?
YES
NO
19 • DEMAND REG sel - 2
O2 flow norm?
YES
NO
20 NO. 1 DEMAND REG FAILED OPEN
21 NO. 2 DEMAND REG FAILED OPEN
22 • DEMAND REG sel - BOTH
• SUIT RETURN VLV - CLOSE (PUSH)
• Clean screen (3)
• SUIT RETURN VLV - OPEN (PULL)
O2 flow norm?
YES
NO
24 Hi O2 flow caused by dirty screens
25 SUIT CKT RET RESTRICTED
23 • DEMAND REG sel - BOTH
• EMER CAB PRESS sel - OFF
• H2O/GLY TK PRESS REG sel - OFF
O2 flow decr?
YES
NO
32
26 • CAB PRESS RELF vlv (2) - CLOSE
O2 flow decr?
YES
NO
7
27 LEAK IN CAB PRESS REG OR 100 PSI LINE
2
28 Determine leak rate
• DEMAND REG sel - OFF
• Hi cryo tk - surge tk ΔP used to determine magnitude of leak
29 • RH CAB PRESS RELF vlv - NORM
O2 flow incr?
YES
NO
30 LH CAB PRESS RELF VLV LEAKING
31 RH CAB PRESS RELF VLV LEAKING
32 • RH CAB PRESS RELF vlv - CLOSE
• LH CAB PRESS RELF vlv - NORM
33 • EMER CAB PRESS sel - BOTH
• H2O/GLY TK REG sel - BOTH
1 Normal range 0.25 to 0.45 lb/hr.
2 A surge tank - cryo tank ΔP of 50 psi will verify a high O2 flow. Typical HI CRYO TK-SURGE TK ΔP:
30 psi ≈1.8 lb/hr
50 psi ≈2.9 lb/hr
100 psi ≈4.8 lb/hr
150 psi ≈6.2 lb/hr
400 psi ≈10.0 lb/hr
700 psi ≈11.7 lb/hr
3 Placing the MAIN REG A & B - close and noting a decrease in O2 flow will validate the sensor indication.
4 Continue with O2 Flow Hi procedure and use C/W lt and surge tank bleed down as indication of O2 flow.
5 This action verifies that inadvertently opened valve has not caused increased O2 flow. However, high O2 flow normal during cabin gas changeover.
6 Assumes partially suited mode is:
• SUIT RETURN vlv - OPEN (PULL)
• DEMAND REG sel - BOTH
7 If leak is not isolated and O2 flow remains high, mission time may be extended by shutting off the main O2 regulators, re-opening them when necessary to maintain cabin pressure and for actuation of the cyclic accumulators. Placing the WASTE STOW VENT valve to VENT may prevent the cabin relief valve from actuating.
SM-2A-2210E

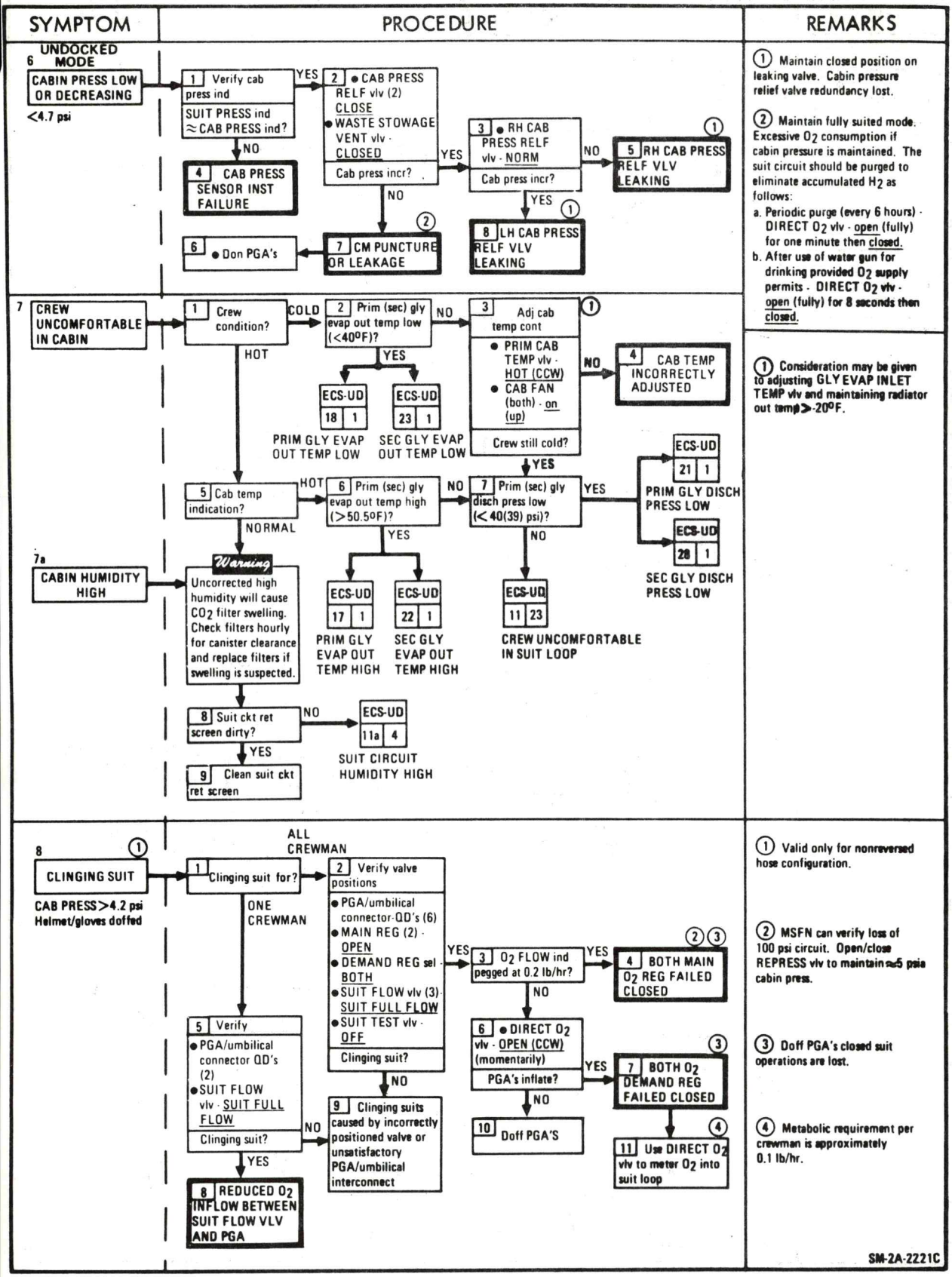
1a (CONT) THRU 3

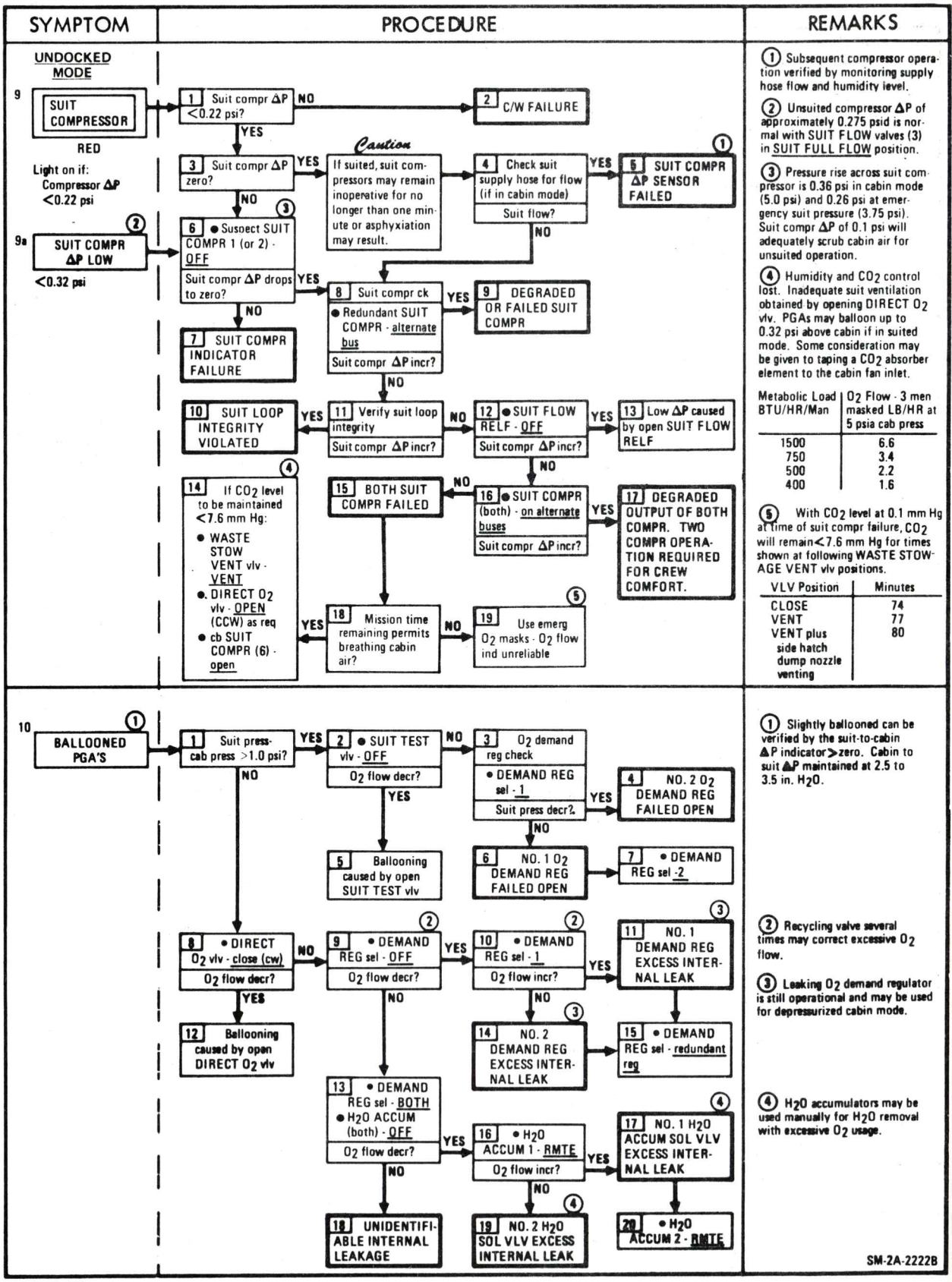
SYMPTOM	PROCEDURE	REMARKS
UNDOCKED MODE 1a (Cont)		(8) MSFN can distinguish between these two failures by reporting tank bladder pressure. (9) PRESS-TO-TEST operation may reseal leaky pool valve. (10) Removes power from H_2O accumulator. (11) H_2O accumulator can be manually operated. (12) Max O_2 bleed 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.

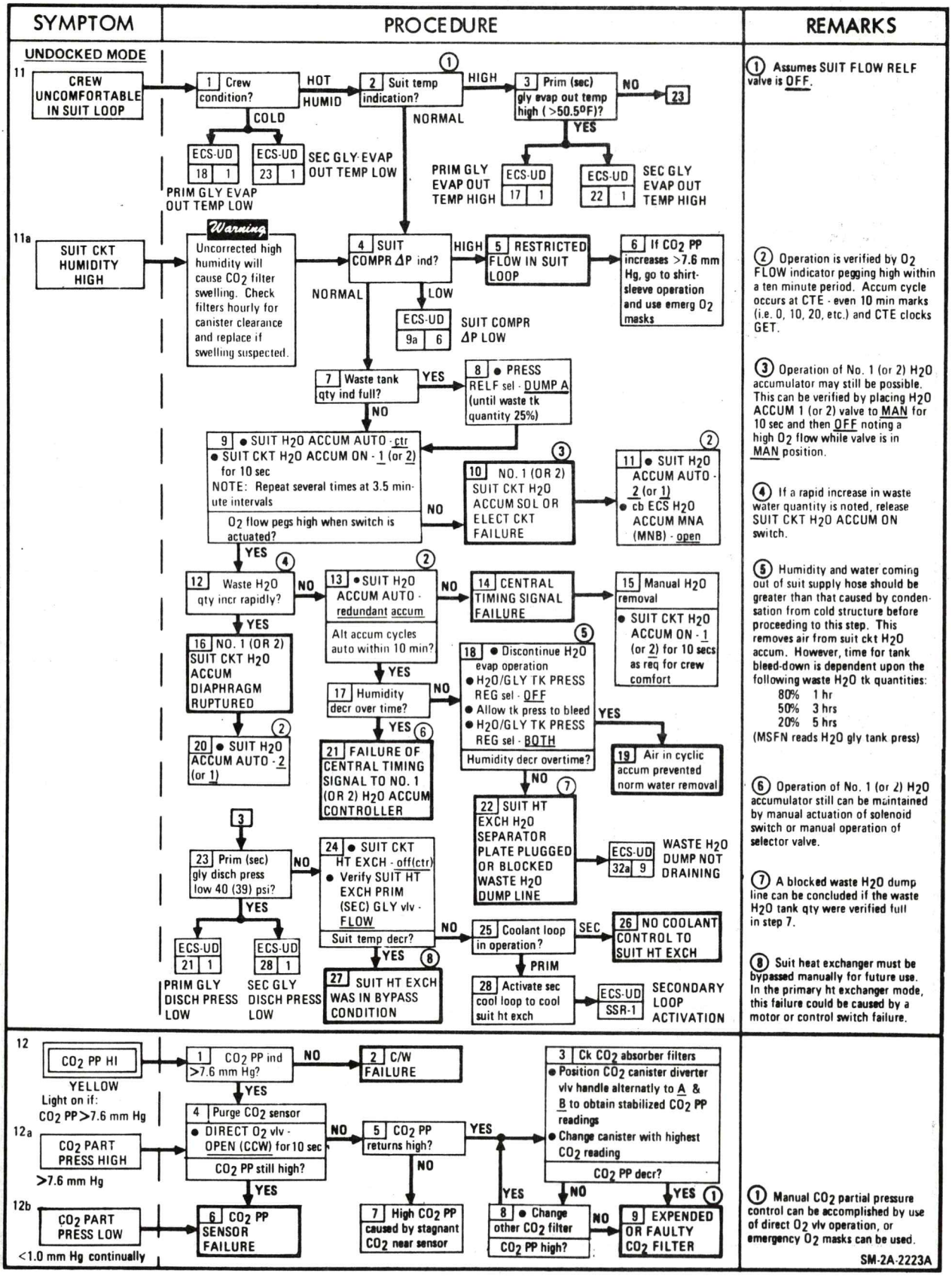
SM-2A-2219D


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
4 CABIN PRESS HIGH OR INCREASING
>5.3 psi
1 Verify cab press inst
SUIT PRESS ind ≈ CAB PRESS ind?
YES
NO
2 O2 flow high?
NO
YES
3 Surge tk press low?
NO
YES
3 CAB PRESS INST FAILURE
4 Use SUIT PRESS ind to estimate cab press
ECS-UD 1 1 O2 FLOW HI
ECS-UD 5 12 SURGE TK PRESS LOW
ECS-UD 5 9 SURGE TK PRESS LOW
1 Cabin pressure >5.3 psi is normal after insertion. Normal range is 4.7 to 5.3 psi
2 Checks repress package.
5 SURGE TANK PRESS LOW
<835 psi
1 ● O2 PRESS IND sw - TK 1
Cryo tk press low?
YES
NO
2 CRYO O2 STORAGE FAILURE
CRYO 1b 12
3 Sensor check
● REPRESS PKG vlv - ON (momentarily) then OFF
Repress pkg press decr?
NO
4 SURGE TK PRESS SENSOR FAILURE
YES
5 O2 FLOW ind
O2 flow high?
NO
YES
ECS-UD 6 2
CABIN PRESS LOW OR DECREASING
6 Line obstruction check
● SM O2 SUP vlv - ON
● SRG TK O2 vlv - OFF
● DIRECT O2 vlv - OPEN (CCW) to 0.95 lb/hr for 45 sec, then CLOSE (CW)
O2 flow ind remaining at 1.0 lb/hr during DIRECT O2 - OPEN?
NO
8 OBSTRUCTION OF O2 RESTRICTORS, FILTERS, OR LINE
7 Reopen O2 vlv
● REPRESS PKG vlv - ON (when surge tk decr to 500 psi)
● SRG TK O2 vlv - ON
Warning
An obstruction severely limits O2 supply rate. May essentially limit supply to that available in CM (surge tk plus repress O2 tk)
YES
9 ● SRG TK O2 vlv - OFF
Surge tk press decr?
YES
NO
10 ● SRG TK RELF vlv - close (CCW)
Surge tk press decr?
YES
NO
11 SURGE TK PLUMBING LEAKING
13 SURGE TK RELF VLV LEAKING
14 ● REPRESS PKG vlv - FILL
● SRG TK O2 vlv - ON
12 Isolate repress O2 tk(s)
● SRG TK O2 vlv - ON
● REPRESS O2 - CLOSE (verify)
● EMER O2 - CLOSE
Repress O2 supply press decr?
YES
NO
15 ● REPRESS O2 RELF vlv - close (CCW)
Repress O2 supply press decr?
YES
NO
16 REPRESS O2 PLUMBING LEAK
19 REPRESS O2 RELF VLV LEAKING
20 ● REPRESS PKG vlv - FILL until REPRESS O2 press ind reads 800 psi
● REPRESS PKG vlv - OFF
17 MAIN REG A VLV FAILED OPEN OR RELF VLV LEAKING
YES
18 ● MAIN REG A - close
Cab press stops incr?
NO
22 ● MAIN REG A - OPEN
● MAIN REG B - close
Cab press stops incr?
NO
YES
21 O2 LEAK BETWEEN MAIN REG AND O2 FLOW SENSOR
23 MAIN REG B VLV FAILED OPEN OR RELF VLV LEAKING
1 REPRESS PKG vlv - FILL; repress O2 supply to perform surge tank function.
2 Use REPRESS O2 RELF vlv for surge tank pressure relief.
3 If subsequent O2 mask use is necessary, position REPRESS PKG vlv to FILL. Excessive O2 consumption results.
4 This step may require considerable time.
5 MSFN can distinguish between these two failures by reporting O2 system pressure.
SM-2A-2220B

