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Ray Fry

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Comments

MSC-04104

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SCIENCE OPERATIONS SUPPORT PLAN
MISSION J-1/APOLLO 15

FINAL

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
June 1, 1971

MSC FORM 2026A (REV MAY 68)

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Prepared for the
Science Requirements and Operations Branch
Science Missions Support Division

Science and Applications Directorate
Manned Spacecraft Center
Houston, Texas

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REFERENCES

1. Apollo Lunar Surface Experiments Operational Requirements. MSC-TA-D-68-1 (December 1968)

2. Measurements Requirements Document. ALSEP-SE-03, Revision M (May 13, 1971).

3. Apollo Lunar Geology Definitive Experiment Plan (April 1968)

4. Apollo Lunar Geology Experiment Operational Requirements (December 1968)

5. Mission Requirements SA-510/CSM-112/LM-10, J-1 Type Mission, Lunar Landing. MSC-02575. January 4, 1971.

6. CSM/LM Spacecraft Operational Data Book, Volume V, ALSEP Data Book, SNA-8-D-027 (V)

7. CSM/LM Spacecraft Operational Data Book, Volume VI, CSM Experiments Data Book for J-Missions. SNA-8-D-027 (VI).

8. Mission Science Planning Document, Apollo Mission J-1. MSC-04010. May 15, 1971.

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TABLES

ILLUSTRATIONS

SCIENCE OPERATIONS SUPPORT PLAN

1.0 GENERAL

This document defines the science operational procedures as set forth by the Principal Investigators and the Science and Applications Directorate. These procedures are for use by mission planners and controllers in satisfying the experiment requirements contained in the Mission Requirements Document, SA-510/CSM-112/LM-10, J-1 Type Mission.

Included in this document are pertinent data resulting from the Principal Investigator's Operational Interface Meetings and are intended for use by the Principal Investigators, members of the scientific community, and personnel responsible for planning and supporting mission science requirements. These data define the scientific experiments operations, the lunar geology investigation, and the crew activities during the lunar surface operation phases. Reference should be made as necessary to the other documents listed in the references.

Reference should also be made as applicable to other MSC documents which provide necessary procedures in a chronological sequence (timeline) for all science activities. These documents include the Flight Plan, Lunar Surface Procedures, Lunar Surface Checklist, Photographic and Television Procedures, and the CSM Solo Book. Detailed operational data not included in this section or other sections of this document may be found in the CSM/LM Spacecraft Operational Data Book, Volumes V (ALSEP Data Book) and VI (CSM Experiments Data Book for J-Missions).

2.0 MISSION PHASES

The mission operational timeline consists of five phases as defined in the following paragraphs. Specific events for each of the phases are identified in Figure 1.

2.1 Phase I (Lunar Surface EVA Phase)

Phase I is outlined in Table 1, and covers the period during which the astronauts are available for specific deployment activities, backup operations, and lunar geology investigations. Refer to Figures 2, through 10 for supplemental information.

2.2 Phase II (Lunar Module Ascent Phase)

Phase II is outlined in Table 2, and covers the period from 30 minutes prior to LM ascent through the checkout and verification of all lunar surface experiments.

2.3 Phase III (Forty-Five Day Phase)

Phase III is outlined in Table 3, and covers the period from experiment checkout and verification through the first 45 calendar days of ALSEP operation. Phase III includes lunar surface experiments only; orbital experiments are covered in Phase V.

2.4 Phase IV (One-Year Phase)

Phase IV is outlined in Table 4, and covers the period from day 45 through the first year of ALSEP operation. Phase IV includes lunar surface experiments only; orbital experiments are covered in Phase V.

2.5 Phase V (Lunar Orbit Phase)

Phase V is outlined in Table 5, and covers all scientific activities for lunar orbit experiments. Phase V does not cover lunar surface experiments.

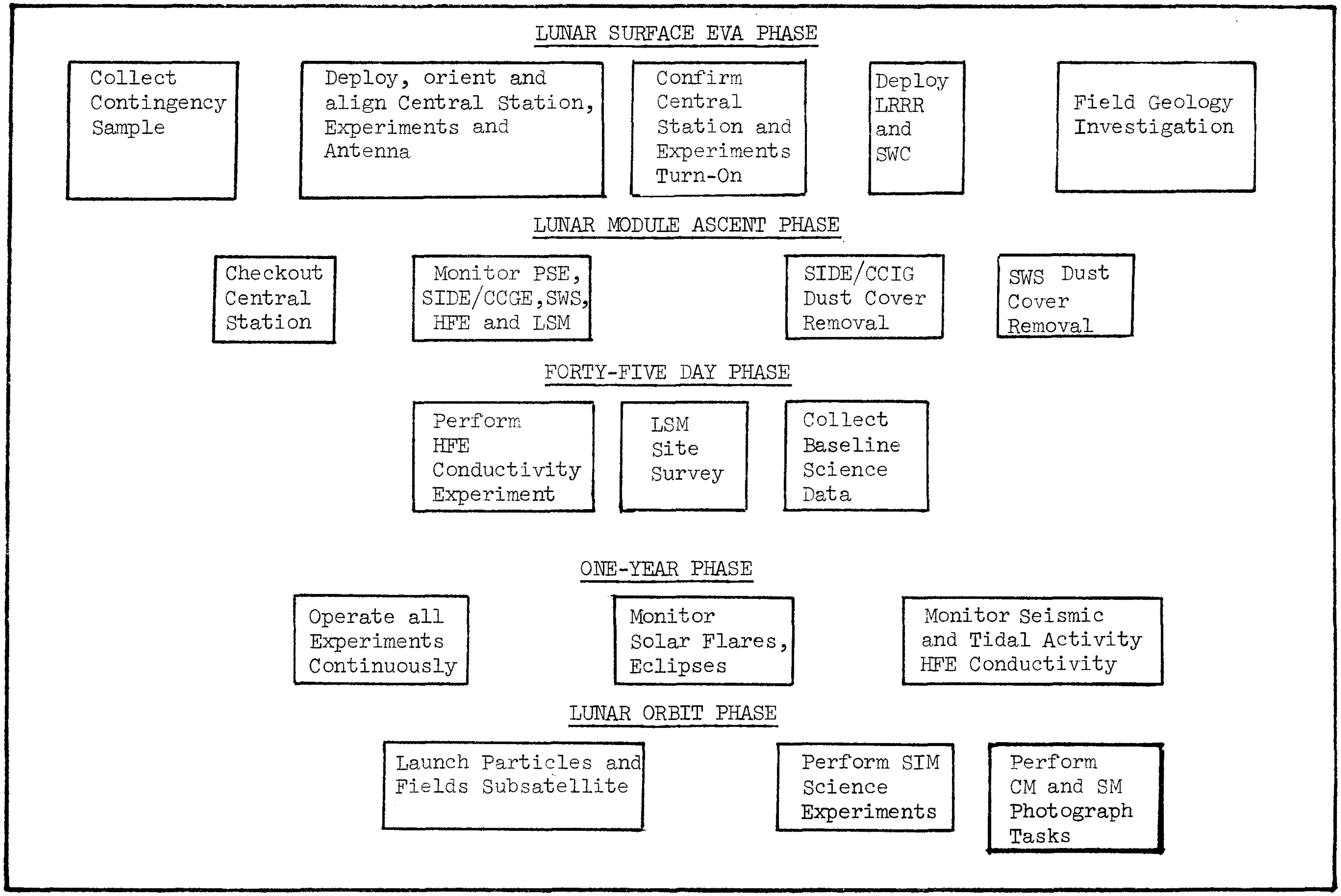


Figure 1. Lunar Operation Phases, Events Identification

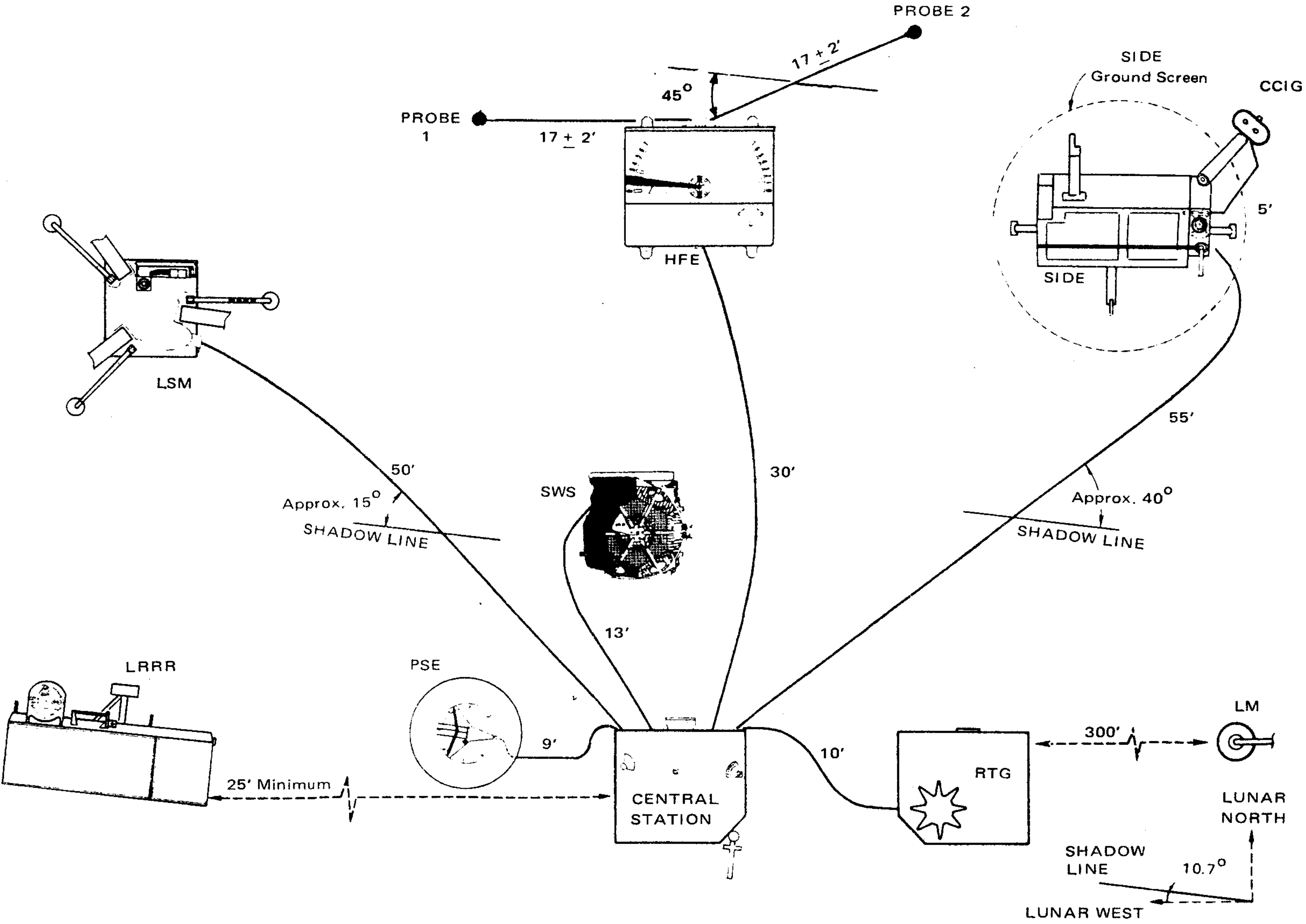


Figure 2. Apollo 15 ALSEP Array A-2 Deployment Layout

Table 1. Phase 1 (Lunar Surface EVA Phase)

Phase I is outlined in Table 1 and covers the period during which the astronauts are on the lunar surface to deploy science experiments and perform field geology investigations. Refer to the Apollo 15 Flight Plan and Lunar Surface Procedures for further information involving astronaut activities during this phase.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
1.0 Contingency Sample Collection	Collect a contingency sample near the LM.		Sample should be taken as soon as possible after egress and placed in the Contingency Sample Return Container.
2.0 Documented Sample Collection	Collect samples of lunar material.		Samples are documented as follows: a. Photograph area before collecting sample. b. Collect sample and place in prenumbered collection bag. c. Photograph area after collecting sample. d. Store samples in the Sample Return Container or Sample Collection Bags. NOTE: For more detailed requirements, reference the Mission Requirements Document, SA-510/CSM-112/LM-10.

Table 1. Phase I, (Lunar Surface EVA Phase)

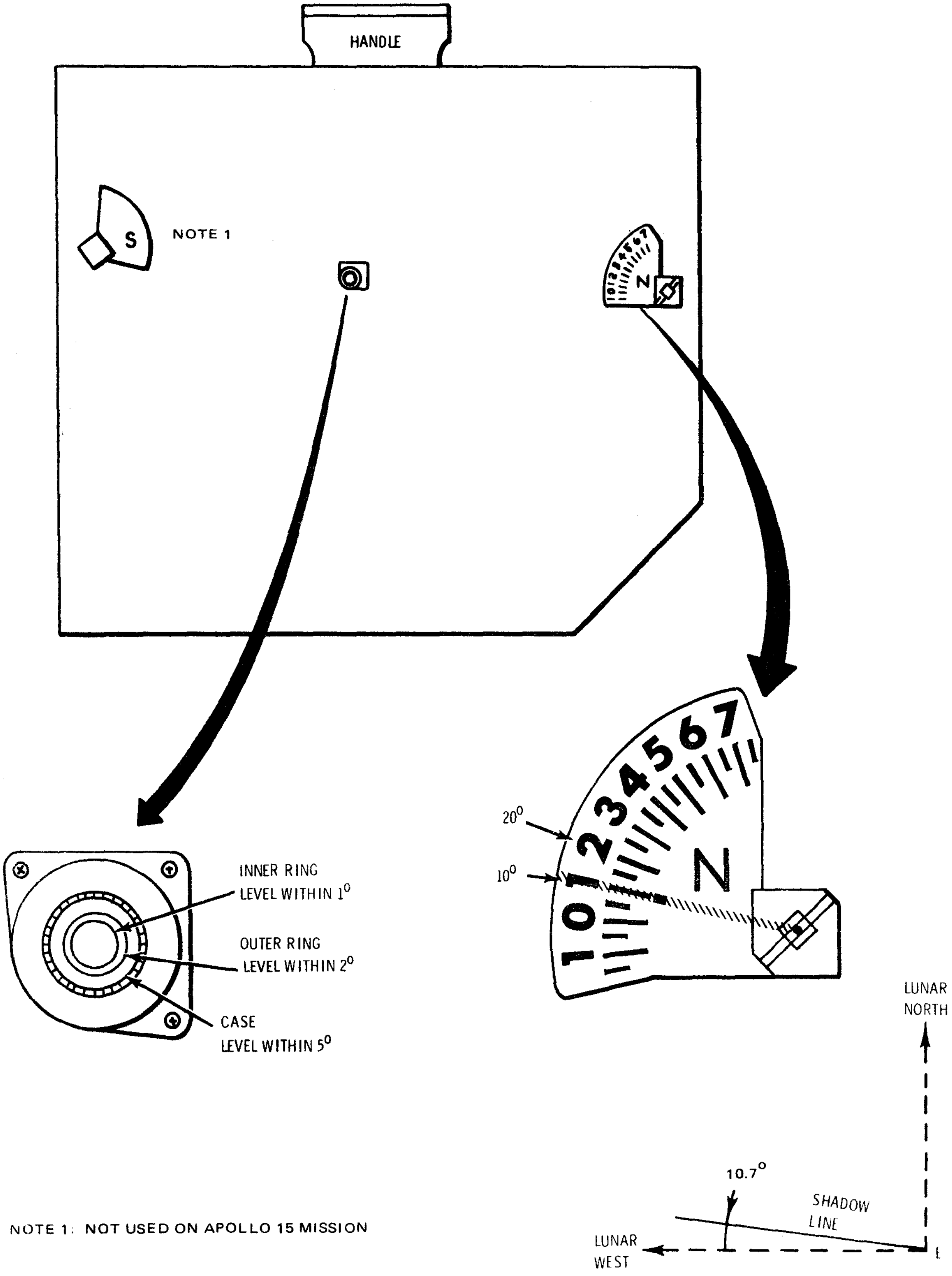
EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
3.0 Solar Wind Composition Deployment	a. Deploy the SWC 60 to 100 feet from the LM.		Deployment distance should prevent dust due to crew activity or residue from vented gases from settling on the aluminum foil.
	b. Orient the SWC facing the sun, i.e., normal to the sun line.		
	c. Erect the SWC in a vertical position.		
	d. Retrieve the foil and reel after completion of all other EVA tasks.		When foil is retrieved, minimize the dust collected in the SWC stowage bag.

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
4.0 ALSEP Central Station Deployment	a. Deploy Central Station a minimum of 300 feet west of LM.		Site should be approximately horizontal with carry handle side of C.S. facing North. Nothing should restrict view of space seen by thermal control surfaces.
	b. Align C.S. within 5° of the shadow line using the "N" compass rose. Align gnomon shadow with alignment mark adjacent to the numeral "1".		Alignment devices are useable at sun elevation angles between 5 and 45 degrees. C.S. should not be shaded from the sun more than absolutely necessary prior to deployment.
	c. Level C.S. within 5° using the bubble level. Sunshield must be still down in stowed position.		ALSEP deployment area must be generally level and free from craters, boulders and debris which might restrict view of space seen by the instruments.
	d. Level antenna within 0.5° of vertical as indicated by bubble level. See Figure 4.		Bubble should be free from case circle to be level within 0.5°.
	e. Align antenna within 0.5° of sun line as determined by sun dial.		When shadow covers shadow reference block, antenna is aligned within 0.5°.

