FINAL

PHOTOGRAPHIC AND TV PROCEDURES

APOLLO 13

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PREPARED BY
EXPERIMENTS SECTION
MISSION OPERATIONS BRANCH
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MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
APOLLO 13

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## Apollo 13 Photo Procedures

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1.0 INTRODUCTION

This document delineates the photographic objectives and defines the crew procedures and photographic equipment required to accomplish these objectives.

Section 2.0 describes each photographic objective, and the required crew procedures and equipment.

The camera settings for lunar surface and orbital photography are presented in Figures 2.1-2.2.

Section 3.0 tabulates the allocation of equipment and film for each category of photography.

Section 4.0 describes the realtime support requirements and the nominal MCCH interfaces with FCSD elements.

Section 5.0 provides a summary of all photographic and television activities scheduled for the mission.

Additional information concerning lunar surface photographic activities can be found in the Lunar Surface Procedures, prepared by the Lunar Surface Operations Office, Mission Operations Branch, Flight Crew Support Division.

All comments on this plan should be directed to W. N. Teague, CF71, Experiments Section, Mission Operations Branch, FCSD Extension 3091.
PHOTOGRAPHIC AND TELEVISION OBJECTIVES AND PROCEDURES

PHOTOGRAPHIC CODE

OBJECTIVE The general target or task to be accomplished. The nomenclature may also indicate the sole use of photographic equipment for clarity purposes.

TASK The specific photographic target type or the target itself.

EXAMPLE:

2.1.A 2

2 - PROCEDURES SECTION
1 - CATEGORY
A - OBJECTIVE
2 - TASK

The equipment to be used for each photographic task will appear in the following coded form:

AAA/BBB/CCC/DDD - XXXX, XXXX (M,N,O) P

AAA - Location from which photos are taken

CM - Command Module

1 LH Side Window
2 LH Rendezvous Window
3 Hatch Window
4 RH Rendezvous Window
5 RH Side Window

LM - Lunar Module

1 LH Window
2 Rendezvous Window
3 RH Window

EV - Extra-vehicular
BBB - Camera used

DAC - Data Acquisition Camera
EL - Electric Hasselblad
DC - Data Camera (Lunar Surface Hasselblad)
TV - TV Camera
CSC - Close-up Stereo Camera
LTC - Lunar Topographic Camera
LDAC - Lunar Surface Data Acquisition Camera

CCC - Lens Used
5, 10, 18, 60, 75, 80, 250, 500mm

DDD - Film Type
CEX - Color Exterior, S0368
HCEX - High Speed Color Exterior, S0168 (ASA 160)
CIN - Color Interior, S0168 (ASA 1000)
BW - Black and White, 3400
HBW - High Speed Black and White, S0267
VHBW - Very High Speed Black and White, 2485

XXXX - Data Recording Aids
SPOT - Spotmeter
IVL - Intervalometer
MIR - Right Angle Mirror
BRKT - DAC Mounting Bracket, EL Camera Adapter,
EL Camera Bracket Assy (500mm Lens)
ULC - Utility Light Clamp
POLZ - Polarizing Filter
HAND - Camera Handle and Trigger
SEXT - Sextant Adapter
CONT - Remote Control Cable
RING - Ring Sight
LTWS - Light Tight Window Shades
M - Lens Aperture Setting

Example: f2.8
S indicates spotmeter reading
CC indicates setting on Cue Card
Decal indicates setting on decal on camera
Chart indicates setting on chart

N - Shutter Speed

Example: 125 = 1/125 of a second
2 sec = 2 seconds

O - Focus Distance (in feet)

P - For EL and DC, Number of frames
For DAC, Frame Rate, Magazine %, and Time (MIN)

CODE EXAMPLE:
CM4/DAC/18/CEX-BRKT,SPOT (S,250,∞) 12fps, .5 mag (4 min)

Meaning: Photos taken from CM right hand rendezvous window using the DAC with 18mm lens and S0368 film. The camera will be bracket mounted with the following camera settings: f-stop from spotmeter reading, shutter speed 1/250 of a second, focus at infinity, 12 frames per second, .5 mag or 4 MIN to be used.
2.1 CSM and LM Engineering (TLC/Lunar Orbit)

a. Description
The LM and S-IVB will be photographed during transposition, docking, and LM ejection providing engineering data on these operations. The LM will also be photographed during rendezvous, formation flying, and jettison following ascent.

b. Procedures (on following page)
2.1.A Transposition/Docking

1 DAC
   CM2/DAC/18/CEX-BRKT, MIR (f8,250,7)
   12fps, .7 mag (5 MIN)

2 EL
   CM2/EL/80/CEX- (f8,250, focus) 10

3 TV
   CM4/TV-PEAK, BRKT (f44) 1 HR 08 MIN
   Hi Gain: P______
   Y______

2.1.B LM Ejection

1 DAC
   CM2/DAC/18/CEX-BRKT, MIR (f8,250,7)
   6fps, .3 mag (5 MIN)

2 EL
   CM4/EL/80/CEX- (f8,250, focus) 5

2.1.C LM Undocking

1 DAC/Cm
   CM2/DAC/18/CEX-BRKT, MIR (f8,250,7)
   6fps, 1 mag (16 MIN)

2 EL/Cm
   CM2/EL/80/CEX- (f8,250, focus) 10

3 DC/LM
   LM/DC/60/HCEX- (f11,250, focus) 10

4 DAC/LM
   LM/DAC/10/CEX- (f8,250,7)
   6fps .25 mag (4 MIN)
2.1.D  LM Active Rendezvous/Docking

1 DAC
CM2/DAC/18/CEX-BRKT, MIR (f8,250,7)
6 fps, 1 mag (16 MIN)

2 EL/CM
CM/EL/80/CEX- (f8,250,focus) 10

(1) Photograph LM as it enters F.O.V.

