

L U N A R M O D U L E P I L O T S H A N D B O O K

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INTRODUCTION

The procedures and notes contained in this document are items which should be studied by Grumman personnel to better acquaint themselves with the Lunar Module Spacecraft.

This is an attempt to share the knowledge of LM cabin characteristics among all personnel involved in cabin operations.

Anyone knowing of possible additions to this document should forward an input as soon as possible to either;

GEORGE DOWLING, CONSULTING PILOTS OFFICE

OR

ROY BIRDWELL, PROCEDURES INTEGRATION

GRUMMAN AEROSPACE CORPORATION, KENNEDY SPACE CENTER

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D. EMERGENCY PROCEDURES

D

A. LM CABIN PROCEDURES

1. PROCEDURE - POWER UP OF IMU AND LGC

- A. To power up the IMU and LGC, the circuit breakers must be closed in the following order:

Panel 11, PGNS

- (1) IMU STBY
- (2) LGC DSKY
- (3) IMU OPR

- B. To remove power from the IMU and LGC, the circuit breakers must be opened in the following order:

Panel 11, PGNS

- (1) IMU OPR
- (2) LGC DSKY
- (3) IMU STBY

IMU heater power is required at all times -

- (1) during G&N testing, CB IMU STBY provides power to flight heaters
- (2) during G&N power down periods, GSE heaters are used via PTC.
- (3) heater power switchover from IMU STBY to PTC (GSE) will be verified when subsystem is powered down.

Failure to follow the outlined procedure could result in damage to the IMU due to lack of heater power to inertial components.

2. PROCEDURE - ERRONEOUS THRUST METER INDICATIONS

During manual operation of the descent engine, it is required that the Engine Thrust cont switch be in the "Manual" position.

In the auto mode the "Thrust Translation Control Assembly" (T/TCA) should be in the "Min. Thrust" position.

Failure to adhere to the outline procedure will result in erroneous indications on the thrust meters.

3. PROCEDURE - PREVENTION OF FALSE ALARM DURING PGNS TURN ON

During initial turn on of PGNS, the LGC/DSKY circuit breaker should be activated at least 20 seconds prior to C&W activation. Failure to observe this procedure can result in a false alarm. (LGC Warning).

When the LGC is turned on, a flip-flop associated with the LGC Warning Logic can come up in either the "set" or "reset" state. If it comes up "set", it will allow a steady state voltage to charge up a capacitor in the warning integrater which normally charges on a pulse signal. When the integrater reaches its threshold level, the LGC warning discrete is issued. The flip-flop is reset within 30 milliseconds but the capacitor, which has been charged up well beyond the threshold level by the steady state input, can require as much as 20 seconds to discharge below the threshold level. As a result, the LGC warning light is on due to this transient and stays on until the capacitor discharges. The master alarm is not activated during the presence of this condition since the master alarm circuit breaker is open at this time.

4. PROCEDURE - LM/HARDLINE COMM SWITCHOVER IN OXYGEN RICH ENVIRONMENT

To eliminate arcing and/or exposure to live terminals in a pure oxygen environment and to ensure that at least one crew man maintains voice communication at all times, the following procedure must be followed when switching from hardline (H/L) to LM and from LM to H/L communication.

1. Both crewmen must not disconnect their Deadface (D/F) box at the same time.
2. Interrupt Mike and Biomed power to the CDR or the LMP by placing the respective deadface box comm sw to Deadface.
3. Open respective Comm SE AUDIO CB or CDR AUDIO CB.
4. Open COMM PMP CB (or TLM BIOMED SW-OFF).

NOTE: If BIOMED is desired, the TLM BIOMED SW will be placed to the LEFT or RIGHT position depending on whether the LMP or CDR is demating the electrical umbilical. (LEFT LMP Switchover and RIGHT for CDR Switchover)

5. Transfer electrical umbilical from deadface box to PGA or from PGA to deadface.
6. Close respective AUDIO CB.
7. Repeat steps 2,3,4,5,6 for other crewman.
8. Close Comm PMP CB (or TLM BIOMED SW-desired position)
9. Deadface box Comm SW-ON (if switchover was to deadface box)

Failure to follow the outline procedures may result in fire inside the chamber and/or in the temporary loss of communication with both crewmen in the chamber.

B. LM NOTES

1. TITLE: TTCA THROTTLE/JETS SELECTOR

STATEMENT: When selecting "jets" on the TTCA/s, the mechanical linkage is such that the control handle is moved to the mid-position (detent). If the throttle is at or near the minimum or maximum thrust position when the selection of jets is made, extremely high forces are required to actuate the throttle/jets selector. This problem is compounded if the friction knob is adjusted to a high friction level.

CHARACTERISTICS: Positioning the throttle to the approximate mid-position prior to selecting jets greatly reduces the forces required to make the selection.

RESOLUTION: Other conditions permitting, position the throttle to the mid-position prior to selecting jets.

2. TITLE: OIL CANNING

STATEMENT: The pressurization and depressurization of the LM-3 cabin during the "Pressurized Cabin C.O.A.S. alignment test" demonstrated the existence of oil canning. The oil canning occurred primarily during the first 1.0 PSID of pressurization and the last 1.0 PSID of depressurization. The affected areas were mostly in the vicinity of the overhead and forward hatches.

COMMENTS: Whether this effect will be noticed by the crew during depressurization and repressurizations will depend upon sound transmission characteristics.

