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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO OPERATIONS HANDBOOK, EXTRAVEHICULAR MOBILITY UNIT

VOLUME II, OPERATIONAL PROCEDURES, CSD-A-789-(2), MISSIONS 12 through 15

CREW SYSTEMS DIVISION

Original Issue May 1969

Revision 1

October 1969



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

INDEXING DATA

| DATE | OPR | # | T | PGM | SUBJECT | SIGNATOR | LOC |
|----------|-----|---|---|-----|---------|----------|--------|
| 10-00-69 | MSC | | R | 501 | (title) | MSC | 072-11 |

Manned Spacecraft Center
Crew Systems Division

PROJECT DOCUMENT COVER SHEET

| | |
|--|------------------|
| APOLLO OPERATIONS HANDBOOK EXTRAVEHICULAR MOBILITY UNIT VOLUME II — OPERATIONAL PROCEDURES | |
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NO. OF PAGES 109

| | | REVISIONS | | | REV. LETTER |
|------|-------------|-----------|----------|----------------|-------------|
| DATE | PREPARED BY | APPROVALS | | | |
| | | BRANCH | DIVISION | PROGRAM OFFICE | |
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PREFACE

This document is the first revised issue of Volume II of the AOH. This revision incorporates Crew Procedures Change Requests 1 through 53. Change requests released subsequent to the publication of this revision will be numbered sequentially with the next change number (i.e., 54 and on).

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FOREWORD

This handbook, sections 4 and 5, of the Apollo Operations Handbook (AOH) series, is bound separately as Volume II and pertains only to the Extravehicular Mobility Unit (EMU). Volume I of the AOH contains sections 1, 2, and 3, and pertains to the description of the EMU.

The operational procedures are written specifically for Missions 12 through 15 EMU hardware and will be superseded by a mission oriented checklist which is reviewed by CSD for unique hardware procedures. Both the operational procedures and the malfunction procedures will be updated for the mission.

This handbook is composed of two major sections:

- a. Section 4 provides a step-by-step operational procedure for activation and deactivation of EMU subsystems.
- b. Section 5 provides emergency procedures for critical EMU symptoms and continuing diagnosis during EVA and post-EVA to determine the EMU malfunction.

Inquiries concerning this handbook should be addressed to Crew Systems Division, Apollo Support Branch, MSC, mail code EC9 or to Flight Crew Support Division, EVA Branch, Office Code CF25.

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ABBREVIATIONS

| | |
|------------------------|---|
| acfm | actual cubic feet per minute |
| AOH | Apollo Operations Handbook |
| CDR | Commander |
| cfm | cubic feet per minute |
| CM | command module |
| CMP | command module pilot |
| CSM | command/service module |
| CWG | constant wear garment |
| "DES" H ₂ O | descent water |
| ECG | electrocardiogram |
| ECS | environmental control system |
| EMU | extravehicular mobility unit |
| EV | extravehicular |
| LEVA | lunar extravehicular visor assembly |
| FCS | fecal containment system |
| ITMG | integrated thermal micrometeoroid garment |
| IV | intravehicular |
| IVA | intravehicular activity |
| kHz | kilohertz (thousand cycles per second) |
| LCG | liquid cooling garment |
| LiOH | lithium hydroxide |
| LM | lunar module |
| MSFN | Manned Space Flight Network |
| OPS | oxygen purge system |
| PGA | pressure garment assembly |

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| | |
|------------|--|
| PHA | pressure helmet assembly |
| PLSS | portable life support system |
| pos. | position |
| POS | primary oxygen system of PLSS |
| press. | pressure |
| psia | pounds per square inch absolute |
| psid | pounds per square inch differential |
| psig | pounds per square inch gage |
| RCU | remote control unit |
| SC | spacecraft |
| SSC | space suit communication |
| SW. | switch |
| TLSA | torso limb suit assembly |
| TM | telemetry |
| UCTA | urine collection and transfer assembly |
| UTS | urine transfer system |
| vlv | valve |
| WMS | waste management system |
| ZPN | impedance pneumograph |
| ΔT | change in temperature |
| ΔP | change in pressure |

SECTION 4

OPERATIONAL PROCEDURES

This section describes the procedures for activation and deactivation of EMU equipment.

The order of appearance of groups of steps required to activate or deactivate components is not necessarily the order of performance of activation and deactivation of components.

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| STEP | PROCEDURE | REMARKS |
|------|---|---|
| 4.1 | PGA DONNING AND DOFFING 4.1.1 PGA IV CONFIGURATION DONNING PROCEDURES 1 Donning FCS a. Don FCS as conventional underwear and place genitals through front opening. b. Position FCS around waist and thighs to insure a seal. Insure a snug fit with no sag in the crotch portion of the FCS. 2 Donning CWG a. Open front buttons. b. Don CWG as conventional long underwear. c. Adjust feet into socks. | Techniques in donning and doffing may vary within an individual step but the sequence of steps outline in each donning and doffing task shall be followed. "Normal" will be with assist from another crewman. CMP only. |

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4.1 PGA DONNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|------|---|--|
| d. | Insert bioinstrumentation leads through slots on chest area of CWG. | Step 4.1.1-3 must be performed before Steps 4.1.1-2d and e. When transferring bioinstrumentation between CWG or LCG, or when reinstalling after removal, the signal conditioners should not be removed from the pockets in the biobelt. Only the nine-pin airlock connector, the sternal electrode harness (Blue Code), and the axillary harness (Yellow Code) should be disconnected. The color code of the harness to signal conditioner should be observed when reinstalling the biobelt. The electrodes are <u>not</u> removed from skin to change garments. |
| e. | Button front opening. | |

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| 3 | <p>Donning bioinstrumentation system (prelaunch)</p> <ol style="list-style-type: none"> a. Shave electrode sites where necessary. Shower after shaving. b. During PGA suiting procedure prior to launch, clean electrode sites with alcohol and let dry. Attach electrodes under medical direction. c. Assemble signal conditioners, biomedical harness with biomedical belt, and test as a system. d. Don top half of CWG, insert harness connectors (blue and yellow) through holes in CWG. Snap biomedical belt to CWG. e. Connect electrode harness to proper color-coded signal conditioner. Dot on electrode harness is facing out. f. Perform functional check. g. Adjust ECG gain for normal signal to 40 percent of full scale. h. Adjust ZPN gain to allow maximum inhalation to be at or near full scale. | <p>CWG is donned to waist.</p> <p>Use caution in mating biomedical connector to signal conditioners. Connectors are keyed for proper fit.</p> <p>See remarks page 4-3, Step 4.1.1-2d.</p> |

4.1 PGA DONNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|--|
| i. | Don lower half of PGA (Step 4.1-5) and connect nine-pin biomedical connector. | See remarks page 4-3, Step 4.1.1-2d. |
| j. | Perform functional check prior to donning PGA helmet and gloves. | |
| 4 | Donning UCTA | |
| a. | Obtain proper size cuff and roll down to cuff flange after removing flange from UCTA. | If the UCTA has been worn, it will be stowed in the PGA with a UCTA clamp on the cuff. Remove and stow the UCTA clamp. |
| b. | Place penis in flange and roll cuff on. | |
| c. | Attach cuff half of the UCTA flange to the UCTA by depressing the flange release lever and twisting the two halves together. | |
| d. | Align the colored waistband patches to the corresponding colors on the UCTA. | Place waistband of harness across "small of the back." |
| e. | Attach the crotch strap to the UCTA. | Strap length can be adjusted at mating point. Verify all straps attached. |
| f. | Connect hand pump to drain hose and evacuate all gas from the UCTA through the drain hose. | This step is required for donning at 14.7 psia ambient pressure only — not required for 5 psia donning. |
| g. | Don leg part of the PGA. | |

| STEP | PROCEDURE | REMARKS |
|---|-----------|---|
| <p>h. Connect the UCTA drain hose to the UCTA transfer hose assembly on the suit.</p> <p>i. Finish donning PGA.</p> <p>5 Donning PGA</p> <p>a. Remove protective cover from PGA electrical connector and two protective plugs from gas connectors and stow.</p> <p>b. Loosen torso tiedown strap.</p> <p>c. Fully open both the restraint and pressure-sealing zippers.</p> <p>d. Grasp PGA at sides. Do NOT pick up PGA at pressure-sealing zipper location. Place both feet into PGA and work feet into the boots.</p> <p>e. Pull excess liner material up around leg. Grab PGA at knee convolutes and pull boots onto feet.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not sit on zippers.</p> <p>f. Pull PGA to knee position.</p> | | <p>Do not coil or loop the drain hose. Do not put hose near the PGA biomedical injection patch.</p> <p>Remove donning lanyards from UCTA/biomedical injection access flap.</p> <p>If unassisted, insert the red suit-donning lanyard through the pull tab of restraint zipper slider and the blue suit-donning lanyard through the pull tab of pressure-sealing zipper slider.</p> <p>Point toes toward boots to avoid pickup of excess liner material.</p> |

4.1 PGA DONNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|---|--|---------|
| g. With front of PGA hanging forward, go to squatting position placing PGA front in lap. h. Reach inside of right leg and connect UCTA quick-disconnect to PGA-UCTA hose assembly. i. Aline index marks and connect biomedical harness electrical branch to suit electrical harness. j. Verify communications carrier connection from electrical harness is pushed through neckring. k. Insert one arm completely into PGA arm while simultaneously inserting head into neckring with assistance from free arm. Insert free arm into other PGA arm. l. Stand erect to permit PGA to settle over torso and limbs. m. Close restraint and pressure-sealing zipper closures. | Alternate methods such as full insertion of arms into suit sleeves, then insertion of head through neckring, or insertion of one arm, then the combined insertion of second arm and head are acceptable, provided the load on the PGA, and/or the zippers is not increased. If unassisted, grasp back of neckring and top of CWG with one hand. With other hand, grasp red donning lanyard, pull out and down to position restraint zipper slider toward middle of the back. Pull red donning lanyard over buttocks while running fingers ahead of slider to prevent snagging of CWG. | |

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| STEP | PROCEDURE | REMARKS |
|---|---|---------|
| <p>n. Engage snap fastener of slider tab to receptacle on PGA.</p> <p>Position lock assembly over slider and push lock button to LOCK.</p> <p>Close cover flap over zipper and engage snap fasteners.</p> <p>o. Don communication carrier by spreading the ear cups and then make fine adjustments to the mike boom by bending it from the center.</p> <p>Adjust the chinstrap for proper fit.</p> <p>p. Connect electrical lead to upper branch of electrical harness.</p> | <p>Grasp cloth tab of restraint slider and fully close.</p> <p>Remove suit-donning lanyard, tuck slider tab up into PGA, and stow lanyard in pocket.</p> <p>Grasp back of neckring with one hand and with other hand grasp blue donning lanyard; pull lanyard out and down to fully close pressure-sealing zipper.</p> <p>Remove and stow blue suit donning lanyard.</p> <p>Do not bend mike boom more than 80° from center. Bend mike boom from the middle section only. Do not straighten or bend the mike boom unless necessary.</p> | |

4.1 PGA DONNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| 6 | <p>q. Connect gas umbilical to PGA.</p> <p>r. Provide ventilation flow.</p> <p>6 Donning pressure helmet</p> <p>a. Place helmet-attaching ring lock subassembly in ENGAGE.</p> <p>b. Place pressure helmet on helmet-attaching ring, insure proper alinement by alining dual white lines and press down on helmet.</p> <p>c. Position lock subassembly to LOCK.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>PGA neckring alinement marks must be alined with the helmet "locked" alinement marks to insure proper helmet ventilation.</p> <p>7 Donning PGA gloves</p> <p>a. Gloves or helmet may be difficult to don. If so, stop gas flow momentarily.</p> <p>b. Place suit wrist disconnects in ENGAGE.</p> <p>c. Insure that glove palm restraint is loosened, then place hand into glove.</p> | <p>Steps 4.1.1-6 and -7 can be reversed provided the second step is accomplished with decreased gas flow.</p> |

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| | <ul style="list-style-type: none">d. Aline glove wrist disconnect with suit wrist disconnect and engage both units.e. Insure that glove can be easily rotated and place the wrist disconnect to LOCK.f. Adjust glove palm restraint.g. Don other glove in the same way. | |
| 8 | <p><u>Donning Neckdam</u></p> <ul style="list-style-type: none">1 Place helmet-attaching ring lock assembly in ENGAGE position.2 Slip neckdam over head so that eyelet tab is forward.3 Aline neckdam ring eyelet tab with index marks on helmet-attaching ring and snap tab in place.4 Continue pushing other tabs down into place until all tabs of neckdam are latched.5 Place the lock assembly into LOCK. | <p>The neckdam is donned before water egress to prevent water from entering the open neck area of the TLSA.</p> |

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| STEP | PROCEDURE | REMARKS |
|-------|--|--|
| 4.1.2 | <p>PGA IV CONFIGURATION DOFFING PROCEDURE</p> <ol style="list-style-type: none">1 Doffing PGA gloves<ol style="list-style-type: none">a. Decrease suit pressure to less than 0.75 psig.b. Loosen palm restraint.c. Place wrist disconnect in open position and remove glove.d. Doff other glove.2 Doffing pressure helmet<ol style="list-style-type: none">a. Place helmet attaching ring latching mechanism to the open position.b. Lift the helmet up and out of helmet attaching ring.3 Doffing PGA<ol style="list-style-type: none">a. Empty UCTA. (See AOH-IM and - CSM procedures.)b. Open slide zipper cover flap. | <p>Unlock pressure sealing zipper lock and release slider tab snap fastener.</p> |

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| c. | <p>Fully open pressure and sealing zippers.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not sit on zippers.</p> | <p>If unassisted, remove blue donning lanyard from lanyard pocket and insert into pressure sealing zipper tab. Grasp blue suit-donning lanyard and pull until the pressure-sealing zipper tab is full OPEN and remove suit-donning lanyard.</p> <p>Remove red suit-donning lanyard from lanyard pocket; release restraint zipper tab from stowed position; and insert lanyard in zipper tab.</p> <p>Grasp red suit-donning lanyard; pull until restraint zipper is full OPEN; and remove lanyard. Restow red and blue lanyards.</p> |
| d. | <p>Disconnect gas inlet and outlet hoses.</p> | |
| e. | <p>Disconnect communications carrier electrical lead and undo chinstrap to remove communication carrier. Remove communications carrier carefully. Do NOT bend mike boom.</p> | |
| f. | <p>Grasp PGA at rear-entry area and separate slide fasteners; then slip PGA from around back and buttocks.</p> | |
| g. | <p>Grasp helmet-attaching ring, slip head out, and pull both arms away from PGA.</p> | |
| h. | <p>Disconnect biomedical connector.</p> | |
| i. | <p>Disconnect UCTA drain hose quick-disconnect. (See Step 4.1.2-4.)</p> | |

4.1 PGA DONNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| | j. Remove legs from TLSA. k. Replace protective covers and caps on PGA electrical connector and two gas connectors. | |

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| 4 | <p>Doffing UCTA</p> <ol style="list-style-type: none"> a. Drain UCTA before doffing. (See AOH-LM and -CSM procedures.) b. Partially doff PGA to disconnect the UCTA drain hose disconnect. c. Disconnect UCTA drain hose from suit-mounted UCTA transfer hose assembly. d. Complete doffing of PGA. e. Remove UCTA elastic harness by detaching waistband Velcro patches while holding UCTA in place. f. Remove cuff half of UCTA flange by using release button and twisting motion. g. Roll cuff from penis. h. Fold cuff and use UCTA clamp to close. i. Stow UCTA in PGA. | |
| 5 | <p>Doffing biomedical harness and belt</p> <ol style="list-style-type: none"> a. Disconnect electrical leads of biomedical electrode harness from signal conditioners in biomedical belt. b. Disengage snaps securing biomedical belt. | <p>See page 4-3, Step 4.1.1-2d.</p> <p>See Step 4.8.2-3 for permanent removal procedures, if necessary.</p> |

4.1 PGA DONNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| 6 | Doffing CWG (if applicable) a. Unbutton front opening. b. Pass bioinstrumentation electrode harness leads through slot on chest area of CWG. c. Remove CWG in the same manner as conventional long underwear. | The CWG without the FCS is normally worn throughout the flight. See remarks page 4-3, Step 4.1.1-2d. |
| 7 | Doffing FCS Doff FCS in the same manner as conventional underwear shorts. | |
| 8 | Doffing neckdam a. Unlock helmet-attaching ring and separate neckdam. b. Pull neckdam over head. | The neckdam is used only for water egress. |

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| STEP | PROCEDURE | REMARKS |
|---|-----------|---|
| 4.1.3 PGA EV CONFIGURATION DONNING PROCEDURE 1 Donning FCS (see Step 4.1.1-1) 2 Donning LCG <u>CAUTION</u> Take care to avoid damaging LCG H ₂ O lines. a. Unstow LCG from bag. b. Open front entry fastener of LCG. c. Don the LCG like conventional long underwear and adjust feet into socks. d. Insert bioinstrumentation leads through holes on front of LCG. e. Close front entry of LCG. 3 Donning bioinstrumentation systems (see Step 4.1.1-5) 4 Donning UCTA (see Step 4.1.1-4) 5 Donning PGA a. Remove one PGA electrical connector cover and four PGA gas connector caps. | | The LCG replaces the CWG for EVA. The LCG may be worn during periods of IVA. See remarks page 4-3, Step 4.1.1-2d. Verify that LCG manifold is outside of biobelt. |

4.1 PGA DONNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| | <p>b. Loosen torso tiedown strap.</p> <p>c. Fully open the restraint, pressure sealing, and ITMG zippers.</p> <p>d. Grasp PGA at sides.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do NOT pick up PGA at pressure-sealing zipper location.</p> <p>Place both feet into PGA and work feet into the boots. Pull excess liner material up around legs.</p> <p>Grab PGA at knee convolutes and pull boots onto feet.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not sit on zippers.</p> <p>Pull PGA tight to knee position. Stand up. Grasp side of coverlayer and pull to waist position with zipper below buttocks.</p> | <p>If alternate method of donning is to be used, unstow donning lanyards and attach after opening zippers. Insert red suit-donning lanyard through pull tab of restraint zipper slider and blue suit-donning lanyard through pull tab of pressure-sealing zipper slider.</p> <p>Point toes toward boots to avoid pickup of excess liner material.</p> |