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
4.0 ALSEP Central Station Deployment (Cont'd)	f. Turn azimuth knob ccw to: Coarse Scale: 35+ Fine Scale : 81 g. Turn elevation knob cw to: Coarse Scale: 4+ Fine Scale : 71		Azimuth and elevation settings are shown in astronaut's cuff check list.



NOTE 1: NOT USED ON APOLLO 15 MISSION

Figure 3. Central Station Leveling and Alignment

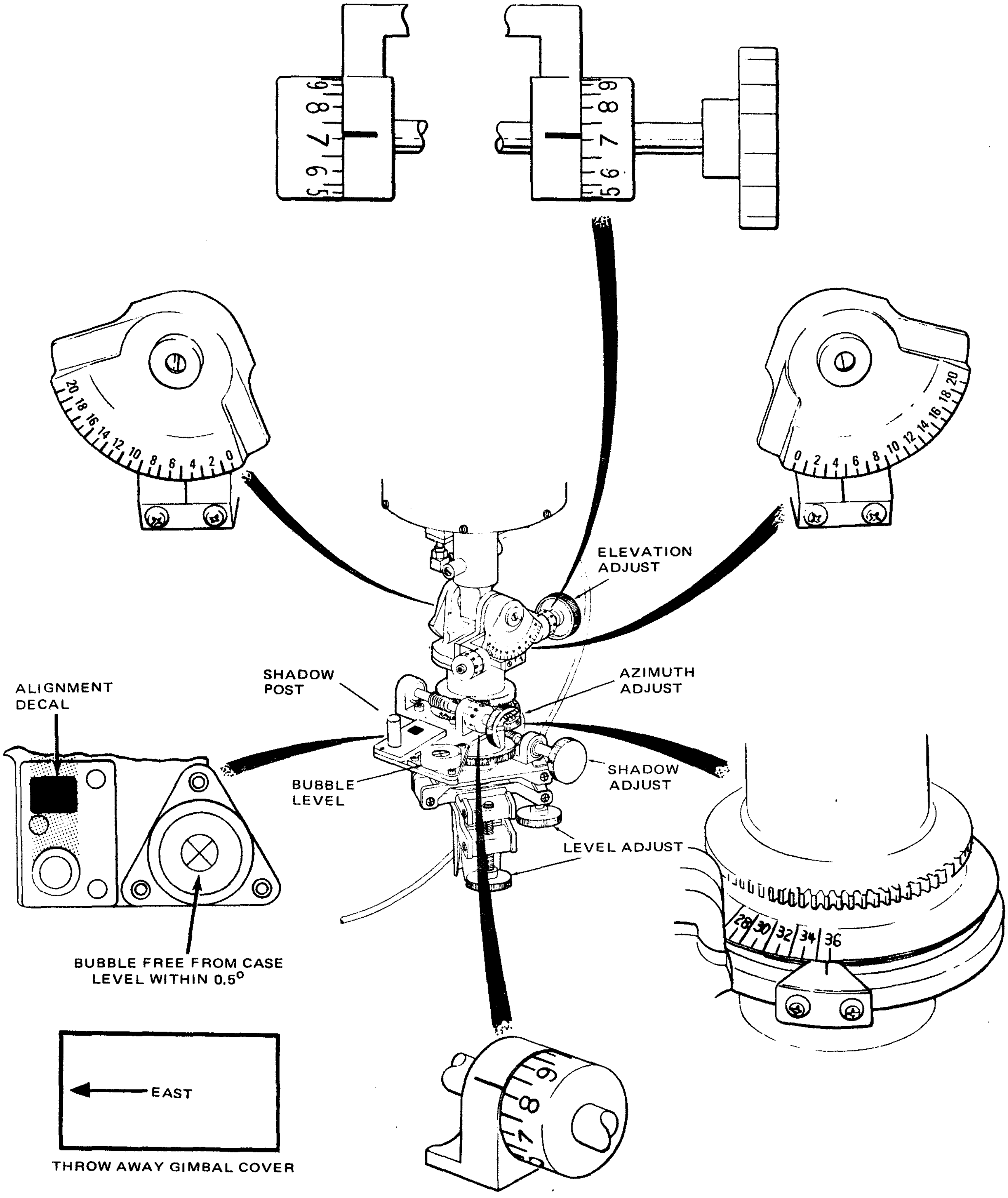
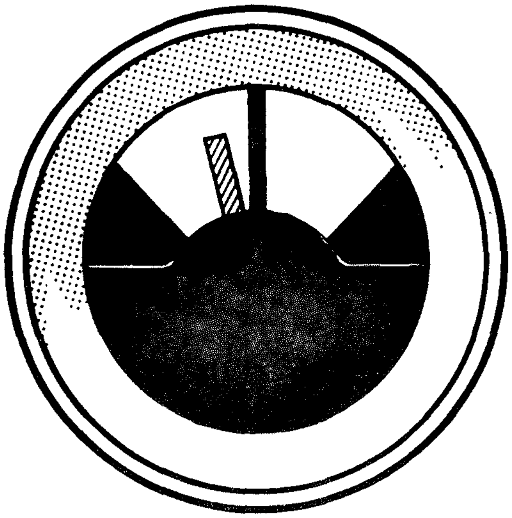


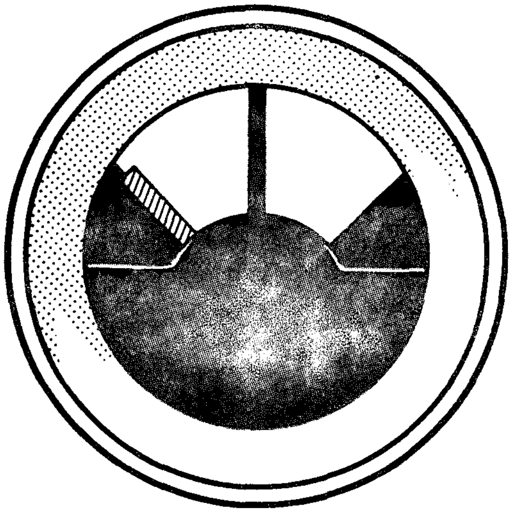
Figure 4. Central Station Antenna Leveling and Alignment

Table 1. Phase J (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
5.0 Radioisotope Thermoelectric Generator Deployment	a. Deploy the RTG 9 to 12 feet from C.S., limited by 13-foot cable.		No part of RTG must be within field-of-view of the open, North side of C.S.
	b. Align RTG so that cable exit from the sub-pallet points toward the C.S. RTG should be generally East of C.S.		Separation between RTG and C.S. must be adequate so that crew does not contact the RTG during C.S. deployment.
	c. Read ammeter on Shorting Switch Box and verify a value greater than zero. Connect RTG cable to C.S. Later in deployment, astronaut will actuate Shorting Switch and verify that ammeter reading drops to zero.		



a. First Reading Nominal Configuration (RTG Short-circuited)



b. Second Reading Nominal Configuration (RTG Short Removed)

Figure 5. RTG Current Indicator

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
6.0 Passive Seismic Experiment Deployment.	a. Deploy PSE 8 to 9 feet West of Central Station. (See Figure 2.)		Limited by 10-foot cable, 15 feet minimum separation from RTG. Separation is necessary to avoid heat input from RTG. PSE must be no less than 10 feet from other units to minimize pickup of stray vibrations by PSE. Pack surface to prevent PSE sensor from touching surface.
	b. Rough align the PSE within 20° of sunline, before opening PSE girdle by pointing arrow on the sensor girdle toward the sun. (See Figure 5.)		When girdle is removed, gnomon will pop up.
	c. Coarse level the PSE to within 5° of vertical utilizing the bubble level. (See Figure 5.)		Bubble should be free from case circle to be within 5°. 5° is the limit of the automatic leveling gimbal system.
	d. Fine level the PSE after removing girdle and spreading the thermal shroud. (See Figure 5.)		Astronaut should read and report, to the nearest degree, the intersection of the shadow of the gnomon on the compass rose. Final azimuth alignment must be known within 5° accuracy with reference to sun line utilizing shadow graph.

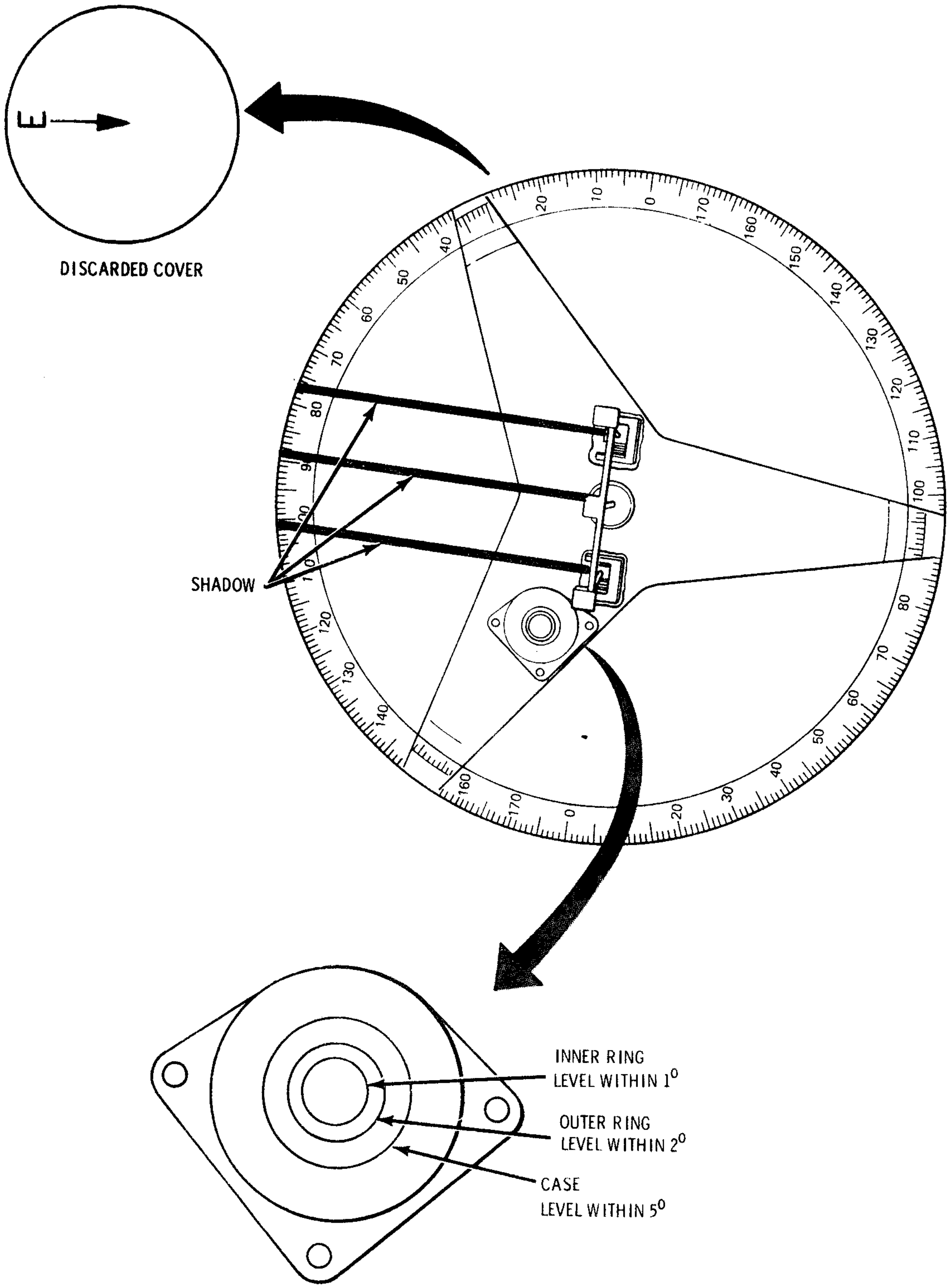


Figure 6. Passive Seismic Experiment (PSE) Leveling and Alignment

Table 1.   Phase I   (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
7.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment Deployment	a. Deploy the SIDE/CCGE 50 to 60 feet Northeast of Central Station. (See Figure 2.)		Limited by 60-foot cable.
	b. Level SIDE within 5° of vertical utilizing bubble level. (See Figure 7.)		Bubble should be free from case
	c. Align SIDE within 5° of sun line.		Astronaut will rough align unit utilizing arrow on top of unit. Arrow, marked "E", points toward sun. He will then fine align unit within 5° of shadow line by visually determining that the shadow cast by the UHT is parallel to the sides of unit and covers the decal.
	d. The CCIG, attached to the ground screen tube, will be lowered to the surface so that the orifice faces horizontally North.		All loose surface material should be removed from in front of the North - facing orifice. Note: The CCIG includes a strong magnet which would affect LSM if separation is not at least 80 feet.

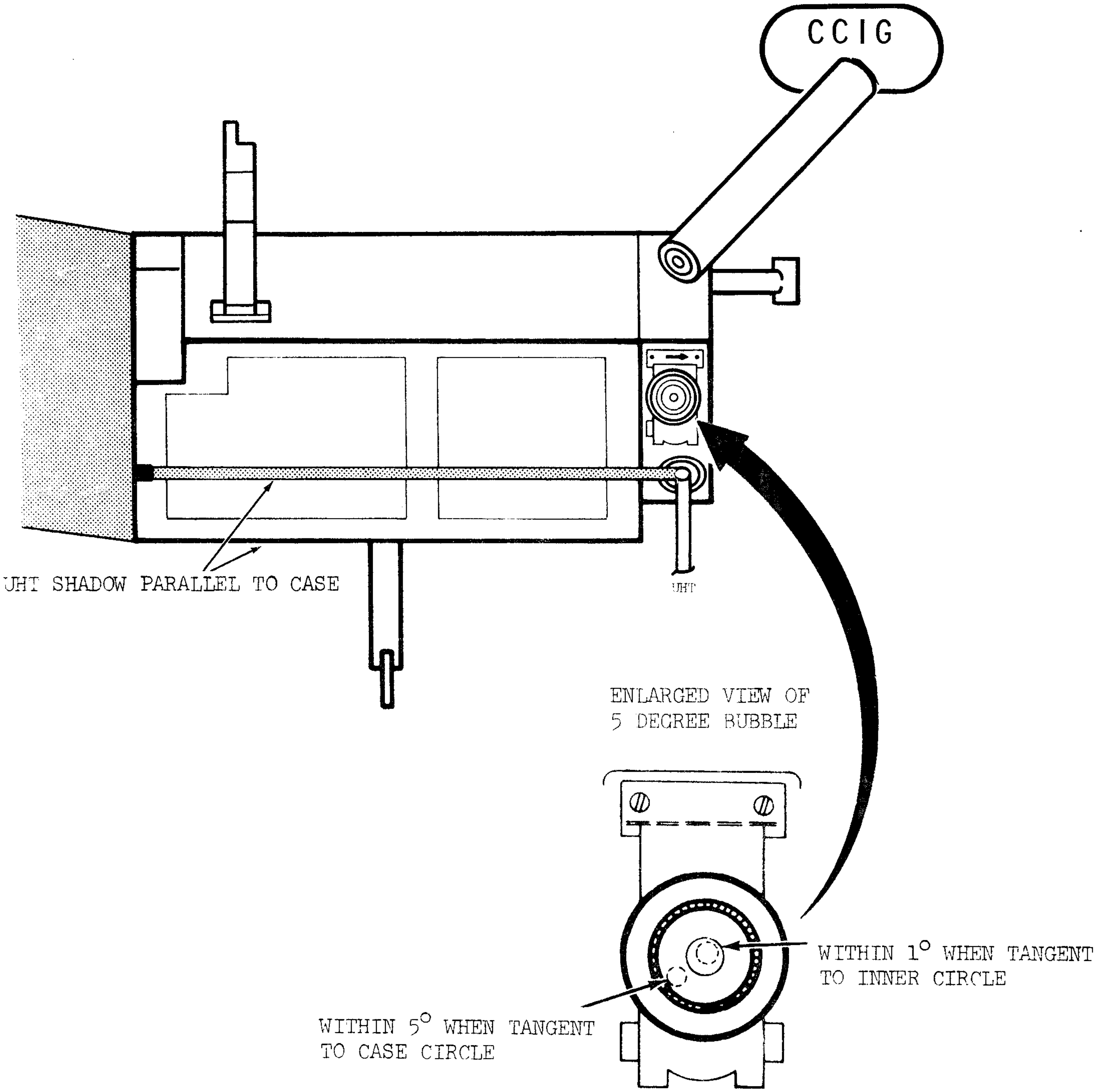


Figure 7. Suprathermal Ion Detector Experiment (SIDE) Leveling and Alignment

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Solar Wind Spectrometer Deployment	a. Deploy SWS 12 to 15 feet North of Central Station. (See Figure 2.)		Limited by 15-foot cable. SWS should be placed in an approximately horizontal spot to avoid thermal perturbations.
	b. Orient SWS so that louvered side (radiator) points North. (Pointing arrow toward sun.)		
	c. Level the SWS within 5° of horizontal about the N-S axis.		Due to A-frame construction, there is a pendulous effect about E-W axis; SWS should swing freely. N-S orientation is determined from sun sensor TM data.