No comments have been received from crews during altitude chamber tests.

3. TITLE: "RATTLES"

STATEMENT: Various areas in LM have "pop-rivet" installations. During manufacturing, when parts are assembled, the tail rivet pops off and is trapped inside closed areas such as:

- (1) forward window crash bars
- (2) certain areas around the overhead hatch

These loose pieces will tend to move around and cause a "Pebbles in the Hub-cap" sound when either the vehicle is re-oriented or the crash bar moved from one position to another in a gravitational field.

COMMENTS: Available manufacturing methods prevent avoidance of this situation.

4. TITLE: ED STAGE SWITCH GUARD

STATEMENT:

1. The ED Stage Switch Guard Mount is flimsy and is easily bent out of shape. The guard was not designed to protect the switch but to prevent the operator from inadvertently throwing it.
2. The Guard and Switch are out of phase i.e., the Guard runs $\pm Z$ and the switch (bayonet) runs $\pm Y$.

COMMENTS:

Handle with care.

5. TITLE: STOP BUTTON HOUSING

STATEMENT: The Stop Button Housing Mount on Panel 6 is weak and gives when a side load is applied.

COMMENTS: DON'T PUSH.

6. TITLE: AOT COUNTER BOX

STATEMENT: The Counter Box mounted on the lower -Y side of the AOT is fastened with short screws.

COMMENTS: 1. The Vendor is of the opinion that there are a sufficient number of threads to hold the box on.
2. Do not use as hand hold.

7. TITLE: FRICTION ADJUSTMENT ON TTCA

STATEMENT: It has been noted at times that the throttle friction knob on the TTCA is hard to turn.

CHARACTERISTICS: This is a push-pull type of knob - ie: pull to turn easily - push for finer control.

COMMENTS: If the friction knob seems hard to turn, pull out on it and then turn.

8. TITLE: RENDEZVOUS RADAR MANUAL SLEWING/NO. 1

STATEMENT: Manual slewing of the Rendezvous Radar in Mode I will provide direct reading rates to the X-pointers on Panels #1 and #2. When the radar is manually slewed in Mode II, however, slew up and down commands will be read out on the X-pointers as inverted rates: A slew-up command will generate a down-slewing antenna rate. Right and left commands will continue to read out directly.

COMMENTS: This situation will only appear during manual slewing. With automatic radar operation, the direction and rate of antenna slewing will be properly sensed by the computer.

9. TITLE: RENDEZVOUS RADAR MANUAL SLEWING/NO. 2

STATEMENT: During manual slew, the X-pointers will indicate a rotation rate as a result of the switch command and will not indicate actual rotation of the radar.

COMMENTS: It is possible to indicate a slew rate while the radar is still stowed. A glance through the AOT is justified- especially during Mode II operation.

10. TITLE: RENDEZVOUS RADAR/FDAI A&E NEEDLES/NO. 2
- STATEMENT: The azimuth and elevation needles on both FDAI's
 will drive in step motions.
- COMMENTS: This is a design item and considered normal.

11. TITLE: DEDA PUSHBUTTON ACTUATIONS

STATEMENT: It is possible for the CLEAR, ENTER, or READOUT discretes to be enabled in the DEDA and not in the AEA.

CHARACTERISTICS: The sampling rate in the AEA is such that if a too rapid actuation is made, a partial or incomplete cycle can occur.

COMMENTS: Positive and complete DEDA button operation is required. When positive depression is made, normal operation will result.

12. TITLE: UPLINK TOO FAST

STATEMENT: DUA power down may output noise pulses in the "zero" and "one" lines to the LGC. The LGC will inhibit use of this input and issue a PROG. ALARM, "Uplink Too Fast."

- COMMENTS:
1. If a prog. alarm (Uplink Too Fast" occurs upon DUA power down, key reset and clear to reset the alarm. This does not clear inlink counter: it only turns off the alarm indication.
 2. Always on power up of DUA:
 - a. Clear inlink counter by keying
V21 N 01 E
00045E
00000E
 - OR
 - b. Call up P00 - (Automatically resets inlink counter)
 - OR
 - c. MSFN - preface all uplink transmission by the proper binary code words to clear the inlink counter and enable the LGC to process subsequent uplink words.

13. TITLE: VHF NOISE

STATEMENTS:

The VHF units used in the Lunar Module do not incorporate automatic squelch circuits, whereas the S-Band units do have these squelch circuits. Consequently, use of S-Band communications will result in a quiet background when no signal is being transmitted. However, the VHF units may have a good deal of white noise present in the receivers when no signal is being received. This noise can be eliminated by adjustments to the "AUDIO" panel VHF "VOLUME" controls, and to the "COMMUNICATIONS" panel VHF manual "SQUELCH" controls.

14. TITLE: AGS WARNING

STATEMENT: The AGS Warning Light will flash and the Master Caution light will illuminate when the AGS Status Switch is turned from OFF to STBY and from STBY to OPER.

CHARACTERISTICS: When switching from OFF to STBY, the CWEA is enabled before the ASA power supply reaches its in-tolerance level. Switching from STBY to OPER triggers the CWEA due to momentary self test failure when memory power is applied.

COMMENTS: The momentary AGS Warning light may not be noticed before it is extinguished. This will leave a master warning light with no apparent cause.

15. TITLE: RCS TCA WARNING WHILE POWERED DOWN

STATEMENT: When powered down with the TCA CB's open, erroneous jet firing indications cause alarms. These alarms are caused by the open TCA line acting as a long wire antenna picking up noise that is misinterpreted as firing commands by the C&WEA system.