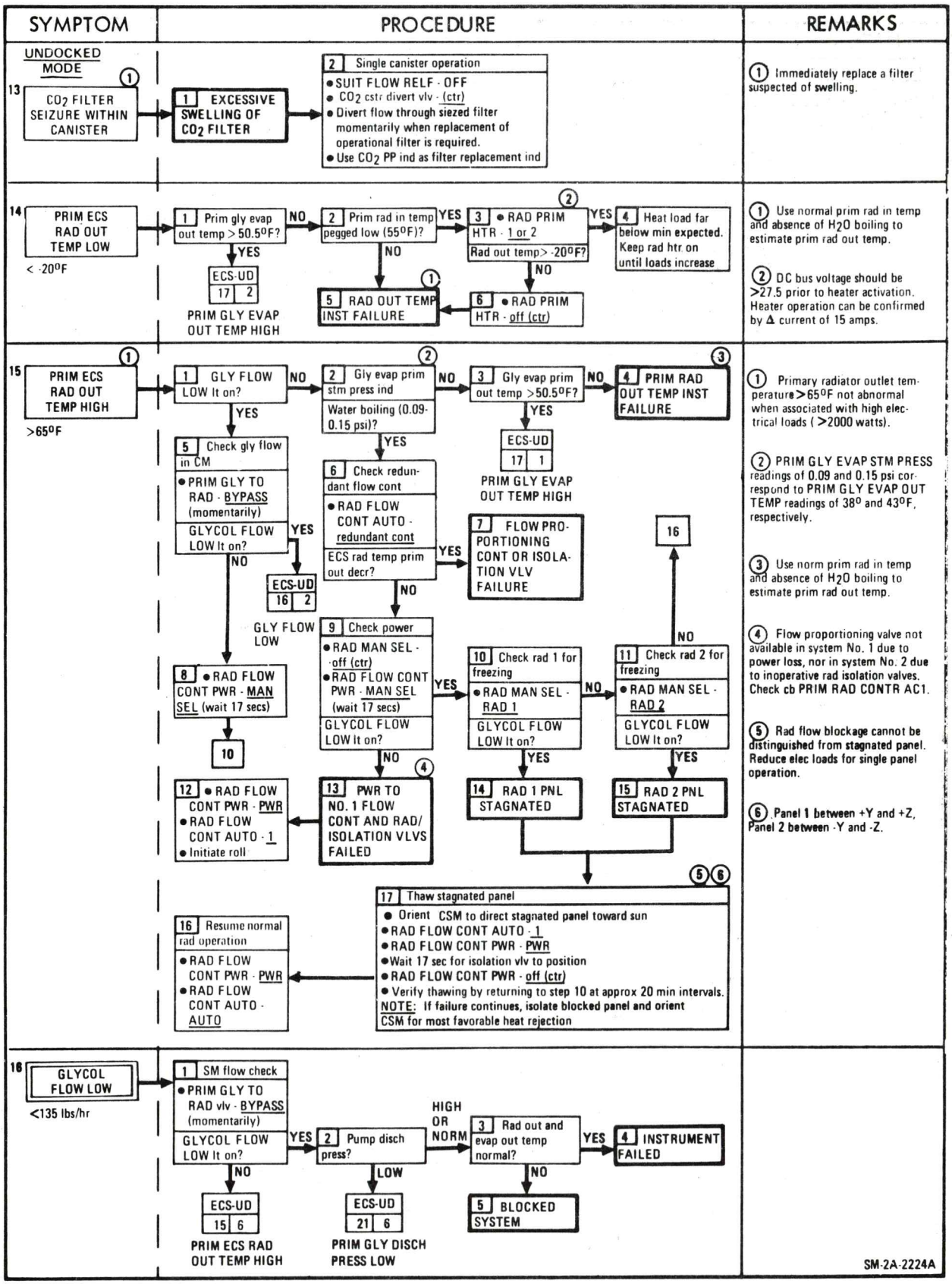
6 THRU 8

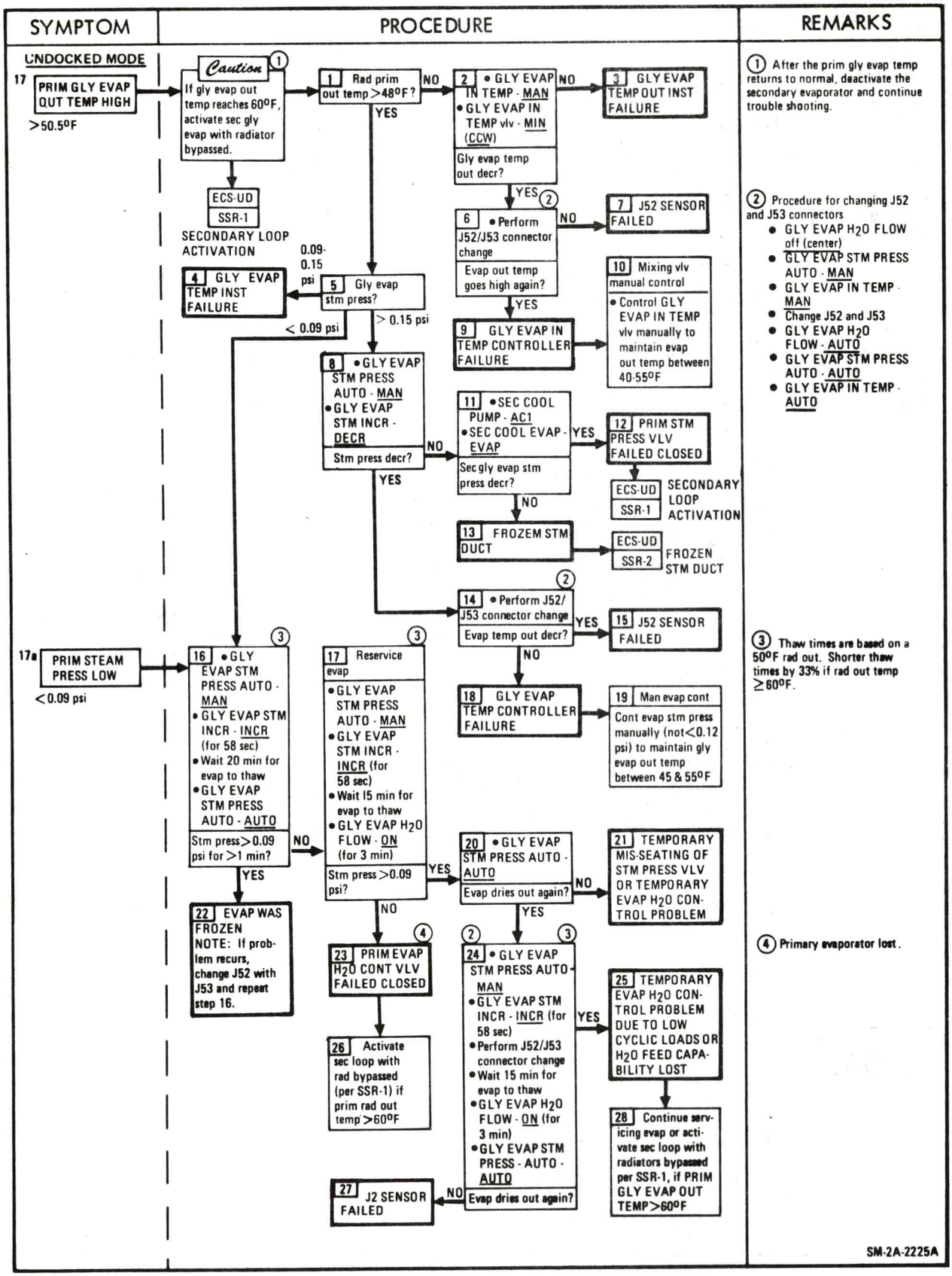

SYMPTOM
PROCEDURE
REMARKS
6 UNDOCKED MODE
CABIN PRESS LOW OR DECREASING
<4.7 psi
1 Verify cab press ind
SUIT PRESS ind ≈ CAB PRESS ind?
YES
NO
2 • CAB PRESS RELF vlv (2) CLOSE
• WASTE STOWAGE VENT vlv - CLOSED
Cab press incr?
YES
NO
3 • RH CAB PRESS RELF vlv - NORM
Cab press incr?
NO
YES
5 RH CAB PRESS RELF VLV LEAKING
8 LH CAB PRESS RELF VLV LEAKING
4 CAB PRESS SENSOR INST FAILURE
6 • Don PGA's
7 CM PUNCTURE OR LEAKAGE
7 CREW UNCOMFORTABLE IN CABIN
1 Crew condition?
COLD
HOT
2 Prim (sec) gly evap out temp low (<40°F)?
YES
NO
ECS-UD 18 1
PRIM GLY EVAP OUT TEMP LOW
ECS-UD 23 1
SEC GLY EVAP OUT TEMP LOW
3 Adj cab temp cont
• PRIM CAB TEMP vlv - HOT (CCW)
• CAB FAN (both) - on (up)
Crew still cold?
NO
YES
4 CAB TEMP INCORRECTLY ADJUSTED
5 Cab temp indication?
HOT
NORMAL
6 Prim (sec) gly evap out temp high (>50.5°F)?
NO
YES
ECS-UD 17 1
PRIM GLY EVAP OUT TEMP HIGH
ECS-UD 22 1
SEC GLY EVAP OUT TEMP HIGH
7 Prim (sec) gly disch press low (< 40(39) psi)?
YES
NO
ECS-UD 21 1
PRIM GLY DISCH PRESS LOW
ECS-UD 28 1
SEC GLY DISCH PRESS LOW
ECS-UD 11 23
CREW UNCOMFORTABLE IN SUIT LOOP
7a CABIN HUMIDITY HIGH
Warning
Uncorrected high humidity will cause CO2 filter swelling. Check filters hourly for canister clearance and replace filters if swelling is suspected.
8 Suit ckt ret screen dirty?
NO
YES
ECS-UD 11a 4
SUIT CIRCUIT HUMIDITY HIGH
9 Clean suit ckt ret screen
8 CLINGING SUIT
CAB PRESS >4.2 psi
Helmet/gloves doffed
ALL CREWMAN
ONE CREWMAN
1 Clinging suit for?
2 Verify valve positions
• PGA/umbilical connector-QD's (6)
• MAIN REG (2) - OPEN
• DEMAND REG sel - BOTH
• SUIT FLOW vlv (3) - SUIT FULL FLOW
• SUIT TEST vlv - OFF
Clinging suit?
NO
YES
3 O2 FLOW ind pegged at 0.2 lb/hr?
YES
NO
4 BOTH MAIN O2 REG FAILED CLOSED
5 Verify
• PGA/umbilical connector QD's (2)
• SUIT FLOW vlv - SUIT FULL FLOW
Clinging suit?
NO
YES
9 Clinging suits caused by incorrectly positioned valve or unsatisfactory PGA/umbilical interconnect
6 • DIRECT O2 vlv - OPEN (CCW) (momentarily)
PGA's inflate?
YES
NO
7 BOTH O2 DEMAND REG FAILED CLOSED
10 Doff PGA'S
11 Use DIRECT O2 vlv to meter O2 into suit loop
8 REDUCED O2 INFLOW BETWEEN SUIT FLOW VLV AND PGA
REMARKS
(1) Maintain closed position on leaking valve. Cabin pressure relief valve redundancy lost.
(2) Maintain fully suited mode. Excessive O2 consumption if cabin pressure is maintained. The suit circuit should be purged to eliminate accumulated H2 as follows:
a. Periodic purge (every 6 hours) - DIRECT O2 vlv - open (fully) for one minute then closed.
b. After use of water gun for drinking provided O2 supply permits - DIRECT O2 vlv - open (fully) for 8 seconds then closed.
(1) Consideration may be given to adjusting GLY EVAP INLET TEMP vlv and maintaining radiator out temp ≥ -20°F.
(1) Valid only for nonreversed 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-2221C


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
9
SUIT COMPRESSOR
RED
Light on if: Compressor ΔP <0.22 psi
9a
SUIT COMPR ΔP LOW
<0.32 psi
1 Suit compr ΔP <0.22 psi?
NO
2 C/W FAILURE
YES
3 Suit compr ΔP zero?
YES
Caution
If suited, suit compressors may remain inoperative for no longer than one minute or asphyxiation may result.
4 Check suit supply hose for flow (if in cabin mode)
Suit flow?
YES
5 SUIT COMPR ΔP SENSOR FAILED
NO
6 • Suspect SUIT COMPR 1 (or 2) - OFF
Suit compr ΔP drops to zero?
YES
NO
7 SUIT COMPR INDICATOR FAILURE
8 Suit compr ck
• Redundant SUIT COMPR - alternate bus
Suit compr ΔP incr?
YES
9 DEGRADED OR FAILED SUIT COMPR
NO
10 SUIT LOOP INTEGRITY VIOLATED
YES
11 Verify suit loop integrity
Suit compr ΔP incr?
NO
12 • SUIT FLOW RELF - OFF
Suit compr ΔP incr?
YES
13 Low ΔP caused by open SUIT FLOW RELF
NO
14 If CO_2 level to be maintained <7.6 mm Hg:
• WASTE STOW VENT vlv - VENT
• DIRECT O_2 vlv - OPEN (CCW) as req
• cb SUIT COMPR (6) - open
15 BOTH SUIT COMPR FAILED
NO
16 • SUIT COMPR (both) - on alternate buses
Suit compr ΔP incr?
YES
17 DEGRADED OUTPUT OF BOTH COMPR. TWO COMPR OPERATION REQUIRED FOR CREW COMFORT.
18 Mission time remaining permits breathing cabin air?
YES
NO
19 Use emerg O_2 masks - O_2 flow ind unreliable
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 valves (3) 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 may balloon up to 0.32 psi above cabin if in suited mode. 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 nozzle venting 80
10
BALLOONED PGA'S
1 Suit press-cab press >1.0 psi?
YES
NO
2 • SUIT TEST vlv - OFF
O_2 flow decr?
YES
5 Ballooning caused by open SUIT TEST vlv
3 O_2 demand reg check
• DEMAND REG sel - 1
Suit press decr?
YES
4 NO. 2 O_2 DEMAND REG FAILED OPEN
NO
6 NO. 1 O_2 DEMAND REG FAILED OPEN
7 • DEMAND REG sel - 2
8 • DIRECT O_2 vlv - close (cw)
O_2 flow decr?
YES
12 Ballooning caused by open DIRECT O_2 vlv
NO
9 • DEMAND REG sel - OFF
O_2 flow decr?
YES
NO
10 • DEMAND REG sel - 1
O_2 flow incr?
YES
11 NO. 1 DEMAND REG EXCESS INTERNAL LEAK
NO
14 NO. 2 DEMAND REG EXCESS INTERNAL LEAK
15 • DEMAND REG sel - redundant reg
13 • DEMAND REG sel - BOTH
• H_2O ACCUM (both) - OFF
O_2 flow decr?
YES
NO
16 • H_2O ACCUM 1 - RMTE
O_2 flow incr?
YES
17 NO. 1 H_2O ACCUM SOL VLV EXCESS INTERNAL LEAK
NO
18 UNIDENTIFIABLE INTERNAL LEAKAGE
19 NO. 2 H_2O SOL VLV EXCESS INTERNAL LEAK
20 • H_2O ACCUM 2 - RMTE
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 several 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.
SM-2A-2222B

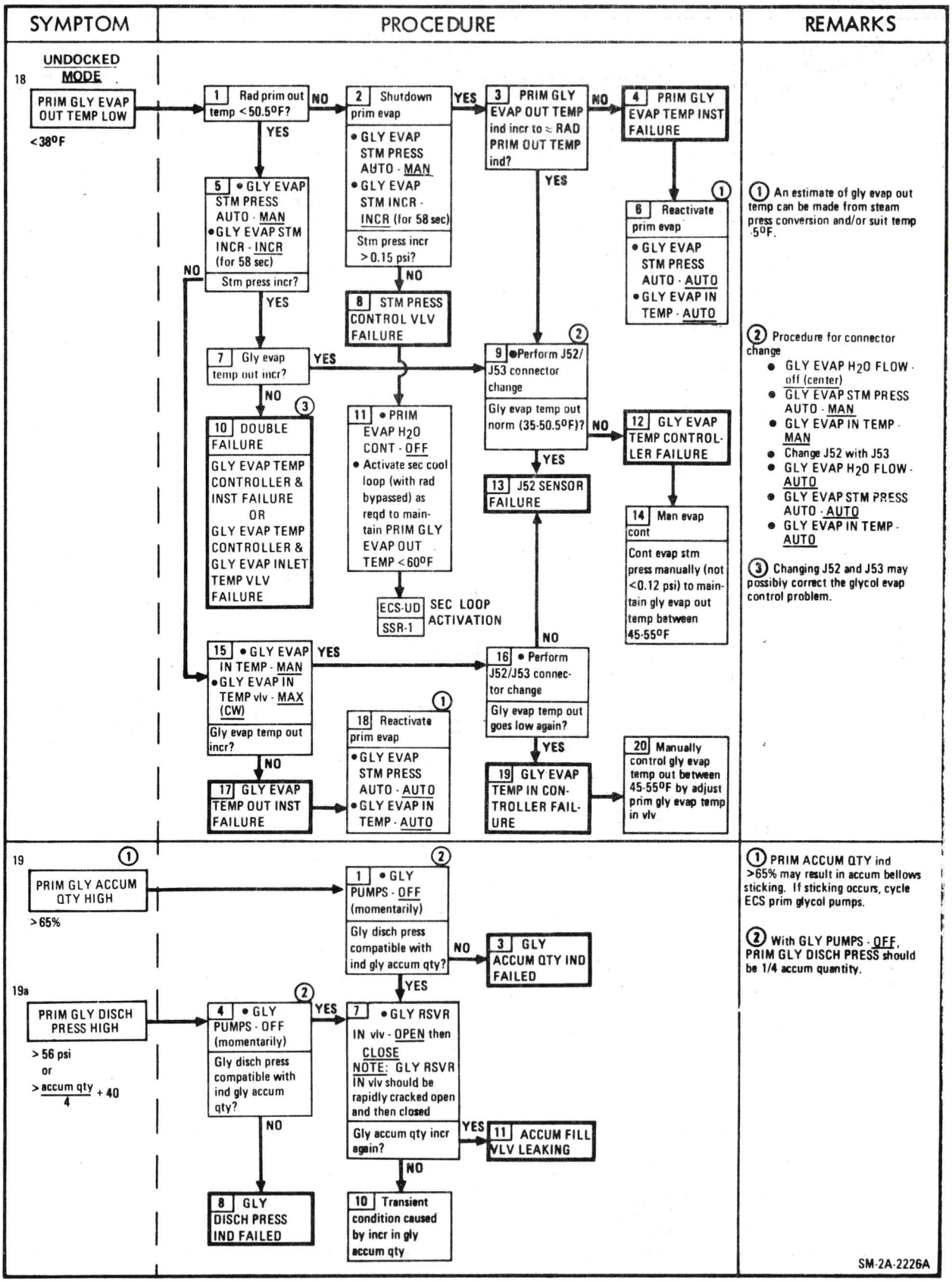

SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
11
CREW UNCOMFORTABLE IN SUIT LOOP
1 Crew condition?
HOT HUMID
COLD
2 Suit temp indication?
HIGH
NORMAL
LOW
3 Prim (sec) gly evap out temp high (>50.5°F)?
NO
YES
23
ECS-UD 18 1
PRIM GLY EVAP OUT TEMP LOW
ECS-UD 23 1
SEC GLY EVAP OUT TEMP LOW
PRIM GLY EVAP OUT TEMP HIGH
ECS-UD 17 1
ECS-UD 22 1
SEC GLY EVAP OUT TEMP HIGH
11a
SUIT CKT HUMIDITY HIGH
Warning
Uncorrected high humidity will cause CO2 filter swelling. Check filters hourly for canister clearance and replace if swelling suspected.
4 SUIT COMPR ΔP ind?
HIGH
5 RESTRICTED FLOW IN SUIT LOOP
6 If CO2 PP increases >7.6 mm Hg, go to shirt-sleeve operation and use emerg O2 masks
NORMAL
LOW
ECS-UD 9a 6
SUIT COMPR ΔP LOW
7 Waste tank qty ind full?
YES
8 • PRESS RELF sel - DUMP A (until waste tk quantity 25%)
NO
9 • SUIT H2O ACCUM AUTO - ctr
• SUIT CKT H2O ACCUM ON - 1 (or 2) for 10 sec
NOTE: Repeat several times at 3.5 minute intervals
O2 flow pegs high when switch is actuated?
NO
3
10 NO. 1 (OR 2) SUIT CKT H2O ACCUM SOL OR ELECT CKT FAILURE
2
11 • SUIT H2O ACCUM AUTO - 2 (or 1)
• cb ECS H2O ACCUM MNA (MNB) - open
YES
4
12 Waste H2O qty incr rapidly?
NO
2
13 • SUIT H2O ACCUM AUTO - redundant accum
Alt accum cycles auto within 10 min?
NO
14 CENTRAL TIMING SIGNAL FAILURE
15 Manual H2O removal
• SUIT CKT H2O ACCUM ON - 1 (or 2) for 10 secs as req for crew comfort
YES
16 NO. 1 (OR 2) SUIT CKT H2O ACCUM DIAPHRAGM RUPTURED
2
20 • SUIT H2O ACCUM AUTO - 2 (or 1)
YES
17 Humidity decr over time?
NO
5
18 • Discontinue H2O evap operation
• H2O/GLY TK PRESS REG sel - OFF
• Allow tk press to bleed
• H2O/GLY TK PRESS REG sel - BOTH
Humidity decr overtime?
YES
19 Air in cyclic accum prevented norm water removal
YES
6
21 FAILURE OF CENTRAL TIMING SIGNAL TO NO. 1 (OR 2) H2O ACCUM CONTROLLER
NO
7
22 SUIT HT EXCH H2O SEPARATOR PLATE PLUGGED OR BLOCKED WASTE H2O DUMP LINE
ECS-UD 32a 9
WASTE H2O 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
8
27 SUIT HT EXCH WAS IN BYPASS CONDITION
28 Activate sec cool loop to cool suit ht exch
ECS-UD SSR-1
SECONDARY LOOP ACTIVATION
YES
ECS-UD 21 1
PRIM GLY DISCH PRESS LOW
ECS-UD 28 1
SEC GLY DISCH PRESS LOW
12
CO2 PP HI
YELLOW Light on if: CO2 PP >7.6 mm Hg
1 CO2 PP ind >7.6 mm Hg?
NO
2 C/W FAILURE
YES
12a
CO2 PART PRESS HIGH
>7.6 mm Hg
4 Purge CO2 sensor
• DIRECT O2 vlv - OPEN (CCW) for 10 sec
CO2 PP still high?
NO
5 CO2 PP returns high?
YES
3 Ck CO2 absorber filters
• Position CO2 canister diverter vlv handle alternatly to A & B to obtain stabilized CO2 PP readings
• Change canister with highest CO2 reading
CO2 PP decr?
YES
1
NO
YES
12b
CO2 PART PRESS LOW
<1.0 mm Hg continually
6 CO2 PP SENSOR FAILURE
7 High CO2 PP caused by stagnant CO2 near sensor
8 • Change other CO2 filter
CO2 PP high?
NO
9 EXPENDED OR FAULTY CO2 FILTER
1 Assumes SUIT FLOW RELF valve is OFF.
2 Operation is verified by O2 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) H2O accumulator may still be possible. This can be verified by placing H2O ACCUM 1 (or 2) valve to MAN for 10 sec and then OFF noting a high O2 flow while valve is in MAN position.
4 If a rapid increase in waste water quantity is noted, release SUIT CKT H2O 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 H2O accum. However, time for tank bleed-down is dependent upon the following waste H2O tk quantities:
80% 1 hr
50% 3 hrs
20% 5 hrs
(MSFN reads H2O gly tank press)
6 Operation of No. 1 (or 2) H2O accumulator still can be maintained by manual actuation of solenoid switch or manual operation of selector valve.
7 A blocked waste H2O dump line can be concluded if the waste H2O tank qty were verified 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 Manual CO2 partial pressure control can be accomplished by use of direct O2 vlv operation, or emergency O2 masks can be used.
SM-2A-2223A

