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APOLLO 17 PHOTOGRAPH EVALUATION (APE) DATA BOOK

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION
National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas

JSC-03573

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PROJECT APOLLO

APOLLO 17 PHOTOGRAPH EVALUATION (APE) DATA BOOK

By H. H. Cunningham
TRW systems Group

February 22, 1974

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
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Analysis and Experiment Support Section
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1.0 INTRODUCTION

This is a catalog of the Apollo 17 photographic evaluation data available at the National Aeronautics and Space Administration, Johnson Space Center. Section 2 provides explanation and definition of all the photographic evaluation data elements. Sections 3 and 4 present data summaries for all of the lightside sequences of Apollo 17 3-inch mapping camera photography and Apollo 17 24-inch panoramic camera photography respectively. Each data summary includes a brief description of the trajectory reconstruction, telemetered data used, and the constants employed for the data processing. They also contain a brief resume of the apparent data trends throughout the sequence and the data for the first and last frame of the sequence.

2.0 EXPLANATION OF APOLLO PHOTOGRAPH EVALUATION (APE) DATA

The first and last frame figures appearing in the data book are typical Apollo 17 photo evaluation data groups. The microfilm of data for each Apollo 17 mapping camera photo sequence also contains two frames that contain stellar camera star pattern definitions. These star patterns are companion to identified map camera photos of the sequence.

GMT - Sidereal time of film exposure (year, month, day, hour, minute, second) - (UT1 - USNO).

CTE - Central clock time of film exposure which is recorded on the film (hour, minute, second).

1950 state vector - Mean of 1950 moon centered, inertial, cartesian coordinates of the spacecraft position (km) and velocity (km/sec).

Selenographic state vector - Selenographic, instantaneous inertial cartesian coordinates of vehicle position (km) and velocity (km/sec).

Nadir Point (Longitude, Latitude) - Intersection with the mean lunar surface, of the vector from the moon's center of mass to the spacecraft.

Camera Axis Intersect (Longitude, Latitude) - Position of principal intersection point - Intersection of camera optical axis direction with mean lunar surface.

Spacecraft radius - Vector from moon center of mass to spacecraft.

Spacecraft altitude - Height of spacecraft above mean lunar surface.

Scale Factor - Proportionality constant relating dimensions on the film to dimensions on the mean lunar surface.

Azimuth of Velocity Vector - Angle, measured positive clockwise in the local horizontal plane at nadir, between North and the projection of the vehicle velocity vector onto the local horizontal plane.

Mean altitude rate - Rate of change in spacecraft altitude above the mean lunar surface.

Horizontal velocity - Component of spacecraft velocity parallel to the lunar local horizontal plane at the nadir point.

Tilt azimuth - Angle, measured positive clockwise in the local horizontal plane at the principal intersection point, between North and the projection of a vector along the camera optical axis onto that local horizontal plane.

Tilt - Angle between the camera optical axis direction and the lunar local vertical at the principal intersection point.

Sun Elevation at Prin Grnd Pnt - Angle between the vector from the sun to the principal intersection point and the lunar local horizontal plane at that point.

Sun Azimuth at Principal Grnd Pnt - Angle, measured positive clockwise in the lunar local horizontal plane, from North to the projection of the vector from the sun to the principal intersection point onto that plane.

Subsolar Point (longitude, latitude) - Intersection with the mean lunar surface, of a vector from the moon's center of mass to the sun's center.

Alpha - Angle between the camera optical axis and the projection of the lunar local vertical at the principal intersection point onto the plane of the phase angle (measure of surface tilt toward or away from the sun).

Swing - Angle between the camera Y axis and the projection of the line between the vehicle nadir and principal intersection point onto the camera X-Y plane.

Emission Angle - Angle between the camera optical axis and the lunar local vertical at the principal intersection point.

Phase Angle - Angle between the camera optical axis and the vector from the sun to the principal intersection point.

North Deviation Angle - Angle, measured positive clockwise in the camera X-Y plane, from the camera X axis to lunar North.

Phi, Kappa, Omega - Angles which rotate the camera axes coordinate system into the nadir point centered lunar local horizontal system, where:

ϕ - primary right-handed rotation about the camera Y axis.

ω - secondary right-handed rotation about the intermediate X-axis.

κ - final right-handed rotation about the local vertical (local horizontal Z-axis).

X-tilt - (Lateral tilt) Angle from the local horizontal plane at the nadir point to the camera Y-axis.

Y-tilt - (Longitudinal tilt) Angle from the local horizontal plane at the nadir point to the camera X-axis.

Heading - Angle, measured positive clockwise in the lunar local horizontal plane at the nadir point, from North to the projection of the camera X-axis onto that plane.

Laser slant range - Telemetered laser altimeter readout.

Spacecraft altitude (Laser) - Vertical component of laser altimeter slant range based on the assumption that the laser altimeter was aligned along the 3-inch mapping camera optical axis.

Selenographic direction Cosines - Direction definition of vector from the spacecraft to the principal intersection point in the instantaneous inertial selenographic coordinate system.

Coordinate Transformation Matrices - Selenocentric coordinate system to camera axes coordinate system and local horizontal coordinate system to the camera axes coordinate system.

Photograph Footprint - Latitudes and Longitudes of field of view corner point projections onto the lunar surface (full field of view only for mapping camera, full field of view and inner field of view for panoramic camera).

Sigmas - First order uncertainties in selected camera aiming parameters arising from uncertainties in camera mounting angles, vehicle attitude measurements and film exposure times.

The following data group is substituted when vehicle attitude is unavailable for the APE computations.

IFRAME - Photograph frame number which corresponds to page number of the standard printout.

GMT - Sidereal time of film exposure (year, month, day, hour, minute, second) - (UT1-USNO).

CTE - Central clock time of film exposure which is recorded on the film (hour, minute, second).

1950 state vector - Mean of 1950 moon cnetered, inertial, cartesian coordinates of the spacecraft position (er) and velocity (er/min).

Selenographic state vector - Selenographic, instantaneous inertial cartesian coordinates of vehicle position (er) and velocity (km/sec).

Note: 6378.16 km/er should be used for conversion of these state vectors to the standard APE units of km and km/sec.

3.0 APOLLO 17 3-INCH MAPPING CAMERA DATA

Mission: Apollo 17, Target: Vertical strip photography

Rev: 1/2, Camera: 3 Inch Mapping Frames: 163 Through: 321

Coverage Interval:

From: 19.8 Deg S Lat., 145.8 Deg W Long., To: 18.3 Deg N Lat., 16.7 Deg E Long.

From: 88 Hr 8 Min 30.350 Sec, To: 89 Hr 14 Min 50.198 Sec.

Date Processed: 9/20/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziel1)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .721533195 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 89 H, 9 m, 44.06 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 2. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1618.8228	$\dot{X}$ =	.8698
Y =	964.2463	$\dot{Y}$ =	-1.2692
Z =	675.1559	$\dot{Z}$ =	- .0665

- Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/20/73 (During APE operation)

Edited Data Tape No. T00412 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a strip of vertical photography starting at 145.8 deg W Long. and ending at 16.7 deg. E Long. Throughout the sequence tilt was maintained at less than 1 deg.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	10	21	41	30.546
CTE			3	16	8	30.350

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1739.7348965	131.1C60952	-683.7605649	-.1759751	-1.5415464	-.5462357
SELENOGRAPHIC	-1456.6731623	-992.1436696	-636.5132694	-.8888314	1.3809315	.0933325

LONGITUDE OF NADIR POINT	-145.7411251 DEG	LATITUDE OF NADIR POINT	-19.8572652 DEG
	-145 DEG, 44 MIN, 28.0503845 SEC		-19 DEG, 51 MIN, 26.1548424 SEC
LONG OF CAMERA AXIS INTERSECT	-145.8171730 DEG	LATI OF CAMERA AXIS INTERSECT	-19.8335075 DEG
	-145 DEG, 49 MIN, 1.6228149 SEC		-19 DEG, 50 MIN, .6271362 SEC
SPACECRAFT RADIUS	1873.6716148 KM	SPACECRAFT ALTITUDE	135.7816184 KM
SCALE FACTOR	.0000000 M/KM	AZIMUTH OF VELOCITY VECTOR	272.5551667 DEG
MEAN ALTITUDE RATE	-.0719107 KM/SEC	HORIZONTAL VELOCITY	1.6432999 KM/SEC
TILT AZIMUTH	288.3600807 DEG	TILT ANGLE	.9648427 DEG
SIGMA TILT AZIMUTH	.C118541 DEG	SIGMA TILT ANGLE	.0002004 DEG
SUN ELEVATION AT PRIN GRND PNT	-5.9896154 DEG	SUN AZIMUTH AT PRINCIPAL GRND P,T	266.9664071 DEG
LONGITUDE OF SUBSOLAR POINT	117.5274220 DEG	LATITUDE OF SUBSOLAR POINT	-.7677054 DEG
	117 DEG, 31 MIN, 38.7192249 SEC		0 DEG, [illegible] MIN, 15.7393456 SEC
ALPHA	-.9680710 DEG	SWING ANGLE	265.8681469 DEG
EMISSION ANGLE	1.0400299 DEG	SIGMA SWING ANGLE	.0118541 DEG
PHASE ANGLE	96.9578190 DEG	NORTH DEVIATION ANGLE	177.5105434 DEG
PHI	.9279048 DEG	X-TILT	.2637496 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-177.5059814 DEG	Y-TILT	-.9278950 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	.2637496 DEG	HEADING	-87.5102517 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	132.7521744 KM	LASER SLANT RANGE	132.7709999 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.76676630	.54157925	.34461770	135.802369

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.51836452-01	-.93334750+00	-.35521171+00
-.36974634+00	.34634970+00	-.86135936+00
.92768549+00	.86688472-01	-.36315924+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99892496+00	.43439933-01	.16199119-01
-.43514615-01	-.99904217+00	-.46032828-02
.15978639-01	-.53030238-02	.99985822+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-16.444	-142.009
-23.422	-142.202
-23.205	-149.883
-16.031	-149.408

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -2 HR, 24 MIN, 22.9 SEC DECLINATION 51 DEG, 59 MIN, 44.6 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	22	47	50.394
CTE			3	17	14	50.198

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1765.2107469	368.3967952	903.6663003	.9413785	1.4092551	.3800453
SELENOGRAPHIC	1837.4410090	550.3947360	635.8970388	.5482962	-1.4104063	-.1880690

LONGITUDE OF NADIR POINT	16.6738496	DEG	LATITUDE OF NADIR POINT 18.3417110 DEG
16 DEG, 40 MIN,	25.8584976	SEC	18 DEG, 20 MIN, 30.1597595 SEC
LONG OF CAMERA AXIS INTERSECT	16.7101157	DEG	LATI OF CAMERA AXIS INTERSECT 16.2655938 DEG
16 DEG, 42 MIN,	36.4164162	SEC	16 DEG, 15 MIN, 56.1375618 SEC
SPACECRAFT RADIUS	2020.7508094	KM	SPACECRAFT ALTITUDE 282.6608131 KM
SCALE FACTOR	.0002696	M/KM	AZIMUTH OF VELOCITY VECTOR 261.8339630 DEG
MEAN ALTITUDE RATE	.0552580	KM/SEC	HORIZONTAL VELOCITY 1.5238467 KM/SEC
TILT AZIMUTH	155.6548882	DEG	TILT ANGLE .5139732 DEG
SIGMA TILT AZIMUTH	.0223064	DEG	SIGMA TILT ANGLE .0001999 DEG
SUN ELEVATION AT PRIN GRND PNT	-9.9837532	DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT 87.5512658 DEG
LONGITUDE OF SUBSOLAR POINT	116.9665433	DEG	LATITUDE OF SUBSOLAR POINT -.7665289 DEG
116 DEG, 57 MIN,	59.5559978	SEC	0 DEG, 47 MIN, 11.5039158 SEC
ALPHA	-.2212724	DEG	SWING ANGLE 164.2426442 DEG
EMISSION ANGLE	.5972128	DEG	SIGMA SWING ANGLE .0223065 DEG
PHASE ANGLE	100.2054987	DEG	NORTH DEVIATION ANGLE 186.5084554 DEG
PHI	-.1394978	DEG	X-TILT -.4993662 DEG
SIGMA PHI	.0002000	DEG	SIGMA X-TILT .0002000 DEG
KAPPA	171.4130116	DEG	Y-TILT .1394926 DEG
SIGMA KAPPA	.0002000	DEG	SIGMA Y-TILT .0002000 DEG
OMEGA	-.4993662	DEG	HEADING -98.5881926 DEG
SIGMA OMEGA	.0002000	DEG	SIGMA HEADING .0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	LASER SLANT RANGE .0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.90784789	-.26805792	-.32242388	282.674021

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.32074776+00	.91987598+00	.22571677+00
-.37549716+00	.34227749+00	-.86130597+00
-.86955313+00	.19150523+00	.45519557+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.98878420+00	-.14933113+00	-.24346029-02
.14930521+00	-.98875350+00	.86282104-02
-.36957081-02	.81679335-02	.99995977+00

PHOTOGRAPH FOOTPRINT LATITUDE	LONGITUDE
27.015	24.071
11.343	25.968
9.112	9.987
24.534	6.985

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -3 HR, 13 MIN, 47.8 SEC DECLINATION 64 DEG, 39 MIN, 41.8 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 13/14, Camera: 3 Inch Mapping Frames: 323 Through: 463

Coverage Interval:

From: 15.0 Deg SLat., 167.4 Deg E Long., To: 18.5 Deg NLat., 6.5 Deg E Long.

From: 111 Hr 29 Min 54.890Sec, To: 112 Hr 23 Min 40.663Sec. CTE

Date Processed: 9/20/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72158319 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable ($1x10^{-14}$ - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 112 H, 16 m, 4.86469 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 14. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1494.5024	$\dot{X}$ =	.8184
Y =	890.1942	$\dot{Y}$ =	-1.4057
Z =	634.0940	$\dot{Z}$ =	.0055

- Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/20/73 (During APE operation)

Edited Data Tape No. T00178 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data for the intervals 111 H, 19 M - 111 H, 29 M, 44 Sec (FMS 323-344) and 111 H, 50 M - 111 H, 52 M, (FMS 390-393).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 167.4 deg E Long. and ending at 6.5 deg E Long. Throughout the sequence tilt is maintained less than 1 deg. Vehicle state vector data only are provided for frames 323 through 344 and 390 through 393 for which vehicle attitude data are unavailable for the computations. Star patterns companion to frames 350 and 450 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	11	21	2	53.091
CTE			4	15	29	54.890

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1387.1310715	-833.5976617	-913.6354860	-.8931372	-1.3437098	-.1528443
SELENOGRAPHIC	-1751.9529529	390.9896696	-481.1812562	.2377280	1.5621142	.3604113

LONGITUDE OF NADIR POINT	167.4192562	DEG	
	167 DEG, 25 MIN,	9.3223572	SEC
LONG OF CAMERA AXIS INTERSECT	167.4383507	DEG	
	167 DEG, 26 MIN,	18.0624390	SEC
SPACECRAFT RADIUS	1858.4260739	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	.0112239	KM/SEC	
TILT AZIMUTH	145.4233761	DEG	
SIGMA TILT AZIMUTH	.0243555	DEG	
SUN ELEVATION AT PRIN GRND PNT	27.4138212	DEG	
LONGITUDE OF SUBSOLAR POINT	105.6803930	DEG	
	105 DEG, 40 MIN,	49.4149590	SEC
ALPHA	.3324605	DEG	
EMISSION ANGLE	.5017746	DEG	
PHASE ANGLE	62.2530789	DEG	
PHI	-.3475782	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-166.7882957	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.3152996	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	121.0469341	KM	

LATITUDE OF NADIR POINT	-15.0059110	DEG	
	-15 DEG, 0 MIN,	21.2795734	SEC
LATI OF CAMERA AXIS INTERSECT	-15.0326644	DEG	
	-15 DEG, 1 MIN,	57.5919056	SEC
SPACECRAFT ALTITUDE	120.3360776	KM	
AZIMUTH OF VELOCITY VECTOR	283.4204819	DEG	
HORIZONTAL VELOCITY	1.6206141	KM/SEC	
TILT ANGLE	.4695585	DEG	
SIGMA TILT ANGLE	.0002004	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	277.1098480	DEG	
LATITUDE OF SUBSOLAR POINT	-.7623122	DEG	
	0 DEG, 45 MIN,	44.3240261	SEC
SWING ANGLE	132.2126631	DEG	
SIGMA SWING ANGLE	.0243556	DEG	
NORTH DEVIATION ANGLE	166.7901494	DEG	
X-TILT	-.3152996	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	.3475730	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-76.7902071	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	121.0509996	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.94336801	-.21529731	.25239626	120.340394

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.56213360+00	-.82201324+00	-.91104074-01
-.35916545+00	.34186121+00	-.86840719+00
.74498717+00	-.45543946+00	-.48741043+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97352190+00	.22851305+00	-.60662554-02
-.22854627+00	-.97351748+00	.55029881-02
-.46481209-02	.67437197-02	.99996642+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-12.676	171.285
-18.810	169.919
-17.323	163.513
-11.309	165.093

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-2 HR, 47 MIN, 2.4 SEC	DECLINATION	54 DEG, 25 MIN, 49.0 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	11	21	56	38.835
CTE			4	16	23	40.633

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1636.7913407	286.0068613	803.0830102	.9728966	1.5111011	.3957653
SELENOGRAPHIC	1738.6778416	196.6330121	586.5145215	.2389736	-1.6004117	-.2126370

LONGITUDE OF NADIR POINT	6.4523596 DEG	LATITUDE OF NADIR POINT	18.5309892 DEG
	6 DEG, 27 MIN, 8.4946203 SEC		18 DEG, 31 MIN, 51.5610123 SEC
LONG OF CAMERA AXIS INTERSECT	6.4677448 DEG	LATI OF CAMERA AXIS INTERSECT	18.5260096 DEG
	6 DEG, 28 MIN, 3.8813782 SEC		18 DEG, 31 MIN, 33.6344147 SEC
SPACECRAFT RADIUS	1845.4442452 KM	SPACECRAFT ALTITUDE	107.3542489 KM
SCALE FACTOR	.0007041 M/KM	AZIMUTH OF VELOCITY VECTOR	262.2555599 DEG
MEAN ALTITUDE RATE	-.0129560 KM/SEC	HORIZONTAL VELOCITY	1.6319853 KM/SEC
TILT AZIMUTH	108.8446846 DEG	TILT ANGLE	.2501739 DEG
SIGMA TILT AZIMUTH	.0457850 DEG	SIGMA TILT ANGLE	.0002001 DEG
SUN ELEVATION AT PRIN GRND PNT	-8.5449047 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	87.9266405 DEG
LONGITUDE OF SUBSOLAR POINT	105.2260109 DEG	LATITUDE OF SUBSOLAR POINT	-.7613156 DEG
	105 DEG, 13 MIN, 33.6392856 SEC		0 DEG, 45 MIN, 40.7361031 SEC
ALPHA	-.2474580 DEG	SWING ANGLE	117.0502919 DEG
EMISSION ANGLE	.2649521 DEG	SIGMA SWING ANGLE	.0457853 DEG
PHASE ANGLE	98.7923746 DEG	NORTH DEVIATION ANGLE	188.2056086 DEG
PHI	-.2222395 DEG	X-TILT	-.1134821 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	171.7947788 DEG	Y-TILT	.2222391 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-.1134821 DEG	HEADING	-98.2056628 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	109.4309568 KM	LASER SLANT RANGE	109.4320002 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.94215596	-.10240356	-.31914833	107.355330

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.28318691+00	.92924750+00	.23728498+00
-.36936432+00	.33400104+00	-.86718699+00
-.88508478+00	.15793143+00	.43781561+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.98975464+00	-.14272568+00	-.38787936-02
.14271883+00	-.98976127+00	.19806345-02
-.41217930-02	.14067609-02	.99999047+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
21.650	8.996
16.140	9.750
15.379	4.040
20.831	3.130

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -3 HR, 15 MIN, 13.5 SEC DECLINATION 65 DEG, 12 MIN, 38.8 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 14/15, Camera: 3 Inch Mapping Frames: 465 Through: 611

Coverage Interval:

From: 19.4 Deg S Lat., 165.2 Deg W Long., To: 19.0 Deg N Lat., 9.8 Deg E Long.

From: 113 Hr 19 Min 54.322 Sec, To: 114 Hr 21 Min 13.920 Sec. CTE

Date Processed: 9/23/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72158319 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 114 H, 14 m, 42.19471 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 15. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1494.3165	$\dot{X}$ =	.8157
Y =	890.0835	$\dot{Y}$ =	-1.4075
Z =	633.5526	$\dot{Z}$ =	.0143

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/23/73 (During APE operation)

Edited Data Tape No. T00178 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the internal 113h, 34 M - 113 H, 52 M (FMS 500-542).