(2) Photograph LM from station Keeping Distance
(50 - 100')

3 DC/LM
LM/DC/60/HCEX- (f11,250,focus) 5

Photograph CSM from station keeping distance as it performs a 360°
Pitch maneuver.

4 TV
CM4/TV:PEAK, BRKT (f44) 12 MIN
Hi Gain: P ___
Y ___

2.1.E  LM Jettison

1 CM4/DAC/18/CEX - BRKT, MIR (f8,250,7)
12 fps, .5 mag (4 MIN)

2 CM/DAC/SEXT/CEX-(fixed,250,fixed) 12fps, .5 mag (4 MIN) - crew option
Start DAC at Deorbit burn - 3 MIN. GET ___:___:___

3 CM3/LTC/BW - (fixed, 50, fixed)
Start LTC at Impact - 1 MIN. GET ___:___:___

2-6
2.2 Distant Earth/Moon Photography

a. Description

The Earth will be photographed just after TLI on a crew option basis for high resolution terrain studies. In addition the Earth will be photographed during TLC and TEC for oceanographic, global weather and documentation purposes. Several photographs should be taken each day during TLC and TEC as spacecraft attitude and crew time permit. Photographs should be taken at approximately 4 hour intervals. The Moon will be photographed during TLC and TEC for documentation purposes.

b. Procedures (on following page)
2.2.A  Earth
CM_/EL/80 or 250/CEX - RING (f11,250,∞) 30

Photograph the earth after TLI, concentrating on cloud free areas using 250mm lens.

2.2.B  Earth Weather
CM_/EL/250/CEX - RING (f11,250,∞) 10
During TLC photograph earth from approximately 35,000 naut. mi, every 20 min. for 3 hr.
Record GET of each photograph.

2.2.C  Moon
CM_/EL/80 or 250/BW - RING (f5.6,250,∞) 10
CM_/EL/80 or 250/CEX - RING (f5.6,250,∞) 10

Photograph during TLC and TEC. For full view of Moon use 80mm lens from GET (TLC) 82:21 to GET (TEC) 175:34.

2.2.D  Earth/Moon TV
CM_/TV - PEAK, BRKT (f44), 10 MIN
2.3 Lunar Surface Structure (Lunar Orbit)

a. Description

Lunar Orbital Science targets will be photographed with the Hasselblad EL.

b. Procedures (on following Page).
2.3.A Lunar Orbital Science Photography
CM/EL/80 or 250/CEX - (CC,250,∞) 327

Maintain ORB RATE
R  0°, P 230°, Y 0°

REV. 15  14
REV. 16  23
REV. 26  5, 13, 25, 56, 46A
REV. 28  18, 33, 58
REV. 29  10, 12, 15, 21
REV. 30  11, 16
REV. 41  17, 27, 30, 69
REV. 42  32, 38, 40, 47, 59, 63
REV. 43  26, 48, 52, 66

Record
(a) Mag ID
(b) FR Nos.
(c) Target
(d) GET of photography
(e) Non-nominal data

2.3.B Lunar Surface/TV
CM/TV - PEAK, BRKT (f44)

GET R ____, P ____, Y ____ HI GAIN: P ____
96:50         Y ____

GET R ____, P ____, Y ____ HI GAIN: P ____
166:10       Y ____

GET R ____, P ____, Y ____ HI GAIN: P ____
168:00       Y ____
2.4 Landing and Exploration Sites

a. Description
During descent and ascent the lunar surface will be photographed to record LM movement, surface disturbances and to aid in determining the landed LM location.

Following an orbital plane change after LM jettison, stereo strip photographs will be taken of candidate exploration sites during two separate revs using the EL with 80mm lens. During one stereo strip and two landmark revs the DAC will simultaneously photograph the surface through the sextant.

Photographs of the site northwest of Censorinus will be obtained with the Lunar Topographic Camera at low altitude. This photography will occur after the DOI maneuver and prior to initial separation of the CSM and LM. After the CSM returns to a 60 nautical mile altitude high resolution photographs of sites near Davy Rille and northwest of Censorinus will be taken with the Lunar Topographic Camera. One pass will be made with the camera axis vertical and a second pass will be made with the camera axis aligned 30 degrees forward of the local vertical.
The above photography will:

1. Improve the accuracy of ground point locations on the surface.

2. Define lunar topography to support scientific studies.

3. Provide photography which can be used for topographic analysis of the approach paths to candidate exploration sites.

4. Provide crew training film.

5. Improve knowledge of landing sites
2.4.A Descent/Ascent

1 Descent PDI + 6 MIN
LM3/DAC/10/CEX - (f2.8,500, ) 12 fps, .75 mag (6 MIN)

2 Ascent APS burn minus 1 MIN
LM3/DAC/10/CEX - (f2.8,500, ) 12 fps, 1 mag (8 MIN)

2.4.B Vertical Stereo Strip

1 Rev 26
CM4/DC/80/BW - BRKT, IVL (f4,250, ) 180
CM /DAC/SEXT/CEX - (fixed,chart,fixed) 1 fps, .66 mag (60 MIN)
+X axis aligned to local vertical

(1) TRN 45°, SFT 0°

(2) V83 (Align FDAI 1)
ORDEAL R 0, P 258, Y 0

(3) V79 R1 (Pitch rate) -0.0507
    R2 (Deadband) +000.50
    R3 (Y axis) +11111

(4) V06 N65 (AGC time displayed on DSKY)

(5) ENTER, DAC - on and DC - on simultaneously
    GET ___ ___:___:___ and record time
    from AGC clock

(6) VI6, N65 (SFT and TRN angles displayed on DSKY)

(7) DAC and DC - off at GET ___ ___:___:___
    and record time from AGC clock
Rev 41
CM4/DC/80/BW - BRKT, IVL (f4,250, ) 180
CM/DAC/SEXT/CEX-(fixed,chart,fixed) 1 fps, .33 Mag (33 MIN)
X axis aligned to local vertical