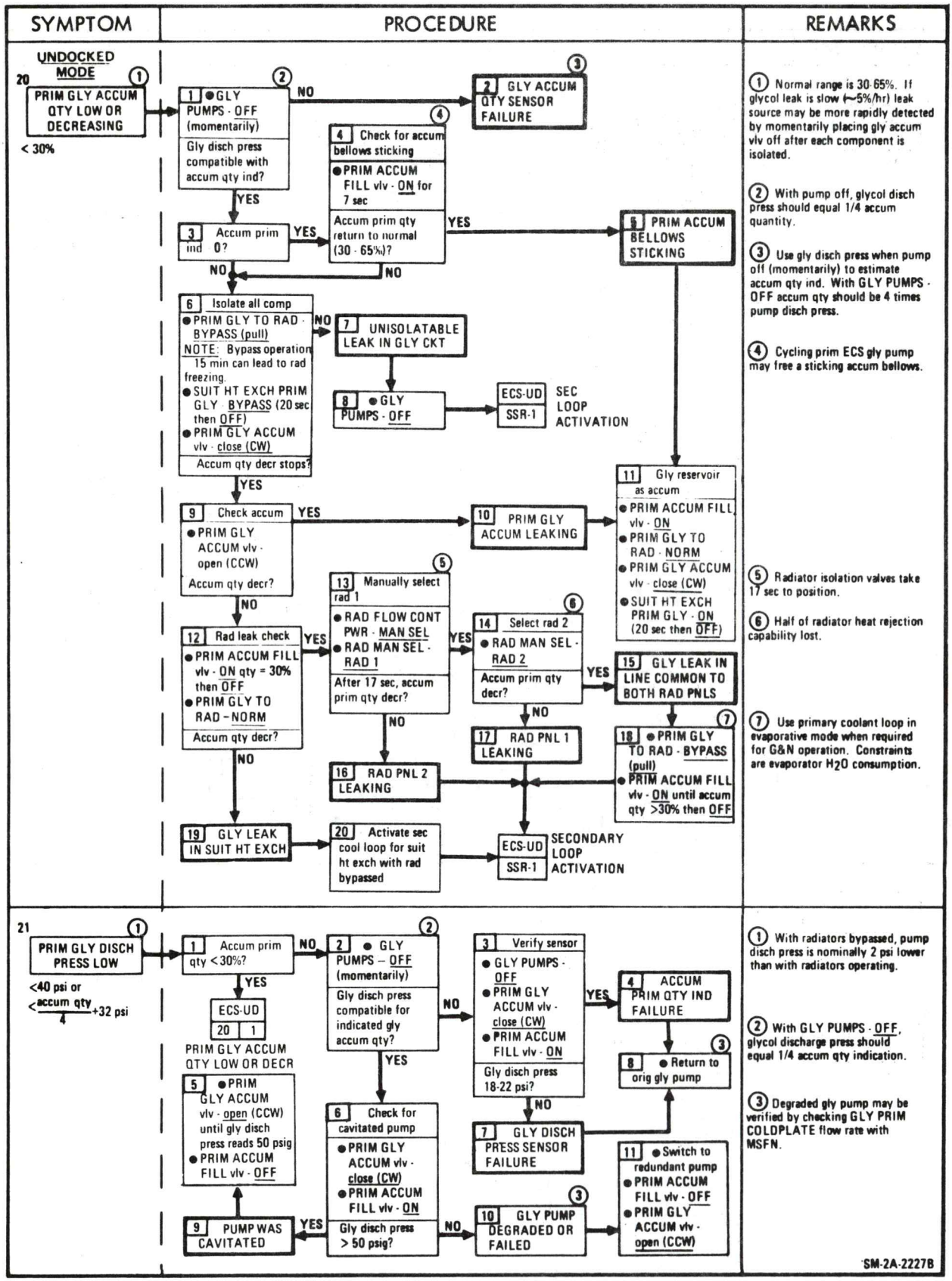
11 THRU 12b


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
13
CO2 FILTER SEIZURE WITHIN CANISTER
1 EXCESSIVE SWELLING OF CO2 FILTER
2 Single canister operation
• SUIT FLOW RELF - OFF
• CO2 cstr divert vlv - (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
PRIM ECS RAD OUT TEMP LOW
< -20°F
1 Prim gly evap out temp > 50.5°F?
NO
2 Prim rad in temp pegged low (55°F)?
YES
3 • RAD PRIM HTR - 1 or 2
Rad out temp> -20°F?
YES
4 Heat load far below min expected. Keep rad htr on until loads increase
YES
NO
ECS-UD 17 2
PRIM GLY EVAP OUT TEMP HIGH
5 RAD OUT TEMP INST FAILURE
6 • RAD PRIM HTR - off (ctr)
(1) Use normal prim rad in temp and absence of H2O boiling to estimate prim rad out temp.
(2) DC bus voltage should be >27.5 prior to heater activation. Heater operation can be confirmed by Δ current of 15 amps.
15
PRIM ECS RAD OUT TEMP HIGH
>65°F
1 GLY FLOW LOW lt on?
NO
2 Gly evap prim stm press ind
Water boiling (0.09-0.15 psi)?
NO
3 Gly evap prim out temp >50.5°F?
NO
4 PRIM RAD OUT TEMP INST FAILURE
YES
YES
YES
ECS-UD 17 1
PRIM GLY EVAP OUT TEMP HIGH
5 Check gly flow in CM
• PRIM GLY TO RAD - BYPASS (momentarily)
GLYCOL FLOW LOW lt on?
YES
NO
ECS-UD 16 2
6 Check redundant flow cont
• RAD FLOW CONT AUTO - redundant cont
ECS rad temp prim out decr?
YES
NO
7 FLOW PROPORTIONING CONT OR ISOLATION VLV FAILURE
16
GLY FLOW LOW
8 • RAD FLOW CONT PWR - MAN SEL (wait 17 secs)
10
9 Check power
• RAD MAN SEL - off (ctr)
• RAD FLOW CONT PWR - MAN SEL (wait 17 secs)
GLYCOL FLOW LOW lt on?
YES
NO
10 Check rad 1 for freezing
• RAD MAN SEL - RAD 1
GLYCOL FLOW LOW lt on?
NO
11 Check rad 2 for freezing
• RAD MAN SEL - RAD 2
GLYCOL FLOW LOW lt on?
NO
YES
YES
12 • RAD FLOW CONT PWR - PWR
• RAD FLOW CONT AUTO - 1
• Initiate roll
13 PWR TO NO. 1 FLOW CONT AND RAD/ISOLATION VLVS FAILED
14 RAD 1 PNL STAGNATED
15 RAD 2 PNL STAGNATED
5 6
17 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)
• Verify thawing by returning to step 10 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 FLOW CONT PWR - PWR
• RAD FLOW CONT AUTO - AUTO
(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 0.15 psi correspond to PRIM GLY EVAP OUT TEMP readings of 38° and 43°F, respectively.
(3) Use norm prim rad in temp and absence of H2O boiling to estimate prim rad out temp.
(4) 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 PRIM RAD CONTR AC1.
(5) Rad flow blockage cannot be distinguished from stagnated panel. Reduce elec loads for single panel operation.
(6) Panel 1 between +Y and +Z, Panel 2 between -Y and -Z.
13 THRU 16
16
GLYCOL FLOW LOW
<135 lbs/hr
1 SM flow check
• PRIM GLY TO RAD vlv - BYPASS (momentarily)
GLYCOL FLOW LOW lt on?
YES
NO
2 Pump disch press?
HIGH OR NORM
LOW
3 Rad out and evap out temp normal?
YES
NO
4 INSTRUMENT FAILED
5 BLOCKED SYSTEM
ECS-UD 15 6
PRIM ECS RAD OUT TEMP HIGH
ECS-UD 21 6
PRIM GLY DISCH PRESS LOW
SM-2A-2224A

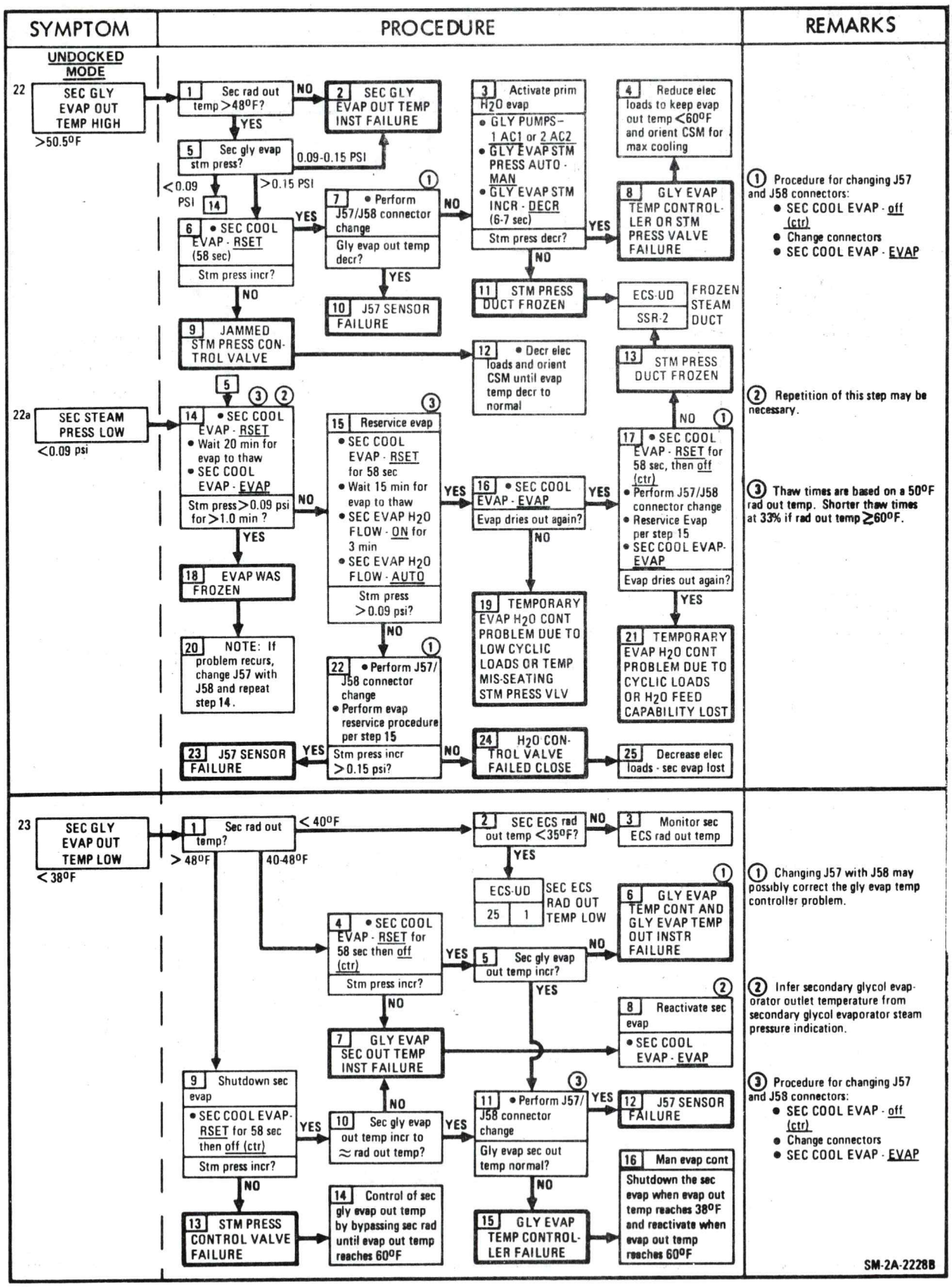

SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
17 PRIM GLY EVAP OUT TEMP HIGH >50.5°F
Caution 1 If gly evap out temp reaches 60°F, activate sec gly evap with radiator bypassed.
ECS-UD SSR-1 SECONDARY LOOP ACTIVATION
1 Rad prim out temp >48°F? NO YES
2 • GLY EVAP IN TEMP - MAN • GLY EVAP IN TEMP vlv - MIN (CCW) Gly evap temp out decr? NO YES
3 GLY EVAP TEMP OUT INST FAILURE
6 • Perform J52/J53 connector change Evap out temp goes high again? NO YES
7 J52 SENSOR FAILED
9 GLY EVAP IN TEMP CONTROLLER FAILURE
10 Mixing vlv manual control • Control GLY EVAP IN TEMP vlv manually to maintain evap out temp between 40-55°F
4 GLY EVAP TEMP INST FAILURE
0.09-0.15 psi
5 Gly evap stm press? < 0.09 psi > 0.15 psi
8 • GLY EVAP STM PRESS AUTO - MAN • GLY EVAP STM INCR - DECR Stm press decr? NO YES
11 • SEC COOL PUMP - AC1 • SEC COOL EVAP - EVAP Sec gly evap stm press decr? YES NO
12 PRIM STM PRESS VLV FAILED CLOSED
ECS-UD SSR-1 SECONDARY LOOP ACTIVATION
13 FROZEM STM DUCT
ECS-UD SSR-2 FROZEN STM DUCT
14 • Perform J52/J53 connector change Evap temp out decr? YES NO
15 J52 SENSOR FAILED
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
17a 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
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
22 EVAP WAS FROZEN NOTE: If problem recurs, change J52 with J53 and repeat step 16.
23 PRIM EVAP H_2O CONT VLV FAILED CLOSED
26 Activate sec loop with rad bypassed (per SSR-1) if prim rad out temp >60°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? NO YES
25 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 PRIM GLY EVAP OUT TEMP>60°F
27 J2 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 H_2O FLOW off (center)
• GLY EVAP STM PRESS AUTO - MAN
• GLY EVAP IN TEMP - MAN
• Change J52 and J53
• GLY EVAP H_2O 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 lost.
SM-2A-2225A

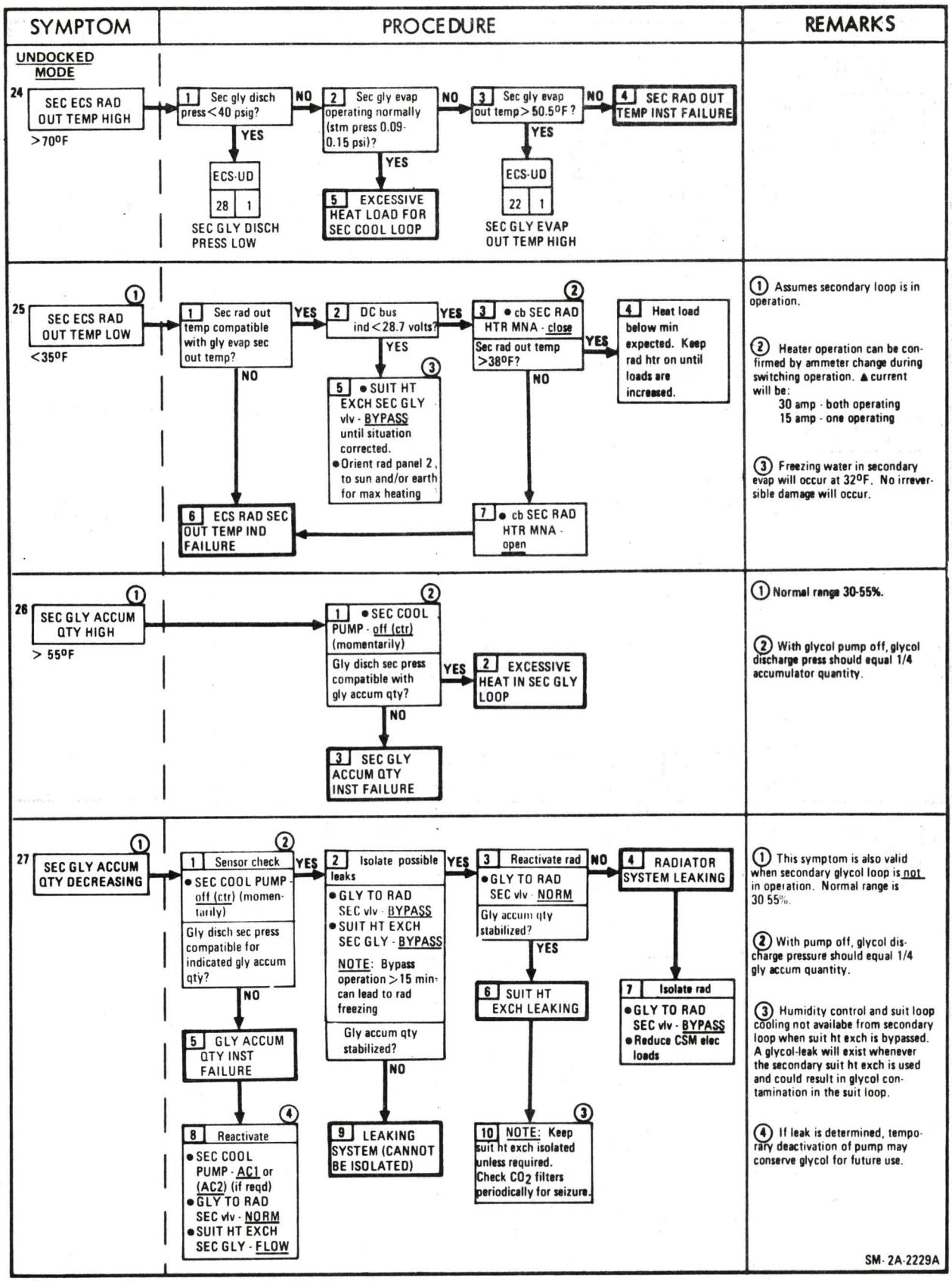
17 THRU 17a


SYMPTOM
PROCEDURE
REMARKS
18
UNDOCKED MODE
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 >0.15 psi?
NO
YES
3 PRIM GLY EVAP OUT TEMP ind incr to ≈ RAD PRIM OUT TEMP ind?
NO
YES
4 PRIM GLY EVAP TEMP INST FAILURE
6 Reactivate prim evap
• GLY EVAP STM PRESS AUTO - AUTO
• GLY EVAP IN TEMP - AUTO
5 • GLY EVAP STM PRESS AUTO - MAN
• GLY EVAP STM INCR - INCR (for 58 sec)
Stm press incr?
NO
YES
8 STM PRESS CONTROL VLV FAILURE
7 Gly evap temp out incr?
YES
NO
9 •Perform J52/J53 connector change
Gly evap temp out norm (35-50.5°F)?
NO
YES
12 GLY EVAP TEMP CONTROLLER FAILURE
13 J52 SENSOR FAILURE
14 Man evap cont
Cont evap stm press manually (not <0.12 psi) to maintain gly evap out temp between 45-55°F
10 DOUBLE FAILURE
GLY EVAP TEMP CONTROLLER & INST FAILURE
OR
GLY EVAP TEMP CONTROLLER & GLY EVAP INLET TEMP VLV FAILURE
11 • PRIM EVAP H2O CONT - OFF
• Activate sec cool loop (with rad bypassed) as reqd to maintain PRIM GLY EVAP OUT TEMP <60°F
ECS-UD
SSR-1
SEC LOOP ACTIVATION
15 • GLY EVAP IN TEMP - MAN
• GLY EVAP IN TEMP vlv - MAX (CW)
Gly evap temp out incr?
YES
NO
16 • Perform J52/J53 connector change
Gly evap temp out goes low again?
YES
NO
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 45-55°F by adjust 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.
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.
19
PRIM GLY ACCUM QTY HIGH
>65%
1 • GLY PUMPS - OFF (momentarily)
Gly disch press compatible with ind gly accum qty?
NO
YES
3 GLY ACCUM QTY IND FAILED
19a
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?
YES
NO
7 • 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?
YES
NO
11 ACCUM FILL VLV LEAKING
8 GLY DISCH PRESS IND FAILED
10 Transient condition caused by incr in gly accum qty
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.
SM-2A-2226A