CHARACTERISTICS: When the ATCA CB is closed, the current surge will cause the RCS TCA light to come on. It may also come on at other times while the TCA CB's are open.

COMMENTS: Ignore TCA alarms when powered down, and after RCS powering, cycle the C&WEA CB when requested to clear any accumulated indications.

OR

Inhibit primary coil operation by the Mode Control Switch ("OFF") rather than opening the TCA CB's (when requested).

16. TITLE GENERAL CWEA

STATEMENT: Some of the "latching" type caution and warning indicators can mis-represent the condition of initial power-up.

CHARACTERISTICS: If the following circuit breakers are closed after the CWEA circuit breakers, an out of tolerance condition will not be detected. In other words, an "in tolerance" condition must exist before a fail indication can be obtained.

	<u>CB</u>	<u>CWEA ANNUNCIATOR</u>
S/C:	ATCA	CES AC & DC
S-Bd:	Prime or Sec. XMTR/Rcvr.	S-Bd Receiver
Inst:	Sig. Sensor	02 Qty. Water Qty. RCS

COMMENTS: Depress the CWEA C.B. after the function CBs, or cycle the CWEA CB after initial power up when requested.

17. TITLE: COAS LIGHTING

STATEMENT: COAS Lighting Adjustment is linear until reaching
midway, at which time it steps to near full bright.

COMMENTS: Consistent: Use as is.

18. TITLE: CIRCUIT BREAKER LOCATIONS

STATEMENT: All subsystem CB's are located in groups with the following exceptions:

1. Panel 11. AC Bus A on the top row is split. There are three CB's on the next row down.
2. Panel 16. ECS on row 3 is split. There is one CB on row 2.

COMMENTS: USE CAUTION.

19. TITLE: TAPE METER/NO. 1

STATEMENT: The RNG/RNG RT-ALT/ALT RT METER can become erratic when in a powered-up condition without a logic input signal present.

COMMENTS: To prevent unnecessary cycling, the following sequence is used providing an input signal before and after meter is powered.

Turn-on:

Close: AC Bus A
RNG/RNG RT - ALT/ALT RT CB

Close: RNG/RNG RT - ALT/ALT RT CB FLT DISP

Turn-off:

Open: RNG/RNG RT - ALT/ALT RT CB FLT DISP

Open: AC Bus A
RNG/RNG RT - ALT/ALT RT CB

20. TITLE TAPEMETER/NO. 2
- STATEMENT: The Tapemeter Power Fail Light will light at random times without indicating power failure.
- CHARACTERISTICS: 1. An inconsistent or random failure light operation is not a failure condition.
2. A steadily blinking or a full-on failure light indicates loss of input signal or loss of power.
3. A flashing of the light at or near zero rate is a characteristic associated with the zero indication.
- COMMENT: Except the light and assess secondary cues to determine nature of problem.

21. TITLE: STICKING FLAGS (TB)
- STATEMENT: There have been several reports of sticking flags on various vehicles.
- CHARACTERISTICS: The flags are not integral parts of the circuitry and therefore have no direct effect on systems operation.
- COMMENTS: Hitting the switch a second time or a gentle tap on the panel usually releases the circuit.

22. TITLE DSKY LIGHTING

STATEMENT: The light level of the DSKY Status Lights and VERB/
NOUN numerals is low when compared to the DSKY numerics.

CHARACTERISTICS: If the DSKY numeric lights are adjusted to a low
comfortable brightness, the DSKY Status Lights and
VERB/NOUN numerals will be dimmer than the other
DSKY lighting.

COMMENTS: Since the Status Lights are normally not on when the
DSKY lighting is adjusted, the level should be set on
the high side if failure to observe a status
light could present checkout problems.

The VERB/NOUN numerals are dimmer than the other
DSKY lighting due to an additional design feature
which limits surge currents to the verb and noun
numerals during flashing displays.

23. TITLE: MISREADING SWITCHES/NO. 1

STATEMENT: There are several areas wherein confusion can arise during switch configuring.

Panel #1: On separate occasions, the "PRPLNT QTY MON" switch has been confused with the "PRPLNT TEMP/PRESS MON" switch. There is also a "TEMP/PRESS MON" switch on Panel #2 and a "TEMP MONITOR" switch on Panel #3.

-NOTE-

The RCS TEMP/PRESS MON selector sw on PNL 2 is a 4-position rotary sw, providing pressure monitoring at all four positions. However, it only provides temperature monitoring at the PRPLNT position. At He, FUEL MANIF, and OXID MANIF, the RCS temperature gage readings will drop to the bottom of the scale.

Panel #12: The LMP will want to definitely differentiate between the "AUDIO" controls and the "COMMUNICATIONS" controls.

24. TITLE: MISREADING SWITCHES/NO. 2

There are several areas wherein confusion can arise during switch configuring.