(1) V83 (Align FDAI)
   ORDEAL R 0, P 258, Y 0

(2) V79 R1 (Pitch rate) -0.0507
    R2 (Deadband)   +000.50
    R3 (Y axis)     +11111

(3) DC - on at GET ___ ___::___::___

(4) DC - off at GET ___ ___::___::___

Record
(a) Mag IDs
(b) Fr Nos and mag % remaining
(c) Non-nominal data
Landmark Tracking Sextant Photography

CM/DAC/SEXT/CSEX - (fixed, chart, fixed) 1 fps, 1 mag (93 MIN)

(1) ORDEAL R 0, P 338 Y 0
   By GET ••••••••••

(2) V79 R1 (Pitch rate) -0.0507
    R2 (Deadband) +000.50
    R3 (Y Axis) +11111

(3) Exit V79, P22

(4) At T2 - 1 MIN GET ••••••••••
    DAC - on

(5) DAC - off after completion of tracking

<table>
<thead>
<tr>
<th>Site</th>
<th>Rev</th>
<th>Long.</th>
<th>Shutter Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pickering B</td>
<td>2</td>
<td>7°.3542 E</td>
<td>1/60</td>
</tr>
<tr>
<td>H-2</td>
<td>3</td>
<td>4°.7666 W</td>
<td>1/60</td>
</tr>
<tr>
<td>13-1</td>
<td>12</td>
<td>15°.616 W</td>
<td>1/60</td>
</tr>
<tr>
<td>13-2</td>
<td>15</td>
<td>15°.316 W</td>
<td>1/60</td>
</tr>
<tr>
<td>13-3</td>
<td>30</td>
<td>15°.483 W</td>
<td>1/60</td>
</tr>
<tr>
<td>Taruntius O</td>
<td>17</td>
<td>54°.3166 E</td>
<td>1/250</td>
</tr>
<tr>
<td>130</td>
<td>17</td>
<td>23°.6789 E</td>
<td>1/125</td>
</tr>
<tr>
<td>Theon Senior B</td>
<td>15</td>
<td>14°.0568 E</td>
<td>1/125</td>
</tr>
<tr>
<td>Mosting A</td>
<td>18</td>
<td>5°.2833 W</td>
<td>1/60</td>
</tr>
<tr>
<td>Secchi B</td>
<td>18</td>
<td>41°.4833 E</td>
<td>1/250</td>
</tr>
<tr>
<td>Euclides F</td>
<td>29</td>
<td>33°.7069 W</td>
<td>1/60</td>
</tr>
<tr>
<td>Reaumur X</td>
<td>29</td>
<td>0°.6725 W</td>
<td>1/125</td>
</tr>
<tr>
<td>Moltke</td>
<td>30</td>
<td>24°.1283 E</td>
<td>1/250</td>
</tr>
<tr>
<td>CP-1</td>
<td>44</td>
<td>107°.15 E</td>
<td>1/60</td>
</tr>
<tr>
<td>CP-2</td>
<td>44</td>
<td>68°.1 E</td>
<td>1/125</td>
</tr>
<tr>
<td>CP-3</td>
<td>45</td>
<td>12°.5166 E</td>
<td>1/250</td>
</tr>
<tr>
<td>CP-4</td>
<td>45</td>
<td>20°.1333 W</td>
<td>1/125</td>
</tr>
<tr>
<td>CP-5</td>
<td>44</td>
<td>44°.2 W</td>
<td>1/60</td>
</tr>
<tr>
<td>Davy Rille</td>
<td>44</td>
<td>6°.1 W</td>
<td>1/250</td>
</tr>
<tr>
<td>LS-1</td>
<td>12</td>
<td>17°.5 W</td>
<td>1/60</td>
</tr>
<tr>
<td>LS-2</td>
<td>13</td>
<td>17°.5 W</td>
<td>1/60</td>
</tr>
</tbody>
</table>

Record
(a) Mag ID
(b) Mag % remaining
(c) Non-nominal data
Lunar Topographic Camera Photography
CM3/LTC/BW-(fixed,100, fixed)

INSTALLATION
(1) Mount and verify direction of flight
(2) SCI pwr Sw (Panel 227) - OFF
(3) AC Utility Pwr (Panel 201) - OFF
(4) Connect vacuum line (Panel 251 and Cam)
(5) Overboard drain - DUMP
(6) Connect Pwr Cable (Panel 227, 201, & LTC)
(7) Connect Control Box, verify Pwr-OFF, MODE - STBY
(8) Remove pip pin from lens cone

CHECKOUT
(1) Verify elect. pwr: Non ESS Bus - MNB (5)
    CB SCI Eq-hatch (1) CLOSED (5)
    SCI Inst Pwr - ON (Panel 227)
    AC Pwr - ON (Panel 201)
(2) Pwr - ON
(3) MODE - Single
(4) Frame Rate - 8/min
(5) Range - 10
(6) Operate "Single Frame" - 2 frames
(7) MODE - AUTO (3-5 frames) (Verify FMC and frame
    control operation, "end-of-film" light out)
(8) MODE - STBY
(9) PWR - OFF

OPERATE
(1) Verify: Pip pin out
    Shutter speed
    Frame Rate
    Range
    Direction of Flight
    Record Frame Counter
    MODE - STBY
(2) PWR - ON (1 min before use of FMC)
(3) MODE - AUTO/SINGLE
(4) MODE - STBY
(5) Pwr - OFF
(6) Frame remaining...
**FILM MAG CHANGE**

1. To save remaining film - Advance 4 frames
   To run film out - film advance until "end of film" light
2. MODE - STBY
3. PWR - OFF
4. Mag lock knob CCW to stop - mag moves out
5. Replace mags without touching platen
6. Mag locking - CW to stop
7. Perform LTC checkout