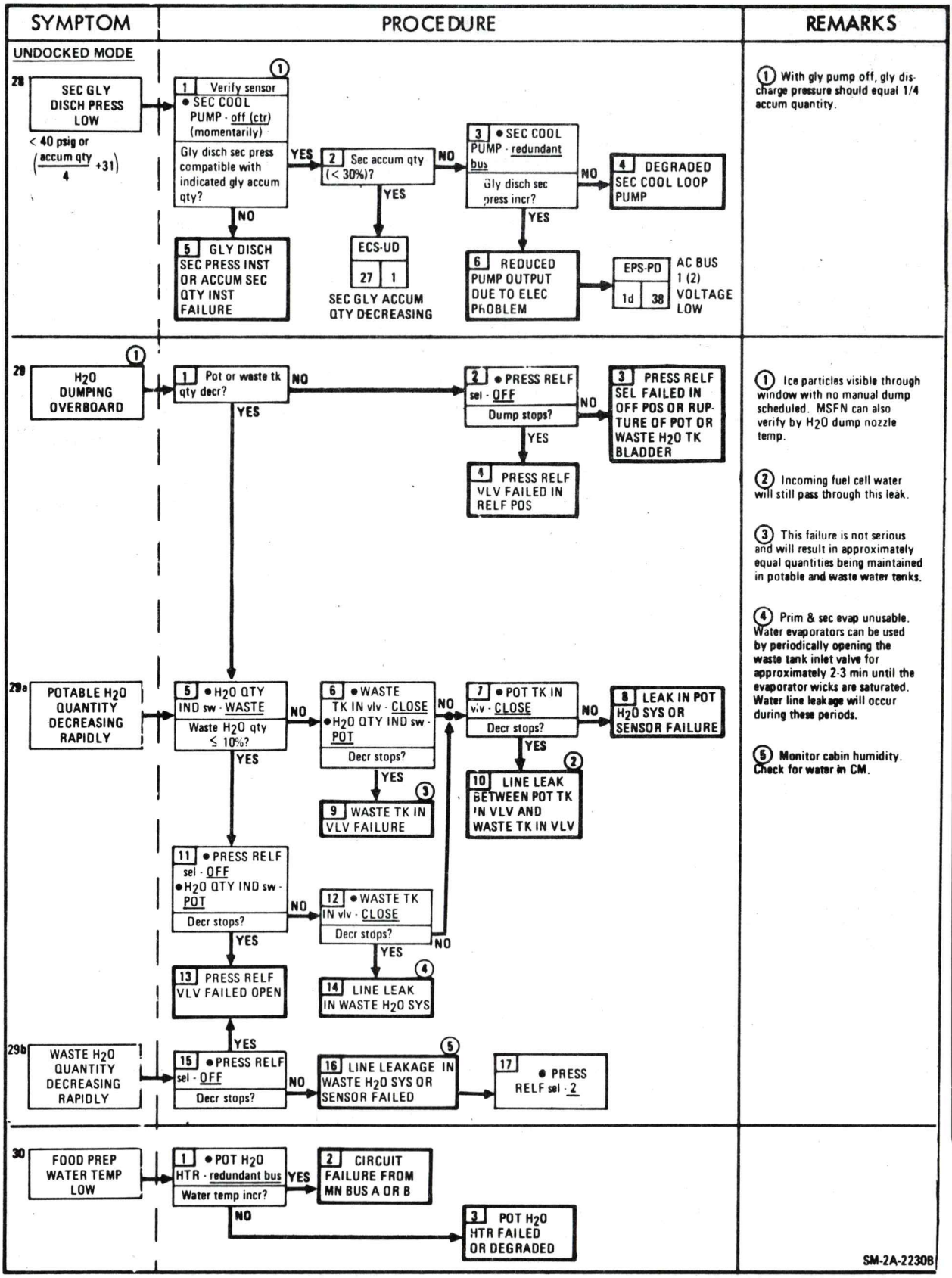

SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
20
PRIM GLY ACCUM QTY LOW OR DECREASING
< 30%
1 ● GLY PUMPS - OFF (momentarily)
Gly disch press compatible with accum qty ind?
NO
2 GLY ACCUM QTY SENSOR FAILURE
YES
3 Accum prim ind 0?
YES
4 Check for accum bellows sticking
● PRIM ACCUM FILL vlv - ON for 7 sec
Accum prim qty return to normal (30 - 65%)?
YES
5 PRIM ACCUM BELLOWS STICKING
NO
NO
6 Isolate all comp
● PRIM GLY TO RAD - BYPASS (pull)
NOTE: Bypass operation 15 min can lead to rad freezing.
● SUIT HT EXCH PRIM GLY - BYPASS (20 sec then OFF)
● PRIM GLY ACCUM vlv - close (CW)
Accum qty decr stops?
NO
7 UNISOLATABLE LEAK IN GLY CKT
8 ● GLY PUMPS - OFF
ECS-UD
SSR-1
SEC LOOP ACTIVATION
YES
9 Check accum
● PRIM GLY ACCUM vlv - open (CCW)
Accum qty decr?
YES
10 PRIM GLY ACCUM LEAKING
11 Gly reservoir as accum
● PRIM ACCUM FILL vlv - ON
● PRIM GLY TO RAD - NORM
● PRIM GLY ACCUM vlv - close (CW)
● SUIT HT EXCH PRIM GLY - ON (20 sec then OFF)
NO
12 Rad leak check
● PRIM ACCUM FILL vlv - ON qty = 30% then OFF
● PRIM GLY TO RAD - NORM
Accum qty decr?
YES
13 Manually select rad 1
● RAD FLOW CONT PWR - MAN SEL
● RAD MAN SEL - RAD 1
After 17 sec, accum prim qty decr?
YES
14 Select rad 2
● RAD MAN SEL - RAD 2
Accum prim qty decr?
YES
15 GLY LEAK IN LINE COMMON TO BOTH RAD PNLS
NO
17 RAD PNL 1 LEAKING
NO
16 RAD PNL 2 LEAKING
18 ● PRIM GLY TO RAD - BYPASS (pull)
● PRIM ACCUM FILL vlv - ON until accum qty >30% then OFF
NO
19 GLY LEAK IN SUIT HT EXCH
20 Activate sec cool loop for suit ht exch with rad bypassed
ECS-UD
SSR-1
SECONDARY LOOP ACTIVATION
21
PRIM GLY DISCH PRESS LOW
<40 psi or < accum qty / 4 + 32 psi
1 Accum prim qty < 30%?
NO
2 ● GLY PUMPS - OFF (momentarily)
Gly disch press compatible for indicated gly accum qty?
NO
3 Verify sensor
● GLY PUMPS - OFF
● PRIM GLY ACCUM vlv - close (CW)
● PRIM ACCUM FILL vlv - ON
Gly disch press 18-22 psi?
YES
4 ACCUM PRIM QTY IND FAILURE
8 ● Return to orig gly pump
NO
7 GLY DISCH PRESS SENSOR FAILURE
YES
ECS-UD
20 1
PRIM GLY ACCUM QTY LOW OR DECR
5 ● PRIM GLY ACCUM vlv - open (CCW) until gly disch press reads 50 psig
● PRIM ACCUM FILL vlv - OFF
YES
6 Check for cavitated pump
● PRIM GLY ACCUM vlv - close (CW)
● PRIM ACCUM FILL vlv - ON
Gly disch press > 50 psig?
NO
10 GLY PUMP DEGRADED OR FAILED
11 ● Switch to redundant pump
● PRIM ACCUM FILL vlv - OFF
● PRIM GLY ACCUM vlv - open (CCW)
9 PUMP WAS CAVITATED
YES
(1) Normal range is 30-65%. If glycol leak is slow (~5%/hr) leak source may be more rapidly detected by momentarily placing gly accum vlv off after each component is isolated.
(2) With pump off, glycol disch press should equal 1/4 accum quantity.
(3) Use gly disch press when pump off (momentarily) to estimate accum qty ind. With GLY PUMPS - OFF accum qty should be 4 times pump disch press.
(4) Cycling prim ECS gly pump may free a sticking accum bellows.
(5) Radiator isolation valves take 17 sec to position.
(6) Half of radiator heat rejection capability lost.
(7) Use primary coolant loop in evaporative mode when required for G&N operation. Constraints are evaporator H2O consumption.
(1) With radiators bypassed, pump disch press is nominally 2 psi lower than with radiators operating.
(2) With GLY PUMPS - OFF, glycol discharge press should equal 1/4 accum qty indication.
(3) Degraded gly pump may be verified by checking GLY PRIM COLDPLATE flow rate with MSFN.
SM-2A-2227B

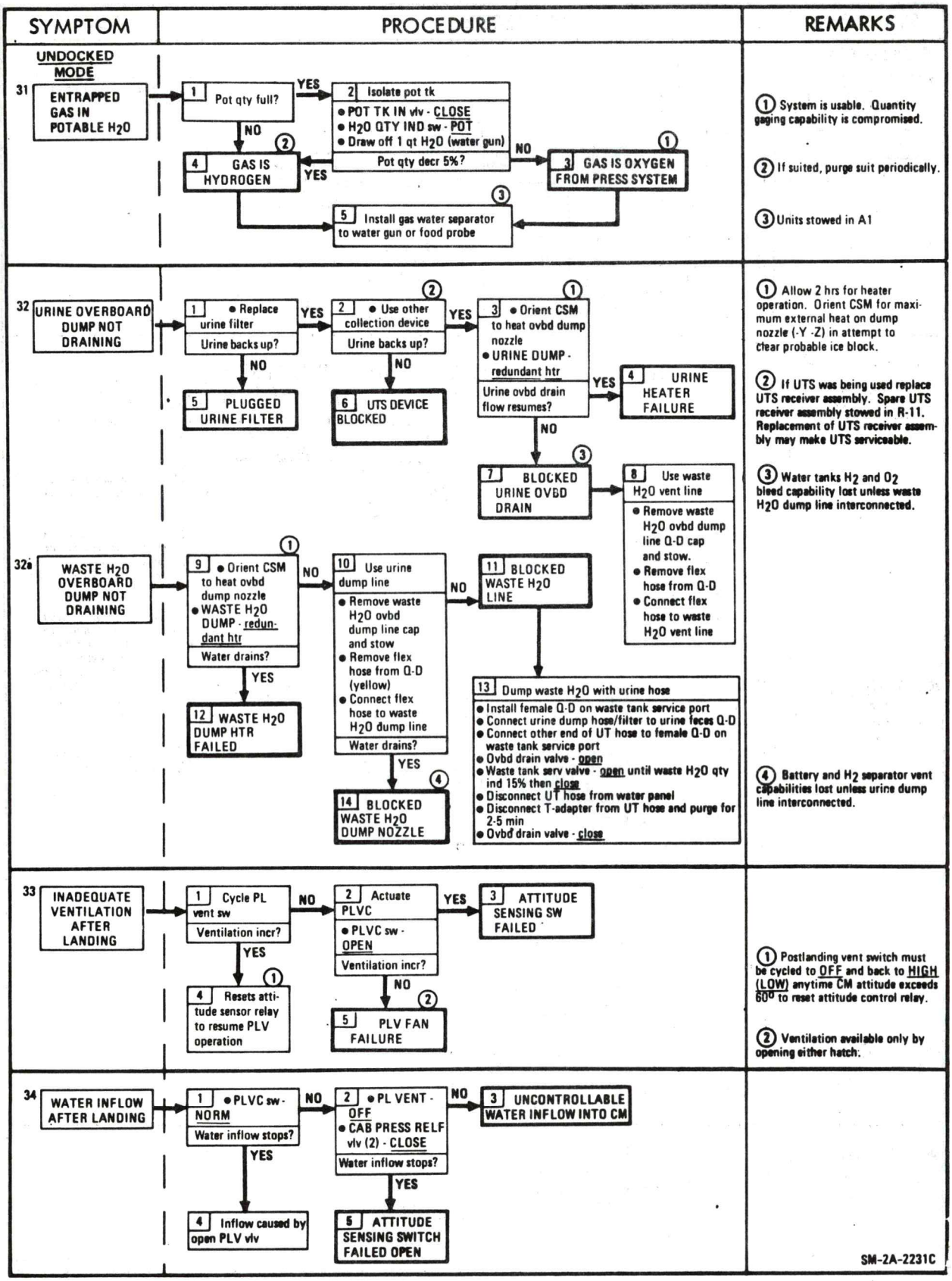
20 THRU 21


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
22 SEC GLY EVAP OUT TEMP HIGH >50.5°F
1 Sec rad out temp >48°F?
NO
2 SEC GLY EVAP OUT TEMP INST FAILURE
YES
5 Sec gly evap stm press?
0.09-0.15 PSI
<0.09 PSI
14
>0.15 PSI
6 • SEC COOL EVAP - RSET (58 sec)
Stm press incr?
YES
7 • Perform J57/J58 connector change
Gly evap out temp decr?
YES
10 J57 SENSOR FAILURE
NO
9 JAMMED STM PRESS CONTROL VALVE
3 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
4 Reduce elec loads to keep evap out temp <60°F and orient CSM for max cooling
8 GLY EVAP TEMP CONTROLLER OR STM PRESS VALVE FAILURE
NO
11 STM PRESS DUCT FROZEN
ECS-UD SSR-2 FROZEN STEAM DUCT
13 STM PRESS DUCT FROZEN
12 • Decr elec loads and orient CSM until evap temp decr to normal
22a SEC STEAM PRESS LOW <0.09 psi
5 3 2
14 • 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
18 EVAP WAS FROZEN
20 NOTE: If problem recurs, change J57 with J58 and repeat step 14.
15 Reservice evap
• SEC COOL EVAP - RSET for 58 sec
• Wait 15 min for evap to thaw
• SEC EVAP H2O FLOW - ON for 3 min
• SEC EVAP H2O FLOW - AUTO
Stm press >0.09 psi?
NO
22 • Perform J57/J58 connector change • Perform evap reservice procedure per step 15
Stm press incr >0.15 psi?
YES
23 J57 SENSOR FAILURE
NO
16 • SEC COOL EVAP - EVAP
Evap dries out again?
YES
NO
19 TEMPORARY EVAP H2O CONT PROBLEM DUE TO LOW CYCLIC LOADS OR TEMP MIS-SEATING STM PRESS VLV
24 H2O CONTROL VALVE FAILED CLOSE
NO
17 • SEC COOL EVAP - RSET for 58 sec, then off (ctr) • Perform J57/J58 connector change • Reservice Evap per step 15 • SEC COOL EVAP - EVAP
Evap dries out again?
YES
21 TEMPORARY EVAP H2O CONT PROBLEM DUE TO CYCLIC LOADS OR H2O FEED CAPABILITY LOST
25 Decrease elec loads - sec evap lost
23 SEC GLY EVAP OUT TEMP LOW <38°F
1 Sec rad out temp?
<40°F
>48°F
40-48°F
2 SEC ECS rad out temp <35°F?
NO
3 Monitor sec ECS rad out temp
YES
ECS-UD 25 1 SEC ECS RAD OUT TEMP LOW
6 GLY EVAP TEMP CONT AND GLY EVAP TEMP OUT INSTR FAILURE
4 • SEC COOL EVAP - RSET for 58 sec then off (ctr)
Stm press incr?
YES
5 Sec gly evap out temp incr?
NO
YES
8 Reactivate sec evap • SEC COOL EVAP - EVAP
NO
7 GLY EVAP SEC OUT TEMP INST FAILURE
9 Shutdown sec evap • SEC COOL EVAP - RSET for 58 sec then off (ctr)
Stm press incr?
YES
10 Sec gly evap out temp incr to ≈ rad out temp?
NO
YES
11 • Perform J57/J58 connector change
Gly evap sec out temp normal?
YES
12 J57 SENSOR FAILURE
NO
13 STM PRESS CONTROL VALVE FAILURE
14 Control of sec gly evap out temp by bypassing sec rad until evap out temp reaches 60°F
15 GLY EVAP TEMP CONTROLLER FAILURE
16 Man evap cont Shutdown the sec evap when evap out temp reaches 38°F and reactivate when evap out temp reaches 60°F
(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 at 33% if rad out temp ≥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-2228B


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
24
SEC ECS RAD OUT TEMP HIGH
>70°F
1 Sec gly disch press<40 psig?
NO
2 Sec gly evap operating normally (stm press 0.09-0.15 psi)?
NO
3 Sec gly evap out temp>50.5°F?
NO
4 SEC RAD OUT TEMP INST FAILURE
YES
ECS-UD 28 1
SEC GLY DISCH PRESS LOW
YES
5 EXCESSIVE HEAT LOAD FOR SEC COOL LOOP
YES
ECS-UD 22 1
SEC GLY EVAP OUT TEMP HIGH
25
SEC ECS RAD OUT TEMP LOW
<35°F
1 Sec rad out temp compatible with gly evap sec out temp?
YES
2 DC bus ind<28.7 volts?
YES
3 • cb SEC RAD HTR MNA - close
Sec rad out temp >38°F?
YES
4 Heat load below min expected. Keep rad htr on until loads are increased.
NO
YES
5 • SUIT HT EXCH SEC GLY vlv - BYPASS until situation corrected.
• Orient rad panel 2, to sun and/or earth for max heating
NO
6 ECS RAD SEC OUT TEMP IND FAILURE
7 • cb SEC RAD HTR MNA - open
1 Assumes secondary loop is in operation.
2 Heater operation can be confirmed by ammeter change during switching operation. ▲current will be:
30 amp - both operating
15 amp - one operating
3 Freezing water in secondary evap will occur at 32°F. No irreversible damage will occur.
26
SEC GLY ACCUM QTY HIGH
> 55°F
1 • SEC COOL PUMP - off (ctr) (momentarily)
Gly disch sec press compatible with gly accum qty?
YES
2 EXCESSIVE HEAT IN SEC GLY LOOP
NO
3 SEC GLY ACCUM QTY INST FAILURE
1 Normal range 30-55%.
2 With glycol pump off, glycol discharge press should equal 1/4 accumulator quantity.
27
SEC GLY ACCUM QTY DECREASING
1 Sensor check
• SEC COOL PUMP - off (ctr) (momentarily)
Gly disch sec press compatible for indicated gly accum qty?
YES
2 Isolate possible leaks
• GLY TO RAD SEC vlv - BYPASS
• SUIT HT EXCH SEC GLY - BYPASS
NOTE: Bypass operation >15 min can lead to rad freezing
Gly accum qty stabilized?
YES
3 Reactivate rad
• GLY TO RAD SEC vlv - NORM
Gly accum qty stabilized?
NO
4 RADIATOR SYSTEM LEAKING
NO
5 GLY ACCUM QTY INST FAILURE
NO
9 LEAKING SYSTEM (CANNOT BE ISOLATED)
YES
6 SUIT HT EXCH LEAKING
7 Isolate rad
• GLY TO RAD SEC vlv - BYPASS
• Reduce CSM elec loads
8 Reactivate
• SEC COOL PUMP - AC1 or (AC2) (if reqd)
• GLY TO RAD SEC vlv - NORM
• SUIT HT EXCH SEC GLY - FLOW
10 NOTE: Keep suit ht exch isolated unless required. Check CO_2 filters periodically for seizure.
1 This symptom is also valid when secondary glycol loop is not in operation. 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 availabe 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.
SM-2A-2229A

