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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1029-1

2-7 FEBRUARY 1966

MISSION 1029-2

8-12 FEBRUARY 1966

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JULY 1966

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
MISSION 1029-1
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NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1029, a 2-part satellite reconnaissance mission, was launched into a pro-grade polar orbit on 2 February 1966. The first payload was recovered dry on pass 81D, 8 February. The mission was terminated by the air catch of the second capsule on pass 160D, 12 February 1966.

Ten cameras were used to acquire imagery during the mission. There were 2 panoramic cameras, 4 horizon cameras, 2 stellar cameras, and 2 index cameras.

Both panoramic cameras operated satisfactorily throughout the mission. The best imagery recorded is approximately equal to the high quality of the best imagery recorded on the past several missions. Hence, the MIP (Mission Information Potential) rating of both halves of the mission is 85. However, unlike most recent missions, the best image quality is confined to only a few passes of the mission. Degradation of image quality is attributed to blowing snow, low solar elevation, and considerable cloud cover. The PI suitability is fair to good.

The imagery recorded by both port horizon cameras is good throughout the mission. However, the starboard-looking horizon camera imagery is veiled on the master (fwd) camera photography exposed during passes 5D through 14D. A similar condition exists on the slave (aft) starboard-looking horizon camera imagery on passes 3D through 150D (end of mission). Further discussion of this subject is included in the text of this report.

The index camera of Mission 1029-1 was operational throughout the mission. However, the stellar camera of the mission operated poorly. The exposure was generally poor because of a defective shutter. The shutter interval varied and the sequence of camera events was not synchronized. Due to the erratic camera operation, many stellar images are recorded in weird configurations (i.e., streaks, arcs, and flares). Nevertheless, the imagery was used for data reduction. (See Part I, Sections 5 and 6).

The stellar and index cameras of Mission 1029-2 were not operational until pass 134D. A relay in the system failed, causing the cameras to receive only the pulses controlling the correlation fiducial lamps and the film advance command. However, since the pressure plate was engaged the film advanced only a small fraction of the designed metering distance. As a result, the film immediately preceding the first frame contains a

multitude of correlation lamp and fiducial images super-imposed or nearly super-imposed on each other. The camera began to operate on the first command generated on pass 134D.

The camera number, horizon fiducials, and binary index lamps of the master (fwd) camera operated erratically throughout the mission. This problem is thought to be unrelated to that which affected the stellar and index cameras.

While there are several anomalies on the imagery of this mission, the overall purpose -- intelligence gathering -- was fulfilled.

GENERAL FLIGHT DATA

1. Launch and Recovery Dates

Launch Date, Missions 1029-1 and 1029-2	2 February 1966
Recovery Date, Mission 1029-1	7 February 1966
Recovery Date, Mission 1029-2	12 February 1966

2. Orbital Parameters (Actual)

	Mission 1029-1 (Rev 42)	Mission 1029-2 (Rev 120)
Period	90.600 min	90.496 min
Perigee	99.041 nm	100.603 nm
Apogee	233.430 nm	231.340 nm
Eccentricity	0.01862	0.01814
Inclination Angle	75.045°	75.045°
Perigee Latitude	28.761°	41.987°

3. Photographic Operations

	Mission 1029-1	Mission 1029-2
Operational Passes	32*	33
Operational/Domestic Passes	1	0
Domestic Passes	4	2
Engineering Passes	3	2
Total Photo Passes	40	37
Recovery Revolution	81	160

*one monc pass

4. Film Footage/Frame Totals

	Master	Slave
Footage Available	16,000 (Approx.)	16,000 (Approx.)
Pre-flight Footage	317.4	314.8
Pre-flight Frames	120	119
Process Footage (1029-1)	8,079	8.075
Process Footage (1029-2)	7,944	7,952
Titled Frames (1029-1)	2,896	2,918
Titled Frames (1029-2)	2,944	3,008

PART I. CAMERA OPERATION

1. Master (Fwd) Panoramic Camera No 178

The master panoramic camera was operational throughout the mission. The image degradations associated with camera operation are described in the following paragraphs.

a. There are fine longitudinal emulsion scratches just inside each format edge, under the camera number and in the same axis, at the take-up end of most frames of the mission. These scratches are caused by the contact of the scan head with the film emulsion. They are normal on the film generated by the panoramic cameras in the J system. However, they are not as pronounced on the film of this mission as they have been on past missions. The degradation caused by these scratches is very minor.

b. Rail scratches are continuous in the border area of both film edges throughout the mission. The scratches had no bearing on the product of this camera. However, the potential degradation of those scratches is demonstrated on the slave panoramic camera of this mission. (See Part I, Paragraph 2).

c. Light leaks cause fog on the first, fifth, last, and next to last frames of most passes throughout the mission. The sixth frame from the end of most camera operations (i.e., 54 of 59) is partially fogged on the photography of the "A" bucket (Mission 1029-1). The density of all fog patterns varies according to the duration of camera inactivity and solar elevation that it is associated with. The fog on the first frame of a pass is of moderate density and has little significance since the first frame is always degraded by smear associated with camera start-up. The fog on the fifth frame of most passes is in the form of a narrow (0.10 inch) streak, parallel to the minor axis of the film, near both ends of the format. The fog extends to both film edges but is of low intensity and causes little degradation. The last frame of most passes is considerably degraded by fog in the form of equipment images. The fog extends approximately 5 inches along the major axis, between the format edges. Its position varies along the major axis in relation to the scan speed at shutdown. The fog on the next to last frame of a pass is in the form of a diagonal streak, approximately 5 inches long and 0.5 inch wide. It occurs near the take-up end of the frame and is of about the same

density as the fog on the last frame. The fog on the sixth frame from the end of a pass is the most degrading result of a light leak on this mission. It usually extends to both film edges, between the camera number and the center shrinkage marker (about 8 inches). The camera and vehicle manufacturers say that all mission fog patterns can be traced to the felt seal on the panoramic camera and the ablative shield. Remedial action is under study.

d. Fog, induced by dendritic static discharges, is present along both film edges on passes 81D through 148D. The fog begins on the second part of pass 81D (recovered in the "B" capsule) and is intermittently severe. On some frames the fog extends from the film edge to the center of the format (pass 131D). The presence of the fog causes a pronounced degradation. There is no fog on the master panoramic camera photography recovered in the "A" capsule. It is not known how much, if any, of the fog was caused in the camera. Processing technicians noted several static discharges during processing. (See Part II, Paragraph 2, Item A).

2. Slave (Aft) Panoramic Camera No 179

The slave panoramic camera was operational throughout the mission. The following paragraphs describe the result of camera operation anomalies.

a. There is a fine longitudinal emulsion scratch just inside the format under the camera number and at the take-up end, between the format edge and the frequency marks, on most frames of the mission. Like the master camera scratches, they are caused by the scan head rollers. They are less pronounced than usual and they cause very little degradation.

b. Rail scratches are continuous in the border at both film edges throughout the mission. The scratch in the border at the binary edge is particularly severe. The scratching caused emulsion to build up along the rail edge, resulting in an extremely ragged format edge. The shrinkage markers become progressively less distinct because of emulsion build-up and, at frame 174, pass 134D, a manufacturing splice passing through the system disturbed the accumulated emulsion and caused the shrinkage mark toward take-up from center to be completely obscured.

c. Light leaks caused less fog on the photography of this mission than on most J system missions. The fog that does exist is of low density and causes little degradation. The most pronounced fog pattern occurs on the third frame from the end of most passes. (i.e., 81 of 83) The fog is in the form of an

equipment image and appears in the vicinity of the binary word. It causes moderate degradation to the imagery. The first frame of most passes is partially fogged, near the center of the format. Its influence or image quality is minor. On the seventh frame from the end of some passes (i.e., 60 of 66) there is an indistinct general fog pattern near the binary word. It extends from one film edge to the other and covers approximately 5 inches along the major axis. However, it is also of low density and causes little degradation. The density of each of the aforementioned fog patterns is relative to the solar elevation, solar azimuth, and duration of a particular period of camera inactivity. The camera manufacturers are aware of the light leaks and are making efforts to eliminate them.

d. Dendritic static discharges caused fog along both film edges intermittently throughout the mission. The fog patterns sometime extend into the format and degrade the imagery. While no specific pattern of incidence is apparent, there were more occurrences along the binary edge than at the frequency mark edge. Also, the resulting fog is more profuse on the photography of the second bucket (Mission 1029-2) than on the photography returned in the first recovery capsule.

3. Master (Fwd) Horizon Cameras

a. The port-looking (supply) horizon camera was operational throughout the mission. The photography recorded good quality, high acuity horizon images.

b. The starboard-looking (take-up) horizon camera imagery is severely degraded by a veiling condition on passes 5D through 14D. The images on passes 1D and 3D are sharp and well defined. At the first frame of pass 5D, the imagery appears to be veiled, as if it were exposed through a diffusing medium. The condition exists through pass 14D. The imagery of all subsequent passes is sharp and well defined. (A history of the incidence of veiled imagery in the horizon cameras is included as Appendix D of this report). There is a small, wire-like obstruction extending into the format from the binary edge of all frames on passes 1D through 9D. It does not degrade the imagery. However, a similar obstruction was noted on the starboard-looking horizon camera on Mission 9023, which was also affected by veiled imagery.

4. Slave (Aft) Horizon Cameras

a. The port-looking (take-up) horizon camera was operational throughout the mission. The horizon arcs are consistently good.

b. The starboard-looking (supply) horizon cameras was operational throughout the mission. However, all images exposed after pass 1D are degraded by a veiled condition. The images exposed on pass 1D are sharp and well defined. The images exposed on pass 3D and all subsequent passes display the most pronounced affect of image veiling ever manifested on the 1,000 series missions. The affected images are vague and indistinct. The condition is very similar to that displayed by an out-of-focus image (Appendix D).

5. Stellar Camera No. 91 (Mission 1029-1)

The camera was operational throughout the mission. However, the sequence of camera events and the duration of exposure were erratic throughout the mission. The shutter usually remained open longer than the programmed 2 second interval. Consequently, the stars are imaged very dense. With the increase in density, resulting from the long exposure duration, the stars are imaged in weird configurations in association with vehicle perturbations during exposure. Most of the images on frames 1 through 280 are elongated or dumbbell shaped (i.e., an image, a smear, and another image). While the shutter operation was erratic throughout the mission, it became more erratic after frame 280. The dumbbell-shaped images became more distinct. There were definite double exposures, some images were in fishhook-like patterns, there were halos around many images, several images were extremely overexposed, and the shutter remained open or partially open during film transport on many occasions. The dumbbell-shaped images are probably the result of vehicle perturbations during exposure (Example: frame 281). The fishhook patterns are probably caused by more severe perturbations during exposure (Example: frame 311). The halo around an image was likely caused when the pressure plate was raised before the shutter closed (Example: frame 374). Extreme overexposure is obviously caused by the shutter remaining open longer than the intended 2 second interval (Example: frame 393). Fog between adjacent frames is common after frame 280 and is undoubtedly caused by the shutter remaining open or partially open during film transport. In spite of the variety of anomalies on the film, the record was used for attitude determination. Only 6 frames of the mission were found to be unsuitable for attitude determination. Plus density streaks parallel to the line of flight were imaged on frames 1, 2, 4-7, 9, 10, 12, 17, 18, 35, 41, 43, 44, 69, 76, 135, 193, 227, 257, and 265. The streaks are assumed to be images of jettisoned crystallized fuel particles. The streaks do not impair the stellar reduction process and therefore are not of great significance.

Approximately 30 percent of each stellar frame is affected by flare from albedo. However, stellar images within the flared portion of the frames are detectable.

6. Stellar Camera No 76 (Mission 1029-2)

The camera was inoperative during the first 29 camera operational orbits of the mission. The first imagery was exposed on pass 134D and the camera remained operational thereafter. In the area of film immediately preceding the first exposure, there is a multitude of fiducial and correlation lamp images superimposed or nearly superimposed on each other. The conclusion is that a relay failed, allowing the camera to receive only the electrical pulses activating the correlation lamps, fiducial lamps, and film advance command. However, because the pressure plate was inoperative the film advance was restricted to a fraction of normal metering. The first frame containing imagery (pass 134D) is a double exposure. The camera operation was normal throughout the remainder of the mission. While there were 140 frames exposed, only the first 98 were exposed prior to exhaustion of the film supply of the panoramic cameras. Hence, only frames 2 through 98 were used for attitude reduction. The stellar images recorded during the mission were useable. However, some images were elongated and/or double imaged. Flare, from earth albedo degrades approximately 30 percent of each frame. However, there are enough images out of the flare to provide good attitude data.

FIGURE 1. DESCRIPTION OF PHOTOGRAPHIC DATA

The data pertaining to photographs contained in this publication are defined as follows:

PASS: A pass is the operational portion of an orbital revolution. A suffix D indicates that the photography was acquired during the descending portion, a suffix A indicates that the photography was acquired during the ascending portion, and a suffix M indicates that the photography was acquired during a pass that includes both ascending and descending portions. An additional suffix E indicates that the pass was an engineering operation or that a portion of the pass has been edited.

DATE OF PHOTOGRAPHY: The date of photography indicates the day, month, and year (GMT) that the photography was acquired.

UNIVERSAL GRID COORDINATES: These coordinates are included to locate the illustrated photography within the panoramic format.

ENLARGEMENT FACTOR: The enlargement factor is included to indicate the number of diameters the original material has been enlarged in the photographic illustration.

GEOGRAPHIC COORDINATES: These coordinates are included to indicate the latitude and longitude of the center of the panoramic format.

ALTITUDE: This measurement is the vertical distance from the vehicle to the Hough Ellipsoid at the time of the acquisition of the photography.

PITCH: Rotation of the camera about its transverse axis. Using appropriate aeronautical terminology, positive readings indicate nose-up attitude and negative readings indicate nose-down attitude.

ROLL: Rotation of the camera about its longitudinal axis. Using appropriate aeronautical terminology, positive readings indicate left wing-up attitude and negative readings indicate right wing-up attitude.

YAW: Rotation of the camera about its vertical axis. Positive readings indicate counterclockwise rotation when viewing the ground nadir from the vehicle-mounted camera in flight.

LOCAL SUN TIME: This time is included to present to the viewer a realistic time of acquisition of the photography illustrated.

SOLAR ELEVATION: The solar elevation is the angular elevation of the sun above a plane tangent to the surface of the earth at the center of the panoramic format. A negative solar elevation indicates that the sun is below the plane.

SOLAR AZIMUTH: The solar azimuth is the angular measurement of the rays of the sun measured from true north in a clockwise direction.

EXPOSURE: The exposure is the duration of the photographic exposure expressed in a fraction of a second and is computed from the scan rate and slit width.

PROCESSING LEVEL: The particular degree of development given to the film to attain negatives of the highest possible quality. Three levels of processing, Primary, Intermediate, and Full, are currently employed.

VEHICLE AZIMUTH: The clockwise measurement from true north to the longitudinal axis of the vehicle heading.

FIGURE 2. STELLAR IMAGES - DUMBBELL SHAPED

The following photograph is an example of the dumbbell-shaped stellar images described in Part I, Paragraph 5 of this report. On this type of image, the actual star centers must be determined before attitude data can be reduced. Although the negative from which this print was made is over-exposed, the images are easily discernible.

NPIC K-8695 (6/66)

Camera	Stellar D79/94/91
Pass	55D
Frame	310
Date of Photography	6 Feb 66
Universal Grid Coordinates	NA
Enlargement Factor	5X
Geographic Coordinates	NA
Altitude (feet)	745,288
Vehicle Attitude:	
Pitch	-0°07'
Roll	-0°09'
Yaw	0°07'
Local Sun Time	NA
Solar Elevation	NA
Solar Azimuth	NA
Exposure	2 sec
Vehicle Azimuth	135°22'
Processing Level	NA

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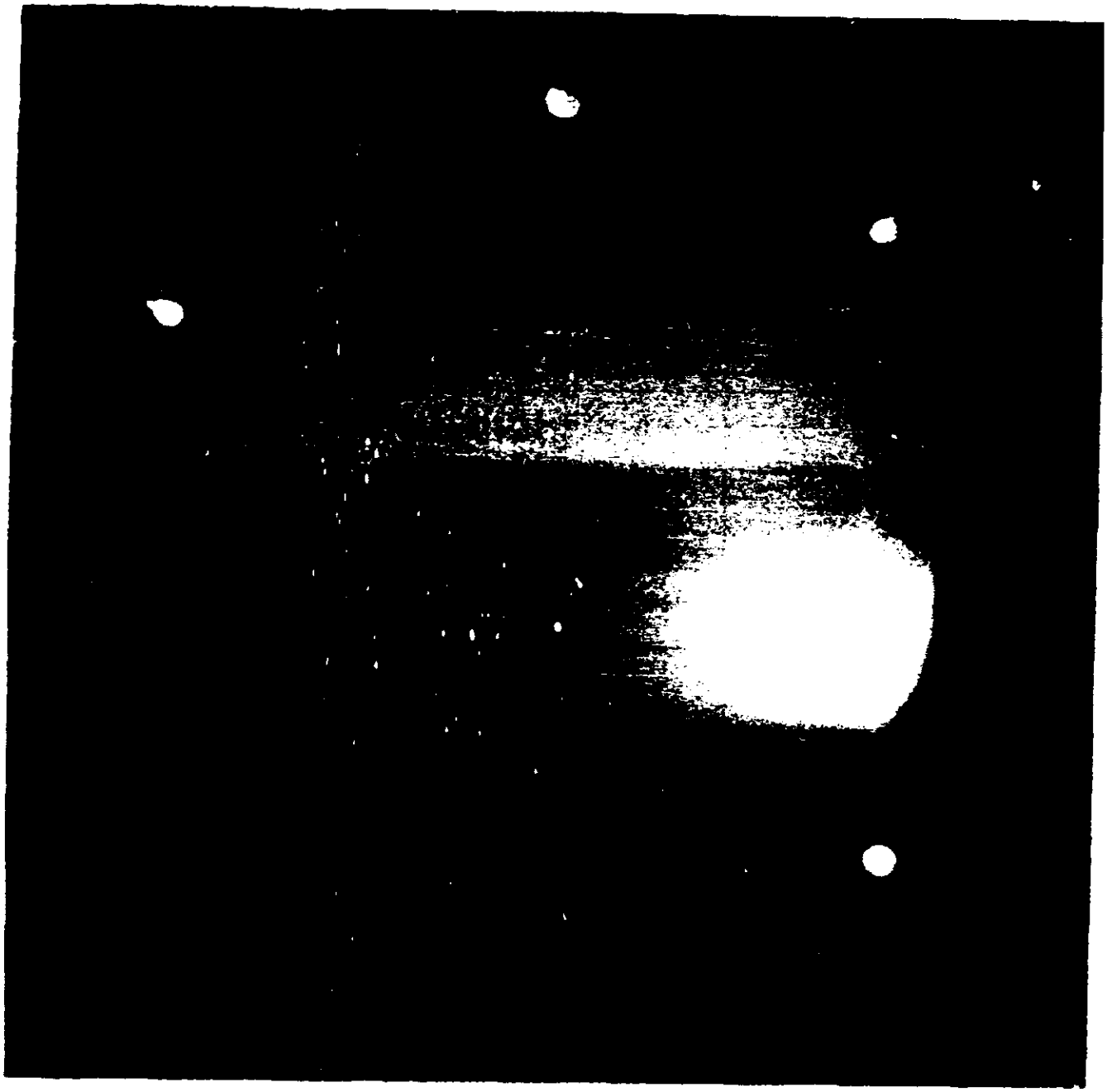

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FIGURE 3. STARS IMAGED IN A FISHHOOK CONFIGURATION

The stellar images displayed on the following photograph are examples of the fishhook-like images resulting from vehicle perturbations during exposure. This frame was overexposed to a greater degree than frame 310 (the preceding illustration).

NPIC K-8696 (6/66)

Camera	Stellar D79/94/91
Pass	55D
Frame	311
Date of Photography	6 Feb 66
Universal Grid Coordinates	NA
Enlargement Factor	5X
Geographic Coordinates	NA
Altitude (feet)	723,401
Vehicle Attitude:	
Pitch	-0°12'
Roll	-0°21'
Yaw	0°20'
Local Sun Time	NA
Solar Elevation	NA
Solar Azimuth	NA
Exposure	2 sec
Vehicle Azimuth	142°33'
Processing Level	NA

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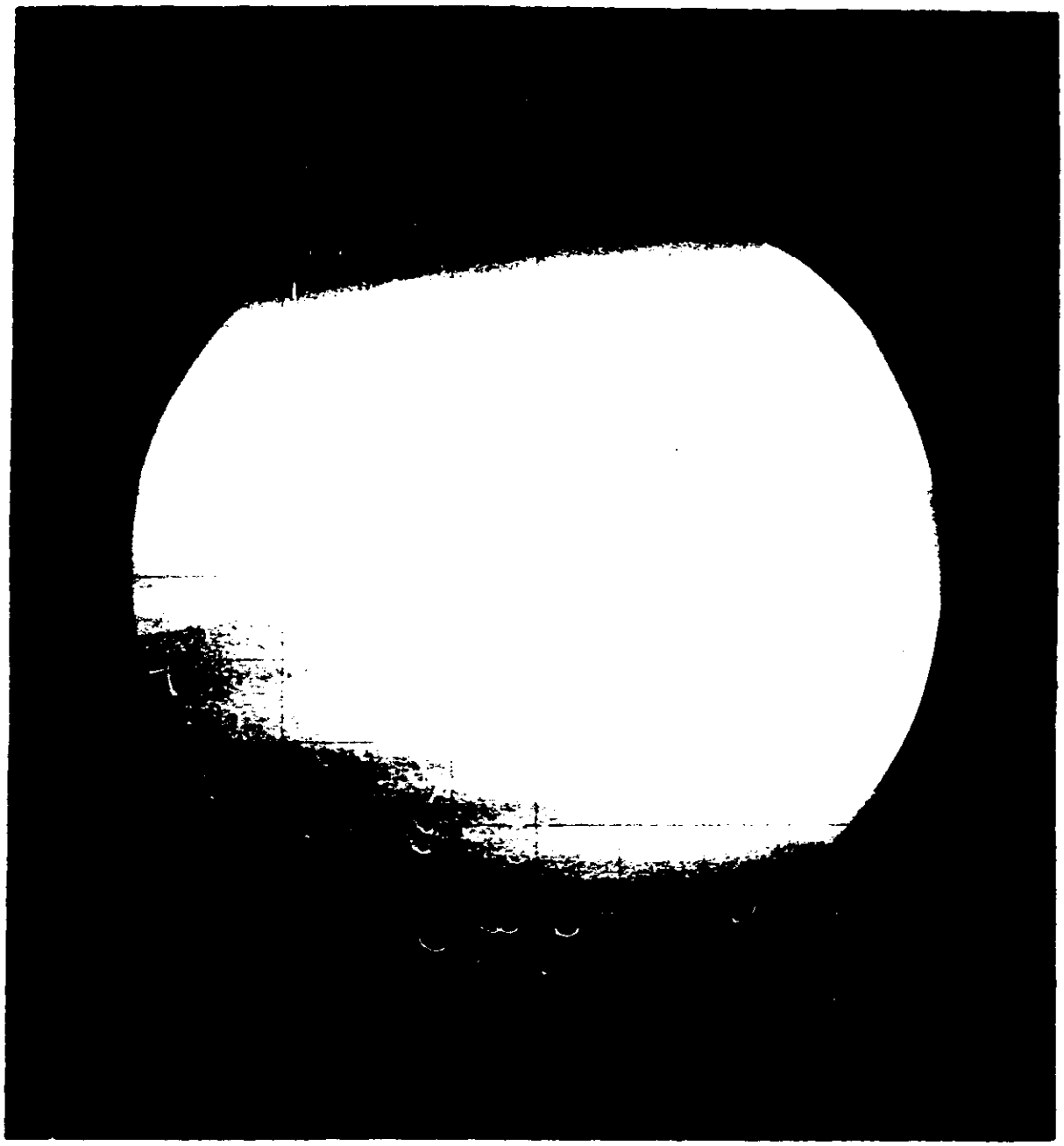


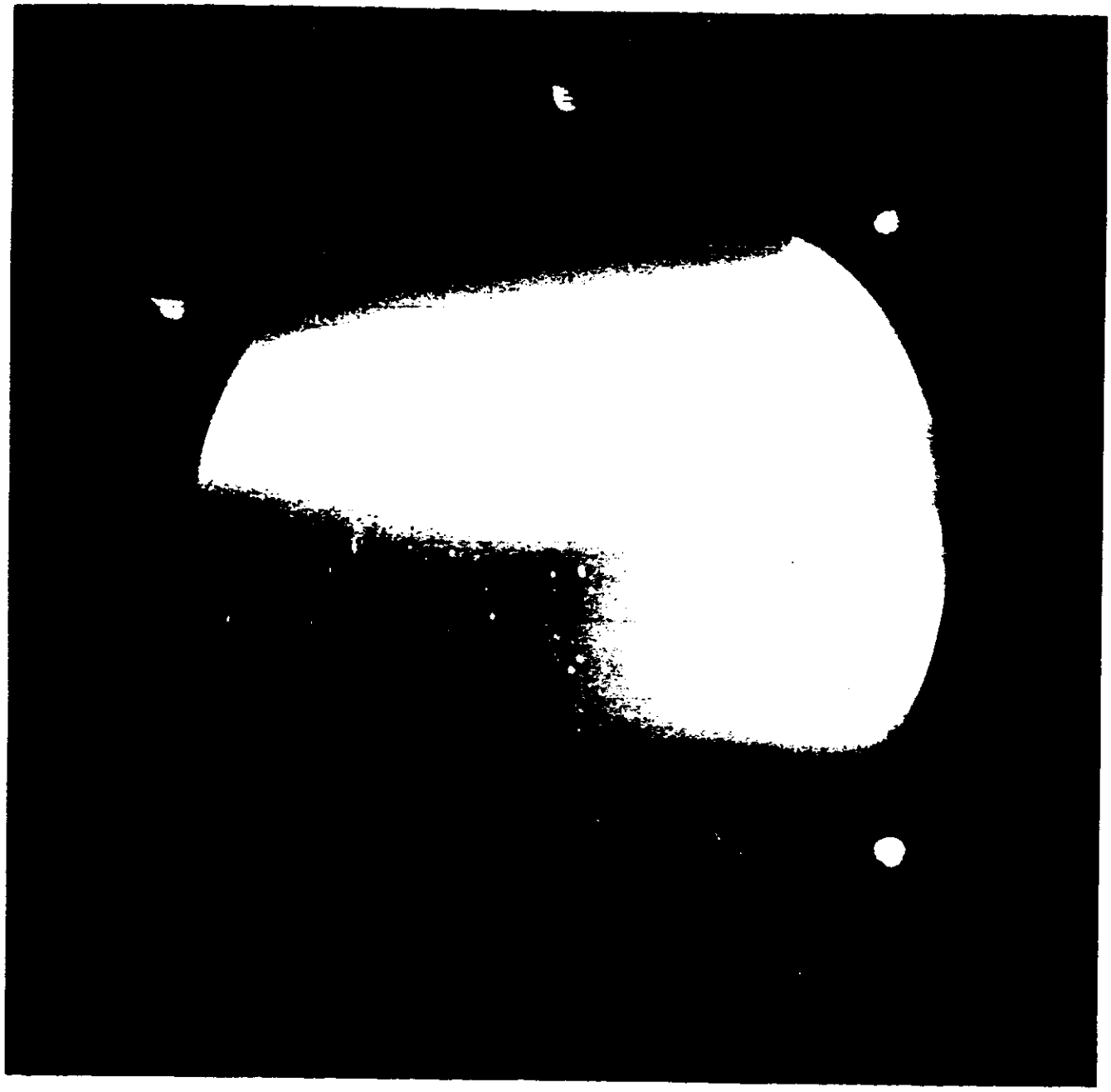
FIGURE 4. STELLAR IMAGES SURROUNDED BY HALOS

The following photograph illustrates the result of non-synchronous camera operation. This imagery displays the affect manifested by raising or lowering the pressure plate during exposure. The problem was caused by the shutter remaining open longer than the programmed 2 seconds duration.

NPIC K-6697 (6/66)

Camera	Stellar D79/94/91
Pass	70D
Frame	374
Date of Photography	7 Feb 66
Universal Grid Coordinates	NA
Enlargement Factor	5X
Geographic Coordinates	NA
Altitude (feet)	694,809
Vehicle Attitude:	
Pitch	-0°26'
Roll	0°08'
Yaw	-0°15'
Local Sun Time	NA
Solar Elevation	NA
Solar Azimuth	NA
Exposure	2 sec
Vehicle Azimuth	147°10'
Processing Level	NA

[redacted]



[redacted]

7. Index Camera No 94 (Mission 1029-1)

The camera was operational throughout the mission. Frames adjacent to heavily exposed frames contain an image of the outer parameter of the reseau grid plate. It is assumed that the grid plate was not sufficiently opaque to avoid the transmission of light across its horizontal axis. The anomaly had little affect on the image quality but the camera manufacturers intend to be more cautious in future systems to avoid a reoccurrence. The last 6 frames of the mission are abraded and partially fogged in association with film supply exhaustion. Prior to the last 6 frames, the image quality is good.

8. Index Camera No 70 (Mission 1029-2)

The camera operated in exactly the same manner as the stellar camera of this mission, i.e., a multitude of correlation lamp and camera number images preceded the first exposure, first frame was double exposed, and no images were obtained before pass 134D. As with the stellar camera of this mission, the camera operated normally after the first frame of pass 134D. Minor traces of static-induced edge fog are intermittent throughout the mission. There is also a trace of static fog in the format of frame 45. The fog was not a degrading factor. The image quality is consistently good after frame 1. The frames correlate exactly with those of the stellar camera.

9. Associated Equipment

(Equipment designed to record information necessary for correlation and mensuration of the camera records).

The camera number, binary fiducial lamps, and horizon fiducial lamp intensity was very erratic on the master camera film of pass 7D through 99D. The images gradually become faint until they disappear. Several frames later they gradually reappear and on occasions are continuously recorded for several frames and then gradually disappear again. The lamps were not recorded on passes A09E through 21D. The referenced lamps became operational at pass 99D, Part 2, and were normally recorded thereafter.

The frequency marks were recorded and are readable on the film of both panoramic cameras. However, the intensity of the marks fluctuated on the master camera film. (Example: pass 36D). The smeared pulse in the frequency marks, indicating stellar index operation, is recorded according to design on every seventh frame of the master camera film.

The binary word on both cameras is readable throughout the mission. However, the fluctuating intensity of the binary index lamps on the master camera caused additional work in the data reduction phase. The weak or missing index lamps had to be hand punched to make the system adaptable

to automatic binary reading equipment. In addition, the following anomalies further complicated the data reduction:

Camera	Pass	Frame	Anomaly
Master	22D	Can 1	Lamp images track off of frame in printing.
Master	27D	All	Binary lamps 23 and 27 are weak.
Master	34D	All	Binary lamps 22 and 27 are weak.
Master	37D	All	Binary lamp 22 weak.
Master	40D-54D	All	Binary lamps 18 and 29 weak.
Master	74D	Can 1	Poor alignment in printing.
Master	89D	All	Binary lamp 18 weak.
Master	150D	65	Lamp images partially cut off in printing.
Master	87D,89D	All	Printing alignment varies but lamp images do not track off film edge.
Master	119D	1-30	Printing alignment varies but lamp images do not track off film edge.
Slave	9D	56	No binary lights.
Slave	37D	40	No binary lights.
Slave	40D	1-8,18-78	Lamp images partially cut off in printing.
Slave	54D	10-73	Lamp images partially cut off in printing.
Slave	81D	20	Binary cut in half during cut-and-wrap operation.
Slave	99D	8-60	Lamps intermittently cut off in printing

Slave	102D	9-20	Alignment varies during printing. Images not cut off.
Slave	134D	150	No binary.
Slave	150D	151	Lamp images track off edge of film in printing.