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| k. | <p>Stand erect and settle PGA over torso and limbs.</p> <p>1. Close restraint and pressure-sealing zipper closures.</p> <p>m. Engage snap fastener of slider tab to receptacle on PGA.</p> <p>Position lock assembly over slider and push lock button to LOCK.</p> <p>Close cover flap over zipper and engage fasteners.</p> | <p>If unassisted, grasp back of neckring and top of CWG with one hand. With other hand, grasp red donning lanyard, pull out and down to position restraint zipper slider toward middle of the back. Pull red donning lanyard over buttocks while running fingers ahead of slider to prevent snagging of CWG. Repeat with blue lanyard and sealing zipper.</p> |

| STEP | PROCEDURE | REMARKS |
|------|--|--|
| | <p>n. Don communication carrier by spreading the ear cups and then make fine adjustments to the mike boom by bending the boom from the center.</p> <p>Adjust the chinstrap for proper fit.</p> <p>o. Connect communications carrier electrical lead to upper branch of electrical harness.</p> <p>p. Connect gas umbilical to PGA.</p> <p>q. Provide ventilation flow.</p> | <p>Do not bend mike boom more than 80° from center. Bend mike boom from the middle section only. Do not straighten or bend unless necessary.</p> |
| 6 | <p>Donning lunar boots.</p> <p>a. Insert PGA boots into lunar boots and position with attached donning straps.</p> <p>b. Engage snap fasteners on tongue of boot.</p> <p>c. Latch adjustment strap and buckle.</p> | |
| 7 | <p>Donning PLSS/OPS (Step 4.3.1)</p> | |

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| STEP | PROCEDURE | REMARKS |
|------|--|--------------------|
| 8 | <p>Donning pressure helmet</p> <p>a. Apply antifog solution.</p> <p>b. Helmet may be difficult to don. Is so, stop gas flow momentarily.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Prior to donning helmet, PGA diverter valves must be EV (vertical) position if O₂ flow is to be provided by PLSS/OPS.</p> <p>c. Place helmet-attaching ring lock subassembly in ENGAGE.</p> <p>d. Place pressure helmet on helmet-attaching ring; insure proper alinement by alining dual white lines and press down on helmet.</p> <p>e. Position lock subassembly to LOCK.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>PGA neckring alinement marks must be alined with the helmet "locked" alinement marks to insure proper helmet ventilation.</p> | See Step 4.8.1-2a. |
| 9 | <p>Donning EV gloves</p> <p>a. Don comfort gloves and wristlets.</p> <p>b. Roll glove gauntlet back to provide access to wrist disconnect.</p> | |

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| STEP | PROCEDURE | REMARKS |
|------|--|---|
| c. | Place suit wrist disconnect in ENGAGE | |
| d. | Gloves may be difficult to don. If so, stop gas flow momentarily. | |
| e. | Insure glove palm restraint is loosened; place hand into glove. | |
| f. | Aline glove wrist disconnect with suit wrist disconnect and engage both units. | |
| g. | Insure glove rotates easily and place suit wrist disconnect to LOCK. | |
| h. | Roll glove gauntlet back over PGA arm. | |
| i. | Adjust palm restraint as desired. Close cover flap and engage fasteners. | |
| j. | Similarly don other glove. | |
| 10 | Donning LEVA | |
| a. | Verify that both visors are open or open the visors. | Aline LEVA by using the projecting PGA feedport as a guide. |
| b. | Disengage latching mechanism through access on LEVA collar. | |
| c. | Place LEVA over pressure helmet and lower onto helmet-attaching ring. | |
| d. | Aline separation of plastic collar with helmet "Engaged" alinement marks. | |

4.1 PGA DONNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| e. | Insure LEVA is properly located on attaching ring and lock. | |
| f. | Lower collar and fasten to PGA. | |
| | <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Collar must conceal helmet-attaching ring area for lunar surface activity only.</p> | |
| 11 | Donning helmet protective shield | |
| a. | Expand shield, slip hole over helmet feedport, rotate opposite side over helmet, and allow to contract in place. | |

| STEP | PROCEDURE | REMARKS |
|---|---|---------|
| <p>4.1.4 PGA EV CONFIGURATION DOFFING PROCEDURES</p> <p>1 Doffing EV glove</p> <p>a. Decrease PGA pressure flow to <0.75 psig.</p> <p>b. Roll glove gauntlet back and put wrist disconnect to OPEN position.</p> <p>c. Doff glove.</p> <p>d. Similarly doff other glove.</p> <p>2 Doffing LEVA</p> <p>a. Verify both visors in full OPEN position.</p> <p>b. Disengage fastener tapes of LEVA collar.</p> <p>c. Disengage locking mechanism.</p> <p>d. Ease LEVA up and off pressure helmet.</p> <p>3 Doffing pressure helmet</p> <p>a. Place helmet-attaching ring in OPEN.</p> <p>b. Ease pressure helmet up and out of helmet-attaching ring.</p> | <p>The EMU is assumed to be in the same configuration as at end of extravehicular configuration donning procedures.</p> | |

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| STEP | PROCEDURE | REMARKS |
|------|--|--|
| 4 | Doffing ITMG connector cover Unsnap cover and remove. | |
| 5 | Doffing PLSS (Step 4.3.2) | |
| 6 | Doffing lunar boots a. Unbuckle adjusting strap and unsnap fasteners. b. Slip boots off | |
| 7 | Doffing PGA a. Empty UCTA. (See AOH-IM and -CSM procedures.) b. Open slide fastener cover flap. c. Unlock pressure-sealing zipper lock and release slider tab snap fastener. d. Fully OPEN pressure and sealing zippers. | <p>If unassisted, remove donning lanyards from stowage and attach to zipper slider tabs. Grasp blue suit-donning lanyard and pull until the pressure-sealing slider tab is full OPEN and remove suit-donning lanyard.</p> <p>Remove red suit-donning lanyard from lanyard pocket; release restraint slider tab from its stowed position and insert lanyard into slider tab.</p> <p>Grasp the red suit-donning lanyard; pull until the restraint slider is full OPEN and remove the suit-donning lanyard.</p> |

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| STEP | PROCEDURE | REMARKS |
|------|--|--------------------------------------|
| | e. Disconnect gas inlet and outlet umbilicals and replace protective covers and caps. | |
| | f. Grasp PGA at rear-entry area and separate zippers then slip PGA from around back and buttocks. | |
| | g. Disconnect communications carrier electrical lead. Power off from electrical umbilical. | |
| | h. Grasp helmet attaching ring, slip head out, and pull both arms away from PGA. | |
| | i. Disconnect LCG multiple water connector. If LCG is to be doffed, reinstall PGA protective plug. | |
| | j. Disconnect biomedical electrical connector. | |
| | k. Disconnect urine connector. | |
| | l. Remove legs from PGA. | |
| 8 | Doffing UCTA (Step 4.1.2-4) | |
| 9 | Doffing biomedical harness and belt (Step 4.1.2-5) | See remarks page 4-3, Step 4.1.1-2d. |
| 10 | Doffing LCG | |
| | a. Open front entry. | |
| | b. Pull bioinstrumentation leads out of LCG front. | |
| | c. Slip out of LCG. | |
| 11 | Doffing FCS (Step 4.1.2-7) | |

4.1 PGA DONNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| 12 | Doffing helmet protective shield a. Expand shield, rotate about helmet feedport, and disengage from feedport. | |

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| STEP | PROCEDURE | REMARKS |
|---|--|--|
| 4.2 OPS OPERATIONS | | |
| 4.2.1 OPS CHECKOUT | | |
| 1 | Open access flaps and verify OPS bottle pressure gage reads 5880 ± 500 psia. | |
| 2 | Verify OPS O ₂ connector locked in stowage plate. | |
| 3 | OPS actuation lever — ON. | |
| 4 | Verify OPS regulator checkout gage reads 3.70 ± 0.30 psid. | |
| 5 | DEPRESS heater test button. | Note the heater test light status. |
| 6 | OPS O ₂ actuation lever is OFF. | The OPS regulator checkout gage will continue to read 3.7 ± 0.3 psid for approximately 3 minutes after OPS actuation lever is OFF. |
| 7 | Secure all access flaps. | |
| 8 | Verify OPS regulator checkout gage less than 2.5 psi. | |
| 4.2.2 OPS DOWNING PRIOR TO CONTINGENCY TRANSFER | | |
| 1 | Pull out tear-tack stitches on the PLSS adjustable harness by yanking on endtab until strap is free. | |
| 2 | Open thermal cover over strap buckle adjustment; remove retaining spring clip. | |

| STEP | PROCEDURE | REMARKS |
|-------|--|---------|
| 3 | Join the fixed waist harness to the adjustable waist harness of the PLSS using the D-buckle under the thermal cover of the adjustable harness (PLSS attachment end) and the hook under the thermal cover on the fixed length strap (PLSS attachment end). The hook on the free end of the straps should be faced inward. | |
| 4 | Loop harnesses around the back of PGA and thread through IM tether restraints. | |
| 5 | Remove OPS O ₂ connector from stowage plate. | |
| 6 | Hook harnesses to OPS. | |
| 7 | Install OPS oxygen connector (blue) into the top (blue) PGA oxygen connector. | |
| 8 | Install purge valve into bottom (red) PGA O ₂ connector and verify locked. | |
| 9 | Open OPS actuator access flap. | |
| 10 | Adjust harnesses to secure OPS. Allow for the expansion of the PGA when pressurized. | |
| 4.2.3 | <p>OPS ACTIVATION</p> <p>Move OPS actuation lever from OFF to ON position and allow it to lock.</p> | |
| 4.2.4 | <p>OPS DEACTIVATION</p> <p>Move OPS actuation lever from ON to OFF position and allow it to lock.</p> | |

4.2 OPS OPERATIONS

| STEP | PROCEDURE | REMARKS |
|-------|--|---|
| 4.3 | PLSS/OPS DOWNING AND DOFFING | |
| 4.3.1 | PLSS/OPS DOWNING | PGA helmet and gloves off. PGA diverter valves (2) — Horizontal |
| 1 | Open access flap, unstow antenna connector, OPS half, secure access flaps. | |
| 2 | Lift OPS locking pin. | |
| 3 | Slide OPS onto PLSS from left to right while facing PLSS conformal side. | Conformal side of PLSS is the side that conforms to the crewman's back when PLSS is donned. |
| 4 | Push locking pin down. | |
| 5 | Remove EVCS antenna connector (J5) dust cap. | |
| 6 | Connect antenna connector, OPS half to antenna connector, PLSS half. Screw on CW. | |
| 7 | Verify sublimator exhaust is clear. | Visual inspection. |
| 8 | Unstow PLSS shoulder and waist harnesses. | |
| 9 | Unstow PLSS PGA electrical umbilical, inlet and outlet O ₂ , and multiple water connectors. | |
| 10 | Remove battery cable from stowage plate. Rotate battery cable handle CCW (90° to alignment marks). | |
| 11 | Remove battery connector (J6) dust cap and stow on battery cable stowage plate. | |

4.3 PLSS/OPS DOWNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|---|---|
| 12 | Connect battery cable to battery. a. Aline marks on battery cable body and handle. b. Aline marks on battery cable handle and battery. c. Connect battery cable to battery connector and rotate handle CW (90°). | |
| 13 | Remove dust cap RCU connector (J3), PLSS half. Twist CCW. | |
| 14 | Verify OPS actuation lever is OFF and OPS regulator checkout gage reads less than 2.5 psi. | |
| 15 | Unstow OPS connector. Pull stowage plate tabs and rotate CCW. | Do not unstow OPS oxygen hose at this time. |
| 16 | Secure PLSS/OPS access flaps. | |
| 17 | Don PLSS/OPS by securing shoulder and waist harnesses to the PGA upper and lower PLSS brackets. | |
| 18 | Connect PLSS inlet and outlet O ₂ (red to red, blue to blue) and multiple water connectors to PGA left side and lock. Connect PLSS PGA electrical umbilical and lock. | |
| 19 | Before connecting RCU, verify: PLSS pump switch — OFF, PLSS fan switch — OFF, and PLSS mode selector switch — Position 0 (OFF). | |

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| STEP | PROCEDURE | REMARKS |
|------|---|---------|
| 20 | Connect RCU electrical connector to the PLSS. a. Aline marks on RCU connector body and handle. b. Aline marks on RCU connector and PLSS, insert, and rotate CW 90°. | |
| 21 | Attach RCU to PLSS straps and PGA as follows: a. Pull Velcro strap away from front of RCU. b. Using strap as a grip, pull directly forward of RCU and then down. Release strap to lock in open position. c. Insert lower clip to PGA upper PLSS bracket. d. Raise RCU and insert the left shoulder clip into left RCU clip, then clip the right side. e. To lock clips, pull strap handle forward and up to a horizontal position and release. Verify hooks are locked in closed position. f. Restow Velcro strap handle on front of RCU. | |
| 22 | Unstow OPS hose. | |
| 23 | Depress OPS actuation lever bracket tab and unstow actuation lever cable. | |

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4.3 PLSS/OPS DORNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|-------|---|---|
| 24 | Attach OPS actuation lever to the RCU. a. Insert lower pins on the OPS actuation lever into the RCU actuation lever bracket slots. b. Push upper portion of the OPS actuation lever toward the bracket until the upper pins engage the bracket and snap locked. | |
| 25 | Install OPS connector to the PGA (blue to blue) and lock. | |
| 26 | Install purge valve in PGA O ₂ connector (red to red). | |
| 27 | Secure all PLSS/OPS access flaps and verify gas connector lock locks (4). | |
| 28 | Unstow antenna. | |
| 4.3.2 | PLSS/OPS DOFFING IN PRESSURIZED ENVIRONMENT | 1. Helmet and gloves - Off 2. PLSS feedwater valve - CLOSED (up) 3. PLSS O ₂ shutoff valve - OFF (up) 4. LM is at 5 psia. 5. OPS actuation lever is OFF. |
| 1 | Remove OPS actuation lever from RCU. | |
| 2 | Disconnect RCU from PGA upper PLSS bracket and PLSS shoulder harnesses. | |
| a. | Pull Velcro strap away from front of RCU. | |
| b. | Using strap as a grip, pull directly forward of RCU and then down. Release strap to lock in open position. | |

4.3 PLSS/OPS DOWNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| | <p>c. Lift RCU from left shoulder strap, then right.</p> <p>d. Lower RCU from PGA upper PLSS bracket.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Before disconnecting RCU, all electrical PLSS controls must be OFF.</p> <p>PLSS pump switch — OFF</p> <p>PLSS fan switch — OFF</p> <p>PLSS mode selector switch — Position 0 (OFF)</p> <p>3 Disconnect RCU electrical umbilical from PLSS by rotating RCU connector handle CCW (90°).</p> <p>4 Disconnect inlet and outlet O₂ and multiple water connectors, electrical umbilical connector, and OPS O₂ connector. The electrical umbilical connector is pulled away from the PGA and rotated CCW to remove.</p> <p>5 Remove the purge valve and stow.</p> <p>6 Remove PLSS shoulder and waist harnesses from the PGA.</p> <p>7 Temporarily stow PLSS.</p> <p>8 Stow OPS antenna.</p> | |

4.3 PLSS/OPS DONNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| 9 | Stow OPS actuation lever. a. Insert lower pins on the OPS actuation lever into the OPS actuation lever bracket slots. b. Push upper portion of the OPS actuation lever down until the upper pins engage the bracket and snap locked. | |
| 10 | Verify OPS actuation lever is OFF and locked. | |
| 11 | Stow OPS O ₂ hose and connector; secure OPS access covers. a. Route the hose around the back of the OPS over the actuation lever cable. b. Verify the OPS connector stowage plate is in the open position (CCW). c. Insert the OPS connector and lock the OPS stowage plate connector (twist CW). d. Secure access flaps over OPS hose. | |
| 12 | Stow PLSS inlet and outlet O ₂ and multiple water hoses and connectors and PLSS PGA electrical umbilical and connector. | |

4.3 PLSS/OPS DOWNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|---|
| | a. Confirm O ₂ water and electrical connector stowage plates are in the open position (CCW). b. Perform stowage routing according to the decal on the PLSS O ₂ bottle shield. c. Lock all stowage connectors (twist CW). | |
| 13 | Disconnect OPS antenna connector from EVCS by unscrewing CCW. | |
| 14 | Replace antenna connector dust cap by pushing straight on. | |
| 15 | Lift OPS locking pin to release. | |
| 16 | Slide OPS off PLSS from right to left while facing PLSS conformal side. | Conformal side of the PLSS is the side that conforms to the crewman's back when PLSS is donned. |
| 17 | Stow antenna connector inside OPS by screwing antenna connector CW on the stowage plate. | |
| 18 | Secure OPS access covers. | |
| 19 | Replace RCU connector (J3) dust cap by alining marks, inserting, and twisting CW | |
| 20 | Restow PLSS shoulder and waist harnesses. | |

| STEP | PROCEDURE | REMARKS |
|-------|---|---|
| 4.3.3 | PLSS/OPS DOFFING IN UNPRESSURIZED ENVIRONMENT | |
| 1 | Verify OPS actuation lever OFF. | |
| 2 | Disconnect purge valve and stow. | |
| 3 | Disconnect OPS O ₂ connector. | |
| 4 | Connect ECS O ₂ umbilicals to PGA (red to red, blue to blue), lock and actuate ECS. | |
| 5 | PLSS fan switch — OFF. | |
| 6 | PLSS O ₂ shutoff valve — OFF (up). | O ₂ shutoff handle safety must be depressed as handle is pulled forward. |
| 7 | Verify PGA pressure gage reads 3.6 to 4.3 psi. | |
| | a. PGA diverter valves (2) — horizontal. | |
| 8 | PLSS mode selector switch — Position 0 (OFF). | |
| 9 | Disconnect PLSS PGA electrical umbilical. The electrical umbilical connector is pulled away from the PGA and rotated CCW to remove. Connect LM communication umbilical. | |
| 10 | PLSS feedwater valve — CLOSED (up). | |
| 11 | PLSS pump switch — OFF. | |
| 12 | Remove OPS actuation lever from the RCU. Depress release lever to free actuation lever upper pins and remove. | |

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| 13 | <p>Disconnect RCU from PGA upper PLSS bracket and PLSS shoulder harnesses.</p> <p>a. Pull Velcro strap away from front of RCU.</p> <p>b. Using strap as a grip, pull directly forward of RCU and then down. Release strap to lock in open position.</p> <p>c. Lift RCU from left shoulder strap, then right.</p> <p>d. Lower RCU from PGA upper PLSS bracket.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Before electrically disconnecting RCU, all PLSS electrical controls must be in OFF position.</p> <p>PLSS pump switch — OFF</p> <p>PLSS fan switch — OFF</p> <p>PLSS mode selector switch — Position 0 (OFF)</p> | |
| 14 | <p>Disconnect RCU electrical connector from the PLSS. Rotate RCU electrical connector handle CCW to disconnect.</p> | |
| 15 | <p>Disconnect PLSS inlet and outlet O₂ and multiple water connectors. Disconnect red O₂ connector first.</p> | |

