NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FINAL

PHOTOGRAPHIC AND TV PROCEDURES

APOLLO 13

APRIL 3, 1970

PREPARED BY
EXPERIMENTS SECTION
MISSION OPERATIONS BRANCH
FLIGHT CREW SUPPORT DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

APOLLO 13

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PHOTOGRAPHIC AND TV PROCEDURES

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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 Divsion.

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

2.0 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, SO368
HCEX - High Speed Color Exterior, SO168 (ASA 160)
CIN - Color Interior, SO168 (ASA 1000)
BW - Black and White, 3400
HBW - High Speed Black and White, SO267
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)
6fps, 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 __ __ __:__ __:__ __

2.2 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 96:50 R ____, P ____, Y ____ HI GAIN: P ____ Y ____

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

GET 168:00 R ____, P ____, Y ____ HI GAIN: P ____ 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 simulataneously 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 flim.

5. Improve knowledge of landing sites

b. Procedures (On following page)

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) V16, N65 (SFT and TRN angles displayed on DSKY)

(7) DAC and DC - off at GET __ __ __:__ __:__ __
and record time from AGC clock

2 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

2.4.C Landmark Tracking Sextant Photography -
CM /DAC/SEXT/CEX - (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

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

Record
(a)Mag ID
(b)Mag % remaining
(c)Non-nominal data

2.4.D 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 _____

2.4.E High Resolution/Oblique Photography

CM4/EL/500/BW - BRKT, CONT (f8,125,) 170
CM2/DAC/18/CEX - BRKT, (f8,125,) 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, f11, f16, and 1 photo, f11, 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
EV/DC/60/HCEX-(f8,250,5)2, X SUN

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

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

4 -Z pad/surface
EV/DC/60/HCEX-(f11,250,5)2, DN SUN

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

2.7.C Panoramas

1 EVA 1
EV/DC/60/HCEX-(Decal,250,74) 40

2 EVA 2
EV/DC/60/HBW-(Decal,250,74) 100

2.7.D Documented Samples
EV/DC/60/HBW-(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.G 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

1 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

Sun angle below horizon	Exposure time
1/2°	1/125 sec.
1°	1/15 sec.
5°	1,1/4,1/8 sec.

2.8.B Zodiacal Light

CM4/DAC/18/VHBW-BRKT, MIR (f0.9,∞)

Sun angle below horizon	Exposure time
75°	18 sec.
65°	16 sec.
55°	12 sec.
45°	9 sec.
35°	7 sec.
25°	5 sec
15°	2 sec.
3°	1/60 sec.

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.E 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.

2.9 CREW AND SPACECRAFT

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/CIN - 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.

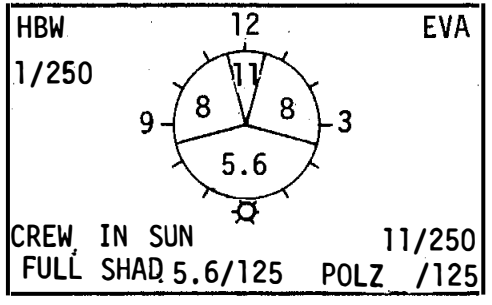
b. Procedures (on following pages)

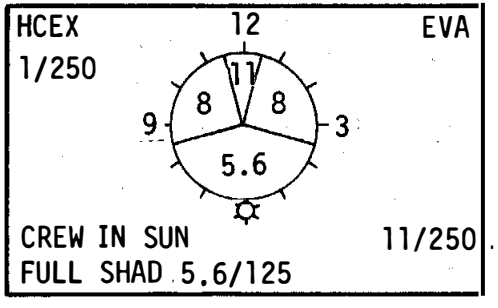
2.10.A Crew Observations (TLC/Lunar Orbit/TEC)
CM_/EL/80/CEX - (Decal), 40