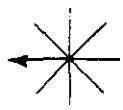
FIGURE 5. ACCUMULATION OF EMULSION ON FILM GUIDE RAILS

This rough format edge was caused by the accumulation of emulsion along the film guide rail. The change in format roughness displayed by these 2 adjacent prints was caused when a manufacturing splice passed through the system near the supply end of frame 174 (top print). The shrinkage marker at the take-up end is completely obliterated on the photography exposed near the end of the mission.

[redacted]

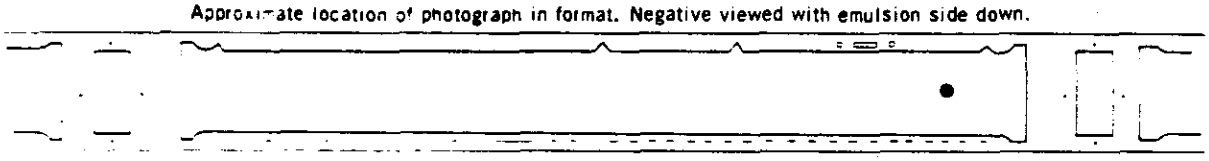
Camera	179
Pass	134D
Frame	174 and 175 Aft
Date of Photography	11 Feb 66
Universal Grid Coordinates	75 Edge to edge
Enlargement Factor	Contact
Geographic Coordinates	46-49N 053-30E
Altitude (feet)	614,511
Camera Attitude:	
Pitch	NA
Roll	NA
Yaw	NA
Local Sun Time	1102
Solar Elevation	28°03'
Solar Azimuth	NA
Exposure	1/381
Vehicle Azimuth	Not Available
Processing Level	Intermediate

Approximate flight direction on photograph



Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.



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PART II. FILM

1. Film Footage/Frame Totals

CAMERA	FOOTAGE	FRAMES
Master (Fwd) Panoramic Camera 178		
(1029-1)	8,079	2,896
(1029-2)	7,944	2,944
Slave (Aft) Panoramic Camera 179		
(1029-1)	8,075	2,918
(1029-2)	7,952	3,008
Stellar Camera No 91		
(1029-1)	51	419
Stellar Camera No 76		
(1029-2)	34	140
Index Camera No 94		
(1029-1)	84	378
Index Camera No 70		
(1029-2)	40	140

2. Film Processing

This section provides an evaluation of exposure, processing, and densities of the original negatives from the 10 cameras used in Missions 1029-1 and 1029-2.

a. Panoramic Cameras. The film of both panoramic cameras was adequately exposed within the practical limits of available light. Because the exposure is commensurate with the solar elevation, the photography exposed at extreme northern latitudes is somewhat underexposed. However, a subjective analysis of the entire take indicates that the exposure provided a good compromise. The solar elevation during photographic acquisition ranges from -1°03' (pass 131D, frame 1) to 79°57' (pass 120D, frame 5). This mission was used as the basis of a study relating solar elevations to priority A and priority B target acquisitions. The results of the analysis are contained in Part II, Item 3a of this report. Static discharges were

noted during pre-spooling and processing of the panoramic camera film from both cameras. Technicians reported that although special caution was exercised, the discharges persisted. The discharges were manifested as dendritic traces on the film as noted in Part I, Paragraph 1 of this report.

b. Index Cameras. The film of both index cameras was adequately exposed.

c. Stellar Cameras. The shutter of stellar camera No 91 (Mission 1029-1) operated erratically throughout the mission. The film is generally overexposed but, because there was a good stellar field for this mission, stellar images are easily defined. The frames recorded by stellar camera No 76 (Mission 1029-2) are adequately exposed and stellar images are easily detectable.

d. Horizon Cameras. The horizon camera exposure is also commensurate with solar elevation. The exposure was generally adequate. However, the starboard horizons were more dense than the port and in some passes appear to be slightly overexposed (Example: pass 132D fwd). The overexposure is not considered to be a degrading factor on this mission.

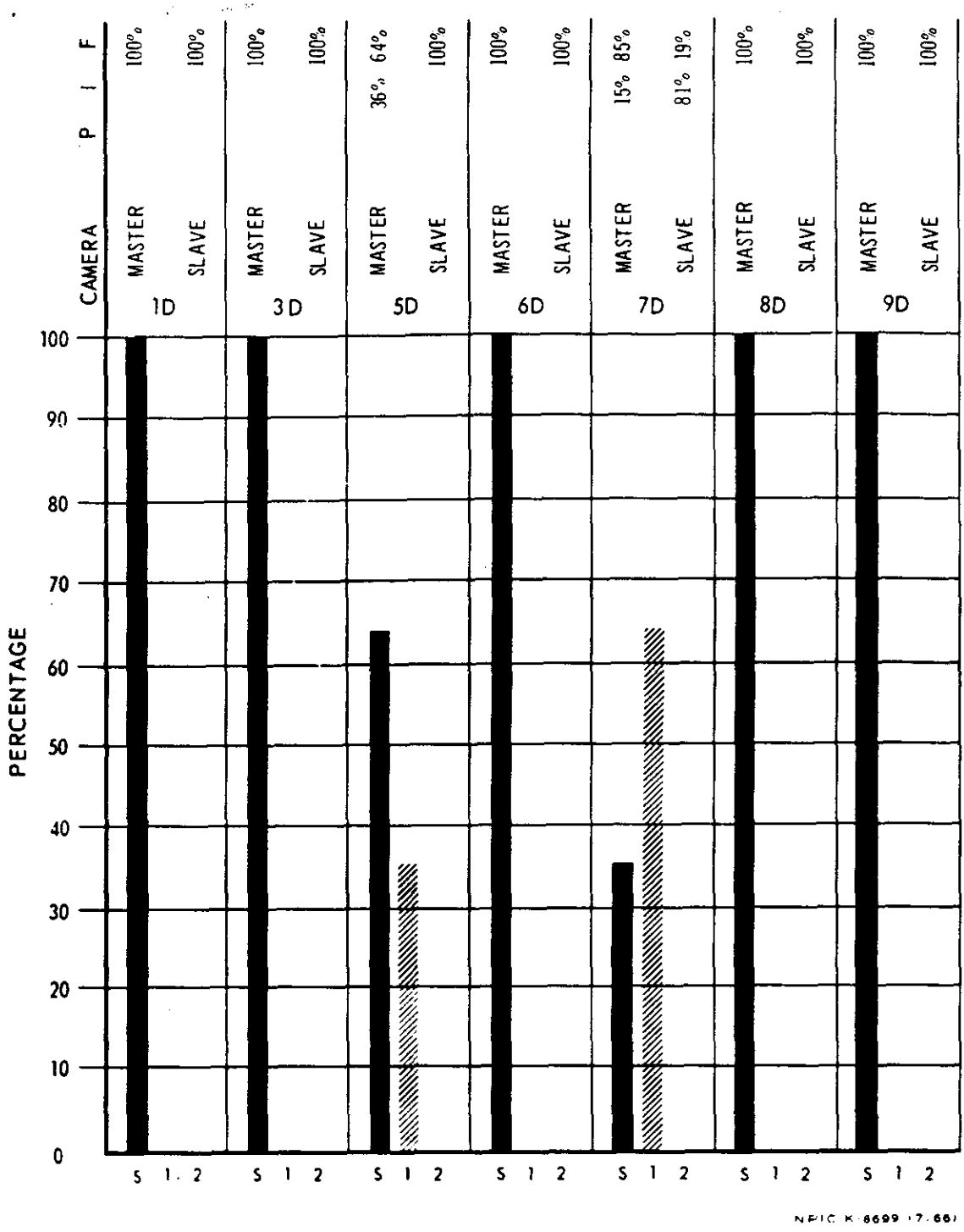
e. Processing Levels. The film of both panoramic cameras was processed in Trenton processing machines. The following information indicates the percentage of film processed at each level of development and the number of processing level changes accomplished during the process.

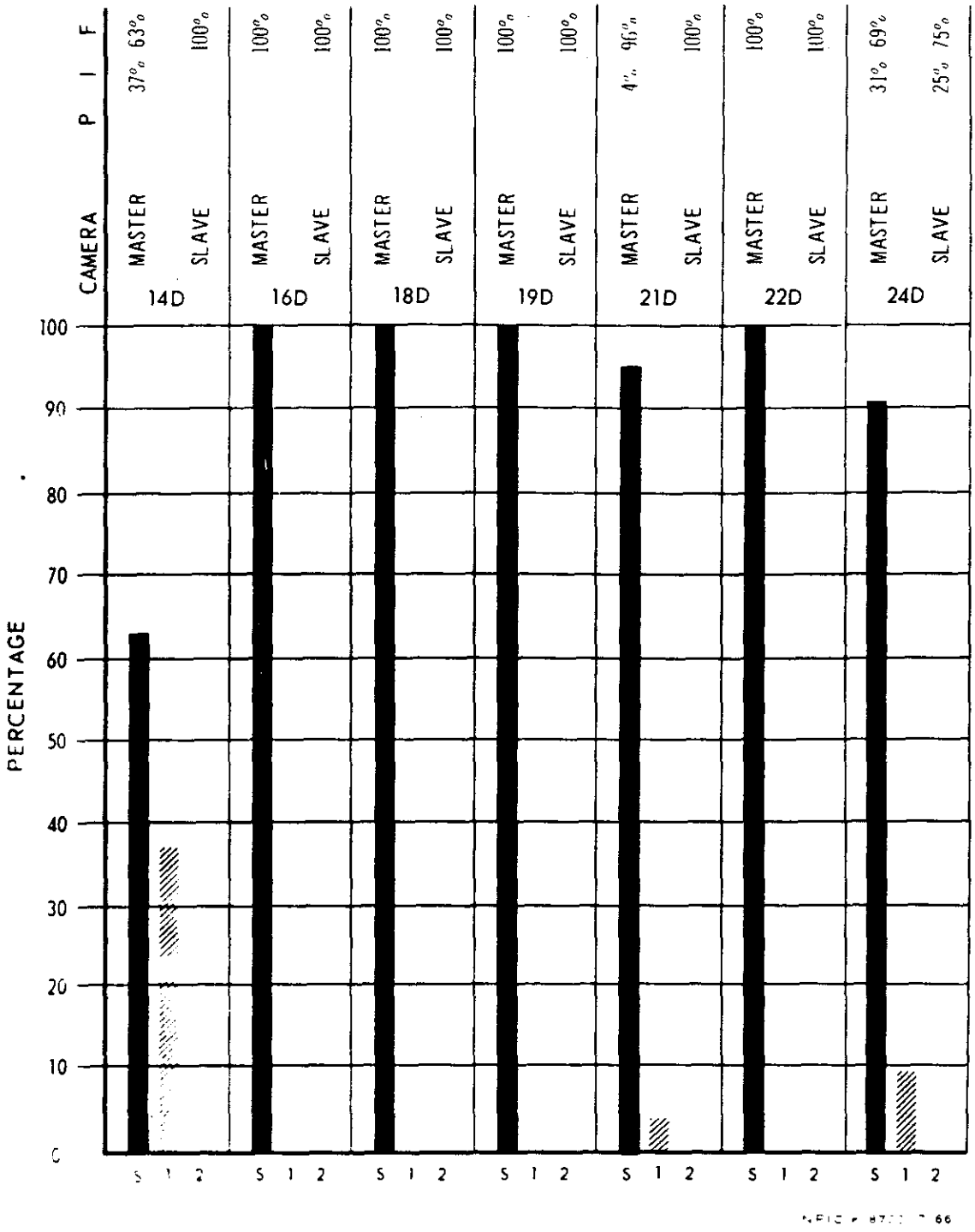
	1029-1		1029-2	
Development Level	Master	Slave	Master	Slave
Primary	1.0%	0.0%	2%	2%
Intermediate	16.2%	20.5%	28%	24%
Full	82.8%	79.5%	70%	74%

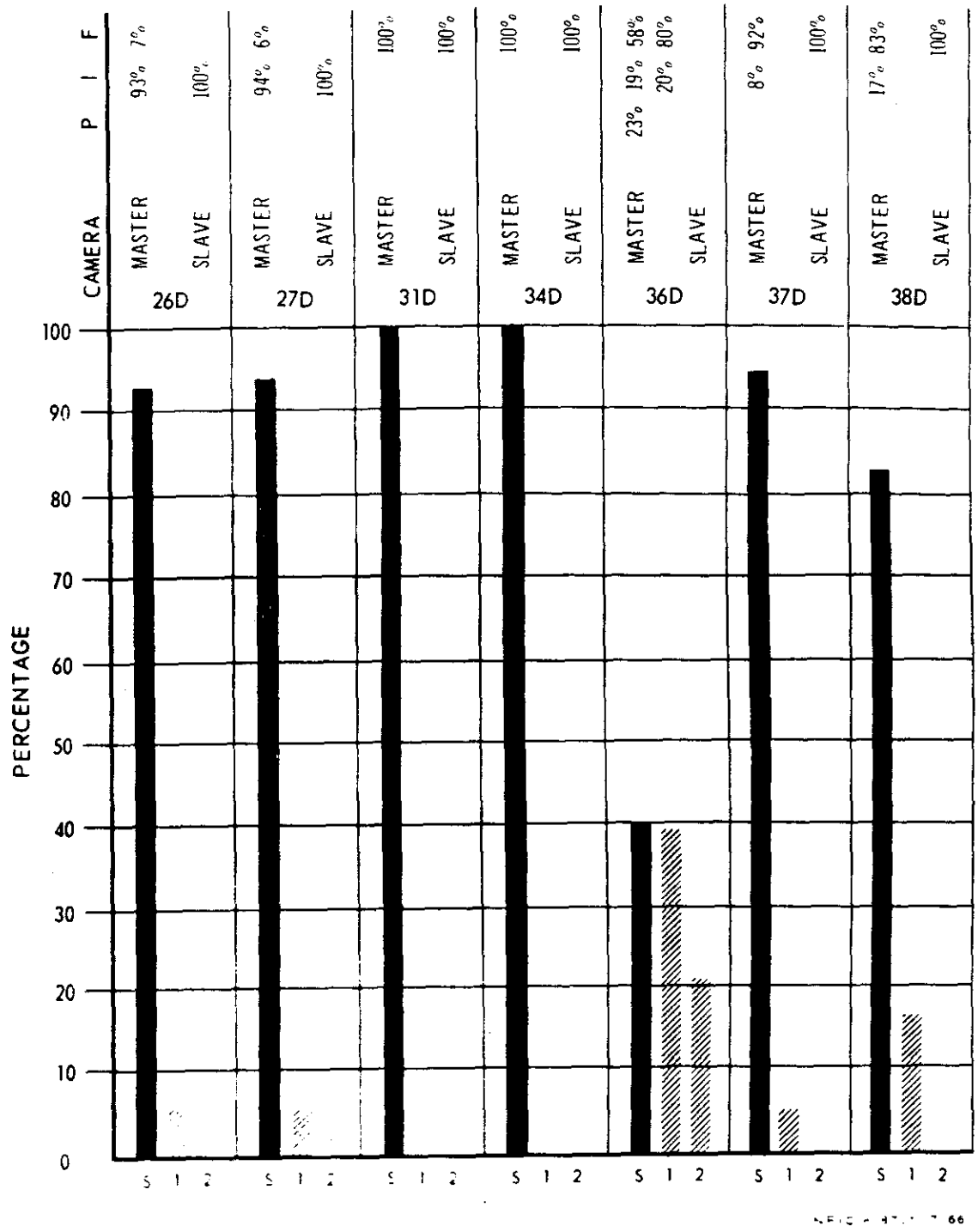
Processing Changes	1029-1	1029-2
Master (Fwd) Camera	30	35
Slave (Aft) Camera	20	39

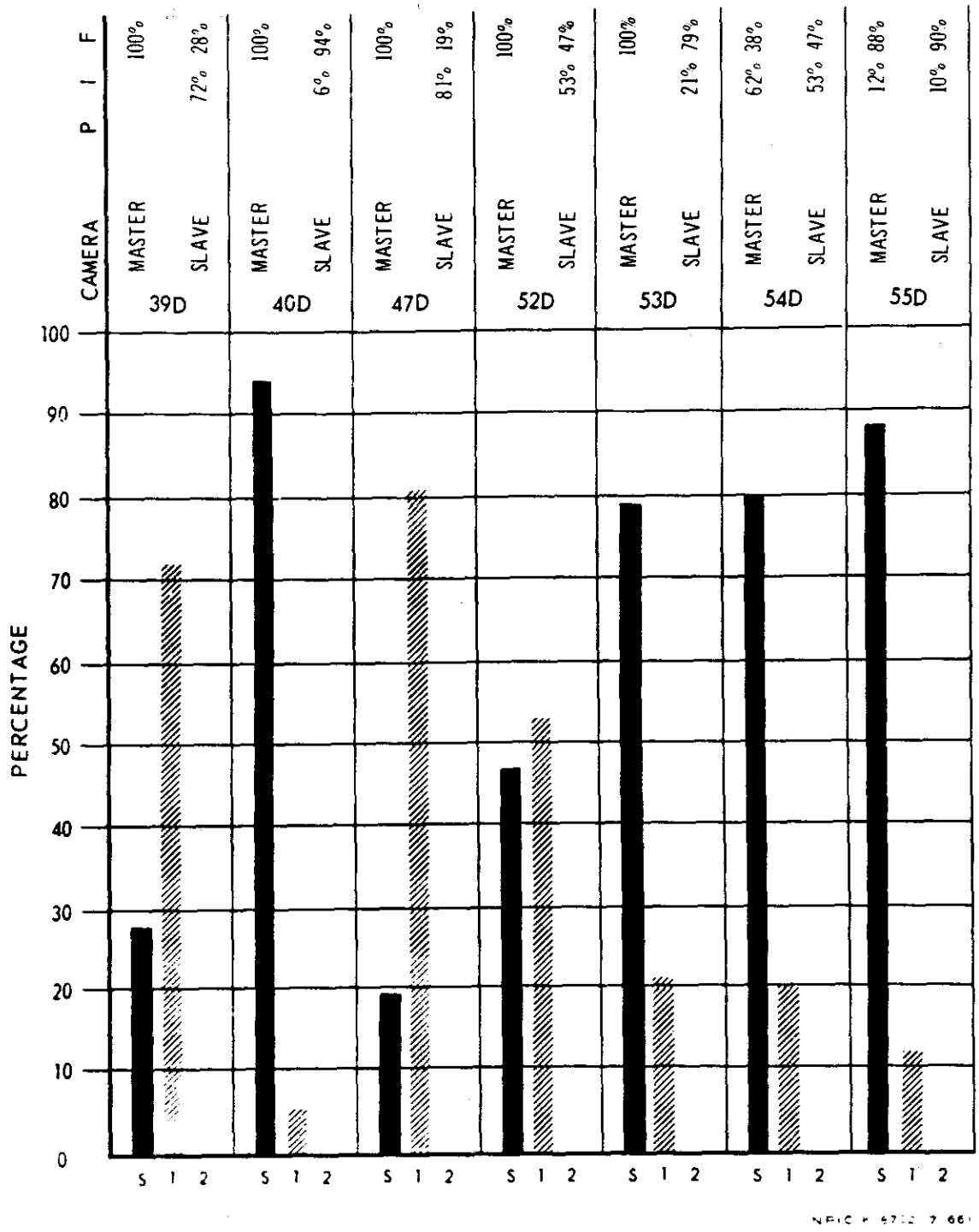
The stellar camera film was processed at one continuous development level in a Trenton processor. The index camera film was processed at one continuous level in an EH6A processing machine.

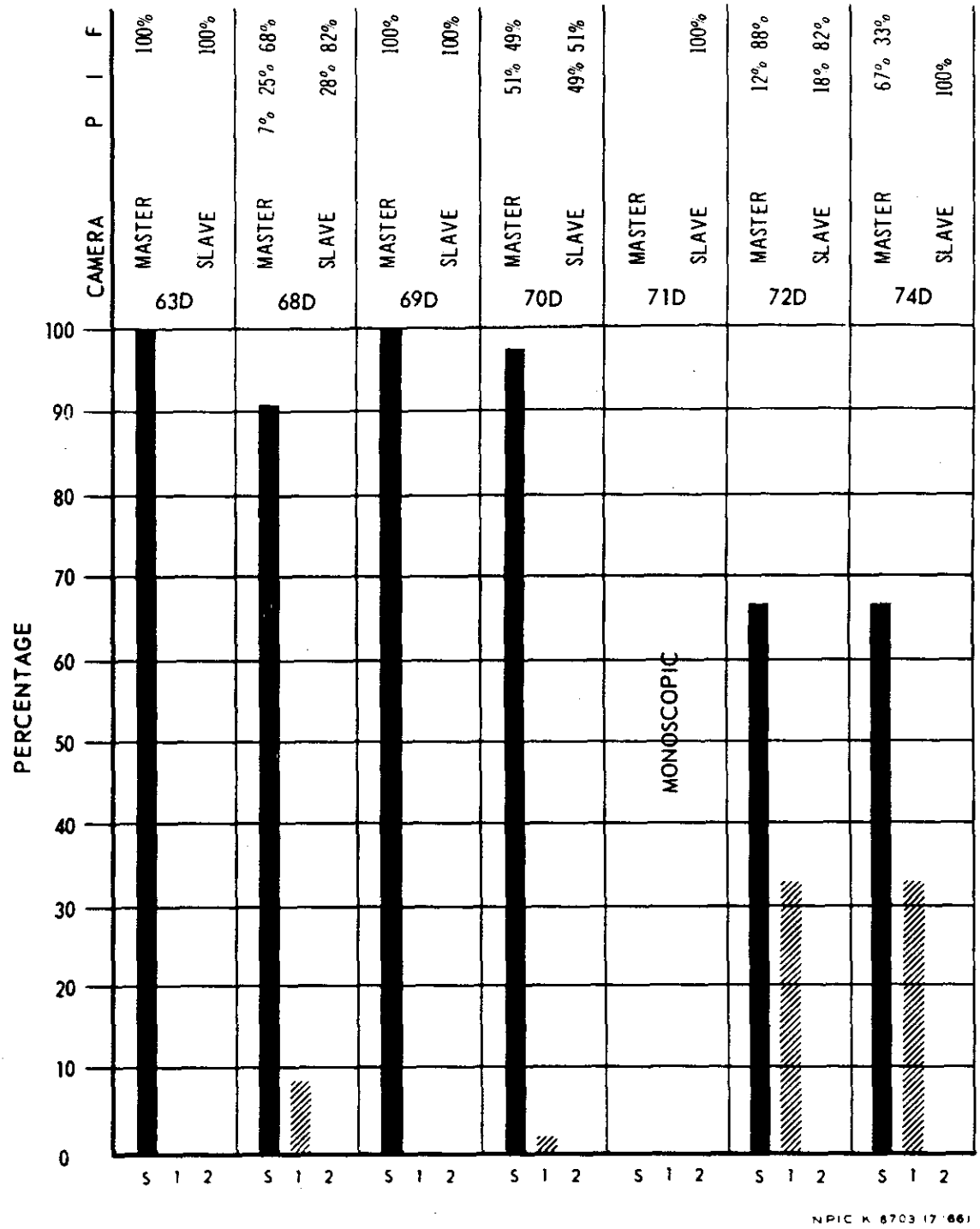
f. Graphic Illustration of Fwd and Aft Process Histories. The following graphs indicate the relation of the process levels of the master (fwd) camera film and the slave (aft) camera film. They show the difference of development level administered to the film of the 2 cameras, i.e., "1" indicates one level of development difference (primary-intermediate or intermediate-full), "2" indicates 2 levels of difference (full-primary), and "S" indicates the films were processed at the same level of development. The comparison is made on a frame-by-frame basis. Therefore, if frames 1-10 of a given pass of 20 frames of master camera photography were processed at primary and frames 11-20 were processed at full, and the slave camera film of the same pass was processed, frames 1-10 at full and 11-20 at primary, the graph would show that 100 percent of the film was processed at "2" levels of difference. The purpose of this analysis is to further study the relation of exposure/processing on the 2 panoramic cameras. The same study was conducted on the film of Mission 1024, comparing Trenton and Yardleigh processing.

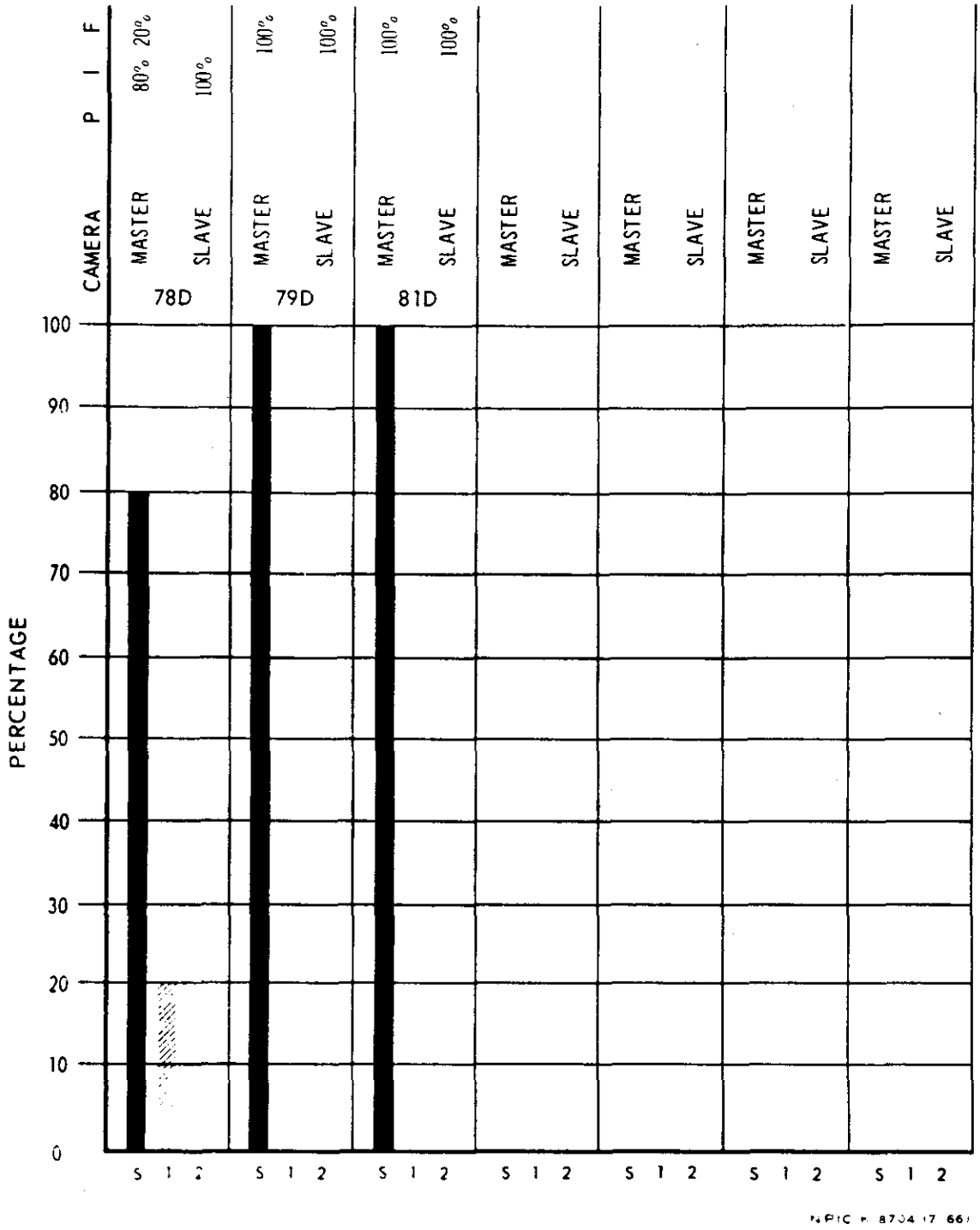

CAMERA
P I F
MASTER
SLAVE
1D
3D
5D
6D
7D
8D
9D
100%
36% 64%
15% 85%
81% 19%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2
NPIC K-8699 (7-66)


CAMERA
P I F
MASTER
SLAVE
37% 63%
100%
100%
100%
100%
100%
100%
100%
100%
4% 96%
100%
100%
100%
31% 69%
25% 75%
14D
16D
18D
19D
21D
22D
24D
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2

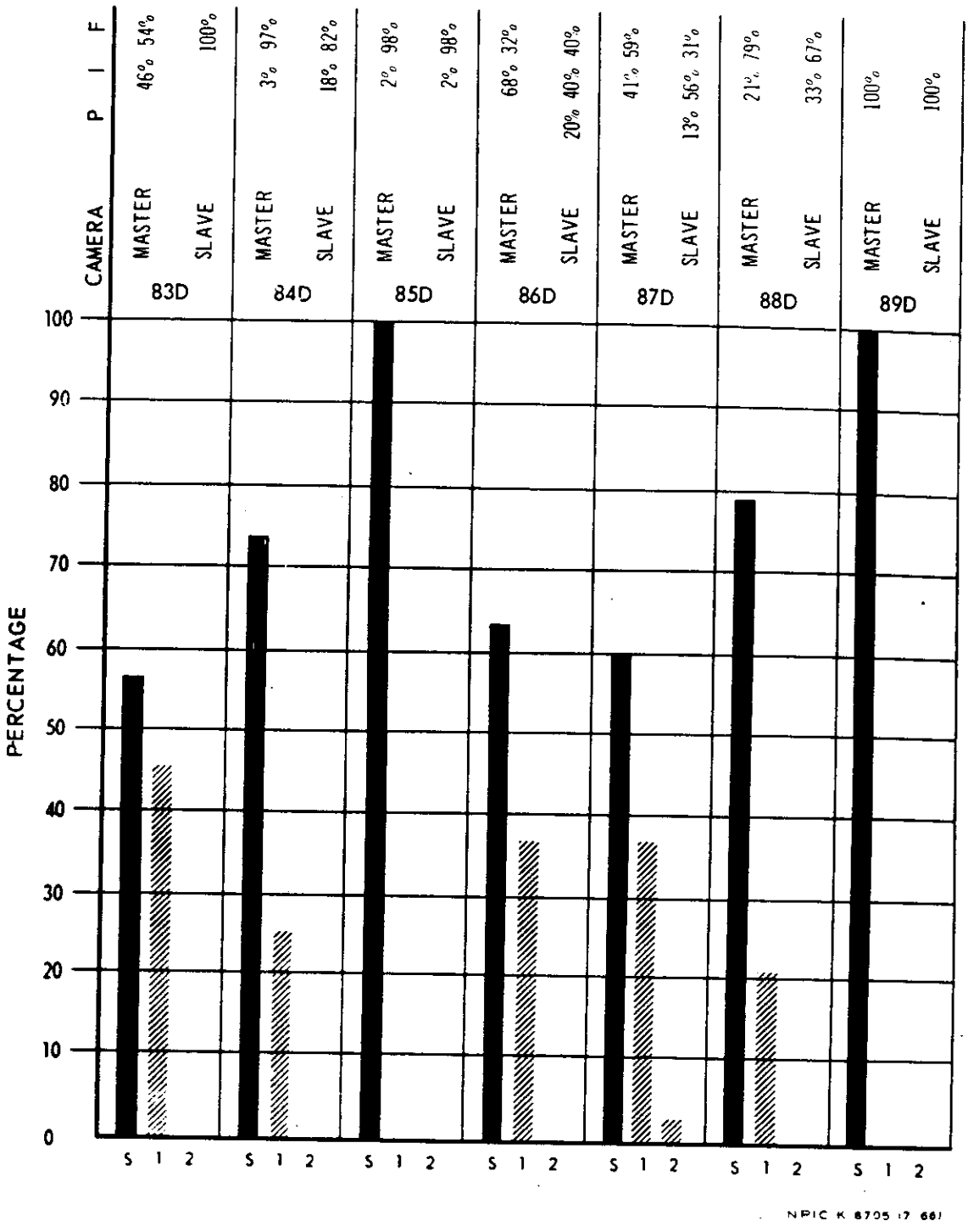

CAMERA
P I F
MASTER
SLAVE
26D
93% 7%
100%
27D
94% 6%
100%
31D
100%
100%
34D
100%
100%
36D
23% 19% 58%
20% 80%
37D
8% 92%
100%
38D
17% 83%
100%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2