24 THRU 27


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
28
SEC GLY DISCH PRESS LOW
< 40 psig or (accum qty / 4 +31)
1 Verify sensor
• SEC COOL PUMP - off (ctr) (momentarily)
Gly disch sec press compatible with indicated gly accum qty?
YES
2 Sec accum qty (< 30%)?
NO
3 • SEC COOL PUMP - redundant bus
Gly disch sec press incr?
NO
4 DEGRADED SEC COOL LOOP PUMP
YES
6 REDUCED PUMP OUTPUT DUE TO ELEC PROBLEM
EPS-PD 1d 38
AC BUS 1 (2) VOLTAGE LOW
NO
5 GLY DISCH SEC PRESS INST OR ACCUM SEC QTY INST FAILURE
YES
ECS-UD 27 1
SEC GLY ACCUM QTY DECREASING
1 With gly pump off, gly discharge pressure should equal 1/4 accum quantity.
29
H2O DUMPING OVERBOARD
1 Pot or waste tk qty decr?
NO
2 • PRESS RELF sel - OFF
Dump stops?
NO
3 PRESS RELF SEL FAILED IN OFF POS OR RUPTURE OF POT OR WASTE H2O TK BLADDER
YES
4 PRESS RELF VLV FAILED IN RELF POS
YES
29a
POTABLE H2O QUANTITY DECREASING RAPIDLY
5 • H2O QTY IND sw - WASTE
Waste H2O qty ≤ 10%?
NO
6 • WASTE TK IN vlv - CLOSE
• H2O QTY IND sw - POT
Decr stops?
NO
7 • POT TK IN vlv - CLOSE
Decr stops?
NO
8 LEAK IN POT H2O SYS OR SENSOR FAILURE
YES
9 WASTE TK IN VLV FAILURE
YES
10 LINE LEAK BETWEEN POT TK IN VLV AND WASTE TK IN VLV
YES
11 • PRESS RELF sel - OFF
• H2O QTY IND sw - POT
Decr stops?
NO
12 • WASTE TK IN vlv - CLOSE
Decr stops?
NO
YES
13 PRESS RELF VLV FAILED OPEN
YES
14 LINE LEAK IN WASTE H2O SYS
29b
WASTE H2O QUANTITY DECREASING RAPIDLY
15 • PRESS RELF sel - OFF
Decr stops?
NO
16 LINE LEAKAGE IN WASTE H2O SYS OR SENSOR FAILED
17 • PRESS RELF sel - 2
1 Ice particles visible through window with no manual dump scheduled. MSFN can also verify by H2O dump nozzle temp.
2 Incoming fuel cell water will still pass through this leak.
3 This failure is not serious and will result in approximately equal quantities being maintained in potable and waste water tanks.
4 Prim & sec evap unusable. Water evaporators can be used by periodically opening the waste tank inlet valve for approximately 2-3 min until the evaporator wicks are saturated. Water line leakage will occur during these periods.
5 Monitor cabin humidity. Check for water in CM.
30
FOOD PREP WATER TEMP LOW
1 • POT H2O HTR - redundant bus
Water temp incr?
YES
2 CIRCUIT FAILURE FROM MN BUS A OR B
NO
3 POT H2O HTR FAILED OR DEGRADED
SM-2A-2230B


SYMPTOM
PROCEDURE
REMARKS
UNDOCKED MODE
31 ENTRAPPED GAS IN POTABLE H2O
1 Pot qty full?
YES
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
3 GAS IS OXYGEN FROM PRESS SYSTEM
NO
4 GAS IS HYDROGEN
YES
5 Install gas water separator to water gun or food probe
32 URINE OVERBOARD DUMP NOT DRAINING
1 • Replace urine filter
Urine backs up?
YES
NO
5 PLUGGED URINE FILTER
2 • Use other collection device
Urine backs up?
YES
NO
6 UTS DEVICE BLOCKED
3 • Orient CSM to heat ovbd dump nozzle
• URINE DUMP - redundant htr
Urine ovbd drain flow resumes?
YES
4 URINE HEATER FAILURE
NO
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
32a WASTE H2O OVERBOARD DUMP NOT DRAINING
9 • Orient CSM to heat ovbd dump nozzle
• WASTE H2O DUMP - redundant htr
Water drains?
YES
12 WASTE H2O DUMP HTR FAILED
NO
10 Use urine dump line
• Remove waste H2O ovbd dump line cap and stow
• Remove flex hose from Q-D (yellow)
• Connect flex hose to waste H2O dump line
Water drains?
YES
14 BLOCKED WASTE H2O DUMP NOZZLE
NO
11 BLOCKED WASTE H2O LINE
13 Dump waste H2O with urine hose
• Install female Q-D on waste tank service port
• Connect urine dump hose/filter to urine feces Q-D
• Connect other end of UT hose to female Q-D on waste tank service port
• Ovbd drain valve - open
• Waste tank serv valve - open until waste H2O qty ind 15% then close
• Disconnect UT hose from water panel
• Disconnect T-adapter from UT hose and purge for 2-5 min
• Ovbd drain valve - close
33 INADEQUATE VENTILATION AFTER LANDING
1 Cycle PL vent sw
Ventilation incr?
YES
4 Resets attitude sensor relay to resume PLV operation
NO
2 Actuate PLVC
• PLVC sw - OPEN
Ventilation incr?
NO
5 PLV FAN FAILURE
YES
3 ATTITUDE SENSING SW FAILED
34 WATER INFLOW AFTER LANDING
1 • PLVC sw - NORM
Water inflow stops?
YES
4 Inflow caused by open PLV vlv
NO
2 • PL VENT - OFF
• CAB PRESS RELF vlv (2) - CLOSE
Water inflow stops?
YES
5 ATTITUDE SENSING SWITCH FAILED OPEN
NO
3 UNCONTROLLABLE WATER INFLOW INTO CM
(1) System is usable. Quantity gaging capability is compromised.
(2) If suited, purge suit periodically.
(3) Units stowed in A1
(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.
(4) Battery and H2 separator vent capabilities lost unless urine dump line interconnected.
(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.
SM-2A-2231C

SPECIAL SUB ROUTINES

PROCEDURE

REMARKS

UNDOCKED MODE

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

NO

③

3 Deactivate prim loop
- PRIM EVAP H_2O CONT vlv - OFF
- 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 - 40 - 52 psig
- SEC GLY EVAP H_2O FLOW - AUTO
- 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)

4 If return to prim operation only is desired.

5 Deactivate sec loop
- SEC COOL EVAP - RESET for 58 sec then off (ctr)
- SEC COOL PUMP - off (ctr)
- SEC EVAP H_2O CONT vlv - OFF

6 Activate prim loop
- ECS IND sel - PRIM
- PRIM GLY TO RAD vlv - NORM
- GLY PUMPS - 1 AC1
- PRIM GLY DISCH PRESS ind - 40 - 52 psig
- 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)

① If one panel of primary radiator is lost, secondary radiator should be used. Bypass of prim rad results in loss of cooling for S071 & S072 experiment coldplates in SM. (See remark No. 3.)

② Operation of both coolant loops may result in low rad out temp in one loop due to evap operation in other loop. Terminate evap operation if necessary.

③ IVA not to be used due to loss of O_2 heating at glycol heat exchange coils.
G&N, DSE, signal conditioners, and S071 & S072 (CSM 117 only) experiments are not coldplated on sec 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

EXPERIMENTS - Backup mode required immediately

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)

Stm press stabilized within 15 min?

YES

NO

2 Service evap when stm press >0.15 psi.
- GLY EVAP H_2O FLOW - ON (2 min) then off (ctr)

Gly evap temp out <47°F?

YES

NO

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

Gly evap temp out <47°F?

NO

YES

4 Resume norm opr
- GLY EVAP STM PRESS AUTO - AUTO
- GLY EVAP H_2O FLOW - AUTO
- GLY EVAP IN TEMP - AUTO

SM-2A-2232A

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ECS DOCKED MALFUNCTIONS INDEX

