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NASA CONTRACT NAS9-12557

FINAL TECHNICAL REPORT

APOLLO DATA ANALYSIS
EXPERIMENT S-211
LOW BRIGHTNESS IMAGE DATA ANALYSIS

January 31, 1974

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FINAL TECHNICAL REPORT

APOLLO DATA ANALYSIS
EXPERIMENT S-211

LOW BRIGHTNESS IMAGE DATA ANALYSIS

Prepared for

Lyndon B. Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas 77058

Robert D. Mercer

Robert D. Mercer
Principal Investigator

January 31, 1974

The Dudley Observatory
100 Fuller Road
Albany, New York 12205

Abstract

This is the Final Technical Report under NASA Johnson Space Center Contract NAS9-12557 for Low Brightness Image Data Analysis. The report gives the background for the contract and technical progress made over a two year period. The purpose of this work was the scientific analyses of photographic data in astronomy obtained by the Apollo Orbital Science Photographic Team during Apollo flights 14 through 17, inclusive. Principal Investigator for this work was Mr. Robert D. Mercer of the Dudley Observatory. Co-Investigator was Mr. Lawrence Dunkelman of the NASA Goddard Space Flight Center. The Johnson Space Center also provided additional funds for portions of this work through a companion Intercenter Agreement to the Co-Investigator.

Elements of analysis of photographic frames provided by NASA are described herein and included several tasks. Some of these tasks were the collection and correlation of Quick-Look listings and working prints for further study and the generation of post-mission and project reports. Postflight calibrations of the flight photographic systems were carried out, and the resulting data were used to correct lens vignetting effects in the original data. The data handling flow included photodigitization of flight data photographic scenes, calibrated step-wedges and vignetting patterns followed by computer program processing of the resulting array of film density readings.

Several factors kept results from reaching the originally anticipated level of accomplishment. However, brightness, polarization and color information on zodiacal light and brightness measurements on the lunar libration region, L4, were nearing the point of scientific publication at the completion of the contracted time period.

Background

The requirement for Principal Investigators and Teams of Investigators to assess scientific and technical data collected on manned lunar flights resulted directly from the activities of the Apollo Orbital Science Photographic Team (APST). This group was established in early 1970 to improve the scientific value of the Apollo lunar missions using photographic techniques and on-board systems capabilities in such fields as geology, geodesy/cartography, photogrammetry, astronomy and space photographic instrumentation. The APST served through the Apollo Program Director's Office at NASA Headquarters and made its detailed recommendations directly to integration and operations groups at NASA's Johnson Space Center (JSC).

Their work was carried out separately from those experiments formally accepted by NASA for specific flights. The formal experiments included the usual preparation, integration, operation and data analyses phases; whereas, the APST work included all but the data analysis phase. In a sense, the APST scientific activities were exploratory in nature and cut across many disciplines; so, no one could be certain of results. For this reason, then, it was considered premature to add data analyses responsibilities to their charter, but the APST members were not precluded from participating in such analyses, if warrented by the quantity and quality of data so obtained.

The work of the APST proved quite fruitful from the beginning, and NASA Headquarters issued an Announcement for Data Analysis Opportunities in the Spring of 1971. Contract NAS9-12557 for Low Brightness Image Data Analysis was one of three proposals accepted in the area of astronomy, the other two being concerned with solar corona data. All used techniques of photographic photometry to obtain absolute brightness measurements on their subject matter. As is NASA's custom, these data analyses efforts were given identifying numbers associated with their experimental work; in the case of Contract NAS9-12557 it became Experiment S-211. Proposals had to include not only known photographic results, but also data expected or possible to collect, because they were submitted to NASA prior to the launch of the last three lunar missions.

The Principal Investigator (PI), Mr. Robert D. Mercer of the Dudley Observatory, and the Co-Investigator (Co-I), Mr. Lawrence Dunkelman of NASA's Goddard Space Flight Center (GSFC), were directly involved in the acquisition of these data as the astronomical members of the APST. They were also involved in reversed roles under the formal Apollo Experiment S-178, Gegenschein/Moulton Region, where the data obtained would be handled in almost exactly the same manner. In both cases, the work was planned to utilize government facilities as much as possible. While the basic government contract was with the Dudley Observatory, a companion effort was funded at GSFC by JSC through an Intercenter Agreement for the Co-I to use GSFC's contract or student service personnel as well as government facilities and equipments. This agreement is included as Attachment 1. Advantages and disadvantages in this joint arrangement will be discussed below.

Technical Progress

The initial technical approach, as outlined in the proposal, was to use an automated, Joyce-Loebl double-beam microdensitometer at GSFC to photodigitize those frames of the original film which contained scientifically valuable information. Stepped line scan readings of film density would be recorded on magnetic tape for later input to a digital computer at GSFC. Density readings of calibrated step-wedges contained on the flight film and of a second standard wedge for instrument calibration would also be recorded and used in a computer program to convert scene densities to absolute brightness measurements. Finally, calibrated readings of the flight len's photometric transfer function, usually referred to as its "vignetting function", would be applied to brightness readings to arrive at actual values of brightness across the scene. The computer program to handle these inputs was in development by another Co-I, Dr. Charles Wolff, on Experiment S-178. This, then, was the situation at the beginning of the contracted effort.

Digitization of data for Experiment S-178 at GSFC proved to be much slower than anticipated, on the order of hours per full frame. Furthermore, the number of frames containing important astronomical data obtained on the last four Apollo lunar missions ran into the hundreds with half again as many calibration frames. The workload grew well beyond that originally anticipated. Other means to carry out this work had to be sought. Fortunately, several vendors were just beginning to produce more fully automated and much faster photodigitizing equipments. The final digitizing method used will be discussed more fully below.

Meanwhile, after careful consideration by all concerned, it was judged too great a burden to develop the Experiment S-178 computer program to meet S-211 requirements. In spite of the much simpler needs for S-178, the programing had gone very slowly. Besides, the S-211 data would require a greater sophistication to deal with frame mosaicing and removal of image smear on the varied subject matter resulting from successful APST efforts. The S-178 program was only intended to remove starlight by clipping sharp gradients in the spacial values of brightness, smoothing over the remaining scene, and, if required, superimposing and adding arrays of values. The last process mentioned required considerable time to adjust arrays representing large granulation in readings, and then checking frame registration outputs before the addition process.

Thus, another premise on which the original proposal had been based had to be modified after six months into the contract. Here, again, alternative techniques were known to be available; however, it had been hoped that the simpler S-178 program would be adequate, because these alternatives involved very large programs with many sophisticated processors. As expected in the case of these larger programs, it required a longer time to become familiar with their use, although the quality of scientific results could be correspondingly improved. One of these new techniques involved a program running on an IBM computer totally dedicated to image processing work at the Visibility Laboratory in La Jolla. However, those in charge of processing activities felt that the time required to support training and use of this system would overtax their limited staff and resources; so, arrangements for its use could not be made.

Another sophisticated system, the Video Image Communication and Retrieval (VICAR) Program, developed at the Jet Propulsion Laboratory (JPL) for processing televised data from the Ranger, Surveyor and Lunar Orbiter spacecraft, was also satisfactory for S-211 requirements. Furthermore, it had already been acquired from JPL by Dr. Dan Klinglesmith of GSFC for his anticipated needs to support the International Ultraviolet Experiment (IUE) Satellite Program. In the fall of 1972 Dr. Klinglesmith, who, like the Co-I, works in the Laboratory for Optical Astronomy, was checking out the VICAR Program at the GSFC Computer Facility for operational use. He was quite willing to include our requirements in return for personnel assistance with the checkout of additional processors in the program as well as some financial support to acquire display devices that are especially useful for presenting VICAR output. These requests were met using Inter-center Agreement funds for graduate student assistants and for a portion of the equipment requirements. In addition, Mr. G. C. Alvord, a consultant to the PI in Albany, made a number of trips and spent many weeks at GSFC working directly on S-211 data requirements. A more detailed description of VICAR processing is given later in this report. After a little more than one year, then, the final direction to proceed on photodigitization and computer processing could be started with certainty.

A belated Data Analysis and Handling Plan was then written, and it is included as Attachment 2. Included with it was a draft Exhibit A for the GSFC Procurement Division to use in its Request for Proposals (RFP) on photodigitizing services. Details for accomplishing all portions of the work are specified in this plan and will not be repeated here. Because of problems noted both above and below and also because many steps in the processing flow had to progress in series as shown on page 3 of Attachment 2, it was not possible to increase the rate of accomplishment simply by spending more time. For instance, final computer program tests could go only so far without digitized data. It took three months from draft of the RFP Exhibit A to bid selection. Only after that could arrangements be made for obtaining the flight film and traveling to vendors facilities. But, computer processing of these data could progress no further than the point where vignetting function corrections had to be applied. Vignetting data, in turn, was dependent on optical tests and access to flight camera systems, and so on.

Identification of subject matter, the celestial coordinates of each frame, and times and duration of exposures began immediately, because this was of great value to all other aspects of the work. This task always seems rather mundane, since it does not usually uncover significant new scientific information, but it is very important, nevertheless, because it requires the collection, assimilation and cross-referencing of all supporting data. This can permit researchers to avoid some blind alleys at later stages in the processing. Results of this work are shown in the Quick-Look Lists included as Attachment 3. Since they have only been distributed to a few interested persons, the PI and Research Assistants, Linda Schwabe and Karen Jacobs, intend to publish these lists soon with supporting information in collaboration with the National Space Science Data Center (NSSDC) for much wider distribution as a Data Users Note.

During the Apollo 17 mission more than a hundred frames of lunar surface targets of opportunity were obtained using the Nikon system and type 2485 film. Most of these photographs were taken near the terminators or in earthshine where the scene brightnesses were too weak for color film or slower lenses. Most of these scenes were interspersed throughout the S-211 data. The PI elected to catalog these frames as a part of S-211 work for two very practical reasons, since it was not a formal requirement on any other PI. First, the supporting data had already been collected for S-211 work and the PI's direct support of the Apollo 17 mission as and APST member made it easier for him to perform this task, than for others not familiar with the celestial scenes or sources of supporting data. Second, the detailed work could be carried out by Research Assistant Karen Jacobs without slighting other on-going work.

In the meantime, photodigitizing services were procured on a trial basis by GSFC, using their Intercenter Agreement funds, from both Photometric Data Systems (PDS) of Perkin-Elmer Corp. in South Pasadena and from Dicomed Corp. in Minneapolis. The results from PDS proved better for experimental requirements, and special arrangements were made with another PI, Dr. Don Von Steen, in the Earth Resources Technology Satellite (ERTS) Program at the Dept. of Agriculture in Washington, D. C. to use exactly the same equipment that had been utilized under the service contract at PDS. This saved considerable travel and service costs on the continuing photodigitization work. Unfortunately, the initial service contracts and subsequent arrangements for the photodigitizing work did not get underway until the last seven months of the two year contract. At the close of this contract photodigitization of some calibration and vignetting frames and all of the Apollo 17 data frames remained to be done.

The details of the photodigitization process are quite simple in principle. A square aperture, thirty-six micrometers on a side, of collimated, white light is allowed to pass perpendicularly through the original negative of a selected photographic frame. This beam then impinges upon a calibrated photomultiplier tube, and the developed grain in the photographic emulsion is put into focus at its photocathode. An output voltage of the photomultiplier is recorded in terms of density, that is, in terms of the logarithm, base 10, of transmitted beam intensity. The beam is first stepped horizontally, thirty-six microns per step, completely across the frame in the "x-direction", which is parallel to a side of the square aperture. This is done by mechanically moving the stage, to which the film is attached, using computer controlled servo-motors. At the end of this line scan, the stage is stepped vertically downward in the "y-direction" by thirty-six microns and scanned back in the "negative x-direction". Individual readings and information on position are temporarily stored by the control computer, then written onto a magnetic tape as a string of values following the frame identification group loaded by the operator. One 35 mm frame scanned side-to-side from the bottom part of upper sprocket holes to the top part of lower sprocket holes requires about forty minutes and produces approximately 0.7 million separate readings. The grain size on the very high-speed, 2485 type emulsion is already on the order of ten microns; so, there is very little resolution loss using the thirty-six micrometer beam. The film could easily be digitized to a higher resolution, but that effort would prove wasteful in terms of the additional computer storage and data manipulations required. For instance, if the aperture were reduced to twelve microns square, the photodigitization time, the data storage array size, and subsequent computer manipulations would each increase by nine times.

Vignetting tests had to be performed with great care. These tests were delayed by non-availability of, first, flight cameras from JSC and, second, personnel and laboratory space at GSFC. The tests were finally carried out during the last three months of the contract. The procedure for these tests required that photographs be made of a perfectly uniform field of white light by each flight camera system at the same lens f-stop setting and in the same filter configuration as that used for the data collection. The image of this scene recorded on the emulsion showed greatest exposure at the center of the frame with response dropping off towards the edges and least response at the corners. This falloff in apparent light level is very pronounced for large lens apertures, that is, for low f-numbers. However, large aperture settings are required for collecting all of the available light in low brightness scenes. Thus, these setting must be used and the data corrected for their effects later.

Test photographs of vignetting on calibrated film is the means for doing this. These test frames are digitized just like data frames. From their step-wedge calibrations,emulsion density can be converted to absolute intensity over the frame, then normalized to the maximum value. The logarithm of these normalized readings will be zero at the brightest point on the optical axis near the center of the frame. At distances away from the optical axis, the log will have negative values of larger and larger magnitude.

This matrix of values is aligned with the digitized emulsion densities converted to log intensities for appropriate data frames. The vignetting log intensities are then subtracted point by point from the data log intensities, which increase the resulting values progressively further away from the optical axis. In essence, this mathematically raises the intensities away from the center of the frame by the inverse ratio of the vignetting falloff, which is exactly the desired result. This process requires careful determination of the emulsion response, or "H&D" curves, both for the data and for the vignetting so that accurate absolute measurements can be made and preserved throughout tedious computer manipulations.

This last consideration cannot be overemphasized, and it is this use of the VICAR program by S211 which is somewhat unique, giving an exploratory nature to this image processing technique. On previous programs some of the available processors of VICAR had been used to enhance, purposely, the scene brightnesses or stretch their contrasts so that lunar surface data might yield more discernable features for scientific study. This is quite valuable for creating data formatted for best interpretation by the eye. Unfortunately, it purposely disregards the fidelity of true scene brightnesses or ratios of brightnesses. Work performed under this contract had to use the opposite emphasis and take great pains to preserve quite accurately the brightness.

This has kept the pace slow and deliberate for the initial data processing. Quality, in terms of photometric accuracies, is the ultimate goal of this data analysis effort. Where the brightnesses are just on the threshold of detectability, the absolute error bars increase rapidly. This, in turn, has great influence on determinating the extent of limits for vague, ragged edged phenomena. So far, only a few of the Apollo 15 data frames have progressed to the stage of corrected brightnesses across their celestial scenes.

Besides the brightness computations, computer programing has begun but results have not yet been forthcoming, on two other parts of the work. The first of these is the VIEWS Program obtained from JSC. When this program is supplied with an appropriate state vector, look angle and field-of-view specifications, it will compute instantaneous celestial coordinates, and it then plots stars, planets and surface features of earth or moon that fall into the field-of-view. The program is actually a synthesis of several, individual subprograms in which each part takes as its input the output of the preceding part. Thus, a given state vector is integrated forward or backward in time by a Lunar Trajectory Module (LTM) to the moment of interest where look angle and field-of-view specifications are supplied. Limiting coordinates of the scene are developed so that a library of star and planet positions and magnitudes can be searched and those objects falling within the scene are converted to plot coordinates. Finally, if either the earth or moon is in view, an orthographic projection of vector segments showing surface details is added and occulted stars removed. An option is available to add celestial, geographic and/or selenographic coordinate lines as well. The computer program which performs these searches and calculations finally produces a magnetic plot tape for use on a Stromberg Carlson 4060 Plotter. Digital values on this tape drive both scan and intensity circuits of a cathode ray tube to produce the final plots for recording on microfilm.

It was intended to use the VIEWS Program to make celestial overlays to match important data frames. While checkout of the program did reach the stage where plot tapes were produced, the need for this type of data was considered less important than checkout of the VICAR Program software; so, no overlays had been developed at the completion of the contract. The LTM routine was used separately, however, in an attempt to compute the instantaneous position of the lunar libration point L_4 with solar and planetary perturbations included. Results from Apollo 15 of one four-minute exposure in the supposed direction of L_4 made this supporting computation important. But, after several weeks work, it was clear that the LTM program could not be used in this way. A second computer program using a Double-Precision Trajectory (DPTraj) routine was obtained and checked out for this work. Several weeks were needed to tailor it to the L_4 problem, and here again, such work had to cease so that the computer consultant, Mr. Alvord, could help with the VICAR processing. The extent to which the effort had grown also indicated that it would be better to delay further computations on the L_4 point until the data frame had been processed and analyzed to assure that publishable data was obvious on the film. It still remains doubtful that the L_4 region of light enhancement is present on this frame. Although this frame is one of a dozen that are the furthest along in analysis, additional VICAR processing will be required prior to publication of scientific results.

There have been many interrelated activities between this contracted effort and NASA Centers. Planned use of government teams and facilities was made, of course, in the interest of economy. However, in many instances the scheduling of the government's support could not be advantageously timed, and this is partly the reason why the contracted effort has been delayed. Reporting of technical activities had always been an important responsibility put on the contractor, but it has not been a companion requirement on government supporting groups, and the intermeshing of milestones has not been clear to all. Verbal communications were good, in general, but the lack of positive management techniques including written technical reports and published schedules for overall control of this work, whether in or out of government, has caused hardships. This point is reported here not as an excuse for delays, but so that future arrangements of this type can be strengthened. As smaller budgets put constraints on NASA's scientific work, it could appear profitable to use joint personnel teams and facilities. Whether the results produced from such arrangements are truly economical will depend on the government's giving equal weight to management of its inhouse participation as well as its contracted efforts.