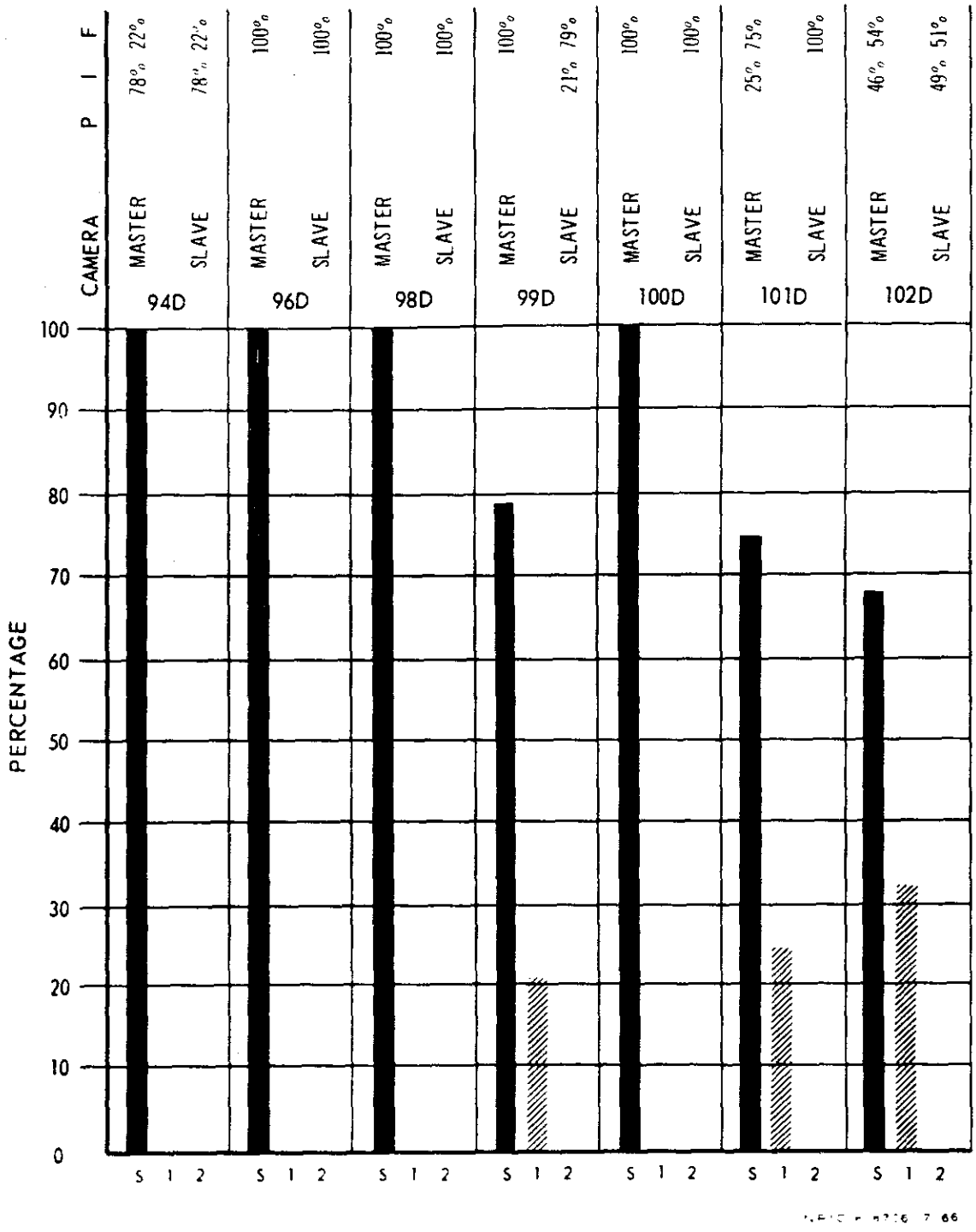

CAMERA
P I F
MASTER
SLAVE
39D
100%
72% 28%
40D
100%
6% 94%
47D
100%
81% 19%
52D
100%
53% 47%
53D
100%
21% 79%
54D
62% 38%
53% 47%
55D
12% 88%
10% 90%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2

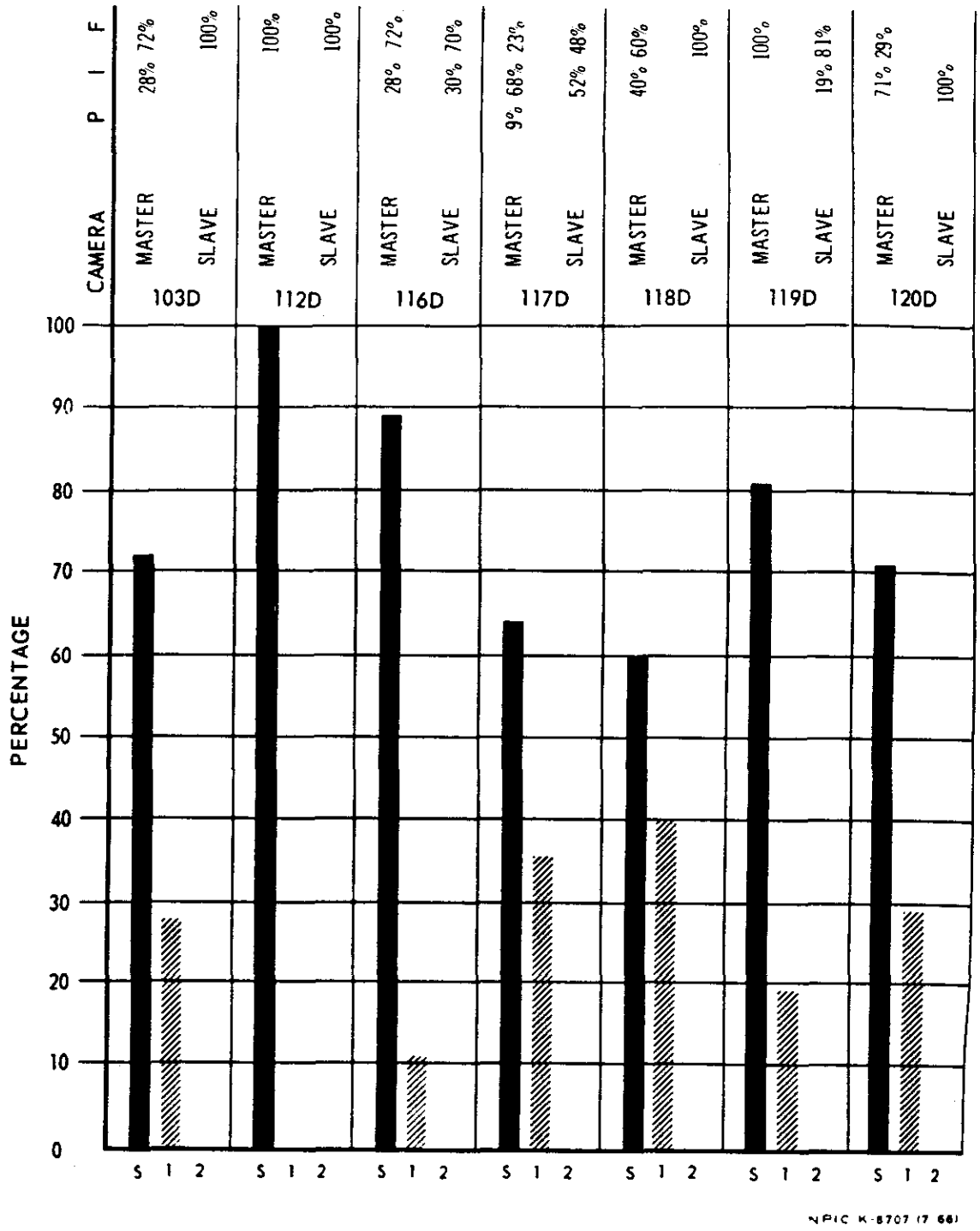

CAMERA
P I F
MASTER 100%
SLAVE 100%
63D
MASTER 7% 25% 68%
SLAVE 28% 82%
68D
MASTER 100%
SLAVE 100%
69D
MASTER 51% 49%
SLAVE 49% 51%
70D
MASTER 100%
SLAVE
71D
MONOSCOPIC
MASTER 12% 88%
SLAVE 18% 82%
72D
MASTER 67% 33%
SLAVE 100%
74D
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2
NPIC K 6703 (7 66)

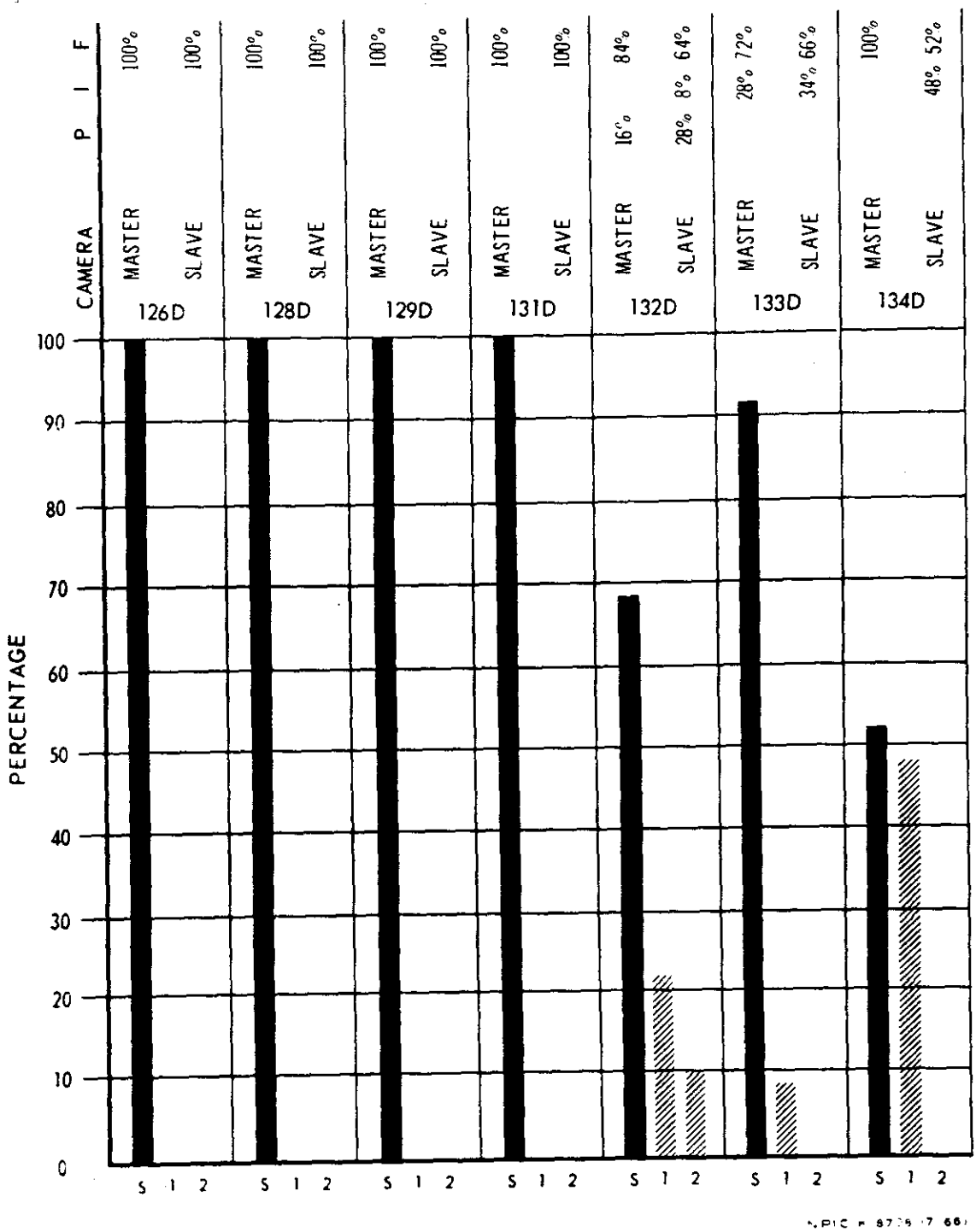


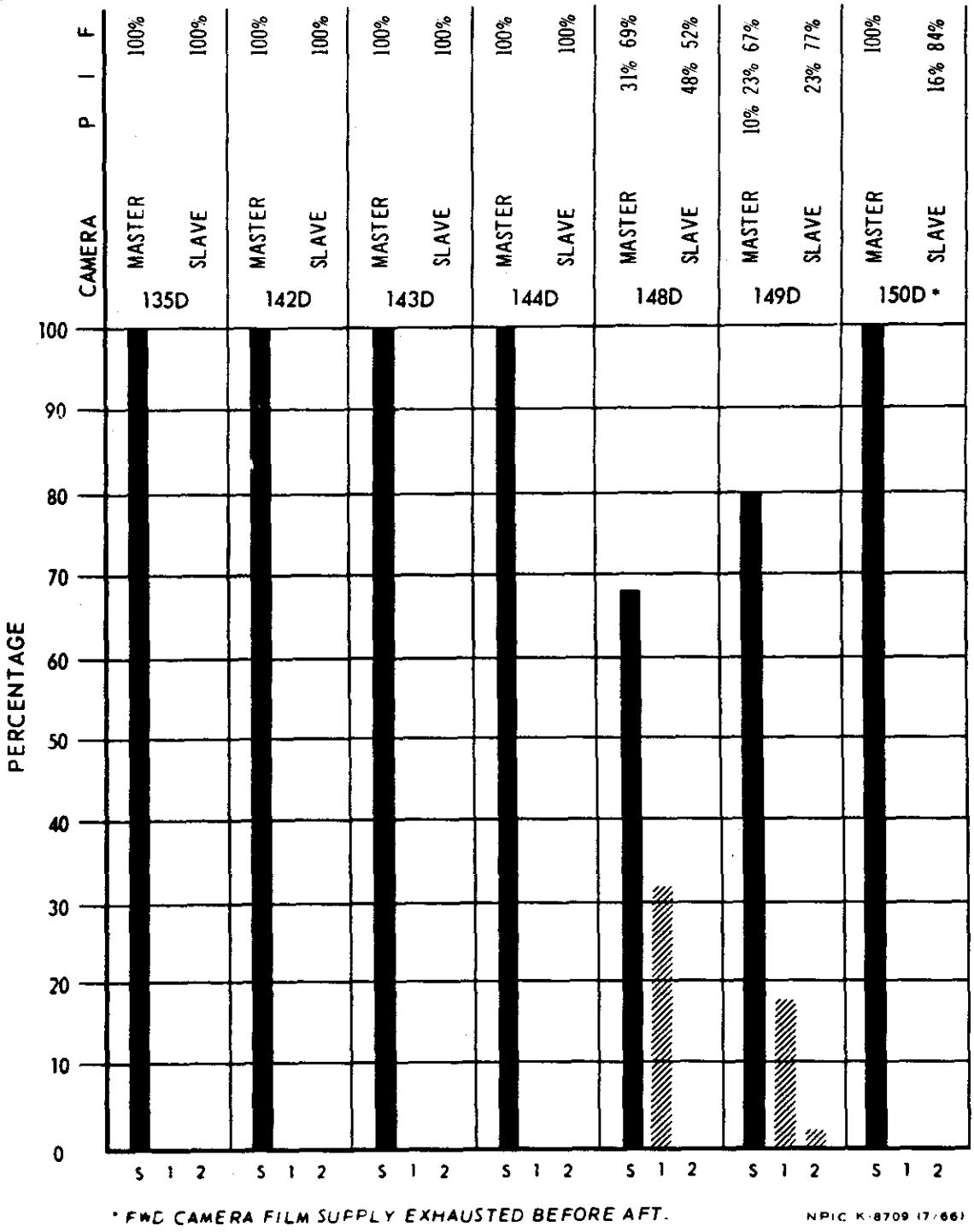
NPIC F 8704 (7 66)


CAMERA
P I F
MASTER 46% 54%
SLAVE 100%
83D
MASTER 3% 97%
SLAVE 18% 82%
84D
MASTER 2% 98%
SLAVE 2% 98%
85D
MASTER 68% 32%
SLAVE 20% 40% 40%
86D
MASTER 41% 59%
SLAVE 13% 56% 31%
87D
MASTER 21% 79%
SLAVE 33% 67%
88D
MASTER 100%
SLAVE 100%
89D
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2
NPIC K 8705 17 661


CAMERA
P I F
MASTER
SLAVE
94D
78% 22%
78% 22%
96D
100%
100%
98D
100%
100%
99D
100%
21% 79%
100D
100%
100%
101D
25% 75%
100%
102D
46% 54%
49% 51%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2


CAMERA
P I F
MASTER
SLAVE
103D
28% 72%
100%
112D
100%
100%
116D
28% 72%
30% 70%
117D
9% 68% 23%
52% 48%
118D
40% 60%
100%
119D
100%
19% 81%
120D
71% 29%
100%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2
NPIC K-8707 (7 66)


CAMERA
P I F
MASTER 100%
SLAVE 100%
126D
MASTER 100%
SLAVE 100%
128D
MASTER 100%
SLAVE 100%
129D
MASTER 100%
SLAVE 100%
131D
MASTER 16% 84%
SLAVE 28% 8% 64%
132D
MASTER 28% 72%
SLAVE 34% 66%
133D
MASTER 100%
SLAVE 48% 52%
134D
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2



* FWD CAMERA FILM SUPPLY EXHAUSTED BEFORE AFT.

NPIC K-8709 (7/66)

g. Observations from the Graphs.

1. The process of the film of the master and the slave was identical on 32 of the 73 passes analyzed.

2. The process differed by 1 level during parts of 37 passes.

3. The process level was different by 2 levels (full-primary) at sometime during the process of 4 passes.

4. The process was continuous at the full level of development on the film of both cameras on 27 passes.

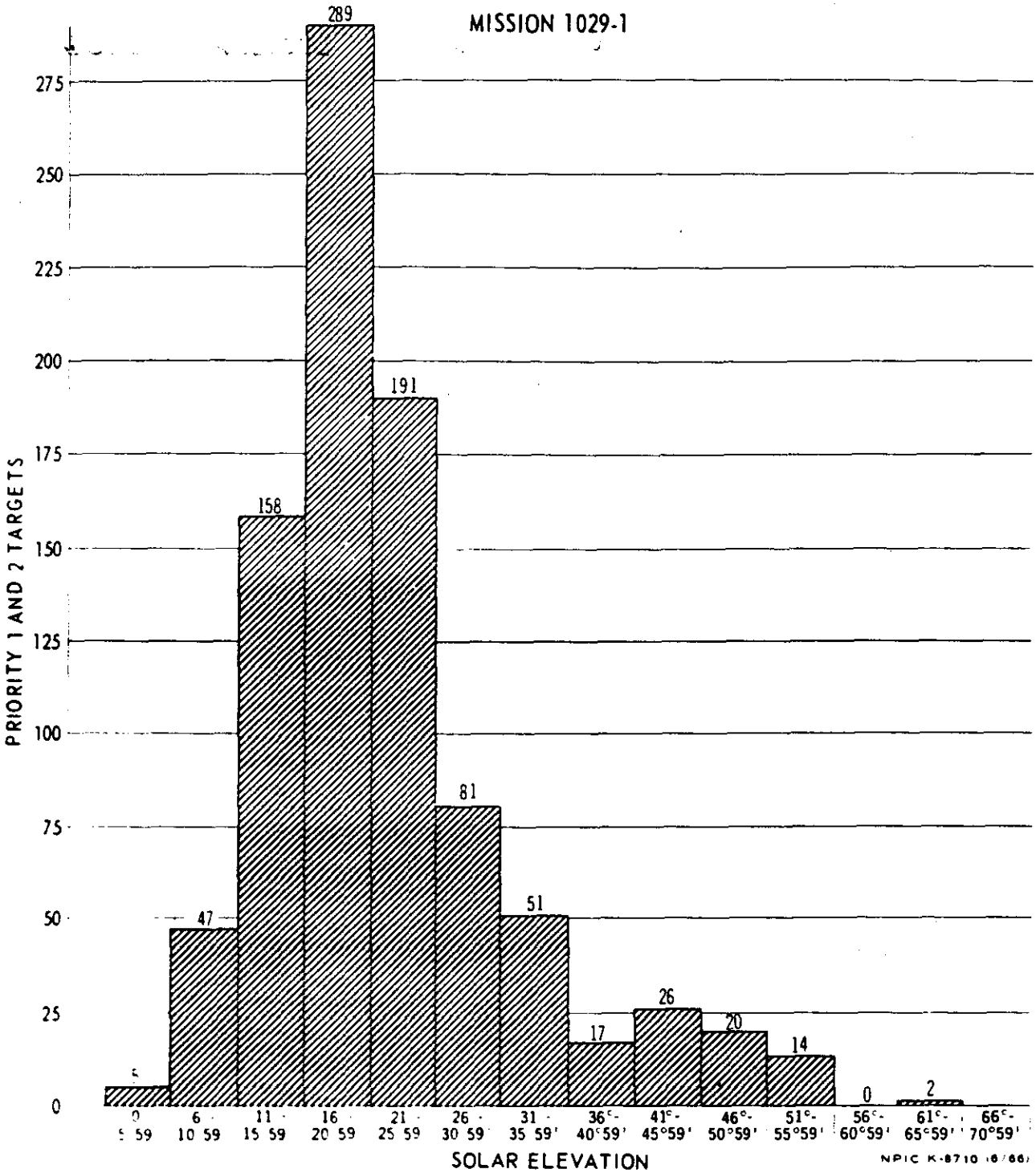
5. The process was continuous at the intermediate level on the film from both cameras on 1 pass.

6. On the 37 passes having a process difference of 1 level, the standard percentage of deviation was 26.59 percent.

7. On the 4 passes that contain variations of 2 increments of development (that is, full-primary), the average deviation is 9 percent.

3. Solar Elevations, Relative to Target Acquisition

A further consideration in the analysis of exposure and processing is the prevailing solar elevations during exposure. The following data describes the solar elevations during the acquisition of photography of all priority A and B targets covered on Missions 1029-1 and 1029-2.


MISSION 1029-1
PRIORITY 1 AND 2 TARGETS
SOLAR ELEVATION
0
25
50
75
100
125
150
175
200
225
250
275
5
47
158
289
191
81
51
17
26
20
14
0
2
0 - 5 59
6 - 10 59
11 - 15 59
16 - 20 59
21 - 25 59
26 - 30 59
31 - 35 59'
36°- 40°59'
41°- 45°59'
46°- 50°59'
51°- 55°59'
56°- 60°59'
61°- 65°59'
66°- 70°59'
NPIC K-8710 (8/66)

MISSION 1029-2

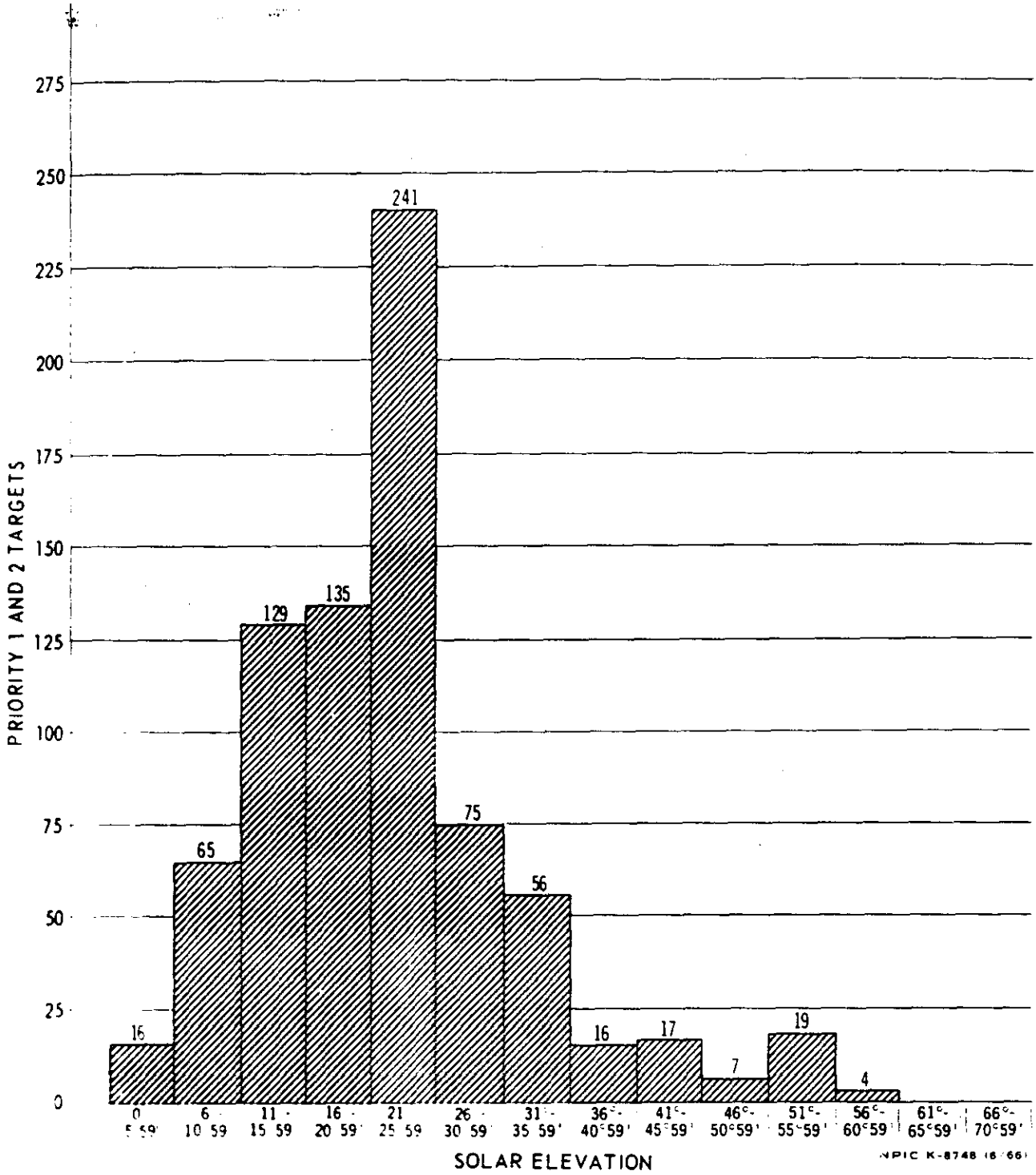
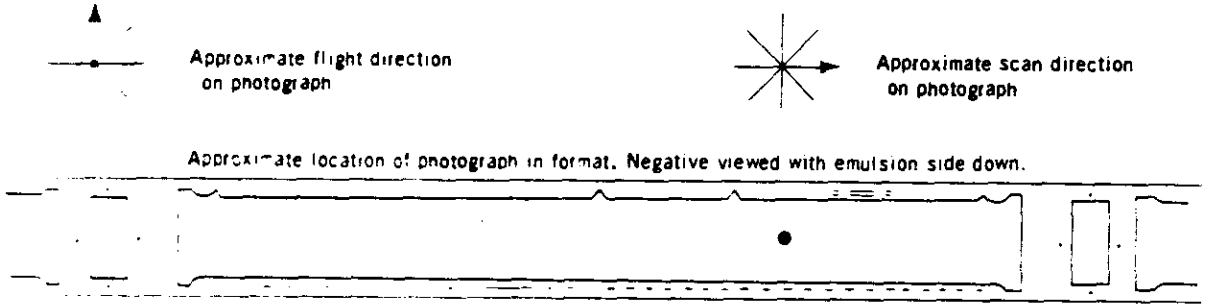


FIGURE 6. PHOTOGRAPHY AT LOW SOLAR ELEVATION

The parent negative of this photograph was exposed at a solar elevation of 4°14'. On Mission 1029, photography was exposed at solar elevations as low as -1°03' and as high as 79°57'. Part II, Item 2h of this report lists the number of priority 1 and 2 targets exposed at various ranges of solar elevation. Appendix G of this report provides a graphic analysis of photographic acquisition, relative to solar elevation.

Camera	178
Pass	55D
Frame	11 Fwd
Date of Photography	6 Feb 66
Universal Grid Coordinates	60.6 - 11.5
Enlargement Factor	40X
Geographic Coordinates	68-41N 032-22E
Altitude (feet)	746,308
Camera Attitude:	
Pitch	14°53'
Roll	-0°07'
Yaw	0°06'
Local Sun Time	1052
Solar Elevation	4°14'
Solar Azimuth	Not Available
Exposure	1/189
Vehicle Azimuth	134°59'
Processing Level	Full



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PART III. IMAGE QUALITY

1. Definition of Photographic Interpretation (PI) Suitability

PI suitability is an assessment of the information content of photographic reconnaissance material and its interpretability. A number of interrelated factors are involved, such as the quality of the photography, the extent of target coverage, scale, and weather limitations. However, the fundamental criteria for assigning a PI suitability rating may be reduced to (a) the scope of the photographic coverage and (b) the degree to which a photographic interpreter may extract useful and reliable information from the material.

PI suitability ratings are: Excellent, Good, Fair, Poor, and Unuseable. These ratings refer to the overall interpretive value of the photography obtained from a particular reconnaissance mission. Individual targets may also be assigned PI suitability ratings. The standards that determine assignment of the various ratings are:

Excellent: The photography is free of degradations by camera malfunctions or processing faults and weather conditions are favorable throughout. The imagery contains sharp, well-defined edges and corners with no unusual distortions. Contrast is optimum and shadow details, as well as details in the highlight areas, are readily detectable. Observation of small objects and a high order of mensuration are made possible by the consistently good quality of the photography.

Good: The photography is relatively free of degradations, or limiting atmospheric conditions. Edges and corners are well defined. No unusual distortions are present. Detection and accurate mensuration of small objects are feasible, but to a lesser degree than in material rated as Excellent.