- APE Card Inputs:

  Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Range Zero-Clock Zero Time Difference 0.0 Sec

  REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

  Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

  Stellar camera Interlock Angles Used:

  Ω = -95° 55' 32.079"
  ϕ = -0° 1' 30.755"
  κ = 0° 0' 58.194"

  Uncertainties Assumed:

  ± 1 degree in camera positioning angle
  ±0.2 mrad in each gimbal angle
  ±20 ms in onboard clock bias definition
  ±5 ms in onboard clock drift rate
  ±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 165.2 deg W Long. and ending at 9.8 deg E Long. At the start of the sequence tilt is 40 deg. Tilt is quickly reduced to less than 1 deg, then maintained at that level or less from that time (frame 480) forward. State vector data only are provided for frames 500-542, for which vehicle attitude data are unavailable for the computations. Star patterns companion to frames 475 and 600 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT1972		12	11	22	52	52.525
CTE			4	17	19	54.322

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1699.5614245	-45.9903979	-734.3966180	-.2423300	-1.5268587	-.4992070
SELENOGRAPHIC	-1692.4960835	-432.3155712	-615.2401035	-.4591775	1.0546019	.1300560

LONGITUDE OF NADIR POINT	-165.6712818	DEG	
	-165 DEG, 40 MIN,	16.6145325	SEC
LONG OF CAMERA AXIS INTERSECT	-165.2197895	DEG	
	-165 DEG, 13 MIN,	11.2722180	SEC
SPACECRAFT RADIUS	1852.0158851	KM	
SCALE FACTOR	.0000000	R/KM	
MEAN ALTITUDE RATE	.0135322	KM/SEC	
TILT AZIMUTH	7.7126189	DEG	
SIGMA TILT AZIMUTH	.0003109	DEG	
SUN ELEVATION AT PRIN GRND PNT	.1038465	DEG	
LONGITUDE OF SUBSOLAR POINT	104.7507986	DEG	
	104 DEG, 45 MIN,	2.8748703	SEC
ALPHA	5.5690440	DEG	
EMISSION ANGLE	43.2553008	DEG	
PHASE ANGLE	84.1797171	DEG	
PHI	.9734826	DEG	
SIGMA PHI	.0002609	DEG	
KAPPA	-175.7735329	DEG	
SIGMA KAPPA	.0002607	DEG	
OMEGA	40.0131140	DEG	
SIGMA OMEGA	.0002005	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	-19.4023750	DEG	
	-19 DEG, 24 MIN,	8.5499362	SEC
LATI OF CAMERA AXIS INTERSECT	-18.1987498	DEG	
	-18 DEG, 11 MIN,	55.4911859	SEC
SPACECRAFT ALTITUDE	113.9258888	KM	
AZIMUTH OF VELOCITY VECTOR	275.0327092	DEG	
HORIZONTAL VELOCITY	1.6261200	KM/SEC	
TILT ANGLE	90.0229697	DEG	
SIGMA TILT ANGLE	.0002004	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	269.2617035	DEG	
LATITUDE OF SUBSOLAR POINT	-.7602715	DEG	
	0 DEG, 45 MIN,	36.9772053	SEC
SKING ANGLE	350.8406019	DEG	
SIGMA SKING ANGLE	.0003107	DEG	
NORTH DEVIATION ANGLE	160.8115261	DEG	
X-TILT	90.0131141	DEG	
SIGMA X-TILT	.0002005	DEG	
Y-TILT	-.7455728	DEG	
SIGMA Y-TILT	.0001996	DEG	
HEADING	-81.3994783	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.51606939	.04274268	.85547984	152.3800222

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.12168767+00	-.95943252+00	-.25432503+00
-.87771114+00	.22366089+00	-.42379110+00
.46346151+00	.17165369+00	-.86932147+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.98867127+00	.14953166+00	.13014333-01
-.12280179+00	-.75596831+00	-.64296293+00
-.86306151-01	-.63727696+00	.76578669+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
********	.000
-19.523	-163.307
-18.833	-166.107
********	.000

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION 0 HR, 50 MIN, 14.6 SEC DECLINATION 19 DEG, 22 MIN, 12.9 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	11	23	54	12.124
CTE			4	18	21	13.920

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1671.5295130	158.4737731	766.8777255	.3641120	1.5265120	.4465010
SELENOGRAPHIC	1719.2655833	298.2128551	602.0143209	.3227935	-1.5898005	-.1746951

LONGITUDE OF NADIR POINT	9.8402551 DEG	LATITUDE OF NADIR POINT	19.0347588 DEG
	9 DEG, 50 MIN, 24.9185085 SEC		19 DEG, 2 MIN, 5.1317024 SEC
LONG OF CAMERA AXIS INTERSECT	9.8680418 DEG	LATI OF CAMERA AXIS INTERSECT	19.0496151 DEG
	9 DEG, 52 MIN, 4.9503136 SEC		19 DEG, 2 MIN, 58.6145210 SEC
SPACECRAFT RADIUS	1845.8673559 KM	SPACECRAFT ALTITUDE	107.7773595 KM
SCALE FACTOR	.0007015 M/KM	AZIMUTH OF VELOCITY VECTOR	263.6569239 DEG
MEAN ALTITUDE RATE	-.0131644 KM/SEC	HORIZONTAL VELOCITY	1.6315359 KM/SEC
TILT AZIMUTH	60.5028586 DEG	TILT ANGLE	.4869332 DEG
SIGMA TILT AZIMUTH	.0235186 DEG	SIGMA TILT ANGLE	.0002001 DEG
SUN ELEVATION AT PRIN GRND PNT	-4.3731089 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	89.2924566 DEG
LONGITUDE OF SUBSOLAR POINT	104.2325077 DEG	LATITUDE OF SUBSOLAR POINT	-.7591306 DEG
	104 DEG, 13 MIN, 57.0277405 SEC		0 DEG, 45 MIN, 32.8699780 SEC
ALPHA	-.4528502 DEG	SWING ANGLE	66.6290342 DEG
EMISSION ANGLE	.5167708 DEG	SIGMA SWING ANGLE	.0235186 DEG
PHASE ANGLE	94.8260002 DEG	NORTH DEVIATION ANGLE	186.1253696 DEG
PHI	-.4466727 DEG	X-TILT	.1930212 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	173.8729935 DEG	Y-TILT	.4466701 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	.1930212 DEG	HEADING	-96.1255028 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	108.7160740 KM	LASER SLANT RANGE	108.7200003 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.93398680	-.15450126	-.32217701	107.781487

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.22430712+00	.93430517+00	.27705611+00
-.36134191+00	.34377352+00	-.86674781+00
-.90505151+00	.94305742-01	.41471447+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99426029+00	-.10670340+00	-.77957851-02
.10673211+00	-.99428209+00	-.33688483-02
-.73917675-02	-.41815739-02	.99996389+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
22.122	12.560
16.545	13.075
16.001	7.326
21.480	6.592

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-3 HR, 25 MIN, 5.4 SEC	DECLINATION	64 DEG, 49 MIN, 49.1 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 23/24, Camera: 3 Inch Mapping Frames: 668 Through: 813

Coverage Interval:

From: 19.5 Deg S Lat., 172.9 Deg W Long., To: 19.3 Deg N Lat., 3.9 Deg E Long.

From: 131 Hr 9 Min 28.805 Sec, To: 132 Hr 10 Min 21.663 Sec. CTE

Date Processed: 8/23/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72161653 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 132 H, 2 M, 2.05295 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 24. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1496.5185	$\dot{X}$ =	.7902
Y =	891.3591	$\dot{Y}$ =	-1.4203
Z =	622.2548	$\dot{Z}$ =	.0931

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/23/73 (During APE operation)

Edited Data Tape No. T01065 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the interval 131 H, 26 M, 54 sec - 131 H, 38 M, 32 sec (FMS 710-737).

APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 172.9 deg W Long. and ending at 3.9 deg E Long. Throughout the sequence tilt is maintained less than 1 deg. State vector data only are provided for frames 710 through 737 for which vehicle attitude data are unavailable for the computations. Star patterns companion to frames 675 and 800 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	12	16	42	27.021
CTE			5	11	9	28.005

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1714.2909924	26.7239675	-707.4456952	-.1750624	-1.5273603	-.5165221
SELENOGRAPHIC	-1735.3678543	-216.4086859	-618.4545478	-.2554425	1.5992610	.1162266

LONGITUDE OF NADIR POINT	-172.8748131 DEG	LATITUDE OF NADIR POINT	-19.4782479 DEG
	-172 DEG, 52 MIN, 29.3270874 SEC		-19 DEG, 28 MIN, 41.6923714 SEC
LONG OF CAMERA AXIS INTERSECT	-172.8870220 DEG	LATI OF CAMERA AXIS INTERSECT	-19.4782023 DEG
	-172 DEG, 53 MIN, 13.2792664 SEC		-19 DEG, 28 MIN, 41.5284348 SEC
SPACECRAFT RADIUS	1854.7202454 KM	SPACECRAFT ALTITUDE	116.6302490 KM
SCALE FACTOR	.0000000 M/KM	AZIMUTH OF VELOCITY VECTOR	274.5195457 DEG
MEAN ALTITUDE RATE	.0131732 KM/SEC	HORIZONTAL VELOCITY	1.6236118 KM/SEC
TILT AZIMUTH	270.2247238 DEG	TILT ANGLE	.1725185 DEG
SIGMA TILT AZIMUTH	.0667554 DEG	SIGMA TILT ANGLE	.0001990 DEG
SUN ELEVATION AT PRIN GRND PNT	-1.0727081 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	268.8353653 DEG
LONGITUDE OF SUBSOLAR POINT	95.7132155 DEG	LATITUDE OF SUBSOLAR POINT	-.7400586 DEG
	95 DEG, 42 MIN, 47.5758648 SEC		0 DEG, 44 MIN, 24.2110062 SEC
ALPHA	-.1829604 DEG	SWING ANGLE	265.3699348 DEG
EMISSION ANGLE	.1830145 DEG	SIGMA SWING ANGLE	.0667549 DEG
PHASE ANGLE	91.2556686 DEG	NORTH DEVIATION ANGLE	175.1453036 DEG
PHI	.1709469 DEG	X-TILT	-.0138443 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-175.1953247 DEG	Y-TILT	-.1709469 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-.0138443 DEG	HEADING	-85.1452818 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	115.4704762 KM	LASER SLANT RANGE	115.4709997 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.93510828	.11990794	.33345854	116.630807

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.11043903+00	-.94394574+00	-.31107781+00
-.36431013+00	.32965540+00	-.87097957+00
.92470593+00	.17137944-01	-.38029609+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99640802+00	.84629089-01	.29835812-02
-.84628705-01	-.99641251+00	.24162904-03
.29933033-02	-.11740405-04	.99999547+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-16.702	-169.489
-22.710	-169.911
-22.204	-176.423
-16.183	-175.760

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-2 HR, 22 MIN, .2 SEC	DECLINATION	55 DEG, 47 MIN, 4.2 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	12	17	43	19.879
CIE			5	12	10	21.663

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1692.6142990	46.4168333	727.4264890	.2650255	1.5387460	.4618951
SELENOGRAPHIC	1735.5831521	119.9690179	608.1078923	.1508124	-1.6202186	-.1495011

LONGITUDE OF NADIR POINT	3.9541765	DEG	
	3 DEG, 57 MIN,	15.0353336	SEC
LONG OF CAMERA AXIS INTERSECT	3.9468652	DEG	
	3 DEG, 56 MIN,	48.7148094	SEC
SPACECRAFT RADIUS	1842.9423898	KM	
SCALE FACTOR	.0007211	M/KM	
MEAN ALTITUDE RATE	-.0127736	KM/SEC	
TILT AZIMUTH	333.7106094	DEG	
SIGMA TILT AZIMUTH	.0941990	DEG	
SUN ELEVATION AT PRIN GRND PNT	-1.4257393	DEG	
LONGITUDE OF SUBSOLAR POINT	95.1989027	DEG	
	95 DEG, 11 MIN,	56.0497785	SEC
ALPHA	.1225412	DEG	
EMISSION ANGLE	.2738487	DEG	
PHASE ANGLE	91.3032112	DEG	
PHI	.0908060	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	174.2953635	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	.2417780	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	106.3359137	KM	

LATITUDE OF NADIR POINT	19.2666974	DEG	
	19 DEG, 16 MIN,	.1106694	SEC
LATI OF CAMERA AXIS INTERSECT	19.2666673	DEG	
	19 DEG, 16 MIN,	59.9622960	SEC
SPACECRAFT ALTITUDE	109.8523934	KM	
AZIMUTH OF VELOCITY VECTOR	269.3954010	DEG	
HORIZONTAL VELOCITY	1.6339980	KM/SEC	
TILT ANGLE	.2569261	DEG	
SIGMA TILT ANGLE	.0002000	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	90.2691044	DEG	
LATITUDE OF SUBSOLAR POINT	-.7308877	DEG	
	0 DEG, 44 MIN,	19.9958324	SEC
SWING ANGLE	339.9151560	DEG	
SIGMA SWING ANGLE	.0941967	DEG	
NORTH DEVIATION ANGLE	165.7050404	DEG	
X-TILT	.2417780	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.0908052	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-95.7050010	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	106.3369999	KM	

	X	Y	Z	MAGNITUDE (KM)
SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	-.94292884	-.06717944	-.32619739	109.8523523

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.15165443+00	.94367816+00	.29406188+00
-.36067443+00	.32982774+00	-.87234355+00
-.92020132+00	.26175372-01	.39056917+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99509561+00	-.99906473-01	.15848482-02
.99399019-01	-.99503869+00	-.42198094-02
.19969373-02	-.40413682-02	.99998979+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
22.227	6.567
16.848	7.021
16.313	1.431
21.686	.748

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -3 HR, 23 MIN, 37.6 SEC DECLINATION 65 DEG, 19 MIN, 54.7 SEC

Mission: Apollo 17, Target: 40 Deg. N oblique strip

Rev: 26/27, Camera: 3 Inch Mapping Frames: 821 Through: 961

Coverage Interval:

From: 6.5 Deg S Lat., 170.1 Deg W Long., To: 21.0 Deg N Lat., 2.7 Deg W Long.

From: 137 Hr 4 Min 20.277 Sec, To: 138 Hr 8 Min 1.617 Sec. CTE

Date Processed: 8/23/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziel1)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72163319 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 137 H, 57 M, 43.60791 sec

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 27. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1497.9383	$\dot{X}$ =	.7817
Y =	892.2408	$\dot{Y}$ =	-1.4326
Z =	615.5754	$\dot{Z}$ =	.1191

- Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/23/73 (During APE operation)

Edited Data Tape No. T00948 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data for the interval 137 H 10 sec - 137 H, 33 M, 18 sec (Fms 876-884).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of 40 deg N oblique strip photography starting at 170.1 deg W Long. and ending at 2.7 deg W Long. Throughout the sequence a tilt of 40.0 ± .5 deg was maintained. State vector data only are provided for frames 876-884 for which vehicle attitude data are unavailable for the computations and for frame 866 for which vehicle attitude data was ignored as a consequence of a computer erratic. Star patterns companion to frames 830 and 950 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	12	22	37	18.496
CTE			5	17	4	20.277

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1726.7126154	197.4391783	-645.6766256	-.0255872	-1.5199837	-.5716887
SELENOGRAPHIC	-1718.8197957	-298.1417394	-627.8431357	-.3145617	1.5920370	.0655932

LONGITUDE OF NADIR POINT	-170.1595421	DEG	
	-170 DEG, 9 MIN, 34.3515015	SEC	
LONG OF CAMERA AXIS INTERSECT	-170.0604515	DEG	
	-170 DEG, 3 MIN, 37.6254272	SEC	
SPACECRAFT RADIUS	1854.0272355	KM	
SCALE FACTOR	.0000600	M/KM	
MEAN ALTITUDE RATE	.0133976	KM/SEC	
TILT AZIMUTH	1.6696043	DEG	
SIGMA TILT AZIMUTH	.0003125	DEG	
SUN ELEVATION AT PRIN GRND PNT	-6.7130804	DEG	
LONGITUDE OF SUBSOLAR POINT	92.7156078	DEG	
	92 DEG, 42 MIN, 56.1880875	SEC	
ALPHA	7.2245381	DEG	
EMISSION ANGLE	43.0499848	DEG	
PHASE ANGLE	91.9067545	DEG	
PHI	.7531729	DEG	
SIGMA PHI	.0002602	DEG	
KAPPA	-177.1534157	DEG	
SIGMA KAPPA	.0002602	DEG	
OMEGA	39.7818599	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	-19.7938845	DEG	
	-19 DEG, 47 MIN, 37.9842567	SEC	
LATI OF CAMERA AXIS INTERSECT	-16.5330672	DEG	
	-16 DEG, 31 MIN, 59.0420151	SEC	
SPACECRAFT ALTITUDE	115.9372392	KM	
AZIMUTH OF VELOCITY VECTOR	272.6303911	DEG	
HORIZONTAL VELOCITY	1.6240559	KM/SEC	
TILT ANGLE	39.7878113	DEG	
SIGMA TILT ANGLE	.0002000	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	267.2269440	DEG	
LATITUDE OF SUBSOLAR POINT	-.7332024	DEG	
	0 DEG, 43 MIN, 59.5287037	SEC	
SWING ANGLE	359.0955329	DEG	
SIGMA SWING ANGLE	.0003125	DEG	
NORTH DEVIATION ANGLE	176.9231814	DEG	
X-TILT	39.7818601	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.5787961	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-87.6353607	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.50213748	.06817551	.86209631	154.542140

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.15722474+01	-.93410015+00	-.35666460+00
-.87527606+00	.18530070+00	-.44671623+00
.48336789+00	.30515653+00	-.82050893+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99909747+00	.41256920-01	.10101725-01
-.38164404-01	-.76753785+00	-.63986643+00
-.18645453-01	-.63967451+00	.76841968+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
********	.000
-19.685	-167.734
-19.488	-172.682
********	.000

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION 0 HR, 37 MIN, 48.1 SEC DECLINATION 21 DEG, 4 MIN, 2.6 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	12	23	40	59.837
CTE			5	18	8	1.617

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1674.1984181	138.5612017	752.5035740	.3408103	1.5366138	.4457211
SELENOGRAPHIC	1739.8500929	-73.9833798	596.5310489	-.0201779	-1.6257789	-.1801019

LONGITUDE OF NADIR POINT	-2.4349128	DEG	
	-2 DEG, 26 MIN,	5.6859684	SEC
LONG OF CAMERA AXIS INTERSECT	-2.7015491	DEG	
	-2 DEG, 42 MIN,	5.5769062	SEC
SPACECRAFT RADIUS	1840.7610325	KM	
SCALE FACTOR	.0005729	M/KM	
MEAN ALTITUDE RATE	-.0120939	KM/SEC	
TILT AZIMUTH	353.2839241	DEG	
SIGMA TILT AZIMUTH	.0003789	DEG	
SUN ELEVATION AT PRIN GRND PNT	-4.8168001	DEG	
LONGITUDE OF SUBSOLAR POINT	92.1776498	DEG	
	92 DEG, 10 MIN,	39.5392513	SEC
ALPHA	4.9924670	DEG	
EMISSION ANGLE	33.9888328	DEG	
PHASE ANGLE	90.7978773	DEG	
PHI	.1330633	DEG	
SIGMA PHI	.0002355	DEG	
KAPPA	173.5360088	DEG	
SIGMA KAPPA	.0002355	DEG	
OMEGA	31.8599291	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	18.9090965	DEG	
	18 DEG, 54 MIN,	32.7473259	SEC
LATI OF CAMERA AXIS INTERSECT	21.0229475	DEG	
	21 DEG, 1 MIN,	22.6111794	SEC
SPACECRAFT ALTITUDE	102.6710361	KM	
AZIMUTH OF VELOCITY VECTOR	263.4628228	DEG	
HORIZONTAL VELOCITY	1.6357742	KM/SEC	
TILT ANGLE	31.8601842	DEG	
SIGMA TILT ANGLE	.0002000	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	88.9312716	DEG	
LATITUDE OF SUBSOLAR POINT	-.7319638	DEG	
	0 DEG, 43 MIN,	55.0696850	SEC
SWING ANGLE	359.7858924	DEG	
SIGMA SWING ANGLE	.0003789	DEG	
NORTH DEVIATION ANGLE	187.6794079	DEG	
X-TILT	31.8599292	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.1130161	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-96.5342292	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.97513172	-.02032192	.22069242	122.295400

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.19985254+00	.94604751+00	.27635041+00
.17156318+00	.24911055+00	-.95445066+00
-.96468903+00	.23816100+00	-.11249144+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99350208+00	-.11379654+00	.19725018-02
.95617753-01	-.84394160+00	-.52784446+00
.61731510-01	-.52422601+00	.84933870+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
********	.000
18.825	-.236
18.354	-4.573
********	.000

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-9 HR, 24 MIN, 29.5 SEC	DECLINATION	69 DEG, 41 MIN, 42.3 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 28, Camera: 3 Inch Mapping Frames: 1094 Through: 1243

Coverage Interval:

From: 19.6 Deg S Lat., 174.0 Deg W Long., To: 19.0 Deg N Lat., 3.0 Deg W Long.