**LTC REMOVAL**

1. Install pip pin in lens cone
2. Overboard drain - OFF
3. PWR (AC, SCI, Box) - OFF
4. Disconnect Box, elect. and vacuum

**REV. 4**
Censorinus/39°E to 30°E

**REV. 27**
6, 9, Censorinus/Vert., 29, 34, 42, 46/54

**REV. 28**
Censorinus/Oblique

**REV. 42**
Vert./102°E to Terminator

**REV. 43**
Oblique/102°E to 32°W

**TEI**
High Altitude Mapping Photography

R __ P __ Y __
T Start __ __ __: __ __ __
T Stop __ __ __: __ __ __
Rng ________________

2-17
2.4.E

High Resolution/Oblique Photography

CM4/EL/500/BW - BRKT, CONT (fs,125, ) 170
CM2/DAC/18/CEX - BRKT, (fs,125, ) 6 fps, 2 mag (32 MIN)
(Performed only if LTC fails)

Northwest of Censorinus

T1 ______:____:____ (3 MIN prior to TCA)
T2 ______:____:____ (1 MIN past TCA)

(1) Align COAS along 500mm BRKT, 10°
pitched up from +X axis

(2) R___, P___, Y___ by GET ____:___:___

(3) At T1 start EL and DAC - initiate
photos approximately every 20 secs

(4) At T2 DAC and EL - off

Davy Rille & Descartes

T1 ______:____:____
T2 ______:____:____

(1) Align COAS along 500mm BRKT, 10° pitched up from
+X axis

(2) R___, P___, Y___ by GET ____:___:___

(3) Track target through COAS using RHC

(4) At T1 start EL-initiate photos approximately
every 20 secs

(5) At T2 DAC and EL - off

(6) Repeat steps 2-5.

Record
(a) Mag ID
(b) FR Nos
(c) Non-nominal data
2.5 Lunar Surface Engineering

a. Description

The LM and Lunar surface experiment equipment will be photographed for postflight analysis and evaluation of performance.

b. Procedures (on following page)
2.5.A ALSEP Site Photography

EV/DC/60/HCEX - (f11,250, focus) 22

1 Heat Flow Experiment (HFE) S037
   (1) Probe - 10 ft, X SUN, each side
   (2) Electronics - 5 ft, X SUN

2 Passive Seismic Experiment (PSE) S031
   (1) C/S in foreground, 5 ft.
   (2) C/S in background, 5 ft.
   (3) X SUN, 3 ft.

3 Charged Particle Lunar Environment Experiment (CPLEE) S038
   C/S in background, 5 ft.

4 Cold Cathode Gauge Experiment (CCGE) S058
   (1) X SUN, 5 ft.
   (2) C/S in background, 10 ft.

5 Central Station C/S
   (1) X SUN, 5 ft.
   (2) DN SUN, 5 ft.

6 Lunar Dust Detector Experiment (LDDE) M515
   Photographed on C/S

7 Radioisotope Thermoelectric Generator (RTG)
   X SUN, 5 ft.

8 Core Sample Drilling
   Approximately 10 photos, X SUN.
2.5.B  **LM Photography**

1  **DC**  
EV/DC/60/HCEx-(f11,250, focus)

2  **DAC**  
EV/LDAC/10/CEX - (f8,250,∞)

The LM will be photographed only if an anomalous condition exists.
2.6 CREW AND SURFACE

a. Description

The movements of the crew in the performance of various lunar surface tasks will be photographed to assist in the preparation of crew tasks during future missions.

Photographs will also be taken of the crew environment that is related to the ability of the crew to function on the lunar surface. The environment includes lighting; lighting contrast; lunar surface terrain features; and soil cohesion, adhesion, and bearing strength.

b. Procedures (on following page)
2.6. A Crew Activities (Lunar Surface)

1. SEQ Bay Operations
   EV/LDAC/10/CEX-(f8,250,∞) 12 fps

2. Drilling Operations
   EV/LDAC/10/CEX-(f8,250∞) 12 fps

3. Barbell Carry
   EV/LDAC/10/CEX-(f8,250∞) 24 fps

4. Trench Digging
   EV/LDAC/10/CEX-(f8,250,∞) 12 & 24 fps

5. Boulder Rolling
   EV/LDAC/10/CEX-(f8,250,∞) 24 fps

6. Crew Movement (loping, walking, etc.)
   EV/LDAC/10/CEX-(f8,250∞) 12 & 24 fps

2.6. B Crew Egress Photography

1. CDR Egress
   LM/DC/60/HCEX-(f5.6,250,5) 6
   LM3/LDAC/10/CEX-(f2.8,60,∞) 12 fps

2. LMP Egress
   EV/DC/60/HCEX-(f5.6,250,15) 6
   EV/LDAC/10/CEX-(f2.0,125,∞) 12 fps

2.6. C Photometric Chart
   EV/DC/60/HBW-(__,250,5) 10

1. Select large boulder

2. Hold chart in front of boulder, facing sun.

3. Take 4 photos normal to chart of f5.6, f8, fl1, fl6, and 1 photo, fl1, at 45° azimuth.

4. Crewmen exchange positions and repeat photography.
2.7 Surface and Sub-Surface Structure

a. Description

Panoramic photographs of the lunar surface and stereo photographs of samples, sample areas, and selenological features will be taken to provide data for scientific study.

b. Procedures (on following page)
2.7.A Lunar Surface/LM

1.  \(-Y\) pad/surface
   \(\text{EV/DC}/60/\text{HCEX}-(f8,250,5)2, \text{X SUN}\)

2.  \(+Z\) pad/surface
   \(\text{EV/DC}/60/\text{HCEX}-(f5.6,250,5)2, \text{UP Sun}\)

3.  \(+Y\) pad/surface
   \(\text{EV/DC}/60/\text{HCEX}-(f8,250,5)2, \text{X Sun}\)

4.  \(-Z\) pad/surface
   \(\text{EV/DC}/60/\text{HCEX}-(f11,250,5)2, \text{DN SUN}\)

2.7.B Contingency Sample Area
   \(\text{EV/DC}/60/\text{HCEX}-(f8,250,5)2, \text{X SUN}\)

2.7.C Panoramas

1.  EVA 1
    \(\text{EV/DC}/60/\text{HCEX}-(\text{Decal},250,74) 40\)

2.  EVA 2
    \(\text{EV/DC}/60/\text{HBW}-(\text{Decal},250,74) 100\)

2.7.D Documented Samples
   \(\text{EV/DC}/60/\text{HBW}-(\text{Decal},250,5) 5\)

(1)  Select sample and position gnomon.