Fair: Degradation is present and the acuity of the photography is less than optimum. Edges and corners are not crisply defined and there is loss of detail in shadow or highlight areas. Detection and identification of small objects are possible but accuracy of mensuration is limited by the fall-off in image quality and the less-than-optimum contrast.

Poor: Camera-induced degradations or weather limitations severely reduce the effectiveness of the photography. Definition of edges and corners are not well defined. Only gross terrain features and culture may be detected or identified and distortion of form may exist. Accurate mensuration of even large objects is doubtful.

Unuseable: Degradation of photography completely precludes detection, identification, and mensuration of cultural details.

2. PI Suitability, Missions 1029-1 and 1029-2

The PI suitability is good. However, the overall image quality is not as good as on most recent missions. The degradation is attributed to heavy snow cover, blowing snow, clouds, cloud shadow, haze, and low solar elevation. The camera system operated satisfactorily. While the low solar elevations were a degrading factor, they were normal for this time of year. Likewise, the degradation associated with snow is normal for this time of year. Haze, however, is more prominent on this mission than on most missions flown this time of year.

The photointerpreters specifically mentioned the beginning of pass 24D as an example of image degradation associated with low solar elevation. The last few frames on pass 144D were given as an example of image degradation associated with blowing snow. The photointerpreters mentioned the photography on pass 103D as an example of imagery degraded by haze.

Passes 6D and 40D are said to be among the best of the mission for photo interpretation. The number of targets on a pass bears heavily on the PI's analysis of pass success. Therefore, the referenced passes are not necessarily the best of the mission from a technical viewpoint.

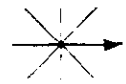
FIGURE 7. GOOD PI SUITABILITY

This print is representative of the image quality on a pass noted by the photointerpreters as being particularly well suited for interpretation.

NPIC K-8712 (6/66)

Camera	178
Pass	40D
Frame	59 Fwd
Date of Photography	5 Feb 66
Universal Grid Coordinates	35.5 - 13.6
Enlargement Factor	40X
Geographic Coordinates	52-56N 036-10E
Altitude (feet)	669,863
Camera Attitude:	
Pitch	14°30'
Roll	-0°16'
Yaw	-0°00'
Local Sun Time	1223
Solar Elevation	21°28'
Solar Azimuth	188°
Exposure	1/225
Vehicle Azimuth	156°25'
Processing Level	Full

Approximate flight direction on photograph



Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.

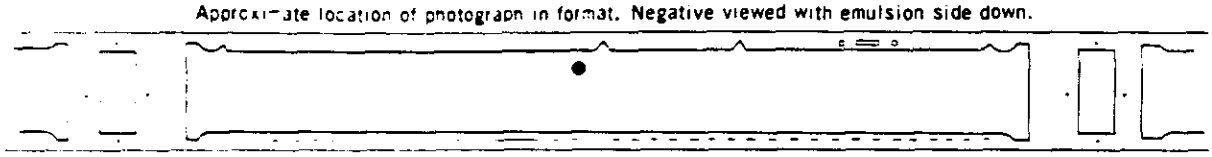


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FIGURE 8. IMAGE DEGRADATION CAUSED BY BLOWING SNOW

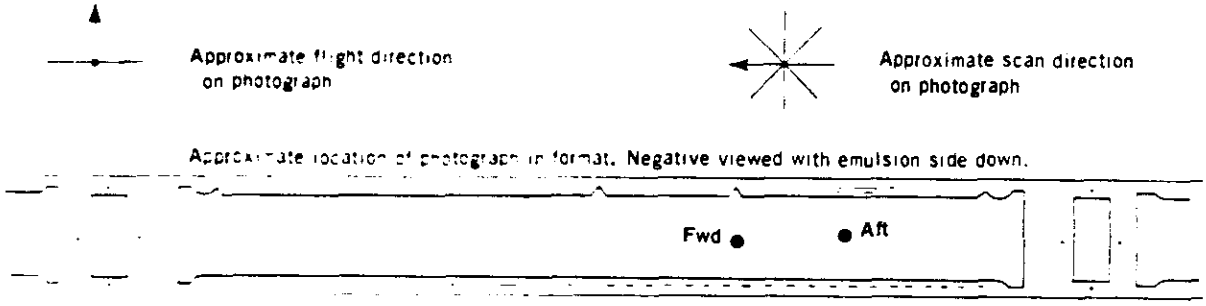
Photointerpreters reported that blowing snow in this part of the mission caused the PI suitability to be poor.

FIGURE 9. FINE DETAIL IN SNOW COVERED TERRAIN

Location, identification, and mensuration of this target would probably have been impossible in a condition of blowing snow as illustrated in the previous print.

NPIC K-8713 (6/66) NPIC K-8714 (6/66)

	FIGURE 8	FIGURE 9
Camera	179	178
Pass	144D	40D
Frame	27 Aft	58 Fwd
Date of Photography	11 Feb 66	5 Feb 66
Universal Grid Coordinates	64.1 - 11.5	53.4 - 10.8
Enlargement Factor	40X	40X
Geographic Coordinates	65-16N 167-53E	53-31N 035-43E
Altitude (feet)	658,139	670,529
Camera Attitude:		
Pitch	Not Available	14°31'
Roll	Not Available	-0°14'
Yaw	Not Available	0°00'
Local Sun Time	0959	1221
Solar Elevation	6°59'	21°19'
Solar Azimuth	Not Available	188°
Exposure	1/348	1/224
Vehicle Azimuth	143°59'	256°19'
Processing Level	Full	Full



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3. Definition of Mission Information Potential (MIP)

The MIP is an arbitrary number, not limited by terminal values, which is subjectively assigned to the panoramic photography of a mission and which compares it to the other missions. It is meant to be a measure of the camera's maximum capability for recording information, discounting adverse atmospheric conditions, minimum solar elevations, camera malfunctions, or other factors which reduce the quality of the photography.

The MIP is based on the best photography found in a mission, even though the photography may be limited to a few frames. Since these frames are considered to be the best in the mission, they do not indicate the overall success, average quality, or general interpretability of the photography.

Criteria for selection of the MIP frame:

a. Eliminate all portions of the mission affected by system malfunctions.

b. Select frames which are free of clouds or atmospheric attenuation.

c. Eliminate the first 10 frames and last frame of a pass because these may be affected by incorrect scan speed.

d. Select frames that are in a continuous strip of approximately 10 cloud-free frames because cloud shadows from weather fronts are cast for great distances.

e. Determine from the horizon cameras that the panoramic photography is not affected by apparent vehicle perturbations.

f. Select targets that are near the center of the format and on frames as close as possible to perigee for scale purposes and to eliminate obliquity.

g. Select frames having near optimum solar elevation.

h. Select a high-contrast target (preferably an airfield) and compare the target to a previous mission which has been given an MIP rating.

4. MIP, Missions 1029-1 and 1029-2

The MIP rating of Missions 1029-1 and 1029-2 is 85. According to the criteria set forth for the selection of the MIP, frame 27 (fwd), pass 37D, Mission 1029-1 and frame 10 (fwd), pass 126D, Mission 1029-2 were selected.

Notice, the criteria for the selection of the MIP rating makes no mention of overall image quality. While the best imagery of this mission is approximately equal to the best of most recent missions, imagery equal to the best is confined to only a few passes.

5. Resolution Targets

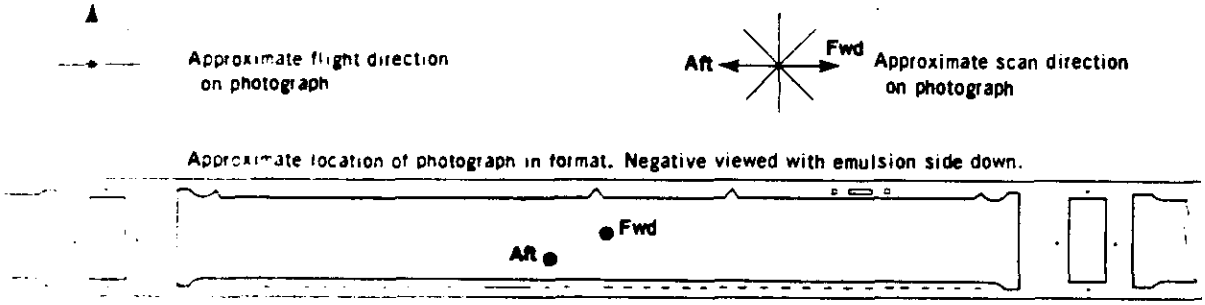
Only 1 resolution target was covered by Mission 1029. It is on pass 47D, frame 9 fwd and frame 15 aft. The target is in cloud shadow and is therefore degraded. Approximately 11 feet is resolved in the flight direction and 13 feet across track (consensus derived from original negative).

FIGURE 10. MIP FRAME, MISSION 1029-1 (MIP 85)

FIGURE 11. SLAVE (AFT) CAMERA COVERAGE OF THE MIP TARGET

NPIC K-8715 (6/66) NPIC K-8716 (6/66)

	FIGURE 10	FIGURE 11
Camera	178	179
Pass	37D	37D
Frame	28 Fwd	33 Aft
Date of Photography	5 Feb 66	5 Feb 66
Universal Grid Coordinates	46.2 - 13.2	43.4 - 10.8
Enlargement Factor	20X	20X
Geographic Coordinates	37-44N 112-27E	37-42N 112-24E
Altitude (feet)	620,047	618,077
Camera Attitude:		
Pitch	14°05'	-15°52'
Roll	-0°07'	0°05'
Yaw	-0°37'	0°41'
Local Sun Time	1300	1301
Solar Elevation	35°45'	35°46'
Solar Azimuth	215°	215°
Exposure	1/245	1/381
Vehicle Azimuth	163°33'	163°49'
Processing Level	Full	Full



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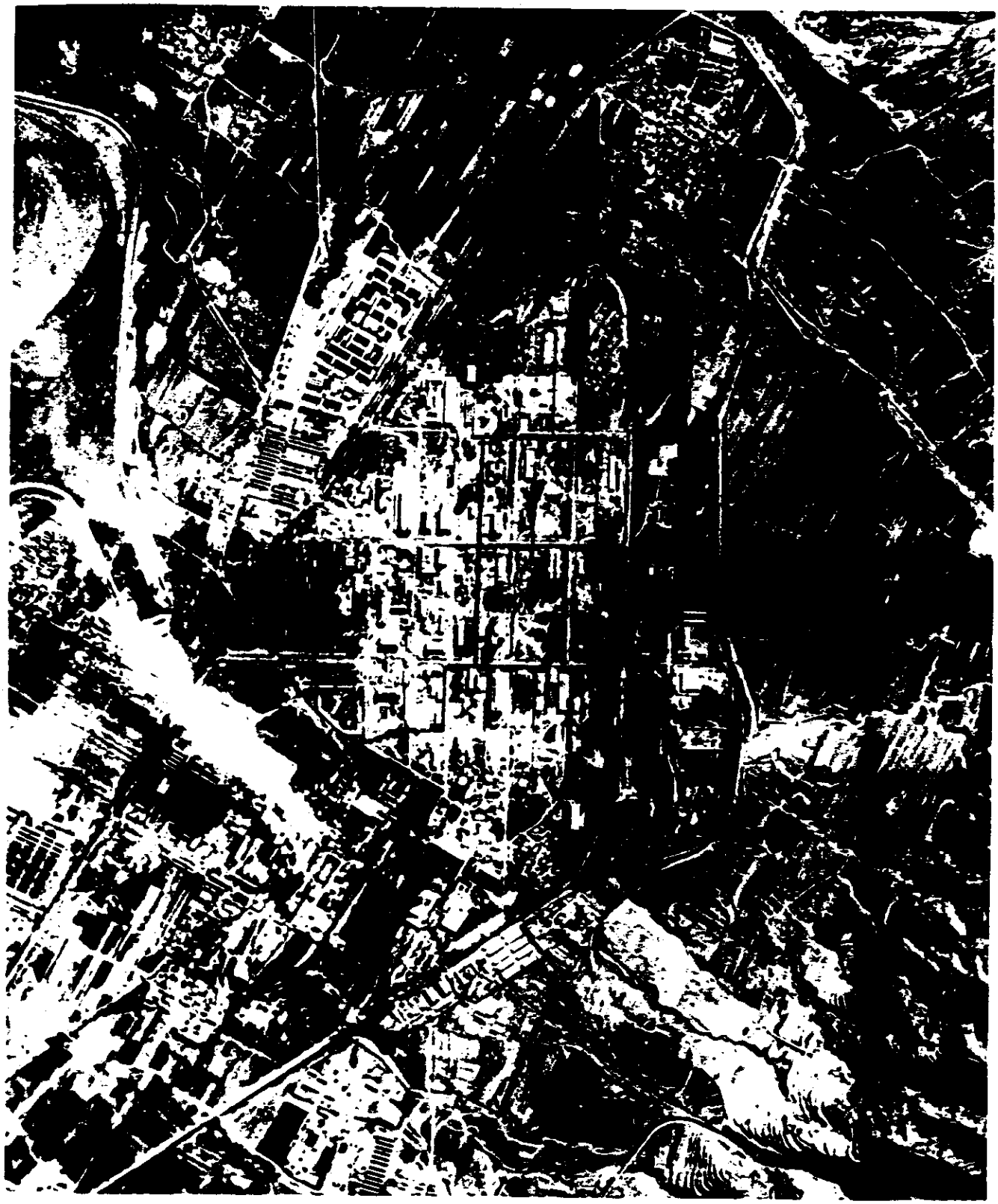

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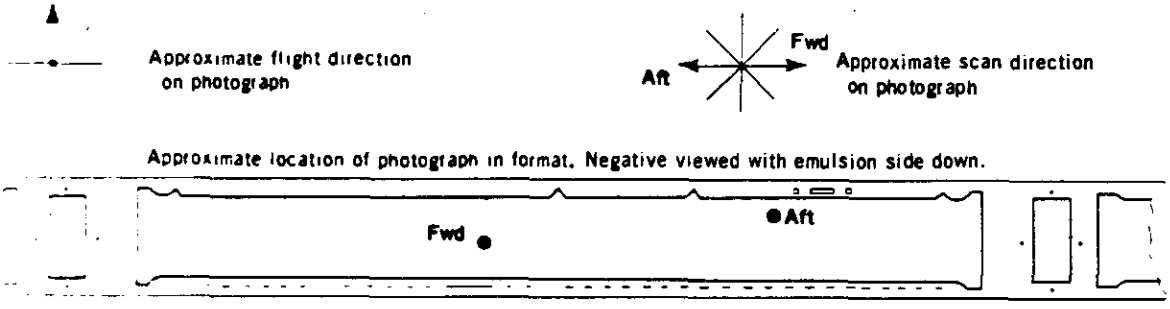
FIGURE 12. MIP FRAME, MISSION 1029-2 (MIP 85)

FIGURE 13. SLAVE (AFT) CAMERA COVERAGE OF THE MIP TARGET

NPIC K-8717 (6/66) NPIC K-8718 (6/66)

	FIGURE 12	FIGURE 13
Camera	178	179
Pass	126D	126D
Frame	10 Fwd	15 Aft
Date of Photography	10 Feb 66	10 Feb 66
Universal Grid Coordinates	32.9 - 10.9	57.8 - 14.1
Enlargement Factor	20X	20X
Geographic Coordinates	34-16N 118-43W	34-17N 118-45W
Altitude (feet)	608,041	608,175
Camera Attitude:		
Pitch	14°36'	15°24'
Roll	-0°29'	-0°29'
Yaw	Not Determined	Not Determined
Local Sun Time	1152	1152
Solar Elevation	41°13'	41°13'
Solar Azimuth	180°	180°
Exposure	1/246	1/380
Vehicle Azimuth	Not Available	Not Available
Processing Level	Full	Full



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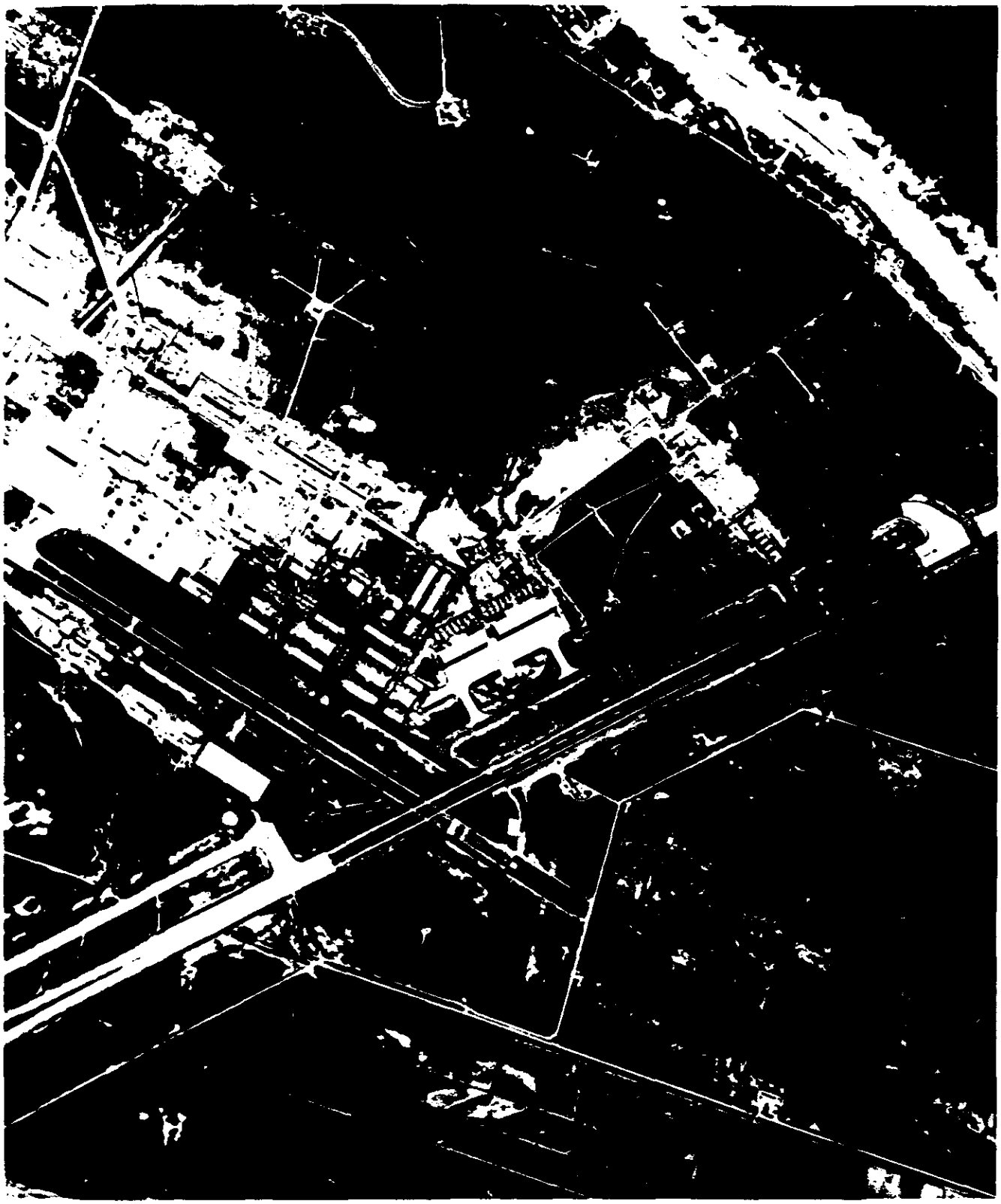

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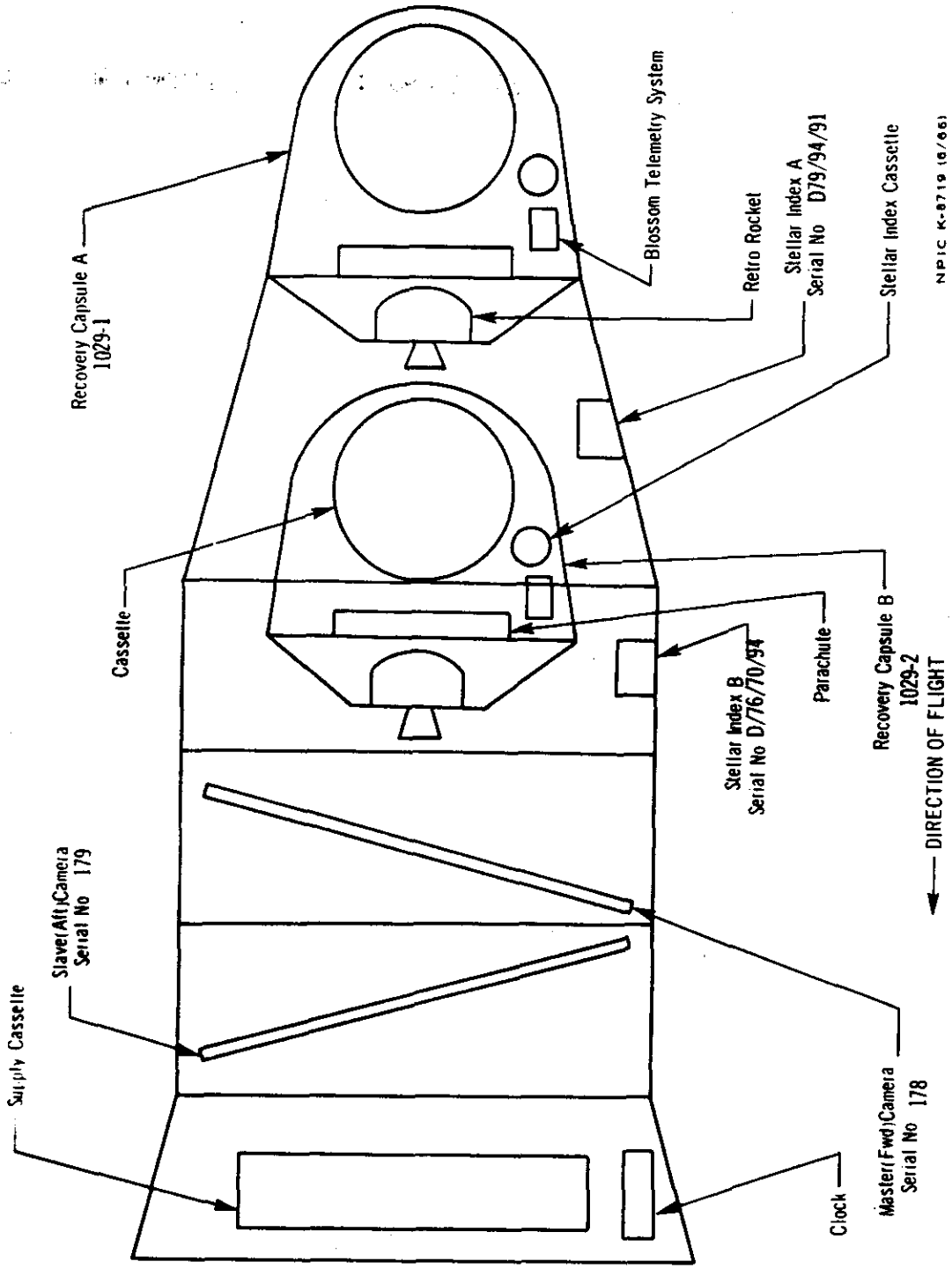
APPENDIX A. SYSTEM SPECIFICATIONS

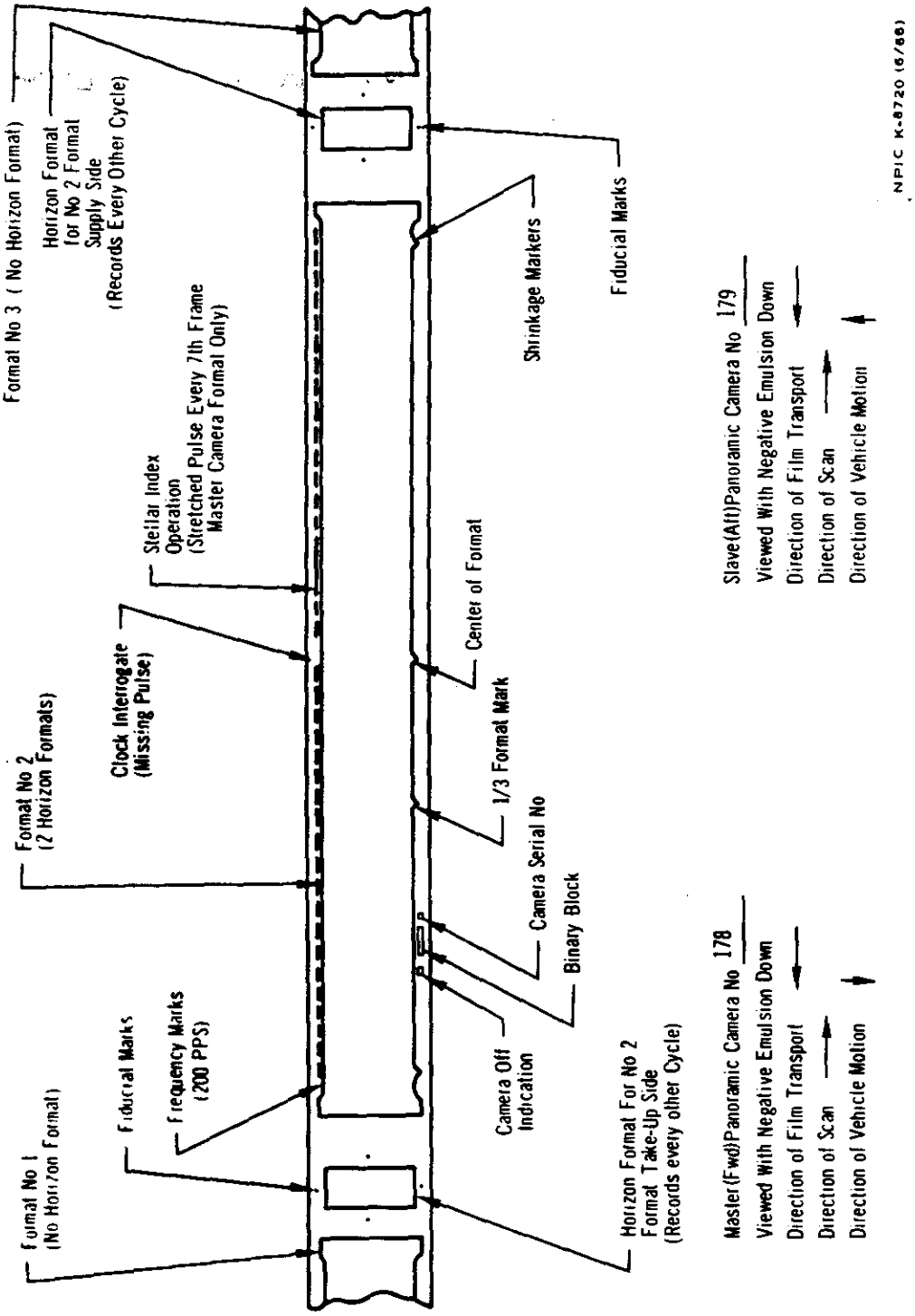
	Master Pan	Master Take-up Horizon	Master Supply Horizon	Slave Pan	Slave Take-up Horizon	Slave Supply Horizon	Mission 1029-1		Mission 1029-2	
							STELLAR	INDEX	STELLAR	INDEX
Camera No	178	N/A	N/A	179	N/A	N/A	D79/94/91	D79/94/91	D76/70/94	D76/70/94
Lens No	N/A	N/A	N/A	N/A	N/A	N/A	91	94	94	70
Lens Serial No	1802436	12848	12839	1812435	12899	12897	10576	819191	10602	817708
Slit Width (Inches)	0.275	N/A	N/A	0.175	N/A	N/A	N/A	N/A	N/A	N/A
Aperture	N/A	F/8.0	F/6.3	N/A	F/6.3	F/8.0	F/1.8	F/4.5	F/1.8	F/4.5
Exposure Time (Sec)	Varies	1/100	1/100	Varies	1/100	1/100	2.0	1/500	2.0	1/500
Filter (Wratten)	25	25	25	21	25	25	None	21	None	21
Focal Length (mm)	610.410	55.00	55.00	610.420	54.95	54.95	84.0	38.49	84.0	38.49
Film Length (ft)	16,000	N/A	N/A	16,000	N/A	N/A	46	92	46	92
Splices	5	N/A	N/A	4	N/A	N/A	0	0	0	0
Emulsion	235-12/ 1-12-5	235-12/ 1-12-5	235-12/ 1-12-5	235-12/ 1-12-5	235-12/ 1-12-5	235-12/ 1-12-5	124-35-10-5	106-14-8-5	124-35-10-5	106-14-8-5
Film Type	3404	3404	3404	3404	3404	3404	3401	3400	3401	3400
Resolution Data (L/mm):										
Static										
High Contrast	238	166	187	257	187	209	*	71 (AWAR)	*	72 (AWAR)
Low Contrast	151	*	*	148	*	*	*	*	*	*
Dynamic										
I High Contrast	190	*	*	203	*	*	*	*	*	*
I Low Contrast	129	*	*	129	*	*	*	*	*	*
P High Contrast	176	*	*	174	*	*	*	*	*	*
P Low Contrast	108	*	*	113	*	*	*	*	*	*

N/A Not Applicable
* Not Available

2. VEHICLE LAYOUT



3. FILM SPECIFICATIONS
FORMAT LAYOUT



NPIC K-8720 (6/88)

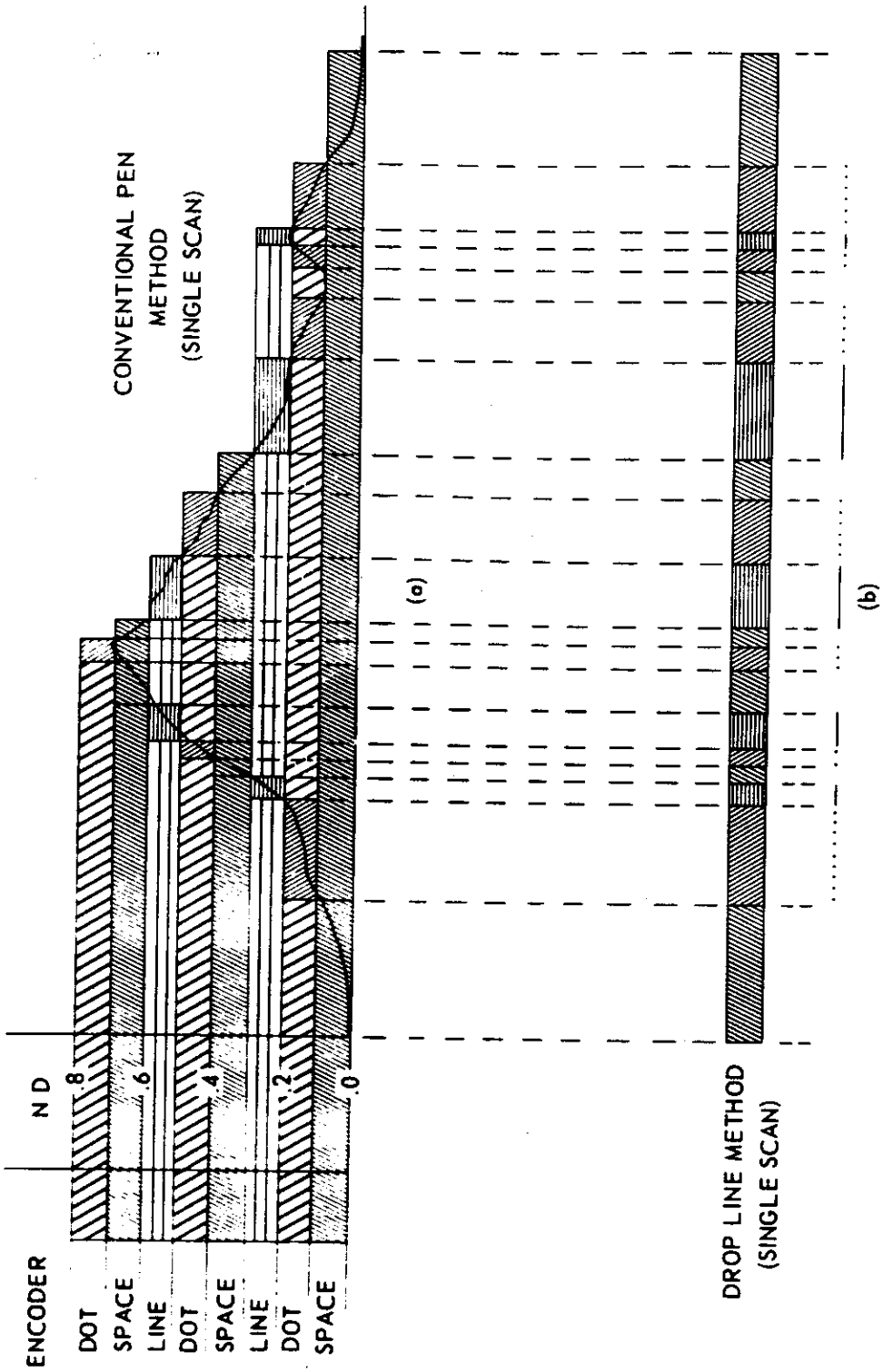
APPENDIX B. ISODENSITOMETRY

1. Introduction

An isodensity trace is, in essence, a contour map of the subject. Whereas conventional microdensitometers yield a graph of the optical density (pen deflection) versus distance across a single line of the subject, the isodensitracer (IDT), by means of the "dropped line" technique, yields a chart of successive microdensitometric scans across the subject. The code in the recorded lines indicates the amount of density change in known, preset increments and also shows whether the density is increasing or decreasing. When density is increasing, the 3-symbol code is printed in the following sequence: blank-dot-line-blank-dot-line. When the density is decreasing, the symbol sequence changes to: line-dot-blank-line-dot-blank. Each symbol in the sequence represents a density increment and is continuously plotted until the density in the specimen changes by that increment. Then the next symbol in the sequence is plotted.