4.3 PLSS/OPS DOWNING AND DOFFING

| STEP | PROCEDURE | REMARKS |
|------|--|----------------------------------|
| 16 | <p>Remove waist harnesses from the PGA.</p> <p>a. Grasp outside loop of right-hand strap between adjustment buckle and PGA hook and tear tack-stitches adjacent to buckle.</p> <p>b. Unsnap harness keeper between adjustment buckle and PLSS hook.</p> <p>c. Grasp exposed end of strap between PLSS hook and adjustment buckle and tear tack-stitches.</p> <p>d. Unsnap adjustment-buckle thermal insulation to expose buckle.</p> <p>e. Grasp buckle roller release tab and rotate outward to release grip on harness. Lengthen the harness by use of the adjustment buckle.</p> <p>f. Unhook right-hand harness from PGA.</p> <p>g. Unhook left-hand harness from PGA.</p> | Crewman will require assistance. |
| 17 | Remove shoulder harnesses from the PGA. | |
| 18 | Temporarily stow the PLSS. | |
| 19 | Stow antenna. | |
| 20 | Disconnect OPS antenna connector from EVCS. Unscrew CCW. | |

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| STEP | PROCEDURE | REMARKS |
|------|--|--|
| 21 | Stow OPS actuation lever. a. Insert lower pins on the OPS actuation lever into the OPS actuation lever bracket slots. b. Push upper portion of the OPS actuation lever down until the upper pins engage the bracket and snap locked. | |
| 22 | Verify OPS actuation lever is OFF and locked. | |
| 23 | Stow OPS hose and connector and secure OPS access flaps. | The hose is routed around the back of the OPS over the actuation lever cable and is held in place by the thermal cover. The OPS hose connector stowage plate must be in the open position (full CCW) when the connector is inserted and twisted CW to close. |

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4.3 PLSS/OPS DOWNING AND DOFFING

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| STEP | PROCEDURE | REMARKS |
|------|---|---|
| 4.4 | <p>PLSS COMMUNICATION CHECK</p> <ol style="list-style-type: none"> 1 PLSS mode selector switch to Position B. 2 Verify 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag shows P, low PGA pressure warning flag shows 0. 3 Read PLSS O₂ gage (percent of full scale). 4 Verify voice communications. Adjust volume. 5 PLSS mode selector switch to Position A. 6 Verify 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag continues to show P. Low PGA pressure warning flag continues to show 0. 7 Read PLSS O₂ gage (percent of full scale). 8 Verify voice communications and TM, adjust volume. 9 PLSS mode selector switch to position AR. 10 Verify 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag shows P. Low PGA pressure warning flag shows 0. | <p>OPS, RCU, PLSS, and PGA systems are properly connected. PLSS/EVCS modes interface with LM and CM communications subsystems. Spacecraft switch positions for various communications modes (PLSS, SC, MSFN) are found in the AOH for CSM and LM. PLSS switches and valves off.</p> <p>Increase volume by rotating blade CCW.</p> <p>Increase volume by rotating wheel CCW.</p> |

4.4 PLSS COMMUNICATION CHECK

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| STEP | PROCEDURE | REMARKS |
|------|---|---------|
| 11 | Read PLSS O ₂ gage (percent of full scale). | |
| 12 | Verify voice communication and TM, adjust volume as required. | |

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4.4 PLSS COMMUNICATION CHECK

| STEP | PROCEDURE | REMARKS |
|-------|---|---|
| 4.5 | PRESSURE INTEGRITY CHECK | |
| 4.5.1 | PLSS/OPS/PGA PRESSURE INTEGRITY CHECK | EMU donned. Ambient pressure 5.0 psia. PLSS fan in ON. ECS O ₂ — OFF. PLSS feedwater valve — CLOSED. |
| 1 | PLSS O ₂ shutoff valve — ON (down) | |
| 2 | Verify PLSS 1.5 kHz warble tone on for 10 seconds. High O ₂ flow warning flag shows 0. Low PGA pressure warning flag shows 0 and clears when PGA pressure reaches 3.1 to 3.4 psid. | |
| 3 | Verify high O ₂ flow warning flag clears as PGA gage reaches 3.85 ± 0.15 psig. | |
| 4 | PLSS O ₂ shutoff valve — OFF (up). | |
| 5 | Read PGA pressure gage and monitor pressure decay for 1 minute. Exercise suit joints during decay period. | |
| 6 | EMU circuit decay is not to exceed 0.3 psid. | |
| 7 | PLSS O ₂ shutoff valve — ON (down). | |
| 8 | Verify PGA pressure is 3.85 ± 0.15 psi and all warning flags are clear. | |

4.5 PRESSURE INTEGRITY CHECK

| STEP | PROCEDURE | REMARKS |
|-------|---|--|
| 4.6 | PLSS NORMAL OPERATING MODES | |
| 4.6.1 | PLSS ACTIVATION | PLSS/OPS donned, helmet and gloves off. |
| 1 | PLSS mode selector switch to position AR. | 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag shows P. Low PGA pressure warning flag shows 0. Verify communication and TM. |
| 2 | PLSS fan switch — ON. | Verify low vent flow warning flag clear. If fan is activated for more than 30 minutes without PGA cooling, visor fogging may occur. |
| 3 | Don helmet and gloves. | |
| 4 | PLSS O ₂ shutoff valve — ON (down). a. Verify low PGA pressure warning flag clear. b. Verify 1.5 kHz tone for 10 seconds and high O ₂ flow warning flag shows 0 and then clear when PGA reaches 3.85 ± 0.15 psig. | |
| 5 | PLSS pump switch — ON. | Low feedwater pressure warning tone on and warning flag shows A at 1.3 to 1.6 psia cabin. |
| 6 | Verify diverter valve in the MINIMUM position. | |
| 7 | PLSS feedwater valve — OPEN (down). | Ambient pressure must be below 1000μ before opening valve. |
| 8 | Position PLSS H ₂ O diverter valve for comfort after low feedwater pressure warning flag clears. | |

4.6 PLSS NORMAL OPERATING MODES

| STEP | PROCEDURE | REMARKS |
|------------------------------|--|--|
| 4.6.2 WET SUBLIMATOR RESTART | <ol style="list-style-type: none"> 1 PLSS feedwater valve is CLOSED (up). 2 PLSS H₂O diverter valve is at MAXIMUM (down). 3 Maintain workload to deplete feedwater rapidly. 4 1.5 kHz warble tone for 10 seconds. Low feedwater pressure warning flag shows A. 5 After 5 minutes, PLSS H₂O diverter valve is at MINIMUM (up). 6 PLSS feedwater valve — OPEN (down). Select desired diverter position after low feedwater pressure warning flag clears. | <p>PLSS operating. Ambient pressure at vacuum.</p> |
| 4.6.3 PLSS DEACTIVATION | <ol style="list-style-type: none"> 1 PLSS water feedwater valve — CLOSED (up). 2 PLSS O₂ shutoff valve — OFF (up). 3 Pump switch — OFF. PGA pressure is equalized with ambient. Helmet and gloves are doffed. 4 Fan switch — OFF. 5 PLSS mode selector switch — Position 0 (OFF). | <p>EMU donned, PLSS operating. Ambient pressure at vacuum.</p> <p>This is performed prior to repressurization to prevent loss of feedwater when pressure is reestablished. The remaining steps are conducted after the cabin is pressurized.</p> |

| STEP | PROCEDURE | REMARKS |
|------|---|---|
| 4.7 | <p>PLSS RECHARGE AND FEEDWATER REMOVAL PROCEDURES</p> <p>4.7.1 BATTERY REPLACEMENT</p> <p>1 If RCU is connected electrically to the PLSS, all electrical controls must be in OFF position before connecting or disconnecting battery cable.</p> <p>PLSS pump switch — OFF</p> <p>PLSS fan switch — OFF</p> <p>PLSS mode selector switch — Position 0 (OFF)</p> <p>2 Rotate PLSS main battery cable 90° CCW and remove from battery. Remove protective cover from main battery cable stowage connector and stow on battery. Depress and rotate battery locking device CCW 90° to unlock battery.</p> <p>3 Remove old battery from PLSS and stow.</p> <p>4 Obtain replacement battery, remove dust cap, and align battery on battery foot and slide into place in PLSS.</p> <p>5 Depress and rotate battery locking device CW 90° to lock battery in PLSS.</p> <p>6 Connect PLSS main battery cable to battery.</p> | <p>The PLSS recharge procedures consist of battery replacement, LiOH cartridge change, oxygen system recharge, and feedwater reservoir recharge. Oxygen- and feedwater-recharge procedures are given in the LM-AOH.</p> |

4.7 PLSS RECHARGE AND FEEDWATER REMOVAL PROCEDURES

| STEP | PROCEDURE | REMARKS |
|-----------------------------|---|---------|
| 7 | Verify battery lift strap snapped in a loop. | |
| 8 | Insert PLSS hose stowage strap through lift strap loop and stow. | |
| 4.7.2 LiOH CARTRIDGE CHANGE | | |
| 1 | Verify PLSS O ₂ shutoff valve — OFF. | |
| 2 | Remove thermal insulation from the canister cover. | |
| 3 | Depress cover lock. | |
| 4 | Rotate canister cover CCW until alinement mark on cover is alined with the open mark on canister. | |
| 5 | Remove cover by pulling from canister. | |
| 6 | Grasp drop handle and rotate contaminant control cartridge CCW until alinement marks on cartridge and canister assembly are alined. | |
| 7 | Pull spent contaminant cartridge out of canister. | |
| 8 | Obtain replacement cartridge, grasp drop handle, and aline marks, and insert replacement cartridge into canister until it bottoms. | |
| 9 | Rotate cartridge CW approximately 90° until marks are alined to lock into position. | |

| STEP | PROCEDURE | REMARKS |
|--|---|---------|
| 10 | Ascertain that alinement marks on both parts of the cover are alined. Grasp cover by handle and depress cover lock. | |
| 11 | Aline the alinement marks on canister cover with the "open" mark on cover. | |
| 12 | Insert cover in canister. | |
| 13 | Rotate cover CW until alinement mark on cover is alined with "closed" mark on canister. | |
| 14 | Resnap insulation flap over canister cover. | |
| 4.7.3 PLSS FEEDWATER REMOVAL AND WEIGHING PROCEDURES | | |
| 1 | Unstow PLSS feedwater collection bag. | |
| 2 | Unfold the bag. | |
| 3 | Remove the spring scale from the bag side pocket. | |
| 4 | Flatten the bag by hand to remove any trapped oxygen. | |
| 5 | Remove the H ₂ O fill connector from the feedwater collection bag connector. | |
| 6 | Zero the spring scale with the adjustment knob. | |
| 7 | Weigh RCU and record weight in pounds. | |

4.7 PLSS RECHARGE AND FEEDWATER REMOVAL PROCEDURES

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| 8 | Lay the spring scale aside. | |
| 9 | Open the PLSS recharge access door to expose the PLSS H ₂ O fill connector. | |
| 10 | Remove the protective cap from the PLSS H ₂ O fill connector. | |
| 11 | Mate the feedwater collection bag to the PLSS H ₂ O fill connector. | |
| 12 | Turn the PLSS O ₂ shutoff valve to the ON (down) position. | |
| 13 | Allow the O ₂ loop to pressurize for 30 seconds. | |
| 14 | Turn the PLSS H ₂ O shutoff and relief valve to the OPEN (down) position. | |
| 15 | Allow 1-1/2 minutes minimum for the feedwater bladder to drain. | |
| 16 | Turn the PLSS H ₂ O shutoff and relief valve to the CLOSED (up) position. | |
| 17 | Turn the PLSS O ₂ shutoff valve to the OFF (up) position. | |
| 18 | Disconnect the feedwater collection bag from the PLSS H ₂ O fill connector. | |

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| STEP | PROCEDURE | REMARKS |
|------|---|---------|
| 19 | Attach the protective cap to the PLSS H ₂ O fill connector. | |
| 20 | Close the PLSS recharge access door. | |
| 21 | Weigh the feedwater collection bag and contents. Record weight in pounds. | |
| 22 | Stow the bag, H ₂ O fill connector, and scale for jettison. | |

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4.7 PLSS RECHARGE AND FEEDWATER REMOVAL PROCEDURES

| STEP | PROCEDURE | REMARKS |
|------|--|---------|
| 4.8 | <p>4.8 EMU INFLIGHT MAINTENANCE</p> <p>4.8.1 PGA AND LEVA INFLIGHT EXAMINATION AND MAINTENANCE</p> <p>This section contains procedures for examining, cleaning, lubricating, and repairing of PGA and LEVA components during flight.</p> <p>1 PGA and LEVA inflight examination</p> <p>At a prescribed interval during the mission, each item shall be examined for the conditions outlined in the inflight examination and maintenance schedule. Tasks may be performed earlier than the scheduled intervals at the discretion of the crewman. A detailed examination is not feasible and shall not be attempted. If damage to a component is suspected, a more detailed examination and analysis of the malfunction should be performed.</p> <p>The term "general condition" implies that the item will be inspected for the following:</p> <ol style="list-style-type: none"> a. Loose or broken stitches b. Rips, snags, and abraded areas c. Sharp edges and scratches d. Damaged seals or O-rings e. Proper position and security of components | |

| STEP | PROCEDURE | REMARKS |
|------|---|---|
| | <p>f. Lack of lubrication</p> <p>g. Cleanliness</p> <p>Inflight repairs on items found to be discrepant in general condition are possible in certain instances, dependent upon the provisions of the EMU maintenance kit.</p> <p>2 PGA inflight maintenance</p> <p>a. Cleaning and antifog treatment of pressure helmet and helmet shield viewing areas</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not clean LEVA because coatings may become damaged.</p> <ol style="list-style-type: none"> 1. Cut antifog containers to open and extract pad. 2. Apply film of solution on all viewing areas, using a continuous straight line motion. 3. Allow to remain a few minutes 4. Wipe clean and dry with towel. 5. Apply second coat on inner surface of pressure helmet, using clean side of pad. 6. Allow to remain a few minutes, wipe dry, and buff with dry towel. | <p>Do not allow film to dry before removing or buffing.</p> |

| STEP | PROCEDURE | REMARKS |
|------|--|--|
| | <p>b. Lubrication of pressure-sealing zippers</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Avoid excessive use of lubricant and wipe away excess. Insure lubricant does not extend beyond specified lubricating area.</p> <ol style="list-style-type: none"> 1. Position zipper in full open position. 2. Remove lubricant pad from maintenance kit and spread lubricant thinly and evenly over the exposed outer side and underside of both closures. <p>c. Maintenance of seals and O-rings</p> <ol style="list-style-type: none"> 1. Removal of seal or O-ring <p>Fit the contoured end of the seal removal tool between the seal O-ring and seat.</p> <p>Rotate the tool circumferentially around until the seal O-ring is free of the recess and remove tool and O-ring.</p> | <p>All accessible seals and O-rings may be lubricated in flight.</p> |

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| STEP | PROCEDURE | REMARKS |
|------|---|---------|
| | <p>2. Inspection of removed seal or O-ring</p> <p>Inspect removed seal and O-ring for cuts, abrasions, or breaks in surface as well as irregularities in shape.</p> <p>If seal and O-ring are not faulty, lubricate and install. Replace if O-ring is faulty.</p> <p>3. Lubrication of seal and O-ring</p> <p>Obtain lubrication pad from maintenance kit.</p> <p>Wipe seal and O-ring with pad, being careful not to get lubricant on any other part of PGA.</p> <p>4. Installation of seal and O-ring</p> | |

4.8 EMU INFLIGHT MAINTENANCE

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| STEP | PROCEDURE | REMARKS |
|------|--|--|
| | <p>Cut the pouch in the maintenance kit to remove replacement seal and O-ring.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Use care to avoid cutting the seal and O-ring.</p> <p>Remove replacement and lubricate.</p> <p>Install seal and O-ring into opening.</p> | |
| d. | <p>Bladder Repair</p> <p>Small punctures in the bladder portion of the PGA may be repaired in flight provided the structural integrity of the PGA is not greatly impaired.</p> <p>Determine location of leakage and obtain a repair patch from maintenance kit.</p> <p>Cut repair patch to desired size. The repair patch shall not extend more than one-fourth inch beyond the damaged area.</p> <p>Remove backing from patch and place adhesive side of patch over damaged area. The patch shall be applied to inside of PGA.</p> <p>Apply pressure to insure positive bond.</p> | <p>The seal removal tool can be used to facilitate installation of seals.</p> <p>Punctures of sufficient magnitude to degrade the restraint quality of the glove bladder may be repaired by a patch. However, the glove will not be used but retained for emergency use.</p> |

| STEP | PROCEDURE | REMARKS |
|-------|--|---|
| 4.8.2 | <p>BIOINSTRUMENTATION INFLIGHT REPAIR</p> <p>1 Replacement of loose electrode</p> <p>a. Remove all trace of old electrode paste from electrode site.</p> <p>b. Replace existing electrode using paste P/N SEB42100014 and electrode attachment assembly P/N SEB42150035.</p> <p>c. Cover electrode with micropore covering P/N SB-AE-005408.</p> <p>2 Replacement of electrode harness</p> <p>a. Obtain spare electrode harness and attached each electrode as described in Step 4.8.2-1.</p> <p>b. Attach electrode harness to signal conditioners. The connectors should be finger-tight.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Do not overtighten connectors.</p> <p>3 Permanent removal of bioinstrumentation system</p> <p>Remove bioinstrumentation system and cover exposed end of the PGA electrical umbilical and/or T-adapter cable with tape P/N SEB12100050-201 (on board).</p> | <p>Located in medical accessories kit</p> <p>Located in medical accessories kit</p> |

4.8 INFLIGHT MAINTENANCE

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| STEP | PROCEDURE | REMARKS |
|---|--|---------|
| 4.9 PURGE VALVE OPERATION | | |
| 4.9.1 ACTIVATION PROCEDURES FOR PURGE VALVE | <ol style="list-style-type: none">1 Remove pull pin by grasping the red apple and pulling with about 20 pound of force.2 Squeeze the two locktabs on the purge valve barrel simultaneously. The valve will now pop open. | |
| 4.9.2 SHUTOFF PROCEDURES | <ol style="list-style-type: none">1 Squeeze the two locktabs simultaneously and push in the purge valve barrel.2 Release the locktabs while still pushing on the barrel until the locktabs are engaged.3 Confirm purge valve closing, either by flow changes or by visually confirming the barrel is no longer extended. | |
| 4.9.3 PURGE VALVE REMOVAL PROCEDURES | <ol style="list-style-type: none">1 Release gas connector lock-lock.2 Lift gas connector locktabs and rotate to release position.3 Remove purge valve from gas connector. | |

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| STEP | PROCEDURE | REMARKS |
|--------|--|--|
| 4.10 | MISCELLANEOUS PROCEDURES | |
| 4.10.1 | PLSS GAS TRAP ACTIVATION | |
| 1 | EV activation (by other crewman) | |
| a. | Shift PLSS to extreme left. | |
| b. | Open gas trap guard. | |
| c. | Depress gas trap button for 5 seconds then release. | Cooling should be improved in 3 minutes. |
| d. | Close guard. | |
| e. | Realign PLSS. | |
| 2 | Pressurized cabin activation — PLSS doffed | |
| a. | Connect PLSS multiple water connector to suit connector. | |
| b. | Switch pump to ON. | |
| c. | Cycle diverter valve slowly (three times). | |
| d. | Switch pump to OFF. | |
| e. | Disconnect multiple water connector from suit. | |
| f. | Connect LM water supply hose to PLSS fill connector and open supply valve. | |
| g. | Open gas trap guard. | |

4.10 MISCELLANEOUS PROCEDURES

| STEP | PROCEDURE | REMARKS |
|------|---|---------|
| | <ul style="list-style-type: none"> h. Depress gas trap button until water is observed at the vent on top of the gas trap then release. i. Close guard. j. Close IM water supply valve and disconnect supply hose. k. Close PLSS fill cover. | |
| | <p>4.10.2 CAMERA MOUNTING/RCU</p> <ul style="list-style-type: none"> 1 Outside IM beginning of EVA <ul style="list-style-type: none"> a. Crewman receives camera with mounting bracket attached. b. Crewman will place the camera bracket (female) and center the base directly center of the RCU and mate the two brackets (camera and RCU halves). c. Push camera and bracket down until lock is in place. 2 Release of camera and bracket (assumes crewman unassisted) <ul style="list-style-type: none"> a. Place right hand under camera and bracket and apply a small force upward. b. Place left thumb or forefinger on tab release lever on front of RCU. c. Push release lever to the right while applying upward force from base of camera and lift camera from RCU mounting. | |

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SECTION 5

EMU

MALFUNCTION PROCEDURES

5.1 INTRODUCTION

5.1.1 The malfunction procedures encompass the recognition, diagnosis and corrective action for system malfunctions. In most cases, the crew is alerted to a malfunction condition by indicators and gages. The malfunction analyses do not contain solutions; such solutions are found in Mission Rules. The procedures in this section cover significant single failures, and are not intended to replace the detailed Failure Modes-Effects Analyses published in other documents.

