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8 May 75

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C06 2724

Post Flight Analysis Report

MISSION 1209-5

ICL-TCS-2004-75

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Exempt from general declassification
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POST FLIGHT ANALYSIS
REPORT NO. 1209-5/75

POST FLIGHT ANALYSIS REPORT

MISSION 1209-5

18 APRIL 1975

This report consists of 126 pages

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PUBLICATION REVIEW

This report has been reviewed and is approved.

PFA Chairman

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FOREWORD

This report was prepared for and by direction of the Director, Program A, and constitutes Volume III of the Final Mission Report.

The preparation, collection, and reduction of data in this report has been a joint effort of the Post Flight Analysis (PFA) Team comprised of the following organizations:

SPO

Stellar Terrain Subsystem Contractor

Processing and Reproduction Contractor

DMATC

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SUMMARY

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SECTION I

SUMMARY

1.1 INTRODUCTION

This report details the technical evaluation of Stellar Terrain (ST) system SN 002 launched on 29 October 1974 (mission 1209) and recovered 27 December 1974. Significant aspects of the ST test and integration, satellite vehicle performance, post-recovery handling, and mapping suitability of the product are also included. Camera data, mission statistics, and recovery data are summarized in Tables 1-1, 1-2, and 1-3.

1.2 CAMERA OPERATIONS AND PERFORMANCE

This ST System, the fifth flown, was fully operational and anomaly free for 59 days on orbit. Post-flight analyses conducted at the processing site, the Contractor's facility, and the Defense Mapping Agency Topographic Center have shown that mission objectives were met with a high level of success. Mission 1209 was the first flight to use EK 3414 film as the primary terrain supply and an equivalent WR-12 filter. This film/filter combination performed as expected. Resolution performance on EK 3414 film was approximately 40 percent higher than previous missions utilizing EK 3400 film. An adequate distribution of sixth magnitude stars was acquired on the stellar frames, and ancillary data generated by both units were acceptable.

Special engineering tests were conducted using a 20-foot length of QX 801 film "tagged" on to the terrain film supply. The initial evaluation of these tests has shown no significant advantages for using QX 801 as the terrain primary film.

Weather conditions during photographic operations were excellent. Approximately 88 percent of all photographed areas were cloud free.

1.3 IMAGE QUALITY

The majority of the terrain photography was good and appeared consistent throughout the flight. The average resolution derived by VEM analysis was 80 l/mm. Stellar imagery was good for both plus and minus Y units. On evaluated frames, each stellar camera recorded between 75 and 100 star images.

1.4 EXPOSURE

Density measurements made at the processing facility indicated exposure levels for the majority of photography were correct. Exposure levels for mission 1210 will be derived from this mission and engineering tests conducted on missions 1207 and 1208.

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1.5 THERMAL PROFILE

There were no thermal control problems. Paint patterns, the same as those on 1208, provided excellent thermal distribution on the MISEA and EDAP assemblies.

1.6 PRESSURE PROFILE

Average chute pressure stabilized at 55 micrometers, an increase of approximately 33 micrometers from the average level of mission 1208. This increase was planned in order to supply pressure levels that were compatible with corona-free pressures experienced during ground testing. A maximum of 76 micrometers and a minimum of 53 micrometers were recorded during the flight.

1.7 CALIBRATE MODE OPERATION

Calibration was conducted on rev 941. Four separate calibration operates were programmed at 20-degree intervals using EK 3401 film in the terrain camera. Analysis of the star imagery and calibration potential of this operation is in process. This ST System was the first to be modified for extended exposure time in the calibrate mode. Exposure time was increased from 2.2 to 3.4 seconds in order to increase the number and density of recorded star images.

1.8 SUMMARY OF ANOMALIES

There were no ST anomalies that resulted in loss of data needed to satisfy mission objectives; however, three minor anomalies were noted during the PFA. The discrepancies noted on the processed film were related to: a characteristic realignment of stellar film tracking during operates 1 and 2, density levels of two bits on the terrain data block, and minor plus density markings which occurred randomly on the stellar film.

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TABLE 1-1

CAMERA STATISTICS

Camera Designations	Terrain		+Y		-Y
Focal length, inches	12.0632		9.978		9.9856
Filter type	WR-12		None		None
Reseau S/N	013		014		015
Lens S/N	002		004		001
Supply spool S/N	110			201	
Supply film weight, pounds	56.0			10.6	
Film data					
Type, terrain	3414	MCD	QX801	MCD	3401
Length, feet	3243	2.0	20	2.0	40
Type, stellar	3401		3400		
Length, feet	1945		100		

TABLE 1-2

MISSION STATISTICS

Mission number	1209
Satellite vehicle	SV-9
Launch date	29 October 1974
Launch time	1930 GMT
Orbit inclination	96.692 degrees
Initial perigee	85.502 nautical miles
Initial apogee	156.00 nautical miles
Argument of perigee	168.557 degrees
Initial period	88.960 minutes
Range of photo altitudes (approx)	86-149 nautical miles
Range of sun angles	3-80 degrees

TABLE 1-3

RECOVERY STATISTICS

Recovery date	27 December 1974
Separation time	2124 GMT
Recovery rev	958
Comment	Routine air catch

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CAMERA OPERATION AND PERFORMANCE

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SECTION II

CAMERA OPERATION AND PERFORMANCE

2.1 PRELAUNCH OPERATIONS

This section briefly outlines the test and integration functions following shipment from the manufacturing facility.

2.1.1 Test and Integration Summary

Following customer acceptance at the manufacturing facility, the system was shipped to the celestial calibration site for starfield calibration. Calibration operations were conducted from 23 July 1973 through 3 August 1973. Upon completion of the calibration, the unit was shipped to the Integrating Contractor's facility on 7 August 1973 for integration and test prior to flight.

Starting on 7 August 1973 and continuing through 27 August 1973 activities necessary to prepare the ST system for mating with the structural assembly, recovery vehicle, and the doppler beacon system, were completed. During this time, preliminary functional tests were conducted, initial film tracking was established, and exposure levels of ancillary data were determined.

Approximately 12 weeks were required to complete module level tests prior to mating the Mapping Camera Module (MCM) with the satellite basic assembly (SBA). The data from these tests serve as baselines throughout the remainder of the integration cycle. By 15 October 1973, anomalies were corrected; functional tests, light leak tests, film tracking, and roller pinning were completed successfully. Mating of the (MCM) with the SBA was accomplished on 29 October 1973.

Performance and acoustic tests were completed without major anomalies and preparations were started for vacuum chamber testing.

Two vacuum chambers, designated A-1 and A-2, are used for vacuum testing of the ST system. The A-1 chamber test provides thermal data and information critical to determining a corona-free pressure range for both the stellar and terrain cameras. The A-2 chamber test supplies the data necessary to evaluate film flatness. Module level testing [stellar terrain and auxiliary payload structure assembly (APSA)] can only be accomplished in the A-1 chamber.

Vacuum tests in the A-1 chamber were completed successfully between 14 January and 21 January 1974. During these tests, four pressure sweeps were conducted; sweeps 1 and 2 were run with EK 3414 film in the terrain unit, and EK 3400 in the stellar unit, while 3 and 4 were run with EK 3400 in the terrain unit and EK 3401 in the stellar unit. On completion of the A-1 test, the vehicle was moved into the A-2 chamber for further vacuum testing. These tests were completed on 13 February 1974 and the film was retrieved for evaluation.

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Evaluation of corona/pressure data from the terrain units showed that a minimum level of corona marking occurred in the 40- to 60-micrometer pressure range. An orifice was selected that would produce the desired pressure range during flight.

Following completion of the EMI-EMC tests on 19 February 1974, the MCM was removed from the SBA to incorporate a modification on the terrain camera. This modification increased the exposure times from 3, 6, or 12 milliseconds to 6, 12, or 24 milliseconds to accommodate use of the slower EK 3414 film. The following subassemblies were removed and returned to the factory for rework:

Subassembly	Required Rework
Rotary shutter	Increased exposure
Terrain platen press	Servo pot modification
Terrain capping shutter	Investigation of misaligned servo pot
Terrain thermal shutter	Replacement of gears
Terrain transport	Platen press modifications associated with above modifications
MISEA PC cards	

The above items were all returned to the Integrating Contractor's facility, and the camera was installed in the structural assembly on 29 March 1974.

The camera unit was again removed from the SBA for rework of the +Y shutter due to binding, replacement of the -Y shutter due to excessive noise, and replacement of the electrical distribution and power unit (EDAP) due to a suspect K-3 relay failure.

Performance test data, subsequent to SBA mating, resulted in another demating and the return of: the terrain rotary shutter for pot replacement; the main instrument system electronics assembly (MISEA) for correction of an interface resistance problem; and the terrain thermal shutter for correction of a broken wire in heater zone 7.

Reassembly of the camera unit to the structural assembly, satisfactory retest, and remate of the MCM to the SBA was completed on 16 July 1974. Since extensive changes and repairs had been accomplished, a full performance test was conducted and completed without incident on 17 July 1974.

Flight loading was completed on 26 August 1974 and the vehicle was shipped to the launch base on 8 October 1974. The final confidence run was conducted and launch occurred on 29 October 1974.

The chronological occurrence of the important test milestones, covering activities at the integration facility, is indicated in Table 2-1. The complete test history for SN 002 is detailed in the following reports:

1. Acceptance Test Report ST Subsystem, CEI System Assembly Number 152000G2, SN 002, 6 July 1973.
2. Addendum I, Acceptance Test Report (Flight Readiness Report), CEI System Assembly Number 152000G2, SN 002, 20 August 1973.

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TABLE 2-1

INTEGRATION/TEST SUMMARY

Activity	Completed
Received system	7 August 1973
Material change detector failure (replaced K-17 relay)	16 August 1973
Receiving/functional	17 August 1973
Replaced A-55 card (transferred to SN 004) [field service bulletin(FSB) 131]	29 August 1973
Replaced failed A-52 card (FSB 132)	29 August 1973
Replaced A-49 card to correct B mode transport anomaly (FSB 135)	5 September 1973
Film tracking	8 September 1973
Replaced A-68 (transferred to SN 004) (FSB 136)	24 September 1973
Installed U transport SN 003 (transferred to SN 004) (FSB 138)	24 September 1973
MCM functional	26 September 1973
Changed "select at test" (SAT) resistors to adjust U reseau densities	27 September 1973
Alpha test (light leak)	2 October 1973
Cleaned D reseau	8 October 1973
Positioned baffle to prevent -Y shutter interference (FSB 142)	11 October 1973
Mated MCM to SBA	29 October 1973
Satellite vehicle (SV) performance test	13 November 1973
Safety shutter failure (clearance adjusted)	16 November 1973
Acoustic test	19 November 1973
D capping shutter problem (returned to factory for pot alignment)	28 November 1973
Installed special film loads for A-1 test. Removed and returned U transport SN 003 to factory, which was temporarily installed (FSB 145). Installed U transport SN 008.	6 December 1973
Replaced 10 electronics cards having suspect resistors (FSB 147)	6 December 1973
Rotary Shutter phase lock problem (later corrected)	10 January 1974
A-1 chamber test	21 January 1974
A-2 chamber test	8 February 1974
EMI-EMC test	13 February 1974
Demated	22 February 1974
Removed mapping camera from APSA for exposure modifications	25 February 1974
Removed rotary shutter, D platen press, D capping shutter, D transport, and D thermal shutter (FSB 169, 170, 180, 171, 168A, 182, and 185)	28 February 1974
Rewired D transport harness for D press monitor (FSB 156)	
Returned A-26 and A-68 cards for update	5 March 1974

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TABLE 2-1

INTEGRATION/TEST SUMMARY (CONT.)

Activity	Completed
Repainted MISEA (FSB 129)	13 March 1974
Rework of safety shutters to prevent binding (FSB 179, 187, and 188)	21 March 1974
Replaced microswitches on +Y shutter (reliability) (FSB 178)	26 March 1974
Mapping camera installed in APSA	29 March 1974
Reinstalled MISEA cards (FSB 171, 185, and 195)	1 April 1974
Changed EDAP hardware to prevent 28-volt short to structure (FSB 196)	8 April 1974
Reselected rotary shutter B mode SAT resistors	9 April 1974
Replaced A-19 card (FSB 199)	10 April 1974
D platen press calibration	12 April 1974
Rotary shutter confidence test	12 April 1974
Tested with 3401 for C mode fiducials	15 April 1974
Tested with 3414 for normal fiducials	16 April 1974
Removed mapping camera from APSA	18 April 1974
Reworked +Y shutter to prevent binding (FSB 197)	18 April 1974
Replaced -Y shutter due to excessive noise (FSB 200)	23 April 1974
Replaced A-69 card due to broken terminal (FSB 198)	23 April 1974
Mated camera system to APSA	23 April 1974
Alpha test (light leak)	24 April 1974
Selected SAT resistors for -Y shutter	2 May 1974
Replaced SAT resistor for D platen press	3 May 1974
Repeated D platen press calibration	4 May 1974
Replaced A-10 and A-30 cards to prevent false shutter startups (FSB 206)	4 May 1974
B mode shutter timing adjustment (FSB 209)	4 May 1974
Repeated confidence test	4 May 1974
Reworked baffle safety shutters to prevent jamming (FSB 202)	6 May 1974
MCM functional	5 May 1974
Replaced S-1 on -Y baffle to correct TM indication	9 May 1974
Replaced EDAP (defective K-3 relay) and recalibrated aux. temp. sensors. (FSB 208, 030A)	9 May 1974
Reselected -Y reseau illuminator SAT resistors	10 May 1974
Modified functional test; D platen press calibration	10 May 1974

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TABLE 2-1

INTEGRATION/TEST SUMMARY (CONT.)

Activity	Completed
Mated MCM to SBA	20 May 1974
Performance test	21 May 1974
Investigated D thermal shutter; returned to factory due to broken wire associated with heater zone 7	29 May 1974
Demated	11 June 1974
Removed mapping camera from APSA	12 June 1974
Investigated isolation problem in MISEA	12 June 1974
Returned rotary shutter to factory SN 008 for pot replacement and A-10 card for terminal stitching (FSB 212, 216)	12 June 1974
Returned MISEA to factory for correction of dc isolation problem (FSB 217)	19 June 1974
Reinstalled rotary shutter (FSB 218)	27 June 1974
Reinstalled mapping camera in APSA	28 June 1974
Reinstalled MISEA and A-10 PC card (FSB 224, 223)	1 July 1974
Reinstalled D thermal shutter (FSB 211)	1 July 1974
Conducted C mode test with 3401 film	2 July 1974
Reworked A-31 card for replacement of suspect SAT resistors	3 July 1974
Conducted receiving functional	5 July 1974
Removed terrain supply for flight loading	25 July 1974
Inspected terrain supply casting for possible cracks (FSB 283)	31 July 1974
Flight loading	26 August 1974
Preship functional tests	30 August 1974
Shipped to VAFB	8 October 1974
Pre-launch functional	10 October 1974
Launched 1930 hours GMT	29 October 1974

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3. Addendum II, Acceptance Test Report (Flight Readiness Report), CEI System Assembly Number 152000G2, SN 002, 19 July 1974.
4. Calibration Test Report Mapping Camera SN 002, 6 July 1973.
5. Acceptance Test Data, Mapping Camera SN 002, 4 October 1973.

2.1.2 Preflight Resolution Testing (Manufacturing Facility Only)

The collimator arrangement test unit (CATU) and the resolution test unit (RTU) are special test equipment used in optical testing of the ST system.

The CATU is used to determine terrain lens resolution, distortion stability, and camera knee angle stability. Results of the collimator tests verify specification parameters of the ST for acceptance prior to delivery. The CATU is not intended to provide the accuracy or precision required for absolute metric calibration.

Test resolution data for acceptance of the ST system is collected in the resolution test unit. An aerial image of a tri-bar target with simulated ground motion is projected by a parabolic collimating system through an optical window in the side of the test chamber and folded by three mirrors to permit format sampling at the ±0.85- and 0-field positions.

Resolution data from the CATU and RTU for SN 002 are shown in Table 2-2.

2.1.3 Vacuum Testing

Results of tests conducted in the vacuum chamber at the integration site, and the thermal vacuum chamber located at the ST Contractor's facility are utilized to determine system pressures that can best provide corona-free photography in flight. Corona data are acquired empirically during ground testing by evaluating film that has been operated through various pressure sweeps. When it is determined that a corona-free pressure range is compatible for both stellar and terrain film loads, the gas orifice that produced this pressure is selected for flight. Factors such as film outgassing, the amount of moisture in the film supplies, and the length of time on orbit are some of the parameters that add to the uncertainty of achieving total success.

2.1.4 Preflight Calibration

To accomplish starfield calibration at the celestial calibration site, the camera system is installed in a vacuum tank which is mounted on a synchronous drive equatorial mount. The vacuum tank is fitted with three calibrated windows to allow simultaneous photography by all cameras. Throughout the calibration, the camera is maintained in a vacuum which approaches the conditions of the operational environment. Approximately 50 exposures are made at various azimuth and elevation angles to optimize star image distributions for each calibration.

2.1.5 Major Configuration Differences

The following is a list of differences between SN 002 (SV-9) and SN 006 (SV-8).

1. Gear ratio on rotary shutter was changed to accommodate exposure requirements for EK 3414 film.

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2. Changes to A-26, A-30, A-48, A-68, and A-75 cards to meet requirements relative to increased exposure.

3. Changed terrain camera filter from WR-21 to WR-12 equivalent.

4. Changed A-55 card to meet requirements for increasing calibrate mode exposure from 2.2 seconds to 3.37 seconds. This change also affects start time, frame time, and stop time.

2.2 ON-ORBIT OPERATIONS

Acquisition requirements of ST photography are generated by the user, based on priorities of selected mapping areas, ephemeris data, weather predictions, fixed camera parameters, and selection criteria contained in the orbital software data base.

The ST system was operated on 150 revs between rev 3 and rev 950. A total of 2,033 operational frames were exposed in the terrain camera and a corresponding number of frame pairs were exposed in the stellar unit. Included were 14 frames of QX-801 in the terrain camera for engineering tests and 24 frames in each camera for in-flight stellar calibration. Film consumption versus rev and days on orbit is plotted in Figure 2-1.

During the runout sequence, a special tag end of EK 3400 was exposed in the stellar unit to judge this film's potential as the primary load in the stellar camera system. All film was recovered successfully and evaluation of the imagery acquired on the 3400 film is in process. Table 2-3 is a summary of the cycles operated and the film recovered.

The ST flight configuration in relation to the satellite vehicle is shown in Figure 2-2. A single terrain footprint from a nominal altitude of 92.5 nautical miles covers 140 nautical miles along track and 70 nautical miles across track. The overlap of the terrain camera frames is controlled to provide contiguous stereo models along the flight path using every other (triple overlap) or every third (quadruple overlap) frame in combination, depending on the stereo separation desired (see Figure 2-3, and photographic example of a stereo pair, Figure 2-4). Measurements of star image locations on the stellar frames are used to accurately orient the terrain camera axis in space at the time of each exposure.

To accomplish the operations necessary to satisfy mission objectives, the ST response is controlled by generating a command load which is transmitted to the command system of the satellite vehicle. Through a network of ground control stations, the satellite vehicle is capable of receiving updated command loads and transmitting telemetry data concerning the status of the ST system.

Several alternate operational modes of the ST camera are available to provide commands for specific events and to permit operation under certain failure conditions. These operation modes are listed in Table 2-4.

2.2.1 Launch and Orbital Conditions

The launch of 1209 took place on the first countdown attempt. Planned and achieved orbital parameters are listed in Table 2-5.

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TABLE 2-2

CATU AND RTU RESOLUTION, L/MM
(3400 Film, WR-12 Filter)

CATU			RTU		
-X/0.85	0	+X/0.85	-X/0.85	0	+X/0.85
44	47	44	44	45	42

TABLE 2-3

FILM RECOVERY SUMMARY

Rev	Operate	Frames Operated	Frames Recovered	Comments
1-914	165	1,999	2,063	Includes 64 frames operated prior to launch
930	166	8	8	QX-801 operates (includes MCD)
939	167	6	6	
941	168	6	6	3401 calibrate (includes MCD)
	169	6	6	
	170	6	6	
	171	8	8	
		16	0-D, 16-U	Last C mode operate extended to clear tag end of terrain film
942	172	218	218	Stellar only—runout (including 111 frames using 3400 material)
950	173	20		(+16 during last C mode)

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FILM CONSUMPTION VERSUS REV/DAYS

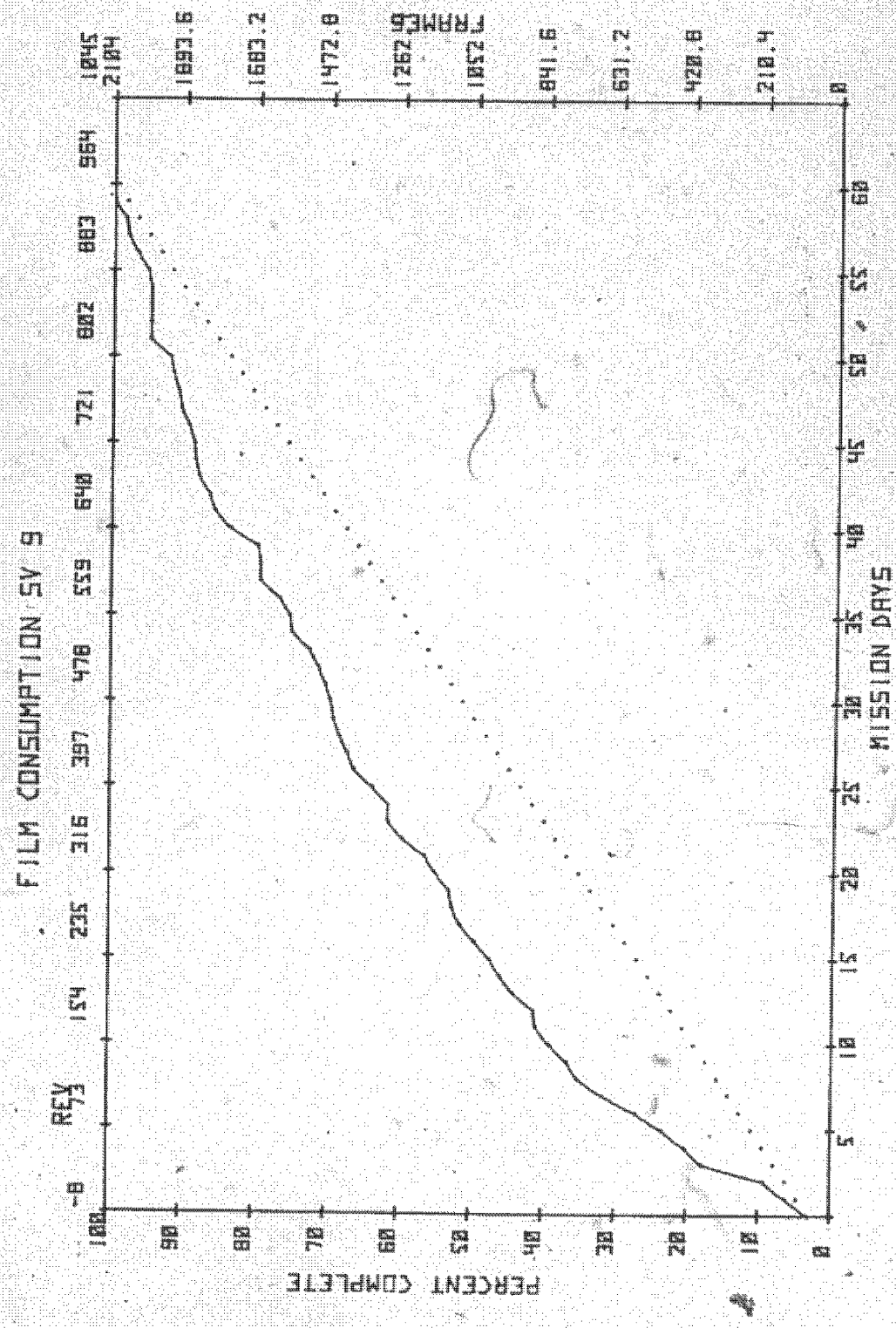


FIGURE 3.1

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HANDLE VIA
TALENT-KEYHOLE

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SATELLITE VEHICLE (92.5-NM NOMINAL ALTITUDE)

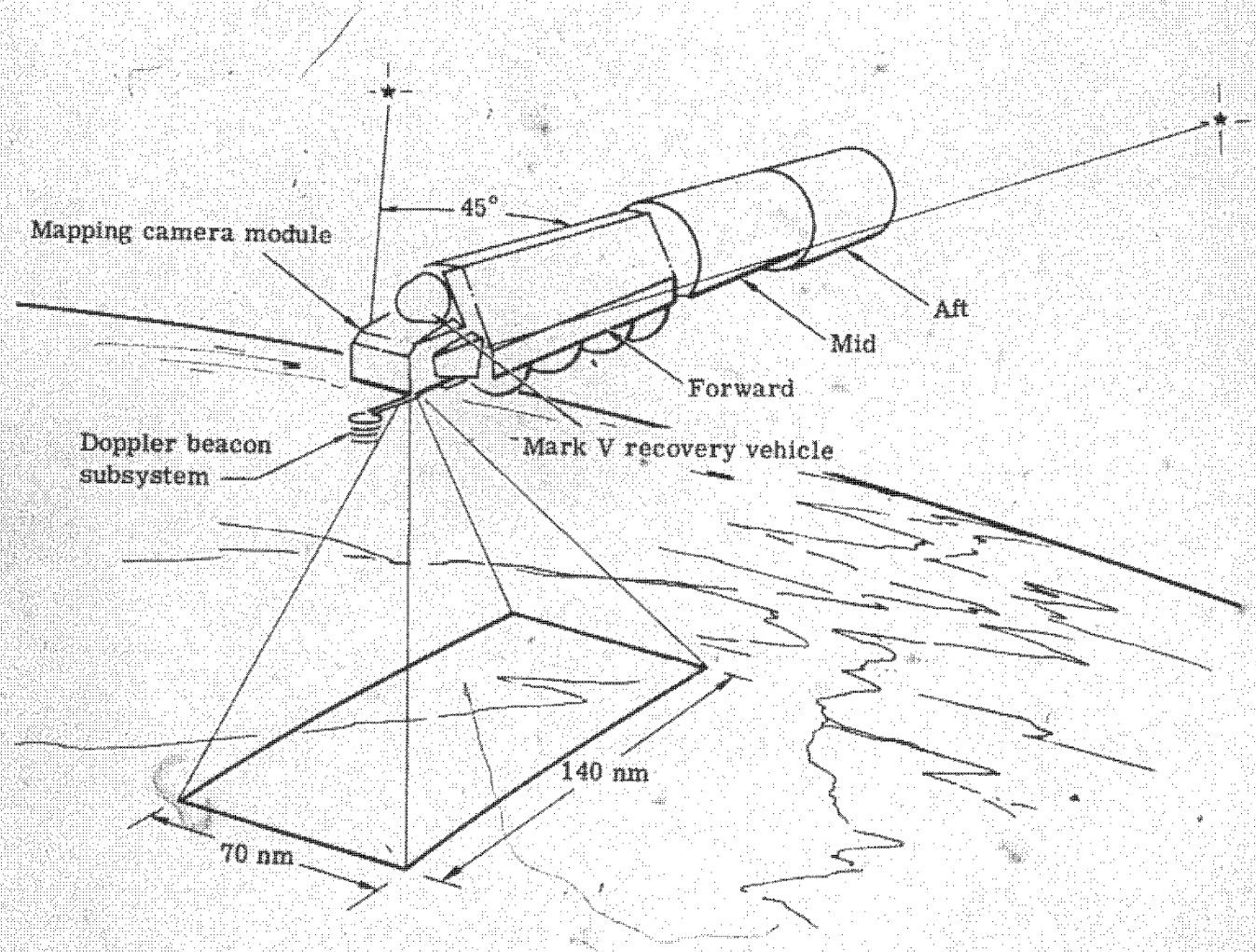
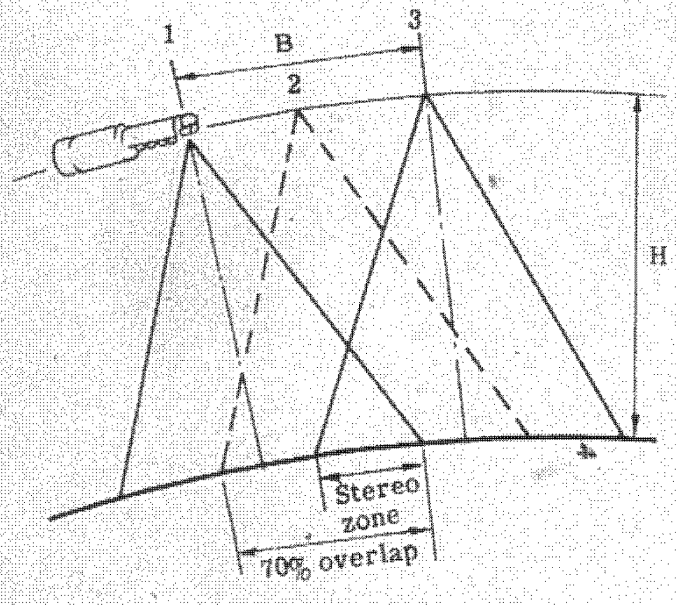