From: 139 Hr 4 Min 5.490 Sec, To: 140 Hr 6 Min 45.050 Sec. CTE

Date Processed: 8/23/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72163319 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable ($\pm 1 \times 10^{-14}$ - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 139 H, 56 M, 16.12701 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 28. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1498.5950	$\dot{X}$ =	.7790
Y =	892.6319	$\dot{Y}$ =	-1.4244
Z =	613.0724	$\dot{Z}$ =	.1278

- Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/23/73 (During APE operation)

Edited Data Tape No. T01307 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the interval 139 H, 25 M, 50 sec - 139 H, 32 M, 45 sec (FMS 1146-1162).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical photography starting at 174.0 Deg W Long. and ending at 3.0 Deg W Long. Throughout the sequence tilt was maintained less than 1 Deg. Vehicle state vector data only are provided for frames 1146-1162 for which vehicle attitude are not available for the computations.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	0	37	3.711
CTE			5	19	4	5.490

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1723.9810848	118.1647634	-679.4621714	-.0942712	-1.5264408	-.5491806
SELENOGRAPHIC	-1737.5493769	-182.0020347	-623.5145024	-.2150628	1.0063553	.0917159

LONGITUDE OF NADIR POINT	-174.0402789 DEG	LATITUDE OF NADIR POINT	-19.6412039 DEG
	-174 DEG, 2 MIN, 13.0041504 SEC		-19 DEG, 38 MIN, 28.3339691 SEC
LONG OF CAMERA AXIS INTERSECT	-174.0917557 DEG	LATI OF CAMERA AXIS INTERSECT	-19.6355450 DEG
	-174 DEG, 2 MIN, 30.3209346 SEC		-19 DEG, 38 MIN, 7.9620552 SEC
SPACECRAFT RADIUS	1859.9859602 KM	SPACECRAFT ALTITUDE	116.8959639 KM
SCALE FACTOR	.0000000 M/KM	AZIMUTH OF VELOCITY VECTOR	273.6036185 DEG
MEAN ALTITUDE RATE	.0130112 KM/SEC	HORIZONTAL VELOCITY	1.6231993 KM/SEC
TILT AZIMUTH	285.6257019 DEG	TILT ANGLE	.3128585 DEG
SIGMA TILT AZIMUTH	.0367443 DEG	SIGMA TILT ANGLE	.0001994 DEG
SUN ELEVATION AT PRIN GRND PNT	-3.7598562 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	267.8784828 DEG
LONGITUDE OF SUBSOLAR POINT	91.7041042 DEG	LATITUDE OF SUBSOLAR POINT	-.7308714 DEG
	91 DEG, 42 MIN, 14.7750950 SEC		0 DEG, 43 MIN, 51.1370659 SEC
ALPHA	-.3174070 DEG	SWING ANGLE	282.1705500 DEG
EMISSION ANGLE	.3332931 DEG	SIGMA SWING ANGLE	.0367442 DEG
PHASE ANGLE	94.0772686 DEG	NORTH DEVIATION ANGLE	176.5952059 DEG
PHI	.3052706 DEG	X-TILT	.0658373 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-176.5948112 DEG	Y-TILT	-.3052704 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	.0658373 DEG	HEADING	-86.5451605 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	117.7162447 KM	LASER SLANT RANGE	117.7180004 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.93563987	.10328262	.33750663	116.8978617

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.61525048-01	-.93966352+00	-.33652200+00
-.36216676+00	.33505151+00	-.86897815+00
.92929927+00	.69086187-01	-.36280830+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99816840+00	.60260935-01	.53279478-02
-.60267821-01	-.99818156+00	-.11490768-02
.52469933-02	-.14680837-02	.99998509+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-16.777	-170.709
-22.795	-170.982
-22.450	-177.522
-16.389	-177.017

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -2 HR, 21 MIN, 55.2 SEC DECLINATION 55 DEG, 45 MIN, 52.1 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	1	39	43.272
CTE			5	20	6	45.050

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1677.1871435	124.6032684	747.7700216	.3261999	1.5381708	.4503870
SELENOGRAPHIC	1738.4269613	-91.9605838	597.5430070	-.0379194	-1.6259939	-.1767453

LONGITUDE OF NADIR POINT	-3.0280518 DEG	LATITUDE OF NADIR POINT	18.9445963 DEG
	-3 DEG, 1 MIN, 40.9864569 SEC		18 DEG, 56 MIN, 40.5466461 SEC
LONG OF CAMERA AXIS INTERSECT	-3.0632997 DEG	LATI OF CAMERA AXIS INTERSECT	18.9574432 DEG
	-3 DEG, 3 MIN, 47.8787613 SEC		18 DEG, 57 MIN, 26.7956543 SEC
SPACECRAFT RADIUS	1840.5549962 KM	SPACECRAFT ALTITUDE	102.4649998 KM
SCALE FACTOR	.0007380 M/KM	AZIMUTH OF VELOCITY VECTOR	263.5857692 DEG
MEAN ALTITUDE RATE	-.0119558 KM/SEC	HORIZONTAL VELOCITY	1.6359378 KM/SEC
TILT AZIMUTH	291.0806923 DEG	TILT ANGLE	.6062336 DEG
SIGMA TILT AZIMUTH	.0188447 DEG	SIGMA TILT ANGLE	.0002006 DEG
SUN ELEVATION AT PRIN GRND PNT	-4.2452259 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	89.3126822 DEG
LONGITUDE OF SUBSOLAR POINT	91.1748689 DEG	LATITUDE OF SUBSOLAR POINT	-.7296482 DEG
	91 DEG, 10 MIN, 29.5280457 SEC		0 DEG, 43 MIN, 46.7336369 SEC
ALPHA	.5960458 DEG	SWING ANGLE	297.4912998 DEG
EMISSION ANGLE	.6416833 DEG	SIGMA SWING ANGLE	.0188446 DEG
PHASE ANGLE	93.6492167 DEG	NORTH DEVIATION ANGLE	186.4117300 DEG
PHI	.5375377 DEG	X-TILT	.2797144 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	173.5906582 DEG	Y-TILT	-.5375313 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	.2797143 DEG	HEADING	-96.4119669 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	101.9502926 KM	LASER SLANT RANGE	101.9560003 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.94621405	.04017178	-.32103769	102.471068

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.18542105+00	.94129467+00	.28210511+00
-.35888058+00	.33212051+00	-.87229620+00
-.91478066+00	.60500054-01	.39939452+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99370084+00	-.11167157+00	.93815532-02
.11162960+00	-.99373788+00	-.48819170-02
.96679510-02	-.38039058-02	.99994402+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
21.847	-.568
16.635	-.057
16.014	-5.494
21.287	-6.235

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -3 HR, 23 MIN, 47.4 SEC DECLINATION 65 DEG, 21 MIN, 56.9 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 29, Camera: 3 Inch Mapping Frames: 1376 Through: 1524

Coverage Interval:

From: 19.6 Deg S Lat., 174.8 Deg W Long., To: 19.0 Deg NLat., 3.1 Deg W Long.

From: 141 Hr 2 Min 52.975 Sec, To: 142 Hr 5 Min 18.266Sec. CTE

Date Processed: 8/23/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72163319 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 14 H, 54 M, 48.39248 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 29. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1429.2959	$\dot{X}$ =	.7762
Y =	893.0494	$\dot{Y}$ =	-1.4252
Z =	610.4121	$\dot{Z}$ =	.1364

- Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/23/73 (During APE operation)

Edited Data Tape No. T01307 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the interval 141 H, 20 M, 41 sec - 141 H, 29 M, 57 sec (FMS 1418-1440).

- APE Card Inputs:

  Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Range Zero-Clock Zero Time Difference 0.0 Sec

  REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

  Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

  Stellar camera Interlock Angles Used:

  Ω = -95° 55' 32.079"
  ϕ = -0° 1' 30.755"
  κ = 0° 0' 58.194"

  Uncertainties Assumed:

  ± 1 degree in camera positioning angle

  ±0.2 mrad in each gimbal angle

  ±20 ms in onboard clock bias definition

  ±5 ms in onboard clock drift rate

  ±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 174.8 deg W Long. and ending at 3.1 deg W Long. Throughout the sequence tilt is maintained less than 1 deg. Vehicle state vector data only are provided for frames 1418-1440 for which vehicle attitude data are not available for the computations. Star patterns companion to frames 1395 and 1515 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	2	35	51.178
CTE			5	21	4	52.775

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1724.8879989	126.4210222	-671.2427228	-.0867439	-1.5260909	-.5459129
SELENOGRAPHIC	-1740.0555518	-157.8840130	-623.7523478	-.1920598	1.6071900	.0901716

LONGITUDE OF NADIR POINT	-174.8154602 DEG
	-174 DEG, 48 MIN, 55.6567383 SEC
LONG OF CAMERA AXIS INTERSECT	-174.8523502 DEG
	-174 DEG, 51 MIN, 8.4608459 SEC
SPACECRAFT RADIUS	1855.2055618 KM
SCALE FACTOR	.0000000 M/KM
MEAN ALTITUDE RATE	.0128779 KM/SEC
TILT AZIMUTH	304.9547882 DEG
SIGMA TILT AZIMUTH	.0102949 DEG
SUN ELEVATION AT PRIN GRND PNT	-3.9425430 DEG
LONGITUDE OF SUBSOLAR POINT	90.7007757 DEG
	90 DEG, 42 MIN, 2.7924728 SEC
ALPHA	-.5350263 DEG
EMISSION ANGLE	.6715135 DEG
PHASE ANGLE	94.4776678 DEG
PHI	.5369378 DEG
SIGMA PHI	.0002000 DEG
KAPPA	-176.4529362 DEG
SIGMA KAPPA	.0002000 DEG
OMEGA	.3278577 DEG
SIGMA OMEGA	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	117.5449066 KM

LATITUDE OF NADIR POINT	-19.0405828 DEG
	-19 DEG, 38 MIN, 47.6982907 SEC
LATI OF CAMERA AXIS INTERSECT	-19.0222892 DEG
	-19 DEG, 37 MIN, 20.2410507 SEC
SPACECRAFT ALTITUDE	117.1155655 KM
AZIMUTH OF VELOCITY VECTOR	273.5495575 DEG
HORIZONTAL VELOCITY	1.6224932 KM/SEC
TILT ANGLE	.6294015 DEG
SIGMA TILT ANGLE	.0001990 DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT	267.8163605 DEG
LATITUDE OF SUBSOLAR POINT	-.7265504 DEG
	0 DEG, 43 MIN, 42.7015628 SEC
SWING ANGLE	301.4091630 DEG
SIGMA SWING ANGLE	.0102948 DEG
NORTH DEVIATION ANGLE	176.4560930 DEG
X-TILT	.3278577 DEG
SIGMA X-TILT	.0002000 DEG
Y-TILT	-.5369290 DEG
SIGMA Y-TILT	.0002000 DEG
HEADING	-86.4560073 DEG
SIGMA HEADING	.0002000 DEG
LASER SLANT RANGE	117.5520000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.93495525	.09386939	.34212163	117.143102

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.52119934+01	-.94010795+00	-.33686863+00
-.36843541+00	.33163215+00	-.86849032+00
.92819112+00	.78848659-01	-.36365372+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99804377+00	.61812190-01	.93710421-02
-.61867374-01	-.99806796+00	-.57221658-02
.89992162-02	-.62907422-02	.99993966+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-16.761	-171.507
-22.769	-171.816
-22.435	-178.343
-16.338	-177.851

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -2 HR, 19 MIN, 29.0 SEC DECLINATION 55 DEG, 42 MIN, 22.3 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	3	38	16.990
CTE			5	22	5	18.206

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1683.1365294	95.2749482	738.4339445	.3023704	1.5404370	.4608325
SELENOGRAPHIC	1737.3133775	-93.6420110	600.2362900	-.0419991	-1.6268160	-.1686784

LONGITUDE OF NADIR POINT	-3.0852840 DEG	LATITUDE OF NADIR POINT	19.0342329 DEG
	-3 DEG, 5 MIN, 7.0223808 SEC		19 DEG, 2 MIN, 3.2365608 SEC
LONG OF CAMERA AXIS INTERSECT	-3.0971646 DEG	LATI OF CAMERA AXIS INTERSECT	19.0071678 DEG
	-3 DEG, 5 MIN, 49.7945639 SEC		19 DEG, 0 MIN, 25.8041382 SEC
SPACECRAFT RADIUS	1840.4646700 KM	SPACECRAFT ALTITUDE	102.3796737 KM
SCALE FACTOR	.0007386 M/KM	AZIMUTH OF VELOCITY VECTOR	263.8630001 DEG
MEAN ALTITUDE RATE	-.0118850 KM/SEC	HORIZONTAL VELOCITY	1.6360037 KM/SEC
TILT AZIMUTH	202.5407162 DEG	TILT ANGLE	.4977767 DEG
SIGMA TILT AZIMUTH	.0230543 DEG	SIGMA TILT ANGLE	.0001997 DEG
SUN ELEVATION AT PRIN GRND PNT	-3.3292303 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	89.6224422 DEG
LONGITUDE OF SUBSOLAR POINT	90.1735744 DEG	LATITUDE OF SUBSOLAR POINT	-.7273273 DEG
	90 DEG, 10 MIN, 24.8679829 SEC		0 DEG, 43 MIN, 38.3784199 SEC
ALPHA	.2053255 DEG	SWING ANGLE	208.2265394 DEG
EMISSION ANGLE	.5267399 DEG	SIGMA SWING ANGLE	.0230543 DEG
PHASE ANGLE	93.1240234 DEG	NORTH DEVIATION ANGLE	165.6699066 DEG
PHI	.2352723 DEG	X-TILT	-.4382835 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	174.3134308 DEG	Y-TILT	-.2352654 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-.4382835 DEG	HEADING	-95.6697714 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	101.7921572 KM	LASER SLANT RANGE	101.7959995 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.94148588	.04741362	-.33370088	102.378759

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.17716217+00	.93961923+00	.29279545+00
-.36883303+00	.33920728+00	-.86539042+00
-.91245583+00	.45321832-01	.40665732+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99507350+00	-.99054933-01	.41061435-02
.99083586-01	-.99504970+00	.76494153-02
.33280839-02	.80185838-02	.99996226+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
21.845	-.579
16.613	-.078
16.075	-5.580
21.335	-6.185

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-3 HR, 22 MIN, 29.3 SEC	DECLINATION	64 DEG, 32 MIN, 19.9 SEC

Mission: Apollo 17, Target: 40 Deg S. oblique strip photography

Rev: 36, Camera: 3 Inch Mapping Frames: 1547 Through: 1686

Coverage Interval:

From: 22.8 Deg S Lat., 176.1 Deg E Long., To: 15.5 Deg N Lat., 15.3 Deg W Long.

From: 154 Hr 55 Min 26.200 Sec, To: 155 Hr 58 Min 49.753 Sec. CTE

Date Processed: 8/24/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72166653 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable ($\pm 1 \times 10^{-14}$ - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 155 H, 44 M, 31.95470 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 36. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1505.8475	$\dot{X}$ =	.7583
Y =	896.9519	$\dot{Y}$ =	-1.4280
Z =	587.5814	$\dot{Z}$ =	.1960

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/24/73 (During APE operation)

Edited Data Tape No. T00319 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the interval 155 H, 20 M, 0 sec - 155 H, 27 M, 55 sec (FMS 1601-1618).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally,the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of 40 Deg. S oblique strip photography starting at 176.1 deg E Long. and ending at 15.3 deg W Long. Throughout all except the final six frames of the sequence tilt is maintained at 40.0 ± .5 deg. Tilt is approximately a degree higher for those last few frames. Vehicle state vector data only are provided for frames 1601-1618 for which vehicle attitude data are not available for the computations. Star patterns companion to frames 1555 and 1675 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	16	28	24.937
CIE			6	10	55	26.200

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1724.4496388	91.6598152	-660.9835256	-.1148385	-1.5297098	-.5268392
SELENOGRAPHIC	-1746.5663627	110.0276614	-619.2132726	.0516670	1.6175005	.1085450

LONGITUDE OF NADIR POINT	176.3953266	DEG	
	176 DEG, 23 MIN,	43.1758118	SEC
LONG OF CAMERA AXIS INTERSECT	176.0807114	DEG	
	176 DEG, 4 MIN,	50.5609131	SEC
SPACECRAFT RADIUS	1656.3472985	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	.0110524	KM/SEC	
TILT AZIMUTH	184.9490299	DEG	
SIGMA TILT AZIMUTH	.0003107	DEG	
SUN ELEVATION AT PRIN GRND PNT	-1.9447298	DEG	
LONGITUDE OF SUBSOLAR POINT	83.6702630	DEG	
	83 DEG, 40 MIN,	13.0189419	SEC
ALPHA	-3.3111130	DEG	
EMISSION ANGLE	43.4211487	DEG	
PHASE ANGLE	95.9846067	DEG	
PHI	.2540872	DEG	
SIGMA PHI	.0002612	DEG	
KAPPA	-175.4457817	DEG	
SIGMA KAPPA	.0002613	DEG	
OMEGA	-40.0575147	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	-19.4853256	DEG	
	-19 DEG, 29 MIN,	7.1720695	SEC
LATI OF CAMERA AXIS INTERSECT	-22.8334678	DEG	
	-22 DEG, 50 MIN,	7.6841354	SEC
SPACECRAFT ALTITUDE	118.2573021	KM	
AZIMUTH OF VELOCITY VECTOR	274.2093280	DEG	
HORIZONTAL VELOCITY	1.6218944	KM/SEC	
TILT ANGLE	40.0581913	DEG	
SIGMA TILT ANGLE	.0002001	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	268.4075584	DEG	
LATITUDE OF SUBSOLAR POINT	-.7120361	DEG	
	0 DEG, 42 MIN,	43.3299923	SEC
SAING ANGLE	180.3021890	DEG	
SIGMA SAING ANGLE	.0003107	DEG	
NORTH DEVIATION ANGLE	173.8474882	DEG	
A-TILT	-40.0375151	DEG	
SIGMA A-TILT	.0002000	DEG	
Y-TILT	-.1944778	DEG	
SIGMA Y-TILT	.0001999	DEG	
HEADING	-85.2922605	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.93706576	-.0034C181	-.34913636	158.415624

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.70773917-01	-.94617898*00	-.31581C56*00
.32040326*00	.27826338*00	-.9C548947*00
.94463363*00	-.16527183*00	.283465C7*00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99660619*00	.82246600-01	.33942713-02
-.6077452D-01	-.76298213*00	.64355626*00
.55520043-01	.64116592*00	.76539121*00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-19.872	178.680
********	.000
********	.000
-19.461	175.841

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -8 HR, 47 MIN, 44.0 SEC DECLINATION 68 DEG, 23 MIN, 59.8 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GET 1972		12	13	17	31	47.986
CTE			0	11	58	49.753

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	$\dot{X}$ (KM/S)	$\dot{Y}$ (KM/S)	$\dot{Z}$ (KM/S)
1950.0	-1652.9966079	220.9120281	771.6749115	.4114825	1.5326827	.4042498
SELENOGRAPHIC	1663.0154427	-460.3326520	579.5120376	-.3687003	-1.5810269	-.2150954

LONGITUDE OF NADIR POINT	-15.2972040	DEG	
	-15 DEG, 17 MIN,	49.9344635	SEC
LONG OF CAMERA AXIS INTERSECT	-15.2567456	DEG	
	-15 DEG, 15 MIN,	24.2847767	SEC
SPACECRAFT RADIUS	1638.5541419	KM	
SCALE FACTOR	.0005529	M/RM	
MEAN ALTITUDE RATE	-.0694532	KM/SEC	
TILT AZIMUTH	179.2247677	DEG	
SIGMA TILT AZIMUTH	.0003086	DEG	
SUN ELEVATION AT PRIN GRND PNT	-6.2760525	DEG	
LONGITUDE OF SUBSOLAR POINT	63.1350644	DEG	
	63 DEG, 8 MIN,	6.2320161	SEC
ALPHA	5.8763158	DEG	
EMISSION ANGLE	43.2945084	DEG	
PHASE ANGLE	95.4673319	DEG	
PHI	7.1381102	DEG	
SIGMA PHI	.0002606	DEG	
KAPPA	166.1739025	DEG	
SIGMA KAPPA	.0002606	DEG	
OMEGA	-39.8831038	DEG	
SIGMA OMEGA	.0002001	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	18.3728805	DEG	
	18 DEG, 22 MIN,	22.3696518	SEC
LATI OF CAMERA AXIS INTERSECT	15.4932506	DEG	
	15 DEG, 29 MIN,	24.9021149	SEC
SPACECRAFT ALTITUDE	100.4641455	KM	
AZIMUTH OF VELOCITY VECTOR	262.1535006	DEG	
HORIZONTAL VELOCITY	1.6375790	KM/SEC	
TILT ANGLE	40.4116211	DEG	
SIGMA TILT ANGLE	.0001999	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	88.4353771	DEG	
LATITUDE OF SUBSOLAR POINT	-.7107606	DEG	
	0 DEG, 42 MIN,	38.7380791	SEC
SWING ANGLE	188.4581395	DEG	
SIGMA SWING ANGLE	.0003086	DEG	
NORTH DEVIATION ANGLE	189.4762522	DEG	
X-TILT	-39.8831041	DEG	
SIGMA X-TILT	.0002001	DEG	
Y-TILT	-5.4716135	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-97.2350006	DEG	
SIGMA HEADING	.0002009	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.49760065	.14519532	-.85516777	134.833912

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.16305889+00	.94072930+00	.29736854+00
-.86679968+00	.28056926+00	-.41224615+00
-.47124305+00	-.19055717+00	.86117239+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.98751775+00	-.12536543+00	.95352584-01
.15726303+00	-.75106648+00	.64122338+00
-.67711120-02	.64821496+00	.76140684+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
16.596	-13.603
********	.000
********	.000
17.648	-17.673

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -1 HR, 20 MIN, 52.6 SEC DECLINATION 29 DEG, 56 MIN, 19.2 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 38, Camera: 3 Inch Mapping Frames: 1688 Through: 1833

Coverage Interval:

From: 19.4 Deg S Lat., 172.8 Deg E Long., To: 19.0 Deg N Lat., 11.1 Deg W Long.

From: 158 Hr 53 Min 34.591 Sec, To: 159 Hr 54 Min 31.327 Sec. CTE

Date Processed: 8/24/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72166653 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 159 H, 41 M, 31.75961 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 38. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1508.0142	$\dot{X}$ =	.7535
Y =	898.2424	$\dot{Y}$ =	-1.4281
Z =	579.6272	$\dot{Z}$ =	.2127

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/24/73 (During APE operation)

Edited Data Tape No. T00319 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the interval 159 H, 15 M, 04 sec - 159 H, 16 M, 43 sec (FMS 1740-1743).

- APE Card Inputs:

  Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Range Zero-Clock Zero Time Difference 0.0 Sec

  REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

- Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 172.8 deg E Long. and ending at 11.1 deg W Long. Throughout the sequence tilt is maintained less than 1 degree. Vehicle state vector data only are provided for frames 1740-1743 for which vehicle attitude data are unavailable for the computations.