(2)  Take two stereo photos, X SUN.

(3)  Take one horizon photo, 15 ft. DN SUN.

(4)  Bag sample

(5)  Take two photos of sample area. DN SUN & X SUN.
2.7.E  Core Tube Samples  
EV/DC/60/HBW-(f8, 250, 15 & 5) e  

(1) Position gnomon up sun.  
(2) Drive tube into surface  
(3) Take one horizon photo, 15 ft, X SUN.  
(4) Remove core tube.  
(5) Take stereo pair, 5 ft, X SUN.

2.7.F  Environmental Sample  
EV/DC/60/HBW-(Decal, 250, 5) 4  

Photo procedures are the same as for a documented sample. Horizon photo is not required.

2.7.C  Gas Analysis Sample  
EV/DC/60/HBW-(Decal, 250, 5) 4  

Same procedures as 2.7.F.

2.7.H  Magnetic Sample  

Same procedures as 2.7.F.

2.7.I  Trench

1  Site Photographs  
EV/DC/60/HBW-(Decal, 250, 15) 2  

(1) Position gnomon up sun.  
(2) Photograph site X Sun & DN Sun.

2  Trench Photographs  
EV/DC/60/HBW-(f5.6, 125, 5) 6  

(1) Take stereo pair on both sides of trench, X Sun.  
(2) Take one photo up sun.  
(3) Take one photo down sun.  
(4) Take CSC photos of trench.
2.7.J Soil Mechanics

Photograph boot print in trench

2.7.K Close-up Stereo Camera Photography

Photograph unexpected features, rock/soil junction, surface patterns, rock surfaces, small craters.

2.7.L TV Panorama
EV/TV-PEAK (f44)

(1) Position TV 50 ft from LM between +Y and -Z axes.

(2) Scan surrounding terrain allowing 10 seconds for each field of view. Avoid pointing the camera closer than 45° of up-sun.

2.7.M Polarization Photography

Near Field
EV/DC/60/HBW-POLZ(f5.6,125,5) 11

(1) Place gnomon in clump of rocks.

(2) LMP photograph rocks before and after sampling, DN SUN.

(3) CDR take one photograph at each of 3 filter positions at phase angles of 90°, 110° and 130°. (9 photos)

(4) Move to crater rim.

(5) Photograph far wall at each filter position.

(6) Move approximately 100 ft. around rim and repeat photography

(7) Remove and discard polarizing filter.
2.8 Dim Light Photography

a. Description

Photographs of various dim light, astronomical phenomena will be acquired in lunar orbit and during TEC. Experiment S 178, Gegenschein From Lunar Orbit, is included in this group.

b. Procedures (on following page)
2.8.A Solar Corona
CM4/EL/80/VHBW-BRKT CONT. (f2.8,∞) 15

<table>
<thead>
<tr>
<th>Sun angle below horizon</th>
<th>Exposure time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2°</td>
<td>1/125 sec.</td>
</tr>
<tr>
<td>1°</td>
<td>1/15 sec.</td>
</tr>
<tr>
<td>5°</td>
<td>1,1/4,1/8 sec.</td>
</tr>
</tbody>
</table>

2.8.B Zodiacal Light
CM4/DAC/18/VHBW-BRKT, MIR (f0.9,∞)

<table>
<thead>
<tr>
<th>Sun angle below horizon</th>
<th>Exposure time</th>
</tr>
</thead>
<tbody>
<tr>
<td>75°</td>
<td>18 sec.</td>
</tr>
<tr>
<td>65°</td>
<td>16 sec.</td>
</tr>
<tr>
<td>55°</td>
<td>12 sec.</td>
</tr>
<tr>
<td>45°</td>
<td>9 sec.</td>
</tr>
<tr>
<td>35°</td>
<td>7 sec.</td>
</tr>
<tr>
<td>25°</td>
<td>5 sec.</td>
</tr>
<tr>
<td>15°</td>
<td>2 sec.</td>
</tr>
<tr>
<td>3°</td>
<td>1/60 sec.</td>
</tr>
</tbody>
</table>

Three exposures at each sun angle are required.

2.8.C Gegenschein From Lunar Orbit - S178
CM4/DAC/18/VHBW-BRKT, MIR (f0.9,20 sec.,∞) 9 frames
Two 20 second exposures followed by one 5 second exposure will be made with the camera pointed toward the anti-solar point, the Moulton point, and at a point midway.

2.8.D Lunar Limb Brightening
CM4/DAC/18/VHBW-BRKT, MIR (f2.0, 125,∞) 12 fps, 40 sec.
2.8.F Contamination/Starfield
CM4/EL/80/VHBW-BRKT, CONT (f2.8,∞) 12

(1) Betelgeuse
Photograph a starfield, including Betelgeuse, in
darkness and in sunlight. Exposure times of
1/4, 1, 4 seconds.

(2) Regulus
Photograph a starfield, including Regulus in
darkness and in sunlight. Exposure times of
1/4, 1, 4 seconds.