FIGURE 2-2

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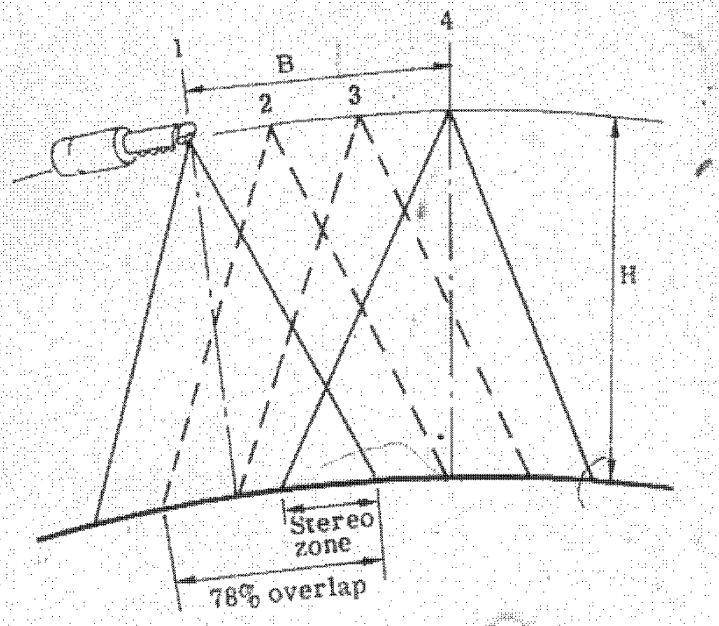
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MAPPING CAMERA OVERLAP/STEREO



Triple overlap; B/H = 0.9

(80 < H < 240 nm)



Quadruple overlap; B/H = 1.0

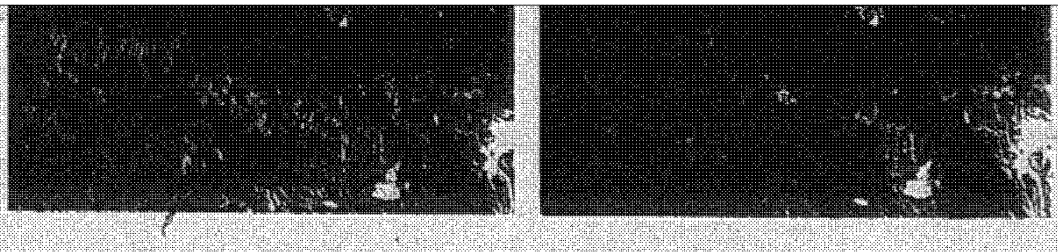
(100 < H < 240 nm)

FIGURE 2-3

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Terrain camera: Op 136; frames 001 and 003; meteor crater and Mormon Lake, Arizona; contact print

FIGURE 2-4

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TABLE 2-4

MODES OF OPERATION

- Standby
  - Heater power only
- Ascent mode
  - Film path tensioned
  - Stellar and thermal shutters closed (ascent condition)
- Normal mode
  - Primary photographic mission
  - $0.0165 > V/h < 0.0565$
  - Terrain exposure: 6, 12, 24 milliseconds
  - Overlap: 78%, 70%, 10%
- Backup mode
  - Backup operating mode in the event of an electrical malfunction in the normal mode
  - Terrain exposure: 12.4 milliseconds
  - FMC correct for nominal $V/h = 0.046$ } Fixed rate
  - Frame rate: 8.9 seconds nominal
  - 70 percent or greater overlap
- Calibration mode
  - Calibration condition
  - Frame time: 28.4 seconds
  - Exposure: 3.37 seconds
  - FMC inhibited
- Redundant modes
  - Command selection of parallel control circuits for terrain capping shutter, thermal shutter, stellar platen press, stellar transport
  - Command terrain thermal shutter open/reset
- Failsafe modes
  - Capping of either stellar shutter (shutter open malfunction)

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TABLE 2-5

PLANNED VERSUS ACTUAL ORBITAL PARAMETERS

	Planned	Actual
Launch time (GMT)	1930-2000	1930:00.255
Launch time (SVT)	–	70200.7
Inclination, degrees	96.799	96.692
Initial perigee, nautical miles	87.145	85.502
Initial apogee, nautical miles	158.585	156.00
Argument of perigee, degrees	160.191	168.557
Initial period, minutes	88.887	88.960
Beta angle control, degrees	+30 – (–) 8	Achieved

TABLE 2-6

SUMMARY OF SIGNIFICANT EVENTS

(SV-9, SN 002)

For sequence number identification, see Appendix

Rev	Activity	Comments
—	Ascent (A mode)	No anomalies
3	Photography	Health check with programmed ocean photography
32	Photography	Bar XC acquisition
259	Photography	Bar XC acquisition
340	Photography	Bar XC acquisition
632	Photography	Bar XC acquisition
930	Photography	QX 801 engineering
939	Photography	QX 801 engineering
941	Photography	ST in-flight calibration (4 operates)
942-950	Film runout	Successful stellar film runout event
958	RV 5 recovery	Successful air recovery of RV 5

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2.2.2 Sequence of Significant Events

A summary of all ST photographic operations is presented in Table 2-11. The summary includes engineering operates as well as mission photographic events. Table 2-6 lists a chronological description of the engineering operates and special nonphotographic events that occurred during the mission.

2.2.3 Thermal Profile

Thermal control for the mapping camera is achieved by a combination of passive and active techniques. Active methods are used where precise temperature levels are required; passive methods are used where rather broad limits suffice. Specifically, the main instrument temperature is maintained by thermostatically controlled heaters, while the supply cassettes and the takeups are controlled by virtue of their location within the passively controlled MCM and RV. The MISEA and EDAP are controlled by proper selection of external thermal finishes located exterior to the MCM.

The main instrument is surrounded by a thermostatically controlled heated structure that contains the heaters, temperature sensors, and a mylar laminated insulation blanket to reduce heat losses. A number of different heater zones are used for reliability and to ensure uniformity of temperature distribution.

The main instrument thermal requirement is to maintain the temperature at which the calibration was performed to within ±1 °F. The camera temperatures were stable throughout the mission, showing only slight deviations. Following on-orbit stabilization, the terrain camera average temperature was steady at 73.5 °F, while the stellar camera unit stabilized at 74.1 °F. Average temperatures for the MISEA and EDAP units were 36.3 degrees and 63.7 degrees, respectively. Average operational temperatures for the total mission are shown in Figures 2-5 and 2-6. Tables 2-7 through 2-9 show once-a-day temperatures taken in rev segments approximately every 36 degrees.

2.2.4 Pressure Profile

It was determined from ground test data that the best operating pressure range to minimize corona marking during flight was between 40 and 60 micrometers. Due to the increased moisture content of EK 3414 film relative to EK 3400, the pressure variation and upper limit was higher than previously experienced. A summary of typical pressures throughout the mission is shown in Table 2-10.

2.2.5 Image Quality

Using copies supplied by the processing facility, an extensive evaluation of all mission 1209 photography has been accomplished at the DMATC and at the ST contractor's facility. This evaluation included, but was not limited to, the following:

1. Subjective image evaluation
2. Visual edge matching (terrain only)
3. Relative density measurements
4. Terrain overlap checks

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INSTRUMENT TEMPERATURE

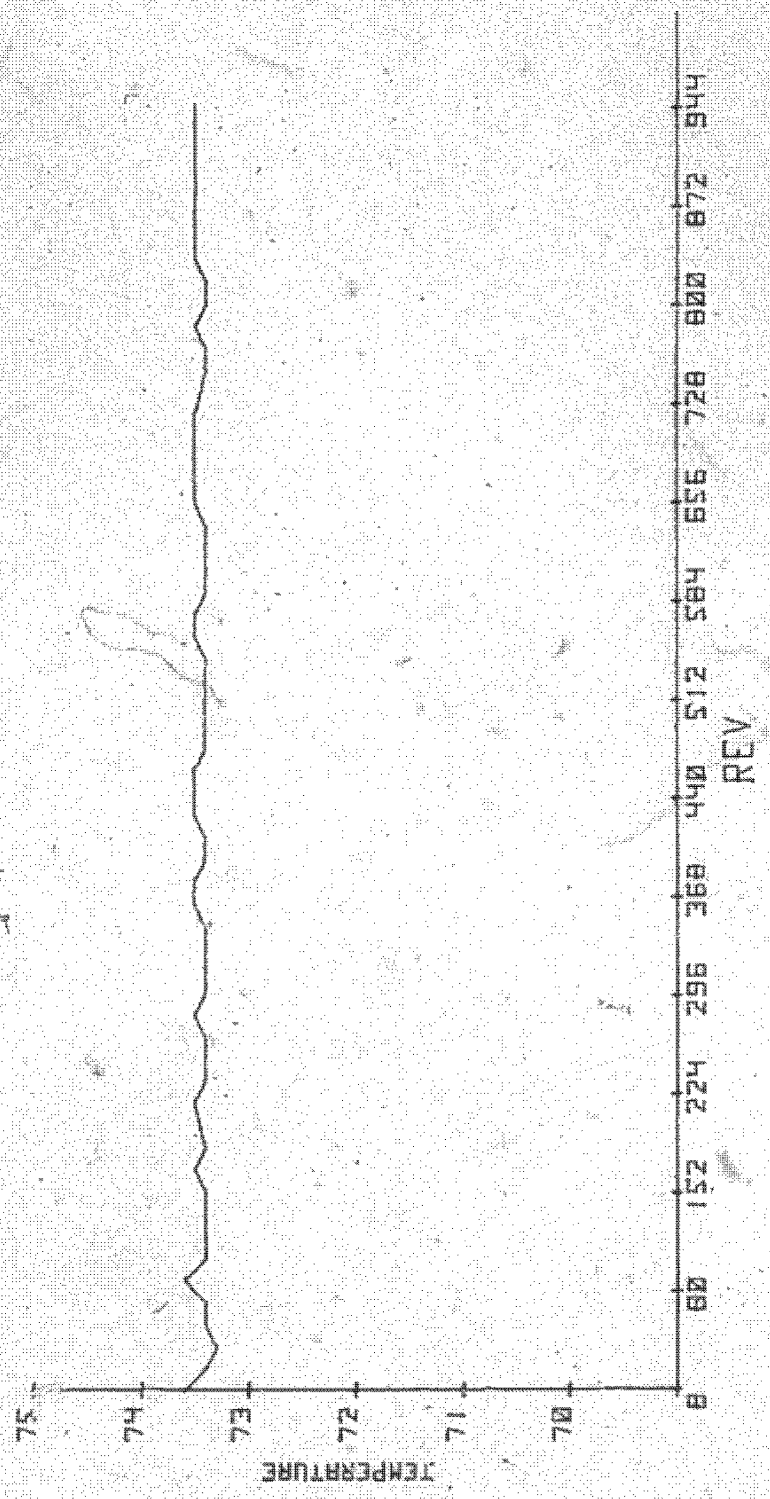


FIGURE 2-5

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MISSION 1209 TYPICAL TEMPERATURE DISTRIBUTION ON ORBIT

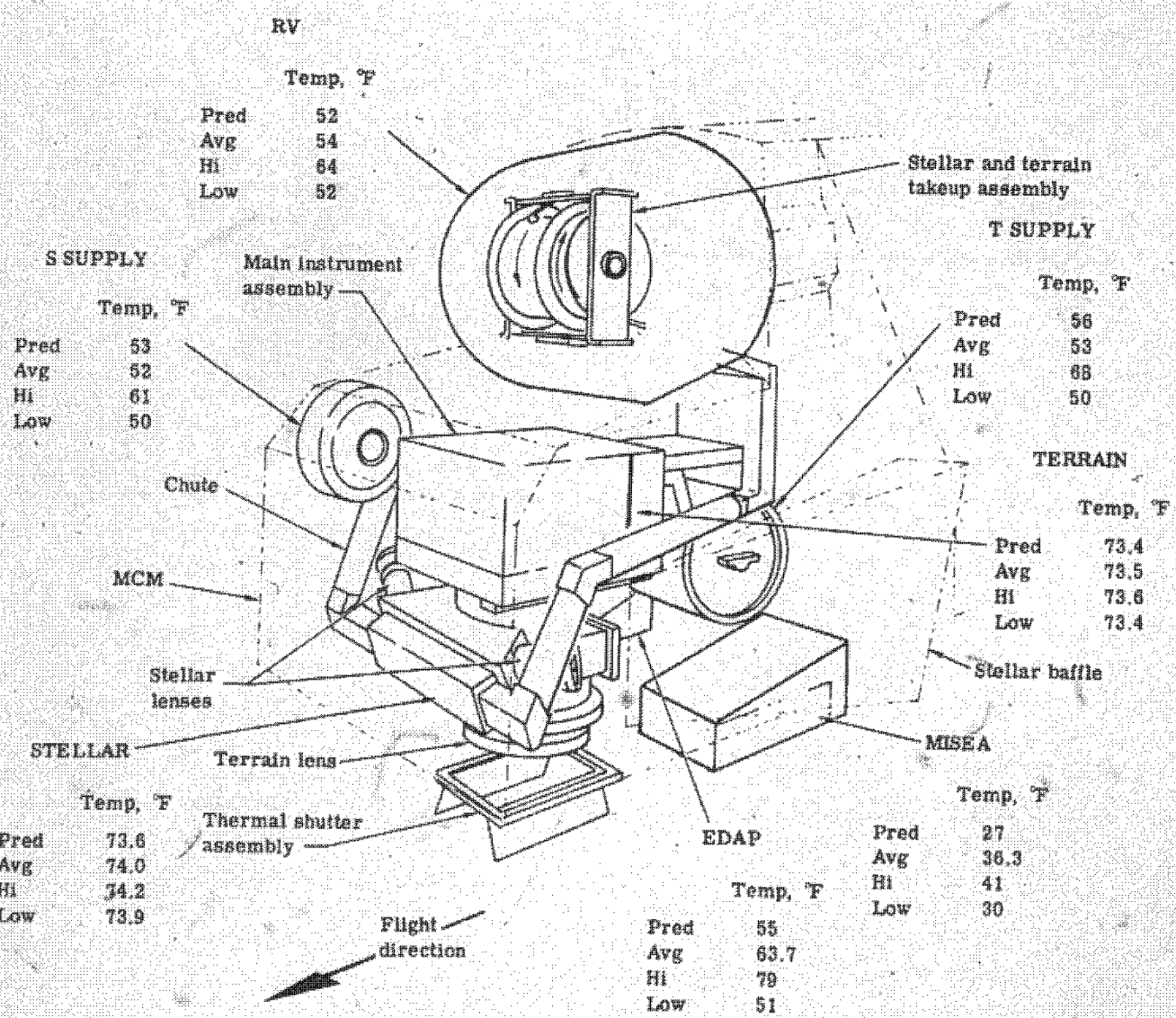


FIGURE 2-6

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TABLE 2-7

REV 7 ORBIT TEMPERATURES (°F)

Rev Seg.	Main Inst. Avg.	+Y Avg.	−Y Avg.	EDAP Avg.	MISEA Avg.	D Supply	U Supply	T/U	Lat.
7.3	73.6	74.2	74.1	55	35	58	57	63	83N
7.4	73.6	74.2	74.1	58	37	59	57	63	47N
7.5	73.6	74.2	74.1	68	49	71	62	63	11N
7.6	73.6	74.1	74.1	70	41	68	61	63	23S
7.7	73.6	74.1	74.1	79	41	65	60	63	59S
7.8	73.6	74.2	74.1	69	42	64	59	64	67S
7.9	73.6	74.1	74.2	63	42	63	58	63	27S
8.1	73.6	74.1	74.1	61	40	62	58	63	12N
Avg.	73.6	74.1	74.1	65	41	64	60	63	

TABLE 2-8

REV 376 ORBIT TEMPERATURES (°F)

Rev Seg.	Main Inst. Avg.	+Y Avg.	−Y Avg.	EDAP Avg.	MISEA Avg.	D Supply	U Supply	T/U	Lat.
376.5	73.5	74.5	74.1	62	32	52	51	53	9N
376.6	73.5	74.1	74.1	66	34	52	52	53	29S
376.7	73.5	74.1	74.0	72	35	52	51	53	62S
376.8	73.5	74.1	74.0	72	35	52	51	53	76S
376.9	73.5	74.1	74.1	66	40	52	51	53	44S
377.0	73.5	74.1	74.1	62	40	52	51	53	8S
377.1	73.5	74.1	74.0	59	38	53	51	53	27N
377.2	73.5	74.0	74.0	52	33	53	51	53	66N
Avg.	73.5	74.1	74.1	64	36	52	51	53	

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TABLE 2-9

REV 928 ORBIT TEMPERATURES (°F)

Rev Seg.	Main Inst. Avg.	+Y Avg.	−Y Avg.	EDAP Avg.	MISEA Avg.	D Supply	U Supply	T/U	Lat.
927.3	73.5	74.1	74.0	51	34	54	52	53	80.1N
927.4	73.5	74.1	74.0	55	33	54	52	52	42.9N
927.5	73.5	74.1	74.0	64	34	54	52	52	6.0N
927.6	73.5	74.1	74.0	66	35	54	52	52	30.8S
927.7	73.5	74.1	74.0	74	37	53	52	52	66.4S
927.8	73.4	74.1	74.0	75	39	53	51	52	81.4S
927.9	73.4	74.1	74.0	68	41	53	52	52	43.3S
928.0	73.5	74.1	74.0	63	41	53	52	52	7.4S
928.1	73.4	74.1	74.0	61	40	53	51	52	28.8N
Avg.	73.4	74.1	74.0	64	37	53.4	51.7	52	

TABLE 2-10

PRESSURE SUMMARY/1209
(Micrometers)

Rev	Max	Min	Avg
7	76	55	66
233	59	57	58
541	57	54	55
816	56	54	55
913	55	53	54
942	36	33	35 (U runout)

Stellar corona-free window—40 to 60 micrometers
Terrain corona-free window—0 to 65 micrometers

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5. Fiducials and reseau grids
6. Effects of corona
7. Flatness measurements
8. In-flight stellar calibration.

The image quality of terrain photography acquired on mission 1209, engineering tests from 1207/1208, and preflight resolution tests was comparable. Characteristic variations in image quality were noted across the format with the best imagery consistently occurring on the trailing end of the format. These differences are more obvious on EK 3414 film due to the increased image quality and resolution levels that can be achieved. Photographic examples are provided for a comparison of imagery acquired on all terrain systems flown to date: Figures 2-7 and 2-8 are composites of EK 3400 imagery on missions 1205 through 1208; Figure 2-9 compares the photography on EK 3414 from missions 1208 and 1209; Figure 2-10 is a composite of imagery acquired during mission 1208 on EK 3400 and imagery on EK 3414 acquired on mission 1209. Additional examples of 1209 imagery at 20× and 40× magnification are provided in Figures 2-11 and 2-12, respectively.

A subjective evaluation of the QX-801 engineering tests has shown that:

1. The resolution capability of QX-801 is nearly equal to EK 3414. (Typically, the EK 3414 frames produced an AWAR of 75-80 l/mm, while the typical AWAR using QX-801 was 70-75 l/mm.)

2. The limited spectral response (510 to 620 nanometers) had an apparent affect on the image quality and content recorded on QX-801. This film is penalized by not recording imagery in the 620- to 690-nanometer spectral range. Though resolution levels of QX-801 and EK 3414 are nearly identical, the information content of EK 3414, which can record imagery to 690 nanometers, was greater. An apparent loss of contrast in most QX-801 imagery was also attributed to the limited spectral response of this film.

3. QX-801 is more sensitive to markings induced by normal handling and system tracking than the EK 3414 film.

It appears that, as currently manufactured, QX-801 film does not exhibit any features that would qualify its use in place of EK 3414. However, should the spectral range of QX-801 be expanded, similar to that of EK 3414, the additional speed and information content could present a totally different output that would merit further evaluation. Figure 2-13 shows a comparison of EK 3414 and QX-801 imagery acquired on mission 1209.

The stellar imagery from both units was considered good to excellent with an adequate distribution of sixth magnitude stars. Figure 2-14 shows typical examples of characteristic variations in star images acquired on a stellar format. Figure 2-15 is a composite of 8 frames to graphically capture a fast moving object traveling in the same general direction as the vehicle..

Exposure

The exposure algorithm, derived from laboratory and engineering tests, resulted in correct exposure of the majority of operational photography.

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Image Analysis Using VEM

VEM analysis was conducted using a matrix calibrated for EK 3414 film. The average VEM resolution read by PFA Team members (Contractor and DMATC personnel) was 80 l/mm.

2.2.6 On-Orbit Calibration

In addition to the preflight calibration data, two additional calibration steps were conducted in flight. The two in-flight calibrations, range and stellar, are distinctly different operations.

Range calibration was conducted while operating the camera in the normal mode over a ground range containing accurately measured control points (typical range is the Bar XC located in Arizona/New Mexico).

Stellar calibration requires the vehicle to be pitched to an attitude that points all three camera lenses at the stars. This was accomplished in four separate operations at the end of mission 1209 by operating in the calibrate (C) mode to record star imagery on the terrain and stellar formats simultaneously. Evaluation has shown that star imagery was adequate for system calibration.

2.2.7 Anomalies—Telemetry

Two data anomalies were observed during operations of mission 1209. On rev 154, Op 1, the stellar platen press telemetry indicated "No Press" on frame 4 and erratic press operation on frames 3, 5, 6, and 7. Also, on revs 7, 628, 658, and 752, the capping shutter telemetry (S 204) indicated "Closed." (This was a known telemetry discrepancy prior to launch.)

Mission photography did not reflect any operational malfunctions related to the two telemetry anomalies.

2.2.8 Anomalies—System

Three anomalies were noted during the PFA activity, none of which affected utilization of photography.

Anomaly (Action Item)

A slight shift of the stellar film tracking occurred during the first two operates.

Analysis

The change in position of the stellar film with respect to stellar reseau observed on this mission is a system characteristic that has been noted on all systems. This condition is most obvious when one or both reseau serial numbers are partially on the edge of the format. The film position change results from the fact that the transport and chute rollers are, by design, wider in the flange-to-flange distance than the 70-mm width.

The initial tracking, performed during ground test, requires manipulation of 1/4-turn twists that change the direction and plane of the film as it enters and leaves the transport area. The film

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may be positioned by roller adjustment to be edge guided by one or more roller flanges. A characteristic of optimum tracking is observed by moving the film to the opposite edge of a roller; the film will then slowly return to its original position as the film is transported. If the film tends to return rapidly to one edge or the other, roller adjustments are made to the path to achieve the optimum condition.

An additional film perturbation results from motion in the articulated 1/4-turn twist rollers entering and leaving the transport region. The motion of these rollers is mechanically restricted by adjusting screws to a small angular deflection to allow for film path disturbances caused by structural dynamics, tension changes, and environmental conditions affecting the film.

A slight angular change within the restricted motion of the articulated rollers allows the film to seek its optimum path when affected by any one or all of the possible conditions noted.

The optimum path may result in the film tracking toward either the top or bottom flanges of the transport rollers, thus causing the apparent displacement of the serial numbers with respect to the edge of the film. Without this allowable freedom of motion, tracking the film reliably through 1/4-turn twists in the stellar unit would be an extremely difficult task.

The condition in question is characteristic of all systems and has had no observed affect on the end product. Measurements made at DMATC have determined that the change in stellar tracking did not affect film flatness characteristics.

Anomaly

There was a discrepancy in the intensity of two bits of the data block. These bits are located in the array at column 2, row 3, and column 3, row 4.

Analysis

Density measurements show the density of the two bits to be 0.17 density unit higher than the surrounding bits when commanded "On" and 0.13 density unit above background fog when in the "Off" mode. The current level of the data block has been increased considerably to accommodate the density requirements of EK 3414 film. As current levels are increased, the chances are greater for a cross-coupling effect to take place. This cross-coupling results in a sympathetic low density of some bits when in the "Off" condition.

The density levels of the two bits in question does not affect readout of the data block.

Anomaly

Minor plus density marks occurred randomly throughout the stellar film.

Analysis

The plus density marks were confined to the titled edge of the stellar film. It was not possible to establish correlation of marking to specific pressures, sit times, or point of origin. Approximately 5 percent of the stellar frames had a plus density pattern occurring at a frequency of 25.4 mm. Although the occurrence relative to the total mission was random, there did appear to be a higher concentration near the end of the mission.

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Conclusion

The marks appear to be electrostatic in nature, however, it is impossible to determine the exact cause or reason. The frequency of the marks indicates that the most probable source is a small imperfection in the roller surface or anodized coating. This is the first occurrence of this type of marking and the effects are considered to be minor. No further analysis is contemplated at this time.

2.2.9 Anomalies—General

Anomaly

The stellar film from all missions has shown varying degrees of density increases in the base fog levels. Mission 1205 was the most severely affected operation and resulted in degradation and loss of some stellar imagery. The stellar fogging continued to appear in lesser degrees on missions 1206, 1207, and 1208. On mission 1209, high fog levels again affected a portion of the stellar imagery. This anomaly appears to be associated with atmospheric related radiation and is not considered to be a camera system malfunction.

Analysis

The stellar film from mission 1209 has been the focal point of the most comprehensive analysis performed on the fogging problem. An attempt is being made to isolate the most seriously affected portion of the film path and to correlate the high base fog values with sit periods, radiation values recorded during flight, temperature, recovery of pan system RV's, and/or any vehicle maneuvers taking place during the mission.

Conclusion

There has not been sufficient time to logically draw conclusions from the data that has been assembled to date. However, sufficient information has been sorted out to isolate the locations in the stellar film path that are most affected by radiation.

A small section of the stellar film chute on system SN 001 (mission 1210) will be covered with aluminum tape to reduce the film's susceptibility to radiation. The results of this shielding experiment and preceding analysis will be presented in the PFA report for mission 1210.

2.2.10 System Functional Measurements

To assess the system functional performance, the mission material was subjected to various mechanical/optical measurements specified for:

Film tracking
Frame metering distance
Frame format size
Overlap
Data block
Image study.

All measured items are within specified tolerances.

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2.3 SOLO OPERATIONS

Following recovery of the RV, engineering and diagnostic operations are programmed for the ST system. Solo operations provide analytical data for anomalies occurring during the mission, and provide support data for maneuvers and operations considered for future flights. A summary of solo activities is presented in Table 2-12.

2.3.1 Significant Solo Activities

The terrain thermal shutter emergency open function is exercised to test capability. When the command is executed successfully, the door is kept open to permit monitoring of temperatures/time to stabilization of the system. The first attempt to actuate the thermal door in the emergency mode was conducted on rev 1006 and was unsuccessful. The second attempt to actuate the emergency command was conducted successfully during rev 1069. This was conducted during a portion of the orbit that presented the warmest environmental conditions for the thermal door. The thermal shutter emergency commands were again successfully operated on revs 1120 and 1165.