Important Related Matters

At the beginning of the contract, the PI designed two filters for use with the flight Nikon camera system. With dedicated services from engineering, drafting and the mechanical shop at Dudley, these filters progressed from concept to acceptance for flight and delivery to the launch site in about nine weeks to carry out an APST requirement on the Apollo 16 flight. One filter provided a blue bandpass from 510 nanometers to the Command Module window cutoff at about 420 nanometers; the other provided a red bandpass from 610 nanometers to type 2485 film sensitivity cutoff at 700 nanometers. These special filters were needed to photograph suggested emission lines of hydrogen in the red and singly and doubly ionized oxygen in the blue from the Gum Nebula while suppressing light from the Milky Way region beyond. A second set of these filters flew on Apollo 17 for two, very successful photographic series of the zodiacal light, another APST requirement.

During the first year of this contract the PI and Co-I were also very busy supporting the APST activities for the Apollo 16 flight in April and the Apollo 17 flight in December of 1972. Those flight schedules and related support work necessarily dictated when and where the investigators could apply themselves to work under this contract. On the one hand, it did delay early training by the PI of his two Research Assistants brought on specifically to help in this work, and it hampered early attempts to follow institutional management of the contract, mainly because the PI had to spend considerable time traveling to NASA Centers. On the other hand, this travel permitted better coordination of the PI's early data requests to NASA, and APST trips to the West Coast were very useful in the final selection of the computer program for processing photodigitized data. Furthermore, it was extremely valuable for the PI and Co-I's to be able to think through their photocalibration and supporting data needs prior to each of these last two flights when specifying experimental requirements as members of the APST. In retrospect, the wearing of these two hats was beneficial overall, but early milestones in the data analysis effort suffered as a result.

A third related matter regards the financial and administrative support of this contract by Dudley Observatory management. This support became a negative factor of large proportion affecting al[illegible] phases of the work. The PI and his assistants had to spend conside[illegible] time checking and reconstructing financial data; this time dimini[illegible]eir scientific and technical efforts. The author of this report n[illegible]ieves quite firmly that Dudley management does not have the qualificat[illegible] experience or desire to deal with day-to-day affairs of scientific [illegible]rogram administration, and that management actions are only taken to deal with crises.

At the PI's request the government stepped in to review the situation two-thirds of the way through the contract. Their review and financial audit resulted in Dudley management returning $20,188 to a $92,541 effort. At the close of this contract, some eight months after the start of the government's review, the Observatory is still in the process of developing financial, administrative and personnel policies under duress and under continuing scrutiny by government monitors. Even though the scientific goals sought under this contract are just now nearing publication stage, the PI has elected to close out work under the Dudley Observatory at the first convenient opportunity so as not to subject the government or himself and his team to further waste of time and money to help an institution solve its own, internally created problems.

Conclusions

The conclusions at the close of this contract are as follows:

1. Results of this data analysis work are nearing the point of publication for NASA and the scientific community. The overall effort is approximately six to nine months behind the original schedule, but the quality expected in results has undergone improvement. Brightness measurements will be most successful for (1) the zodiacal light in polarized and plain white light and in red and blue light from about one to eighty degrees elongation and for (2) the lunar libration region L_4 in white light.

2. The requirement for controlling technical progress through technical reporting and milestone scheduling is, of course, vital, but it must be extended to include inhouse government technical activities supporting outside contracted efforts.

3. The uncertain nature of data analysis work, particularly when portions of the data are not yet collected, requires that contractual goals and schedules undergo periodic review to change emphasis as needed. This is particularly true for work where the data analysis techniques themselves are undergoing development, and time is needed for exploring various options. This factor determines the research versus the production nature of the data analysis tasks.

Recommendations

Recommendations concerning this work are as follows:

1. This data reduction and analysis work should be continued. It will provide two important results. First, it will complete the development of new techniques for accomplishing photographic photometry using sophisticated computer techniques. Second, new scientific measurements will result from completed analysis of the zodiacal light and lunar libration region, L_4, data now in processing.

2. Data analysis work should be carefully assessed for the degree of new techniques required. The quantity or rate of production for processed data and the time involved should be extended in proportion to the uncertainties in such developmental efforts.

Acknowledgements

The author wishes to express his sincere appreciation to the many NASA and supporting contractor personnel whose help has made the present level of accomplishment possible. Some of these people have been mentioned above, and the author wishes to include in his thanks Dr. Floyd I. Roberson, Messers. S. Nat Hardee, Tony C. Riggan, James Taylor, and James Ragan of NASA, Mr. Paul Hopkins of the Department of Agriculture, and Mr. Joe Dixon and J. Wesley Simpson of Lockheed Aircraft Corp.

In addition to two Research Assistants at Dudley Observatory, the work benefitted greatly from the excellent services of Mr. Dave Wachtel, photography, Mrs. Gail Chien, drafting, and Mrs. Gen Pruscop, typing.

MSC/GSFC AGREEMENT

APOLLO LOW BRIGHTNESS IMAGE ANALYSIS

The tasks to be performed by GSFC, in support of Apollo Low Brightness Image Analysis and the Dudley Observatory, are specified in the attached statement of work. This will apply to film analysis for Apollo Missions 14, 15, 16, and 17. The relations and effort between the two Centers will be conducted according to this agreement.

Approved:

for Robert R. Gilruth
Director
Manned Spacecraft Center

John F. Clark
Director
Goddard Space Flight Center

STATEMENT OF WORK

Experiment Long Title: Low Brightness Image Analysis

Experiment Short Title: Same

Number:

Concurrence:

Principal Investigator

Co-Investigator (GSFC)

Concurrence (MSC):

TD43/S. N. Hardee

TD/J. G. Zarcaro

BT4/E. L. Tribble

PA/J. A. McDivitt

STATEMENT OF WORK

SERVICES REQUIRED OF GODDARD SPACE FLIGHT CENTER IN SUPPORT OF LOW BRIGHTNESS IMAGE ANALYSIS (DUDLEY OBSERVATORY)

1.0 PURPOSE

1.1 The purpose of this statement of work (SOW) is to define those services which are required of GSFC in support of the Low Brightness Image Analysis. In addition, these services will pertain to the support of the NASA/MSC Experiment Manager for this analysis.

2.0 OBJECTIVES

2.1 To furnish the sensitometric equipment and accessories necessary to give the support required to complete the subject analysis.

3.0 TASKS

3.1 Close coordination is required between the PI, Co-I, GSFC technical personnel, and the MSC Experiment Manager on all aspects of GSFC's services in support of the Low Brightness Image Analysis. Mr. L. Dunkleman, Co-Investigator, is completely responsible for the management and implementation of all GSFC effort.

3.2 All original films applicable to Apollo 14, 15, 16, and 17 Dim Light Photography will be transmitted to Mr. Dunkleman, Co-I. He will have the responsibility of their transmittal for analysis, safekeeping, and ultimate return to MSC.

3.3 GSFC will provide the densitometer and related equipment necessary to provide isophotes, isodensitracings, and digital program readouts on magnetic tape.

3.4 GSFC will provide the necessary technical personnel (including computer programmer) to secure the data required by the PI, calibrate the equipment, and maintain the optimum equipment performance.

4.0 DOCUMENTATION REQUIREMENTS

4.1 Monthly Cost Reports to date

4.2 Quarterly Cost Projections per 533 requirements

5.0 FUNDING REQUIREMENTS

Funding requirements are as follows:

LOW BRIGHTNESS IMAGE ANALYSIS	FY72		FY73				TOTAL
	JAN FEB MAR 3	APR MAY JUNE 4	JULY AUG SEPT 1	OCT NOV DEC 2	JAN FEB MAR 3	APR MAY JUNE 4	
(1) CONTRACT PROGRAMMER + 100% OVERHEAD	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$24,000
(2) MAINTENANCE	$2,670	$2,670	$2,670	$2,670	$2,670	$2,650	$16,000
TOTALS	$6,670	$6,670	$6,670	$6,670	$6,670	$6,650	$40,000

NASA CONTRACT NAS9-12557

Apollo Data Analysis

Experiment S-211

LOW BRIGHTNESS IMAGE DATA ANALYSIS

DATA ANALYSIS AND HANDLING PLAN

Prepared for

National Aeronautics and Space Administration
Johnson Space Center
Houston, Texas 77058

Robert D. Mercer
Principal Investigator

March 30, 1973

The Dudley Observatory
100 Fuller Road
Albany, New York 12205

General

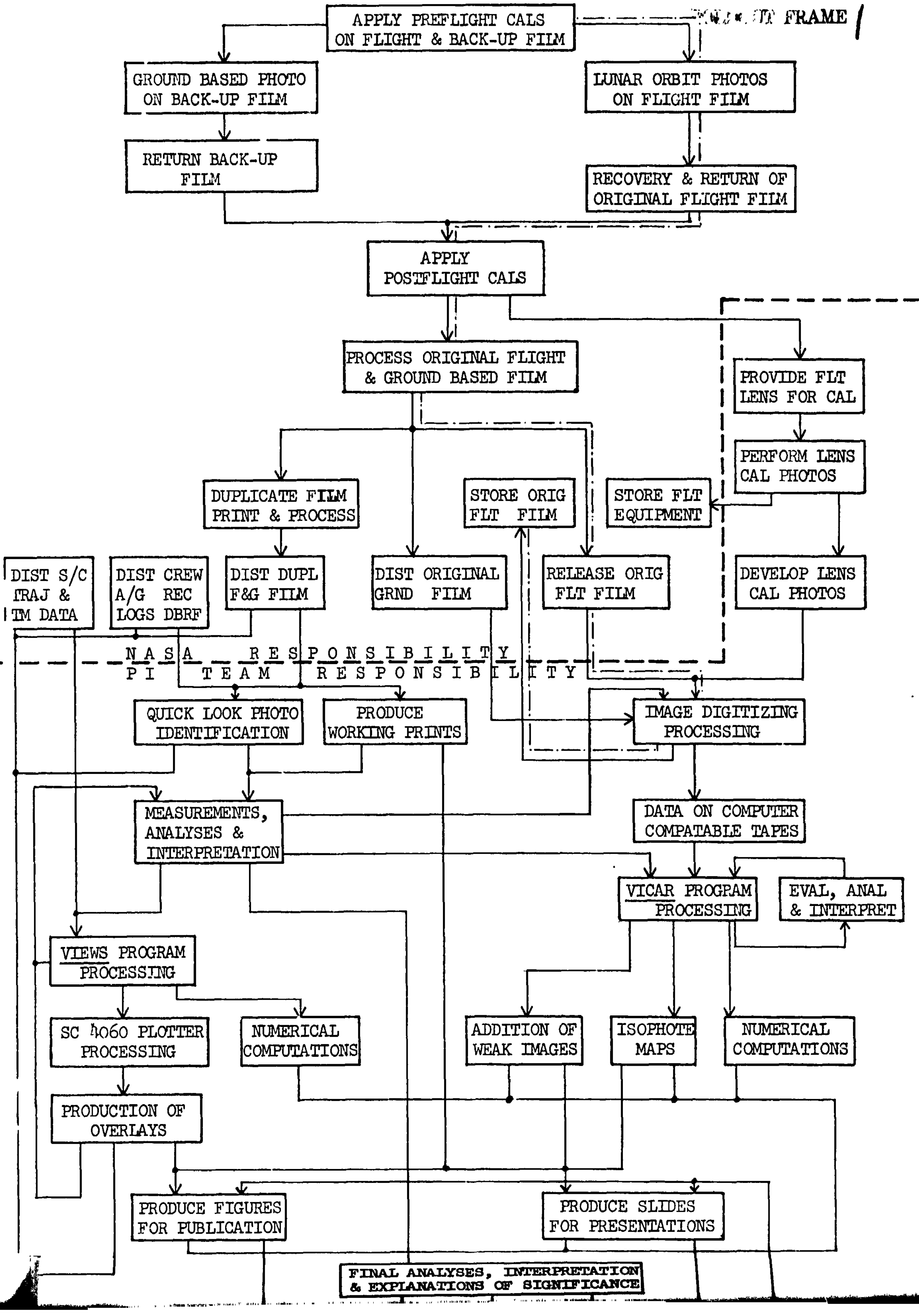
This document presents a plan for data handling and analysis of low brightness images from those portions of astronomical photography covered by Experiment S-211 (Contract NAS9-12557). This plan is required from the Principal Investigator (PI) both scientifically and contractually for good reasons. First, it assures that the methods and procedures for accomplishing the final objective have been clearly thought through. This assures that maximum scientific content will be extracted within the time and cost scope of the contract. It also guarantees that original photographic materials will be properly safeguarded by the PI prior to their release to him and his team.

It was originally proposed that individual plans be submitted for each of the Apollo missions covered by this data reduction work. However, the similarity in procedures, particularly with regard to the establishment and utilization of image brightness digitization techniques to be followed by highly sophisticated computer processing, indicated that one overall procedure could be written. This composite plan is presented below and applies equally to photographic images, calibrations, and equipment test data for each mission covered by this data analysis work, namely Apollo flights 14,15,16 and 17.

Data Processing Flow

An overview of the data handling and analysis process will now be presented. Figure 1 shows this data flow in block diagram format. This will be followed by an elaboration on certain special details such as film handling and the like.

Master positive transparencies and duplicate negatives of each photographic data frame will be scanned visually to ascertain the scientific value, image quality and data reduction priority of each frame. Quick-look identification listings of all frames will be made. These listings relate frames by their NASA photo numbers to the times made, subject matter, approximate celestial location and orientation, and associated camera configuration and settings. These lists, one for each flight from Apollo 14 to 17 inclusive, become interim but finished products that are individually complete enough for use by others. In that sense they will be made available to all NASA personnel associated with this work, including the National Space Science Data Center (NSSDC), outside scientists, and interested laymen who express a specific interest in our early results. Such lists are particularly important in this field of work where the phenomena under study are relatively unknown and where there is a very limited number of easily identifiable objects even to the trained eye of most astronomers.



APPLY PREFLIGHT CALS ON FLIGHT & BACK-UP FILM
GROUND BASED PHOTO ON BACK-UP FILM
LUNAR ORBIT PHOTOS ON FLIGHT FILM
RETURN BACK-UP FILM
RECOVERY & RETURN OF ORIGINAL FLIGHT FILM
APPLY POSTFLIGHT CALS
PROCESS ORIGINAL FLIGHT & GROUND BASED FILM
PROVIDE FLT LENS FOR CAL
PERFORM LENS CAL PHOTOS
DUPLICATE FILM PRINT & PROCESS
STORE ORIG FLT FILM
STORE FLT EQUIPMENT
DIST S/C TRAJ & TM DATA
DIST CREW A/G REC LOGS DBRF
DIST DUPL F&G FILM
DIST ORIGINAL GRND FILM
RELEASE ORIG FLT FILM
DEVELOP LENS CAL PHOTOS
NASA RESPONSIBILITY
PI TEAM RESPONSIBILITY
QUICK LOOK PHOTO IDENTIFICATION
PRODUCE WORKING PRINTS
IMAGE DIGITIZING PROCESSING
MEASUREMENTS, ANALYSES & INTERPRETATION
DATA ON COMPUTER COMPATABLE TAPES
VICAR PROGRAM PROCESSING
EVAL, ANAL & INTERPRET
VIEWS PROGRAM PROCESSING
SC 4060 PLOTTER PROCESSING
NUMERICAL COMPUTATIONS
ADDITION OF WEAK IMAGES
ISOPHOTE MAPS
NUMERICAL COMPUTATIONS
PRODUCTION OF OVERLAYS
PRODUCE FIGURES FOR PUBLICATION
PRODUCE SLIDES FOR PRESENTATIONS
FINAL ANALYSES, INTERPRETATION & EXPLANATIONS OF SIGNIFICANCE

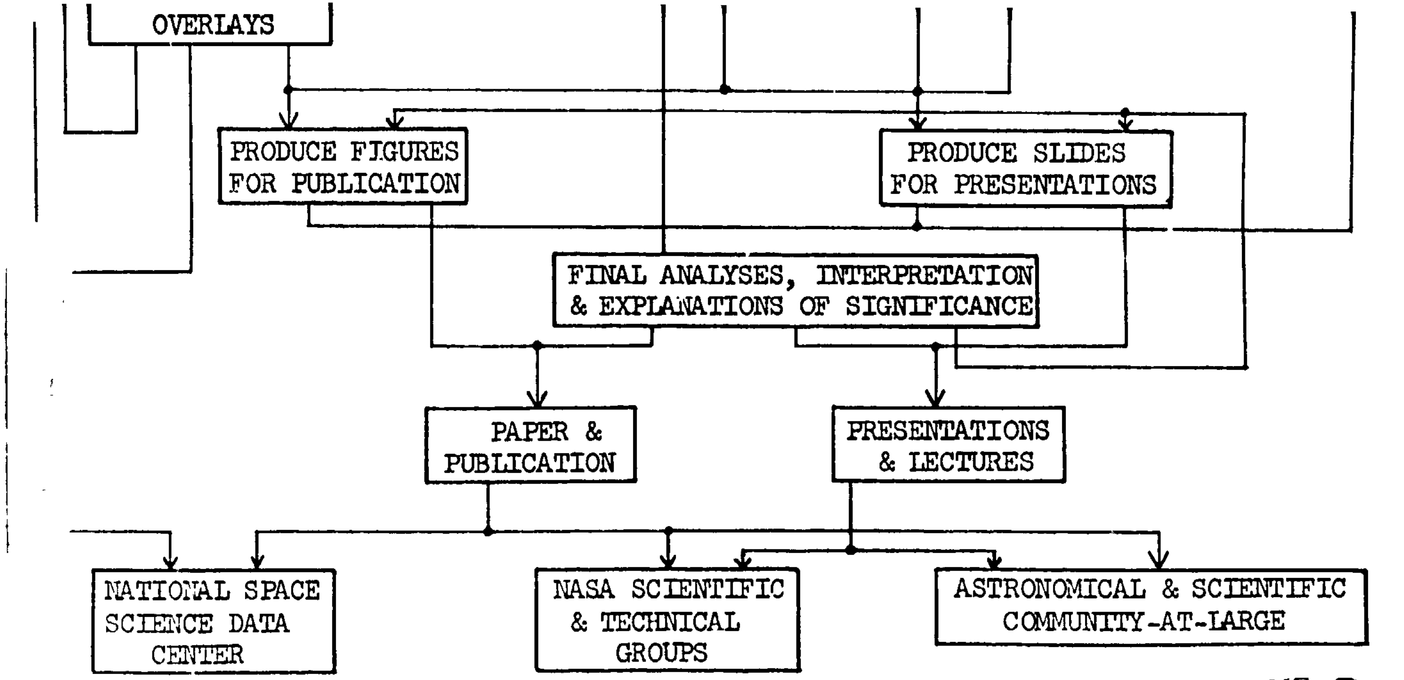


Figure 1

FOLDOUT FRAME 2

Concurrent with this effort, data technicians will make blow-up prints from the master positives and duplicate negatives. These prints are much easier to handle and to study for more detailed visual analyses. They are absolutely essential for measurements of angles and distances between celestial objects; such data extracted from these working prints will be used as numerical inputs to sophisticated computer processing later. In addition, such prints and associated projector slides are used for presentations and publications of preliminary results required by NASA. They are required by the scientific obligations inherently levied on all investigators as reporters to their disciplines within the scientific community at large.