1 O_2 FLOW HI

RED

1a O_2 FLOW HIGH-MAIN REG'S CLOSED

1b O_2 FLOW HIGH-MAIN REG'S OPEN

2 CABIN PRESS HIGH OR INCREASING

3 SURGE TANK PRESS LOW

4 PRIM ECS RAD OUT TEMP LOW

5 PRIM ECS RAD OUT TEMP HIGH

6 GLYCOL FLOW LOW

7 PRIM GLY EVAP OUT TEMP HIGH

8 PRIM GLY EVAP OUT TEMP LOW

9 PRIM GLY ACCUM QTY LOW OR DECREASING

10 PRIM GLY ACCUM QTY HIGH

10a PRIM GLY DISCH PRESS HIGH

11 PRIM GLY DISCH PRESS LOW

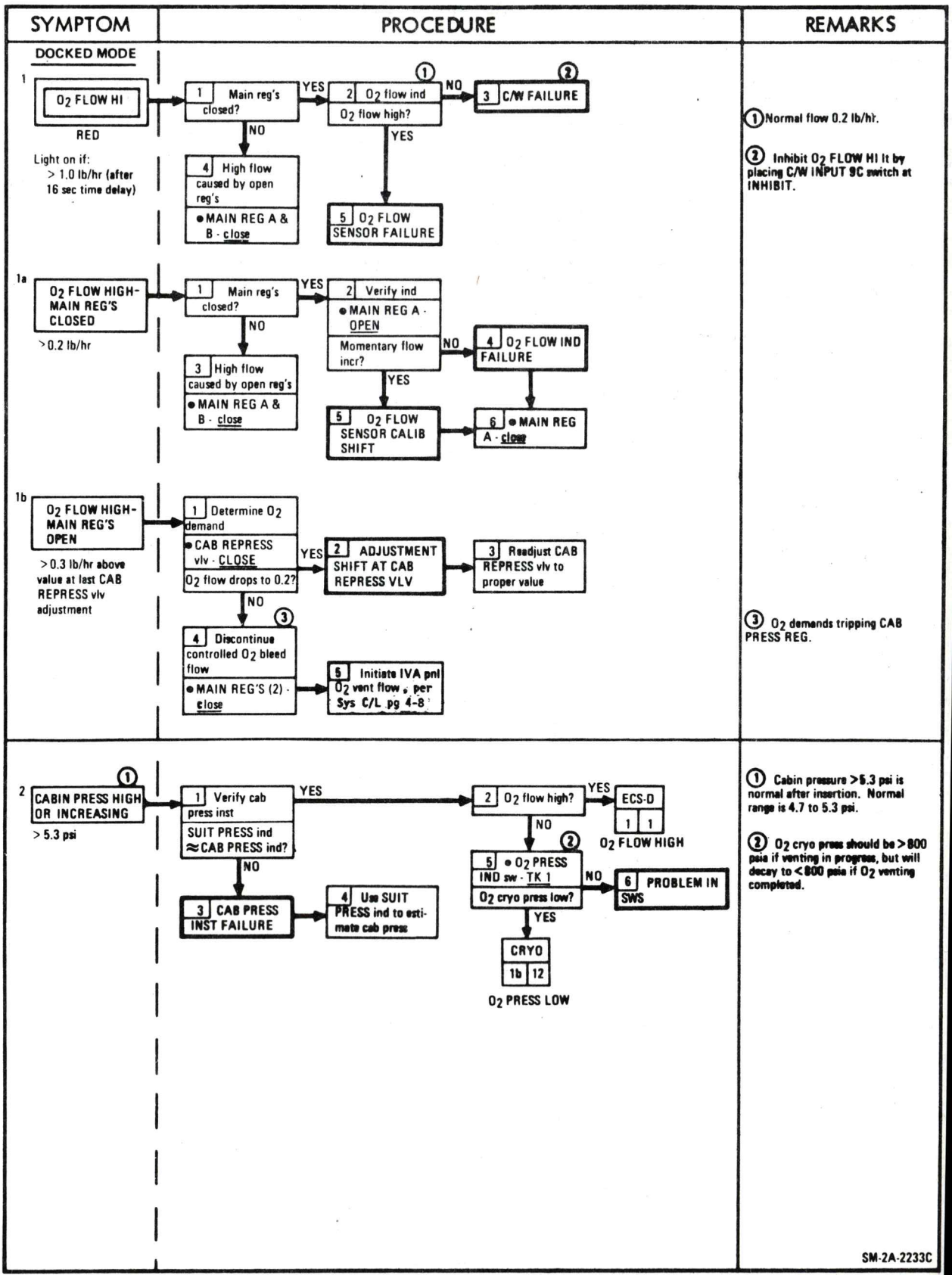
12 SEC GLY ACCUM QTY HIGH

13 SEC ECS RAD OUT TEMP HIGH

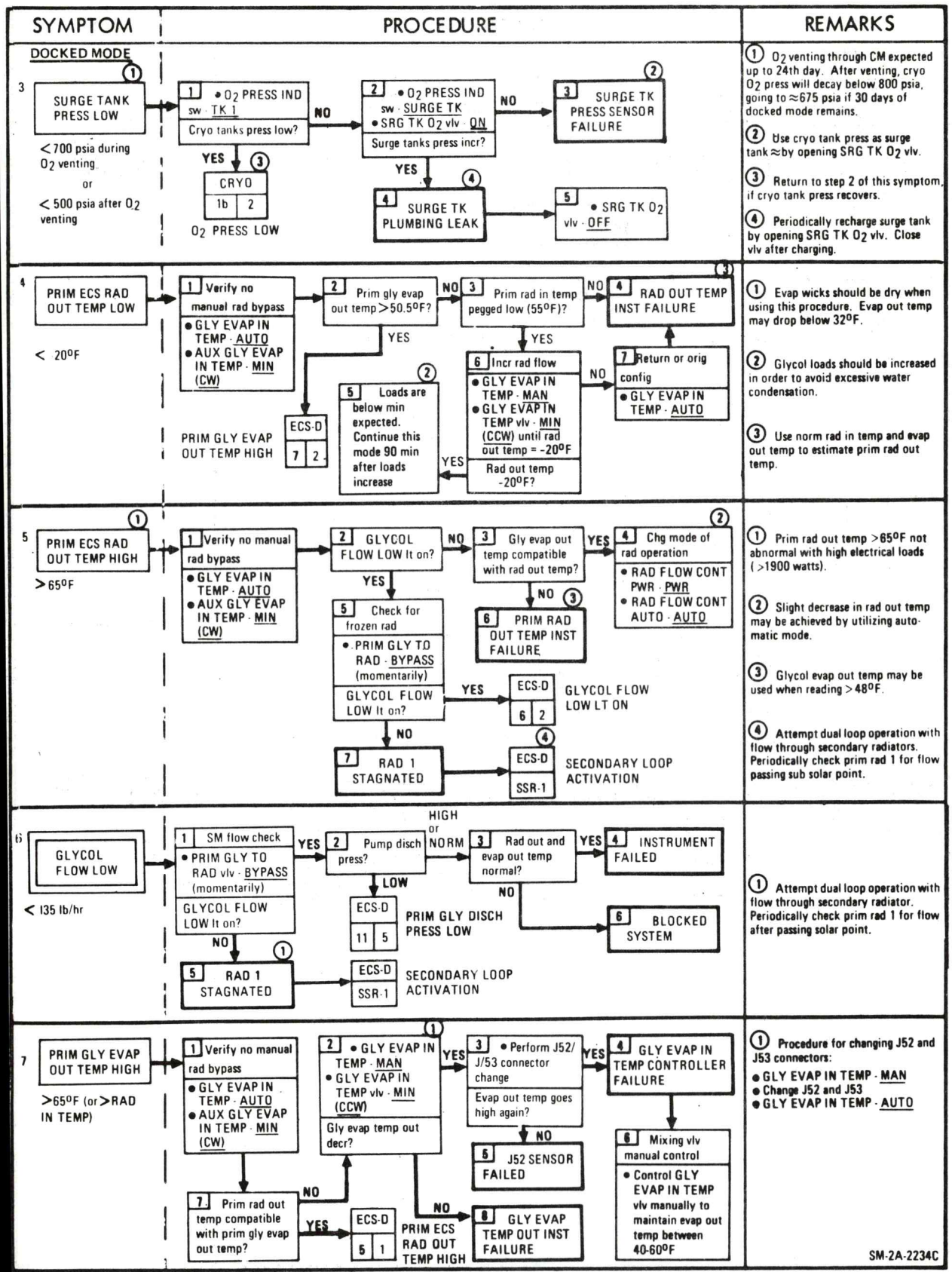
14 SEC GLY ACCUM QTY DECREASING

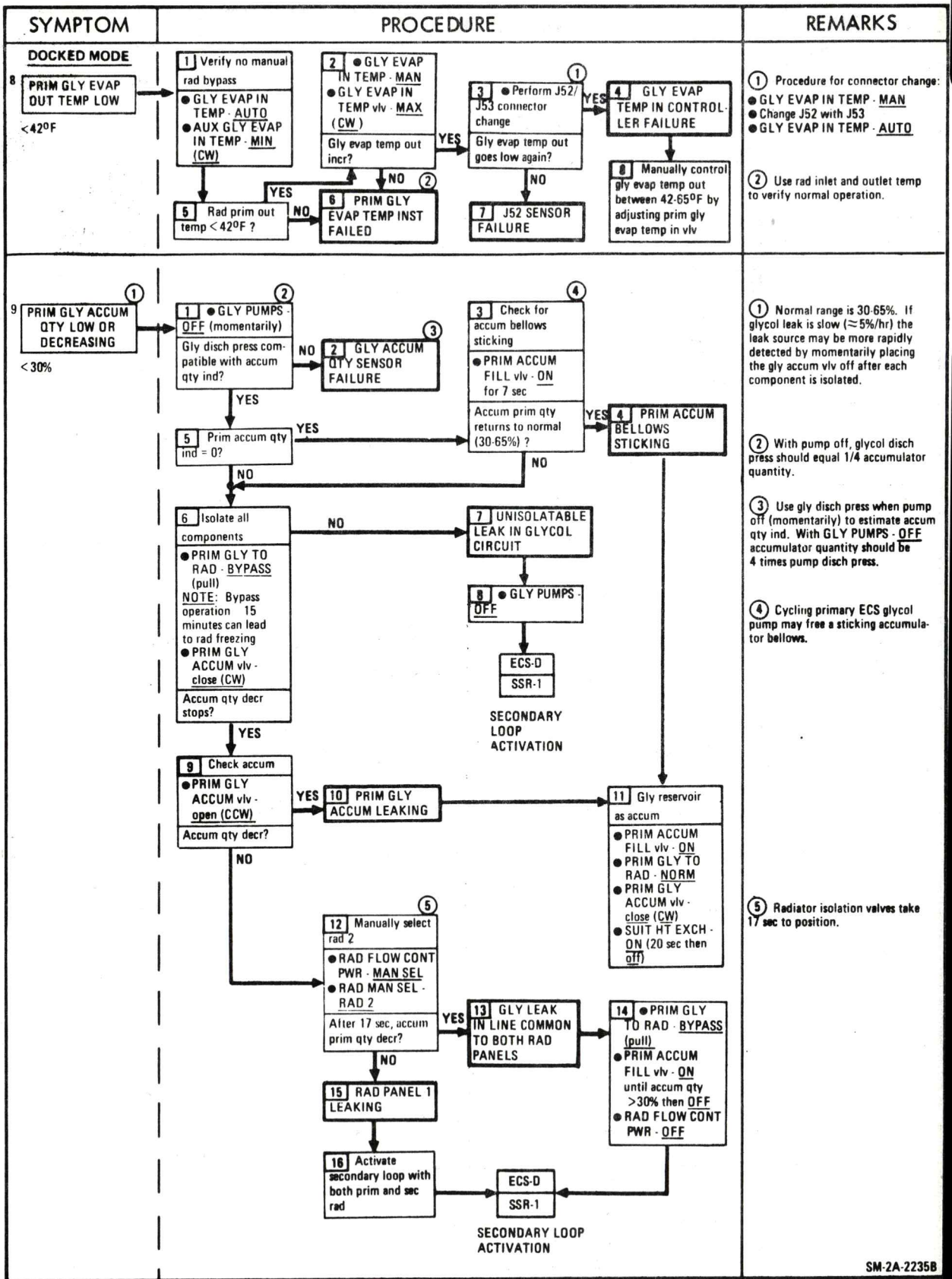
15 SEC GLY DISCH PRESS LOW

SSR-1 SEC LOOP ACTIVATION

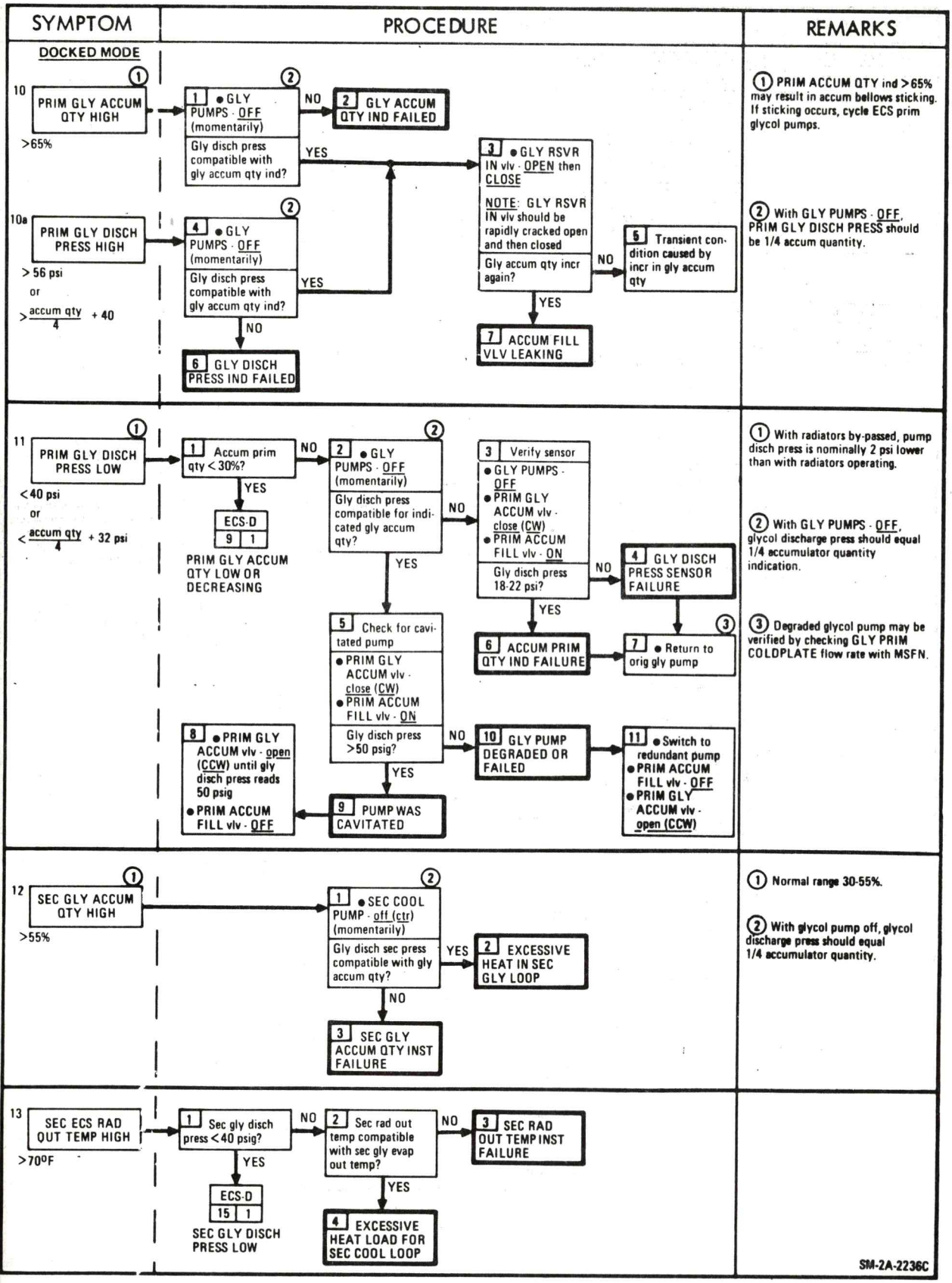

SYMPTOM
PROCEDURE
REMARKS
DOCKED MODE
1
O2 FLOW HI
RED
Light on if:
> 1.0 lb/hr (after 16 sec time delay)
1 Main reg's closed?
YES
2 O2 flow ind
O2 flow high?
NO
3 C/W FAILURE
NO
YES
4 High flow caused by open reg's
• MAIN REG A & B - close
5 O2 FLOW SENSOR FAILURE
1a
O2 FLOW HIGH-MAIN REG'S CLOSED
>0.2 lb/hr
1 Main reg's closed?
YES
2 Verify ind
• MAIN REG A - OPEN
Momentary flow incr?
NO
4 O2 FLOW IND FAILURE
NO
YES
3 High flow caused by open reg's
• MAIN REG A & B - close
5 O2 FLOW SENSOR CALIB SHIFT
6 • MAIN REG A - close
1b
O2 FLOW HIGH-MAIN REG'S OPEN
>0.3 lb/hr above value at last CAB REPRESS vlv adjustment
1 Determine O2 demand
• CAB REPRESS vlv - CLOSE
O2 flow drops to 0.2?
YES
2 ADJUSTMENT SHIFT AT CAB REPRESS VLV
3 Readjust CAB REPRESS vlv to proper value
NO
4 Discontinue controlled O2 bleed flow
• MAIN REG'S (2) - close
5 Initiate IVA pnl O2 vent flow, per Sys C/L pg 4-8
2
CABIN PRESS HIGH OR INCREASING
>5.3 psi
1 Verify cab press inst
SUIT PRESS ind ≈ CAB PRESS ind?
YES
NO
3 CAB PRESS INST FAILURE
4 Use SUIT PRESS ind to estimate cab press
2 O2 flow high?
YES
ECS-D
1 1
O2 FLOW HIGH
NO
5 • O2 PRESS IND sw - TK 1
O2 cryo press low?
NO
6 PROBLEM IN SWS
YES
CRYO
1b 12
O2 PRESS LOW
1 Normal flow 0.2 lb/hr.
2 Inhibit O2 FLOW HI lt by placing C/W INPUT 9C switch at INHIBIT.
3 O2 demands tripping CAB PRESS REG.
1 Cabin pressure >5.3 psi is normal after insertion. Normal range is 4.7 to 5.3 psi.
2 O2 cryo press should be >800 psia if venting in progress, but will decay to <800 psia if O2 venting completed.
SM-2A-2233C

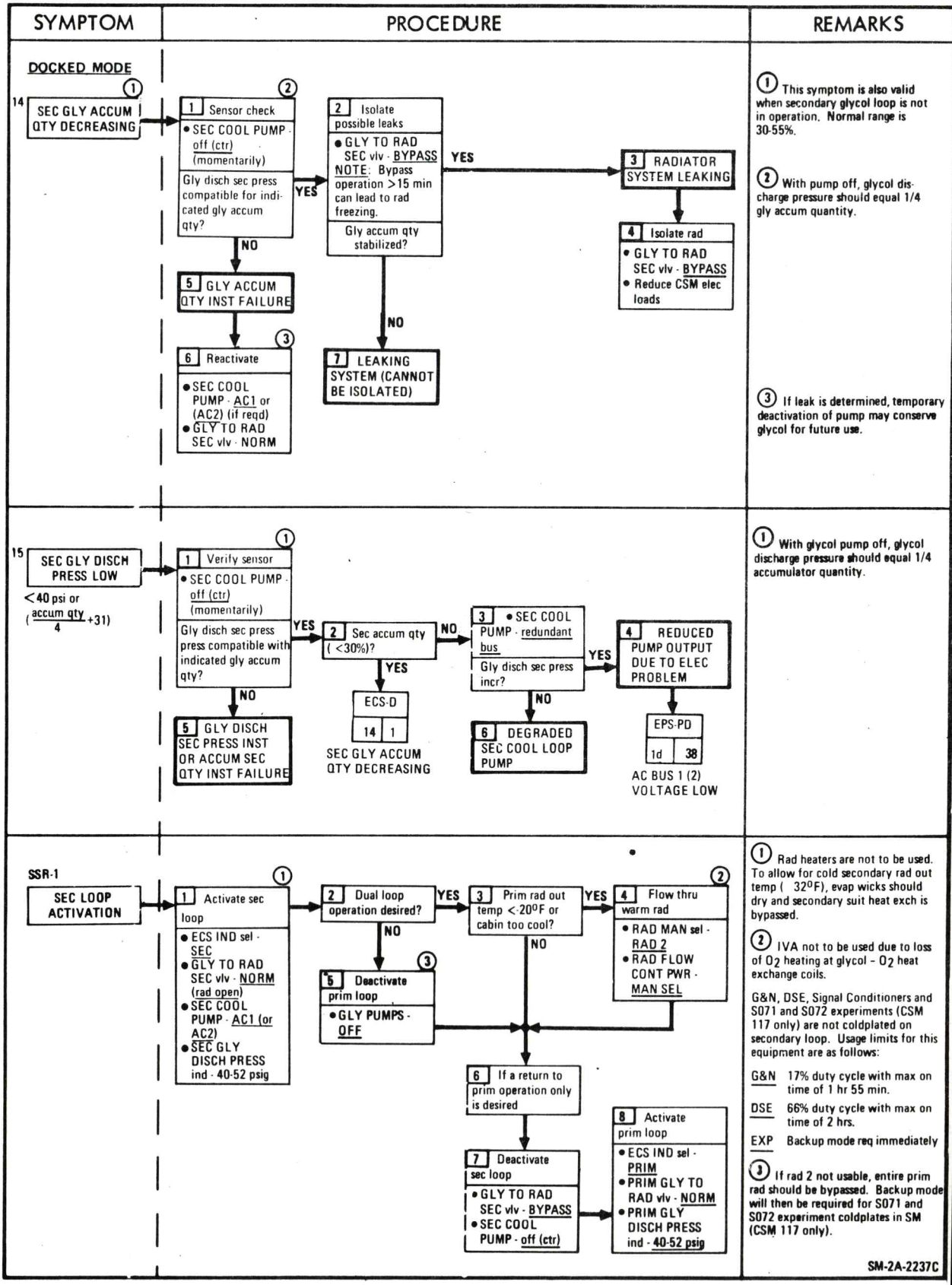
3 THRU 7


SYMPTOM
PROCEDURE
REMARKS
DOCKED MODE
3
SURGE TANK PRESS LOW
< 700 psia during O2 venting
or
< 500 psia after O2 venting
1 • O2 PRESS IND sw · TK 1
Cryo tanks press low?
NO
2 • O2 PRESS IND sw · SURGE TK • SRG TK O2 vlv · ON
Surge tanks press incr?
NO
3 SURGE TK PRESS SENSOR FAILURE
YES
3 CRYO 1b 2
O2 PRESS LOW
YES
4 SURGE TK PLUMBING LEAK
5 • SRG TK O2 vlv · OFF
1 O2 venting through CM expected up to 24th day. After venting, cryo O2 press will decay below 800 psia, going to ≈675 psia if 30 days of docked mode remains.
2 Use cryo tank press as surge tank ≈by opening SRG TK O2 vlv.
3 Return to step 2 of this symptom, if cryo tank press recovers.
4 Periodically recharge surge tank by opening SRG TK O2 vlv. Close vlv after charging.
4
PRIM ECS RAD OUT TEMP LOW
< 20°F
1 Verify no manual rad bypass • GLY EVAP IN TEMP · AUTO • AUX GLY EVAP IN TEMP · MIN (CW)
2 Prim gly evap out temp >50.5°F?
NO
3 Prim rad in temp pegged low (55°F)?
NO
4 RAD OUT TEMP INST FAILURE
YES
YES
PRIM GLY EVAP OUT TEMP HIGH
ECS-D 7 2
5 Loads are below min expected. Continue this mode 90 min after loads increase
6 Incr rad flow • GLY EVAP IN TEMP · MAN • GLY EVAP IN TEMP vlv · MIN (CCW) until rad out temp = -20°F
Rad out temp -20°F?
YES
NO
7 Return or orig config • GLY EVAP IN TEMP · AUTO
1 Evap wicks should be dry when using this procedure. Evap out temp may drop below 32°F.
2 Glycol loads should be increased in order to avoid excessive water condensation.
3 Use norm rad in temp and evap out temp to estimate prim rad out temp.
5
PRIM ECS RAD OUT TEMP HIGH
>65°F
1 Verify no manual rad bypass • GLY EVAP IN TEMP · AUTO • AUX GLY EVAP IN TEMP · MIN (CW)
2 GLYCOL FLOW LOW lt on?
NO
3 Gly evap out temp compatible with rad out temp?
YES
4 Chg mode of rad operation • RAD FLOW CONT PWR · PWR • RAD FLOW CONT AUTO · AUTO
NO
6 PRIM RAD OUT TEMP INST FAILURE
YES
5 Check for frozen rad • PRIM GLY TO RAD · BYPASS (momentarily)
GLYCOL FLOW LOW lt on?
YES
ECS-D 6 2
GLYCOL FLOW LOW LT ON
NO
7 RAD 1 STAGNATED
4 ECS-D SSR-1
SECONDARY LOOP ACTIVATION
1 Prim rad out temp >65°F not abnormal with high electrical loads (>1900 watts).
2 Slight decrease in rad out temp may be achieved by utilizing automatic mode.
3 Glycol evap out temp may be used when reading >48°F.
4 Attempt dual loop operation with flow through secondary radiators. Periodically check prim rad 1 for flow passing sub solar point.
6
GLYCOL FLOW LOW
< 135 lb/hr
1 SM flow check • PRIM GLY TO RAD vlv · BYPASS (momentarily)
GLYCOL FLOW LOW lt on?
YES
2 Pump disch press?
HIGH or NORM
3 Rad out and evap out temp normal?
YES
4 INSTRUMENT FAILED
LOW
ECS-D 11 5
PRIM GLY DISCH PRESS LOW
NO
6 BLOCKED SYSTEM
NO
1
5 RAD 1 STAGNATED
ECS-D SSR-1
SECONDARY LOOP ACTIVATION
1 Attempt dual loop operation with flow through secondary radiator. Periodically check prim rad 1 for flow after passing solar point.
7
PRIM GLY EVAP OUT TEMP HIGH
>65°F (or >RAD IN TEMP)
1 Verify no manual rad bypass • GLY EVAP IN TEMP · AUTO • AUX GLY EVAP IN TEMP · MIN (CW)
1
2 • GLY EVAP IN TEMP · MAN • GLY EVAP IN TEMP vlv · MIN (CCW)
Gly evap temp out decr?
YES
3 • Perform J52/J53 connector change
Evap out temp goes high again?
YES
4 GLY EVAP IN TEMP CONTROLLER FAILURE
NO
5 J52 SENSOR FAILED
6 Mixing vlv manual control • Control GLY EVAP IN TEMP vlv manually to maintain evap out temp between 40-60°F
7 Prim rad out temp compatible with prim gly evap out temp?
NO
YES
ECS-D 5 1
PRIM ECS RAD OUT TEMP HIGH
NO
8 GLY EVAP TEMP OUT INST FAILURE
1 Procedure for changing J52 and J53 connectors:
• GLY EVAP IN TEMP · MAN
• Change J52 and J53
• GLY EVAP IN TEMP · AUTO
SM-2A-2234C


SYMPTOM
PROCEDURE
REMARKS
DOCKED MODE
8
PRIM GLY EVAP OUT TEMP LOW
<42°F
1 Verify no manual rad bypass
● GLY EVAP IN TEMP - AUTO
● AUX GLY EVAP IN TEMP - MIN (CW)
2 ● GLY EVAP IN TEMP - MAN
● GLY EVAP IN TEMP vlv - MAX (CW)
Gly evap temp out incr?
YES
NO
3 ● Perform J52/J53 connector change
Gly evap temp out goes low again?
YES
NO
4 GLY EVAP TEMP IN CONTROLLER FAILURE
8 Manually control gly evap temp out between 42-65°F by adjusting prim gly evap temp in vlv
5 Rad prim out temp < 42°F ?
YES
NO
6 PRIM GLY EVAP TEMP INST FAILED
7 J52 SENSOR FAILURE
(1) Procedure for connector change:
● GLY EVAP IN TEMP - MAN
● Change J52 with J53
● GLY EVAP IN TEMP - AUTO
(2) Use rad inlet and outlet temp to verify normal operation.
8 THRU 9
9
PRIM GLY ACCUM QTY LOW OR DECREASING
<30%
1 ● GLY PUMPS - OFF (momentarily)
Gly disch press compatible with accum qty ind?
NO
2 GLY ACCUM QTY SENSOR FAILURE
YES
5 Prim accum qty ind = 0?
YES
NO
3 Check for accum bellows sticking
● PRIM ACCUM FILL vlv - ON for 7 sec
Accum prim qty returns to normal (30-65%) ?
YES
NO
4 PRIM ACCUM BELLOWS STICKING
6 Isolate all components
● PRIM GLY TO RAD - BYPASS (pull)
NOTE: Bypass operation 15 minutes can lead to rad freezing
● PRIM GLY ACCUM vlv - close (CW)
Accum qty decr stops?
NO
7 UNISOLATABLE LEAK IN GLYCOL CIRCUIT
8 ● GLY PUMPS - OFF
ECS-D
SSR-1
SECONDARY LOOP ACTIVATION
YES
9 Check accum
● PRIM GLY ACCUM vlv - open (CCW)
Accum qty decr?
YES
10 PRIM GLY ACCUM LEAKING
11 Gly reservoir as accum
● PRIM ACCUM FILL vlv - ON
● PRIM GLY TO RAD - NORM
● PRIM GLY ACCUM vlv - close (CW)
● SUIT HT EXCH - ON (20 sec then off)
NO
12 Manually select rad 2
● RAD FLOW CONT PWR - MAN SEL
● RAD MAN SEL - RAD 2
After 17 sec, accum prim qty decr?
YES
NO
13 GLY LEAK IN LINE COMMON TO BOTH RAD PANELS
14 ● PRIM GLY TO RAD - BYPASS (pull)
● PRIM ACCUM FILL vlv - ON until accum qty >30% then OFF
● RAD FLOW CONT PWR - OFF
15 RAD PANEL 1 LEAKING
16 Activate secondary loop with both prim and sec rad
ECS-D
SSR-1
SECONDARY LOOP ACTIVATION
(1) Normal range is 30-65%. If 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 primary ECS glycol pump may free a sticking accumulator bellows.
(5) Radiator isolation valves take 17 sec to position.
SM-2A-2235B