At no time during this exercise was the normal mode of operation affected. This failure is similar to the unsuccessful attempts to actuate the emergency open mode during solo operations of missions 1207 and 1208. This anomaly is currently under investigation.

The remainder of the normally programmed solo activities were completed successfully.

2.3.2 Extended Solo Activities

In order to acquire maximum data from each system, solo activities were extended through rev 2254. Operations conducted during the period following routine solo functions were designed to acquire data pertaining to operational limits, time in orbit, and analysis of past/potential problems. Solo operations after rev 1298 included subjecting the camera system to out-of-specification conditions and commands. A complete listing of solo tests and results is being published in a separate report.

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TABLE 2-11

MISSION SUMMARY

Revs Successful Operate		Revs Able But No Operates	Revs/w Anom.	Revs Inhibit	Total Revs	Comments
		1-2			2	
3	Op 1					2 fr Op—Health check
		4-6			3	
7	Op 2					32 fr
7	Op 3					17 fr
8	Op 4					16 fr
		9-21			13	
22	Op 5					22 fr
22	Op 6					9 fr
23	Op 7					15 fr
24	Op 8					19 fr
		25-28			4	
29	Op 9					17 fr
		30-31			2	
32	Op 10					8 fr—Bar XC
32	Op 11					14 fr
		33-37			5	
38	Op 12					44 fr
39	Op 13					23 fr
39	Op 14					29 fr
40	Op 15					9 fr
40	Op 16					9 fr
40	Op 17					17 fr
41	Op 18					10 fr
42	Op 19					9 fr
		43-54			12	
55	Op 20					11 fr
56	Op 21					6 fr
57	Op 22					9 fr
58	Op 23					11 fr
59	Op 24					6 fr
		60-61			2	
62	Op 25					10 fr
		63-69			7	
70	Op 26					20 fr
71	Op 27					9 fr
72	Op 28					14 fr

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs/w Anom.	Revs Inhibit	Total Revs	Comments
	73				
74 Op 29					14 fr
	75-77			3	
78 Op 30					14 fr
	79-86			8	
87 Op 31					16 fr
88 Op 32					5 fr
88 Op 33					25 fr
89 Op 34					7 fr
89 Op 35					10 fr
	90-93			4	
94 Op 36					9 fr
	95-96			2	
97 Op 37					8 fr
	98-102			5	
103 Op 38					8 fr
103 Op 39					6 fr
104 Op 40					23 fr
105 Op 41					8 fr
105 Op 42					12 fr
105 Op 43					12 fr
106 Op 44					12 fr
	107-112			6	
113 Op 45					9 fr
	114-117			4	
118 Op 46					8 fr
119 Op 47					12 fr
120 Op 48					23 fr
121 Op 49					20 fr
	122-128			7	
129 Op 50					14 fr
	130-135			6	
136 Op 51					16 fr
	137-150			14	
151 Op 52					6 fr
152 Op 53					11 fr
152 Op 54					11 fr

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs w/ Anom.	Revs Inhibit	Total Revs	Comments
	153				
154 Op 55					10 fr
154 Op 56					6 fr
	155-156			2	
157 Op 57					7 fr
	158-160			3	
161 Op 58					8 fr
	162-166			5	
167 Op 59					8 fr
	168				
169 Op 60					25 fr
	170-184			15	
185 Op 61					6 fr
	186-200			15	
201 Op 62					22 fr
201 Op 63					11 fr
202 Op 64					12 fr
	203				
204 Op 65					9 fr
	205				
206 Op 66					7 fr
	207-215			9	
216 Op 67					12 fr
216 Op 68					8 fr
	217-218			2	
219 Op 69					11 fr
220 Op 70					7 fr
	221-232			12	
233 Op 71					22 fr
	234				
235 Op 72					9 fr
	236-248			13	
249 Op 73					21 fr
250 Op 74					15 fr
	252				
253 Op 75					7 fr
	254-258			5	
259 Op 76					10 fr—Bar XC

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs/w Anom.	Revs Inhibit	Total Revs	Comments
	260-263			4	
264 Op 77					13 fr
265 Op 78					11 fr
	266				
267 Op 79					10 fr
	268-281			14	
282 Op 80					8 fr
283 Op 81					15 fr
299 Op 82					10 fr
	300-312			13	
313 Op 83					11 fr
314 Op 84					11 fr
	315				
316 Op 85					10 fr
	317-328			12	
329 Op 86					8 fr
330 Op 87					20 fr
	331				
332 Op 88					10 fr
	333-339			7	
340 Op 89					9 fr—Bar XC
	341-345			5	
346 Op 90					23 fr
347 Op 91					27 fr
348 Op 92					7 fr
	349-361			13	
362 Op 93					7 fr
362 Op 94					11 fr
363 Op 95					8 fr
364 Op 96					9 fr
	365				
366 Op 97					6 fr
	367-393			27	
394 Op 98					13 fr
394 Op 99					10 fr
395 Op 100					6 fr
396 Op 101					8 fr
397 Op 102					10 fr

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs w Anom.	Revs Inhibit	Total Revs	Comments
	398-409			12	
410 Op 103					12 fr
411 Op 104					15 fr
412 Op 105					8 fr
412 Op 106					5 fr
413 Op 107					13 fr
	414-426			13	
427 Op 108					8 fr
428 Op 109					13 fr
	429-442			14	
443 Op 110					5 fr
	444-445			2	
446 Op 111					10 fr
447 Op 112					8 fr
	448-458			11	
459 Op 113					11 fr
	460-462			3	
463 Op 114					6 fr
	464-475			12	
476 Op 115					8 fr
	477-491			15	
492 Op 116					5 fr
492 Op 117					4 fr
	493				
494 Op 118					7 fr
	495-510			16	
511 Op 119					15 fr
512 Op 120					6 fr
	513-526			14	
527 Op 121					18 fr
528 Op 122					8 fr
	529-532			4	
533 Op 123					8 fr
	534-539			6	
540 Op 124					11 fr
541 Op 125					21 fr
	542				
543 Op 126					9 fr

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs/w Anom.	Revs Inhibit	Total Revs	Comments
	544-548			5	
549 Op 127					7 fr
	550-572			23	
573 Op 128					12 fr
	574				
575 Op 129					11 fr
575 Op 130					8 fr
	576-589			14	
590 Op 131					27 fr
	591				
592 Op 132					28 fr
	593-622			30	
623 Op 133					8 fr
	624-627			4	
628 Op 134					10 fr
629 Op 135					13 fr
	630-631			2	
632 Op 136					9 fr—Bar XC
	633				
634 Op 137					6 fr
	635-637			3	
638 Op 138					17 fr
	639-640			2	
641 Op 139					25 fr
	642-644			3	
645 Op 140					9 fr
	646-653			8	
654 Op 141					26 fr
	655-657			3	
658 Op 142					10 fr
	659-663			5	
664 Op 143					17 fr
	665-685			21	
686 Op 144					4 fr
	687				
688 Op 145					16 fr
	689				
690 Op 146					9 fr

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs/w Anom.	Revs Inhibit	Total Revs	Comments
	691-703			13	
704 Op 147					11 fr
	705-721			17	
722 Op 148					5 fr
	723-735			13	
736 Op 149					7 fr
	737-738			2	
739 Op 150					8 fr
	740-751			12	
752 Op 151					5 fr
	753-754			2	
755 Op 152					18 fr
	756-765			10	
766 Op 153					3 fr
	767-770			4	
771 Op 154					5 fr
	772-786			15	
787 Op 155					9 fr
787 Op 156					6 fr
	788-800			13	
801 Op 157					11 fr
	802-815			14	
816 Op 158					24 fr
	817				
818 Op 159					34 fr
	819-881			63	
882 Op 160					10 fr
	883-897			15	
898 Op 161					11 fr
899 Op 162					15 fr
	900-901			2	
902 Op 163					5 fr
	903-912			10	
913 Op 164					11 fr
914 Op 165					15 fr
	915-929			15	
930 Op 166					8 fr—QX 801

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TABLE 2-11

MISSION SUMMARY (CONT.)

Revs Successful Operate	Revs Able But No Operates	Revs/w Anom.	Revs Inhibit	Total Revs	Comments
	931-938			8	
939 Op 167					6 fr—QX 801
	940				
941 Op 168					6 fr }
941 Op 169					6 fr } Calibrate
941 Op 170					6 fr }
941 Op 171					8 fr }
950					Film runout

TABLE 2-12

SOLO OPERATIONS SUMMARY

Rev	Cycles	Event	Comments
1006	4	Thermal shutter emergency open	Did not open
1054	4	Emergency open reset	Normal operation
1069	4	Thermal shutter emergency open (warmer orbit sector)	Normal operation
1119	4	Emergency open reset	Normal operation
1120	4	Thermal shutter emergency open (colder orbit sector)	Normal operation
1135	—	Stellar safety shutters closed	Normal operation
1151	2	Emergency open reset	Normal operation
1151	5	Redundant electronics (OPS-1)	Normal operation
1168	5	Normal mode—converter 1 off	Normal operation
1168	5	Normal mode—converter 2 off	Normal operation
1184	5	Backup mode baseline	Normal operation
1184	5	Backup mode—converter 1 off	Normal operation
1184	5	Backup mode—converter 2 off	Normal operation
1265	4	Thermal shutter emergency open (colder orbit sector)	Normal operation
1266	4	Emergency open reset	Normal operation
1298	25	Operate with emergency open and reset	Normal operation

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PROCESSING AND REPRODUCTION

HANDLE VIA
TALENT-KEYHOLE
CONTROL SYSTEM ONLY

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SECTION III

PROCESSING AND REPRODUCTION

3.1 INTRODUCTION

This section, prepared by the Processing Facility, discusses defilming, processing, titling and reproduction of the mission 1209-5 Stellar and Terrain Camera original films.

3.2 RECEIPT AND DEFILMING

The RV arrived at the processing site at 0615 hours, EST, 28 December 1974. Both the stellar and terrain records were at the top of the takeup flanges and the material appeared in good condition. On 6 January 1975 down-loading of both records was accomplished. No static discharges were noted at any time and there were no problems during the despooling operation. The total weight of both payloads was 68 pounds.

3.3 PROCESSING AND OPTICAL TITLING

3.3.1 Processing

All operational camera records were processed on 7 and 8 January 1975. The terrain record was processed without incident. A high base plus fog of varying densities ranging from 0.43 to 1.49 appears throughout the 3401 stellar film (see Section 3.3.3). The Type 3400 film on the stellar record was processed on the Dundee Processor using experimental chemistries. Base plus fog on the 3400 was approximately 0.40.

Processing data are presented in Tables 3-1 and 3-2 with corresponding sensitometric curves in Figures 3-1 through 3-5.

3.3.2 Optical Titling of Operational Film

97.4 percent of the terrain 3414 film was optically titled. The first three operates were used for system synchronization and were manually titled on the Unimak Titler.

The stellar 3401 was not optically titled because of the inability to read frame marks at the point of detection (film ≈ 1/4 processed). The delta density between the base plus fog and frame mark density was insufficient for detection by the optical titling equipment.

3.3.3 Stellar Base Plus Fog

High and variable base plus fog levels were noted on the stellar film. Figure 3-6 shows the base plus fog densities measured on the 3401 original negative between the frame mark and data block of the first and last frames of a sampling of ops as an operator scanned the film looking for

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density changes. As this data was being collected, numerous instances of still higher base plus fog levels were noted within some ops. Those instances where the level exceeded 1.00 are listed in Table 3-3.

Two observations are made from looking at the base plus fog data. First, the level becomes higher and more variable around Ops 80-85. RV-1 was recovered on rev 310, which was between Ops 82 and 83 of the stellar. Similar correlation has been noted on previous missions. Second, looking through the raw density data, it appears that the highest base plus fog levels occurred on frame 5 of an operate.

TABLE 3-1

PROCESSOR AND DEVELOPER DATA

Camera	Film Type	Processor	Developer
Terrain	3414-43	Yardleigh 5	19DN
Terrain	QX-801-001	Yardleigh 5	29 DN
Terrain	3401-419	Versamat	MX-689
Stellar	3401-416*	Yardleigh 6	17DN
Stellar	3400-284	Dundee	27DN

*Approximately 75 feet at the tail of this material was not processed. It is being held for potential processing experiments.

TABLE 3-2

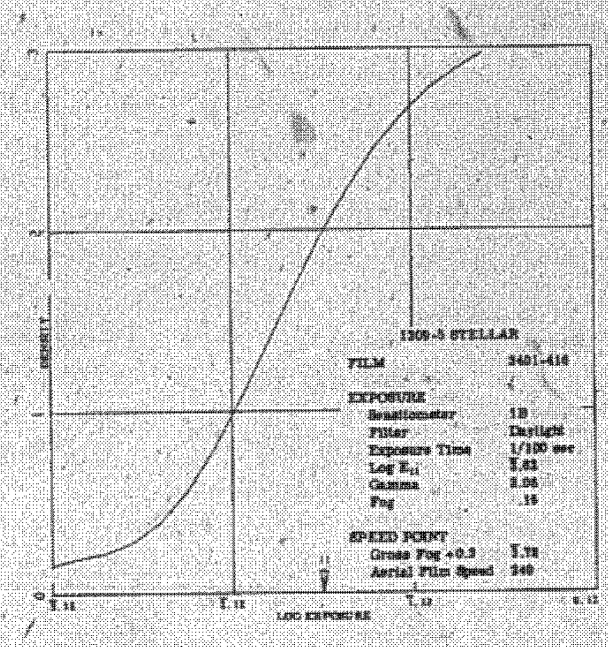
FRAME AND FOOTAGE DATA

	Stellar Camera	Terrain Camera
Operational frames	2,261 (pairs)	1,999
Other frames		
3400	20 (pairs)	—
3401	—	25
QX-801	—	14
Footage		
Pre/post flight	18	32
Operational		
3400	125*	—
3401	1,895	40
3414	—	3,236
QX-801	—	20

*Includes 25 feet from 1208-5.

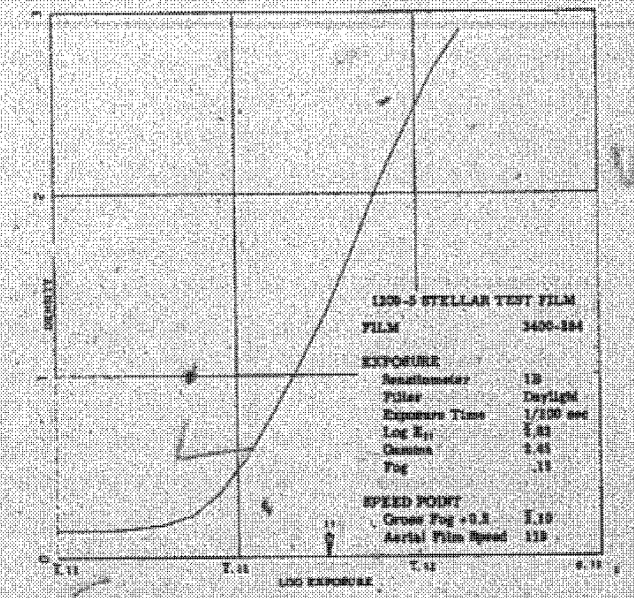
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PROCESSING CURVE, STELLAR, 3401 FILM

FIGURE 3-1

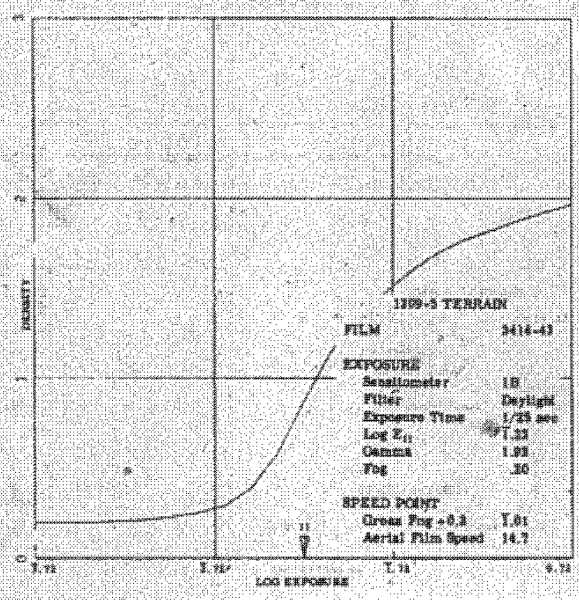


PROCESSING CURVE, STELLAR, 3400 FILM

FIGURE 3-2

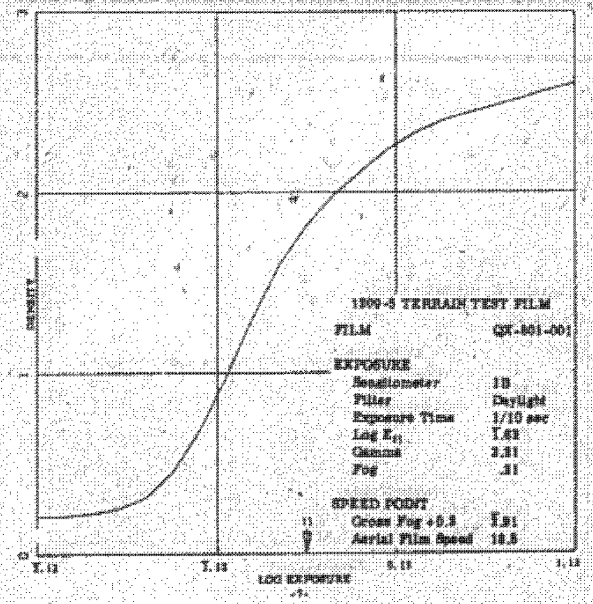
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PROCESSING CURVE, TERRAIN, 3414 FILM

FIGURE 3-3

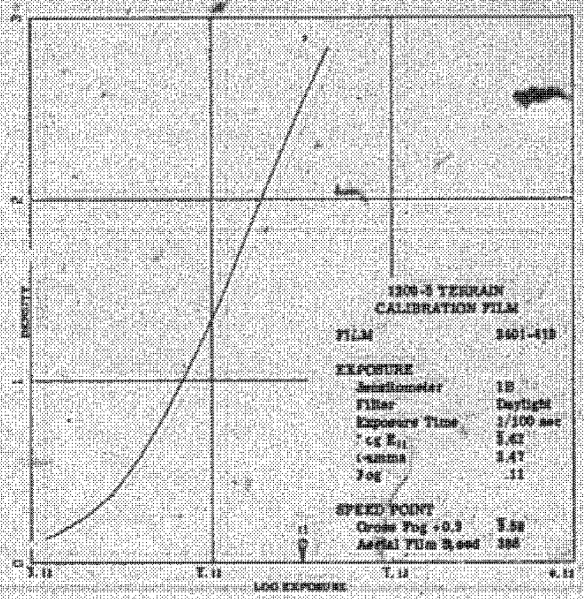


PROCESSING CURVE, TERRAIN, QX-801 FILM

FIGURE 3-4

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PROCESSING CURVE, TERRAIN CALIBRATION, 3401 FILM

FIGURE 3-5

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STELLAR BASE PLUS FOG DENSITIES

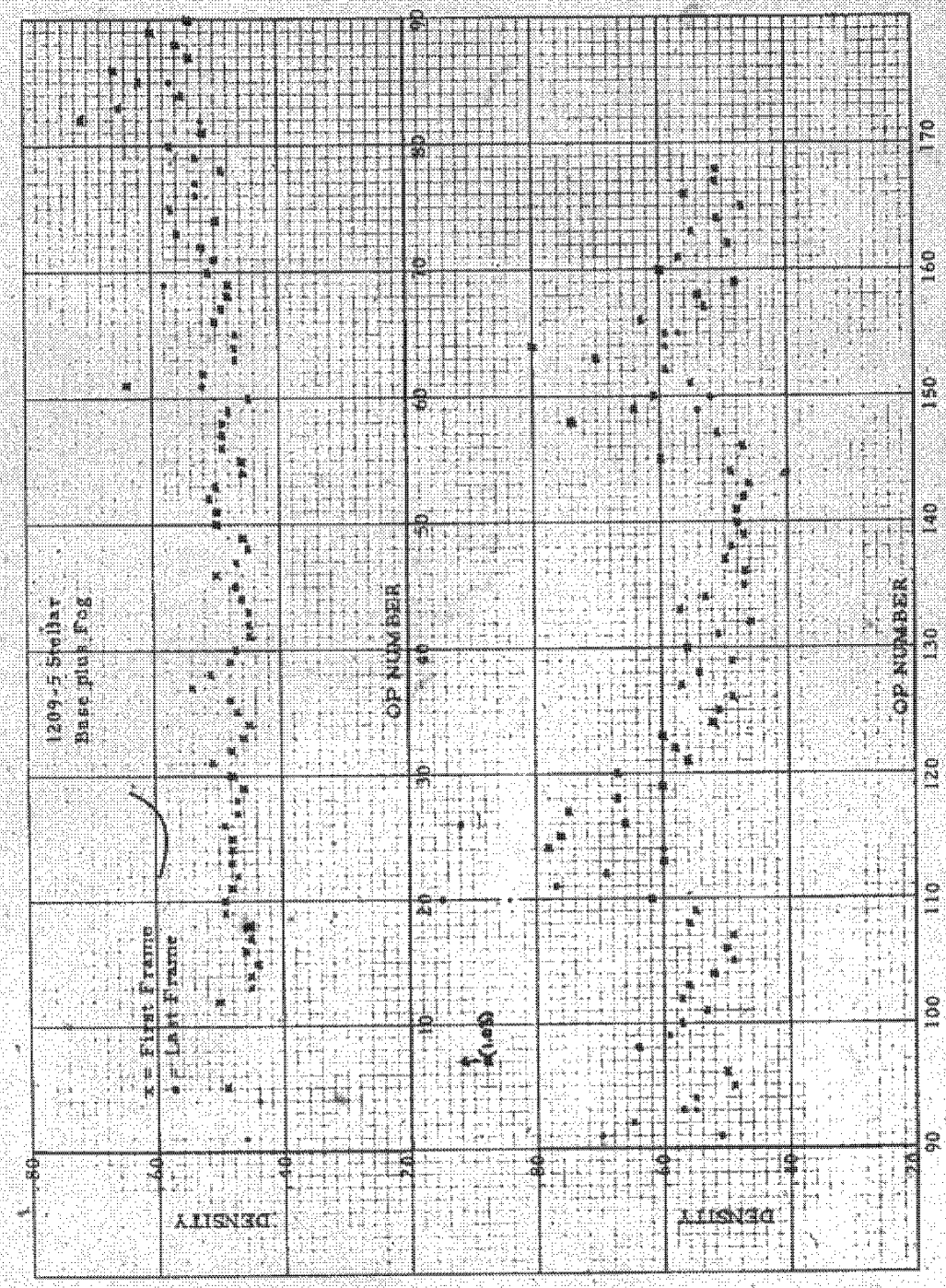


FIGURE 3-6

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TABLE 3-3

STELLAR BASE PLUS FOG

Op	Frame	B&F
81	11	1.20
	13	1.05
82	3	1.22
	5	1.46*
	6	1.31
83	5	1.08
85	7	1.01
86	5	1.01
89	5	1.00
97	1	1.03
	2	1.32
	4	1.17
98	3	1.15
	5	1.32
115	3	1.00
159	30	1.05
160	5	1.11

*1.49 on untitled edge.

3.4 SENSITOMETRY

Sensitometric exposures are used to establish and maintain process control. In the case of the original camera films, flight roll film samples are evaluated prior to mission arrival so that process conditions can be adjusted, if necessary, to obtain the optimum sensitometry for the particular batch of flight film involved. The mission records are then processed under these adjusted conditions with additional flight roll sensitometric strips attached. Sensitometric curves from these strips are shown in Figures 3-1 through 3-5 and are most representative of the sensitometry of those flight films.

3.5 REPRODUCTION

3.5.1 Breakdown

After processing, the operational original negatives were "broken down" into lengths not exceeding 325 feet on the terrain and 240 feet on the stellar. The ops were left in sequential order, with corresponding parts of the two records containing the same ops.

3.5.2 Printing

All duplicate copies were printed on the Kingston printers, using the Actinic-Butterfly Contrast Control (ABCC) technique. With certain film types, the ABCC method provides improved

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system sensitometry and flexibility in achieving the desired system contrast. Duplicate positives of the terrain 3414 were prepared using Kodak High Resolution Aerial Duplicating Film (Estar base) SO-192 and those for the QX-801 were prepared using Kodak Aerial Duplicating Film (Estar base) SO-284. The duplicate positives for the terrain 3401 and both stellar films were prepared using Kodak Aerographic Duplicating Film (Estar base) 2420. All duplicate negatives were prepared using Kodak Direct Duplicating Aerial Film (Estar base) 2422. Viscous Dalton processors were used for all duplicate processing. The system reproduction curves for these applications are shown in Figures 3-7 through 3-11.

3.6 TERRAIN CAMERA EXPOSURE ANALYSIS

Microdensitometer analysis of the 1209 terrain camera exposure indicated an underexposure of 0.06 log E for 3414 film. In consideration of exposure only, the associated algorithm error of 0.09 log E underexposure suggests an algorithm change. The recommended exposure algorithm for 3414 film with Wratten 12 equivalent filtration is included in this report.

Evaluation of only four samples of QX-801 imagery indicated some overexposure (0.08 log E) as acquired, but only 0.04 log E was traced to the exposure algorithm. No algorithm change is warranted for this film/filter combination in the future.

3.6.1 Basic Exposure Recommendation

The 1209 terrain camera exposure algorithm for 3414, and QX-801 films, through a W-12 equivalent filter, is a KSCOPE-generated curve. The actual exposure function used is a three-step function of solar altitude approximating this curve (Figure 3-12). In actual operation, the effective exposure time may vary from the nominal due to a V/h change.

3.6.2 Method of Analysis

Frame Selection for Microdensitometry

The microdensitometer analysis of terrain camera exposure was done based on the evaluation of 28 urban/industrial area acquisitions on 3414 and 4 on QX-801. The 3414 acquisitions were comprised of 15 vegetation surround scenes over a 20- to 70-degree solar-altitude range, and 13 acquisitions of snow surround below 20 degrees solar altitude. The 4 acquisitions of QX-801 were all of vegetation surround.

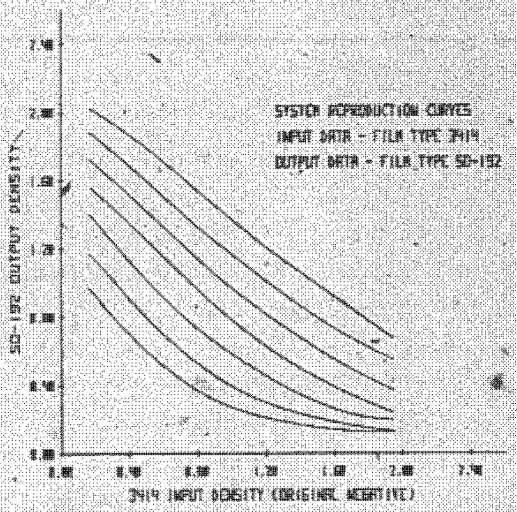
The PDS microdensitometer was used with a 10-micrometer aperture. Calibration of the microdensitometer was achieved with the macrocharacteristic curve exposed on the 1B sensitometer and processed with the terrain camera record of the mission. Program HISTO was then used to analyze the scan data in terms of parameters meaningful to exposure analysis.

Density Profiles

Density profiles of each of the scanned urban area scenes were generated. These profiles highlight important density statistics of each scene. The important density statistics, from measured distribution of each acquisition, are presented as a vertical line whose extremes represent the 95 percent and 5 percent cumulative points of the distribution (refer to Figures 3-13 and 3-14). The dot represents the mean density of the scene. To the right is the appropriate film process curve relating measured density to relative log E.