Second and third generation 35mm format film must also be used for some photometry and microdensitometry. Certain frames will undergo unsophisticated measurements to determine approximate values of brightness of key features, ranges of brightness within a frame and base fog levels. From these analyses a first selection of frames will be made for further processing.

This initial group will contain the following information: data frames, brightness calibration frames, and exposures to assess the brightness portion of the optical transfer function for the flight lenses and for the image digitizing equipments used in the data reduction process. Lens calibration photography will be obtained by the Co-Investigator (Co-I) using appropriate optical laboratory facilities and components at NASA's Goddard Space Flight Center (GSFC). All of these photographic images will be digitized from original flight and ground calibration negatives using the most economical and scientifically qualified technique available. The digitizing services will be obtained by the Co-I through the GSFC Procurement Office using a portion of the funds transferred for this work from the NASA Johnson Space Center(JSC) to GSFC. A suggested Statement of Work for the first digitizing effort is included as Appendix A. The results of this work will be a set of digitized brightness measurements for each frame recorded on computer-compatable magnetic tapes.

These tapes along with program control statements and other numerical data from earlier processing will become the input to the Video Image Communication and Retrieval (VICAR) Program developed by the Jet Propulsion Laboratory (JPL) and now being made operational at GSFC for a number of image processing applications. The VICAR Program will be used for the many tasks specified below.

1. Eliminate camera lens and digitizing equipment brightness recording (vignetting) effects.

2. Locate and eliminate starlight.

3. Smooth unnatural discontinuities in digital readings.

4. Create brightness-versus-position contour (isophote) maps.

5. Match up and extend isophote maps over many adjacent frames.

6. Perform special additions of data where scenes overlap and signals are extremely weak.

7. Remove image motion from longer exposures where rates of change in vehicle attitudes could not be avoided.

This VICAR Program processing is iterative, i.e. the results of manipulations with any data set must be analyzed by both investigators and programers to best determine what subsequent VICAR processing must be attempted. Moreover, the same set of brightness measurements may undergo several different kinds of computer processing depending upon the particular scientific objective being sought.

Another computer effort, using the VIEWS Program developed at JSC, will be carried out at Dudley Observatory to produce star field and celestial coordinate overlays for selected data frames. It will be checked out on a Univac computer at the State University of New York in Albany. Inputs to this program will include: time-related trajectory state vectors, telemetered attitude and rate data for the Command Modules, and the data cameras' lines-of-sight and fields-of-view with respect to the vehicles' body axes. Output will be computed pointing position and a special computer magnetic tape for processing orientation on the SC4060 plotter at GSFC. Processing by the plotter will produce scenes identically located on the celestial sphere as the data frame made at the same corresponding time. These microfilms will be enlarged and printed on ortho, clear-backed, film base to produce overlays for working prints of the data frames. A copy of the microfilm will also be provided to NSSDC, since it will be very useful for other researchers who might wish to extract other information from the flight data.

Final results of all of the above work will be information for publication in NASA documents and scientific journals including statements on the interpretation and significance of findings. Accompanying analyses will attempt to provide mathematical expressions for the brightness patterns being studied. Where possible, information on polarization and spectral parameters will also be included.

The initial group of original data and calibration frames, containing approximately 20% of all frames which might eventually be processed, will be digitized and started through the handling and analysis process as a verification that the procedures are adequate and that detailed problems in the date flow are well understood. The suggested Statement of Work in Appendix A is meant to include only this initial group. Once this work has progressed to the point where intermediate results, including computer outputs, are available for investigator analysis, decisions will be made on which frames and how many of the remainder should also be digitized. This also assures that all financial resources are not expended only on early stages of data reduction without reaching finished conclusions on at least some portion of the work.

It should be further noted that data from Apollo Lunar Experiment S178, Gegenschien/Moulton Region will also be handled in a similar manner, since it is also contained on the same flight emulsion and because its subject matter is analogous to the low brightness phenomena under this task. In fact, some early digital data read from S178 frames on GSFC Joyce-Loebl microdensitometer is being used as test input for early checkout of VICAR Program processing routines. One important conclusion from this test work has been that digitization on this GSFC equipment is far too slow and expensive for the amount of data yet to be digitized. Therefore, it has been necessary to seek vendor services that were not originally contemplated. It has further been ascertained that such an approach will definitely be much faster and less costly for the government, and at the same time it will greatly reduce the amount of film handling necessary for the original flight negatives. This is the only subcontracted effort that is now foreseen.

Handling of Original Flight Negatives

In Figure 1 a dash-dot line has been added to show the path followed by the original flight film. It will only be required by the PI and his team during the digitization process after which it is returned to NASA JSC for storage. It is proposed to arrange in advance for these uses of the original photographic materials. Then the PI or his authorized representative will personally pick it up at JSC, hand carry it to the vendor's site of digitization, remain with the film and monitor the digitizing process, and return the film to JSC by hand-carry immediately thereafter.

As noted previously, not all frames will be digitized initially. Therefore, a minimum of two such trips are necessary, and it is expected that this would be the maximum, as well. If problems occur in later stages of the data processing tasks for the initial group digitized, it could require that three or, at the very most, four trips might be necessary. In each instance it is expected that the original flight negatives would be away from JSC no longer than one week at a time.

At later stages in the analyses it might be necessary to make a few special readings on the GSFC microdensitometers to clarify certain readings in the production phase digitization performed previously at the vendor's facility. Here, again, the time away from JSC might be as long as one month for any recheck, and arrangements for handling and storage at GSFC would be identical with those already used for the S178 film with hand-carry back and forth between NASA centers.

At NASA centers and the vendor's facility the original flight film will be maintained at $70 \pm 10^{\circ}F$ and $50 \pm 25\%$ relative humidity normally provided by air conditioned offices and optical laboratories. When not in use or in the hands of responsible personnel, it will be stored in locked containers located in air conditioned quarters. During transit it will be double-bagged polyethylene envelopes sealed air-tight to avoid humidity changes. The courier will insure that the film containers do not experience excessive temperatures or rapid changes in temperature.

Film will be handled directly only with gloved hands on its edges or on its base side, and cloth mouth-guards will be used when film is under examination or when personnel must work in close proximity to the film. Light tables and other surfaces with which film may come in contact will be cleaned by normal optical procedures, i.e. grease and oil film removers applied, wiped dry with a clean, lint-free cloth and a final lens tissue rub down. Emulsion side of original film will always be maintained away from mechanical surfaces. Emulsion side of film will only come in contact with mechanical or optical surfaces at sprocket holes or outer edges during frame by frame transport or if curl must be removed using edge clamps.

Requirements for Data from NASA

Initial sources of data for this data reduction and analysis work are, of course, NASA JSC. Figure 1 shows the types of data that must come to the investigators for their use. Some of these requirements are as specified in the Mission Requirements Document (MRD) and Photographic Distribution Plans for each mission on which this photography was accomplished.

In general, they include:

1. Best Estimated Trajectory data during periods of low brightness photography in each mission. One copy of this data is required on computer compatable magnetic tapes or on microfilm printout accompanied by documents on formats.

2. Command Module attitudes and rates data in Earth Centered Inertial (ECI) coordinates during these same periods. One copy of this data is required either on magnetic tapes or on strip chart recordings with formats specified.

3. Command Module telemetry measurement numbers CG0001 V on Apollo 14, CK 1043 X on Apollo 15, CK 1040 X and CK 1043 X on Apollo 16, and CK 1043 X on Apollo 17 during these same periods on strip chart recordings at ten inches per second. Data channels and time channels must be properly identified, and time code format specified.

4. Command Module air-to-ground voice transcripts with time references for those comments applicable to this photography. One copy is required, and this must specifically include pertinent portions of the DSE Voice Dump Transcriptions.

5. Crew logbooks containing annotated flight plans, checklists and log sheets. One copy is required for each, entire mission.

6. Scientific and photographic procedures debriefings of flight crews.

One copy of debriefing transcriptions or voice-recorded magnetic tapes is required.

7. Second and third generation photographic products of all Very High-speed Black and White (VHBW) film. Number of copies must be as specified in the Photographic Distribution Plan for the PI and Co-I for applicable flights.

8. Original VHBW backup film used for ground based photography by the investigators and developed along with the flight film. In addition, one copy of the H & D curves used to establish control of its photoprocessing at JSC will be required.

9. Access to and occasional possession of original VHBW flight film under handling conditions specified previously. H & D curves of its photoprocessing will also be required.

Those, then, are the products required by the investigators from the government. The photo products can be supplied by the Photographic Technology Division. Spacecraft telemetry data, air-ground voice and debriefing transcript and logbooks can be supplied from the Metric Data File. The postflight, Best Estimated Trajectory tapes are created by the Mission Planning and Analysis Division. Original photographic materials should only be transferred using courier hand-carry by duly authorized representatives of the government or the PI. All other data sources can be mailed or shipped with appropriate follow-up communications to assure all items are received by the PI or his team members.

Scientific Disciplines Involved in Analyses

The scientific phenomena on which data are now thought to exist include:

1. Zodiacal light

2. Lunar libration region, L_4

3. Diffuse galactic light

4. Large filaments and extended galactic regions

5. Lunar eclipse

6. Contamination particles near vehicle

7. Solar Corona

The last two subjects f analyses will only be accomplished in coordination with Experiment S21ʟ and S212 PI's who have formal responsibilities for these areas of data, because there is some level of overlap between the three experiments' requirements.

Extent of Data Analyses

The level of data reduction and analyses to be expected cannot be completely specified, as yet. It can be stated that full processing and analyses on each data frame and the interrelationship between frames is a task requiring several years work and, therefore, beyond the scope of time and cost alloted for this work. However, that was not unexpected considering the degree of success in data collection from flight to flight. The major decision for the investigators, therefore, is the priority to be given to the various subjects under study and what level of data reduction to attempt in each case in order to maximize the scientific return.

The pacing item for all of this work will be the amount of output and degree of sophistication that can be achieved by VICAR Program processing. This certainly does not imply that valuable results cannot be realized without it. Indeed, some preliminary results from Apollo's 15 and 17 already reported now provide scientifically valuable information on zodiacal light and solar corona previously unknown.

The major goal of the current work will be to obtain brightness maps to the best accuracy possible over as large an area of the celestial sphere as data frame coverage permits. Particular areas of interest will be along and close to the ecliptic plane on both sides of the sun, the lunar libration region L_4, the Gum nebula, galactic light, and the lunar disk entering and leaving the earth's shadow. Brief analyses of airglow and atmospheric extinction may be attempted using the ground-based data frames made on backup film in conjunction with corresponding flight data frames.

The main goal using the VICAR Program will be the complete development of isophote maps prior to removing image smear for each frame adjudged to have scientific importance. A higher level goal, if it can be achieved within the time and cost limitations of this work, will be to integrate the isophote maps of individual, adjacent frames into a larger isophote map, but again, without consideration for image smear. Finally, if all proceeds extremely well, the goal will be to remove image smear prior to the creation of individual and composite isophote maps mentioned previously.

Some of the procedures outlined in Figure 1 have been underway for many months. Well over half of the required data has been received from JSC. This has included all of the critical items except some camera lenses needed for calibration tests and the original flight film. Initial access to the latter will be requested in late April or early May 1973 to begin the digitization processing.

Required scientific reporting up through and including the Preliminary Science Reports (PSR) has been completed except for the photographic figure for the Apollo 17 PSR. This will be submitted in April

1973. The excellent results from Apollo 15 were reported to the Optical Society of America (OSA) meeting at Ottawa in October 1971 and to the Committee on Space Research (COSPAR) at Madrid in May 1972. Both papers were joint efforts from several investigators including the Command Module Pilot, A. Worden. The COSPAR Paper will appear shortly in Space Research XIII which is now in press. Similar papers on Apollo 17 results and on the low light level photographic effort for the combined four missions are planned for the summer of 1973; the latter will be a GSFC Technical Report. An article for the journal Sky and Telescope is also in the planning stage. As more precise information is developed, the investigators intend to present papers at scientific meetings and to submit articles to well known journals in the field of optics, astronomy, physics and general science.

Quick-look identification lists for Apollo missions 14,15, and 16 have been prepared and distributed to all appropriate parties including NSSDC. A similar list for Apollo 17 has also been made; however, it only contains low brightness astronomy information. It will be completed after coordination with investigators and crew about such subjects as lunar surface features and cabin interior scenes, that are interspersed in the VHBW film along with the astronomical data. The abbreviated list on Apollo 17 astronomical photography has had limited distribution among investigators and among individuals at JSC who are cognizant of this work.

Additional Postmission Information Requirements

The only postmission requirements now foreseen are the use of flight lenses and filters for transmission and vignetting calibration tests. As noted previously, data from such tests is vital in computing brightness corrections for the data frames. Part of this testing is currently underway at GSFC; however, lenses from Apollo missions 14,15, and 17 will be required by the end of June 1973. All flight filters have been received by the PI.

One other possible source of error has already been tested. An unexpected, weak exposure was experienced on the 16mm Data Acquisition Camera film of Apollo 14. In order to verify whether or not this effect might have been caused by a loss in window transmission, the investigators performed postflight tests on the right-hand rendezvous window at the Rockwell International plant in Downey, California during May 1971. These tests showed negligible transmission losses. This has not been considered a source of error in subsequent flights, and requirements for such additional tests are, therefore, waived.

Conclusions

This concludes the data handling and analysis plans for low brightness image studies. As of this writing on 1 April 1973, it provides a best estimate of total planning in this regard. Should additional or modified requirements arise, the investigators will communicate variances in this plan to the Technical Monitor.

STATEMENT OF WORK

Respondents to this RFP must make digital readings of black-and-white, photographic emulsion densities on roll film to be supplied by the government. These readings, along with appropriate identification and X-Y positional information within each frame, must be recorded on computer compatable magnetic tapes. The films provided will include original photographic materials from Apollo lunar orbital flights. This will require that a government representative be in attendance during densitometry operations, and the respondent must provide safekeeping of such film at all times when it is in his hands for processing. Detailed specifications are provided below:

A. Photographic Materials Input

1. 16 mm film

   a) Uncut reeled motion picture film, 40 frames per foot, 100 feet in length, PH22. 110 perforation configuration

   b) Type 2485 Eastman Kodak emulsion on 4-mil Estar base

   c) Base plus fog density approximately 0.70

   d) Density range of interest approximately 0.65 to 1.85.

   e) Dimensions of interest for each full frame including some portion of adjacent sprocket holes are 8 mm by 12 mm.

   f) Number of frames approximately ten (10) and they are not located sequentially on film.

2. 35 mm film

   a) Two reels of spliced film, 8 frames per foot, one reel 50 feet in length and one reel 100 feet in length, PH22.139 perforation configuration.

   b) Type 2485 Eastman Kodak emulsion on 4-mil Estar base

   c) Base plus fog density approximately 0.65 for reel #1 and 0.55 for reel #2

d) Density range of interest approximately 0.35 to 1.85 for reel #1 and 0.35 to 1.85 for reel #2

e) Dimensions of interest for each data frame including some portion of adjacent sprocket holes are 38 mm by 22 mm, and for partial sections of calibration frames they are 30 mm by 18 mm.

f) Number of frames approximately thirty (30) full data frames and ten (10) calibration frames, with frames not necessarily located sequentially on film.