	YEAR	MONTH	DAY	HOUR	MINUTE	SEC
GMT	1972	12	13	20	26	32.627
CTE			6	14	53	34.591

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1721.2490810	51.7136096	-693.5235680	-.1485044	-1.5314882	-.5112240
SELENOGRAPHIC	-1737.8857318	217.8666521	-615.3500355	.1471805	1.4103746	.1229497

LONGITUDE OF NADIR POINT	172.8545017	DEG	
	172 DEG, 51 MIN,	16.2062073	SEC
LONG OF CAMERA AXIS INTERSECT	172.8454285	DEG	
	172 DEG, 50 MIN,	43.5424805	SEC
SPACECRAFT RADIUS	1856.4397004	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	.0104537	KM/SEC	
TILT AZIMUTH	196.1444149	DEG	
SIGMA TILT AZIMUTH	.0252135	DEG	
SUN ELEVATION AT PRIN GRND PNT	-.8835440	DEG	
LONGITUDE OF SUBSOLAR POINT	81.6597593	DEG	
	81 DEG, 39 MIN,	35.1334190	SEC
ALPHA	-.1427817	DEG	
EMISSION ANGLE	.4828210	DEG	
PHASE ANGLE	91.0263548	DEG	
PHI	.0840702	DEG	
SIGMA PHI	.0001999	DEG	
KAPPA	-174.5738297	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.4441523	DEG	
SIGMA OMEGA	.0002001	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	-19.3578908	DEG	
	-19 DEG, 21 MIN,	28.4070396	SEC
LATI OF CAMERA AXIS INTERSECT	-19.3874595	DEG	
	-19 DEG, 23 MIN,	14.8542595	SEC
SPACECRAFT ALTITUDE	118.3497040	KM	
AZIMUTH OF VELOCITY VECTOR	274.7392950	DEG	
HORIZONTAL VELOCITY	1.6216905	KM/SEC	
TILT ANGLE	.4524263	DEG	
SIGMA TILT ANGLE	.0002009	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	268.9391708	DEG	
LATITUDE OF SUBSOLAR POINT	-.7072309	DEG	
	0 DEG, 42 MIN,	26.0312748	SEC
SWING ANGLE	190.7180686	DEG	
SIGMA SWING ANGLE	.0252134	DEG	
NORTH DEVIATION ANGLE	174.5730258	DEG	
X-TILT	-.4441523	DEG	
SIGMA X-TILT	.0002001	DEG	
Y-TILT	-.0840677	DEG	
SIGMA Y-TILT	.0001999	DEG	
HEADING	-84.5731761	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.93887528	-.11548935	.32430760	118.353638

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.91849778-01	-.94859423+00	-.30287380+00
-.35564459+00	.31534915+00	-.87981351+00
.93009700+00	.26904733-01	-.36632716+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99551669+00	.94574285-01	.14672579-02
-.94560182-01	-.99548895+00	.77518426-02
.21937408-02	.75783397-02	.99996882+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-16.616	176.305
-22.725	175.855
-22.137	169.207
-16.042	169.988

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-2 HR, 18 MIN, 45.9 SEC	DECLINATION	56 DEG, 50 MIN, 29.4 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	21	27	29.564
CTE			6	15	54	31.327

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1692.7042760	45.9759944	718.3275519	.2533219	1.5464401	.4726435
SELENOGRAPHIC	1706.0662496	-334.3817386	600.7352450	-.2686537	-1.6064809	-.1615087

LONGITUDE OF NADIR POINT	-11.0891612	DEG	
	-11 DEG, 5 MIN, 20.9801674	SEC	
LONG OF CAMERA AXIS INTERSECT	-11.0610378	DEG	
	-11 DEG, 3 MIN, 39.7360039	SEC	
SPACECRAFT RADIUS	1839.3901244	KM	
SCALE FACTOR	.0007468	M/KM	
MEAN ALTITUDE RATE	-.0098875	KM/SEC	
TILT AZIMUTH	134.3518753	DEG	
SIGMA TILT AZIMUTH	.0177973	DEG	
SUN ELEVATION AT PRIN GRND PNT	-2.3158550	DEG	
LONGITUDE OF SUBSOLAR POINT	81.1452510	DEG	
	81 DEG, 8 MIN, 42.9036999	SEC	
ALPHA	-.4820059	DEG	
EMISSION ANGLE	.6750113	DEG	
PHASE ANGLE	92.7979393	DEG	
PHI	-.4062982	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	173.9209938	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.4916851	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	103.8815565	KM	

LATITUDE OF NADIR POINT	19.0622237	DEG	
	19 DEG, 3 MIN, 44.0035057	SEC	
LAT; OF CAMERA AXIS INTERSECT	19.0362306	DEG	
	19 DEG, 2 MIN, 10.4300308	SEC	
SPACECRAFT ALTITUDE	101.3001281	KM	
AZIMUTH OF VELOCITY VECTOR	264.1275590	DEG	
HORIZONTAL VELOCITY	1.6367179	KM/SEC	
TILT ANGLE	.6380991	DEG	
SIGMA TILT ANGLE	.0002018	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	89.9479418	DEG	
LATITUDE OF SUBSOLAR POINT	-.7059952	DEG	
	0 DEG, 42 MIN, 21.5826702	SEC	
SWING ANGLE	140.327037	DEG	
SIGMA SWING ANGLE	77974	DEG	
NORTH DEVIATION ANGLE	186.0825254	DEG	
X-TILT	-.4916851	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	.4062832	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-96.0824942	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	103.8879995	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.92343476	.18910082	-.33392983	101.306771

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.15441521+00	.94596320+00	.28514819+00
-.37017944+00	.32297991+00	-.87100581+00
-.91603658+00	.28940573-01	.40004915+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99434533+00	-.10595759+00	-.70909205-02
.10589581+00	-.99434018+00	.85814187-02
-.79600779-02	.77819976-02	.99993799+00

PHOTOGRAPH FOOTPRINT LATITUDE	LONGITUDE
21.884	-8.567
16.662	-8.025
16.147	-13.475
21.297	-14.098

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-3 HR, 17 MIN, 4.4 SEC	DECLINATION	65 DEG, 11 MIN, 59.7 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 49, Camera: 3 Inch Mapping Frames: 1979 Through: 2133

Coverage Interval:

From: 22.2 Deg S Lat., 165.3 Deg E Long., To: 19.4 Deg N Lat., 32.6 Deg W Long.

From: 180 Hr 39 Min 47.074 Sec, To: 181 Hr 44 Min 44.470 Sec. CTE

Date Processed: 8/24/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 km

  Ephemeris-Universal Time Difference: .72171653 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 181 H, 25 M, 11.1075 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 49. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1488.5866	$\dot{X}$ =	.7256
Y =	886.6705	$\dot{Y}$ =	-1.4287
Z =	649.3576	$\dot{Z}$ =	.2875

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/24/73 (During APE operation)

Edited Data Tape No. T00114 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally,the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 165.3 deg E Long. and ending at 32.6 deg W Long. Throughout the sequence tilt is maintained less than 1 deg. Vehicle state vector data only are provided for frame 2100 for which vehicle attitude data were ignored as consequence of a computer erratic. The star pattern companion to frame 2125 is included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	14	18	12	45.325
CTE			7	12	39	47.074

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1693.1073459	209.3832557	-716.9678588	-.0063177	-1.5584577	-.4701949
SELENOGRAPHIC	-1657.3263715	434.8030830	-699.0796237	.3412565	1.5820551	.1748104

LONGITUDE OF NADIR POINT	165.2996216	DEG	
	165 DEG, 17 MIN,	58.6376953	SEC
LONG OF CAMERA AXIS INTERSECT	165.3029995	DEG	
	165 DEG, 18 MIN,	10.7981873	SEC
SPACECRAFT RADIUS	1850.5395816	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	.0000555	KM/SEC	
TILT AZIMUTH	172.6970825	DEG	
SIGMA TILT AZIMUTH	.0301278	DEG	
SUN ELEVATION AT PRIN GRND PNT	-4.0619659	DEG	
LONGITUDE OF SUBSOLAR POINT	70.6355166	DEG	
	70 DEG, 38 MIN,	7.8598309	SEC
ALPHA	.0348008	DEG	
EMISSION ANGLE	.4046730	DEG	
PHASE ANGLE	94.0272655	DEG	
PHI	-.0911268	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-173.4306679	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.3689959	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	112.2405338	KM	

LATITUDE OF NADIR POINT	-22.1956625	DEG	
	-22 DEG, 11 MIN,	44.3849945	SEC
LATI OF CAMERA AXIS INTERSECT	-22.2200553	DEG	
	-22 DEG, 13 MIN,	12.1992302	SEC
SPACECRAFT ALTITUDE	112.4495853	KM	
AZIMUTH OF VELOCITY VECTOR	276.6610285	DEG	
HORIZONTAL VELOCITY	1.6278257	KM/SEC	
TILT ANGLE	.3797618	DEG	
SIGMA TILT ANGLE	.0002003	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	267.6005974	DEG	
LATITUDE OF SUBSOLAR POINT	-.6802004	DEG	
	0 DEG, 40 MIN,	48.7215042	SEC
SWING ANGLE	166.1280569	DEG	
SIGMA SWING ANGLE	.0301278	DEG	
NORTH DEVIATION ANGLE	173.4311252	DEG	
X-TILT	-.3689959	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	.0911249	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-83.4312592	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	112.2430000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.89776148	-.23640139	.37167015	112.452220

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.60260117-02	-.95712189+00	-.28962264+00
-.39769539+00	.26803157+00	-.87749502+00
.91749775+00	.10989381+00	-.38225816+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99343402+00	.11439502+00	-.15904292-02
-.11440303+00	-.99341357+00	.64401483-02
-.84323197-03	.65797978-02	.99997803+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-19.641	168.707
-25.439	168.152
-24.748	161.743
-19.001	172.620

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -1 HR, 50 MIN, 9.9 SEC DECLINATION 56 DEG, 25 MIN, 49.9 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	14	19	17	42.722
CTE			7	13	44	44.470

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1621.6841132	300.9579261	838.7784538	.4275944	1.5470566	.2718145
SELENOGRAPHIC	1469.8540744	-941.5686665	613.9721306	-.7545063	-1.4012817	-.3423946

LONGITUDE OF NADIR POINT	-32.6430755	DEG	
	-32 DEG, 38 MIN,	35.0716782	SEC
LONG OF CAMERA AXIS INTERSECT	-32.6436749	DEG	
	-32 DEG, 38 MIN,	37.2294617	SEC
SPACECRAFT RADIUS	1850.4011271	KM	
SCALE FACTOR	.0006753	M/KM	
MEAN ALTITUDE RATE	.0000900	KM/SEC	
TILT AZIMUTH	181.8427219	DEG	
SIGMA TILT AZIMUTH	.0421414	DEG	
SUN ELEVATION AT PRIN GRND PNT	-12.2294283	DEG	
LONGITUDE OF SUBSOLAR POINT	70.0874484	DEG	
	70 DEG, 5 MIN,	14.8144162	SEC
ALPHA	.0279438	DEG	
EMISSION ANGLE	.2897148	DEG	
PHASE ANGLE	102.2016420	DEG	
PHI	.0702417	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	166.8835564	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.2629050	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	114.2597141	KM	

LATITUDE OF NADIR POINT	19.3783612	DEG	
	19 DEG, 22 MIN,	42.1004105	SEC
LATI OF CAMERA AXIS INTERSECT	19.3607845	DEG	
	19 DEG, 21 MIN,	38.8243103	SEC
SPACECRAFT ALTITUDE	112.3111307	KM	
AZIMUTH OF VELOCITY VECTOR	257.1160050	DEG	
HORIZONTAL VELOCITY	1.6278844	KM/SEC	
TILT ANGLE	.2717740	DEG	
SIGMA TILT ANGLE	.0002001	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	86.3700495	DEG	
LATITUDE OF SUBSOLAR POINT	-.6788257	DEG	
	0 DEG, 40 MIN,	43.7223923	SEC
SWING ANGLE	194.9585043	DEG	
SIGMA SWING ANGLE	.0421417	DEG	
NORTH DEVIATION ANGLE	193.1162568	DEG	
X-TILT	-.2629050	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.0702409	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-103.1161172	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	114.2609997	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.79309059	.50786175	-.33627928	112.312479

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.26000904+00	.95158556+00	.16395162+00
-.40870410+00	.26228615+00	-.87416645+00
-.87484645+00	.16028343+00	.45711373+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97391140+00	-.22692509+00	.12259350-02
.22692842+00	-.97390066+00	.45885420-02
.15272583-03	.47470731-02	.99998875+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
22.814	-30.304
17.149	-28.985
15.842	-34.908
21.484	-36.379

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION	-2 HR, 30 MIN, 32.8 SEC	DECLINATION	66 DEG, 27 MIN, 24.2 SEC

Mission: Apollo 17, Target: Roll to vertical and Vertical strip photography

Rev: 62, Camera: 3 Inch Mapping Frames: 2151 Through: 2298

Coverage Interval:

From: 22.1 Deg S Lat., 152.0 Deg E Long., To: 21.2 Deg N Lat., 35.8 Deg W Long.

From: 206 Hr 28 Min 44.160 Sec, To: 207 Hr 30 Min 36.102 Sec. CTE

Date Processed: 8/26/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziel1)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72178319 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 207 H, 9 M, 58.94921 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 62. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1513.7465	$\dot{X}$ =	.6941
Y =	901.6569	$\dot{Y}$ =	-1.4169
Z =	566.6613	$\dot{Z}$ =	.4033

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/26/73 (During APE operation)

Edited Data Tape No. T00293 T01247 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of strip photography that starts at 152.0 E Long. and ends at 35.8 W Long. The initial 56 frames were taken during a "Roll to Vertical" spacecraft maneuver. During the maneuver tilt is increased from its initial value of 3.7 deg to a maximum of 52.4 deg at frame 2192 (95 deg E Long.). From that point to 76.22 deg E Long. (frame 2212), tilt is steadily reduced to less than 1 deg. The remainder of the sequence is vertical strip photography with tilt maintained less than 1 deg. Star patterns companion to frames 2160 and 2290 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	15	20	1	42.428
CTE			8	14	28	44.160

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1696.6347399	240.0795348	-705.3147570	.0248561	-1.5583227	-.4659212
SELENOGRAPHIC	-1517.9272475	799.4988751	-700.2677705	.6695112	1.4623139	.1796728

LONGITUDE OF NADIR POINT	152.2240273 DEG	LATITUDE OF NADIR POINT	-22.2040710 DEG
	152 DEG, 13 MIN, 26.4994812 SEC		-22 DEG, 12 MIN, 14.6557617 SEC
LONG OF CAMERA AXIS INTERSECT	151.9761944 DEG	LATI OF CAMERA AXIS INTERSECT	-22.1137617 DEG
	151 DEG, 58 MIN, 34.2997742 SEC		-22 DEG, 6 MIN, 49.5419889 SEC
SPACECRAFT RADIUS	1853.0182218 KM	SPACECRAFT ALTITUDE	114.9282255 KM
SCALE FACTOR	.0000000 M/KM	AZIMUTH OF VELOCITY VECTOR	276.8257545 DEG
MEAN ALTITUDE RATE	-.0017962 KM/SEC	HORIZONTAL VELOCITY	1.6266439 KM/SEC
TILT AZIMUTH	291.4307022 DEG	TILT ANGLE	3.7241552 DEG
SIGMA TILT AZIMUTH	.0031735 DEG	SIGMA TILT ANGLE	.0001937 DEG
SUN ELEVATION AT PRIN GRND PNT	-3.8369484 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	267.7384796 DEG
LONGITUDE OF SUBSOLAR POINT	57.5703224 DEG	LATITUDE OF SUBSOLAR POINT	-.6466035 DEG
	57 DEG, 34 MIN, 13.1607914 SEC		0 DEG, 38 MIN, 47.7725029 SEC
ALPHA	-3.6300576 DEG	SWING ANGLE	274.2050927 DEG
EMISSION ANGLE	3.9708436 DEG	SIGMA SWING ANGLE	.0031736 DEG
PHASE ANGLE	97.4685249 DEG	NORTH DEVIATION ANGLE	162.8155656 DEG
PHI	3.7141902 DEG	X-TILT	.2728917 DEG
SIGMA PHI	.0001964 DEG	SIGMA X-TILT	.0002035 DEG
KAPPA	-162.7655506 DEG	Y-TILT	-3.7141982 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0001964 DEG
OMEGA	.2728917 DEG	HEADING	-72.7832682 DEG
SIGMA OMEGA	.0002035 DEG	SIGMA HEADING	.0002009 DEG
SPACECRAFT ALTITUDE (LASER)	117.4994591 KM	LASER SLANT RANGE	117.6980000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.83767624	-.37287103	.39908109	115.187572

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.14760255+00	-.97791395+00	-.14797864+00
-.39655073+00	.78551019-01	-.91464599+00
.90606900+00	.19368513+00	-.37619825+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.95318568+00	.29546531+00	.64778724-01
-.29627899+00	-.95508960+00	-.47628410-02
.60462697-01	-.23732456-01	.99788832+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-20.209	155.753
-25.620	154.020
-24.117	147.637
-18.114	149.762

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION 0 HR, 27 MIN, 22.3 SEC DECLINATION 60 DEG, 33 MIN, 29.9 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	15	21	3	34.371
CTE			8	15	30	36.102

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/)
1950.0	-1687.4275553	-21.4985092	764.7234369	.1536281	1.5724907	.3878234
SELENOGRAPHIC	1400.7752573	-1010.8028052	669.9121156	-.8574920	-1.3592213	-.2525927

LONGITUDE OF NADIR POINT	-35.8143072	DEG	
	-35 DEG, 48 MIN,	51.5059662	SEC
LONG OF CAMERA AXIS INTERSECT	-35.8285885	DEG	
	-35 DEG, 49 MIN,	42.9185486	SEC
SPACECRAFT RADIUS	1852.7481953	KM	
SCALE FACTOR	.0006617	M/KM	
MEAN ALTITUDE RATE	.0019086	KM/SEC	
TILT AZIMUTH	309.9777832	DEG	
SIGMA TILT AZIMUTH	.0432132	DEG	
SUN ELEVATION AT PRIN GRND PNT	-2.9157534	DEG	
LONGITUDE OF SUBSOLAR POINT	57.0486642	DEG	
	57 DEG, 2 MIN,	55.1909781	SEC
ALPHA	.2137794	DEG	
EMISSION ANGLE	.2807326	DEG	
PHASE ANGLE	92.7019882	DEG	
PHI	.1696722	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	170.0867699	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	.2014174	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	116.6517715	KM	

LATITUDE OF NADIR POINT	21.1971090	DEG	
	21 DEG, 11 MIN,	49.5923424	SEC
LATI OF CAMERA AXIS INTERSECT	21.2082715	DEG	
	21 DEG, 12 MIN,	29.7774124	SEC
SPACECRAFT ALTITUDE	114.6581989	KM	
AZIMUTH OF VELOCITY VECTOR	260.3871893	DEG	
HORIZONTAL VELOCITY	1.6268000	KM/S, C	
TILT ANGLE	.2629124	DEG	
SIG A TILT ANGLE	.0002017	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	89.5605707	DEG	
LATITUDE OF SUBSOLAR POINT	-.6452260	DEG	
	0 DEG, 38 MIN,	42.8136635	SEC
SWING ANGLE	319.8896706	DEG	
SIGMA SWING ANGLE	.0432132	DEG	
NORTH DEVIATION ANGLE	189.9118219	DEG	
X-TILT	.2014174	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.1696711	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-99.9118228	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	116.6529979	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.75897167	.54333228	-.35882034	114.659490

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.90715829-01	.96786515+00	.23453694+00
-.39900655+00	.25110259+00	-.88189643+00
-.91244971+00	-.13579836-01	.40896355+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.98506946+00	-.17213161+00	.29613156-02
.17212111+00	-.98506955+00	-.35153889-02
.35222288-02	-.29531742-02	.99998947+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
24.623	-33.177
18.773	-32.224
17.759	-38.359
23.592	-39.596

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -2 HR, 38 MIN, 32.3 SEC DECLINATION 66 DEG, 51 MIN, 15.0 SEC

Mission: Apollo 17, Target: N&S 40° Oblique strip photography

Rev: 65, Camera: 3 Inch Mapping Frames: 2354 Through: 2460

Coverage Interval:

From: 7.1 Deg S Lat., 102.5 Deg E Long., To: 19.1 Deg N Lat., 44.8 Deg W Long.