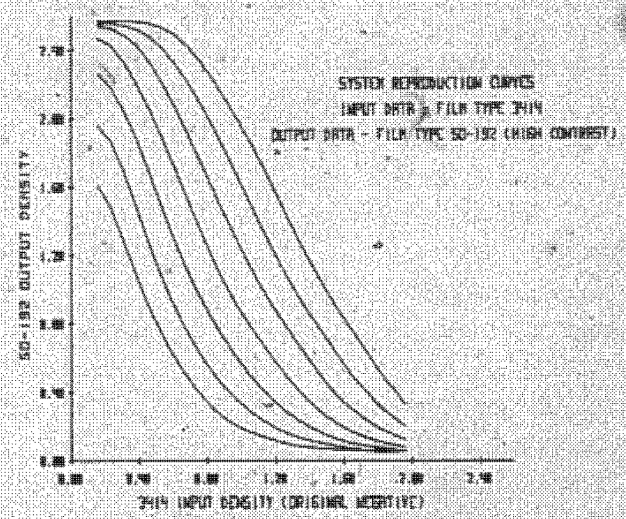
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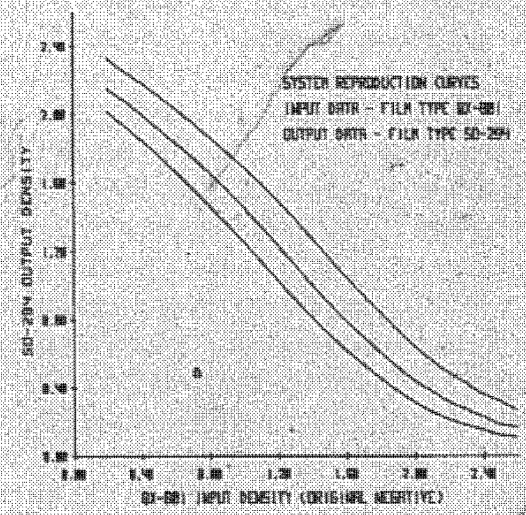
INPUT/OUTPUT DENSITY, 3414 VERSUS SO-192 FILMS

FIGURE 3-7



INPUT/OUTPUT DENSITY, 3414 VERSUS SO-192 FILMS (HIGH DENSITY)

FIGURE 3-8

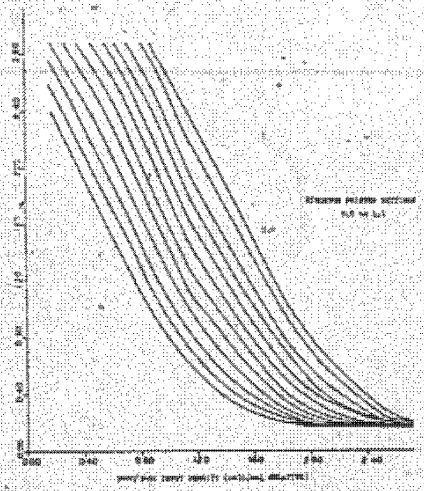


INPUT/OUTPUT DENSITY, QX-801 VERSUS SO-284 FILMS

FIGURE 3-9

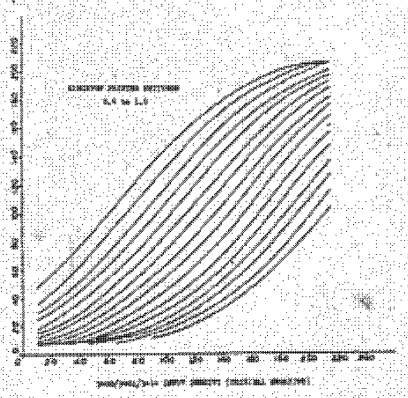
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REPRODUCTION CURVES, KINGSTON PRINTER,
2420 FILM

FIGURE 3-10



REPRODUCTION CURVES, KINGSTON PRINTER,
2422 FILM

FIGURE 3-11

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TERRAIN CAMERA EXPOSURE RECOMMENDATION

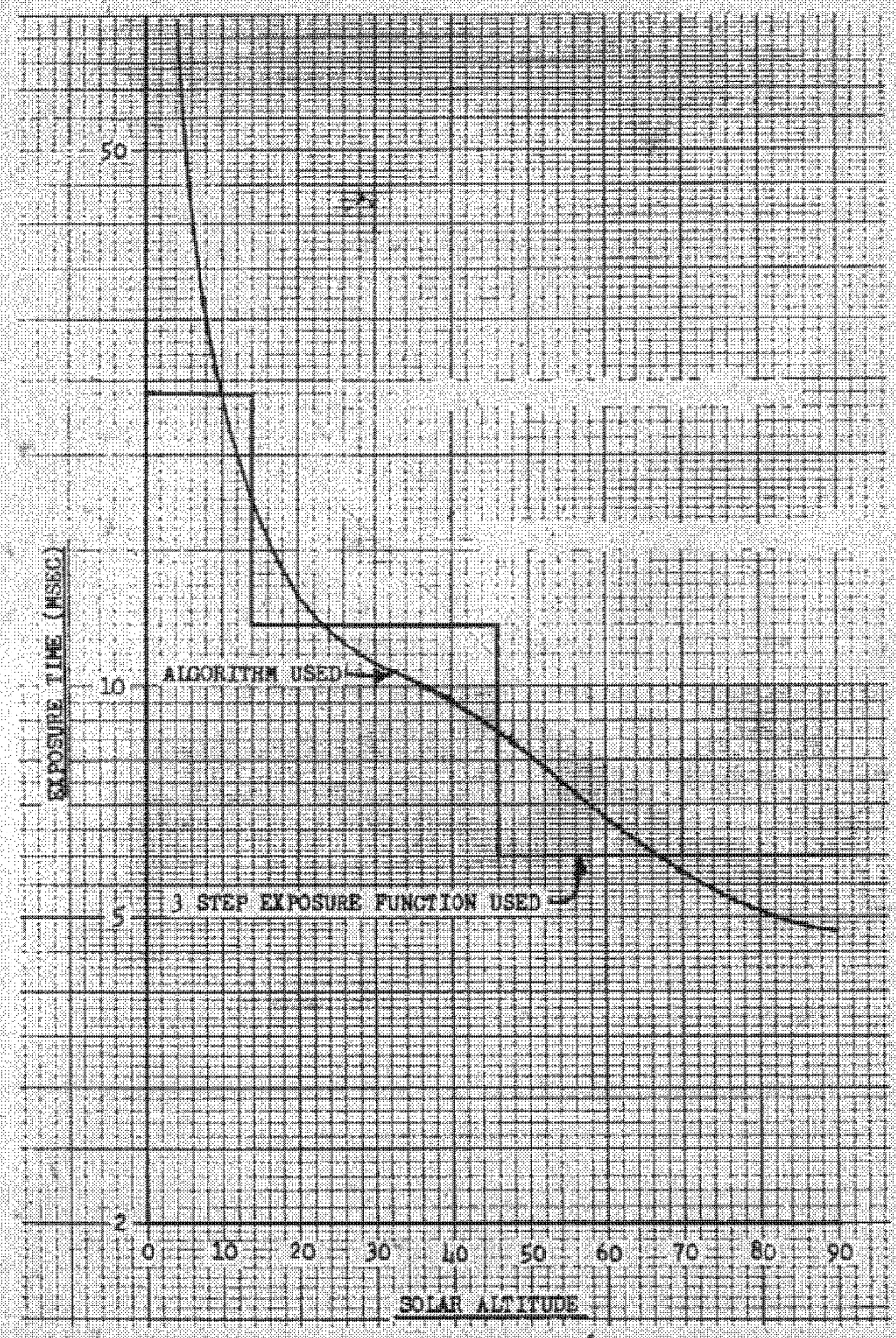


FIGURE 3-12

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TERRAIN CAMERA DENSITY PROFILE (3414 FILM)

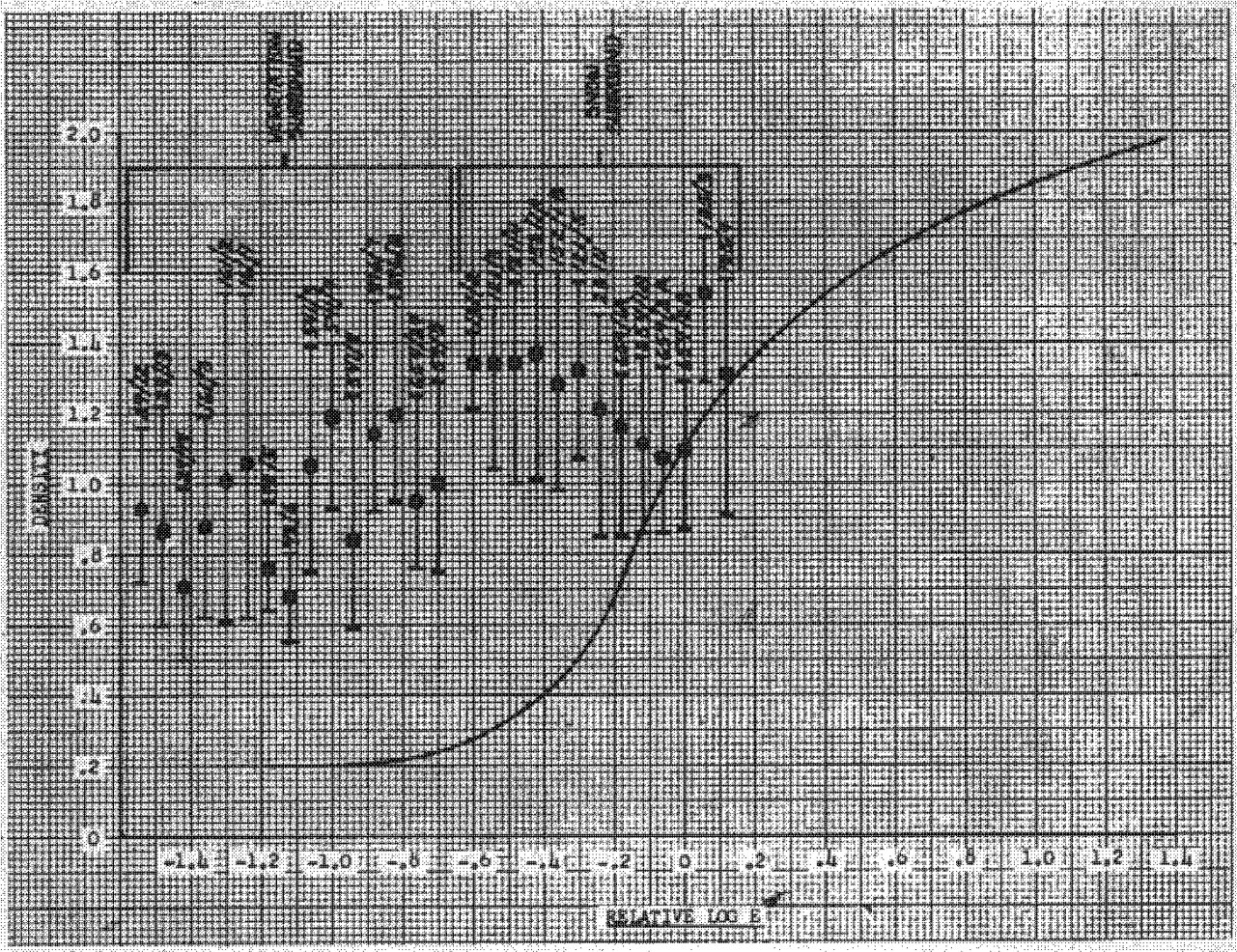


FIGURE 3-13

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TERRAIN CAMERA DENSITY PROFILE (QX-801 FILM)

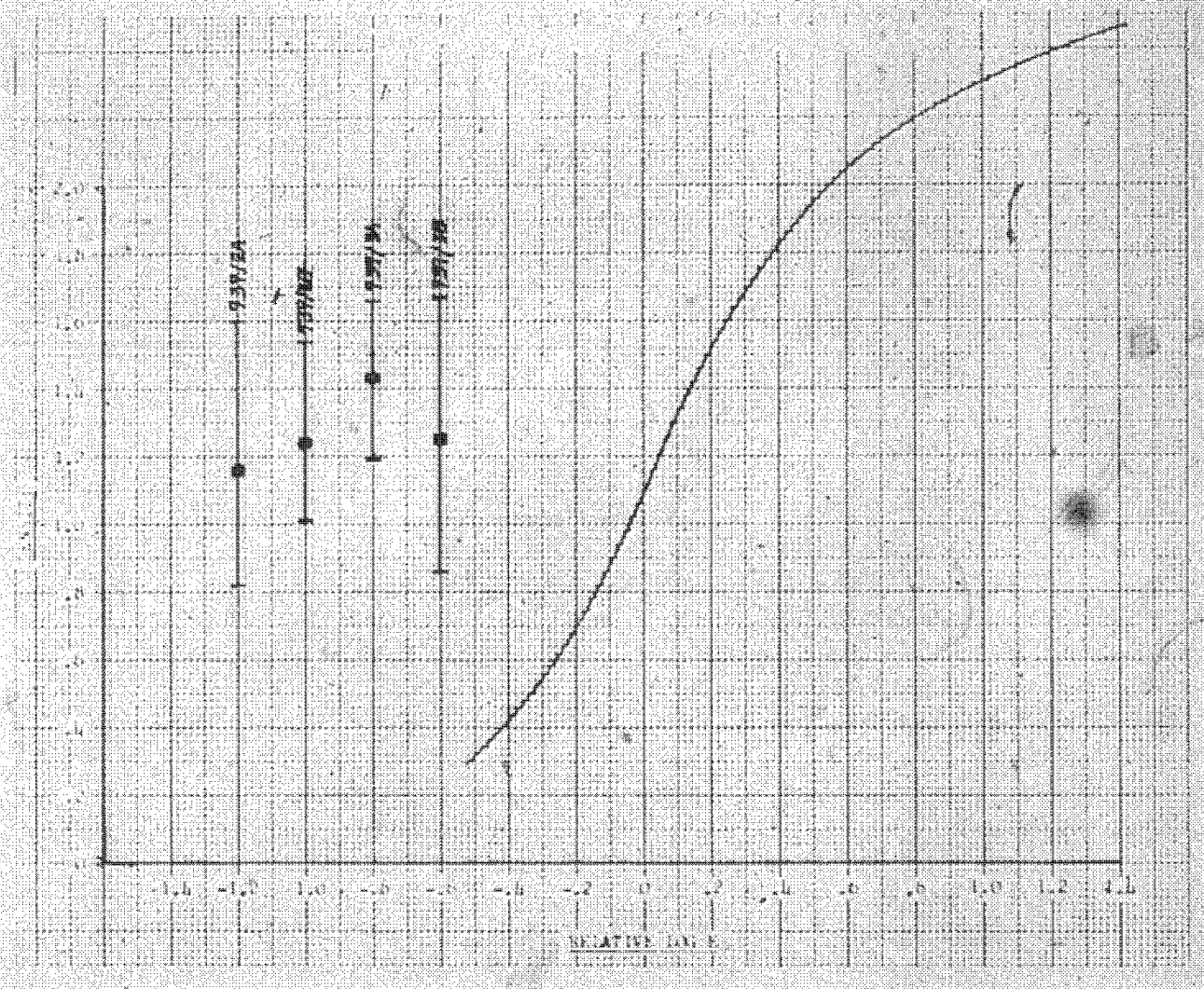


FIGURE 3-14

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Log E Analysis

The exposure of each foreign camera acquisition was rated on its log E deviation (total delta log E) from the aim criteria of 1.1 mean density. The total delta log E is composed of two factors. The first is the deviation of the actual exposure time from algorithm exposure time. This is called "camera delta log E." The second factor is the exposure error attributed to the correctness of the exposure algorithm called "algorithm delta log E." The arithmetic difference between the "total delta log E" and the "camera delta log E" is the "algorithm delta log E." A positive value indicates an overexposure and a negative value indicates an underexposure.

3.6.3 Exposure Evaluation

Table 3-4 gives the mean exposure errors for all samples analyzed by film and surround type. The fifteen 3414 acquisitions are most significant considering their number and the range of solar altitudes covered (20 to 70 degrees). The underexposure of 0.06 log E as acquired and the algorithm error of 0.09 log E underexposure indicate that an exposure increase is warranted on the basis of exposure considerations alone.

TABLE 3-4

LOG EXPOSURE ERRORS

Surround	Film	No. of Samples	Total Delta Log E Error	Algorithm Delta Log E Error
Vegetation	3414	15	−0.06	−0.09
Vegetation	QX-801	4	0.08	0.04
Snow	3414	13	0.12	0.10

The ideal exposure algorithm for 3414 was found by plotting the ideal exposure time for each of the analyzed acquisitions as a function of solar altitude. The "ideal exposure time" is defined as the time necessary to achieve a mean scene density of 1.1 and can be extrapolated from the actual acquisition exposure times used and their resultant measured densities. In Figure 3-15, each data point represents the average ideal exposure time of all acquisitions measured at the same solar altitude. The number in parentheses next to each point represents the number of samples represented. The solid curve represents the ideal exposure algorithm (GI) recommended for 3414 with W-12 equivalent filtration.

The importance of snow acquisitions for mapping purposes is questionable, but the data acquired was extrapolated to give some insight into the exposure of nonsnow, low solar altitude acquisitions. Since snow surround generally increases exposure by one stop (0.30 log E), the implication is that the algorithm would cause an underexposure of 0.11 log E for low-solar-altitude urban industrial scenes without snow. This concurs with the conclusions based on measured vegetation surround scenes. QX-801 was found to be overexposed by 0.08 log E, but the small algorithm error of 0.04 log E suggests that the algorithm used was correct.

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REPORT NO. 1209-5/75

TERRAIN CAMERA DENSITY PROFILE (QX-801 FILM)

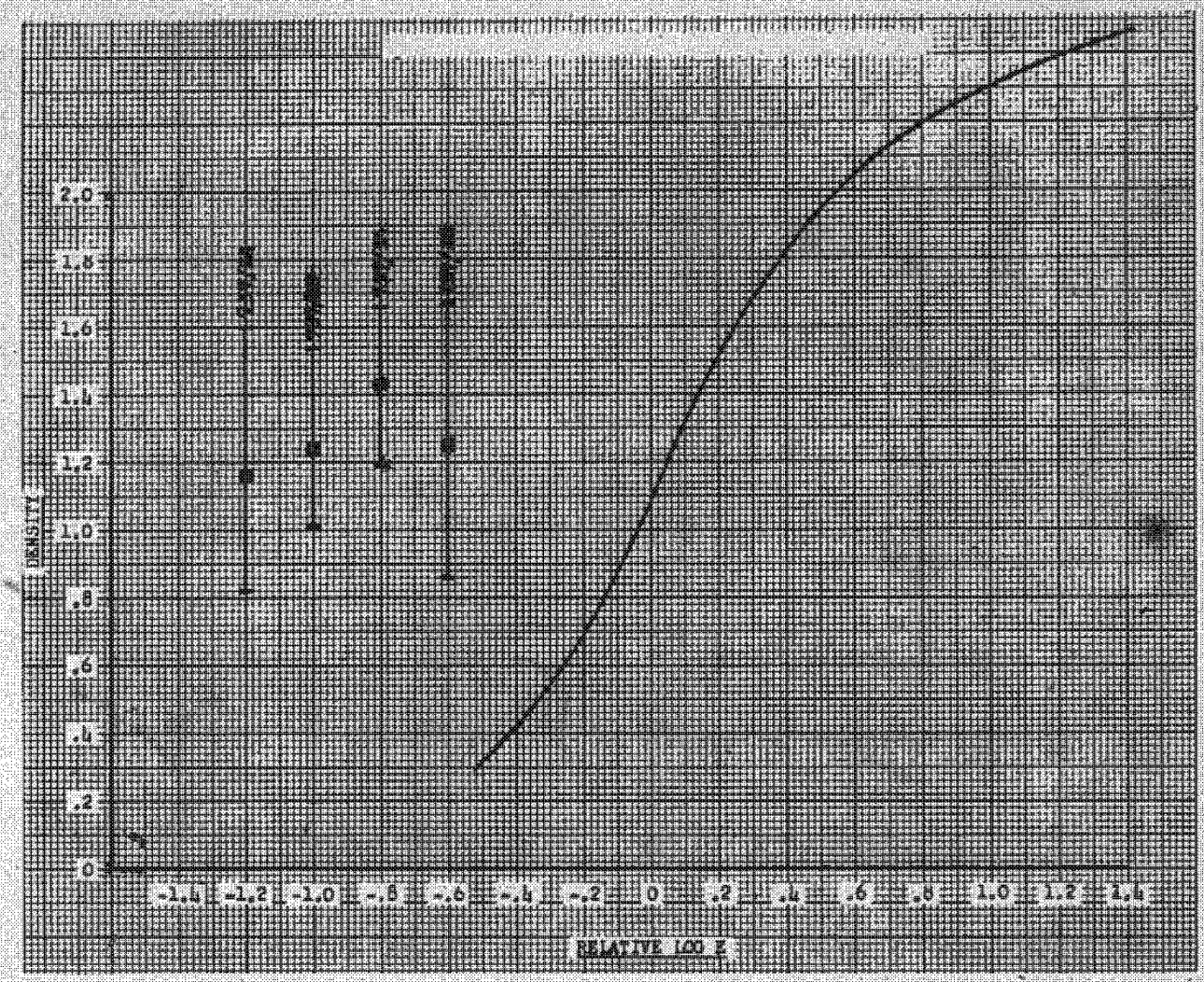


FIGURE 3-14

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Log E Analysis

The exposure of each terrain camera acquisition was rated on its log E deviation (total delta log E) from the aim criteria of 1.1 mean density. The total delta log E is composed of two factors. The first is the deviation of the actual exposure time from algorithm exposure time. This is called "camera delta log E." The second factor is the exposure error attributed to the correctness of the exposure algorithm called "algorithm delta log E." The arithmetic difference between the "total delta log E" and the "camera delta log E" is the "algorithm delta log E." A positive value indicates an overexposure and a negative value indicates an underexposure.

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Table 3-4 gives the mean exposure errors for all samples analyzed by film and surround type. The fifteen 3414 acquisitions are most significant considering their number and the range of solar altitudes covered (20 to 70 degrees). The underexposure of 0.06 log E as acquired and the algorithm error of 0.09 log E underexposure indicate that an exposure increase is warranted on the basis of exposure considerations alone.

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Vegetation	3414	15	−0.06	−0.09
Vegetation	QX-801	4	0.08	0.04
Snow	3414	13	0.12	0.19

The ideal exposure algorithm for 3414 was found by plotting the ideal exposure time for each of the analyzed acquisitions as a function of solar altitude. The "ideal exposure time" is defined as the time necessary to achieve a mean scene density of 1.1 and can be extrapolated from the actual acquisition exposure times used and their resultant measured densities. In Figure 3-15, each data point represents the average ideal exposure time of all acquisitions measured at the same solar altitude. The number in parentheses next to each point represents the number of samples represented. The solid curve represents the ideal exposure algorithm that is recommended for 3414 with W-12 equivalent filtration.

The importance of snow acquisitions for mapping purposes is questionable, but the data acquired was extrapolated to give some insight into the exposure of nonsnow, low solar altitude acquisitions. Since snow surround generally increases exposure by one stop (0.30 log E), the implication is that the algorithm would cause an underexposure of 0.11 log E for low-solar-altitude urban/industrial scenes without snow. This concurs with the conclusions based on measured vegetation surround scenes. QX-801 was found to be overexposed by 0.08 log E, but the small algorithm error of 0.04 log E suggests that the algorithm used was correct.

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IDEAL EXPOSURE TIME VERSUS SOLAR ALTITUDE

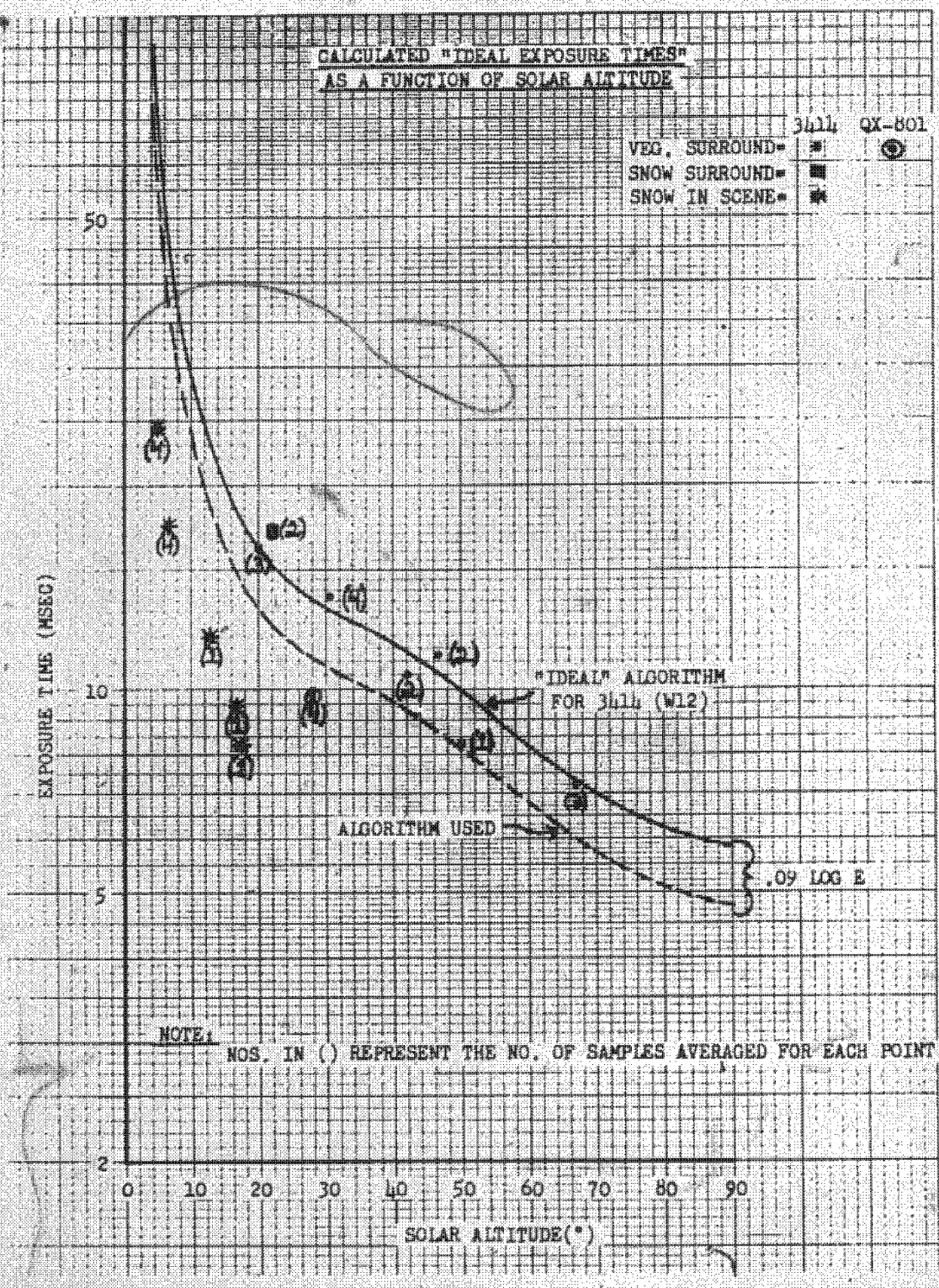


FIGURE 3-15

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3.6.4 Conclusions/Recommendations

1. The exposure algorithm errors of 3414 film with vegetation and snow surround indicate an algorithm caused underexposure. An exposure algorithm change of 0.09 log E increase is recommended for future missions. This can be approximated by a three-step function as follows:

Solar Altitude, degrees	Exposure Time
0 > 18	24ms
18 > 58	12ms
58 > 90	6ms

2. The QX-801 exposure algorithm error was only 0.04 log E. No exposure algorithm change should be made for the QX-801/W-12 combination in future missions, if used.

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DMA EVALUATION

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SECTION IV

DMA EVALUATION

4.1 INTRODUCTION

Comparison of the photography with the system specifications indicates that system SN 002 provided the necessary data and that all critical performance requirements were met. This section details the technical analysis of mission 1209 material by the DMA Post Flight Analysis Team.