3. 70 mm film

a) One reel of spliced film, 4.8 frames per foot, 50 feet in length, type 2 perforations.

b) Type 2485 Eastman Kodak emulsion on 4-mil Estar base

c) Base plus fog density approximately 0.6.

d) Density range of interest approximately 0.35 to 1.85

e) Dimensions of interest for each full data frame including some portion of adjacent sprocket holes are 62 mm by 62 mm, and for partial sections of calibration frames they are 30 mm by 18 mm.

f) Number of frames is approximately six (6) full data frames and four (4) calibration frames, with frames not necessarily located sequentially on film.

B. Digital Data Output

1. Number of gray levels to include the ranges specified above will be sixty four (64) and steps must provide linear change in density to within $\pm$ 1% over the entire range.

2. Signal to noise ratio must be better than 20 db.

3. Two additional matrices of values must be provided to determine

densitometer flatness of field over each density range and the largest dimension size specified. One matrix must be made after densitometry equipment warm-up and stabilization but just prior to reading of data and/or calibration frames; the second matrix must be made immediately after these readings and prior to any change in photometric settings of the densitometry equipment.

4. Output of all digital information must be stored on 9-track, 800 bits-per-inch magnetic, computer compatable tapes to be supplied by the government. Storage format on these tapes will require one value of grey level per character block.

5. Equipment must be available to reconstruct any image from matrix of readings on output tapes in order to verify adequacy and completeness of digitization process.

6. Scanning Specifications

   a) Sizes of two dimensional scanning matrices may change from frame to frame but will include 2048 x 2048, 1024 x 1024, 512 x 512 and 100 x 1024 matrix formats.

   b) Densitometered spot size and accuracy in the X-Y centering for each position examined must be such that the 1024 x 1024 matrix of positions covers more than 75% of the total area with less than 10% overlap.

   c) Scanning rates must be rapid enough that the set up and reading of sixty (60) frames in the formats specified can be accomplished within five (5) normal working days.

NASA Magazine No AS 14 Magazine Flight Designator J

Film Type 2485 Film Size 16 mm

Quick Look Begin Fr No	Quick Look End Fr No	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
0000	0001	Mag Film Loading	26 Jan.1971	0400	-	-	-	-	-	
0002	0015	Protect Frames	" " "	-	-	-	-	-	-	
0016	0020	" "	" " "	-	-	-	-	-	-	Orig. Removed for S-178,3/12/71
0021	-	Calibration Frame	" " "	0431	60	-	-	-	-	" " " " "
0022	0023	Protect Frames	" " "	0432	-	-	-	-	-	" " " " "
0024	-	Calibration Frame	" " "	0432	20	-	-	-	-	" " " " "
0025	0026	Protect Frames	" " "	0432	-	-	-	-	-	" " " " "
0027	-	Calibration Frame	" " "	0432	5	-	-	-	-	" " " " "
0028	-	Protect Frame	" " "	0433	-	-	-	-	-	" " " " "
0029	-	Protect Frame	" " "	0433	-	-	-	-	-	
0030	-	Calibration Frame	" " "	0433	60	-	-	-	-	
0031	0032	Protect Frames	" " "	0434	-	-	-	-	-	
0033	-	Calibration Frame	" " "	0434	20	-	-	-	-	
0034	0035	Protect Frames	" " "	0434	-	-	-	-	-	
0036	-	Calibration Frame	" " "	0434	5	-	-	-	-	
0037	0069	Protect Frames	" " "	-	-	-	-	-	-	
0070	0084	First Mag Removal	" " "	-	-	-	-	-	-	
0085	0248	NASA PTL Identification	" " "	0500	-	-	-	-	-	
0249	0264	Second Mag Removal	2 Feb.1971	-	-	-	-	-	-	
0265	0306	Protect Frames	" " "	-	-	-	-	-	-	
0307	-	Earth Darkside, through Sextant	" " "	0351	60	-	-	-	-	
0308	-	" " "	" " "	0352	20	-	-	-	-	
0309	-	" " "	" " "	0352	5	-	-	-	-	
0310	-	" " "	" " "	0353	60	-	-	-	-	
0311	-	" " "	" " "	0354	20	-	-	-	-	
0312	-	" " "	" " "	0354	5	-	-	-	-	
0313	0347	Protect Frames	" " "	-	-	-	-	-	-	
0348	0353	Third Mag Removal	" " "	-	-	-	-	-	-	
0354	0423	Protect Frames	" " "	-	-	-	-	-	-	
0424	-	S IV B	" " "	0705	60	-	-	-	-	
0425	-	"	" " "	0706	20	-	-	-	-	
0426	-	"	" " "	"	5	-	-	-	-	
0427	0468	Protect Frames	" " "	-	-	-	-	-	-	
0469	0474	Fourth Mag Removal	" " "	-	-	-	-	-	-	
0475	0508	Protect Frames	" " "	-	-	-	-	-	-	
0509	-	S IV B	3 Feb.1971	0602	60	-	-	-	-	

NASA Magazine No AS 14 — Magazine Flight Designator J —

Film Type 2485 — Film Size 16 mm

Quick Look Begin Fr No	Quick Look End Fr No	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
0510	-	S IV B	3 Feb.1971	0603	20	-	-	-	-	
0511	-	"	" " "	"	5	-	-	-	-	
0512		"	" " "	0604	50	-	-	-	-	
0513	0554	Protect Frames	" " "	-	-	-	-	-	-	
0555	0557	Fifth Mag Removal	" " "	-	-	-	-	-	-	Orig. Removed for S-178,3/12/71
0558	0561	" " "	" " "	-	-	-	-	-	-	" " " " "
0562	0670	Protect Frames	" " "	-	-	-	-	-	-	" " " " "
0671	-	Gegenschein	5 Feb.1971	1226	20	$8^h\ 45^m$	$+22^\circ$	$9^h\ 15^m$	$+33^\circ$	" " " " "
0672	-	"	" " "	"	"	$8^h\ 50^m$	$+22^\circ$	$9^h\ 15^m$	$+34^\circ$	" " " " "
0673	-	"	" " "	"	5	$8^h\ 50^m$	$+22^\circ$	$9^h\ 15^m$	$+34^\circ$	" " " " "
0674	-	"	" " "	1227	"	$8^h\ 50^m$	$+24^\circ$	$9^h\ 20^m$	$+35^\circ$	" " " " "
0675	-	"	" " "	"	20	$8^h\ 50^m$	$+23^\circ$	$9^h\ 15^m$	$+33^\circ$	" " " " "
0676	-	"	" " "	"	5	$8^h\ 50^m$	$+23^\circ$	$9^h\ 15^m$	$+33^\circ$	" " " " "
0677	-	"	" " "	1232	20	$9^h\ 05^m$	$+22^\circ$	$9^h\ 25^m$	$+35^\circ$	" " " " "
0678	-	"	" " "	"	"	$9^h\ 10^m$	$+23^\circ$	$9^h\ 25^m$	$+36^\circ$	" " " " "
0679	-	"	" " "	"	5	$9^h\ 10^m$	$+25^\circ$	$9^h\ 30^m$	$+37^\circ$	" " " " "
0680	0770	Protect Frames	" " "	"	-	-	-	-	-	" " " " "
0771	-	Gegenschein	" " "	1237	20	$9^h\ 20^m$	$+23^\circ$	$10^h\ 05^m$	$+31^\circ$	" " " " "
0772	-	"	" " "	"	"	$9^h\ 20^m$	$+23^\circ$	$10^h\ 10^m$	$+32^\circ$	" " " " "
0773	-	"	" " "	"	5	$9^h\ 20^m$	$+23^\circ$	$10^h\ 10^m$	$+31^\circ$	" " " " "
0774	0853	Protect Frames	" " "	"	-	-	-	-	-	" " " " "
0854	-	Gegenschein	" " "	1242	20	$10^h\ 00^m$	$+13^\circ$	$11^h\ 00^m$	$+24^\circ$	" " " " "
0855	-	"	" " "	"	"	$10^h\ 00^m$	$+13^\circ$	$11^h\ 00^m$	$+24^\circ$	" " " " "
0856	-	"	" " "	"	5	$10^h\ 05^m$	$+14^\circ$	$11^h\ 00^m$	$+26^\circ$	" " " " "
0857	-	"	" " "	1243	10?	$10^h\ 05^m$	$+13^\circ$	$11^h\ 00^m$	$+26^\circ$	" " " " "
0858	0894	Protect Frames	" " "	-	-	-	-	-	-	" " " " "
0895	0897	Sixth Mag Removal	" " "	-	-	-	-	-	-	
0898	0901	" " "	" " "	-	-	-	-	-	-	
0902	0961	Protect Frame	" " "	-	-	-	-	-	-	
0962	-	Zodiacal Light		1428	4?	-	-	-	-	Star Field too weak
0963	-	" "	" " "	"	5	$2^h\ 55^m$	$+15^\circ$	$3^h\ 20^m$	$+24^\circ$	
0964	-	" "	" " "	"	20	$2^h\ 55^m$	$+15^\circ$	$3^h\ 20^m$	$+24^\circ$	
0965	-	" "	" " "	"	5	$2^h\ 55^m$	$+15^\circ$	$3^h\ 20^m$	$+24^\circ$	
0966	-	" "	" " "	1429	4?	-	-	-	-	Star Field too weak
0967	-	" "	" " "	"	16	$2^h\ 45^m$	$+14^\circ$	$3^h\ 10^m$	$+24^\circ$	
0968	-	" "	" " "	"	8	$2^h\ 40^m$	$+14^\circ$	$3^h\ 10^m$	$+24^\circ$	

NASA Magazine No AS 14 Magazine Flight Designator J

Film Type 2485 Film Size 16 mm

Quick Look Begin Fr No	Quick Look End Fr No	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
0969	-	Zodiacal Light	5 Feb.1971	1430	20	2^h 05^m	$+10^o$	3^h 05^m	$+22^o$	
0970	-	" "	" " "	"	16	2^h 05^m	$+11^o$	3^h 05^m	$+23^o$	
0971	-	" "	" " "	"	4	2^h 00^m	$+13^o$	2^h 50^m	$+27^o$	
0972	-	" "	" " "	1431	16	2^h 05^m	$+10^o$	2^h 30^m	$+25^o$	
0973	-	" "	" " "	"	8	2^h 05^m	$+10^o$	2^h 30^m	$+25^o$	
0974	-	" "	" " "	"	1	-	-	-	-	Star Field too weak
0975	-	" "	" " "	"	4	-	-	-	-	" " " "
0976	-	" "	" " "	"	1	-	-	-	-	" " " "
0977	-	" "	" " "	1432	16	1^h 20^m	$+08^o$	2^h 10^m	$+19^o$	
0978	-	" "	" " "	"	8	1^h 20^m	$+08^o$	2^h 10^m	$+19^o$	
0979	-	" "	6 Feb.1971	"	1	-	-	-	-	Star Field too weak
0980	-	" "	" " "	"	"	-	-	-	-	" " " "
0981	-	" "	" " "	"	"	-	-	-	-	" " " "
0982	-	" "	" " "	"	"	-	-	-	-	" " " "
0983	-	" "	" " "	"	4	-	-	-	-	" " " "
0984	-	" "	" " "	"	1	-	-	-	-	" " " "
0985	-	" "	" " "	1433	"	-	-	-	-	" " " "
0986	-	" "	" " "	"	8	-	-	-	-	" " " "
0987	-	" "	" " "	"	2	-	-	-	-	" " " "
0988	-	" "	" " "	"	4	-	-	-	-	" " " "
0989	-	" "	" " "	"	1	-	-	-	-	" " " "
0990	-	" "	" " "	"	8	-	-	-	-	" " " "
0991	-	" "	" " "	1434	4	-	-	-	-	" " " "
0992	-	" "	" " "	"	1	-	-	-	-	" " " "
0993	-	" "	" " "	"	1	-	-	-	-	" " " "
0994	1066	Protect Frames	" " "	-	-	-	-	-	-	
1067	1079	Seventh Mag Removal	" " "	-	-	-	-	-	-	
1080	1124	Protect Frames	" " "	-	-	-	-	-	-	
1125	-	North Ecliptic Pole	" " "	1823	20	17^h 50^m	$+68^o$	19^h 50^m	$+58^o$	
1126	-	" " "	" " "	"	1	-	-	-	-	Star Field too weak
1127	-	" " "	" " "	1824	10	18^h 00^m	$+67^o$	20^h 00^m	$+58^o$	
1128	-	" " "	" " "	"	20	18^h 10^m	$+68^o$	20^h 00^m	$+58^o$	
1129	-	" " "	" " "	"	5	18^h 00^m	$+68^o$	19^h 00^m	$+58^o$	
1130	1179	Protect Frames	" " "	-	-	-	-	-	-	
1180	1188	Eighth Mag Removal	" " "	-	-	-	-	-	-	
1189	1249	Protect Frames	" " "	-	-	-	-	-	-	

NASA Magazine No AS 14 Magazine Flight Designator J

Film Type 2485 Film Size 16 mm

Quick Look Begin Fr No	End Fr No	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1250	-	North Galactic Pole	6 Feb.1971	1009	20	12^h 40^m	$+27^o$	13^h 30^m	$+35^o$	
1251	-	" " "	" " "	"	"	12^h 40^m	$+27^o$	13^h 30^m	$+35^o$	
1252	-	" " "	" " "	1010	5	12^h 40^m	$+28^o$	13^h 40^m	$+38^o$	
1253	-	" " "	" " "	"	1	12^h 30^m	$+28^o$	13^h 30^m	$+38^o$	
1254	1316	Protect Frames	" " "	-	-	-	-	-	-	
1317	-	North Galactic Pole	" " "	1010	20	12^h 35^m	$+29^o$	13^h 30^m	$+40^o$	
1318	1319	Unexposed Frames	-	-	-	-	-	-	-	
1320	-	North Galactic Pole	6 Feb.1971	1011	10	12^h 30^m	$+29^o$	13^h 35^m	$+40^o$	
1321	-	" " "	" " "	"	20	12^h 50^m	$+30^o$	13^h 35^m	$+41^o$	
1322	-	" " "	" " "	"	5	12^h 45^m	$+30^o$	13^h 35^m	$+41^o$	
1323	1470	Protect Frames	" " "	-	-	-	-	-	-	
1471	-	Lunar Libration	" " "	1031	60	13^h 50^m	-17^o	14^h 50^m	-5^o	
1472	-	" "	" " "	1032	1	13^h 40^m	-16^o	14^h 45^m	-5^o	
1473	-	" "	" " "	"	20	14^h 55^m	-17^o	15^h 00^m	-3^o	
1474	-	" "	" " "	1033	20	14^h 55^m	-17^o	15^h 00^m	-3^o	
1475	-	" "	" " "	"	5	14^h 55^m	-17^o	15^h 00^m	-3^o	
1476	1563	Protect Frames	" " "	-	-	-	-	-	-	
1564	1568	Ninth Mag Removal	" " "	-	-	-	-	-	-	
1569	1514	Protect Frames	" " "	-	-	-	-	-	-	
1615	-	Earth Darkside	9 Feb.1971	0251	60	-	-	-	-	
1616	-	" "	" " "	0252	20	-	-	-	-	
1617	-	" "	" " "	"	5	-	-	-	-	
1618	1663	Protect Frames	" " "	-	-	-	-	-	-	
1664	1669	Tenth Mag Removal	" " "	-	-	-	-	-	-	
1670	1675	Protect Frames	" " "	-	-	-	-	-	-	
1676	1677	Splice	-	-	-	-	-	-	-	
1678	1700	Protect Frames	9 Feb.1971	-	-	-	-	-	-	
1701	1705	Eleventh Mag Removal	" " "	-	-	-	-	-	-	
1706	1814	Protect Frames	" " "	-	-	-	-	-	-	
1815	-	1st Postflight CAL	17 Feb.1971	1100	5	-	-	-	-	
1816	-	2nd Postflight CAL	" " "	"	20	-	-	-	-	
1817	-	3rd Postflight CAL	" " "	1101	60	-	-	-	-	
1818	1864	Protect Frames	" " "	-	-	-	-	-	-	Orig. Removed for S-178, 3/12/71
1865	1867	" "	" " "	-	-	-	-	-	-	
1868	-	4th Postflight CAL	" " "	1102	5	-	-	-	-	" " " " "
1869	-	5th Postflight CAL	" " "	"	20	-	-	-	-	" " " " "

NASA Magazine No AS 14   Magazine Flight Designator J

Film Type 2485   Film Size 16 mm

Quick Look Begin Fr No	Quick Look End Fr No	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
1870	-	6th Postflight CAL	17 Feb.1971	1103	60	-	-	-	-	Orig. Removed for S-178,3/12/71
1871	1872	Protect Frames	" " "	-	-	-	-	-	-	" " " " "
1874	2174	Unused "	-	-	-	-	-	-	-	" " " " "

