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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

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF ILLUSTRATIONS

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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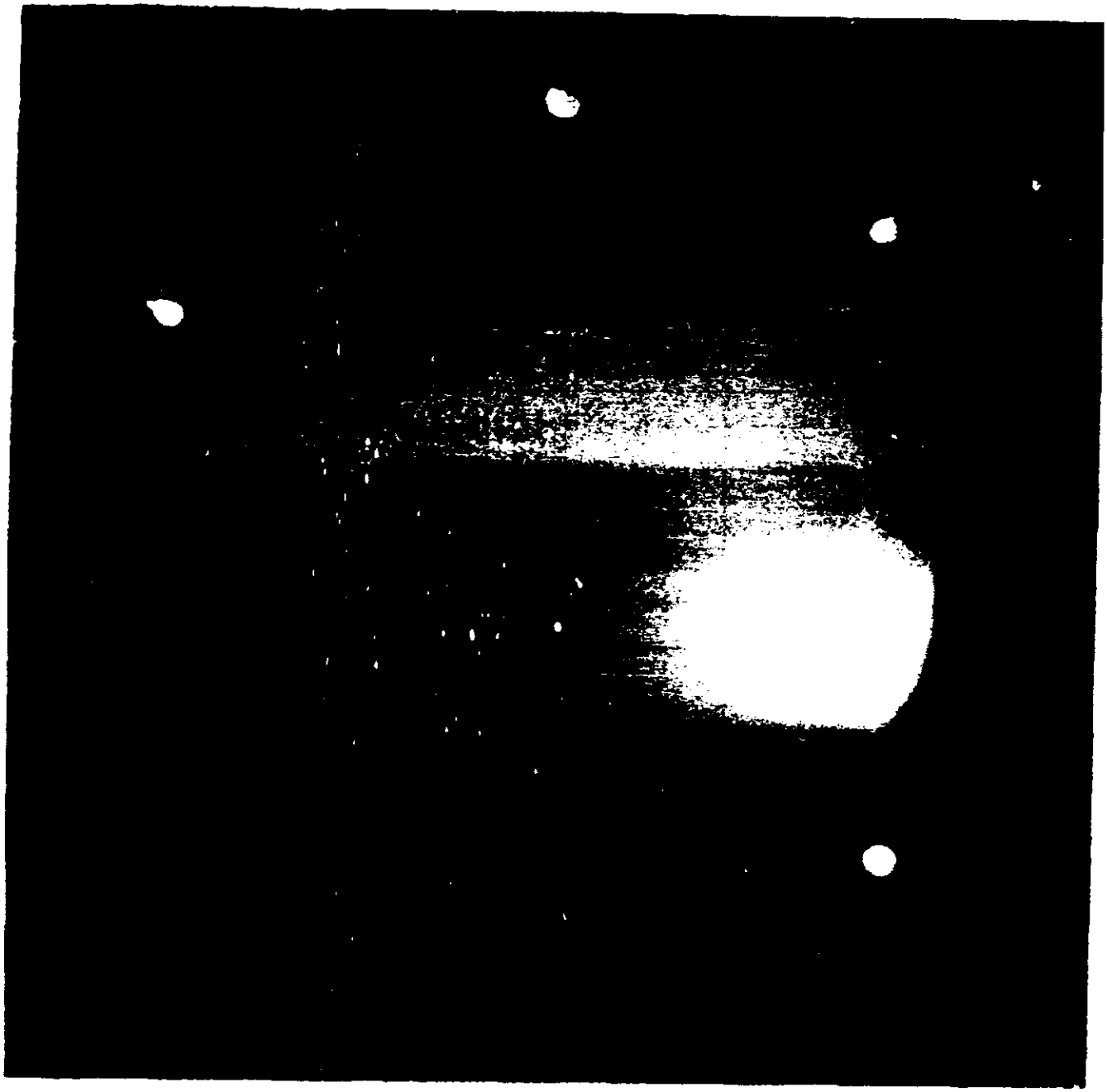

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FIGURE 3. STARS IMAGED IN A FISHHOOK CONFIGURATION

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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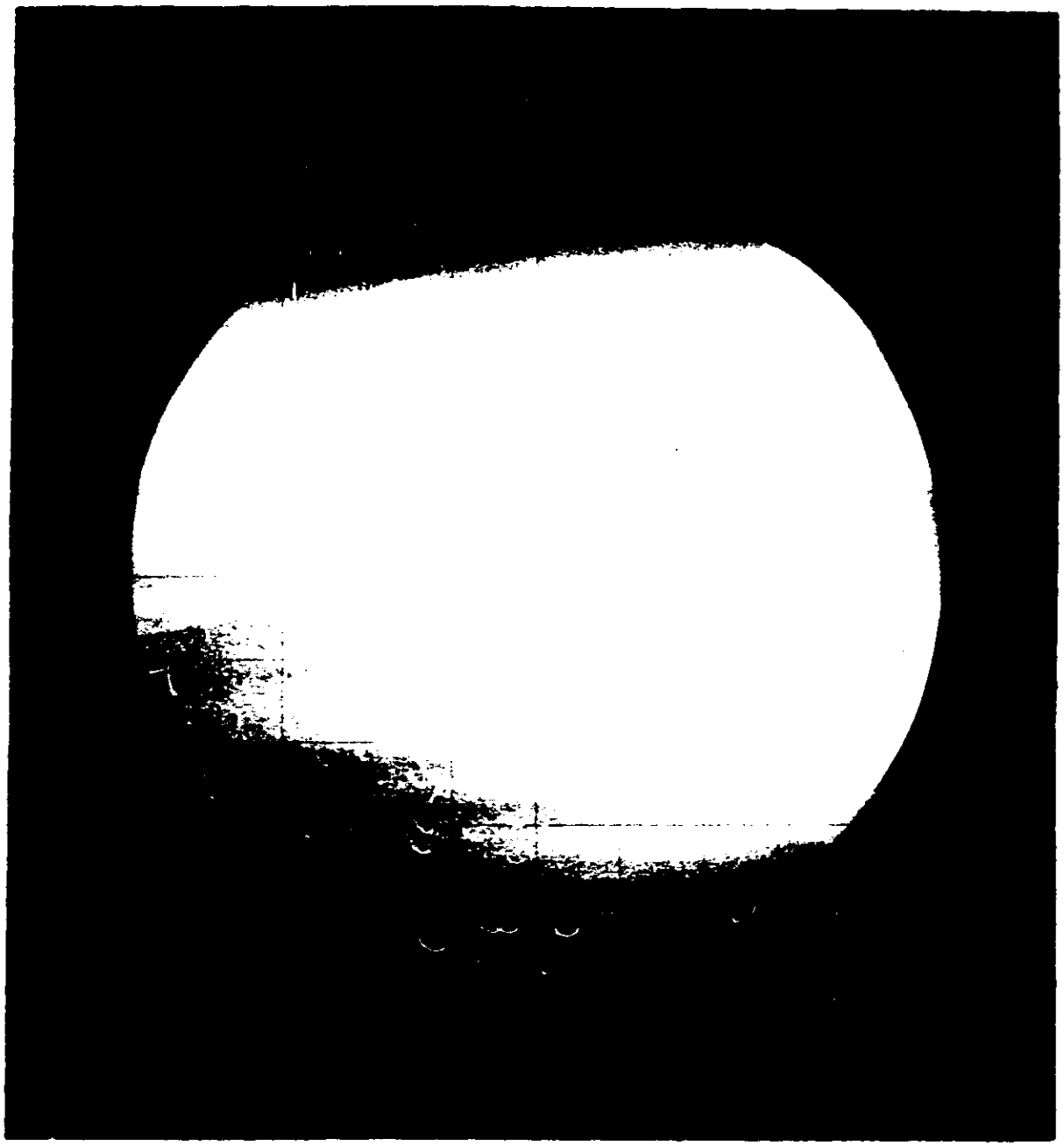