Data collection began with the tabulation of fiducial positions obtained during preflight calibration. During the orbital phase, mission performance report (MPR) data were accumulated and added to the post flight analysis (PFA) data file in preparation for the film analysis at the Processing Facility. During analysis of the mission photography, numerous instrument measurements and various metric evaluations were made. The results of the system specification check are provided in the form of discussions, tables of metric results, and illustrations (figures, photographs, and graphs). Also presented under the various subheadings are data on specifications, data acquisition procedures and evaluation results, discussions of anomalies, and conclusions.

4.2 FILM EVALUATION/ANOMALIES

Terrain Frame Anomalies

Minor superficial blemishes throughout the mission were much the same as in previous missions. These static, water, corona, processing, and dust marks are of minor consequence in the use of the material.

Stellar Frame Anomalies

Although the operate/frame mark exposures met specifications, the relatively high base plus fog combined with a restricted detection device to prevent the optical titling of the stellar record.

Relatively numerous "cosmetic" blemishes were noted on the stellar film, consisting of the following:

1. Foreign particles in platen press area
2. Direct or reflected lunar light
3. Frame edges wrinkled on ON's during duplication
4. "Cosmetic" marks resulting from processing.

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4.3 MENSURATION

4.3.1 Film Deformation

Specification

For the film deformation evaluation, 30 terrain frames and 60 stellar frames (coincident to the above terrain frames) are required. The deformation rejection criterion for a six-parameter, least-squares fit of the terrain reseau measurements to the calibrated reseau system is a 12.9-micrometer standard deviation. A tolerance of 6.0-micrometer standard deviation is used as a rejection criteria for the stellar frame's mensuration results.

Procedure

Two frames were selected from each of the first and last operates; the remaining 26 frames were evenly distributed throughout the mission. One frame from the QX-801 film and one from the EK 3401 were also selected for evaluation.

The following steps outline the film deformation evaluation:

1. Frame selection
2. Mensuration
3. Six-parameter transformation
4. Computer run analysis
5. Plotting of residual vectors
6. Data results analysis
7. Anomaly study (if appropriate)
8. Data tabulation and reporting.

All terrain and stellar frame mensuration was performed on duplicate positives. Each frame was read at one sitting by one reader, performing one reading per intersection with no frame rotation.

Evaluation Results

The mensuration results indicated no significant deformation anomalies on this mission material. All terrain mensuration results fell within the specified tolerance of 12.9 micrometers. The stellar mensuration data was within the 6.0 micrometers tolerance. A deformation summary is presented in Table 4-1 and the deformation statistics for this mission are listed in Table 4-2. Typical plots of terrain and stellar deformation values are presented in Figures 4-1, 4-2, and 4-3, respectively.

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TABLE 4-1

FILM DEFORMATION SUMMARY
(Average Values, Micrometers)*

Mission	Terrain	Port (-y)	Starboard (+y)
1205-5	8.3	4.7	4.6
1206-5	7.9	3.4	4.2
1207-5	7.1	4.0	4.2
1208-5	7.1	3.9	3.8
1209-5	7.8	4.1	3.6
(Tolerance)	12.9	6.0	6.0

*Values represent averages of standard deviations for 30 frames for each camera per mission.

4.3.2 Fiducial Stability Evaluation

Specifications

Due to the importance of the fiducial system to data reduction, this evaluation has been added as an addition to the original requirement to determine the "yardstick" distances between the four terrain frame fiducials. The fiducial "calibration" approach verifies the stability of the fiducial system and provides transformed values to satisfy the measurement requirement. Specifications for the distance measurements between fiducials are as follows:

X axis	386.600 to 388.100 mm
Y axis	232.000 to 233.200 mm

Fiducials are routinely read on each terrain frame used for the film deformation study.

Procedure

The following steps outline the fiducial stability evaluation procedure:

1. Frame selection
2. Mensuration (three readings per intersection-fiducial)
3. Mensuration (180-degree rotation)
4. Six-parameter transformations
5. Data analysis
6. Average transformed values (0- to 180-degree rotation)
7. Select "best" transformed frame
8. Three-parameter transformation (remaining frames into "best" frame)

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TABLE 4-2

FILM DEFORMATION STATISTICS

REV	OP	FRM	STANDARD DEVIATION (MICROMETERS) TERRAIN	PORT (-Y)	STARBOARD (+Y)
1	2		-	4.9	4.1
2	3		9.5	4.5	2.9
2	7		-	4.4	3.9
2	11		-	4.5	4.6
2	13		-	3.4	5.2
2	17		-	4.3	3.9
2	21		-	3.6	3.5
2	25		-	3.5	4.3
2	29		-	4.2	4.4
6	3		10.6	5.9	4.3
12	1		4.7	5.6	3.9
14	14		7.3	4.8	4.4
20	11		8.3	4.0	3.9
27	9		9.3	4.9	4.7
34	1		5.3	4.5	3.9
42	2		8.6	5.5	4.1
48	17		7.4	3.8	3.1
54	7		7.1	3.3	3.2
62	6		10.1	4.0	3.6
69	4		7.2	-	-
69	5		-	5.3	2.6
74	15		6.5	3.3	3.8
82	6		8.9	4.7	9.3*
89	6		11.9	3.5	3.4
95	2		3.8	4.1	4.1
103	12		9.2	4.4	4.7
112	3		6.8	3.9	3.1
121	13		6.5	4.2	3.0
129	11		5.6	3.5	2.4
133	5		6.3	3.4	4.0
139	22		6.4	3.7	3.1
145	11			4.3	3.2
156	5		9.8	3.2	3.6
157	5		5.7	4.6	5.3
159	23		3.4	3.4	3.5
164	11		3.4	4.6	3.1
165	5		10.2	2.8	3.1
165	10		6.1	3.4	2.8
167	4		9.7	3.4	2.8
170	4		6.7	3.1	4.0

*Large value due to difficulty in seeing reseaux because of over exposure.

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TERRAIN FILM DEFORMATION PLOT

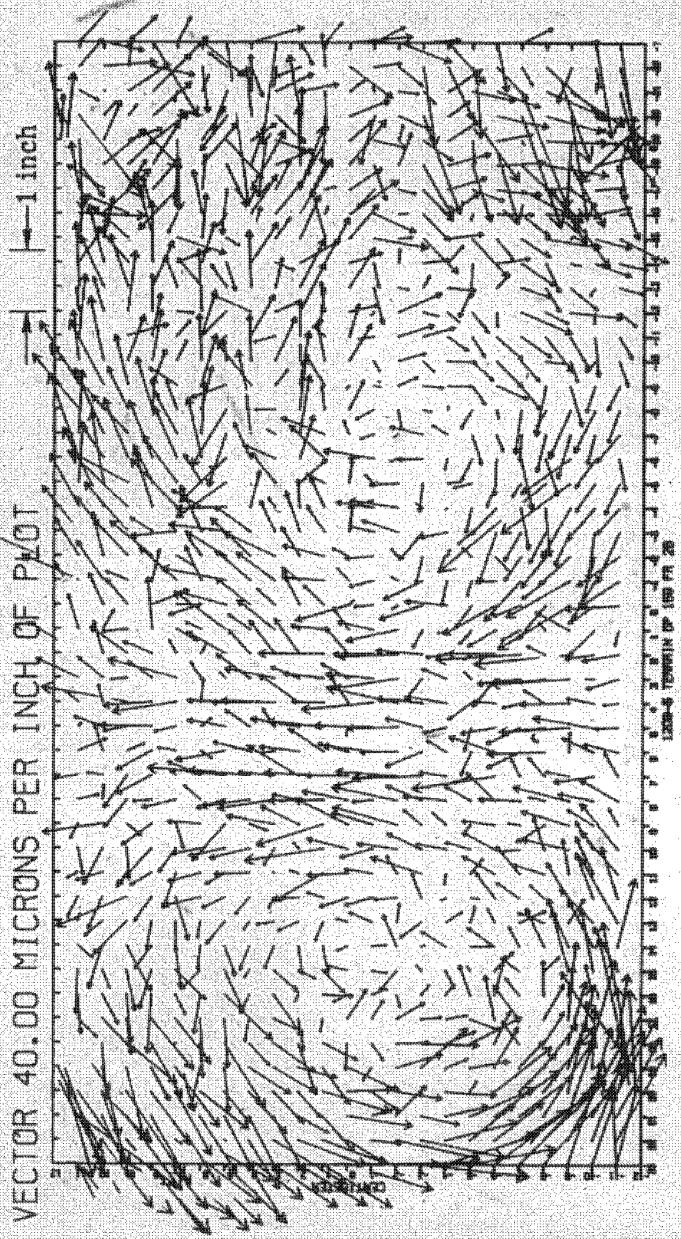


FIGURE 4-1

HANDLE VIA
TALENT-KEYHOLE

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PORT STELLAR FILM DEFORMATION PLOT

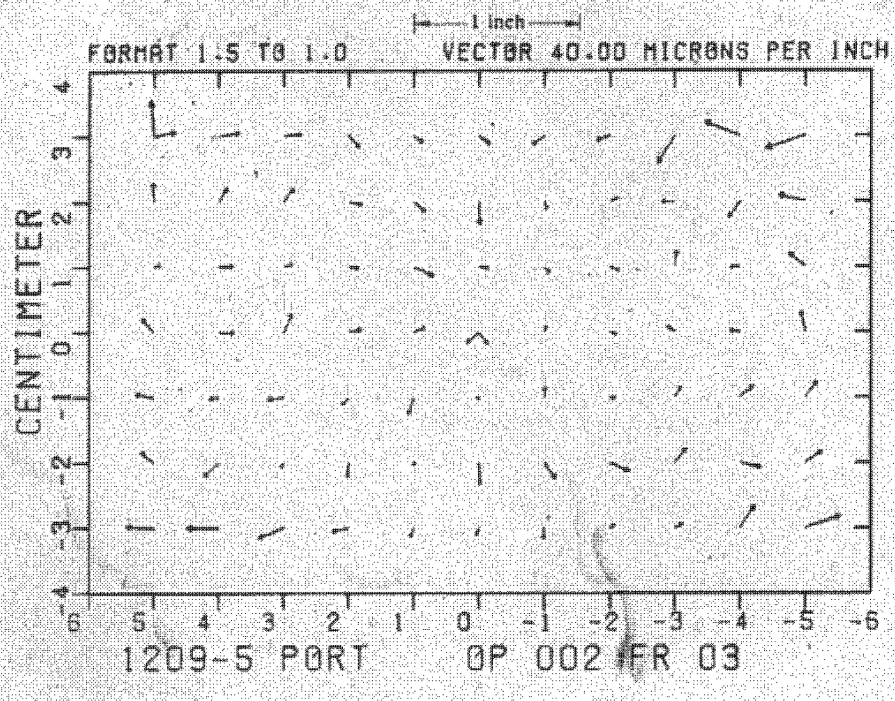


FIGURE 4-2

STARBOARD STELLAR FILM DEFORMATION PLOT

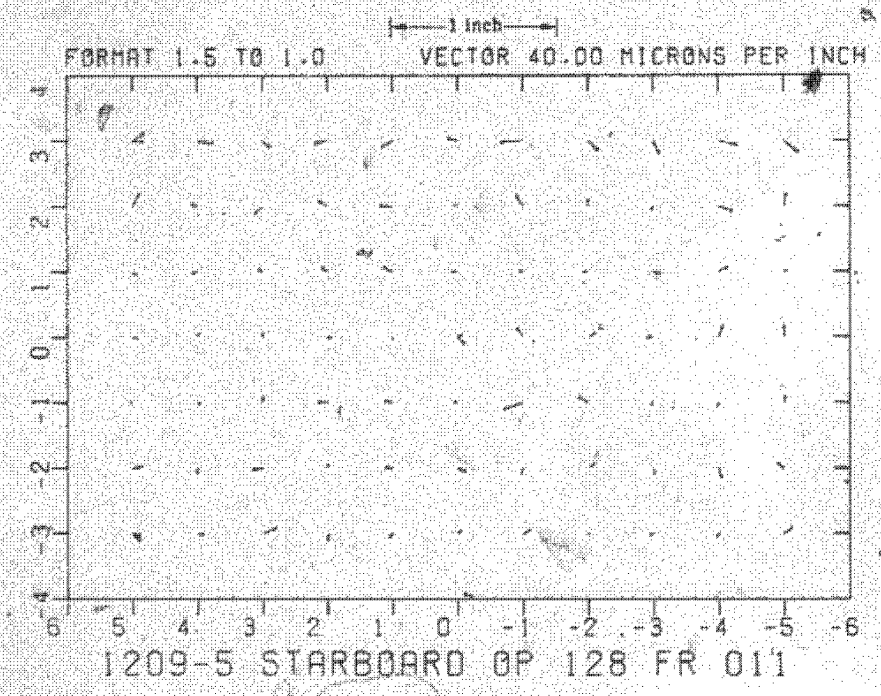


FIGURE 4-3

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9. Mean resulting fiducial sets
10. Correct four fiducials to zero x/zero y center
11. Three-parameter transformation (in-flight into preflight fiducial values)
12. Comparison analysis
13. Anomaly study (if appropriate)
14. Data tabulation and reporting.

Evaluation Results

All measured values were within the tolerance values. A comparison of the fiducial spacing for particular frames is displayed in Table 4-3. The same procedures used for the preflight fiducial calibration were followed to generate an in-flight set of "calibrated" fiducials. The two sets were then compared to verify the stability of the fiducial system. The tabulated results are presented in Tables 4-4 and 4-5.

Conclusions

It is concluded from the results, that the fiducial system remained stable throughout the mission. The total standard deviation value of 0.00239 micrometer for the three-parameter fit of the in-flight calibrated fiducial set is a reasonably good indication of the fiducial system's stability.

4.3.3 Macrodensitometry

Specifications

The requirements for macrodensitometry are two minimum density and two maximum density readings for two terrain frames. The frames are to be located near each end of the mission. Also, two stellar sets are to be sampled. All densitometry is to be performed on original negative material. The background density resulting from artificial illumination of stellar formats should be between 0.6 and 1.1 above base plus fog.

Procedure

All readings were performed on a Macbeth Model TD 404 macrodensitometer.

Evaluation Results

In addition to the required sampling, twenty well distributed terrain frames and corresponding stellar pairs were evaluated for typical maximum and minimum densities in the format area. Some stellar frames have been rejected on the basis of high fog levels, primarily in the area of operates 79-82 and 97-98. Tables 4-6 and 4-7 summarize the data extracted from a large volume of macrodensitometric readings made at the Processing Facility.

4.3.4 Microdensitometry

4.3.4.1 Reseau Intersections

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TABLE 4-3

FIDUCIAL SPACING

		LENGTH		WIDTH	
OP	FRM	5001-5004	5002-5003	5001-5002	5003-5004
2	13	387.362	387.362	232.473	232.491
12	1	387.354	387.357	232.470	232.499
27	9	387.343	387.370	232.474	232.494
43	17	387.356	387.361	232.462	232.486
69	1	387.349	387.360	232.467	232.495
89	6	387.351	387.366	232.471	232.496
103	12	387.348	387.359	232.466	232.492
133	5	387.360	387.364	232.472	232.499
156	5	387.343	387.364	232.465	232.503
157	5	387.350	387.362	232.470	232.500
159	20	387.356	387.363	232.461	232.494
170	4	387.351	387.359	232.470	232.486

Specifications: Width 232.0-233.2 mm
Length 386.6-388.1 mm

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TABLE 4-4

IN-FLIGHT TO PREFLIGHT FIDUCIAL TRANSFORMATION

5001	193.6053	-116.3514
5002	193.7472	116.1163
5003	-193.6096	116.3632
5004	-193.7429	-116.1279

Total Standard Deviation in X = 0.00299
Total Standard Deviation in Y = 0.00156
Standard Deviation of Total Fit = 0.00239

TABLE 4-5

TERRAIN FIDUCIAL STABILITY EVALUATION

Preflight

TOTAL STD DEV .00207
X STD DEV .00220
Y STD DEV .00193

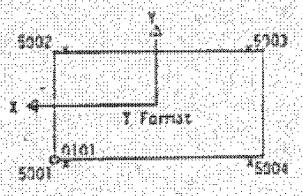
FRAME ID OP	NO	STD DEV
	1	.00283
	5	.00301
	7	.00310
	9	.00324
	21	.00492
	25	.00230
	26	.00353
	27	.00412
	36	.00393

Inflight

TOTAL STD DEV .00199
X STD DEV .00169
Y STD DEV .00227

FRAME ID OP	NO	STD DEV
2?	11	.00251
12	3	.00091
2?	9	.00145
43	17	.00353
52	4	.00248
82	6	.00156
156	5	.00234
166	11	.00121
170	4	.00330

Fiducial Locations



(All values in millimeters.)

	5001	5002	5003	5004		5001	5002	5003	5004
X Pre-	193.6025	193.7461	-193.6069	-193.7417	Y Pre-	-116.3497	116.1155	116.3621	-116.1278
X Inflight	193.6084	193.7480	-193.6126	-193.7439	Y Inflight	-116.3527	116.1176	116.3637	-116.1286
Delta Xs	0.0059	0.0019	-0.0057	-0.0022	Delta Ys	-0.0030	0.0021	0.0016	-0.0008

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TABLE 4-6

TERRAIN FORMAT DENSITY STATISTICS

OP	FRAME	MAX DENSITY	MIN DENSITY	BASE+FOG
2	2	1.60	0.56	0.24
10	2	1.44	1.02	0.24
20	3	1.08	0.50	0.30
30	3	1.70	1.05	0.28
40	1	1.42	0.60	0.28
50	1	1.52	0.56	0.26
60	21	1.48	0.50	0.28
70	6	0.90	0.50	0.28
80	6	1.54	0.52	0.26
90	6	1.26	0.92	0.24
100	1	1.46	0.80	0.28
110	3	1.10	0.68	0.26
120	1	1.52	1.06	0.26
130	1	1.52	0.76	0.24
145	1	1.80	0.30	0.28
150	8	1.50	1.40	0.28
160	5	1.36	0.84	0.28
165	10	1.70	1.06	0.26
166	1	1.40	0.48	0.28
167	1	1.84	1.04	0.24
168	5	4.23	3.24	0.54
169	5	3.69	1.44	0.51
170	3	1.65	1.04	0.52
170	6	1.66	1.04	0.52
171	2	1.64	1.02	0.51
171	8	1.66	1.01	0.53

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TABLE 4-7

STELLAR FORMAT DENSITY STATISTICS

POSITION	LOCATION
A	Reseau 701 Corner
B	Center Format
C	Reseau 111 Corner

		PORT			STARBOARD			BASE +
OP	FRAME	A	B	C	A	B	C	FOG
2	2	0.32	0.92	0.76	0.76	1.00	0.74	0.45
10	2	0.80	0.94	0.32	0.70	0.90	0.72	0.46
20	3	0.80	0.94	0.90	0.88	1.02	0.86	0.57
30	3	0.92	1.04	0.84	0.76	1.00	0.78	0.53
40	1	0.84	0.94	0.78	0.74	0.94	0.78	0.43
50	1	0.86	0.96	0.78	0.78	0.96	0.78	0.50
60	21	0.94	1.00	0.84	0.92	1.10	0.92	0.64
70	6	0.84	1.00	0.32	0.94	1.00	0.84	0.51
79	6							1.01
80	6	1.08	1.21	0.38	1.30	1.31	1.08	0.77
81	11							1.21
82	5							1.46
82	6							1.34
90	6	1.04	1.10	0.96	1.00	1.24	1.00	0.56
92	3							1.00
96	1							0.51
97	2							1.33
97	5							0.61
98	5							1.33
100	1	0.90	1.02	0.84	0.82	1.04	0.88	0.57
110	5							0.93
120	1	1.02	1.14	1.00	0.98	1.18	1.04	0.67
130	1	0.92	1.06	0.92	0.92	1.12	0.98	0.56
140	1	0.94	1.08	0.38	0.92	1.08	0.36	0.52
150	8	0.88	1.02	0.86	0.92	1.14	0.90	0.52
159	1							0.48
159	30							1.08
160	5	1.30	1.40	1.20	1.58	1.70	1.50	1.10
155	10	0.98	1.10	0.92	0.98	1.28	1.02	0.59
166	1	0.94	1.00	0.86	0.94	1.18	0.94	0.55
167	1	0.09	1.00	0.34	0.90	1.18	0.94	0.51
168	1	1.20	1.36	1.12	1.50	1.76	1.54	

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Specifications

Typically, four intersections per frame on two frame sets (terrain, port, starboard), selected from the first and last operates of the mission, are scanned on the microdensitometer. The reseau intersection illustrated in Figure 4-4 displays dimensions for the intersection found on the camera reseau plates. The dimensions determined from microdensitometry are film dependent, consequently no specification is provided. The dimension values are reported for relative mission to mission comparisons or as an anomaly diagnostic device. Included for convenience are reseau format diagrams (Figures 4-5 and 4-6).

Procedures

Microdensitometry was performed on original negative material. All data measurements are made on a GAF microdensitometer with chart recorder. The microdensitometer is calibrated for absolute density and against a calibrated line width as a standard operating procedure. Once an image trace is recorded on the graph paper, it is further analyzed in the following manner.

1. Background density is obtained from the graph.
2. Depth of curve is determined from the background line.
3. One-third of the depth value is measured from the background line into the curve throat.
4. A parallel line (parallel to the background line) is then drawn through the curve at the one-third distance.
5. The distance between the two intersections of the curve and the parallel line is determined.
6. From the microdensitometer table entitled "Speed and Chart Speed," a speed factor is obtained.
7. This speed factor multiplied by the intersection distance gives the final image width.

Evaluation Results

Sample graphs of microdensitometer profiles across reseau intersection lines (Figures 4-7 and 4-8), and the resulting statistical values (Table 4-8), are provided for relative comparison to previous mission results.

Conclusions

All intersections evaluated or visually inspected were considered to be usable. The results of this evaluation are considered representative of the SN 002 camera system. There continues to be some degradation of reseau intersects in the areas of splices made during processing. The tape used in fixing leader to the film obscures the column of reseau intersects nearest the cut end.

To place the density values of the microdensitometer and the macrodensitometer in proper perspective, a graph has been included which illustrates density range comparison of a calibrated step tablet made with the microdensitometer and macrodensitometer (Figure 4-9).

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STELLAR/TERRAIN, RESEAU INTERSECTION

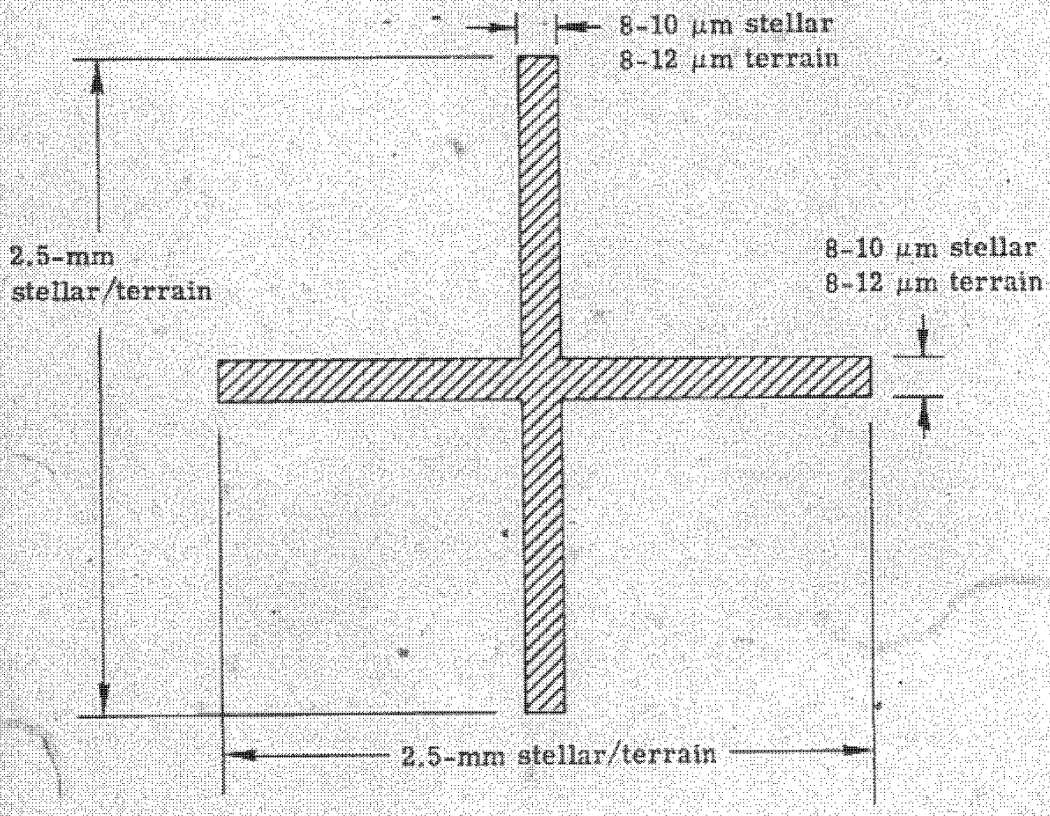


FIGURE 4-4

STELLAR RESEAU FORMAT

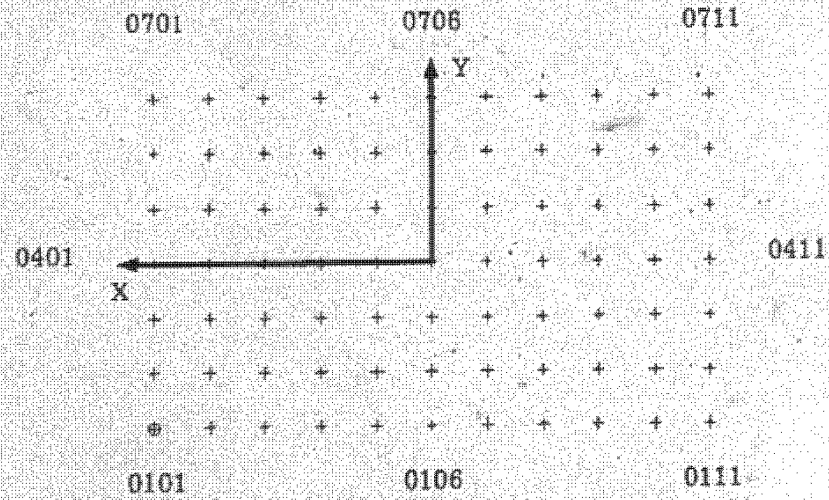


FIGURE 4-5

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POST FLIGHT ANALYSIS
REPORT NO. 1209-5/75

TERRAIN RESEAU FORMAT

FIGURE 4-6

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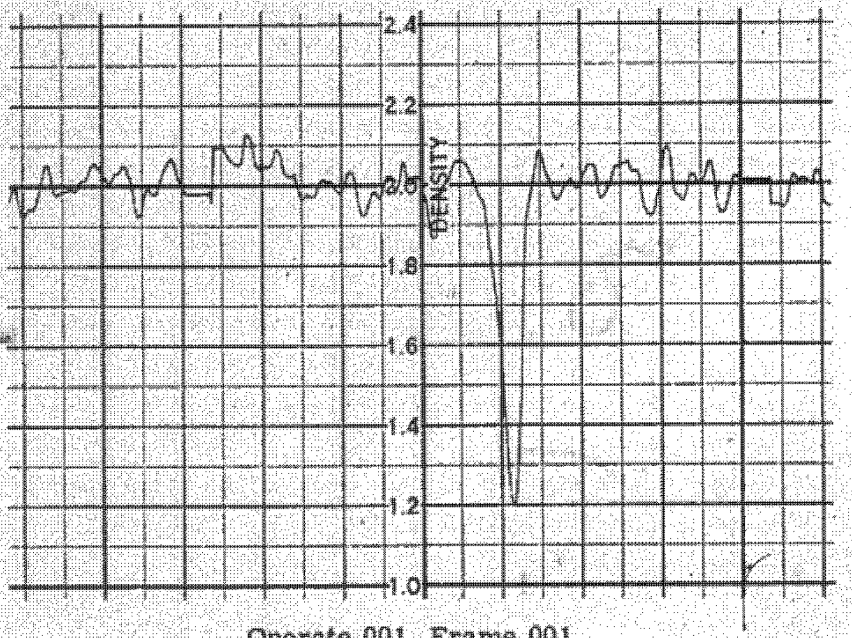
MICRODENSITOMETER PROFILE, TERRAIN RESEAU INTERSECTION LINE