5.1.2 The malfunction procedures are for use during Apollo missions where an EMU having an SV 706100-6 PLSS (without a CO₂ sensor) will be worn. The procedures have been classified as (1) emergency, (2) EVA, and (3) post-EVA.

5.1.3 For maximum safety, all emergency procedures should be memorized so action can be taken immediately when the malfunction occurs. The EVA procedures do not need to be memorized since they are provided through voice communications, except for steps which cover EVA procedures for loss of voice communications.

5.1.4 The post-EVA procedures are designed to extract a maximum amount of information on any observed anomaly, since the PLSS/OPS and associated hardware would not normally be returned to earth for postflight analysis.

5.1.5 The procedures and remarks are representative of a nominal EMU. Values and quantities which are characteristic of an individual EMU, and which can be established only by testing the actual EMU to be used in the flight, are underlined in each case.

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5.2 **FORMAT OF PROCEDURES**

The malfunction procedures are presented in a three-column, logic flow diagram format. A description and use of each of these columns is as follows:

- | | |
|------------------|--|
| SYMPTOM | The primary purpose of the symptom column is to give "First Indication" of the malfunction as received by either the crew or telemetry. The possible causes of the malfunction are indicated in this column. |
| PROCEDURE | The procedures column presents a step-by-step logic flow diagram of actions and decisions used to isolate or correct a malfunction symptom. The remote-event number symbols are used to reference items to the "Remarks" column or to refer to other procedural steps. |
| REMARKS | This column will include the following information: <ol style="list-style-type: none">a. Amplifying additional remarks related to the symptom, such as relief valve vents at _____ psid.b. Amplifying remarks which relate to a decision and/or action items.c. Explaining resultant system status or operational capability after a failure has been identified.d. Cautions or warnings, as necessary, to cover conditions that may exist because of a failure. |

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5.3 MALFUNCTION SYMPTOMS FOR EMU USING PLSS SV 706100-6

| Symptom | Page |
|--|------|
| EMU 1 - Warning tone and low vent flow flag "P" | 5-4 |
| EMU 2 - Warning tone and low PGA pressure flag "O". | 5-6 |
| EMU 3 - Warning tone and high O ₂ flow flag "O". | 5-10 |
| EMU 4 - Warning tone and low feedwater pressure flag "A". | 5-12 |
| EMU 5 - Warning tone with no warning flags | 5-14 |
| EMU 6 - PGA pressure gage <3.7 psid and apparently stable (no warning tone) | 5-16 |
| EMU 7 - PLSS O ₂ quantity indicator abnormal reading | 5-17 |
| EMU 8 - PGA pressure gage >4.0 psid | 5-19 |
| EMU 9 - Loss of pump noise | 5-20 |
| EMU 10 - Inadequate cooling of crewman (diverter valve - MAX. cooling) | 5-21 |
| EMU 11 - EVA-1 loses voice from MSFN (EVA-1 has voice from EVA-2) | 5-23 |
| EMU 12 - EVA-1 loses voice from MSFN (EVA-1 does not have voice from EVA-2) | 5-24 |
| EMU 13 - EVA-1 loses voice from EVA-2 (EVA-1 has voice from MSFN) | 5-26 |
| EMU 14 - EVA-2 loses voice from MSFN (EVA-2 receives voice from EVA-1) | 5-28 |
| EMU 15 - EVA-2 loses voice from MSFN (EVA-2 does not have voice from EVA-1) | 5-29 |
| EMU 16 - EVA-2 loses voice from EVA-1 (EVA-2 has comm. with MSFN) | 5-31 |
| EMU 17 - Loss of voice comm. with EVA-1, EVA-2, or MSFN (two-man EVA) (comm. restoration procedure) . . . | 5-33 |
| EMU 18 - EVA loses voice from LM | 5-34 |

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| Symptom | Page |
|---|------|
| EMU 19 - LM loses voice from EVA | 5-36 |
| EMU 20 - GT8168P/GT8268P PGA pressure <3.7 psid and apparently stable (no warning tone) | 5-38 |
| EMU 21 - GT8168P/GT8268P PGA pressure >4.0 psid | 5-40 |
| EMU 22 - GT8182P/GT8282P PLSS O ₂ pressure abnormal | 5-41 |
| EMU 23 - GT8182P/GT8282P PLSS O ₂ pressure <800 psia (pre-EVA) | 5-43 |
| EMU 24 - GT8182P/GT8282P PLSS O ₂ pressure <350 psia (post-EVA) | 5-44 |
| EMU 25 - GT8110P/GT8210P feedwater pressure <1.8 psid (no warning tone) | 5-45 |
| EMU 26 - GT8154T/GT8254T LCG H ₂ O temperature >68° F with diverter valve in MAX. cooling | 5-47 |
| EMU 27 - GT8196T/GT8296T LCG H ₂ O ΔT >11° F (MAX. diverter valve position) | 5-48 |
| EMU 28 - GT8140C/GT8240C PLSS battery current >3.0 amps | 5-50 |
| EMU 29 - GT8140C/GT8240C PLSS battery current <2.3 amps (no warning tone) | 5-52 |
| EMU 30 - GT8141V/GT8241V PLSS battery voltage ≤16.0 Vdc (no warning tone) | 5-54 |
| EMU 31 - GT8170T/GT8270T O ₂ temperature <38° F (no warning tone) | 5-56 |
| EMU 32 - GT8170T/GT8270T O ₂ temperature >52° F (no warning tone) | 5-57 |

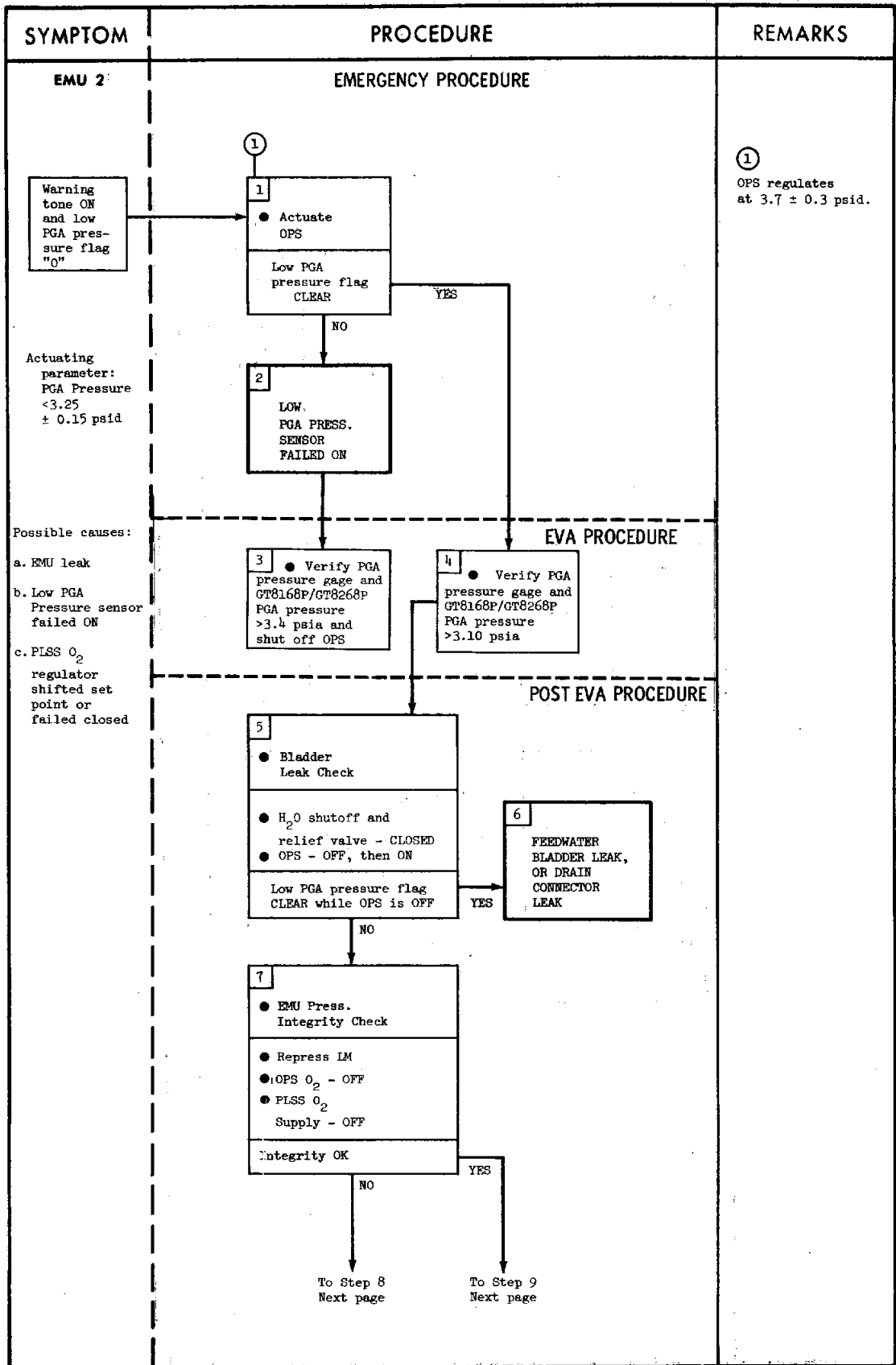
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| SYMPTOM | PROCEDURE | REMARKS |
|---|---|--|
| <p>EMU 11</p> <p>Warning tone ON and low vent flow flag "P"</p> <p>Actuating parameter: Vent flow <4.0 to 5.3 acfm for >5 sec</p> <p>Possible causes: a. Fan OFF or degraded b. Battery degraded c. High PGA ΔP d. Low vent flow sensor failed on or shifted set point e. Flow restriction in PLSS vent loop</p> | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <div style="text-align: center;"> <p>1</p> <p>● Cycle Fan OFF/ON Low vent flow flag CLEAR after 10 sec</p> <p>YES</p> <p>NO</p> </div> <div style="text-align: center;"> <p>2</p> <p>FAN SWITCHED OFF INADVERTENTLY</p> </div> <div style="text-align: center;"> <p>3</p> <p>● Actuate OPS ● Open purge valve</p> </div> <hr/> <p style="text-align: center;">EVA PROCEDURE</p> <div style="text-align: center;"> <p>4</p> <p>GT8140C/ GT8240C PLSS battery current <1.1 amps</p> <p>YES</p> <p>NO</p> </div> <div style="text-align: center;"> <p>5</p> <p>FAN CIRCUIT FAILED</p> </div> <hr/> <p style="text-align: center;">POST EVA PROCEDURE</p> <div style="text-align: center;"> <p>6</p> <p>GT8140C/ GT8240C PLSS Batt. Curr. >3.0 amps</p> <p>YES</p> <p>NO</p> </div> <div style="text-align: center;"> <p>7</p> <p>● Fan OFF/ON GT8140C/GT8240C PLSS Batt. Curr. <1.1 amps while fan OFF</p> <p>NO</p> <p>YES</p> </div> <div style="text-align: center;"> <p>8</p> <p>FAN DEGRADED</p> </div> <div style="text-align: center;"> <p>9</p> <p>GT8141V/ GT8241V PLSS Batt. Volt <16.0 Vdc</p> <p>YES</p> <p>NO</p> </div> <div style="text-align: center;"> <p>10</p> <p>FAILING BATTERY CAUSED FAN DEGRADATION</p> </div> <p style="text-align: center;">To Step 11 Next page</p> | <p style="text-align: center;">①</p> <p>The OPS regulates at 3.7 ± 0.3 psid. A full OPS will provide a minimum of 30 min operation at 8 lb/hr flow at 50° to 80° F inlet temperature with purge valve open.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|--|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>11</p> <ul style="list-style-type: none"> ● Low Vent Flow Sensor Check ● Repress LM ● PLSS O₂ - OFF ● OPS O₂ - OFF ● Doff Helmet and gloves ● Disconnect OPS and purge valve ● Connect blue LM ECS and red PGA Gas Connectors ● Connect red LM ECS and blue PGA Gas Connectors ● Activate ECS <30 sec <p>Low vent flow flag "p"</p> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>NO</p> <p>↓</p> </div> <div style="text-align: center;"> <p>YES</p> <p>→</p> </div> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px; width: fit-content;"> <p>12</p> <p>LOW VENT FLOW SENSOR SHIFTED SET POINT OR FAILED CLOSED</p> </div> <div style="border: 1px solid black; padding: 5px; width: fit-content;"> <p>13</p> <p>HIGH PGA ΔP, OR FAN PERFORMANCE DEGRADED, OR SHIFT IN LOW VENT FLOW SENSOR SET POINT</p> </div> | |

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APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--------------------------------|---|---------|
| POST EVA PROCEDURE (continued) | | |
| | <div style="display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; padding: 5px; width: 80%; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">8</div> <ul style="list-style-type: none"> ● PGA/PLSS Press. Integrity Check ● Disconnect OPS ● Purge valve - CLOSED ● PLSS O₂ - ON, then OFF <p style="margin-top: 5px;">Integrity OK</p> </div> <div style="display: flex; justify-content: space-between; width: 80%;"> <div style="width: 45%;"> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">11</div> <ul style="list-style-type: none"> ● PGA Press. Integrity Check ● Connect ECS to PGA ● Disconnect PLSS Hoses <p style="margin-top: 5px;">Integrity OK</p> </div> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">14</div> <p style="text-align: center;">PGA LEAK</p> </div> </div> <div style="width: 45%;"> <p style="text-align: center;">YES</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">9</div> <p style="text-align: center;">Doff PLSS</p> </div> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">10</div> <p style="text-align: center;">PLSS O₂ Quantity Indicator <gauge zero</p> </div> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">13</div> <ul style="list-style-type: none"> ● Recharge PLSS O₂ </div> </div> </div> </div> <div style="display: flex; justify-content: space-between; width: 80%;"> <div style="width: 45%;"> <p style="text-align: center;">YES</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">12</div> <p style="text-align: center;">LEAK BETWEEN OPS SHUTOFF VLV. AND PGA</p> </div> <p style="text-align: center;">YES</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">15</div> <p style="text-align: center;">LEAK BETWEEN PLSS O₂ SHUTOFF VLV. AND PGA</p> </div> </div> <div style="width: 45%;"> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">17</div> <ul style="list-style-type: none"> ● Pressurize O₂ Vent Loop ● Depress blue PLSS gas connector to vent PLSS ● Release blue PLSS gas connector ● PLSS O₂ - ON, then OFF after 5 min ● Depress blue PLSS gas connector <p style="margin-top: 5px;">Verify PLSS O₂ flow</p> </div> <p style="text-align: center;">NO</p> <p style="text-align: center;">To Step 18 Next page</p> </div> </div> | |

YES

16

- DEGRADED PRESS. REGUL.
- RECORD GT8168P/ GT8268P PGA PRESSURE OR ● CONNECT BLUE PLSS GAS CONNECTOR TO OPS PRESSURE REGULATOR CHECKOUT STOWAGE PLATE
- PLSS O₂ - ON
- RECORD GAGE PRESSURE