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Solar Wind Spectrometer Deployment (Cont'd)	d. Align the SWS by rotating about a vertical axis so that the shadow cast by the North edge of the sensor assembly gnomon runs parallel to the orange alignment stripe on the sunshield. (See Figure 8.)		Radiator louvres should face away from RTG due to science and thermal control requirements.
	e. Check alignment of the SWS by touching box with the handling tool near the bottom on the south side to verify that it swings freely on its E-W pivot.		If not free, move the leg assemblies farther apart so that the instrument swings freely. Recheck alignment. No fine leveling is required.

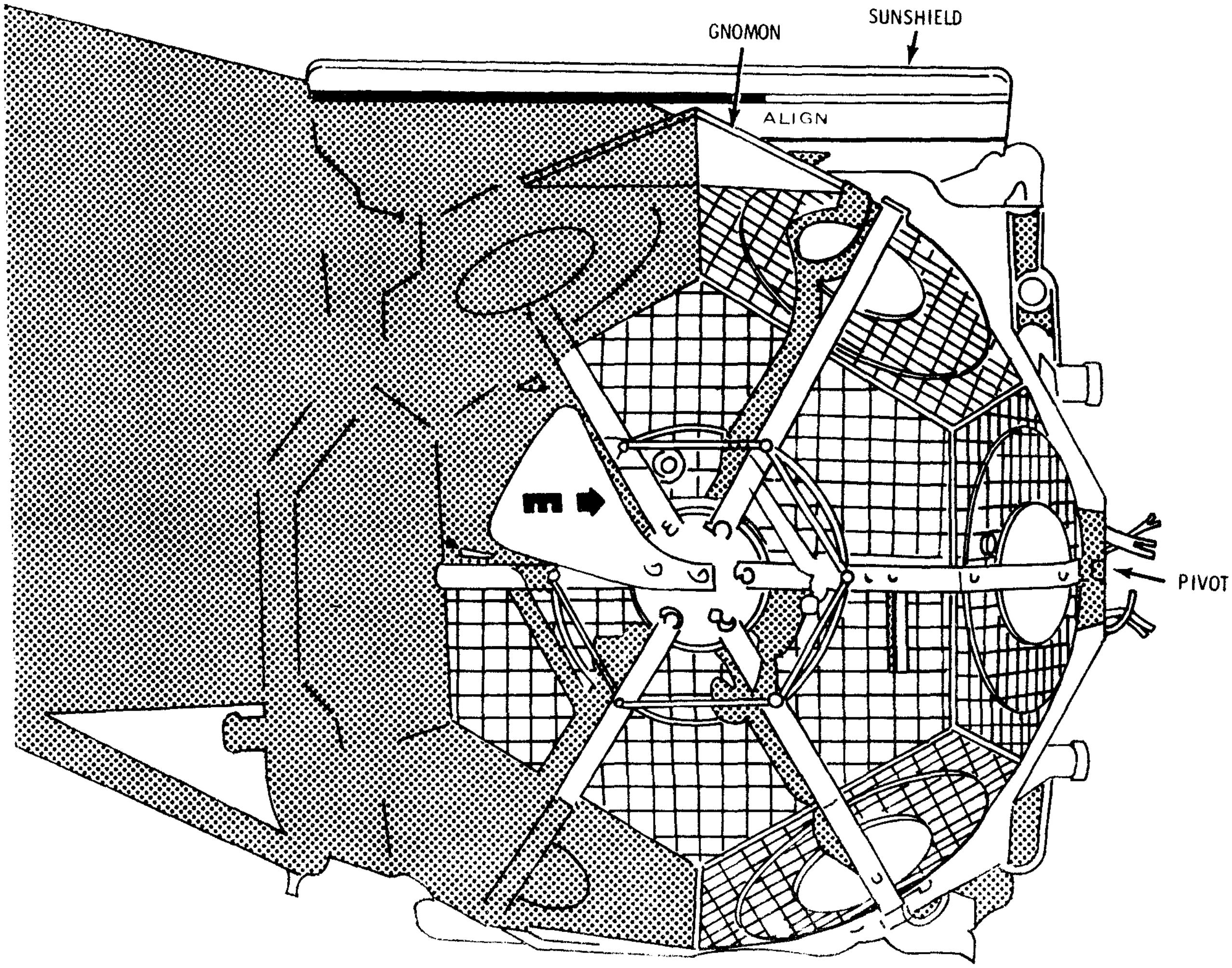


Figure 8. Solar Wind Spectrometer Leveling and Alignment

Table **1.** Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
9.0 Lunar Surface Magnetometer Deployment	a. Deploy LSM 45 to 50 feet Northwest of C.S., limited by 50-foot cable.		LSM must be a minimum of 80 feet from the CCIG which contains a strong magnet.
	b. Deploy shadowgraph, ensure it is tilted to the proper 26° angle. Align LSM within 3° of shadow line using shadowgraph. (Reference Figure 9.)		Astronaut will report shadowgraph reading within 1°. Exact alignment must be known to interpret LSM data.
	c. Level the LSM within 3° using bubble level and leg adjustment screws.		Turn leg adjustment screw clockwise to raise that corner of LSM. Bubble should be free of case circle.
	d. Deploy sunshade by pulling ring on sensor head, then recheck level.		

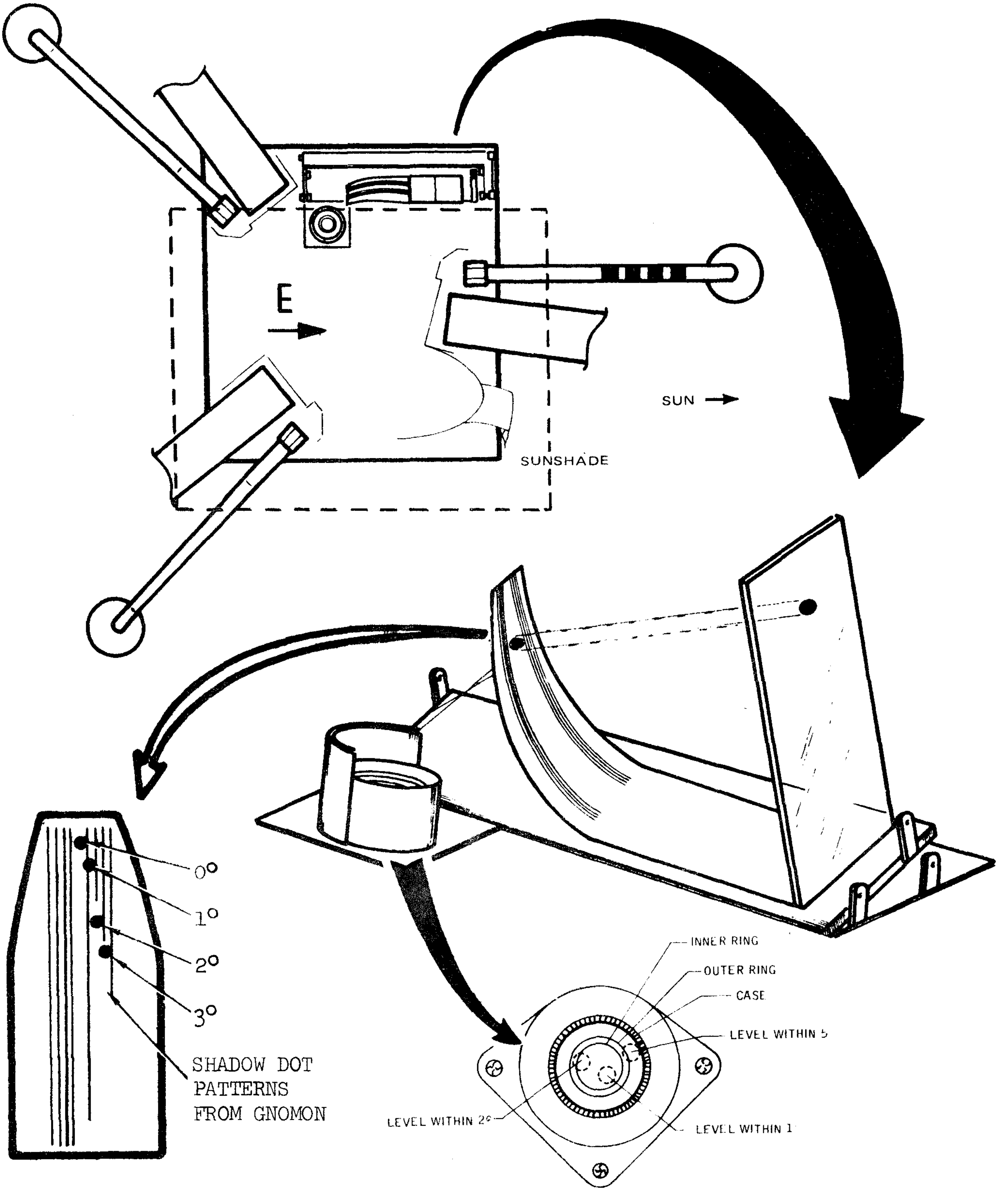


Figure 9. Lunar Surface Magnetometer Leveling and Alignment

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
10.0 Heat Flow Experiment Deployment	a. Deploy the HFE Electronics Package 25 to 30 feet North of the Central Station. (See Figure 2.)		Limited by 30-foot cable. HFE Electronics Package should be placed in an approximately level area, removed from any surface irregularities or rocks that may obscure the field-of-view of the HFE sunshield reflector.
	b. Align the HFE Electronics Package to within 5° of the shadow line decal utilizing the shadowgraph. (See Figure 10.)		Radiator must face North away from equator and the Central Station. Alignment of HFE package is accomplished by rotating package until shadow cast by UHT covers alignment decal.
	c. Level the HFE Electronics Package to within 5° of vertical for maximum utilization of the thermal sunshield utilizing the bubble level. (See Figure 10.)		
	d. Deploy the Probe 16 to 18 feet from the Electronics Package.		Limited by length of cable. Deploy one probe West of the Electronics Package maintaining 30-foot minimum separation between Probe and RTG.

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
10.0 Heat Flow Experiment Deployment (Cont'd)	e. HFE Probe-to-Probe separation should be at least 30 feet.		The HFE probes should be at least 10 feet from all other experiments, 20 feet minimum from the PSE, and 30 feet minimum from the RTG. Reference Figure 2 for typical ALSEP deployment arrangement.
	f. Use the Apollo Lunar Surface Drill to make a lined bore hole approximately 3 meters deep in the lunar surface and align the HFE Probe to within 15° of vertical.		Each hole should be $1\frac{1}{2}$ diameters from the rims of "fresh" craters more than 1 meter across. Each hole should be 3 or more diameters from boulders more than 1 meter across. Astronaut should try to avoid having a "fresh" crater greater than 2 meters across betwen bore holes. Astronaut should try to avoid having a "fresh" crater greater than 5 meters across between the HFE bore holes and the core sample hole.

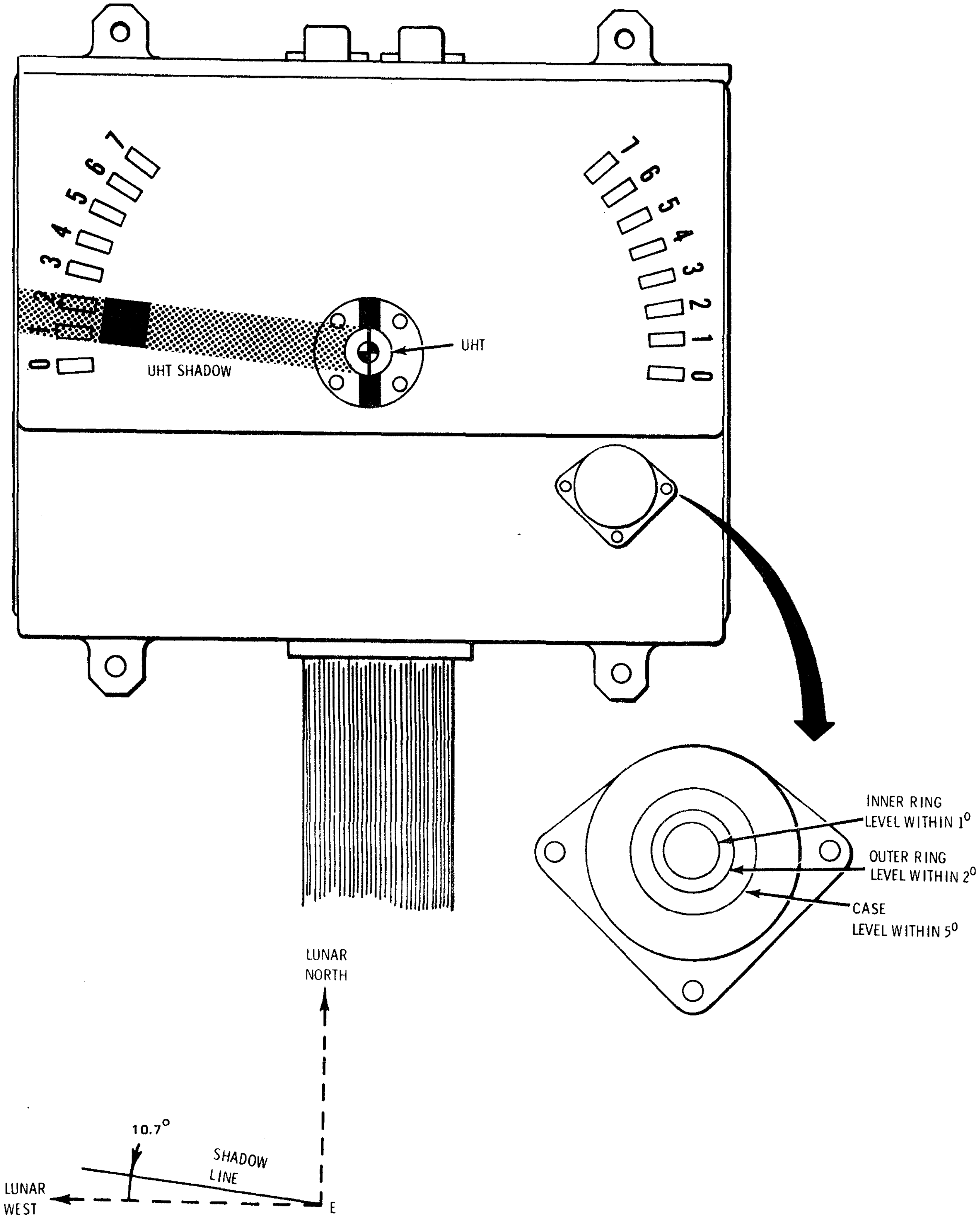


Figure 10. Heat Flow Experiment Leveling and Alignment

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
11.0 ALSEP Turn-On		a. Start Data Recorders	Note: Astronaut will read ammeter on shorting switch box (to confirm a value greater than zero) and then connect RTG to Central Station. After connection is made, the shorting switch is actuated and ammeter reading should go to zero.
	a. Astronaut will notify MCC of readiness status via voice link and actuate Switch S-1.	b. Acknowledge readiness message via voice link.	If ALSEP does not respond, initiate command octal 013, "Transmitter On."
		c. Verify reception of RF signal from ALSEP.	If ALSEP still does not respond, astronaut will actuate Switches SW-2 and SW-3.
		d. Verify transmission of 1060 bps telemetry.	Verify all data are within operational limits (Word 33).
	b. Acknowledge MCC receipt of RF signal and useful data via voice link.	e. Advise astronaut via voice links that ALSEP transmitter is functioning.	
			Note: Reference the Scientific Experiments Contingency Planning and Procedures Document, Table 19, for ALSEP Activation Contingencies.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On		a. Check experiment status telemetry AB-04. and CS-02 for correct indication and Shunt Reg #1 current status telemetry AE-05 for indication lower than octal 267.	
		b. Initiate command octal 036, PSE Operational Power ON.	If telemetry data are interrupted for more than 5 minutes, command PSE to Standby (Octal 037).
		c. Check experiment status telemetry, AB-04, and CS-02 for correct indication.	
		d. PSE Housekeeping Data Check (Word 33)	
		(1) Long period gain X and Y AL-01.	Preset condition: -30 db
		(2) Long period Z amplifier gain AL-02.	Preset condition: -30 db
		(3) Level direction and speed AL-03.	Preset condition: + low
		(4) Short period amplifier gain Z, AL-04.	Preset condition: -30 db