From: 212 Hr 42 Min 3.963 Sec, To: 213 Hr 30 Min 20.836 Sec. CTE

Date Processed: 8/24/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziel1)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72178319 Min

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 213 H, 6 M, 41.13411 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 65. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1520.1005	$\dot{X}$ =	.6897
Y =	905.4417	$\dot{Y}$ =	-1.4117
Z =	543.3302	$\dot{Z}$ =	.4284

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High and Low

Date Edited: 8/24/73 (During APE operation)

Edited Data Tape No. T01247 File No.: 1 Location: TRW

Remarks: High bit rate in 212 H, 42 M - 212 H, 45 M and 212 H, 49 M - 213 H, 30 M. Low bit rate in 212 H, 45 M - 212 H, 49 M. There were no attitude data for the interval 212 H, 45 M - 212 H, 47 M, 10 sec (FMS 2362-2365).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of strip photography which begins as 40 deg N oblique and ends as 40 deg S oblique. The photography starts as 102.5 deg E Long. and ends at 44.8 deg W Long. The sequence is N oblique from its start to 80.7 deg E Long. (frame 2371). Over the next 7 frames, the photography was taken during the roll maneuver executed to switch to 40 deg S oblique. From that point, 69 deg E Long. (frame 2378) the photography is 40 deg S oblique. State vector data only are provided over the interval where vehicle attitude data are unavailable for the computations (frames 2362-2365). The star pattern companion to frame 2365 is included in these data.

```
                              YEAR   MONTH   DAY   HOUR   MINUTE   SECOND
                           GMT1972     12     16      2      15     2.237
                           CTR          8     20     42     3.963
STATE VECTOR      X (KM)          Y (KM)          Z (KM)          XDOT (KM/S)     YDOT (KM/S)     ZDOT (KM/S)
 1950.0        1177.5571710   -1133.5343795   -365.3054471    -1.0?20591      -1.2183972      .1373290
SELENOGRAPHIC  -357.5359?98    1706.5389?06   -324.6345766    1.4711160       .3975604        .5748262

LONGITUDE OF NADIR POINT            101.3169670 DEG     LATITUDE OF NADIR POINT
              101 DEG, 19 MIN, 1.0812378 SEC                          -10.1026450 DEG
LONG OF CAMERA AXIS INTERSECT       102.4656916 DEG          -10 DEG, 6 MIN, 10.2418327 SEC
              102 DEG, 27 MIN, 56.4890393 SEC   LATI OF CAMERA AXIS INTERSECT  -7.0829751 DEG
SPACECRAFT RADIUS                  1850.6595621 KM           -7 DEG, 4 MIN, 58.7103224 SEC
SCALE FACTOR                          .0000000 M/KM    SPACECRAFT ALTITUDE          112.5695658 KM
MEAN ALTITUDE RATE                   -.0012580 KM/SEC  AZIMUTH OF VELOCITY VECTOR   290.9993200 DEG
TILT AZIMUTH                         20.7008939 DEG    HORIZONTAL VELOCITY          1.6286692 KM/SEC
SIGMA TILT AZIMUTH                    .0003092 DEG     TILT ANGLE                   40.3034353 DEG
SUN ELEVATION AT PRIN GRND PNT       41.6672756 DEG    SIGMA TILT ANGLE              .0002000 DEG
LONGITUDE OF SUBSOLAR POINT          54.4225554 DEG    SUN AZIMUTH AT PRINCIPAL GRND PNT  275.4831276 DEG
              54 DEG, 25 MIN, 21.1993217 SEC   LATITUDE OF SUBSOLAR POINT   -.6382497 DEG
ALPHA                               -25.9285071 DEG             0 DEG, 38 MIN, 17.6989746 SEC
EMISSION ANGLE                       43.5297984 DEG    SWING ANGLE                  359.1614199 DEG
PHASE ANGLE                          52.0079074 DEG    SIGMA SWING ANGLE             .0003092 DEG
PHI                                    .7111921 DEG    NORTH DEVIATION ANGLE        152.6027927 DEG
SIGMA PHI                              .0002622 DEG    X-TILT                       40.2962298 DEG
KAPPA                               -158.1995602 DEG   SIGMA X-TILT                  .0002000 DEG
SIGMA KAPPA                            .0002622 DEG    Y-TILT                        -.5424121 DEG
OMEGA                                40.2982297 DEG    SIGMA Y-TILT                  .0002000 DEG
SIGMA OMEGA                            .0002000 DEG    HEADING                      -68.6595565 DEG
SPACECRAFT ALTITUDE (LASER)           .0000000 KM      SIGMA HEADING                 .0002000 DEG
                                                       LASER SLANT RANGE             .0000000 KM

SELENOGRAPHIC DIRECTION COSINES        X               Y               Z              MAGNITUDE (KM)
   OF CAMERA AXIS                  -.07769699      -.67699987      .72946999          151.218987

        TRANSFORMATION MATRIX FROM                         TRANSFORMATION MATRIX FROM
         SELENOCENTRIC TO CAMERA                          LOCAL HORIZONTAL TO CAMERA

-.64927905+00  -.75531169+00   .89766681-01     -.93139284+00   .36389249+00   .94667357-02
-.72536935+00   .58108136+00  -.36776769+00     -.28324332+00  -.70814311+00  -.64676622+00
 .22863898+00  -.30027398+00  -.92609623+00     -.22864954+00  -.60507489+00   .76262954+00

                         PHOTOGRAPH FOOTPRINT
                         LATITUDE    LONGITUDE
                         ********       .000
                          -13.731    103.197
                           -9.051     99.214
                         ********       .000

                     DIRECTION TO STELLAR PHOTO CENTER
RIGHT ASCENSION     -2 HR, 37 MIN, 17.3 SEC      DECLINATION     15 DEG, 40 MIN, 42.4 SEC
```

Original scan of fiche poor

Original fiche poor quality pg 1 of 2 3-84

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	16	3	3	19.110
CTE			8	21	33	20.836

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1661.7377451	164.3033056	605.1899278	.3042772	1.3561677	.3133364
SELENOGRAPHIC	1224.3780694	-1238.5104752	635.2095631	-1.0408331	-1.2016743	-.3152495

LONGITUDE OF NADIR POINT	-45.3288946 DEG	LATITUDE OF NADIR POINT	20.0410702 DEG
	-45 DEG, 19 MIN, 44.0206146 SEC		20 DEG, 2 MIN, 27.8528023 SEC
LONG OF CAMERA AXIS INTERSECT	-44.8086381 DEG	LATI OF CAMERA AXIS INTERSECT	17.9386514 DEG
	-44 DEG, 48 MIN, 31.0971451 SEC		17 DEG, 50 MIN, 19.1451073 SEC
SPACECRAFT RADIUS	1855.6119572 KM	SPACECRAFT ALTITUDE	115.7219608 KM
SCALE FACTOR	.0009100 M/KM	AZIMUTH OF VELOCITY VECTOR	259.0516036 DEG
MEAN ALTITUDE RATE	.0020794 KM/SEC	HORIZONTAL VELOCITY	1.6258423 KM/SEC
TILT AZIMUTH	167.3178486 DEG	TILT ANGLE	33.3173321 DEG
SIGMA TILT AZIMUTH	.0003962 DEG	SIGMA TILT ANGLE	.0002000 DEG
SUN ELEVATION AT PRIN GRND PNT	-6.5935622 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	87.4900309 DEG
LONGITUDE OF SUBSOLAR POINT	54.0155012 DEG	LATITUDE OF SUBSOLAR POINT	-.5371521 DEG
	54 DEG, 0 MIN, 55.8042712 SEC		0 DEG, 38 MIN, 13.7636361 SEC
ALPHA	-2.6250973 DEG	SWING ANGLE	179.4775500 DEG
EMISSION ANGLE	32.5500509 DEG	SIGMA SWING ANGLE	.0003962 DEG
PHASE ANGLE	102.8276753 DEG	NORTH DEVIATION ANGLE	179.0349233 DEG
PHI	-.3053767 DEG	X-TILT	-33.3179442 DEG
SIGMA PHI	.0002316 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	167.9250408 DEG	Y-TILT	.2636582 DEG
SIGMA KAPPA	.0002317 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-30.3079441 DEG	HEADING	-102.2270656 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.37276571	.53466171	-.75837807	135.605202

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.19038627+00	.96402225+00	.18551[illegible]+00
-.79921117+00	.26173848+00	-.54097114+00
-.57010054+00	-.45266729-01	.82032691+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97729317+00	-.21181335+00	-.45016877-02
.18059999+00	-.84422435+00	.50464733+00
-.11077842+00	.47235789+00	.85331335+00

PHOTOGRAPH FOOTPRINT

LATITUDE LONGITUDE

SUN ELEVATION AT PRIN GRND PNT	-6.5935622 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	87.3900309 DEG
LONGITUDE OF SUBSOLAR POINT	54.0155012 DEG	LATITUDE OF SUBSOLAR POINT	-.5371521 DEG
54 DEG, 0 MIN,	55.8042712 SEC	0 DEG, 38 MIN,	13.7336361 SEC
ALPHA	-2.6250973 DEG	SWING ANGLE	179.4775560 DEG
EMISSION ANGLE	32.5560509 DEG	SIGMA SWING ANGLE	.0003962 DEG
PHASE ANGLE	122.8276753 DEG	NORTH DEVIATION ANGLE	179.0349233 DEG
PHI	-.3053767 DEG	X-TILT	-30.3079442 DEG
SIGMA PHI	.0002316 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	167.9250468 DEG	Y-TILT	.2636382 DEG
SIGMA KAPPA	.0002317 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-30.3079491 DEG	HEADING	-102.2270656 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.37276571	.53466171	-.75839607	135.605202

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.19036627+00	.96452225+00	.18551000+00
-.79921117+00	.26193848+00	-.54097114+00
-.57010054+00	-.45266429-01	.82032691+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97729817+00	-.21181335+00	-.45016877-02
.18059999+00	-.84422435+00	.50464733+00
-.11077842+00	.47235789+00	.85331335+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
23.971	-42.954
....	.000
....	.000
19.974	-47.441

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION [illegible] HR, [illegible] MIN, [illegible] SEC DECLINATION [illegible] DEG, [illegible] MIN, [illegible] SEC

2 of 2 Pg ~~3-82~~ 3-84

Mission: Apollo 17, Target: Vertical strip photography

Rev: 66, Camera: 3 Inch Mapping Frames: 2591 Through: 2734

Coverage Interval:

From: 22.2 Deg S Lat., 147.8 Deg E Long., To: 21.8 Deg N Lat., 35.4 Deg W Long.

From: 214 Hr 25 Min 47.917 Sec, To: 215 Hr 26 Min 9.042 Sec. CTE

Date Processed: 8/25/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziel1)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72179986 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 115 H, 5 M, 35.15633 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 66. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1522.2772	$\dot{X}$ =	.6884
Y =	906.7382	$\dot{Y}$ =	-1.4098
Z =	535.1852	$\dot{Z}$ =	.4365

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/25/73 (During APE operation)

Edited Data Tape No. T01639 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle
±0.2 mrad in each gimbal angle
±20 ms in onboard clock bias definition
±5 ms in onboard clock drift rate
±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 147.8 deg E Long. and ending at 35.4 deg W Long. Throughout the sequence tilt is maintained less than 1 deg. State vector data only are provided for frame 2621 for which vehicle attitude data were ignored as the result of a computer erratic. Star patterns companion to frames 2600 and 2725 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	16	3	58	46.191
CTE			8	22	25	47.917

STATE VECTOR 1950.0	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
SELENOGRAPHIC	1696.0486038	238.4430730	-704.4615308	.0255265	-1.5607277	-.4610881
	-1451.5268326	913.4346662	-698.8626323	.7985111	1.4061393	.1851405

LONGITUDE OF NADIR POINT	147 DEG, 49 MIN,	147.8181076 DEG 5.1873779 SEC	
LONG OF CAMERA AXIS INTERSECT	147 DEG, 48 MIN,	147.8109188 DEG 39.3077087 SEC	
SPACECRAFT RADIUS		1851.9454673 KM	
SCALE FACTOR		.0000000 M/KM	
MEAN ALTITUDE RATE		-.0021769 KM/SEC	
TILT AZIMUTH		333.9646034 DEG	
SIGMA TILT AZIMUTH		.0495010 DEG	
SUN ELEVATION AT PRIN GRND PNT		-3.7069874 DEG	
LONGITUDE OF SUBSOLAR POINT	53 DEG, 32 MIN,	53.5480057 DEG 52.8203487 SEC	
ALPHA		-.0996342 DEG	
EMISSION ANGLE		.2467238 DEG	
PHASE ANGLE		3.8066502 DEG	
PHI		.1241466 DEG	
SIGMA PHI		.0002000 DEG	
KAPPA		-173.6137733 DEG	
SIGMA KAPPA		.0002000 DEG	
OMEGA		.1954606 DEG	
SIGMA OMEGA		.0002000 DEG	
SPACECRAFT ALTITUDE (LASER)		114.5520678 KM	

LATITUDE OF NADIR POINT	-22 DEG, 10 MIN,	-22.1706676 DEG 14.4035339 SEC	
LATI OF CAMERA AXIS INTERSECT	-22 DEG, 9 MIN,	-22.1570375 DEG 25.3349876 SEC	
SPACECRAFT ALTITUDE		113.8554709 KM	
AZIMUTH OF VELOCITY VECTOR		277.0240772 DEG	
HORIZONTAL VELOCITY		1.6275821 KM/SEC	
TILT ANGLE		.2310290 DEG	
SIGMA TILT ANGLE		.0002004 DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT		267.7997551 DEG	
LATITUDE OF SUBSOLAR POINT	0 DEG, 38 MIN,	-.6359110 DEG 9.2794991 SEC	
SWING ANGLE		327.5784791 DEG	
SIGMA SWING ANGLE		.0495011 DEG	
NORTH DEVIATION ANGLE		173.6141733 DEG	
X-TILT		.1954606 DEG	
SIGMA X-TILT		.0002000 DEG	
Y-TILT		-.1241459 DEG	
SIGMA Y-TILT		.0002000 DEG	
HEADING		-83.6142001 DEG	
SIGMA HEADING		.0002000 DEG	
LASER SLANT RANGE		114.5529995 KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.78356346	-.49099458	.38072645	113.856462

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.14413376-01	-.95557014+00	-.29441104+00
-.40451916+00	.26369746+00	-.87568713+00
.91441597+00	.13171652+00	-.38274569+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99379313+00	.11122237+00	.21667532-02
-.11122939+00	-.99378893+00	-.34114237-02
.17738661-02	-.36312695-02	.99999187+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-19.519	151.266
-25.370	160.672
-24.713	144.233
-18.863	145.052

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -1 HR, 46 MIN, 31.7 SEC

DECLINATION 56 DEG, 14 MIN, 21.2 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	16	4	57	7.317
CTL			8	23	26	9.042

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1697.4263825	-161.0725849	727.2509327	.0350768	1.5664479	.4345053
SELENOGRAPHIC	1402.5076406	-996.7411141	689.6188008	-.8619974	-1.3625919	-.2103466

LONGITUDE OF NADIR POINT	-35.4008360	DEG	
	-35 DEG, 24 MIN,	3.0095673	SEC
LONG OF CAMERA AXIS INTERSECT	-35.4457069	DEG	
	-35 DEG, 26 MIN,	44.5429230	SEC
SPACECRAFT RADIUS	1853.6705604	KM	
SCALE FACTOR	.0006564	M/KM	
MEAN ALTITUDE RATE	.0022301	KM/SEC	
TILT AZIMUTH	289.7602119	DEG	
SIGMA TILT AZIMUTH	.0171594	DEG	
SUN ELEVATION AT PRIN GRND PNT	1.1698036	DEG	
LONGITUDE OF SUBSOLAR POINT	53.0392046	DEG	
	53 DEG, 2 MIN,	21.1366510	SEC
ALPHA	.6725669	DEG	
EMISSION ANGLE	.7096130	DEG	
PHASE ANGLE	88.1576204	DEG	
PHI	.5894788	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	172.1297112	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	.3085852	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	117.5310783	KM	

LATITUDE OF NADIR POINT	21.8407917	DEG	
	21 DEG, 50 MIN,	26.8501262	SEC
LATI OF CAMERA AXIS INTERSECT	21.8557463	DEG	
	21 DEG, 51 MIN,	20.6865692	SEC
SPACECRAFT ALTITUDE	115.5805841	KM	
AZIMUTH OF VELOCITY VECTOR	261.9569980	DEG	
HORIZONTAL VELOCITY	1.6259887	KM/SEC	
TILT ANGLE	.6651804	DEG	
SIGMA TILT ANGLE	.0002008	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	91.1531668	DEG	
LATITUDE OF SUBSOLAR POINT	-.6345468	DEG	
	0 DEG, 38 MIN,	4.3684101	SEC
SWING ANGLE	297.6321711	DEG	
SIGMA SWING ANGLE	.0171594	DEG	
NORTH DEVIATION ANGLE	187.8731002	DEG	
X-TILT	.3085852	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.5894703	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-97.8734590	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	117.5389996	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.76408151	.52961376	-.36835949	115.588896

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.14601663-01	.96181579+00	.27330765+00
-.39618138+00	.25653045+00	-.88160790+00
-.91805619+00	-.95406477-01	.38479932+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99052055+00	-.13697644+00	.10288016-01
.13692888+00	-.99056626+00	-.53858022-02
.10926704-01	-.39260053-02	.99993261+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
25.192	-32.640
19.301	-31.921
18.446	-38.149
24.402	-39.204

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -2 HR, 45 MIN, 54.7 SEC DECLINATION 66 DEG, 27 MIN, 16.1 SEC

Mission: Apollo 17, Target: Vertical strip photography

Rev: 74, Camera: 3 Inch Mapping Frames: 2790 Through: 2942

Coverage Interval:

From: 22.2 Deg S Lat., 140.2 Deg E Long., To: 19.8 Deg N Lat., 55.6 Deg W Long.

From: 230 Hr 19 Min 34.445 Sec, To: 231 Hr 23 Min 51.425 Sec. CTE

Date Processed: 8/25/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

HOPE Version Used: B-6.4 (Relocatable)

Constants Used:

Lunar Potential Model: L-1

Ephemeris: JPL DE 19 (Double Precision)

Libration Model: RTCC (Koziell)

Lunar Radius: 1738.09 km

Ephemeris-Universal Time Difference: .72183319 Min.

Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Computation Interval: Computation at each film exposure time

Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 230 H, 56 M, 45.08191 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 74. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1539.6136	$\dot{X}$ =	.6839
Y =	917.0646	$\dot{Y}$ =	-1.3913
Z =	463.1958	$\dot{Z}$ =	.4984

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 8/25/73 (During APE operation)

Edited Data Tape No. T01532 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis (camera positioning angle) was 37.75 degrees.

Stellar camera Interlock Angles Used:

Ω = -95° 55' 32.079"
ϕ = -0° 1' 30.755"
κ = 0° 0' 58.194"

Uncertainties Assumed:

± 1 degree in camera positioning angle
±0.2 mrad in each gimbal angle
±20 ms in onboard clock bias definition
±5 ms in onboard clock drift rate
±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of vertical strip photography starting at 140.2 deg E Long. and ending at 55.6 deg W Long. Throughout the sequence tilt is maintained less than 1 deg. Vehicle state vector data only are provided for frame 2839 for which vehicle attitude data were ignored as the result of a computer erratic. Star patterns companion to frames 2800 and 2940 are included in these data.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	16	19	52	32.730
CTE			9	14	19	34.445

STATE VECTOR 1950.0 SELENOGRAPHIC	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
	1693.2654350	269.7651620	-692.3029863	.0557865	-1.5617179	-.4639196
	-1315.1130427	1095.3242113	-699.9621832	.9803436	1.2893548	.1838122

LONGITUDE OF NADIR POINT	140.2099438	DEG	
	140 DEG, 12 MIN,	35.7975749	SEC
LONG OF CAMERA AXIS INTERSECT	140.1723404	DEG	
	140 DEG, 10 MIN,	20.4254150	SEC
SPACECRAFT RADIUS	1849.1091100	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	-.0030624	KM/SEC	
TILT AZIMUTH	252.4723110	DEG	
SIGMA TILT AZIMUTH	.0199184	DEG	
SUN ELEVATION AT PRIN GRND PNT	-4.0823402	DEG	
LONGITUDE OF SUBSOLAR POINT	45.5084933	DEG	
	45 DEG, 30 MIN,	30.5757666	SEC
ALPHA	-.5865860	DEG	
EMISSION ANGLE	.6078103	DEG	
PHASE ANGLE	94.6689415	DEG	
PHI	.5197695	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-173.0028210	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.2371529	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	109.8045454	KM	

LATITUDE OF NADIR POINT	-22.2432902	DEG	
	-22 DEG, 14 MIN,	35.8446693	SEC
LATI OF CAMERA AXIS INTERSECT	-22.2542772	DEG	
	-22 DEG, 15 MIN,	15.3980255	SEC
SPACECRAFT ALTITUDE	111.0191137	KM	
AZIMUTH OF VELOCITY VECTOR	276.9531307	DEG	
HORIZONTAL VELOCITY	1.6300890	KM/SEC	
TILT ANGLE	.5711024	DEG	
SIGMA TILT ANGLE	.0002015	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	267.6608772	DEG	
LATITUDE OF SUBSOLAR POINT	-.6140558	DEG	
	7 DEG, 36 MIN,	50.6007957	SEC
SWING ANGLE	245.4740029	DEG	
SIGMA SWING ANGLE	.0199184	DEG	
NORTH DEVIATION ANGLE	173.0009309	DEG	
X-TILT	-.2371529	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.5197651	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-83.0006726	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	109.8100004	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.71813755	-.58574439	.37574190	111.024986

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.44562203-01	-.95660230+00	-.28796899+00
-.39638674+00	.24766248+00	-.88094802+00
.91700154+00	.15354223+00	-.36814812+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.99250669+00	.12185267+00	.70714877-02
-.12181943+00	-.99254367+00	.41390870-02
.95082006-02	.30029767-02	.99995032+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-19.752	143.529
-25.415	142.922
-24.741	136.610
-19.022	137.519

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -1 HR, 41 MIN, 6.9 SEC DECLINATION 57 DEG, 15 MIN, 58.1 SEC

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	14	20	56	49.711
CTE			9	15	23	51.425

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1663.9705181	180.3207747	805.1144249	.3111063	1.5646132	.2977409
SELENOGRAPHIC	987.3687127	-1441.9136598	628.8964357	-1.2392362	-.9948396	-.3286929

LONGITUDE OF NADIR POINT	-55.5981197 DEG
	-55 DEG, 35 MIN, 53.1984329 SEC
LONG OF CAMERA AXIS INTERSECT	-55.6162014 DEG
	-55 DEG, 36 MIN, 58.3256427 SEC
SPACECRAFT RADIUS	1857.2892739 KM
SCALE FACTOR	.0006366 M/KM
MEAN ALTITUDE RATE	.0022485 KM/SEC
TILT AZIMUTH	315.3171425 DEG
SIGMA TILT AZIMUTH	.0322770 DEG
SUN ELEVATION AT PRIN GRND PNT	-10.1603699 DEG
LONGITUDE OF SUBSOLAR POINT	44.9667419 DEG
	44 DEG, 58 MIN, .2706814 SEC
ALPHA	.2508657 DEG
EMISSION ANGLE	.3771048 DEG
PHASE ANGLE	99.9096289 DEG
PHI	.1892914 DEG
SIGMA PHI	.0002000 DEG
KAPPA	167.7555923 DEG
SIGMA KAPPA	.0002000 DEG
OMEGA	.2978411 DEG
SIGMA OMEGA	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	121.9306898 KM

LATITUDE OF NADIR POINT	19.7922032 DEG
	19 DEG, 47 MIN, 31.9314766 SEC
LATI OF CAMERA AXIS INTERSECT	19.8094119 DEG
	19 DEG, 48 MIN, 33.8823509 SEC
SPACECRAFT ALTITUDE	119.1990776 KM
AZIMUTH OF VELOCITY VECTOR	257.5397061 DEG
HORIZONTAL VELOCITY	1.6227601 KM/SEC
TILT ANGLE	.3526029 DEG
SIGMA TILT ANGLE	.0002014 DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT	86.9613285 DEG
LATITUDE OF SUBSOLAR POINT	-.6125605 DEG
	DEG, 36 MIN, 45.2177525 SEC
SWING ANGLE	327.5624856 DEG
SIGMA SWING ANGLE	.0322770 DEG
NORTH DEVIATION ANGLE	192.2454384 DEG
X-TILT	.2978411 DEG
SIGMA X-TILT	.0002000 DEG
Y-TILT	-.1892889 DEG
SIGMA Y-TILT	.0002000 DEG
HEADING	-12.2453877 DEG
SIGMA HEADING	.0002000 DEG
LASER SLANT RANGE	121.9329996 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.53601951	.77511567	-.33448286	119.201494

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.19149902+00	.96339476+00	.18761282+00
-.39474389+00	.25060752+00	-.88395316+00
-.89861307+00	.95217112-01	.42828532+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97724280+00	-.21209784+00	.33037077-02
.21207941+00	-.97723864+00	-.51982840-04
.43310895-02	-.43793040-02	.99998106+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
23.472	-53.037
17.424	-51.795
16.125	-58.072
22.146	-59.614

DIRECTION TO STELLAR PHOTO CENTER

RIGHT ASCENSION -2 HR, 34 MIN, 11.9 SEC DECLINATION 67 DEG, 26 MIN, 50.3 SEC

4.0 APOLLO 17 24-INCH PANORAMIC CAMERA DATA

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 1/2, Camera: 24-Inch Panoramic Frames: 1588 Through: 1880

Coverage Interval:

From: 19.3 Deg S Lat., 154.2 Deg W Long., To: 11.9 Deg N Lat., 95.7 Deg E Long.