10 THRU 13


SYMPTOM
PROCEDURE
REMARKS
DOCKED MODE
10
PRIM GLY ACCUM QTY HIGH
>65%
1 • GLY PUMPS - OFF (momentarily)
Gly disch press compatible with gly accum qty ind?
NO
2 GLY ACCUM QTY IND FAILED
YES
3 • 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
5 Transient condition caused by incr in gly accum qty
YES
7 ACCUM FILL VLV LEAKING
10a
PRIM GLY DISCH PRESS HIGH
> 56 psi
or
> accum qty / 4 + 40
4 • GLY PUMPS - OFF (momentarily)
Gly disch press compatible with gly accum qty ind?
YES
NO
6 GLY DISCH PRESS IND FAILED
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.
11
PRIM GLY DISCH PRESS LOW
< 40 psi
or
< accum qty / 4 + 32 psi
1 Accum prim qty < 30%?
NO
YES
ECS-D 9 1
PRIM GLY ACCUM QTY LOW OR DECREASING
2 • GLY PUMPS - OFF (momentarily)
Gly disch press compatible for indicated gly accum qty?
NO
YES
3 Verify sensor
• GLY PUMPS - OFF
• PRIM GLY ACCUM vlv - close (CW)
• PRIM ACCUM FILL vlv - ON
Gly disch press 18-22 psi?
NO
4 GLY DISCH PRESS SENSOR FAILURE
YES
6 ACCUM PRIM QTY IND FAILURE
7 • Return to orig gly pump
3
5 Check for cavitated pump
• PRIM GLY ACCUM vlv - close (CW)
• PRIM ACCUM FILL vlv - ON
Gly disch press >50 psig?
NO
10 GLY PUMP DEGRADED OR FAILED
11 • Switch to redundant pump
• PRIM ACCUM FILL vlv - OFF
• PRIM GLY ACCUM vlv - open (CCW)
YES
9 PUMP WAS CAVITATED
8 • PRIM GLY ACCUM vlv - open (CCW) until gly disch press reads 50 psig
• PRIM ACCUM FILL vlv - OFF
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.
12
SEC GLY ACCUM QTY HIGH
>55%
1 • SEC COOL PUMP - off (ctr) (momentarily)
Gly disch sec press compatible with gly accum qty?
YES
2 EXCESSIVE HEAT IN SEC GLY LOOP
NO
3 SEC GLY ACCUM QTY INST FAILURE
1 Normal range 30-55%.
2 With glycol pump off, glycol discharge press should equal 1/4 accumulator quantity.
13
SEC ECS RAD OUT TEMP HIGH
>70°F
1 Sec gly disch press < 40 psig?
NO
YES
ECS-D 15 1
SEC GLY DISCH PRESS LOW
2 Sec rad out temp compatible with sec gly evap out temp?
NO
3 SEC RAD OUT TEMP INST FAILURE
YES
4 EXCESSIVE HEAT LOAD FOR SEC COOL LOOP
SM-2A-2236C


SYMPTOM
PROCEDURE
REMARKS
DOCKED MODE
14
SEC GLY ACCUM QTY DECREASING
1 Sensor check
• SEC COOL PUMP - off (ctr) (momentarily)
Gly disch sec press compatible for indicated gly accum qty?
YES
NO
2 Isolate possible leaks
• GLY TO RAD SEC vlv - BYPASS
NOTE: Bypass operation >15 min can lead to rad freezing.
Gly accum qty stabilized?
YES
NO
3 RADIATOR SYSTEM LEAKING
4 Isolate rad
• GLY TO RAD SEC vlv - BYPASS
• Reduce CSM elec loads
5 GLY ACCUM QTY INST FAILURE
6 Reactivate
• SEC COOL PUMP - AC1 or (AC2) (if reqd)
• GLY TO RAD SEC vlv - NORM
7 LEAKING SYSTEM (CANNOT BE ISOLATED)
1 This symptom is also valid when secondary glycol loop is not in operation. Normal range is 30-55%.
2 With pump off, glycol discharge pressure should equal 1/4 gly accum quantity.
3 If leak is determined, temporary deactivation of pump may conserve glycol for future use.
14 THRU SSR-1
15
SEC GLY DISCH PRESS LOW
<40 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
NO
ECS-D
14 1
SEC GLY ACCUM QTY DECREASING
3 • SEC COOL PUMP - redundant bus
Gly disch sec press incr?
YES
NO
4 REDUCED PUMP OUTPUT DUE TO ELEC PROBLEM
EPS-PD
1d 38
AC BUS 1 (2) VOLTAGE LOW
5 GLY DISCH SEC PRESS INST OR ACCUM SEC QTY INST FAILURE
6 DEGRADED SEC COOL LOOP PUMP
1 With glycol pump off, glycol discharge pressure should equal 1/4 accumulator quantity.
SSR-1
SEC LOOP ACTIVATION
1 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 - 40-52 psig
2 Dual loop operation desired?
YES
NO
3 Prim rad out temp <-20°F or cabin too cool?
YES
NO
4 Flow thru warm rad
• RAD MAN sel - RAD 2
• RAD FLOW CONT PWR - MAN SEL
5 Deactivate prim loop
• GLY PUMPS - OFF
6 If a return to prim operation only is desired
7 Deactivate sec loop
• GLY TO RAD SEC vlv - BYPASS
• SEC COOL PUMP - off (ctr)
8 Activate prim loop
• ECS IND sel - PRIM
• PRIM GLY TO RAD vlv - NORM
• PRIM GLY DISCH PRESS ind - 40-52 psig
1 Rad heaters are not to be used. To allow for cold secondary rad out temp (32°F), evap wicks should dry and secondary suit heat exch is bypassed.
2 IVA not to be used due to loss of O2 heating at glycol - O2 heat exchange coils.
G&N, DSE, Signal Conditioners and S071 and S072 experiments (CSM 117 only) 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.
EXP Backup mode req immediately
3 If rad 2 not usable, entire prim rad should be bypassed. Backup mode will then be required for S071 and S072 experiment coldplates in SM (CSM 117 only).
SM-2A-2237C

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EMS MALFUNCTIONS 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

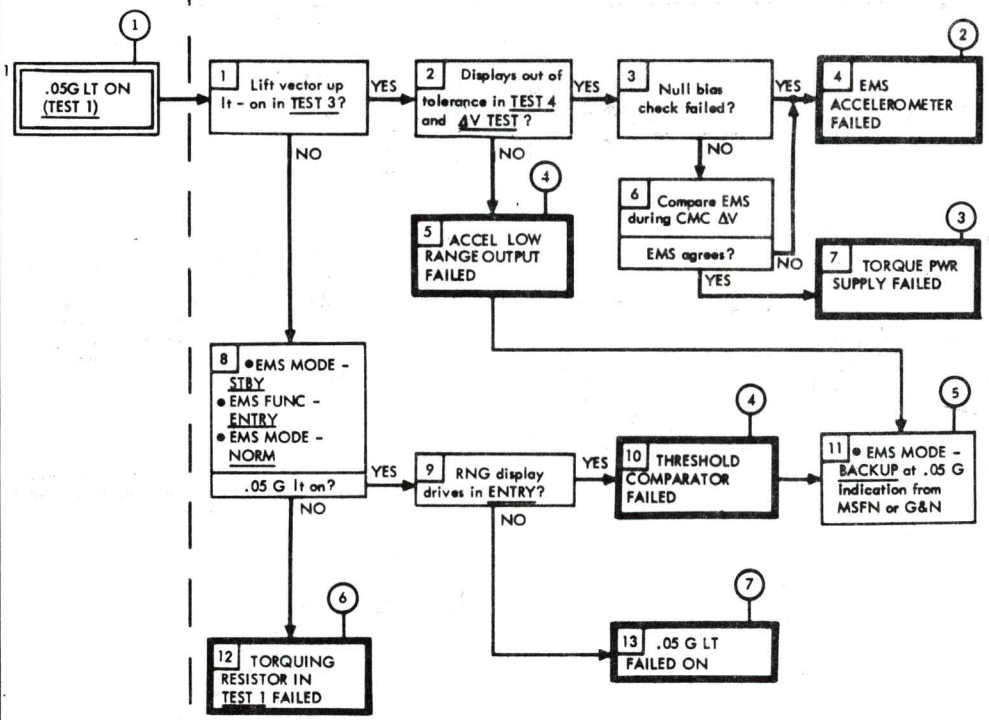
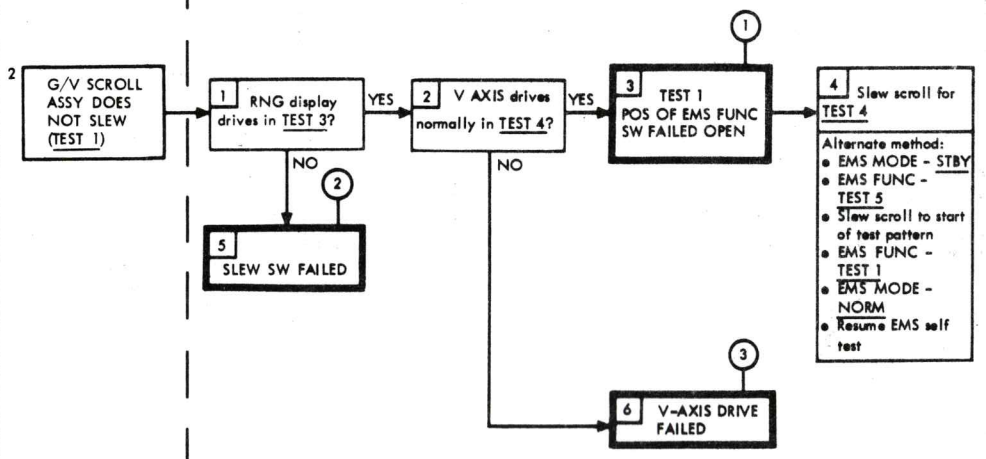
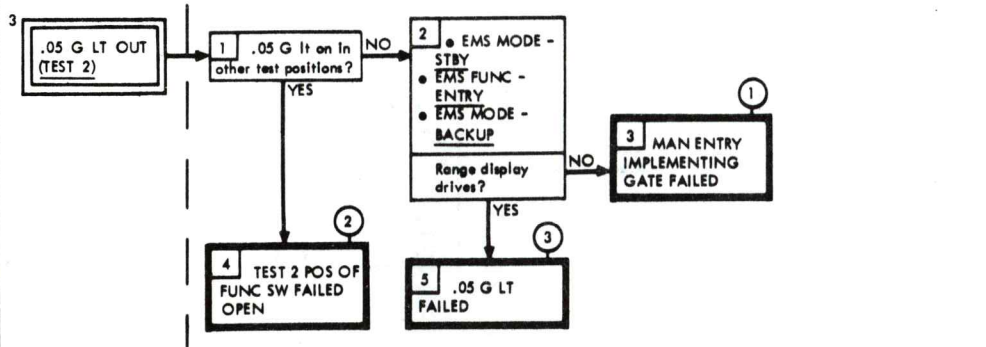
13 ΔV IND DOES NOT SLEW IN ΔV SET

14 ΔV/RNG IND FAILS TO COUNT DURING ΔV'S

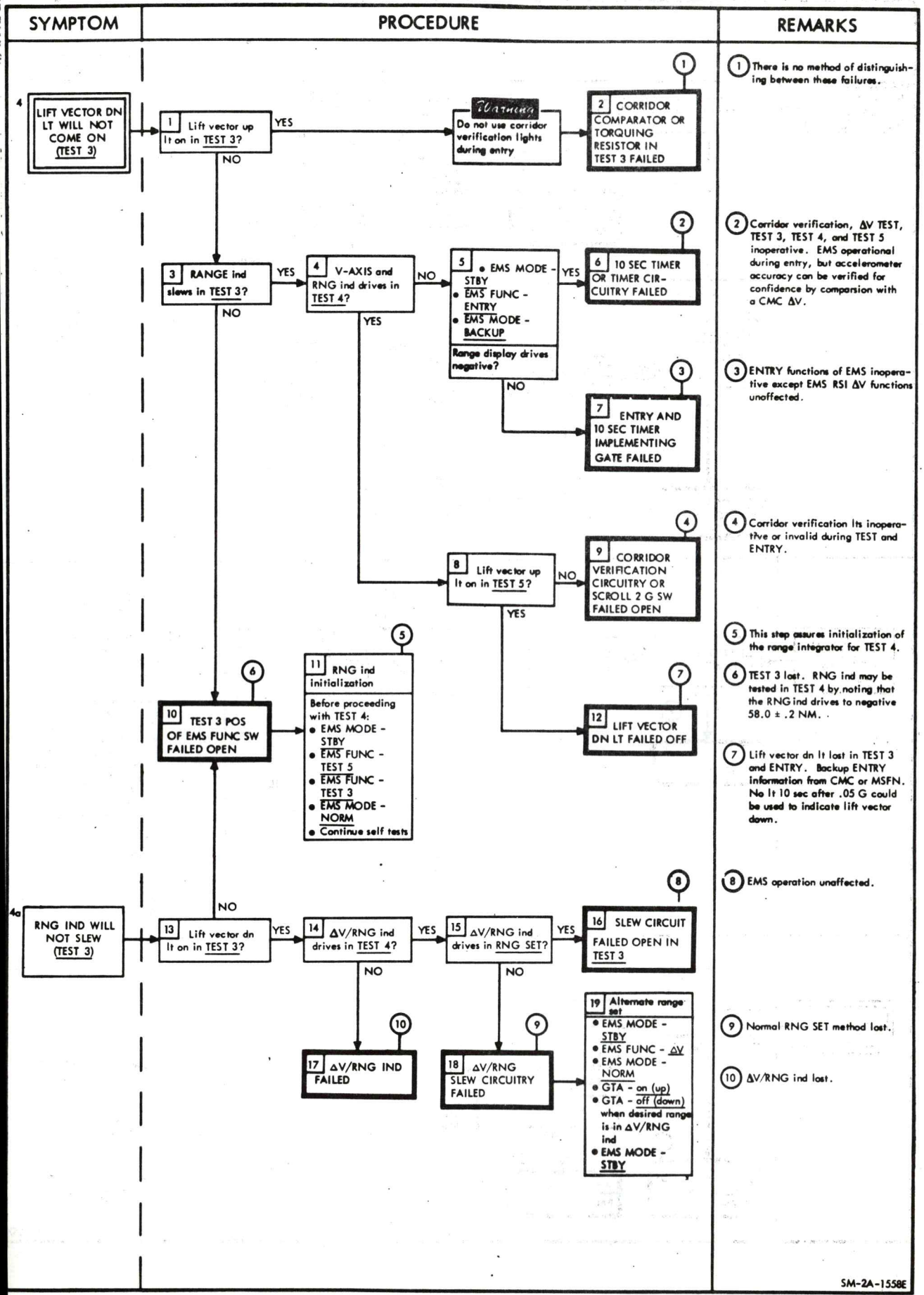
15 EITHER LIFT VECTOR LT ON AFTER 2 G

EMS

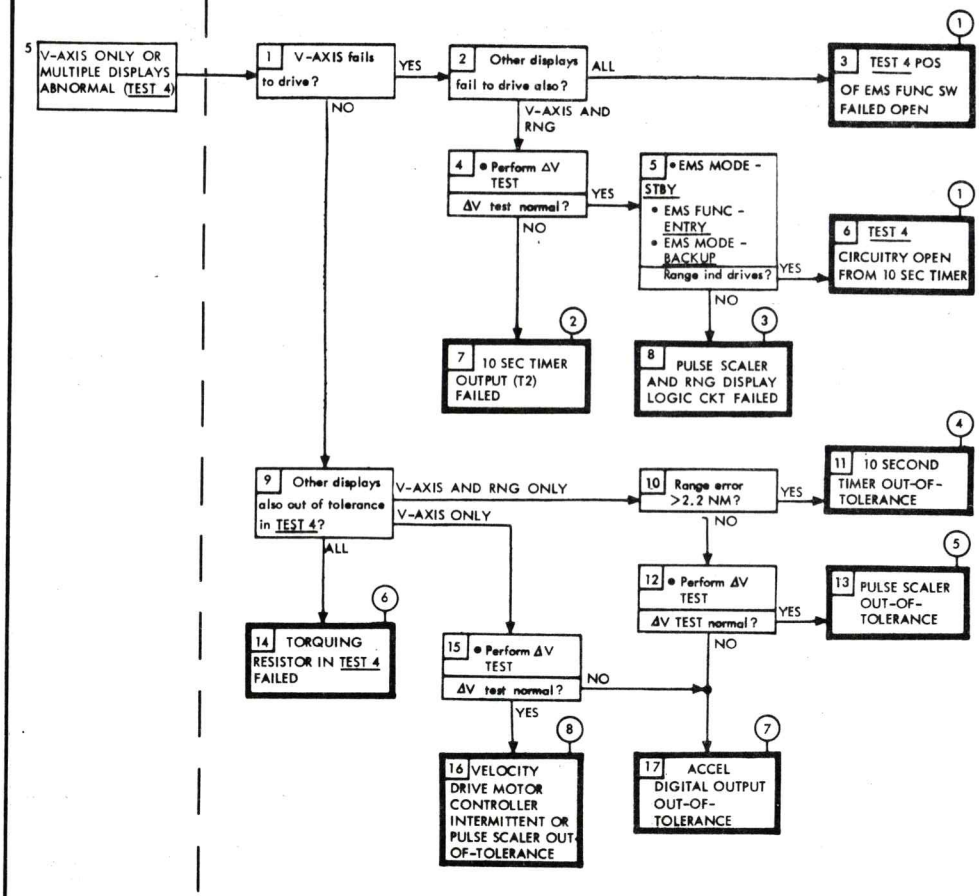
1 THRU 3

SYMPTOM	PROCEDURE	REMARKS
1 .05G LT ON (TEST 1)		(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.
2 G/V SCROLL ASSY DOES NOT SLEW (TEST 1)		(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.
3 .05 G LT OUT (TEST 2)		(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.

4 THRU 4a


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.

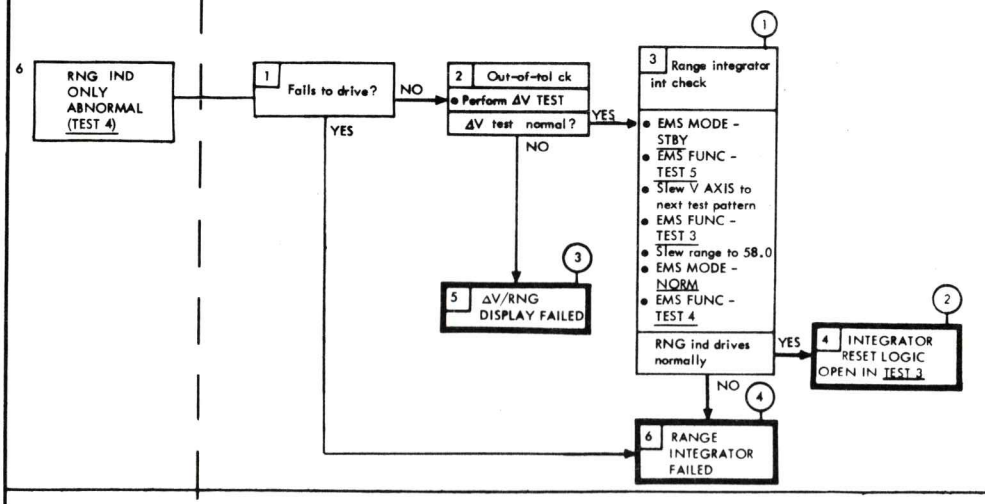
(4) This failure will invalidate the ΔV TEST and TEST 4, except the G-axis display. EMS should be operational but corridor verification erroneous during entry.

(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.