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		(5) Leveling mode and coarse sensor mode AL-05.	Auto, Coarse Sensor Out
		(6) Thermal control status AL-06.	Auto, On
		(7) Calibration status (L.P. and S.P.) AL-07.	All Off
		(8) Uncage status AL-08.	Caged.
		e. Uncage Passive Seismometer	
		(1) Initiate command - octal 073, Uncage Arm/Fire.	
		(2) Verify change in uncage status AL-08.	Arm
		(3) Reinitiate command octal 073.	Wait 30 seconds between reinitiation of command octal 073.
		(4) Verify change in uncage status AL-08.	Uncage
		(5) Observe short period scientific data on drum recorder for evidence of physical uncaging.	Consult P.I. before adjusting any gains. Adjust gain to visible signal.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		f. Level Passive Seismometer.	
		(1) Verify that feedback filter is switched OUT by comparing LP Seismic and LP Tidal data on recorders.	During initial leveling or when all LP components are off level, verify feedback position during Step f(7).
		(2) Initiate command octal 102, COARSE LEVEL SENSOR IN/OUT	
		(3) Check telemetry AL-05 for change in status of COARSE LEVEL SENSOR and verification of AUTO Leveling mode.	Switch as required to obtain COARSE LEVEL SENSOR and AUTO status by commands octal 102 and octal 103.
		(4) Initiate command octal 070 LEVELING POWER X MOTOR ON.	
		(5) Observe recording of long period, tidal X-axis data as leveling proceeds.	During initial leveling, verify that feedback filter is switched out. This can be done by verifying the time lag between tidal and seismic data. If filter is in, execute command octal 101 and note response.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		f. Level Passive Seismometer (Cont'd)	
		(6) Observe SP-Z Seismic data on recorder.	Observe SP-Z channel for activity and coarse sensor operations.
		(7) When X tidal output reaches a value of ± 5 micro radians or less, initiate command octal 070 LEVELING POWER X MOTOR OFF.	If tidal outputs are not within ± 5 micro radians, repeat steps f(1) to f(7) deleting step f(2).
		(8) Repeat Event 12, steps f(4) thru (7) for Y-axis, initiating and verifying command octal 071 LEVELING POWER Y MOTOR (ON/OFF) while monitoring appropriate recorder.	
		(9) Initiate and verify command octal 102 COARSE LEVEL SENSOR.	
		(10) Check AL-05 for change of status.	Auto, Coarse Sensor OUT.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		f. Level Passive Seismometer (Cont'd) (11) Verify that X and Y tidal outputs are within ± 5 micro radians. (12) Initiate and verify command octal 072 LEVELING POWER Z MOTOR ON. (13) When a zero crossing is observed on Z tidal output, initiate command octal 103, leveling mode AUTO. (14) When Z tidal output reaches a value of ± 0.5 milli gals, initiate and verify command octal 072 LEVELING POWER Z MOTOR OFF. (15) Verify that X and Y tidal outputs are within ± 5 micro radians and Z tidal output is within ± 0.5 milli gals.	Leveling of Z axis requires: Level mode: Manual (103) Leveling speed: High (075) Leveling direction: Positive (074)

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		f. Level Passive Seismometer (Cont'd) (16) Initiate and verify command PSE FILTER IN octal 101. (17) Verify that filter has been switched IN by comparison of LP Seismic and LP Tidal data on recorders. (18) Execute command octal 076 THERMAL CONTROL MODE SELECT as required to keep within limits.	
		g. Passive Seismometer Calibration (1) Initiate and verify command octal 066 CALIBRATION LP ON/OFF	
		(2) Check for status change in AL-07.	LP On. SP Off.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		g. Passive Seismometer Calibration (Cont'd)	
		(3) Initiate and verify command octal 066 CALIBRATION LP ON/OFF.	Approximately 60 seconds after step (2).
		(4) Check for status change in AL-07.	All Off.
		(5) Initiate and verify command octal 065 CALIBRATION SP/ON/OFF.	
		(6) Check for status change in AL-07.	
		(7) Initiate and verify command octal 065 CALIBRATION SP ON/OFF.	
		(8) Check for status change in AL-07.	All Off.
		h. Thermal Stabilization of Passive Seismometer. (1) Monitor sensor unit temperature and verify that temperature stabilizes at 125 ± 1°F.	Relevel as required. Command Octal 076 should be used to maintain 125 ± 1°F (DL-07).

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Passive Seismic Experiment Turn-On (Cont'd)		i. Collection of Baseline Passive Seismic Data. (1) Record data without further transmission of command for determination of background noise level, frequency and magnitude of detectable seismic events. (2) Fix gains at levels determined from Step i(1) above.	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
13.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment Turn-On		a. Turn-On Checks	Consult P.I. before initiating commands.
		(1) Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indication.	SIDE/CCGE average thermal temperature must be below 25°C for initial operation.
		(2) Initiate and verify command octal 153 SIDE/CCGE OPERATIONAL POWER ON.	Do not initiate any commands to the channeltron high voltage supply or the gauge high voltage supply.
		(3) Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indication.	
		(4) Initiate the following commands: Octal 105 and Octal 110	105 and 110 CCGE Seal Break.
		b. Telemetry Checks	
		(1) Examine telemetry data and ensure that SIDE frame counter (SIDE Word 1) cycles from 0-127.	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
13.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment Turn-On (Cont'd)		b. Telemetry Checks (Cont'd)	
		(2) Check the reference and calibration voltages in SIDE Word 2.	DI-21, DI-22, DI-23, DI-25, DI-26, DI-27, DI-28, DI-30,
		(3) Check the power supply output and performance parameters in SIDE Word 2.	DI-2, DI-13, DI-14, DI-15, DI-16, DI-17, DI-18, DI-20, DI-29
		(4) Check the experiment temperatures in SIDE Word 2.	DI-4, DI-5, DI-6, DI-9, DI-10, DI-19
		(5) Check the status parameters on SIDE Word 2.	DI-12, DI-24, DF-29
		(6) Check for appropriate cycling of the Ground Plane Voltage in SIDE Word 2.	DI-11
		(7) Check for appropriate cycling of High Energy Curved Plate Analyzer Filter Voltage, SIDE Word 3.	DI-40 thru DI-60

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
13.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment Turn-On (Cont'd)		b. Telemetry Checks (Cont'd)	
		(8) Check the status parameters in SIDE Word 6.	DI-63, DI-64, DI-65, DI-66, DI-68, DI-69, DI-70 and DI-71
		(9) Check for appropriate cycling of Velocity Filter Voltage in SIDE Word 7.	DI-72 thru DI-99 and DJ-00 thru DJ-97
		(10) Check for appropriate cycling of Low Energy Curved Plate Analyzer Filter Voltage in SIDE Word 8.	DJ-98, DJ-99 and DF-00 thru DF-04
		(11) Check High Energy data in SIDE Words 4 and 5 for base-line level with Dust Cover On.	DI-61 and DI-62
		(12) Check Low Energy data in SIDE Words 9 and 10 for base-line level.	DF-05 and DF-06

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
13.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment Turn-On (Cont'd)		b. Telemetry Checks (Cont'd)	
		(13) Check telemetry associated with CCGE performance in SIDE Word 2.	DI-03, DI-08 and DI-67

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
13.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment (Turn-On (Cont'd)		c. (1) Transmit and verify command octal 053, SIDE/ CCGE Standby Power. (2) Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indication.	During all of above, watch for spontaneous mode changes and if before LM ascent, go to SIDE/ CCGE standby or if after LM ascent go to -3.5 KV and +4.5 KV OFF. NOTE: Repeat Phase I, event 13 steps a, b and c (deleting step a(4) on the following occasions: SIDE/CCGE Power On - 10 minutes prior to start of cabin venting for EVA-2 and for equipment jettisoning operation. SIDE/CCGE to Standby Power - 20 minutes after completion of each of the above operations.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
14.0 Lunar Surface Magnetometer Turn-On		a. Initiate Command octal 042, LSM Operational Power SELECT.	
		b. Check experiment status telemetry, AB-4 for correct indication.	
		c. LSM Range Adjustment (DM-16)	
		(1) Observe baseline scientific data for X, Y and Z axis on analog recorder.	Consult PI for proper range setting.
		(2) Initiate and verify Command octal 123 RANGE SELECT.	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
14.0 Lunar Surface Magnetometer Turn-On (Cont'd)		c. LSM Range Adjustment (DM-16) (Cont'd)	
		(3) Check for response in science data on analog recorders.	Should indicate a range change from 200 to 50 gammas.
		(4) Check for status DM-16.	
		(5) If required, repeat event 14 steps c(2), c(3), and c(4).	Step c(3) should indicate a range change from 50 to 100. gammas.
		(6) Set range to optimum by repetition, as required of command octal 123 RANGE SELECT.	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
14.0 Lunar Surface Magnetometer Turn-On (Cont'd)		c. LSM Range Adjustment (DM-16) (Cont'd) (7) Confirm proper setting by examination of data on analog recorders.	
		d. LSM Flip Calibrate No. 1	LSM Flip Calibrate No. 1 to be initiated one hour before LM ascent.
		(1) Initiate and verify Command octal 127 FLIP/ CAL INHIBIT	Check PSE scientific data during flip period for crosstalk and detection of motion by the PSE.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
14.0 Lunar Surface Magnetometer Turn-On (Cont'd)		d. LSM Flip Calibrate No. 1 (Cont'd)	
		(2) Check telemetry for status of calibration inhibit gate, DM-23.	
		(3) Initiate and verify Command octal 131 FLIP/CAL INITIATE	Consult PI before initiating this command. This command to be initiated 1 hour before LM ascent. Record in running log.
		(4) Observe calibration rasters on analog recorder.	Record as FLIP/CAL No. 1 in Flight Controller's log.
		(5) Verify that mode state telemetry, DM-20 has changed.	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
14.0 Lunar Surface Magnetometer Turn-On (Cont'd)		d. LSM Flip Calibrate No. 1 (Cont'd)	
		(6) Verify that sensor Flip Positions have changed. (DM-09, DM-10, DM-11).	
		(7) Monitor mode state telemetry for return to original status in approximately 7 minutes. (DM-20.)	
		(8) Initiate and verify Command octal 127 FLIP/CAL INHIBIT.	
		(9) From LSM data, printout 5 minutes prior to, during, and 5 minutes subsequent to the FLIP/CAL sequence.	Use either real-time data or tape recorder data for this requirement.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
14.0 Lunar Surface Magnetometer Turn-On (Cont'd)		d. LSM Flip Calibrate No. 1 (Cont'd) (10) Verify change in status on LSM. (DM-20.)	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
15.0 Heat Flow Experiment Turn-On		a. Check experiment reserve power status. b. Initiate Command 055 HFE Operational Power On. c. Check experiment status for correct indications AB-05, CS-02. d. Check HFE data channels as shown below: (1) +5V supply AH-01 (2) -5V supply AH-02 (3) +15V supply AH-03 (4) -15V supply AH-04 (5) Low Conductivity Heater AH-06 (6) High Conductivity Heater AH-07	Reserve Power CS-02 > 8 watts.

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
15.0 Heat Flow Experiment Turn-On (Cont'd)		e. Thermal check of HFE:	Should turn-on in Mode 1.
		(1) Check telemetry data word 21 for subsystem mode indications (DH-90)	Gradient Mode (100) Low Conductivity Mode (010) High Conductivity Mode (001)
		(2) If system is not in mode 1, initiate and verify Command octal 135, HFE mode/Select.	Refer to HFE command description.
		(3) Initiate and verify octal commands 144 and 146.	This sequence of commands selects an operating subsequence which includes ambient temperatures at both probes and at the electronic package.
		(4) Check telemetry indication of HFE thermocouple reference and probe cable temperature (word 21 subcommutated).	DH-13, DH-14, DH-15, DH-24, DH-26, DH-34, DH-36, DH-44, DH-46

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
15.0 Heat Flow Experiment Turn-On (Cont'd)		e. Thermal check of HFE: (Cont'd) (5) Continue to monitor until stabilization of temperatures has been confirmed.	

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
16.0 Solar Wind Spectrometer Turn-On		a. Turn-On Checks (1) Check for adequate reserve power, AE-05 (Shunt regulator current) and adjust PDR's if necessary. (2) Initiate and verify command octal 045 SWS OPERATIONAL POWER SELECT. (3) Check AB-05 for change in status of SWS. b. Telemetry Check (1) Examine telemetry data and ensure that decommutation is being properly executed and sequence is identified (SWS words 184 & 185).	

Table 1. Phase I (Lunar Surface EVA Phase)

<table>
<tr><th>EVENT</th><th>ASTRONAUT ACTIVITY</th><th>MCC ACTIVITY</th><th>REMARKS</th></tr>
<tr><td>16.0 Solar Wind Spectrometer Turn-On (Cont'd)</td><td></td><td>b. Telemetry Check (Cont'd)
(2) Check A/D Converter Calibrations, sequence ID: LSB = 0
<table>
<tr><th>ID</th><th>Level</th><th>Words</th></tr>
<tr><td>DW-3</td><td>9 mv</td><td>112,117</td></tr>
<tr><td>DW-4</td><td>90 mv</td><td>113</td></tr>
<tr><td>DW-5</td><td>900 mv</td><td>114,118</td></tr>
<tr><td>DW-6</td><td>3000 mv</td><td>115</td></tr>
<tr><td>DW-7</td><td>9000 mv</td><td>116,119</td></tr>
</table>
(3) Check Electrometer calibration, SWS words 120-127.
(a) 0 amp., DW-19 to DW-26, sequence ID: LSB = 0.
(b) $5.76x10^{-12}$ amp. calibration sequence, ID: LSB = 01
DW-27 (sum) ($7x5.76 \times 10^{-12}$)
DW-28 to DW-34 (Cups 1-7)</td><td></td></tr>
</table>

Table **1.** Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
16.0 Solar Wind Spectrometer Turn-On (Cont'd)		b. Telemetry Check (Cont'd) (c) 5.76 x 10^{-11} amp. calibration sequence ID: LSB = 10 DW-35 (sum) DW-36 to DW-42 (Cups 1-7) (d) 5.76 x 10^{-9} amp. calibration sequence ID: LSB = 11 DW-43 (sum) DW-44 to DW-50 (Cups 1-7) (4) Check temperature and performance, monitor telemetry, SWS words 112-119, sequence ID: LSB = 1 (DW-11 to DW-13 Temperature Sensors) DW-14 (Temp. Sensor) Cups Assy. DW-15 (Sun Angle Sensor) DW-16 (Programmer Volt.) DW-17 (Step Generator Volt.) DW-18 (Modulator Monitor)	

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
16.0 Solar Wind Spectrometer Turn-On (Cont'd)		b. Telemetry Check (Cont'd) (5) Check DC High Voltage Calibrations sequence ID: LSB = 1110	

Symbol	Level	SWS Word
DW-51	1	0
DW-52	2	8
DW-53	3	16
DW-54	4	24
DW-55	5	32
DW-56	6	40
DW-57	7	48
DW-58	8	56
DW-59	9	64
DW-60	10	72
DW-61	11	80
DW-62	12	88
DW-63	13	96
DW-64	14	104
DW-65	15	128
DW-66	16	136
DW-67	17	144
DW-68	18	152
DW-69	19	160
DW-70	20	168
DW-71	21	176

Table 1. Phase I (Lunar Surface EVA Phase)

<table>
<tr><th>EVENT</th><th>ASTRONAUT ACTIVITY</th><th>MCC ACTIVITY</th><th>REMARKS</th></tr>
<tr>
<td>16.0 Solar Wind Spectrometer Turn-On (Cont'd)</td>
<td></td>
<td>b. Telemetry Check (Cont'd)

(6) Check AC High Voltage calibrations, sequence LD: LSB = 1111
<table>
<tr><th>Symbol</th><th>Level</th><th>SWS Word</th></tr>
<tr><td>DW-72</td><td>1</td><td>0</td></tr>
<tr><td>DW-73</td><td>2</td><td>8</td></tr>
<tr><td>DW-74</td><td>3</td><td>16</td></tr>
<tr><td>DW-75</td><td>4</td><td>24</td></tr>
<tr><td>DW-76</td><td>5</td><td>32</td></tr>
<tr><td>DW-77</td><td>6</td><td>40</td></tr>
<tr><td>DW-78</td><td>7</td><td>48</td></tr>
<tr><td>DW-79</td><td>8</td><td>56</td></tr>
<tr><td>DW-80</td><td>9</td><td>64</td></tr>
<tr><td>DW-81</td><td>10</td><td>72</td></tr>
<tr><td>DW-82</td><td>11</td><td>80</td></tr>
<tr><td>DW-83</td><td>12</td><td>88</td></tr>
<tr><td>DW-84</td><td>13</td><td>96</td></tr>
<tr><td>DW-85</td><td>14</td><td>104</td></tr>
<tr><td>DW-86</td><td>15</td><td>128</td></tr>
<tr><td>DW-87</td><td>16</td><td>136</td></tr>
<tr><td>DW-88</td><td>17</td><td>144</td></tr>
<tr><td>DW-89</td><td>18</td><td>152</td></tr>
<tr><td>DW-90</td><td>19</td><td>160</td></tr>
<tr><td>DW-91</td><td>20</td><td>168</td></tr>
<tr><td>DW-92</td><td>21</td><td>176</td></tr>
</table>
</td>
<td></td>
</tr>
</table>

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
16.0 Solar Wind Spectrometer Turn-On (Cont'd)		c. Collection of SWS Baseline Data Record data without further transmission of commands to establish background noise level and the frequency and magnitude of plasma current peaks.	