Operate 197, Frame 018

FIGURE 4-7

MICRODENSITOMETER PROFILE, STELLAR RESEAU INTERSECTION LINE



Operate 001, Frame 001

FIGURE 4-8

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TABLE 4-8

RESEAU INTERSECTION STATISTICS (STELLAR/TERRAIN)

OP	FRAME	CAMERA	LOCATION	MEAN BACKGROUND DENSITY (mean of six to eight readings)	MEAN PEAK DENSITY	MEAN WIDTH (MICROMETERS)
2	3	TERRAIN	0102 Reseau	2.31	1.17	18.80
			1220 Reseau	2.00	0.91	25.22
			1226 Reseau	2.02	0.96	21.16
			2302 Reseau	1.85	0.90	15.13
2	3	STARBOARD	111 Reseau	1.45	1.07	17.28
			305 Reseau	1.72	1.17	21.28
			505 Reseau	1.72	1.11	21.28
			711 Reseau	1.36	1.06	19.62
2	3	PORT	101 Reseau	1.31	0.95	21.03
			405 Reseau	1.70	1.14	21.65
			406 Reseau	1.71	1.14	22.33
			701 Reseau	1.41	1.05	18.14
165	10	TERRAIN	0202 Reseau	1.68	0.77	23.37
			1223 Reseau	1.49	0.69	19.76
			1247 Reseau	1.59	0.71	19.99
			2202 Reseau	1.56	0.70	18.14
165	10	STARBOARD	0205 Reseau	1.76	1.27	23.50
			0405 Reseau	1.77	1.26	21.96
			0407 Reseau	1.82	1.25	23.49
			0410 Reseau	1.64	1.23	21.40
165	10	PORT	0101 Reseau	1.57	1.14	21.77
			0304 Reseau	1.93	1.21	23.25
			0504 Reseau	1.99	1.21	24.17
			0701 Reseau	1.61	1.07	23.68

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MICRO/MACRODENSITOMETER RANGE COMPARISON

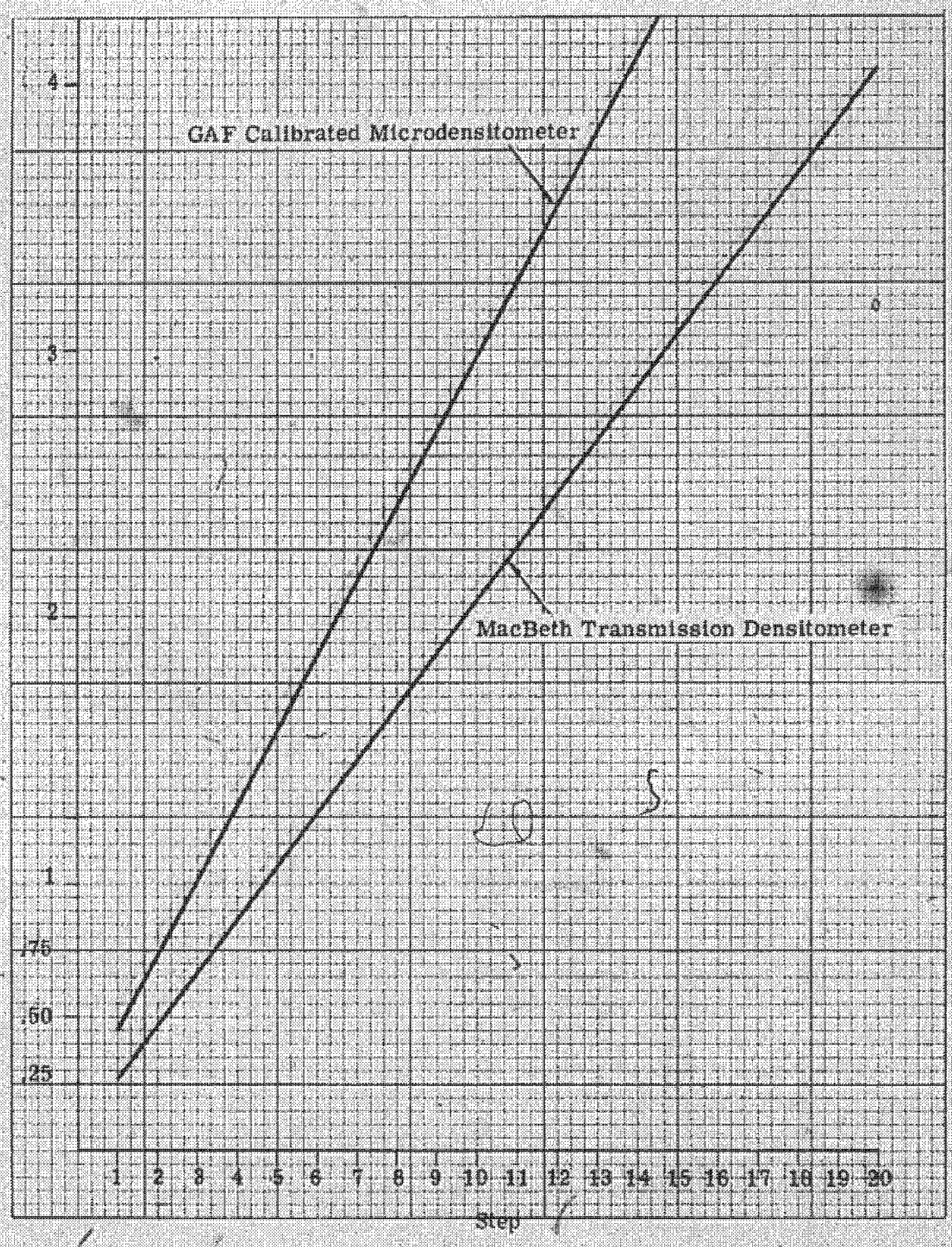


FIGURE 4-9

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4.3.4.2 Fiducials

Specifications

The fiducial measurement requirements are similar to those for reseau intersection measurements in that four fiducials are to be measured per frame for one frame at each end of the mission. The dimension values (blueprint) are illustrated in the fiducial diagram (Figure 4-10).

Procedures

The data reduction procedures are the same as for reseau measurements. Microdensitometer profiles of a fiducial leg and dot are shown in Figures 4-11 and 4-12.

Evaluation Results

The fiducial statistics are listed in Tables 4-9 and 4-10. The fiducial images appear nicely defined with visible center dots for all four fiducials. The fiducial stability evaluation indicates the readability of the fiducials for this material.

Conclusion

Results of this evaluation indicate that fiducial densities were within specifications. Fiducial quality on this mission is excellent, with the center dot readily visible. This is the first system to incorporate the modification which masks imagery from the area surrounding the fiducials. Evaluation reports of missions prior to 1209 stated the difficulty in locating and pointing fiducials which were surrounded by high density imagery. The solution to mask the imagery proved to be completely successful. Figure 4-13 is a composite of fiducial imagery with high density photography from missions 1208 and 1209.

4.3.4.3 Data Block

Specifications

The following are the measurement requirements and design criteria tolerances for the data block evaluation:

1. Two frame sets are to be scanned.
   a. The terrain data block and the stellar data block for each set
   b. Sets located near each end of mission material.
2. Tolerances are as follows:
   a. Peak density of each dot with respect to background fog must be greater than 0.2 of a density unit.
   b. Density between dots with respect to the background fog must be less than 0.10 of a density unit.
   c. Dot diameter of the 0.3 density level must fall between 152.0 and 254.0 micrometers.

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TERRAIN FIDUCIAL DIAGRAM

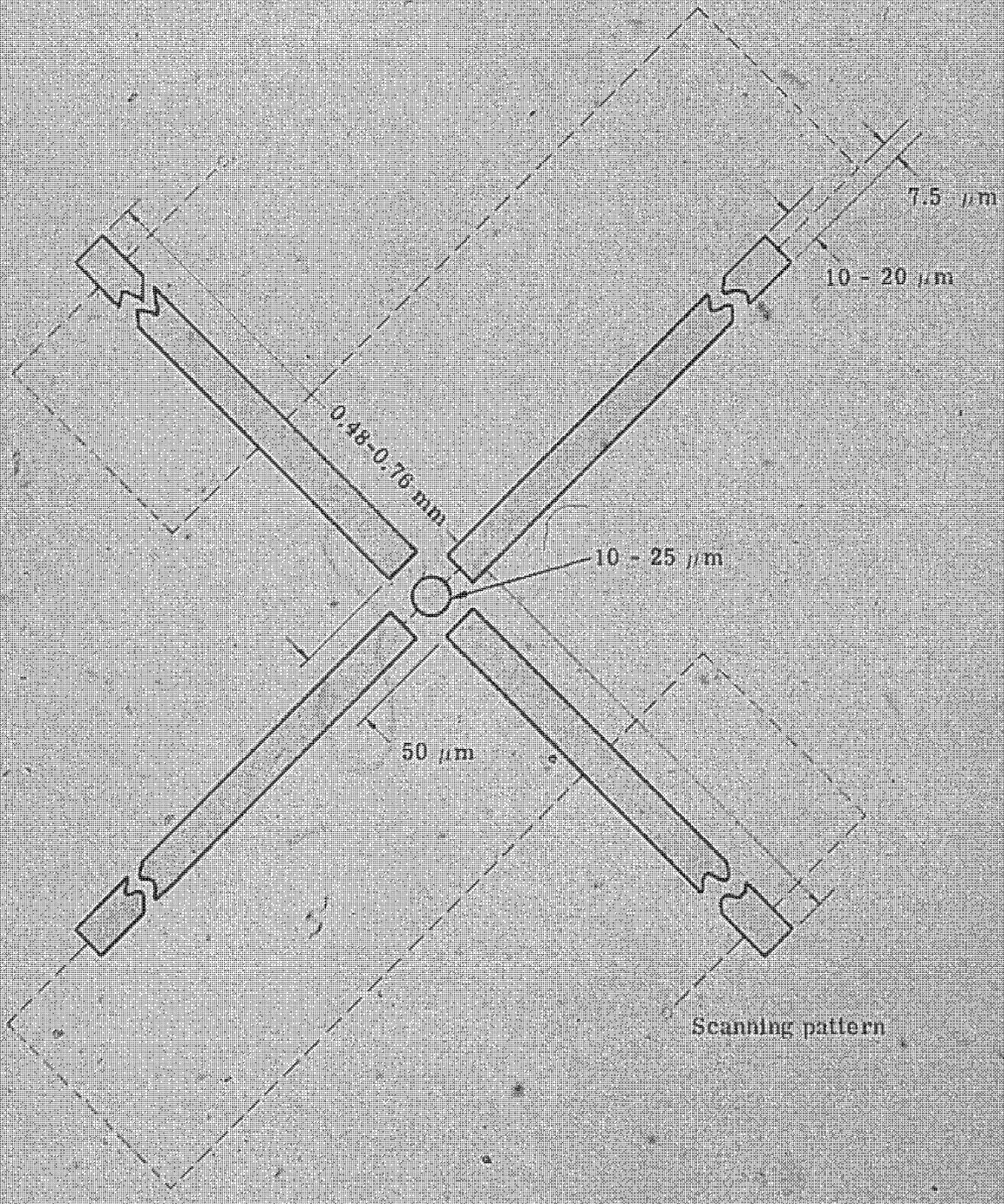


FIGURE 4-10

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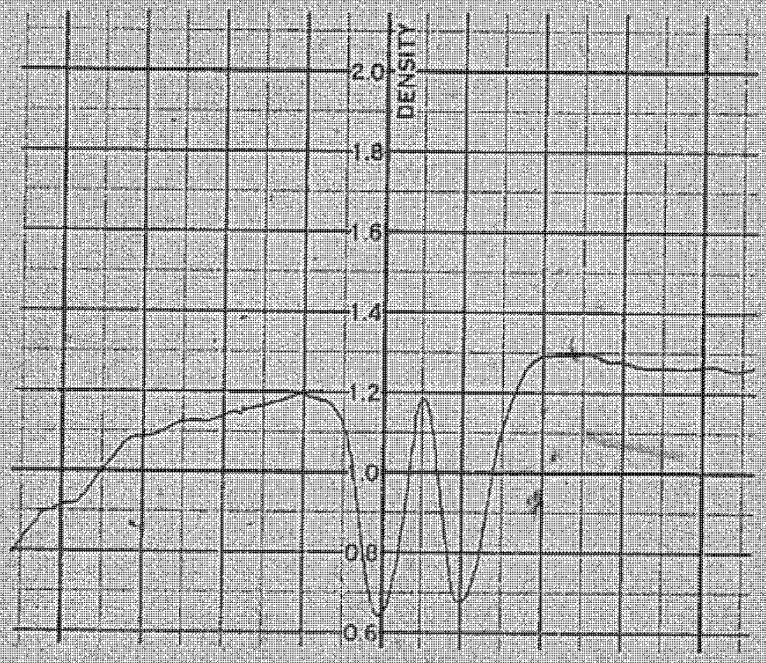
FIDUCIAL LINE MICRODENSITY PROFILE



Operate 165, Frame 010, Fiducial 5001

FIGURE 4-11

FIDUCIAL DOT MICRODENSITY PROFILE



Operate 165, Frame 010, Fiducial 5002

FIGURE 4-12

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TABLE 4-9

FIDUCIAL LINE MICRODENSITY STATISTICS

(Mean of six to eight readings)

OP	FRAME	FIDUCIAL	BACKGROUND DENSITY	PEAK DENSITY	WIDTH (MICROMETERS)
2	3	1	0.37	1.25	28.29
		2	0.35	1.14	27.76
		3	0.39	1.15	30.14
		4	0.35	1.13	25.65
165	10	1	0.46	1.21	25.84
		2	0.40	1.34	28.30
		3	0.48	1.30	27.22
		4	0.49	1.32	24.80

TABLE 4-10

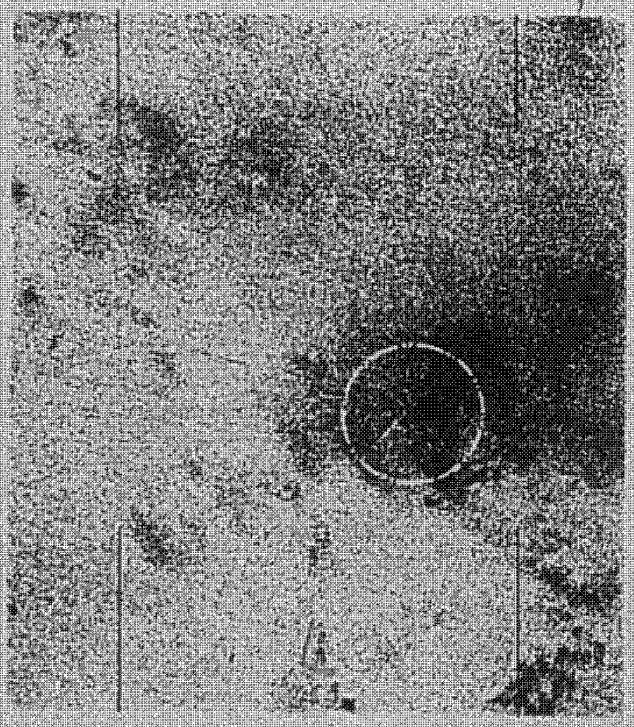
FIDUCIAL DOT MICRODENSITY STATISTICS

Op	Frm	Fiducial	Background Density	Peak Density	Diameter (Micrometers)
2	3	5001	0.80	1.13	14.3
		5002	0.66	1.18	13.2
		5003	0.52	0.88	17.2
		5004	0.85	1.27	18.7
165	10	5001	0.66	1.12	15.7
		5002	0.87	1.35	19.2
		5003	0.50	0.82	16.7
		5004	0.68	1.27	19.4

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COMPOSITE 1208/1209 FIDUCIAL IMAGERY



Terrain camera: 1208-5—Op 169; frame 005; 20× enlargement
1209-5—Op 010; frame 003; 20× enlargement

FIGURE 4-13

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TABLE 4-11

DATA BLOCK DENSITY STATISTICS (STELLAR/TERRAIN)

Camera	Op	Frame	Background Density	Peak Density	Diameter (Micrometers)
Terrain	02	03	0.41	0.65	150
			0.41	0.65	153
			0.41	0.90	138
			0.41	0.64	138
	165	10	0.35	0.70	148
			0.35	0.71	160
			0.34	0.88	153
			0.32	0.72	165
			0.32	0.60	150
Stellar	02	03	0.95	1.70	207
			0.95	1.70	219
			0.95	1.70	194
			0.95	1.70	187
	165	10	0.95	1.89	194
			0.95	1.84	207
			0.95	1.94	194
			0.95	1.90	202
			0.95	1.92	202

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EXAMPLE OF TERRAIN DATA BLOCKS

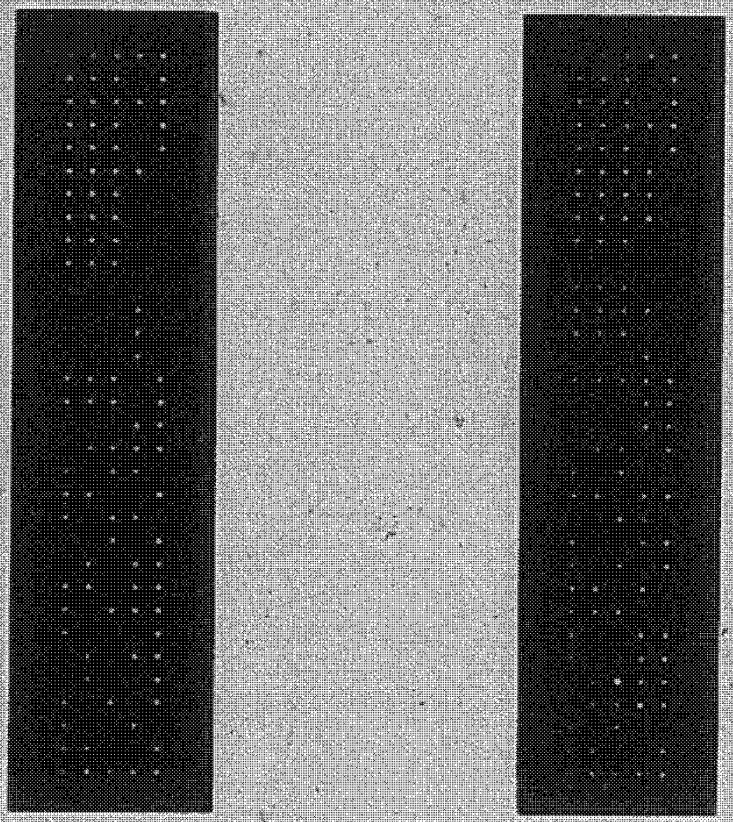
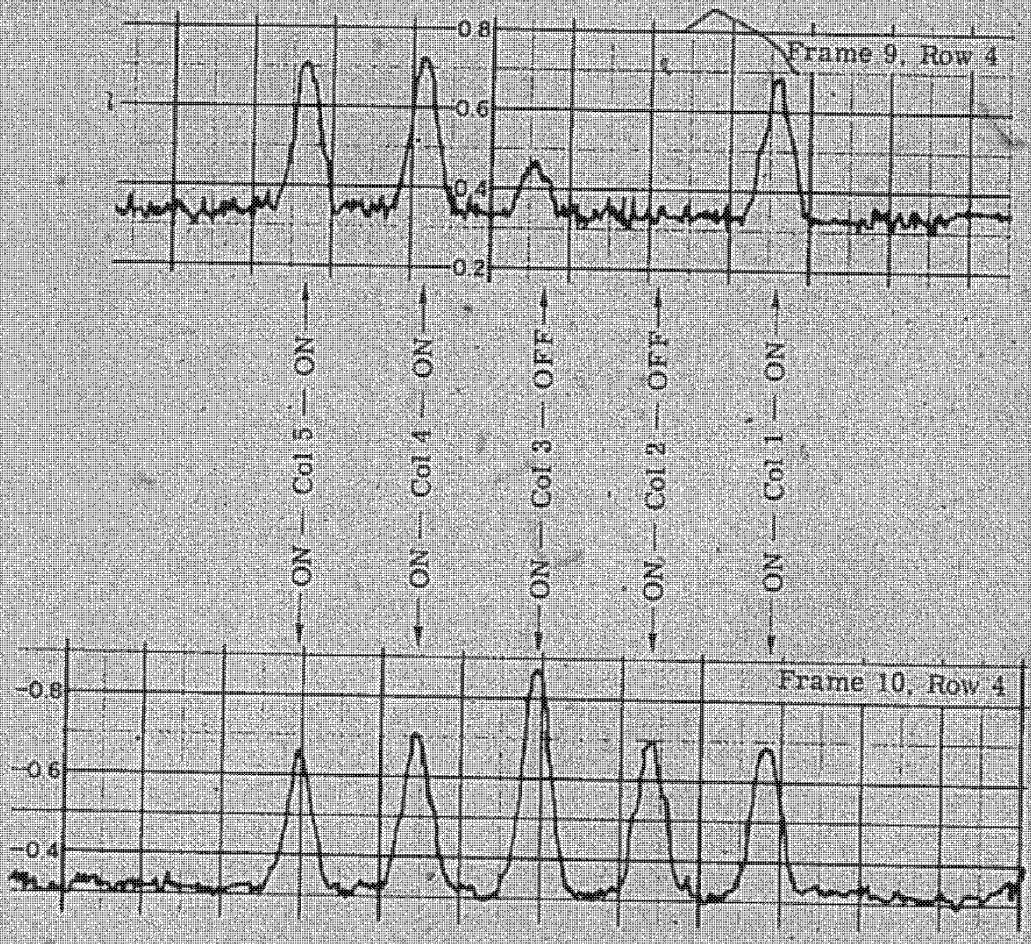


FIGURE 4-14

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DENSITY PROFILE OF TERRAIN DATA BITS



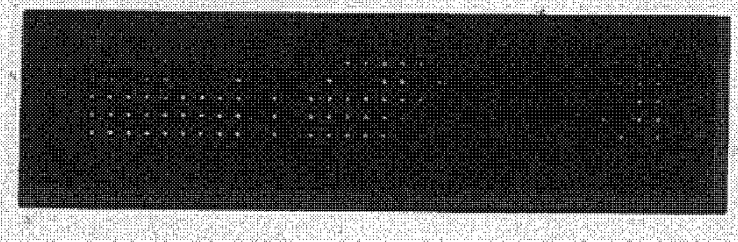
Operate 165

FIGURE 4-15

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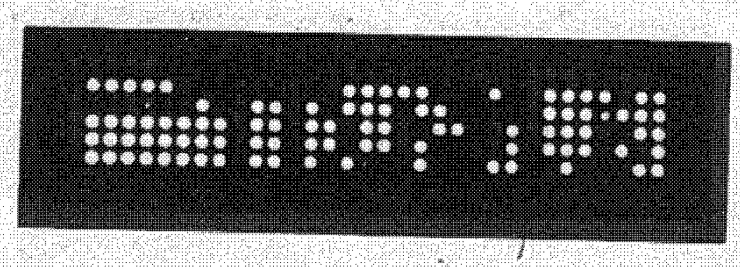
STELLAR DATA BLOCK



Stellar camera: Op 095; frame 005; typical data block

FIGURE 4-16

CALIBRATE MODE TERRAIN DATA BLOCK



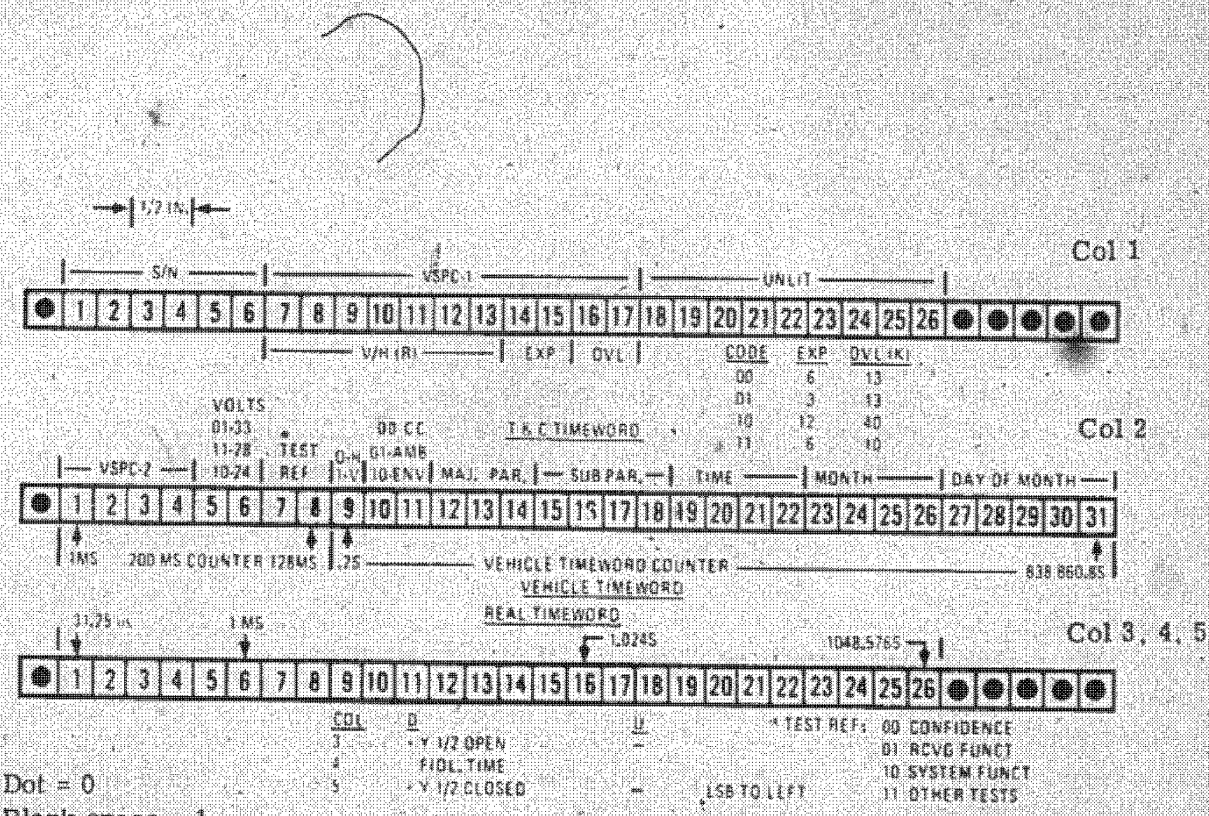
Terrain camera: Op 170; frame 005; calibrate mode—3401 film

FIGURE 4-17

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DATA BLOCK GUIDE



Note: Dot = 0
Blank space = 1

The above guide matches the special reading devices (10× Lupes with guide) necessary to effectively interpret the data blocks.