2.8.F Water Dump Photography

(a) CM4/DAC/18/VHBW-BRKT, MIR (f2.0, 125, 10) 6 fps, 30 sec.

(b) Change focus to ∞ and exposure time to 1/60 sec and
continue photography. Use remaining VHBW film.
a. Description

Crew activities and controls and displays in the CSM and LM will be photographed to:

1. Evaluate crew tasks in a zero-gravity environment
2. Evaluate crew mobility in the LM
3. Evaluate the crew transfer from vehicle to vehicle through the tunnel
4. Document systems performance

b. Procedures (on following page)
2.9.A Spacecraft Interior - DAC
CM/DAC/5/CTN - SPOT (f2.8, 60, fixed), 6 fps, 1 mag (16 MIN)

Spotmeter is required for good interior photography

1/2 Stowing/Unstowing Equipment (Aft Bulkhead)

3 LM to CSM Crew Transfer

4/5 Donning/Doffing Spacesuit

Record
(a) Mag ID
(b) % Mag remaining
(c) GET DAC - on
(d) Non-nominal data

2.9.B Spacecraft Interior - TV
CM/TV - ALC
2.10 Mission Documentation

a. Description

Crew photography of phenomena or activities which have not been called out specifically as requirements but which will support scientific, engineering, or documentation objectives.

b. Procedures (on following pages)
2.10.A Crew Observations (TLC/Lunar Orbit/TEC)
CM_/EL/80/CEX - (DeCal), 40

2.10.B Earth/LM/Lunar Surface
EV_/DC/60/HCEX - (fll, 250, 15/74) 4
### TABLE 2.1 CAMERA SETTINGS-EVA PHOTOGRAPHY

#### DC (70 mm)/HBW or HCEX

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
<th>EVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBW</td>
<td>1/250</td>
<td>12</td>
</tr>
<tr>
<td>Crew in Sun</td>
<td>11/250</td>
<td>8</td>
</tr>
<tr>
<td>Full Shad</td>
<td>5.6/125</td>
<td>3</td>
</tr>
<tr>
<td>POLZ</td>
<td>1/125</td>
<td>5.6</td>
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</table>

#### DC (70mm) WINDOW PHOTOGRAPHY/HBW

<table>
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<th>Setting</th>
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<td>(f11,74)</td>
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<td>(f8,74)</td>
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<tr>
<td>(f8,30)</td>
<td>(f8,30)</td>
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<tr>
<td>(f8,15)</td>
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#### DAC (16 mm)/CEX

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<th>Value</th>
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<tbody>
<tr>
<td>CEX</td>
<td>12</td>
</tr>
<tr>
<td>Crewman</td>
<td>11/250</td>
</tr>
<tr>
<td>In: Shadow</td>
<td>2.8/60/BRKT</td>
</tr>
<tr>
<td>Sun</td>
<td>8/250</td>
</tr>
<tr>
<td>DAY</td>
<td>DATE</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>SATURDAY</td>
<td>APR 11</td>
</tr>
<tr>
<td>SATURDAY</td>
<td>APR 11</td>
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<tr>
<td>SUNDAY</td>
<td>APR 12</td>
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<td>MONDAY</td>
<td>APR 13</td>
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<tr>
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<td>APR 15</td>
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<tr>
<td>THURSDAY</td>
<td>APR 16</td>
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<td>APR 16</td>
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<td>FRIDAY</td>
<td>APR 17</td>
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<td>SATURDAY</td>
<td>APR 18</td>
</tr>
<tr>
<td>SATURDAY</td>
<td>APR 18</td>
</tr>
<tr>
<td>MONDAY</td>
<td>APR 20</td>
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*Recorded Only

**TV On Time
### 3.0 ALLOCATION OF EQUIPMENT AND FILM

<table>
<thead>
<tr>
<th>Category</th>
<th>Equipment</th>
<th>70mm Film (Frames)</th>
<th>16mm Film (Feet)</th>
<th>LTC Film (Feet)</th>
<th>TV (Thou)</th>
<th>HRB (MIN)</th>
</tr>
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<tbody>
<tr>
<td>CSK and LR Engineering</td>
<td></td>
<td>35 15</td>
<td>995 140</td>
<td>6</td>
<td>6.15</td>
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<tr>
<td>Distant Earth/Moon</td>
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<td>50 10</td>
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<td>Lunar Surface Structures (Linear Orbit)</td>
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<td>Crew/Spacecraft Compatibility</td>
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<td>Surface and Sub-surface Structures</td>
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<td>Mission Documentation</td>
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<td>Oblique Photography</td>
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</tr>
<tr>
<td><strong>Total (maps)</strong></td>
<td></td>
<td>4 2 3 1 15 2 1 2</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
4.0 Photo and TV Support for Control Center Operations

The following information indicates how the Photo and TV Operations Plan is supported in real time. It does not define the functions of any MCCH position.
4.1 Flight Director's SSR

a. Supporting FCSD elements:

**FP2**
- Experiment Section (MOB) (Prime participants)
- Lunar Surface Operations Office (EVA periods)
- Flight Equipment Section (Photographic equipment support)

**FP1**
- Flight Plan Branch (Prime participants)
- Technical Assistance (CMS-LMS)

b. Mission Control Center Nominal Interfaces

**FP2**
- Flight Activity Officer
- Computer Dynamics
- Weather
- S&AD Representatives
- Principal Investigators

**FP1**
- Flight Activity Officer
- Electrical, Environmental, and Communications Officer (EE COM)

4.2 Flight Crew Mission Support (FP2)

Real time information concerning:

a. Photographic, TV, and experiment procedures for orbital and lunar surface operations

b. Operational mechanics of:

1) Photographic Equipment: Cameras, lenses, films, brackets, filters, intervalometer, spotmeter, etc.