Table 1. Phase I, (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
17.0 Dust Detector Turn-On		a. If necessary, initiate and verify reception of command octal 027 Dust Detector - ON. b. Verify Dust Detector status by observing data in AX-04, AX-05 and AX-06 (cell voltages). c. Check temperature of Dust Detector cells in parameters AX-01, AX-02 and AX-03.	May be in "ON" condition. The Dust Detector remains in the "ON" condition through the life of ALSEP and is monitored as part of the Central Station format, Word 33.

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
18.0 Experiments Turn-On Verification	Acknowledge report.	a. Advise crewmen that the PSE, SIDE/CCGE, LSM, SWS and HFE experiments have been turned on.	PSE Power ON SIDE/CCGE Standby ON LSM Power ON SWS Power ON HFE Power ON, Mode 1 If experiments cannot be turned on by ground command, astronaut will activate ALSEP backup switch #3.
		b. Monitor PSE data.	
		c. Monitor LSM data.	
		d. Monitor HFE data.	
		e. Monitor SWS data.	

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
19.0 Laser Ranging Retro-Reflector Experiment Deployment	a. Deploy the LR^3 a minimum of 300 feet West of LM. (See Figure 2.)		A deployment distance of greater than 500 feet is requested to minimize dust fall-out from LM ascent engine blast.
	b. Level LR^3 within 2° as indicated by bubble level. (See Figure 11.)		Craters and slopes which would degrade thermal control should be avoided.
	c. Align the LR^3 to within 2.5°, using the shadowgraph. (See Figure 11.)		Shadow of gnomon should fall across center alignment mark on the shadowgraph.
			Correct alignment assumes a shadow angle of 10.7° at the time of LRRR deployment.

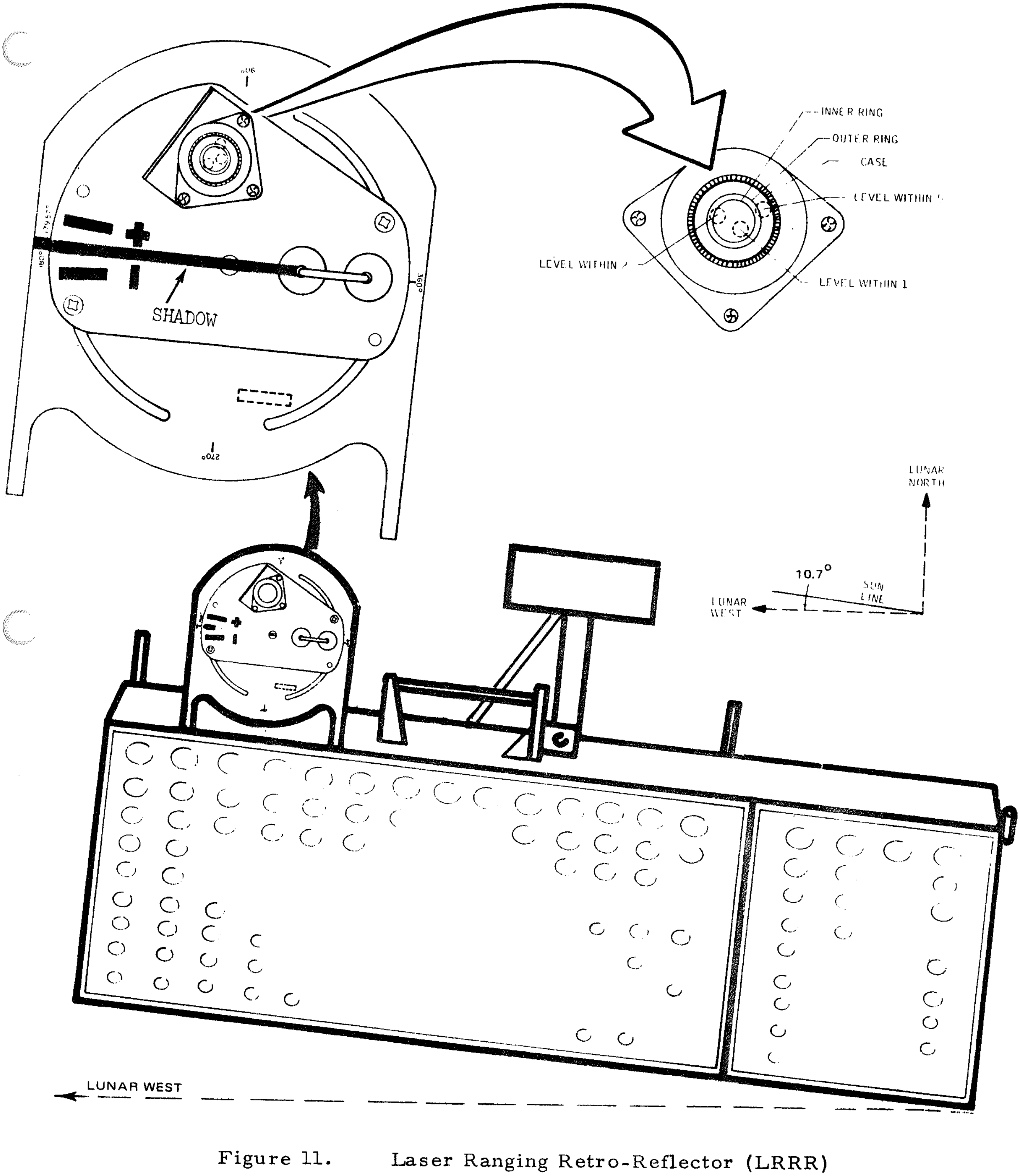


Figure 11. Laser Ranging Retro-Reflector (LRRR) Leveling and Alignment

Table 1. Phase I (Lunar Surface EVA Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
20.0 Field Geology Investigation (Cont'd)	d. Collect and photographically document large rock samples. Collect rock fragments. Try to move large boulders or pry beneath them after photographing their original position. e. In special containers provided, collect special environmental samples.		Activities a through e will be performed consistent with the Apollo 15 Flight Plan. These activities are not necessarily listed in order or priorities.

PHASE I (LUNAR SURFACE EVA PHASE)

GENERAL PLANNING CHART FOR LUNAR GEOLOGY INVESTIGATION OF HADLEY-APENNINE SITE

Geology Traverse Station Description	Astronaut Activity
High point enroute to Apennine front	Collect samples, take photos, examine and describe.
Apennine front	Collect samples, take photos at the front which rings Mare Imbrium.
Crater on Apennine front	Observe and describe the bend in Hadley Rille. Collect samples in vicinity of craters along the front.
Hadley Rille	Collect samples along edge of rille. Observe, describe the amount of mare fill in rille. Gather data on the formation of the rille.
Edge of secondary crater cluster.	Investigate the origin of secondary clusters.
Mare	Collect samples, take photos to possibly determine volcanic fill of a mare.
North Complex	Investigate, describe large crater, scarp, large boulder. Sample domical structures, collapsed domes and blocky crater.

The astronaut activity will consist of observation, photography, description, and sampling of certain geologic features conducted along the traverse. At the same time MSC will be monitoring and documenting the astronaut activity.

TABLE 2. Phase II (Lunar Module Ascent Phase)

Phase II is outlined in Table 2 and covers the period from 30 minutes prior to LM ascent through the checkout and verification of all lunar surface experiment subsystems.

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
1.0 LM Ascent	Monitor all scientific and engineering telemetry during and after launch noting any changes attributable to LM activity.	Note significant trends in the ALSEP experiments data.

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
2.0 ALSEP Central Station Power Supply Check	a. Check the following parameters: (1) 0.25 Vdc Calibration AE-01 (2) 4.75 Vdc Calibration AE-02 (3) Converter Input Voltage AE-03 (4) Converter Input Current AE-04 b. Verify that system is operating on PCU #1. (1) Shunt Regulator #1 current AE-05. (2) Power Oscillator #1 AT-36. (3) Regulator #1 AT-38	When telemetry indicates the need for adjustment of the DC load, the necessary control can be accomplished by switching power dumps in or out through use of the following commands: PDR Load #2 ON (14W) Octal 022 PDR Load #2 OFF (14W) Octal 023 Preset condition at turn-on is PDR #2 OFF. Optimize Central Station thermal environment by dumping reserve power into the external power dissipation resistors. Initiate commands in accordance with the following table: If AE-5 Shunt Current is: — Command PDR 0.6 to 1.1A — Octal 017 DSS Htr. #1 ON 1.1 to 1.5A — Octal 022 PDR #2 ON 1.5A — Octal 017 and 022 Both DSS Htr. #1 & PDR #2 ON 0.6A — Octal 021 and 023, Both DSS Htr. #1 & PDR #2 OFF

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
2.0 ALSEP Central Station Power Check (Cont'd)	b. Verify that system is operating on PCU #1. (Cont'd) (4) Output Voltage +29V AE-07 +15V AE-08 +12V AE-09 + 5V AE-10 -12V AE-11 - 6V AE-12 c. Check RTG temperatures as follows: (1) Hot Frame #1 AR-01 * (2) Hot Frame #2 AR-02 * (3) Hot Frame #3 AR-03 * (4) Cold Frame #1 AR-04 (5) Cold Frame #2 AR-05 (6) Cold Frame #3 AR-06 ** * Inoperative ** Intermittent	

Table 2. Phase II, (Lunar Module Ascent Phase)

<table>
<tr><th>EVENT</th><th>MCC ACTIVITY</th><th>REMARKS</th></tr>
<tr>
<td>3.0 Central Station Temperature Check and Thermal Control</td>
<td>a. Check telemetry parameters as indicated below for pertinent temperature measurements:
<table>
<tr><th>TM Meas. Location</th><th>TM Meas. No.</th></tr>
<tr><td>(1) Sunshield</td><td>AT-01, 02</td></tr>
<tr><td>(2) Thermal Plate</td><td>AT-03, 04, 05</td></tr>
<tr><td>(3) Structure Sides</td><td>AT-08, 09</td></tr>
<tr><td>(4) Structure Bottom and Back</td><td>AT-10, 11</td></tr>
<tr><td>(5) Inner Multilayer Insulation</td><td>AT-12</td></tr>
<tr><td>(6) Outer Multilayer Insulation</td><td>AT-13</td></tr>
<tr><td>(7) Analog Data Processor Base</td><td>AT-27</td></tr>
<tr><td>(8) Analog Data Processor Internal</td><td>AT-28</td></tr>
<tr><td>(9) Digital Data Processor Base</td><td>AT-29</td></tr>
<tr><td>(10) Digital Data Processor Internal</td><td>AT-30</td></tr>
<tr><td>(11) Command Decoder Base</td><td>AT-31</td></tr>
<tr><td>(12) Command Decoder Internal</td><td>AT-32</td></tr>
</table>
</td>
<td>If necessary turn Central Station Back-up Heater #1 On and Off by initiation and verification of following commands:
<table>
<tr><th></th><th></th></tr>
<tr><td>DSS HTR 1 ON (10w)</td><td>Octal 017</td></tr>
<tr><td>DSS HTR 1 OFF</td><td>Octal 021</td></tr>
<tr><td>DSS HTR 2 ON (5w)</td><td>Octal 024</td></tr>
<tr><td>DSS HTR 2 OFF</td><td>Octal 025</td></tr>
</table>
Preset condition at turn-on is:
<table>
<tr><th></th><th></th></tr>
<tr><td>DSS Heater #1</td><td>OFF</td></tr>
<tr><td>DSS Heater #2</td><td>ON</td></tr>
</table>
</td>
</tr>
</table>

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
3.0 Temperature Check and Thermal Control (Cont'd)	a. (Cont'd) (13) Command Demodulation VCO AT-33 (14) Power Distribution Unit Base AT-34 (15) Power Distribution Unit Internal AT-35	

Table 2. Phase II (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
4.0 Transmitter Checkout	a. Monitor the following transmitter parameters: (1) Transmitter A Crystal Temp. AT-23 (2) Transmitter A Heat Sink Temp. AT-24 (3) Transmitter A AGC Voltage AE-15 (4) Transmitter A Power Doubler Current AE-17	

Table 2. Phase II (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
5.0 Receiver Checkout	a. Check Local Osc. Crystal A Temp. AT-21	Central Station will initialize with either Local Osc. A or B on.
	b. Check Local Osc. Crystal B Temp. AT-22	
	c. Check Local Osc. Level AE-14	
	d. Check Receiver Prelimiting Level AE-13	
	e. Check Command Demodulation, 1 kHz Present AB-01	No modulation 0 to 76 counts Modulation 77 to 127 counts No carrier 128 to 255 counts

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
6.0 Passive Seismic Experiment Checkout	Monitor all PSE science data measurements on a continuous basis. Level PSE as required.	Note significant trends, especially during the turn-on period for the other experiments. During LM ascent, PSE scientific data must be monitored continuously so as to measure any seismic disturbance due to ascent engine blast.

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
7.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment	a. Check experiment status telemetry AB-05 and CS-02 for correct indications.	SIDE/CCGE Standby Power.
	b. Initiate command octal 153, SIDE Operational Power ON.	Consult P.I. before sending this command.
	c. Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indications.	SIDE/CCGE Power On.
	d. Initiate the following commands: (1) Octal 107 (2) Octal 110	Consult P.I. before sending this command sequence. 107 and 110 SIDE Dust Cover removal.
	e. Check science data for verification of Dust Cover removal.	
	f. Transmit and verify command octals 053 and 054 SIDE/CCGE Standby OFF.	
	g. Check experiment status telemetry AB-04, AB-05, and CS-02 for correct indication.	SIDE/CCGE STANDBY OFF.

Table 2. Phase II (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
8.0 Solar Wind Spectrometer Checkout	a. Dust Cover Removal	
	(1) Check for the availability of adequate reserve power. Adjust PDR's if necessary.	
	(2) Initiate and verify Command Octal 122 DUST COVER REMOVAL.	Do not initiate Command 122 without direction from P.I.
	(3) Check science data for periods before and after dust cover removal to confirm that cover has properly cleared sensor.	

Table 2. Phase II (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
8.0 Solar Wind Spectrometer Checkout	b. High Voltage Gain Change (1) Initiate and verify Command Octal 122 HIGH VOLTAGE GAIN CHANGE. (2) Check DC and AC High Voltage Calibrations per Table 1, Phase I, Event 16, Steps b(5) and b(6) to confirm execution of the command. c. Collection of Baseline SWS Data in High Gain. Record data without further transmission of commands to establish background noise level and frequency and magnitude of plasma current peaks.	Consult P.I. before sending this command. This command is decoded in the SWS if Octal 122 is received three times within ten seconds.

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
9.0 Lunar Surface Magnetometer Checkout	a. Housekeeping Data Check Check the following data parameters in the indicated subcommutation of ALSEP word 5, bits 2-8 on printout: (1) X Sensor Temperature. DM-1 (2) Y Sensor Temperature. DM-2 (3) X Sensor Temperature. DM-3 (4) Gimbal Flip Unit Base Temperature. DM-4 (5) Internal Electronics Temperature. DM-5 (6) Level Sensor #1 DM-6 (7) Level Sensor #2 DM-7 (8(DC Supply Voltage. DM-8 b. Initial Status Check Check the status of the following parameters in ALSEP word 5, subcommutation as indicated: (1) X-axis Flip Position Frame 1, bits 9-10. DM-9 (2) Y-axis Flip Position Frame 2, bits 9-10. DM-10	

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
9.0 Lunar Surface Magnetometer Checkout (Cont'd)	b. Initial Status Check (Cont'd)	
	(3) Z-axis Flip Position Frame 3, bits 9-10. DM-11	
	(4) X-axis Gimbal Position Frame 4, bit 9. DM-12	Pre-site-survey position
	(5) Y-axis Gimbal Position Frame 4, bit 10. DM-13	Pre-site-survey position
	(6) Z-axis Gimbal Position Frame 5, bit 9. DM-14	Pre-site-survey position
	(7) Temperature Control State Frame 5, bit 10. DM-15	X-axis address
	(8) Heater power status Frame 6, bit 10. DM-28	On or Off
	(9) Measurement Range Frame 7, bits 9-10. DM-16	200 gammas
	(10) X-axis Field Offset. Frame 9, bits 9-10 and Frame 10, bit 9. DM-17	0%
	(11) Y-axis Field Offset. Frame 10, bit 10 and Frame 11, bits 9-10. DM-18	0%
	(12) Z-axis Field Offset. Frame 12, bits 9-10 and Frame 13, bit 9. DM-19	0%
	(13) Calibration Mode State Frame 13, bit 10. DM-20	Scientific
	(14) Offset Address State. Frame 14, bits 9-10. DM-21	Neutral
	(15) Filter Status Frame 15, bit 9. DM-22	IN

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
9.0 Lunar Surface Magnetometer Checkout (Cont'd)	b. Initial Status Check (Cont'd)	
	(16) Calibration Inhibit status Frame 15, bit 10. DM-23	Inhibited
	c. Field Offset Determination	
	(1) Initiate and verify Command octal 125 OFFSET ADDRESS	Consult PI before initiating command.
	(2) Check telemetry for indication of OFFSET ADDRESS, ALSEP word 5, LSM Frame 14, bit 9 and 10. DM-21	X-axis
	(3) Initiate and verify Command octal 124 FIELD OFFSET	
	(4) Verify that X-axis offset has changed, (Frame 9, bits 9 and 10 and Frame 10, bit 9).	
	(5) Observe change in X-axis data on analog recorder.	
	(6) Repeat Event 9, Step c(3) as necessary to bring X-axis output to suitable value. Observe the shift in X-axis offset per analog recorder and Frame 9 and 10 telemetry.	Consult PI before repeating this step.