FIGURE 4-18

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TERRAIN DATA BLOCK ORIENTATION

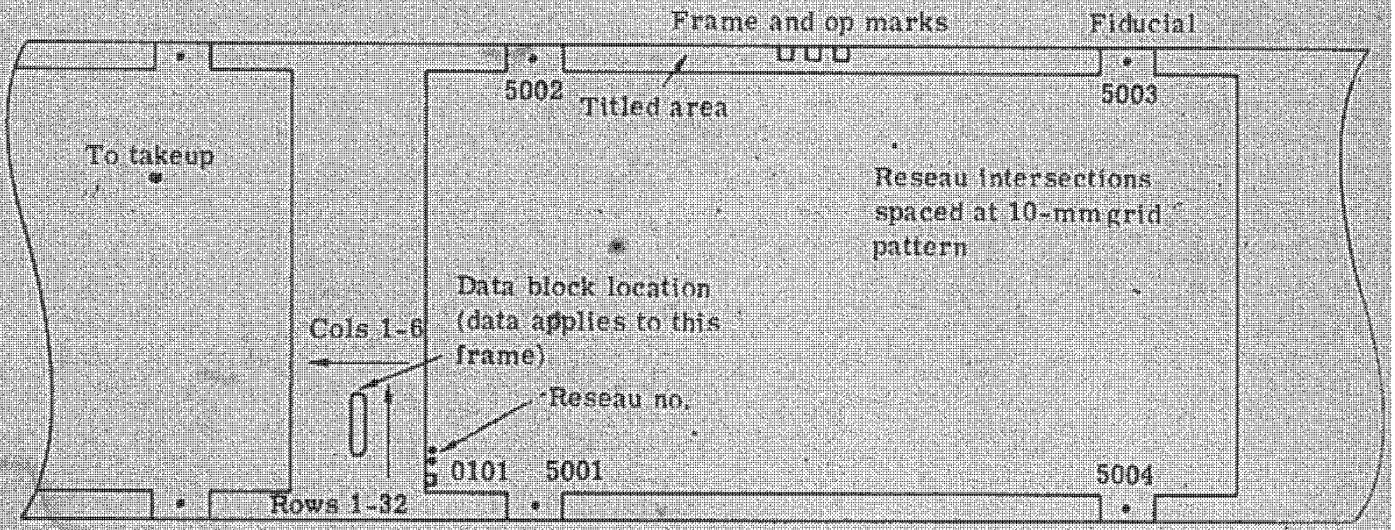
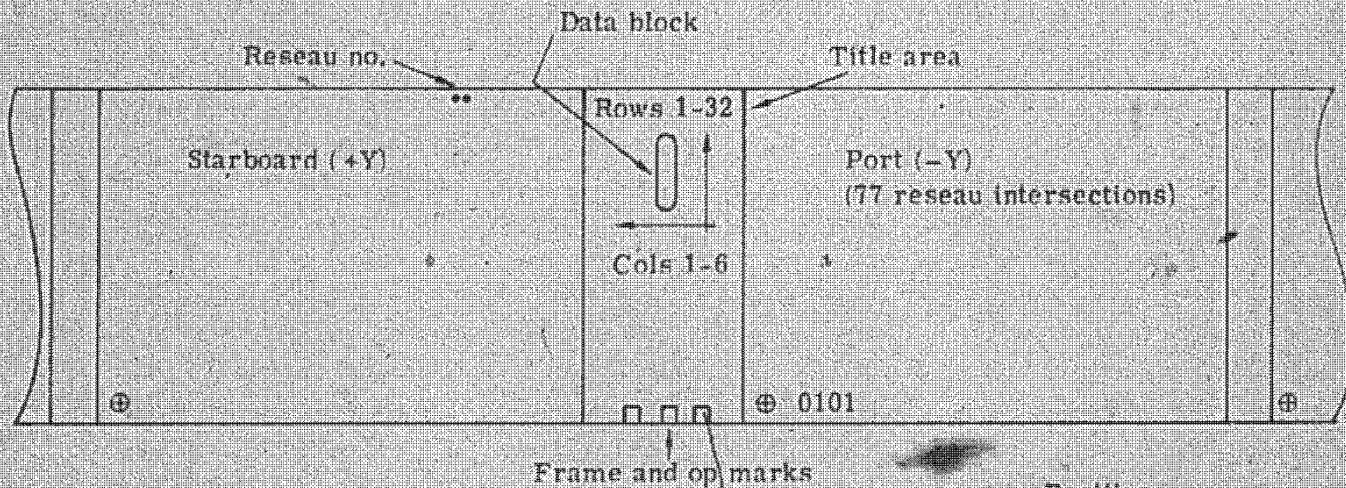


FIGURE 4-19

STELLAR DATA BLOCK ORIENTATION



Positive emulsion up

FIGURE 4-20

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OPERATE/FRAME MARKS DIAGRAM (STELLAR/TERRAIN)

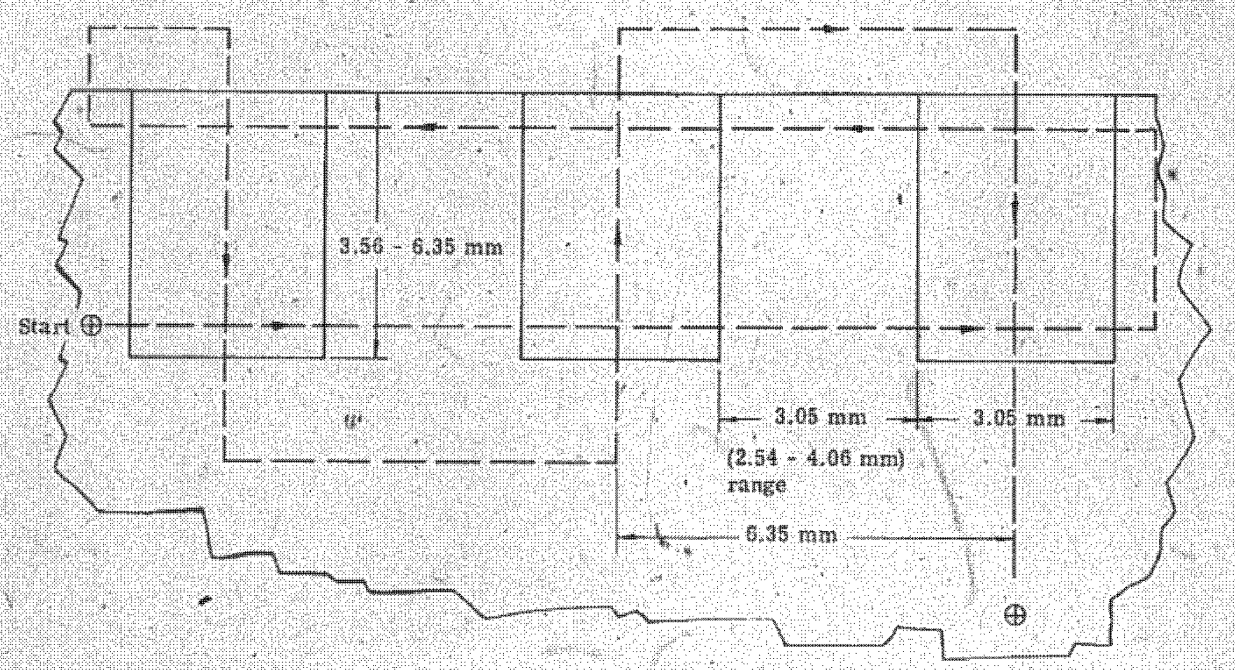


FIGURE 4-21

TABLE 4-12

OPERATE/FRAME MARKS STATISTICS (STELLAR/TERRAIN)

Op	Frame	Camera	Background Density	Peak Density	Width (MM)
2	3	Terrain	0.36	2.38	3.359
			0.38	2.58	3.594
			0.36	2.60	3.500
			0.36	2.38	3.320
		Stellar	0.95	3.80	3.242
			0.95	3.80	3.242
			0.90	3.80	3.242
			0.90	3.90	3.281
165	10	Terrain	0.28	2.07	3.386
		Stellar	0.98	3.60	3.203
			1.00	3.40	3.242
			1.00	3.50	3.242
			1.00	3.55	3.242

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Tolerances: terrain: 5.08 to 6.60 millimeters
stellars: usable format extends out to film edge.

Thirty consecutive frames are to be measured from both stellar and terrain cameras.

Procedures

All measurements were made using 10× magnifiers with millimeter scales.

Evaluation Results

1. Tracking measurements were taken from three areas of the total film load.
2. Measurements were made on the original negative material at the processing site.
3. All measurements were within tolerance.
4. Stellar frames were inspected to ensure usable format to the film base edge.

Conclusions

No tracking problems have been detected on this mission.

4.3.5.2 Frame Metering Distances

Specifications

Frame spacing requirements are in three parts:

1. Terrain frame to frame distance. Tolerance (blueprint): 19.81 to 32.51 millimeters
2. Stellar frame pair to frame pair distance. Tolerance (blueprint): 3.56 to 8.64 millimeters
3. Stellar frame port (−y) to simultaneously exposed starboard (+y) distance. Tolerance (blueprint): 46.99 to 49.53 millimeters.

Thirty terrain frames and thirty stellar frame pairs are required for the frame to frame measurements. Two stellar pairs are required to satisfy the port to starboard measurement specifications.

Procedures

All of the measurements were made on a monocomparator during the film deformation determination phase of the PFA.

Evaluation Results

1. The distances between terrain frames were within the operational specifications.
2. The distances between stellar frame pairs were within specifications.
3. Port (−y) to starboard (+y) distances were within specifications.

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Conclusions

Measurements indicate nominal condition for the metering phase of the camera's operations (Table 4-13).

4.3.5.3 Frame Format Size

Specifications

The following values were taken from the format blueprints.

Terrain frame: 228.600 × 462.788 millimeters
Stellar frame: 70 × 110 millimeters.

Procedures

Two frame sets located at each end of the mission material were designated for the measurements. All data were obtained from monocomparator readings.

Evaluation Results

The data are presented in Table 4-14.

Conclusions

Measurements indicate no anomalies.

4.3.5.4 Fiducial Positioning With Respect to Surrounding Reseau Intersections

Specifications

Figure 4-22 shows the required tolerances for fiducial positioning with respect to the reseau system.

Procedures

All values were derived from the results of the film deformation six-parameter transformation runs.

Evaluation Results

Figures 4-23 through 4-26 illustrate the grouping of fiducials and the position of each grouping to the reseau system. (Four surrounding reseau intersections.)

Conclusions

All frames evaluated are within the specified tolerance.

4.3.5.5 Overlap Study

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TABLE 4-13

METERING DISTANCE MEASUREMENTS (STELLAR/TERRAIN)

Location	Actual Range, mm	Tolerance, mm
Terrain/terrain	22.515-29.905	19.81-32.51
Stellar pair/stellar pair		
OP/FR mark edge	4.08-4.23 } *	3.56-8.64
Non-OP/FR mark edge	5.24-5.41 }	
Port (-Y)/starboard (+Y)	47.324-48.522	46.99-49.53

*Difference is a result of tracking changes characteristic of the stellar film path.

TABLE 4-14

USABLE FORMAT DIMENSIONS
(STELLAR/TERRAIN)

Frame	Average Size, mm
Terrain	228.956 × 463.357
Port (-Y)	69.572 × 110.378
Starboard (+Y)	69.525 × 110.333

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FIDUCIAL/RESEAU ORIENTATION

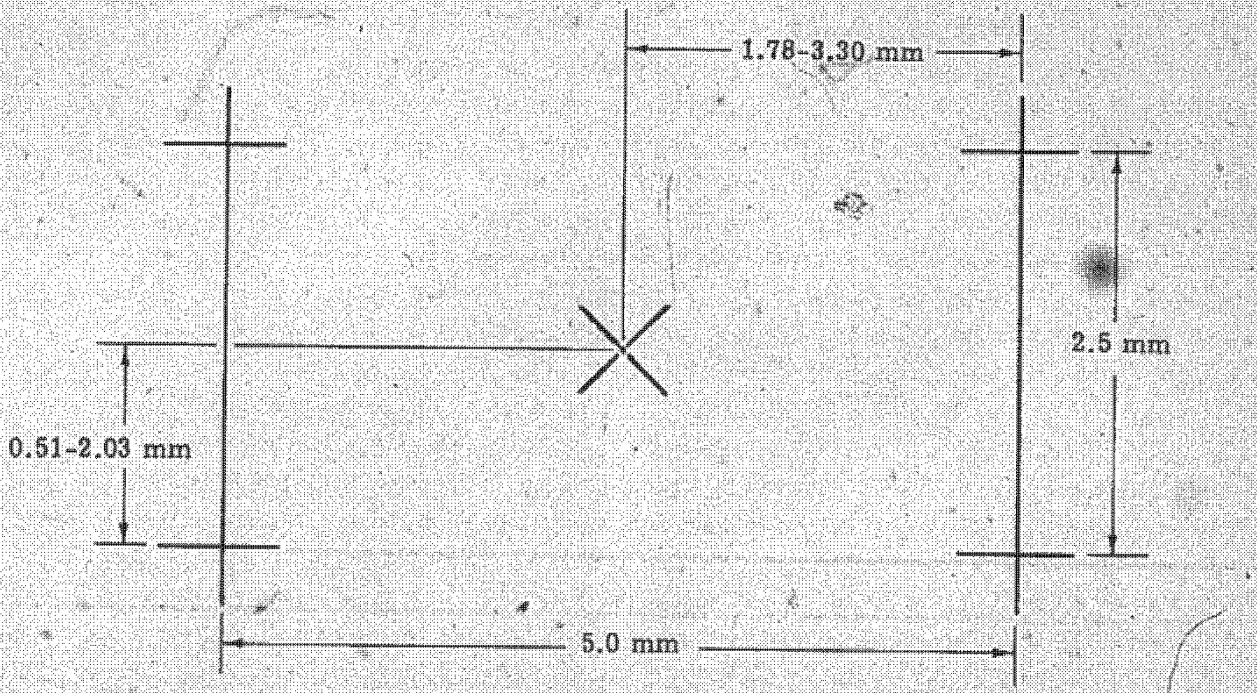


FIGURE 4-22

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FIDUCIAL (5001) ORIENTATION PLOT (1)

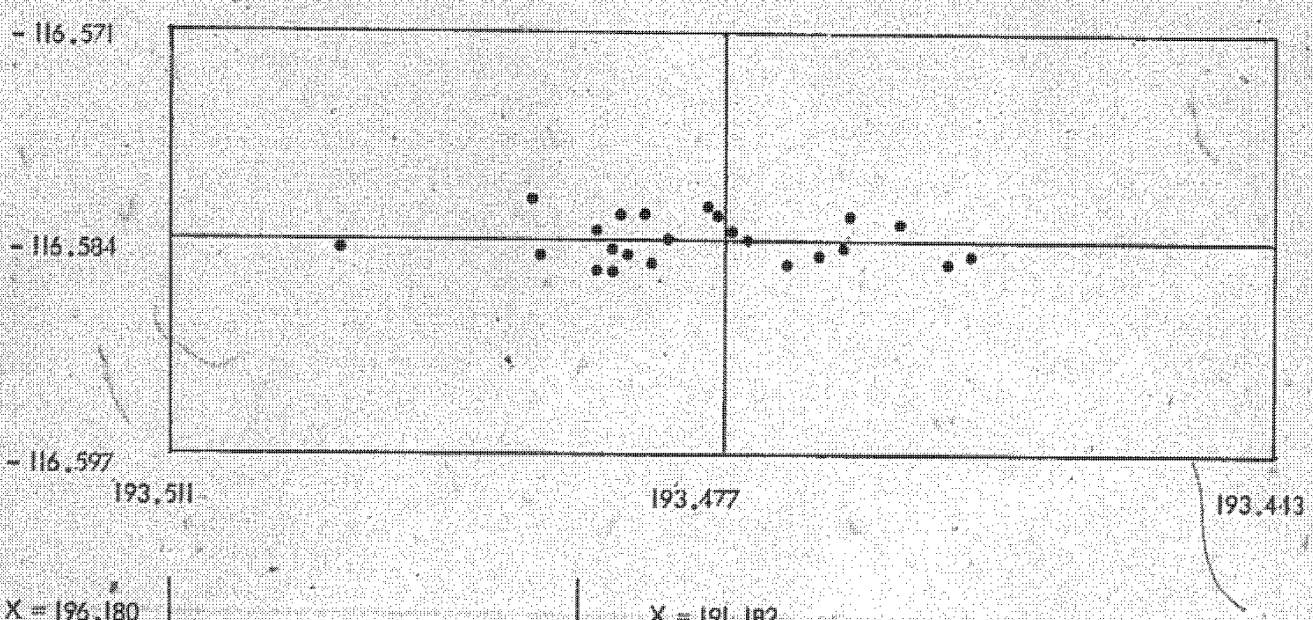


FIGURE 4-23

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FIDUCIAL/RESEAU ORIENTATION

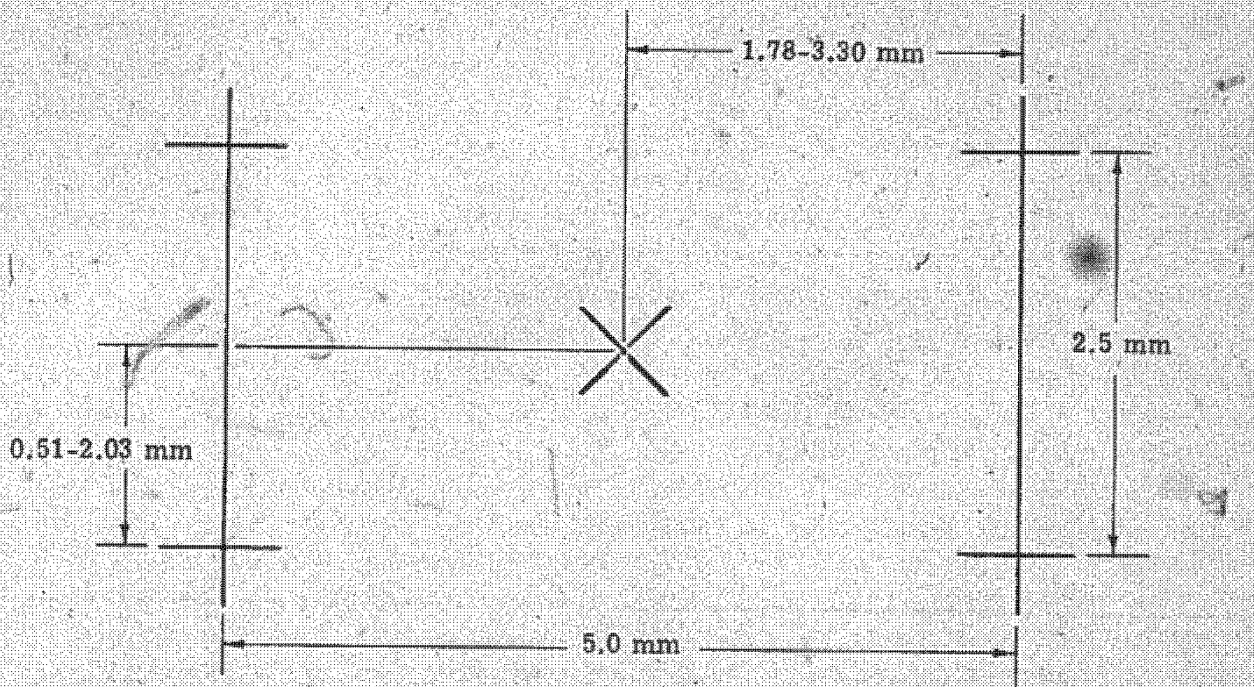


FIGURE 4-22

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FIDUCIAL (5001) ORIENTATION PLOT (1)

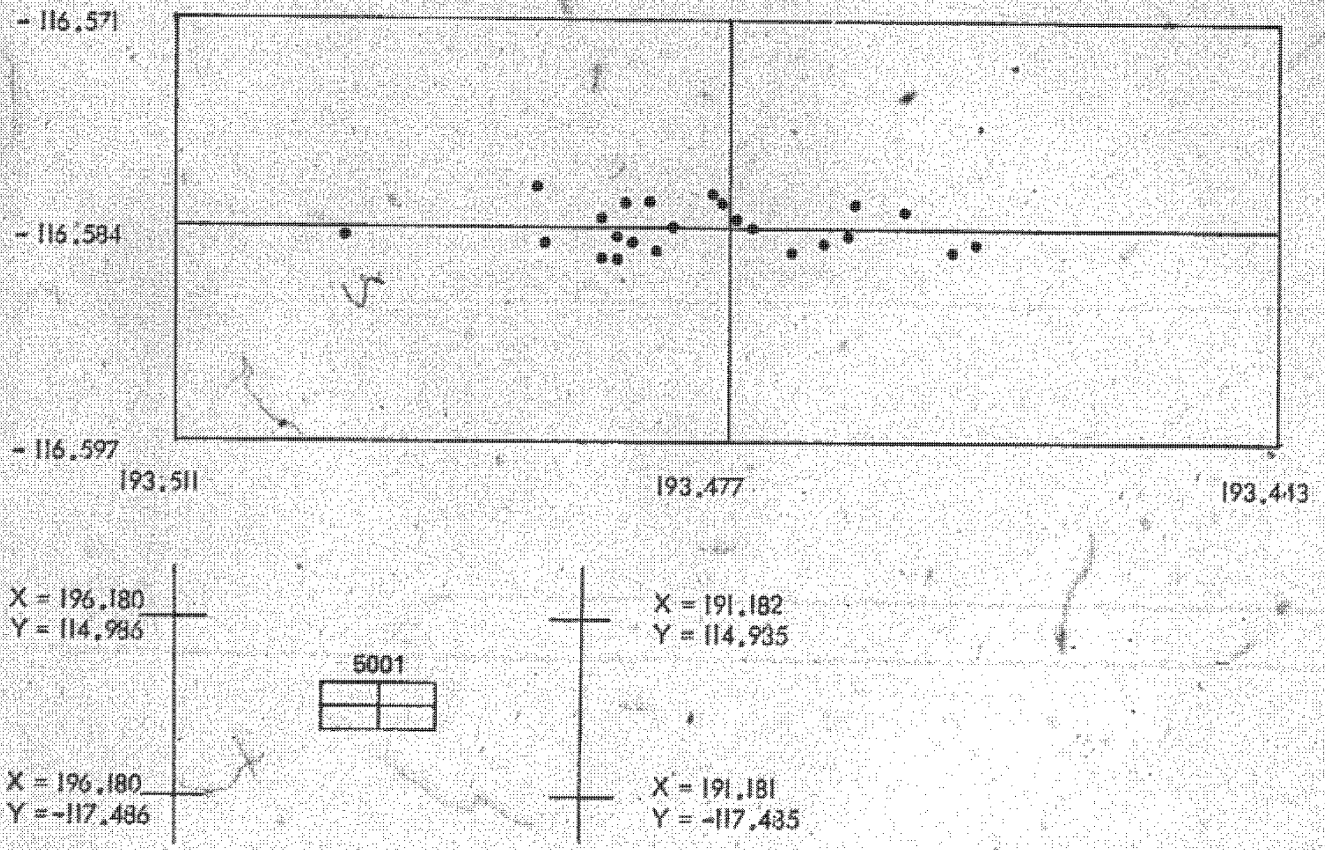


FIGURE 4-23

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FIDUCIAL/RESEAU ORIENTATION

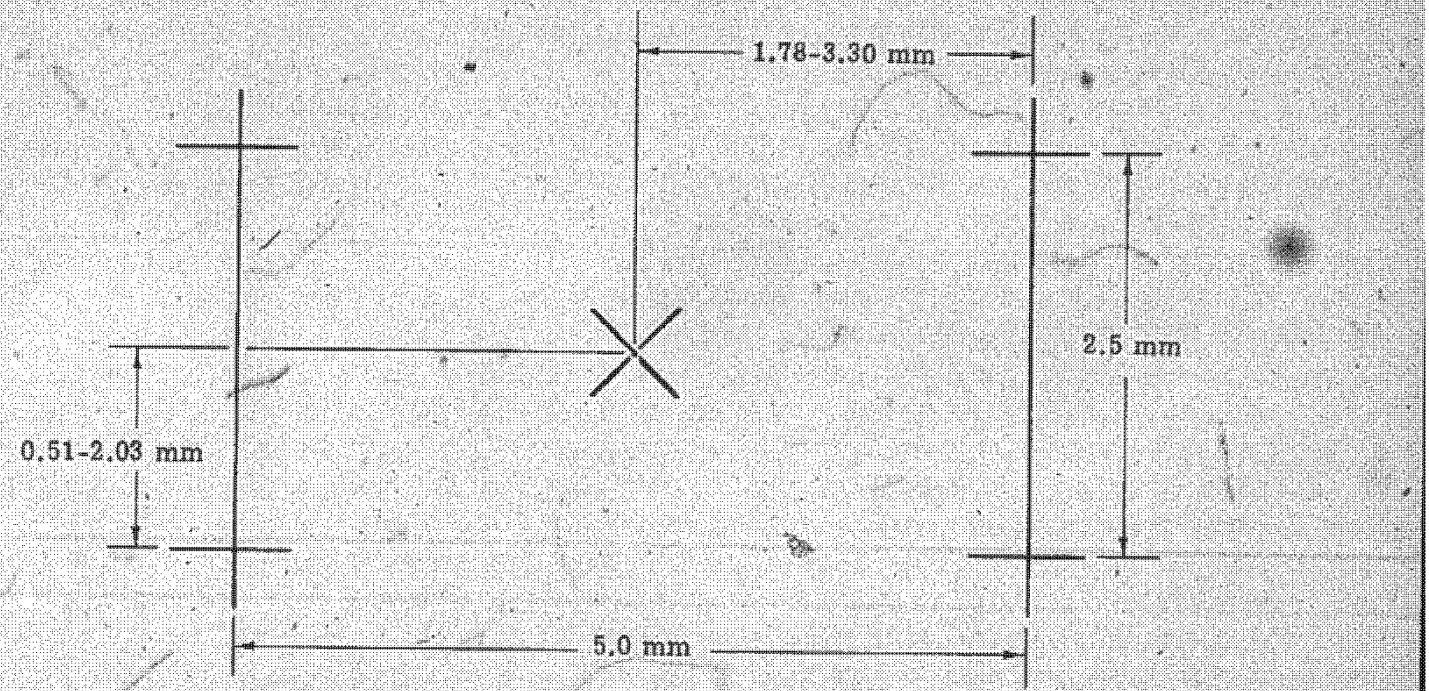


FIGURE 4-22

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FIDUCIAL (5001) ORIENTATION PLOT (1)

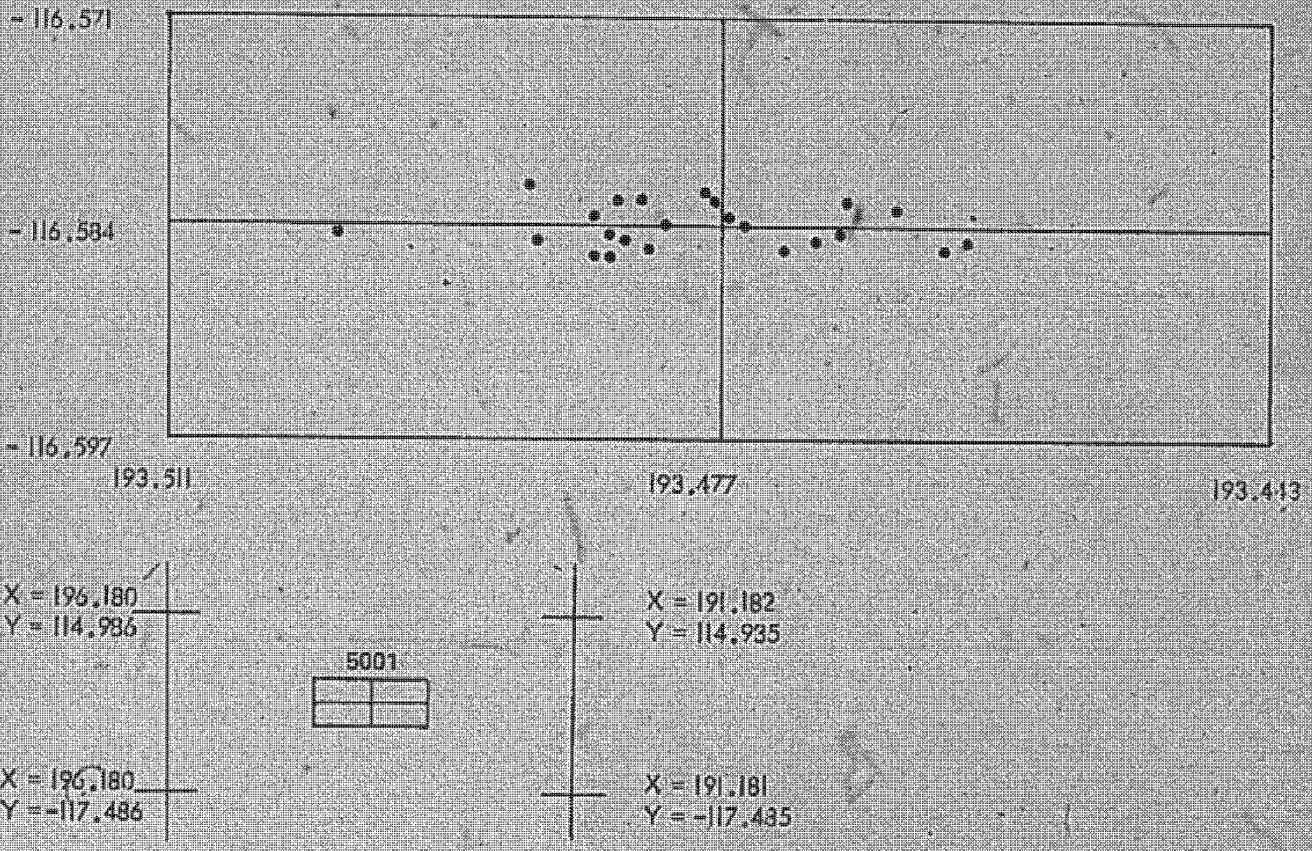


FIGURE 4-23

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FIDUCIAL (5002) ORIENTATION PLOT (2)