NASA Magazine No AS15-101- Magazine Flight Designator T

Film Type Eastman Kodak 2485 Film Size 35mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
1	-	Film Loading	-	-	-	-	-	-	-	
2	13563	Film Loading Advance Frame	-	-	-	-	-	-	-	
3	13564	Film Loading Advance Frame	-	-	-	-	-	-	-	
4	13565	Protect Frame	-	-	-	-	-	-	-	
5	13566	Lunar Libration Region, L4	31 Jul 71	1337	240	23^h15^m	-3°	$0^h 30^m$	-12°	
6	13567	" " " "	"	1342	90	23^h10^m	-2°	$0^h 30^m$	-12°	
7	13568	" " " "	"	1344	90	23^h05^m	-2°	$0^h 25^m$	-12°	
8	13569	" " " "	"	1346	30	23^h05^m	-2°	$0^h 25^m$	-12°	
9	13570	Protect Frame	-	-	-	-	-	-	-	
10	13571	" "	-	-	-	-	-	-	-	
11	13572	" "	-	-	-	-	-	-	-	
12	13573	" "	-	-	-	-	-	-	-	
13	13574	" "	-	-	-	-	-	-	-	
14	13575	" "	-	-	-	-	-	-	-	
15	13576	" "	-	-	-	-	-	-	-	
16	13577	" "	-	-	-	-	-	-	-	
17	13578	" "	-	-	-	-	-	-	-	
18	13579	" "	-	-	-	-	-	-	-	
19	13580	Lunar Surface in Sunlight	1 Aug 71	0849	1/125	-	-	-	-	
20	13581	Lunar Surface in Sunlight	"	0849	1/125	-	-	-	-	
21	13582	Lunar Surface Terminator	"	0850	1/125	-	-	-	-	
22	13583	Lunar Surface in Earthshine	"	0850	1/125	-	-	-	-	
23	13584	" " " "	"	0851	1/15	-	-	-	-	
24	13585	" " " "	"	0851	1/15	-	-	-	-	
25	13586	" " " "	"	0852	1/15	-	-	-	-	
26	13587	" " " "	"	0852	1/15	-	-	-	-	
27	13588	" " " "	"	0853	1/8	-	-	-	-	
28	13589	" " " "	"	0853	1/8	-	-	-	-	
29	13590	" " " "	"	0854	1/8	-	-	-	-	
30	13591	" " " "	"	0854	1/8	-	-	-	-	Crater Aristarchus
31	13592	" " " "	"	0855	1/8	-	-	-	-	" "
32	13593	" " " "	"	0855	1/8	-	-	-	-	" "
33	13594	" " " "	"	0856	1/8	-	-	-	-	" "
34	13595	" " " "	"	0856	1/8	-	-	-	-	
35	13596	" " " "	"	0857	1/8	-	-	-	-	

NASA Magazine No AS15-101- Magazine Flight Designator T

Film Type Eastman Kodak 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
36	13597	Lunar Surface in Earthshine	1 Aug 71	0857	1/8	-	-	-	-	
37	13598	" " " "	"	0858	1/8	-	-	-	-	
38	13599	Protect Frame	-	-	-	-	-	-	-	
39	13600	Lunar Surface Terminator	1 Aug 71	0900	1/125	-	-	-	-	Postflight Cal. 1/8 sec exp.
40	13601	Lunar Surface in Sunlight	"	0900	1/125	-	-	-	-	" " " " "
41	-	Postflight Calibration Frm	12 Aug 71	-	1/15	-	-	-	-	
42	-	" " "	"	-	1/15	-	-	-	-	
43	-	" " "	"	-	1/125	-	-	-	-	
44	-	" " "	"	-	1/125	-	-	-	-	
45	-	Unused Frame	-	-	-	-	-	-	-	
46	-	" "	-	-	-	-	-	-	-	
47	-	" "	-	-	-	-	-	-	-	
48	-	" "	-	-	-	-	-	-	-	
49	-	Preflight Calibration Frm	18 Jul 71	-	1/8	-	-	-	-	
50	-	" " "	"	-	1/15	-	-	-	-	
51	-	" " "	"	-	1/125	-	-	-	-	
52	-	" " "	"	-	1/8	-	-	-	-	
53	-	" " "	"	-	1/15	-	-	-	-	
54	-	" " "	"	-	1/125	-	-	-	-	

NASA Magazine No AS15-100- Magazine Flight Designator U

Film Type Eastman Kodak 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1	13507	Protect Frame	-	-	-	-	-	-	-	
2	13508	Delphinus/Milky Way	1 Aug 71	1118	60	21h 00m	+17°	22h 25m	+11°	Erroneously pointed Gegenschein
3	13509	" " "	"	1119	180	21h 00m	+17°	22h 25m	+11°	" " "
4	13510	" " "	"	1122	180	21h 00m	+17°	22h 00m	+17°	" " "
5	13511	Protect Frame	-	-	-	-	-	-	-	
6	13512	" "	-	-	-	-	-	-	-	
7	13513	Zodiacal Light, 75° E. Ecl	1 Aug 71	1334	120	14h 05m	-36°	14h 25m	-16°	
8	13514	" " " " "	"	1336	30	13h 50m	-35°	14h 30m	-20°	
9	13515	" " 65° " "	"	1337	120	13h 35m	-32°	13h 50m	-16°	
10	13516	" " " " "	"	1339	30	13h 25m	-32°	13h 50m	-13°	
11	13517	" " 55° " "	"	1341	90	12h 55m	-29°	13h 25m	-10°	
12	13518	" " " " "	"	1342	30	12h 50m	-28°	13h 25m	-12°	
13	13519	" " " " "	"	1343	10	12h 45m	-27°	13h 10m	-10°	
14	13520	" " 45° " "	"	1344	90	12h 30m	-25°	13h 05m	- 7°	
15	13521	" " " " "	"	1345	30	12h 15m	-24°	12h 45m	- 5°	
16	13522	" " " " "	"	1346	10	12h 10m	-23°	12h 45m	- 5°	
17	13523	Protect Frame	-	-	-	-	-	-	-	
18	13524	" "	-	-	-	-	-	-	-	
19	13525	Zodiacal Light, 35°E. Elong.	1 Aug 71	1347	60	12h 00m	-14°	12h 30m	- 2°	
20	13526	" " " " "	"	1348	20	11h 55m	-13°	12h 20m	+ 5°	
21	13527	" " " " "	"	1349	8	11h 55m	-13°	12h 15m	+ 8°	
22	13528	" " 25°" "	"	1351	60	11h 35m	0°	12h 20m	+14°	
23	13529	" " " " "	"	1352	20	11h 30m	+ 7°	12h 15m	+20°	
24	13530	" " " " "	"	1353	8	11h 25m	+ 7°	12h 10m	+21°	
25	13531	" " 15°" "	"	1354	30	11h 10m	+11°	11h 45m	+16°	
26	13532	" " " " "	"	1355	10	11h 10m	+13°	11h 15m	+19°	
27	13533	" " " " "	"	1355	4	11h 05m	+12°	11h 15m	+19°	
28	13534	" " 3.0° " "	"	1357	1/8	10h 50m	+15°	11h 05m	+23°	
29	13535	" " 2.3° " "	"	1357	1/15	10h 50m	+15°	11h 05m	+23°	
30	13536	" " 1.5° " "	"	1358	1/30	10h 45m	+16°	11h 00m	+24°	
31	13537	" " 0.8° " "	"	1358	1/60	10h 45m	+16°	11h 00m	+24°	
32	13538	Protect Frame	-	-	-	-	-	-	-	
33	13539	" "	-	-	-	-	-	-	-	
34	13540	Delphinus/Milky Way	2 Aug 71	0901	60	20h 20m	+19°	19h 00m	+12°	
35	13541	" " "	"	0902	180	20h 20m	+19°	19h 00m	+12°	

NASA Magazine No AS15-100-   Magazine Flight Designator U

Film Type Eastman Kodak 2485   Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
36	13542	Protect Frame	-	-	-	-	-	-	-	
37	13543	" "	-	-	-	-	-	-	-	
38	13544	Delphinus/Milky Way	2 Aug 71	0909	60	$20^h\ 50^m$	+16°	$19^h\ 40^m$	+ 9°	
39	13545	" " "	"	0910	180	$21^h\ 00^m$	+16°	$19^h\ 40^m$	+ 8°	
40	13546	Protect Frame	-	-	-	-	-	-	-	
41	13547	" "	-	-	-	-	-	-	-	
42	13548	Delphinus/Milky Way	2 Aug 71	0917	60	$21^h\ 30^m$	+12°	$20^h\ 20^m$	+ 7°	
43	13549	" " "	"	0918	180	$21^h\ 35^m$	+13°	$20^h\ 20^m$	+ 7°	
44	13550	Protect Frame	-	-	-	-	-	-	-	
45	13551	Unused Frame	-	-	-	-	-	-	-	
46	13552	" "	-	-	-	-	-	-	-	
47	13553	" "	-	-	-	-	-	-	-	
48	13554	" "	-	-	-	-	-	-	-	
49	13555	" "	-	-	-	-	-	-	-	
50	13556	" "	-	-	-	-	-	-	-	

NASA Magazine No AS15-102- Magazine Flight Designator V

Film Type Eastman Kodak 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1	13602	Film Loading Advance Frame	-	-	-	-	-	-	-	
2	13603	" " " "	-	-	-	-	-	--	-	
3	13604	Protect Frame	-	-	-	-	-	-	-	
4	13605	Protect Frame	-	-	-	-	-	-	-	
5	13606	Delphinus/Milky Way	3 Aug 71	1231	60	$20^h 50^m$	+17°	$19^h 30^m$	+12°	Erroneously Pointed Gegenschein
6	13607	" " "	"	1232	180	$20^h 50^m$	+17°	$19^h 30^m$	+12°	" " "
7	13608	Protect Frame	-	-	-	-	-	-	-	
8	13609	" "	-	-	-	-	-	-	-	
9	13610	Delphinus/Milky Way	3 Aug 71	1248	30	$21^h 30^m$	+12°	$20^h 15^m$	+11°	Erroneously Pointed Gegenschein
10	13611	" " "	"	1249	60	$21^h 30^m$	+12°	$20^h 15^m$	+11°	" " "
11	13612	" " "	"	1250	180	$21^h 30^m$	+11°	$20^h 10^m$	+ 9°	" " "
12	13613	Protect Frame	-	-	-	-	-	-	-	
13	13614	Lunar Eclipse Entry	6 Aug 71	1338	< 1	$21^h 40^m$	- 4°	$23^h 25^m$	-10°	
14	13615	" " "	"	1338	2	$21^h 40^m$	- 3°	$23^h 25^m$	- 6°	
15	13616	" " "	"	1339	4	$21^h 40^m$	- 3°	$23^h 25^m$	- 6°	
16	13617	" " "	"	1339	~ 1	$21^h 40^m$	- 3°	$23^h 25^m$	- 6°	
17	13618	" " "	"	1340	8	$21^h 40^m$	- 3°	$23^h 25^m$	- 6°	
18	13619	" " "	"	1341	15	$21^h 40^m$	- 3°	$23^h 25^m$	- 6°	
19	13620	" " "	"	1342	30	$21^h 40^m$	- 3°	$23^h 25^m$	- 6°	
20	13621	" " "	"	1343	60	$21^h 40^m$	- 3°	$23^h 30^m$	- 6°	
21	13622	Protect Frame	-	-	-	-	-	-	-	
22	13623	" "	-	-	-	-	-	-	-	
23	13624	Lunar Eclipse Exit	6 Aug 71	1525	60	$22^h 30^m$	+ 2°	$21^h 20^m$	+18°	
24	13625	" " "	"	1526	30	$22^h 30^m$	+ 2°	$21^h 20^m$	+18°	
25	13626	" " "	"	1527	15	$22^h 30^m$	+ 2°	$21^h 20^m$	+18°	
26	13627	" " "	"	1528	8	$22^h 30^m$	+ 2°	$21^h 20^m$	+18°	
27	13628	" " "	"	1529	~ 1	$22^h 30^m$	+ 2°	$21^h 20^m$	+18°	
28	13629	" " "	"	1529	4	$22^h 30^m$	+ 3°	$21^h 20^m$	+18°	
29	13630	" " "	"	1530	2	$22^h 30^m$	+ 5°	$21^h 20^m$	+18°	
30	13631	Protect Frame	-	-	-	-	-	-	-	
31	13632	Unused Frame	-	-	-	-	-	-	-	
32	13633	Postflight Calibration Frm	12 Aug 71	-	15	-	-	-	-	3.0 ND Filter
33	13634	" " "	"	-	10	-	-	-	-	" " "
34	13635	" " "	"	-	10	-	-	-	-	" " "
35	13636	" " "	"	-	9	-	-	-	-	" " "

NASA Magazine No AS15-102- Magazine Flight Designator V

Film Type Eastman Kodak 2425 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
36	13637	Postflight Calibration Frm	12 Aug 71	-	8	-	-	-	-	3.0 ND Filter
37	13638	" " "	"	-	4	-	-	-	-	" " "
38	13639	" " "	"	-	4	-	-	-	-	" " "
39	13640	" " "	"	-	2	-	-	-	-	" " "
40	13641	" " "	"	-	2	-	-	-	-	" " "
41	13642	" " "	"	-	1/8	-	-	-	-	" " "
42	13643	" " "	"	-	1/8	-	-	-	-	" " "
43	13644	" " "	"	-	1/15	-	-	-	-	" " "
44	13645	" " "	"	-	1/15	-	-	-	-	" " "
45	13646	" " "	"	-	1/30	-	-	-	-	" " "
46	13647	" " "	"	-	1/30	-	-	-	-	" " "
47	13648	" " "	"	-	1/60	-	-	-	-	" " "
48	13649	" " "	"	-	1/60	-	-	-	-	" " "
49	13650	Unused Frame	-	-	-	-	-	-	-	
50	13651	MSC Photo Lab Calibrations	18 Jul 71/ 12 Aug 71	-	1/100	-	-	-	-	

NASA Magazine No________ Magazine Flight Designator W

Film Type Eastman Kodak 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1		Preflight Calibration Frm.	18 Jul 71	-	240	-	-	-	-	3.0 ND Filter
2		" " "	"	-	240	-	-	-	-	" " "
3		" " "	"	-	180	-	-	-	-	" " "
4		" " "	"	-	180	-	-	-	-	" " "
5		" " "	"	-	120	-	-	-	-	" " "
6		" " "	"	-	120	-	-	-	-	" " "
7		" " "	"	-	90	-	-	-	-	" " "
8		" " "	"	-	90	-	-	-	-	" " "
9		" " "	"	-	60	-	-	-	-	" " "
10		" " "	"	-	60	-	-	-	-	" " "
11		" " "	"	-	30	-	-	-	-	" " "
12		" " "	"	-	30	-	-	-	-	" " "
13		" " "	"	-	2	-	-	-	-	" " "
14		" " "	"	-	20	-	-	-	-	" " "
15		" " "	"	-	15	-	-	-	-	" " "
16		" " "	"	-	15	-	-	-	-	" " "
17		" " "	"	-	10	-	-	-	-	" " "
18		" " "	"	-	10	-	-	-	-	" " "
19		" " "	"	-	8	-	-	-	-	" " "
20		" " "	"	-	8	-	-	-	-	" " "
21		" " "	"	-	4	-	-	-	-	" " "
22		" " "	"	-	4	-	-	-	-	" " "
23		" " "	"	-	2	-	-	-	-	" " "
24		" " "	"	-	2	-	-	-	-	" " "
25		" " "	"	-	1/8	-	-	-	-	" " "
26		" " "	"	-	1/8	-	-	-	-	" " "
27		" " "	"	-	1/15	-	-	-	-	" " "
28		" " "	"	-	1/15	-	-	-	-	" " "
29		" " "	"	-	1/30	-	-	-	-	" " "
30		" " "	"	-	1/30	-	-	-	-	" " "
31		" " "	"	-	1/60	-	-	-	-	" " "
32		" " "	"	-	1/60	-	-	-	-	" " "
33		Protect Frame	-	-	-	-	-	-	-	
34		Postflt. Calibration Frame	12 Aug 71	-	240	-	-	-	-	3.0 ND Filter
35		" " "	"	-	240	-	-	-	-	" " "

NASA Magazine No__________ Magazine Flight Designator W

Film Type Eastman Kodak 2485 Film Size 35mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
36		Postflt. Calibration Frame	12 Aug 71	-	180	-	-	-	-	3.0 ND Filter
37		" " "	"	-	180	-	-	-	-	" " "
38		" " "	"	-	2.5	-	-	-	-	" " "
39		" " "	"	-	120	-	-	-	-	" " "
40		" " "	"	-	90	-	-	-	-	" " "
41		" " "	"	-	90	-	-	-	-	" " "
42		" " "	"	-	60	-	-	-	-	" " "
43		" " "	"	-	60	-	-	-	-	" " "
44		" " "	"	-	30	-	-	-	-	" " "
45		" " "	"	-	30	-	-	-	-	" " "
46		" " "	"	-	20	-	-	-	-	" " "
47		" " "	"	-	20	-	-	-	-	" " "
48		" " "	"	-	15	-	-	-	-	" " "

NASA Magazine No AS15-96- Magazine Flight Designator Q(partial)

Film Type Eastman Kodak SO-368 Film Size 70 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1	13105	Protect Frame	-	-	1/500	-	-	-	-	
2	13106	Lunar Eclipse	6 Aug 71	1324	1	$23^h\ 40^m$	$+6^o$	-	-	250 mm Lens
3	13107	" "	"	1324	1	$23^h\ 40^m$	$+6^o$	-	-	" " "
4	13108	" "	"	1327	2	$23^h\ 40^m$	$+6^o$	-	-	" " "
5	13109	" "	"	1327	2	$23^h\ 40^m$	$+6^o$	-	-	" " "
6	13110	" "	"	1327	1	$23^h\ 40^m$	$+6^o$	-	-	80 mm Lens
7	13111	" "	"	1330	1	$23^h\ 40^m$	$+6^o$	-	-	" " "
8	13112	" "	"	1330	2	$23^h\ 40^m$	$+6^o$	-	-	" " "
9	13113	" "	"	1333	2	$23^h\ 40^m$	$+6^o$	-	-	" " "
10	13114	" "	"	1333	10	$23^h\ 40^m$	$+6^o$	-	-	" " "
11	13115	" "	"	1336	10	$23^h\ 40^m$	$+6^o$	-	-	" " "
12	13116	" "	"	1336	120	$23^h\ 40^m$	$+6^o$	-	-	" " "
13	13117	Protect Frame	-	-	1/500	-	-	-	-	
14	13118	Lunar Eclipse	6 Aug 71	1528	120	$23^h\ 45^m$	$+7^o$	-	-	" " "
15	13119	" "	"	1532	10	$23^h\ 45^m$	$+7^o$	-	-	" " "
16	13120	" "	"	1535	2	$23^h\ 45^m$	$+7^o$	-	-	" " "
17	13121	" "	"	1535	2	$23^h\ 45^m$	$+7^o$	-	-	" " "
18	13122	" "	"	1538	1	$23^h\ 45^m$	$+7^o$	-	-	" " "
19	13123	" "	"	1541	2	$23^h\ 45^m$	$+7^o$	-	-	250 mm Lens
20	13124	" "	"	1541	2	$23^h\ 45^m$	$+7^o$	-	-	" " "
21	13125	" "	"	1544	1	$23^h\ 45^m$	$+7^o$	-	-	" " "
22	13126	" "	"	1544	1	$23^h\ 45^m$	$+7^o$	-	-	" " "
23	13127	Protect Frame	-	-	1/500	-	-	-	-	