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| SYMPTOM | PROCEDURE | REMARKS |
|--------------------------------|---|---------|
| POST EVA PROCEDURE (continued) | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>18</p> <ul style="list-style-type: none"> ● Connect PLSS O₂ Bottle to LM ECS <p>GF3589P PLSS Recharge Press. < 111 psi</p> </div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>22</p> <p>PLSS O₂ PRESS. REGUL. FAILED CLOSED</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>25</p> <ul style="list-style-type: none"> ● Pressurize O₂ Vent Loop ● PLSS Gas Connectors to be stowed in stowage plates ● PLSS O₂ - ON <p>GT8182P/GT8282P PLSS O₂ Press. or GF3589P PLSS Recharge Press. decay after 5 min</p> </div> <p style="text-align: center;">NO</p> <p style="text-align: center;">To Step 27 Next page</p> </div> <div style="width: 50%;"> <p>YES</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>20</p> <p>Do PLSS O₂ Quantity Indicator and GT8182P/GT8282P PLSS O₂ Press. agree</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>21</p> <p>PRIMARY O₂ PRESS. SENSOR FAILED (COMMON XDUCCER)</p> </div> <p>NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>23</p> <p>PLSS O₂ QUANT. INDIC. FAILED</p> </div> <p>YES</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>24</p> <p>GT8182P/GT8282P PLSS O₂ Press. or GF3589P PLSS Recharge Press. stable 50 min after recharge</p> </div> <p>NO</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>26</p> <p>LEAK ABOVE PLSS O₂ SHUTOFF VALVE</p> </div> <p>YES</p> <p style="text-align: center;">To Step 28 Next page</p> </div> </div> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|---|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>27</p> <ul style="list-style-type: none"> ● PLSS/PGA Press. Verification ● PLSS O₂ - OFF ● Connect blue PLSS Gas Connector to OPS Regulator Press. Checkout Stowage Plate ● PLSS O₂ - ON <p>Checkout Gage Press. <4.2 psid</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>28</p> <p>LEAK BETWEEN PLSS O₂ SHUTOFF VLV. AND PLSS O₂ PRESS. REGULATOR</p> </div> </div> <div style="margin-top: 20px; display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>29</p> <p>PRIMARY O₂ PRESS. REGULATOR REGULATING HIGHER THAN PRV CRACKING PRESS.</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>30</p> <p>HIGH O₂ USAGE</p> </div> </div> <p style="margin-top: 10px;"> YES → (to 30) NO ↓ (to 29) </p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|---------|
| <p>EMU 3</p> <p>Warning tone ON and high O₂ flow flag "0"</p> <p>Actuating parameter: PLSS O₂ flow >0.50 to 0.65 lb/hr for >5 sec</p> <p>Possible causes:</p> <ul style="list-style-type: none"> a. EMU leak b. Primary O₂ pressure regulator regulating higher than PRV cracking pressure c. High O₂ flow sensor failed on | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <pre> graph TD Start[Warning tone ON and high O2 flow flag "0"] --> Step1[1 Low PGM pressure flag "0"] Step1 -- YES --> Step3[3 Actuate OPS] Step1 -- NO --> Step2[2 PLSS C2 Quant. Indic. decreasing] Step2 -- YES --> Step3 Step2 -- NO --> Step4[4 HIGH O2 FLOW SENSOR FAILED ON] Step3 --> Step5[5 Bladder Leak Check H2O shutoff and relief valve - CLOSED OPS - OFF, then ON High O2 flow flag CLEAR while OPS is OFF.] Step5 -- YES --> Step6[6 FEEDWATER BLADDER LEAK, OR DRAIN CONNECTOR LEAK] Step5 -- NO --> Step7[7 EMU Press. Integrity Check Repress LM OPS O2 - OFF PLSS C2 supply - OFF Integrity O.K.] Step7 -- YES --> Next13[To Step 13 Next page] Step7 -- NO --> Next8[To Step 8 Next page] </pre> <p style="text-align: center;">EVA PROCEDURE</p> <p style="text-align: center;">POST EVA PROCEDURE</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS | | | | |
|--|--|---------|--|--|--|--|
| POST EVA PROCEDURE (continued) | | | | | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>8</p> <ul style="list-style-type: none"> ● PGA/PLSS Press. Integrity Check ● Disconnect OPS ● Purge valve - CLOSED ● PLSS O₂ - ON, then OFF <p>Integrity OK</p> </div> | | | | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>9</p> <p>LEAK BETWEEN OPS SHUTOFF VALVE AND PGA</p> </div> | | | | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>10</p> <ul style="list-style-type: none"> ● PGA Press. Integrity Check ● Connect ECS to PGA ● Disconnect PLSS Hoses <p>Integrity OK</p> </div> | | | | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>11</p> <p>LEAK BETWEEN HIGH O₂ FLOW SENSOR AND PGA</p> </div> | | | | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>12</p> <p>PGA LEAK</p> </div> | | | | | |
| | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>13</p> <p>Was GT8168P/ GT8268P PGA Press. <4.5 psia</p> </div> | | | | | |
| <div style="border: 1px solid black; padding: 5px;"> <p>14</p> <p>PRIMARY O₂ PRESS. REGULATOR REGULATING HIGHER THAN PRV CRACKING PRESS.</p> </div> | | | | | | |
| <div style="border: 1px solid black; padding: 5px;"> <p>15</p> <p>HIGH O₂ USAGE</p> </div> | | | | | | |

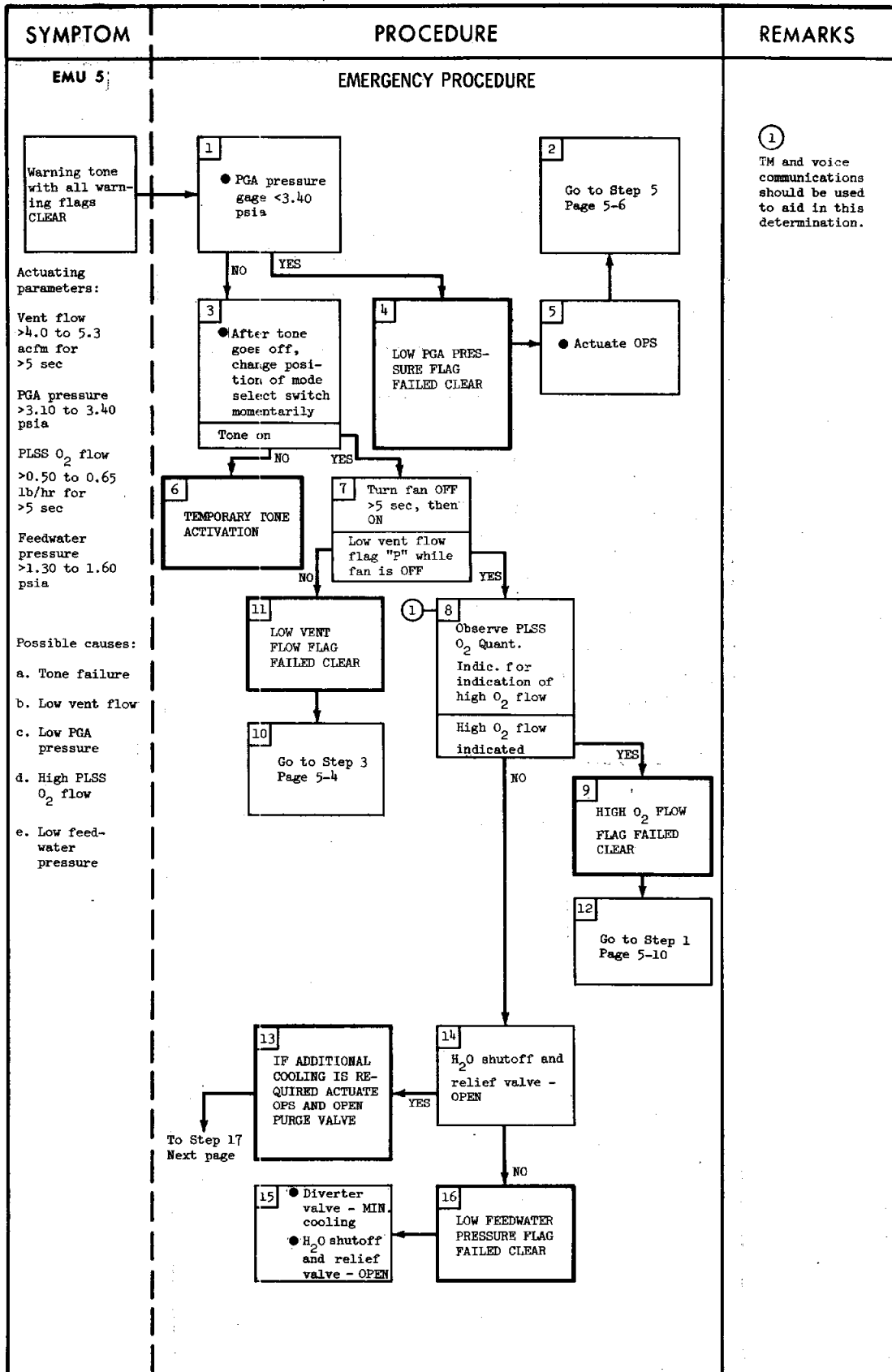
APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---|
| <p>EMU 4</p> <p>Warning tone and low feedwater pressure flag "A"</p> | <p>EMERGENCY PROCEDURE</p> <pre> graph TD Start[Warning tone and low feedwater pressure flag "A"] --> Step1[1 Is feedwater valve OPEN] Step1 -- YES --> Step2[2 If additional cooling is required, actuate OPS and open purge valve] Step1 -- NO --> Step3[3 FEEDWATER VALVE CLOSED] Step3 --> Step4[4 Diverter valve - MIN. Feedwater valve - OPEN] </pre> | |
| <p>Actuating parameter: Feedwater pressure <1.45 ± 0.15 psia</p> <p>Possible causes:</p> <ol style="list-style-type: none"> Sublimator breakthrough H₂O separator blocked Depleted feedwater reservoir Blockage between feedwater bladder and pressure Xducer Feedwater pressure sensor failed on Feedwater valve CLOSED | <p>EVA PROCEDURE</p> <pre> graph TD Step5[5 Sublimator restart] --> Step6[6 SUBLIMATOR BREAKTHROUGH] Step6 -- YES --> Step7[7 GT8196T/GT8296T LCG H2O AT >15° F for >5 min and GT8110P/GT8210P feedwater pressure <1.3 psia] Step7 -- NO --> PostEva[POST EVA PROCEDURE] </pre> <p>Step 5 details: ● Sublimator restart ● Feedwater valve - CLOSED ● PLSS diverter valve - MAX. cooling detent ● After ½ min, PLSS diverter valve - MIN. cooling ● Feedwater valve - OPEN Low feedwater pressure flag CLEAR after ¼ min</p> | <p>① The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator</p> |
| | <p>POST EVA PROCEDURE</p> <p>To step 8 Next page</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--------------------|--|---------|
| POST EVA PROCEDURE | | |
| | <pre> graph TD 8["8 ● Repress LM Flag CLEAR before cabin press. >1.6 psia"] -- YES --> 9["9 ● Pressurize backside of Feedwater Bladder from O2 Vent Loop ● Connect LM Waste Mgmt. Bag to PLSS Vent Connector ● PLSS O2 - ON ● Hoses dis- connected from PGA Feedwater expelled through Vent Connector"] 8 -- NO --> 10["10 FEEDWATER PRESS. TRANSDUCER FAILED ON"] 9 -- YES --> 11["11 BLOCKAGE BETWEEN BLADDER AND FEEDWATER PRESS. TRANSDUCER"] 9 -- NO --> 13["13 ● Connect LM Waste Mgmt. Bag to Drain Connector Drain H2O or O2 expelled from H2O Drain Connector"] 10 --> 10 11 --> 11 13 -- YES --> 12["12 FEEDWATER RESERVOIR DEPLETED"] 13 -- NO --> 14["14 WATER SEPARATOR BLOCKED"] </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU



APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|--|
| EVA PROCEDURE | | |
| <p>17 GT8196T/ GT8296T LCG H₂O ΔT >15° for >5 min and GT8110P/ GT8210P feed- water pressure <1.3 psia</p> | <p>18 LOW FEEDWATER PRESSURE FLAG FAILED CLEAR</p> | <p>19 Go to Step 6 Page 5-12</p> |
| <p>20 ●H₂O shutoff and relief valve - CLOSED for 5 min with diverter valve in MAX. Low feedwater pressure flag "A"</p> | <p>21 WARNING TONE FAILED (CAME ON WHEN THERE WAS NO CAUSE)</p> | |
| <p>22 LOW FEEDWATER PRESSURE FLAG FAILED CLEAR</p> | | |
| POST EVA PROCEDURE | | |
| <p>23 Go to Step 9 Page 5-13</p> | | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|--|
| <p>EMU 6</p> <p>① PGA pressure gage <3.7 psid and apparently stable (with no warning tone and warning flags clear)</p> <p>Possible causes;</p> <p>a. Gage shift or failure</p> <p>b. PLSS O₂ regulator shift/degraded</p> <p>c. EMU leak</p> | <p>EMERGENCY PROCEDURE</p> <p>①</p> <p>1 • Actuate the OPS Does PGA press. gage respond</p> <p>YES</p> <p>NO</p> <p>2 PGA PRESSURE GAGE FAILED</p> <hr/> <p>EVA PROCEDURE</p> <p>3 GT8168P/GT8268P PGA pressure >3.7 psia</p> <p>4 • Turn off OPS</p> <p>YES</p> <p>NO</p> <p>5 Go to Step 5 on Page 5-6</p> | <p>① PLSS O₂ pressure regulator regulates the PGA to 3.7 psid minimum if flow is 0.07 to 0.7 lb/hr.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---|
| <p>EMU 7:</p> <p>PLSS O₂ QUANTITY INDICATOR abnormal reading</p> <p>Possible causes:</p> <ul style="list-style-type: none"> a. PLSS O₂ quantity indicator failed b. EMU leak c. PLSS O₂ pressure Xducer failed d. PLSS O₂ regulator regulating out of spec. e. High O₂ usage | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <p>1 Low PGA pressure flag "0" or PGA pressure gage reads <3.7 psia and decreasing</p> <p>2 ● Actuate OPS</p> <p>3 High O₂ flow flag "0"</p> <hr/> <p style="text-align: center;">EVA PROCEDURE</p> <p>4 GT8182P/GT8282P PLSS O₂ pressure abnormal reading</p> <hr/> <p style="text-align: center;">POST EVA PROCEDURE</p> <p>6 ● Recharge PLSS O₂</p> <p>7 ● Connect PLSS O₂ Bottle to LM ECS Does GB 589P PLSS Recharge Press. agree with GT8182P/GT8282P</p> <p>8 PLSS O₂ Quantity Indicator shows re-charge</p> <p>9 GT8182P/GT8282 PLSS O₂ PRESS FAILED</p> <p>10 ● PLSS O₂ shutoff valve - OFF</p> <p>11 PLSS O₂ PRESSURE XDUCER FAILED (COMMON XDUCER)</p> <p>5 Go to Step 5 Page 5-6</p> | <p>1 1600 Btu/hr metabolic load plus allowable EMU leakage consumes approximately 0.25 lb/hr O₂. Without makeup O₂, this will reduce PGA pressure to 3 psia in approximately 3 min.</p> <p>2 OPS regulates at 3.7 ± 0.3 psid.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|--|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <pre> graph TD 12[12 PLSS O₂ QUANTITY INDIC. FAILED] --> 13[13 ● Recharge PLSS O₂] 13 --> 14[14 GF3589F PLSS Recharge Press. stable after 50 min] 14 -- YES --> 15[15 LEAK BETWEEN PLSS O₂ SHUT- OFF VLV. AND HIGH O₂ FLOW SENSOR] 14 -- NO --> 16[16 LEAK UPSTREAM OF PLSS O₂ SHUTOFF VLV.] </pre> | |

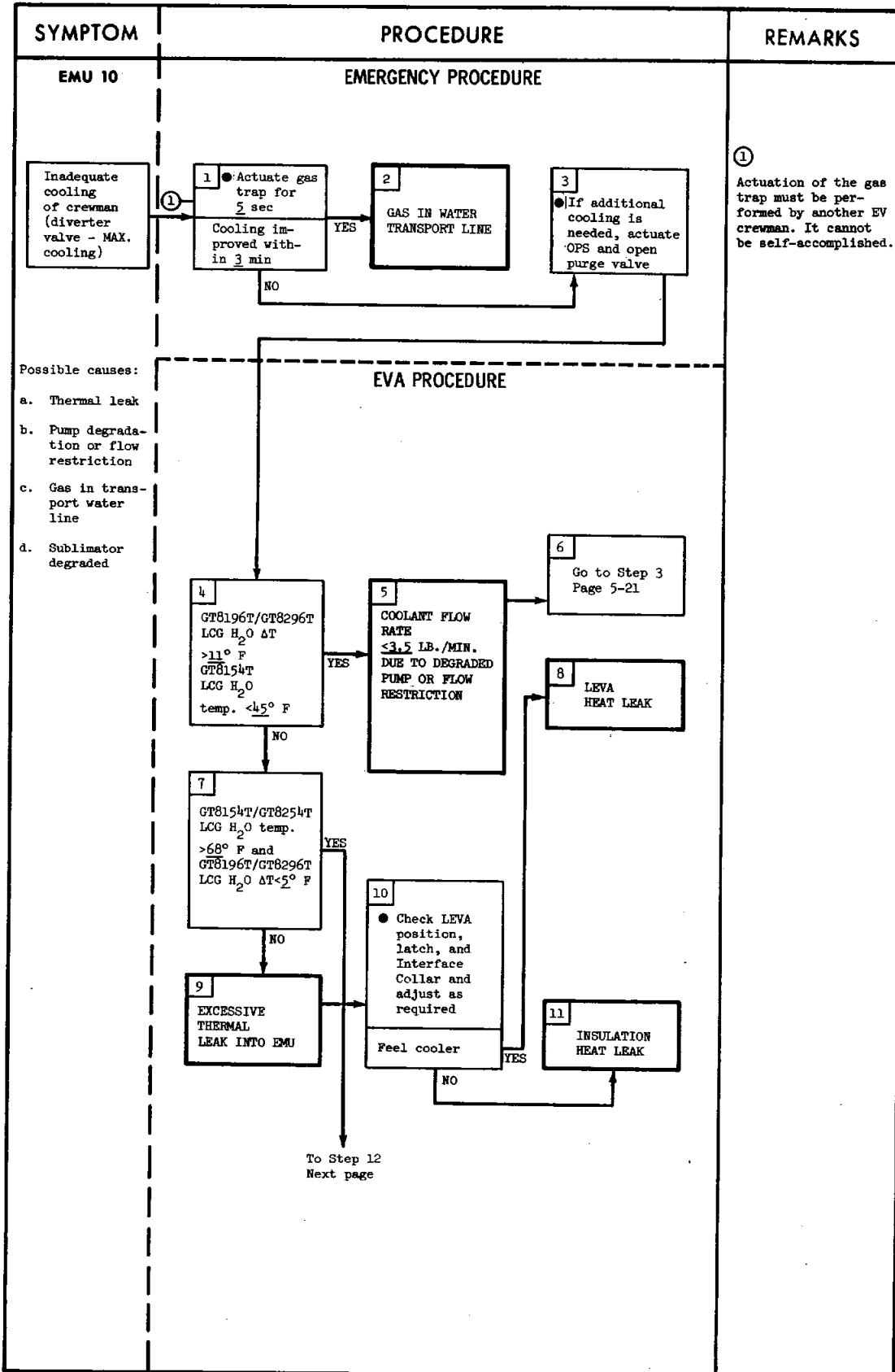
APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|---|--|
| <p>EMU 8</p> <p>① PGA pressure gage >4.0 psid</p> <p>Possible causes: a. Regulator fails open or shifts set point b. PGA pressure gage fails</p> | <p>EMERGENCY PROCEDURE</p> <p>②</p> <p>1 High O₂ flow flag "0" (after 5 sec)</p> <p>2 ● Actuate OPS</p> <p>3 PLSS O₂ PRESS. REGUL. FAILED OPEN OR SHIFTED SET POINT</p> <hr/> <p>EVA PROCEDURE</p> <p>4 Does GT8168P/GT8268P PGA Press. agree with PGA Press. Gage</p> <p>5 SHIFT IN PLSS O₂ REGULATED PRESSURE</p> <hr/> <p>POST EVA PROCEDURE</p> <p>6 ● Connect blue PLSS Gas Connector to OPS Regul. Check-out Storage Plate Does OPS gage agree with PGA gage</p> <p>7 GT8168P/GT8268P PGA PRESS. FAILED</p> <p>8 PGA PRESS. GAGE FAILED</p> | <p>① PLSS O₂ pressure regulator regulates to 4.0 psid maximum to PGA. PGA pressure relief valve cracks at 4.5 to 5.5 psid.</p> <p>② The PLSS O₂ shutoff valve should be closed if possible. If additional mobility is needed, open purge valve to reduce PGA pressure to >3.4 psid.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|---------|
| <p>EMU 9</p> <p>Loss of pump noise</p> <p>Possible causes:</p> <ul style="list-style-type: none"> a. Pump switch OFF b. Power failure c. Open RCU connection d. Pump failure | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <pre> graph TD Start[Loss of pump noise] --> 1[1 Receiving Sidetone] 1 -- YES --> 2[2 Actuate OPS and open purge valve] 1 -- NO --> 2 2 --> 3[3 Pump switch ON] 3 -- YES --> 5[5 GT8140C/ GT8240C PLS5 Batt. Current <1.9 amp] 3 -- NO --> 4[4 PUMP SWITCHED OFF] 5 -- YES --> 6[6 PUMP MOTOR FAILED (OPEN CIRCUIT)] 5 -- NO --> 7[7 PUMP SEIZED OR SLOWED] 4 --> 8[8 Is RCU Connection properly mated] 6 --> 8 7 --> 8 8 -- YES --> 9[9 MAIN POWER FAILED] 8 -- NO --> 10[10 OPEN RCU CONNECTION] </pre> <p style="text-align: center;">EVA PROCEDURE</p> <p style="text-align: center;">POST EVA PROCEDURE</p> | |