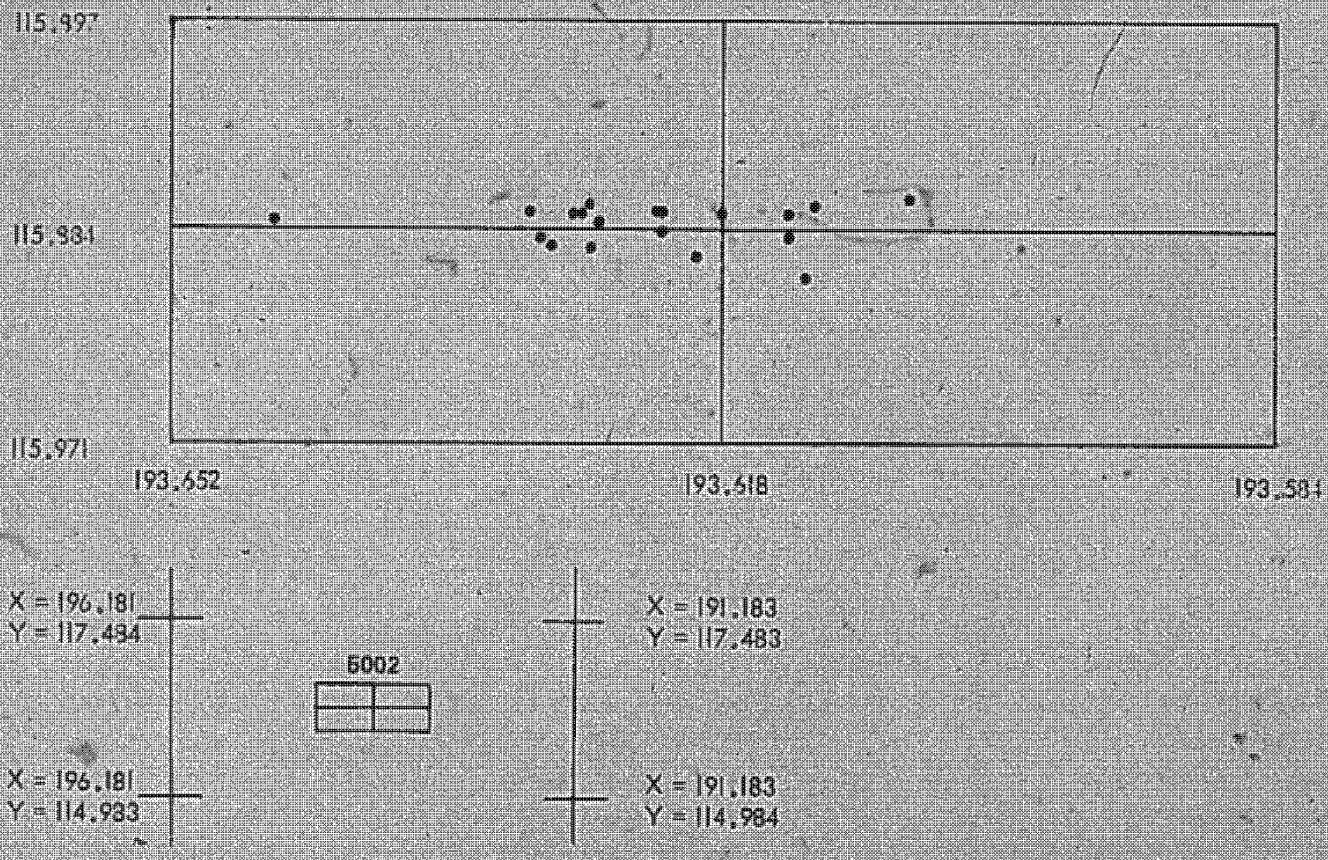


FIGURE 4-24

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FIDUCIAL (5003) ORIENTATION PLOT (3)

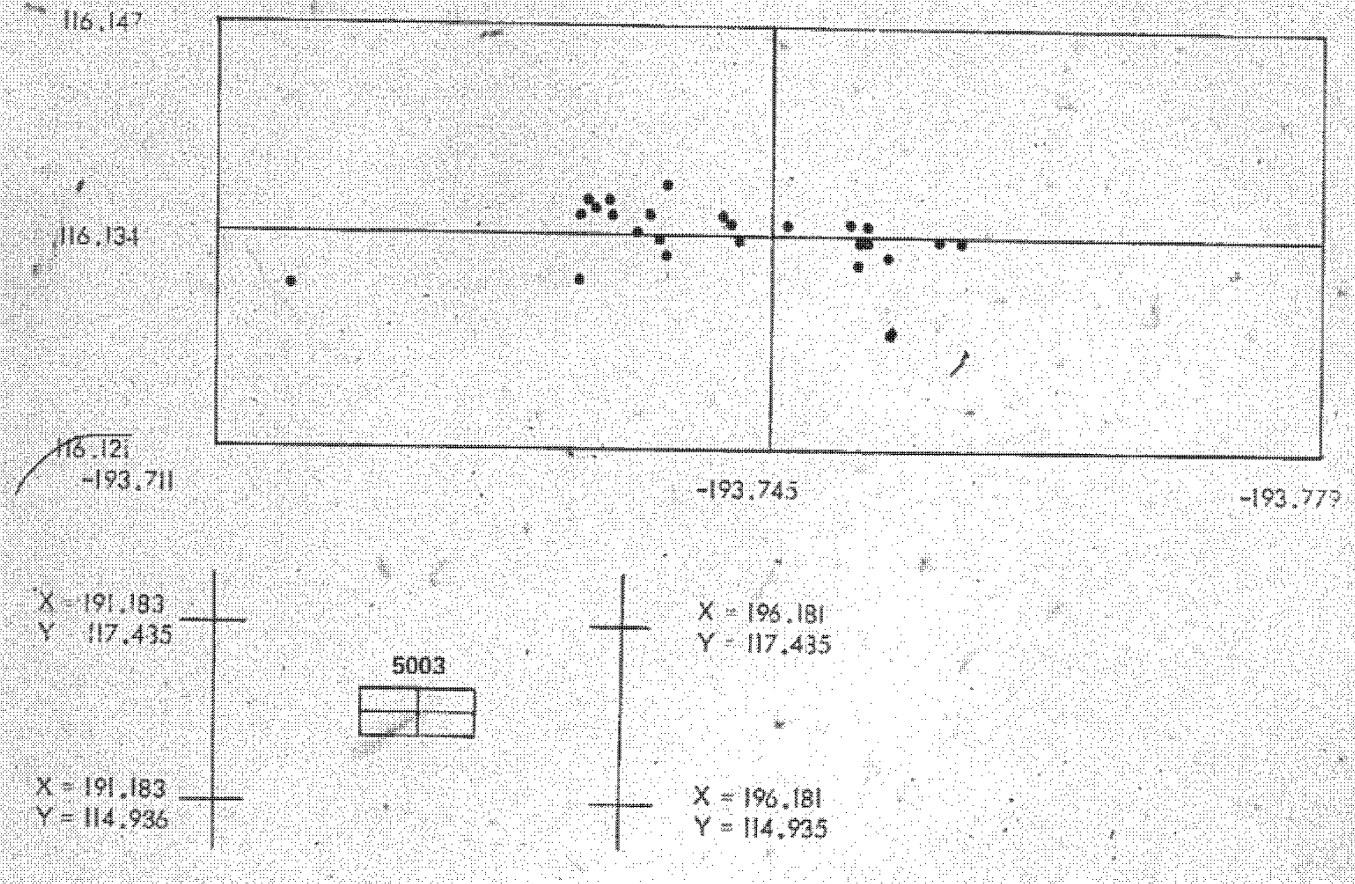


FIGURE 4-25

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FIDUCIAL (5004) ORIENTATION PLOT (4)

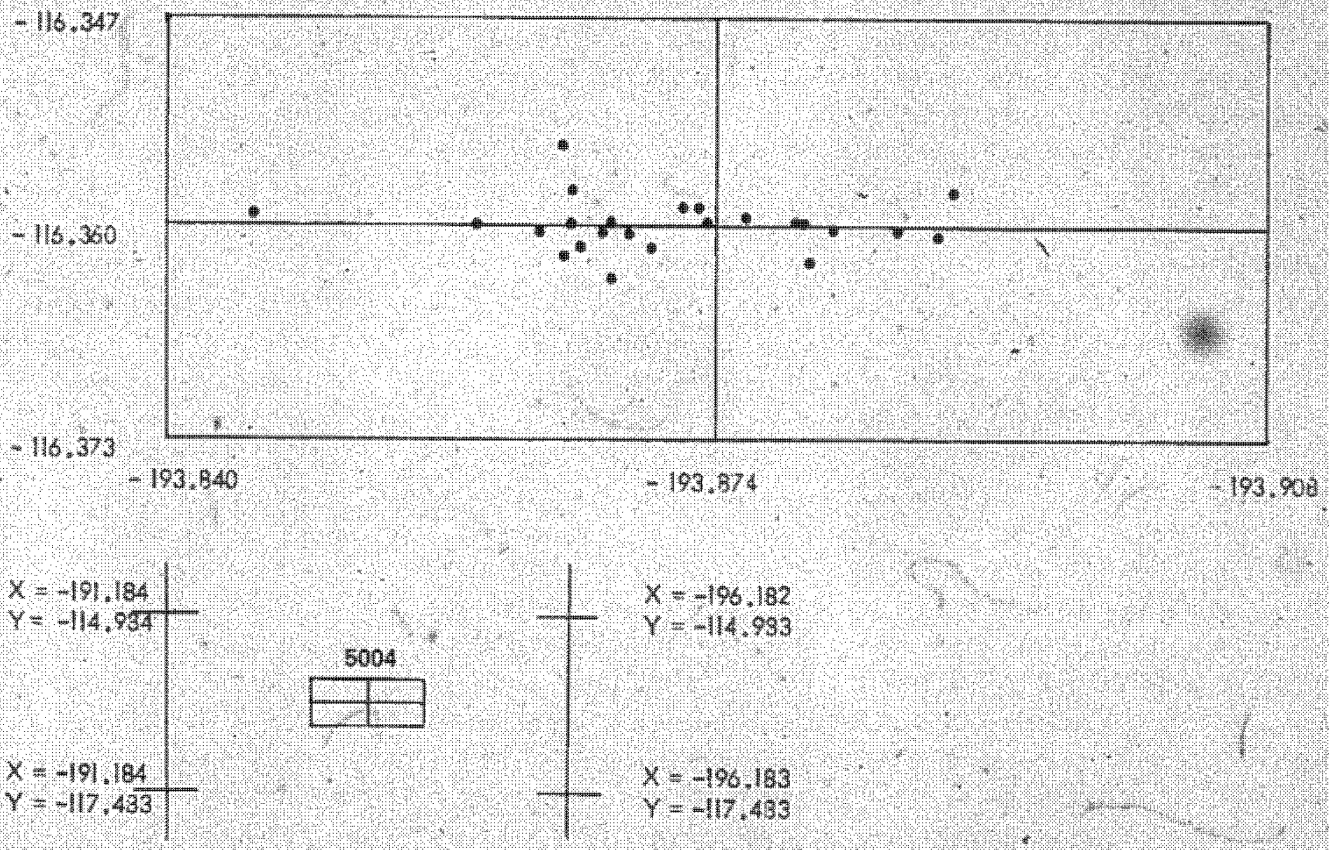


FIGURE 4-26

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Specifications

For the overlap evaluation, it was required to compare the actual overlap of 30 pairs of terrain frames against the commanded overlap. Mission Performance Report (MPR) and actual overlap values should agree to within 2 percent.

Procedures

Film measurements were used for the overlap evaluation on randomly selected frames.

The overlap percentage values are listed on the overlap data sheet (Table 4-15).

Evaluation Results

All frames evaluated are within the required overlap values.

4.3.6 Terrain Image Study

Specifications

Resolution specifications for a given system would logically require the detection of values comparable to ground testing results. However, because of scale, CORN targets or alternate methods have not been available that will give ground resolution information comparable to pre-flight test specifications. The visual edge matching (VEM) instrument is used to acquire VEM numbers and associated resolution values. The measured film values have not been correlated to ground resolution and should not be misconstrued as directly representing ground resolution. The main importance and use for VEM resolution values is a relative mission to mission comparison.

Procedures

An SO-192 matrix was used for the VEM analysis. Each of 225 measurements was identified by the nearest reseau number to fix its position in the format. All VEM targets selected were airport runways.

The primary terrain camera film (EK 3414) used on mission 1209 provided the first film/system combination capable of sufficient resolving qualities to permit measurements of one CORN target in both in-track and cross-track directions.

Evaluation Results

On frame 6, Op 89, it is possible to resolve the target bars of the Ft. Huachuca target for the in- and cross-track directions of bar unit 2, leg A. The bars have dimensions of 8 feet $10^{5}/_{8}$ inches × 44 feet $3^{7}/_{8}$ inches.

Table 4-16 lists the VEM statistics considered representative of the performance of the terrain camera and EK 3414 film. VEM values were not acquired for QX-801 imagery. Figures 4-27 through 4-33 are provided as examples of the mission's image quality.

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TABLE 4-15

PERCENT OVERLAP COMPARISONS (TERRAIN)

Operate	1st Frame	2nd Frame	Percent Overlap	MPR Overlap (%)
2	2	3	70.6	70
2	12	13	70.7	70
6	2	3	70.6	70
12	1	2	70.7	70
14	13	14	70.7	70
20	10	11	70.7	70
27	3	9	70.6	70
34	1	2	70.3	70
42	1	2	70.9	70
48	16	17	70.0	70
54	6	7	70.6	70
62	6	7	70.7	70
69	4	5	70.9	70
74	14	15	70.7	70
82	5	6	70.4	70
89	5	6	70.7	70
95	1	2	71.0	70
103	11	12	70.5	70
112	2	3	71.0	70
121	13	14	70.8	70
129	10	11	71.0	70
133	4	5	70.6	70
139	21	22	70.8	70
145	10	11	70.9	70
156	4	5	70.9	70
157	4	5	71.1	70
159	27	28	70.7	70
164	10	11	70.8	70
165	10	11	70.9	70
165	4	5	70.9	70
167	3	4	70.8	70

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4.3.7 Stellar Image Study

Specifications

In order to satisfy the design specifications, stellar frames must contain a relatively large number of sixth magnitude star images. Sixty stellar frames are visually evaluated against star charts for sixth magnitude images, star distribution and quality of images.

Procedures

The randomly selected frames are overlaid with a Duratrace sheet to "pull up" the film images. The Duratrace overlay is then matched to an appropriate star chart of the same scale. MPR camera axis data provides a star chart "window" in which the overlay is visually positioned to the star field. Once located, an approximate count is made of sixth magnitude images. Not all images marked on the overlay or measured during data reduction are star images but may be images of foreign material caught in the duplication process.

Evaluation Results

All 60 frames evaluated indicate a comparable number of sixth magnitude images as found on previous missions.

4.3.8 Calibration Mode Imagery (Terrain)

The extended C-Mode exposure time has provided a greater number and an increase in overall brightness of star images on terrain frames. A star count on Op 170, frame 6, accomplished by matching images to star charts, revealed over 350 positively identified star images. Making star counts from overlapping adjacent frames provided counts well in excess of 100 stars in the overlap area.

A statement defining the impact of increased C-Mode exposure time to in-flight calibration will be issued when all measurements are completed.

An attempt to obtain four separate ops of maximum starfield coverage during one revolution resulted in lost frames due to sunlight in Ops 168 and 169. Op 170 (6 frames) and the first four frames of Op 171 provided the useful imagery for the C-Mode in-flight calibration. The results of the calibration effort will be published as a separate report.

4.3.9 Time Word Study

Specifications

Five data block times (vehicle time) are to be compared to the associated telemetry vehicle times printed in the MPR. Comparable values must agree to within 1 millisecond.

For a sequence of exposures having a common ground point, the variation in elapsed time between the terrain camera fiducial exposure times (internal clock times) should be less than 0.10 millisecond.

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TABLE 4-17

DATA BLOCK/MPR TIME COMPARISON

Operate 23

Fr	Data Block Time	MPR Time	Agreement of Stellar Mid-points with Fiducial Time STARBOARD	PORT
7	3665305.224	3665305.224	.00062	- .00041
8	3665314.075	3665314.075	.00063	- .00039
9	3665322.927	3665322.927	.00059	- .00044
10	3665331.778	3665331.850	.00063	- .00041
11	3665340.683	3665340.608	.00059	- .00041

TABLE 4-18

MIDEXPOSURE TIME COMPARISON
(All times in seconds)

OP	FRAME	MID-EXPOSURE DIFFERENCES Starboard-Fid	Port-Fid	TOTAL EXPOSURE TIME Starboard	Port
29	1	.00030	.00070	.2030	.2043
	2	.00040	.00075	.2032	.2043
	3	.00030	.00070	.2034	.2042
	4	.00020	.00075	.2024	.2043
	5	.00023	.00075	.2029	.2043
	6	.00015	.00085	.2029	.2043
	7	.00025	.00075	.2029	.2043
	8	.00025	.00075	.2027	.2043
	9	.00015	.00100	.2029	.2045
	10	.00025	.00075	.2029	.2043
	11	.00075	.00075	.2023	.2043
	12	.00025	.00030	.2029	.2041
	13	.00035	.00070	.2029	.2044
	14	.00025	.00075	.2029	.2043

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TABLE 4-19

MISSION FRAME COVERAGE STATISTICS

Mission Number	1205-5	1206-5	1207-5	1208-5
+Total Accessed	*5,894	6,282	6,671	6,487
Unique Trilap MC&G Coverage (Acceptable)	2,700	2,400	2,600	1,300
+Total Accessed Trilap	4,457	4,936	5,021	4,418
+Total Accessed Bilap	719	672	825	1,035
+Total Accessed Mono	718	673	825	1,034
Redundant Coverage Within a Mission	70	150	150	470
Redundant Mission to Mission Coverage		160	410	977

*Thousands of Square Nautical Miles

+MDA derived values

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TABLE 4-20

MISSION STATISTICS

Mission Number	1205	1206	1207	1208	1209
Launch data	9 Mar 73	13 Jul 73	10 Nov 73	12 Apr 74	29 Oct 74
Launch time	1300 PST	2022 GMT	1210 PT	2020 GMT	1940 GMT
Satellite vehicle	SV-5	SV-6	SV-7	SV-8	SV-9
ST system	S/N 003	S/N 005	S/N 004	S/N 006	S/N 002
Orbit inclination (degrees)	95.696	96.207	96.93	94.52	96.692
Initial perigee (NM)	85.252	87.681	88.673	85.55	85.50
Initial apogee (NM)	158.008	155.342	154.400	164.73	156.00
Argument of perigee (degrees)	133.584	139.626	142.801	141.36	168.557
Initial period (minutes)	88.83093	88.8643	88.883	89.0	88.960
Range of photo altitudes (approx. - NM)	85-156	86-116	87-119	86-117	86-149
Range of sun angles (degrees)	9-90	12-90	1-85	15-86	3-80
Recovery date	20 Apr 73	24 Aug 73	7 Jan 74	3 Jun 74	27 Dec 74
Recovery time	2336Z/1536 PST	2331 GMT/Z	2245 GMT	2231 GMT	2158 GMT
Recovery rev	683	683	942	973	NA
Comment	Routine air catch (12,400 feet)	Routine air catch (12,800 feet)	Routine air catch	Routine air catch	Routine air catch

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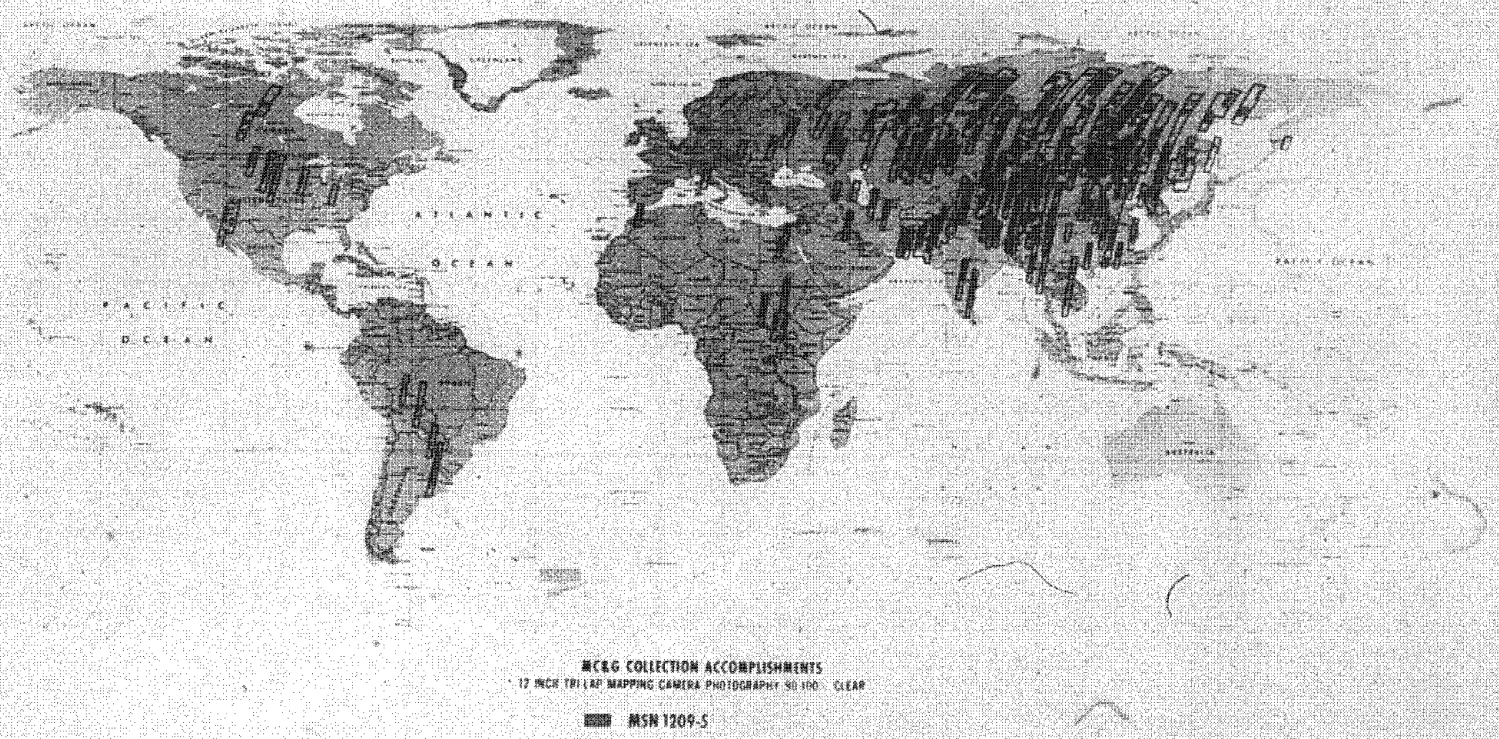
TABLE 4-21

CAMERA STATISTICS

Mission Number	Camera Designation	Focal Length (mm)	Standard Deviation (mm)	Filter Type	Reseau S/N	Lens S/N
1205	T	306.3291	0.0010	WR-21	014	003
	(-y)P	253.2472	0.0063	None	023	007
	(+y)S	253.5919	0.0071	None	017	006
1206	T	304.8521	0.0009	WR-21	016	005
	(-y)P	253.2181	0.0053	None	027	011
	(+y)S	253.1646	0.0054	None	026	009
1207	T	305.1991	0.0008	WR-21	015	004
	(-y)P	253.2043	0.0043	None	022	010
	(+y)S	253.1630	0.0046	None	025	008
1208	T	306.7604	0.0011	WR-21	012	006
	(-y)P	253.4402	0.0056	NA	024	005
	(+y)S	253.4504	0.0056	NA	029	012
1209	T	306.3207	0.0011	WR-12	013	002
	(-y)P	253.5875	0.0065	NA	015	001
	(+y)S	253.2996	0.0065	NA	014	004

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MAPPING, CHARTING, AND GEODETIC REQUIREMENTS FOR MISSION 1209-5

FIGURE 4-34

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CONCLUSIONS, RECOMMENDATIONS AND ACTION ITEMS

HANDLE VIA
TALENT-KEYHOLE
CONTROL SYSTEM ONLY

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SECTION V

CONCLUSIONS, RECOMMENDATIONS, AND ACTION ITEMS

5.1 CONCLUSIONS

5.1.1 Operations

The operation and performance of camera system SN 002 was judged outstanding by the PFA team. All aspects of operation pertaining to mission objectives were anomaly free for the entire mission. Photographically, the terrain camera performance was the best of all missions and the stellar camera formats contained an adequate number of sixth magnitude star images. Masking imagery surrounding terrain fiducials and extended C mode exposure times proved to be successful changes, eliminating problems in these areas reported on past missions.

5.1.2 Engineering Operations (QX-801)

There is general agreement among all PFA team members that QX-801 does not provide a level of information content comparable to EK 3414 film.

5.1.3 Exposure

Subjective and objective analyses of exposure levels acquired on 3414 film (terrain camera) have shown that the majority of photography was correctly exposed. Based on EK 3414 exposure data, acquired on the past three missions, a new algorithm will be used for mission 1210.

5.1.4 EK 3400 Film (Stellar Camera)

Evaluation has shown that an adequate number of star images can be recorded when using EK 3400 film as the primary film for the stellar cameras.

5.2 RECOMMENDATIONS

5.2.1 Mission 1210 Exposure

Exposure analyses of the past three missions provided empirical data for the following exposure recommendation.

Sun Angle, degrees	Exposure Time, milliseconds
0 > 18	24
18 > 58	12
58 > 90	6

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5.2.2 EK 3400 Film

Star image evaluation has shown that EK 3400 could be used as primary film load for the stellar units on mission 1210.

5.2.3 QX-801 Film

There are no advantages to using QX-801 film in the terrain camera. No further engineering tests are recommended unless changes are made in the spectral characteristics of this film.

5.3 ACTION ITEMS

5.3.1 Mission 1209 In-Flight Calibration (DMATC)

Complete the evaluation/mensuration process and report on the results of the in-flight starfield calibration.

5.3.2 Extended Solo Operations (Camera Contractor)

Report results of the extended solo operations conducted on mission 1209.

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APPENDIX—COMMAND SEQUENCE

HANDLE VIA
TALENT-KEYHOLE
CONTROL SYSTEM ONLY

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APPENDIX

COMMAND SEQUENCE DEFINITIONS

Sequence Number	Descriptive Title	Purpose
148	Backup off command	For operations over real time station (RTS). Automatically calls seq. 150.
149	Instrumentation on Redundant off	Primary sequence for operations not over RTS. Includes instrumentation, tape recorder, and redundant off commands. Automatically calls seq. 150.
150	Normal operating sequence	Redundant seq. that controls ST operations.
151	V/H update	Update exposure and V/H during an ST operation.
152	B mode backup off	Used over RTS. Same as seq. 148 except it automatically calls seq. 153 when B mode is required.
153	Operation — B mode	Replaces seq. 150 when operating in B mode.
380	ST calibration	Used for in-flight starfield calibration.

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