From: 88 Hr 10 Min 48.331 Sec, To: 88 Hr 47 Min 45.531 Sec. CTE

Date Processed: 9/11/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .721533195 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 89 H, 9 M, 44.06 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 2. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1618.8228	$\dot{X}$ =	.8698
Y =	964.2463	$\dot{Y}$ =	-1.2692
Z =	675.1559	$\dot{Z}$ =	-.0665

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T00412 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Eacn tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally,the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of panoramic stereo strip photography starting at 154.2 deg W Long. and ending at 95.7 deg E Long. Throughout the sequence tilt is maintained within half a degree of its nominal value of 12.5 deg. State vector data only are provided for frame 1724 for which vehicle attitude data were ignored as the result of a computer erratic. There is an 8 M, 24 Sec data gap between frames 1790 and 1791.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	10	21	43	48.527
CTE			3	16	10	48.331

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1703.1200908	-82.0272881	-754.0771129	-.3545727	-1.5440927	-.4715808
SELENOGRAPHIC	-1568.9391017	-794.4114533	-619.1279938	-.7313306	1.4738914	.1585310

LONGITUDE OF NADIR POINT	-153.1452312 DEG
	-153 DEG, 8 MIN, 42.8324890 SEC
LONG OF CAMERA AXIS INTERSECT	-154.1999321 DEG
	-154 DEG, 11 MIN, 59.7555542 SEC
SPACECRAFT RADIUS	1864.3977075 KM
SCALE FACTOR	.0000000 M/KM
MEAN ALTITUDE RATE	-.0652289 KM/SEC
TILT AZIMUTH	273.9838867 DEG
SIGMA TILT AZIMUTH	.0008602 DEG
SUN ELEVATION AT PRIN GRND PNT	1.8722658 DEG
LONGITUDE OF SUBSOLAR POINT	117.5079762 DEG
	117 DEG, 30 MIN, 28.7142706 SEC
ALPHA	-14.3991504 DEG
EMISSION ANGLE	14.4441215 DEG
PHASE ANGLE	102.5265064 DEG
PHI	13.4437351 DEG
SIGMA PHI	.0002000 DEG
KAPPA	-174.8799515 DEG
SIGMA KAPPA	.0002000 DEG
OMEGA	-.2716252 DEG
SIGMA OMEGA	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM

LATITUDE OF NADIR POINT	-19.3950293 DEG
	-19 DEG, 23 MIN, 42.1055031 SEC
LATI OF CAMERA AXIS INTERSECT	-19.3226752 DEG
	-19 DEG, 19 MIN, 21.6308212 SEC
SPACECRAFT ALTITUDE	126.3077111 KM
AZIMUTH OF VELOCITY VECTOR	275.0400390 DEG
HORIZONTAL VELOCITY	1.6516592 KM/SEC
TILT ANGLE	13.4464407 DEG
SIGMA TILT ANGLE	.0002000 DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT	269.8216209 DEG
LATITUDE OF SUBSOLAR POINT	-.7876646 DEG
	0 DEG, 47 MIN, 15.5926609 SEC
SWING ANGLE	268.8318241 DEG
SIGMA SWING ANGLE	.0008602 DEG
NORTH DEVIATION ANGLE	174.9568065 DEG
X-TILT	-.2716252 DEG
SIGMA X-TILT	.0002000 DEG
Y-TILT	-13.4435806 DEG
SIGMA Y-TILT	.0002000 DEG
HEADING	-84.8150211 DEG
SIGMA HEADING	.0002056 DEG
LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.70888168	.61894854	.33821513	130.138564

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.39565300-01	-.92201232+00	-.38513347+00
-.36146629+00	.34612498+00	-.86575954+00
.93154528+00	.17346679+00	-.31958185+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.96861953+00	.87895245-01	.23248775+00
-.89241795-01	-.99599869+00	.47407371-02
.23197417+00	-.10155666-01	.97258772+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-13.184	-153.228
-25.634	-154.482
-25.923	-155.551
-12.732	-154.124

LATITUDE	LONGITUDE
-10.394	-153.492
-22.348	-154.087
-22.421	-155.027
-16.161	-154.360

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	10	22	20	45.727
CTE			3	16	47	45.531

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1022.5726082	-1576.8572871	-202.3161630	-1.2766595	.6285830	.7936531
SELENOGRAPHIC	-150.3319678	1842.3667900	403.0563696	1.5612403	.1110700	.4533918

LONGITUDE OF NADIR POINT		94.6648359	DEG
	94 DEG, 39 MIN,	53.4093475	SEC
LONG OF CAMERA AXIS INTERSECT		95.7328405	DEG
	95 DEG, 43 MIN,	56.2259369	SEC
SPACECRAFT RADIUS		1891.9241269	KM
SCALE FACTOR		.0038690	M/KM
MEAN ALTITUDE RATE		.0006944	KM/SEC
TILT AZIMUTH		109.2985096	DEG
SIGMA TILT AZIMUTH		.0009391	DEG
SUN ELEVATION AT PRIN GRND PNT		65.1785135	DEG
LONGITUDE OF SUBSOLAR POINT		117.1955057	DEG
	117 DEG, 11 MIN,	43.8203573	SEC
ALPHA		-13.3086846	DEG
EMISSION ANGLE		13.3963688	DEG
PHASE ANGLE		38.0851259	DEG
PHI		-12.2584008	DEG
SIGMA PHI		.0002000	DEG
KAPPA		-164.7293797	DEG
SIGMA KAPPA		.0002000	DEG
OMEGA		-.8766358	DEG
SIGMA OMEGA		.0002000	DEG
SPACECRAFT ALTITUDE (LASER)		.0000000	KM

LATITUDE OF NADIR POINT		12.3005902	DEG
	12 DEG, 18 MIN,	2.1245670	SEC
LATI OF CAMERA AXIS INTERSECT		11.9326365	DEG
	11 DEG, 55 MIN,	57.4913979	SEC
SPACECRAFT ALTITUDE		153.8341306	KM
AZIMUTH OF VELOCITY VECTOR		285.9209385	DEG
HORIZONTAL VELOCITY		1.6275023	KM/SEC
TILT ANGLE		12.2892414	DEG
SIGMA TILT ANGLE		.0002001	DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT		119.3634586	DEG
LATITUDE OF SUBSOLAR POINT		-.7670095	DEG
	0 DEG, 47 MIN,	13.2340336	SEC
SWING ANGLE		94.1220198	DEG
SIGMA SWING ANGLE		.0009391	DEG
NORTH DEVIATION ANGLE		165.2340595	DEG
X-TILT		-.8766358	DEG
SIGMA X-TILT		.0002000	DEG
Y-TILT		12.2569432	DEG
SIGMA Y-TILT		.0002000	DEG
HEADING		-74.9198443	DEG
SIGMA HEADING		.0002047	DEG
LASER SLANT RANGE		.0000000	KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.12380098	-.95289380	-.27688757	157.773868

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.63067879+00	.59995751+00	.49197852+00
-.36525241+00	.32978237+00	-.87053675+00
-.68453088+00	-.72889953+00	.11083245-01

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.94355313+00	.25423962+00	-.21229609+00
-.26334758+00	-.96457967+00	.15299584-01
-.20088671+00	.70343662-01	.97708556+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
19.401	98.655
3.545	94.218
4.327	93.212
19.300	97.411

LATITUDE	LONGITUDE
15.420	97.316
8.040	95.253
8.493	94.279
15.533	96.247

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 13/14, Camera: 24-Inch Panoramic Frames: 1881 Through: 2120

Coverage Interval:

From: 15.2 Deg S Lat., 168.4 Deg E Long., To: 6.8 Deg N Lat., 101.1 Deg E Long.

From: 111 Hr 23 Min 30.530 Sec, To: 111 Hr 53 Min 22.987 Sec. CTE

Date Processed: 9/11/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72158319 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 112 H, 16 M, 4.86469 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 14. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1494.5024	$\dot{X}$ =	.8184
Y =	890.1942	$\dot{Y}$ =	-1.4057
Z =	634.0940	$\dot{Z}$ =	.0055

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T00178 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data available for the interval 11 H, 23 M, 30.5 sec - 111 H, 29 M, 44 sec (FMS 1881-1934) and the interval 111 H, 49 M, 59 sec - 111 H, 52 M, 4 sec (FMS 2094-2111).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These data are for a sequence of panoramic stereo strip photography starting at 168.4 deg E Long. and ending at 101.1 deg E Long. Throughout the sequence a tilt of 12.5 ± 0.5 deg is maintained. Vehicle state vector data only are provided for frames 1881-1934 and frames 2094-2111 for which vehicle attitude data are unavailable for the calculations. The footprint for frame 2048 was omitted due to a printer failure.

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IFRAME = 1881

		YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
	GMT	1972	12	11	20	56	.287+002
	CTE			4	15	23	30.530

STATE VECTOR	X	Y	Z	X DOT	Y DOT	Z DOT
1950.0	.1649452+004	-.2716491+003	-.8010822+003	-.4330824+000	-.1511509+001	-.4096256+000
SELENOGRAPHIC	-.1743205+004	-.2218489+003	-.5901147+003	-.2839711+000	.1587148+001	.2008381+000

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	11	21	26	21.188
CTE			4	15	53	22.987

STATE VECTOR 1950.0	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
SELENOGRAPHIC	-498.2482113	-1733.4751519	-472.8402742	-1.4392348	.2274159	.6968256
	-326.3393871	1821.6529994	227.7021331	1.5167303	.2035219	.5165158

LONGITUDE OF NADIR POINT	100.1564960	DEG	
	100 DEG, 9 MIN,	23.3857727	SEC
LONG OF CAMERA AXIS INTERSECT	101.0654993	DEG	
	101 DEG, 3 MIN,	55.7975006	SEC
SPACECRAFT RADIUS	1864.6086204	KM	
SCALE FACTOR	.0046982	M/KM	
MEAN ALTITUDE RATE	-.0035455	KM/SEC	
TILT AZIMUTH	106.2205858	DEG	
SIGMA TILT AZIMUTH	.0009116	DEG	
SUN ELEVATION AT PRIN GRND PNT	81.2898932	DEG	
LONGITUDE OF SUBSOLAR POINT	105.4820457	DEG	
	105 DEG, 28 MIN,	55.3643703	SEC
ALPHA	-13.0501460	DEG	
EMISSION ANGLE	13.6190608	DEG	
PHASE ANGLE	20.8296354	DEG	
PHI	-12.6707263	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-161.7344799	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	.4599501	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	7.0143498	DEG	
	7 DEG, 0 MIN,	51.6591311	SEC
LATI OF CAMERA AXIS INTERSECT	6.7508747	DEG	
	6 DEG, 45 MIN,	3.1488991	SEC
SPACECRAFT ALTITUDE	126.5186241	KM	
AZIMUTH OF VELOCITY VECTOR	288.8128806	DEG	
HORIZONTAL VELOCITY	1.6151078	KM/SEC	
TILT ANGLE	12.6789463	DEG	
SIGMA TILT ANGLE	.0001999	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	149.4380741	DEG	
LATITUDE OF SUBSOLAR POINT	-.7618774	DEG	
	0 DEG, 45 MIN,	42.7585602	SEC
SWING ANGLE	87.9039911	DEG	
SIGMA SWING ANGLE	.0009117	DEG	
NORTH DEVIATION ANGLE	162.0588606	DEG	
X-TILT	.4599502	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	12.6703108	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-71.6310756	DEG	
SIGMA HEADING	.0002050	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.03801833	-.98293310	-.17999203	129.920638

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.81408512+00	.34188025+00	.46944992+00
-.35469543+00	.34736754+00	-.86805928+00
-.45984396+00	-.87318591+00	-.16152336+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.92593615+00	.30746029+00	-.21934068+00
-.31341092+00	-.94958366+00	-.80275583-02
-.21075044+00	.61310788-01	.97561526+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
12.924	103.796
.412	99.528
1.017	98.781
12.876	102.773

LATITUDE	LONGITUDE
9.598	102.522
3.655	100.506
9.056	99.749
9.730	101.651

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 15, Camera: 24-Inch Panoramic Frames: 2121 Through: 2362

Coverage Interval:

From: 7.5 Deg N Lat., 97.6 Deg E Long., To: 19.4 Deg N Lat., 13.3 Deg E Long.

From: 113 Hr 51 Min 33.304 Sec, To: 114 Hr 20 Min 18.075 Sec. CTE

Date Processed: 9/11/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziel1)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72158319 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 114 H, 14 M, 42.19471 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 15. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1494.3165	$\dot{X}$ =	.8157
Y =	890.0835	$\dot{Y}$ =	-1.4075
Z =	633.5526	$\dot{Z}$ =	.0143

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T00178 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data for the interval 113 H, 51 M, 33 sec - 113 H, 52 M, 29 sec (FMS 2121-2129).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle
±0.2 mrad in each gimbal angle
±20 ms in onboard clock bias definition
±5 ms in onboard clock drift rate
±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of panoramic stereo strip photography starting at 97.6 deg E Long. and ending at 13.3 deg E Long. Throughout the sequence tilt is maintained at 12.5 ± 0.5 deg. Vehicle state vector data only are provided for frames 2121-2129 for which vehicle attitude data are unavailable for the computations and for frame 2338 for which vehicle attitude data were ignored as the result of a computer erratic. All camera axis direction associated data for frames 2355-2363 are in error as the consequence of film reader errors. For these frames, the fore and aft designations were reversed.

IFRAME = 2121

		YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
	GMT	1972	12	11	23	24	.315+002
	CTE			4	17	51	33.304
STATE VECTOR	X	Y	Z	X DOT	Y DOT	Z DOT	
1950.0	-.4182849+003	-.1745275+004	-.5056710+003	-.1456565+001	.1575334+000	.6755688+000	
SELENOGRAPHIC	-.3648107+003	.1817140+004	.2038787+003	.1504754+001	.2405737+000	.5236373+000	

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	11	23	53	22.708
CTE			4	18	20	18.075

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1687.9258782	82.9145182	744.0913242	.2994131	1.5311518	.4756057
SELENOGRAPHIC	1701.6343824	376.6879381	610.0710522	.3888816	-1.5767502	-.1513434

LONGITUDE OF NADIR POINT	12.4821755 DEG
12 DEG, 28 MIN,	55.8316898 SEC
~~LONG OF CAMERA AXIS INTERSECT~~	~~13.3455744 DEG~~
~~13 DEG, 20 MIN,~~	~~44.0778843 SEC~~
SPACECRAFT RADIUS	1846.5210641 KM
SCALE FACTOR	.0054843 M/KM
MEAN ALTITUDE RATE	-.0132889 KM/SEC
~~TILT AZIMUTH~~	~~83.6730986 DEG~~
~~SIGMA TILT AZIMUTH~~	~~.0008964 DEG~~
~~SUN ELEVATION AT PRIN GRND PNT~~	~~-1.0951090 DEG~~
LONGITUDE OF SUBSOLAR POINT	104.2394680 DEG
104 DEG, 14 MIN,	22.0847654 SEC
ALPHA	-13.6204675 DEG
EMISSION ANGLE	13.7100486 DEG
PHASE ANGLE	104.7159929 DEG
PHI	-12.8882633 DEG
SIGMA PHI	.0002000 DEG
KAPPA	174.7512894 DEG
SIGMA KAPPA	.0002000 DEG
OMEGA	.2467360 DEG
SIGMA OMEGA	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM

LATITUDE OF NADIR POINT	19.2724142 DEG
19 DEG, 17 MIN,	32.6910782 SEC
~~LATI OF CAMERA AXIS INTERSECT~~	~~19.1066861 DEG~~
~~19 DEG, 22 MIN,~~	~~59.4608196 SEC~~
SPACECRAFT ALTITUDE	108.4310677 KM
AZIMUTH OF VELOCITY VECTOR	264.5221136 DEG
HORIZONTAL VELOCITY	1.6309511 KM/SEC
~~TILT ANGLE~~	~~12.8805878 DEG~~
~~SIGMA TILT ANGLE~~	~~.0002000 DEG~~
~~SUN AZIMUTH AT PRINCIPAL GRND PNT~~	~~80.4195828 DEG~~
LATITUDE OF SUBSOLAR POINT	-.7591459 DEG
0 DEG, 45 MIN,	32.9251957 SEC
SWING ANGLE	88.8939410 DEG
SIGMA SWING ANGLE	.0008964 DEG
NORTH DEVIATION ANGLE	185.0626364 DEG
X-TILT	.2467360 DEG
SIGMA X-TILT	.0002000 DEG
Y-TILT	12.8881412 DEG
SIGMA Y-TILT	.0002000 DEG
HEADING	-95.1922546 DEG
SIGMA HEADING	.0002052 DEG
LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.95416527	.01587713	-.29885875	111.416746

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.37736482+00	.90381328+00	.20178516+00
-.36056308+00	.34409782+00	-.86694344+00
-.85298883+00	.25439771+00	.45573212+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97080735+00	-.88218068-01	-.22304636+00
.91478330-01	-.99579774+00	-.43063431-02
-.22173118+00	-.24584729-01	.97479782+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
25.025	13.325
13.903	14.299
14.124	13.488
24.661	12.501

LATITUDE	LONGITUDE
22.095	13.515
16.752	13.985
16.813	13.220
21.905	12.743

DATA CARDS ENCOUNTERED BY SYSTEM - IGNORED
F2364 4 18,20,24.505.

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 28, Camera: 24-Inch Panoramic Frames: 2365 Through: 2594

Coverage Interval:

From: 14.8 Deg S Lat., 153.1 Deg E Long., To: 7.4 Deg N Lat., 85.3 Deg E Long.

From: 139 Hr 14 Min 19.593 Sec, To: 139 Hr 38 Min 37.812 Sec. GTE

Date Processed: 9/12/73, APE Version Used: 7.

INPUT DATA

0 Trajectory Tape:

HOPE Version Used: B-6.4 (Relocatable)

Constants Used:

Lunar Potential Model: L-1

Ephemeris: JPL DE 19 (Double Precision)

Libration Model: RTCC (Koziell)

Lunar Radius: 1738.09 Km

Ephemeris-Universal Time Difference: .72163319 Min.

Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Computation Interval: Computation at each film exposure time

Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 139 H, 56 M, 16.12701 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 28. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1498.5950	$\dot{X}$ =	.7790
Y =	892.6319	$\dot{Y}$ =	-1.4244
Z =	613.0724	$\dot{Z}$ =	.1278

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/12/73 (During APE operation)

Edited Data Tape No. T01307 File No.: 1 Location: TRW

Remarks: There were no vehicle attitude data for the interval 139 H, 25 M, 50 sec - 139 H, 32 M, 45 sec (FMS 2474-2537).