2.10.B Earth/LM/Lunar Surface
EV_/DC/60/HCEX - (f11,250,15/74) 4

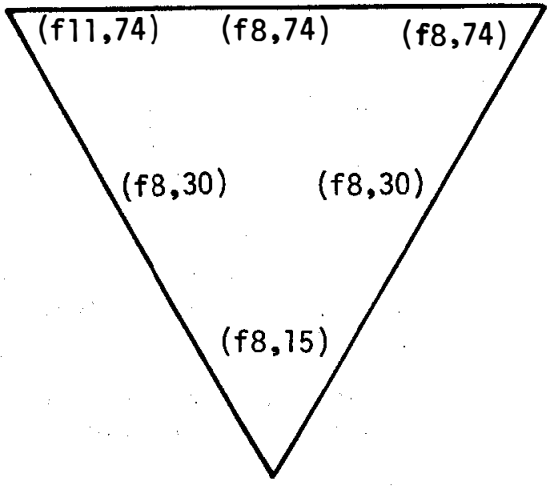
TABLE 2.1 CAMERA SETTINGS-EVA PHOTOGRAPHY

DC (70 mm)/HBW or HCEX





DC (70mm) WINDOW PHOTOGRAPHY/HBW



DAC (16 mm)/CEX

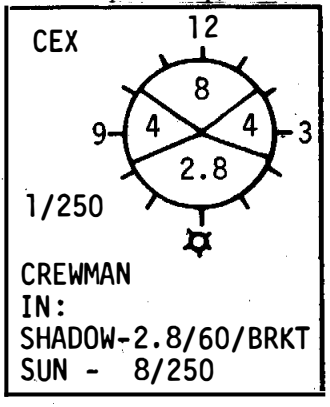


TABLE 2.2 - CAMERA SETTINGS, LUNAR ORBIT

APOLLO 13 TV SCHEDULE

DAY	DATE	CST	GET	DURATION	ACTIVITY/SUBJECT	VEH	STA
SATURDAY	APR 11	2:49 PM	01:36	5 MIN	CAPE KENNEDY	CSM	MILA
SATURDAY	APR 11	4:28 PM	03:15	1 HR 08 MIN	TRANSPOSITION & DOCKING	CSM	GDS
SUNDAY	APR 12	7:28 PM	30:15	30 MIN	SPACECRAFT INTERIOR (MCC-2)	CSM	GDS
MONDAY	APR 13	11:13 PM	58:00	30 MIN	INTERIOR & IVT TO LM	CSM	GDS
WEDNESDAY	APR 15	1:03 PM	96:50	15 MIN	FRA MAURO LANDING SITE	CSM	MAD
THURSDAY	APR 16	1:23 AM	108:10	3 HR 52 MIN	LUNAR SURFACE (EVA-1)	LM	GDS/HSK
THURSDAY	APR 16	9:03 AM	127:50	6 HR 35 MIN**	LUNAR SURFACE (EVA-2)	LM	GDS
FRIDAY	APR 17	9:36 AM	140:23	12 MIN	DOCKING	CSM	MAD
SATURDAY	APR 18	11:23 AM	166:10	40 MIN	LUNAR SURFACE	CSM	MAD*
SATURDAY	APR 18	1:13 PM	168:00	25 MIN	LUNAR SURFACE (POST TEI)	CSM	MAD*
MONDAY	APR 20	6:58 PM	221:45	15 MIN	EARTH SPACECRAFT INTERIOR	CSM	GDS