When the IDT has completed a scan, the pen lifts from the recording paper and both the specimen table and the recording table return to the starting X position. At the same time, the specimen table and the recording pen step in the Y direction, then the next scan begins. This sequence is repeated automatically until the instrument has mapped the density of the specimen area. Contours are thus formed by adjacent like symbols.

The following illustration shows how a conventional microdensitometric trace is portrayed as a 3-symbol code line by the IDT. Each successive scan is a code line and is printed parallel to (b).



NPIC K-4839 (9/65)

DESCRIPTION OF ISODENSITOMETRIC CODE.

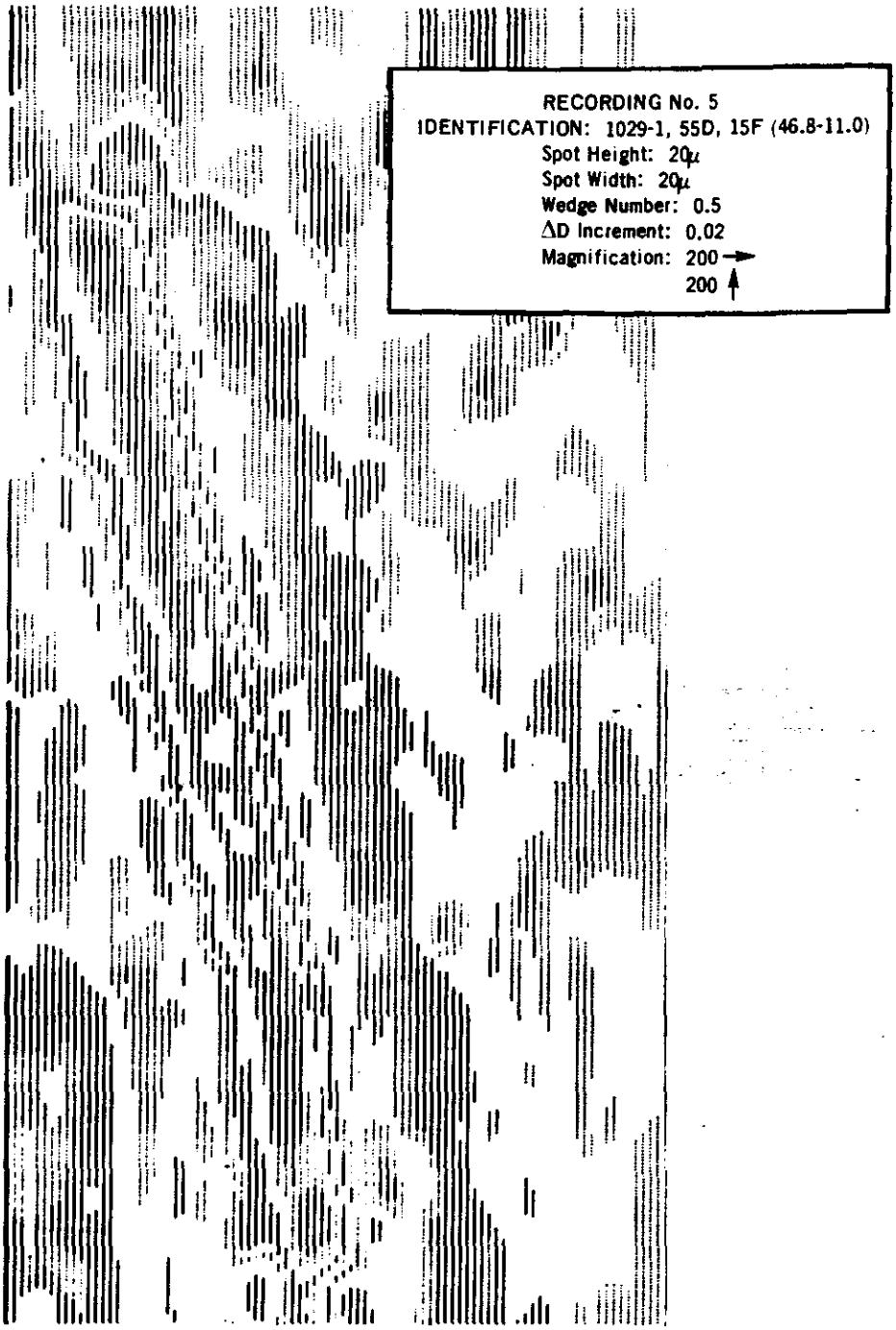
The information contained in the coded isodensity trace is directly related to the density of the image that is scanned. The trace effectively portrays the density contours of the image at a greatly expanded scale. By this high magnification of the image, small density changes and patterns are made evident but the small image degradations caused by limitations in the photographic system also become evident. Therefore, caution is recommended in establishing whether any minute density gradient in the trace relates directly to a change in the subject reflectivity.

Isodensity traces should be analyzed in conjunction with the original image and not as if they were separate representations of the subject.

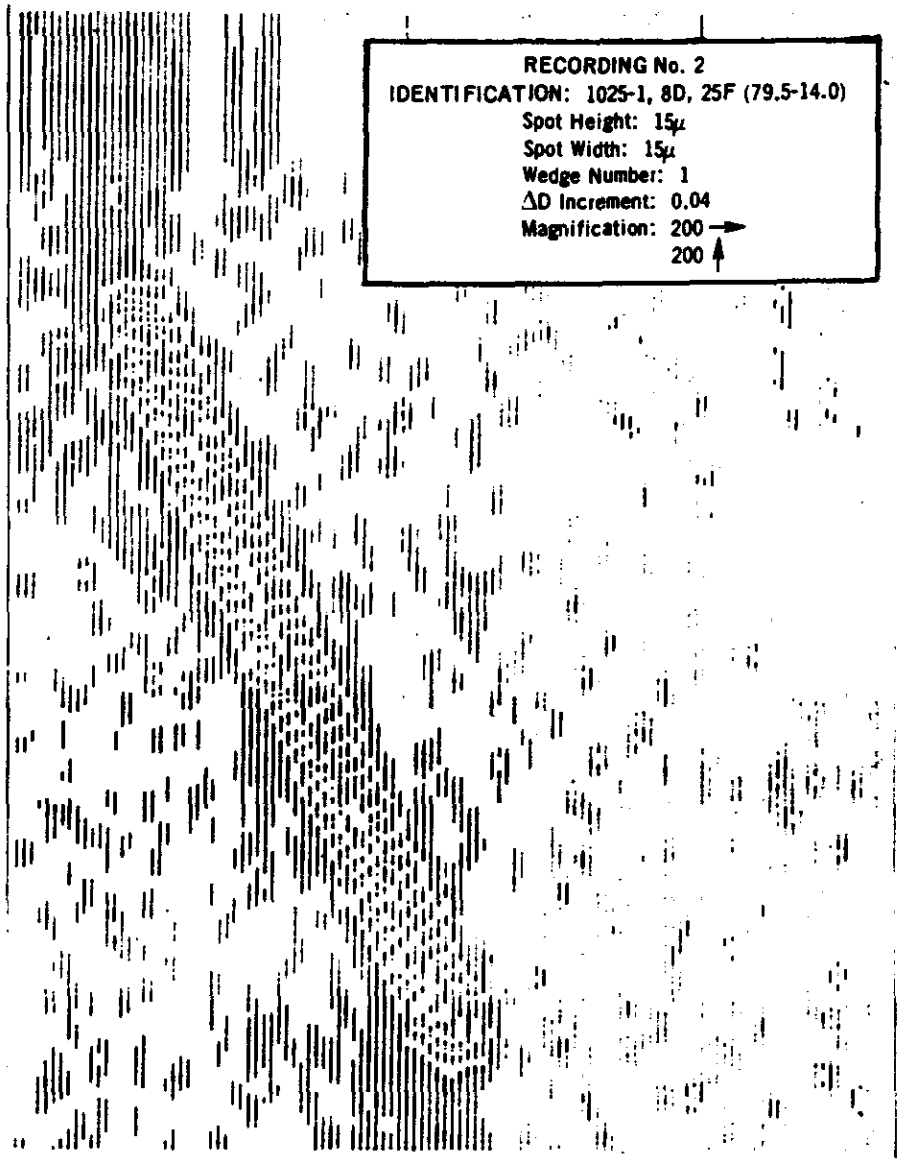
2. Isodensitometry, Missions 1022-1, 1025-1, and 1029-1

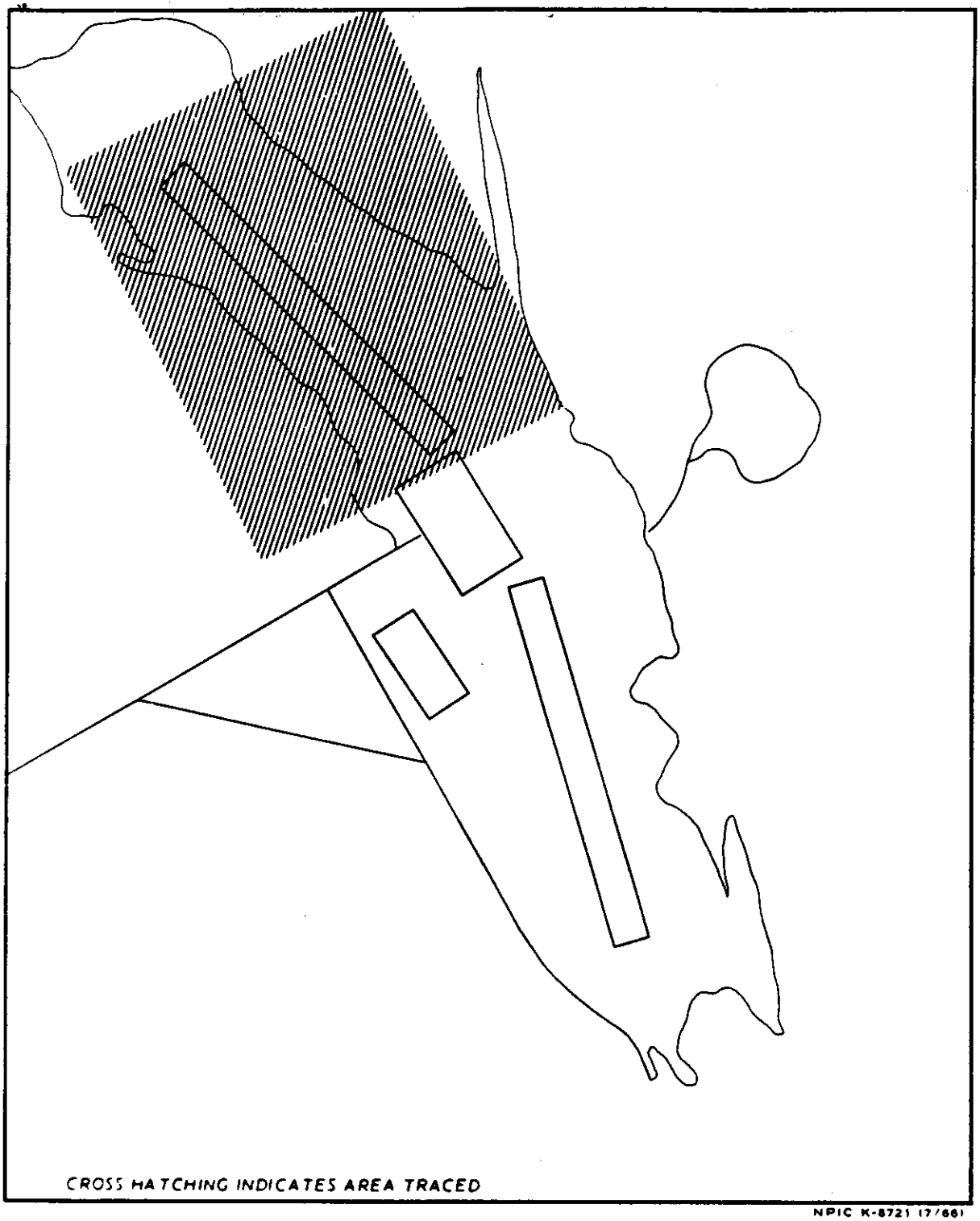
For this study, traces were made over the same area of the same subject using material from 3 missions (1022-1, 1025-1, and 1029-1). Because of differences in density level and contrast among the 3 images, it is impossible to make meaningful traces using the same parameters, i.e., spot height and width, density wedge, and density increment. Therefore, it should be noted that while the magnification is the same on all traces, the above-mentioned parameters were altered in order to obtain the optimum trace from each image. All traces were made from original negatives.

Providing objective verification to subjective visual analysis, the traces increase in detail and, therefore, in information content with Mission 1025-1 (Trace no 3) having the least detail and Mission 1022-1 (Trace no 2) the most. Density differences not apparent to the eye, but recorded by the IDT, are demonstrated most graphically by comparing the IDT trace of Mission 1025-1 with its corresponding photograph. Detail barely seen in the photograph of Mission 1029-1 takes form in the IDT trace of the same mission.


RECORDING No. 5
IDENTIFICATION: 1029-1, 55D, 15F (46.8-11.0)
Spot Height: 20μ
Spot Width: 20μ
Wedge Number: 0.5
ΔD Increment: 0.02
Magnification: 200 →
200 ↑


RECORDING No. 7
IDENTIFICATION 1022-1, 36D, 18F (62.9-B.8)
Spot Height: 10μ
Spot Width: 10μ
Wedge Number: 3
ΔD Increment: 0.12
Magnification: 200 →
200 ↑


RECORDING No. 2
IDENTIFICATION: 1025-1, 8D, 25F (79.5-14.0)
Spot Height: 15μ
Spot Width: 15μ
Wedge Number: 1
ΔD Increment: 0.04
Magnification: 200 →
200 ↑



NPIC K-8721 (7/66)

4. Isodensitrace No 1

Trace No 1 was made across an edge that appears to be degraded by low solar elevation and haze. The characteristics of the frame are:

Mission 1029-1	
Camera No	178
Pass	55D
Frame	15 Fwd
Universal Grid Coordinates	46.8 - 11.0
Sun Time	1053
Solar Elevation	4°57'
Solar Azimuth	Not Available
Exposure	1/191 sec
Vehicle Azimuth	136°27'
Camera	
Pitch	14°53'
Roll	-0°15'
Yaw	0°11'
Geographic Coordinates	68-07N 033-47E
Processing Level	Full

5. Isodensitrace No 2

Trace No 2 was made from photography of the same image as that of Trace No 1. However, this photography is from a previous mission and was made during more favorable photographic conditions. The characteristics of Trace No 2 are:

Mission 1022-1	
Camera No	168
Pass	56D
Frame	18 Fwd
Universal Grid Coordinates	62.9 - 13.8
Sun Time	1303
Solar Elevation	41°13'
Solar Azimuth	Not Available
Vehicle Azimuth	167°46'
Camera	
Pitch	15°16'
Roll	-0°16'
Yaw	Not Determined
Geographic Coordinates	67-55N 032-28E
Processing Level	Full

6. Isodensitrace No 3

Trace No 3 represents an edge photographed while the solar elevation was 05°52'. It is presented here as a comparison to traces No 1 and No 2, the same images photographed on other missions with varying photographic exposure parameters. It is significant that the subject matter of this trace is far removed from the center of format.

Mission 1025-1	
Camera No	142
Pass	8D
Frame	25 Fwd
Universal Grid Coordinates	79.5 - 14.0
Sun Time	0745
Solar Elevation	05°52'
Solar Azimuth	Not Available
Exposure	1/306 sec
Vehicle Azimuth	138°50'
Camera	
Pitch	15°00'
Roll	-0°12'
Yaw	1°09'
Geographic Coordinates	67-06N 031-45E
Processing Level	Full

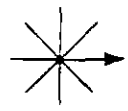
FIGURE 14. TARGET EXPOSED UNDER ADVERSE CONDITIONS

The solar elevation was low and there was considerable haze when the negative of this print was made. Compare the quality and parameters of acquisition of this photograph with that of the same target exposed on earlier missions, Figures 15 and 16. The isodensitraces in Appendix B of this report objectively compare the negatives that Figures 14, 15, and 16 were made from. Trace No 1 represents this image.

NPIC K-6722 (6/66)

Camera	178
Pass	55D
Frame	15 Fwd
Date of Photography	6 Feb 66
Universal Grid Coordinates	46.8 - 11.0
Enlargement Factor	40X
Geographic Coordinates	68-07N 033-47E
Altitude (feet)	742,265
Camera Attitude:	
Pitch	14°53'
Roll	-0°15'
Yaw	0°11'
Local Sun Time	1053
Solar Elevation	4°57'
Solar Azimuth	Not Available
Exposure	1/191 sec
Vehicle Azimuth	136°27'
Processing Level	Full

Approximate flight direction on photograph



Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.

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FIGURE 15. EARLIER COVERAGE OF MISSION 1029-1 TARGET

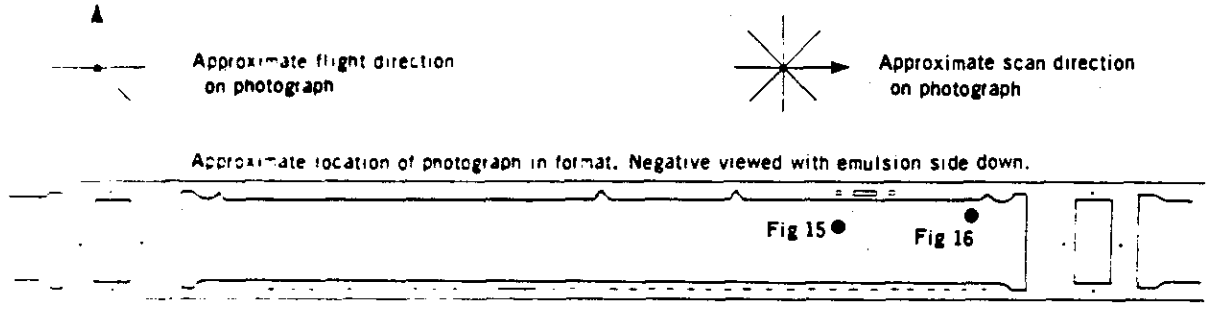
The imagery displayed in this print was acquired on Mission 1022-1. The prevailing solar elevation and atmospheric attenuation rendered favorable photographic conditions. However, the target image was positioned slightly further off center on this mission than on Mission 1029-1. Isodensitrace No 2 in Appendix B represents this image.

FIGURE 16. EARLIER COVERAGE OF MISSION 1029-1 TARGET

This imagery was exposed on Mission 1025-1. While the effect of atmospheric attenuation was minimal, the solar elevation was low and the target is positioned far off center, in the format. Isodensitrace No 3 was made from this image.

NPIC K-8723 (6/66) NPIC K-8724 (6/66)

	FIGURE 15	FIGURE 16
Mission	1022-1	1025-1
Camera	168	142
Pass	56D	8D
Frame	18 Fwd	25 Fwd
Date of Photography	23 Jul 65	6 Oct 65
Universal Grid Coordinates	62.9 - 13.8	79.5 - 14
Enlargement Factor	40X	40X
Geographic Coordinates	67-55N 032-28E	67-06N 031-45E
Altitude (feet)	711,691	738,261
Camera Attitude:		
Pitch	15°16'	15°00'
Roll	-0°16'	-0°12'
Yaw	Not Determined	1°09'
Local Sun Time	1303	0745
Solar Elevation	41°13'	5°52'
Solar Azimuth	Not Available	Not Available
Exposure	1/238	1/306
Vehicle Azimuth	167°46'	138°50'
Processing Level	Full	Full



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APPENDIX C. DENSITY READINGS

The following density readings were measured on the stellar and index film of Missions 1029-1 and 1029-2. The readings were derived from a Mac-Beth Quantalog Densitometer, Model EP 1000, with an ET20 attachment and 0.5 mm aperture. (The correlation of the stellar-index and master (fwd) panoramic camera photography follows the density readings.)

STELLAR CAMERA MISSION 1009-1

Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Pass	Frame	Dmax	Dmin	Delta	Gross Fog
1	1	0.52	0.20	0.32	0.17	A26E	148		NO EXPOSURE		
	2	2.29	0.19	2.10	0.16	26	149	1.48	0.48	1.00	0.16
3	3	0.42	0.17	0.15	0.16		155	1.56	0.27	1.29	0.15
	11	0.78	0.18	0.60	0.14	A27E	156		NO EXPOSURE		
	12	0.80	0.17	0.63	0.16	27	157	1.30	0.26	1.04	0.17
	19	1.04	0.23	0.81	0.14		163	1.49	0.27	1.22	0.16
	20	0.68	0.18	0.50	0.16	31	164	1.05	0.22	0.83	0.16
	23	0.74	0.18	0.56	0.15		166	1.04	0.22	0.82	0.16
	24	0.92	0.20	0.70	0.14	34	167	0.85	0.19	0.66	0.16
	40	1.08	0.22	0.86	0.15		169	0.92	0.19	0.73	0.15
	50	0.48	0.16	0.32	0.15	36	170	0.67	0.18	0.49	0.16
	59	0.94	0.19	0.75	0.15		184	1.18	0.20	0.98	0.15
9E	60		NO EXPOSURE			37	185	1.08	0.21	0.87	0.15
	61		NO EXPOSURE				204	1.09	0.36	0.73	0.15
9	62	0.73	0.19	0.54	0.16	38	205	1.41	0.25	1.16	0.16
	69	1.01	0.21	0.80	0.16		233	1.62	0.30	1.32	0.15
14	70	1.37	0.26	1.11	0.16	39	234	1.62	0.30	1.32	0.15
	80	0.98	0.19	0.79	0.18		244	1.35	0.24	1.11	0.16
16	81	1.32	0.27	1.05	0.16	40	245	0.94	0.22	0.72	0.17
	83	1.13	0.26	0.87	0.16		256	1.32	0.24	1.08	0.17
18	84	0.69	0.21	0.48	0.19	47	257	1.38	0.26	1.12	0.17
	88	0.91	0.22	0.69	0.17		258	1.55	0.29	1.26	0.15
19	89	0.63	0.17	0.46	0.17	52	259	0.91	0.19	0.72	0.15
	94	0.88	0.19	0.69	0.16		270	2.27	0.60	1.67	0.15
21	95	0.63	0.17	0.46	0.16	53	271	1.04	0.20	0.84	0.15
	110	1.21	0.22	0.99	0.15		297	1.42	0.27	1.15	0.15
22	111	0.98	0.19	0.79	0.15	54	298	0.72	0.20	0.50	0.16
	130	1.53	0.28	1.25	0.14		308	2.03	0.48	1.55	0.15
24	131	0.64	0.17	0.47	0.15	55	309	1.95	0.55	1.40	0.15
	147	1.39	0.23	1.16	0.15		330	2.31	0.59	1.72	0.15
						63	331	1.90	0.38	1.52	0.16
							332	1.60	0.32	1.28	0.16

MISSION 1029-1 (CONTINUED)

Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Pass	Frame	Dmax	Dmin	Delta	Gross Fog
	333	1.10	0.21	.89	0.15	74	403	1.21	0.28	0.93	0.18
	348	1.45	0.28	1.17	0.16		408	2.63	0.99	1.64	0.18
	364	1.14	0.25	0.89	0.17	78	409	1.47	0.31	1.16	0.19
	367	2.05	0.58	1.47	0.25		411	2.08	0.63	1.45	0.19
	368	NO READINGS MADE				79	412	1.42	0.33	1.09	0.20
	389	1.51	0.31	1.20	0.20		414	2.58	1.02	1.56	0.17
72	390	1.01	0.27	0.74	0.21	81	415	0.73	0.22	0.51	0.17
	402	2.75	1.10	1.65	0.19		419	2.91	1.39	1.52	0.15

Gross Fog Range	0.14 - 0.25
Dmax Range	0.42 - 2.91
Dmin Range	0.17 - 1.39
Delta D Range	0.15 - 2.10
Average Gross Fog	0.16
Average Dmax	1.28
Average Dmin	0.31

INDEX CAMERA MISSION 1029-1

		LIMITING				TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta
1	1	1.33	0.13	1.20	0.05	--	--	--
	2	1.30	0.20	1.10	0.05	--	--	--
3	3	0.90	0.21	0.69	0.05	0.90	0.21	0.69
	11	1.32	0.17	1.15	0.04	--	--	--
5	12	1.40	0.65	0.75	0.04	1.40	0.65	0.75
	19	1.63	0.71	0.92	0.04	--	--	--
6	20	1.18	0.31	0.87	0.04	1.09	0.31	0.78
	33	1.82	0.50	1.32	0.04	--	--	--
7	34	1.43	0.71	0.72	0.04	--	--	--
	49	1.76	0.43	1.33	0.04	1.31	0.70	0.61
8	50	0.82	0.29	0.53	0.04	0.91	0.29	0.62
	59	1.33	0.58	0.75	0.03	1.33	0.58	0.75
A9E	60				EDITED			
	61							
14	70	1.61	0.77	0.84	0.04	--	--	--
	80	1.27	0.54	0.73	0.04	0.92	0.54	0.38
16	81	1.64	0.21	0.43	0.03	--	--	--
	83	2.08	0.15	1.93	0.04	--	--	--
18	84	0.92	0.27	0.65	0.03	0.88	0.27	0.61
	88	1.21	0.20	1.01	0.04	1.21	0.59	0.62
19	89	1.04	0.17	0.87	0.05	1.04	0.17	0.87
	94	1.18	0.23	0.95	0.05	1.17	0.46	0.71
21	95	1.20	0.15	1.05	0.05	1.17	0.26	0.91
	110	1.54	0.41	1.13	0.05	1.54	0.41	1.13

		LIMITING				TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta
22	111	1.58	0.29	1.29	0.04	1.20	0.29	0.91
	130	1.22	0.15	1.07	0.05	1.22	0.15	1.07
24	131	0.72	0.32	0.40	0.05	--	--	--
	147	1.66	0.80	0.85	0.06	1.33	0.84	0.49
A26E	148				NO EXPOSURE			
26	149	1.90	0.76	1.14	0.07	1.65	0.76	0.89
	155	1.82	0.80	1.02	0.07	1.38	1.14	0.24
A27E	156				NO EXPOSURE			
27	157	1.51	0.23	1.28	0.07	1.51	0.50	1.01
	163	1.76	0.87	0.89	0.06	1.62	0.87	0.75
31	164	1.76	0.49	1.27	0.06	1.44	0.49	0.95
	166	1.24	0.36	0.88	0.05	1.24	0.36	0.88
34	167	1.10	0.30	0.80	0.05	--	--	--
	169	1.35	0.48	0.87	0.05	1.09	0.78	0.31
36	170	1.06	0.24	0.82	0.05	0.67	0.24	0.43
	184	2.11	1.35	1.76	0.05	--	--	--
37	185	1.34	0.38	0.96	0.05	1.27	0.38	0.89
	204	2.05	0.52	1.53	0.05	--	--	--
38	205	1.54	0.74	0.80	0.06	--	--	--
	233	1.63	0.33	1.30	0.06	--	--	--
39	234	0.92	0.78	0.14	0.06	0.92	0.78	0.14
	244	1.45	0.72	0.73	0.06	0.85	0.61	0.24
40	245	0.89	0.35	0.54	0.06	0.89	0.35	0.54
	256	1.74	0.48	1.26	0.06	1.74	0.48	1.26
47	257	1.98	0.62	1.36	0.06	0.91	0.57	0.34
	258	1.79	0.50	1.29	0.06	0.84	0.50	0.34

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TOP SECRET RUFF
NO FOREIGN DISSEM

MISSION 1029-1 (CONTINUED)

	LIMITING				Gross	TERRAIN				LIMITING				Gross	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Fog	Dmax	Dmin	Delta	Pass	Frame	Dmax	Dmin	Delta	Fog	Dmax	Dmin	Delta
[illegible]	269	1.40	0.43	0.97	0.07	1.15	0.45	0.70	63	331	2.03	0.51	1.52	0.10	0.83	0.58	0.25
	270	1.65	0.40	1.25	0.07	0.72	0.40	0.32		332	1.97	0.22	1.75	0.10	--	--	--
[illegible]	271	1.59	0.33	1.27	0.07	1.21	0.33	0.88	68	333	1.37	0.53	0.84	0.09	1.37	0.53	0.84
	297	1.85	0.52	1.33	0.07	--	--	--		348	1.70	0.37	1.33	0.09	0.89	0.59	0.30
[illegible]	298	0.91	0.44	0.47	0.07	0.91	0.44	0.47	69	349	1.49	0.54	0.95	0.09	1.14	0.79	0.35
	308	1.75	1.13	0.62	0.07	1.75	1.13	0.62		367	1.89	0.47	1.42	0.08	1.35	0.47	0.88
55	309	0.42	0.11	0.31	0.07	0.42	0.11	0.31	70	368	0.60	0.36	0.24	0.09	0.60	0.36	0.24
	330	1.74	0.58	1.16	0.07	1.04	0.73	0.31		378	1.98	1.15	0.83	0.75	1.98	1.15	0.83