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
9.0 Lunar Surface Magnetometer Checkout (Cont'd)	c. Field Offset Determination (Cont'd)	
	(7) Confirm optimum range and offset setting by observation of analog recorder.	
	(8) Initiate and verify Command Octal 125 OFFSET ADDRESS.	Y-Axis address
	(9) Check telemetry of offset address, Frame 14, bits 9-10. DM-21	
	(10) If required, repeat Event 9, Step c(3).	
	(11) Confirm that Y-axis offset has changed.	
	(12) Repeat Event 9, Step c(3) as necessary observing change in Y-axis offset.	Consult PI before repeating this step.
	(13) Initiate and verify Command octal 125 OFFSET ADDRESS.	
	(14) Check telemetry of offset address Frame 14, bits 9-10. DM-21	Z-axis address

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
9.0 Lunar Surface Magnetometer Checkout (Cont'd)	c. Field Offset Determination (Cont'd)	
	(15) Repeat Event 9, Step c(3).	
	(16) Confirm that Z-axis offset has changed.	
	(17) Repeat Event 9, Step c(3) as necessary, observing change in Z-axis offset.	Consult PI before repeating this step.
	(18) Initiate and verify Command octal 125 OFFSET ADDRESS.	

Table 2. Phase II, (Lunar Module Ascent Phase)

EVENT	MCC ACTIVITY	REMARKS
10. Heat Flow Experiment Checkout	a. Check HFE data on a continuous basis.	Note significant trends, especially during the turn-on period for the other experiments.
	b. Check need for leveling of the HFE electronics package.	
	c. Initiate and verify octal command 152 twice.	To ensure heater sequence is operating properly.
	d. Monitor HFE engineering channels as shown below: Telemetry word 33: (1) +5 v supply (AH-1) (2) -5 v supply (AH-2) (3) +15 v supply (AH-3) (4) -15 v supply (AH-4)	Note significant trends.
	(5) Low conductivity heater (6) High conductivity heater	Should be zero except during the conductivity experiment.

TABLE 3. PHASE III (Forty-Five Day Phase)

Phase III is outlined in Table 3 and covers the period from experiment checkout and verification through the following 45 calendar days. Table 3 includes lunar surface experiments only; orbital experiment operations are covered in Table 5. Phase V (Lunar Orbit Phase).

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY		REMARKS
1.0 Central Station	a. Monitor and record all engineering telemetry and utilize reserve power to optimize Central Station thermal environment.		Note any out-of-limit readings and significant trends toward limits.
	Lunar Cycle	Commands	
	Day/Night	Octal 022 PDR #2 ON	PDR #2 is a 14-watt power dump resistor.
	Day/Night	Octal 023 PDR #2 OFF	
	Night	Octal 024 DSS Htr #1 ON	DSS Heater #1 is a 10-watt heater.
	Night	Octal 017 DSS Htr #2 ON	DSS Heater #2 is a 5-watt heater.
	b. Confirm an appropriate change for each command executed.		
	c. Check downlink signal strengths at each "hand-over" from one MSFN station to the next. Log results and note any significant trend.		

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
2.0 Passive Seismic Experiment	a. Monitor and record all science and engineering data continuously. b. Relevel in Auto Mode as required. Octal 070 - X-Motor ON/OFF Octal 071 - Y-Motor ON/OFF Octal 072 - Z-Motor ON/OFF c. Check for evidence of automatic calibration of short period sensor at 18-hour intervals.	Record impact of spent LM-10 ascent stage on lunar surface.

Table 3.- Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
3.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment	a. Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indications.	SIDE/CCGE Standby Off.
	b. Monitor SIDE/CCGE average temperature.	Near the first lunar sunset, the SIDE/CCGE average temperature will approach 25°C.
	c. Initiate command octal 153, SIDE Operational Power On.	Consult P.I. before sending the command. This command is to be issued approximately 10 minutes before impact of the LM ascent stage.
	d. Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indications.	SIDE/CCGE Power on.
	e. Monitor and record all SIDE/CCGE Engineering and Scientific data continuously.	Note any significant trends.
	f. At discretion of the P.I., utilize SIDE/CCGE voltage step commands.	
	g. Initiate and verify the following sequence of commands:	Consult the P.I. before sending these commands.
	CCGE high voltage OFF, octals 104, 106, 107 and 110.	These commands to be issued approximately 20 minutes after LM impact.

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
3.0 Suprathermal Ion Detector Experiment/Cold Cathode Gauge Experiment (Cont'd)	h. Check experiment status telemetry AB-04, AB-05 and CS-02 for correct indications.	SIDE/CCIG Power On. High Voltage Off. NOTE: The SIDE/CCGE will remain in this power configuration unless directed otherwise by the P.I.

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY		REMARKS	
4.0 Solar Wind Spectrometer	a. Monitor science data on a continuous basis and advise SWS PI of significant measurement developments.		Note any out-of-limit conditions and significant trends toward limits.	
	b. Once per day, log and note significant trends of the following:			
	Temp. Meas.	Description	SWS Word	LSB
	DW-11	Temp. Mod 100	112	1
	DW-12	Temp. Mod 200	113	1
	DW-13	Temp. Mod 300	114	1
	DW-14	Temp. Sensor Cup Assembly	115	1
	DW-15	Sun Angle Sensor	116	1
	DW-16	Programmer Voltage	117	1
	DW-17	Step Generator Voltage and Supply Voltage, HK-20	118	1
	DW-18	Modulation Monitor	119	1
	c. Monitor SWS engineering data on a continuous basis and advise PI of significant measurement developments.		Note any out-of-limit conditions and significant trends toward limits.	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
5.0 Lunar Surface Magnetometer	a. Monitor science data measurement, DM-25 through DM-27, on a continuous basis.	During non-active periods of LSM activity, printout 5 minutes of data per hour on the high speed printer.
	b. Once per day, record housekeeping data as in Phase II, Event 9, Step a.	Note significant trends.
	c. Once per day, record experiment supply voltage, DM-08.	
	d. Flip Calibrate No. 2	
	(1) Check science data for evidence of automatic flip/calibration.	Turn on high speed printer and brush recorder for continuous recording.
	(2) Repeat Phase I, Event 14, Step d, FLIP/CAL INITIATE octal 131.	Consult PI before initiating command. Record as FLIP CAL No. 2 in Flight Controller's log.
	e. Housekeeping Data Check	
	Repeat check of Phase II, Event 9, Step a and compare with original data.	
	f. Flip Calibrate No. 3	
	Repeat Phase I, Event 14, Step d,	Consult PI before initiating command. Record as FLIP/CAL No. 3 in the Flight Controller's log.

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
5.0 Lunar Surface Magnetometer (Cont'd)	g. Flip Calibrate No. 4	
	Repeat Phase I, Event 14, Step d,	Consult PI before initiating command. Record as FLIP/CAL No. 4 in the Flight Controller's log.
	h. After the fourth Flip/Cal cycle, perform site survey as follows:	
	(1) Check for adequate reserve power, AE-05.	
	(2) Initiate and verify Command octal 133 SITE SURVEY	NOTE: First transmission of this command initiates X-axis survey.
	(3) From LSM data, printout 5 minutes prior to, during, and 5 minutes subsequent to the Flip/Cal sequence.	Use either real-time data or tape recorder data for this requirement.
	(4) Verify appropriate change in science data as survey progresses.	PI requires 3 hours for data analysis prior to initiation of next step.

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
5.0 Lunar Surface Magnetometer (Cont'd)	i. Repeat Step h(1) through h(4) above, twice to perform Y-axis and Z-axis site surveys.	
	j. At least 6 days after completion of site survey, initiate Command octal 132 FILTER BYPASS. Verify as per Frame 15, bit 9.	Filter Out
	k. Record data for 6 hours.	
	l. Initiate Command octal 132 FILTER BYPASS. Verify as per Frame 15, bit 9.	Filter In
	m. Ground Command FLIP/CAL during lunar sunrise: Initiate FLIP/CAL Command every 6 hours commencing 18 hours prior to lunar sunrise and continuing for a period of 18 hours after the event. Procedure will follow Phase I, Event 14, Step d.	
	n. Ascertain from scientific data that the 18-hour automatic Flip/Cal sequence is in effect at all times other than Step m above.	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
5.0 Lunar Surface Magnetometer (Cont'd)	o. Auxiliary Commands These commands will be initiated at the request of the PI due to special scientific requirements. (1) Command octal 123, Range Select (2) Command octal 124, Steady Field Offset (3) Command octal 125, Steady Field Offset Address (4) Command octal 127, FLIP/CAL Inhibit In/Out (5) Command octal 131, FLIP/CAL (6) Command octal 132, Filter Failure Bypass In/Out (7) Command octal 134 Temperature Control	Log all timer (delayed command sequence) FLIP/CAL commands.

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
6.0 Heat Flow Experiment	a. Monitor the HFE Engineering and Scientific Data.	Monitor temperature trends at each sensor. Monitor mode, heater, and programmer status and note abnormal readings.
	b. Heat Flow Conductivity Experiment. 1. Check HFE data telemetry word 21, bits 3, 4, 5, 6 of HFE word 5 for correct heater state. 2. If bits 3, 4, 5, 6 of HF word 5 are not 0000, send octal command 152 (Heater Advance) until the bits are in the proper state. Reference HFE heater sequence. Figure 12.	Consult PI prior to performing conductivity experiment. During the conductivity experiment consult the PI before making any mode changes or data interruptions. The time interval for hard copy printouts will be a real-time decision by the PI. Octal command 152 advances the heater switch one state for each command sent. The next state after Heater 23 ON is Heater 12 OFF. Heat Flow Cond. Experiment — Heater Energized 1 — H12 2 — H14 3 — H11 4 — H13 5 — H22 6 — H24 7 — H21 8 — H23

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
7.0 Heat Flow Conductivity Experiment 1 Mode 2 Operation H12	Command Sequence (Initiate and verify)		
A. Initiation	Monitor for 2 hours	DTH 11	0000
B. Heating Phase (a) PI will determine, after 1 hr, to continue in Mode 2 or switch to Mode 3 operation	152, 136	DTH 11 If PI elects to stay in Mode 2 the heating phase will be from 15 to 36 hours. (a) The heater advance Command 152, in Mode 2 operation, can be sent during the 2 hour initiation period.	0001

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
8.0 Heat Flow Conductivity Experiment 1 Mode 3 Operation (Cont'd)			
(D) Monitor Probe 1 gradient bridge for 15 minutes. (see note b)	135, 142, 152 (14 times)	DTH (11, 12) T (11, 12)	0010
(E) Monitor Lower section ring bridge for 15 minutes.	140, 144	DTR 12, TR 12	0010
		(a) For ring bridge, Mode 3 measurements, the 15 minute period starts when the last command has been initiated and verified. (b) For gradient bridge measurements, the 15 minute period starts when command 135 has been initiated and verified.	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
8.0 Heat Flow Conductivity Experiment 1 Mode 3 Operation (Cont'd)		
(F) Return to Step 3 and repeat steps (C-E) for a minimum of 6 hours.		
(G) Return to Mode 1 operation, full sequence.	135, 141	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
9.0 Heat Flow Conductivity Experiment 2 Mode 2 Operation H 14			
(A) Initiation	Monitor for 2 hours	DTH 12	0010
(B) Heating Phase	152, 136	DTH 12	0011
PI will determine, after 1 hour to continue in Mode 2 or switch to Mode 3 operation.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
10.0 Heat Flow Conductivity Experiment 2 Mode 3 Operation	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Heating Phase 10 hours Terminate on approval of PI.	140, 144	DTR 12, TR 12	0011
(B) Monitor lower section ring bridge for 15 minutes.	135, 152, 152, 152, 140, 144	DTR 12, TR 12	0110
(C) Monitor Probe 1 gradient bridge for 15 minutes.	135, 142	DTH (11, 12) T (11, 12)	0110
(D) Monitor lower section ring bridge for 15 minutes.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
10.0 Heat Flow Conductivity Experiment 2 Mode 3 Operation (Cont'd)		
(E) Return to Step C and repeat steps (C and D) for a minimum of 6 hrs.		
(F) Return to Mode 1 Operation, full sequence	135, 141	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
11.0 Heat Flow Conductivity Experiment 3 Mode 2 Operation H 22	Command Sequence (Initiate and verify)	Bridge Measurement	Heater State
(A) Initiation	Monitor for 2 hours	DTH 21	0110
(B) Heating Phase	152, 152, 152, 136	DTH 21	1001
PI will determine after one hour, to continue in Mode 2 or switch to Mode 3 operation.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
12.0 Heat Flow Conductivity Experiment 3 Mode 3 Operation	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Heating Phase 10 hr. Terminate on approval of PI.	140, 144	DTR 21, TR 21	1001
(B) Monitor lower section ring bridge for 15 minutes	152	DTR 22, TR 22	1010
(C) Monitor upper section ring bridge for 15 minutes.	135, 152, 152, 140, 144	DTR 21, TR 21	1100
(D) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143, 152 (14 times)	DTH (21, 22) T (21, 22)	1010

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
12.0 Heat Flow Conductivity Experiment 3 Mode 3 Operation (Cont'd)			
(E) Monitor lower section ring bridge for 15 minutes.	140, 144	DTR 22, TR 22	1010
(F) Return to Step C and repeat steps (C-E) for a minimum of 6 hrs.			
(G) Return to Mode 1 operation, full sequence.	135, 141		

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
13.0 Heat Flow Conductivity Experiment 4 Mode 2 Operation H-24	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Initiation	Monitor for 2 hours	DTH 22	1010
(B) Heating Phase	152, 136	DTH 22	1011
PI will determine, after 1 hour to continue in Mode 2 or switch to Mode 3 operation.			

Table 3. Phase III (Forty--Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
14.0 Heat Flow Conductivity Experiment 4 Mode 3 Operation	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Heating Phase 10 hours Terminate on approval of PI.	140, 144	DTR 22, TR 22	1011
(B) Monitor lower section ring bridge for 15 minutes.	135, 152, 152, 152, 140, 144	DTR 22, TR 22	1110
(C) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143	DTH (21, 22) T (21, 22)	1110

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
14.0 Heat Flow Conductivity Experiment 4 Mode 3 Operation (Cont'd)		Bridge Measurement	Heater State
(D) Monitor lower section ring bridge for 15 minutes.	140, 144	DTR 22, TR 22	1110
(E) Return to Step C and repeat steps (C thru D) for a minimum of 6 hrs.			
(F) Return to Mode 1 operation, full sequence.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
15.0 Heat Flow Conductivity Experiment 5 Mode 2 Operation H 11.	Command Sequence (Initiate and Verify)		
(A) Initiation	Monitor for 2 hours	DTH 11	1110
(B) Heating Phase	152 (7 times), 136	DTH 11	0101
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 Operation.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
16.0 Heat Flow Conductivity Experiment 5 Mode 3 Operation.	Command Sequence (Initiate and Verify)		
(A) Heating Phase 10 hrs. Terminate on approval of PI.	140, 144	DTR 11, TR 11	0101
(B) Monitor upper section ring bridge for 15 minutes.	135, 152 (11 times) 140, 144	DTH 11, TR 11	0000
(C) Monitor Probe 1 gradient bridge for 15 minutes.	135, 142	DTH (11, 12) T (11, 12)	0000
(D) Monitor upper section ring bridge for 15 minutes	140, 144	DTR 11, TR 11	0000

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
16.0 Heat Flow Conductivity Experiment 5 Mode 3 Operation (Cont'd)		
(E) Return to Step 3 and repeat steps (C-D) for a minimum of 6 hrs.		
(F) Return to Mode 1 Operation full sequence	135, 141	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
17.0 Heat Flow Conductivity Experiment 6 Mode 2 Operation H 13	Command Sequence (Initiate and Verify)		
(A) Initiation	Monitor for 2 hours	DTH 12	0000
(B) Heating Phase	152 (7 times), 136	DTH 12	0111
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
18.0 Heat Flow Conductivity Experiment 6 Mode 3 Operation.	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Heating Phase 10 hrs. Terminate on approval of PI.	140, 144	DTR 12, TR 12	0111
(B) Monitor upper section ring bridge for 15 minutes	135, 152 (9 times), 140, 144	DTR 11, TR 11	0000
(C) Monitor lower section ring bridge for 15 minutes	135, 152, 152, 140, 144	DTR 12, TR 12	0010
(D) Monitor Probe 1 gradient bridge for 15 minutes	135, 142, 152 (14 times)	DTH (11, 12) T (11, 12)	0000

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
18.0 Heat Flow Conductivity Experiment 6 Mode 3 Operation. (Cont'd)		Bridge Measurement	Heater State
(E) Monitor upper section ring bridge for 15 minutes	140, 144	DTR 11, TR 11	0000
(F) Return to Step C and repeat steps (C thru E) for a minimum of 6 hrs.			
(G) Return to Mode 1 operation, full sequence.	135, 141		

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
19.0 Heat Flow Conductivity Experiment 7 Mode 2 Operation H21	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Initiation	Monitor for 2 hours	DTH 21	0000
(B) Heating Phase	152 (13 times), 136	DTH 21	1101
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
20.0 Heat Flow Conductivity Experiment 7 Mode 3 Operations	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Heating Phase 10 Hrs. Terminate on approval of PI.	140, 144	DTR 21, TR 21	1101
(B) Monitor upper section ring bridge for 15 minutes	132, 152 (11 times), 140, 144	DTR 21, TR 21	1000
(C) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143	DTH (21, 22) T (21, 22)	1000
(D) Monitor upper section ring bridge for 15 minutes.	140, 144	DTR 21, TR 21	1000

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS
20.0 Heat Flow Conductivity Experiment 7 Mode 3 Operations (Cont'd)		
(E) Return to Step C and repeat steps (C thru D) for a minimum of 6 hrs.		
(F) Return to Mode 1 operation, full sequence.	135, 141	

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
21.0 Heat Flow Conductivity Experiment 8 Mode 2 Operation H 23	Command Sequence (Initiate and Verify)		
(A) Initiation	Monitor for 2 hours	DTH 22	1000
(B) Heating Phase	152 (7 times), 136	DTH 22	1111
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 Operation.			