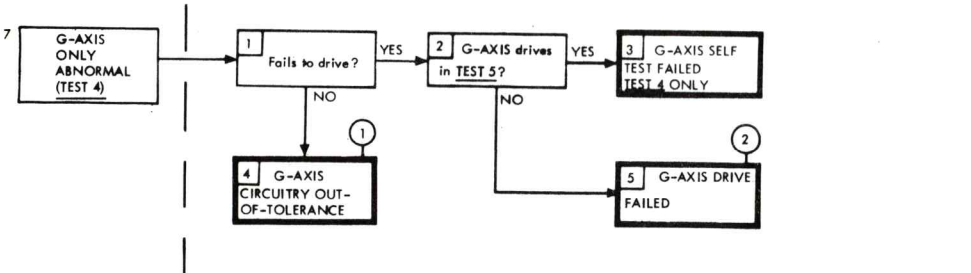


(1) This check constrained by test pattern availability.

(2) EMS ENTRY and ΔV functions unaffected.

(3) RNG and ΔV displays lost.

(4) RNG display lost.

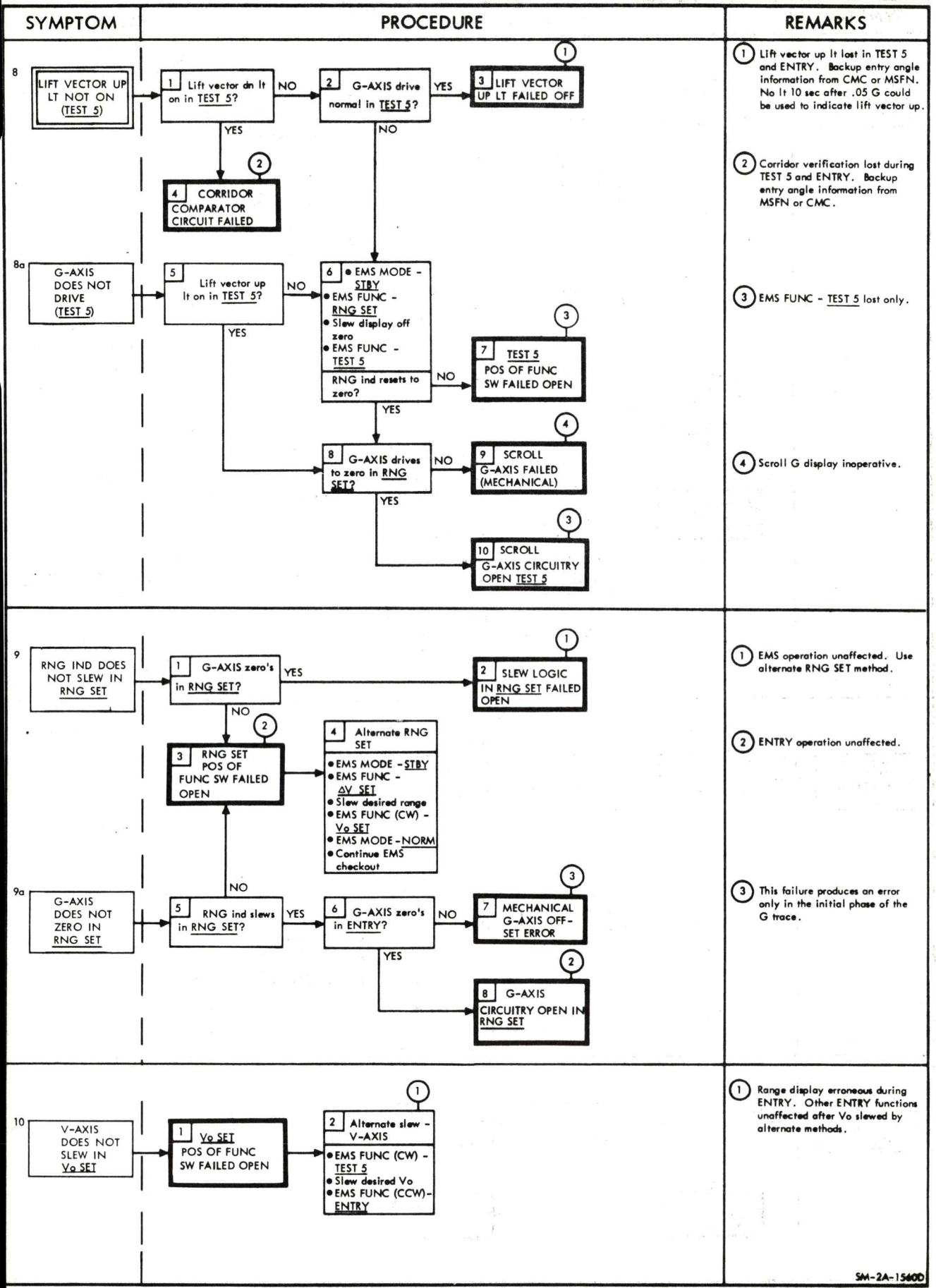


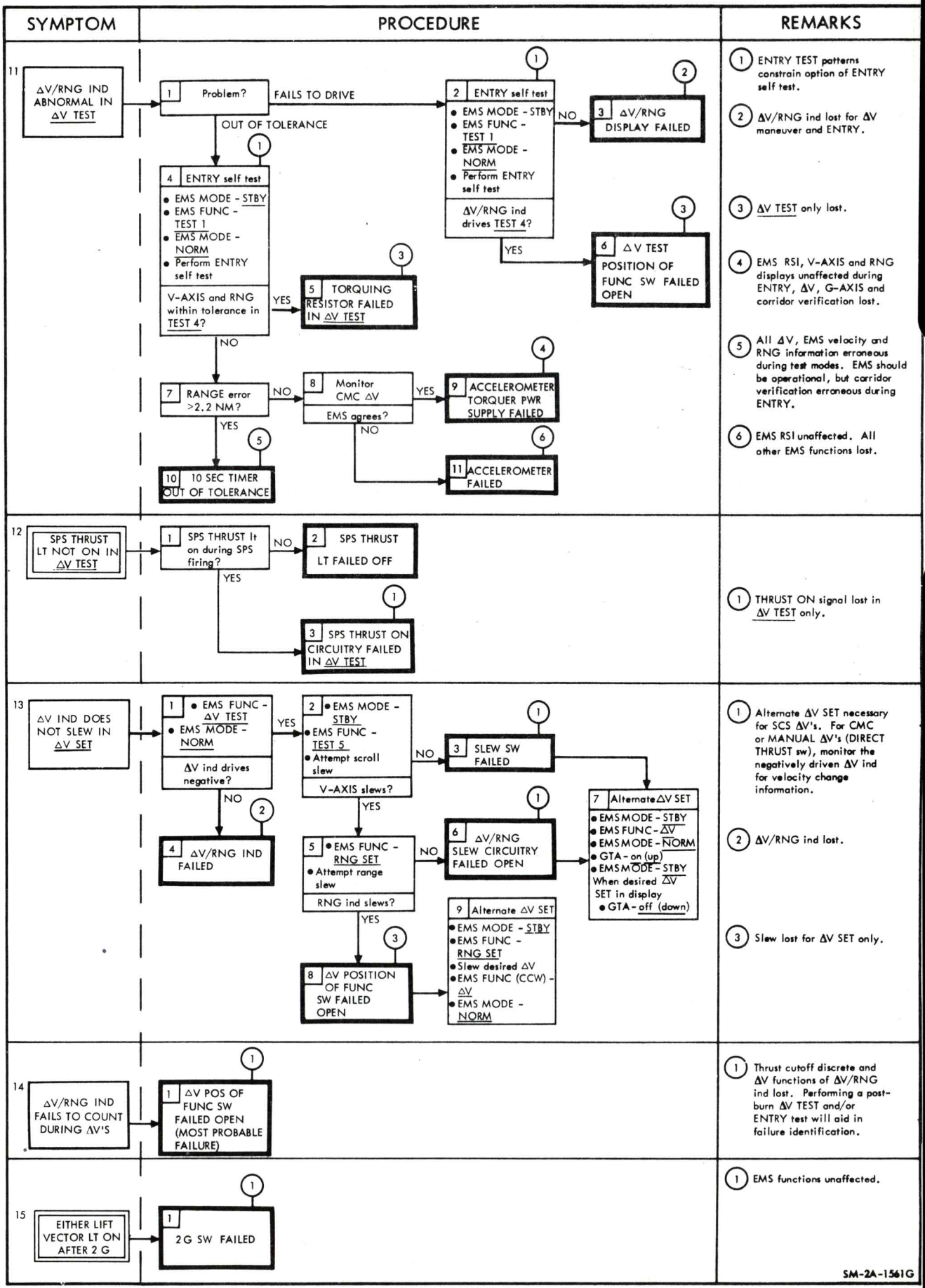
(1) Scroll G display erroneous.

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

SM-2A-155PD

8 THRU 10


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?
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
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
NO
4 ΔV/RNG IND FAILED
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.

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DOCK AND HATCH MALFUNCTIONS INDEX

SYMPTOM	PROCEDURE	REMARKS
DOCKING		
1 DOCK PROBE WILL NOT FOLD	• Verify probe support beams unloaded • Using tools F, W and 1, remove nut and bolt from one end of shock struts (3) • Connect probe umbilicals (2) (yellow) • Cock docking latches No. 1 & 3 • cb DOCK PROBE (2) - closed • cb SECS ARM (2) - closed • After MSFN AOS, SECS LOGIC (both) - on (up) • After go from MSFN, SECS PYRO ARM (2) - on (up) • PROBE EXTD/REL - RETRACT • PROBE RETRACT SEC - 1 • PROBE RETRACT (2) - off • SECS PYRO ARM (2) - off • SECS LOGIC (both) - off • cb SECS ARM (2) - open • Manually release docking latches 1 & 3 • Preload the probe • PROBE EXTD/REL - EXTD/REL for 20 sec max. • Verify extend latch indicator (red) is visible • Depress probe BLEED button (red) at intervals to allow probe to extend slowly • PROBE EXTD/REL - EXTD/REL and hold • Pull probe aft (20 lb) to release from drogue • PROBE EXTD/REL - OFF (release) • cb DOCK PROBE (2) - open • Disconnect probe umbilicals (2) (yellow) and remove probe from tunnel	
2 DOCK PROBE EXTD/REL tb A(B) REMAINS GRAY AFTER CAPTURE	1 Attempt retraction: • PROBE EXTD/REL - RETR • PROBE RETR - PRIM 1 (SEC 1) — Retraction? NO → 2 • PROBE RETR - PRIM 2 (SEC 2) — Retraction? YES → 3 PYRO OR GN_2 BOTTLE FAILURE; NO → 5 • PROBE RETR - SEC-1 (PRIM-1) → 6 (1) Troubleshoot system A(B) before removing probe as follows: • PROBE RETR (2) - OFF • cb DOCK PROBE (2) - open • Interchange probe umbilical connectors (cut cable retainers if necessary) • Cock docking latches 1 and 7 • cb DOCK PROBE (2) - close • PROBE EXTD/REL - RETR — DOCK PROBE EXTD/REL tb B(A) - gray? YES → 7 SYSTEM A (B) CIRCUIT FAILURE IN PROBE → 9 • Interchange umbilicals again • Use SEC 2 (PRIM 2) to initiate only available GN_2 bottle when required • Manually release docking latches No.'s 1 and 7; NO → 8 SYSTEM A (B) CIRCUIT FAILURE IN CSM → 10 • Use SEC-1 (PRIM 1) and SEC-2 (PRIM-2) to initiate two available GN_2 bottles when required • Manually release docking latches No.'s 1 and 7 YES → 4 tb OR tb CIRCUIT FAILURE	(1) Probe telemetry will be lost when umbilicals are interchanged.

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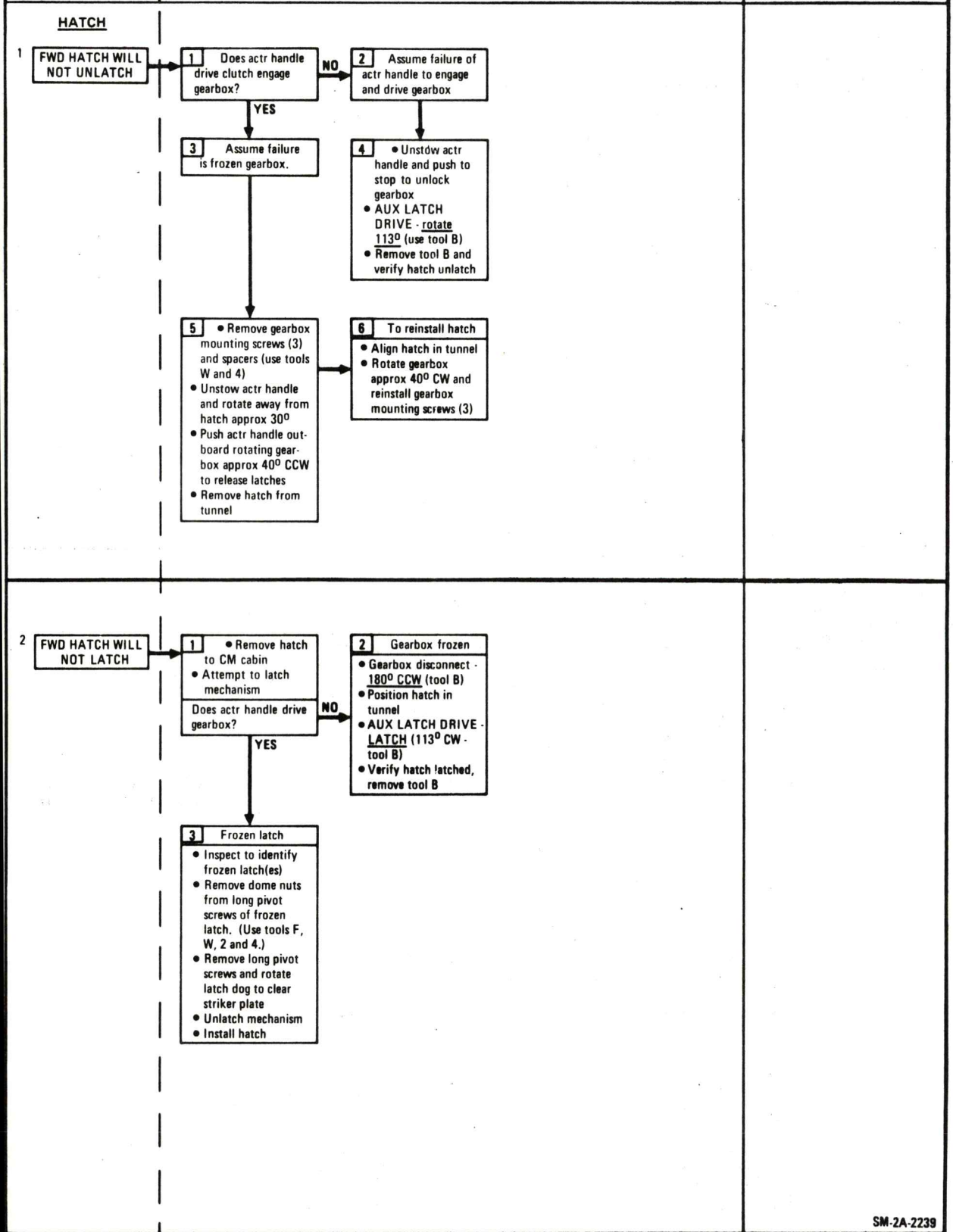
1 THRU 2

SYMPTOM	PROCEDURE	REMARKS



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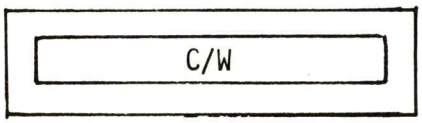
CAUTION AND WARNING MALFUNCTION INDEX

1 

RED

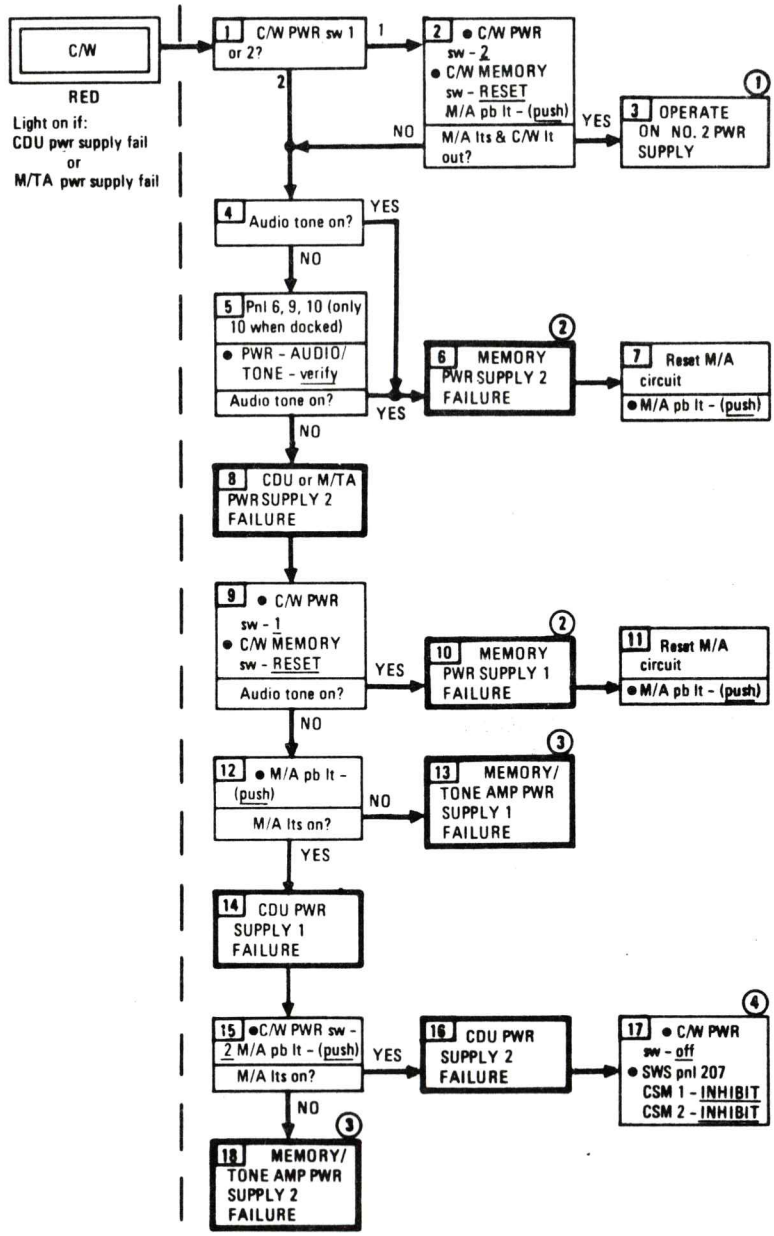
SYMPTOM	PROCEDURE	REMARKS

CAUTION AND WARNING

C/W

RED

Light on if:
CDU pwr supply fail
or
M/TA pwr supply fail



(1) C/W completely operational on redundant power supplies.

(2) Caution detection unit (CDU) and tone operational. Loss of memory operation. C/W status lt remains on. This is best failed configuration.

(3) CDU operational. Loss of memory and tone operation. C/W status lt remains on. This is best failed configuration.

(4) Loss of master alarm lts, memory, and tone.

The following status lts will be lost:

- CO_2 PP HI
- O_2 TK 1 HTR TEMP
- O_2 TK 2 HTR TEMP
- CRYO PRESS.
- GLYCOL FLOW LOW
- CM RCS 1, 2
- SM RCS PSM 1
- SM RCS A, B, C, D
- FC1 & FC3 (skin temp, cond exh temp, and ph inputs).
- INV 1 TEMP HI
- SPS PRESS.
- C/W
- SUIT COMPRESSOR

The following status lts remain operational:

- BMAG 1 & 2
- GIMBALS (4)
- F/C 1 & 3 (Reac vlvs inputs only)
- AC BUS 1 & 2 OVERLOAD
- CMC
- CREW ALERT
- MN BUS A & B UNDERVOLT
- ISS
- O_2 FLOW HI
- pH talk back ind

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C/W

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