Limiting Dmax Range 0.60-2.11
Limiting Dmin Range 0.11-1.35
Limiting Delta Range 0.11-2.11

Terrain Dmax Range 0.60-1.75
Terrain Dmin Range 0.11-1.15
Terrain Delta Range 0.11-1.26

Average Gross Fog 0.07
Average Limiting Dmax 1.46
Average Limiting Dmin 0.46
Average Delta of Limiting Densities 1.00
Average Terrain Dmax 1.15
Average Terrain Dmin 0.53
Average Delta of Terrain Densities 0.62

INDEX CAMERA, MISSION 1029-2

		LIMITING				TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta
134	1	0.64	0.08	0.56	0.07	0.64	0.09	0.57
	33	1.48	0.27	1.21	0.06	1.48	0.27	1.21
135	34	1.24	0.11	1.13	0.06	0.93	0.11	0.82
	40	1.41	0.45	0.96	0.06	NR	NR	NR
142	41	1.85	0.10	1.75	0.06	NR	NR	NR
	42	0.84	0.10	0.74	0.06	NR	NR	NR
143	43	0.48	0.07	0.41	0.06	NR	NR	NR
	46	1.07	0.11	0.96	0.06	0.74	0.40	0.34
144	47	0.50	0.10	0.40	0.08	0.50	0.10	0.40
	50	0.98	0.18	0.80	0.07	0.98	0.22	0.76
148	51	1.32	0.30	1.02	0.07	1.32	0.30	1.02
	74	1.90	0.26	1.74	0.06	1.90	0.26	1.74
149	75	1.61	0.10	1.51	0.06	NR	NR	NR
	88	1.64	0.81	0.83	0.05	1.64	0.81	0.83
150	89	0.49	0.08	0.41	0.06	0.49	0.13	0.36
	119	1.74	0.28	1.46	0.05	NR	NR	NR
A151E	120			NO EXPOSURE				
151	121	1.32	0.22	1.10	0.05	1.04	0.62	0.42
	138	1.74	0.15	1.59	0.06	NR	NR	NR
158	139	1.81	0.39	1.42	0.05	NR	NR	NR
	140	1.77	0.26	1.51	0.06	NR	NR	NR

Limiting Dmax Range	0.05-0.08	Terrain Dmax Range	0.49-1.90
Limiting Dmin Range	0.07-0.81	Terrain Dmin Range	0.09-0.81
Limiting Delta Range	0.56-1.75	Terrain Delta Range	0.34-1.74
Average Limiting Dmax	1.29	Average Terrain Dmax	1.06
Average Limiting Dmin	0.22	Average Terrain Dmin	0.30
Average Delta of Limiting Densities	1.08	Average Delta of Terrain Densities	0.77
Average Gross Fog	0.06		

STELLAR CAMERA, MISSION 1029-2

Pass	Frame	Dmax	Dmin	Delta D	Gross Fog
134D	1	1.35	0.24	1.11	0.22
	33	2.03	0.51	1.52	0.21
135D	34	1.66	0.40	1.26	0.22
	40	2.01	0.46	1.55	0.22
142D	41	1.21	0.38	0.83	0.24
	42	1.29	0.36	0.93	0.23
143D	43	0.97	0.26	0.71	0.21
	46	1.40	0.28	1.12	0.21
144D	47	1.37	0.28	1.09	0.22
	50	1.58	0.30	1.28	0.20
148D	51	1.50	0.38	1.12	0.21
	74	2.45	0.62	1.83	0.20
149D	75	1.36	0.26	1.10	0.21
	88	2.08	0.54	1.54	0.20
150D	89	1.33	0.28	1.05	0.21
	119	2.01	0.40	1.61	0.20
A151E	120		NO EXPOSURE		
151D	121	1.82	0.33	1.49	0.20
	138	1.94	0.42	1.52	0.22
158D	139	2.12	0.42	1.70	0.20
	140	2.18	0.41	1.77	0.20

DENSITY RANGES

Gross Fog Range	0.20-0.24
Dmax Range	0.97-2.45
Dmin Range	0.24-0.62
Delta D Range	0.71-1.83
Average Gross Fog	0.21
Average Dmax	1.68
Average Dmin	0.38

FRAMING CAMERA/MAIN CAMERA CORRELATION

MISSION 1029-1

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
0				41		50	
1	1D	3		42		57	
2		10	15	43		64	
3	3D	2		44		71	
4		9		45		78	
5		16		46		85	
6		23		47		92	
7		30		48		99	
8		37		49		106	107
9		44		50	8D	6	
10		51		51		13	
11		58	59	52		20	
12	5D	6		53		27	
13		13		54		34	
14		20		55		41	
15		27		56		48	
16		34		57		55	
17		41		58		62	
18		48		59		69	75
19		55	59	60	A09E	1	
20	6D	3		61		8	10
21		10		62	9D	5	
22		17		63		12	
23		24		64		19	
24		31		65		26	
25		38		66		33	
26		45		67		40	
27		52		68		47	
28		59		69		54	57
29		66		70	14D	4	
30		73		71		11	
31		80		72		18	
32		87		73		25	
33		94	100	74		32	
34	7D	1		75		39	
35		8		76		46	
36		15		77		53	
37		22		78		60	
38		29		79		67	
39		36		80		74	79
40		43		81	16D	2	

FRAMING CAMERA/MAIN CAMERA CORRELATION (CONTINUED)

MISSION 1029-1

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
82		9		122		80	
83		16	16	123		87	
84	18D	7		124		94	
85		14		125		101	
86		21		126		108	
87		28		127		115	
88		35	41	128		122	
89	19D	1		129		129	
90		8		130		136	137
91		15		131	24D	6	
92		22		132		13	
93		29		133		20	
94		36	38	134		27	
95	21D	5		135		34	
96		12		136		41	
97		19		137		48	
98		26		138		55	
99		33		139		62	
100		40		140		69	
101		47		141		76	
102		54		142		83	
103		61		143		90	
104		68		144		97	
105		75		145		104	
106		82		146		111	
107		89		147		118	119
108		96		148	A26E	6	6
109		103		149	26D	7	
110		110	114	150		14	
111	22D	3		151		21	
112		10		152		28	
113		17		153		35	
114		24		154		42	
115		31		155		49	54
116		38		156	A27E	2	5
117		45		157	27D	4	
118		52		158		11	
119		59		159		18	
120		66		160		25	
121		73		161		32	

FRAMING CAMERA/MAIN CAMERA CORRELATION (CONTINUED)

MISSION 1029-1

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
162		39		203		127	
163		46	47	204		134	137
164	31D	6		205	38D	4	
165		13		206		11	
166		20	21	207		18	
167	34D	6		208		25	
168		13		209		32	
169		20	26	210		39	
170	36D	1		211		46	
171		8		212		53	
172		15		213		60	
173		22		214		67	
174		29		215		74	
175		36		216		81	
176		43		217		88	
177		50		218		95	
178		57		219		102	
179		64		220		109	
180		71		221		116	
181		78		222		123	
182		85		223		130	
183		92		224		137	
184		99	105	225		144	
185	37D	1		226		151	
186		8		227		158	
187		15		228		165	
188		22		229		172	
189		29		230		179	
190		36		231		186	
191		43		232		193	
192		50		233		200	200
193		57		234	39D	7	
194		64		235		14	
195		71		236		21	
196		78		237		28	
197		85		238		35	
198		92		239		42	
199		99		240		49	
200		106		241		56	
201		113		242		63	
202		120		243		70	

FRAMING CAMERA/MAIN CAMERA CORRELATION (CONTINUED)

MISSION 1029-1

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
244		77	81	285		104	
245	40D	3		286		111	
246		10		287		118	
247		17		288		125	
248		24		289		132	
249		31		290		139	
250		38		291		146	
251		45		292		153	
252		52		293		160	
253		59		294		167	
254		66		295		174	
255		73		296		181	
256		80	80	297		188	193
257	47D	7		298	54D	2	
258		14	17	299		9	
259	52D	4		300		16	
260		11		301		23	
261		18		302		30	
262		25		303		37	
263		32		304		44	
264		39		305		51	
265		46		306		58	
266		53		307		65	
267		60		308		72	74
268		67		309	55D	5	
269		74		310		12	
270		81	82	311		19	
271	53D	6		312		26	
272		13		313		33	
273		20		314		40	
274		27		315		47	
275		34		316		54	
276		41		317		61	
277		48		318		68	
278		55		319		75	
279		62		320		82	
280		69		321		89	
281		76		322		96	
282		83		323		103	
283		90		324		110	
284		97		325		117	

FRAMING CAMERA/MAIN CAMERA CORRELATION (CONTINUED)

MISSION 1029-1

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
326		124		367		127	131
327		131		368	70D	3	
328		138		369		10	
329		145		370		17	
330		152	152	371		24	
331	63D	7		372		31	
332		14	17	373		38	
333	65D	4		374		45	
334		11		375		52	
335		18		376		59	
336		25		377		66	
337		32		378		73	--LAST INDEX
338		39		379		80	FRAME
339		46		380		87	
340		53		381		94	
341		60		382		101	
342		67		383		108	
343		[illegible]		384		115	
344		81		385		122	
345		88		386		129	
346		95		387		136	
347		102		388		143	
348		109	115	389		150	153
349	69D	1		390	72D	4	
350		8		391		11	
351		15		392		18	
352		[illegible]		393		25	
353		29		394		32	
354		36		395		39	
355		43		396		46	
356		50		397		53	
357		57		398		60	
358		64		399		67	
359		71		400		74	
360		78		401		81	
[illegible]		[illegible]		402		88	88
[illegible]		[illegible]		403	74D	7	
[illegible]		[illegible]		404		14	
[illegible]		107		405		21	
[illegible]		113		406		28	
[illegible]		120		407		35	

FRAMING CAMERA/MAIN CAMERA CORRELATION (CONTINUED)

MISSION 1029-1

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
408		42	48	414		15	21
409	78D	1		415	81D	1	
410		8		416		8	
411		15	21	417		15	
412	79D	1		418		22	
413		8		419		29	29

FRAMING CAMERA/MAIN CAMERA CORRELATION

MISSION 1029-2

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
1	D134	5&12		36		15	
2		19		37		22	
3		26		38		29	
4		33		39		36	
5		40		40		43	46
6		47		41	D142	4	
7		54		42		11	17
8		61		43	D143	1	
9		68		44		8	
10		75		45		15	
11		82		46		22	22
12		89		47	D144	7	
13		96		48		14	
14		103		49		21	
15		110		50		28	29
16		117		51	D148	6	
17		124		52		13	
18		131		53		20	
19		138		54		27	
20		145		55		34	
21		152		56		41	
22		159		57		48	
23		166		58		55	
24		173		59		62	
25		180		60		69	
26		187		61		76	
27		194		62		83	
28		201		63		90	
29		208		64		97	
30		215		65		104	
31		222		66		111	
32		229		67		118	
33		236	242	68		125	
34	D135	1		69		132	
35		8		70		139	

FRAMING CAMERA/MAIN CAMERA CORRELATION (CONTINUED)

MISSION 1029-2

Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames	Framing Camera Frame Number	Main Camera Pass	Main Camera Frame	Total Frames
71		146		106			
72		153		107			
73		160		108			
74		167	171	109			
75	D149	3		110			
76		10		111			
77		17		112			
78		24		113			
79		31		114			
80		38		115			
81		45		116			
82		52		117			
83		59		118			
84		66		119			
85		73		120	A151E		
86		80		121	D151		
87		87		122			
88		94	100	123			
89	D150	1		124			
90		8		125			
91		15		126			
92		22		127			
93		29		128			
94		36		129			
95		43		130			
96		50		131			
97		57		132			
98		64	FORWARD FILM	134			
99			SUPPLY EXPIRED	135			
100				136			
101				137			
102				138			
103				139	D158		
104				140			
105							

APPENDIX D. HISTORY OF VEILED HORIZON IMAGERY

1. Introduction

A condition of image veiling has been prevalent on the starboard-looking horizon camera imagery of several J system missions. The term veiling is used here to describe an image condition that appears to be generally masked or veiled. The affected images appear to be out-of-focus. However, magnification reveals sharp images partially masked by a vague overall density.

The presence of veiled horizon imagery seriously impairs the intended use of the horizon camera product. The horizon cameras are used to check the attitude data produced from the stellar camera and as the sole source of attitude data in the event of stellar camera failure. The cause of the image veiling is unknown.

However, it is generally agreed that the source of degradation is outside of the vehicle. For instance, the vehicle is yawed 180° after injection into orbit. During the yaw operation, the starboard horizon camera window is rotated through the fuel which was jettisoned on a previous operation. There is a good possibility that the jettisoned fuel is the source of degradation. Horizon image veiling was originally thought to be caused by the relationship of solar position and the camera principal ray. It has always occurred on the sun side of the vehicle and the earth flare theory may still have merit. This report therefore presents a history of the condition to facilitate further analysis of the problem.

The following list describes the focal lengths, aperture, exposure, and filter used on each M and J system mission since Mission 9031.

2. Past Missions Horizon Camera Data

Mission	Focal Length		Aperture		Exposure		Filter	
	Port	Star	Port	Star	Port	Star	Port	Star
9031 Fwd	89.1	89.0	F6.8	F6.8	50	100	25	25
Aft	88.8	89.0	F6.8	F6.8	100	50	25	25
9032 Fwd	89.0	88.8	F6.8	F6.8	50	50	25	25
Aft	89.0	89.2	F6.8	F6.8	50	50	25	25
9035 Fwd	89.2	89.1	F6.8	F8.0	50	50	25	25
Aft	89.0	89.0	F6.8	F8.0	50	50	25	25
9036 Fwd	89.0	89.0	F6.8	F6.8	25	25	--	--
Aft	89.1	89.25	F8.0	F6.8	50	50	25	25
9037 Fwd	89.05	89.3	F8.0	F8.0	50	50	25	25
Aft	89.25	89.1	F6.8	F6.8	25	25	--	--
9038 Fwd	89.0	89.0	F6.8	F6.8	25	25	--	--
Aft	89.3	89.0	F8.0	F8.0	50	50	25	25
9039 Fwd	89.0	89.2	F8.0	F8.0	50	50	25	25
Aft	88.95	89.0	F8.0	F6.8	100	10	--	25
9040 Fwd	89.0	89.0	F6.8	F6.8	200	200	25	25
Aft	89.1	89.15	F8.0	F8.0	200	200	--	--
9041 Fwd	89.2	89.4	F6.8	F6.8	200	200	25	25
Aft	89.1	89.4	F8.0	F8.0	200	200	12	12
9043 Fwd	89.3	89.2	F6.8	F6.8	200	200	25	25
Aft	89.0	89.3	F6.8	F6.8	200	200	25	25
9044 Fwd	89.05	89.15	F6.8	F6.8	200	200	25	25
Aft	88.95	89.0	F6.8	F6.8	200	200	25	25
9045 Fwd	89.0	89.1	F6.8	F6.8	200	200	25	25
Aft	88.95	89.2	F6.8	F6.8	200	200	25	25
9047 Fwd	89.2	89.0	F6.8	F6.8	100	100	25	25
Aft	89.3	89.1	F6.8	F6.8	100	100	25	25
9048 Fwd	88.95	89.2	F6.8	F6.8	100	100	25	25
Aft	89.0	89.05	F6.8	F6.8	100	100	25	25
9050 Fwd	89.0	89.2	F8.0	F8.0	100	100	25	25
Aft	89.15	88.95	F6.8	F6.8	100	100	25	25
9051 Fwd	89.3	89.2	F6.8	F6.8	100	100	25	25
Aft	89.2	89.7	F6.8	F6.8	100	100	25	25
9053 Fwd	89.0	88.9	F6.8	F6.8	100	100	25	25
Aft	89.2	89.9	F6.8	F6.8	100	100	25	25
9054 Fwd	89.2	89.25	F6.8	F6.8	100	100	25	25
Aft	89.2	89.2	F6.8	F6.8	100	100	25	25
9055 Fwd	89.0	89.0	F6.8	F6.8	100	100	25	25
Aft	88.9	89.1	F6.8	F6.8	100	100	25	25

Mission	Focal Length		Aperture		Exposure		Filter	
	Port	Star	Port	Star	Port	Star	Port	Star
9057 Fwd	89.5	81.7	F6.8	F6.8	100	100	25	25
Aft	89.2	89.5	F6.8	F6.8	100	100	25	25
9062 Fwd	54.68	54.98	F6.8	F8.0	100	100	25	25
Aft	55.08	54.93	F6.8	F8.0	100	100	25	25
1001 Fwd	88.96	89.9	F6.8	F6.8	100	100	25	25
Aft	89.12	89.1	F6.8	F6.8	100	100	25	25
1002 Fwd	89.1	89.75	F6.8	F6.8	100	100	25	25
Aft	89.8	89.7	F6.8	F6.8	100	100	25	25
1004 Fwd	54.33	54.45	F6.8	F8.0	100	100	25	25
Aft	54.48	54.48	F6.8	F8.0	100	100	25	25
1006 Fwd	54.83	54.75	F6.8	F8.0	100	100	25	25
Aft	54.24	55.12	F6.8	F8.0	100	100	25	25
1007 Fwd	54.40	54.53	F6.8	F8.0	100	100	25	25
Aft	54.33	54.51	F6.8	F8.0	100	100	25	25
1008 Fwd	55.13	54.71	F6.8	F8.0	100	100	25	25
Aft	54.84	55.29	F6.8	F8.0	100	100	25	25
1009 Fwd	55.03	55.01	F6.8	F8.0	100	100	25	25
Aft	54.77	54.97	F6.8	F8.0	100	100	25	25
1010 Fwd	54.43	54.54	F6.8	F8.0	100	100	25	25
Aft	55.06	55.21	F6.8	F8.0	100	100	25	25
1011 Fwd	55.14	54.65	F6.8	F8.0	100	100	25	25
Aft	55.07	55.60	F6.8	F8.0	100	100	25	25
1012 Fwd	54.98	54.45	F6.8	F8.0	100	100	25	25
Aft	54.97	55.21	F6.8	F8.0	100	100	25	25
1013 Fwd	55.12	55.07	F6.8	F8.0	100	100	25	25
Aft	54.48	54.90	F6.8	F8.0	100	100	25	25
1014 Fwd	54.42	54.50	F6.8	F8.0	100	100	25	25
Aft	55.02	55.10	F6.8	F8.0	100	100	25	25
1015 Fwd	54.89	54.93	F6.8	F8.0	100	100	25	25
Aft	54.93	54.80	F6.8	F8.0	100	100	25	25
1016 Fwd	55.05	54.90	F6.8	F8.0	100	100	25	25
Aft	55.26	54.69	F6.8	F8.0	100	100	25	25
1017 Fwd	55.22	55.13	F6.8	F8.0	100	100	25	25
Aft	54.60	54.11	F6.8	F8.0	100	100	25	25
1018 Fwd	54.69	55.02	F6.8	F8.0	100	100	25	25
Aft	55.02	54.45	F6.8	F8.0	100	100	25	25
1019 Fwd	54.55	54.92	F6.8	F8.0	100	100	25	25
Aft	54.94	54.70	F6.8	F8.0	100	100	25	25

Mission	Focal Length		Aperture		Exposure		Filter	
	Port	Star	Port	Star	Port	Star	Port	Star
1020 Fwd	54.37	54.84	F6.8	F8.0	100	100	25	25
Aft	54.90	54.90	F6.8	F8.0	100	100	25	25
1021 Fwd	55.53	54.77	F6.8	F8.0	100	100	25	25
Aft	54.30	54.56	F6.8	F8.0	100	100	25	25
1022 Fwd	55.07	54.59	F6.8	F8.0	100	100	25	25
Aft	55.16	55.19	F6.8	F8.0	100	100	25	25
1023 Fwd	55.32	55.37	F6.8	F8.0	100	100	25	25
Aft	55.22	55.22	F6.8	F8.0	100	100	25	25
1024 Fwd	55.40	54.19	F6.8	F8.0	100	100	25	25
Aft	54.93	54.70	F6.8	F8.0	100	100	25	25
1025 Fwd	54.83	54.67	F6.8	F8.0	100	100	25	25
Aft	54.49	54.01	F6.8	F8.0	100	100	25	25
1026 Fwd	54.50	54.40	F6.8	F8.0	100	100	25	25
Aft	54.90	54.70	F6.8	F8.0	100	100	25	25
1027 Fwd	55.20	54.33	F6.8	F8.0	100	100	25	25
Aft	55.05	54.56	F6.8	F8.0	100	100	25	25
1028 Fwd	55.00	54.30	F6.8	F8.0	100	100	25	25
Aft	54.60	54.83	F6.8	F8.0	100	100	25	25

3. M System Horizon Camera History

A study of M (9000 Series) system photography shows the horizon images of both the port and starboard cameras to be out-of-focus or veiled on most missions. The condition was usually accompanied by extreme overexposure and was often explained as simple overexposure. The incident of the anomaly in the M system missions was nearly continuous. Therefore, no pattern was suggested and only a cursory investigation of the photography was made. However, it is interesting to note the similarity of the condition in the early missions and in Mission 1029. The following is a list of examples of veiled, out-of-focus, or smeared horizon images on various early missions.

Mission	Pass	Frame	Veiled Images
9009	14D	31	Take-up
9009	14D	31	Supply
9013	34D	34	Take-up
9017	9D	91	Supply
9019	9D	10	Supply
9022	9D	34	Take-up
9022	9D	34	Supply
9023	9D	3	Take-up
9038	55D	41 Aft	Supply
9057	9D	7 Fwd	Take-up

The quality of the horizon camera photography gradually improved throughout the history of the system. The term veiling was first used to describe the horizon imagery degradation on Mission 1006. On the J system missions, the veiling has always been on the starboard-looking horizon camera imagery, except on Mission 1002. A history of the anomaly shows that it usually begins on the second orbital camera operation of a mission and is continuous through approximately pass 14D. However, there is no absolute pattern of incidents.

4. J System Veiled Horizon History

The following table presents data pertinent to the degraded J system horizon camera images. While there is no apparent correlation in the data presented here, this list is provided for further analysis.

Mission	LAUNCH		ORBITAL PARAMETERS					Remarks
	Date	Time	Perigee (nm)	Apogee (nm)	Period (min)	Inclination (degrees)	Eccentricity	
[illegible]	[illegible] Dec 64	[illegible]	100.05	239.[illegible]	90.75	74.95	[illegible]0179	The aft port horizon imagery is blurred and generally overexposed throughout.
[illegible]	[illegible] Jan 65	[illegible]	96.32	253.[illegible]	90.50	79.95	0.0232	The master starboard horizon imagery is veiled through pass 65D. The slave starboard horizon imagery is veiled through pass 96D.
[illegible]	[illegible] Mar 65	[illegible]	100.71	2[illegible]	90.98	84.99	[illegible].0198	The slave starboard horizon imagery is veiled throughout the -1 portion of the mission.
[illegible]	[illegible] Apr 65	[illegible]	100.88	243.42	90.69	79.99	0.01975	The slave starboard horizon imagery is veiled at extreme northern latitudes.
1021	19 May 65	[illegible]	100.33	180.[illegible]	89.81	75.03	0.00989	The slave starboard horizon imagery is veiled throughout.
1024	22 Sep 65	2130Z	96.28	203.37	90.00	80.06	0.01491	The slave starboard horizon imagery is veiled from pass 5D through 18D.
1026	28 Oct 65	2116Z	93.13	232.93	90.51	74.97	0.01939	The master starboard horizon imagery is veiled from pass 3D through pass 14D. The slave starboard horizon imagery is veiled from pass 1D through pass 116D.
1028	24 Dec 65	2106Z	98.43	242.98	90.73	80.01	0.02002	The master starboard horizon imagery is veiled throughout the -1 portion of the mission. The slave starboard horizon imagery is veiled from pass 3D throughout the mission.
1029	2 Feb 66	2132Z	100.60	231.34	90.49	75.04	0.01814	The master starboard horizon imagery is veiled from pass 1D through pass 18D. The slave starboard horizon imagery is veiled from pass 3D throughout the mission.

FIGURE 17. NORMAL STARBOARD HORIZON IMAGERY-MASTER CAMERA

The horizon image illustrated here was the last starboard horizon exposure on pass 3D. All starboard horizon images exposed through the first 3 orbits are of similar good quality. The first starboard horizon frame on the next camera operation (pass 5D) is veiled (Figure 18).

FIGURE 18. VEILED STARBOARD HORIZON IMAGERY-MASTER CAMERA

This photograph displays the veiling described in Part I, Paragraph 3 of this report. This veiled condition persisted through pass 14D. All subsequent images are of similar quality to that image illustrated in Figure 17.

	FIGURE 17	FIGURE 18
	Starboard Horizon	
Camera	178	178
Pass	3D	5D
Frame	58 Fwd	3 Fwd
Date of Photography	3 Feb 66	3 Feb 66
Universal Grid Coordinates	NA	NA
Enlargement Factor	3.5X	3.5X
Geographic Coordinates	NA	NA
Altitude (feet)	689,112	692,149
Vehicle Attitude:		
Pitch	-0°25'	-0°32'
Roll	-0°16'	-0°24'
Yaw	0°05'	-0°57'
Local Sun Time	NA	NA
Solar Elevation	NA	NA
Solar Azimuth	NA	NA
Exposure	1/100 sec	1/100 sec
Vehicle Azimuth	157°27'	156°48'
Processing Level	Full	Intermediate

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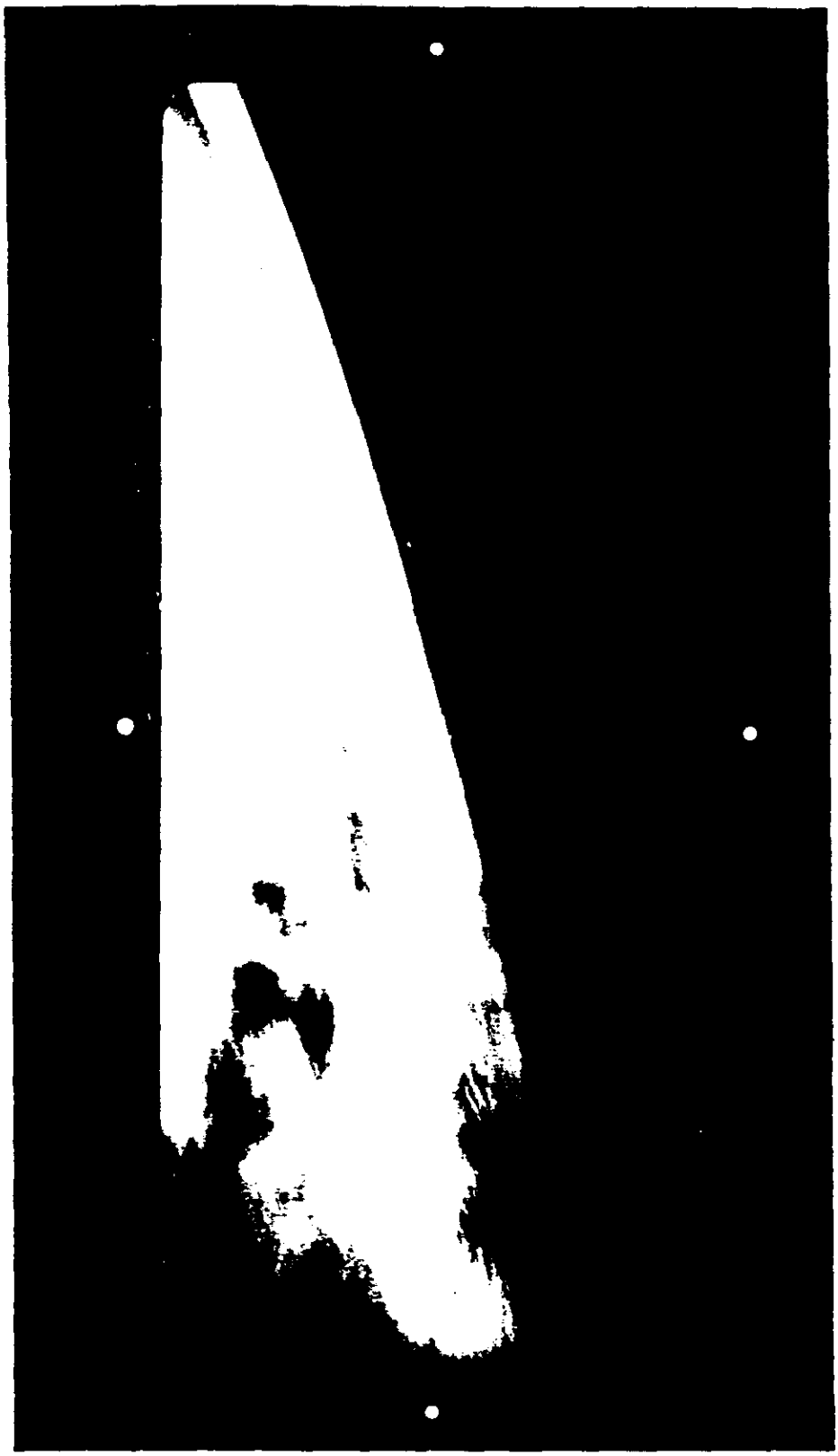

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FIGURE 19. NORMAL STARBOARD HORIZON IMAGERY-SLAVE CAMERA

The image displayed in the following photograph was the first starboard-(looking) horizon camera exposure of the slave (aft) camera on Mission 1029. The good image quality of this frame is consistent throughout Pass 1D. The imagery generated by this camera on all subsequent passes is veiled. Horizon image veiling is discussed in Part I, Paragraphs 3 and 4 and in Appendix D of this report.

FIGURE 20. VEILED STARBOARD HORIZON IMAGERY-SLAVE CAMERA

The veiled appearance displayed in this frame is typical of all slave starboard-(looking) horizon camera imagery generated after Pass 1D on Mission 1029.