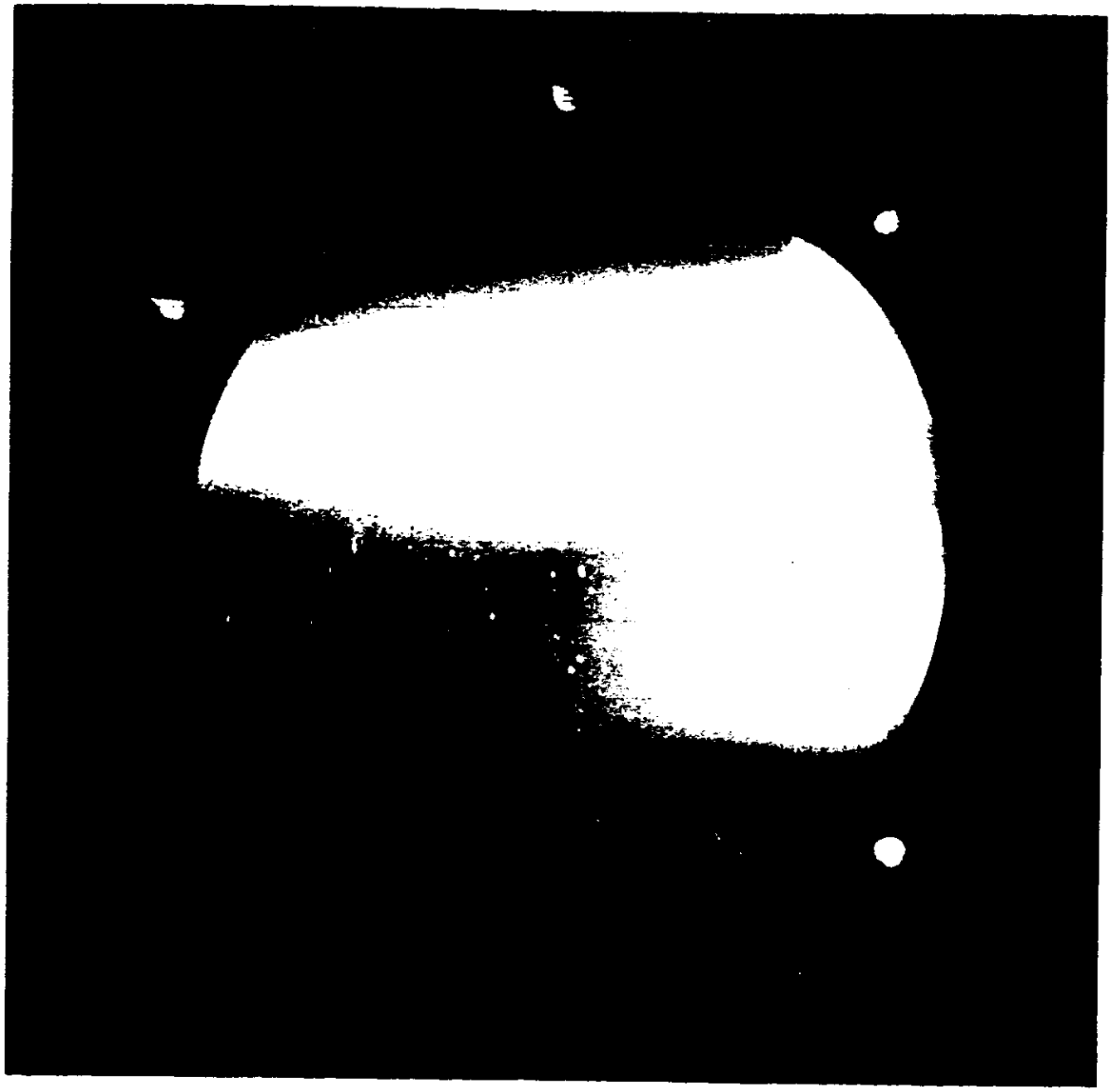
FIGURE 4. STELLAR IMAGES SURROUNDED BY HALOS

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.

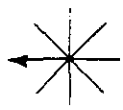
FIGURE 5. ACCUMULATION OF EMULSION ON FILM GUIDE RAILS

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]

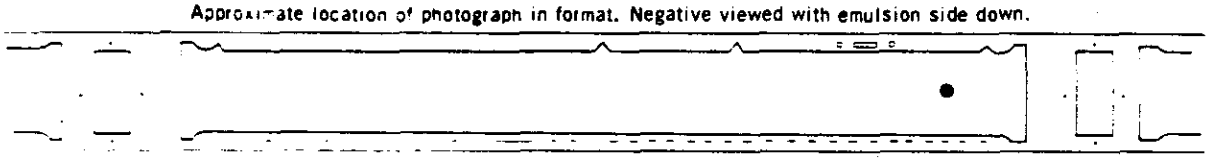
Camera	179
Pass	134D
Frame	174 and 175 Aft
Date of Photography	11 Feb 66
Universal Grid Coordinates	75 Edge to edge
Enlargement Factor	Contact
Geographic Coordinates	46-49N 053-30E
Altitude (feet)	614,511
Camera Attitude:	
Pitch	NA
Roll	NA
Yaw	NA
Local Sun Time	1102
Solar Elevation	28°03'
Solar Azimuth	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.

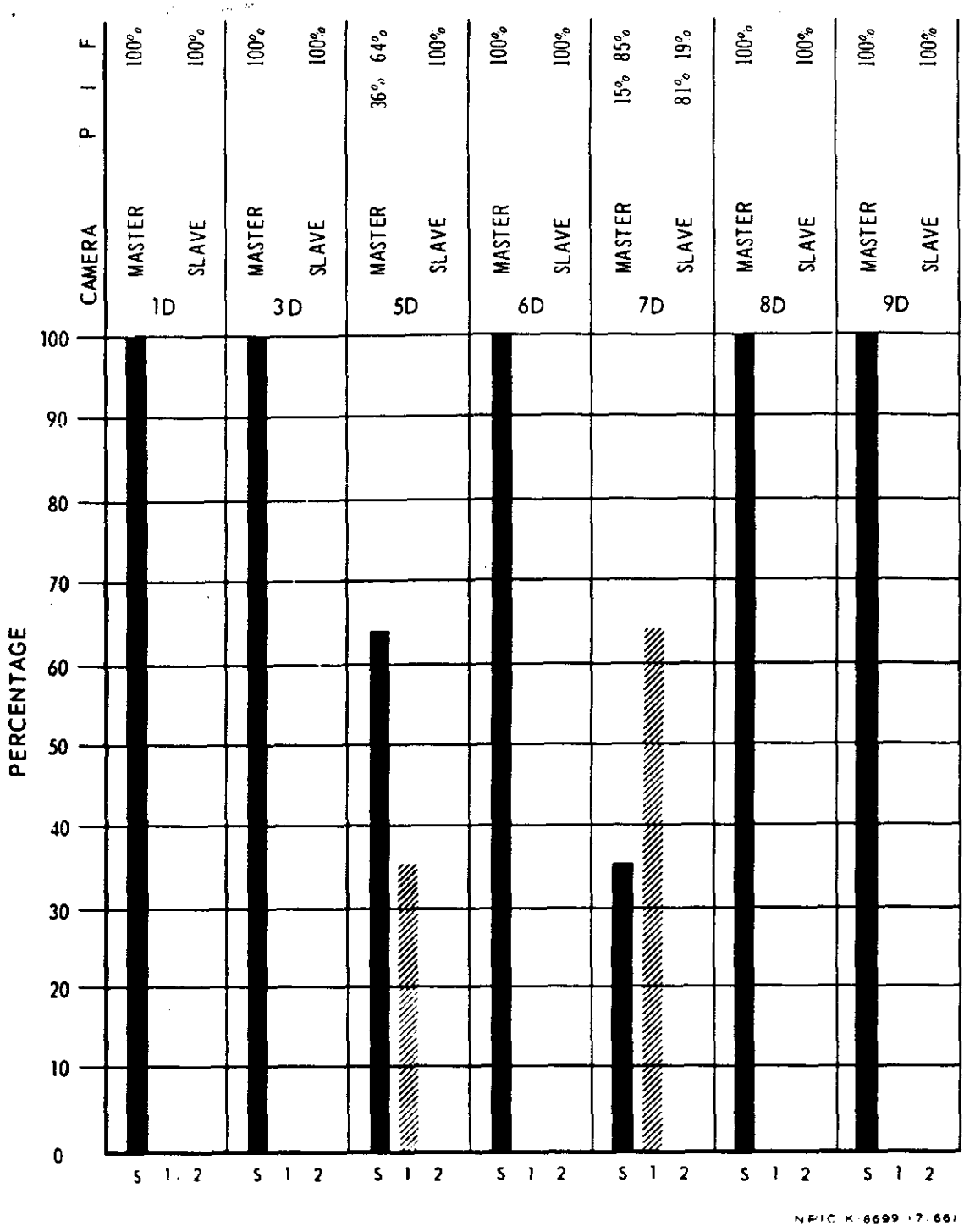
e. Processing Levels. The film of both panoramic cameras was processed in Trenton processing machines. The following information indicates the percentage of film processed at each level of development and the number of processing level changes accomplished during the process.