2) Lunar surface equipment: Camera staff and pan bracket, gnomon, sampling tools, LEC, etc.

c. Spacecraft Attitudes and Trajectory Data*

*See Table 4.1
TABLE 4.1 Attitude Requirements

FP2 personnel will have the primary responsibility for the generation of the following information. Corrections or additions to these requirements should be received shortly after the start of Apollo 13 simulations.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>RESPONSE TIME</th>
<th>UPDATED INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lunar Orbit Photography</td>
<td>20 MIN</td>
<td>S/C attitude T start (GET) T stop (GET)</td>
</tr>
<tr>
<td>P52 NAV Star</td>
<td>30 MIN</td>
<td>Provide NAV STARS in PTC attitude for the P52 option 3 realignments</td>
</tr>
<tr>
<td>P22</td>
<td>30 MIN</td>
<td>Provide T1 and T2 times, distance north or south of track</td>
</tr>
<tr>
<td>P23</td>
<td></td>
<td>Check the NAV Stars in the flight plan and select other stars if the flight plan is altered. Generate SFT, TRN, R, P, Y, and horizon illumination and identification if required.</td>
</tr>
<tr>
<td>Sleep Attitude</td>
<td>1 HR</td>
<td>Provide a particular S/C attitude to satisfy thermal and communications constraints.</td>
</tr>
<tr>
<td>S/C Pointing With Minimum Middle Gimbal Angle</td>
<td>30 MIN</td>
<td>R,P,Y, to point windows or instruments with minimum gimbal angles.</td>
</tr>
<tr>
<td>To Point Window at the Moon, shortly prior to LOI and after TEI</td>
<td>10 MIN</td>
<td>R,P,Y, number of degrees window is pointing below horizon</td>
</tr>
<tr>
<td>Pointing Windows at Earth and Moon simultaneously (PTC Mode)</td>
<td>10 MIN</td>
<td>R,P,Y, to orient left hand window to Earth and right-hand window at Moon</td>
</tr>
<tr>
<td>Map Update</td>
<td>25 MIN</td>
<td>Provide prime meridian crossing, and AOS - LOS for MSFN prime active sites.</td>
</tr>
<tr>
<td>TV</td>
<td>30 MIN</td>
<td>Provide the proper S/C R,P,Y, and Hi-Gain antenna P,Y, for TV coverage as required during the mission.</td>
</tr>
</tbody>
</table>
5.0 PHOTOGRAPHIC SUMMARY
<table>
<thead>
<tr>
<th>Mission Phase (GET)</th>
<th>Activity</th>
<th>Camera Code</th>
<th>Mag</th>
</tr>
</thead>
<tbody>
<tr>
<td>03:15</td>
<td>T &amp; D</td>
<td>CM2/DAC/18/CEX-BRKT,MIR (f8,250,7)12fps,.7mag (5Min)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CM_/EL/80/CEX-SPOT(f8,250, focus)10</td>
<td>L</td>
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<td></td>
<td></td>
<td>CM4/TV-PEAK,BRKT(f22)</td>
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<tr>
<td>03:59</td>
<td>LM Ejection</td>
<td>CM2/DAC/18/CEX-BRKT,MIR (f8,250,7) 6fps,.3 mag(5min.)</td>
<td>A</td>
</tr>
<tr>
<td>Crew Option</td>
<td>S/C Interior</td>
<td>CM/DAC/5/CIN-SPOT(f2.8,60,ff)6fps,1 mag</td>
<td>J</td>
</tr>
<tr>
<td>07:10</td>
<td>Earth Weather</td>
<td>CM_/EL/250/CEX-RING (f11,250,∞)10</td>
<td>L</td>
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<tr>
<td>30:15</td>
<td>MCC-2</td>
<td>CM/TV-AVG (f5.6)</td>
<td></td>
</tr>
<tr>
<td>Crew Option</td>
<td>Lunar Photography</td>
<td>CM_/EL/80or250/BW-RING (f5.6,250,∞)10</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CM_/EL/80or250/CEX-RING (f5.6,250,∞)10</td>
<td>L</td>
</tr>
<tr>
<td>58:00</td>
<td>IVT</td>
<td>CM/TV-AVG(f5.6)</td>
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<tr>
<td>84:24</td>
<td>Low Alt.</td>
<td>CM3/LTC/BW-(fixed,50, fixed)</td>
<td>U</td>
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<tr>
<td></td>
<td>Photos of Censorinus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99:15</td>
<td>Undocking</td>
<td>CM2/DAC/18/CEX-BRKT,MIR (f8,250,7) 6fps,1mag(16min)</td>
<td>B</td>
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<td></td>
<td></td>
<td>CM2/EL/80/CEX-(f8,250, focus)10</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LM_/DC/60/HCEX-(f11,250, focus)10</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LM3/DAC/10/CEX-ULC(f8,250,7)6fps,.2mag (3min)</td>
<td>AA</td>
</tr>
<tr>
<td>100:35</td>
<td>CSM Circ. Burn</td>
<td>LM3/DAC/10/CEX-ULC(f8,250,∞)6fps,.03mag (30sec)</td>
<td>AA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LM_/DC/60/HCEX-(f11,250,∞)2</td>
<td>II</td>
</tr>
<tr>
<td>103:40</td>
<td>LM Landing</td>
<td>CM3/LTC/BW-(fixed,50, fixed)</td>
<td>U</td>
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</tbody>
</table>