NASA Magazine No AS15-98- Magazine Flight Designator R (Partial)

Film Type Eastman Kodak 2485 Film Size 70 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
-	-	Preflight Calibration Frm	18 Jul 71	-	1/125	-	-	-	-	
-	-	" " "	"	-	1/60	-	-	-	-	
-	-	" " "	"	-	1/30	-	-	-	-	
-	-	" " "	"	-	1/15	-	-	-	-	
-	-	" " "	"	-	1/8	-	-	-	-	
-	-	" " "	"	-	1/4	-	-	-	-	
-	-	" " "	"	-	1	-	-	-	-	
1	13309	Protect Frame	-	-	1/500	-	-	-	-	
2	13310	Solar Corona Sunrise	31 Jul 71	1159	1	-	-	-	-	GET 123:23:40, SR -70 sec.
3	13311	" " "	"	1159	~10	9^h 20^m	+13°	11^h 20^m	+18°	GET 123:23:50, SR -60 sec.
4	13312	" " "	"	1159	1/8	-	-	-	-	GET 123:24:00, SR -50 sec.
5	13313	" " "	"	1159	1/15	-	-	-	-	GET 123:24:10, SR -40 sec.
6	13314	" " "	"	1159	1/30	-	-	-	-	GET 123:24:20, SR -30 sec.
7	13315	" " "	"	1159	1/60	-	-	-	-	GET 123:24:30, SR -20 sec.
8	13316	" " "	"	1200	1/125	-	-	-	-	GET 123:24:40, SR -10 sec.
9	13317	Protect Frame	"	1200	1/500	-	-	-	-	GET 123:24:50, Sunrise
10	13318	Solar Corona Sunset	"	1311	1/125	-	-	-	-	GET 124:37:32, SS +10 sec.
11	13319	" " "	"	1311	1/60	-	-	-	-	GET 124:37:42, SS +20 sec
12	13320	" " "	"	1311	1/30	-	-	-	-	GET 124:37:52, SS +30 sec.
13	13321	" " "	"	1311	1/15	-	-	-	-	GET 124:38:02, SS +40 sec.
14	13322	" " "	"	1311	1/8	-	-	-	-	GET 124:38:12, SS +50 sec.
15	13323	" " "	"	1311	1/4	-	-	-	-	GET 124:38:22, SS +60 sec.
16	13324	" " "	"	1312	1	-	-	-	-	GET 124:38:32, SS +70 sec.
17	13325	" " "	"	1312	~10	7^h 55^m	+38°	6^h 20^m	+30°	Earthshine on Lunar Surface
18	13377	Solar Corona Sunrise	4 Aug 71	0845	1	-	-	-	-	GET 216:10:45, SR -70 sec.
19	13378	" " "	"	0845	1/4	-	-	-	-	GET 216:10:55, SR -60 sec.
20	13379	" " "	"	0845	1/8	-	-	-	-	GET 216:11:05, SR -50 sec.
21	13380	" " "	"	0845	1/15	-	-	-	-	GET 216:11:15, SR -40 sec.
22	13381	" " "	"	0845	1/30	-	-	-	-	GET 216:11:25, SR -30 sec.
23	13382	" " "	"	0845	1/60	-	-	-	-	GET 216:11:35, SR -20 sec.
24	13383	" " "	"	0846	1/125	-	-	-	-	GET 216:11:45, SR -10 sec.
25	13384	" " "	"	0846	1/250	-	-	-	-	GET 216:11:50, SR - 5 sec.
26	13385	Protect Frame	"	0846	1/500	-	-	-	-	GET 216:11:55, Sunrise
27	13398	Solar Corona Calibration	5 Aug 71	0739	1/125	-	-	-	-	Lunar Disc

NASA Magazine No AS [illegible]-98[illegible] Magazine Flight Designator R (Partial)

Film Type Eas[illegible]n Kodak 2485 Film Size 70 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
28	13399	Solar Corona Calibration	5 Aug 71	0739	1/60	-	-	-	-	Lunar Disc
29	13400	" " "	"	0739	1/30	-	-	-	-	Lunar Disc
30	13401	" " "	"	0739	1/500	-	-	-	-	Lunar Disc

NASA Magazine No AS16-128 Magazine Flight Designator MAG W (Label Y . film)

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1		Calibration, ND 3 Filter	10 Apr 72		300					
2		" " " "	" " "		"					
3		" " " "	" " "		180					
4		" " " "	" "		"					
5		" " " "	" "		100					
6		" " " "	" "		"					
7		" " " "	" " "		90					
8		" " " "	" " "		1(?)					
9		" " " "	" " "		90					
10		" " " "	" " "		60					
11		" " " "	" " "		"					
12		" " " "	" " "		30					
13		" " " "	" " "		"					
14		" " " "	" " "		20					
15		" " " "	" " "		"					
16		Calibration No. Filter	" " "		20					
17		" " "	" " "		"					
18		" " "	" " "		10					
19		" " "	" " "		"					
20		" " "	" " "		5					
21		" " "	" " "		"					
22		" " "	" " "		3					
23		" " "	" " "		"					
24		" " "	" " "		1					
25		" " "	" " "		"					
26		" " "	" " "		½					
27		" " "	" " "		"					
28		" " "	" " "		¼					
29		" " "	" " "		"					
30		" " "	" " "		1/8					
31		" " "	" " "		"					
32		" " "	" " "		1/15					
33		" " "	" " "		"					
34		" " "	" " "		1/30					
35		" " "	" " "		"					
36		" " "	" " "		1/60					

NASA Magazine No AS16-128 Magazine Flight Designator MAG W (Label Y . Film)

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
37		Calibration No. Filter	10 Apr 72		1/60					
38		" " "	" " "		1/1000					
39		" " "	" " "		"					
	20027	Unused Frame								
	20028	" "								
	20029	" "								
	20030	" "								
	20031	" "								
	20032	" "								

NASA Magazine No AS16-129 Magazine Flight Designator X

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
1	20079	Protect Frame								
2	20078	" "								
3	20077	Skylab Contamination			1/8					Attitude #1
4	20076	" "			1					" "
5	20075	" "			10					" "
6	20074	" "			100					" "
7	20073	" "			1/8					" "
8	20072	" "			1					" "
9	20071	" "			10					" "
10	20070	" "			100					" "
11	20069	" "			1/8					Attitude #2
12	20068	" "			1					" "
13	20067	" "			10					" "
14	20066	" "			100					" " Moon Shining in
15	20065	" "			1/8					" ", Moon Shining in
16	20064	" "			1					" " " " "
17	20063	" "			10					" " " " "
18	20062	" "			100					" " " " "
19	20061	Protect Frame								
	20060	Unused Frame								
	20059	" "								
	20058	" "								
	20057	" "								
	20056	" "								
	20055	" "								
	20054	" "								
	20053	" "								
	20052	" "								
	20051	" "								
	20050	" "								
	20049	" "								
	20048	" "								
	20047	" "								
	20046	"								
	20045	"								
	20044	"								

NASA Magazine No AS16-129 Magazine Flight Designator X Page f

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
	20043	Unused Frame								
	20042	" "								
	20041	" "								
	20040	" "								
	20039	" "								
	20038	" "								
	20037	" "								
	20036	" "								
	20035	" "								
	20034	" "								
	20033	" "								

NASA Magazine No AS16-130 Magazine Flight Designator MAG Y (Labeled W on film)

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
	20080	Unused Frame								
	20081	" "								
	20082	" "								
	20083	" "								
	20084	" "								
	20085	" "								
	20086	" "								
	20087	" "								
	20088	" "								
	20089	" "								
	20090	" "								
	2009[illegible]	" "								
	20092	" "								
	20093	" "								
1		Calibration, Red Filter	10 Apr 72		240					
2		" " "	" " "		"					
3		" " "	" " "		60					
4		" " "	" " "		"					
5		Calibration, Blue Filter	" " "		240					
6		" " "	" " "		"					
7		" " "	" " "		60					
8		" " "	" " "		"					
9		Calibration, Polaroid Filt.	" " "		1/1000					
10		" " "	" " "		1/60					
11		" " "	" " "		1/30					
12		" " "	" " "		1/15					
13		" " "	" " "		1/8					
14		" " "	" " "		¼					
15		" " "	" " "		½					
16		" " "	" " "		1					
17		" " "	" " "		3					
18		" " "	" " "		5					
19		" " "	" " "		10					
20		" " "	" " "		20					
21		" " "	" " "		30					
22		" " "	" " "		60					

NASA Magazine No AS16-130 Magazine Flight Designator MAG Y (Labeled W on film)

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
23		Calibration, Polaroid Filt.	10 Apr 72		90					
	20094	Unused Frame								
	20095	" "								
	20096	" "								
	20097	" "								
	20098	" "								
	20099	" "								

NASA Magazine No AS16-127 Magazine Flight Designator XX

Film Type 2485 Film Size 35MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1		Unused Frame								
2	20026	Protect Frame								Light Streak
3	20025	" "								Half Light Streak, Half Dark
4	20024	Gum Nebula,Pt.1,Red Filt.	21 Apr. 72	1847	60	$7^h\ 20^m$	-30°	$6^h\ 10^m$	-15°	
5	20023	" " " " "	" " "	1848	240	$7^h\ 20^m$	-32°	$6^h\ 10^m$	-15°	
6	20022	" " " Blue "	" " "	1856	60	$7^h\ 20^m$	-30°	$6^h\ 20^m$	-17°	
7	20021	" " " " "	" " "	1857	240	$7^h\ 35^m$	-33°	$6^h\ 30^m$	-17°	
8	20020	Protect Frame								
9	20019	Earthshine	21 Apr. 72	2022	1/125	76.0° W	2.0°S	80.0° W	1°NL*	Selenographic coordinates
10	20018	"	" " "	2024	"	69.5° W	1.0°S	73.0° W	0.0°	Surface contrast extremely weak
11	20017	"	" " "	2026	"	-	-	-	-	" " " "
12	20016	"	" " "	2028	"	-	-	-	-	" " " "
13	20015	"	" " "	2030	"	-	-	-	-	" " " "
14	20014	"	" " "	2032	"	-	-	-	-	" " " "
15	20013	Protect Frame								
16	20012	Zodiacal Light	21 Apr. 72	2052	90	$6^h\ 00^m$	45°	$4^h\ 40^m$	35°	
17	20011	" "	" " "	2054	90	$5^h\ 50^m$	44°	$4^h\ 25^m$	35°	
18	20010	" "	" " "	2056	60	$5^h\ 00^m$	44°	$3^h\ 55^m$	32°	
19	20009	" "	" " "	2057	"	$4^h\ 40^m$	42°	$3^h\ 30^m$	29°	
20	20008	" "	" " "	2059	30	$4^h\ 20^m$	39°	$3^h\ 10^m$	29°	
21	20007	" "	" " "	2101	"	$4^h\ 00^m$	41°	$3^h\ 10^m$	29°	Bright Object Venus
22	20006	" "	" " "	2102	20	$3^h\ 50^m$	36°	$3^h\ 00^m$	26°	
23	20005	" "	" " "	2103	"	$3^h\ 30^m$	36°	$3^h\ 40^m$	26°	
24	20004	" "	" " "	2104	10	$3^h\ 30^m$	35°	$2^h\ 05^m$	25°	
25	20003	" "	" " "	2104	01					Star images to weak
26	20002	" "	" " "	2104	10	$3^h\ 30^m$	35°	$2^h\ 05^m$	25°	
27	20001	" "	" " "	2105	05	$3^h\ 30^m$	35°	$2^h\ 05^m$	25°	
28	20000	" "	" " "	2105	"	$3^h\ 25^m$	35°	$2^h\ 00^m$	25°	
29	19999	" "	" " "	2105	03	$3^h\ 20^m$	33°	$1^h\ 50^m$	25°	
30	19998	" "	" " "	2105	"	$3^h\ 20^m$	33°	$1^h\ 50^m$	25°	
31	19997	" "	" " "	2105	01					Star images too weak
32	19996	" "	" " "	2105	"					" " " "
33	19995	" "	" " "	2105	1/8					" " " "
34	19994	" "	" " "	2106	"					" " " "
35	19993	" "	" " "	2106	1/15					" " " "
36	19992	" "	" " "	2106	"					" " " "

NASA Magazine No AS16-127   Magazine Flight Designator XX

Film Type 2485   Film Size 35MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
37	19991	Zodiacal Light	21 Apr. 72	2106	1/30					Star images too weak
38	19990	" "	" " "	2106	"					" " " "
39	19989	" "	" " "	2106	1/60					" " " "
40	19988	" "	" " "	2107	"					" " " "
41	19987	Protect Frame								
--	19986	Unused Frame								
--	19985	" "								
--	19984	" "								
--	19983	" "								
--	19982	" "								
--	19981	" "								
--	19980	" "								

NASA Magazine No NONE — Magazine Flight Designator MAG YY (Postflight calibration)

Film Type 2485 — Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure: Date	Time of Exposure: GMT	Exp. Time (sec)	Cntr Frm Loc: Rt Asc	Cntr Frm Loc: Dec	Crnr Frm Loc: Rt Asc	Crnr Frm Loc: Dec	Remarks
1		Calibration, ND 3 Filter	2 May 1972		300					309^s Actual
2		" " " "	" " "		180					Lost in 2nd light leak
3		" " " "	" " "		100					
4		" " " "	" " "		90					
5		" " " "	" " "		60					Lower wedges lost in 4th light leak
6		" " " "	" " "		30					
7		" " " "	" " "		20					Lost in 5th light leak
8		" " " "	" " "		10					
9		" " " "	" " "		5					
10		Calibration, No Filter	" " "		30					
11		" " "	" " "		20					
12		" " "	" " "		10					
13		" " "	" " "		5					
14		" " "	" " "		3					
15		" " "	" " "		1					
16		" " "	" " "		½					
17		" " "	" " "		¼					
18		" " "	" " "		1/8					
19		" " "	" " "		1/15					
20		" " "	" " "		1/30					
21		" " "	" " "		1/60					
22		" " "	" " "		1/1000					
23		Calibration, Red Filter	" " "		240					
24		" " "	" " "		60					
25		Calibration, Red & ND 3 Fil.	" " "		240					
26		" " " " " "	" " "		60					
27		Calibration, Blue Filter	" " "		240					
28		" " "	" " "		60					
29		Calibration, Blue & ND 3 Fil.	" " "		240					
30		" " " " "	" " "		60					
31		Calibration, Polaroid Filt.	" " "		1/1000					
32		" " "	" " "		1/60					
33		" " "	" " "		1/30					
34		" " "	" " "		1/15					
35		" " "	" " "		1/8					
36		" " "	" " "		¼					

NASA Magazine No NONE Magazine Flight Designator MAG YY (Post flight - Calibration)

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure: Date	Time of Exposure: GMT	Exp. Time (sec)	Cntr Frm Loc: Rt Asc	Cntr Frm Loc: Dec	Crnr Frm Loc: Rt Asc	Crnr Frm Loc: Dec	Remarks
37		Calibration, Polaroid Filt.	2 May 1972		½					
38		" " "	" " "		1					
39		" " "	" " "		3					
40		" " "	" " "		5					
41		" " "	" " "		10					
42		" " "	" " "		20					
43		" " "	" " "		30					
44		" " "	" " "		60					
45		" " "	" " "		90					
46		Calibration, ND 3 Filter	" " "		90					
47		" " " "	" " "		60					