*Recorded Only

**TV On Time

3.0 ALLOCATION OF EQUIPMENT AND FILM

	El Camera (80mm lens) (2)	250mm Lens	500mm Lens	DC(60mm Lens) (2)	DC Mount (RCU) Bracket	Intervalometer	Remote Control Cable (70mm)	Camera Bracket ASSy(70mm)	Polarizing FIL	Camera Handle Trigger (2)	Close-up Stereo Camera	DAC (2)	5mm Lens	10mm Lens	18mm Lens	75mm Lens	Right Angle Mirror	DAC Power Cable(2)	DAC BRKT(2) (CSM/LM)	Remote Control Cable (16mm)	Sextant Adapter	Utility Light Clamp	Spotmeter	Color TV Camera	Zoom Lens	TV Monitor and Cable	Ringsight	TV Cable 12 ft.	TV Mounting BRKT	Lunar Color TV Camera	Zoom lens	TV Monitor and Cable	TV Tripod	TV Cable Assy (100 ft.)	Lunar Topographic Camera	70mm Film (Frames)					16mm Film (Feet)				LTC Film (Feet)			TV (Time) HRS:MIN	
																																				CEX	HCEX	BW	HBW	VHBW	CEX	CIN	VHBW		MBW			CM	EVA
CSM and LM Engineering	X			X								X			X		X	X	X	X					X	X	X	X	X						X	35	15				595	140			8			1:15	
Distant Earth/Moon	X	X																						X		X	X	X								50		10										:10	
Lunar Surface Structure (Lunar Orbit)	X	X																						X	X	X	X	X	X							327												1:10	
Landing and Exploration Sites	X		X			X	X					X		X	X			X	X	X	X														X			710			805				395				
Lunar Surface Engineering				X	X					X																											24												
Crew/Surface Compatibility				X	X					X		X		X				X	X											X	X	X	X	X			20		4		560								10:27
Surface and Sub-surface Structure				X	X				X	X	X																			X	X	X	X	X		100	397		36										
Crew/Spacecraft Compatibility												X	X					X					X	X	X	X		X														140						1:15	
Mission Documentation	X			X	X																															40	4											:05	
Dim Light Photography	X						X	X				X			X		X	X	X	X																				36			140						
																																			Total (mags)	4	2	4	3	1	16	2	1		2			3:55	10:27

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 Dymanics
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.

ACTIVITY	RESPONSE TIME	UPDATED INFORMATION
Lunar Orbit Photography	20 MIN	S/C attitude T start (GET) T stop (GET)
P52 NAV Star	30 MIN	Provide NAV STARS in PTC attitude for the P52 option 3 realignments
P22	30 MIN	Provide T1 and T2 times, distance north or south of track
P23		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.
Sleep Attitude	1 HR	Provide a particular S/C attitude to satisfy thermal and communications constraints.
S/C Pointing With Minimum Middle Gimbal Angle	30 MIN	R,P,Y, to point windows or instruments with minimum gimbal angles.
To Point Window at the Moon, shortly prior to LOI and after TEI	10 MIN	R,P,Y, number of degrees window is pointing below horizon
Pointing Windows at Earth and Moon simultaneously (PTC Mode)	10 MIN	R,P,Y, to orient left hand window to Earth and right-hand window at Moon
Map Update	25 MIN	Provide prime meridian crossing, and AOS - LOS for MSFN prime active sites.
TV	30 MIN	Provide the proper S/C R,P,Y, and Hi-Gain antenna P,Y, for TV coverage as required during the mission.

5.0 PHOTOGRAPHIC SUMMARY

Mission Phase (GET)	Activity	Camera Code	Mag
03:15	T & D	CM2/DAC/18/CEX-BRKT,MIR (f8,250,7)12fps, .7mag (5Min)	A
		CM_/EL/80/CEX-SPOT(f8,250,focus) 10	L
		CM4/TV-PEAK,BRKT(f22)	
03:59	LM Ejection	CM2/DAC/18/CEX-BRKT,MIR(f8,250,7) 6fps,.3 mag(5min.)	A
Crew Option	S/C Interior	CM/DAC/5/CIN-SPOT(f2.8,60,ff)6fps, 1 mag	J
07:10	Earth Weather	CM_/EL/250/CEX-RING (f11,250,∞)10	L
30:15	MCC-2	CM/TV-AVG (f5.6)	
Crew Option	Lunar Photography	CM_/EL/80or250/BW-RING(f5.6,250,∞)10	P
		CM_/EL/80or250/CEX-RING(f5.6,250,∞)10	L
58:00	IVT	CM/TV-AVG(f5.6)	
84:24	Low Alt. Photos of Censorinus	CM3/LTC/BW-(fixed,50,fixed)	U
99:15	Undocking	CM2/DAC/18/CEX-BRKT,MIR (f8,250,7) 6fps, 1mag(16min)	B
		CM2/EL/80/CEX-(f8,250,focus)10	L
		LM_/DC/60/HCEX-(f11,250,focus)10	II
		LM3/DAC/10/CEX-ULC(f8,250,7)6fps, .2mag (3min)	AA
100:35	CSM Circ. Burn	LM3/DAC/10/CEX-ULC(f8,250,∞)6fps, .03mag (30sec)	AA
		LM_/DC/60/HCEX-(f11,250,∞)2	II
103:40	LM Landing	CM3/LTC/BW-(fixed,50,fixed)	U