STATEMENT:

1. Panel #11: There are two sets of BUS TIE INV 1 and INV 2 CB's. One set is under AC Bus B and one set is under AC Bus A. Both sets are on the same row and next to each other.
2. Panel #11: There are two RNDZ RDR CB's. One is under AC Bus A on the top row and the other is under PGNS on the fourth row down.
3. Panel #11: There are two RNG/RNG RT ALT/ALT RT CB's. One is under FLIGHT DISPLAYS and one is under AC Bus A.
4. Panel #11: There are four similar CB's under EPS. They are DES ECA CONT, DES ECA, ASC ECA CONT and ASC ECA and are located on the bottom row.
5. Panel #11: There are two sets of QUAD 1, 2, 3 and 4 CB's. One set is under RCS SYS A and one set is under HEATERS RCS SYS A/B-1.
6. Panel #11: There are two similar CB's under RCS SYS A. They are ASC FEED 1 and ASC FEED 2 and are located on the second row next to each other.
7. Panel #11: There are two similar CB's under PGNS. They are IMU STBY and IMU OPR and are next to each other.

25. TITLE: MISREADING SWITCHES/NO. 3

STATEMENT: There are several areas wherein confusion can arise during switch configuration.

1. Panel #16: There are two similar CB's on the top row. One is PQGS/DISP under RCS SYS B and one is PQGS under PROPUL.
2. Panel #16: There are three similar CB's under ECS. They are SUIT FLOW CONT, SUIT FAN Δ P and SUIT FAN 2. Two are next to each other.
3. Panel #16: There are two S-BD ANT CB's. One is under HEATERS on row 4 and the other is under COMM on row 3.
4. Panel #16: There are 4 similar CB's under EPS. They are ASC ECA CONT, ASC ECA DES ECA CONT and DES ECA on the bottom row.
5. Panel #16: There are two sets of QUAD 1, 2, 3 and 4 CB's. One set is under RCS SYS B and one set is under HEATERS RCS SYS A/B-2.
6. Panel #16: There are two similar CB's under RCS SYS B. They are ASC FEED 1 and ASC FEED 2 and are located on the top row next to each other.
7. Panel #16: There are two similar CB's under STAB/CONT. They are ATCA and ATCA (AGS) and are on the same row.

26. TITLE: ECS CAUTION LIGHT

STATEMENT: Cycling the Suit Fan Switch from #2 to #1 may cause the ECS Caution and Suit Fan component lights to flash and trigger the Master Alarm. ECS Caution light may again flash in 3-7 seconds. A new Master Alarm will come on, if it has been reset. (Suit Fan component light will not flash at this time.)

CHARACTERISTICS: The first alarm caused by switching from 2 to 1 is due to CWEA sensing low Δp across fan 1 initially. The second is due to a capacitor across relay contacts activating the M.A. 3-7 seconds after selecting 1.

COMMENTS: Expect it and reset as requested.

27. TITLE: CO2 PARTIAL PRESSURE INDICATOR
- STATEMENT: When the CO2 Sensor CB is closed, the Panel 2, ECS PART PRESS CO2 meter will momentarily rise to any value before settling back to an operational readout. This may/may not activate the Master Alarm and ECS Caution light.
- COMMENTS: This is an acceptable nuisance. Expect and reset Master Alarm when requested.

28. TITLE: SUIT/FAN WARNING

STATEMENT: When switching from suit fan 1 to 2, either due to failure of 1 or for purpose of checkout, the suit/fan warning light and suit/fan component light may flash and trip the Master Alarm. Suit/Fan Warning may again flash in 3-7 seconds, re-triggering the Master Alarm if it has been reset. (Suit Fan Component Light will not flash at this time.)

CHARACTERISTICS: The first alarm caused by switching from 1 to 2 is due to CWEA sensing low Δp across fan 2 initially. The second is due to a capacitor across relay contact activating the M.A. 3-7 seconds after selecting 2.

COMMENT: Expect and reset as requested.

29. TITLE: ECS VALVE POSITIONING

STATEMENT: All valves should be "felt" into detent positions in addition to checking alignment marks.

COMMENTS: Use standard "airplane" valve positioning techniques.

All two-position valves and the end stops on three and four position valves leave no question as to which position the valves are in.

The mid-position on three and four position valves must be carefully felt into detent positions in addition to checking alignment marks.

30. TITLE: C02 CANISTER SELECT

STATEMENT: The labeling on the C02 Canister Select Valve is different from most other valve and switch labeling. It indicates the direction to move the valve rather than the valve positions. Thus it may be confusing.

COMMENTS: A convenient rule of thumb to use with the C02 Canister Select is to point the valve lever to the actual C02 Canister desired.

31. TITLE: REVERSE CURRENT DURING LV TO HV SWITCHOVER

STATEMENT: During switchover from LV Taps to HV Taps on the descent batteries, battery malfunction indications may be obtained as a result of reverse currents.

COMMENT: This a normal operation but master alarm activation is possible.

Expect and reset as requested.

32. TITLE: CIRCUIT BREAKER OPERATION

STATEMENT: Care must be taken during all opening and closing of LM circuit breakers.

CHARACTERISTICS: LM circuit breakers are of light weight construction and can be damaged with improper operation.

COMMENTS: To minimize the possibility of physical or electrical failure, the following precautions should be taken:

1. When closing circuit breakers, use a positive, straight in motion.
2. When opening circuit breakers, employ minimum force in a straight-out motion.

33. TITLE: COAS INSTALLATION POSITION DETENTS

STATEMENT: Changing the COAS glass angle from left window to overhead (or vice versa) is complicated by having to position the glass to a detent while simultaneously aligning the "barrel lock" to its detent.

CHARACTERISTICS: Awkward and difficult two-handed, overhead operation.

34. TITLE: RANGE/ALT. METER "JUMP"

STATEMENT: The Range/Alt. meter may appear to "jump" during normal operation.