Table 3. Phase III (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
22.0 Heat Flow Conductivity Experiment 8 Mode 3 Operation	Command Sequence (Initiate and Verify)	Bridge Measurement	Heater State
(A) Heating Phase 10 hrs. Terminate on approval of PI.	140, 144	DTR 22, TR 22	1111
(B) Monitor upper section ring bridge for 15 minutes	135, 152 (9 times), 140, 144	DTR 21, TR 21	1000
(C) Monitor lower section ring bridge for 15 minutes	135, 152, 152, 140, 144	DTR 22, TR 22	1010

Table 3. Phase III. (Forty-Five Day Phase)

EVENT	MCC ACTIVITY	REMARKS	
		Bridge Measurement	Heater State
22.0 Heat Flow Conductivity Experiment 8 Mode 3 Operation (Cont'd)			
(D) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143, 152 (14 times)	DTH (21, 22) T (21, 22)	1000
(E) Monitor upper section ring bridge for 15 minutes.	140, 144	DTR 21, TR 21	1000
(F) Return to Step C and repeat Steps (C thru E) for a minimum of 6 hours.			
(G) Return to Mode 1 Operation, full sequence	135, 141		

State					Heater	Function	Bridge Energized
	H4	H3	H2	H1			
1	0	0	0	0	12	OFF	DTR 11
2	0	0	0	1	12	ON	DTR 11
3	0	0	1	0	14	OFF	DTR 12
4	0	0	1	1	14	ON	DTR 12
5	0	1	0	0	11	OFF	DTR 11
6	0	1	0	1	11	ON	DTR 11
7	0	1	1	0	13	OFF	DTR 12
8	0	1	1	1	13	ON	DTR 12
9	1	0	0	0	22	OFF	DTR 21
10	1	0	0	1	22	ON	DTR 21
11	1	0	1	0	24	OFF	DTR 22
12	1	0	1	1	24	ON	DTR 22
13	1	1	0	0	21	OFF	DTR 21
14	1	1	0	1	21	ON	DTR 21
15	1	1	1	0	23	OFF	DTR 22
16	1	1	1	1	23	ON	DTR 22

	Bore Hole 1		Bore Hole 2	
Top	H11	DTR 11	H21	DTR 21
	H12		H22	
	H13	DTR 12	H23	DTR 22
Bottom	H14		H24	

Figure 12. Heat Flow Experiment Heater Sequence

TABLE 4. Phase IV (One-Year Phase)

Phase IV as outlined in Table 4 covers the period from forty-five (45) days through the first year of operational life for ALSEP. Table 4 includes lunar surface experiments only; orbital experiment operations are covered in Table 5, Phase V (Lunar Orbit Phase).

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS
1.0 Central Station	a. Check Central Station engineering telemetry as in Phase III, Event 1, Step a, and initiate any contingency action indicated. b. Optimize the Central Station thermal environment for the next 24-hour period as in Phase III, Event 1, Step a.	Check temperatures early in each access period, and every day during continuous coverage.

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS
2.0 Passive Seismic Experiment	a. Early in the access period and every day during continuous coverage, check PSE sensor temperature, DL-07.	Log temperatures and note trends.
	b. Early in the access period and again near end of access, check Tidal X, Y and Z data, DL-04, DL-05 and DL-06, respectively, for excessive drift of sensor and relevel as required.	X MTR ON/OFF Octal 070 Y MTR ON/OFF Octal 071 Z MTR ON/OFF Octal 072
	c. During each continuous coverage access period, check for evidence of automatic calibration in short period data, DL-08 and initiate contingency action if necessary. Adjust gain, if necessary, per Phase I, Event 12, Step d.	
	d. During each access period, calibrate long period circuitry as in Phase I, Event 12, Step g.	
	e. Monitor science data for evidence of unusual developments.	
	f. Record seismic event resulting from impact, on lunar surface, of the S-IV-B stage from the Apollo 16 mission.	

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS
3.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment	a. Early in each access period and daily during continuous coverage, check instrument temperatures as in Phase I, Event 13, Step b(4), and initiate contingency action if required. b. Early in each access period and daily during continuous coverage, check power supply performance as in Phase I, Event 13, Step b(3) and initiate contingency action, if required. c. Monitor SIDE/CCGE science data and adjust operating mode at the discretion of the PI to optimize data.	Log temperatures and note trends.

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS
4.0 Solar Wind Spectrometer	a. Early in each access period and every day during continuous coverage, check telemetry as in Phase II, Event 8, Step b, and initiate contingency action, if required. b. Near the end of each access period, examine science data for evidence of unusual developments.	Log data and note significant trends.

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS
5.0 Lunar Surface Magnetometer	a. Early in each access period and every day during continuous coverage, check engineering data as in Phase II, Event 9, Step a(1) through a(8) and initiate contingency action if required.	Log analog engineering value and note significant trends.
	b. During each continuous coverage access period, check science data for evidence of automatic FLIP/CAL at 18-hour intervals.	Initiate following contingency action if required because of timer failure. Initiate command octal 131, LSM FLIP/CAL initiate, once every day during intermittent support and every six hours during continuous support.
	c. During periods of continuous coverage, perform additional FLIP/CAL cycles as required, per Phase I, Event 14, Step d, Readjust gain and offset per Phase I, Event 14, Step c if required.	
	d. Near the end of each access period, examine LSM scientific data for evidence of unusual developments.	Compare LSM data with data obtained from the Sub-Satellite Magnetometer, S-174.

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS	
6.0 Heat Flow Experiment	Command Sequence:	Bridge Measurement:	Heater State:
(A) Check HFE data for 2 hr. periods.	(Initiate and Verify)	Monitor temperature trends at each sensor. Monitor mode, heater, and programmer states and note abnormal readings.	
1. Initiation		Ensure heater state is 0000. If not, send command 152 until state 0000 is reached.	
2. M 3 operation - 15 min.	140, 144	DTR11	0000
3. M 1 operation - 15 min.	135, 152, 152	Full Sequence	0010
4. M 3 operation - 15 min.	140, 144	DTR 12	0010
5. M 1 operation - 15 min.	135, 152 (6 times)	Full Sequence	1000
6. M 3 operation - 15 min.	140, 144	DTR 21	1000

Table 4. Phase IV, (One Year Phase)

EVENT	MCC ACTIVITY	REMARKS	
6.0 Heat Flow Experiment (Cont'd)	Command Sequence:	Bridge Measurement:	Heater State:
A. 7. M 1 operation - 15 min.	135, 152, 152	Full Sequence	1010
8. M 3 operation - 15 min.	140, 144	DTR 22	1010
9. M 3 operation - 15 min.	135, 152 (6 times)	Full Sequence	0000
		The PI will perform a second set of conductivity experiments during the final two months of the lunar year.	

Table 5. Phase V (Lunar Orbit Phase)

Phase V is outlined in Table 5 and covers the period of all scientific activity for the lunar orbit experiments beyond earth orbit. Table 5 does not include those experiments performed on the lunar surface.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
1.0 Orbital Experiments			Most experiments require a field-of-view along the local vertical when mounted in the SIM. However, for calibration purposes, some experiments require CSM orientation to other attitudes for various time periods. In the case where the SIM is not pointing along the local vertical, some experiments should be turned to Standby or OFF. This decision will be made in Real-Time by the PI. Lunar Orbit experiments must be scheduled relative to time-critical operations such as LM descent and ascent, rendezvous and transearth injection and without interference with essential mission profile operations.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 SM Orbital Science Photography	a. Launch or Powered Flight		
2.1 24-Inch Panoramic Camera	Place the Panoramic Camera POWER/OFF/BOOST switch (S12) in the BOOST postion.	None	Provides film supply spool tension to prevent slack during launch and other powered flight phases.
	b. Film Advance Each twenty-four (24) hours (± 6 hours) momentarily place the Panoramic Camera SELF TEST/OFF/HEATERS switch (S10) to the Self Test position.	None	Automatically advances film 5 frames to prevent film set. Not necessary if camera was operated in that 24-hour period.
	c. Camera Warm-up Non-Operating Conditions Place the Panoramic Camera OPERATE/STANDBY switch (S11) to STANDBY and the SELF TEST/OFF/HEATERS switch (S10) to HEATERS (as required).	Monitor camera optical temperatures and housekeeping data.	40 to 100°F.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd) 2.1 24-Inch Panoramic Camera (Cont'd)	d. <u>Camera Operation</u>		
	(1) Retract the Mass Spectrometer and Gamma Ray booms prior to camera operation.		
	(2) Select the Panoramic Camera power ON/OFF/BOOST switch (S12) to "ON" and the OPERATE/STANDBY switch (S11) to OPERATE.	a. Monitor camera optics temperatures, housekeeping, and operational data. b. Provide voice uplink requests for mode and AEC Bias selection per P.I. request.	85 to 95°F.
	(3) Maintain spacecraft attitude.		
	(4) Select AEC Bias and modes per flight plan and/or voice uplink P.I. requests.		Stereoscopic or monoscopic mode.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd)			
2.1 24-Inch Panoramic Camera (Cont'd)	e. Camera Shut Down Select Panoramic Camera OPERATE/STAND-BY switch (S11) to STANDBY and SELF TEST/OFF/HEATERS switch (S10) to OFF.	a. Monitor camera optics temperatures, housekeeping data.	85 to 95°F. Camera heaters are thermostatically controlled ON at 85.5°F and OFF at 86.5°F when selected to HEATER/STANDBY or OPERATE modes. To assure lens stowage when selecting "OFF", place in the "STANDBY" position for a minimum of twenty seconds then select "OFF."
	f. EVA Retrieve film cassette.		Film cassette should not be exposed to any degree of solar radiation or deep-space sink temperatures for more than 40 minutes.
	g. Stow Film Cassette.		Cassette to be stowed aboard the CM and the cassette orifices taped shut.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd) 2.2 Three Inch Mapping Camera	a. <u>Launch or Powered Flight</u> Place mapping camera ON/OFF/STANDBY switch (S6) to STANDBY.	None	Activates film supply cassette back-tensioning mechanism. Image motion compensation switch must be "OFF" for launch
	b. <u>Film Advance</u> (1) Each twenty-four (24) hours (±6) the mapping camera switch (S6) is placed to STANDBY.	Monitor film cassette and optical temps.	40 to 100°F. To prevent film set. Not necessary if camera was operated during that 24-hour period.
	(2) Place switch (S6) to "ON" for 5 camera cycles (approximately 2 minutes for normal V/H setting). Then select switch (S6) to "OFF".	Monitor optical and film cassette temps.	40 to 100°F.
	c. <u>Camera Warm-Up</u> Twenty-five (25) hours prior to mapping camera experiment place the ON/OFF/STANDBY switch (S6) to STANDBY.	Monitor camera optical and cassette temperatures.	40 to 90°F. Twenty-five (25) hours will be required if the optical system temperatures are between 40° and 60°F. at the beginning of the warm-up period.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd)			
2.2 Three Inch Mapping Camera (Cont'd)	d. <u>Camera Operation Extend Boom</u>		
	(1) Open camera lens contamination cover.		Talkback indicator is gray when cover is open or closed and "barber pole" when in transition.
	(2) Prior to beginning of camera operations the Panel 181 Logic Switch must be placed in the DEPLOY position.	Monitor camera optical temperatures.	40 to 90°F.
	(3) Place the mapping camera Panel 230 Track EXTEND/RETRACT switch (S14) to the EXTEND position.		The camera boom system requires four minutes to extend 18 inches. The track indicator should show a barber pole during the extension period and gray when extension is complete.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd)			
2.2 Three Inch Mapping Camera (Cont'd)	e. Operation with Image Motion "ON"		
	(1) Place the mapping camera ON/OFF STANDBY switch (S6) to the STANDBY position. Place the image motion increase ON/OFF switch (S27) to the ON position.		Image motion ON or OFF is enabled only when mapping camera switch is set to Standby position, and the camera is in its "Home" position.
	(2) Select the Mapping Camera ON/OFF/STANDBY switch (S6) to "ON".	a. Monitor optical temperatures and housekeeping data.	70°F ± 10°F.
	(3) Select the Image Motion Increase switch (S27) to INCREASE upon request from MCC (V/H correction).	b. Monitor optical temperatures and housekeeping data.	70°F ± 10°F. Image motion increase is enabled only when mapping camera switch is set to ON position. Each time the image motion switch is set to its momentary increase position, and released (causing the switch to return to the ON position), a (Continued on next page.)

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd) 2.2 Three Inch Mapping Camera (Cont'd)	(3) Continued)		pulse is produced. This pulse causes the MC internally generated V/H signal to increase in value by approximately 1.0 milliradian/second. A total of five such rates is provided: 12.1, 13.1, 14.1, 15.1 and 16.1 milliradians/second. Upon reaching its highest value, the next pulse produces the lowest V/H signal, so that the 5 step cycle can be repeated. (Barber pole only while in momentary increase position for 14.1 V/H rate.) Setting the image motion switch to OFF position locks out the image motion correction capability of the camera. Setting the image motion switch to ON position permits image motion correction mechanism to function.
	(4) Maintain Spacecraft Attitude		

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd)			
2.2 Three Inch Mapping Camera (Cont'd)	f. Completion of Mapping Camera Pass		
	(1) Select Mapping Camera image motion switch (S-27) to OFF. Place ON/OFF/STANDBY switch (S6) to STANDBY.	Monitor optical temperatures	40 to 90°F
	g. End of Mapping Camera Photographic Mission		
	h. Repeat Mapping Camera Operations per Flight Plan or Photo Team Requests		
	(1) Place Mapping Camera ON/OFF/STANDBY switch (S6) to STANDBY. Place Image motion switch (S27) to OFF. Place ON/OFF/STANDBY switch (S6) to OFF.		

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd) 2.2 Three Inch Mapping Camera (Cont'd)	(2) Place DEPLOY/RETRACT logic switch (Panel 181) to RETRACT.		Retraction requires approximately 4 minutes.
	i. EVA: Retrieve film cassette.		Film cassettes should not be exposed to any degree of direct solar radiation or deep-space sink temperature for more than 40 minutes.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
2.0 (Cont'd)			
2.3 Laser Altimeter (S-175)	a. <u>Laser Altimeter Operation</u>		
	(1) Select Laser Altimeter power ON/OFF switch (S8) to "ON".	Monitor Altimeter data word and housekeeping data.	32 to 131°F. Altimeter may be operated at anytime after SIM door removal (retracted or extended). The laser altimeter is sun sensitive.
	(2) Maintain required spacecraft attitudes.		The laser altimeter is automatically slaved to the Mapping Camera whenever the laser altimeter is ON and the Mapping Camera is operating.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
3.0 Gamma Ray Spectrometer (S-160)			
	a. Extend Gamma-Ray Sensor & Boom	a. Monitor Sim Bay environmental temperature.	Less than 110°F. Following SIM Bay Door removal, the Gamma Ray Spectrometer must be extended (not necessarily full extension) when the SIM Bay environment reaches or exceeds 110°F. Cover opens automatically when Boom is extended.
	b. Activate Gamma-Ray Spectrometer.	b. Monitor Gamma-Ray Spectrometer output and housekeeping data.	Extend boom to 25 feet. Turn Spectrometer ON for a minimum of 10 hours operation (not necessarily continuous). Operation to be concurrent with Alpha and X-Ray experiments. Sensor orientation must be within ± 11 1/2° of local vertical.
	(1) Accomplish experiment gain changes per PI request.	c. Request gain changes as required and monitor Gamma-Ray Spectrometer science data output.	
	(2) Maintain required spacecraft attitude.		Select to "SHIELD OFF" for 10 minutes within one hour after initial boom extension and once after each five hours of operation thereafter. (Instrument Functional Check.) (This is not a requirement during crew rest periods.)
	c. Experiment Inhibit (SHIELD OFF)		

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
3.0 (Cont'd) Gamma Ray Spectrometer (S-160)	d. Retract Boom to 8-foot position prior to Mapping or Pan Camera operations.	d. Monitor SIM Bay Environment temperature.	Less than 110°F. The sensor should be partially extended if the SIM Bay Environment temperature exceeds 110° F. (Sensor should be fully retracted for TEI burn.)
	e. Post-TEI Gamma-Ray Activation.	e. Monitor Gamma-Ray Spectrometer output and housekeeping data.	As soon as practical after TEI, for 30 cumulative hours of data. (Not to constrain PTC.)
	f. Retract Boom (3 step sequence).	f. Monitor Gamma-Ray Spectrometer output and housekeeping data.	Retract Boom 10 feet to the 15-foot position. Collect 2 hours of highly desirable plus 2 hours of additional data. Retract Boom 7 feet to the 8 foot position. Collect 2 hours of highly desirable plus 2 hours of additional data. Retract Boom fully. Collect 1 hour of highly desirable plus 1 hour of additional data.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
3.0 (Cont'd) Gamma Ray Spectrometer (S-160)	g. Deactivate Gamma-Ray Experiment. Select power switch to OFF.		