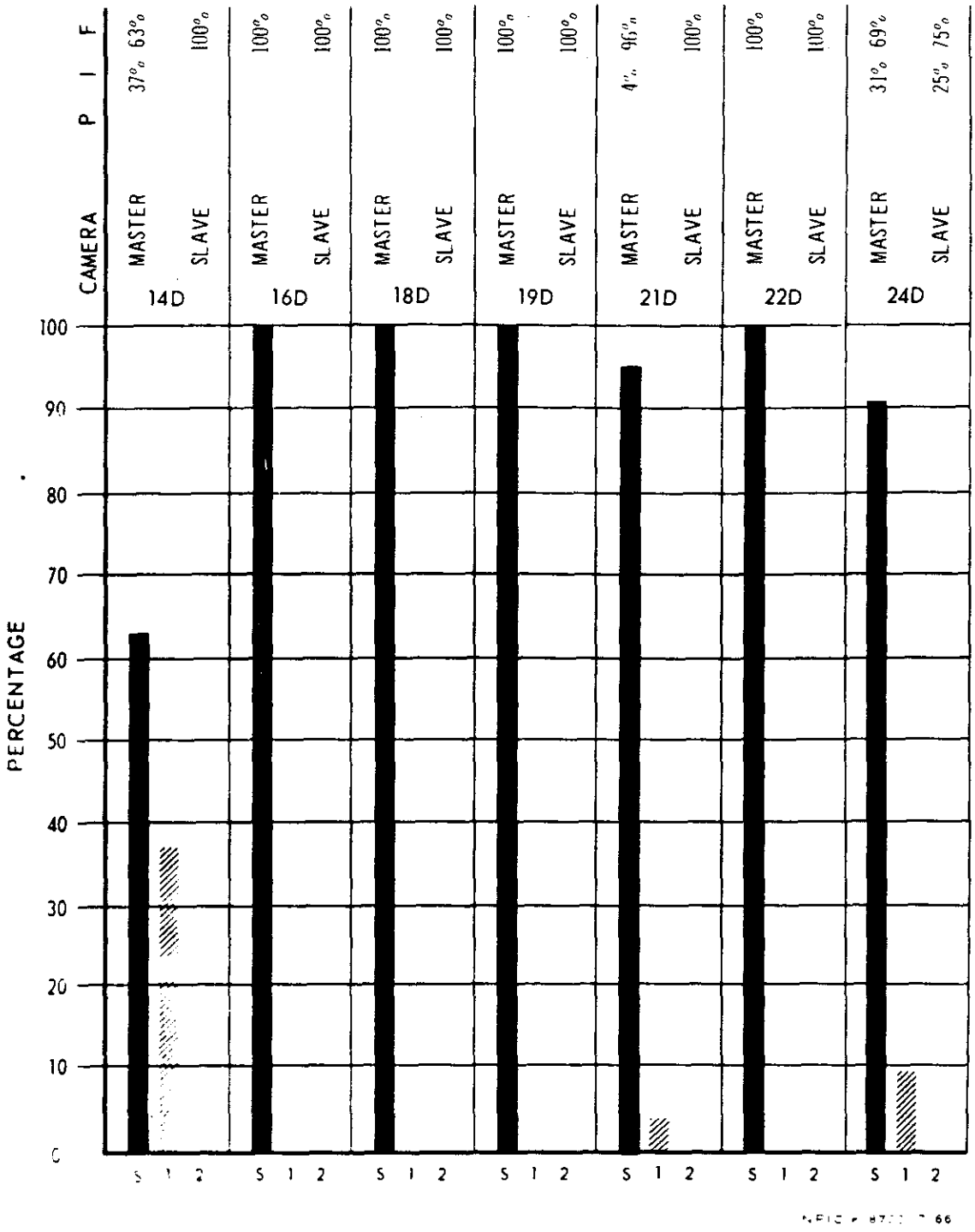
	1029-1		1029-2	
Development Level	Master	Slave	Master	Slave
Primary	1.0%	0.0%	2%	2%
Intermediate	16.2%	20.5%	28%	24%
Full	82.8%	79.5%	70%	74%