NPIC K-8727 (6/66) NPIC K-8728 (6/66)

	FIGURE 19	FIGURE 20
	Starboard Horizon	
Camera	179	179
Pass	1D	150D
Frame	2 Fwd	149 Fwd
Date of Photography	2 Feb 66	12 Feb 66
Universal Grid Coordinates	NA	NA
Enlargement Factor	3.5X	3.5X
Geographic Coordinates	NA	NA
Altitude (feet)	702,600	Not Available
Vehicle Attitude:		
Pitch	-0°29'	-0°32'
Roll	-0°15'	-0°45'
Yaw	-0°07'	ND
Local Sun Time	NA	NA
Solar Elevation	NA	NA
Solar Azimuth	NA	NA
Exposure	1/100 sec	1/100 sec
Vehicle Azimuth	155°07'	159°55'
Processing Level	Full	Full

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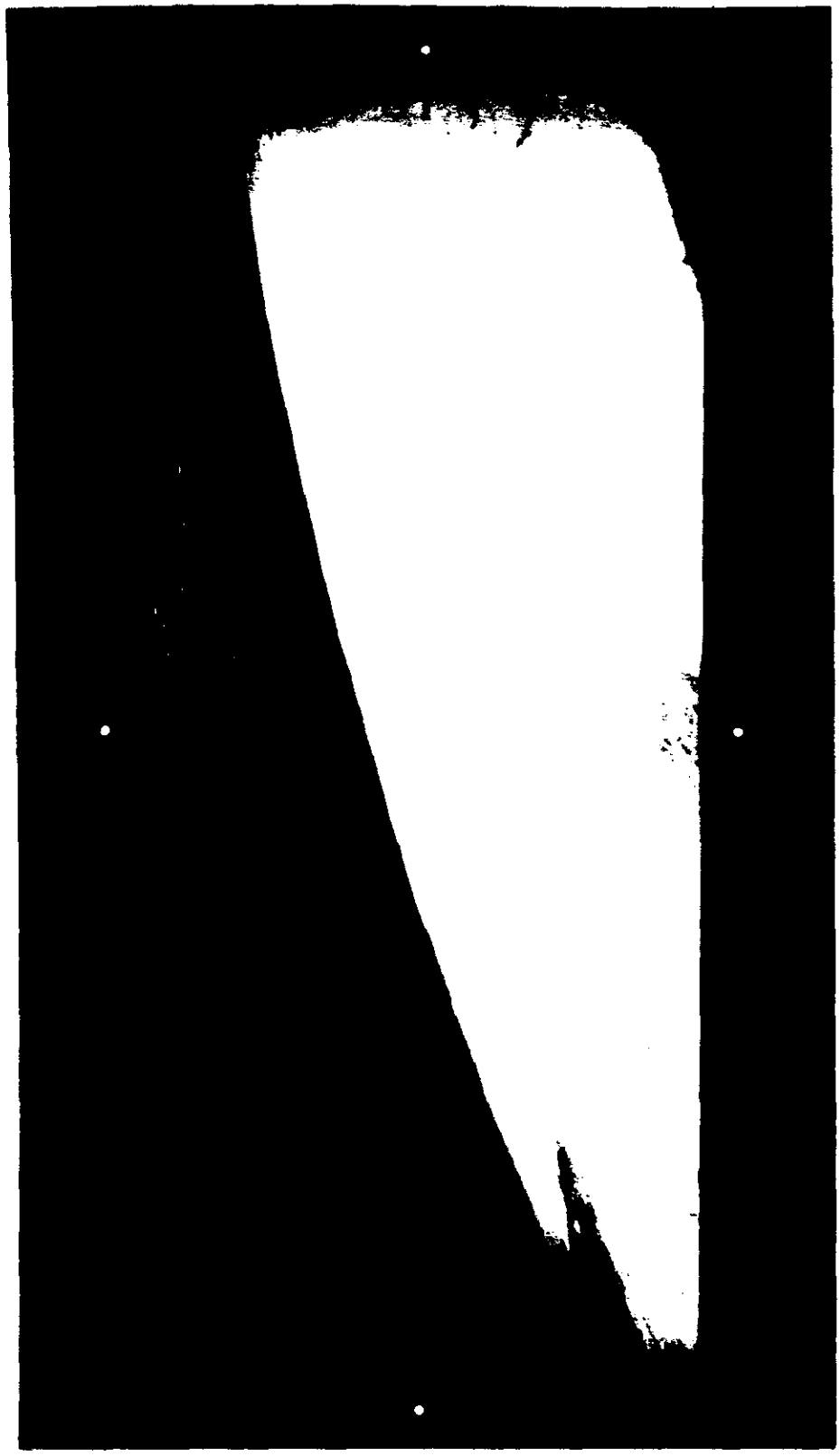

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APPENDIX E. CLOUD COVER ANALYSIS

1. Introduction

This study represents a statistical analysis of the cloud cover on the photography of Missions 1029-1 and 1029-2. The basis of this study is the cloud cover data for each quarter segment of every individual frame of photography. The data is obtained by analysts specifically trained in estimating cloud cover by designated categories.

Five cloud categories have been formulated for use in this photography (Reference, Table 1). These categories allow for the wide latitude of cloud cover conditions commonly found on a frame of this photography. Note in Table 1 that a mean cloud percentage value has been calculated for each category for use in determining a combined cloud cover percentage for all operational passes of the mission.

The occurrence of each cloud category within an operational pass is expressed as a percentage of 100 and appears in Table 2. Each percentage is a ratio of the number of occurrences of a given cloud cover category to the total number of cloud observations in a photo pass. For example: If the number of category 1 occurrences in a given pass is 200 out of a total of 1,000 (250 frames x 4 quarters), all categories combined, then 20 percent of the pass would be classed as category 1.

Also a cloud cover percentage per pass is included in the last column of Table 2 under "Cloud Cover % Per Pass." This value is determined by the summation of the products of category percentage in each pass and the mean cloud percentage for that category as established in Table 1. For example: If it is determined that the following percentages exist in a given pass:

20% Category 1
15% Category 2
30% Category 3
25% Category 4
10% Category 5

Then, by using the mean cloud percentage established in Table 1 the following computations are made:

0.20	x 5.0	=	1.00%
0.15	x 17.5	=	2.63%
0.30	x 38.0	=	11.40%
0.25	x 75.0	=	18.75%
0.10	x 100.0	=	10.00%
			43.78%

Hence, 43.8 percent of this pass is cloud covered.

TABLE 1

CLOUD COVER CATEGORIES

Category Number	Percent of Cloud Cover	Description	Mean Cloud Percentage
1	Less than 10%	Clear	5%
2	10% - 25%	Small Scattered Clouds	17.5%
3	26% - 50%	Large Scattered Clouds	38%
4	51% - 99%	Broken or Connected Clouds	75%
5	100%	Complete Overcast	100%

2. Cloud Cover Data, Mission 1029

Pass Number	1	2	3	4	5	Cloud Cover % Per Pass
3D	55.7	12.3	13.5	18.5	0.0	23.9
5D	42.3	18.3	23.6	15.8	0.0	26.1
6D	21.0	8.1	15.3	41.6	14.0	53.5
7D	37.6	13.0	8.2	35.7	5.5	39.5
8D	87.4	12.3	0.3	0.0	0.0	6.6
9D	42.0	21.8	15.1	17.5	3.6	28.4
14D	82.4	12.7	4.9	0.0	0.0	8.2
18D	58.5	3.7	11.7	26.1	0.0	27.6
19D	63.6	19.9	6.3	10.2	0.0	16.7
21D	73.7	14.8	9.8	1.7	0.0	11.3
22D	48.9	12.9	9.5	28.1	0.6	30.0
24D	72.6	17.2	9.2	1.0	0.0	10.9
26D	33.8	12.5	11.3	38.6	3.8	40.9
27D	75.0	8.5	15.1	1.4	0.0	12.0
34D	26.6	14.8	12.5	46.1	0.0	43.2
36D	47.2	9.7	3.6	37.5	2.0	35.6
37D	75.7	4.9	3.9	10.6	4.9	19.0
38D	53.1	9.6	8.7	19.3	9.3	31.4
39D	12.1	38.2	31.9	17.8	0.0	32.8
40D	75.0	16.9	8.1	0.0	0.0	9.8
52D	56.4	9.3	10.4	23.1	0.8	26.5
53D	66.5	6.5	8.5	18.5	0.0	21.6
54D	43.4	21.6	23.8	10.6	0.6	23.5
55D	59.9	10.7	7.2	22.2	0.0	24.3
68D	51.7	19.4	19.8	9.1	0.0	20.3
69D	58.9	4.2	7.2	21.7	8.0	30.7
70D	66.3	15.5	10.3	7.9	0.0	15.9
71D	49.6	33.2	17.2	0.0	0.0	14.8
72D	10.4	16.5	22.9	50.2	0.0	49.8
74D	79.6	13.0	3.2	4.2	0.0	10.6
81D	63.0	8.0	10.0	19.0	0.0	22.6
	54.9*	13.3*	11.1*	18.4*	2.3*	25.4**

*Average percentage by category for mission
** Overall mission cloud cover percentage

Pass Number	1	2	3	4	5	Cloud Cover % Per Pass
83D	73.5	18.4	6.1	2.0	0.0	10.7
84D	79.7	4.3	6.3	9.5	0.2	14.5
85D	56.4	12.2	14.1	17.3	0.0	23.3
86D	6.9	21.1	47.6	22.6	1.8	40.9
87D	44.4	7.2	1.9	9.8	36.7	48.3
88D	45.1	17.7	25.6	11.6	0.0	23.8
89D	7.4	13.9	31.6	47.1	0.0	50.1
96D	60.6	20.6	14.0	4.8	0.0	15.6
98D	59.2	1.1	0.7	37.9	1.1	32.9
99D	61.5	7.1	9.9	21.1	0.4	24.3
100D	51.3	12.2	11.8	18.0	6.7	29.4
101D	38.7	8.0	10.4	40.8	2.1	40.0
102D	37.2	9.0	12.0	37.0	4.8	48.5
103D	40.3	24.7	14.9	16.9	3.2	27.9
112D	76.1	9.2	7.1	7.6	0.0	13.8
116D	15.0	11.6	24.8	48.6	0.0	48.7
117D	57.3	12.6	9.0	20.6	0.0	24.0
118D	58.2	21.9	12.9	7.0	0.0	16.9
119D	57.3	13.9	4.7	10.8	13.3	28.5
120D	0.0	0.0	14.6	85.4	0.0	69.6
128D	58.8	8.8	19.9	12.5	0.0	21.4
129D	41.2	17.3	21.3	20.2	0.0	28.3
131D	81.8	10.0	8.2	0.0	0.0	9.0
132D	37.6	11.4	9.6	25.0	16.4	42.7
133D	62.3	8.7	10.7	18.3	0.0	22.4
134D	62.2	7.3	4.9	11.3	14.3	29.0
135D	53.9	12.0	10.1	20.2	3.8	27.6
143D	57.2	11.6	8.0	23.2	0.0	25.3
144D	90.7	4.3	0.7	4.3	0.0	8.8
148D	52.2	4.2	6.9	35.9	0.8	33.7
149D	73.7	9.8	7.3	9.2	0.0	15.1
150D	47.3	12.5	2.7	23.1	14.4	37.3
	52.0*	10.8*	11.2*	21.0*	5.0*	29.5**

*Average percentage by category for mission
**Overall mission cloud cover percentage

APPENDIX F. MISSION COVERAGE STATISTICS

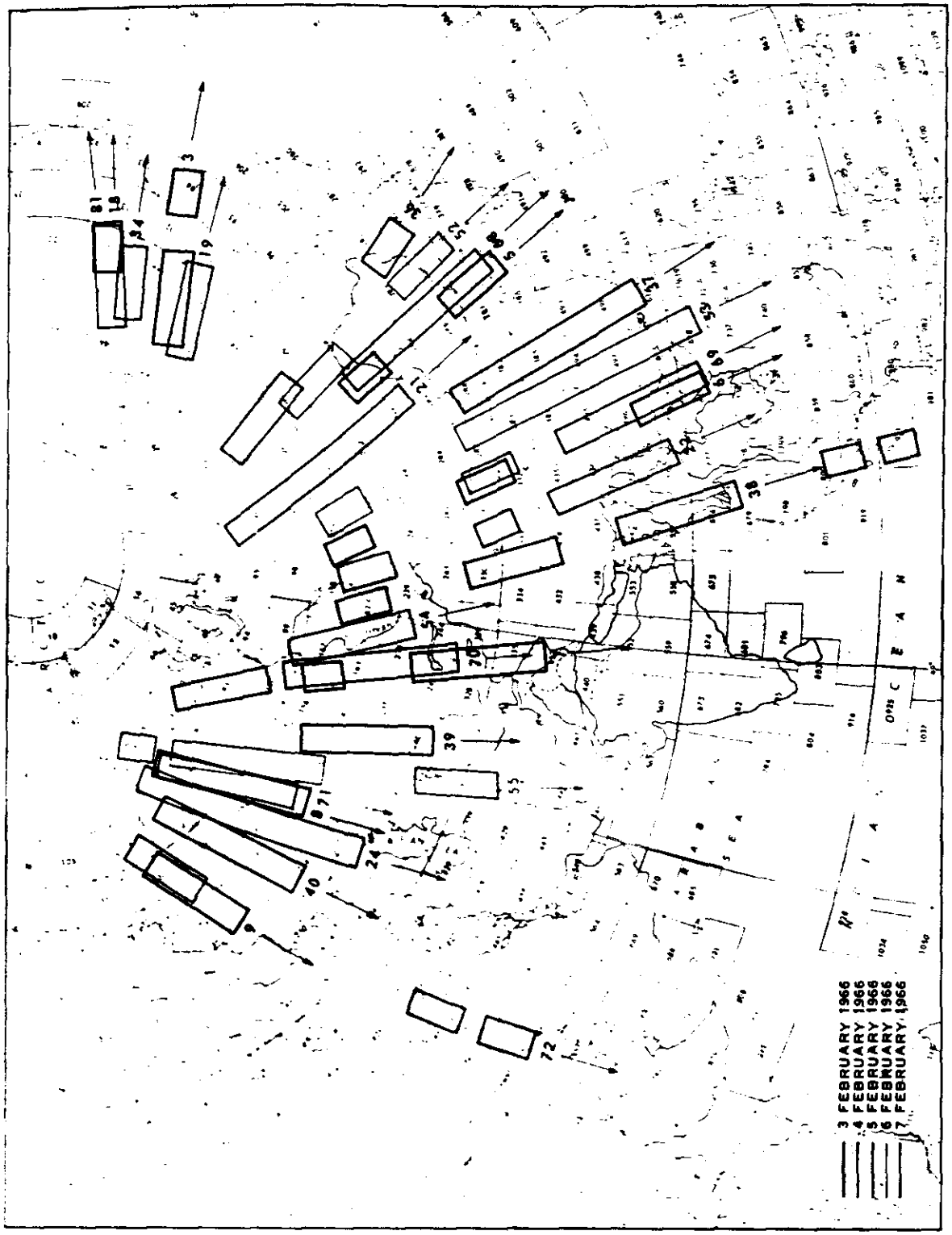
1. Summary of Plottable Photographic Coverage, Mission 1029-1

	FORWARD CAMERA		AFT CAMERA		TOTALS	
Country	Linear nm	Square nm	Linear nm	Square nm	Linear nm	Square nm
USSR	12,565	1,967,522	13,435	2,105,646	26,000	4,073,168
China	6,165	870,024	6,149	863,778	12,314	1,733,802
Burma	574	75,648	560	73,632	1,134	149,280
Argentina	519	98,330	486	91,628	1,005	189,958
N Vietnam	438	34,272	446	36,394	884	70,666
Mauritania	463	66,672	397	57,168	860	123,840
Niger	427	61,488	390	56,160	817	117,648
Spanish Sahara	280	25,344	310	29,664	590	55,008
N Korea	292	17,762	258	17,752	550	35,514
Sweden	216	8,792	334	14,712	550	23,504
Indonesia	247	21,016	267	18,796	514	39,812
Finland	183	29,226	293	44,920	476	74,146
Mongolia	196	32,408	225	35,688	421	68,096
Saudi Arabia	204	18,144	210	11,376	414	29,520
India	119	17,850	160	24,000	279	41,850
Laos	175	14,400	34	1,728	209	16,128
Jordan	98	12,672	74	8,496	172	21,168
Kashmir	78	12,324	66	10,428	144	22,752
Egypt	92	6,912	49	7,056	141	13,968
Poland	70	11,340	62	10,044	132	21,384
Israel	37	4,320	74	7,488	111	11,808
S Vietnam	82	6,048	- - - -	- - - - -	82	6,048
Norway	21	1,870	49	5,780	70	7,650
Iran	40	6,000	12	1,800	52	7,800
Mexico	52	7,562	- - - -	- - - - -	52	7,562
Algeria	7	1,008	44	6,336	51	7,344
Pakistan	16	2,400	20	2,820	36	5,280
Syria	- - - -	- - - - -	25	1,152	25	1,152
Bahama Is	25	432	- - - -	- - - - -	25	432
Bhutan	- - - -	- - - - -	20	3,000	20	3,000
Chile	2	364	10	1,820	12	2,184
S Korea	9	608	- - - -	- - - - -	9	608
Afghanistan	6	900	- - - -	- - - - -	6	900
TOTAL	23,698	3,433,658	24,459	3,549,322	48,157	6,982,980
Continental US	679	91,476	769	101,768	1,448	193,244
GRAND TOTAL	24,377	3,525,134	25,228	3,651,090	49,605	7,176,224

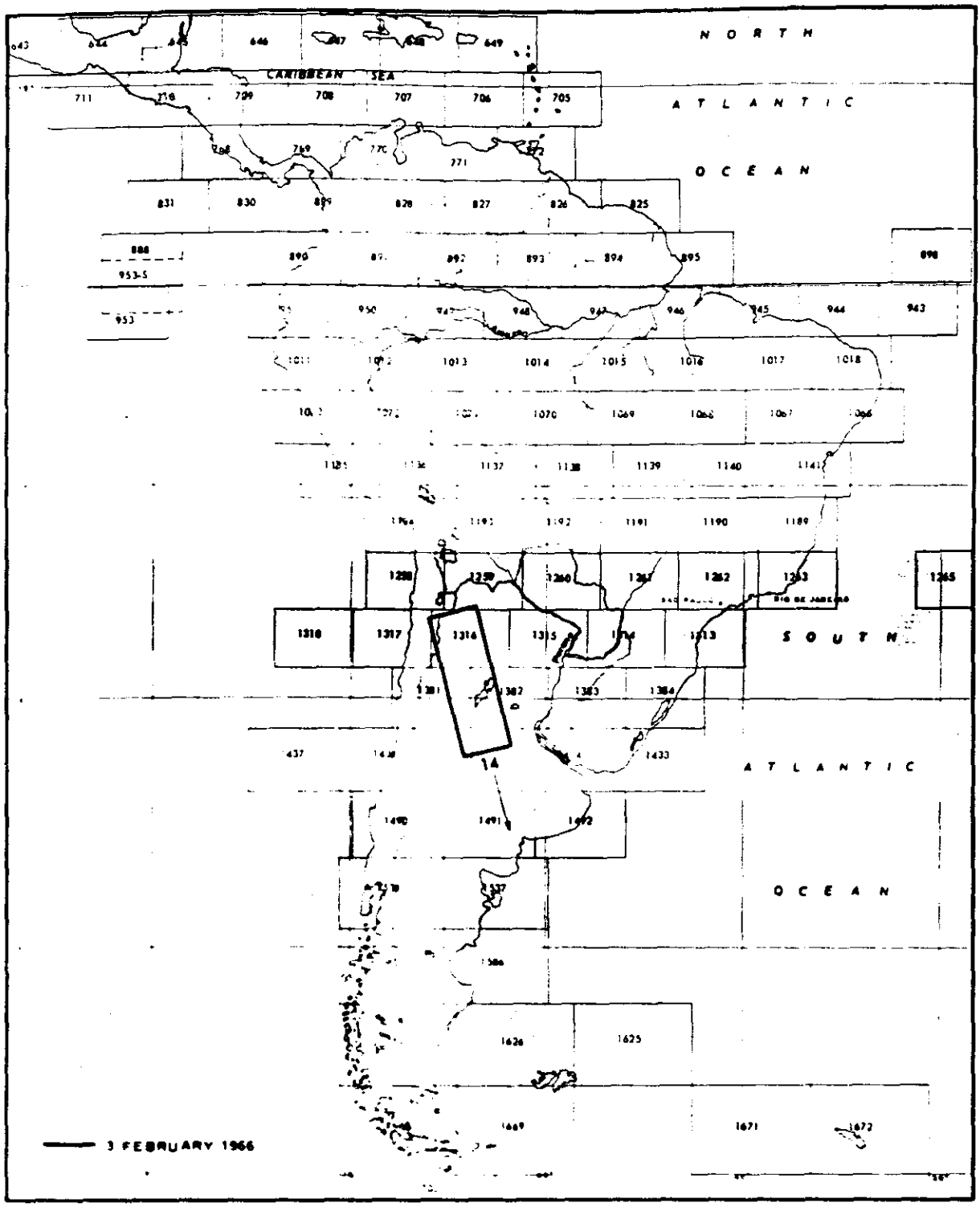
Summary of Plottable Photographic Coverage, Mission 1029-2

	FORWARD CAMERA		AFT CAMERA		TOTALS	
Country	Linear nm	Square nm	Linear nm	Square nm	Linear nm	Square nm
USSR	14,618	2,326,796	15,359	2,462,860	29,977	4,789,656
China	5,287	710,202	5,314	726,850	10,601	1,437,052
Rhodesia	474	79,632	446	74,928	920	154,560
Union of South Africa	452	85,880	424	80,560	876	166,440
Finland	142	23,856	382	62,136	524	85,992
Egypt	279	40,176	234	33,696	513	73,872
Norway	252	38,976	238	40,230	490	79,206
Mongolia	215	33,998	239	36,862	454	70,860
S W Africa	129	24,510	212	40,280	341	64,790
N Korea	164	17,250	143	15,000	307	32,250
Sweden	209	35,112	63	8,736	272	43,848
Laos	115	16,560	74	10,656	189	27,216
Sudan	111	15,984	74	10,656	185	26,640
Congo	56	9,408	84	14,112	140	23,520
Bechuanaland	64	12,160	71	13,490	135	25,650
Mexico	84	12,264	42	6,132	126	18,396
N Vietnam	67	9,648	49	7,056	116	16,704
Iran	51	7,650	24	3,600	75	11,250
S Korea	41	2,400	21	1,200	62	3,600
Mozambique	28	4,704	28	4,704	56	9,408
Kashmir	35	5,250	- - - -	- - - - -	35	5,250
Afghanistan	31	4,650	- - - -	- - - - -	31	4,650
Hong Kong	10	345	10	345	20	690
Taiwan	20	288	- - - -	- - - - -	20	288
Macao	6	6	6	6	12	12
TOTAL	22,940	3,517,705	23,537	3,654,095	46,477	7,171,800
Continental US	313	40,296	355	49,056	668	89,352
GRAND TOTAL	23,253	3,558,001	23,892	3,703,151	47,145	7,261,152

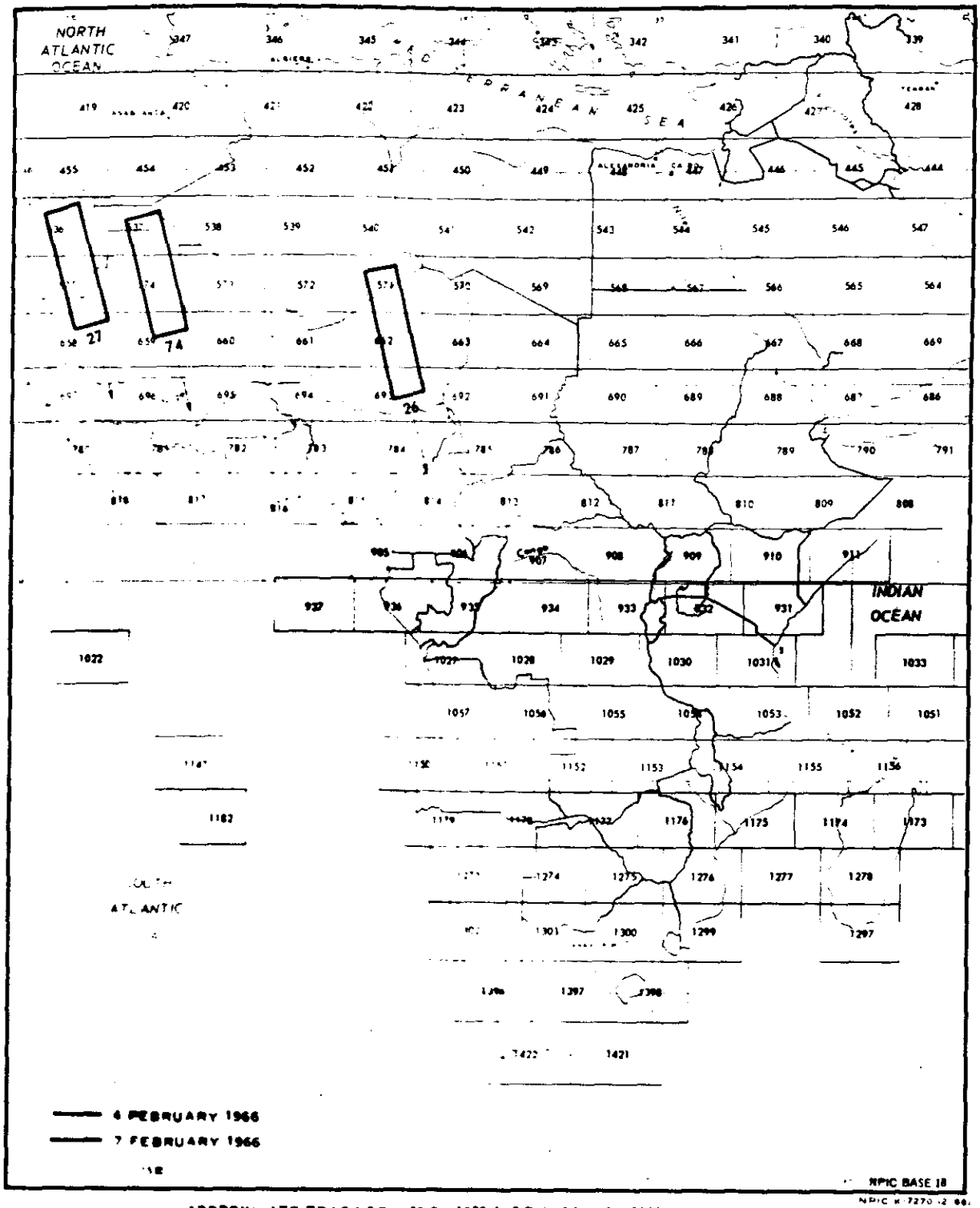
2. Mission Coverage Tracks



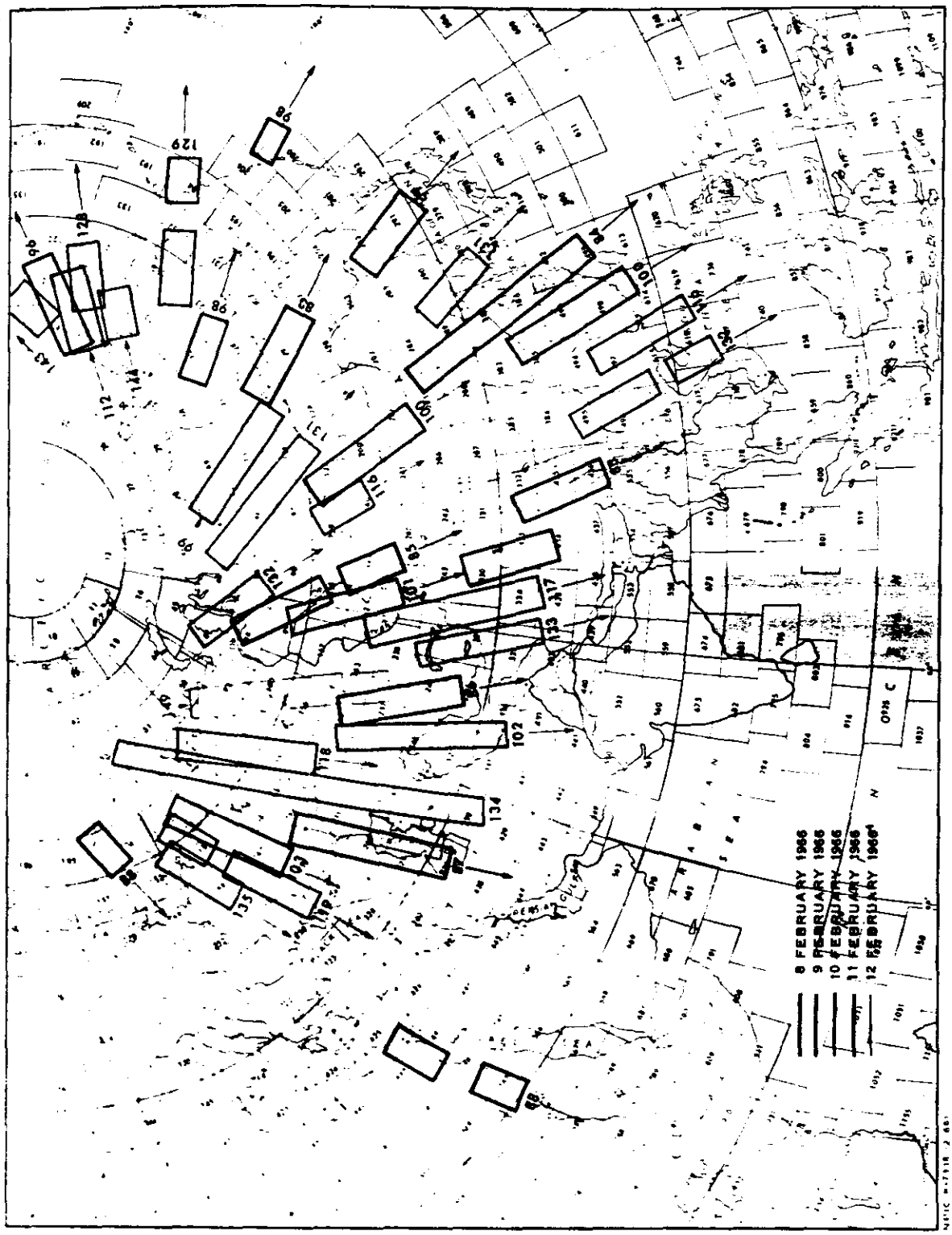
APPROXIMATE TRACK OF MISSION 1029-1, 3-7 FEBRUARY 1966 OVER USSR, FAR AND MIDDLE EAST.