CHARACTERISTICS: The following chart shows the relationship between tape markings, range, value of the Least Significant Bit and Tape Travel per Least Significant Bit:

RANGE	VALUE OF LSB	TAPE MARKINGS	TAPE TRAVEL PER LSB
50 ft. to 898 ft.	R.R. - 9.38 ft. Others - 2.34 ft.	0 to 1000 ft. Markings every 5' = 0.2" apart	R.R. = 0.375 inches Others = 0.093 inches
900' to 1200'	18.76 ft.	1000' to 60,500' mkgs every 100' = 0.08 inches apart	From 900' to 1000' = 0.75 inches From 1000' to 1200' = 0.015 inches
1200' to 38,418	37.52 ft.		0.03 inches
38,420' to 57,628'	300.16 ft.		0.24 inches
57,630' to 76,838 12.6 NM	1200.64 ft.		From 57,630' to 60,500' = 0.96 in. From 60,500' to 12.6 NM = 0.02 in.
12.6 NM to 404.4 NM	2401.28 ft. (1/3 mile)		0.04 inches

Since the Range/Alt. tape drives at a constant rate (2 inches per second) it may seem at times to "step" from one reading to the next. This characteristic is due to R, tape drive rate and the value of tape travel per LSB. To illustrate, (from the table above), in the range between 57,630 feet to 76,838 feet (12.6 NM), the value of the LSB is 1200.64 feet and tape travel per LSB (from 57,630 feet to 60,500 feet) is 0.96 inch. If the vehicle is moving at 600 FPS, it takes 2 seconds to update the LSB input to the meter and the meter will jump 0.96 inch every 2 seconds. If the vehicle were moving at 1200 FPS or higher, the tape would follow more smoothly because its travel rate of 2 inches per second would have it "behind" all the time and would only catch up when R comes below the effective tape speed of 2 inches per second.

COMMENTS: This is "normal" operation for this meter

35. TITLE: HELIUM INDICATOR

STATEMENT: It has been observed that the Helium Indicator displays a reading with the Helium Monitor Selector Switch in the "OFF" position.

CHARACTERISTICS: Whenever the AC BUS B Numerics CB and AC BUS He/PQGS Propulsion disp. CB are depressed, the indicator will show some reading. This happens regardless of the Position of the Helium Monitor Select Switch.

COMMENTS: The readings are valid only if the selector switch is in other than the "OFF" position. If the switch is "OFF" and the display is annoying, it may be blanked by pulling the AC BUS B, He/PQGS Propulsion display CB per procedure.

36. TITLE: T/TCA THROTTLE - JETS SELECTOR LEVER

STATEMENT: Comment has been made concerning the necessity to positively insure that the Throttle - Jets selector lever is definitely in the desired detent position. If not, the respective selected function (Throttle or Jets) may not be enabled. Some difficulty has been experienced, however, with moving the lever from one setting to the other. When moving from Throttle to Jets, position the Throttle at the mid-position to remove some of the positioning load from the centering cams. Also, when moving the selector lever either direction, put some outward (from the panel, -Z) pressure on the lever first. This will disengage the detent first making the $\pm X$ movement much easier.

COMMENTS: Be firm with the lever and feel it snap into the detents.

37. TITLE: LGC WARNING LIGHT

STATEMENT: If the LGC/DSKY C.B. is closed subsequent to CWEA power-up, a MASTER ALARM and LGC WARN LT may be generated for as long as 15-20 seconds.

DISCUSSION: Due to the mechanization and timing of the LGC warning circuitry, it is possible upon LGC power-up for the state of the warning logic to be in the "set" condition. If the logic happens to be "set" at power-up, it will remain in the "set" state for 250 msec. This is well in excess of the 7.4 msec required to trigger the LGC warning circuitry. Because of the long duration of the "set" state, the warning circuitry capacitor will be charged well above threshold and a LGC WARN LT and MASTER ALARM will persist for 15-20 sec.

RESOLUTION: 1) Expect a possible warning indication and reset when requested.
OR
2) Close LGC/DSKY C.B. prior to CWEA activation (per procedure).

38. TITLE: INVERTER

STATEMENT: Moving the INVERTER SW from OFF to 1, 1 to 2, or back may cause the MASTER ALARM to trigger and the INVERTER CAUT LT to flash.

DISCUSSION: Nominal CWEA operation -

Excitation: 1) Bus voltage falls below 112 VAC.
2) Bus frequency 398 CPS or 402 CPS.

Inhibited: INVERTER SW in "OFF" position.

When the INV SW is moved from OFF to 1 or 2, the CWEA is enabled before the INV voltage and frequency reach intolerance limits and therefore a MASTER ALARM and momentary INV CAUT LT is generated.

When the INV SW is moved from 1 to 2 or back, MASTER ALARM and CAUT LT may occur because of momentary bus interruption while the inhibit is lifted.

RESOLUTION: 1) For initial INV turn-on (OFF to 1 or 2), turn-on INV prior to CWEA power-up (per procedure).
2) For other cases, expect a possible momentary failure and reset the MASTER ALARM when requested.

39. TITLE: STICKY SUIT PRESSURE METER
- STATEMENT: Occasionally the SUIT PRESSURE METER (PNL 2) remains pegged at 10 psia during suit loop pumpdown.
- DISCUSSION: With the sensor transducer and Pressure Meter (PNL 2) activated, normal atmospheric pressure will peg the meter at 10 psia. During subsequent pumpdown of the suit loop, the meter fails to track, i.e., it remains pegged. In all cases where this has occurred, tapping the meter has caused it to change to the correct reading.
- RESOLUTION: Use as is. Tap meter if it hangs-up.