NASA Magazine No AS16-126 Magazine Flight Designator ZZ

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Dec	Crnr Frm Loc Rt Asc	Dec	Remarks
1	19979	Protect Frame								
2	19978	" "								
3	19977	Gegenschein Calibration	22 Apr 72	0043	3	-	-	-	-	Star images too weak
4	19976	" "	" " "	0043	60	14^h 10^m	-24^o	15^h 10^m	-15^o	
5	19975	" "	" " "	0044	180	14^h 10^m	-26^o	15^h 25^m	-20^o	
6	19974	Protect Frame								
7	19973	" "								
8	19972	Galactic Cluster in Virgo	22 Apr 72	1612	300	12^h 20^m	$+9^o$	11^h 00^m	$+5^o$	
9	19971	Gegenschein/Moulton Region	" " "	1617	60	13^h 45^m	-12^o	12^h 20^m	-08^o	
10	19970	" " "	" " "	1619	180	13^h 45^m	-12^o	12^h 20^m	-08^o	
11	19969	" " "	" " "	1623	180	14^h 10^m	-14^o	13^h 00^m	-11^o	
12	19968	" " "	" " "	1627	60	14^h 20^m	-11^o	13^h 00^m	-12^o	
13	19967	" " "	" " "	1629	180	14^h 50^m	-18^o	13^h 35^m	-17^o	
14	19966	" " "	" " "	1632	60	14^h 50^m	-18^o	13^h 35^m	-17^o	
15	19965	Protect Frame								
16	19964	" "								
17	19963	Gum Nebula Pt.2,Red Filt.	24 Apr 72	2142	240	8^h 40^m	-48^o	10^h 20^m	-39^o	
18	19962	" " " " " "	" " "	2146	60	8^h 40^m	-52^o	10^h 20^m	-40^o	
19	19961	" " " " Blue "	" " "	2148	60	8^h 30^m	-49^o	10^h 00^m	-37^o	
20	19960	" " " " " "	" " "	2150	30	8^h 40^m	-49^o	9^h 50^m	-39^o	
21	19959	" " " " " "	" " "	2151	240	8^h 35^m	-48^o	9^h 55^m	-41^o	
22	19958	Protect Frame								
23	19957	Inside cabin H_2O Droplet								
24	19956	" " " "								
25	19955	Protect Frame								
26	19954	Gegenschein/Moulton Region	25 Apr 72	0342	180	14^h 55^m	-19^o	13^h 50^m	-32^o	
27	19953	" " "	" " "	0345	60	14^h 50^m	-18^o	14^h 00^m	-30^o	
28	19952	" " "	" " "	0347	180	14^h 25^m	-15^o	14^h 40^m	-35^o	
29	19951	" " "	" " "	0352	?	14^h 25^m	-15^o	14^h 40^m	-35^o	
30	19950	" " "	" " "	0353	60	14^h 20^m	-15^o	14^h 45^m	-30^o	
31	19949	Galactic Clust.in Centaurus	" " "	0356	300	13^h 10^m	-39^o	13^h 55^m	-52^o	
32	19948	Protect Frame								
	19947	Unused Frame								
	19946	" "								
	19945	" "								
	19944	" "								
	19943	" "								

NASA Magazine No AS16-126 Magazine Flight Designator ZZ

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
	19942	Unused Frame								
	19941	" "								
	19940	" "								
	19939	" "								
	19938	" "								
	19937	" "								
	19936	" "								
	19935	" "								
	19934	" "								
	19933	" "								

NASA Magazine No NONE — Magazine Flight Designator MAG W (Back Up, co)

Film Type 2485 Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Cntr Frm Loc Rt Asc	Cntr Frm Loc Dec	Crnr Frm Loc Rt Asc	Crnr Frm Loc Dec	Remarks
1		Calibration, ND 3 Filter	10 Apr 72		300					
2		" " " "	" " "		"					
3		" " " "	" " "		180					
4		" " " "	" " "		"					
5		" " " "	" " "		100					
6		" " " "	" " "		"					
7		" " " "	" " "		90					
8		" " " "	" " "		"					
9		" " " "	" " "		60					
10		" " " "	" " "		"					
11		" " " "	" " "		30					
12		" " " "	" " "		"					
13		" " " "	" " "		20					
14		" " " "	" " "		"					
15		Calibration, NO Filter	" " "		20					
16		" " "	" " "		"					
17		" " "	" " "		10					
18		" " "	" " "		"					
19		" " "	" " "		5					
20		" " "	" " "		"					
21		" " "	" " "		3					
22		" " "	" " "		"					
23		" " "	" " "		1					
24		" " "	" " "		"					
25		" " "	" " "		½					
26		" " "	" " "		"					
27		" " "	" " "		¼					
28		" " "	" " "		"					
29		" " "	" " "		1/8					
30		" " "	" " "		"					
31		" " "	" " "		1/15					
32		" " "	" " "		"					
33		" " "	" " "		1/30					
34		" " "	" " "		"					
35		" " "	" " "		1/60					
36		" " "	" " "		"					

NASA Magazine No NONE   Magazine Flight Designator MAG W (Back Up, Ground)

Film Type 2485   Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	Cntr Frm Loc		Crnr Frm Loc		Remarks
			Date	GMT		Rt Asc	Dec	Rt Asc	Dec	
37		Calibration, NO Filter	10 Apr 72		1/1000					
38		" " "	" " "		"					

NASA Magazine No NONE — Magazine Flight Designator MAG Y — (Back up, Ground)

Film Type 2485 — Film Size 35 MM

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure: Date	Time of Exposure: GMT	Exp. Time (sec)	Cntr Frm Loc: Rt Asc	Cntr Frm Loc: Dec	Crnr Frm Loc: Rt Asc	Crnr Frm Loc: Dec	Remarks
1		Calibration, Red Filter	10 Apr 72		240					
2		" " "	" " "		"					
3		" " "	" " "		60					
4		" " "	" " "		"					
5		Calibration, Blue Filter	" " "		240					
6		" " "	" " "		"					
7		" " "	" " "		60					
8		" " "	" " "		"					
9		Calibration, Polaroid Filt.	" " "		1/1000					
10		" " "	" " "		1/60					
11		" " "	" " "		1/30					
12		" " "	" " "		1/15					
13		" " "	" " "		1/8					
14		" " "	" " "		¼					
15		" " "	" " "		½					
16		" " "	" " "		1					
17		" " "	" " "		3					3.3^s actual
18		" " "	" " "		5					
19		" " "	" " "		10					
20		" " "	" " "		20					
21		" " "	" " "		30					
22		" " "	" " "		60					
23		" " "	" " "		90					

NASA Magazine No AS17-156 Magazine Flight Designator UU [illegible] of 2

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	CNTR FRM LOC RT ASC LONG	CNTR FRM LOC DEC LAT	CRNR FRM LOC RT ASC LONG	CRNR FRM LOC DEC LAT	Remarks
1	23777	Calibration, Red Filter	29 Nov. 1972	-	90	-	-	-	-	
2	23778	" " "	" " "	-	60	-	-	-	-	
3	23779	" " "	" " "	-	40	-	-	-	-	
4	23780	" " "	" " "	-	20	-	-	-	-	
5	23781	" " "	" " "	-	10	-	-	-	-	
6	23782	" " "	" " "	-	6	-	-	-	-	
7	23783	" " "	" " "	-	2	-	-	-	-	
8	23784	" " "	" " "	-	1	-	-	-	-	
9	23785	" " "	" " "	-	1/2	-	-	-	-	
10	23786	" " "	" " "	-	1/4	-	-	-	-	
11	23787	" " "	" " "	-	1/8	-	-	-	-	
12	23788	" " "	" " "	-	1/15	-	-	-	-	
13	23789	" " "	" " "	-	1/30	-	-	-	-	
14	23790	" " "	" " "	-	1/60	-	-	-	-	
15	23791	Calibration, Blue Filter	" " "	-	~1	-	-	-	-	
16	23792	" " "	" " "	-	90	-	-	-	-	
17	23793	" " "	" " "	-	60	-	-	-	-	
18	23794	" " "	" " "	-	40	-	-	-	-	
19	23795	" " "	" " "	-	20	-	-	-	-	
20	23796	" " "	" " "	-	10	-	-	-	-	
21	23797	" " "	" " "	-	6	-	-	-	-	
22	23798	" " "	" " "	-	2	-	-	-	-	
23	23799	" " "	" " "	-	1	-	-	-	-	
24	23800	" " "	" " "	-	1/2	-	-	-	-	
25	23801	" " "	" " "	-	1/4	-	-	-	-	
26	23802	" " "	" " "	-	1/8	-	-	-	-	
27	23803	" " "	" " "	-	1/15	-	-	-	-	
28	23804	" " "	" " "	-	1/30	-	-	-	-	
29	23805	" " "	" " "	-	1/60	-	-	-	-	

NASA Magazine No AS17-156 Magazine Flight Designator UU Pa 2 of 2

Film Type 2485 Film Size 35 mm

Quick Lock Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	CNTR FRM LOC RT ASC LONG	DEC LAT	CRNR FRM LOC RT ASC LONG	DEC LAT	Remarks
30	23806	Calibration, Polaroid Filter	29 Nov. 1972	-	~ 2	-	-	-	-	
31	23807	" " "	" " "	-	90	-	-	-	-	
32	23808	" " "	" " "	-	60	-	-	-	-	
33	23809	" " "	" " "	-	30	-	-	-	-	
34	23810	" " "	" " "	-	20	-	-	-	-	
35	23811	" " "	" " "	-	10	-	-	-	-	
36	23812	" " "	" " "	-	5	-	-	-	-	
37	23813	" " "	" " "	-	3	-	-	-	-	
38	23814	" " "	" " "	-	1	-	-	-	-	
39	23815	" " "	" " "	-	1/2	-	-	-	-	
40	23816	" " "	" " "	-	1/4	-	-	-	-	

NASA Magazine No. AS 17-157 Magazine Flight Designator VV

Film Type 2485 Film Size 35 mm

Quick Look Fr No	Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	CENTER FRM LOC RT ASC LONG	CENTER FRM LOC DEC LAT	CORNER FRM LOC RT ASC LONG	CORNER FRM LOC DEC LAT	Remarks
1	23817	Interior - Hatch handle				-	-	-	-	
2	23818	LMP off duty				-	-	-	-	
[illegible]	23319	LMP off duty				-	-	-	-	
4	23820	CDR eating				-	-	-	-	
5	23821	CMP at center of CM				-	-	-	-	
6	23822	CDR with checklist				-	-	-	-	
7	23823	CMP drinking at G&N Station				-	-	-	-	
8	23824	CMP drinking at G&N Station				-	-	-	-	
9	23825	Protect Frame				-	-	-	-	
10	23826	Post TEI				118.5°E	41.5° S	127.0°E	33.0°SL*	Looking south of Milne
11	23827	Tsiolkovsky				119.0°E	16.0° S	117.5°E	17.0°S	
12	23828	Tsiolkovsky				124.5°E	13.0° S	120.0°E	5.0°SL	Danjon near center
13	23829	Tsiolkovsky				120.0°E	12.0° S	112.0°E	8.0°SL	Langemark in background
14	23830	Fermi Area				122.0°E	14.5° S	119.5°E	17.5°S	
15	23831	Tsiolkovsky, Fermi				125.5°E	16.5° S	123.0°E	13.0°S	
16	23832	Tsiolkovsky, Fermi				124.0°E	17.0° S	121.0°E	15.0°S	Lutke & Delporte upper L.H. area
17	23833	Tsiolkovsky, Fermi				122.5°E	18.0° S	118.5°E	18.0°S	Lutke & Delports upper L.h. area
18	23834	Fermi Area				124.5°E	20.0° S	122.0°E	17.5°S	
19	23835	Fermi Area				123.5°E	19.0° S	121.5°E	17.0°S	
20	23836	Fermi Area				128.0°E	16.5° S	125.0°E	9.0°S	
21	23837	Tsiolkovsky Central Peak				128.5°E	19.5° S	126.5°E	19.0°S	
22	23838	Tsiolkovsky Central Peak				127.5°E	18.5° S	126.0°E	19.0°S	
23	23839	Tsiolkovsky				124.5°E	18.0° S	112.0°E	16.0°SL	Lutke & Delporte upper center
24	23840	Tsiolkovsky				129.5°E	19.0° S	128.5°E	17.5°S	
25	23841	Tsiolkovsky Floor				129.0°E	19.5° S	125.5°E	19.0°S	
26	23842	Mare Imbrium				38.0°W	21.0° N	41.0°W	21.5°N	Braley C and Braley E
27	23843	Mare Imbrium				33.5°W	16.0° N	37.0°W	18.5°N	
28	23844	Mare Imbrium				38.5°W	17.0° N	38.0°W	20.5°N	Bessarion & Bess. A, B, C, E
29	23845	Mare Imbrium Basin				39.0°W	24.0° N	43.5°W	22.0°N	Ariscarchus N&D upper L.H.corner
30	23846	Mare Imbrium Basin				37.5°W	26.5° N	46.0°W	25.5°N	Delisle & Diophantes foreground
31	23847	Mare Imbrium Basin				36.0°W	28.0° N	45.5°W	29.0°N	Delisle & Diophantes foreground
32	23848	LMP Closeup				-	-	-	-	
33	23849	[illegible]IP Closeup				-	-	-	-	
34	23850	[illegible]sic lkovsky				120.0°E	24.5° S	120.0°E	22.0°S	Zhiritsky near center
35	23851	Tsiolkovsky				125.0°E	19.0° S	128.0°E	18.5°S	
36	23852	Tsiolkovsky Floor				127.5°E	20.0° S	130.5°E	20.0°S	
37	23853	Tsiolkovsky Floor				129.5°E	19.5° S	130.5°E	21.0°S	

* L refers to Lunar Limb
Lunar corrdinates are given to nearest 0.5°

NASA Magazine No. AS 17-157 Magazine Flight Designator VV

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	CENTER FRM LOC		CORNER FRM LOC		Remarks
			Date	GMT		RT ASC / LONG	DEC / LAT	RT ASC / LONG	DEC / LAT	
38	23854	Tsiolkovsky Floor				129.0°E	20.0° S	130.5°E	21.0°S	
39	23855	Tsiolkovsky Floor				129.5°E	21.0° S	131.5°E	21.0°S	
40	23856	Waterman				129.0°E	24.0° S	128.0°E	23.0°S	
41	23857	CMP				-	-	-	-	
42	23858	CMP				-	-	-	-	
43	23859	CDR, Closeup				-	-	-	-	
44	23860	CDR, Closeup				-	-	-	-	
45	23861	Waterman				126.0°E	26.0° S	130.0°E	33.5°SL	
46	23862	Waterman				128.0°E	24.0° S	129.0°E	22.0°S	
47	23862A	Earth's Cusps				-	-	-	-	
48	23862B	Earth's Cusps				-	-	-	-	
49	23862C	Earth's Cusps				-	-	-	-	
50	23862D	Earth's Cusps				-	-	-	-	
51	23862E	Earth's Cusps				-	-	-	-	
52	23862F	Earth's Cusps				-	-	-	-	

NASA Magazine No. AS 17-158 Magazine Flight Designator WW

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	Center Frm Loc RT ASC LONG	Center Frm Loc DEC LAT	Corner Frm Loc RT ASC LONG	Corner Frm Loc DEC LAT	Remarks
1	23863	Eratosthenes				-	-	-	-	Highly overexposed
2	23864	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
3	23865	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
4	23866	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
5	23867	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
6	23868	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
7	23869	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
8	23870	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
9	23871	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
10	23872	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
11	23873	Eratosthenes				11.5° W	14.5° N	12.5° W	12.5° N	
12	23874	Copernicus				19.5° W	9.5° N	22.0° W	11.5° N	Highly overexposed
13	23875	Copernicus				19.5° W	9.5° N	22.0° W	11.5° N	Highly overexposed
14	23876	Copernicus				19.5° W	9.5° N	22.0° W	11.5° N	Highly overexposed
15	23877	Copernicus				19.5° W	9.5° N	22.0° W	11.5° N	
16	23878	Copernicus				19.5° W	9.5° N	22.0° W	11.5° N	
17	23879	Copernicus				19.5° W	9.5° N	22.0° W	11.5° N	
18	23880	Copernicus				20.0° W	9.5° N	22.0° W	11.5° N	
19	23881	Copernicus				20.0° W	9.5° N	22.0° W	11.5° N	
20	23882	Copernicus				22.5° W	10.5° N	24.0° W	11.0° N	
21	23883	Copernicus				23.5° W	8.5° N	22.5° W	11.0° N	
22	23884	Unknown				-	-	-	-	Highly overexposed
23	23885	Unknown				-	-	-	-	Highly overexposed
24	23886	Reiner				55.0° W	6.0° N	52.0° W	8.0° N	Highly overexposed
25	23887	Reiner				55.0° W	6.0° N	52.0° W	8.0° N	Highly overexposed
26	23888	Reiner & Reiner Y				56.5° W	6.5° N	52.5° W	8.0° N	Highly overexposed
27	23889	Reiner & Reiner Y				57.0° W	6.5° N	53.0° W	8.0° N	Highly overexposed
28	23890	Reiner & Reiner Y				57.5° W	6.5° N	53.0° W	7.5° N	Highly overexposed
29	23891	Reiner & Reiner Y				58.0° W	7.0° N	53.5° W	8.0° N	Overexposed
30	23892	Reiner & Reiner Y				57.5° W	6.5° N	54.0° W	7.5° N	Overexposed
31	23893	Reiner & Reiner Y				57.5° W	6.5° N	54.0° W	7.5° N	
32	23894	Reiner & Reiner Y				57.5° W	7.5° N	54.0° W	7.5° N	
33	23895	Reiner Y				60.5° W	6.5° N	57.0° W	6.5° N	
34	23896	Reiner Y				61.5° W	5.5° N	58.5° W	6.0° N	Cavalerius lower R. H. corner
35	23897	Reiner Y				58.5° W	7.5° N	56.5° W	6.5° N	
36	23898	Reiner Area				63.5° W	4.0° N	61.0° W	5.0° N	Cavalerius foreground
37	23899	Reiner Area				65.5° W	3.0° N	63.5° W	4.5° N	Cavalerius, "Flash" area
38	23900	Grimaldi Area				69.0° W	0.5° S	66.0° W	1.5° N	Lohrmann and Riccioli

NASA Magazine No AS 17-158 Magazine Flight Designator WW

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	CENTER FRM LOC		CORNER FRM LOC		Remarks
			Date	GMT		RT ASC LONG	DEC LAT	RT ASC LONG	DEC LAT	
39	23901	Orientale				83.0° W	12.0° S	83.5° W	9.0° S	Schluter A rim upper L.H. edge
40	23902	Orientale				82.0° W	13.5° S	84.5° W	10.5° S	
41	23903	Orientale				88.0° W	14.5° S	89.5° W	12.0° S	Kopff lower left edge