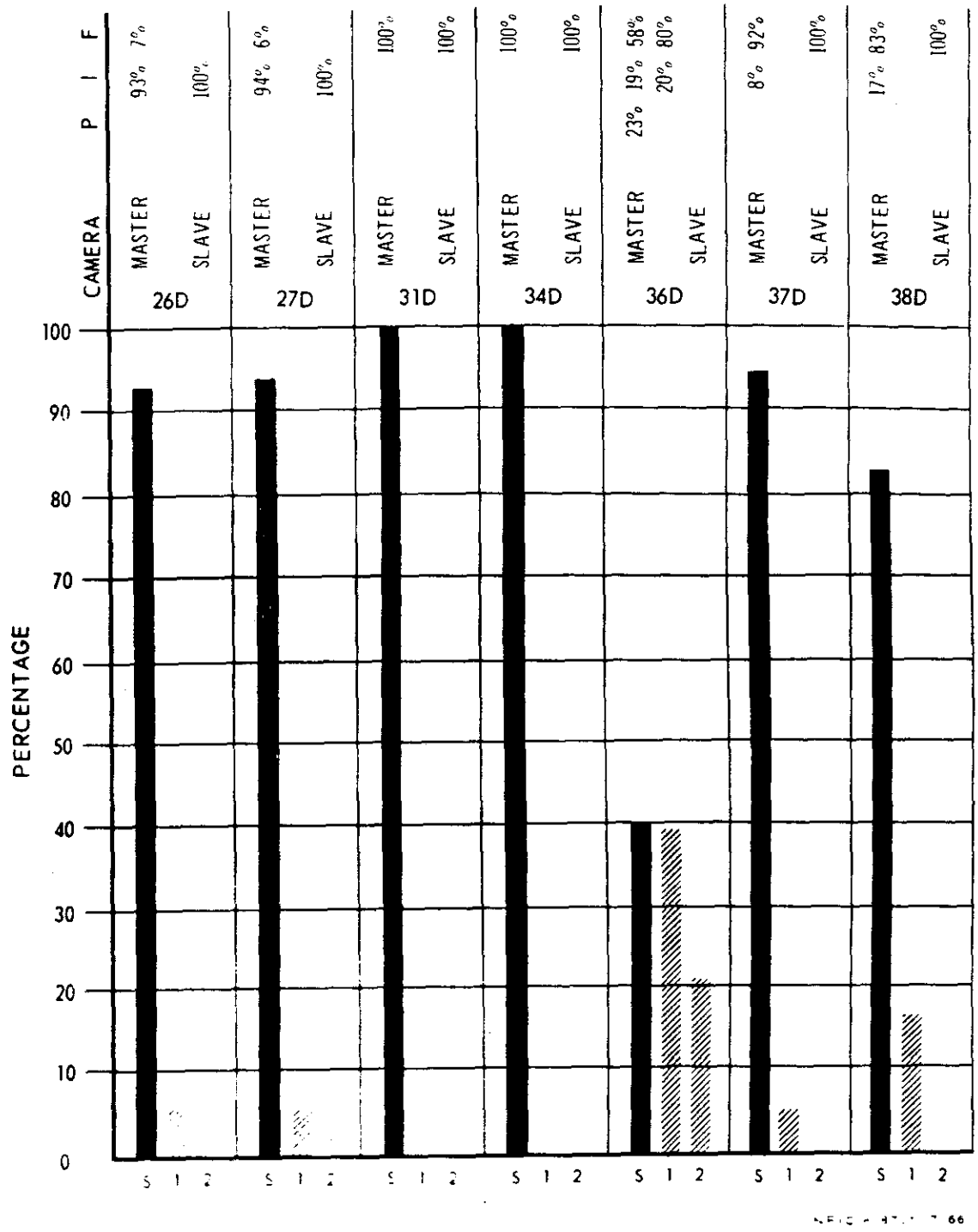
Processing Changes	1029-1	1029-2
Master (Fwd) Camera	30	35
Slave (Aft) Camera	20	39

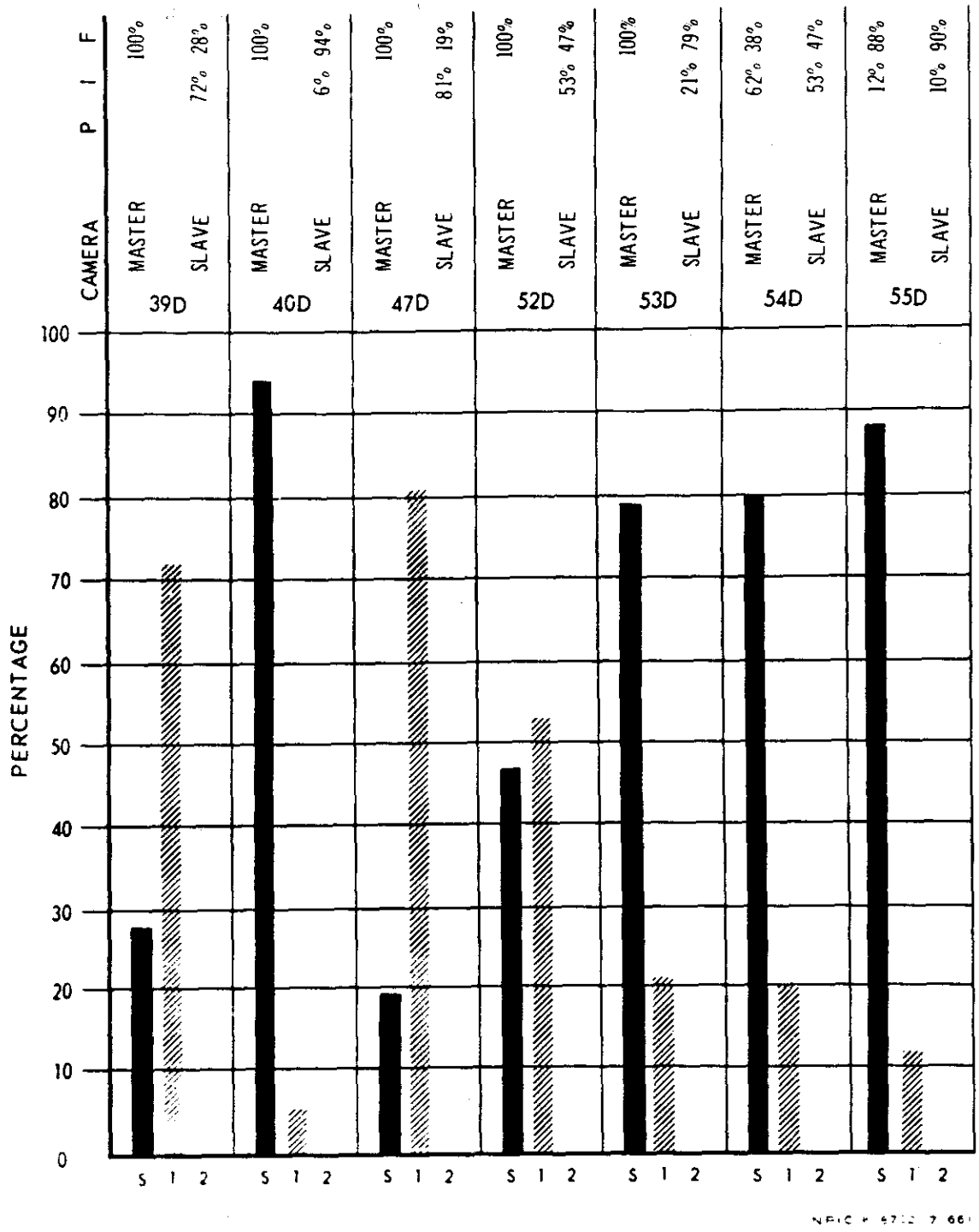
The stellar camera film was processed at one continuous development level in a Trenton processor. The index camera film was processed at one continuous level in an EH6A processing machine.