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
4.0 X-Ray Fluorescence (S-161)	a. Open solar monitor door		Collects data on lunar sunlit side.
	b. Open experiment cover before operation.		Talkback indicator is "barber pole" during cover transition.
	c. Select to Standby.	a. Monitor SIM Bay Environment temperature and experiment housekeeping data.	Experiment must be set to STANDBY once SIM Door is jettisoned to provide thermal protection. (When SIM Bay temperature falls below 0°F.)
	d. Activate experiment and maintain required spacecraft attitude.	b. Monitor X-Ray Pulse Height Amplitude and housekeeping data. c. Monitor spacecraft attitude.	Minimum of 10 hours of continuous operation required. Operation to be concurrent with Gamma-Ray and Alpha Particle Spectrometer experiments. Fluid dumps and certain thrusters must be inhibited during operations. Surface sensor to be within ± 6.5° of local vertical. Should the surface sensor field-of-view approach within ± 60° of the sun, the experiment must be set to STANDBY. Background data will be obtained once each activity day while over the dark side of the moon by rolling the fluorescence sensor 135 to 180° to view deep space.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
4.0 X-Ray Fluorescence (S-161) (Cont'd)	e. TEC Operation	Monitor X-Ray Pulse Height Amplitude and housekeeping data.	Collect TEC data for a minimum of 15 hours.
	f. Galactic Object Survey	Monitor X-Ray science and housekeeping data. Monitor spacecraft attitude.	Selected objects will be observed during TEC.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
5.0 CSM/LM S-Band Transponder (S-164)	a. The CSM must be in a quiescent condition during data collection period. b. Data will be collected during non-powered flight in 60 x 8 N.M. lunar orbit. c. Data will be collected during non-powered portion of LM descent. d. Data will be collected during 60X60 orbit of CSM-LM docked and undocked (non-powered flight) e. 170 x 60 N.M. orbit.		All functions that cause CSM translation (water dumps, purges, water boiler operations, etc.) must be inhibited. MSFN will obtain and record S-Band doppler measurement during front side passes of the CSM/LM in lunar orbit, the undocked CSM, the LM descent, and the LM ascent stage during descent for impact on lunar surface.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
6.0 Particles and Fields Subsatellite Experiment (S-173) (S-174) (S-164)	a. Spacecraft shall be in inertial hold for subsatellite launch. b. Position Panel 181 logic switch to JETT. c. Position Panel 230 switch to EXTEND/LAUNCH. d. Following launch, or unsuccessful attempt to launch, position panel 230 switch to RETRACT. e. Photograph the subsatellite immediately after launch.		In a nominal 60 NM circular orbit at time of launch. Power to Panel 230. Protective cover opens automatically. Barber pole will show on initiation. On completion of launch, indicator will return to grey and the event will be transmitted via PCM. Launch must occur within ± 10 minutes of the crossing of the reference plane.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
7.0 Alpha Particle Spectrometer Experiment (S-162)	a. Open experiment cover.		Talkback indicator is a barber pole during cover transition.
	b. Set to OPERATE.	Monitor experiment science and housekeeping data - SIM Bay Environment.	Experiment must be turned on to provide thermal protection when SIM Bay Environment falls below $0^{\circ}F$ after SIM Bay door jettison.
	c. Maintain required spacecraft attitudes.	Monitor experiment science and housekeeping data.	Experiment to be operated concurrently with Gamma and X-Ray Experiments. 10 hours operation minimum. The sensor is to be pointed within $\pm 6\frac{1}{2}^{\circ}$ of local vertical. Once each operational day, while over the lunar dark side, the spacecraft is to be rolled 135 to 180° to expose the sensor to deep space for a 15 minute period to obtain background data. Direct sunlight should not enter to within $\pm 45^{\circ}$ of the sensor field of view for more than 5 minutes at any one time or for more than a total exposure of 30 minutes.
	d. Select to OFF	Monitor SIM Bay temperature environment.	Experiment may be set to OFF prior to TEI to conserve power.
	e. TEC Operation per Flight Plan		

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Mass Spectrometer Experiment (S-165)	a. <u>Experiment Boom Deployment</u> Following SIM Bay Door removal the experiment boom must be extended prior to initiating the 6-hour ion source heater operation.	Monitor astronaut activity.	Select the Mass Spectrometer Boom Deploy Logic Switch on Panel 181. Set Boom Deploy/Retract Switch S-7/S-4 to Deploy. Switch S-7/S-4 may be left in either the Extend or Retract position as a boom position crew reminder. Protective cover opens automatically. An Extension Talkback indicator is provided.
	b. <u>Experiment Ion Source Heater Operation</u>	Monitor cumulative Ion Source Heater "ON" time, and effluent dumps.	Set Mass Spectrometer Experiment ON/OFF/STANDBY Switch (S-18) to "STANDBY". The boom will be fully extended for all mass spectrometer ion source heater operations, and waste water and urine dumps. Before initial data collection, the ion source heaters will be operated for a cumulative period of 6 hours of which the last hour will be continuous. One half hour of heater operation will be added to the 6-hour total each time heater operation is interrupted. Waste water and urine dumps will be inhibited 1 hour before ion source heater operation (i.e., heater OFF for 1 hour after dump). Before a dump is initiated, the

Table 5. Phase V (Lunar [illegible]it Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Mass Spectrometer Experiment (S-165) (Cont'd)			heater will be set to OFF for at least 15 minutes but it is highly desirable that the heater be OFF for 1 hour. RCS jets A2, A4, B1, B4, C1, and C3 which could contaminate the experiment will be inhibited during heater operation. CSM attitude will not be critical during ion source heater operation. Before each data collection period, following the initial period, the ion source heaters will be operated continuously for 30 minutes. Waste water and urine dumps will be inhibited 2 hours before and during data collection, and a minimum of 5 minutes following data collection. RCS jets A2, A4, B1, B4, C1 and C3 will also be inhibited during data collection.
	c. <u>Experiment Operation</u> (1) Initiate experiment approximately one hour prior to crew sleep periods.	a. Monitor experiment scientific and housekeeping data. b. Evaluate science data and prepare uplink multiplier and discriminator switch changes via voice request.	For data collection, the CSM -X axis will be oriented to within TBD degrees of the velocity vector and the centerline of the SIM pointed toward the lunar local vertical. (Tolerances: ± 10° pitch, ± 15° yaw, and ± 60° roll with respect to the velocity vector.) Drift rates in all axes are not critical.

Table 5. Phase V, (Lunar bit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Mass Spectrometer Experiment (S-165) (Cont'd)	c. (2) Set experiment ON/OFF/STANDBY Switch (S-18) to "ON" and the Ion Source Switch (S-19) to "ON" (3) During the initial hour of operation or following crew sleep periods the astronaut will operate the multiplexer and discriminator Switches (S-16 and S-15) per up-link voice request. (4) Maintain spacecraft attitudes.		The lunar surface area of prime interest extends ± 15° longitude each side of the sunset and sunrise terminators. Background contamination data will be collected for one complete revolution with the CSM +X axis pointed in the direction of the velocity vector. It is desirable that these data be obtained toward the end of the experiment period. The experiment will be operated and data collected for a minimum of two complete revolutions, not necessarily consecutive nor continuous, during each of three separate periods. During each of these six revolutions, a Mapping Camera photograph of the boom will be obtained at sunrise, at noon, and at sunset to determine the extent of boom thermal distortion and the resultant change in experiment scoop orientation. Mass spectrometer data collection for three additional revolutions during the above separate periods is highly desirable.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Mass Spectrometer Experiment (S-165) (Cont'd)	d. <u>Boom Retractions</u>		Periodically the Mass Spectrometer boom will be retracted from the Panoramic Camera and Mapping Camera fields-of-view.
	(1) TEI Boom Retraction.		The mass spectrometer boom will be fully retracted prior to the TEI SPS burn.
	(2) Post TEI operation	Monitor experiment scientific and housekeeping data.	The experiment will be operated during transearth coast no sooner than 6 hours after TEI or an MCC burn. Before data collection, the ion heaters will be operated for a cumulative period of 3 hours of which the last hour will be continuous. During this ion source heater activity, the boom may be in the one-half extension position, if required by operational constraints. Effluent dumps will be inhibited 1 hour before and during ion source heater operation and data collection.

Table 5. Phase V, (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
8.0 Mass Spectrometer Experiment (S-165) (Cont'd)			RCS jets A2, A4, B1, B4, C1, and C3 will be inhibited; the heater will be set to OFF 15 minutes before a dump is initiated, and for 1 hour after the dump. Data will be collected for 1 hour minimum with the boom fully extended. The boom will then be retracted in five equal steps with data being collected for 7 minutes after each retraction step, for a total of 35 minutes. The last 7-minute data collection period will occur with the boom in a fully retracted position. CSM attitude is not critical during this transearth coast activity.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
9.0 UV Photography Earth and Moon (S-177) (2) As early as practical into TLC	A minimum of 12 sets of quadruple exposures will be taken as follows: a. Earth Parking Orbit (1) ~~Clouds~~ Earth Limb ~~(2) Land and water~~ b. TLC Earth Disc (3) 60K N.M. from earth. (4) 120K N.M. from earth. (5) 180K N.M. from earth. c. Lunar Orbit (6) Earth (7) Earth and Lunar Horizon. (8) Lunar Terra. (9) Lunar Maria.	Camera, the optical axis of which is normal to the	~~At least one frame of protective film will be run before and after each set of photographs.~~ It is highly desirable that one color photograph be obtained with each set of four above, using the 70 mm Hasselblad electric camera and showing approximately the same scene that is taken in the set of four photographs. Tolerance on the times of TLC and TEC photography is ± 30 minutes from the time of passage through the indicated distances, except that photography is not to interfere with scheduled crew sleep periods. The spacecraft attitude must be such that the photographic subject area is in the field-of-view of the RH side window. The CSM attitude rates will not exceed ± 0.05 degrees/second during periods of photography.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
9.0 UV Photography Earth and Moon (S-177)	d. <u>TEC Earth Disc</u> (10) 180K N.M. from earth. (11) 120K N.M. from earth. (12) 60K N.M. from earth. (13) As late as practical into TEC Crew will be required to change filters and timer settings per Flight Plan.		~~A set of calibration photos will be taken ASAP after TLI and another set late in the TEC period. 70 mm HE camera will be used.~~

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
10.0 CM Orbital Science Photography			
10.1 Hasselblad Electric Camera - 70 mm	a. Color photo with each set of UV photos.		This HD requirement uses 70 mm HEC with 80 mm lens.
	b. Solar Corona photos, after CSM sunset and before CSM sunrise.		Three series of 7 photos each, using 70 mm HEC with 80 mm lens, bracket-mounted.
	c. TEI Calibration Photos		Three photos of moon through right-hand rendezvous window, bracket-mounted HEC with 80 mm lens. Minimum interior lighting.
	d. Lunar Eclipse Photos		Two series of photos of the moon during lunar eclipse by the earth. Photos to be taken thru left-hand rendezvous window. Use both 80 mm and 250mm lenses.
	e. Near-Terminator Photos Set Intervalometer to provide stereo strips with 55-60% overlap.		Point HEC vertically. Use 80 mm and 250 mm lenses. ~~Bracket-mounted camera~~.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
10.1 Hasselblad Electric Camera - 70 mm (Cont'd)	f. Low Resolution Photos		B&W photos using 80 mm lens. Provide 55-60% overlap. Medium resolution photos of selected lunar regions will be taken with 250 mm lens.
	g. TEI Photos Take 5 overlapping photos ~~centered on~~ covering the visible disc.		Use 250 mm lens.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
10.2 Maurer Data Acquisition Camera - 16 mm	a. Solar Corona Photos, after CSM sunset and before CSM sunrise Run camera at 1 fps. Use~~,~~ 18 mm lens.		Bracket-mounted camera shooting through CM window. Pitch CSM at approximately the orbital rate. Maintain CSM attitude deadbands within ± 5°.
	b. ~~Lunar Eclipse Photos~~ Comet Photos		If comet is in favorable position. For lunar eclipse and comet photos, CSM attitude rates will be allowed to damp automatically after acquisition of each photographic target.
	c. Star Field Photos During TEC. Use DAC connected by optical adapter to the CM sextant optics.		Selected star field~~s~~. When photos are being taken, electrical power to the sextant optics internal lighting will be disconnected. Two additional sets of star field photos during TLC are HD.
	d. ~~Low Resolution Photos~~ ~~Set DAC at 1 frame/second. Photograph selected lunar regions.~~		

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
10.3 35 mm Camera	a. Lunar Eclipse During lunar eclipse by the earth. Mount 35 mm camera in R~~+~~H rendezvous window. b. Lunar Libration Photos Take 4 photos of lunar libration point L-4. c. Zodiacal Light Photos Take a series of 23 photos as the CSM approaches sunrise. d. Earthshine ~~Near Terminator~~ Earthshine photos with camera pointed vertically. Provide stereo strip~~s~~ with 55-60% overlap.		Two series of 6 photos each, entering and leaving earth's umbra. Use automatic exposure feature of the shutter speed selector. Bracket mounting of camera is desirable. It is HD that CM cabin lighting be reduced while earthshine photos are taken.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
11.0 Gegenschein from Lunar Orbit (S-178)	~~Nine~~ Six 35 mm camera photographs to be taken in three different directions as follows: a. ~~Three~~ Two photographs with camera pointed in the anti-solar direction. b. ~~Three~~ Two photographs with camera pointed toward the Moulton point. c. ~~Three~~ Two photographs with camera pointed midway between the anti-solar and the Moulton point directions.		The photographs should be taken while the CSM is in total darkness in lunar orbit with all exterior lights turned off. ~~and window shades deployed~~. ~~Lunar orbit~~ Photographs ~~of the Gegenschein and Moulton point regions~~ should be obtained with a darkened CM cabin and window shades installed. Following the attitude maneuver for each of the three camera pointing angles, the CSM attitude rates must not exceed 0.05 degrees per second. Forward-firing SM RCS jets should be inhibited during film exposure. An additional 6 photographs as listed under a, b, and c. are highly desirable. Two additional photographs as listed under c. are highly desirable for window calibration. The 2 photographs to be taken through the RH side window.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
12.0 Downlink Bi-Static Radar Experiment (S-170)	The CSM will be maneuvered so that a preselected position of the antenna radiation pattern remains pointed near the instantaneous point on the lunar surface from which the maximum power will be reflected toward the earth. (Specular point) Deviation of the pointing direction from the specular point will be restricted so that the specular point will lie within 5° half angle cone, symmetric about the nominal pointing direction.	Turn off uplink TLM during S-Band test period.	S-Band Antenna / VHF Antenna / θ Deg. / φ Deg. Hi Gain / RH(A) / 145±15 / 129.5 Hi Gain / LH(B) / 145±15 / 309.5 OMNI A / RH(A) / 106 / 132.25 OMNI C / LH(B) / 106 / 312.25 Data will be collected during at least one-half of a front side pass for both VHF and S-Band.

Table 5. Phase V (Lunar Orbit Phase)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	REMARKS
13.0 Apollo Window Meteoroid Experiment (S-176)	None. This is a passive experiment. The standard spacecraft window subjected to meteoroid environment encountered in flight.	None	The Apollo windows must be scanned at 20X magnification and any surface imperfections noted before flight. The Apollo windows must be recovered and delivered to MSC for post-flight analysis.

APPENDIX A ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS	DEFINTIONS
ALSEP	Apollo Lunar Surface Experiments Package
CCGE	Cold Cathode Gauge Experiment*
CCIG	Cold Cathode Ion Gauge*
C.S.	Central Station
HFE	Heat Flow Experiment
LGE	Lunar Geology Experiment
LP	Long Period
LRRR or LR^3	Laser Ranging Retro-Reflector
LSM	Lunar Surface Magnetometer
MCC	Mission Control Center
MESA	Modularized Equipment Stowage Assembly
MHz	MegaHertz
PCU	Power Conditioning Unit
PDR	Power Dissipation Resistor
PDU	Power Distribution Unit
PI	Principal Investigator
PSE	Passive Seismic Experiment
RTG	Radioisotope Thermoelectric Generator
SEQ	Scientific Equipment Bay
SIDE	Suprathermal Ion Detector Experiment
SIM	Scientific Instrument Module
SP	Short Period
SRC	Sample Return Container
SWS	Solar Wind Spectrometer

*The acronyms CCGE and CCIG are used interchangeably in this document.

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