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of panoramic stereo strip photography starting at 153.1 deg E Long. and ending at 85.3 deg E Long. Throughout the sequence a tilt of 12.5 ± 0.7 degrees is maintained with the forward tilt approximately .12 deg higher than the aft tilt. State vector data only are provided for frames 2474-2537 for which vehicle attitude data are unavailable for the computations and for frame 2455 for which vehicle attitude data were ignored as a result of a computer erratic.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	0	47	17.614
CTE			5	19	14	19.593

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1425.9948902	-791.5467610	-897.7547351	-.8514388	-1.3654973	-.1661763
SELENOGRAPHIC	-1617.3411810	786.3686213	-481.9490563	.5939803	1.4612582	.3577222

LONGITUDE OF NADIR POINT	154.2790787	DEG	
	154 DEG, 4 MIN, 44.6832275	SEC	
LONG OF CAMERA AXIS INTERSECT	153.1165009	DEG	
	153 DEG, 6 MIN, 59.4030762	SEC	
SPACECRAFT RADIUS	1861.7119181	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	.0083667	KM/SEC	
TILT AZIMUTH	284.1824417	DEG	
SIGMA TILT AZIMUTH	.0008740	DEG	
SUN ELEVATION AT PRIN GRND PNT	27.6862931	DEG	
LONGITUDE OF SUBSOLAR POINT	91.6176557	DEG	
	91 DEG, 37 MIN, 3.5604000	SEC	
ALPHA	-14.0970860	DEG	
EMISSION ANGLE	14.1896960	DEG	
PHASE ANGLE	76.3985443	DEG	
PHI	13.2284484	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-166.5826359	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	.1798596	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	-15.0032675	DEG	
	-15 DEG, 0 MIN, 11.7630959	SEC	
LATI OF CAMERA AXIS INTERSECT	-14.7660322	DEG	
	-14 DEG, 45 MIN, 57.7159882	SEC	
SPACECRAFT ALTITUDE	123.6219218	KM	
AZIMUTH OF VELOCITY VECTOR	283.3184511	DEG	
HORIZONTAL VELOCITY	1.6173707	KM/SEC	
TILT ANGLE	13.2296591	DEG	
SIGMA TILT ANGLE	.0002000	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	277.0888138	DEG	
LATITUDE OF SUBSOLAR POINT	-.7306718	DEG	
	0 DEG, 43 MIN, 50.4183769	SEC	
SWING ANGLE	270.7859352	DEG	
SIGMA SWING ANGLE	.0008740	DEG	
NORTH DEVIATION ANGLE	166.9652688	DEG	
X-TILT	.1798596	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-13.2283815	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-76.6249148	DEG	
SIGMA HEADING	.0002054	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.92961779	-.20512026	.30616408	127.242826

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.34069453+00	-.91708113+00	-.20709741+00
-.36663181+00	.33243119+00	-.86894797+00
.86574144+00	-.22011735+00	-.44948862+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.94706189+00	.22518681+00	.22883310+00
-.23204153+00	-.97270080+00	-.31391365-02
.22187923+00	-.56071731-01	.97346057+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
-8.877	154.920
-20.742	151.951
-20.868	150.935
-8.315	154.118

LATITUDE	LONGITUDE
-12.006	154.207
-17.691	152.789
-17.635	151.905
-11.665	153.412

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT1972		12	13	1	11	36.034
CTE			5	19	38	37.812

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-510.5859244	-1733.2896967	-448.8857977	-1.4376152	.2521125	.6966028
SELENOGRAPHIC	178.3744647	1836.2248899	249.5136193	1.5192565	-.2249423	.5067565

LONGITUDE OF NADIR POINT		84.4515848	DEG
LONG OF CAMERA AXIS INTERSECT	84 DEG, 27 MIN,	5.7053375	SEC
		85.3093548	DEG
	85 DEG, 18 MIN,	33.6772156	SEC
SPACECRAFT RADIUS		1861.6649382	KM
SCALE FACTOR		.0048056	M/KM
MEAN ALTITUDE RATE		-.0083809	KM/SEC
TILT AZIMUTH		109.8108168	DEG
SIGMA TILT AZIMUTH		.0009243	DEG
SUN ELEVATION AT PRIN GRND PNT		79.8472443	DEG
LONGITUDE OF SUBSOLAR POINT		91.4123806	DEG
	91 DEG, 24 MIN,	44.5703316	SEC
ALPHA		-12.9854064	DEG
EMISSION ANGLE		13.3957038	DEG
PHASE ANGLE		22.5858426	DEG
PHI		-12.4844646	DEG
SIGMA PHI		.0002000	DEG
KAPPA		-162.1044807	DEG
SIGMA KAPPA		.0002000	DEG
OMEGA		-.4242263	DEG
SIGMA OMEGA		.0002000	DEG
SPACECRAFT ALTITUDE (LASER)		.0000000	KM

LATITUDE OF NADIR POINT		7.7023676	DEG
LATI OF CAMERA AXIS INTERSECT	7 DEG, 42 MIN,	8.5233593	SEC
		7.3950952	DEG
	7 DEG, 23 MIN,	42.3428249	SEC
SPACECRAFT ALTITUDE		123.5749419	KM
AZIMUTH OF VELOCITY VECTOR		288.4759550	DEG
HORIZONTAL VELOCITY		1.6172162	KM/SEC
TILT ANGLE		12.4915670	DEG
SIGMA TILT ANGLE		.0002001	DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT		142.9087296	DEG
LATITUDE OF SUBSOLAR POINT		-.7301975	DEG
	0 DEG, 43 MIN,	48.7109184	SEC
SWING ANGLE		91.9616907	DEG
SIGMA SWING ANGLE		.0009243	DEG
NORTH DEVIATION ANGLE		162.5845264	DEG
X-TILT		-.4242263	DEG
SIGMA X-TILT		.0002000	DEG
Y-TILT		12.4841164	DEG
SIGMA Y-TILT		.0002000	DEG
HEADING		-72.1984100	DEG
SIGMA HEADING		.0002048	DEG
LASER SLANT RANGE		.0000000	KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.29513764	-.93353196	-.20349902	126.792769

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.81412220*00	.35255014*00	.46142536*00
-.35638035*00	.32402678*00	-.87635589*00
-.45847353*00	-.87790375*00	-.13815543*00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.92960889*00	.29849322*00	-.21616896*00
-.30727374*00	-.95159234*00	.74040777-02
-.20349462*00	.73305973-01	.97632785*00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
13.248	87.823
1.023	83.829
1.629	83.078
13.215	86.864

LATITUDE	LONGITUDE
10.147	86.683
4.330	84.786
4.721	84.034
10.273	85.845

Mission: Apollo 17, Target: Test Cycle

Rev: 36, Camera: 24-Inch Panoramic Frames: 2595 Through: 2599

Coverage Interval:

From: 8.1 Deg N Lat., 64.2 Deg E Long., To: 8.7 Deg N Lat., 61.8 Deg E Long.

From: 155 Hr 33 Min 20.192 Sec, To: 155 Hr 34 Min 9.378 Sec. CTE

Date Processed: 9/11/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

HOPE Version Used: B-6.4 (Relocatable)

Constants Used:

Lunar Potential Model: L-1

Ephemeris: JPL DE 19 (Double Precision)

Libration Model: RTCC (Koziell)

Lunar Radius: 1738.09 Km

Ephemeris-Universal Time Difference: .72166653 Min.

Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Computation Interval: Computation at each film exposure time

Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 155 H, 44 M, 31.954702 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 36. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1505.8475	$\dot{X}$ =	.7583
Y =	896.9519	$\dot{Y}$ =	-1.4280
Z =	587.5814	$\dot{Z}$ =	.1960

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T00319 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.9271362	-.2076425	.3119342
.3673256	-.3389995	.8661127
-.0740963	.9175859	.3905711

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally,the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a short sequence of 40 deg S oblique panoramic photography starting at 64.2 deg E. Long. and ending at 61.8 deg E. Long. Throughout the sequence tilt is maintained at 40 ± 0.5 deg. All photos of this sequence are of the lunar horizon.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	17	6	18.925
CTE			6	11	33	20.172

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-812.7310565	-1695.7596313	-283.3743673	-1.0296170	.5901627	.7544629
SELENOGRAPHIC	765.1765549	1652.3750134	363.0965547	1.3680080	-.7495497	.4504519

LONGITUDE OF NADIR POINT	65.1522358 DEG	LATITUDE OF NADIR POINT	11.2766657 DEG
	65 DEG, 9 MIN, 8.0599450 SEC		11 DEG, 16 MIN, 36.7706080 SEC
LONG OF CAMERA AXIS INTERSECT	64.2202549 DEG	LATI OF CAMERA AXIS INTERSECT	8.0937935 DEG
	64 DEG, 13 MIN, 12.9176331 SEC		8 DEG, 5 MIN, 37.6560410 SEC
SPACECRAFT RADIUS	1856.7922749 KM	SPACECRAFT ALTITUDE	118.7022786 KM
SCALE FACTOR	.0000000 /KM	AZIMUTH OF VELOCITY VECTOR	286.5357761 DEG
MEAN ALTITUDE RATE	-.0107195 KM/SEC	HORIZONTAL VELOCITY	1.6213145 KM/SEC
TILT AZIMUTH	195.1798715 DEG	TILT ANGLE	39.5539546 DEG
SIGMA TILT AZIMUTH	.0003140 DEG	SIGMA TILT ANGLE	.0002000 DEG
SUN ELEVATION AT PRIN GRND PNT	55.9945536 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	113.9127789 DEG
LONGITUDE OF SUBSOLAR POINT	83.3502956 DEG	LATITUDE OF SUBSOLAR POINT	-.7112738 DEG
	83 DEG, 21 MIN, 1.0640860 SEC		0 DEG, 42 MIN, 40.5657649 SEC
ALPHA	-39.3669658 DEG	SWING ANGLE	179.3260140 DEG
EMISSION ANGLE	42.8669310 DEG	SIGMA SWING ANGLE	.0003140 DEG
PHASE ANGLE	99.4013910 DEG	NORTH DEVIATION ANGLE	158.7040813 DEG
PHI	-.5566275 DEG	X-TILT	-39.5506753 DEG
SIGMA PHI	.0002594 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-162.9459972 DEG	Y-TILT	.4291919 DEG
SIGMA KAPPA	.0002594 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-39.5576749 DEG	HEADING	-73.3004420 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES	X	Y	Z	MAGNITUDE (KM)
OF CAMERA AXIS	-.10696015	-.65218325	-.75054663	157.720692

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.81662019+00	.33279650+00	.45794682+00
-.56367560+00	-.30957672+00	-.76578845+00
-.11013791+00	-.89066017+00	.44112781+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.95779790+00	.28734506+00	-.74907332-02
-.22013149+00	-.73715710+00	.63676044+00
.17744816+00	.61158170+00	.77102525+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
12.172	65.698	10.882	65.385
....	.000	....	.000
....	.000	....	.000
12.301	65.259	11.057	64.799

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	13	17	7	7.611
GET			0	11	34	9.375

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-877.3565031	-1417.6745529	-293.0371127	-1.4977702	.5016944	.7693235
SELENOGRAPHIC	831.9480910	1114.1250751	349.9092490	1.3378713	-.8062847	.9363516

LONGITUDE OF NADIR POINT	62.7326305 DEG	LATITUDE OF NADIR POINT	11.7675493 DEG
	62 DEG, 43 MIN, 57.4912252 SEC		11 DEG, 56 MIN, 3.1775065 SEC
LONG OF CAMERA AXIS INTERSECT	61.8450278 DEG	LATI OF CAMERA AXIS INTERSECT	8.0916277 DEG
	61 DEG, 50 MIN, 42.1073914 SEC		8 DEG, 41 MIN, 29.8598071 SEC
SPACECRAFT RADIUS	1856.2576413 KM	SPACECRAFT ALTITUDE	110.1676949 KM
SCALE FACTOR	.2238477 M/KM	AZIMUTH OF VELOCITY VECTOR	206.0495908 DEG
MEAN ALTITUDE RATE	-.2110101 KM/SEC	HORIZONTAL VELOCITY	1.9217832 KM/SEC
TILT AZIMUTH	175.0074100 DEG	TILT ANGLE	40.2958913 DEG
SIGMA TILT AZIMUTH	.0003091 DEG	SIGMA TILT ANGLE	.0002001 DEG
SUN ELEVATION AT PRIN GRND PNT	26.6063209 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	112.0434584 DEG
LONGITUDE OF SUBSOLAR POINT	33.3433744 DEG	LATITUDE OF SUBSOLAR POINT	-.7112573 DEG
	33 DEG, 20 MIN, 36.1477375 SEC		0 DEG, 42 MIN, 40.5260901 SEC
ALPHA	-39.5083336 DEG	SWING ANGLE	179.1930330 DEG
EMISSION ANGLE	93.6861629 DEG	SIGMA SWING ANGLE	.0003091 DEG
PHASE ANGLE	51.2081797 DEG	NORTH DEVIATION ANGLE	159.7766915 DEG
PHI	-.7265391 DEG	X-TILT	-40.2904517 DEG
SIGMA PHI	.0002622 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-133.3690777 DEG	Y-TILT	.5542185 DEG
SIGMA KAPPA	.0002622 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-90.2904515 DEG	HEADING	-74.3389516 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.13363503	-.62481196	-.76925398	158.917959

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.80123075+00	.37597455+00	.46570613+00
-.58274422+00	-.31332616+00	-.74982384+00
-.13578669+00	-.87216736+00	.46993050+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.96283040+00	.26993327+00	-.96721870-02
-.21192414+00	-.73274506+00	.64666267+00
.16746813+00	.62467643+00	.76271471+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
12.814	63.254	11.528	62.967
********	.000	********	.000
********	.000	********	.000
12.914	62.814	11.691	62.373

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 49, Camera: 24-Inch Panoramic Frames: 2600 Through: 2768

Coverage Interval:

From: 5.9 Deg N Lat., 78.4 Deg E Long., To: 21.5 Deg N Lat., 24.9 Deg E Long.

From: 181 Hr 8 Min 59.654 Sec, To: 181 Hr 26 Min 44.054 Sec. CTF

Date Processed: 9/11/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72171653 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 181 H, 25 M, 11.1075 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 49. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1488.5866	$\dot{X}$ =	.7256
Y =	886.6705	$\dot{Y}$ =	-1.4287
Z =	649.3576	$\dot{Z}$ =	.2875

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T00114 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally,the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of panoramic stereo strip photography starting at 78.4 deg E. Long. and ending at 24.9 deg E. Long. Throughout the sequence tilt is maintained at 12.5 ± 0.5 deg with forward tilt slightly higher than aft tilt.

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	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	10	18	41	57.905
CTE			7	13	8	59.654

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	42.1558756	-1764.7909125	-554.7132756	-1.4866229	-.2293456	.6169652
SELENOGRAPHIC	347.8799534	1608.5922642	178.7009352	1.4654644	-.3433101	.6199380

LONGITUDE OF NADIR POINT	79.1117611 DEG	LATITUDE OF NADIR POINT	5.5419901 DEG
	79 DEG, 6 MIN, 42.3369353 SEC		5 DEG, 32 MIN, 30.9645349 SEC
LONG OF CAMERA AXIS INTERSECT	78.3470287 DEG	LAT OF CAMERA AXIS INTERSECT	5.8554341 DEG
	78 DEG, 20 MIN, 49.3034363 SEC		5 DEG, 51 MIN, 19.5626163 SEC
SPACECRAFT RADIUS	1850.3974981 KM	SPACECRAFT ALTITUDE	112.3075016 KM
SCALE FACTOR	.0000000 M/KM	AZIMUTH OF VELOCITY VECTOR	292.4970219 DEG
MEAN ALTITUDE RATE	-.0001566 KM/SEC	HORIZONTAL VELOCITY	1.6278002 KM/SEC
TILT AZIMUTH	292.4200891 DEG	TILT ANGLE	12.5124257 DEG
SIGMA TILT AZIMUTH	.0005231 DEG	SIGMA TILT ANGLE	.0004000 DEG
SUN ELEVATION AT PRIN GRND PNT	79.7122479 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	230.0194733 DEG
LONGITUDE OF SUBSOLAR POINT	70.3890596 DEG	LATITUDE OF SUBSOLAR POINT	-.6795826 DEG
	70 DEG, 23 MIN, 20.6146431 SEC		0 DEG, 40 MIN, 46.4972876 SEC
ALPHA	-11.9386710 DEG	SWING ANGLE	269.5005035 DEG
EMISSION ANGLE	13.3354122 DEG	SIGMA SWING ANGLE	.0009231 DEG
PHASE ANGLE	20.3215055 DEG	NORTH DEVIATION ANGLE	157.5539956 DEG
PHI	12.5119516 DEG	X-TILT	-.1062151 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-157.0842896 DEG	Y-TILT	-12.5119283 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-.1062151 DEG	HEADING	-67.0602756 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002049 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES	X	Y	Z	MAGNITUDE (KM)
OF CAMERA AXIS	.0114C463	-.99986054	-.01200946	115.223440

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.88487713+00	-.34623317+00	.31163221+00
-.41033859+00	.26271055+00	-.87327264+00
.22048756+00	-.90061377+00	-.37453570+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.69904459+00	.38050805+00	.21664286+00
.38937583+00	-.92107706+00	.18847095-02
.20026343+00	-.62657523-01	.97624905+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
10.762	80.610	8.152	79.711
.655	76.509	3.276	77.640
.650	75.655	3.451	76.697
11.345	80.182	8.560	79.062

original bad quality

1116-24-41

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	15	18	41	57.905
GET			7	13	8	59.654

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	42.1558756	-1764.7909125	-554.7132756	-1.4866229	-.2273450	.0169652
SELENOGRAPHIC	347.8749534	1608.5922692	178.7009352	1.4654844	-.3433101	.0199380

LONGITUDE OF NADIR POINT	79.1117611 DEG	LATITUDE OF NADIR POINT	5.5419901 DEG
	79 DEG, 6 MIN, 42.3399353 SEC		5 DEG, 32 MIN, 30.9693349 SEC
LONG OF CAMERA AXIS INTERSECT	78.3470287 DEG	LATI OF CAMERA AXIS INTERSECT	5.8554341 DEG
	78 DEG, 20 MIN, 49.3034363 SEC		5 DEG, 51 MIN, 19.5626163 SEC
SPACECRAFT RADIUS	1850.3974981 KM	SPACECRAFT ALTITUDE	112.3075016 KM
SCALE FACTOR	.0000000 M/KM	AZIMUTH OF VELOCITY VECTOR	292.4970219 DEG
MEAN ALTITUDE RATE	-.0001566 KM/SEC	HORIZONTAL VELOCITY	1.6278002 KM/SEC
TILT AZIMUTH	292.4260891 DEG	TILT ANGLE	12.5124257 DEG
SIGMA TILT AZIMUTH	.0009231 DEG	SIGMA TILT ANGLE	.0004000 DEG
SUN ELEVATION AT PRIN GRND PNT	79.7122479 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	250.6194733 DEG
LONGITUDE OF SUBSOLAR POINT	70.3890596 DEG	LATITUDE OF SUBSOLAR POINT	-.6795826 DEG
	70 DEG, 23 MIN, 20.6146431 SEC		0 DEG, 40 MIN, 46.4972876 SEC
ALPHA	-11.9366710 DEG	SWING ANGLE	269.5005035 DEG
EMISSION ANGLE	13.3364122 DEG	SIGMA SWING ANGLE	.0009231 DEG
PHASE ANGLE	20.3215055 DEG	NORTH DEVIATION ANGLE	157.5539956 DEG
PHI	12.5119516 DEG	X-TILT	-.1062151 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-157.0642896 DEG	Y-TILT	-12.5119283 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	-.1062151 DEG	HEADING	-67.0602756 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002049 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.01140463	-.99986054	-.01200946	115.223440

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.88487713+00	-.34623387+00	.31163221+00
-.41033859+00	.26271055+00	-.87327264+00
.22048756+00	-.90061377+00	-.37453970+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.69904454+00	.38050805+00	.21664286+00
.38937583+00	-.92107706+00	.18887095-02
.20026343+00	-.62657521-01	.97624905+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
10.762	80.810	8.152	79.711
.655	76.509	3.276	77.640
.690	75.655	3.451	76.697
11.345	80.182	8.560	79.062

2P2-4-41

APOLLO 17 REV 49 PAN 4773F PAGE - F 2768

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	14	16	59	44.054
CTE			7	13	26	45.602

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1339.7137653	-1254.0219117	237.3478463	-.9105939	1.1162975	.7563306
SELENOGRAPHIC	1551.1652039	750.6796132	673.3737994	.6158730	-1.4878029	.2398116

LONGITUDE OF NADIR POINT	25.8244270 DEG	LATITUDE OF NADIR POINT	21.3577583 DEG
	25 DEG, 49 MIN, 27.9402351 SEC		21 DEG, 21 MIN, 27.9298210 SEC
LONG OF CAMERA AXIS INTERSECT	24.9335597 DEG	LATI OF CAMERA AXIS INTERSECT	21.4897635 DEG
	24 DEG, 56 MIN, .8113289 SEC		21 DEG, 29 MIN, 23.1485939 SEC
SPACECRAFT RADIUS	1850.3345015 KM	SPACECRAFT ALTITUDE	112.2445052 KM
SCALE FACTOR	.0053006 M/KM	AZIMUTH OF VELOCITY VECTOR	279.1000655 DEG
MEAN ALTITUDE RATE	.0000334 KM/SEC	HORIZONTAL VELOCITY	1.6279650 KM/SEC
TILT AZIMUTH	279.2066536 DEG	TILT ANGLE	12.7649655 DEG
SIGMA TILT AZIMUTH	.0009052 DEG	SIGMA TILT ANGLE	.0002000 DEG
SUN ELEVATION AT PRIN GRND PNT	40.5449138 DEG	SUN AZIMUTH AT PRINCIPAL GRND PNT	110.7046645 DEG
LONGITUDE OF SUBSOLAR POINT	70.2391338 DEG	LATITUDE OF SUBSOLAR POINT	-.6792064 DEG
	70 DEG, 14 MIN, 20.8815908 SEC		0 DEG, 40 MIN, 45.1421942 SEC
ALPHA	13.1408600 DEG	SWING ANGLE	270.2592115 DEG
EMISSION ANGLE	13.6047146 DEG	SIGMA SWING ANGLE	.0009052 DEG
PHASE ANGLE	36.2197366 DEG	NORTH DEVIATION ANGLE	171.2763512 DEG
PHI	12.7648402 DEG	X-TILT	.0572732 DEG
SIGMA PHI	.0002000 DEG	SIGMA X-TILT	.0002000 DEG
KAPPA	-171.0461559 DEG	Y-TILT	-12.7648339 DEG
SIGMA KAPPA	.0002000 DEG	SIGMA Y-TILT	.0002000 DEG
OMEGA	.0572732 DEG	HEADING	-81.0591302 DEG
SIGMA OMEGA	.0002000 DEG	SIGMA HEADING	.0002051 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM	LASER SLANT RANGE	.0000000 KM

	X	Y	Z	MAGNITUDE (KM)
SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	-.73417561	-.59760447	-.32226552	115.260349

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.70455058+00	.51973438+00	.48326153+00
-.40149323+00	.26444347+00	-.87685382+00
-.58273340+00	-.81237026+00	.21824690-01

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.96343471+00	.15157401+00	.22094994+00
-.15563805+00	-.98781358+00	-.99960542-03
.21810574+00	-.35351429-01	.97528464+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
26.871	26.213	24.054	25.746
16.025	24.412	18.822	24.082
15.843	23.545	18.606	24.077
27.296	25.376	24.246	24.955

original fiche poor quality

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 62, Camera: 24-Inch Panoramic Frames: 2769 Through: 2900

Coverage Interval: Roll to Vertical Stereo

From: 18.2 Deg S Lat., 129.7 Deg E Long., To: 4.6 Deg S Lat., 90.6 Deg E Long.