40. TITLE: FM RESET

STATEMENT: It may, under certain circumstances, be necessary to recycle the PM/FM switch in order to reset the FM modulator.

CHARACTERISTICS: If the PM/FM switch is in the FM position and either emergency key or DN voice BU is selected, the system automatically switches to PM. When returning to the normal FM mode, the FM modulator will not come on without cycling the PM/FM switch.

COMMENTS: To return to the normal FM mode after being in emergency key or backup voice, the PM/FM switch will be recycled to PM and back to FM to properly reset the FM modulator.

41. TITLE: STEERABLE S-BAND ANTENNA SLEWING

STATEMENT: The Pitch Servo Meter on Panel 14 for the Steerable S-Band Antenna is not accurate in its readings for antenna positions.

COMMENTS: The servo meter is not really required for positioning the antenna. The LGC will be used to compute the correct pointing angle and the antenna will be slewed by setting the pitch and yaw controls at the desired setting. The signal can then be peaked until the signal strength meter indicates maximum signal strength. The antenna "Track Mode" switch will then be placed to "auto" and the antenna will automatically track the desired signal.

The Pitch Servo Meter (at angles greater than $+120^\circ$ pitch) can be used to indicate motion and relative direction of the antenna.

42. TITLE: S-BAND EMERGENCY KEY MODE

STATEMENT: The emergency key mode cannot be selected with the Panel 16 COMM PMP CB closed.

COMMENTS: The PMP CB on Panel 16 must be open when selecting the emergency key mode.

43. TITLE: PANEL #1 "HUM"

STATEMENT: In a lighting check following LM-5 DSKY reinstallation, the "INTEGRAL" lighting control on Panel #5 was set to the maximum ("BRIGHT") position. Panel #1 was discovered to be emitting a hum which was traced to the "RANGE/ALTITUDE" meter. This is a normal condition caused by the presence of the A/C voltage lighting being applied to a transformer within the meter case.

COMMENTS: Annoyance.

44. TITLE: CDR'S X-POINTER CB

STATEMENT:

The CDR's X-Pointer Circuit Breaker also powers the relay box for the Panel 1 Mode Sel SW. If the CDR's X-Pointer C/B is pulled, the Mode Sel System will revert to PGNS regardless of switch position.

45. TITLE: D-C BUS VOLT READOUTS

STATEMENT: The DC Voltmeter receives its signals from the Signal Conditioner. In order to read D-C Bus Volts and the Signal Conditioner C/Bs must be closed for the respective bus.

46. TITLE: TELEMETRY BIOMED SWITCH

 STATEMENT: The TELEMETRY BIOMED SWITCH on PANEL 12 works
 in a direction opposite to its labeling. BIOMED
 RIGHT position is to the left and BIOMED LEFT
 position is to the right.

 COMMENTS: Use caution in selecting proper position.

47. TITLE: HEATER CAUTION LIGHT (LR TEMP.)

STATEMENT: The Landing Radar temperature input to the Heater Caution Light has been inhibited.

COMMENTS: Master Alarm and Heater Caution due to overtemperature (above 148.9°F) or undertemperature (below - 150°F) would be expected on a lunar landing mission. This warning is undesirable during or after lunar touchdown, the time that an overtemperature is most likely and of little importance to the crew. The data is downlink via telemetry (Measurement # GN 7563T) and may be read by manually selecting LR on the Temp. Monitor switch and observing the Heater Control Temp. indicator.

48. TITLE: HEATER CAUTION LIGHT (RCS QUAD TEMPS.)

STATEMENT: The RCS Quad temperature input to the Heater Caution Light has been inhibited.

COMMENTS: Master Alarm and Heater Caution due to overtemperature or undertemperature of RCS Quads will no longer occur but the temperature can be read via telemetry data or through the cabin display.

49. TITLE: LANDING RADAR CAUTION LIGHT

 STATEMENT: The LDG RDR Caution Light has been eliminated and the data good measurement removed from the CWEA circuit.

 CHARACTERISTICS: Prior to this modification the range data and velocity data once detected as good data enabled the CWEA circuit so that subsequent loss of good data or the loss of LR power caused the LDG RDR Caution Light and Master Alarm to be activated. This measurement has been removed from CWEA due to the high probability of an undesirable alarm during lunar surface approach.

 COMMENTS: The telemetry data has not been inhibited; therefore, MSFN will receive the data good or no good information for range and velocity.

50. TITLE: ENGINE STOP PUSH BUTTON
- STATEMENT: In the original stop-push button design, an inadvertent double-push or latch-up failure when attempting to shut down the engine could have resulted in an undesirable engine restart. For this reason, an external latching device has been added.
- CHARACTERISTICS: In normal operation, if the button (yoke) is pushed straight and firmly, it will ensure against an inadvertent restart. Prior to depressing the latch release tab, care must be taken to de-arm the engine as the first depression of the release tab may result in completing the re-set action. Normally the button (yoke) must be pushed again and then the tab depressed again to complete the re-set action.
- COMMENTS: This entire mechanism will be adjusted and individually qualified so as to minimize possible anomalies.