APOLLO OPERATIONS HANDBOOK-EMU



APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|--|---|
| | <p style="text-align: center;">EVA PROCEDURE (continued)</p> <div style="text-align: center;"> <p>①</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>12</p> <ul style="list-style-type: none"> ● Sublimator restart ● Feedwater valve - CLOSED ● PLSS diverter - MAX. cooling ● After 5 min, PLSS diverter in MIN. cooling position ● Feedwater valve - OPEN <p>GT8154T/GT8254T LCG H₂O temp. <68° F after 5 min</p> </div> <div style="display: flex; justify-content: center; align-items: center; margin: 5px 0;"> YES <div style="border: 1px solid black; padding: 2px 5px;">13 SUBLIMATOR BREAKTHROUGH</div> </div> <div style="display: flex; justify-content: center; align-items: center; margin: 5px 0;"> NO <div style="border: 1px solid black; padding: 2px 5px;">14 SUBLIMATOR DEGRADED OR FEEDWATER FLOW RESTRICTED</div> </div> </div> | <p>①</p> <p>The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---------|
| <p>EMU 11</p> <p>EVA-1 loses voice from MSFN (see "Additional conditions" below)</p> <p>Additional conditions:</p> <ol style="list-style-type: none"> Dual EVA EVA-1 has voice from EVA-2 <p>Possible causes:</p> <ol style="list-style-type: none"> LM or MSFN failed EVA-1 "A" volume control turned too low EVA-1 R/T Relay K-1 failed closed in backup mode Triplexer "A" section failed EVA-1 "A" Receiver RF section failed EVA-1 Triplexer "A" section, "A" Receiver, or R/T Relay K-1 failed open in both modes EVA-1 "A" Receiver audio section failed Receiver "A" RCU volume control failed | <p>EVA PROCEDURE</p> <pre> graph TD Start[EVA-1 loses voice from MSFN] --> Step1{1 Does EVA-2 receive voice from MSFN} Step1 -- YES --> Step2{2 Does EVA-1 have side-tone} Step1 -- NO --> Step4{4 LM OR MSFN FAILED} Step2 -- YES --> Step3{3 Set EVA-1 Mode Sel. Sw. at "B" Set EVA-2 Mode Sel. Sw. at "A"} Step2 -- NO --> Step5{5 EVA-1 set RCU "A" volume control to max. Comm. restored} Step3 --> Step6{6 Does EVA-2 receive voice from EVA-1} Step5 -- YES --> Step7{7 EVA-1 "A" VOLUME CONTROL TURNED TOO LOW} Step5 -- NO --> Step10{10 Swap EVA-1 RCU with EVA-2 EVA-1 receive on "A" Receiver} Step6 -- YES --> Step5 Step6 -- NO --> Step8{8 EVA-1 R/T RELAY K-1 FAILED OPEN IN BOTH MODES, OR TRIPLEXER "A" SECTION FAILED} Step8 --> Step9{9 EVA-1 R/T RELAY K-1 FAILED CLOSED IN MODE "B", OR "A" RECEIVER RF SECTION FAILED} Step10 -- YES --> Step11{11 RCVR "A" RCU VOLUME CONTROL FAILED} Step10 -- NO --> Step12{12 EVA-1 "A" RCVR FAILED} </pre> <p>POST EVA PROCEDURE</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---------|
| <p>EMU 12:</p> <p>EVA-1 loses voice from MSPFN (see "Additional conditions" below)</p> <p>Additional conditions:</p> <ol style="list-style-type: none"> Dual EVA EVA-1 does not receive voice from EVA-2 <p>Possible causes:</p> <ol style="list-style-type: none"> Comm. carrier failed RCU mode selector "A" section failed RCU cable failed Primary dual comm. regulator failed PLSS electrical umbilical failed Antenna or triplexer common port failed J-3 Pin 8 failed | <p align="center">EVA PROCEDURE</p> <pre> graph TD Start[EVA-1 loses voice from MSPFN] --> Step1{1 Does EVA-1 have sidetone} Step1 -- YES --> Step13[To Step 13 Next Page] Step1 -- NO --> Step2{2 • EVA-1 set: Mode Sel. Sw. in "A" position Comm. restored with MSPFN} Step2 -- YES --> Step3{3 RCU MODE SELECTOR DUAL CONTACT "A" WAFER FAILED} Step2 -- NO --> Step4{4 • EVA-1 set: Mode Sel. Sw. in position "B" Does EVA-1 hear sidetone} Step4 -- YES --> Step5{5 • EVA-1 Mode Sel. Sw. in Pos. "B" • EVA-2 Mode Sel. Sw. in Pos. "A"} Step4 -- NO --> Step6{6 • EVA-1 PLSS fan - OFF >5 sec EVA-1 hear warning tone} Step6 -- YES --> Step7{7 RCU MODE SELECTOR "A" WAFER FAILED} Step6 -- NO --> Step8{8 • EVA-1 low vent flow flag "F" while fan is OFF} Step8 -- YES --> Step16[To Step 16 Next Page] Step8 -- NO --> Step9{9 RCU J-3 PIN 8 FAILED} Step9 --> Step18[To Step 18 Next page] </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------------------------|---|---------|
| POST EVA PROCEDURE | | |
| | <pre> graph TD Start(()) --> 10[10 ● Swap EVA-1 Comm. Carrier with EVA-2 Comm. restored] 10 -- Yes --> 11[11 EVA-1 COMM. CARRIER FAILED] 10 -- No --> 12[12 SUIT ELECTRICAL HARNESSED FAILED] 12 --> 13[13 ● Swap EVA-1 RCU with EVA-2 Comm. re- stored in Mode Sel. Sw. Pos. "A", "AR", and "B"] 13 -- Yes --> 14[14 RCU MODE SE- LECTOR DUAL CONTACT "A" WAFER FAILED] 13 -- No --> 15[15 PRI/DUAL COMM. REGUL. FAILED] 15 --> 16[16 ● EVA-1 connect to IM electrical umbilical Comm. restored] 16 -- YES --> 17[17 PLSS ELEC- TRICAL UMBILICAL FAILED] 16 -- NO --> 18[18 ● Swap EVA-1 OPS with EVA-2 Comm. restored] 18 -- Yes --> 19[19 EVA-1 ANTENNA OR CABLE FAILED] 18 -- No --> 20[20 EVA-1 TRIPLEX- ER COMMON PORT FAILED] </pre> | |

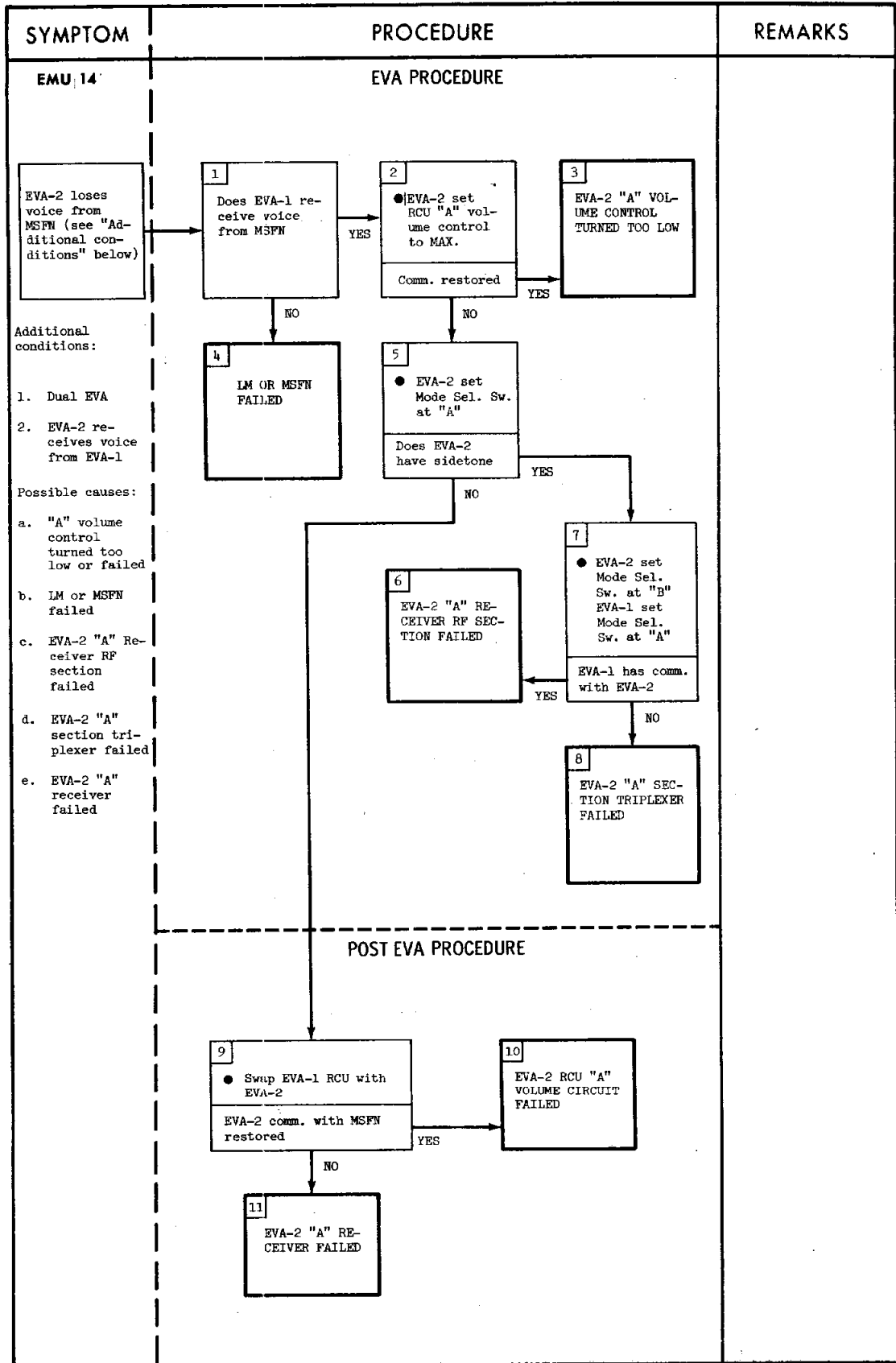
APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---------|
| <p>EMU 13</p> <p>EVA-1 loses voice from EVA-2 (See "Additional conditions" below)</p> <p>Additional conditions:</p> <ol style="list-style-type: none"> 1. EVA-1 has voice from MSFM 2. Dual EVA <p>Possible causes:</p> <ol style="list-style-type: none"> a. EVA-1 B/C volume control set too low b. EVA-1 "B" receiver audio section failed c. EVA-2 PTT switch was OFF d. EVA-2 R/T Relay K-2 failed closed in "A" position e. FM link failed f. Audio section of signal processor failed <p>(continued on next page)</p> | <p style="text-align: center;">EVA PROCEDURE</p> <pre> graph TD Start["EVA-1 loses voice from EVA-2 (See 'Additional conditions' below)"] --> Step1["1 ● EVA-1 set RCU B/C volume to MAX. Comm. restored"] Step1 -- YES --> Step2["2 VOLUME CONTROL WAS TURNED TOO LOW"] Step1 -- NO --> Step3["3 Does MSFM hear EVA-2 and receive 'IM from EVA-2"] Step3 -- YES --> Step4["4 EVA-1 'B' RCVR. AUDIO SECTION FAILED"] Step3 -- NO --> Step5["5 Does MSFM receive 'IM but no voice from EVA-2"] Step5 -- YES --> Step6["6 ● EVA-2 switch PTT OFF/MAIN Comm. restored"] Step5 -- NO --> Step8["8 ● EVA-2 Mode Sel. Sw. - Pos. 'B' Comm. restored"] Step6 -- YES --> Step7["7 EVA-2 PTT SWITCH WAS OFF"] Step6 -- NO --> Step9["9 ● EVA-2 go to MOM. from MAIN. Comm. restored"] Step8 -- YES --> Step9 Step8 -- NO --> Step10["10 EVA-2 R/T RELAY K-2 FAILED CLOSED IN 'A' POSITION"] Step9 -- YES --> Step12["To Step 12 Next page"] Step9 -- NO --> Step15["To Step 15 Next page"] Step10 --> Step11["11 FM LINK FAILED"] Step11 --> Step15 </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---------|
| <p>Possible causes: (continued)</p> <p>g. PTT circuit in EVA-2 RCU failed</p> <p>h. PTT circuit in EVA-2 PLSS failed</p> <p>i. EVA-2 comm. carrier failed</p> | <p style="text-align: center;">POST EVA PROCEDURE</p> <pre> graph TD 12["12 ● Swap EVA-2 RCU with EVA-1 Comm. restored"] -- YES --> 13["13 MAIN CONTACTS OF PTT SWITCH IN EVA-2 RCU FAILED"] 12 -- NO --> 14["14 PRIMARY VOX CIRCUIT IN EVA-2 PLSS FAILED"] 14 --> 15["15 ● Swap EVA-1 Comm. Carrier with EVA-2 Comm. restored"] 15 -- YES --> 16["16 EVA-2 COMM. CARRIER FAILED"] 15 -- NO --> 17["17 AUDIO SECTION OF SIGNAL PROCESSOR FAILED"] </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU



APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|---------|
| <p>EMU 15</p> <p>EVA-2 loses voice from MSFN (See "Additional conditions" below)</p> <p>Additional conditions:</p> <ol style="list-style-type: none"> 1. Dual EVA 2. EVA-2 does not receive voice from EVA-1 <p>Possible causes:</p> <ol style="list-style-type: none"> a. RCU mode selector dual contact failed b. RCU mode selector switch "A" wafer failed c. RCU P-3 Pin 8 failed <p>(continued on next page)</p> | <p style="text-align: center;">EVA PROCEDURE</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>1</p> <p>Does EVA-1 have sidetone</p> <p>YES → To Step 12 Next page</p> <p>NO → 2</p> </div> <div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>2</p> <p>● EVA-2 set mode sel. sw. in "A" position</p> <p>MSFN comm. restored</p> <p>YES → 3</p> <p>NO → 4</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>3</p> <p>RCU MODE SEL. DUAL CONTACT "A" WAFER FAILED</p> <p>→ To Step 17 Next page</p> </div> </div> <div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>4</p> <p>● EVA-2 set mode sel. sw. to "B"</p> <p>Does EVA-2 hear sidetone</p> <p>YES → 5</p> <p>NO → 6</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>5</p> <p>● EVA-2 mode sel. sw. to "B"</p> <p>● EVA-1 mode sel. sw. to "A"</p> <p>→ To Step 17 Next page</p> </div> </div> <div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>6</p> <p>● EVA-2 Fan OFF/ON</p> <p>EVA-2 hear warning tone</p> <p>YES → 7</p> <p>NO → 8</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>7</p> <p>RCU MODE SEL. SW. "A" WAFER FAILED</p> <p>→ To Step 17 Next page</p> </div> </div> <div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>8</p> <p>EVA-2 low vent flow warning flag "p"</p> <p>YES → To Step 10 Next page</p> <p>NO → 9</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>9</p> <p>RCU P-3 PIN 8 FAILED</p> <p>→ To Step 17 Next page</p> </div> </div> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|---------|
| <p>EMU 15</p> <p>d. PLSS electrical umbilical failed</p> <p>e. EVA-2 comm. carrier failed</p> <p>f. EVA-2 triplexer failed</p> <p>g. EVA-2 suit electrical harness failed</p> <p>h. RCU mode selector switch dual and primary contact "A" wafer failed</p> <p>i. Primary/dual comm. regulator failed</p> <p>j. EVA-2 antenna or cable failed</p> | <p style="text-align: center;">POST EVA PROCEDURE</p> <pre> graph TD 10["10 ●EVA-2 connect to LM umbilical MSFN comm. all right"] -- YES --> 11["11 PLSS ELEC- TRICAL UMBIL- ICAL FAILED"] 10 -- NO --> 13["13 ●EVA-2 swap comm. carrier with EVA-1 MSFN comm. all right"] 11 --> 12["12 ●EVA-2 swap OPS with EVA-1 Comm. restored"] 13 -- YES --> 14["14 EVA-2 COMM. CARRIER FAILED"] 13 -- NO --> 16["16 EVA-2 SUIT ELECTRICAL HARNESS FAILED"] 12 -- NO --> 15["15 EVA-2 TRI- PLEXER FAILED"] 14 --> 15 15 --> 18["18 RCU MODE SEL. SW. DUAL AND PRIMARY CON- TACT "A" WAFER FAILED"] 16 --> 17["17 ●EVA-2 swap RCU with EVA-1 Comm. all right in "A" and "AR""] 17 -- YES --> 18 17 -- NO --> 19["19 PRIMARY/DUAL COMM. REG. FAILED"] 18 --> 20["20 EVA-2 ANTENNA OR CABLE FAILED"] 19 --> 20 </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---------|
| <p>EMU 16</p> <p>EVA-2 loses voice from EVA-1 (See "Additional conditions" below)</p> <p>Additional conditions:</p> <ol style="list-style-type: none"> 1. Dual EVA 2. EVA-2 has comm. with MSFN <p>Possible causes:</p> <ol style="list-style-type: none"> a. EVA-2 B/C volume control turned too low b. EVA-2 "B" receiver failed c. EVA-1 RCU PTT switch turned OFF d. EVA-2 "B" section triplexer or K-2 relay antenna section failed <p>(Continued next page)</p> | <p style="text-align: center;">EVA PROCEDURE</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>1</p> <p>● EVA-2 set RCU B/C volume to MAX.</p> <p>Comm. restored</p> </div> <p>YES →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>2</p> <p>VOLUME CONTROL WAS TURNED TOO LOW</p> </div> <p>NO →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>3</p> <p>Does MSFN have comm. from EVA-1</p> </div> <p>YES →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>4</p> <p>● EVA-2 set Mode Sel. Sw. to "A"</p> <p>● EVA-1 set Mode Sel. Sw. to "B"</p> <p>EVA-2/EVA-1 comm. all right</p> </div> <p>NO →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>5</p> <p>EVA-2 "B" RECEIVER FAILED</p> </div> <p>YES →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>6</p> <p>● EVA-1 insure that RCU PTT switch is in MAIN position</p> <p>EVA-2/EVA-1 comm. restored</p> </div> <p>NO →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>7</p> <p>EVA-1 RCU PTT SW. ACCIDENTLY SET TO OFF POSITION</p> </div> <p>YES →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>8</p> <p>EVA-2 "B" SECTION TRIPLEXER OR K-2 RELAY ANTENNA SEC. FAILED</p> </div> <p>NO →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>9</p> <p>● EVA-1 set RCU PTT switch to MOM. position</p> <p>EVA-2/EVA-1 comm. restored</p> </div> <p>NO →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>10</p> <p>EVA-1 VOX CIRCUIT OR RCU PTT SWITCH VOX SECTION FAILED</p> </div> <p>YES →</p> <p style="text-align: center;">POST EVA PROCEDURE</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>11</p> <p>● EVA-1 swap RCU with EVA-2</p> <p>EVA-2/EVA-1 comm. restored</p> </div> <p>YES →</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>12</p> <p>EVA-1 RCU PTT SWITCH CIRCUIT FAILED</p> </div> <p>NO →</p> <p>To Step 13 Next page</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---------|
| POST EVA PROCEDURE (continued) | | |
| <p>Possible causes: (continued)</p> <p>e. EVA-1 VOX circuit or RCU PTT switch VOX section failed</p> <p>f. EVA-1 RCU PTT switch circuit failed</p> <p>g. EVA-1 primary/dual signal processor failed</p> <p>h. EVA-1 VOX/PTT circuit failed</p> <p>i. EVA-1 comm. carrier failed</p> <p>j. EVA-1 suit electrical harness failed</p> | <pre> graph TD 13["13 ● EVA-1 connect to LM umbilical EVA-1/EVA-2 comm. restored"] 14["14 ● EVA-1 reconnect to PLSS ● RCU mode sel. switch to 'B' ● LM set for backup mode EVA-1/MSFN comm. restored"] 15["15 EVA-1 PRIMARY/DUAL SIGNAL PROCESSOR FAILED"] 16["16 EVA-1 VOX/PTT CIRCUIT FAILED"] 17["17 ● EVA-1 swap comm. carrier with EVA-2 EVA-1/MSFN comm. restored"] 18["18 EVA-1 COMM. CARRIER FAILED"] 19["19 ● EVA-1 SUIT ELECTRICAL HARNESS FAILED"] 13 -- YES --> 14 13 -- NO --> 17 14 -- YES --> 15 14 -- NO --> 16 17 -- YES --> 18 17 -- NO --> 19 </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|-----------------------------|--|
| <p>EMU 17</p> <p>Loss of voice comm. with EVA-1, EVA-2, or MSFN (two-man EVA) (comm. restoration procedure)</p> <p>Possible causes:</p> <ol style="list-style-type: none"> EVCS receiver "A" squelch failure LM VHF "A" failure Volume control to low PTT switch OFF or intermittent VOX circuit failure EVA-1 XMTR "B", EVA-1 RCVR "c", EVA-2 RCVR "B", or EVA-2 XMTR "c" failed. EVA-1 RCVR "B"/RCVR "C" summed output failure EVA-1 or EVA-2 total comm. failure | <p>EVA PROCEDURE</p> | <p>① Reception of MSFN is disabled while outer volume is in full DECREASE.</p> <p>② EMU data not available from EVA-1. EVA-1 cannot hear MSFN.</p> <p>③ EMU data not available from EVA-2. EVA-2 cannot hear MSFN.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---------|
| <p>EMU 18:</p> <p>EVA loses voice from LM (see "Additional conditions" below)</p> <p>Additional conditions:</p> <p>1. Single EVA</p> <p>Possible causes:</p> <p>a. EVA "A" volume control turned too low</p> <p>b. EVA "A" receiver RF section failed</p> <p>c. R/T Relay K-1 failed</p> <p>d. EVA antenna failed</p> <p>e. EVA comm. carrier failed</p> <p>f. Triplexer common port failed</p> <p>g. LM electrical umbilical failed</p> <p>(Continued next page)</p> | <p style="text-align: center;">EVA PROCEDURE</p> <pre> graph TD S1[1] -- YES --> S12[To Step 12 Next page] S1 -- NO --> S2[2] S2 -- YES --> S3[3] S2 -- NO --> S4[4] S3 -- YES --> S5[5] S3 -- NO --> S4 S4 -- YES --> S5 S4 -- NO --> S7[7] S5 -- YES --> S6[6] S5 -- NO --> S8[8] S6 -- YES --> S9[9] S6 -- NO --> S8 S7 -- YES --> S15[To Step 15 Next page] S7 -- NO --> S10[10] S8 -- YES --> S11[11] S8 -- NO --> S11 </pre> <p style="text-align: center;">POST EVA PROCEDURE</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---------|
| <p>Possible causes: (continued from preceding page)</p> <p>h. EVA RCU "A" volume circuit failed</p> <p>i. LM failed</p> <p>j. EVA "A" receiver RF section failed</p> <p>k. PLSS electrical umbilical failed</p> <p>l. Primary dual comm. regulator failed</p> <p>m. EVA "A" receiver failed</p> | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <pre> graph TD 12["12 ● LM Crewman transfer to Pilot's Elect. Umbilical Comm. with MSFN O.K."] -- YES --> 13["13 LM ELECT. UMBIL. FAILED"] 12 -- NO --> 14["14 LM CREWMAN COMM. CARRIER FAILED"] 15["15 ● EVA connect to other PLSS Comm. restored"] -- YES --> 16["16 ● EVA reconnect to original PLSS, swap RCU with other crewman Comm. restored"] 15 -- NO --> 18["18 LM FAILED"] 16 -- YES --> 17["17 EVA RCU 'A' VOLUME CIRCUIT FAILED"] 16 -- NO --> 19["19 Does EVA hear sidetone"] 19 -- YES --> 20["20 EVA 'A' RCVR. RF SECTION OR R/T RELAY K-1 FAILED"] 19 -- NO --> 22["22 Did LM receive voice from EVA"] 22 -- YES --> 23["23 EVA 'A' RCVR. OR R/T RELAY K-1 FAILED"] 22 -- NO --> 21["21 PRI./DUAL COMM. REGUL. FAILED"] </pre> | |

AFOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---------|
| <p>EMU 19</p> <p>LM loses voice from EVA (see "Additional conditions" below)</p> <p>Additional conditions:</p> <ol style="list-style-type: none"> 1. Single EVA <p>Possible causes:</p> <ol style="list-style-type: none"> a. LM failed b. EVA RCU PTT switch turned OFF c. EVA VOX circuit failed d. EVA "A" mode failed e. EVA comm. carrier failed f. EVA RCU VOX circuit failed <p>(continued next page)</p> | <p style="text-align: center;">EVA PROCEDURE</p> <pre> graph TD S1[1] -- YES --> S2[2] S1 -- NO --> S4[4] S2 -- YES --> S3[3] S2 -- NO --> S5[5] S3 --> S3 S4 --> S4 S5 -- YES --> S6[6] S5 -- NO --> S7[7] S6 --> S6 S7 -- YES --> S10[10] S7 -- NO --> S8[8] S8 -- YES --> S9[9] S8 -- NO --> S10 S9 --> S9 S9 --> S10 </pre> <p style="text-align: center;">POST EVA PROCEDURE</p> <p>10 • EVA check comm. using other PLSS/OPS Comm. with LM YES → To Step 16 Next page NO → To Step 11 Next page</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---------|
| <p>Possible causes: (Continued from preceding page)</p> <p>g. EVA RCU mode select "A" wafer failed</p> <p>h. EVA antenna failed</p> <p>i. EVA triplexer common port failed</p> <p>j. Suit electrical harness failed</p> | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <pre> graph TD 11["11 ● EVA swap comm. carrier Comm. restored"] -- YES --> 12["12 EVA COMM. CARRIER FAILED"] 11 -- NO --> 13["13 ● LM OR SUIT ELECTRICAL HARNESS FAILED"] 13 --> 14["14 EVA RCU VOX CIRCUIT FAILED"] 15["15 ● Swap RCU ● EVA operates in MAIN Comm. all right"] -- YES --> 14 15 -- NO --> 18["18 EVA VOX CIRCUIT FAILED"] 16["16 ● EVA swap back to original RCU Comm. restored"] -- YES --> 17["17 ● EVA swap back to original OPS Comm. all right"] 16 -- NO --> 19["19 EVA RCU 'A' WAFER MODE SELECTOR FAILED"] 17 -- YES --> 21["21 EVA TRIPLEXER FAILED"] 17 -- NO --> 20["20 EVA ANTENNA FAILED"] 19 --> 21 20 --> 21 </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---|
| <p>EMU 20</p> <p>①</p> <p>GT8168F/ GT8268F PGA pressure <3.7 psid and apparently stable (no warning tone)</p> <p>Possible causes:</p> <p>a. GT8168F/ GT8268F failed</p> <p>b. PLSS O₂ regulator shift/de- graded</p> <p>c. EMU leak</p> | <p>EMERGENCY PROCEDURE</p> <p>①</p> <pre> graph TD S1[1 ● Low PGA pressure flag "0"] -- YES --> S1A[1A WARNING TONE FAILED] S1A --> S2[2 Go to Step 1 Page 5-6] S1 -- NO --> S3[3 PGA Press. Gage <3.7 psia] S3 -- YES --> S4[4 ● Monitor PGA Press. for 1 min Is there a decay] S4 -- YES --> S5[5 ● Actuate OPS] S4 -- NO --> S9[9 ● Doff PLSS/ OPS] S9 --> S10[To Step 10 Next page] S3 -- NO --> S6[6 ● Flex arms Does GT8168F/ GT8268F PGA Press. respond] S6 -- YES --> S4 S6 -- NO --> S7[7 GT8168F/ GT8268F PGA PRESS. FAILED] S5 --> S8[8 Go to Step 5 Page 5-6] </pre> <p>EVA PROCEDURE</p> <p>POST EVA PROCEDURE</p> | <p>①</p> <p>PLSS O₂ pressure regulator regu- lates the PGA to 3.7 psid minimum if flow is 0.07 to 0.7 lb/hr.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|--|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <pre> graph TD 10["10 ● PLSS O2 Regul. Verification ● Connect blue PLSS Gas Connector to OPS Regul. Checkout Stowage Plate Press.>3.7 psid"] 11["11 ● PGA Press. Readout Check ● Connect PGA to ECS Hoses ● Don Helmet and Gloves GT8168P/GT8268P PGA Press.<3.7 psia and constant"] 12["12 SHIFT IN PLSS O2 REGULATED PRESSURE"] 13["13 SHIFT IN GT8168P/GT8268P PGA PRESS. CALIBRATION"] 14["14 TRANSIENT ERROR IN GT8168P/GT8268P PGA PRESS. READING"] 10 -- YES --> 11 10 -- NO --> 12 11 -- YES --> 13 11 -- NO --> 14 </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---|
| <p>EMU 21</p> <p>① GT8168P/ GT8268P PGA Press. >4.0 psid</p> <p>Possible causes: a. Regulator fails open or shifts set point b. GT8168P/ GT8268P fails</p> | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <p>① High O₂ flow flag "0" (after 5 sec); or GT8182P/ GT8282P PLSS O₂ pressure or PLSS O₂ quant. indic. decreas- ing rapidly</p> <p>YES → ② ● Actuate OPS</p> <p>③ PLSS O₂ PRESS. REG. FAILED OPEN OR SHIFTED SET POINT</p> <hr/> <p style="text-align: center;">EVA PROCEDURE</p> <p>④ Does PGA Press. Gage agree with GT8168P/GT8268P PGA Press.</p> <p>YES → ⑤ SHIFT IN PLSS O₂ REGULATED PRESS.</p> <p>NO → ⑥ Reduced mobility or hear relief Vlv. relieving</p> <p>YES → ⑦ PGA PRESS. GAGE FAILED</p> <p>NO → ③ ⑧ GT8168P/GT8268P PGA PRESS. FAILED</p> | <p>① PLSS O₂ pressure regulator regulates to 4.0 psid maximum to PGA. PGA pressure relief valve cracks at 4.5 to 5.5 psid.</p> <p>② The PLSS O₂ shutoff valve should be CLOSED if possible. If additional mobility is needed, open purge valve to reduce PGA pressure to >3.4 psid.</p> <p>③ Upon returning to the LM, Steps 7 and 8 can be verified by con- necting the blue PLSS gas con- nector to the OPS pressure regulator checkout stowage plate.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|---|
| <p>EMU 22</p> <p>GT8182P/ GT8282P PLSS O₂ pressure abnormal</p> <p>Possible causes:</p> <p>a. GT8182P/ GT8282P failed</p> <p>b. EMU leak</p> <p>c. Common PLSS O₂ pressure sensor failed</p> <p>d. PLSS O₂ pressure regulator out of spec.</p> <p>e. High O₂ usage</p> | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <p style="text-align: center;">①</p> <p>1 Low PGA pressure flag "0", or PGA pressure gage reads <3.7 psia or GT8168P/ GT8268P PGA pressure <3.7 psia and decreasing</p> <p>2 ● Actuate OPS</p> <p>3 High O₂ flow flag "0"</p> <hr/> <p style="text-align: center;">EVA PROCEDURE</p> <p>4 PLSS O₂ Quantity Indicator abnormal reading</p> <p>5 Go to Step 5 Page 5-6</p> <hr/> <p style="text-align: center;">POST EVA PROCEDURE</p> <p>6 ● Recharge PLSS O₂</p> <p>7 ● Connect PLSS O₂ Bottle to LM ECS Does GF3589P PLSS Recharge Press. agree with GT8182P/GT8282P</p> <p>8 GT8182P/GT8282P PLSS O₂ Press. shows recharge</p> <p>9 PLSS O₂ QUANTITY INDICATOR FAILED</p> <p>10 PLSS O₂ PRESS. XDUCER FAILED (COMMON XDUCER)</p> <p>11 ● PLSS O₂ shutoff valve - OFF</p> <p>To Step 12 Next page</p> <p>To Step 13 Next page</p> | <p>① 1600 Btu/hr metabolic load plus allowable EMU leakage consumes approximately 0.25 lb/ hr O₂. Without makeup O₂, this will reduce PGA pressure to 3 psia in approximately 3 min.</p> <p>② OPS regulates at 3.4 to 4.0 psid.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|--|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE (continued)</p> <pre> graph TD 12[12 GT/8182P/GT8282P PLSS O₂ PRESS. FAILED] --> 13[13 ● Recharge PLSS O₂] 13 --> 15[15 GF3589P PLSS Recharge Press. stable after 50 minutes] 15 -- YES --> 14[14 LEAK BETWEEN PLSS O₂ SHUTOFF VLV. AND HIGH O₂ FLOW SENSOR] 15 -- NO --> 16[16 LEAK UPSTREAM OF PLSS O₂ SHUTOFF VLV.] </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|---|
| <p>EMU 23</p> <p>①</p> <div data-bbox="243 383 389 504" style="border: 1px solid black; padding: 5px;"> GT8182P/ GT8282P PLSS O₂ pressure <800 psia (pre-EVA) </div> <p>Possible causes:</p> <ol style="list-style-type: none"> GT8182P/ GT8282P failed Inadequate PLSS O₂ charge for EVA Common PLSS O₂ pressure sensor failed | <p align="center">PRE-EVA PROCEDURE</p> <pre> graph TD Start[① GT8182P/ GT8282P PLSS O2 pressure <800 psia (pre-EVA)] --> Step1[1 PLSS O2 Quantity Indicator >3/4] Step1 -- YES --> Step2[2 ● Connect PLSS O2 Bottle to LM ECS GF3589P PLSS Recharge Press. <800 psia] Step1 -- NO --> Step4[4 ● Connect PLSS O2 bottle to LM ECS GF3589P PLSS Recharge Press. <800 psia] Step2 -- YES --> Step3[3 PLSS O2 QUANTITY INDICATOR FAILED] Step2 -- NO --> Step5[5 GT8182P/ GT8282P PLSS O2 PRESS. FAILED] Step4 -- YES --> Step6[6 INSUFFICIENT O2 SUPPLY TO SUPPORT PLANNED EVA] Step4 -- NO --> Step7[7 ● Pressurize LM PLSS Manifold from LM ECS GF3589P PLSS recharge pressure <800 psia] Step5 --> Step6 Step7 -- YES --> Step8[8 GF3589P PLSS RECHARGE PRESSURE FAILED] Step7 -- NO --> Step9[9 COMMON PLSS O2 PRESSURE SENSOR FAILED] Step3 --> Step6 Step8 --> Step6 </pre> | <p>①</p> <p>Provides enough O₂ for:</p> <ol style="list-style-type: none"> PLSS checkout >3 hours normal operation at 1200 Btu/hr metabolic load, plus allowable EMU leakage. |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|---|
| <p>EMU 24</p> <p>①</p> <p>GT8182P/GT8282P PLSS O₂ pressure <350 psia (post-EVA)</p> <p>Possible causes:</p> <ol style="list-style-type: none"> GT8182P/ GT8282P failed Common PLSS O₂ pressure sensor failed Inadequate PLSS O₂ charge for contingency transfer to CM | <p>POST EVA PROCEDURE</p> <p>1</p> <p>PLSS O₂ Quantity Indicator <1/4 full</p> <p>YES</p> <p>2</p> <p>● Connect PLSS O₂ Bottle to LM ECS</p> <p>GF3589P PLSS Recharge Press. <350 psia</p> <p>YES</p> <p>3</p> <p>INSUFFICIENT PLSS O₂ SUPPLY TO SUPPORT A CONTINGENCY TRANSFER TO CM</p> <p>NO</p> <p>4</p> <p>● Pressurize LM PLSS Manifold from LM ECS</p> <p>Does GF3589P read >800 psid</p> <p>YES</p> <p>5</p> <p>COMMON PLSS O₂ PRESSURE SENSOR FAILED</p> <p>NO</p> <p>6</p> <p>GF3589P PLSS RECHARGE PRESSURE FAILED</p> <p>NO</p> <p>7</p> <p>● Connect PLSS O₂ Bottle to LM ECS</p> <p>GF3589P PLSS Recharge Press. <350 psid</p> <p>YES</p> <p>8</p> <p>PLSS O₂ QUANTITY INDICATOR FAILED</p> <p>NO</p> <p>9</p> <p>GT8182P/GT8282P PLSS O₂ PRESS. FAILED</p> | <p>①</p> <p>Provides enough O₂ for:</p> <ol style="list-style-type: none"> PLSS checkout 30-min contingency transfer at 2000 Btu/hr. |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|--|
| <p>EMU 25</p> <p>GT8110P/GT8210P feedwater pressure <1.8 psid (no warning tone)</p> <p>Possible causes:</p> <ol style="list-style-type: none"> GT8110P/GT8210P failed Sublimator breakthrough H₂O separator blocked Depleted feedwater reservoir Blockage between feedwater bladder and pressure Xducer Feedwater pressure Xducer failed High feedwater usage rate Low PGA pressure Feedwater valve CLOSED | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <pre> graph TD S1[1] --> B1{ } B1 -- YES --> S2[2] B1 -- NO --> S4[4] S2 --> B2{ } B2 -- YES --> S3[3] S4 --> B3{ } B3 -- YES --> S5[5] B3 -- NO --> S7[7] S5 --> B4{ } B4 -- YES --> S6[6] S7 --> S8[8] S8 --> B5{ } B5 -- YES --> S9[9] B5 -- NO --> S12[12] S9 --> S10[10] S10 --> S11[11] S11 --> S12 </pre> <p style="text-align: center;">EVA PROCEDURE</p> <p>11 ● Sublimator restart</p> <ul style="list-style-type: none"> ● Feedwater valve - CLOSED ● PLSS diverter - MAX. cooling ● After 5 min, PLSS diverter - MIN. cooling ● Feedwater valve - OPEN <p style="text-align: center;">To Step 12 Next page</p> | <p>① Low feedwater pressure warning actuates at 1.45 ± 0.15 psid.</p> <p>② The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|---|--|
| <p>EMU 24:</p> <p>①</p> <p>GT8182P/GT8282P PLSS O₂ pressure <350 psia (post-EVA)</p> <p>Possible causes:</p> <p>a. GT8182P/ GT8282P failed</p> <p>b. Common PLSS O₂ pressure sensor failed</p> <p>c. Inadequate PLSS O₂ charge for contingency transfer to CM</p> | <p>POST EVA PROCEDURE</p> <p>1</p> <p>PLSS C₂ Quantity Indicator <1/4 full</p> <p>YES</p> <p>2</p> <p>● Connect PLSS O₂ Bottle to LM ECS</p> <p>GF3589P PLSS Recharge Press. <350 psia</p> <p>YES</p> <p>3</p> <p>INSUFFICIENT PLSS O₂ SUPPLY TO SUPPORT A CONTINGENCY TRANSFER TO CM</p> <p>NO</p> <p>4</p> <p>● Pressurize LM PLSS Manifold from LM ECS</p> <p>Does GF3589P read >800 psid</p> <p>YES</p> <p>5</p> <p>COMMON PLSS O₂ PRESSURE SENSOR FAILED</p> <p>NO</p> <p>6</p> <p>GF3589P PLSS RECHARGE PRESSURE FAILED</p> <p>NO</p> <p>7</p> <p>● Connect PLSS O₂ Bottle to LM ECS</p> <p>GF3589P PLSS Recharge Press. <350 psid</p> <p>YES</p> <p>8</p> <p>PLSS O₂ QUANTITY INDICATOR FAILED</p> <p>NO</p> <p>9</p> <p>GT8182P/GT8282P PLSS O₂ PRESS. FAILED</p> | <p>①</p> <p>Provides enough O₂ for:</p> <p>a. PLSS checkout</p> <p>b. 30-min contingency transfer at 2000 Btu/hr.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|---|--|
| <p>EMU 25</p> <p>GT8110P/GT8210P feedwater pressure <1.8 psid (no warning tone)</p> <p>Possible causes:</p> <ol style="list-style-type: none"> GT8110P/GT8210P failed Sublimator breakthrough H₂O separator blocked Depleted feedwater reservoir Blockage between feedwater bladder and pressure Xducer Feedwater pressure Xducer failed High feedwater usage rate Low PGA pressure Feedwater valve CLOSED | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <pre> graph TD S1[1] --> B1{ } B1 -- YES --> B2[2] B1 -- NO --> B4[4] B2 --> B3[3] B4 --> B5{ } B5 -- YES --> B6[6] B5 -- NO --> B7[7] B7 --> B8[8] B8 -- YES --> B9[9] B8 -- NO --> B12[] B9 --> B10[10] B10 --> B11[11] </pre> <p style="text-align: center;">EVA PROCEDURE</p> <p>Step 11 details:</p> <ul style="list-style-type: none"> ● Sublimator restart ● Feedwater valve - CLOSED ● PLSS diverter - MAX. cooling ● After 5 min, PLSS diverter - MIN. cooling ● Feedwater valve - OPEN <p>To Step 12 Next page</p> | <p>① Low feedwater pressure warning actuates at 1.45 ± 0.15 psid.</p> <p>② The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|---|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE</p> <pre> graph TD 12["12 ● Close PLSS Feedwater Vlv. Warning tone and low feedwater pressure flag "A" within 2 min"] 13["13 ● Open PLSS Feedwater Vlv. ● Repress LM GT8110P/GT8210P Feedwater Press. increase with LM Press."] 14["14 HIGH FEEDWATER USAGE RATE"] 15["15 GT8110P/GT8210P FEEDWATER PRESSURE FAILED"] 16["16 COMMON FEEDWATER PRESS. REDUCER FAILED"] 12 -- YES --> 13 12 -- NO --> 16 13 -- YES --> 14 13 -- NO --> 15 </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|--|
| <p>EMU 26</p> <p>GT815T/ GT8154T GT8254T LCG H₂O temperature > 68° F with diverter valve in MAX. cooling</p> <p>Possible causes: a. GT8154T/ GT8254T failed b. Sublimator degraded c. Feedwater flow re- stricted d. Sublimator breakthrough</p> | <p>EMERGENCY PROCEDURE</p> <p>EVA PROCEDURE</p> <pre> graph TD Start[1] --> Box1["1 Actuate gas trap for 2 sec GT8154T/ GT8254T <68° F within 2 min"] Box1 -- YES --> Box2["2 GAS IN TRANSPORT WATER LINE"] Box1 -- NO --> Box3["3 GT8196T/ GT8296T LCG H2O ΔT >15° F >5 min and GT8110P/ GT8210P feed- water pres- sure <1.3 psia"] Box3 -- YES --> Box4["4 SUBLIMATOR BREAKTHROUGH"] Box3 -- NO --> Box6["6 GT8196T/ GT8296T LCG H2O ΔT <5° F AND/OR GT8170T/ GT8270T O2 TEMPERA- TURE >50° F"] Box6 -- YES --> Box5["5 Sublimator re- start Feedwater valve - CLOSED PLSS diverter - MAX. cooling After 2 min, PLSS diverter valve - MIN. cooling Feedwater valve - OPEN"] Box6 -- NO --> Box8["8 GT8154T/ GT8254T LCG H2O TEMP- ERATURE FAILED"] Box5 --> Box7["7 SUBLIMATOR DEGRADED OR FEEDWATER FLOW RE- STRICTED"] Box4 --> Box7 </pre> | <p>① The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.</p> <p>② Actuation of the gas trap must be performed by another EV crewman. It cannot be self-accomplished.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|---|--|
| <p>EMU 27</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> GT8196T/GT8296T LCG H₂O AT >11° F (MAX. diverter valve position) </div> <p>Possible causes:</p> <ol style="list-style-type: none"> a. GT8196T/ GT8296T failed b. Pump de- gradation c. Gas in trans- port water line d. Sublimator breakthrough | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">EVA PROCEDURE</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>1 GT8154T/ GT8254T LCG H₂O Temp. <45° F</p> <p>NO</p> <p>3 GT8140C/ GT8240C PLSS Batt. Current >3.0 amps</p> <p>NO</p> <p>5 ● Actuate gas trap for 5 sec Cooling improved in 3 min</p> <p>NO To Step 7 Next page</p> </div> <div style="width: 45%;"> <p>2 PUMP DEGRADATION (COOLANT FLOW RATE <3.5 LB/MIN.)</p> <p>4 GT8154T/ GT8254T LCG H₂O TEMP. FAILED</p> <p>6 GAS IN TRANSPORT WATER LINE</p> </div> </div> <p style="text-align: center;">①</p> | <p>① During EVA operations, actuation of the gas trap can be performed by an assisting crewman only.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|---|--|
| | <p style="text-align: center;">EVA PROCEDURE (continued)</p> <pre> graph TD 7["7 GT8196T/ GT8296T LCG H₂O ΔT > 15° F > 5 min and GT8110P/ GT8210P feed- water pressure <1.3 psia"] -- YES --> 8["8 SUBLIMATOR BREAKTHROUGH"] 7 -- NO --> 9["9 GT8196T/ GT8296T LCG H₂O AT FAILED OR SHIFTED CALI- BRATION"] 8 -- 1 --> 10["10 ● Sublimator restart ● Feedwater valve-CLOSED ● PLSS diverter valve - MAX. cooling ● After 5 min, PLSS diverter valve - MIN. cooling ● Feedwater valve - OPEN"] </pre> | <p>① The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---|--|--|
| <p>EMU 28</p> <p>①</p> <p>GT8140C/GT8240C PLSS battery current > <u>3.0</u> amps</p> <p>2.4 to 2.6 is normal operating current</p> <p>Possible causes:</p> <p>a. GT8140C/ GT8240C failed</p> <p>b. Fan degraded</p> <p>c. Current sensor failed</p> <p>d. Pump degraded</p> | <p>EMERGENCY PROCEDURE</p> <p>1</p> <p>GT8140C/GT8240C double normal current reading</p> <p>YES</p> <p>2</p> <p>ONE OF TWO CURRENT SENSOR ELEMENTS FAILED OPEN</p> <p>3</p> <p>Low vent flow flag "P"</p> <p>YES</p> <p>4</p> <p>● Actuate OPS, open purge valve</p> <hr/> <p>EVA PROCEDURE</p> <p>5</p> <p>GT8170T/GT8270T O₂ Temp. < <u>38</u>°F</p> <p>YES</p> <p>6</p> <p>FAN DEGRADED</p> <p>7</p> <p>● Fan - CFF/ON</p> <p>GT8140C/GT8240C PLSS battery current <u>≤ 1.1</u> amp. while fan is OFF</p> <p>YES</p> <p>NO</p> <p>To Step 8 Next page</p> | <p>①</p> <p>Nominal PLSS power loads with EVCS operating in the primary mode:</p> <p>a. EVCS - <u>0.6</u> amp</p> <p>b. Fan - <u>1.3</u> amp</p> <p>c. Pump - <u>0.5</u> amp</p> <p>Total <u>2.4</u> amp</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|--|--|
| | <p style="text-align: center;">EVA PROCEDURE (continued)</p> <pre> graph TD 8["8 GT8196T/GT8296T LCG H₂O AT >11 °F and/or GT8154T/GT8254T LCG H₂O Temp. <45 °F"] 9["9 ● If required for cooling, actuate OPS and open purge valve"] 10["10 PUMP DEGRADED (FLOW RATE <3.2 lb./min.)"] 11["11 ● Turn pump OFF/ON GT8140C/GT8240C PLSS battery current <1.9 amp when pump is OFF"] 12["12 Record GT8141V/ GT8241V Battery Voltage"] 8 -- YES --> 9 9 --> 10 8 -- NO --> 11 11 -- YES --> 10 11 -- NO --> 12 </pre> <p style="text-align: center;">POST EVA PROCEDURE</p> | <p>① Normal PLSS battery voltage = 16.8 ± 0.8 Vdc and GT8141V/GT8241V inaccuracy is ±0.19 Vdc.</p> |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|--|---------|
| <p>EMU 29</p> <p>GT8140C/GT8240C PLSS battery current < 2.3 amp (no warning tone)</p> <p>2.4 to 2.6 is normal operating current</p> <p>Possible causes:</p> <p>a. GT8140C/ GT8240C failed</p> <p>b. Fan OFF, failed, or degraded</p> <p>c. Pump OFF, failed, or degraded</p> | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <pre> graph TD Start[GT8140C/GT8240C PLSS battery current < 2.3 amp (no warning tone)] --> Step1[1 GT8140C/ GT8240C PLSS batt. current ≤ 1.1 amp.] Step1 -- YES --> Step2[2 Low vent flow flag "p" (after 5 sec)] Step1 -- NO --> Step4[4 GT8140C/ GT8240C PLSS BATTERY CURRENT FAILED] Step2 -- YES --> Step3[3 ● Cycle fan OFF/ON Low vent flow flag CLEAR (after 10 sec)] Step2 -- NO --> Step4 Step3 -- YES --> Step3 Step3 -- NO --> Step7[7 FAN SWITCHED OFF INAD- VERTENTLY] Step4 --> Step5[5 Low vent flow flag "p" (after 5 sec)] Step5 -- YES --> Step6[6 ● Actuate OPS ● Open purge valve] Step5 -- NO --> Step8[8 FAN FAILED OR DEGRADED] Step6 --> Step8 Step7 --> Step8 Step8 --> Step9[9 Hear pump running and GT8140C/GT8240C PLSS battery current ≥ 1.2 amp] Step9 -- YES --> Step10[10 GT8196T/ GT8296T LCG H₂O AT > 11°F and GT8154T/ GT8254T LCG H₂O temp. < 45°F] Step9 -- NO --> Next12[To Step 12 Next page] Step10 -- YES --> Step11[11 PUMP DEGRADED (FLOW RATE < 3.5 LB./MIN.)] Step10 -- NO --> Next17[To Step 17 Next page] </pre> <p style="text-align: center;">EVA PROCEDURE</p> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|----------------------------------|--|---------|
| EVA PROCEDURE (continued) | | |
| | <pre> graph TD 12["12 Pump switch ON"] -- YES --> 13["13 If additional cooling required, actuate OPS and open purge valve"] 12 -- NO --> 15["15 PUMP SWITCHED OFF INADVERTENTLY"] 13 --> 14["14 PUMP FAILED"] </pre> | |
| POST EVA PROCEDURE | | |
| | <pre> graph TD 17["17 Record GT8141V/GT8241V Battery Voltage"] --> 16["16 Replace Battery (from other PLSS)"] 16 --> 18["18 GT8141V/GT8241V PLSS Batt. Volt. >16.0 Vdc"] 18 -- YES --> 19["19 DEGRADED BATTERY"] 18 -- NO --> 20["20 GT8141V/GT8241V PLSS BATT. VOLT. FAILED"] </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|---|---------|
| <p>EMU 30</p> <div data-bbox="337 370 483 540" style="border: 1px solid black; padding: 5px;"> GT8141V/ GT8241V PLSS battery voltage ≤ 16.0 Vdc (no warn- ing tone) </div> <div data-bbox="337 600 500 770" style="margin-top: 20px;"> Possible causes: a. GT8141V/ GT8241V failed b. Battery failed or degraded </div> | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <div data-bbox="516 370 685 540" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> 1 Low vent flow flag "p" (after 5 sec) </div> <div data-bbox="734 370 964 540" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> 2 ● Actuate OPS ● Open purge valve </div> <div data-bbox="1013 370 1188 540" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> 3 BATTERY FAILED </div> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">EVA PROCEDURE</p> <div data-bbox="516 762 685 1092" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> 4 GT8170T/GT8270T O₂ Temp. $< 38^{\circ}\text{F.}$ or GT8196T/ GT8296T LCG H₂O Temp. $> 11^{\circ}\text{F.}$ and GT8154T/ GT8254T LCG H₂O Temp. $< 45^{\circ}\text{F}$ or, sense any indication of degraded fan or pump </div> <div data-bbox="776 870 964 983" style="border: 1px solid black; padding: 5px;"> 5 BATTERY FAILING </div> <div data-bbox="558 1427 652 1467" style="margin-top: 20px;"> To Step 6 Next page </div> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|---------|---|---------|
| | <p style="text-align: center;">POST EVA PROCEDURE</p> <pre> graph TD 6[6 • Replace Battery (from other PLSS)] --> 7[7 GT8141V/GT8241V PLSS Batt. Volt. >16.0 Vdc] 7 -- YES --> 8[8 DEGRADED BATTERY] 7 -- NO --> 9[9 GT8141V/GT8241V PLSS Batt. Voltage failed] </pre> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|---|---------|
| <p>EMU 31</p> <p>GT8170T/ GT8270T O₂ temperature ≤38° F (no warning tone)</p> <p>Possible causes:</p> <ul style="list-style-type: none"> a. GT8170T/ GT8270T failed b. Fan OFF or degraded c. High PGA AP d. Flow restriction in vent loop | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>1 Low vent flow flag "P" YES → 2 Go to Step 1 Page 5-4</p> <p style="text-align: center;">NC</p> </div> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">EVA PROCEDURE</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>3 GT8140C/GT8240C PLSS Batt. Curr. ≥3.0 amp YES → 4</p> <p style="text-align: center;">NC</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>4 ● Fan OFF/ON GT8140C/GT8240C PLSS Battery Current ≤1.1 amp while fan OFF YES → 5 FAN DEGRADED</p> <p style="text-align: center;">NO</p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>6 GT8141V/GT8241V PLSS Batt. Volt ≤16.0 Vdc YES → 7 FAILING BATTERY CAUSED FAN DEGRADATION</p> <p style="text-align: center;">NO</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p>8 GT8170T/GT8270T O₂ TEMPERATURE FAILED, OR HIGH PGA AP, OR FLOW RESTRICTION IN VENT LOOP</p> </div> | |

APOLLO OPERATIONS HANDBOOK-EMU

| SYMPTOM | PROCEDURE | REMARKS |
|--|---|---------|
| <p>EMU 32</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> GT8170T/ GT8270T O₂ temperature >52° F (no warning tone) </div> <p>Possible causes:</p> <ul style="list-style-type: none"> a. GT8170T/ GT8270T failed b. Sublimator breakthrough or degradation c. Feedwater depleted d. Blocked water separator | <p style="text-align: center;">EMERGENCY PROCEDURE</p> <hr style="border-top: 1px dashed black;"/> <p style="text-align: center;">EVA PROCEDURE</p> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>1 Low feedwater pressure flag "A"</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>2 Go to Step 1 Page 5-12</p> </div> </div> <p style="text-align: center;">NO</p> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>3 GT8154T/GT8254T LCG H₂O temper- ature >60° F (Diverter valve- MAX. cooling)</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>4 SUBLIMATOR DEGRADED</p> </div> </div> <p style="text-align: center;">NO</p> <div style="display: flex; justify-content: space-between; width: 100%;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>5 GT8196T/ GT8296T LCG H₂O ΔT >11° F</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>6 EXCESSIVE HEAT LOAD</p> </div> </div> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>7 Crewman feels hot, sweats</p> </div> <p style="text-align: center;">NO</p> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p>8 GT8170T/ GT8270T O₂ TEMP. FAILED</p> </div> </div> | |