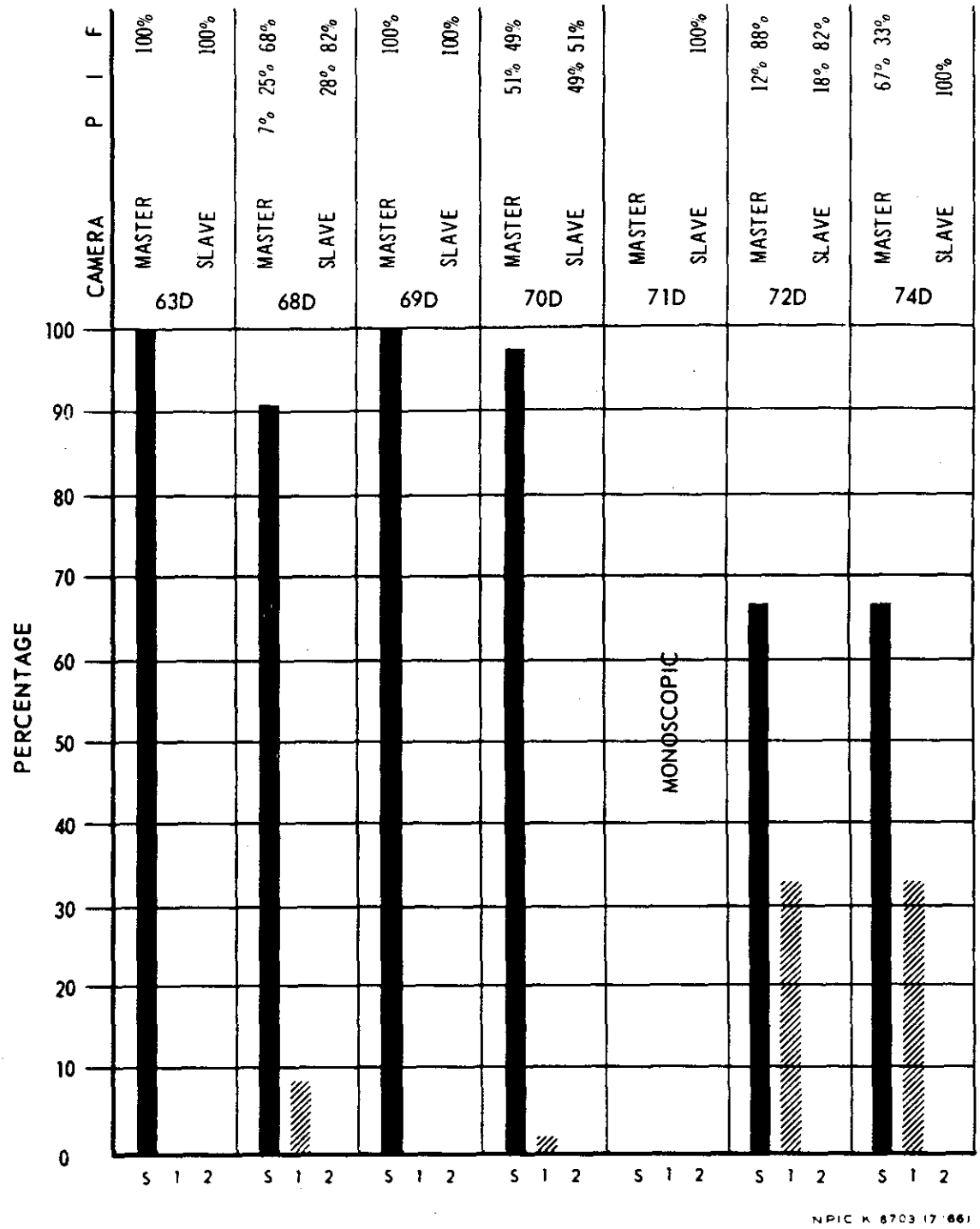
f. Graphic Illustration of Fwd and Aft Process Histories. The following graphs indicate the relation of the process levels of the master (fwd) camera film and the slave (aft) camera film. They show the difference of development level administered to the film of the 2 cameras, i.e., "1" indicates one 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.

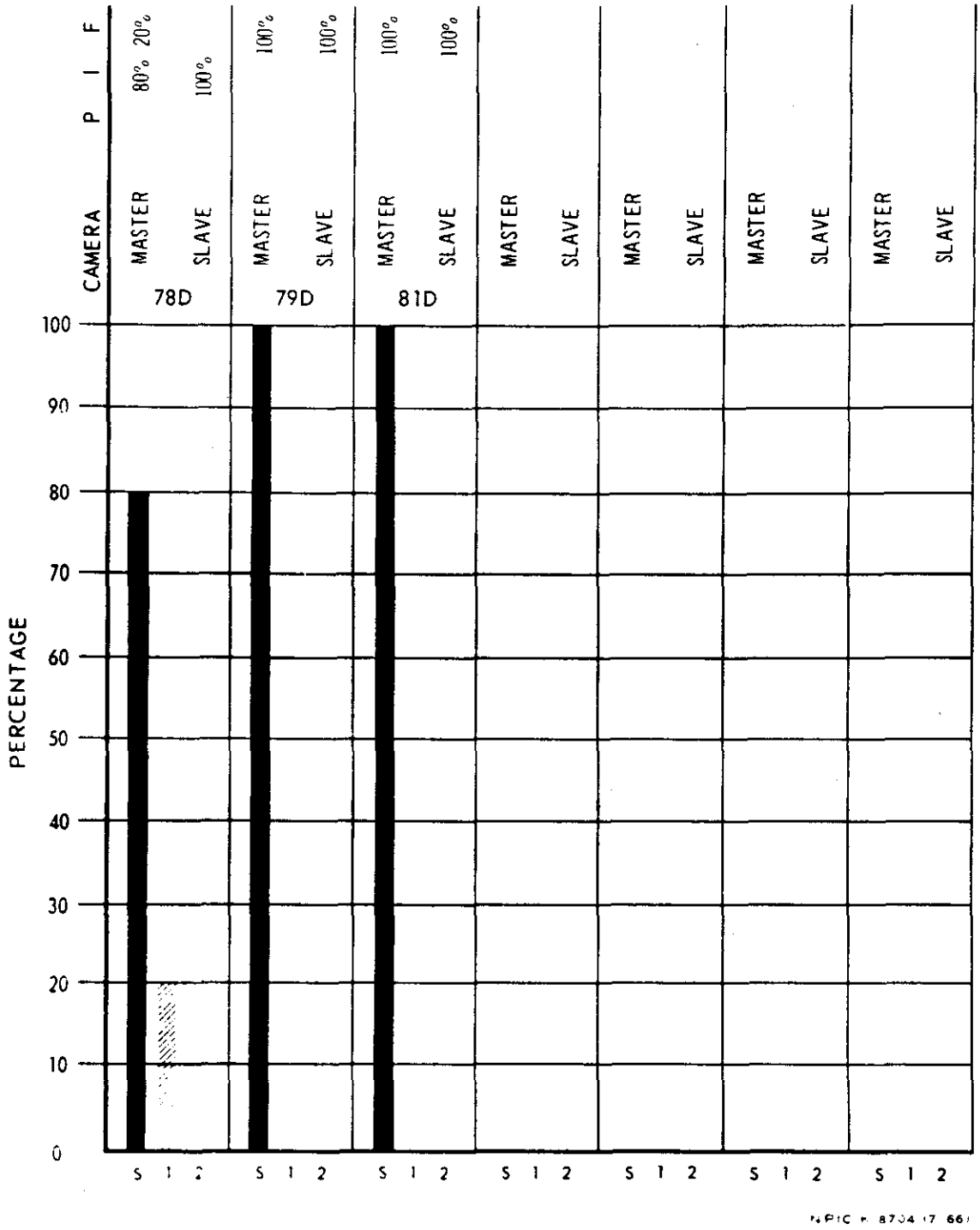

CAMERA
P I F
MASTER
SLAVE
1D
3D
5D
6D
7D
8D
9D
100%
36% 64%
15% 85%
81% 19%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2
NPIC K-8699 (7-66)