5-2
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
<th>Camera Details</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>104:30</td>
<td>Contamination</td>
<td>CM4/EL/80/VHBW-BRKT,LTWS CONT (f2.8,∞)6</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td>L.O. Orbital Sci. Photography</td>
<td>CM/EL/80or250/EX-(,250,∞)328</td>
<td>L,M,N</td>
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<td></td>
<td>L.O. Lmk Track SEXT Photos</td>
<td>CM/DAC/SEXT/EX-(fixed, ,fixed) 1fps, Imag (93Min.)</td>
<td>C</td>
</tr>
<tr>
<td>107:35</td>
<td>LTC Photos of Landed LM</td>
<td>CM3/LTC/BW-(fixed,50, fixed)</td>
<td>U</td>
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<tr>
<td>107:48</td>
<td>Solar Corona</td>
<td>CM4/EL/80/VHBW-BRKT,CONT(f2.8,∞)15</td>
<td>T</td>
</tr>
<tr>
<td>108:08</td>
<td>Lunar Limb Brightening</td>
<td>CM4/DAC/18/VHBW-BRKT,MIR(f2.0,125,∞) 12fps,40 sec.</td>
<td>G</td>
</tr>
<tr>
<td>109:45</td>
<td>Earthshine Photography</td>
<td>CM4/DAC/18/VHBW-BRKT,MIR(f0.9,125,∞) 1fps(5Min)</td>
<td>G</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CM4/EL/80/VHBW-BRKT,CONT(f2.8,125,∞) 18</td>
<td>T</td>
</tr>
<tr>
<td></td>
<td>L.O. Vertical Stereo</td>
<td>CM4/DC/80/BW-BRKT,IVL(f__,250,∞)360 R,S</td>
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<tr>
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<td></td>
<td>CM/DAC/SEXT/EX-(fixed, ,fixed) 1fps,Imag</td>
<td>D</td>
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<tr>
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<td>L.O. LTC Photography</td>
<td>CM3/LTC/BW-(fixed, ,fixed)</td>
<td>U,V</td>
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<tr>
<td></td>
<td>L.O. High Resolution Oblique Photography</td>
<td>CM4/EL/500/BW-BRKT,CONT(f8,125,∞) 170</td>
<td>P</td>
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<tr>
<td></td>
<td></td>
<td>CM2/DAC/18/EX-BRKT(f8,125,∞) 6fps,2mag (32min)</td>
<td>H,I</td>
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<tr>
<td>131:50</td>
<td>Zodiacal Light</td>
<td>CM4/DAC/18/VHBW-BRKT,MIR(f0.9, ,∞)</td>
<td>G</td>
</tr>
<tr>
<td>133:45</td>
<td>Gegenschein</td>
<td>CM4/DAC/18/VHBW-BRKT,MIR(f0.9,20sec, )12fr.</td>
<td>G</td>
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<tr>
<td>137:10</td>
<td>APS Liftoff</td>
<td>LM3/DAC/10/EX-BRKT(f2.8,500,∞) 12fps,1Mag</td>
<td>HH</td>
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<tr>
<td>Time</td>
<td>Event</td>
<td>Camera/Settings</td>
<td>Notes</td>
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<tr>
<td>140:30</td>
<td>Rendezvous &amp; Docking</td>
<td>CM2/DAC/18/CEX-BRKT,MIR(f8,250,7) 6fps,1Mag</td>
<td>E</td>
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<tr>
<td></td>
<td></td>
<td>CM2/EL/80/CEX(f8,250,focus)10.</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>LM3/DC/60/HCEX-(f11,250,focus)15</td>
<td>II</td>
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<tr>
<td></td>
<td></td>
<td>CM4/TPEAK,BRKT(f22)</td>
<td></td>
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<tr>
<td>143:04</td>
<td>LM Jettison</td>
<td>CM4/DAC/18/CEX-BRKT,MIR(f8,250,7) 12fps, (4Min)</td>
<td>F</td>
</tr>
<tr>
<td>144:32</td>
<td>LM Deorbit</td>
<td>CM/DAC/SEXT/CEX-(fixed,250,fixed)</td>
<td>F</td>
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<td></td>
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<td>12fps (4min)</td>
<td></td>
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<tr>
<td>145:00</td>
<td>LM Impact</td>
<td>CM3/LTC/BW-(fixed,___,fixed)</td>
<td>V</td>
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<tr>
<td>168:01</td>
<td>Post TEI</td>
<td>CM3/DC/80/CEX-(f5.6,250,∞)4</td>
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<td>Lunar Photos</td>
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<tr>
<td>168:42</td>
<td>Post TEI</td>
<td>CM3/DC/80/CEX-(f5.6,250,∞)2</td>
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<tr>
<td>168:38</td>
<td>Post TEI</td>
<td>CM3/EL/250/CEX(f5.6,250,∞)3</td>
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<tr>
<td>168:50</td>
<td>Post TEI</td>
<td>CM_/TPEAK(f22)15min</td>
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<td>Lunar Photos</td>
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<tr>
<td>169:29</td>
<td>Post TEI</td>
<td>CM3/LTC/BW-(fixed,100,fixed)5</td>
<td>V</td>
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<tr>
<td></td>
<td>Lunar Photos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>182:01</td>
<td>Water Dump</td>
<td>CM1/DAC/18/VHBM-(f2.0,125,10) 6fps,30 sec. Change focus to ∞ &amp; exposure time to 1/60, use remaining film.</td>
<td>G</td>
</tr>
<tr>
<td>182:50</td>
<td>Lunar Photos</td>
<td>CM3/LTC/BW-(fixed,100,fixed)</td>
<td>V</td>
</tr>
<tr>
<td>240:50</td>
<td>Reentry</td>
<td>CM4/DAC/18/CIN-(f16,250,7) 12fps,(4min)</td>
<td>K</td>
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<td></td>
<td>Chutes</td>
<td>Change to f11,(4min)</td>
<td></td>
</tr>
</tbody>
</table>
Command Module

**CEX:** A B C D E F H I

**VHBW:** G

**CIN:** J K

**CEX:** L M N O

**BW:** P Q

**BW (Reseau):** R S

**VHBW:** T

**BW:** U V - LTC

Lunar Module

**CEX:** AA BB CC DD EE FF GG HH - 16mm

**HCEX:** II JJ - 70mm

**HRW:** KK LL MM - 70mm