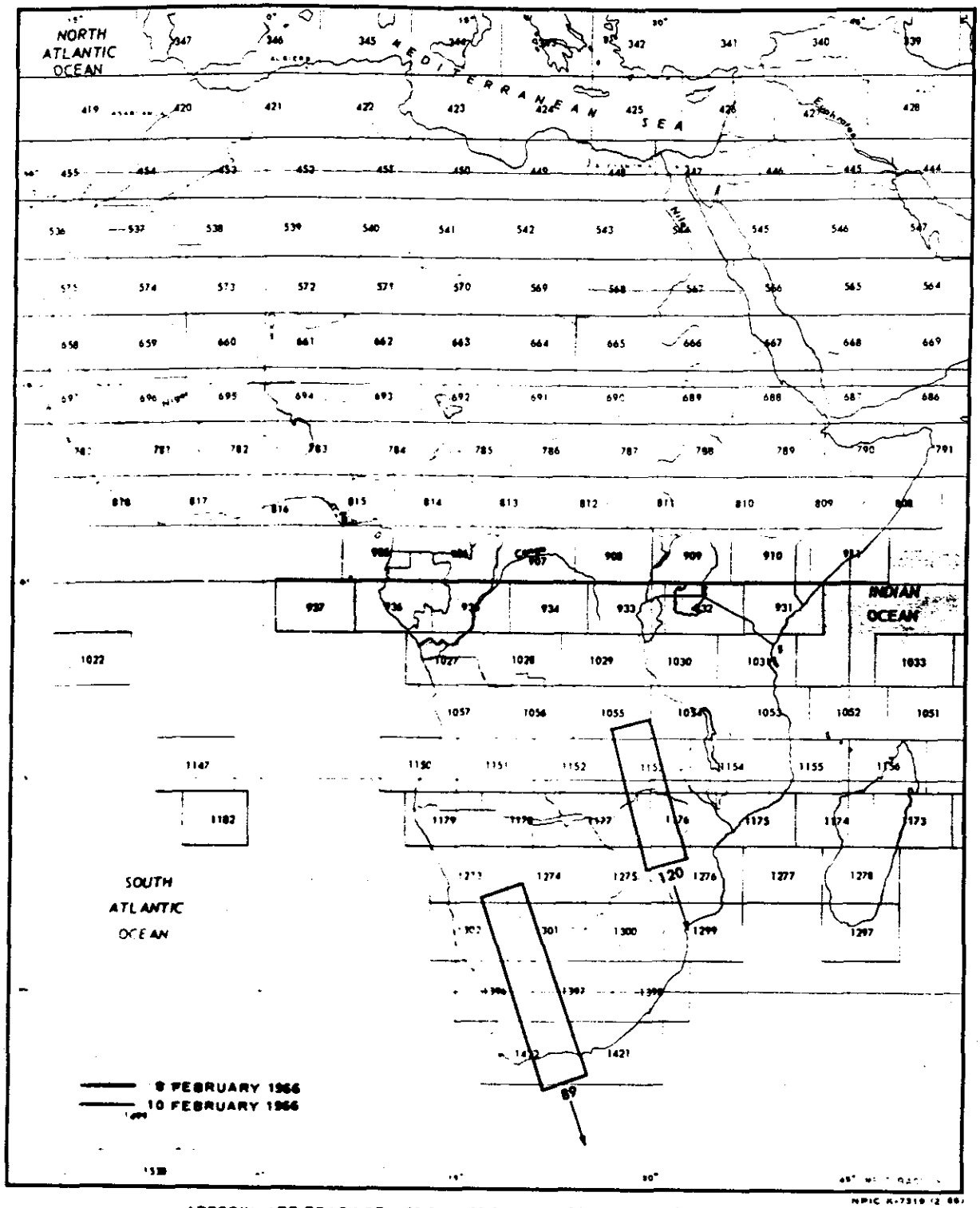
APPROXIMATE TRACK OF MISSION 1029-1, 3-7 FEBRUARY 1966 OVER SOUTH AMERICA.



APPROXIMATE TRACK OF MISSION 1029-1, 3-7 FEBRUARY 1966 OVER AFRICA.



APPROXIMATE TRACK OF MISSION 1029-2, 8-12 FEBRUARY 1966 OVER USSR, FAR AND MIDDLE EAST

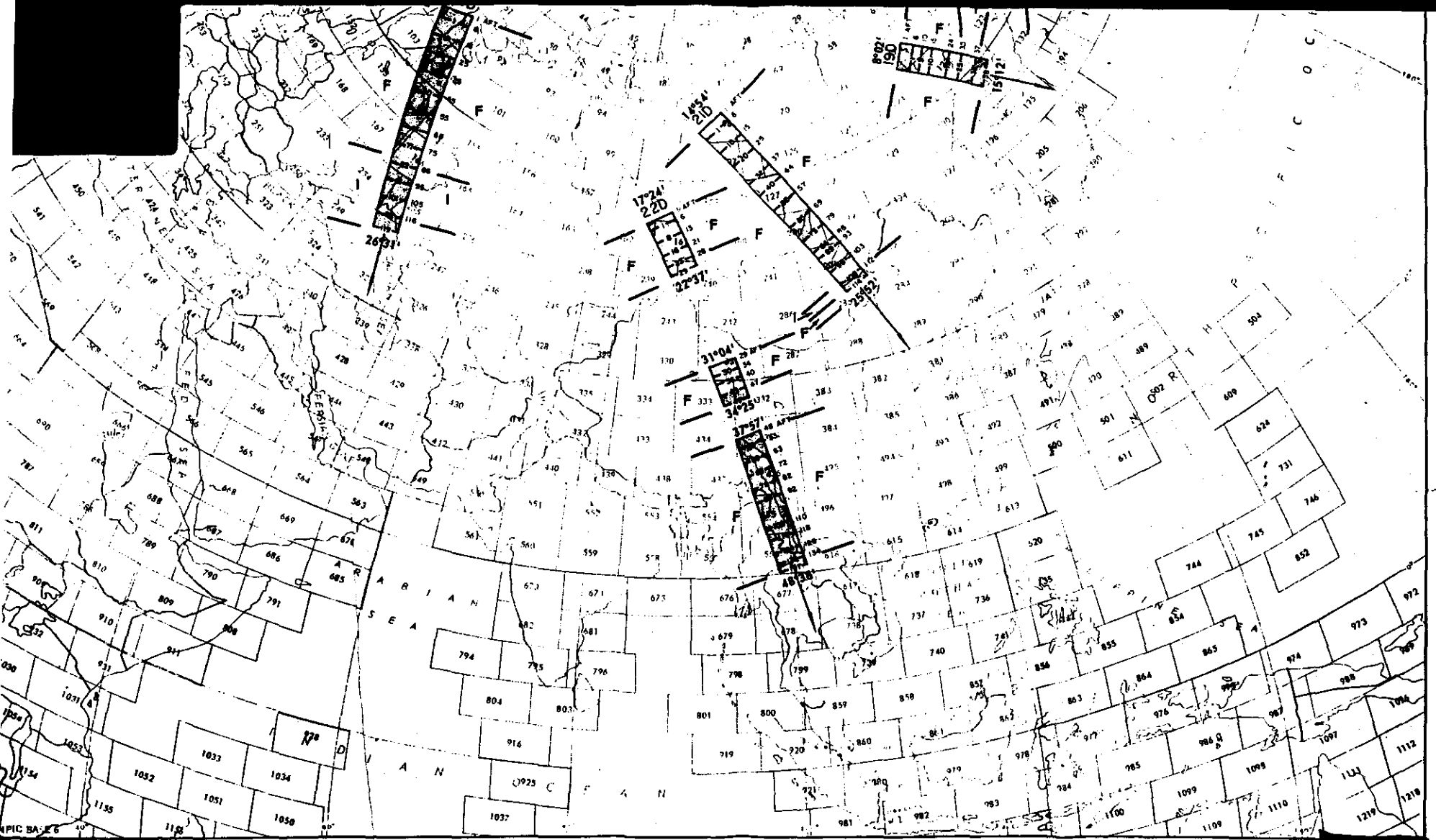


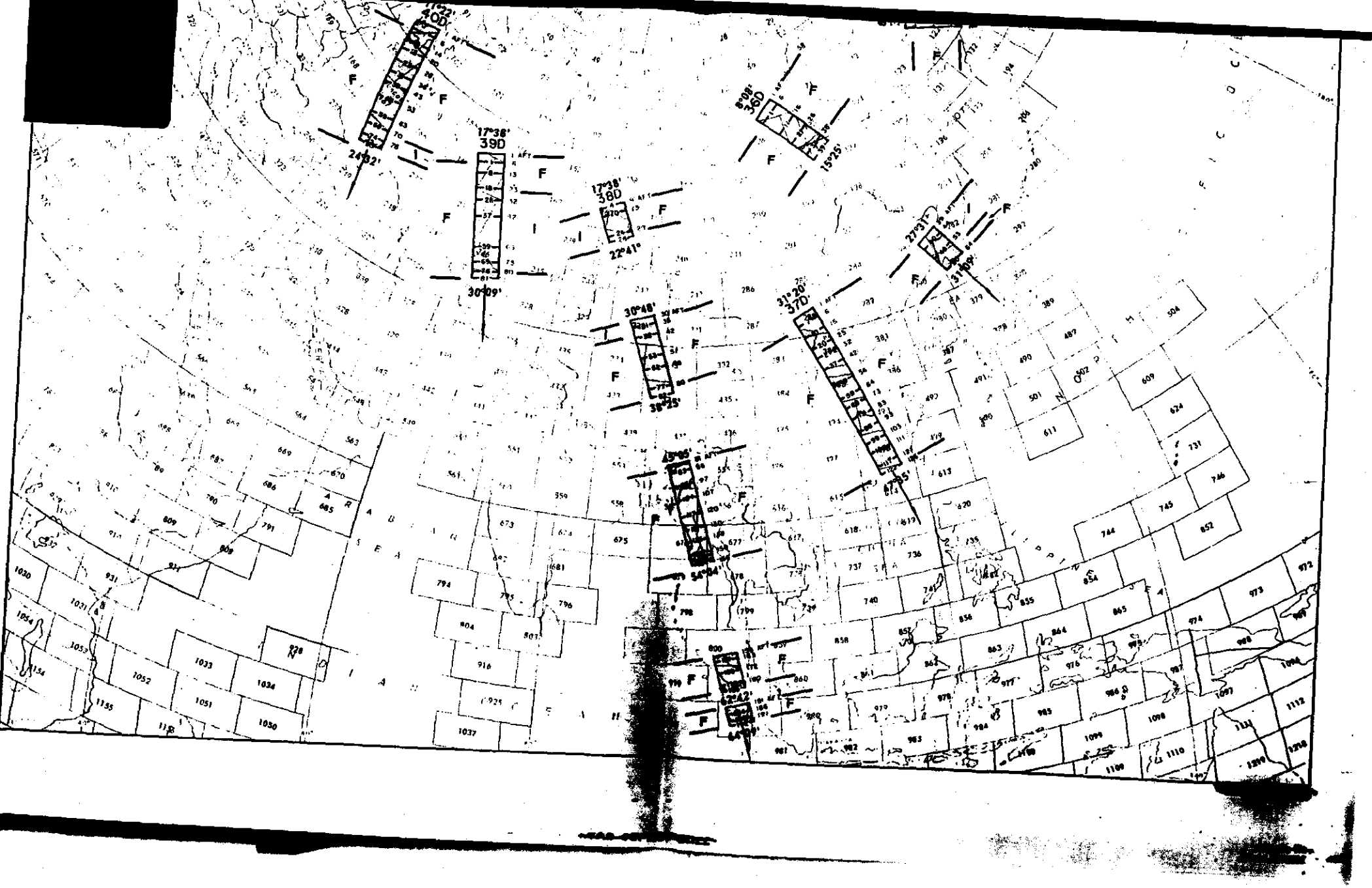
APPROXIMATE TRACK OF MISSION 1029-2, 8-12 FEBRUARY 1966 OVER AFRICA

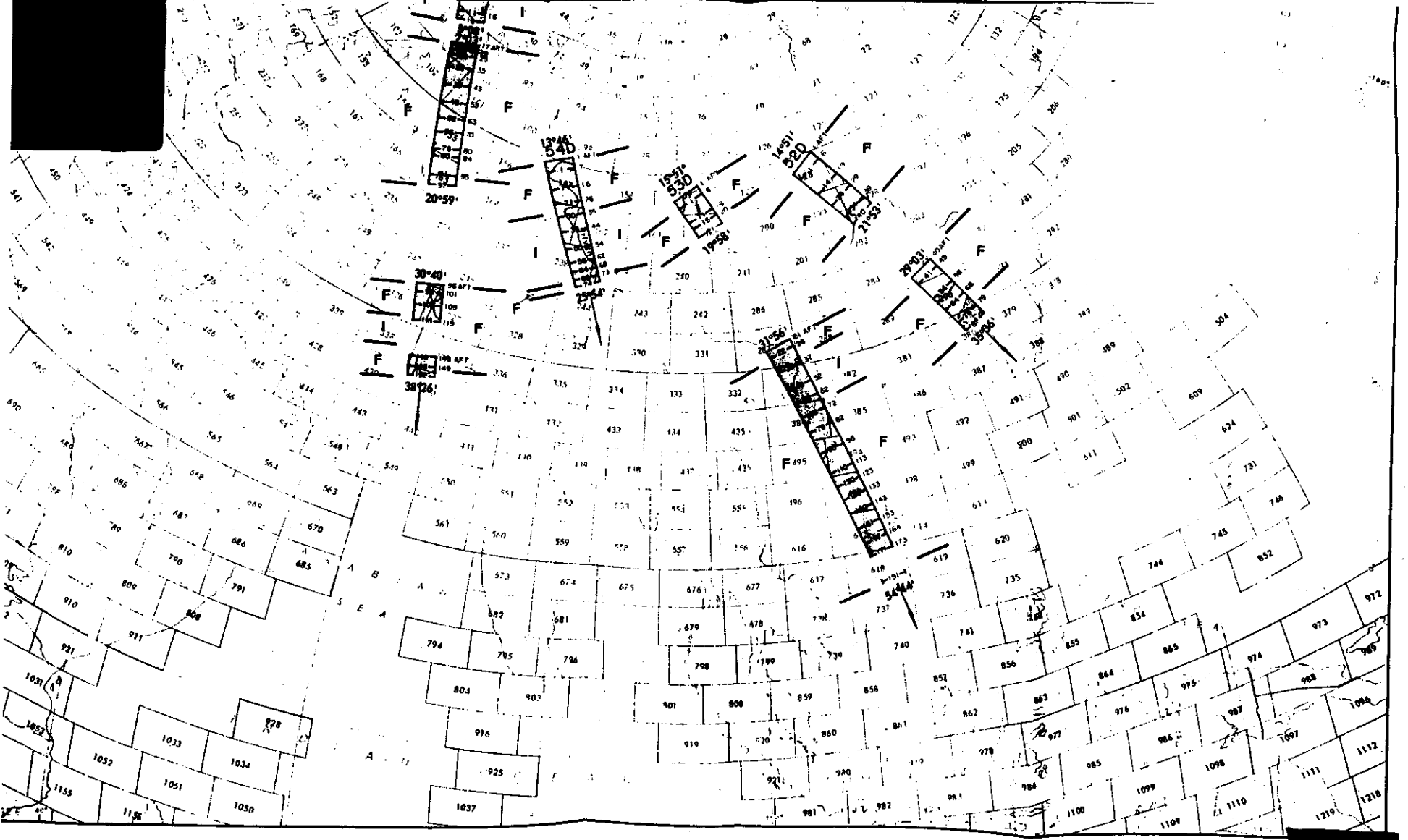
APPENDIX G. GRAPHIC CORRELATION OF GEOGRAPHIC LATITUDE-LONGITUDE, SOLAR ELEVATION, PROCESSING LEVEL

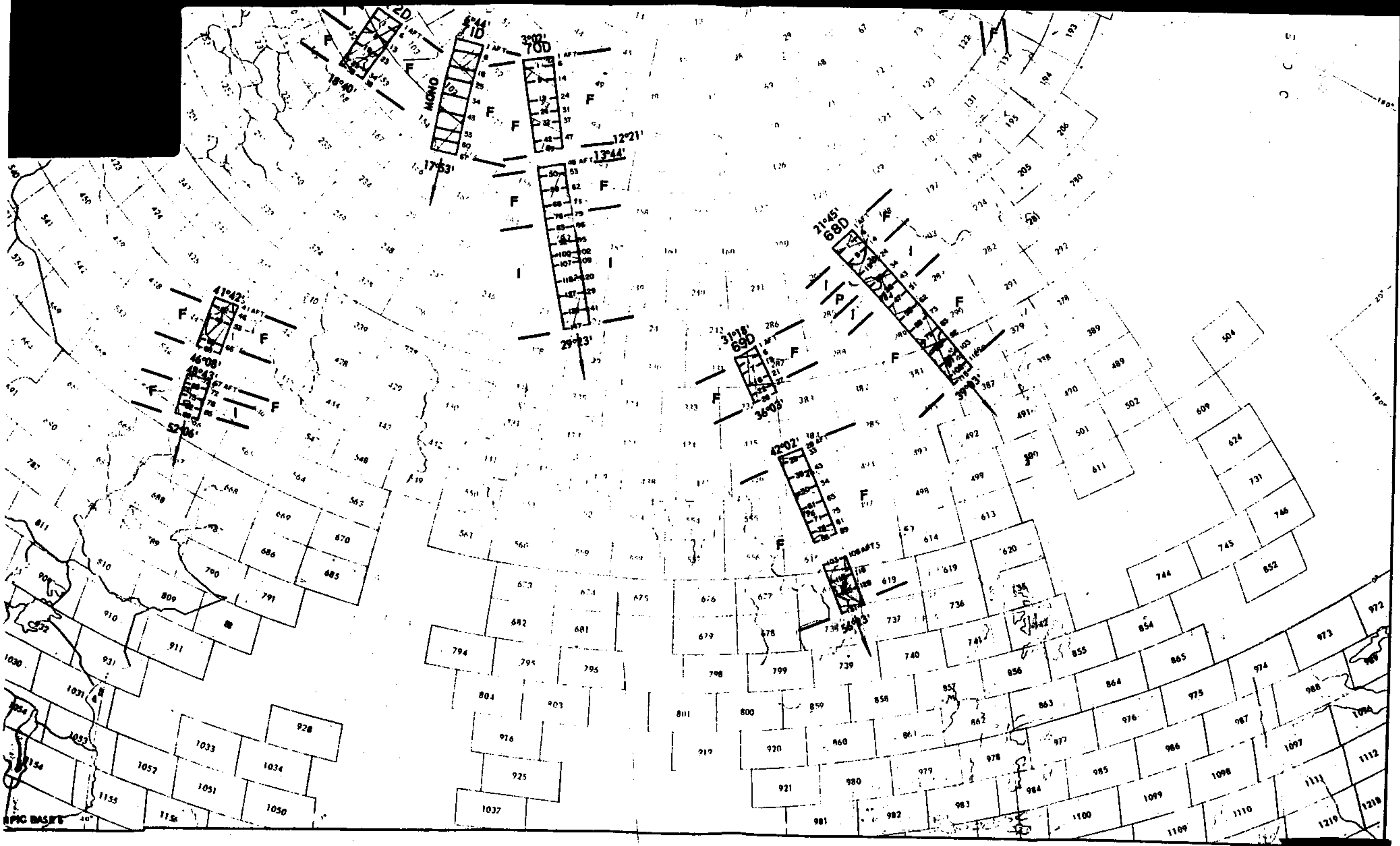
1. The following pages provide a graphic illustration of the relation of geographic coordinates, solar elevations, and processing levels on each operational (descending) pass over the Eurasia land mass during Missions 1029-1 and 1029-2. The figure immediately above each pass number indicates the solar elevation at the beginning of the pass or part. The figure following each plotted pass or part represents the solar elevation at the end of that photographic operation. The letter designations on either side of each pass indicate the processing level changes -- F indicates a full level of development; I represents the intermediate level; and P indicates that the section of film was processed at the primary level of development. The letters to the right of a pass are pertinent to the processing level of slave (aft) camera film and the letters to the left of a pass pertain to the master (fwd) camera film.


ATLANTIC OCEAN
90
8D
7D
6D
5D
3D
F
I


ARABIAN SEA
INDIAN OCEAN
INDIA
PAKISTAN
OMAN
26°31'
17°24'
22D
27°37'
18°54'
21D
31°04'
34°25'
37°57'
48°38'
8°02'
19D
15°12'

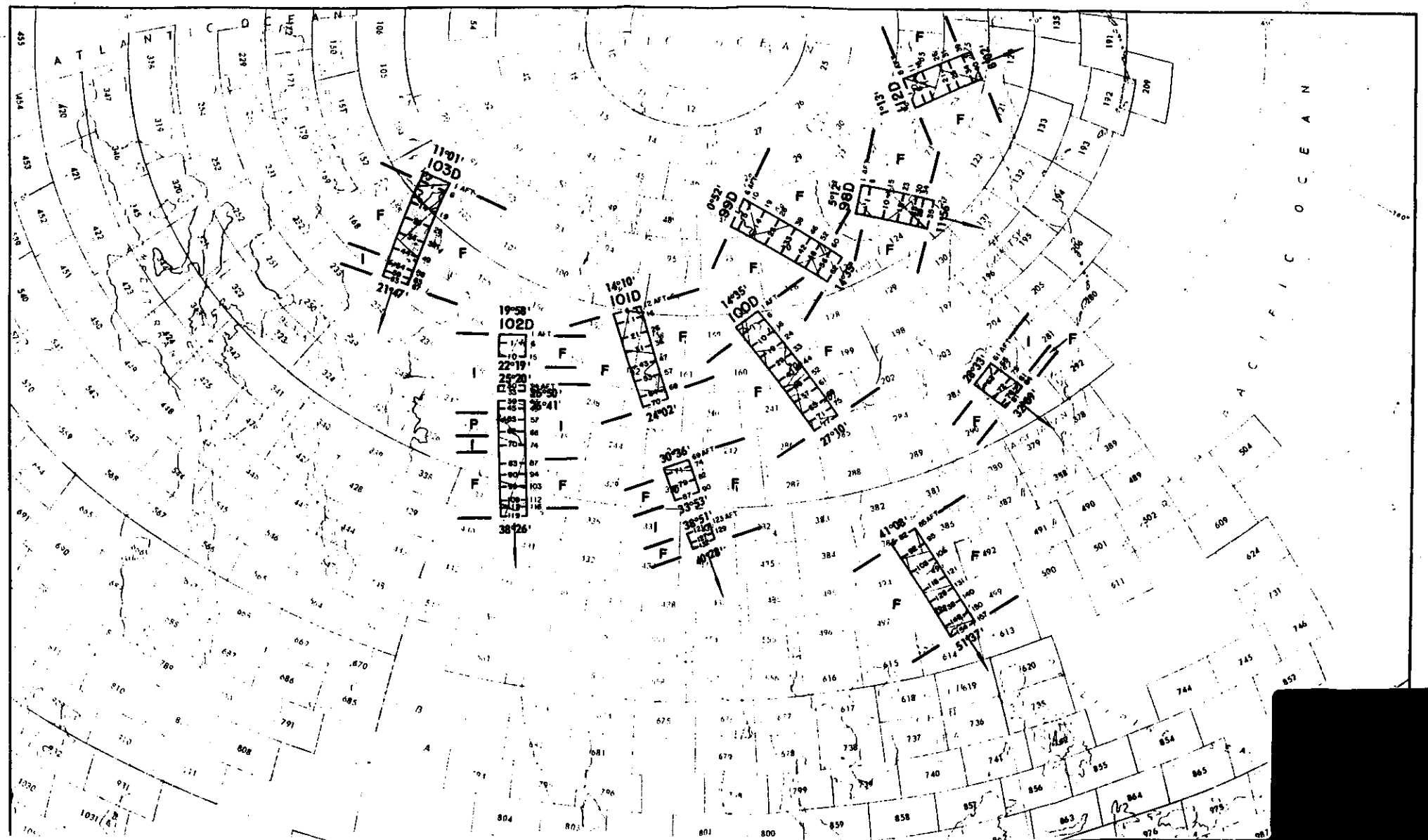

17°38'
39D
30°09'
17°38'
38D
22°41'
30°48'
39°25'
31°20'
37D
27°31'
31°09'
8°08'
36D
15°25'
45°05'
54°04'
62°42'
64°09'

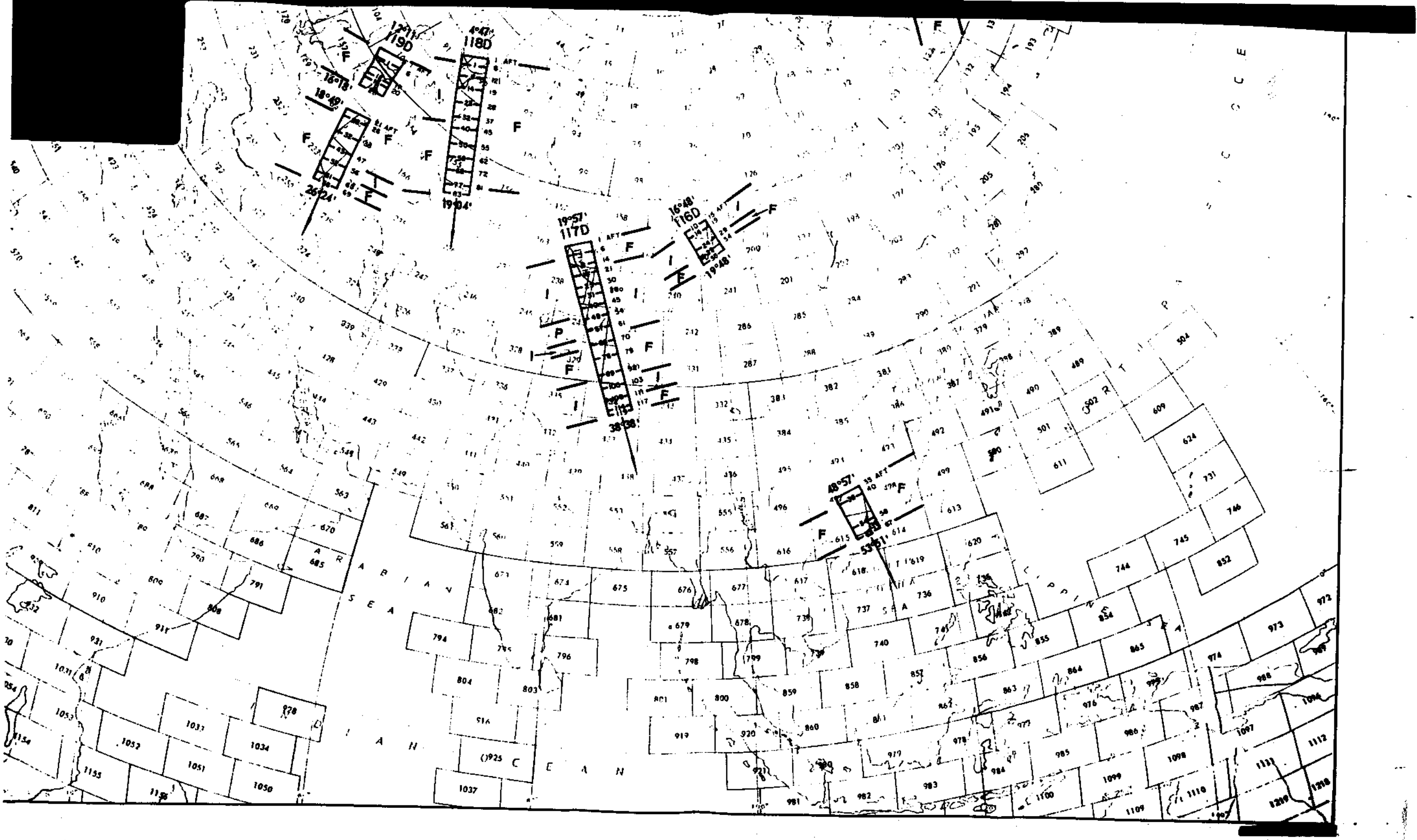




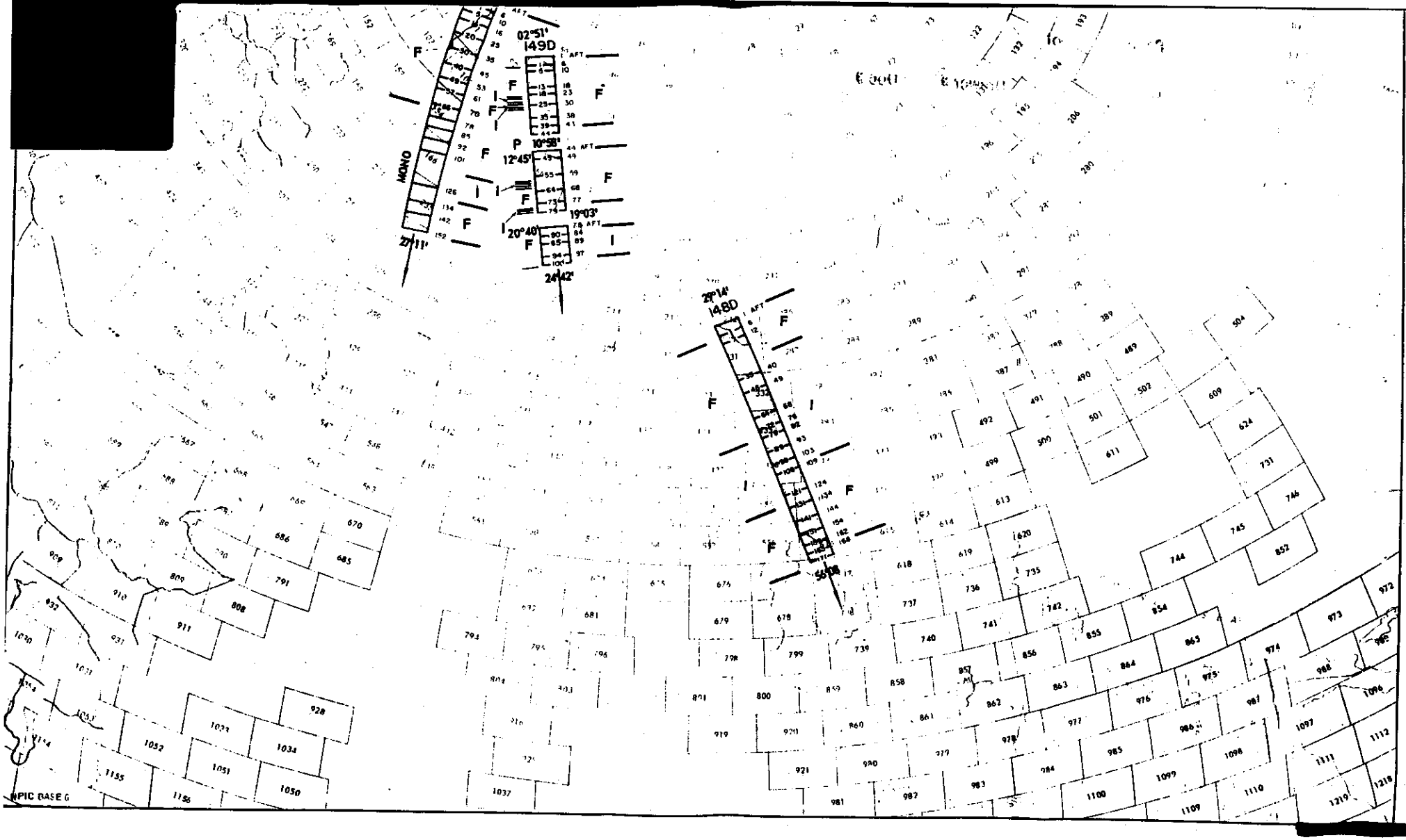
68D
21°45'
69D
31°18'
36°03'
42°02'
70D
3°02'
12°21'
13°44'
29°23'
71D
17°53'
MONO
41°42'
46°08'
52°06'
18°40'


ATLANTIC OCEAN
PACIFIC OCEAN
88D
87D
86D
85D
84D
83D
69D
68D


11°01'
103D
21°47'
19°58'
102D
22°19'
25°20'
35°30'
35°41'
38°26'
14°10'
101D
24°02'
14°55'
100D
27°10'
30°36'
33°53'
38°51'
40°28'
0°52'
99D
14°55'
5°12'
98D
11°56'
13°01'
97D
26°35'
32°09'
41°08'
51°37'
PACIFIC OCEAN


117D
118D
119D
116D
ARABIAN SEA
INDIAN OCEAN


ATLANTIC OCEAN
ARCTIC OCEAN
PACIFIC OCEAN
1340
1350
1320
1310
1330
1290
1440
1430
25°00'
29°26'
26°20'
39°43'
38°38'
30°29'
38°31'
49°40'
53°07'
55°12'
57°47'
7°43'
14°26'
18°42'
19°37'


MONO
02°51'
149D
10°58'
12°45'
19°03'
20°40'
24°42'
29°14'
148D
F
I
P