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

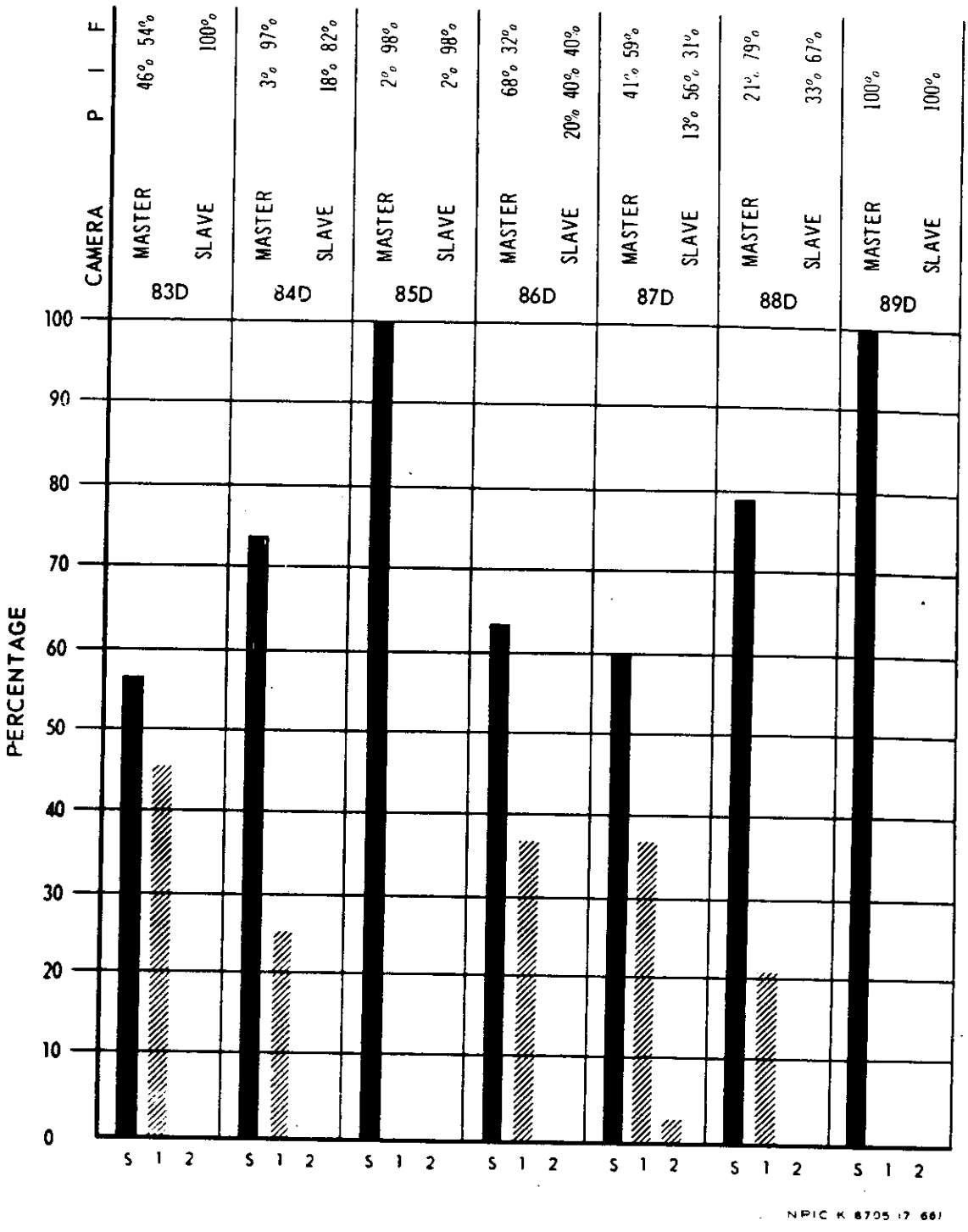

CAMERA
P I F
MASTER
SLAVE
26D
93% 7%
100%
27D
94% 6%
100%
31D
100%
100%
34D
100%
100%
36D
23% 19% 58%
20% 80%
37D
8% 92%
100%
38D
17% 83%
100%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2

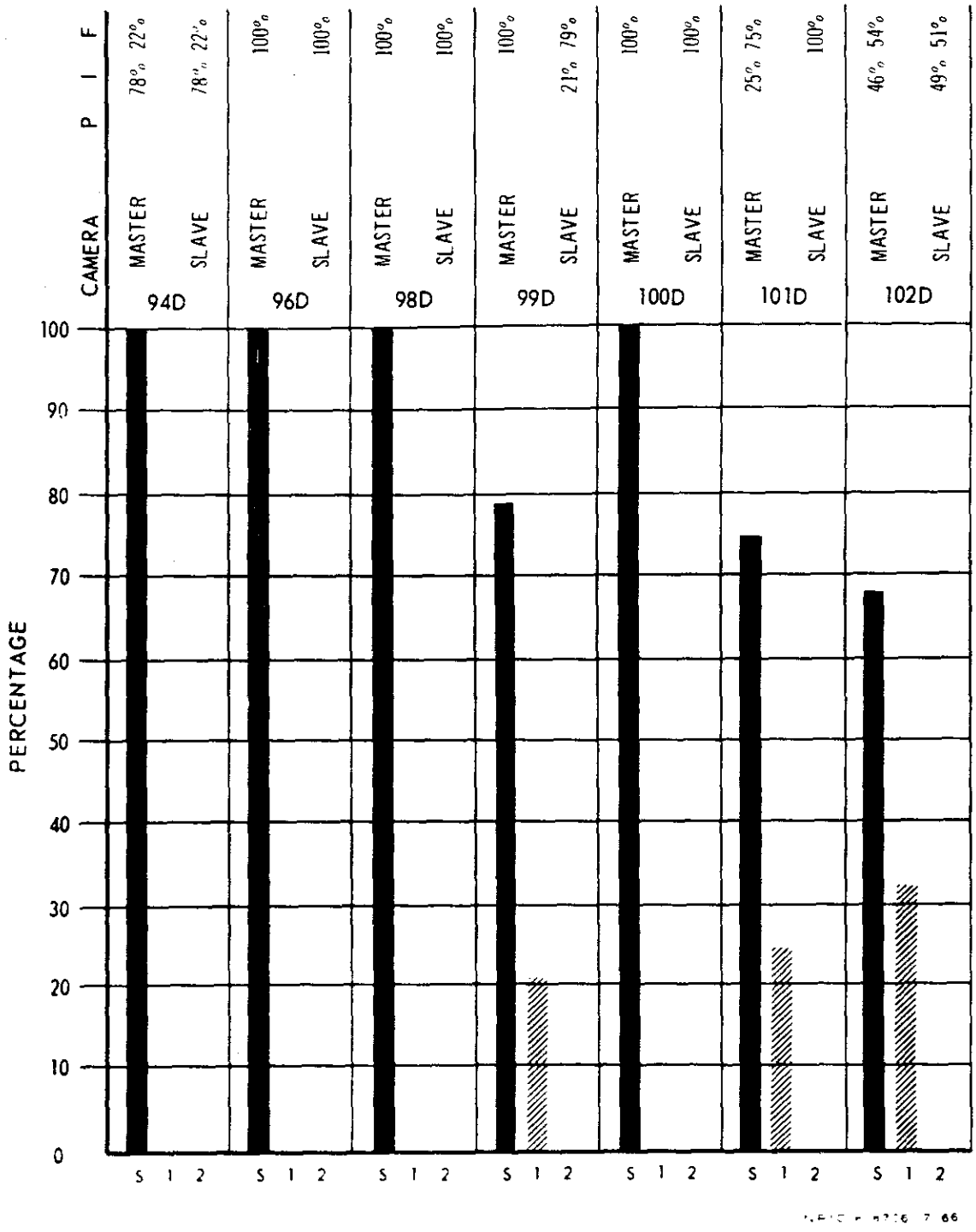

CAMERA
P I F
MASTER
SLAVE
39D
100%
72% 28%
40D
100%
6% 94%
47D
100%
81% 19%
52D
100%
53% 47%
53D
100%
21% 79%
54D
62% 38%
53% 47%
55D
12% 88%
10% 90%
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2