51. TITLE: COAS INSTALLATION IN BRACKET
- STATEMENT: The COAS bracket locking pin on both brackets seats stiffly and may require positive action by the crew to seat the pin.
- CHARACTERISTICS: This is a minor hinderance that could be a little time consuming due to the requirement for exact alignment of the COAS base to the pin. Lack of pin seating does not affect the COAS alignment accuracy but could allow the COAS to be inadvertently removed from the bracket.
- COMMENTS: The alignment occurs at the end of the COAS connector mating travel, and the alignment tolerance is so close that slight readjustment of the COAS mating travel may be required in order to seat the pin.

52. TITLE: COAS BARREL ADJUSTMENT

STATEMENT: The locking positions under the "LW" or "OW" indications must be felt for by rotating the barrel "alignment" marks slightly under "LW" or "OW" until the Barrel Locking Knob drops into place.

CHARACTERISTICS: This is a slight hinderance in selecting the proper window setting when moving the COAS to the other window.

COMMENTS: When changing the COAS setting with gloves on, the clicking into place may be missed. In this case a soft rotation effort will confirm the detent position.

53. TITLE: TTCA MAX THRUST - COMMAND THRUST INDICATION
- STATEMENT: When the TTCA is placed in the maximum thrust position, the commanded thrust meter will indicate above 100%; it extrapolates to about 104%.
- CHARACTERISTICS: The maximum throttle position on the TTCA puts out an analog voltage to the DECA which is approximately equivalent to 112% of the voltage required for 100% thrust. The commanded thrust indicator receives this excess voltage and drives to its upper limit; something above 100%. When the voltage reaches the throttle valve actuator, the excess is screened out and the engine will not operate above 100% thrust.
- COMMENTS: This item is included as information only.

54. TITLE: TTCA SOFT STOP - COMMANDED THRUST INDICATION
- STATEMENT: The specifications for the commanded thrust indication are very wide ($52.7 \pm 6.5\%$) at the TTCA soft stop position.
- CHARACTERISTICS: During LM-7 FEAT both the CDRs and LMPs TTCAs were tested at the soft stops and both produced a commanded thrust indication of 53%.
- COMMENTS: This item is included for information only since the specifications are so wide.

55. TITLE: SLIP-CLUTCHES ON THE FLOODLIGHT POTENTIOMETERS
- STATEMENT: The overhead/forward floodlight potentiometers on Panels 3 and 5 have been modified to include slip clutches that allow the handles to rotate beyond the internal stops. This feature was designed to prevent damage to the pots.
- CHARACTERISTICS: The knob alignment mark may not be aligned with either "dim" or "bright" at the ends of rotation travel due to this built in slippage. There is no harm done to the assembly when the slippage occurs so they may be re-aligned with these limit marks if desired.
- COMMENTS: Only these potentiometers have the clutches, so do not force the others beyond their stops or damage will occur.

56. TITLE: HEATER CONTROL TEMPERATURE INDICATOR

STATEMENT: The old 190° temperature limit on the RCS thruster quads was recently removed; as was the quad over temperature activation of the "Heater" caution and master alarm lights. When these changes were made, a higher reading temperature scale was added to Panel 3 so that the higher allowable quad temperature could be read from this meter. It reads from -60° F to +260° F.

CHARACTERISTICS: This added temperature scale is glued to the panel face so there is no back lighting. In a dim cabin another light source will be required to read it. In addition, the scale is placed far enough to the left of the meter so that a straight edge (like the top of the check list) should be placed against the meter and scale for a reasonably accurate reading.

COMMENT: There is little enough need for accuracy in reading the precise quad temperatures so that no engineering change has been requested at this time.

57. TITLE: ED RELAY CAUTION/MASTER ALARM

STATEMENT: When the ABORT STAGE button is cycled OFF, a MA with a C&W light (Flash) may occur.

CHARACTERISTICS: This occurs after staging or when the ENG ARM switch is thrown to the ASC position for a second or subsequent APS burn.

COMMENTS: Expect the MASTER ALARM and reset when requested.

58. TITLE: E.D. RELAY CAUTION/MASTER ALARM

STATEMENT: When the abort stage button is reset, a master alarm with E.D. Caution Light and E.D. stage sequence relay A&B component lights will occur.

CHARACTERISTICS:

1. When the abort stage button is reset after staging, the E.D. caution light (Panel 2) plus E.D. stage sequence relay A&B component lights (Panel 8) will be on and the master alarm will come on.
2. After manual staging, if the master arm switch is off and the abort stage switch is in the "reset" position (has not been used), firing of the ascent engine (equivalent to issuing a stage command to E.D.) will energize the staging relay (K2) and cause the master alarm to be activated as well as the E.D. caution light (Panel 2) and stage sequence relay A&B component lights (Panel 8).

COMMENTS: For (1) and (2) above expect the master alarm and cycle the stage relay switch (Panel 8) to reset then off and reset the master alarm when requested.

59. TITLE: AC OVER-VOLTAGE INDICATIONS
- STATEMENT: The voltmeter, on Panel 14, has a small green-band area that is used for AC readings. When there is little or no load on the selected inverter, the reading on this meter will be above the green arc.
- CHARACTERISTICS: This green arc runs from the 35.8 to 37.7 DC volt indications of the meter and corresponds to the normal AC operating range of 112 to 118 VAC. Any voltage below 112 will trigger the "inverter" caution light and the master alarm but higher levels will not and an unloaded inverter will always put out more than 118 volts.
- COMMENTS: Expect AC readings above the green band when powering up the AC Bus.