104:30	S/C Contamination	CM4/EL/80/VHBW-BRKT,LTWS CONT (f2.8,___,∞)6	T
L.O.	Orbital Sci. Photography	CM_/EL/80or250/CEX-(__,250,∞)328	L,M, N
L.O.	Lmk Track SEXT Photos	CM/DAC/SEXT/CEX-(fixed,___,fixed) 1fps, 1mag (93Min.)	C
107:35	LTC Photos of Landed LM	CM3/LTC/BW-(fixed,50,fixed)	U
107:48	Solar Corona	CM4/EL/80/VHBW-BRKT,CONT(f2.8,∞)15	T
108:08	Lunar Limb Brightening	CM4/DAC/18/VHBW-BRKT,MIR(f2.0,125,∞) 12fps,40 sec.	G
109:45	Earthshine Photography	CM4/DAC/18/VHBW-BRKT,MIR(f0.9,125,∞) 1fps(5Min)	G
		CM4/EL/80/VHBW-BRKT,CONT(f2.8,125,∞) 18	T
L.O.	Vertical Stereo	CM4/DC/80/BW-BRKT,IVL(f__,250,∞)360	R,S
		CM/DAC/SEXT/CEX-(fixed,____, fixed)1fps,1mag	D
L.O.	LTC Photography	CM3/LTC/BW-(fixed,____,fixed)	U,V
L.O.	High Resolution Oblique Photography	CM4/EL/500/BW-BRKT,CONT(f8,125,∞) 170	P
		CM2/DAC/18/CEX-BRKT(f8,125,∞) 6fps,2mag (32min)	H,I
131:50	Zodiacal Light	CM4/DAC/18/VHBW-BRKT,MIR (f0.9,___,∞)	G
133:45	Gegenschein	CM4/DAC/18/VHBW-BRKT,MIR (f0.9,20sec,)12fr.	G
137:10	APS Liftoff	LM3/DAC/10/CEX-BRKT(f2.8,500,∞) 12fps,1Mag	HH

140:30	Rendezvous & Docking	CM2/DAC/18/CEX-BRKT,MIR(f8,250,7) 6fps,1Mag	E
		CM2/EL/80/CEX(f8,250,focus)10	O
		LM3/DC/60/HCEX-(f11,250,focus)15	II
		CM4/TV-PEAK,BRKT(f22)	
143:04	LM Jettison	CM4/DAC/18/CEX-BRKT,MIR(f8,250,7) 12fps, (4Min)	F
144:32	LM Deorbit	CM/DAC/SEXT/CEX-(fixed,250,fixed) 12fps (4min)	F
145:00	LM Impact	CM3/LTC/BW-(fixed,___,fixed)	V
168:01	Post TEI Lunar Photos	CM3/DC/80/CEX-(f5.6,250,∞)4	O
168:42	Post TEI Lunar Photos	CM3/DC/80/CEX-(f5.6,250,∞)2	O
168:38	Post TEI Lunar Photos	CM3/EL/250/CEX(f5.6,250,∞)3	O
168:50	Post TEI	CM_/TV-PEAK(f22)15min	
169:29	Post TEI Lunar Photos	CM3/LTC/BW-(fixed,100,fixed)5	V
182:01	Water Dump	CM1/DAC/18/VHBW-(f2.0,125,10) 6fps,30 sec. Change focus to ∞ & exposure time to 1/60, use remaining film.	G
182:50	Lunar Photos	CM3/LTC/BW-(fixed,100,fixed)	V
240:50	Reentry	CM4/DAC/18/CIN-(f16,250,7) 12fps,(4min)	K
	Chutes	Change to f11,(4min)	

APOLLO 13 MAGAZINE/FILM DISTR.

Command Module

CEX: A B C D E F H I
VHBW: G
CIN: J K
— 16mm

CEX: L M N O
BW: P Q
BW (Reseau): R S
VHBW: T
— 70mm

BW: U V - LTC

Lunar Module

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

HCEX: II JJ - 70mm

HBW: KK LL MM - 70mm

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