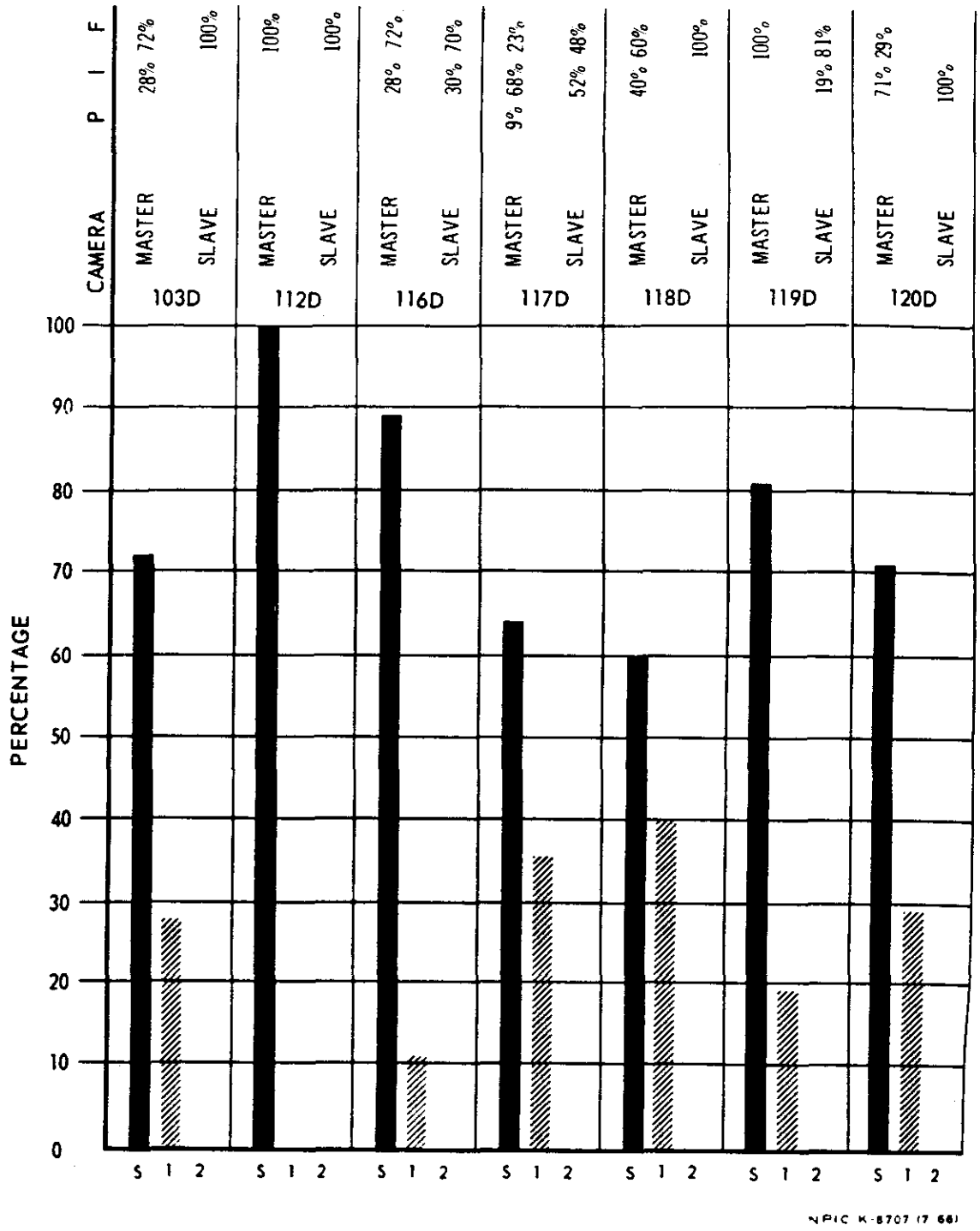

CAMERA
P I F
MASTER 100%
SLAVE 100%
63D
MASTER 7% 25% 68%
SLAVE 28% 82%
68D
MASTER 100%
SLAVE 100%
69D
MASTER 51% 49%
SLAVE 49% 51%
70D
MASTER 100%
SLAVE
71D
MONOSCOPIC
MASTER 12% 88%
SLAVE 18% 82%
72D
MASTER 67% 33%
SLAVE 100%
74D
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
S 1 2
NPIC K 6703 (7 66)