60.

TITLE

APPARENT DOUBLE DETENT IN OPEN POSITION OF THE
CABIN GAS RETURN VALVE

STATEMENT:

In the LM-7 C2 F2 test, a TDR was taken on this item because it was noticed that this valve handle could be rotated slightly beyond the point where the open detent was felt. This raised some doubt as to whether the valve opening action and electrical contact indicating the valve open position were occurring at the same point. Further testing revealed that there was no problem.

CHARACTERISTICS:

When the vehicle was configured to evaluate this condition, it was found that the electrical contact and valve opening were occurring simultaneously. Attempts were made to "tease" the valve through and out of its wide detent to separate these actions but this would not happen.

COMMENTS:

The valve works properly and the over-travel in the open detent can be disregarded.

61: TITLE: DIFFICULTY IN STOWING THE CDR'S ACA ARMREST

STATEMENT: Raising the CDRs armrest from a deployed position to the full up and stowed position requires approximately 25-30 pounds of force for the final move into the detent position.

CHARACTERISTICS: This force is about the same in all vehicles for that one armrest and is a result of the lever action that lifts the ACA out of its seats. The springs that hold the ACA down when the armrest is deployed have to be overcome at this point.

COMMENTS: There now is also a lock on this ACA that must be released prior to stowing the armrest. Failure to unlock the ACA will cause a complete stop to be experienced at the normal resistance point.

62. TITLE: ERECTING EVA ANTENNA TO VERTICAL POSITION

STATEMENT: Rapid rotation of the EVA Antenna erection handle causes the antenna mast to leave the stowage trough with surprising velocity and may cause the mast to overshoot the vertical position. The handle should be rotated positively and slowly the full 225 degrees and pressed into its detent when deploying or stowing the antenna. Less than 225° rotation of the handle will prevent the mast from erecting fully to the vertical position.

CHARACTERISTICS: When deploying the antenna, the first 90° of handle rotation shifts the antenna out of the locked position and separates the retaining wire for the antenna cone. The remainder of the 225° handle rotation raises the antenna to the vertical position. There is a detent at both the stowed and erected extents of the handle's rotation and the handle may have to be pressed into the detent to insure detent engagement.

63. TITLE: DSKY DISPLAY

STATEMENT: The DSKY Display has at times flashed with all segments illuminated (All Eights). Should this be observed, report immediatley to ACE Control.

COMMENT: When observing "All Eights", note the sign segments (whether plus or minus). This is significant for troubleshooting.

64. TITLE: RANGE/RANGE RATE INDICATOR OPERATION

STATEMENT: The Range/Range Rate Indicator has indicated long pauses when being operated in the AGS Altitude Profile Mode and would update, pause, then update again. The length of the pause period increased as the Altitude Profile progressed and reached a maximum of approximately 30 seconds near the maximum altitude in the profile. (Refer to LM note No. 34, Page B-34)

COMMENT: This is a normal operating characteristic of the Range/Range Rate Indicator in the AGS Altitude Profile Mode.

65. TITLE: ACA Y AXIS MOVEMENT (CDR'S ONLY)

STATEMENT: The CDR's ACA (entire assembly) can move approximately 1/4" in either direction in the Y plane with or without the ACA armrest lock engaged.

CHARACTERISTICS: As a function of design, it is necessary to allow this tolerance in the Y plane to permit ACA stowage and positive locking. The ACA may shift slightly when a force greater than that required to reach hard stop in roll is applied.

C. INDIVIDUAL LM CHARACTERISTICS

LUNAR MODULE -7

7A. TITLE: HEATER CAUT. LT. (CWEA POWER-UP)

STATEMENT: When CWEA is powered-up, a HEATER CAUT. LT. and a MASTER ALARM will occur due to a false LDG RDR/RCS QUAD out-of-temp indication.

DISCUSSION: The RDR and RCS QUAD temperature inputs to CWEA are cut and capped to prevent an erroneous HTR CAUT LT and MASTER ALARM at staging. This open temp line appears to CWEA as a low temp condition, and therefore each time CWEA is activated, the HTR CAUT and MASTER ALARM are triggered. Once the LDG RDR and RCS QUAD temp FLIPFLOPS are reset after CWEA power-up, it can only be set by powering-up CWEA again.

NOTE: Telemetry and Cabin readouts are still available.

RESOLUTION: Expect the CWEA indication and reset by cycling the HTR CONT: TEMP MONITOR SW through all positions when requested.

7B. TITLE: MISSION TIMER - LATE STARTS

STATEMENT: All of the LM Mission Timers tend to skip the first second after start switch actuation. The specifications allow ± 1 second error in a given run period including start.

CHARACTERISTICS: This new LM-7 Mission Timer was installed after completion of "FEAT". A subsequent test series of starts revealed that the first second would be lost in just over 50% of the mission timer start attempts. In all of these cases the event timer was started simultaneously and never failed to pick up the first second.

COMMENTS: This could cause some annoyance when attempting to synchronize the mission timer to another clock. The "seconds" digit could be slewed to "1" prior to start, or the start switch actuated a second early--if the lag could be assured. Perhaps a normal start actuation and accepting a one second delta would be preferable.

LUNAR MODULE-8

** TO BE SUPPLIED**

LUNAR MODULE-9

** TO BE SUPPLIED**

D. EMERGENCY PROCEDURES

** TO BE SUPPLIED**