NASA Magazine No AS 17-159 Magazine Flight Designator XX

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	GMT	Exp. Time (sec)	CENTER FRM LOC RT ASC LONG	CENTER FRM LOC DEC LAT	CORNER FRM LOC RT ASC LONG	CORNER FRM LOC DEC LAT	Remarks
1	23904	Protect Frame	12 Dec'72	-	1/1000	-	-	-	-	
2	23905	Zodiacal Light,Red Filter	12 Dec'72	1523	90	$21^h\ 40^m$	-30°	$23^h\ 20^m$	-27°	
3	23906	Zodiacal Light,Red Filter	12 Dec'72	1527	60	$21^h\ 05^m$	-30°	$22^h\ 40^m$	-28°	
4	23907	Zodiacal Light,Red Filter	12 Dec'72	1530	~1	-	-	-	-	Too faint
5	23908	Zodiacal Light,Red Filter	12 Dec'72	1532	40	$19^h\ 42^m$	-31°	$21^h\ 30^m$	-36°	Bright Object - Jupiter
6	23909	Zodiacal Light,Red Filter	12 Dec'72	1534	20	$19^h\ 08^m$	-29°	$21^h\ 00^m$	-36°	Bright Object - Jupiter
7	23910	Zodiacal Light,Red Filter	12 Dec'72	1535	10	$18^h\ 55^m$	-28°	$20^h\ 35^m$	-37°	Bright Object - Jupiter
8	23911	Zodiacal Light,Red Filter	12 Dec'72	1536	6	$18^h\ 50^m$	-28°	$20^h\ 25^m$	-37°	Bright Object - Jupiter
9	23912	Zodiacal Light,Red Filter	12 Dec'72	1536	2	$18^h\ 50^m$	-27°	$20^h\ 20^m$	-36°	Bright Object - Jupiter
10	23913	Zodiacal Light,Red Filter	12 Dec'72	1536	1/2	$18^h\ 50^m$	-26°	$20^h\ 15^m$	-36°	Bright Object - Jupiter
11	23914	Zodiacal Light,Red Filter	12 Dec'72	1537	1/8	$18^h\ 45^m$	-26°	$20^h\ 10^m$	-36°	Bright Object - Jupiter
12	23915	Zodiacal Light,Red Filter	12 Dec'72	1538	1/30	$18^h\ 45^m$	-26°	$20^h\ 10^m$	-36°	Bright Object - Jupiter
13	23916	Protect Frame	12 Dec'72	-	1/1000	-	-	-	-	
14	23917	Aitken				173.5°E	17.0° S	175.0° E	17.5° S	
15	23918	Littrow Area, Red Filter				31.0°E	20.0° N	33.5° E	20.5° N	
16	23919	Littrow Area, Red Filter				31.0°E	20.0° N	33.5° E	20.5° N	Lens f/16, Overexposed
17	23920	Littrow Area, Red Filter				31.0°E	20.0° N	33.0° E	20.5° N	Lens f/16, Overexposed
18	23921	Littrow Area,Blue Filter				31.0°E	20.0° N	33.0° E	20.5° N	Lens f/16, Overexposed
19	23922	Littrow Area,Blue Filter				31.0°E	20.0° N	33.0° E	20.5° N	Lens f/16, Overexposed
20	23923	Littrow Area,Blue Filter				31.0°E	20.0° N	32.5° E	21.0° N	Lens f/16, Littrow
21	23924	Littrow Area,Polaroid Filter				30.5°E	20.0° N	32.5° E	21.0° N	Lens f/16, Littrow
22	23925	Littrow Area,Polaroid Filter				30.5°E	20.0° N	32.5° E	21.0° N	Lens f/16, Littrow
23	23926	Littrow Area				29.0°E	22.0° N	30.0° E	24.0° N	Lens f/16,Rima Littrow VII
24	23927	Littrow Area				29.0°E	22.0° N	30.0° E	24.5° N	Lens f/16,Rima Littrow VII
25	23928	Sulpicius Gallus				10.5°E	21.5° N	11.0° E	20.0° N	
26	23929	Sulpicius Gallus				8.0°E	24.5° N	11.0° E	27.0° N	
27	23930	Sulpicius Gallus				9.0°E	26.0° N	12.5° E	23.0° N	
28	23931	Manilius E				5.5°E	18.5° N	7.0° E	18.5° N	D Caldera
29	23932	Aitken				173.5°E	17.0° S	172.0° E	18.0° S	
30	23933	Protect Frame	13 Dec'72	-	1/1000	-	-	-	-	
31	23934	Zodiacal Light,Blue Filter	13 Dec'72	2206	90	$21^h\ 45^m$	-30°	$23^h\ 20^m$	-25°	Bright Object - Jupiter
32	23935	Zodiacal Light,Blue Filter	13 Dec'72	2210	60	$20^h\ 50^m$	-30°	$22^h\ 30^m$	-32°	Bright Object - Jupiter
33	23936	Zodiacal Light,Blue Filter	13 Dec'72	2213	60	$20^h\ 10^m$	-30°	$22^h\ 00^m$	-31°	Bright Object - Jupiter
34	23937	Zodiacal Light,Blue Filter	13 Dec'72	2215	40	$19^h\ 45^m$	-30°	$21^h\ 35^m$	-33°	Bright Object - Jupiter
35	23938	Zodiacal Light,Blue Filter	13 Dec'72	2216	20	$19^h\ 30^m$	-29°	$20^h\ 50^m$	-32°	Bright Object - Jupiter
36	23939	Zodiacal Light,Blue Filter	13 Dec'72	2218	10	$19^h\ 15^m$	-29°	$20^h\ 50^m$	-32°	Bright Object - Jupiter
37	23940	Zodiacal Light,Blue Filter	13 Dec'72	2218	6	$19^h\ 15^m$	-28°	$20^h\ 50^m$	-33°	Bright Object - Jupiter

NASA Magazine No. AS 17-159 Magazine Flight Designator XX

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure		Exp. Time (sec)	CENTER FRM LOC		CORNER FRM LOC		Remarks
			Date	GMT		RT ASC / LONG	DEC / LAT	RT ASC / LONG	DEC / LAT	
38	23941	Zodiacal Light, Blue Filter	13 Dec'72	2219	2	19^h 10^m	-28°	20^h 35^m	-31°	Bright Object - Jupiter
39	23942	Zodiacal Light, Blue Filter	13 Dec'72	2219	1	19^h 10^m	-28°	20^h 35^m	-31°	Bright Object - Jupiter
40	23943	Zodiacal Light, Blue Filter	13 Dec'72	2219	1/8	19^h 00^m	-27°	20^h 30^m	-31°	Bright Object - Jupiter
41	23944	Zodiacal Light, Blue Filter	13 Dec'72	2220	1/30	18^h 50^m	-27°	20^h 25^m	-31°	Bright Object - Jupiter
42	23945	Protect Frame	13 Dec'72	-	1/1000	-	-	-	-	

NASA Magazine No. AS 17-160 Magazine Flight Designator YY

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	CENTER FRM LOC RT ASC LONG	CENTER FRM LOC DEC LAT	CORNER FRM LOC RT ASC LONG	CORNER FRM LOC DEC LAT	Remarks
1	23946	Eratosthenes				6.5°W	14.5° N	6.5°W	17.5° N	Marco Polo C
2	23947	Timocharis				10.5°W	25.0° N	6.5°W	26.0° N	
3	23948	Beijerick				153.0°E	15.0° S	156.0°E	16.5° S	Gagarin on right edge
4	23949	Agassiz				148.0°E	17.5° S	151.0°E	17.0° S	
5	23950	Jules Verne				147.0°E	25.0° S	143.0°E	36.0° SL	Pavlov in background
6	23951	Jules Verne				148.5°E	26.0° S	151.0°E	41.0° SL	Pavlov at upper R.H. edge
7	23952	Protect Frame	14 Dec'72	-	1/1000	-	-	-	-	
8	23953	Zodiacal Light, Polaroid	14 Dec'72	1953	90	21h 45m	-12°	22h 55m	+2°	
9	23954	Zodiacal Light, Polaroid	14 Dec'72	1955	90	21h 15m	-15°	22h 10m	+3°	
10	23955	Zodiacal Light, Polaroid	14 Dec'72	1957	60	20h 50m	-18°	21h 55m	-4°	
11	23956	Zodiacal Light, Polaroid	14 Dec'72	1959	60	20h 35m	-18°	21h 35m	-3°	
12	23957	Zodiacal Light, Polaroid	14 Dec'72	2000	30	20h 15m	-19°	21h 30m	-3°	
13	23958	Zodiacal Light, Polaroid	14 Dec'72	2001	30	20h 05m	-20°	21h 20m	-1°	
14	23959	Zodiacal Light, Polaroid	14 Dec'72	2002	20	19h 50m	-21°	20h 55m	-4°	Bright Object - Jupiter
15	23960	Zodiacal Light, Polaroid	14 Dec'72	2003	20	19h 45m	-20°	20h 55m	-4°	Bright Object - Jupiter
16	23961	Zodiacal Light, Polaroid	14 Dec'72	2004	10	19h 35m	-21°	20h 45m	-2°	Bright Object - Jupiter
17	23962	Zodiacal Light, Polaroid	14 Dec'72	2004	10	19h 25m	-21°	20h 40m	-5°	Bright Object - Jupiter
18	23963	Zodiacal Light, Polaroid	14 Dec'72	2005	5	19h 15m	-21°	20h 05m	-7°	Bright Object - Jupiter
19	23964	Zodiacal Light, Polaroid	14 Dec'72	2006	5	19h 15m	-21°	20h 15m	-4°	Bright Object - Jupiter
20	23965	Zodiacal Light, Polaroid	14 Dec'72	2006	3	19h 10m	-21°	20h 00m	-4°	Bright Object - Jupiter
21	23966	Zodiacal Light, Polaroid	14 Dec'72	2006	3	19h 10m	-21°	20h 00m	-4°	Bright Object - Jupiter
22	23967	Zodiacal Light, Polaroid	14 Dec'72	2006	1	19h 05m	-21°	20h 00m	-4°	Bright Object - Jupiter
23	23968	Zodiacal Light, Polaroid	14 Dec'72	2006	1	19h 00m	-21°	20h 00m	-4°	Bright Object - Jupiter
24	23969	Zodiacal Light, Polaroid	14 Dec'72	2007	1/4	19h 00m	-21°	20h 00m	-4°	Bright Object - Jupiter
25	23970	Zodiacal Light, Polaroid	14 Dec'72	2007	1/4	19h 00m	-21°	20h 00m	-4°	Bright Object - Jupiter
26	23971	Zodiacal Light, Polaroid	14 Dec'72	2007	1/15	19h 00m	-21°	20h 00m	-4°	Bright Object - Jupiter
27	23972	Zodiacal Light, Polaroid	14 Dec'72	2007	1/15	18h 55m	-21°	19h 55m	-4°	Bright Object - Jupiter
28	23973	Zodiacal Light, Polaroid	14 Dec'72	2007	1/60	18h 55m	-21°	19h 55m	-4°	Bright Object - Jupiter
29	23974	Zodiacal Light, Polaroid	14 Dec'72	2007	1/60	18h 55m	-21°	19h 55m	-4°	Bright Object - Jupiter
30	23975	Protect Frame	14 Dec'72	2007	1/1000	-	-	-	-	
31	23976	Jules Verne				146.5°E	27.5° S	143.0°E	24.5° S	Jules Verne and Pavlov
32	23977	Jules Verne				143.5°E	25.5° S	141.0°E	23.0° S	Pavlov lower L.H. corner
33	23978	Agassiz				144.5°E	17.5° S	153.0°E	11.0° SL	
34	23979	Lambert				21.5°W	24.0° N	21.0°W	26.0° N	
35	23980	Euler				31.0°W	24.0° N	28.0°W	27.0° N	
36	23981	Euler Hills				29.0°W	16.0° N	25.0°W	10.0° NL	Tobias Mayer
37	23982	Euler Hills				30.0°W	17.0° N	30.0°W	20.0° N	Tobias Mayer
38	23983	Euler Hills				31.0°W	20.5° N	29.5°W	23.0° N	Euler P near center

NASA Magazine No. AS 17-160 Magazine Flight Designator YY

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	CENTER FRM LOC RT ASC LONG	CENTER FRM LOC DEC LAT	CORNER FRM LOC RT ASC LONG	CORNER FRM LOC DEC LAT	Remarks
39	23984	Blank				-	-	-	-	
40	23985	Overexposure				-	-	-	-	
41	23986	Overexposure				-	-	-	-	
42	23987	Tsiolkovsky				137.0°E	27.0° S	132.0°E	37.0° SL	
43	23988	Tsiolkovsky				133.0°E	22.0° S	130.0°E	24.0° S	
44	23989	Waterman				129.0°E	24.5° S	123.0°E	32.0° SL	
45	23990	Tsiolkovsky				128.0°E	19.5° S	127.0°E	19.0° S	
46	23991	Euler Hills				27.5°W	17.0° N	31.5°W	17.5° N	Tobias Mayer
47	23992	Euler Hills				31.0°W	19.0° N	33.5°W	20.0° N	Euler P near center
48	23993	Euler Hills				34.0°W	15.0° N	37.0°W	19.0° N	Tobias Mayer W
49	23994	Euler Hills				36.0°W	14.5° N	39.5°W	16.5° N	Tobias Mayer W,Bessarion &Bess
50	23995	Euler Hills				38.0°W	16.5° N	45.0°W	21.0° N	Bessarion and Bessarion E
51	23996	CDR, Closeup				-	-	-	-	
52	23997	CMP at G & N Station				-	-	-	-	

NASA Magazine No. AS 17-161 Magazine Flight Designator ZZ

Film Type 2485 Film Size 35 mm

Quick Look Fr No	NASA Frame No.	Subject	Time of Exposure Date	Time of Exposure GMT	Exp. Time (sec)	CENTER FRM LOC RT ASC LONG	CENTER FRM LOC DEC LAT	CORNER FRM LOC RT ASC LONG	CORNER FRM LOC DEC LAT	Remarks
1	23998	Riccioli				71.0°W	1.5° S	73.0° W	3.0° SL	
2	23999	Riccioli				70.5°W	1.0° S	73.0° W	3.0° SL	
3	24000	Riccioli				71.0°W	2.0° S	74.0° W	1.0° S	
4	24001	Riccioli				70.0°W	1.5° S	73.5° W	2.0° S	
5	24002	Riccioli				71.5°W	0.5° S	83.0° W	0.0°	Double Crater-Riccioli C
6	24003	Riccioli				71.0°W	1.5° S	73.0° W	2.0° S	
7	24004	Riccioli G				71.0°W	2.0° S	73.5° W	2.0° S	
8	24005	Riccioli G				72.5°W	1.0° S	75.0° W	1.0° S	
9	24006	Riccioli G				71.0°W	0.5° S	72.5° W	0.0°	
10	24007	Riccioli G				70.5°W	2.0° S	72.0° W	0.5° S	
11	24008	Riccioli				74.0°W	1.5° S	78.0° W	1.0° N	
12	24009	Riccioli				75.5°W	1.0° S	78.5° W	1.0° N	
13	24010	Schluter A				79.0°W	6.0° S	88.0° W	9.0° SL	Schluter & Hartwig A
14	24011	Schluter A				76.0°W	3.5° S	77.5° W	3.5° S	
15	24012	Schluter A				77.0°W	11.5° S	79.0° W	8.5° S	
16	24013	Schluter				82.5°W	6.0° S	81.0° W	7.0° S	
17	24014	Schluter				83.0°W	5.5° S	82.0° W	7.0° S	
18	24015	Mare Orientale				90.5°W	9.0° S	99.0° W	14.0° S	
19	24016	Mare Orientale				90.0°W	14.5° S	90.0° W	28.0° SL	Kopff
20	24017	Calibration,Polaroid Filter	29 Nov'72		1/8	-	-	-	-	
21	24018	Calibration,Polaroid Filter	29 Nov'72		1/15	-	-	-	-	
22	24019	Calibration,Polaroid Filter	29 Nov'72		1/30	-	-	-	-	
23	24020	Calibration,Polaroid Filter	29 Nov'72		1/60	-	-	-	-	
24	24021	Calibration,ND 2 Filter	29 Nov'72		300	-	-	-	-	
25	24022	Calibration,ND 2 Filter	29 Nov'72		180	-	-	-	-	
26	24023	Calibration,ND 2 Filter	29 Nov'72		60	-	-	-	-	
27	24024	Calibration, No Filter	29 Nov'72		60	-	-	-	-	
28	24025	Calibration, No Filter	29 Nov'72		20	-	-	-	-	
29	24026	Calibration, No Filter	29 Nov'72		6	-	-	-	-	
30	24027	Calibration, No Filter	29 Nov'72		2	-	-	-	-	
31	24028	Calibration, No Filter	29 Nov'72		1	-	-	-	-	
32	24029	Calibration, No Filter	29 Nov'72		1/2	-	-	-	-	
33	24030	Calibration, No Filter	29 Nov'72		1/4	-	-	-	-	
34	24031	Calibration, No Filter	29 Nov'72		1/8	-	-	-	-	
35	24032	Calibration, No Filter	29 Nov'72		1/15	-	-	-	-	
36	24033	Calibration, No Filter	29 Nov'72		1/30	-	-	-	-	
37	24034	Calibration, No Filter	29 Nov'72		1/60	-	-	-	-	