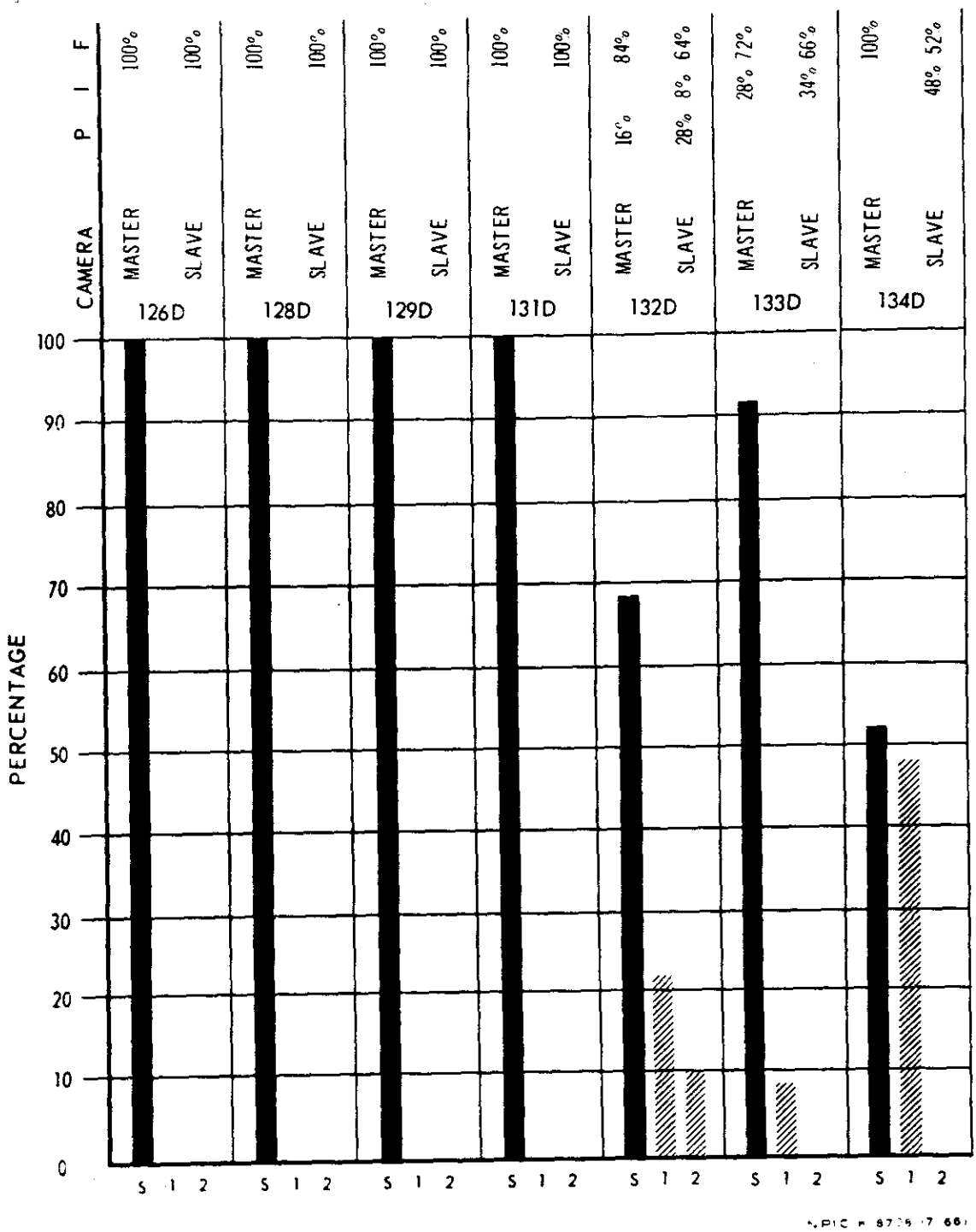


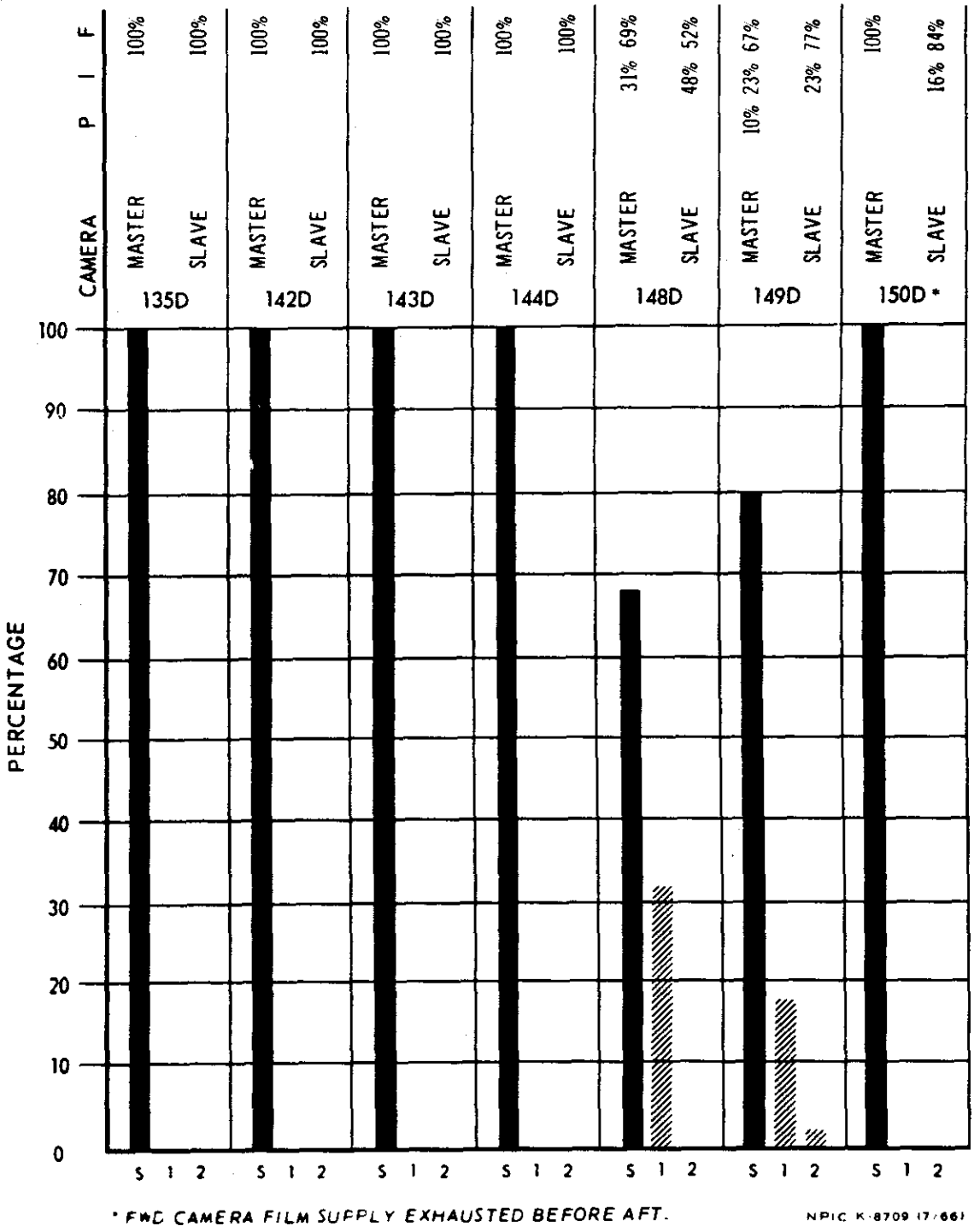
NPIC F 8704 (7 66)


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.

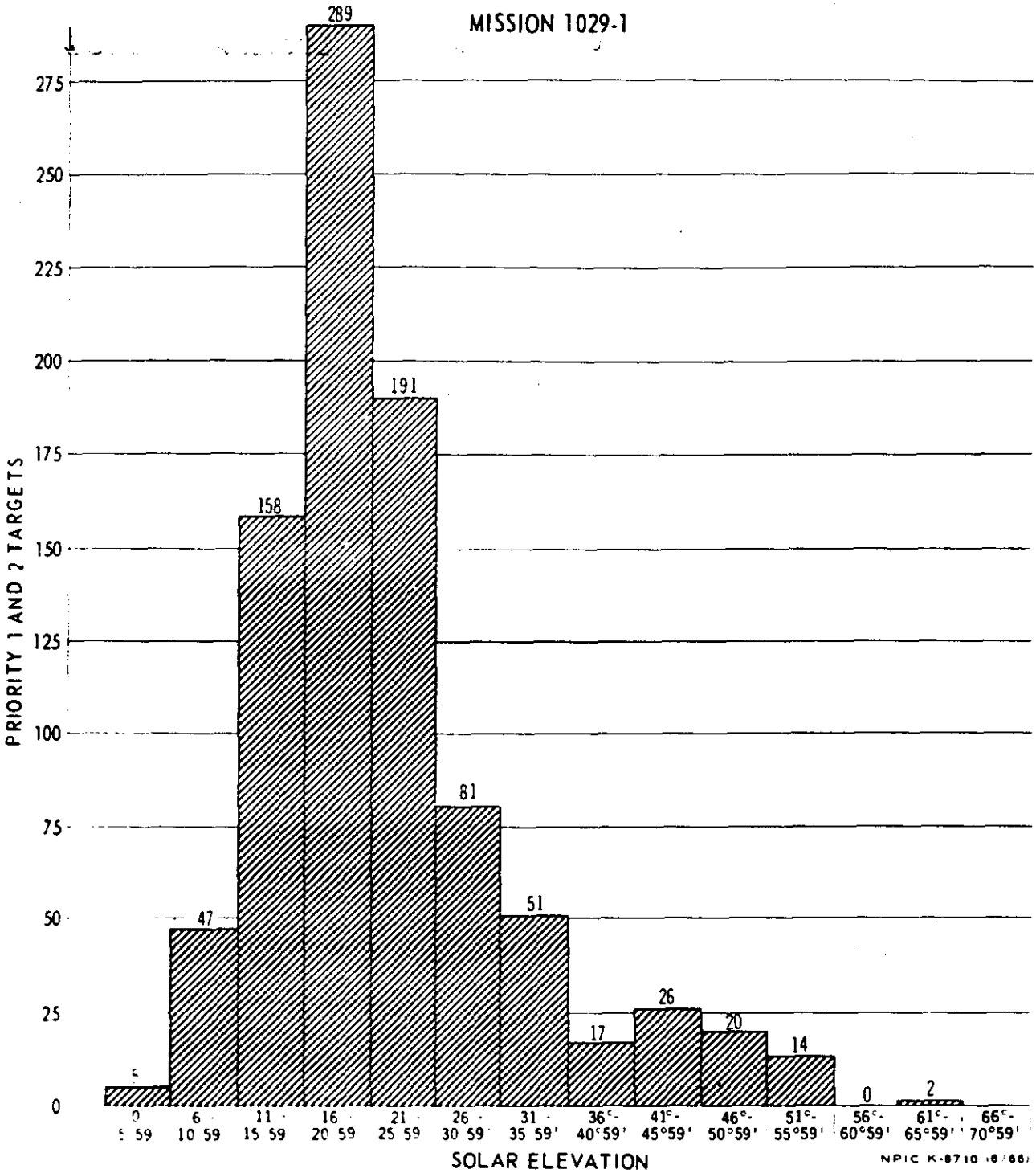
5. The process was continuous at the intermediate level on the film from both cameras on 1 pass.

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)