From: 206 Hr 35 Min 3.974 Sec, To: 206 Hr 47 Min 46.834 Sec. CTE

Coverage Interval: Vertical Mono

From: 17.5 Deg N Lat., 32.0 Deg E Long., To: 18.9 Deg N Lat., 26.4 Deg E Long.

From: 207 Hr 9 Min 36.520 Sec, To: 207 Hr 11 Min 36.599 Sec. CTE

Date Processed: 9/11/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

  HOPE Version Used: B-6.4 (Relocatable)

  Constants Used:

  Lunar Potential Model: L-1

  Ephemeris: JPL DE 19 (Double Precision)

  Libration Model: RTCC (Koziell)

  Lunar Radius: 1738.09 Km

  Ephemeris-Universal Time Difference: .72178319 Min.

  Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

  Computation Interval: Computation at each film exposure time

  Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 207 H. 9 M. 58.94921 sec.

Type: One Revolution Solution

Description. This vector was determined from a solution based on a fit of data from Rev 36. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1513.7465	$\dot{X}$ =	.6941
Y =	901.6569	$\dot{Y}$ =	-1.4169
Z =	566.6613	$\dot{Z}$ =	.4033

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T00293 T01247 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

- APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

OUTPUT

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally,the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for two sequences of panoramic strip photography. The first is a sequence of stereo photography taken during a roll maneuver to bring the camera axis to the vertical. This sequence starts at 129.7 deg E Long. (frame 2769) and ends at 90.6 deg E Long. (frame 2889). Throughout this sequence tilt is constantly changing, ranging from a low of 7.3 deg (frame 2770) to a high of 64.7 (frame 2871). Only vehicle state vector data are provided for frame 2850 for which vehicle attitude data were ignored as the result of a computer erratic.

The second sequence is panoramic vertical mono photography starting at 32.0 deg E Long. and ending at 26.4 deg E Long. (frames 2890-2900). During this sequence tilt is maintained less than 0.7 deg.

There is a 21 minute gap between the two sequences.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMTI	72	12	15	20	8	2.243
CTE			8	14	35	3.974

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	1612.4293013	-354.1185919	-840.1215264	-.9642648	-1.5414958	-.2373010
SELENOGRAPHIC	-1175.9238111	1301.8031823	-594.6662500	1.0890392	1.1507476	.3712632

LONGITUDE OF NADIR POINT	132.0916233	DEG	
	132 DEG, 5 MIN,	29.8439026	SEC
LONG OF CAMERA AXIS INTERSECT	129.6543560	DEG	
	129 DEG, 39 MIN,	15.6816101	SEC
SPACECRAFT RADIUS	1852.3272615	KM	
SCALE FACTOR	.0000000	M/KM	
MEAN ALTITUDE RATE	-.0018128	KM/SEC	
TILT AZIMUTH	283.4722176	DEG	
SIGMA TILT AZIMUTH	.0003778	DEG	
SUN ELEVATION AT PRIN GRND PNT	17.1552410	DEG	
LONGITUDE OF SUBSOLAR POINT	57.5169446	DEG	
	57 DEG, 31 MIN,	1.0007143	SEC
ALPHA	-34.0042458	DEG	
EMISSION ANGLE	34.3437474	DEG	
PHASE ANGLE	106.7776928	DEG	
PHI	31.9617467	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-166.2035103	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.2023278	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	-18.7256713	DEG	
	-18 DEG, 43 MIN,	32.4166489	SEC
LATI OF CAMERA AXIS INTERSECT	-18.1552000	DEG	
	-18 DEG, 9 MIN,	18.7200165	SEC
SPACECRAFT ALTITUDE	114.2372652	KM	
AZIMUTH OF VELOCITY VECTOR	283.9173969	DEG	
HORIZONTAL VELOCITY	1.6272563	KM/SEC	
TILT ANGLE	31.9623168	DEG	
SIGMA TILT ANGLE	.0002000	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	275.0945740	DEG	
LATITUDE OF SUBSOLAR POINT	-.6464627	DEG	
	0 DEG, 38 MIN,	47.2655582	SEC
SWING ANGLE	269.6177868	DEG	
SIGMA SWING ANGLE	.0003778	DEG	
NORTH DEVIATION ANGLE	168.1290901	DEG	
X-TILT	-.2023278	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-31.9615249	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-76.0772748	DEG	
SIGMA HEADING	.0002357	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	.89406868	-.22179018	.38916618	136.419887

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

.2195876E+00	-.9050771E+00	-.3641654E+00
-.3980834E+00	.2576624E+00	-.8804201E+00
.8906800E+00	.3382976E+00	-.3037167E+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.8234785E+00	.2041369E+00	.5293496E+00
-.2384724E+00	-.9711428E+00	.3531279E-02
.5147950E+00	-.1233273E+00	.8483964E+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
-12.086	131.579	-15.345	130.885
-24.445	128.167	-21.200	129.283
-25.236	126.477	-21.352	128.040
-10.692	130.637	-14.655	129.924

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	15	20	44	22.853
CTE			8	15	11	36.599

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	-1043.3082670	-1528.5083508	31.3340502	-1.1758601	.8172518	.7755235
SELENOGRAPHIC	1567.9868328	780.0723086	598.9292336	.5937851	-1.4716876	.3654941

LONGITUDE OF NADIR POINT	26.4503114	DEG	
26 DEG, 27 MIN,	1.1211205	SEC	
LONG OF CAMERA AXIS INTERSECT	26.4252565	DEG	
26 DEG, 25 MIN,	30.9233665	SEC	
SPACECRAFT RADIUS	1850.8948488	KM	
SCALE FACTOR	.0054052	M/KM	
MEAN ALTITUDE RATE	.0010425	KM/SEC	
TILT AZIMUTH	275.3835335	DEG	
SIGMA TILT AZIMUTH	.0312980	DEG	
SUN ELEVATION AT PRIN GRND PNT	54.0140886	DEG	
LONGITUDE OF SUBSOLAR POINT	57.2104915	DEG	
57 DEG, 12 MIN,	37.7695298	SEC	
ALPHA	.3561392	DEG	
EMISSION ANGLE	.3906686	DEG	
PHASE ANGLE	35.6294622	DEG	
PHI	.3633559	DEG	
SIGMA PHI	.0002000	DEG	
KAPPA	-166.6888847	DEG	
SIGMA KAPPA	.0002000	DEG	
OMEGA	-.0506000	DEG	
SIGMA OMEGA	.0002000	DEG	
SPACECRAFT ALTITUDE (LASER)	.0000000	KM	

LATITUDE OF NADIR POINT	18.8801124	DEG	
18 DEG, 52 MIN,	48.4046745	SEC	
LATI OF CAMERA AXIS INTERSECT	18.8823447	DEG	
18 DEG, 52 MIN,	56.4410019	SEC	
SPACECRAFT ALTITUDE	112.8048525	KM	
AZIMUTH OF VELOCITY VECTOR	283.7082540	DEG	
HORIZONTAL VELOCITY	1.6284758	KM/SEC	
TILT ANGLE	.3670210	DEG	
SIGMA TILT ANGLE	.0001995	DEG	
SUN AZIMUTH AT PRINCIPAL GRND PNT	119.4246817	DEG	
LATITUDE OF SUBSOLAR POINT	-.6456536	DEG	
0 DEG, 38 MIN,	44.3530369	SEC	
SWING ANGLE	262.0720722	DEG	
SIGMA SWING ANGLE	.0312975	DEG	
NORTH DEVIATION ANGLE	166.6888333	DEG	
X-TILT	-.0506000	DEG	
SIGMA X-TILT	.0002000	DEG	
Y-TILT	-.3633557	DEG	
SIGMA Y-TILT	.0002000	DEG	
HEADING	-76.6885628	DEG	
SIGMA HEADING	.0002000	DEG	
LASER SLANT RANGE	.0000000	KM	

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.84446798	-.42724208	-.32301397	112.807315

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.72801981+00	.49889128+00	.47020703+00
-.39725325+00	.25199488+00	-.88243328+00
-.55872808+00	-.82922009+00	.14728926-01

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.97311336+00	.23023937+00	.63417110-02
-.23023842+00	-.97313388+00	.88313601-03
.63745729-02	-.60072641-03	.99997948+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
24.119	28.202	21.372	27.450
13.446	25.501	16.223	26.151
13.607	24.746	16.381	25.427
24.305	27.406	21.542	26.707

Mission: Apollo 17, Target: Panoramic strip photography

Rev: 74, Camera: 24-Inch Panoramic Frames: 2901 Through: 3151

Coverage Interval:

From: 1.1 Deg N Lat., 65.3 Deg E Long., To: 21.6 Deg N Lat., 45.7 Deg W Long.

From: 230 Hr 44 Min 26.952 Sec, To: 231 Hr 20 Min 32.685 Sec. CTF

Date Processed: 9/12/73, APE Version Used: 7.

INPUT DATA

- Trajectory Tape:

HOPE Version Used: B-6.4 (Relocatable)

Constants Used:

Lunar Potential Model: L-1

Ephemeris: JPL DE 19 (Double Precision)

Libration Model: RTCC (Koziell)

Lunar Radius: 1738.09 Km

Ephemeris-Universal Time Difference: .72183319 Min

Base Time: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Computation Interval: Computation at each film exposure time

Integration Interval: Variable (1×10^{-14} - 64 Min)

Initial State Vector Used:

Coordinate System: Selenographic (Instantaneous Inertial)

Time From Base: 230 H, 56 M, 45.08191 sec.

Type: One Revolution Solution

Description: This vector was determined from a solution based on a fit of data from Rev 74. For the solution the energy of the orbit was constrained to be an analytically determined value.

Units: Km, Second, Degree

Components:

X =	1539.6136	$\dot{X}$ =	.6839
Y =	917.0646	$\dot{Y}$ =	-1.3913
Z =	463.1953	$\dot{Z}$ =	.4984

● Telemetered Data Tape

Data Source: Station Tapes

Bit Rate: High

Date Edited: 9/11/73 (During APE operation)

Edited Data Tape No. T01532 File No.: 1 Location: TRW

Remarks: There were no gaps in the vehicle attitude data used for this sequence.

● APE Card Inputs:

Time of Launch: Yr 1973 Month 12 Day 7 Hr 5 Min 33 Sec 0

Range Zero-Clock Zero Time Difference 0.0 Sec

REFSMMAT Used:

-.6493783	-.7570575	.0719149
.4029205	-.2623184	.8768376
-.6449519	.5983752	.4753779

Camera Positioning Angles Used: The angle from the spacecraft body X-Z plane to the camera optical axis when positioned for vertical or "mono" photography (camera positioning angle) was 37.75 degrees.

The angle between the camera optical axis central position and its fore or aft positions (excursion angle) was 12.5 degrees.

Uncertainties Assumed:

± 1 degree in camera positioning angle

±0.2 mrad in each gimbal angle

±20 ms in onboard clock bias definition

±5 ms in onboard clock drift rate

±5 ms in universal to sidereal time conversion

General Description:

The basic output is a listing of single page tabulations of computed spacecraft state, camera orientation and photograph position and lighting data. Each tabulation presents the computation results for a specified photograph time. The basic data for each map camera sequence is preceded and followed by a star pattern description for a stellar photograph that is companion to a specific map camera photograph of the sequence.

Basic Data Format:

Generally, the format will be as shown in figures 1 and 2. However, when the calculated camera aiming direction is above the lunar horizon, a message to that effect along with the vehicle state vector and the computed value of tilt are substituted for the tabulation.

With the exception of its initial line, all entries of each tabulation are self explanatory. The initial line contains six entries that are from left to right:

1. Mission title
2. State vector identification
3. Date of data origin
4. Status of data PRE = preliminary, F = final
5. Page number within the sequence

Star Pattern Format:

The star pattern format is a star pattern plot preceded by identification, and field of view direction information. It is followed by a tabulation of the stellar camera diapositive coordinates and identification numbers of the plotted stars. All angular quantities are expressed in radian measure.

OUTPUT Summary: These photo evaluation data are for a sequence of panoramic stereo strip photography starting at 65.3 deg E. Long. and ending at 45.7 deg W Long. Throughout the sequence a tilt of 12.5 ± 0.7 deg is maintained with forward tilt slightly greater than aft tilt.

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	16	20	17	25.238
CTE			9	19	44	26.952

STATE VECTOR	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
1950.0	489.1293989	-1646.1185909	-683.8562297	-1.9300010	-.6242514	.4735445
SELENOGRAPHIC	750.4246789	1689.0355901	25.1972916	1.3665429	-.6141987	.6435507

LONGITUDE OF NADIR POINT	66.0448141 DEG
	66 DEG, 2 MIN, 41.3307953 SEC
LONG OF CAMERA AXIS INTERSECT	65.2827816 DEG
	65 DEG, 16 MIN, 58.0137634 SEC
SPACECRAFT RADIUS	1848.4083226 KM
SCALE FACTOR	.0000000 M/KM
MEAN ALTITUDE RATE	.0023262 KM/SEC
TILT AZIMUTH	291.6098137 DEG
SIGMA TILT AZIMUTH	.0009111 DEG
SUN ELEVATION AT PRIN GRND PNT	69.9451065 DEG
LONGITUDE OF SUBSOLAR POINT	45.2988543 DEG
	45 DEG, 17 MIN, 55.8754778 SEC
ALPHA	-12.9688232 DEG
EMISSION ANGLE	13.4976618 DEG
PHASE ANGLE	32.6798501 DEG
PHI	12.6712363 DEG
SIGMA PHI	.0002000 DEG
KAPPA	-156.5122528 DEG
SIGMA KAPPA	.0002000 DEG
OMEGA	-.4223778 DEG
SIGMA OMEGA	.0002000 DEG
SPACECRAFT ALTITUDE (LASER)	.0000000 KM

LATITUDE OF NADIR POINT	.7810737 DEG
	0 DEG, 46 MIN, 51.8653965 SEC
LATI OF CAMERA AXIS INTERSECT	1.0828041 DEG
	1 DEG, 4 MIN, 58.0948091 SEC
SPACECRAFT ALTITUDE	110.3183262 KM
AZIMUTH OF VELOCITY VECTOR	293.2466513 DEG
HORIZONTAL VELOCITY	1.6305627 KM/SEC
TILT ANGLE	12.6781709 DEG
SIGMA TILT ANGLE	.0002000 DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT	265.2387657 DEG
LATITUDE OF SUBSOLAR POINT	-.6134775 DEG
	0 DEG, 36 MIN, 48.5189438 SEC
SWING ANGLE	268.0751578 DEG
SIGMA SWING ANGLE	.0009111 DEG
NORTH DEVIATION ANGLE	156.9452539 DEG
X-TILT	-.4223778 DEG
SIGMA X-TILT	.0002000 DEG
Y-TILT	-12.6708857 DEG
SIGMA Y-TILT	.0002000 DEG
HEADING	-66.4172918 DEG
SIGMA HEADING	.0002050 DEG
LASER SLANT RANGE	.0000000 KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.21006080	-.97535392	.06752183	113.257495

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.79564658+00	-.56902292+00	.20774858+00
-.40199585+00	.23943147+00	-.88378276+00
.45315110+00	-.78669268+00	-.41924771+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.69410301+00	.39032915+00	.21935047+00
-.39854210+00	-.91712049+00	.73718161-02
.20904826+00	-.80828856-01	.97561823+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
5.827	67.708	3.314	66.634
-4.045	63.393	-1.453	64.555
-4.004	62.541	-1.273	63.823
6.397	67.109	3.720	66.009

	YEAR	MONTH	DAY	HOUR	MINUTE	SECOND
GMT	1972	12	16	20	53	24.679
CTE			9	15	20	32.685

STATE VECTOR 1950.0 SELENOGRAPHIC	X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
	-1700.7179502	-141.6531312	731.4729720	.0463463	1.5676801	.4184924
	1224.9153634	-1215.2253135	685.8350051	-1.0645753	-1.2045878	-.2252109

LONGITUDE OF NADIR POINT	-44.7724733	DEG
	-44 DEG, 46 MIN, 20.9040070	SEC
LONG OF CAMERA AXIS INTERSECT	-45.7487473	DEG
	-45 DEG, 44 MIN, 55.4904556	SEC
SPACECRAFT RADIUS	1856.7605835	KM
SCALE FACTOR	.0050195	M/KM
MEAN ALTITUDE RATE	.0028939	KM/SEC
TILT AZIMUTH	263.1999397	DEG
SIGMA TILT AZIMUTH	.0008801	DEG
SUN ELEVATION AT PRIN GRND PNT	-.9173479	DEG
LONGITUDE OF SUBSOLAR POINT	44.9955403	DEG
	44 DEG, 59 MIN, 43.9452267	SEC
ALPHA	13.9249076	DEG
EMISSION ANGLE	14.0451072	DEG
PHASE ANGLE	76.9929199	DEG
PHI	13.1241916	DEG
SIGMA PHI	.0002000	DEG
KAPPA	171.4049454	DEG
SIGMA KAPPA	.0002000	DEG
OMEGA	.4186485	DEG
SIGMA OMEGA	.0002000	DEG
SPACECRAFT ALTITUDE (LASER)	.0000000	KM

LATITUDE OF NADIR POINT	21.6768799	DEG
	21 DEG, 40 MIN, 36.7675781	SEC
LATI OF CAMERA AXIS INTERSECT	21.5657628	DEG
	21 DEG, 33 MIN, 56.7459297	SEC
SPACECRAFT ALTITUDE	118.0705872	KM
AZIMUTH OF VELOCITY VECTOR	261.3728390	DEG
HORIZONTAL VELOCITY	1.6232584	KM/SEC
TILT ANGLE	13.1307410	DEG
SIGMA TILT ANGLE	.0002001	DEG
SUN AZIMUTH AT PRINCIPAL GRND PNT	90.2962275	DEG
LATITUDE OF SUBSOLAR POINT	-.6126400	DEG
	0 DEG, 36 MIN, 45.5041695	SEC
SWING ANGLE	271.8431554	DEG
SIGMA SWING ANGLE	.0008800	DEG
NORTH DEVIATION ANGLE	188.4670173	DEG
X-TILT	.4186485	DEG
SIGMA X-TILT	.0002000	DEG
Y-TILT	-13.1238356	DEG
SIGMA Y-TILT	.0002000	DEG
HEADING	-98.6926591	DEG
SIGMA HEADING	.0002054	DEG
LASER SLANT RANGE	.0000000	KM

SELENOGRAPHIC DIRECTION COSINES OF CAMERA AXIS	X	Y	Z	MAGNITUDE (KM)
	-.79427531	.47023877	-.38471059	122.083857

TRANSFORMATION MATRIX FROM SELENOCENTRIC TO CAMERA

-.17901609+00	.92360658+00	.33897495+00
-.39341402+00	.24859485+00	-.88511359+00
-.90176422+00	-.29180706+00	.31885734+00

TRANSFORMATION MATRIX FROM LOCAL HORIZONTAL TO CAMERA

-.96269482+00	-.14718078+00	.22705647+00
.14944601+00	-.98874292+00	-.73067299-02
.22557591+00	.20898534-01	.97385422+00

PHOTOGRAPH FOOTPRINT

LATITUDE	LONGITUDE
27.456	-46.418
15.925	-44.465
15.476	-45.279
27.656	-47.447

LATITUDE	LONGITUDE
24.409	-45.831
18.869	-44.900
18.610	-45.706
24.422	-46.728

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